

Message from the Chairman



Dear IEEE Indian Members,

First of all, I would like to thank all the IEEE India members for showing the trust on me to serve as IEEE India Council (IC) Chair for 2019. It is a great honour with big responsibility for me. I will try my best to meet the expectations of IEEE members in India. I am extremely happy to have a very strong and energetic team including office bearers and ExeCom members to take forward to various activities of IEEE IC. My appreciation and heartfelt thanks to all of them for shouldering such responsibility. As we all know that IEEE India Council (IC) works in total synchronism and harmony of actions and thoughts of its members. I am fully confident that we will work even better manner during 2019.

As you may be aware that Mr. H.R. Mohan has once again taken up the challenging task of the Newsletter Editor (He was the editor during 2013 & 2017-2018). I thank the Section leaders for their support & cooperation in providing the inputs to the newsletter. The flagship program of IEEE IC, viz. INDICON 2019, will be held in Marwadi University, Rajkot in collaboration with IEEE Gujarat Section in Dec 2019. I hereby appeal to all members to make this INDICON another success story, as in the previous years. All India Student, Young Professional, Women in Engineering Congress (AISYWC) 2019 will be hosted by Hyderabad Section. Vice-Chairs, Student Activities (Dr Rajashree Jain), YP (Er Vamshikrishna J) and WIE (Dr Rachana Garg) are working in consultation with Hyderabad Section Chair. The details will be communicated soon.

IEEE Kerala Section is hosting TENCON-2019, the prestigious conference of IEEE R10 at Kochi during 17-20 Oct 2019 on the theme “Sustainable and Innovative Technologies For A Brighter Tomorrow”. IEEE Kolkata Section will be hosting TENSYP-2019, another flagship conference of IEEE R10 at Kolkata during June 7-9, 2019 on the theme “Technological Innovation for Humanity”. Both these events will be great opportunities for our members to submit papers, network, enhance their domain expertise and expand their knowledge base.

Being the IC Chair Elect during 2017-2018, I found that IC has moved rightly far ahead with leaving back the differences. There are few concerns about the INDICON, AISYWC which need to be stream-lined. New Technically Co-Sponsored conference fee imposed by IEEE should be implemented without hampering the number of events. In the second IC ExCom meeting held in Melbourne on March 3, 2019, it was decided to close the IC chapter due to various complaints and sustainability, and merge them to the sections. New guidelines for IC Awards and eNotice are formulated and few more issues need to be looked into are

- Reach and regular broadcast of IC Newsletter to be increased.
- More information on IC Website can be posted for benefit of the members.
- Organisation of Leadership programs for women, conference organisers, students, YP can be made.
- Membership retention, growth and their elevation to higher grade should be increased.
- Creation of Joint Secretary, advisors and inclusion of sub-sections chairs in IC ExCom can be explored.

I am sure that with the help of active IEEE volunteers in India, we will be able to make one of the best councils of IEEE. Please do look for regular newsletters and other updates.

With warm fraternal greetings

Prof. Sri Niwas Singh, *FIEEE, FIET, FNAE, FIETE, FIE(I)*
IEEE IC Chair 2019
snsingh@iitk.ac.in



Message from Editor

H.R. Mohan, hrmohan.ieee@gmail.com

Dear readers,

At the outset, let me wish all our readers a Happy New Year 2019. We are presenting the first quarter issue of India Council Newsletter (ICNL) for the year 2019. This current issue of ICNL in 160 pages features a record number of 25 articles, few items unique to the 1st issue of the year such as India Council Execom members details for the year 2019, Reference to the Section Reports for the year

2018 submitted to R10 and a report on the recent R10 meeting held in Mar 2019 at Melbourne.

ICNL thanks the chairs of the Bangalore, Kerala/Kochi, Hyderabad, Madras, UP Sections for sending the reports of their Section activities as per guidelines, Dr. B. Satyanarayana, convener of the IEEE Foundation supported event “Celebrating Sir Jagadish Chandra Bose” and IEEE OES India Chapter for the report on the “Conference on Technologies for Renewable Energy and Water” and IC Chair and Secretary for their coordination. We look forward to receiving matter from all the organizers of events at the newsletter email id ieee.icnl@gmail.com as per the guidelines published in the newsletter and also available at <https://goo.gl/DcVPmx>

ICNL thanks the authors who have positively responded to our request and contributed the following informative and interesting articles which are included in this issue.

- The Cybersecurity Renaissance: Security Threats, Risks, and Safeguards by Dr. San Murugesan
- Solar Energy Harvesting Through Photovoltaics and Photocatalysis by Dr. Somnath C Roy
- A step towards integrated environment of technology based learning and quality assessment framework by Dr. N. Sarat Chandra Babu and Mr. N. Satyanarayana
- Dew Computing: A New Era of Computing Implying Minimization Over Internetwork Backhaul by Mr. Partha Pratim Ray
- The Convergence of IoT, AI and Blockchain Technologies by Mr. T.A. Balasubramanian
- Electronic Nose- An epitome of perfect sensor systems by Dr. Saakshi Dhanekar
- Design of Renewable Energy Powered Car by Dr. S. Elangovan
- Prayagraj Smart City by Mr. R. Srinivasan
- IoT Edge Systems with IEEE 21451 Standards A Perspective of Experiential Learning by Mr. P. V. S. Maruthi Rao
- Artificial Intelligence’s Journey from a “Value Optimizer” to a “Value Creator” by Mr. Sojan George and Mr. Rajeev Mullakkara Azhuvath
- Sensor Hub Environment for Autonomous Cars by Mr. V. P. Sampath
- Elliptic Curve Cryptography based Certification Authority by Mr. Kunal Abhishek
- The Smart Grid Computing: A Comprehensive View to Power Grid Systems by Sanjeevikumar Padmanaban1, Robin Singh Bhadoria, Frede Blaabjerg
- Driving disruption through innovation: The new business reality by Mr. Dinanath Kholkar
- Investigate the relationship between Lean and Industry 4.0 Technologies by Sanjiv Narula, Dr. Vishal Talwar, Dr. Maheshwar Dwivedy, Dr. Suya Prakash, Mr. Saravjit Singh
- Making Innovation work for your company by Prof. Arcot Desai Narasimhalu
- How To Win Customers And Influence Sales In Co-operative Banks Using Digital transformation by Mr. Sridhar Pandurangiah and Mr. Ganesh Chandrasekaran
- Machine Learning, the Next Milestone in Human Evolution by Dr. Subburaj Ramasamy
- Seasons of Code by Mr. Shakthi Kannan
- Techniques for efficient ETL Jobs using Apache Spark by Mr. M.G. Thiruvalluvan
- DeepVoice & DeepFakes: Exploiting AI-Generated Audio & Video — Boon & Bane by Ms. K. Visalini
- Social Listening through Sentiment Analysis by Ms. Mini Ulanat
- The Neoskilling Imperative for Fostering Innovation by Prof. L. Prasad (Retd.) and Mr. S. Ramachandran
- Jobs and Careers in the New Era by Mr. Gopalaswamy Ramesh
- Inclusion begins at Home by Dr Saundarya Rajesh

ICNL wishes to add that the above articles published in this issue are not peer reviewed and are also not checked for plagiarism/copyright/accuracy for which the authors are responsible. Further, the views expressed in these articles are that of the authors and ICNL is not responsible for any consequences of using the information provided in these articles.

We are happy to have published the following excerpts from books with the permission of the authors & publishers.

- “Project Guidelines” Chapter 4 of the book, “i want 2 do project. tell me wat 2 do” by Shakthi Kannan
- “Self-Learner” Excerpts from the Chapter 1 of the book “ShapeIT: A Perfect Gift for Budding Engineers to Become Industry Ready” by R. Subramani & S. Vijayanthi

Chairman Dr. S.N. Singh in his message has highlighted about the forthcoming major events and also outlined few issues to be addressed and the guidelines formulated at IC. The “What’s hot in IT - An Indian Perspective” feature by Prof. S. Sadagopan, Director, IIIT Bangalore provides a broad overview on various important happenings in the IT and Telecom sectors in India during Jan-Feb 2019. We are sure that readers will find the information and the related links provided in the column “Information Resources” compiled by the editor Mr. H.R. Mohan useful. We wish to add that “Interesting Reads”, a regular blog post published once in 5 days by him may also be of interest to our readers. The archives of these blog posts can be accessed at <https://goo.gl/VGXizd>. A note from Mr. Deepak Mathur, IEEE Region 10 Director-Elect 2019-2020 provides a brief on the incentive R10 scheme to the sections and highlights the ‘Conference Leadership Program’ being planned in Aug 2019.

We have also included briefs on nine books -- Wiley Innovation Black Book on Exponential Technologies 2019; ARTIFICIAL INTELLIGENCE: Reshaping Life and Business; i want 2 do project. tell me wat 2 do; Internet of Things; Business Analytics with Management Science Models and Methods; Failing to Succeed: The Story of India’s First E-Commerce Company; Future Proof Your Business: A Practical Guide to protect your Business – Now & into the Future; The Power of 360 Degree Feedback: The India Way for Leadership Effectiveness; and YD - Year Down.

We request the readers to make note of the announcements relating to various prestigious events such as TENSYP-2019, TENCON-2019 and INDICON-2019 etc., and submit papers and register early and get benefited.

We wish to remind our readers to encourage new members to join IEEE at 50% of the annual subscription and enjoy the membership benefits till Dec 2019.

ICNL thanks the various Internet sources and inshorts (<https://www.inshorts.com>) for the information nuggets. ICNL also thank Mr. Sunil Agarwal and Mr Ajit Ninan for the permission to use their thought provoking cartoons appeared in Times of India.

Note from IEEE R10 Director Elect – 2019-2020



Region 10 had devised new incentive scheme to motivate sections for the doing activities. Active sections, who submit the activity reports, are considered for the incentives from Region 10 under this scheme. The scheme was started by 2017-2018 Region 10 Director Prof Kukjin Chun and same has to continue in 2019. Region 10 recommends that the Section Chairs to utilize this incentive grants for new IEEE membership support.

Nine sections out of eleven sections from India got the incentives from Region 10 under this scheme. It is great to note that top 6 sections in the list are from India and Kerala Section secured top most position. With such an exemplary performance by Indian Sections, we still struggle with issues like member retention, inactive chapters, inactive student branches and conference quality. There is need to brainstorm to devise mechanism to curb this condition. Our sections, student branches and volunteers are continuously receiving awards and accolades at Region and MGA levels. I am sure with some planning and efforts, we’ll be able to improve the health of OUs in India. In my view, we should have thorough discussion in Student Branches, Sections, Chapters and Council on these issues and let us come out with some action plans. I am sure our volunteer leaders will be able to rejuvenate ailing OUs.

IEEE organizes approximately 2000 conferences annually and 50% conferences are Technically Cosponsored. Region 10 organizes more than 700 conferences every year and 60% of conferences are Technically Cosponsored conferences. Whereas India organizes 150+ conferences and 75% conferences are Technically Cosponsored. We need to check the quality of our conferences as per IEEE standards. There is a need to have more trained volunteers in sections who could guide conference organizers to run conferences as per IEEE Standards and follow the process to organize quality conferences. With this objective, Region 10 is planning to have a ‘Conference Leadership Program’ to train volunteers. I am sure sections will take advantage of this program.

Deepak Mathur
IEEE Region 10 Director-Elect 2019-2020
IEEE India Council Chair 2015-2016

IC ExeCom 2019

Sl. No	Name	Role	Membership No	Section
1	Dr. Sri Niwas Singh	Chair	F 41398439	UP
2	Mr. Puneet K Mishra	Secretary	SM 80451724	Bangalore
3	Dr. R.B. Jadeja	Treasurer	SM 90525637	Gujarat
4	Dr. Sivaji Chakravorti	Immediate Past Chair	SM 00244426	Kolkata
5	Dr. Suresh Nair	Chair Elect	SM 03757648	Kerala
6	Mr. Deepak Mathur	Advisor	SM 40324184	Gujarat
7	Mr. RK Asthana	Ombudsman	LSM 08056459	Delhi
8	Mr. H R Mohan	Newsletter Editor	SM 04142691	Madras
9	Dr. Chankya Jha	Webmaster	SM92310626	Bombay
10	Mr. Vamsikrishna J	Vice Chair Young Professional	M 92210741	Hyderabad
11	Dr. Sujit K Biswas	Vice Chair - Technical Activities	SM 8264129	Kolkata
12	Dr. Rajashree Jain	Vice Chair - Student Activities	SM 90384280	Pune
13	Dr. Preeti Bajaj	Vice Chair - Awards	SM 40286317	Bombay
14	Dr. Rachana Garg	Vice Chair - WIE	SM 90384280	Delhi
15	Dr. Kumar Vaibhav Srivasnata	Vice Chair - Educational Activities	SM 90648252	UP
16	Ms.Sarada Jayakrishnan	Vice Chair-Professional Activities	SM 90746441	Kerala
17	Mr. Girish Khilari	Vice Chair-Chapter Co-ordination	SM 92533680	Pune
18	Dr. Sudeendra Kaushik	Vice chair - Industry Relations	SM91134687	Bangalore
19	Dr. Amit Kumar	Vice Chair - Conferences	SM90732008	Hyderabad
20	Dr. T. Michael N. Kumar	Vice Chair - Branding	SM 41452564	Madras
21	Mr. Ashok Jagatia	Vice Chair - Membership Development	SM 151373	Bombay
22	Dr. P A Manoharan	Vice Chair-HTA	SM 90307049	Madras
23	Mr. Harish Mysore	India Office	M 92523596	Bangalore
Section Chairs				
1	Mr. Keshav Bapat	Section Chair	SM 92221422	Bangalore
2	Dr. Purna Gaur	Section Chair	SM 41359245	Delhi
3	Prof. Maniklal Das	Section Chair	SM 80608714	Gujarat
4	Mr. N Venkatesh	Section Chair	SM 41506407	Hyderabad
5	Dr. SK Varshney	Section Chair	SM 41406211	Kharagpur
6	Mr. Sanjay Kar Chaudhary	Section Chair	SM 40301940	Kolkata
7	Dr. P A Manoharan	Section Chair	SM 90307049	Madras
8	Mr. Dinanath Kholkar	Section Chair	SM 41238762	Pune
9	Dr Asheesh K Singh	Section Chair	SM 90349548	UP
10	Dr. Sameer S. M.	Section Chair	SM 80401549	Kerala
11	Mr. Abhay Phansikar	Section Chair	SM 91160918	Bombay

IEEE R10 Meeting



All the 11 Sections of India along with IEEE India Council attended the IEEE R10 Annual General Meeting held at Melbourne, Australia during March 2-3, 2019. Multiple presentations on various IEEE initiatives and programs were given by IEEE President, IEEE R10 Director, IEEE R10 Director-Elect, IEEE R10 ExeCom Members. Awards distribution was held during Gala Dinner on March 2, 2019. Following Awards were received by various Sections and Volunteers from India during the award ceremony.

Sl. No.	Name of Award	Recipient
1	2018 R10 Outstanding Large Section Award	Hyderabad Section
2	2018 R10 Educational Activities Group Award	UVCE, Bangalore Section
3	2018 R10 Education Activities Outstanding Volunteer Award	Ms. Shabana Urooj, Delhi Section
4	2017 MGA Achievement Award	Mr. Puneet Kumar Msihra, Bangalore Section



Mr. Deepak Mathur attended the meeting as 2019-2020 IEEE R10 Director-Elect. India Council wishes him a successful tenure in IEEE R10. He has announced that first Region 10 Conference Leadership Program will be held in Goa, India during Aug 24-25, 2019. Aim of this program is to train volunteers to organize and guide IEEE conferences efficiently and effectively ensuring the quality as per IEEE standards.

A Q&A session with 2020 IEEE President-Elect Candidates were also organized which was attended by both the President Elect Candidates.

2018 R10 Councils & Sections Reports are available at <https://www.ieeer10.org/2018-r10-councils-sections-reports/>

IEEE Bangalore Section Events

IEEE Bangalore Section Annual General Meeting



The IEEE Bangalore Section Annual General Meeting with 650 participants was held on 6th January 2019 at Dayanand Sagar College of Engineering. The event brought together the entire student branch chapters across Bangalore under one roof. The AGM was an opportunity to interact with other members, enrich our professional lives as well as promote your career interests, enhance our understanding of the Section and its activities. The various awards given by the Bangalore Section encouraged the student chapters to work more and get benefited from IEEE. Mr Sudeendra, Chair, summarized the year 2018 initiatives and challenges. Mr S. Rajashekhar, Secretary presented the activities report of 2018 and Ms Sadhana, Treasurer presented the finance report, which were approved by members. A cultural program was conducted in the second half.

WIE Summit at National Institute of Technology, Karnataka



NITK IEEE Student Branch organized the Women in Technology Summit, a national level three day event during 21-23 Dec 2018 under the aegis of IEEE Bangalore Section, IEEE Computer Society, IEEE IAS and IEEE Mangalore Subsection. The event was a huge success with 140+ delegates coming from eight different IEEE Sections in India. The event comprised of workshops and talks by professionals from leading companies such as Texas Instruments, Global Foundries, Intel, SAP, DELL, TCS under three different tracks, Computing, Electronics and Automation and Entrepreneurship. Over 70+ volunteers worked tirelessly and contributed for the success of this event.

Embedathon at National Institute of Technology, Karnataka

In the month of January 2019, NITK IEEE conducted NITK's first hardware hackathon, named Embedathon, a 24 hour night-long event. The event had 180+ registrations for the preliminary round which involved a written test comprising questions from electronics and basic programming. Top 10 teams were selected for the final hackathon which had to come up with a solution for the problem posed. There were multiple stages and checkpoints to cross and complete to finish the hackathon. Over 10+ volunteers stayed up all over the night to ensure successful completion of the event. The winners and runners bagged cash prize as a reward.

Workshop on Basic Electrical Engineering at Sambhram Institute of Technology, Bengaluru



IEEE SB of SaIT organized a one day workshop on Basic Electrical Engineering on 3rd Jan 2019. Dr. S. Sridhar, Prof & Head, Dept of EEE, CiTech, Bengaluru was the resource person at the workshop. The event was presided by Dr. H.G. Chandarakanth, Principal, SaIT and Dr C.V. Ravishankar, HoD, Electronics and Communication. The event was conducted successfully with the participation of 164 students. The workshop had informative presentations covering KVL, KCL, Single phase, 3-phase motors induction motors, transformers, domestic wiring. The sessions were informative with ideas to solve the problem from the

examination point of view.

Program on Career Opportunities in Armed Forces & Drug Free India Awareness Program at Sambhram Institute of Technology, Bengaluru

IEEE SB of SaIT organized a one day programme on “Career Opportunities in Armed Forces for Technical Graduates” with Col. K A Ramachandra as the resource person. The event, attended by around 400 students provided an overview on career opportunities in armed forces for engineers. The speaker enlightened the students on deciding in their 12th grade itself to join the armed forces. During the day, the participants also supported the event “Drug Free India Live program,” organized by Art of Living to bring awareness and promote Drug free India movement.

SDP on “Recent Trends in Network Security & Cryptography” at Sambhram Institute of Technology, Bengaluru

IEEE SB of SaIT organized a SDP on “Recent Trends in Network Security & Cryptography” during 22-23 Feb 2019 with Dr. C. D. Jaidhar, Dept. of IT, NITK, Suratkal as resource person.. The event was attended by around 50 students. The technical presentations sessions on network security and cryptography were very informative and interactive. The participants also had hands-on sessions on these topics.

Workshop on “OFDM LTE Wireless Technology” at Sambhram Institute of Technology, Bengaluru



IEEE SB of SaIT organized a two-days' workshop on “OFDM LTE Wireless Technology” with A T Kishore , Principal Consultant, Telecom, UTL Technologies as the resource person during 25-26 Feb 2019. 189 students participated in this workshop and benefited. The workshop sessions covered the advantages, channel equalization techniques, low symbol rate transmission, and its future advances.

Workshop on Introduction to Python Programming and Profile Building on LinkedIn at KLS's GIT, Belagavi

About 50 students of 4th and 6th semester ECE participated in one day workshop on Introduction to Python Programming and Profile Building on LinkedIn on 22nd Feb 2019. The morning session was dedicated to PYTHON PROGRAMMING where introduction and few basic codes were exercised. The session included hands-on activity. In the afternoon, hands-on session was conducted on how to build an effective and attractive LinkedIn Profile. The participants witnessed the detailed demonstration using a dummy profile, learnt how the skills, academic strengths, networks and other avenues of a strong bio-data can be prepared.

Hackers Richard Zhu and Amat Cama won a Tesla Model 3 by Elon Musk-led electric carmaker and ₹25 lakh after they successfully hacked the car through its browser at hacking contest 'Pwn2Own'. They used a JIT, or just-in-time bug, in the browser renderer process to execute code on the car's firmware. Tesla will release an update to fix the vulnerability.

ICEECCOT-2018: Third IEEE INTERNATIONAL CONFERENCE on Electrical, Electronics, Communication, Computer and Optimization Techniques at GSSS Institute of Engineering & Technology for Women, Mysore



GSSS Institute of Engineering & Technology for Women, Mysore organized an International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT-2018) on 14th and 15th Dec 2018 in association with IEEE Bangalore Section.

ICEECCOT-2018 was inaugurated by the Chief Guest Dr. Shubhalaxmi Kher, Director & Associate Professor, Department of Electrical Engineering Arkansas State University, USA and Guest of Honor Dr. K.N. Bhanu Prakash, Group Leader, Signal & Image Processing Group, Agency for Science, Technology and Research (A*STAR), Singapore.

Dr. Shubhalaxmi Kher appreciated GSSSIETW for its reputation as the first women's engineering college in Karnataka and motivated the engineers to contribute towards the society by supporting our eco-system. In her keynote address on "Smart Grid and Cyber Security", she highlighted the scope for research in the fields of sustainable power in the future with an objective of creating a carbon free world. Dr. K.N. Bhanu Prakash said that conferences are the platforms to know about of disruptive technologies and to gain the knowledge on the required skills to cope up with these technological changes. In his keynote address on "AI in Healthcare", he said that there is a need to handle lot of data and added that it can be done through good research.

The keynote speaker on 15th Dec was Dr. Teo Yong Meng, Professor, Dept. of CS, National University of Singapore, Singapore. The conference received scholarly papers and good participation from authors across the world including from India, USA, South Korea, Italy, Brazil, Columbia, China, Malasiya, Taiwan & United Arab Emirates.

Reports compiled and presented by: Mr. S. Rajashekhar, Rajashekhar.S@ge.com



IEEE Hyderabad Section Events

AHCSSC-2019: The All Hyderabad Section Computer Society Student Congress



The All Hyderabad Section Computer Society Student Congress (IEEE AHCSSC 2019) is the yearly congress from the IEEE Computer Society Chapter of Hyderabad Section. This flagship event of IEEE CS Chapter was organized during 3-5 Jan 2019 at Vardhaman College of Engineering, Hyderabad.

AHCSSC 2019 highlights include: Three key note addresses ; Nine plenary talks; Robotic Expo; 300 +delegates. The theme of this 2019 congress was “Artificial Intelligence and Robotics”. This congress attracted student members from different student branches across the country to collaborate on new ideas and get awareness about the latest trends in computing technologies.

Dr M.A. Jabbar, Convener and Vice Chair, IEEE CS Chapter, Hyderabad advised the students to learn both soft skills and hard skills to be competent in the dynamic changing world. He had also thanked Vardhaman College of Engineering thankful for hosting the Congress.

Some of the prominent speakers addressed at the Congress include:

- S Venkatraman Amazon
- Sanjeev Reddy Bora, CTO e Biz Solutions
- Madhav Negi, DXC Technologies
- Dr Atul Negi ,HCU
- PSV Kisshaan, CEO HBots
- Gopal Krishna Kuppa, IEEE Hyderabad Section
- Ravi Bulusu, CEO Enmovil
- Venkat Ramana P, Principle Engineer and Associate Architect Samsung
- Rajnikanth aluvalu, Head of CIE, Vardhaman college of Engg
- Senthil Kumar Vijaykumar , TCS
- Amarendra Katkam, Founder and CEO Smart Bridge Educational Services Pvt Ltd.

This Congress helped the students to learn about artificial intelligence and get insights into the latest development in AI and Robotics Domain which will help in their research.

The organizing committee of the Congress included: Principal of Vardhaman College of Engineering Dr S Saisatyanarayana Reddy, EXECOM members of IEEE CS Chapter, Hyderabad Section Mr Bala Prasad Peddigari (Past Chair and Secretary, Hyd Section), Chair IEEE CS Chapter T Vidyasagar , Vice Chair Dr M.A Jabbar, Secretary Dr Rajanikanth Aluvalu and Treasurer Ramesh Chandra. Heads of ECE, CSE, EEE, IT, Mech, Civil, H and S also participated in the Congress sessions.

Report by: Dr. M.A. JABBAR, akhiljabbar@ieee.org

Speaking at the launch of Stanford Institute for Human-Centered Artificial Intelligence, Bill Gates compared AI with nuclear technology. "The world hasn't had that many technologies that are both promising and dangerous. We had nuclear weapons and nuclear energy, and so far so good," Gates said. He added his foundation is experimenting with AI to identify causes of malnutrition in Africa.

SoftBank Founder and CEO Masayoshi Son revealed he missed out on buying 30% stake in Amazon in its early years as he didn't have \$30 million. Son offered \$100 million, but Amazon Founder Jeff Bezos insisted on \$130 million for the stake worth about \$260 billion now.

ISED-2018 International Symposium on Embedded Computing & System Design (ISED 2018)



The 8th International Symposium on Embedded Computing & System Design (ISED 2018) was organised during 13-15 Dec 2018 in co-sponsorship with KSCSTE and CSIR and Technical Sponsorship by IEEE Kerala Section & Kochi Sub Section. The conf. was inaugurated by Sri. Mohammed Hanish IAS, MD of Kochi Metro Rail Limited on 13th Dec 2019. Dr. R Sasidharan, VC of CUSAT presided over the function.

Professor Dr. Supriya M.H., of the Department of Electronics welcomed the gathering. Dr. Bijoy, Programme Chair, ISED 2018 provided an overview of the conf. and its relevance. The Proceedings of ISED 2018 was released by Prof. Sandeep Shukla, General Chair, ISED 2018 and HoD/CSE, IIT Kanpur. Prof. Gerhard W. Dueck, Professor of Computer Science, University of New Brunswick offered felicitation. The inaugural session concluded with the Vote of Thanks by Dr. Tripti S Warrior, Assistant Professor, Department of Electronics, CUSAT.

ISED 2018 had six keynote addresses as given below:

- “Cyber-Physical System Security: Convergence of Electrical Engineering and Computer Science” by Prof. Sandeep K. Shukla, IIT was about cyber attacks and the need for improving security in our fast growing world.
- “Scalable and secure deployment of IoT devices” by Mr. Arvind Raju, Senior Architect, Intel Corporation, India explained about the different projects and development process happening in Intel.
- “Prospects and Challenges of Reversible Computing” by Prof. Gerhard W. Dueck, University of New Brunswick, Canada highlighted the research ongoing in his university and country.
- “Revamping Industrial Processes with Block chain” by Dr. V. Ramakrishna, Researcher, IBM Research India explained in detail about the block chain management and the process flow and control as well the role of IBM in the field of block chain management.
- “System Level Design Tool Set and RTOS for SoC FPGA” by Dr. Shinya Honda, Associate Professor, Graduate School of Informatics, Nagoya University addressed the RTOS design tools and its importance in chip level designing.
- “IoT and Embedded systems” by Dr. Lenin Gopal, Associate Professor, Curtin University, Miri, Malaysia explained in detail about embedded technology trends and its research scope.

The day one of the conf had technical sessions on Machine learning; VLSI System and Signal Processing; and Embedded Challenge in Industry.

After the end of day one sessions, a conference banquet was organised at RECCA club, Co-located with NITCAA and Kerala Start-up Mission.

On day 2 of the conf, the programme had parallel technical sessions in Communication Systems, Power-Aware Systems, System Design and Security, Embedded System Design, Signal Processing and VLSI System.

At the valedictory function Dr. Bijoy A. Jose, Program Chair of ISED 2018 addressed and thanked the gathering for the smooth conduct of ISED 2018. Certificates for best paper presentations was awarded to Sree Ranjani R from Amrita School of Engineering, Coimbatore, India on the paper “A Novel Logical Locking Technique against Key-guessing Attacks” and Purvi Patel from DA-IICT, Gandhinagar, India on the paper Low Power Management Unit with Load Regulation using DC-DC Switched Capacitor Converters in 0.18um CMOS.

Workshop on “Machine Learning”



A three-day workshop on “Machine Learning” was conducted in colocation with the IEEE Co-Sponsored 8th International Symposium on Embedded Computing and System Design, (ISED 2018) during 13-15 Dec 2018. This workshop/FDP was organized by Department of Electronics, CUSAT and Amazon Corporation in association with IEEE COMSOC Kerala Chapter.

A total of 62 participants from all over India attended the workshop. On the first day, the ISED 2018 included paper presentations in Machine Learning track. The participants got a brief idea on current areas of research in the field of ML. Eight papers were presented during the technical session and academicians from institutes like IITs, NITs and different Central and State Universities presented their papers.

On 13th Dec, software installation session was coordinated where the participants were directed to install necessary software required for the ML Workshop in their Laptop.

On 14th Dec, the first session was on familiarization of Amazon Web Services (AWS) by Mr. Sriram Kuravi, Solutions Architect-Cloud & IoT. He explained all the services provided over AWS and how to do projects over them. The participants got the insight of the real-time applications like Cloud Computing services over AWS like Amazon Sagemaker Ground Truth, Amazon Recognition, Amazon Comprehend, Amazon Polly, Amazon Lex, Amazon Transcribe and Amazon Translate. The next session directed by Mr. Sachin Rout, Research Associate from Amazon was an introduction to Artificial Learning, Machine Learning and Deep Learning. It was an informative session and the participants learned regarding the various parameters in Machine Learning and the difference between Deep Learning and Machine Learning. Many real-time applications and the collaboration of AI, ML with the Internet of Things (IoT) was discussed. It was followed by a detailed explanation of Artificial Neural Network and the architecture of the same.

In the next session, Mr. Arzan Amaria, Sr. Solutions Architect-cloud & IoT, explained the mathematical approach of an Artificial Neural Network and the mathematics and statistics behind it. Mr. Sachin Rout, Research Associate, took a session on Deep Learning and Shallow Learning. It was followed by a hands-on session where all the participants actively participated and the basic code for prediction and classification problem was carried on. Participants were explained about various platforms for Machine Learning applications. The QA sessions followed was very informative and interactive.



On the last day, 15th Dec, the participants had the first introduction of perceptron and Artificial Neural Network by Mithun Sir, Assistant Professor, Department of Electronics, CUSAT. He had explained the similarity of a biological neuron and Artificial Neuron, a perceptron. He further explained about working of a perceptron and different types of Neural Network. In the next session directed by Dilip Thomas was an interactive session on Computer Vision and Deep Learning in which various real-time applications of Computer Vision using Deep Learning like real-time object detection, Image segmentation, a decision based on the classification of the image were discussed. He had shown the implementation of Deep Learning in the Computer Vision and the applications. He later explained the basics of Convolutional Neural Network (CNN) and its working. He explained the various operations involved in a Convolutional Neural Network like convolution, pooling, noisy image data cancellation, striding. In the hands-on session participants were explained the working of the code of a binary image classification problem, the challenges in real-time applications and how to solve them. At the end of the workshop participation certificates were distributed.



An “Intelligent Embedded Systems Challenge (IESC)” was organised as a co-located event of the IEEE Co-Sponsored 8th International Symposium on Embedded computing & System Design (ISED 2018) in December 2018. This exciting competition for both academia and industry IESC was launched on 1st November 2018 to encourage innovative ideas from the participants. Identifying ideas in Intelligent, Embedded and Software/App controlled systems that can help people and society was the aim of this challenge.

Initially, the registered teams were requested to submit an abstract and report with its implementation, applications and future scope. Over 40 submissions from various academic institutions in the southern part of India were received. From these submissions, 30 teams were shortlisted to the next phase in which 15 minutes Skype interview was conducted with the team members.

Over a period of two weeks, a two-member panel had an interactive discussion with all the selected teams through Skype. Most of the teams were prepared for a demonstration of their project proposals. The coordinators were Dr. Tripti Warriar of DOE CUSAT and Thomas Sabu of IEEE. Based on the Skype evaluation, six teams were shortlisted for the final presentation and demonstration on 13th December 2018 at the ISED 2018 conf. held at CUSAT. The List of the teams shortlisted for the academic track are:

1. Zone Adaptive Response System from Muthoot Institute of Technology and Science, Varikoli, Kerala.
2. Smart Transport Supervise System from KLE Technological University, Hubli, Karnataka.
3. Web-Based Automated Farm Irrigation Control System using IoT from Multimedia University, Malaysia.
4. Real Time Garbage Monitoring Network form Department of Electronics, CUSAT, Kerala.
5. “I See It All” Implementation of Face Recognition Surveillance System Using FaceNet and MTCNN on Jetson TX2 from Department of Electronics, CUSAT, Kerala.
6. Driver Assistance Device from KLE Technological University, Hubli, Karnataka.

For the finals round, four out of the six teams shortlisted and had demonstration booths at the ISED venue which got a lot of attention from students and professionals. The last level evaluation consisted of a three-member team -- Sri Arvind Raju of Intel Corporation, Dr. Babita Jose of SOE, CUSAT and Dr. Deepti Das of DOE, CUSAT. The evaluation was based on demonstration, presentation and on criteria such as innovation, implementation and toughness of the project proposal

The team with the project proposal titled “Driver Assistance Device” from KLE Technological University, Hubli, Karnataka was chosen as the winner of IESC academic track. The prize money of Rs 25,000 sponsored by IEEE Circuits and Systems Society was presented to winners by Mr. Shilen Sagunan, organizer of the Entrepreneurship event by Kerala Startup Mission.

The industry track was won by “Basic Utility Lower Exoskeleton” from Astrex Innovations, Cochin.

Reports by: Dr. Bijoy A. Jose. bijoyjose@cusat.ac.in

Eighty-two years old Pope Francis has become the first Pope of the Vatican City State to write a line of code. In Vatican City, Pope Francis with three young women aged between 11-16 years, contributed a line of code to an app aimed at promoting United Nations Sustainable Development Goals. Pope Francis wrote the last line of code.

IEEE Madras Section Events

Annual Meet



The IEEE Madras Section Annual Meet was held on 9th Feb 2019 at the Koodal Hall, Anna University, Chennai. About 125 members attended the Annual Meeting.

Dr. P.A. Manoharan, Section Chair, welcomed the gathering and provided an overview and the highlights of the section activities during the year 2018. He thanked all the members for extending their support for successful conduct of the section activities.

Dr. T. Micheal N. Kumar, Secretary, presented the Secretary's Report for the year 2018, explaining the activities of the section, societies, affinity groups, student branches and the membership status and developmental initiatives etc. The report was approved by the members.

Dr. V. Jayaprakash, Treasurer, presented the un-audited financial report for the year 2018 which was also approved by the general body. The members were informed that the audited accounts will be finalized as at March 31st 2019 and will be presented to the members during the Annual General Body Meeting subsequently.

Mr. C.R. Sasi, Chief Guest, Dr. P.A. Manoharan, Chairman, IEEE Madras Section and Dr. S. Salivahanan, Ombudsman, IEEE Madras Section presented the cash awards and certificate of appreciation to the best activity performing student branches and the student branches with largest numbers of members and to the student branches hosting the sections events like FDPs, technical activities and best performing section society chapters and affinity groups.

Dr. P.A. Manoharan, Chairman, IEEE Madras Section, introduced the new Execom Members to the members at the Annual Mee. The Secretary, Dr. T. Micheal Kumar proposed the vote of thanks.

The Annual Meet photos are shared in the out web site: <https://www.ieeemadras.org/ieee-agm/>

Cluster Meetings

IEEE MAS formed clusters with IEEE Society Chapters and organised technical talks. Three such cluster meetings were organised and brief reports are presented below:

Cluster I



The IEEE Madras Section organized Symposium Cluster 2019 in association with societie chapters of EMBS, RAS, CIS and EDS on 24.01.2019 & 25.01.2019. The symposium was inaugurated by Dr. Vijay K Varadhan, Distinguished Professor, University of Arkansas, US. Dr. P.A. Manoharan, Chairman, IEEE Madras Section, presided and delivered the presidential address. Dr .N .R. Alamelu, Principal, Sri Ramakrishna Engineering College, Coimbatore welcomed the gathering.

Dr. Vijay K Varadhan, spoke about Wearable Device for Heart Health monitoring. The session was very interactive. Dr

Thyagarajan R, IIT Madras, delivered a presentation on "Underwater Robotics -- Challenges in design and control". Dr. B. Banu Rekha, Assistant Professor (Sr.), Department of Biomedical Engg., PSG College of Technology, Coimbatore, gave a talk on "Introduction to Health Care Analytics. Dr. P. Ganeshkumar, Associate Prof., University College of Engineering, Coimbatore, talked on "Bio-Inspired Algorithms for Engineering Optimization". Dr. S. Balamurugan, Associate Prof.,

Amirtha University, Coimbatore, gave a lecture on “Intelligent Control for Power System Operation”. It was followed by a talk on “Solid State Semi-Conductor Devices Recent Trends” by Dr. D. Nirmal, Associate Professor, Dept. of ECE, Karunya Institute of Technology and sciences, Coimbatore. ∴

The two day session was very interesting and informative to the students, faculties and research scholars . The event was ended with the Vote of Thanks by Mr. K. Balamurugan, IEEE SB Counsellor, Sri Ramakrishna Engineering College, Coimbatore.

Cluster II



The IEEE Madras Section MASSYMP-CL-2 was organized on 07.02.19 at Alumni Center, College of Engineering, (Anna University) Guindy, Chennai. Mr. S. Sunderash, Vice-Chairman, IEEE Madras Section welcomed the gathering. The Section Chairman, Dr. P. A. Manoharan introduced the Chief Guest, Mr. C.R. Sasi, Former Chairman, IEEE Madras Section who inaugurated the MASSYMP-CL-2 and addressed the gathering.

Students, Research Scholars, Faculties of various colleges participated in this program. There were around 45 participants. The first session was on Carbon Nanotubes And Reduced

Graphene Oxide Composites for Energy Applications by Prof. Sundara Ramaprabhu, Professor, Department of Physics, IIT Madras, Chennai. The second session presentation was by Ms. M. Akila, SSN College of Engineering. Dr. Uday K. Khankhoje, Assistant Professor, Dept. of EE, IIT Madras, Chennai delivered a talk on “Signal Processing meets Maxwell's Equations: Microwave based breast cancer imaging”

IEEE-PELS, Madras Section organized a session on, “Design and Fabrication of Electric Vehicle using Brushless DC Motor Drive”, by Dr. A. Bharathi Sankar, Post Doctoral Fellow, Centre for Nano materials, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad. This session focused on the basics of electric vehicle and the application of solar energy to power up the electric vehicle. The fabrication of electric vehicle employing BLDC motor was discussed in detail. The talk focused on the design, simulation and implementation of the various components of the solar based electric vehicle namely: solar panel, charge controller, battery, dc-dc boost converter, dc-ac power converter (Inverter Circuit) and BLDC motor. It also gave a thorough understanding of batteries employed for EV. A glimpse of lead acid and lithium ion battery was put forth to the participants. Technical specifications of prototypes of electric bicycle, tricycle and four-wheeler were exposed to the student participants. This was followed by an interactive session with respect to the selection of batteries, electric motors and controllers for EV were discussed enthusiastically by the student and research scholars.

The last session talks were delivered by Dr. N. Hema, Professor, English, Rajalakshmi, and Dr. S. Raja, Associate Professor, CSE, Vel Tech University on “ Career Resources & Recognition, Professional Communication : Professional Practices and Managing a Professional Network” The event ended with a valedictory session..

Cluster III



IEEE Madras Section Event of Cluster – 3 (MASSYMP-CL-3) was held at Thiagarajar College of Engineering (TCE) among various IEEE Societies (Such as MTT, IT, ComSoc) on 9th March 2019 as a part of IEEE SB activities in TCE organized by IEEE Madras Section. The goal of this program is to ensure the growth of skills and knowledge among professionals and to foster individual commitment to continuing education among the IEEE members, the Engineering and Scientific Community and the general public.

The participants of this one day event were the students, student members of IEEE, Research Scholars and faculty members from various colleges numbering about 50. At the inaugural session, Chief Guest Dr. V. Abhaikumar, Principal, Thiagarajar College of Engineering and Chair, IEEE Microwave Theory and Techniques Society, Madras delivered the presidential address.

Mr. Rajendran Venkataramasubbu, CEO, Adroit Soft India Private Ltd, Chennai took part in the inaugural session along with Prof D Vijendra Babu, Vice Principal, Aarupadai Veedu Institute of Technology, Chennai. The first inspirational session on Blockchain Architecture was delivered by Mr. Rajendran Venkataramasubbu. The next session was on Cloud

based repository for snapping document taken by Dr. Padmavathi. The session was very detailed one, starting from the basics (what are data centres, cloud etc.,). The live demonstration by the staff was interesting.

In a presentation session on 5G communications, Dr. Vijendra Babu, was the speaker and gave additional information about 5G. The next interactive session was handled by Dr. Mrs. Raju who had discussed about antennas in 5G, the advantages and real live problems in the design part of antenna in 5G. The last session on “Wireless radios for IoT applications” was handled by Dr. Deepak Ramprasath, Vice President R&D, Thiagarajar Telecom Solutions, Madurai. He had stimulated the students by arising many questions towards them. He explained the concept of IoT with real life applications. Finally, the symposium ended up with a valedictory address by Dr. B. Manimegalai, Professor, Member, IEEE Antennas and Propagation Society. Overall, the symposium was informative.

Report by Dr. S. Joseph Gladwin, josephgladwins@gmail.com

The 10 business phrases most likely to make you scream

- Touch base offline (let's meet and talk)
- Blue-sky thinking (creative ideas free from practical constraints)
- Punch a puppy (do something detestable but good for the business)
- Thought shower (to come up with several ideas)
- Thinking outside the box (thinking creatively and innovatively)
- It's on my radar (I'm aware of it)
- Close of play (the end of the day)
- Singing from the same hymn sheet (all in agreement)
- Peel the onion (to examine a problem in detail)
- To wash its own face (to justify or pay for itself)

Did You Know These Things Had Names?

- The space between your eyebrows is called a glabella.
- The way it smells after the rain is called petrichor.
- The plastic or metallic coating at the end of your shoelaces is called an aglet.
- The rumbling of stomach is actually called a wamble.
- The cry of a new born baby is called a vagitus.
- The prongs on a fork are called tines.
- The sheen or light that you see when you close your eyes and press your hands on them is called phosphenes.
- The tiny plastic table placed in the middle of a pizza box is called a box tent.
- The day after tomorrow is called overmorrow.
- Your tiny toe or finger is called minimus.
- The wired cage that holds the cork in a bottle of champagne is called an agraffe.
- The 'na na na' and 'la la la', which don't really have any meaning in the lyrics of any song, are called vocables.
- When you combine an exclamation mark with a question mark (like this ?!), it is referred to as an interrobang.
- The space between your nostrils is called columella nasi.
- The armhole in clothes, where the sleeves are sewn, is called armscye.
- The condition of finding it difficult to get out of the bed in the morning is called dysania.
- Unreadable hand -writing is called griffonage.
- The dot over an “i” or a “j” is called tittle.
- That utterly sick feeling you get after eating or drinking too much is called crapulence.
- The metallic device used to measure your feet at the shoe store is called Bannock device.

CONFLUENCE 2019



The CSE Dept, Amity School of Engineering and Technology with the technical co-sponsorship of IEEE UP Section organized the 9th International Conference CONFLUENCE-2019 during 10-11, Jan 2019 on the theme of “Cloud Computing, Data Science and Engineering” at Amity Campus, Noida.

The 2019 Summit witnessed 10 international speakers from across the globe including University of Florida, USA, NTU, Singapore, Middlesex University, London, University of South Alabama, USA, University of Aizu, Japan, University of Limerick, Ireland, University of Newfoundland, Canada, Dortmund University, Germany, Waseda University, Japan, Weizmann Institute, Israel, and Israel Academy of science and humanities.

126 papers were accepted for presentation out of 562 research paper submissions from across the globe. All the papers registered and presented will be sent to IEEE Xplore Digital Library for publication and all published papers would be indexed in SCOPUS.

The conference inaugural session dignitaries included: Prof. (Dr.) Manuel E. Bermudez, University of Florida, USA; Prof. (Dr.) Glenford Mapp, Middlesex University, London; Prof. (Dr.) Hiroshi G Okuna, Waseda University, Japan; Prof. (Dr.) Bernhard Steffen, TU Dortmund University, Germany; Prof. (Dr.) Tizinia Margaria, University of Limerick, Ireland; Prof. (Dr.) Subhash Bhalla, University of Aizu, Japan; Prof. (Dr.) David Peleg, Weizmann Institute, Israel; Prof. (Dr.) Balvinder Shukla, Vice Chancellor, AUUP & Patron, Confluence 2018, Prof. (Dr.) Abhay Bansal, Jt. Head, ASET & HoD CSE; Dr. M.K. Pandey, Jt. Head, ASET; and Dr. Abhishek Singhal, Deputy HoD(CSE), ASET.

Embracing the distinguished forum, Prof. (Dr.) Balvinder Shukla, Vice Chancellor, AUUP & Patron, Confluence 2019, shared her thoughts upon how the 9th International Confluence provides a manifesto for the research community, industrial experts, scientists, participants and students to collectively exchange innovative ideas and enable contributions to novel research and developments in the field of Cloud Computing, Data Science and Engineering. Prof. (Dr.) Abhay Bansal, Jt. Head, ASET & HoD CSE as a mentor, motivated the students to ace for opportunities whilst their interactions with the renowned Academicians.

Through a range of 20+ keynote speeches, special sessions like CXO Forum and Plenary session, audience witnessed new ways to deal with the challenges faced in areas of Cloud computing, data science and engineering. The heritage of India was also showcased through an exceptionally well performed series of cultural events on the evening of day one.

“Cyber Cup” was organized as Pre Conference Event on 8th & 9th of January, 2019. The fest was a culmination of skill and prowess. All competitions under the Cup were set to test the intellectual, oratory and creative skills of participants. The fest served as a platform for talents to compete among college fraternities while basking in the spirit of conviviality. Over 700 students from various schools under “Cyber Cup-Junior” and Colleges and Universities under “Cyber Cup” participated in this fest. Also five Pre Conference talks by International experts were organized.

Valedictory Session was graced by Mr. Manav Sehgal, Head of Solutions, Architect, Amazon Internet Services Pvt. Ltd., Prof. (Dr.) Shyi-Ming Chen, National Taiwan University of Science and Technology, Taiwan, Prof. (Dr.) Harlod Pardue, University of South Alabama Graduate School, USA, Prof. (Dr.) David Harel, Vice President of Israel Academy of Science and Humanities, Israel, Prof. (Dr.) Naveen Chilamkurti, La Trobe University, Australia, Prof. (Dr.) Andrew Keong Ng, Singapore Institute of Technology, Singapore, Prof. (Dr.) Mahardhika Pratama, Nanyang Technological University, Singapore and Prof. (Dr.) Manfred Broy, Technical University of Munich, Germany. Founder President, RBEF & Chairman AKC Group of Companies, Dr. Ashok K.Chauhan also graced the dais. Top officials of various industries like Honeywell Automation India Limited, Spicejet, Picture Time DigiPlex Pvt Ltd, Goods and Services Tax Network, Hanu Software, Bravura Solutions, HCL Healthcare, Qualcomm Ventures, Flipkart, IBM India Pvt Ltd, Interra Systems and

Collins Aerospace were welcomed and honoured. Also Amity Researcher Awards were conferred upon to distinguished researchers and academicians for their significant contribution in their respective fields. Amity University also conferred Honorary Professorships to eminent scientists and industrialists.

Showcasing its hospitality, Amity also organized a trip to Taj Mahal, Agra for the foreign delegates to help them explore the diverse culture of India.

Workshop on RC Aircraft and Sensor Guided Autonomous Robot



On the occasion of National Science Day, IEEE SB of REC Mainpuri in association with Sky-fi Labs organised a workshop on RC Aircraft and Sensor Guided Autonomous Robot during Feb 28 – Mar 2, 2019. The 3-day workshop was inaugurated by the Director. Dean Academics, Dean Student Welfare and HODs of various departments participated in the inaugural.

The introduction to the topics, the important terms and the basics of robotics is what started the robotics classes. In aircraft, aerodynamics starts the lecture. On the first say itself, Software Coding of Arduino Board and the wings for Aircraft made everyone excited. The students enthusiastically showed keen interest and were delighted to learn about the new concepts and technical aspects like coding, mechanical aspects of the RC airplane and much more.

On the second day, students of various departments collectively were asked to think, analyse and suggest solutions. The third day focused on testing. Self-made Airplanes flying in the sky, Robots working as desired created the aura of satisfaction and pride. Various Competitions were organised for both workshops and winners were awarded cash prizes worth Rs. 4000.

The event ended with the prize distribution ceremony for the top performers, mementos to the trainers and motivational words by the Convener Professional Activity Committee IEEE UP Section Dr. Aseem Chandel. He encouraged the students to actively participate in such events to grab all these opportunities. He further demonstrated that the team works like this enhances the cooperation among the students and also builds up the confidence and leadership quality.

SPIN 2019: 6th International Conference on Signal Processing and Integrated Networks

The 6th International Conference on Signal Processing and Integrated Networks, SPIN-2019 was organized by Department of ECE, Amity School of Engineering & Technology, Amity University during 7-8 March, 2019. This conference was technically co-sponsored by IEEE UP Section. Over the past few years, SPIN has emerged as a well-recognized conference in the country and overseas because of its high quality peer-reviewed research articles, invited talks from renowned academic and industry leaders, showcasing latest innovations and networking opportunities.



The conference had a very high quality technical program consisting of 38 invited talks and 227 contributory papers. The invited talks were delivered by renowned researchers throughout the world from countries: USA, UK, Turkey, Taiwan, Sweden, Spain, South Korea, Singapore, Portugal, Japan, Italy, Indonesia, Greece, Egypt, Czech Republik etc. SPIN-2019 attracted contributions from several countries such as Japan, USA, Sweden, Portugal, China, South Korea, Egypt Spain, UK, Costa Rica, Czech Republik, UAE and many premier academic institutions and organizations of India like IITs, NITs, DRDO, NPL, ISRO, CSIR-CSIO Delhi, BEL, BITS Pilani, DTU, NSIT, Jamia Milia Islamia, and JNU etc. Seven Special Technical Sessions and 19 Poster Presentations were also organized during these two days.

Additionally, the following activities had been conducted.

- A Gamified workshop for data driven innovation “Innovators Marketplace on Data Jackets” by Dr. Teruaki Hayashi and Mr. Masahiro Senda, The University of Tokyo, Japan.
- Session on Plagiarism and Ethical Issues Related to Scientific Research Paper Writing and Student Conclave to Promote IEEE Membership and Leadership Skills.
- Design Thinking Workshop on “Engineering Design & New Product Development”.
- A session on “IEEE Women in Engineering (WIE)” to Promote Women Engineers and Scientists.
- A session on “Recent Research & Innovation Trends”.
- Special Session on funding opportunity and challenges in research and innovations conducted by distinguished panellist from DRDO, DoT and DST, Govt. of India.
- Industry Interaction session with more than 25 Industry Experts including Airtel, Samsung, and Havells etc.

In SPIN 2019 conference, the Chief Guest Prof. (Dr.) Raj Mittra, University of Central Florida, USA and Guests of Honour Dr. Kazuya Kobayashi, Chuo University, Japan, Mr. Arun Malik, Director, Quality, Airtel, Dr. Kaushik Saha, CTO, Samsung, and Mr. Anil Bhasin, President, Havells India Ltd had shared their thoughts and knowledge with the researchers, faculties, students and participants.

Prof. (Dr.) Manoj Kumar Pandey, General Chair, Prof. Raj Kamal Kapur, Conference Chair, Dr Pradeep Kumar and Dr. Ashwani Kumar Dubey were the Organizing Chairs of SPIN 2019.



The Dept of ECE, Jaypee Institute of Information Technology, Noida with the technical sponsorship of IEEE UP Section and IEEE UP Section Signal Processing and Computer Society Joint Chapter successfully organized the fifth edition of International Conference on Signal Processing and Communication (ICSC 2019) from March 7 - 9, 2019.. The event was inaugurated by the Vice Chancellor, Prof. S. C. Saxena.

Furthermore, ICSC team had brought together a session on Women In Engineering and also . and put together student project exposition. The conference witnessed plenary talks by world renowned academicians and legends from industry as listed below:

- Dr. Gurtej Sandhu, IEEE Fellow is Director Micron Technologies Inc., Idaho, USA and has around 1350 US patents. He has the honour of having more patents than Thomas Edison. He has pioneered several process technologies currently employed in mainstream CMOS semiconductor chip manufacturing that enables DRAM and NAND memory chip scaling.
- Prof. Mohamed-Slim Alouini, IEEE Fellow, Professor and Assoc. Dean KAUST, with Google Citations of around 45,000. He is IEEE Distinguished Lecturer of IEEE Communication Society. He is currently Editor of IEEE Transactions on Wireless Communications.
- Prof. George K. Karagiannidis, IEEE Fellow, Aristotle University of Thessaloniki, Greece with Google Citation of around 15,000. He has served as Editor-In-Chief of IEEE Communication Letters and is highly cited researcher continuously from year 2015 onwards. He is IEEE Distinguished Lecturer of IEEE Communication Society.
- Prof. Dipankar Dasgupta, IEEE Fellow and ACM Distinguished Speaker, Professor at University of Memphis, USA with Google Citations around 16,000.
- Prof. S. N. Singh, IEEE Fellow is Vice Chancellor MMMUT Gorakhpur and Chairman of IEEE India Council. He is also IEEE Distinguished Lecturer has google citations around 10,000.
- Dr. Ashok Chandra, International Telecommunications Union (ITU) Expert, has served as Wireless Advisor to GOI, Ministry of Comm. & IT and helped establish new IIT's and IIM's and IIIT's, he is currently serving as Adjunct Professor in IIT Bombay.
- Dr. Panagiotis D. Diamantoulakis, Aristotle University of Thessaloniki, Greece is researcher in the field of Wireless Communication and Editor of IEEE Wireless Communication Letters.

68 papers were accepted for presentation in ICSC 2019 out of around 160 submissions from across the world. There were a total of seven technical sessions covering different and all possible aspects of Wireless Communication Systems, Signal Processing for System Analysis, VLSI Circuits and Systems, Embedded Systems, Machine Learning in Signal Processing, Internet Of Things in Communication, Machine Learning in Communication, Image Processing, etc. There were three poster sessions covering many posters in all above mentioned fields of Electronics Engineering.

Reports compiled and presented by: Dr. Danish Ather, danishather@gmail.com

A "high-severity" Android bug that exposed user data for over five years and could let hackers spy on them was fixed only for newer phones. Google will provide automatic update to users of Android 7 or above, while Android 5 or 6 will need a manual update through Play Store. However, Google said it won't be fixed on 'Android 4.4'.

Celebrating Sir Jagadish Chandra Bose

Sir Jagadish Chandra Bose, one of the fathers of Radio Physics, demonstrated in Calcutta, India, the generation, transmission and reception of electromagnetic waves at 60 GHz frequency over a distance of 23 meters through two intervening walls by ringing a bell and detonating gunpowder in 1895. He developed several components such as a spark-gap transmitter, coherer, horn antenna, dielectric lens, polarizer, and cylindrical diffraction grating. Some of his concepts and components, in a further refined form, continue to be used today in space communications. His work is considered to be at least 50 years ahead of his time. In fact, IEEE named Sir J.C Bose as one of the fathers of radio sciences.



IEEE celebrated the 160th anniversary of Sir Jagadish Chandra Bose on February 17, 2019 by reflecting on his life and works through eminent speakers compassionately projecting his work to 150 plus aspirant IEEE members and engineers on a Sunday morning in Bengaluru, INDIA. This workshop, which was inaugurated by Dr. S.N.Singh (Chair, IEEE India Council), showcased the innovations of Sir J C Bose and its relevance and contribution to the modern technology. While Prof. B S Sonde (ASM Technologies), Prof. D P Sengupta (NIAS) and Dr. Surendra Pal (DRDO) reflected on the life of Sir Jagadish Chandra Bose, Mr. C S Rao (Quadgen Wireless Solutions) and Dr. Yashwant Gupta (TIFR) presented the application of Sir J C Bose's work in unlicensed 5G band for communication networks and Radio Astronomy.





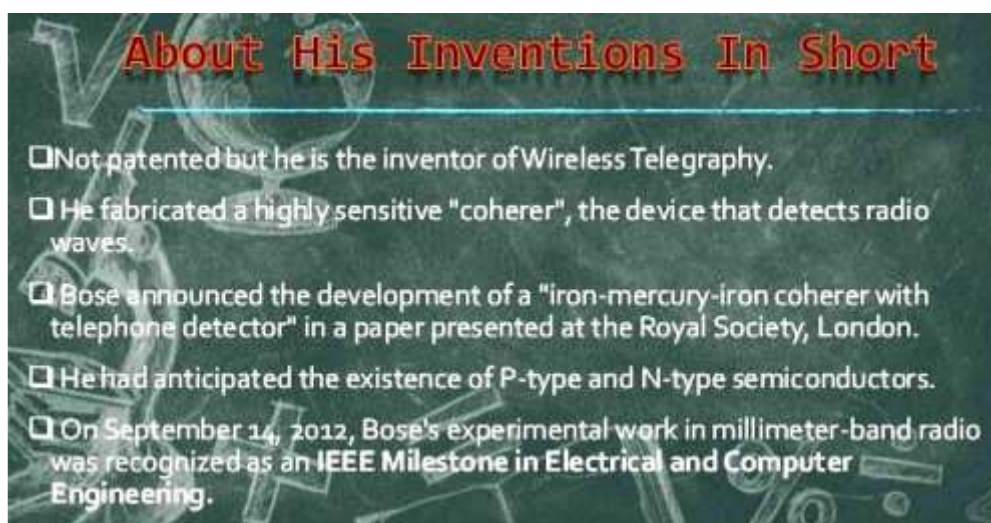
The highlight of the workshop was the demonstration of the working replica model of JC Bose's millimetre wave experiment by Dr. Dr. K.A. Shaik (MJCET) and Dr. S.I. Mohiuddin (MJCET) as well as demonstration of microwave apparatus by Mr. Sudhir Phakatkar (TIFR).



IEEE Foundation as part of the "Furthering Indian Perception of IEEE" project sponsored this workshop organized by the IEEE India Council, IEEE Bombay Section, IEEE Bangalore Section and supported by IEEE SPS Bombay Chapter and IEEE APS-MTTS Bangalore Joint Chapter. The workshop held at the landmark World Trade Center Auditorium in Bengaluru was sponsored by the World Trade Center, Bengaluru for this noble cause. The Organising committee for this event comprised of B. Satyanarayana, Harish Mysore, Munir Mohammed, Puneet Mishra and Sri Chandra.

Articles based on the presentations and demonstrations by the distinguished speakers will be brought out soon as a special section of the Newsletter.

Report by: Dr. B. Satyanarayana, bsn@tifr.res.in



IEEE OES India Council Chapter Event

Conference on Technologies for Renewable Energy and Water (TREW)



National Institute of Ocean Technology (NIOT), Institute of Electrical and Electronics Engineers –IEEE Oceanic Engineering Society India Council Chapter (IEEE-OES), Indian Desalination Association South Zone (InDA (SZ)) and the SRM Institute of Science and Technology joined hands and organized a three day conference from 7th to 9th March, 2019 at NIOT, Chennai 600100. The unique conference on the twin topics of water and energy was conspicuous by the presence of high profile technology thought leaders and the attendance of aspiring and ambitious young science and technology students with the active intervention by industry experts and corporate C-suite CEOs.

Dr Purnima Jaliwal welcomed the gathering. Dr S. Prabhakar mentioned the role of Indian Desalination Association in the arena of water and renewable energy. Dr M.A. Atmanand's remarks included the activities of NIOT during the past 25 years and the importance of renewable energy and water. Dr. Rajeevan Secretary, Ministry of Earth Sciences expressed that the growth of renewable energy in the country has been satisfactory with its 4th rank in global solar power production and with an ambitious futuristic program on the anvil. He added that water could be a vexatious issue unless addressed expeditiously and energetically, this merits immediate attention of water technologists and professionals.

Dr. V.K. Saraswat, Member NITI Aayog was the Chief Guest and delivered the keynote address. In a scintillating discourse covering the whole spectrum of water and energy, he demonstrated the power of technology as the art of the soluble and also as the art of the possible. The Smart Energy Program envisions smart cities, smart, transportation, smart grids, smart water supply and smart living. He lamented the 'luxurious' misuse and abuse of water in a five star setting for a bath, which could quench the thirst of a whole population of a Rajasthan village. He emphasized that energy efficiency and resource recovery are the twin critical variables of sustainable development.

The two million liters per day capacity low temperature thermal desalination plant using condenser reject heat at Tuticorin Thermal Power station was flagged off. A coffee table book which chronicles the 25 year journey of NIOT in the area of ocean energy and water was also released.



Dr. V.K. Saraswat also presented the coveted Make in India Awards of InDA South Zone to the recipients. The Award for Energy sector was conferred on Professor Chetan Singh Solanki of IIT Bombay and that for Water sector was conferred on Dr. Asim Kumar Ghosh of Bhabha Atomic Research Centre. He also inaugurated the exhibition section participated by various industries related to the field of renewable energy and water

Dr. M.A. Atmanand delivered the opening plenary session talk on "Technology Developments for Blue Economic Growth in India".

Recalling the fact that India is having a coastline of around 7600 km long and an exclusive economic zone of 2.3 million square kilometers, he reiterated the need for strategic technology developments for the harvesting of living and non-living blue economic resources and for protecting the oceanic ecosystems.

Dr. K. Balaraman, Director General, National Institute of Wind Energy provided an overview of Wind Power Development in India. He informed that the governmental target for wind power is 60 GW by 2020 and India's rank today is 4th in the world.

Dr. G.V. Reddy of DST presented an outline of the water technology initiatives undertaken by the department to address the water challenges and capacity building of research professionals and water managers.

Dr. N. Vedachalam of NIOT focused attention on the oceans as a strategic frontier with reference to gas hydrates. It is estimated that 1894 trillion cubic metre of methane gas as gas hydrates below the Indian sea floor between 800 to 3000 m depth. A reservoir with 90% hydrate saturation can produce 8 billion cubic metres of methane and 75 million cubic metre of water over a period of 3.6 years.

Many delegates participated from various Government organizations, Research Institutes, Academia and Industries participated and stressed about the importance of technology for renewable energy and water

In the Oral and Poster Sessions, young scientists, engineers and research students presented a wide spectrum of research findings pertaining to water and energy and explained their work to the delegates.

SRMIST, as part of the conference conducted an exhibition of working models which had wide participation from the students of various schools across Tamil Nadu



The conference concluded with a valedictory function with remarks by Dr. G A Ramadass, Chairman, IEEE-OES , Guest of Honour Dr. M. Vairamani, Dean, School of Bio Engineering, SRMIST and the Chief Guest Dr. M.A. Atmanand, Director, NIOT. Prize distribution to school and college students for model competition and paper and poster presentations was the highlight of the valedictory function.

The conference highlights include:

No. of Participants: 300

No. of Exhibitors: 6

No. of invited talks: 37

No. of Student Papers & Posters received: 28

No. of Papers presented: 8

No. of Posters presented: 12

An Organizing Committee of 10 distinguished Patrons, a Conference Advisory Committee of 11 Desalination thought leaders and a National Organizing Committee of 36 experts powered the high quality and high density conference. Coherent synergy was brought into action between academia and industry. On the whole, the conference brought together academia, industry and researchers for the common cause of renewable energy and water.

Report by: Dr Purnima Jalihal



What's hot in IT - An Indian Perspective (Jan-Feb 2019)



Prof. S. Sadagopan
Director, IIIT-Bangalore
ss@iiitb.ac.in

February 2019

Universities, Science & Technology and Policy

- **IIT-Delhi** announces **500 PhD Fellowships for International students** from the academic year 2019-20, a game changer initiative of the Indian higher education system
- **Prime Minister** dedicates **IIT-Dharwad** and **IIIT-Dharwad** to the Nation on February 10, 2019
- German auto components biggie **Bosch** funds an **AI Research Center in IIT Madras** with planned investments of Rs 20 Crores on February 6, 2019
- **ISRO** unveils "**Human Space Flight Center**" in Bangalore on February 1, 2019; 31st communication satellite **GSAT 31** launched from France on February 6, 2019
- Considering the fact that Government's "**Angel Tax**" continued to bother **start-up** community in India, the tax exemption cap was hiked to Rs 25 Crores and the effective time was increased to 10 years, in February 2019
- The new **policy** on **e-Commerce** for firms kicks in from February 1, 2019
- **TRAI** norms for **broadcast TV channel pricing** comes into effect from February 1, 2019; expected to save money for hundreds of millions of TV consumers
- **Union Government** presents its **Vote on Account** on February 1, 2019; acting **Finance Minister Piyush Goyal** (Finance Minister Arun Jaitley is away in USA on medical grounds) creates history – the first finance minister who is a formally trained accountant (in fact the national topper in his batch) - does a fine balance between fiscal discipline and populism

Products

- **MWC 2019 (February 25 - 28)** had many products particularly smartphones that "fold" from **LG** (Dual Screen) and **Huawei** (Mate X) - in addition to **Samsung** "Fold" - **5G** was the dominant theme
- **Samsung** launched its revolutionary phone with foldable display **Samsung Galaxy Fold** on February 20, 2019 at Bill Graham Civic Auditorium in San Francisco, the place where Steve Jobs launched Apple II way back in 1977

Indian IT Companies

- **TCS** posts good results on January 10, 2019, with the highest-ever **quarterly profit Rs 8,105 Crores**

MNC IT Companies in India

- In February 2019, French major **Thales** launches its R & D Center in Bangalore
- **Hero Chip Design facility** was launched in Bangalore on February 20, 2019
- **Samsung** R & D Institute signs up for another 4,00,000 sq. ft. space in Bangalore on February 16, 2019
- **Amazon & Wal-Mart** lose \$ 50 Billion in market-capitalization in early February 2019, partly impacted by the Indian e-Commerce rule kicking in on February 1, 2019; Amazon license gets restored on February 6, 2019

People

- Prime Minister **Modi** receives **Seoul Peace Prize** on February 23, 2019
- IIT-KGP Alumnus and IITB faculty **Dr Subasis Chaudhury** named **IIT - Bombay Director**; to take charge on April 15, 2019
- February 2019 saw **Sriram Raghavan of IBM Research (India)** moving to USA to lead AI Research in NYC

- India-educated BITS-Pilani alumnus Ms **Revathi Advaiti** was named **Flex** (earlier Flextronics) **CEO** on February 11, 2019
- **CTS CEO Francisco D'Souza** steps down after 12 years of glorious innings (CTS revenue saw top-line growing from \$ 1.42 Billion in 2006 to \$ 16.1 Billion in 2018); settles a long-pending dispute with US Regulator Securities & Exchange Commission for \$ 25 Million on February 15, 2019
- **Mukesh Ambani** (with \$ 54 Billion) in global **Top 10 in Global Rich** list of Hurun (February 27, 2019), for the first time; **Bill Gates** is **No 2** with \$ 96 Billion and **Bezos of Amazon** tops the list with \$ 147 Billion. Interestingly, 2470 individuals account for 12% of global GDP, demonstrating the concentration of wealth among the top

Start-up Scene

- **Intel** acquires Hyderabad-based start-up **Ineda** – a silicon and platform services provider in the graphics arena for GPU - on February 18, 2019
- India's hotel room aggregator start-up **Oyo** enters US market in February 2019
- **Swiggy** (food delivery company) acquired AI-startup **Kint.io** on February 4, 2019

Interesting numbers

- India's **IP Index rank** moved from 44 to 36 in the year 2018, as per US Department of Commerce Report; the largest jump in the year across all countries
- **GST collections** in February 2019 sees a marginal drop (Rs 97,247 Crores)
- India's Central Bank **RBI** cuts "repo rate" by 25 basis points on February 7, 2019
- **Akshaya Patra** mid-day meal program among School students in India (run by ISKCON) touches 3 Billion mark on February 11, 2019; starting with 1,500 children in 2000, it crossed the 1 Billion milestone in 2012 and the 2 Billion milestone on 2016
- **Government of India** increases **DA** by **3%** (from 9% to 12%) effective January 1, 2019 on February 19, 2019
- **Tata Motors** posts a record loss of Rs 27,000 Crores for the October – December 2018 quarter; the largest ever loss for any Indian company in the corporate history of India!

General

- India's **National War Memorial** (built over 2017 to 2019) was launched in New Delhi near India Gate on February 25, 2019
- **Indian Railways'** Integral Coach Factory (ICF), Chennai built **Vande Bharat** Express train commissioned on Delhi – Varanasi route on February 17, 2019; it starts a new era in high-speed train travel in India
- **Bangalore Airport** commissions its 3.4 MW **solar plant** on February 6, 2019
- In early February 2019, **Airbus** decides to stop production of its iconic jumbo aircraft "**Airbus 380**" from 2021
- **US President Trump** declares **local emergency** to press through his demand for billions of dollars for the planned Mexico Wall on February 15, 2019
- A major forest fire destroys 6,000 acres of forest land in Bandipur, Karnataka during February 22 - 26, 2019; 300 cars gutted during Bangalore Aero Show on February 23, 2019
- Terrorists with Pakistan support kill 40 Central Reserve Police personnel in **Pulwama** Kashmir on February 14, 2019; India conducts **Surgical Strike 2.0** and kill 300 terrorists in a terror camp by flying planes 70 Km into Pakistan territory in a sophisticated and swift 21-minute operation in the wee hours of February 26, 2019; in turn, it leads to loss of Indian Air Force Pilot Abhinandan Varthaman; luckily, Pakistan released him and Abhinandan reaches India back on March 1, 2019 after 60 hours of captivity

January 2019

Universities, Science & Technology and Policy

- **JEE Mains 2019** held in January 2019 by National Testing Agency in online mode spread over January 9, 10, 11 & 12; results declared on January 19, 2019 (10 days ahead of time); nearly 10 Lakhs took the exam; one more attempt available for students in April 2019
- **Drone Policy 2.0** enters Draft stage and ready for comments on January 15, 2019
- **Doordarshan Science channel** launched on January 15, 2019 by DST Secretary & S&T Minister
- Micro-satellite "**KalamSat**" weighing little over 1 Kg (designed by students with guidance from NGO SpaceKidz India) was put in orbit by **ISRO** on January 24, 2019

- **PhD students' stipend** amounts increased from Rs 25,000 to Rs 31,000 by Government of India on January 31, 2019
- **AICTE** cuts 40,000 engineering seats and decides not to give permission for new engineering colleges for 2 years, on January 31, 2019
- **600 Indian students "trapped"** in USA by fake university created by INS in January 2019

Products

- **CES 2019 (Jan 7 - 10)** had many products show-cased, but nothing spectacular

Markets

- **Byju's**, Bangalore-based learning solutions company acquires US-based learning games company **Osmo** for \$ 20 million on January 16, 2019
- Bangalore-based analytics firm **Fractal** gets \$ 200 Million capital infusion from **Apax** on January 16, 2019
- **Bain Capital** acquires majority stake in **Brillio** (Bangalore-based and Santa Clara headquartered) analytics / digital company on January 15, 2019
- **Apple** revises quarterly revenue target downward from \$ 89 Billion to \$ 84 Billion on January 2, 2019, the first ever in 15 years, and its stock price falls by 7% on the very first day of trading in 2019
- **Indian start-ups** raise \$ 38.3 Billion in 2018 (LiveMint January 3, 2019)

Indian IT Companies

- **TCS** posts good results on January 10, 2019, with the highest-ever **quarterly profit Rs 8,105 Crores**; its Brand value takes it to global No 3 (next only to Accenture & IBM) as per Brand Finance Report of January 23, 2019; makes 30,000 offers in 2018-19 season (up from 20,000+ last year)
- **Infosys** posts good quarterly results on January 11, 2019; important, considering the fact that the **new CEO Salil Parekh** just completed a year on January 2, 2019; bags Rs 4,241 Crores Income Tax order on January 16, 2019; its **Verizon** contract value goes up from \$ 750 Million to 1 Billion in January 2019
- **Wipro** quarterly (Oct – Dec) profits jump 30%; quarterly revenue crosses \$ 2 Billion

MNC IT Companies in India

- With 9,100 **patents** in 2018 (with more than 4,000 patents in AI), **IBM** continues its record of holding the No 1 position for 26 years; interestingly, 800 of them were from IBM India, the largest for IBM outside USA
- **Volkswagen** starts India Tech Centre in Pune on January 19, 2019
- **SAP India** to see 400+ **layoffs** (part of 4,400 planned layoff globally) in January 2019

People

- Computer scientist **Dr Subhash Kak**, **ISRO** scientist (who was wrongly punished accused of terrorist link) **Dr Nambi Narayan**, **Cisco** Chairman **John Chambers**, **Adobe** CEO **Santanu Narain** and **L&T** Chairman **AM Naik** are part of Padma awards 2019
- **Vinod Kumar Yadav** is the new **Railway Board Chairman** (effective January 1, 2019), heading the organization with nearly 1.5 Million staff
- **Intel** names Interim CEO **Bob Swan** as **permanent CEO** on January 31, 2019

Start-up Scene

- **MilkBasket** starts Bangalore operations on January 15, 2019
- **Byju's**, Bangalore-based learning solutions company acquires US-based learning games company **Osmo** for \$ 120 million on January 16, 2019
- Bangalore-based analytics firm **Fractal** gets \$ 200 Million capital infusion from **Apax** on January 16, 2019
- **Bain Capital** acquires majority stake in **Brillio** (Bangalore-based and Santa Clara headquartered) analytics / digital company on January 15, 2019
- Online car trading start-up **CarDekho** raises \$ 110 Million on January 3, 2019

Interesting Application & Apps

- Finance Ministry's "ITR Filing 2.0" order of Rs 4,241 Crores goes to **Infosys** on January 16, 2019
- **Finance Ministry** starts an interesting **Budget Series** on **Twitter** (January 15 to February 1)

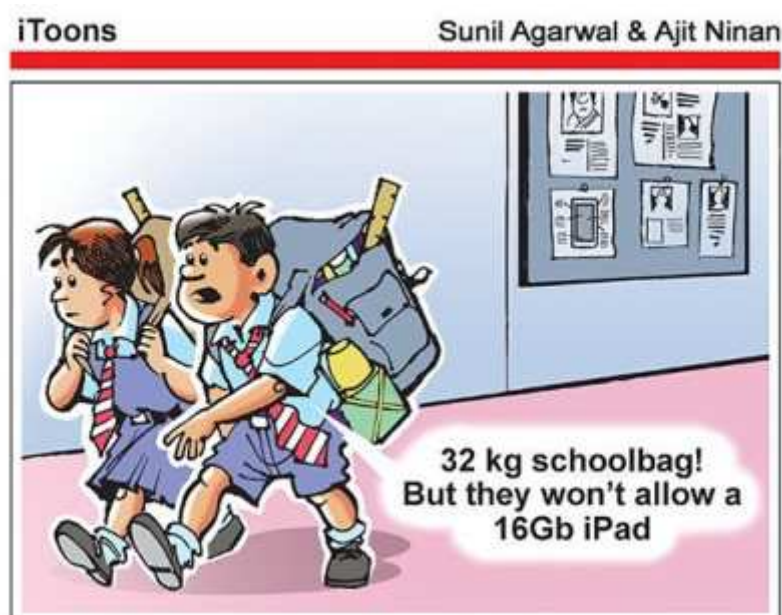
Interesting numbers

- **RIL** posts Rs 10,251 Crores profit for October – December 2018 quarter, the first private enterprise to cross Rs 10,000 quarterly profit; for the same period, **TCS** posts Rs. 8,105 Crores profit, the highest ever
- **ModiCare (Aayushman Bharat)** treats 6,85,000 patients free of cost in the first 100 days

General

- **Tata** brand reaches the global **Top 100** (the only entry from India) in January 2019
- **UK Prime Minister** loses "Brexit poll" but narrowly wins "confidence vote" in January 2019
- JLL Survey puts **Bangalore as No 1** in the list of "Most Dynamic Cities" (2019 Edition of City Momentum)
- **GST** doubled the exemption limits for MSME's (from Rs 20 Lakhs to Rs 40 Lakhs per year) on January 10, 2019
- Kumbh Mela in Prayagraj (erstwhile Allahabad) starts at 4 AM on January 15, 2019; 150 million visitors expected over 2 months (Jan 15 (Sankranti) to March 6 (Mahashivratri)); 800 special trains, 50,000-strong security force, 220 KM of road, thousands of doctors, hundreds of tents, 4000 Wi-Fi hotspots and 1,20,000 toilets Kumbh Mela 2019 is spectacular in every respect
- US Government shut-down that started on December 22, 2018 continued for the longest time till January 25, 2019
- **CES 2019** (January 8 – 11, 2019) at Las Vegas show-cased many exciting products; however, most of them including LG foldable TV's were incremental, rather than breakthrough innovations
- **620 Km long human chain** from Kasrgod to Thiruvananthapuram with 3.5 Million participants create history in Kerala on January 1, 2019
- Government introduces Constitutional Amendment (103 Amendment 2019) "**quota for economically backward people**" on January 9, 2019; it is passed in both the Houses (Parliament & Rajya Sabha) and with Presidential nod on January 12, 2019 becomes a law, one of the fastest legislation in Indian Parliamentary history
- **CBI Chief Alok Varma** is reinstated and transferred; but, he decides to retire; all within days, unfortunate developments for the country

About the author: Professor Sowmyanarayanan Sadagopan (ss@iiitb.ac.in) is the Director of IIIT-Bangalore. These are his personal views. He has been writing on "What's Hot in IT" from an Indian perspective continuously from 1997; Times of India, Financial Express, IT Magazine carried the monthly (and yearly columns) till 2016; IEEE India has been carrying the quarterly columns since 2017



Information Resources



Compiled by

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A Dozen Times Artificial Intelligence Startled The World: Generative Adversarial Networks (GANs) are some of the most fascinating ways to “teach” computers to do human tasks. We’ve always heard that competition can boost performance, but now GANs are taking “learning from Competition” to an industrial scale. Generative Adversarial Networks are defined by AI entities (Neural Networks) that compete with each other to get better at their respective tasks. This post highlights some of the coolest GAN applications in action. [Full Post](#)

38 Ways Drones Will Impact Society: From Fighting War To Forecasting Weather, UAVs Change Everything: UAVs are tackling everything from disease control to vacuuming up ocean waste to delivering pizza, and more. Drone technology has been used by defense organizations and tech-savvy consumers for quite some time. However, the benefits of this technology extends well beyond just these sectors. With the rising accessibility of drones, many of the most dangerous and high-paying jobs within the commercial sector are ripe for displacement by drone technology. The use cases for safe, cost-effective solutions range from data collection to delivery. And as autonomy and collision-avoidance technologies improve, so too will drones’ ability to perform increasingly complex tasks. According to forecasts, the emerging global market for business services using drones is valued at over \$127B. As more companies look to capitalize on these commercial opportunities, investment into the drone space continues to grow. A drone or a UAV (unmanned aerial vehicle) typically refers to a pilotless aircraft that operates through a combination of technologies, including computer vision, artificial intelligence, object avoidance tech, and others. But drones can also be ground or sea vehicles that operate autonomously. Below, check out the ways companies are harnessing drone technology for commercial purposes across industries. [Full Post](#)

The Future Of Data Centers: With over 175 zettabytes of data expected by 2025, data centers will continue to play a vital role in the ingestion, computation, storage, and management of information. Often hidden in plain sight, data centers are the backbone of our internet. They store, communicate, and transport the information we produce every single day. The more data we create, the more vital our data centers become. But many of today’s data centers are clunky, inefficient, and outdated. To keep them running, data center operators, from FAMGA to colocation providers, are working on upgrading them to fit our ever-changing world. In this report, we take a deep dive into the many aspects of data centers and how they’re evolving, from where and how they’re built, to the energy they’re using, to the hardware that operates inside them. [Full Post](#)

A Visual Summary: 32 Learning Theories Every Teacher Should Know: Learning theory—and the research that goes into it—is a topic seen frequently in universities and teaching programs, then less frequently after once teachers begin practicing in the classroom. Why this is true is complicated. (If you’re teaching, you may have more pressing concerns than being able to define obscure learning theories which don’t seem to have a place or role in what you’re teaching tomorrow.) I thought it might be useful to have a brief overview of many of the most important learning theories teachers should know in a single graphic, which is why I was excited to find Richard Millwood’s excellent graphic. [Full Post](#)

Looking Back at Google’s Research Efforts in 2018: 2018 was an exciting year for Google’s research teams, with our work advancing technology in many ways, including fundamental computer science research results and publications, the application of our research to emerging areas new to Google (such as healthcare and robotics), open source software contributions and strong collaborations with Google product teams, all aimed at providing useful tools and services. Below, we highlight just some of our efforts from 2018, and we look forward to what will come in the new year. [Full Post](#)

Kojo Yakei – Industrial Sightseeing after Dark: Do you think that ‘industrial’ isn’t the most appropriate word for promoting a tourist destination? Are ammonia plants and oil refineries places you’d rather avoid on your holidays? Japan’s urbanites used to go out of their way to avoid the country’s sprawling petrochemical zones, but now they’ve been reinvented as tourist attractions due to their unique, otherworldly beauty. The ‘kojo yakei’ (meaning ‘factory night view’)

phenomenon kicked off a few years ago, and now tourists are signing up en masse for bus trips and boat cruises of Japan's industrial complexes, so they can admire the aesthetics of these chemical bakeries. [Full Post](#)

3D metal printing cheat sheet: Printers, print methods, materials, use cases: Advances in 3D metal printing technology that allow for micrometer-scale precision make the rapidly-maturing field compelling for a wide variety of industries. Businesses in various sectors increasingly rely on additive manufacturing technology for rapid prototyping, as well as production-ready parts and reducing warehousing overhead with just-in-time order fulfillment. Likewise, materials costs can be reduced with additive manufacturing, as the amount of waste produced is less. This Tech Republic's cheat sheet about 3D metal printing is an introduction to the additive manufacturing technology. [Full Post](#)

27 Amazing Data Science Books Every Data Scientist Should Read: Learning Data Science on your own can be a very daunting task! There are numerous ways to learn today – MOOCs, workshops, degrees, diplomas, articles, and so on. But putting them in a structure and focusing on a structured path to become a data scientist is of paramount importance. But there are hundreds of books out there about data science. How do you choose where to start? Which books are ideal for learning a certain technique or domain? While there's no one-shoe-fits-all answer to this, the author of this post has done his best to cut down the list to these 27 books. [Full Post](#)

110 Best Science Fiction Movies of All Time: Cue the theremin, summon some extraterrestrials, and insert that social commentary: It's Rotten Tomatoes' list of the 110 best sci-fi movies of all time, ranked by adjusted Tomatometer from at least 40 reviews! [Full List](#)

Building an AI World: Report on National and Regional AI Strategies: In March 2017, the Government of Canada announced the launch of the Pan-Canadian AI Strategy. The first fully-funded strategy of its kind, Canada's AI strategy was followed by announcements of a variety of forms of AI strategies by 18 countries, including France, Mexico, the UAE, and China. [Full Post](#)

HQ 2.0: The Next-Generation Corporate Center: The corporate center in many companies is not what it used to be. It will change even more over the next five years. This change is not just a matter of the look and feel of the building. It concerns the size of headquarters (HQ), its location, its mix of talent, and its ways of working: everything to do with the role of leadership in your enterprise. As an executive or an aspiring functional leader, you have a once-in-a-lifetime opportunity — and frankly, an obligation — to rethink your function in order to better fit the needs of your business moving forward. [Full Post](#)

Embedding ethics in computer science curriculum Barbara Grosz has a fantasy that every time a computer scientist logs on to write an algorithm or build a system, a message will flash across the screen that asks, "Have you thought about the ethical implications of what you're doing?" Until that day arrives, Grosz, the Higgins Professor of Natural Sciences at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), is working to instill in the next generation of computer scientists a mindset that considers the societal impact of their work, and the ethical reasoning and communications skills to do so. "Ethics permeates the design of almost every computer system or algorithm that's going out in the world," Grosz said. "We want to educate our students to think not only about what systems they could build, but whether they should build those systems and how they should design those systems." [Full Post](#)

Smart Farming: The Future of Agriculture: "Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production. [Full Story](#)

5G Radiation Dangers – 11 Reasons To Be Concerned: Like it or not we're rapidly moving into the world of 5G, or 5th generation cellular telecommunications. Why? Because the frequency bandwidths used currently by cell phones and similar technologies are becoming saturated. And also because we live in a world where people want more. 5G, and the Internet of Things (IoT) that goes with it, promises to give us more. But more what? The USA is currently leading the way on 5G. At the June 2016 press conference where the Federal Communications Commission's (FCC) head Tom Wheeler announced the opening up of low, mid and high spectrum's. There was no mention of health effects whatsoever. But the dangers are real. [Full Story](#)

The Third Law: The future of computing is analog: The history of computing can be divided into an Old Testament and a New Testament: before and after electronic digital computers and the codes they spawned proliferated across the earth. The Old Testament prophets, who delivered the underlying logic, included Thomas Hobbes and Gottfried Wilhelm Leibniz. The New Testament prophets included Alan Turing, John von Neumann, Claude Shannon, and Norbert Wiener. They delivered the machines. The next revolution in computing will be signaled by the rise of analog systems over which digital programming no longer has control. [Full Post](#)

More information resources are at the archives of Interesting Reads blog posts by the author at <https://goo.gl/VGXizd>

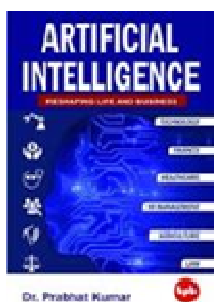
Books



Wiley Innovation Black Book on Exponential Technologies 2019
Wiley Innovation Advisory Council
2019 / 352 Pages / Hardcover / Rs. 999 (On Amazon India Rs. 909)
ISBN: 9788126578177 / Wiley

Technology is evolving at an exponential rate, transforming the world and our lives more rapidly than we can ever imagine. Undoubtedly, the business landscape is changing drastically as well, with new strategic and business models and disruptions leading to new challenges and opportunities. Industry 4.0 is expected to transform the future of work, learning and research in the coming years. In this VUCA world, the agility and relevance of business to transform, innovate and

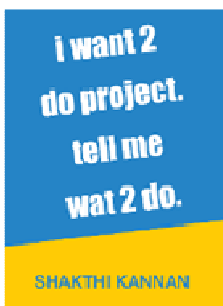
disrupt, leveraged by AI and exponential technologies will decide the course of winners. Adapt or perish. For the first time, 15 top industry leaders and technology innovators collaborate to author the first edition of the Wiley Innovation Black Book on exponential technologies is an annual presentation by Wiley, bringing together the collective wisdom in form of possibility and future scenarios of how today's industries are expected to transform in the coming years. The chapters of the book include: The New Age Marketing; Disruption in Media and Technology Industry; The InsureTech Revolution; From Physical Retail to e-commerce with Exponential Technologies Telecom Disrupted; Future of Retail and Smart Store; Factory of the Future; Impact of AI on Life Sciences Industry; Impact on Transportation and Mobility; Automation & Transformation – Ethical issues; Fintech for Growth and Customer Experience; AI in the Forefront of CPG Storefront; Governance, Ethics and Compliance of AI; Being AI +ve; Impact of AI on Travel and Hospitality; and Transforming the Learning Ecosystem. A must read for those who want to keep track of technology landscape.



ARTIFICIAL INTELLIGENCE: Reshaping Life and Business
Prabhat Kumar
2019 / 298 Pages / Paperback / Rs. 445
ISBN: 9789388511070 / BPB Publications

Our world of personal life and work is set to change dramatically over the next decade as Artificial Intelligence (AI) strikes deeper roots with new products and services; robots take charge of manufacturing and warehouses, and drones reach the remote corners to deliver orders to customers. AI will raise the productivity of the economy and provide lot more convenience, though there is bound to be short-term pain in the transformational process. This book explains the concepts of AI with lots

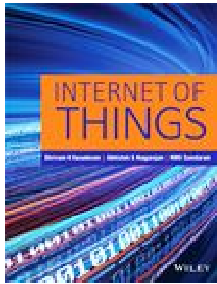
of real-life examples. While the big tech companies like Alphabet, Amazon, Apple, Facebook, IBM, Microsoft (3AFIM) of the US and Alibaba, Baidu, JD.com, Tencent (JT) of China are busy re-fashioning their businesses by integrating AI into all products and services they deliver, startups on the other hand are disrupting the traditional business models in finance, e-commerce, healthcare, HR management, fashion, law and even agriculture. AI-driven smart cities would provide a richer quality of living to their residents. This book also provides an insight into various social and ethical issues, such as monopoly of the big tech, ownership of data, personal privacy, job losses and autonomy of technology particularly in military warfare, which poses an existential threat to mankind. Future of AI is also discussed taking a 360-degree approach. AI offers a huge economic opportunity, but a thoughtful approach for democratization of technology is required to provide benefits to all sections of the society. Nations and communities need to come together to evolve models that will be sustainable in the long run.



i want 2 do project. tell me wat 2 do
Shakthi Kannan
2014 / 135 Pages / Paperback / Rs. 399
ISBN: 9789351741879 / Self Published

This book is written to help students and professionals of computer science work on free and open source software projects. The software projects mentioned in the book are released under a freely distributable license, which enables the users you to copy, make changes and distribute the software. Proprietary software, unlike open software, comes with a restrictive license and the source code is not provided to the users. The book provides an incisive look into the different projects and teaches

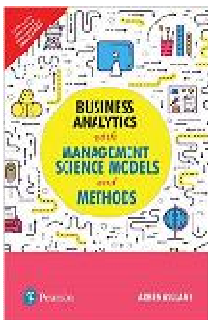
the readers the methods that need to be followed while working with F/OSS projects and similar programs. This book will be useful for computer science engineers and software professionals and help to become a valuable contributor to open source projects and get wider recognition. The contents of the book include: Mailing List Guidelines; Attention Details (of the projects); Project Communication; Project Guidelines; Development Guidelines; Methodology of Work; Tools; Reading and Writing; Art of Making Presentations; and Sustenance. The author is a Free Software enthusiast and blogs at <http://shakthimaan.com/> and advocating the use of F/OSS across India.



Internet of Things

Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram
2019 / 332 Pages / Paperback / Rs. 479 (on Amazon India Rs. \$54)
SBN: 9788126578375 / Wiley

This book written by professionals with considerable experience in embedded systems, service engineering and software architecture presents the subject in seven chapters. Starting with the introduction to IoT for beginners covering the characteristics and enabling technologies of IoT the authors move on to detail the sensors and other related hardware units which form the core part of any IoT application in the next chapter. Multiple protocols are followed in IoT domain and they are detailed in chapters 3 and 4. Cloud is another major component as they help to control things from remote places, process and feedback data, etc. The chapter 5 is an in-depth discussion on cloud technology from IoT perspective. Data analytics is another associated field of IoT discussed in Chapter 6, which looks into different machine learning algorithms and real-time data analytics. The last chapter deals with application building with IoT. The annexures which deal with Getting Familiarized with Arduino IDE, Raspberry Pi, Analysis and Study of IoT Security: Case Study Examples, Interview Questions from IoT, and Objective Type Questions are quite useful. This book will meet the requirements of both beginners and professionals.



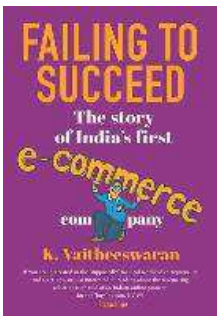
Business Analytics with Management Science Models and Methods

Asllani Arben

2017 / 400 Pages / Paperback / Rs. 529 (on Amazon India Rs. 387)
ISBN: 9789352861743 / Pearson Education

This book is aimed to help students and practitioners use business analytics to improve decision-making systems. It sets itself apart from the competition by emphasizing the application of practical management science techniques in business analytics, rather than the theoretical. Drawing on 20+ years of teaching and consulting experience, Dr. Arben Asllani introduces decision analytics through realistic examples and intuitive explanations — not complex formulae and theoretical definitions. Throughout, Asllani helps practitioners focus more on the crucial input-output aspects of decision

making — and less upon internal model complexities that can usually be "delegated" to software. This book which serves as practical, managerial guide to decision modelling and analytics presents success stories showing how each chapter's key concepts can be applied to improve decision-making and provides Excel templates, heuristics, algorithms, tips and user-friendly interfaces that make "big data" decision models easier to create and use.



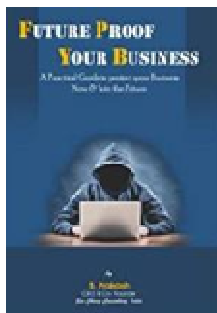
Failing to Succeed: The Story of India's First E-Commerce Company

K. Vaitheeswaran

2017 / 224 Pages / Hardcover / Rs. 595 (on Amazon India Rs. 331)
ISBN: 9788129148025 / Rupa Publications India

In 1999, when hardly anyone in India transacted on the Internet, K. Vaitheeswaran co-founded India's first e-commerce company. Yet, years later, when e-commerce was exploding in India—despite enjoying first-mover advantage—Indiaplaza shut down. What went wrong? Lack of funding? Wrong strategies? Or was it 'something else'? For the first time ever, Vaitheeswaran reveals that it was indeed something else—a set of inexplicable events that destroyed what could have been a profitable business (an extreme rarity among technology start-ups). He bares his extraordinary trials

and tribulations while dealing with business failure and the impossible pressures that can threaten entrepreneurs in India. Coming at the back of stories of young start-ups raising billions of dollars in funding and creating unicorns in just a few years, as well as the recent setbacks in the e-commerce industry, Failing to Succeed delves deep into the dark side of starting up and its myriad pitfalls. Filled with interesting anecdotes, tongue-in-cheek observations, amazing customer insights, hard-hitting predictions and behind-the-scenes industry happenings, this book is an extraordinary unravelling of the challenges facing technology start-ups in India. It is a must-read for aspiring entrepreneurs, investors, industry professionals or business school students and anyone interested in India's start-up ecosystem. A powerful narration, Failing to Succeed is eventually about finding ways to move forward and succeed despite failures.



Future Proof Your Business: A Practical Guide to protect your Business – Now & into the Future

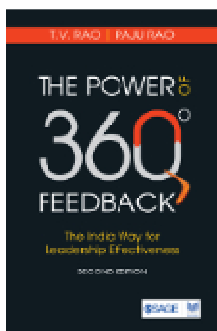
S. Prakash

2016 / 184 Pages / Paperback / Rs. 295

ISBN: 978-8193248706 / See Change Consulting

This book, according to the author, is a result of his research and hands-on experience in turning around 100s of small, medium and large organizations, representing a cross section of business verticals. The book written in workbook style provides broad insights to various aspects relevant to running an organization successfully. The “Self-Assessment Questionnaire” is the unique feature of this book. Each chapter of the book is standalone and does not necessitate sequential reading. The

book covers: Cash/Funds Flow; Inventory Control; Finance; Marketing and Sales; Human Resources and Talent Optimization; Core Competencies and Utilization; Customer Service & Retention; Change Management; Supply Chain Automation / Management, R&D; Business Expansion & Consolidation; Revenue, Risk; Investor’s Confidence; Business Owner’s Perspective; Business Optimization; Business Continuity & Succession Planning; Cost of Not Innovating; This book is recommended as a must read by business owners and senior management and even startups so that they can protect their business and make it future proof.



The Power of 360 Degree Feedback: The India Way for Leadership Effectiveness

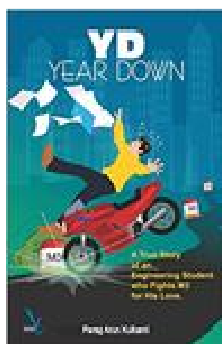
T. V. Rao & Raju Rao

2014 / 292 Pages / Paperback / Rs. 525 (on Amazon India Rs. 385)

ISBN: 9788132119692 / SAGE Response

360 Degree Feedback, or multi-rater feedback, is an established HR methodology used in organizations across the world. This book presents in-depth details about the process of developing managers into leaders and outlines methodologies for designing and using a 360 Degree Programme for managers at all levels. This second edition draws extensively from the authors' own experiences in the last decade since the first edition. The book also includes research done using over 8,000 top-level managers whose leadership roles and qualities were profiled using the authors' Roles, Styles,

Delegation and Qualities (RSDQ) model. Lessons from their stories and practices of some of the HR award - winning organizations are presented in this edition. Further, this book also presents a section on the various tools of 360 Degree Feedback for a variety of groups. It is hoped that this edition will give an update of the 360 Degree Feedback the Indian way. The contents of the book include: How to Be an Effective Person? What Makes Managers Effective? What Makes a Good Leader? Managerial and Leadership Roles Managerial and Leadership Styles 360 Degree Feedback: The Power Tool Competence Building through 360 Degree Feedback Coaching in 360 Degree Feedback Myths and Realities of 360 Degree Feedback Conditions for Successful 360 Degree Feedback 360 Degree Feedback: Indian Experience Life after 360 Degree Feedback: Lessons for Future Getting ROI on 360 Degree Feedback Lessons from 100 Impact-making Managers Experiences from Other Countries 360 Degree Feedback Tools for School Principals 360 Degree Feedback Tools for Teachers, Students and Parents 360 Degree Feedback Tools for Non-governmental Organizations. The appendix lists the organizations using 360 degree feedback.



YD - Year Down

Parag Kulkarni

2017 / 192 Pages / Paperback / Rs. 250 (on Amzaon India Rs. 175)

ISBN: 978-9385665905 / Vishwakarma Publications

YD (Year Down) is a touching story of a bright Engineering student. Probably of every engineering student, every professional who has spent sleepless nights chasing grades and deriving meaning from heaps of meaningless facts from syllabus... It is a story of every student who has withstood long monotonous lectures without sleeping due to fear of punishment and defaulter list. It is a story of youthful exuberance, long tiring preparation leave nights and innocent dreamy eyes. It is a story of students with sleepy days and sleepless nights! It is a story of every YOU who fought all hurdles for love. Sameer a.k.a Square Root is one such young student who is full of dreams of becoming an

Engineer and getting the girl of his dreams. Due to his past professors and present, Sameer begins to realise how tough a time he has cracking the most detested subject of Engineering – M3! He loses everything to this horrible subject – his grades, his girlfriend, his years and worst; his passion for Engineering. Read Sameer's full story to understand how he comes back stronger from the depressing clutches of M3 and takes control of his life. This book is a compelling story in which every moment of childhood and college life is portrayed with perfection. A must read book for every student, all parent.

The Cybersecurity Renaissance: Security Threats, Risks, and Safeguards

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We're entering a new digital era driven by significant technological advances and widespread adoption of digital technologies and applications by business, industry, government and individuals. While the new digital era offers us several benefits and presents new opportunities, it faces increased and sophisticated cybersecurity threats and comes with risks. Phishing, ransomware, and other forms of cyberattacks are growing, exposing the personal data of millions of people and costing the economy huge sums of money (billions of dollars) every year. These threats and risks are compounded with newer threats and concerns as we begin to embrace artificial intelligence (AI), machine learning (ML), robo-advisors, and the Internet of Things (IoT) and adopt autonomous systems for a range of tasks that can make and execute decisions with little human intervention.

The cybersecurity landscape continues to change significantly posing major challenges to IT professionals, and businesses. Cybersecurity attacks have increased in number, severity and sophistication, and some of them are often coordinated. Increasing number of cybercriminals and state-sponsored actors target organizations to steal valuable data and disrupt their working and try to sabotage operation of national critical infrastructure. Cyberattackers also monetize their threats. Cyberattacks can be devastating to the affected organizations and individuals. The biggest threat to mankind is cyberthreats, even more so than nuclear weapons threats, cautions multi-billionaire investor Warren Buffett.

There is now growing concern and renewed interest on security of digital systems and their numerous applications on which we highly rely on. It is important that we constantly improve our understanding of how we may detect, respond, learn from security breaches, and develop and implement new security measures. Despite significant research and development, availability of established security practices and techniques, reports on security incidents and failures and information on common known vulnerabilities, security breaches continues occur and securing digital systems and applications remains a key challenge for security professionals and organizations. Besides hardware and software vulnerabilities, human vulnerabilities remain the weakest link in cybersecurity and are hard to mitigate.

To comprehensively and holistically address cybersecurity issues and provide secure and safe applications now and in the future, we need to address several questions such as:

- What can we expect on the cybersecurity front now, and in the near future?
- What are the trends and activities most likely to affect organizations, governments, and individuals?
- Can we secure our growing vast digital landscape, and how? Will our digital assets be safe and secure, and data and information be free from cyberbreaches? What might we need to do safeguard our cybersystems?
- How might we effectively address emerging cyber-threats that automation systems might encounter, including obscure, new, and unknown (future) threats that could be serious or even catastrophic?
- If don't or can't secure them adequately, how might security incidents impact us?
- Are the traditional techniques adequate to address the potential new security threats? If not, what might be new approaches and techniques that we could adopt?

This article examines the looming cyberthreat, examines new cyberthreats and presents a glimpse of cybersecurity renaissance. It also emphasizes that IT professionals, organizations and governments must take adequate steps to bolster security of digital systems and applications that we rely on.

SECURITY THREATS: AN OVERVIEW

Cybercriminals target and attack different types of digital assets – data, infrastructure, and applications and people like IT administrators and users – by several ways. Table 1 presents a brief summary of various threats digital systems and applications face. For a detailed account of potential threats digital systems face, refer to the recent European Union Agency for Network and Information Security (ENISA) Threat Landscape Report 2018 [1]. Security professionals and organisations should examine potential threat they might face, assess impact of those threats and implement adequate measures to address the critical ones.

Table-1: A brief outline of security threats and controls

Asset	Threats	Controls
Data	• Data breach • Misuse or manipulation of information • Corruption of data	• Data protection (encryption) • Boundary defense • Data-recovery capability
Infrastructure	• Denial of service • Manipulation of hardware/software • Botnets • Malware • Network intrusion	• Secure configuration • Network controls (configuration, ports) • Continuous vulnerability assessment • Continuous monitoring of emerging attacks. • Control of privileged access
Applications	• Manipulation of software • Unauthorised installation of software • Misuse of data or applications • Denial of service	• Application software security • Continuous vulnerability assessment • Continuous monitoring of emerging attacks. • Email/browser protection
People	• Identity theft • Abuse of authorisation • Man-in-the-middle • Social engineering	• Controlled access • Account monitoring • Background screening • Security awareness and security skills training
Others (organisation, individuals)	• Ransomware	

Source: McKinsey & Co, The SANS Institute, and ENISA

Threat Agents

Based on their motives, activities and other factors and on the threats faced in 2018, ENISA classified top threat creators, also called threat agents, as [ENISA 2019]:

- Cybercriminals
- Malicious and negligent insiders – users, privileged users and service providers or contractors
- Nation States
- Corporations that try to obtain competitive knowledge from competitors.
- Hacktivists
- Cyberfighters or cyberterrorists
- Script kiddies

Now a days attackers are not just amateurs, they are professionals with high degree of expertise and skills. They are also innovative in advancing threats and use sophisticated tools for launching attacks. Major threats presented by each of these threat agents are highlighted in Table 2, and discussed in detail in [1].

Attack Vectors

An attack vector is a “path or means by which a threat agent can gain access to a computer or network server, abuse weaknesses or vulnerability on assets (including human) in order to achieve a specific outcome.” It gives a structured way for threat analysts to describe a threat agent’s behaviour and defenders to implement appropriate defences, following a “Course of Action.” To understand various tactics, techniques and procedures (TTP) used by threat agents, description of an attack vector is essential. Table 3 provides a categorization of the most predominant and noteworthy attack vectors (observed by ENISA).

Table 2: Top threats and their creators

Threat	Threat creators						
	Cybercriminals	Insiders	Nation states	Corporations	Hacktivists	Cyber-terrorists	Script kiddies
Malware	√	√	√	√	√	√	√
Web-based attacks	√		√	√	√	√	√
Web application attacks	√		√	√	√	√	√
Denial of Service	√		√	√	√	√	√
Botnets	√		√	√	√	√	√
Phishing	√	√	√	√	√		√
Spam	√	√	√	√			
Ransomware	√	√	√	√			√
Insider threat	√	√	√	√		√	
Physical manipulation, damage, theft, loss	√	√	√	√	√	√	√
Exploit kits	√		√	√			
Data breaches	√	√	√	√	√	√	√
Identity theft	√	√	√	√	√	√	√
Information leakage	√	√	√	√	√	√	√
Cyber espionage		√	√	√			

Source: ENISA Threat Landscape Report 2018

Security Attacks and Failures Are Real and Severe

Cyberattacks and security failures are real. Despite advances in security measures, significant high-profile security attacks and data breaches continue to occur causing major concerns. For example, there were several major security failures - breaches, data exposures, ransomware attacks, state-sponsored campaigns, and general hacks, last year. The following are few of the major failures [2]:

- One of the largest data breaches in history is the Marriot incident in which 500 million travellers who made a reservation at a Starwood hotel since 2014 had their data compromised. Reports say state-sponsored Chinese hackers were behind the attack, this attribution, however, has not been officially confirmed.
- Facebook encountered a data breach in which attackers gained access to 30 million accounts by stealing "user authorization tokens" – essentially stealing access.
- A ransomware attack locked down the City of Atlanta's digital systems, destabilizing municipal operations. The recovery took months and costed millions of dollars. The worldwide WannaCry ransomware cyberattack in 2017 targeted computers running the Microsoft Windows operating system by encrypting data and demanding ransom payments in the Bitcoin cryptocurrency. There were a series of successful follow-up ransomware attacks targeting high-profile victims.
- Before the 2018 Winter Olympics opening ceremony, Russian hackers orchestrated a hack that crippled the event's IT infrastructure, knocking out Wi-Fi, the Olympics website, and network devices in the process as retaliation for the country's doping ban from the games.
- A major data breach impacted British Airways reservation system. Names, addresses, email addresses, and sensitive payment card details of 380,000 reservations made between August 21 and September 5 of this year were stolen in the breach. Airline data is a particularly valuable target for hackers, because they hold both personal and financial data, as well as travel data and passport numbers.
- Google discovered a bug in its social network Google+ that had exposed 500,000 users' data for about three years.
- Hackers didn't spare even small and medium enterprises. SMEs are not only just as vulnerable to a breach; the consequences of an event can be catastrophic. According to data gathered by the Ponemon Institute, in 2017, 61% percent of small businesses have experienced a cyberattack. Verizon's 2018 Data Breach Investigations Report categorises 58% of malware attack victims to small businesses. A representative 2018 survey of 400 senior SME

business and IT leaders in Australia revealed 60% of SMEs have experienced a cyber incident over 12 months and 30% didn't know which data files are affected after a breach [3]. Worryingly, 28% of SMEs took no action following a cyber incident.

- According to the FBI, Russian persistent threat actor Sofacy group, infected more than 500,000 home office routers and network attached to storage devices worldwide to remote control them.

Table 3: Common Attack Vectors

Attacking the human element

- Social engineering
- Phishing/spear-phishing/business email compromise(BEC)/whaling/spam through email/social media/online services
 - Malicious attachments in emails; Malicious URLs in emails and social media; Microsoft office attack vectors (macros etc)
- Social media messaging services
- Scams
 - Customer/tech support scams; Phone scams (Vishing) ; SMS scams (Smishing)

Web and browser based attack vectors

- Drive-by downloads
- Drive-by mining (cryptojacking)
- Malicious scripts/URLs

Exploit-kits

- Malvertising
- Web application attacks (SQL injection)
- Browser based attacks
- Malicious browser add-ons (updates)
- Watering hole attacks
- Mouse hovering

Internet exposed assets

- Unprotected assets exposed on the internet
- Default/weak service credentials
- Password reuse

Exploitation of vulnerabilities/misconfigurations and cryptographic/network/security protocol flaws

Supply-chain attacks

- Software manipulation or third-party API/software
- Hardware manipulation

Network propagation/lateral movement

Active network attacks

- DNS attacks (DNS hijacking/poisoning)

Privilege or user credentials misuse/escalation

- Access token manipulation
- Sticky-keys
- Account manipulation –

Fileless or memory-based attacks

- Malicious PowerShell and XSL scripts

Misinformation/Disinformation

- Online trolling
 - Spread of fake news online
 - Abuse of social media and search engines algorithms; Illegitimate use of social bots
-

What's Ahead?

What can we expect on the cybersecurity front in 2019 and in the near future? Cyberthreats will be more rampant – several threats will be deployed more aggressively on more fronts. “Target zone” of cyber attacks or threat landscape will be bigger than what is now, as companies increasingly pursue digitization to drive efficiency, reduce costs and build data-driven businesses, and more people use online services. Ransomware attacks will increase. Compounding these is new threats posed by the use cyberphysical system, AI, machine learning, and autonomous systems. Hackers will employ

advanced tools to generate sophisticated security attacks that are new and evade detection, and there will be significant increase in nation-state attacks.

NEWER CYBERTHREATS

The already complex cybersecurity landscape now faces several new threats: those emerging from the IoT, cyber-physical systems and AI and machine learning systems, cryptojacking, formjacking, software update supply chain attacks, rogue robots, and attacks on small clouds and managed IT services. Cyber-defenders should be paying attention to new and known older cyber threats.

The IoT and Cyber Physical Systems

IoT devices have become indispensable, bringing unprecedented levels of convenience and making our lives easier and more enjoyable. In the future it's likely that almost every device in our homes could be equipped with sensors and connected to the internet. Driven by ongoing advances in sensors, the IoT, cloud, fog and edge computing, data storage, (big) data analytics and communications, cyberphysical systems (CPSs) are growing in number and capabilities and are being deployed in several domains offering convenience and several benefits. Within the next three years, 30 billion to 50 billion new IoT devices are estimated to be part of these systems. But CPSs are a major security risk and challenge.

The security landscape of CPSs is vast and more vulnerable to malicious attacks and hacks as these systems use cheap unsecure sensing and communication devices. IoT devices are notorious for their lack of security, leaving these devices exposed to attacks from the outside. Most IoT manufacturers neglect security aspect in the rush to get their products to the market or find implementing strong security features expensive and time-consuming and choose not to implement them. Within the next three years, 30 billion to 50 billion new IoT devices are estimated to be part of these systems. As the number of IoT devices increases, so does the number of cyberattacks directed at them. As communication networks, computing platforms and mobile devices are relatively better protected, cybercriminals are targeting softer targets, like IoT devices.

The IoT is vulnerable to distributed denial-of-service (DDoS) attacks [4]. In 2016, the Mirai attack showed the destructive potential of a botnet on IoT devices and how dangerous unsecured IoT devices can be. In this most disruptive DDoS attack in history, hackers gained control of over 100,000 poorly secured IoT devices and used them to launch a sustained assault on the leading DNS provider Dyn, taking down numerous important websites such as Twitter, Netflix, Amazon and CNN. According to the Nokia's Threat Intelligence Report 2019, in 2018 IoT, botnet caused 78% of malware incidents in communication service provider (CSP) networks in 2018.

Hackers are also increasingly using IOT to attack consumers directly and steal their personal data or use their systems to mine cryptocurrencies. Safety- and mission-critical CPSs raise heightened security and privacy concerns as attackers can compromise or take over portions of the entire system. Exploiting billions of poorly secured IoT devices nation-states attacks will increase.

A new set of approaches, tools, and techniques is needed to secure CPSs that continue to influence us significantly. Governments are considering regulatory measures to address IoT security risks. California recently passed an IoT cybersecurity bill, which will require manufacturers to equip all connected devices with reasonable security features.

Software Update Supply Chain Attacks

'Software update supply chain attack' implants a piece of malware into an otherwise legitimate software package. This can occur during production at the software vendor, at a third-party storage location, or through redirection. This is subversion of software development process. For further information on some recent attacks and how you can manage them, refer to [5].

There has been surge in supply chain attacks in the last two years and this trend will continue as they are attractive to cybercriminals since [5]:

- They allow cyber criminals to infiltrate well-protected organizations by exploiting an already trusted channel.
- The number of infections can grow quickly due to automatic updates.
- They can allow attackers to target specific regions or sectors—as was the case with the well-known Petya/NotPetya attacks. An accounting software that is primarily used in Ukraine was compromised to gain access to victims' machines.
- They can target specific isolated targets, such as those in industrial environments.
- They can also make it more difficult for victims to figure out how attackers got onto their systems as trusted processes are abused.

Cyber-defenders need to anticipate and address adequately software update supply chain attacks.

AI and ML: Solution or Threat?

Artificial intelligence and machine learning are both a saviour and a threat to cybersecurity. They can be used to defend security attacks as well as to create new kinds of attacks and aid cybercriminals and hackers.

A significant feature of a ML algorithm is their ability to quickly find normal patterns across large data sets and detect anomalies or abnormal patterns if any. In its simplest form, it can create a baseline model of what's normal in an environment and then flag and investigate anomalies to that baseline, which could potentially be a threat. This feature can be used in various environments, from individual residence (smart home) with a few IoT devices to a large business. Thus, ML algorithms can be used to learn about potential cyberattacks, and to anticipate and identify them in real time.

They can also be employed to detect fake or edited images and videos as two start-ups have recently demonstrated. A machine learning algorithm uses tweets to spot security flaws [6]. In the coming years, defenders will depend increasingly on AI to counter attacks and identify vulnerabilities.

The Dawn of Adversarial AI

Like defenders, attackers will also exploit AI and ML and use them to aid assaults and create more sophisticated attacks. We are seeing the emergence of a class of attacks known as 'Deep Attacks', which use AI-generated content to evade AI security detection and controls. For example, consider rogue AI-driven chatbot. Cybercriminals and hackers can create a malicious chatbot that tries to socially engineer victims into clicking links, downloading files or sharing private information. Attackers are also likely to leverage web application flaws in legitimate websites to insert a malicious chatbot into a site that doesn't have one.

Consider another example of deep fake. With a typical personal computer and a good graphics card, it's now possible to easily create a fake video or audio message that is incredibly difficult to distinguish from the real thing. Hackers are now able to use a highly realistic fake video and audio, either to reinforce instructions in a phishing e-mail or as a standalone phishing video. Cybercriminals could also use the technology to manipulate stock prices by, say, posting a fake video of a CEO of company announcing that a company is facing a financial problem or some other crisis, or had huge growth and profits. There's also the danger that deepfakes could be used to spread false news in elections. In the future, we'll see deep attacks deployed more commonly in an attempt to evade both human detection and smart defences.

Still worse, cybercriminals could target data sets used to train learning models and poison them — for instance, by switching labels on samples of malicious code to indicate that they are safe rather than suspect [7].

Attacks on Small Cloud Computing Vendors

While big cloud service providers like Amazon, Microsoft and Google can afford to invest heavily in cybersecurity defense and employ some of the best talent in the field, smaller cloud vendors and IT service providers can't afford to implement high security and are vulnerable to security breaches. It's more likely that hackers will target them. In a recent incident, hackers sneaked into the computer systems of a company that managed IT for other firms and were allegedly able to gain access to the computers of 45 companies around the world, in industries from aviation to oil and gas exploration.

Attacks on Robots

While industrial robots boost productivity and efficiency, they're vulnerable to hacks and the risk levels are rising as more robots move from being offline and isolated to being internet-connected machines, often working alongside humans. Factories, hospitals and other robot users often lack sufficient levels of defense against a digital attack, and damage that a hacked robot can cause could be huge and even catastrophic.

Cryptojacking

Cryptojacking is a quiet, more insidious method of steal resources from unsuspecting victims for monetary benefits, and we're likely to see surge in incidences of this type attack.

Formjacking

Formjacking is essentially virtual ATM skimming. In Formjacking cyber criminals inject malicious code into retailers' websites to steal shoppers' payment card details. On average, more than 4,800 unique websites are compromised with formjacking code every month globally. Symantec blocked more than 3.7 million formjacking attacks on endpoints in 2018, with nearly a third of all detections occurring during the busiest online shopping period of the year – November and December [8]. Formjacking is simple and will become more frequent.

Human Error and Human Factors in Cybersecurity

Most organizations tend to focus on external threats, but insider threats are increasingly taking center stage. Insider threats come not only from the malicious insider, but also from infiltrators and unintentional insiders as well.

According to a research study, the majority of information security attacks stem from human error, not from malicious intent. It's imperative that organizations put together a training plan for new employees who are not up to speed on cyber security basics. Employee education and training will help mitigate attacks caused by human error. However, most security awareness training, often conducted by IT, is focused on information security as a topic and doesn't emphasize the human element of the risk sufficiently. Effective training includes content that addresses the threat's psychological, behavioural, and economic aspects, with practical advice on how to spot scams and protect data.

Employee education and applying common sense practices needs to be a priority at companies.

CYBERSECURITY STRATEGY

Organisations should develop and successfully implement an appropriate cybersecurity strategy, which is a good foundational step for obtaining the level of cybersecurity necessary to protect their business, employees, customers and reputation. When done well, it's one of the most worthwhile investments of time, effort and money an organization can make. As the threats will only grow in size, scale and sophistication, with a proactive cybersecurity strategy, businesses can stay one step ahead of attacks.

Cyber resilience is the ability to prepare for, respond to, and recover from cyber security incidents. A cyber-resilient organisation gets protected from cyber risks, defends against and limits the severity of attacks, and ensures that business operations continue to function in the event of a disruption.

In developing a cybersecurity strategy to be cyber-resilient, 1) set out clear objectives, 2) identify your assets to establish cybersecurity priorities, 3) determine where you're vulnerable, 4) examine and plan to put right technology and systems in place, 5) employ right personnel to look after organisation's security needs, and 6) assess the overall organization's cybersecurity awareness and implement requisite awareness and training programs, and periodically reassess and update your cybersecurity strategy. Also consider cyber-insurance, if required.

CYBER-INSURANCE

To protect themselves from financial effects of an attack, businesses can invest in cyber-insurance. Cyberinsurance providers require that companies demonstrate strong cybersecurity to attain cyber-insurance coverage. Businesses use insurance to control risk, and insurers limit their exposure to risk by imposing standards and constraints. Though cyber-insurance has been available since the 1990s, it has not yet taken off and faces some challenges.

As outlined by Nir Kshetri in a recent article [9], "Cyber-insurance provides coverage for the theft or loss of first-party and third-party data, as well as support services. For the loss or theft of first-party data, an insurer may cover expenses related to notifying clients regarding the data breach, extortion, and launching a public relations campaign to restore the company's reputation following a cyberattack-led negative publicity. Third-party cyber-insurance protects a firm from being accused in case of a breach. Third-party coverage includes claims related to unlawful disclosure of a third-party's information and infringement of intellectual property rights. It may also protect if an insurance holder's weak cybersecurity practices result in passing malware or virus to another user. Support services can help limit losses after a cyberattack. They cover expenses such as those related to public relations, IT forensics, and hiring experts in crisis management."

Actuarially estimating the likelihood of cyberattacks and the total anticipated costs of such attacks remains a challenge. The lack of relevant data results in an inaccurate assessment of cyber risks and higher premiums, and stalls adoption and growth of cyber-insurance.

The Way Forward For Secured Future

Cybersecurity will continue to be an ever-growing challenge for professionals, IT industry, businesses and government. Cybercriminals will continue to launch more sophisticated attacks, and cybersecurity incidents and breaches can seriously damage a company. Individuals and enterprises need to be more proactive in their security practice, and security risk management must be integral to corporate governance. It also requires constant evaluation and forward thinking solutions development to advanced solutions.

Security is also a concern for governments that are investing in smart city infrastructure. Without adequate security, innocuous items which generally pose no threat can be transformed into something far more sinister — for example, traffic lights that tell cars and pedestrians to go at the same time or changing tracks to put a commuter train on the wrong course.

A survey of Australia SMEs reveals significant perception gap for cyber awareness and preparedness, and most are not well prepared to navigate and manage cyber risks.

Cybersecurity Education

There is global shortage of skilled cybersecurity professionals, and, the number of vacancies just keeps growing. To take advantage of the opportunities, interested people should upskill in relevant areas. This can be achieved by undertaking certification program, specialised educational programs at colleges and universities or self-learning.

Cybersecurity Research

Cybersecurity is an active area of research and development. In addition to traditional and new technical areas of investigation and development, we need more research into psychology and criminal motivations of hackers and cybercriminals. We need to broaden our research.

The new reality of the digital world is all businesses – from small and medium businesses to big business and corporations, industries of all types and government agencies must place a higher priority on implementing cybersecurity measures to address not only today's threats but tomorrow's as well.

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Solar Energy Harvesting Through Photovoltaics and Photocatalysis

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Introduction

The rise in global population is driving the demand for energy every day. However, the depleting fossil fuel reserves and greenhouse emissions have thrown the challenge of finding alternative energy sources that are both clean and renewable. The solar energy, with a power output of 3×10^{24} J/year has the capability of fulfilling the Earth's energy demand. However, the sunlight needs to be properly harvested in order to generate alternative energy sources. This article presents a brief overview of the solar photovoltaic (PV) (sunlight to electricity) and solar photocatalysis (sunlight to chemical/fuel) materials and current technologies. [1] Under the PV domain, only basic categories of solar cells have been discussed. The advanced categories such as tandem, multijunction or hybrid configurations have not been mentioned. Similarly, a brief discussion on photocatalysis centres around the basic principles and various materials under study. The details of reactor designs, product profiles and efficiency values have not been discussed. Such details can be found in the cited papers and references therein.

Solar Photovoltaic Technologies

The photovoltaic effect was discovered by Henry Becquerel in 1839. However, it took more than 100 years to develop first solar cell with Silicon having 6% efficiency [2]. Since the initial years of development, till today, silicon solar cells remain the backbone of PV technology. The development of microelectronics industry also contributed a lot into the progress of Si based solar cells since its discovery. The rapid development over the past fifty years has also been made possible by increasing awareness about global warming and depleting fossil fuel reserves, which has triggered large scale research on PV technologies. As a result of which, the contribution of PV to gross electricity production has grown from 0.01 % in 1990 to about 1.7% in the recent times. Globally, 300 GW of total installation has been targeted for the year 2017. [3] At the fundamental scale, the solar cell materials should satisfy two conditions: (i) Efficient light absorption and charge carrier generation (ii) separation of charges to minimise recombination. All materials development revolves around the challenge of finding the suitable materials and their combinations that can satisfy the above two requirements. Fig. 1 shows the basic classification of solar PV devices.

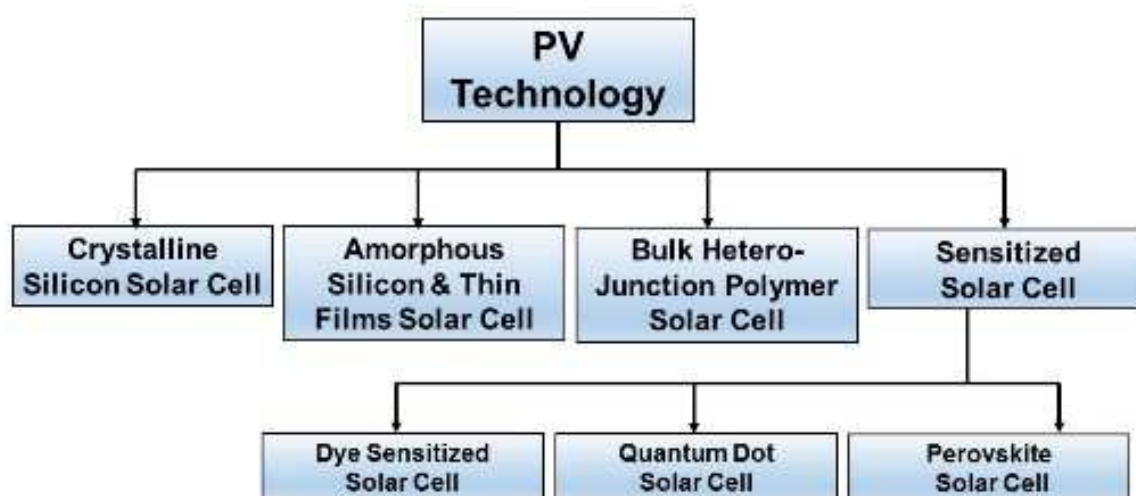


Fig. 1 Broad classification of existing solar cell (PV) technologies

Crystalline Silicon solar cells

Since the first silicon *p-n* junction solar cell was demonstrated by the Bell Laboratories in 1954, over 60 years of research in both academics and industrial research labs has resulted reaching efficiencies of more than 25 % in the recent times. The crystalline silicon has been the primary material for solar cells, however, amorphous and polycrystalline silicon have also been used extensively. Solar cells based on single crystal Si wafers have undergone much improvement in the recent times due to light trapping by texturing, nano-structuring, passivating layers, efficient charge collecting contacts and annealing technologies. At present, there are few different approaches to fabricate high efficiency solar cells, which are discussed below.

PERC solar cells: The Passivated Emitter Rear Cell was proposed by Marteen Green of the University of New South Wales, Australia, through which they had obtained an efficiency of 22.8 %. [4] One of the main features is the engineering of the back contact by passivation for minimizing recombination, which is great drawback for conventional crystalline silicon solar cells. Further, it is designed in a way that the optical losses arising from the Aluminium back contacts were also reduced. Additionally, the front side of the cell can also be modified using the existing PV technologies resulting in a higher efficiency. The rear side is coated with $\text{Al}_2\text{O}_3/\text{SiN}$ layer, which helps to passivate the dangling bonds and reduce recombination. Fig. 2 shows a schematic representation of a PERC solar cell.

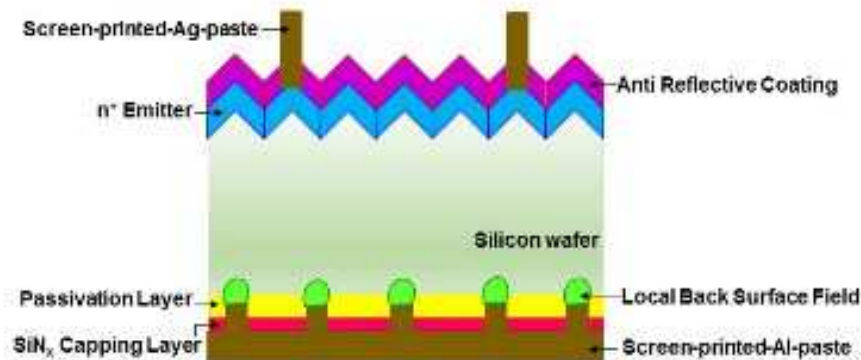


Fig. 2 Schematic representation of an PERC (Passivated Emitter - Rear Contact) solar cell
Adapted from <https://www.pv-tech.org/technical-papers/the-road-to-industrializing-perc-solar-cells>

Tunnel Oxide Passivated Contact (TOPCon) solar cells : The PERC solar cells described above suffer from relatively complicated fabrication protocol. This has been simplified using an ultrathin SiO_2 layer (1 – 2 nm), followed by a layer of doped silicon. The presence of the extremely thin oxide layer ensures uniformity while the charges can flow through tunnelling process. This was developed by Fraunhofer ICE and resulted in an improved efficiency compared to that of PERC cells. The full metallization at the back contact simplified the fabrication process and also the passivation led to minimization of the recombination. [5]

HIT solar cells: Heterojunction with Intrinsic Thin (HIT) layer type configurations are based on the silicon heterojunction design, but a very thin intrinsic amorphous Si (a-Si) layer helps in charge separation. Further, a hydrogenated a-Si layer ensures the passivation by reducing the interfacial charge density. [6].

Thin Film Solar Cells:

Although crystalline silicon solar cells, fabricated on single crystal Si wafers, have dominated both the research and commercial worlds, the inherent limitations such as higher recombination, thermal degradation and indirect band gap of Si had motivated research on alternative compound semiconductors such as CdTe for solar cell applications. Further, it was realised that, these materials have high visible light absorption and hence a thin coating/layer was sufficient to achieve PV effect, leading to substantial savings in terms of materials cost.

Amorphous Silicon (a-Si) solar cells: In this context, amorphous silicon solar cells, fabricated on a layer of silicon grown by CVD process, was in fact the first type of thin film solar cells. The a-Si layers show direct band gap and therefore higher absorption of light even in a smaller quantity of material. However, though the toxicity is far less compared to the Cd or Te based materials, the a-Si technology employed expensive, explosive and highly toxic gaseous precursors such as silane and phosphene. Further, the dangling bonds leads to higher recombination which resulted in hydrogen passivation approach (a-Si: H). The discovery of a-Si and a-Si: H happened in late 1970s and early 1980s and it was predicted that the technology had the potential to achieve about 15 % efficiency. Using textured surfaces for light trapping and multijunction design, a stabilised efficiency of 13.6 % has recently been achieved.

CIGS and CZTS Solar cells: The Cu(In,Ga)Se_2 and Cu(Zn,Sn)S_2 are the quaternary compound semiconductor material which have been extensively investigated for solar cell applications. Due to suitable band gap to absorb large part of the solar radiation and ease of chemical synthesis, these materials have been the dominant players in thin film solar cell technology. Although its challenging to maintain the composition/stoichiometry; however, one main advantage is that the band gap can be tuned to a desired value by changing the relative composition of the constituents. Depending on the type of conductivity of the prepared materials (*n* or *p* type), another *p* or *n* type material is usually employed to design the solar cell device in a *p-n* junction configuration. Fig. 3 presents a schematic representation of a CIGS thin film solar cell.

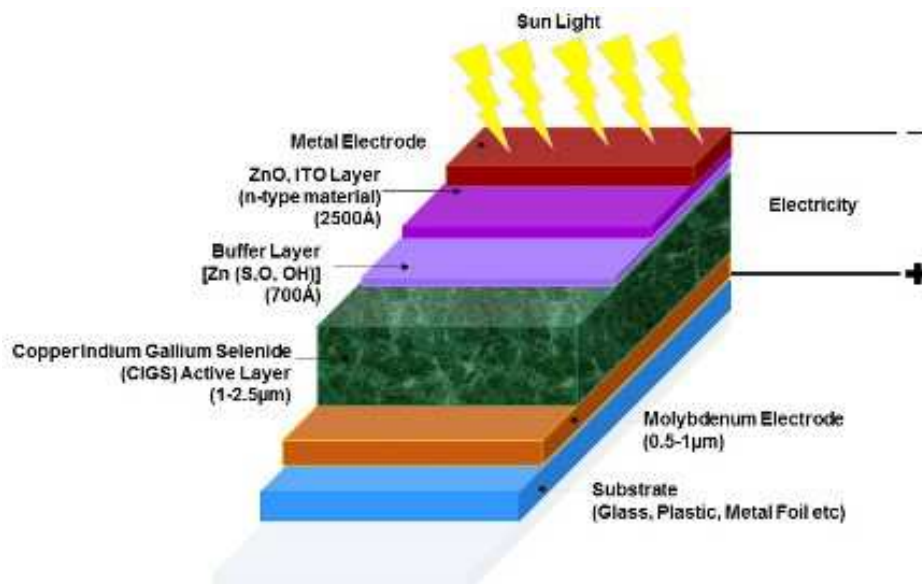


Fig. 3 Representative description of a $\text{Cu}(\text{In,Ga})\text{Se}_2$ thin film solar cell

Adapted from <https://www.nrel.gov/pv/copper-indium-gallium-diselenide-solar-cells.html>

CdTe solar cells: CdTe is a compound semiconductor with a direct band gap and one of the first ‘non- silicon’ material to be explored for solar cell designs. In spite of toxicity and environmental concerns, a lot of research has been carried out in fabrication of CdTe thin films and solar cell devices. One of the advantages has been that simple chemical processing can be done using aqueous precursors to obtain CdTe thin films. However, high vacuum and high temperature deposition processes for Cd and Te has been widely employed for the fabrication of high quality CdTe thin films. Usually a p - n junction is formed with an n -type material such as CdS to achieve a solar cell design. The developments in the field of thin film solar cells have been nicely reviewed in the references [7, 8].

Dye Sensitized solar cell:

In 1991, O’Regan and Michael Gratzel proposed a revolutionary new concept in solar cells called Dye Sensitised Solar cells (DSSC), which paved the way to fabricate relatively low- cost PV devices.[9] The basic components of DSSC are conductive glasses (as electrodes), TiO_2 or similar chemically stable n -type conductor, an electrolyte redox reaction (and hole conduction) and a dye for absorbing the solar radiation. [1]

Transparent conducting electrodes: The purpose of the TC electrodes is to collect and transport electrons generated by light irradiation to and from the outer circuit of the device. Since sunlight has to enter through the electrodes, the basic design involves a glass substrate coated with F doped SnO_2 (FTO) layer. On the other hand, very thin and semi-transparent coatings of highly conductive metals such as Platinum or Gold are also employed on the glass substrates. The FTO coated glass substrates are widely commercially available and serve as the backbone of DSSCs.

Nanostructured semiconductors: TiO_2 (Titanium dioxide) was the first and foremost material to be used in the DSSC design. In particular, materials in nanostructured form is highly desirable, which possesses higher surface to volume ratio for anchoring the dye (or sensitizer) molecules. The chemical stability of the metal-oxide based semiconductors is one of the most important characteristics for the fabrication of DSSCs.

Light absorbing dye: The light absorbing dyes lie at the centre of DSSC concept. Gratzel’s group invested a class of Ruthenium based dyes for use in DSSCs. One of them is $\text{C}_{58}\text{H}_{86}\text{N}_8\text{O}_8\text{RuS}_2$, popularly known as N-719 dye. These class of materials have high absorption capability particularly in the visible region of the solar spectra; however, almost 30 years of research have produced many highly functional dyes with suitably engineered HOMO and LUMO levels as well as with tailored energy gaps for achieving desired absorption of light.

Redox electrolytes: The redox electrolyte is another integral component of DSSC, which work in conjunction with the dye. When the dye absorbs light and the photogenerated electrons are transferred to the conduction band of the semiconductor, the holes are taken away by the electrolyte and undergoes a simultaneous oxidation and reduction processes. This also helps to regenerate the dye. A detail description of the operation of DSSCs can be found in references. Efficient operation of a DSSC requires that the electrolyte should be stable in contact with the dye, should not absorb light by itself and must have long red-ox cycle life. A typical example of a common electrolyte is a mixture of iodine/tri-iodide solution, which cycles between I/I^{3-} states to take care of the photogenerated holes and keep the dye protected from degradation. Although, liquid based electrolytes have been used extensively in the initial stages of the development of DSSCs, potential problems with leakage and stability resulted in the invention of solid and quasi-solid-state electrolytes. A schematic description of a DSSC is presented in Fig. 4.

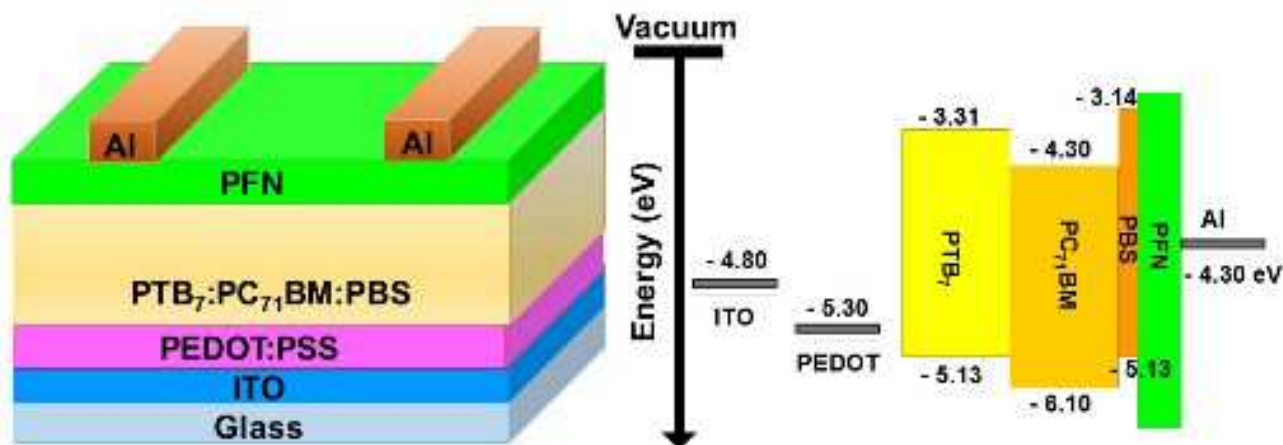


Fig. 4 Schematic representation (left) and energy level diagram (right) of a polymer based Bulk Heterojunction (BHJ) solar cell

Polymer Solar cells:

The polymer solar cells owe their existence to the discovery of conducting and light absorbing polymers by Alan Heeger and group. [10] In generic terms, however, polymer can find application in any part of the solar cell, as flexible substrate, hole or electron conducting layers and light absorbing active medium. The central concept of polymer solar cells is the bulk heterojunction (BHJ) formed between interpenetrating layers of an electron donor and an acceptor, one or both of which can be polymers. In case of polymeric BHJ, the transfer of photogenerated electrons takes place in an ultrafast manner giving rise to charge separation upon irradiation of light. In contrast with inorganic materials, the polymeric materials have Highest Occupied Molecular Orbitals (HOMO), which is equivalent to valence band maxima and Lowest Unoccupied Molecular Orbitals (LUMO), equivalent to the conduction band minima. The light absorption takes place according to the difference between these two energy levels. One of the most promising ways to achieve higher efficiency in polymer solar cells is to have a BHJ formed between an electron donor and an electron acceptor. [6,6]-phenyl C_{61} -butyric acid methylester (PCBM) is a fullerene derivative, which forms an efficient BHJ with poly(3-hexylthiophene) (P3HT). The P3HT(donor)-PCBM (acceptor) combination has yielded polymer solar cells with efficiencies higher than 5%. Use of conductive polymers as hole conduction layer is also adopted for solar cells. poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) is such a conjugated polymer, which is coated onto FTO or ITO coated glass as a hole extraction layer before depositing the active layer. [11] A representative diagram of a polymer solar cell is shown in Fig. 5.

Quantum Dot Solar cells

The concept of QD solar cells is similar to that of DSSCs, where the quantum dots of suitable light absorption characteristics are used for the functionalization of the active layer (for eg. TiO_2). The QDs of suitable band gaps not only modify the overall absorption features of the solar cells but also helps to separate the electron-hole pairs generated by light. In general, for active layers with higher band gap, QDs of lower band gap are chosen so that higher amount of visible light is absorbed. Chalcogenide based semiconductors have been widely used for QD fabrication because of size and composition dependent optical absorption behaviour. Normally, the dimensions of QDs are controlled within a few nm to few 10s of nm to achieve effective quantum confinement and modification of optical properties with respect to their bulk counterparts. Both binary semiconductor systems (CdS, CdTe, CdSe, ZnS etc) and ternary semiconductors such as $CuInS_2$ have been employed. In order to sensitize the host material (such as TiO_2), a number of different strategies have been implemented. These include functionalization (attachment of the QD to the surface of the bigger TiO_2 particles), alloying or composite formation, core-shell structuring and doping into the host material. The choice of the sensitization protocol depends on the availability of the suitable process and precursor materials as well the targeted level of sensitization required. The QDs are fabricated in-situ by simple chemical techniques such as chemical bath deposition and successive ionic layer adsorption and reaction (SILAR). In these techniques, the QD particles are directly grown onto the host materials leading to better interfacial property and resultant charge transfer mechanism. However, in some cases, the host material may not withstand chemical processing for the growth of QDs and hence the QDs are grown ex-situ and then deposited onto the host material by dip or spin coating techniques. In spite of great advancement in the fabrication of quantum dots with superior light absorption capabilities, the photovoltaic device performance has not improved much beyond 10 % efficiency. Much of the limitation of QD sensitized solar cells can be attributed to the lack of stability of the QD systems and hence the devices need to be operated in suitable redox couple electrolytes (hole scavenging medium), which ensures chemical stability of the materials. The innovation in solid state hole transporting materials may lead to better flexibility in the deployment and operation of QD sensitized solar cells.[12]

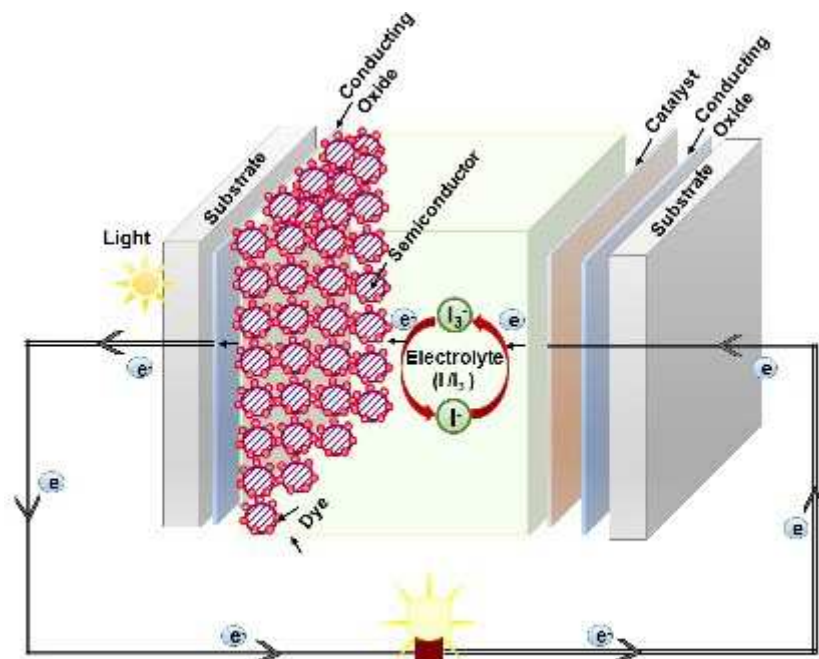


Fig. 5 Schematic representation of a Dye Sensitised Solar Cell
(adapted from Parisi *et al.* Renewable and Sustainable Energy Reviews. 39. 2014)

Metal Halide Perovskite based solar cells

Metal halide based perovskites (for eg. Methylammonium lead trihalide, $\text{CH}_3\text{NH}_3\text{PbX}_3$) have attracted a lot of attention in the recent times as a solar cell light absorbing materials since its discovery in 2009 with an initial efficiency of 3.8 %.[13] A hybrid material consisting of both organic and inorganic components, such perovskites show exceptionally high light absorption and hence even a 500 nm film (layer) is sufficient to absorb a significant part of the visible spectrum. Further, the material can be solution processed / screen printed on different types of substrates (including the flexible materials), which, therefore has potential of wide-scale deployment and lowering of fabrication costs. In about 10 years since the first report, the perovskite based solar cells have reached about 25 % efficiency and has emerged as one of the leading solar cell technologies. Initial research and development work centred around Lead based perovskites; however, concerns about toxicity soon led to search of lead-free perovskites. One of the promising alternatives is Tin (Sn) in terms of power conversion efficiencies and a lot of research has been carried out in the recent times to achieve stability of the devices. It has been shown that the lone pair s^2 electrons of divalent metal ions and the symmetry of structure lead to high optical absorption in such perovskites. Further, the dispersion of the valence band caused by the interaction of s^2 orbitals of metal ions and p orbitals of the halogen ions results in a small effective mass of the holes, which also contributes towards the photovoltaic activity. Alternatively, Sn based perovskites show high carrier mobility and long diffusion lengths, which are essential for solar cell applications. Furthermore, the optical band gap of Sn based perovskites is smaller than that of Pb based counterparts, leading to the absorption of wider part of the solar spectrum. [14]

Solar Energy Harvesting through Photocatalysis

Although solar photovoltaic (PV) technology is the most efficient way to harness solar energy, but photocatalysis offers an alternative pathway to utilize solar power for driving chemical reactions. At the fundamental scale, in a manner similar to solar cells, a photoactive material absorbs sunlight and produces electron hole pairs. In this case, however, both electrons and holes are utilised to carry out oxidation and reduction processes to achieve certain chemical reactions. Fig. 6 depicts the schematic representation of a photocatalysis process. When a semiconductor of suitable band gap (band gap energy equivalent to the energy of the incoming light) is irradiated with light, electrons from the valence band are excited to the conduction band, leaving vacancies (or positively charged holes, h^+) at the VB. As the Figure Y shows, an example of photocatalytic water decomposition, the *holes* can initiate a chemical reaction (oxidation) by ionising water and the ionized radical can take *electrons* (reduction) from the conduction band of the photocatalyst to form hydrogen. The research in photocatalysis practically originated with the 1972 report from Fujishima and Honda on photoelectrochemical decomposition of water to produce hydrogen. [15] In these initial stages, however, the photocatalyst material was used as an electrode and the water splitting was caused by sunlight with assistance from applied bias (which helped to separate the electron-hole pairs by providing additional energy). The concept of solar energy driven water splitting was then extended to water purification (such as photocatalytic dye degradation and pollutant removal) and CO_2 reduction (conversion of CO_2 into carbon containing fuel/useful materials).[16,17]

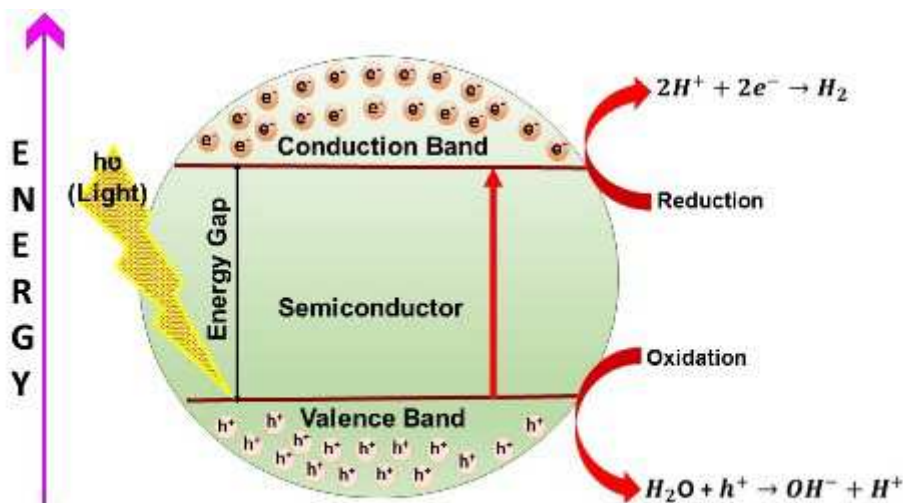


Fig. 6 Diagram showing basic principle of photocatalysis (semiconductor in circular shape only for representation)

The central concept of a photocatalysis process is a semiconductor material with suitable band gap to efficiently absorb the solar radiation. However, the band-gap energy alone is insufficient to drive efficient photocatalysis process. The electrons and holes should have sufficient energy required for carrying out the desired chemical reaction. This implies, in addition to a suitable band gap energy, the positions of the valence and conduction band edges also have high importance. There are various semiconducting materials that have been explored for photocatalysis. As discussed under the thin film solar cells subtopic, the compound semiconductor materials such as CdTe, CdS, ZnS, CdSe have direct band gap suitable for visible light absorption and the band edges are also suitable for photocatalytic water decomposition. However, lack of stability in aqueous ambience is a serious drawback of these types of materials. The metal oxides, such as SnO₂, ZnO, TiO₂, SrTiO₃ are highly stable but possess larger band gap (> 3 eV), which results in the absorption of only UV part of the solar spectra (< 5 % of sunlight). On the other hand, there are a few stable oxide materials such as hematite (Fe₂O₃), BiFeO₃, BiVO₄, which show excellent visible light absorption because of lower band gaps (2 – 3 eV); however, the conduction or valence band positions are not always suitable for a desired chemical reaction. Extensive research is currently underway on improving the photocatalyst materials to achieve better stability, and to tailor the band gap for suitable energy and position of the band edges. Such approaches include doping, composite formation, functionalization, Z-scheme process etc. Details of these can be found in the listed references.

Conclusions: More than half a century of research in solar PV technologies, in particular on Silicon solar cells, has resulted in fully commercialised products. However, drawbacks and limitations of Silicon has also provided motivation to explore other types of solar cell devices. In one of such latest developments, organic halide based perovskites have shown high potential in solar cell efficiencies, reaching more than in less than 10 years since discovery. On the Silicon front, multijunction, tandem and hybrid technologies are gaining momentum to achieve higher efficiencies. On the other hand, photocatalysis has largely remained at the research level because of inherent thermodynamic limitations. However, new materials combinations, configurations and reactor design along with higher temperature operation may yield higher efficiency.

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About the author



Somnath C Roy completed his BSc and MSc degrees in Physics from the Banaras Hindu University, Varanasi in 1997 and 1999, followed by PhD from IIT Delhi in 2005. After a brief stint as a Lecturer in the Amity University Noida, he joined the prestigious Materials Research Institute at the Pennsylvania State University, USA in 2006 as a Post-doctoral researcher. In 2010, he moved to IIT Madras as an Assistant Professor in the department of Physics, and became an Associate Professor in 2015. During the past 9 years at IIT Madras, he has been involved in the growth and study of 1D nanostructures for solar energy and gas sensing applications and has guided two PhD theses. At present, Dr. Roy's group, called the Environmental Nanotechnology Lab, is comprising of 8 PhD students, 2 post docs and a number of UG and PG project students. Several funding agencies such as DST, DRDO, Nissan, CSIR and ONGC have generously funded his research. Dr. Roy has taught both UG and PG level courses at IIT Madras. With a total of 40 publications till date, his current *h*-index is 15. Recently, he has been selected for the Bhaskara Advanced Solar Energy (BASE) Fellowship and also the Shastri Indo Canadian Institute's (SICI) Faculty Travel and Internationalization (FTI) award grant.

The Architecture of Open Source Applications

Carpentry is an exacting craft, and people can spend their entire lives learning how to do it well. But carpentry is not architecture: if we step back from pitch boards and miter joints, buildings as a whole must be designed, and doing that is as much an art as it is a craft or science.

Programming is also an exacting craft, and people can spend their entire lives learning how to do it well. But programming is not software architecture. Many programmers spend years thinking about (or wrestling with) larger design issues: Should this application be extensible? If so, should that be done by providing a scripting interface, through some sort of plugin mechanism, or in some other way entirely? What should be done by the client, what should be left to the server, and is "client-server" even a useful way to think about this application? These are not programming questions, any more than where to put the stairs is a question of carpentry.

Building architecture and software architecture have a lot in common, but there is one crucial difference. While architects study thousands of buildings in their training and during their careers, most software developers only ever get to know a handful of large programs well. And more often than not, those are programs they wrote themselves. They never get to see the great programs of history, or read critiques of those programs' designs written by experienced practitioners. As a result, they repeat one another's mistakes rather than building on one another's successes.

This book is our attempt to change that. Each chapter describes the architecture of an open source application: how it is structured, how its parts interact, why it's built that way, and what lessons have been learned that can be applied to other big design problems. The descriptions are written by the people who know the software best, people with years or decades of experience designing and re-designing complex applications. The applications themselves range in scale from simple drawing programs and web-based spreadsheets to compiler toolkits and multi-million line visualization packages. Some are only a few years old, while others are approaching their thirtieth anniversary. What they have in common is that their creators have thought long and hard about their design, and are willing to share those thoughts with you. We hope you enjoy what they have written.

If you are a junior developer, and want to learn how your more experienced colleagues think, these FOUR books are the place to start. If you are an intermediate or senior developer, and want to see how your peers have solved hard design problems, these FOUR books can help you too.

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A step towards integrated environment of technology based learning and quality assessment framework

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I. Introduction

Using computer resources and Internet technologies for educational purposes, is being seen as E-Learning in present day scenario. Initiatives such as developing eContents and setting up of infrastructure at school or higher education level are already started in India long back. Referring eContents and online courses for national level entrance examinations is growing day by day. Some of the courses are available for free and others on some price. Open Universities, Government Organizations and other academic institutions are slowly adopting online training as means for imparting requisite skills to their students and as a supplement method to traditional physical class room environment. There is no doubt this initiative of online learning has potential to reach millions of users when compared to traditional training methodologies.

At the same time there is a concern about requirement of a quality framework for online learning environments. This will ensure long term sustainability of eLearning and also benefit the end users in getting quality education through online mode. There are several proposals made towards this direction by different researchers in the past and standard bodies. However, when the eLearning quality models become integral part of online learning environment its value or impact can be realized. To do this several factors need to be considered. A move towards this direction is the focus of this article.

The quality frameworks usually emerge from the commonly used best practices that solve a particular purpose in a defined way. In order to arrive at a quality assessment framework in eLearning, we need to look at current practice of instructional delivery process and how effectively it can be replicated or improvised by adopting technology. At the same time we also need to look at the associated technological challenges.

Usually a learner is said to have learned the subject when his ability in accomplishing the task corresponding to the subject is judged. To assess this factor the only instrument that is available is assessment of student's knowledge level. Student's knowledge level will improve when he is given sufficient details about the subject matter. Sufficient details are nothing but information about what the student is expected to know/perform after completion of the course, actual content supplemented with illustrations/demonstrations wherever required, additional information about the topic's background or advanced details and a self-assessment.

If these details are designed using technology in such a manner that would help students in engaging themselves in learning actively, having curiosity about a topic, probe critical thinking skills and allow them to interact with the content in a variety of ways (which can be regarded as necessary elements to judge one's motivational level) then the content is expected to be used by many and thus can be regarded as quality content. This can be addressed by effective utilization of text and multimedia coupled with little programming skills for event generation, notification and handling in content development process.

Developing content using multimedia technology is considered as a collaborative effort of instructional designer, subject matter expert, multimedia expert, videographer etc. In this situation, a uniform comprehensive set of guidelines corresponding to each role in their efforts of content development will be the first step towards building a quality assessment framework.

This exercise will eventually help in defining quality criteria that the online course contents and hosting platform will need to meet in order to be of sufficient quality to be offered to its users will be the next step. Once the quality criteria consisting of measurable quality dimensions are prepared development of corresponding measurement methods will be the next step. Finally, development of tools to assess the conformance to quality criteria based on the methods developed and integration of the same with online course hosting platforms will be the right direction towards facilitating quality conformance verification of online courses. This exercise helps in moving towards a national level policy on quality assessment practices of eLearning technology and courseware which not only harmonize the eLearning quality assessment practices but also provides an effective mechanism for monitoring and adaptation of necessary changes to meet the present and future challenges in online learning.

II. An Initiative towards Quality Assessment Framework for online courses and hosting platform

Centre for Development of Advanced Computing, Hyderabad has taken an initiative in defining and building a quality model with appropriate measurement approaches for online course contents development and hosting platform. A detailed research study done and a proposal towards quality assessment of eContents by Satyanarayana, et. al can be found here [2] and for online hosting platform by Sarat Chandra Babu, et. al can be found here [1].

Based on the work carried out in the above papers, quality criteria for development of online course contents is proposed as “A set of individual course contents suitable for offline and online reading which are organized in to a course with objectives or expected learning outcome associated with each of them, visual and auditory legible, interoperable with course delivery platform, understandable to readers and having sufficient coverage of information”.

Majority of the online courses are being offered through web platform. Web has become a defacto method for dissemination of information. Hence, quality criteria for web based applications are equally applicable to online courses hosting platform when Web is used as a medium for offering courses. Its quality criteria is proposed as “A platform which can support delivery of online courses according to the instructional strategy, meets the minimum expected performance in terms of its access through Internet, secured from most common web vulnerabilities, accessible and is easy to use”.

The online course contents quality dimensions are based on factors concerned with (a) Technology (b) Content. Technology factors deals with assessing impact of technological errors that creep in to the content development and content factors deals with assessing usefulness of the content based on predefined rubrics.

As a whole the quality framework for assessing online course contents and its hosting platform is depicted through a pictorial representation below.

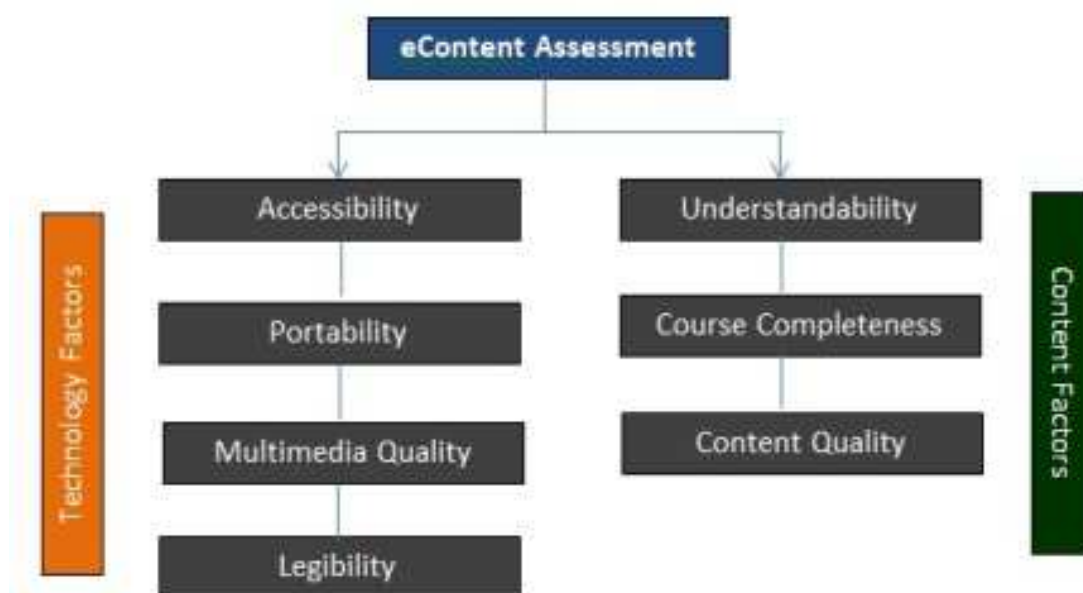


Fig 1: eContent Quality Criteria

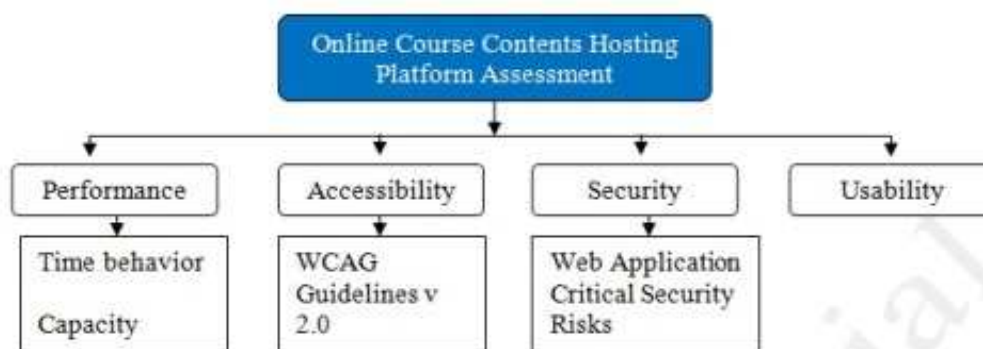


Fig 2: Hosting Platform Quality Criteria

III. Online Course Contents Quality Dimensions:

(A) Accessibility (WCAG Guidelines) is one of the most widely supported guidelines in almost all the word processors and web page editors. This support will enable people with physical disabilities to use assistive technologies in using content effectively.

(B) No reference metrics for impairment analysis of multimedia content such as audio or video elements reduces the video quality assessment time as the subject matter expert need not focus on technical errors that creep in to the video at the time of its recording.

(C) Legibility of the content has direct impact on readability of the material. In the empirical study conducted by Satyanarayana et. al [1] students have expressed that consistency in font style, size and color etc., quality of images used in the material and color contrast are the dominating factors in influencing text content legibility.

(D) Readability of the text is most important as it has direct impact on understandability. Readability is generally affected by length of sentences, vocabulary and legibility. Content is considered to be easily understandable when its readability value is high.

(E) Sharable content object reference model (SCORM) is ISO standard for content aggregation and runtime environment. The events generated within the content due to user's action such as clicking a button, drag and drop etc., can be communicated to course hosting environment through SCORM's runtime environment. Thus SCORM's runtime environment will act as a bridge between course content and tracking & analysis module of course hosting environment. This is useful in understanding student's motivation level.

(F) Whether the course is complete in all aspects or not is another important aspect that needs to be judged. To accomplish this we need to verify whether the course is designed with sufficient details or not. This can be evaluated by looking at whether the content is prepared for both online and offline reading in different formats viz., pdf/html for running text and ppt/video for presentation, contains objectives/expected learning outcomes for each topic in the course, whether any reference material or assessment is attached to the content etc.

When the course is designed with conformance to all the above quality dimensions it can be regarded as suitable for online learning.

IV. Hosting Platform Quality Dimensions:

(A) Performance refers to the extent which the online course contents hosting platform can support simultaneous requests while meeting minimum response time constraints. It is difficult to define the minimum recommended response times due to various factors such as application's functionality, network bandwidth etc. Usability studies by Jakob Nielsen reported that 0.1sec as the limit for having the user feel the system is reacting instantaneously, 1 sec is the limit for the user's flow of thought to stay uninterrupted and 10sec as the limit for keeping the user's attention focused on the dialogue. In the present scenario of Internet based applications meeting these time limits depends on network latency especially when the web content is hosted at remote places. Hence, an approach to find out the percentage of deviation from minimum expected response time and determining its grade level is proposed in [2]. The minimum expected response time has to be determined by the hosting service provider to know whether the hosting site is reachable as expected in ideal network conditions after performing few trial runs from remote places through Internet.

Using observed average response time and expected response time of an URL, percentage of deviation and associated scale has been proposed as below.

Deviation %	
<26	VERY GOOD
>25	GOOD
>50	AVERAGE
>75	NOT SUITABLE FOR ONLINE LEARNING

This approach can be used during internal audit trails and serves as a benchmark during future upgradations of the hosting platform. A deviation of 25% corresponds to 250 ms or ¼ of a second if the minimum expected response time determined as 1000ms and observed response time is 1250ms. For business oriented applications a delay of 250ms results in losing of site traffic to some extent which may not be the case with the online learning platforms.

(B) Apart from the performance of the hosting platform it is also important to check whether the application is prone to exploitation of any critical web application security risks as an end-user will try to upload various documents corresponding to course work. The Open Web Application Security Project (OWASP) releases list of top 10 web

application vulnerabilities every year and the top 5 almost remain consistent with minor changes in the order of their impact in a particular year.

(C) User satisfaction in terms of degree to which the application is easy to operate, a user is satisfied with their perceived achievement of pragmatic goals, confident in using the application again is required to be judged.

The final score of the Usability test reflects the usability score of an individual. Based on below grading mechanism the score obtained can be categorized in to one of four groups. A. Bangor et. al, [3] given detailed report on how individual Simple Usability Scale scores can be mapped to an adjective scale.

>85	VERY GOOD;
<=85	GOOD;
<73	AVERAGE;
<70	NOT SUITABLE FOR ONLINE LEARNING;

Then mode/median (as the case may be) of the ordinal data will determine the usability of the online hosting platform as one of the above categories. However, the end users should be given a task to be performed concerned with usage of the system so that individual score can be obtained.

(D) Accessibility refers to the extent to which the application supports people with the different capabilities can access the hosting platform. W3C has given recommendations on accessibility guidelines for web pages.

V. Use Case Scenario

With the above quality assessment framework in place it will be useful to the academic and training institutes in making the course contents free from technical and non-technical errors before publishing them online and verify whether their hosting platform is meeting the specified quality criteria so that any necessary corrective steps can be initiated. Like how a book gets its reputation gradually after it is read by several readers same would be the case with the integrated environment of quality assessment framework and online learning environment.

Integration of this framework with Learning Management Systems will provide a first-hand report on quality of the online course initiative of academic institutes as the course offering starts only after preliminary check of technical and non-technical errors as described in this article.

VI. Acknowledgements

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Dew Computing: A New Era of Computing Implying Minimization Over Internetwork Backhaul

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Abstract

Grid Computing, Cloud Computing, and Fog Computing and Edge Computing have catered various services toward digitization of ICT-based aspects. Although, these technologies are still in very good shape they do heavily rely on connectivity issue i.e. internet. To cover up this challenge, Dew Computing (DC) paradigm is proposed. DC relies over the Dew-Cloud architecture that brings the power of Cloud Computing together with the Dew Computing. Originally, the Dew-Cloud architecture is an extension of existing Client-Server architecture where two servers are placed at both ends of the communication link. With help of Dew Server, user holds more control and flexibility to access his/her personal data in absence of internet connection. Primarily, the data is stored at Dew Server as a local copy which upon instantiation of internet, is synchronized with the master copy at the Cloud-side. User can browse, read, write, or append data on the local Dew Site which is a local web form of an actual web site. The aim of the DC are as follows: (i) minimization of internet-backhaul dependent services, (ii) provide extreme flexibility to the Dew users in terms of web-data access and visualization, and (iii) leverage an internet-free ecosystem toward achieving green-computing through less use of data center and middle-tiers of communication-infrastructure of existing network.

Keywords: Dew Computing, Dew Site, Dew Server, Dew System.

A. Dew Computing as Post-Cloud Computing Paradigm: If in a stage of computing the following two conditions hold, this stage of computing could be called post-cloud computing era [1][2]:

- (i) Cloud computing is not dominant.
- (ii) The relative importance of cloud computing is not increasing.

Cloud computing obtained widely acceptance in the past decade; its usage was increasing quickly. But we believe that cloud computing has never dominated the computing world. With the quick development of Internet of Things, wireless devices, and artificial intelligence, the relative importance of cloud computing is increasing slowly or not increasing at all. Thus, we believe that post-cloud computing era is coming or has already come. Post-cloud computing is not a specific computing paradigm; instead, it covers a few computing models that are related to cloud computing and remedial to cloud computing in the post-cloud computing era. Major post-cloud computing models include CDEF, i.e. Cloudlet, Dew computing, Edge computing, and Fog computing.

Since cloud computing has been widely accepted, progress in research and development enriched the landscape of this area. Such progress can be summarized in the following way: From cloud to CDEF, where C represents Cloudlet, D represents Dew Computing, E represents Edge Computing, and F represents Fog Computing. CDEF starts with C also implies that these four models all started from Cloud Computing.

The cloudlet model promotes to put small-scale cloud data centers at locations where they are closer to users [3][4]. The key features of dew computing are that on-premises computers provide functionality independent of cloud services and they also collaborate with cloud services. Dew computing promotes that all on-premises computer applications get support from cloud services, if possible. With dew computing, cloud computing can reach its greatest popularity. Dew computing is complementary to cloud computing [5][6][7].

Edge computing pushes applications, data, and services away from central servers (core) to the edge of a network; it is based on the core-edge topology. Edge Computing refers to the enabling technologies allowing computation to be performed at the edge of the network, on downstream data on behalf of cloud services and upstream data on behalf of IoT services [8][9][10][11].

Fog computing is a scenario where a huge number of heterogeneous devices communicate and potentially cooperate among them and with the network to perform storage and processing tasks without the intervention of third-parties.

Fog computing extends cloud computing and services to devices such as routers, routing switches, multiplexers, and so on [12][13][14].

All these computing models share a common feature: they all perform computing tasks at devices that are closer to users [15].

CDEF (Cloudlet, Dew computing, Edge computing, and Fog computing) appeared after cloud computing was widely accepted; they could be called *post-cloud computing models*. CDEF is an unofficial, easy-to-remember way to refer to these models. CDEF starts with C also implies that these models all started from cloud computing.

CDEF originated from different background, proposed to solve different problems, related to different disciplines/industries, involved different devices, and have different methodologies. The relationships among CDEF are similar to the relationships among different programming languages: although each programming language has full computing power of a Turing Machine, each language has its own style, strength, and characteristics. In the similar way, although the definitions of each of these CDEF computing models may be expanded to cover wider application areas, each of these models are more suitable to be used in some specific areas. From cloud to CDEF, the landscape of post-cloud computing is more versatile and prosperous.

B. Definition of Dew Computing: The definition of dew computing may be presented as follows: “Dew Computing is a programming model for enabling ubiquitous, pervasive, and convenient ready-to-go, plug-in facility empowered personal network that includes Single-Super-Hybrid-Peer P2P communication link. Its main goal is to access a pool of raw data equipped with meta-data that can be rapidly created, edited, stored, and deleted with minimal internetwork management effort (i.e. offline mode). It may be specially tailored for efficient usage, installation, and consumption of local computing (i.e. on-premises) resources like PC, Laptop, Tablet, high end Smart Phone. This computing model is composed of six essential characteristics such as. Rule-based Data Collection, Synchronization, Scalability, Re-origination, Transparency, and Any Time Any How Accessibility; three service models such as Software-as-a-Dew Service, Software-as-a-Dew Product, Infrastructure-as-a-Dew; and two identity models (e.g. Open, Closed). All such efforts shall be made towards running of applications in a purely-distributed and hierarchical manner without requiring continuous intervention from remotely located central communication point e.g. cloud server etc.” [16].

C. Objectives of Dew Computing: Dew computing brings the centralized core cloud services nearest to the user. The objectives of bringing complex computational part from the remote cloud platform to end-user via DC are as follows [17]:

- a. **Internet access minimization:** Dew computing is envisaged to minimize the usability of internetworking facility such that user specific instantaneous supply service could be provided.
- b. **Personal service provisioning:** Unlike other computing paradigms, dew computing handles the higher expectation of user services at user’s end. Without or minimal use of internetwork facilitates user in form of a true personal digital assistant.
- c. **User flexibility maximization:** Existing computing solutions provides pre-defined set of services to user. Dew computing benefits user with unlimited amount of user-willed performances.
- d. **Backhaul traffic reduction:** In reality, the overloading minimization effort on the network backhaul depends on data-traffic in average duration. A dew user relies upon localized services that requires minimum network intervention. Moreover, the dew computing paradigm encourages its user to stay with the user’s prioritized data pre-saved as dew copy in local dew database. In most of the cases dew user utilizes personalized data to surf over dew sites rather on real web sites. If a required data is not present in the dew computer, the dew server first fetches from nearby dew cluster upon a dew permission over local network communication protocols. Only when a data is not present in the dew machine as well as dew cluster, it may require access to remote cloud for which actual internetwork backhaul will be responsible. Thus, minimum usage of internetworking is needed in reality, resulting optimal access over existing network traffic.
- e. **Bandwidth saving:** As dew computers impose over self-system self-service notion, hence communication bandwidth is minimally utilized.
- f. **Carbon footprint minimization:** Less implications over current network assets lowers down dependency over physical establishments such as base stations, enterprise fog, big-data centers etc. Indirect reduction of power consumption is thus evitable which may proportionally help to minimize the carbon footprint.
- g. **Utility maximization:** The Quality of User Experience (QoX) can be improved. Dew computers can fetch and provide the information from low-end network hierarchy. Cloud and fog services can be effectively use dynamically with the requirement of information in real-time. The overall difference between other computing paradigms and DC is presented in Table I [17].

TABLE I

DIFFERENCE AMONG CLOUD, FOG, EDGE AND DEW COMPUTING

Parameters	Cloud Computing	Fog Computing	Edge Computing	Dew Computing
Service location	Within the Internet	Within the Internet	In edge network	In edge network
Distance (number of loops)	Multiple loops	Multiple loops	Single loop	No loop
Latency	Very high	High	Low	Negligible
Jitter	Very high	High	Low	Negligible
Location awareness	No	No	Yes	Yes
Geo-distribution	Centralized	Semi centralized	Distributed	Highly distributed
Mobility support	Very limited	Limited	Semi supported	Highly supported
Data reroute attacks	Very high probability	High probability	Low probability	Very low probability
Target users	General internet users	General internet users	Semi mobile users	Purely mobile users
Service scope	Global	Semi global	Semi limited	Purely limited
Hardware	Scalable capabilities	Scalable capabilities	Limited capabilities	Very limited capabilities
User experience	Very normal	Normal	Good	Highly satisfactory
Internet dependency	Every access time	Every access time	Every access time	Not essential
Client-Server connectivity	Yes	Yes	Yes	No
Synchronization feature	Not essential	Not essential	Not essential	Always essential
Green energy compliant	Very Low	Very Low	Low	High
Delay tolerant	No	No	No	Yes
Computational offloading	Very Less	Less	High	Very High
Deployment scenario	Large enterprises	SME	Router, gateway	PC, laptop, smart phone

D. Key Enabling Technologies of Dew Computing: The assimilation of dew computing may be attributed to the recently proposed key enablers as presented follows [17]:

- Dew Site:** It is a localized copy of actual web site that has complete read, write, append and delete access to dew user. Every frequently visited or prompted web site should have a corresponding dew site at on-premises dew computer. For example, if *www.abc.com* is the actual web site then its dew site may be designed *wid.abc.com*. Here, *wid* resembles to the *www* protocol, but in on-premises dew devices.
- Dew Script:** It is a scripting tool available to dew user for possible modifications in the dew site placed at the dew device. For instance, user can change the formatting of *instagram* personal profile which is only visible to the dew user at the dew computer (*wid.instagram.com*). Upon access rights from user, the same could be synchronized with the actual web template for global visibility. If *partha* has user profile for *instagram*, then a remote shadow copy of local dew site could be positioned at the *instagram* cloud i.e. *partha.wid.instagram.com*.
- Dew Analyzer:** This is a software package meant to coordinate and control over all task and assignments performed by dew script on a specific dew site. When a user does any changes in a file of a dew site, the dew client program activates the dew analyzer to create, delete or append the local dew script file names like *file1.dewscript* in absence of internet. When internet resumes, the modifications of *file1.dewscript* could be interleaved with the *partha.wid.instagram.com*. The authorization related issues could be solved by incorporating a master mapping table between dew site and actual web site.
- Dew DBMS:** As an original web site needs to have a set of database for storing and logging of activity records, the same is essential for the dew site. The dew database management system is essentially a personalized copy of personal database to provide personal dew site surfing experience in reality.
- Dew DNS:** It is assumed that a dew server will host multiple dew sites in one dew computer. Hence, a sophisticated and unique page naming mechanism is evitable. Dew domain naming service shall provide such on-device dew site searching and access features that can be achieved by the host-to-IP mapping. For example, if *wid* is mapped to *127.0.0.1* then other dew sites could be mapped with *127.0.0.1* i.e. All local URLs could be mapped to localhost e.g. *wid.abc1.com*, *wid.abc2.com*, ..., *wid.abc10.com* to *localhost -127.0.0.1*. Dew domain naming redirection (Dew DNR) could be another technique by which such redirection could be possible.
- Dewlets:** It is an extended dew service to a dew computer by which associated dew supported equipment could receive "let services". In this context, multiple things of Internet of Things (IoT) could be associated with one or more dew computers. Self-explanatory dew computing architecture is presented in Fig. 1 [16].

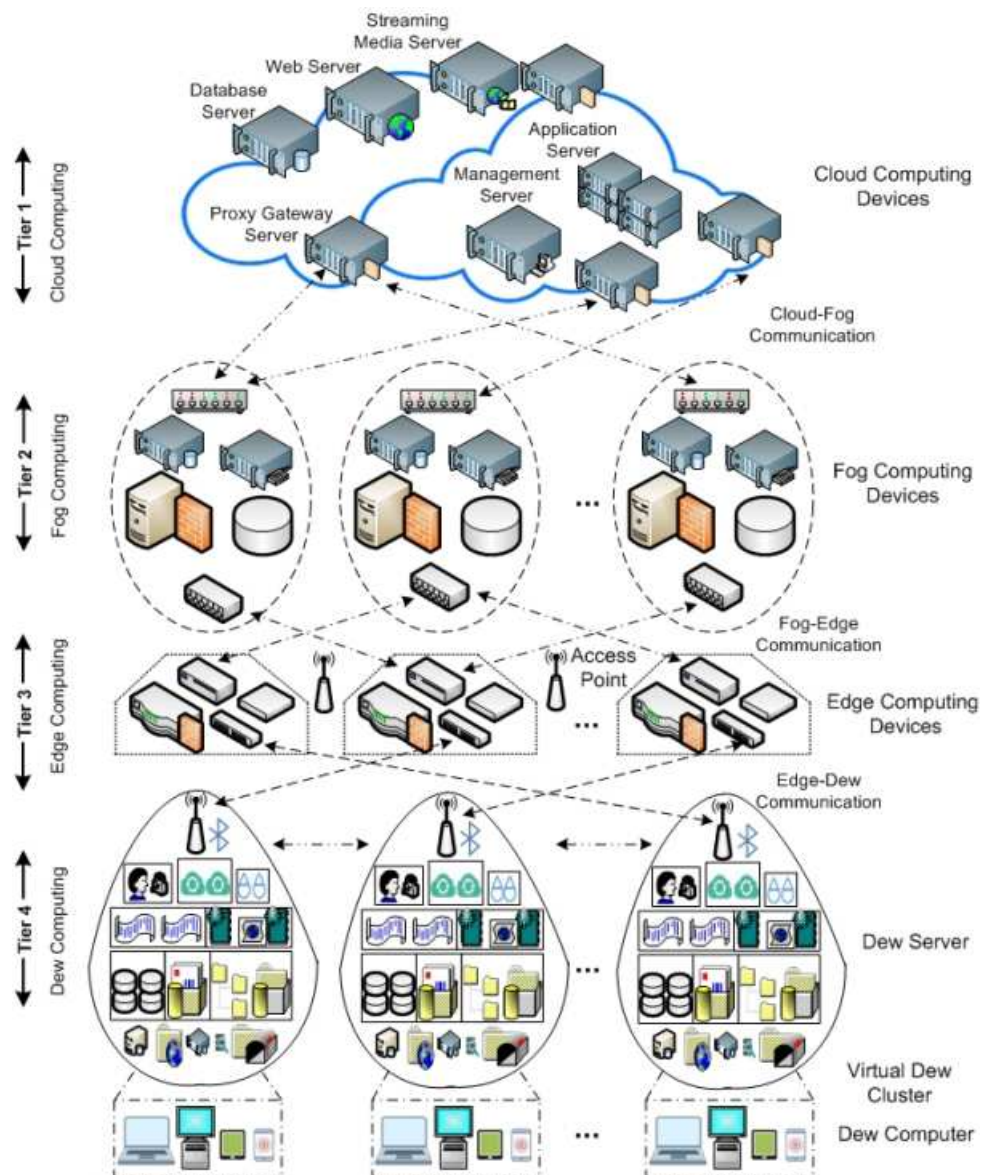


Fig. 1. Hierarchical dew computing architecture.

E. IEEE DewCom STC: In 2018, IEEE has constituted a Special Technical Committee i.e. STC under the purview of the IEEE Computer Society to cultivate and disseminate the novel opportunities and research inclusiveness by incorporating the Dew Computing i.e. DewCom STC. It is a new worldwide Open Community on Dew Computing within IEEE. Dew Computing is an emerging research/application area that is the complementary piece of cloud computing. The goal of dew computing is to fully realize the potentials of on-premises computers and cloud services. The vision of the Dew Computing Special Technical Community is that its efforts shall facilitate dew-computing research and dew computing application, for the benefit of all users and providers of the future global cloud-dew computing environment [18].

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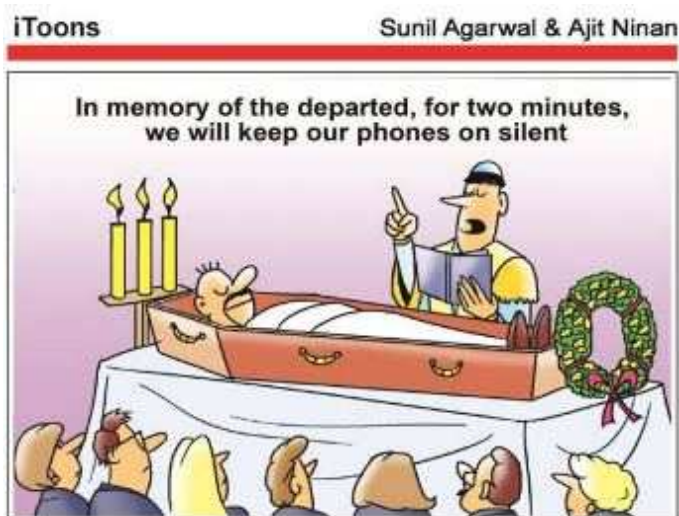
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The Convergence of IoT, AI and Blockchain Technologies

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The traditional ways of data processing and storage based on data centers have been changing rapidly in the last decade. Isolated data centers maintained by elaborate IT departments in corporate offices have given way to a simple subscription model where companies access cloud computing services that are managed by cloud vendors such as Amazon, Microsoft, Google and IBM to serve hundreds of businesses. *Cloud computing* has evolved as a remote centralized solution to manage the surge of information. The cloud gives IT users of all kinds (corporations, small businesses and individuals) cost-effective access to processing, storage and networking facilities.

However, with the percolation of digital technology into every stream of human activity and the rapid growth of telecom infrastructure and smart mobile personal devices, IT services are grappling with new demands in accessibility and security. With the explosive acceleration of consumer-driven interactions, devices and data flows, cloud computing faces a new era of challenges in servicing the extended digital enterprise of today.

Edge computing: Clouds are, by design, remote processing and storage resources. To bring processing and storage closer to the devices generating data, the concept of *edge computing* has evolved in recent years. Edge computing (simply called ‘the edge’) is performed directly on (or very close) to the device, which is typically a programmable automation controller (PAC). It is an IT architecture that minimizes or eliminates the need to use remote centralized cloud systems for processing. In many situations, on-device computing on the edge can dramatically improve the performance and processing speeds of the IoT simply by removing the distance and time handicaps associated with the cloud.

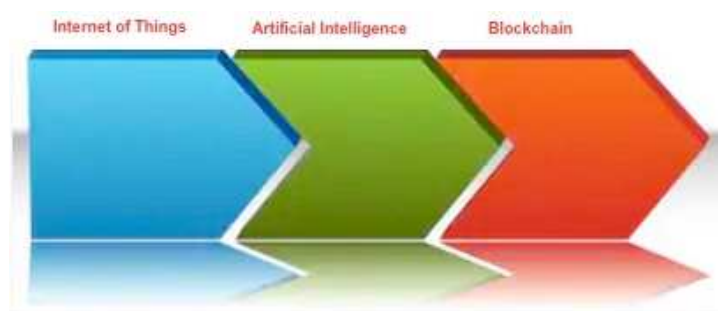
Fog computing: To maintain the integrity of edge computing, some standards have evolved in parallel. One such standard, proposed by Cisco (and available freely to users) is *fog computing*. Fog computing is typically more scalable than edge computing. It specifies standards for data flow, processing and storage on local area network nodes between the cloud and edge devices dispersed across distant locations.

IoT – the Internet of Things: Corporate boundaries and interactions between people and industries are no longer confined to a few secure business locations. Easy access to the Internet and mobile technology has driven computer networking devices into the domain of customers, distributors and virtually anyone who deals with a business. Computing devices are proliferating in millions of forms as nodes (or ‘things’ in general) on an extended Internet that embraces wireless stations and smartphones, as well as a variety of electronic products such as notepads and music systems. As the population of the *Internet of Things* (IoT, or small, embedded computing devices) widely distributed in remote places continues to grow exponentially, performance issues and processing delays are also multiplying.

Artificial Intelligence: *Artificial Intelligence* (AI) is the generic term that describes a class of independent software ‘agents’ or ‘bots’ built with the ability to learn and improve their skill to achieve a specific goal, without (or with partial) human intervention. AI programs are typically algorithms that are capable of learning from data, and modifying their own patterns of behavior.

Blockchain: As digital storage costs have come down, and networks have become more distributed, security and reliability concerns are increasingly being addressed by the concept of blockchains. These are open (but secure) distributed ledgers that provide a reliable way to protect IT assets of all kinds. With blockchain encryption, users can transfer or exchange all kinds of critical digital information securely, with no fear of attacks by hackers or inexplicable data losses.

In the past decade, we have seen how consumer and industrial products and services have been changing rapidly because of evolution in communication and networking technologies. Let’s look at some paired possibilities of how convergence between IoT, AI, blockchain and the underlying infrastructural technologies of the cloud, big data and edge computing will most likely evolve to create a “whole” greater than the “sum of the parts.”



Convergence of AI and IoT

Almost every sector of business has moved from the mere assembly of isolated products and services to the creation of a network of products and services that are collectively included in the IoT. With increasing focus on digital distribution of resources, the IoT itself is evolving, and there is a movement towards adding more intelligence to IoT, closer to the device. This is where parallel developments in artificial intelligence (AI) are providing a fertile ground for convergence.

AI's impact on IoT

By nature, artificial intelligence systems are ideally deployed to make sense of big data (the vast streams of data being produced in the physical world by human-to-machine and machine-to-machine interactions). They are essentially software modules built to take human-independent decisions in machine-to-machine or man-machine environments. AI programs are increasingly being invoked to work in tandem with IoT data flows to make sense of it all. Specifically, here are some ways this convergence might work.

Economies of operation: While collecting data in vast streams, an IoT device must make an intelligent decision as to when and where a collection of data is sufficient for the prediction of a result. This is where an AI algorithm might kick in smartly to prevent any excess or wasteful spillover in the store of data. This intelligence will produce economies of operation by reducing loads on storage, servers and computational cycles. Consequently, there is a saving in energy and costs. Another possible point of convergence is in predictive maintenance. In a network which includes hundreds of equipment, AI algorithms embedded alongside IoT devices can produce early warning signals to pinpoint likely points of failure, and in some cases, take corrective steps automatically.

Computing on the device: In business critical applications, users need to cache data in central storage and for performing high intensity computations. In such applications, the cloud is still needed to provide the extra layer of security and to prevent a possible network collapse. Edge or fog computing enables on-device (or close-to-the-device) computation. This proximity reduces problems of latency due to slow response time on a cloud and curtails exposure of data on a network. AI can place edge computing algorithms directly on a device to perform most of the routine operations with no latency.

Security: AI algorithms might be used to add preventive as well as predictive intelligence to identify possible security threats to an IoT system and prevent breaches. For example, the startup AnChain (www.anchain.ai) offers transaction protection using AI as well as blockchain concepts.

IoT's impact on AI

While AI will boost the efficiency of IoT networks, the reverse effect is also possible – the multiplying number and spread of IoT devices will be a bonanza for AI innovation – where more intelligence can be added in specific situations. Let's look at some ways in which the convergence of IoT and AI is evolving.

Sense-making: In terms of numbers, it is estimated that, by the year 2020, there will be over 30 billion connected IoT devices, and users will spend around \$250 billion on IoT networks. Presently, IoT nets are picking up over 2.5 quintillion bytes of data every single day. All this data needs to be processed and analyzed by intelligent sense-making programs and fed to systems that can do something useful in real life applications – which is one point of convergence where AI algorithms come in.

Higher efficiency levels: In both products, as well as services, IoT data streams can be processed with higher efficiency (than presently possible) with the use of AI interventions. For example, applications in healthcare presently use remote monitoring to send signals or critical data about patients to doctors. IoT devices can provide speedier and more intelligent levels of healthcare – for example, an AI-enabled 'smart' bed can detect when a patient's position needs to be adjusted and perform the task without the need for human intervention.

Design modifications: Miniature IoT devices are easy to embed or integrate into products and services in a limitless number of ways. The design of any product – such as a motor vehicle – can be improved in various ways by adding AI capabilities to IoT devices. For example, an autonomous vehicle might be equipped with motion sensors to decide whether an obstacle is in its travel path. By adding an AI algorithm to the design, the sensors can be given the 'smart' ability to analyze whether the object is a person or another vehicle.

Convergence of Blockchain and IoT

Blockchains are increasingly being used in automated cloud and edge transactions. With the proliferation of IoT and AI, there are numerous innovative products and services evolving with blockchain features to provide a layer of security. Blockchain technologies are typically built in an IoT network design where each participant computer or device is a node,

to provide a means of authentication in the stages of data capture and validation. Here are some points of convergence between blockchain and IoT networks.

Distributed networks: The blockchain concept has become feasible because computer networks on the Internet are deployed as linked nodes across vast distances to enable a distribution of workloads. In new approaches to high-performance computing applications, a dedicated IoT system would include common computer nodes linked dynamically for parallel processing. In such a decentralized high-performance system, blockchain schemes can be built in readily to validate and authenticate data exchanges between the nodes. Several companies are working on projects to make the power of such decentralized heterogeneous networks accessible to customers anywhere.

Secure data storage: While the blockchain protocol itself is based on ledger designs that do not rely on voluminous data, blockchain nodes can act as reliable guardians to protect large databases (databanks and data lakes) that form an essential component of IoT networks in big data applications. They can be deployed at strategic control points to validate and authenticate access points.

Facilitating data sharing: While the technology for connectivity of IoT devices between all kinds of industries is easily available, there is reluctance to share IoT generated data across different industries (for example, between retail and banking businesses) because of reliability, security and integrity concerns. The use of traceable blockchain protocols can facilitate cross-functional and cross-business data sharing because it can be based on a common trust-worthy system of token validation and authentication.

IoT's effect on Blockchain

As decentralized systems with millions of IoT nodes proliferate, a major challenge is to build systems that are economical as well as easy to manage. Let's consider some ways in which IoT design can have an impact on blockchains.

Reducing data load and bandwidth: Research and experiments are under way to produce reliable convergent models of IoT-blockchain architectures that might also be supported by AI protocols for intelligent management of data streams. Data loads in IoT network systems can be extreme. The intelligence of handling data for the blockchain is determined by the structure of the IoT-blockchain interfaces. Mediation by built-for-the-task AI algorithms will ensure that only the relevant data is used. The appropriate design of intelligent IoT nodes will help reduce data loads and the bandwidth requirements.

Upgrading nodes: In distributed IoT systems used in blockchains, the simpler (or lightweight) node devices are often passive links on a chain, passing on data to the full power nodes where the actual storage and validation functions to create new blocks are performed. With improved architecture and support from AI, the next generation of IoT devices will be able to upgrade lightweight nodes into full power nodes.

Lower energy requirements: High energy usage is presently a major concern with IoT-blockchain networks. With improvements in IoT architecture, the energy consumption patterns of blockchain devices will change to produce a 'greener' network.

Convergence of Blockchain and AI

AI algorithms are becoming common in a wide range of industries, ranging from healthcare and manufacturing to consumer goods and aerospace. In many cases, there is a need to bring in layers of authentication to ensure the fidelity of operations or even the value of the product of the service. This is the niche where blockchain can converge with AI to create new levels of security or transparency.

Traceability: Blockchains are models of transparency. They carry a complete and perfect record of historic data blocks in an immutable form, and they cannot be altered by stray hackers. AI algorithms, however, are typically black boxes. They don't make the process of decision-making visible because of numerous levels of complexity embedded in the design. So it's possible to envisage a convergence of the two technologies in the area of transparency and accountability. For example, in applications such as machine-to-machine communications, where no human intervention is possible, the inclusion of a blockchain audit trail will provide a layer of traceability that might help in tuning up performance or to create a rigorous system of preventive maintenance.

Boosting AI efficiency: AI algorithms are typically 'trained' on an enormous variety of simulated data sets before they can become 'intelligent' enough to be moved into real world situations. Blockchain protocols can ensure that the training data sets are 'cleanly validated' or otherwise purposed intelligently for the task. In a network, blockchains can draw upon hundreds of IoT nodes to simulate the necessary training data feed for an AI algorithm to sharpen its functional efficiency.

Democratic data access: Many companies are working on the creation of blockchain-enabled secure access to tap big data marketplaces. These access services will enable even small companies to create and refine economical AI products and services by opening up and democratizing data that only large corporations are currently able to tap. For example, companies such as Ocean Protocol (www.oceanprotocol.com) offer what they call ‘tokenized’ service layers that act as an intelligent blockchain agent between ‘data providers’ and ‘data consumers’ in an open market. In a typical use case, a small market research company may be a data consumer, whereas many large telecom service corporations may be data providers. In this scenario, a secondary benefit to the providers is that their big data assets can be easily monetized with blockchain tracking.

De-risking operations: a blockchain layer will act as a security lock on AI programs that run on data access objects (DAOs) that act as interfaces in client networks. A DAO is a mechanism that acts as an abstract layer that protects a database from direct interactions with clients (which may affect the integrity of data sets).

AI’s effect on blockchain

While blockchain protocols are virtually tamper-proof, there are limitations and some areas of concern in the usability of the technology universally. AI is being applied to solve some of these issues.

Energy management: Blockchain operations consume vast amounts of energy as the processing and verification steps in transactions increase in complexity and blocks are maintained indefinitely. AI algorithms are already in use for optimizing energy usage in many networks. It is natural, therefore to expect that future developers will continue to refine and use AI-based protocols to solve blockchain’s energy management issues. These initiatives may be directly focused on energy savings, or they may be indirect results produced through performance improvements or design innovation.

Computing: Typically, blockchain uses a brute force approach to identify every possible solution and checking if each of them meets a problem specification before any transaction is validated. AI algorithms could be trained on suitable problem solving sets to learn and evolve intelligent ways to handle this bottleneck.

Speed and performance: Blockchains are notoriously slow. For example, a typical cryptocurrency blockchain works at a speed between 3 to 15 transactions per second (as compared to normal legacy computers which process thousands of transactions per second). This is because blockchains use rigorous and extensive consensus mechanisms to achieve total authentication. AI developers are working on new consensus protocols that could help boost blockchain’s sluggish speeds and thereby improve performance. For example, one method, called ‘sharding’ uses parallel processing across blockchain nodes to speed up consensus.

Boosting efficiency: Blockchain sizes are growing at a phenomenal rate. For example, it is estimated that every 10 minutes, 1MB of data is being added to the existing stack of the Bitcoin blockchain, which has reached about 197 GB in January 2019. AI designers are exploring ways to use sharding or new types of decentralized learning models to improve the efficiency of blockchain handling.

Summing Up

As the digital economy evolves, legacy data processing is being transformed into an open source model that includes data processing and storage in clouds, and extends to edge computing and a distributed intelligence in billions of IoT devices and embedded interfaces. Computing power is now available at the level of miniature and mobile devices, and it is economical enough to reach even the lowest strata of society. Computer processing power has become the most accessible democratic asset for people, available to anyone, anywhere, at any time.

In tandem with these developments, we are witnessing greater intelligence and autonomy being added to computing infrastructures everywhere. The convergence of IoT, AI and blockchain technologies is creating a wave of new business opportunities and innovations. It is also opening up unlimited possibilities for penetrating the culture and lifestyles of individual consumers in myriad ways. With digital services becoming more predominant than traditional products and markets, we will continue to see the evolution of new business models that combine IoT, AI and blockchain functions to deliver value to consumers, supply and distribution chains, corporations, and even entire ‘smart cities’.

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10 Blockchain Implementation Risks in International Development

One of the most discussed technologies today is distributed ledger technology, a decentralized system for recording transactions with mechanisms for processing, validating and authorizing transactions that are then recorded on an immutable ledger.

Distributed ledger technology exploits a set of well-established principles, including public key cryptography, peer-to-peer (P2P) networking, and consensus algorithms (e.g., proof-of-work (PoW), proof-of-stake (PoS), Federated Byzantine Agreement).

Blockchain is one implementation of distributed ledger technology (DLT), and other new technologies such as Directed Acyclic Graph (DAG) are emerging. IOTA and Hashgraph are examples of DAG-based DLTs.

Distributed ledger technology hasn't yet reached maturity therefore it brings in certain implementation risks that are important to comprehend and wherever possible to mitigate before deployment.

A good understanding of the risks would assist in deciding whether DLT or a centralized database would be more appropriate, and further choosing the appropriate DLT for a given scenario as the risks vary with the type of deployment, i.e. permissioned (private) or permissionless (public).

- Is software code mature enough to replace the law?
- Standards are underdeveloped and not mature yet
- Energy requirement can be high
- Trusting the blockchain developers and managers
- Increased responsibility on the user
- Implementing data privacy legislation
- Policy and regulatory risks
- Speed of transactions
- Malicious users
- Identity and security

Read the full post at www.ictworks.org/blockchain-implementation-risks/

Electronic Nose- An epitome of perfect sensor systems

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An old saying, “United we stand, divided we fall”. Synonymously, if an array of sensors is used instead of a single one, then a high degree of specificity can be achieved. Thus, there is a great advantage of using multiple sensors, training these and performing artificial intelligence. These are very closely related and together the system is called as ‘Electronic Nose’ or ‘E-nose’. An E-nose is an artificial nose which mimics the human olfaction system, uses the intelligence to make decisions and identify specific analytes from a mix of analytes [1]. Traditionally, an E-nose system has an array of electronic sensors, pattern recognition ability and decision making capability. In simple words, it is a machine, intelligent enough to recognize flavours and odors. It started around 1980s when scientists were making efforts to manufacture an intelligent device for recognizing odors. This field is still being explored and continuously expanding. Immense attempts are evidenced in the literature which talk about e-nose [2-6]. Various application areas of E-nose are agriculture, cosmetics, biomedical, food, environmental, pharmaceutical and various other scientific research fields.

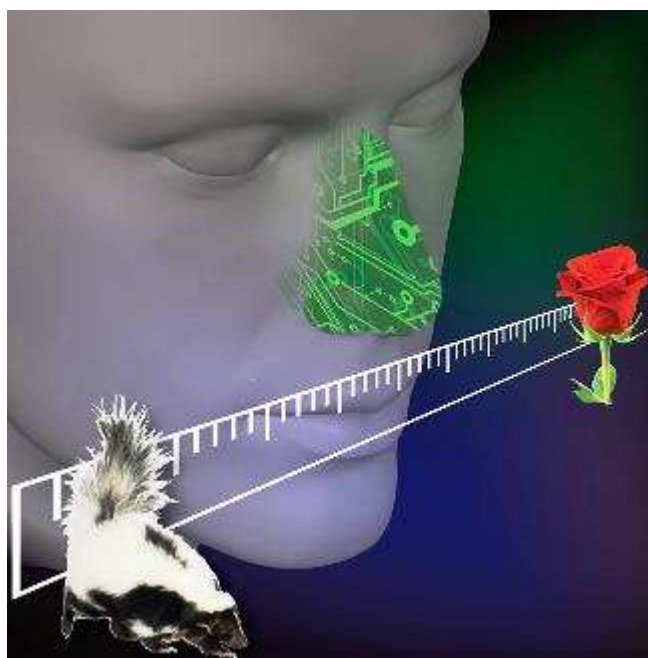


Fig. 1. Electronic nose schematic [1]

The most primary section of the E-nose is a sensor array. The array comprises of individual sensors which give different response to analytes. The parameters which set the benchmark of the quality of a sensor are: specificity, sensitivity, response- and recovery-time, ageing, stability and reproducibility. Many reports have shown the performance of sensors based on these parameters [7-9]. And of course, the parameters are highly dependent on the make of these sensors which includes the material, mechanism, interconnects and packaging. Several materials and their types have been explored till date, examples include porous, metal oxides, semiconductors, nanowires, nanorods, thin films, nanotubes etc. Also, many mechanisms like electrical, optical, chemical, electrochemical and physical are continuously being researched. These building blocks of a sensor effect not just the performance but also the viability of the sensor. The biggest challenge with the individual sensors is specificity especially when it is exposed to a combination of analytes of similar type. Here, the sensor needs to be intelligent to decide which analyte it is exposed to. Also, then it is required for it to apply learning patterns, think, decide, quantify and convey. Thus the sensor array passes on the information to a signal conditioning circuit which extracts the information from the signal and sends it to the decision making (neural network) system. This uses graphical analysis, multivariate data analysis and network analysis to make decisions. In the end, the quantified information is converted to a user friendly interface for display.

Artificial intelligence (AI) is an area of computer science and electronics where the intelligent machines/systems are endowed with the intellectual processes of human characteristics or machines just behave like humans. This similarity with human brain makes the operation of such systems extremely challenging. These not have to just be fast like humans but also accurate and should have a good memory capacity to save the necessary information. Efforts are being made to have

AI in applications like medical diagnostics, space and communications and voice or handwriting recognitions. There are three main aspects of AI, (1) main AI (a machine doing work like human would do), (2) Machine Learning (a computer learning how to perform a function) and (3) Deep Learning (technique or algorithm for learning a pattern) [10].

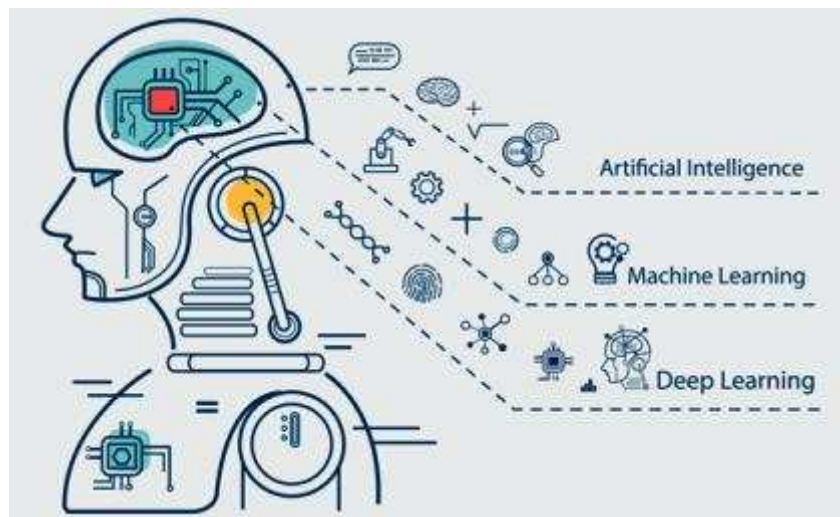


Fig. 2. Artificial Intelligence and its aspects [10]

One of our work on an E-nose system was published in IEEE Transactions on Electron Devices in 2018 where the concept of E-nose with 3 sensors was discussed [11]. Three types of devices viz. porous silicon (PS), TiO₂ on PS and TiO₂ on crystalline silicon (c-Si) were fabricated, characterized and tested for sensing applications. These were fabricated using scalable processes and wire bonded to the header for packaging. Sensing tests were performed in the presence of VOCs (volatile organic compounds) and the data from each sensor was combined for signal processing applications. Ethanol (alcohol) was distinctively separated from the other VOCs using Principal Component analysis (PCA).

The fabrication process involved a 2" silicon wafer which was turned into porous silicon (PS) using electrochemical etching. A very thin layer of TiO₂ was then deposited on this PS. Cr/Au electrodes were formed using metal mask and RF sputtering technique (Fig. 3(a)-(e)). The model and the schematic of the device is shown in Fig. 3(f) and 3(g) respectively.

The characterization of the device shows an underlying porous layer and a top porous TiO₂ layer. Further XRD and Raman spectroscopy results confirmed the structural formation of the materials. Sensing tests were performed in presence of VOCs and the concentration of these were controlled by tuning their vapor pressures. The real time data was acquired using Keithley electrometer and labview program. The sensing response is shown in fig. 4. The optimized response of the TiO₂/PS sensor was obtained at around 100 deg C which was quite close to the one obtained at the room temperature (Fig. 4(a)). As the temperature was increased, a drop in the response was noticed. This sensor had shown maximum response to ethanol and lesser to other VOCs. In comparison to this, its single layer counterparts have either shown more response to acetone or less to ethanol. PS alone had shown higher affinity to acetone in comparison to other VOCs tested (Fig. 4(b)). The sensor response was measured as a change in resistance of the device upon exposure to different analytes. It can be formulated as in the following equation:

$$S(\%) = (R_a - R_0)/R_0 \times 100\% \quad (1)$$

where R_a and R_0 are the resistance change in presence and absence of analyte, respectively.

Sensitivity is calculated as slope obtained from sensor response % versus ppm graph. For TiO₂/PS, it was calculated as 8.5 unit/ppm (Fig. 4(c)). Dynamic response for TiO₂/PS sensor measured at 100 deg C is shown in Fig. 4(d)). Response time is defined as the interval between the time when response to analyte starts from 10% (t_s) to 90% (t_{90}) of the response value and is given by $t_{90} - t_s$. Recovery time is defined as the interval between

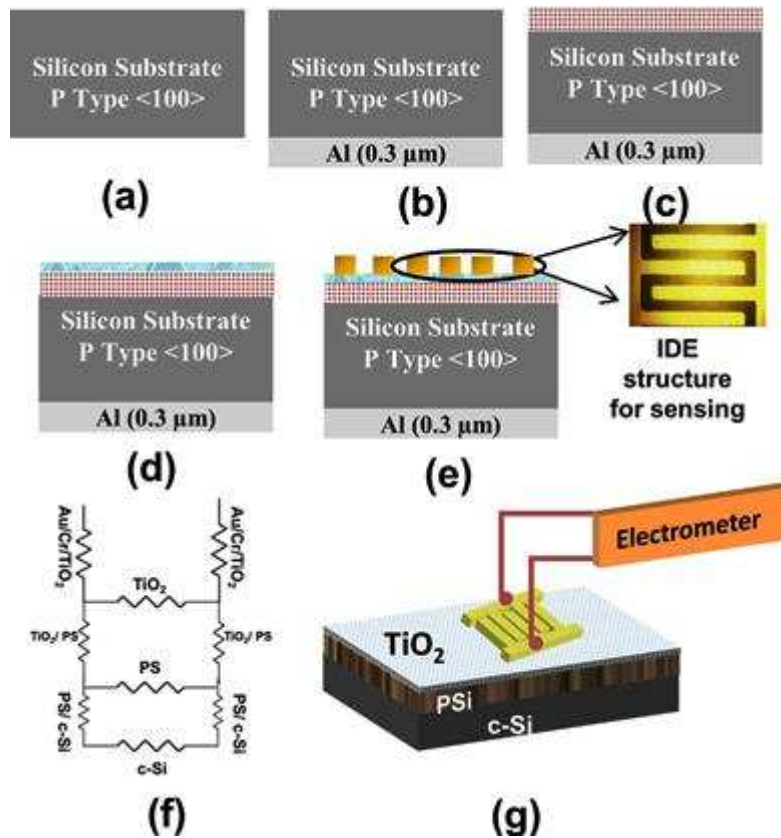


Fig. 3. (a)-(e) Fabrication process flow for making TiO_2/PS devices, (f) model and (g) schematic of the device

the time (t_{st}) when response to analyte stops or saturates to 10% (t_s) of its response value and is given by $t_{st} - t_s$ (Fig. 4(e)). It can be inferred from Fig. 4(f) that the values of response time and recovery time are very high for sensor tested at room temperature, however, as the temperature rose to 100 °C, the values were much lesser and almost constant at higher ppm. Repeatability and ageing studies were performed and the sensor was found to be quite stable. Also, sensors were picked up from various locations of the wafer and their similar response is a proof of scalability of the process and uniformity of the film.

The data from each of the sensor was combined to estimate the vapour concentration using regression model given in the following equation:

$$ppm_{gas} = a_1x + a_2x^2 + \dots + a_nx^n. \quad (2)$$

Where a_i s are the coefficients and x is the sensor output. These coefficients are obtained using least-squares approximation [12].

The fourth-order and third-order polynomial regression models were found to be fit best to estimate ppm of ethanol and acetone vapors, respectively (Fig. 5(a)). PCA was used for overall view of the data by giving an appropriate visual representation with fewer dimensions in the form of clusters. Fig. 5(b) shows the clear separation obtained from the sensor outputs of all the sensors which directly discriminates between acetone and ethanol vapors. Further IPA, xylene, and benzene can also be separated with clear demarcation boundaries. Inset of Fig. 5(b) depicts the final fabricated sensor bonded on ceramic IC header for interfacing with other circuits. Likewise, a sensor array will have different sensors giving response to various vapour differently. Their data can be combined and estimation of their concentration and separation of a particular vapour from a mix of vapours can be done.

Thus, an E-nose system can easily and accurately identify an analyte from a group of analytes using AI, signal processing and machine learning techniques.

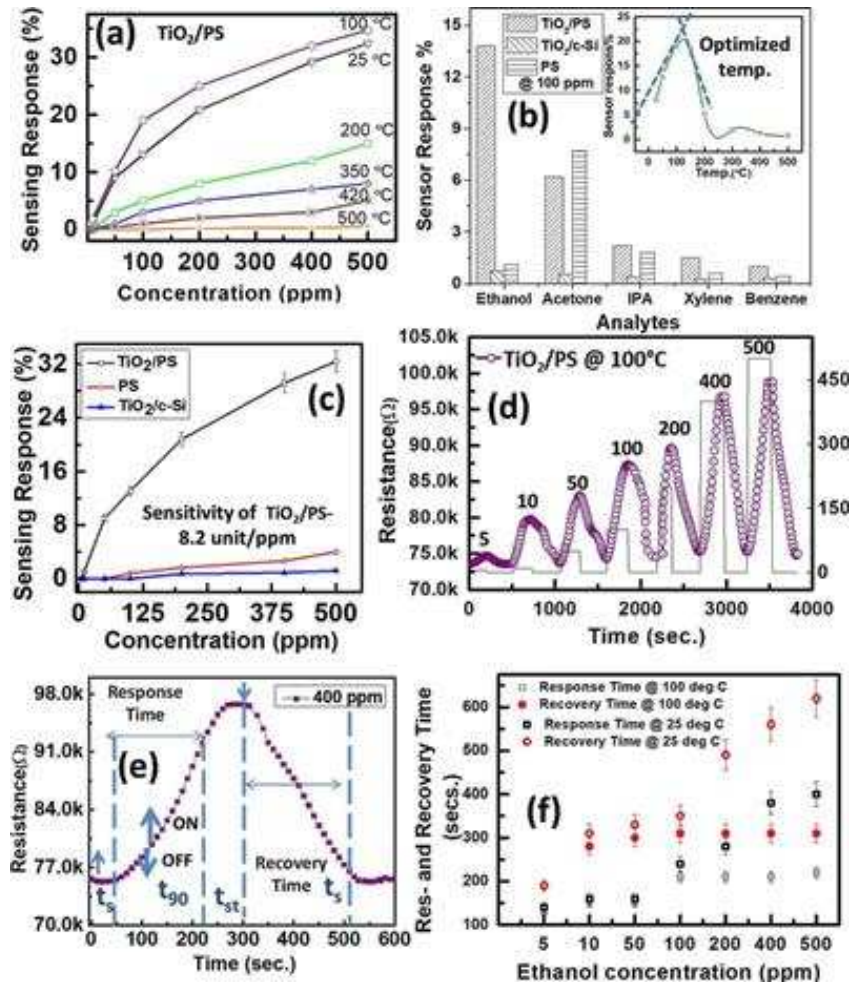


Fig. 4 Sensor response (%) (a) at various concentrations of ethanol and different temperatures, (b) given by all sensors for different analytes (inset shows optimized temperature range), (c) Comparative sensor testing of TiO_2/PS , PS , and TiO_2 , error bars present but too small to be visible, (d) dynamic response of TiO_2/PS sensor at 100°C ; the grey dashed lines indicate exposure ON/OFF timings of the analyte, (e) response time and recovery time of sensors at 400 ppm of ethanol, and (f) response time and recovery time of TiO_2/PS at different temperatures.

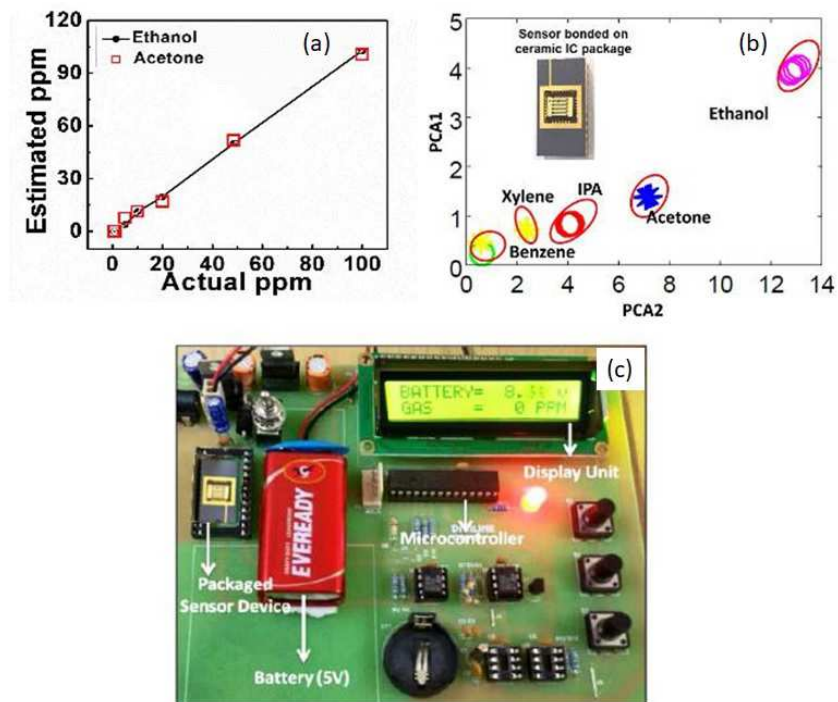


Fig. 5. (a) Estimated and actual ppm for ethanol and acetone. (b) 2-D PCA map showing ethanol vapors discrimination by the sensor, inset shows packaged sensor. (c) Lab prototype of TiO₂/PS sensor

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The Times of India

Design of Renewable Energy Powered Car

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Abstract

Based on the research and other findings, the hybrid vehicle will become popular and people will be interested on this. Our country can become independent of oil import. So this research is more important when considering the current investments by both government and the auto industry. It gives clear energy and no harm to the environment and no emissions. This hybrid vehicles technology will play an important role in future as they are the vehicles of tomorrow. Now we are more depending on Japanese or Korean models. Once this technology is developed and HEV sales will grow and more people will adopt this technology. Marketing and sales will not require more investment as they are eco-friendly and better than current existing models.

This article aims at the design of wind-solar hybrid energy systems. It highlights the economic attractiveness of hybrid vehicles and need for this in the future auto Industry.

Key words: Wind energy, Solar energy, Shock absorber, Hybrid vehicle, Battery & DC Motor.

I. Introduction

1.1. Solar Energy

Sun has enormous potential of renewable energy. The worldwide power demand is 10^{13} W. But, the Earth's surface is receiving almost 10^{16} W of energy at an average sunny day. So, we receive more than sufficient power from Sun. So, technical utilization of solar energy is proved to be very useful. Utilization of solar energy is of great importance to India since it lies in a temperature climate of the region of the world where sunlight is abundant for a major part of the year. The recent applications of solar energy in India, are the energisation of pump sets for irrigation, drinking water supply and rural electrification covering street lights, community TV sets, medical refrigerators.

1.2. Wind Energy

The potential of wind energy as a source of power is large. The energy available in the winds over the earth is surface is estimated to be 1.6×10^7 mW which is of the same order of magnitude as present energy consumption on the earth. In India, high wind speeds, are obtainable in coastal areas of Saurashtra, western Rajasthan and some parts of central India. They are non-polluting and it has no adverse influence on the environment.

The first power source is photo-voltaic solar cell. These cells convert sun light directly into DC power without any emissions. The second power source is wind energy i.e., the kinetic energy of air in motion. The third one is shock absorber which is connected to suspension. It converts kinetic energy into another form of energy.

II. Methodology

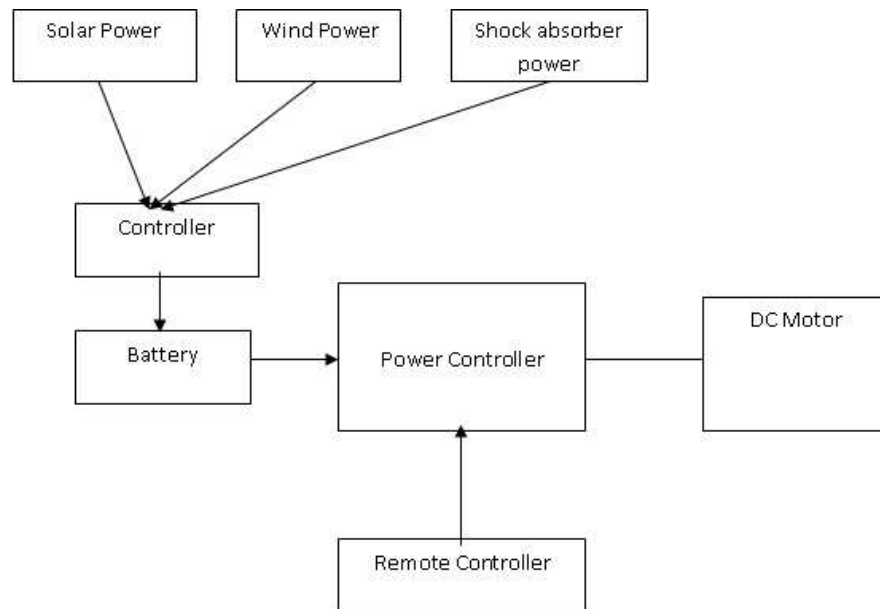
2.1. Hybrid Solar Energy

On-Grid solar PV system is used for usage of solar power in house and factory utilities. Stand alone PV system is including photovoltaic panels. It depends on the necessity of user and the number may vary. This stand alone PV system is not connected with grid. It can be called as off-grid operation. It is charged during day time and power is stored in battery. This stored energy is used as per our requirements. It is placed on the top of the car or automobile appliances. In the system, batteries charge controller, one or more PV panels, electrical switches and off-grid inverter is used. This charge controller is also called as charge regulator. This arrangement of charge controller helps the battery to avoid overcharge and discharge but helps to control output voltage from solar panel. Then inverter is arranged to modify DC power as per our requirement.

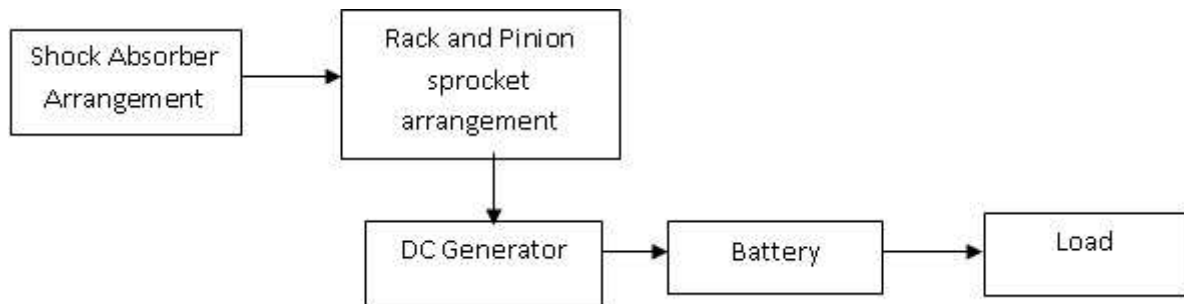
2.2. Hybrid Solar PV System

Hybrid solar PV system means solar PV system is combined with other power source for utilities.

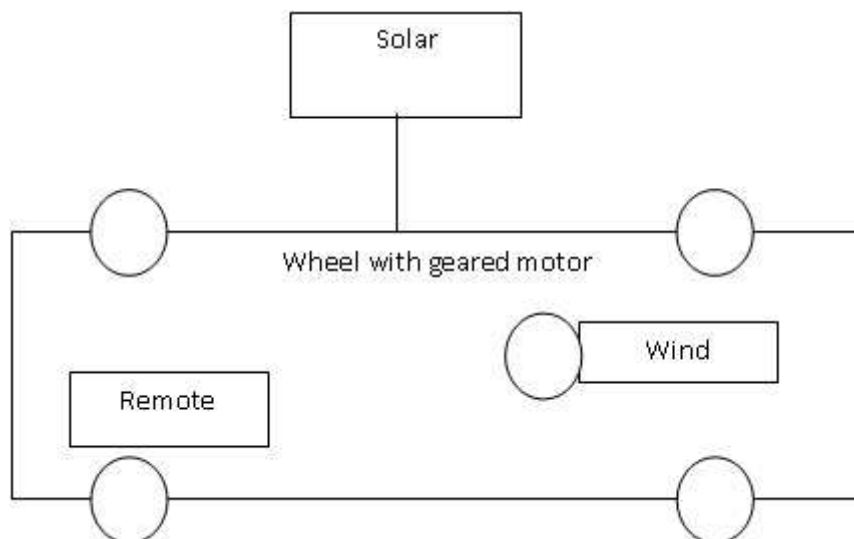
1. Photo voltaic diesel hybrid system.
2. Solar - wind hybrid system (PV-wind hybrid system).



Block diagram of wind-solar hybrid car



Power generation by Shock Absorber



Line diagram of PV-wind hybrid car

In this article, we discuss about PV-wind hybrid system. In this solar PV system and wind power generation are combined. Both differ in a day at different timings. Solar energy is available in day time and wind energy depends on the wind speed at different occasions. But we get power continuously to run the car or utilities.

In this combined system, fluctuation is very less when compared to separate system. The load is also more in the combined system.

The disadvantage is, it is difficult and installation is tedious, compared to normal design. It greatly depends on the nature and power generation varies to some extent.

The advantages are it is less costly, economical and no pollution at all. The developed countries like U.K, implemented a policy to go petrol less car by the year 2030. This research will greatly help our country to adopt this new technology as we are one of the major producers of automobiles and export to various countries.

When we use wind energy the average speed must be minimum 20 km in one hour (20 kmph).

III. Shock absorbers

Generally the hybrid car gets power from both sources and runs efficiently. When we drive uneven roads, we can get power using shock absorbers also. Shock absorbers are provided as a part of the suspension system of motor vehicles. If we drive uneven roads, they will continue to vibrate for some time even after the bump has passed, when the vehicle wheel strikes a bump, the spring is compressed enough and only a vertical upward motion is transferred to the frame. When the wheel comes down from the bump, the spring expands very rapidly, to control this vibration; the shock absorber is used in the suspension system. When the wheel falls over a hole, the spring expands and is unable to take the full vehicle load. The shocks absorber takes a part of this load.

It is the difficult to predict and control the output of the wind generation, So the potential impacts on the electric grid varies. It is essential to manage the uncertainty, and an approach is needed to make wind power, a more reliable source. The wind power generation system becomes reliable when we combine with other energy store system to avoid fluctuation of wind power. The wind generation is depending upon the geographical condition and location. The wind speed is high in hilly areas and can produce more energy and these energies stored in batteries.

The hybrid energy system consists of two or more energy sources, a power conditioning equipment, a controller and energy storage system that is battery. The hybrid car utilizes wind and solar energy and power generated by shock absorber to move. The power is generated by these sources and is stored in the battery and the battery supplies electric power to the DC motor. The DC motor is responsible for rotation of the wheels.

IV. Components used:

4.1. Photovoltaic solar cell

To use solar energy we use photo-voltaic solar cell. Photo voltaic energy is the energy obtained from Sun by conversion of electromagnetic energy into electric energy in a PV Cell. These cells convert sunlight directly into DC power. In general, silicon is used as semiconductor material.

4.2. Basic principle of wind energy source

Wind power is used to produce electric power with the help of multi blade turbine alternator combinations. It is the cheapest of all energies. But it requires high wind for a longer period in the same direction. It consists of stand, turbine, generator assembly, gear box, control system and yawing system. Turbines have generally three blades. The blades convert wind energy into mechanical energy. This mechanical energy is converted into electrical energy by means of generator. The blades are made of low weight and have high modules of elasticity. Yawing is done for keeping nacelle (metal box) to face the wind direction. The various advantages of Wind energy sources are: the initial and running costs are very low, Wind power is free from pollution, It is quick and easy to control

V. Advantages & Disadvantages of Hybrid Car

5.1. Advantages

- Operating costs are low
- Saving costs (Purchasing electricity and fuel)
- It is pollution free and completely clean
- Wind and solar are freely available

- It generates electricity without polluting the environment
- It does not require more skilled operator

5.2. Disadvantages

- It is purely dependent on weather conditions
- Space required for installation
- Initial cost is high
- It must be maintained carefully
- Solar PV modules require more care

VI. Mechanical Modelling:



VII. Conclusion

Renewable energy is an indigenous resource available in considerable quantities to India. It is having a significant local, regional or national economic impact. The use of renewable energy could help to conserve foreign exchange and generate local employment if these technologies are designed, manufactured, assembled and installed locally. Nowadays the costs of transmitting electrical power or transporting conventional fuels are high. Renewable energy is cheap and best and can be produced as per our needs.

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About the author:



Dr.S. Elangovan has 18 years of experience in Academic, Research and Administration in various premier engineering institutions. He received his Ph.D. degree under the faculty of electrical engineering. His research area includes power quality enhancement, Power electronics application to power system, multilevel inverter, converter topologies etc. He has published three engineering text books. He also published his research findings in six international journals, six international conferences and seven national conferences. With his experience, he has established several state-of-the-art laboratories. He is a recipient of Best Teacher award from Akshaya Institute of Management Studies in 2013. He has received certificate from University of Dale Carnegie for attaining "High impact teaching skills" for the various pedagogical teaching learning process followed by him. WIPRO had selected him as a master trainer for their project Mission 10x. Dr. Elangovan, as an active volunteer of IEEE Madras Section had initiated the networking among the student members and professional members and had organized 100+ events/activities. He has served as the Secretary, IEEE MAS WIE (2008) and Vice Chair, IEEE MAS GOLD (2009 to 2014), Vice Chair, IEEE MAS GINI (2008-2010), Chair, IEEE MAS SAC (2014-2015), Chair, IEEE MAS YP AG (2014-2016) and Chair, SB Revamping Committee (2016-2017), Chair, IEEE MAS Student Project Funding (2016). Chair, IEEE MAS SB Revamping Committee (2016). He had also successfully organized the IEEE Madras Section Nagercoil Hub Congress (2015), Coimbatore Hub Congress (2016) and IEEE GeniOS'15, an Online Symposium in which over 1000 participated across the globe.

Prayagraj Smart City

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Prayagraj Smart City is an Integrated Smart City project, which leverages technology to ensure enhanced security & safety, facilitate city administrators to seamlessly manage the mega religious convergence, the largest crowd gathering of its kind across the world (Approx. 23 crore representing 83 Countries) held at the Kumbh Mela event at Prayagraj.

Strategic objectives

The geographical coverage and strategic focus of the project has been divided in two perspectives as mentioned below:

1. ICCC for Pan City Area from Smart City perspective

ICCC for Pan City area to enable collation of information and collaborative monitoring, thus helping in the analysis of data for quicker decision making. Intelligent operations capability shall ensure integrated data visualization, real-time collaboration and deep analytics that can help different stakeholders prepare for exigencies, coordinate and manage response efforts, and enhance the ongoing efficiency of city operations. The interface at ICCC gives a real-time and unified view of the operations.

2. City Surveillance for areas impacting from Kumbh Mela 2019 perspective

ICCC for Kumbh Area has been set up to implement holistic and integrated video surveillance system for Kumbh Mela 2019 in Prayagraj City. The major objectives of the systems are: -

- Support Traffic Police to maintain peaceful Law and Order 24X7
- Act as an aid to investigation
- Improve Crowd Gathering at Triveni Sangam area (By Artificial Intelligence-video Analytics)
- Help in deterring, detecting and thus dealing with criminal activities
- Monitor select vital public places of Kumbh Mela 2019 in Prayagraj City for keeping Birds Eye on Various activities
- Regular monitoring and Incident data/IOT data storage at disaster management

Project Highlights

Process Efficiency

- Prayagraj Smart City features 24x7 City Operations Center with Integrated dashboard to give a Birds Eye view of various activities at Kumbh area and the City, enabling real-time, Data-Driven Decision making and actionable insights.
- Multi-domain analytics through Artificial Intelligence & Machine Learning-Video Analytics and first-of-its-kind implemented crowd management solution that proactively interprets crowd dynamics and provides timely alerts by taking into account head count and people density at mega events.
- State-of-the-art Integrated Command and Control Centres (ICCC), at the Kumbh Mela specific area and another viewing centre at Police Lines (Modern Control Room) for the overall city surveillance.

Scope of the Project

Surveillance Cameras	▪ 743 Fixed box and 292 PTZ cameras ▪ 188 existing CCTV cameras to be integrated ▪ ANPR - 18 Junctions
Variable Message Board	▪ Variable message sign - 40 junctions

Data Center & Disaster Recovery centre	▪ On premises DC and DR at Cloud ▪ Network & Compute infrastructure
Integrated Command and Control Center (ICCC)	▪ Primary and secondary CCC with displays of 55" LED in 10*2 and 8*2 arrangement respectively
Last Mile Network Connectivity	▪ 350 km of the Optical Fiber Cable network connectivity
Smart Elements	▪ Solid Waste Management - 500 Bins ▪ Aadhar based biometric devices – 100 nos.
Contact Centre	▪ 24*7 operating contact centre with 90 operators with technical trainers
Training, Helpdesk & FMS	▪ Traffic Police personnel training (Functional/Administrative/Sr. Management) ▪ 24/7 Helpdesk system and Maintenance of IT/Non-IT Infra for 5 Years

Implementation of Prayagraj Smart City

Prayagraj Smart City is one of India's fully Integrated Command and Control Centre which involves physical and digital convergence –

Command and Control Centres

- State-of-the-art Command and Control Centers, at the Kumbh Mela specific area and another for the overall city surveillance Viewing centre serve as centralized monitoring decision making hubs with state-of-the-art dashboards that provide an integrated overview of the various smart features highlighting key performance indicators, situational awareness, incident management, integrated systems monitoring, facilitating generation of user centric charts and data drill downs.
- ICCC integrated with DIAL 100 and HELP DESK solution, complement each other while taking crucial decisions.
- Data Analytics across multiple government systems for analysis to understand activity patterns and abnormal events, provide timely alerts, Actionable Insights with configurable Standard Operating Procedures (SOPs).
- KPI Monitoring, Event / Incident management through effective visualization for Decision support & quick response
- Without any interruption, the traffic Police monitored the live video feeds 24 x 7, and critical decisions were made real time.

Crowd Management

- Taking support from the emerging **Artificial Intelligence (AI) technology**, L&T has developed a first-of-its-kind global crowd management system that proactively interprets crowd dynamics and provides timely alerts by taking into account head count and people density at mega events like Kumbh Mela.
- **Deep Learning based Alert Generation** for identifying crowd gatherings and warn city administrators for effective decision making.
- **AI based Solid Waste Management System** for routing collection vehicles dynamically based on waste bin sensor data and traffic data to achieve route optimization and cost reduction for the municipality
- **4 viewing centres** at Kumbh Area for better monitoring and faster response

Infrastructure

- Prayagraj Smart City features Tier III Data centre and a Disaster Recovery Centre on Cloud.
- The culmination of more than 1100+ CCTV Cameras installations spread across 268 locations using 350 Km of Optical Fiber Cable network backbone which supports the Police to deter, detect and deal with criminal activities to ensure citizens' safety, 23 Adaptive Traffic Control Signals to facilitate alignment of traffic flow based on prevailing situations, 40 Variable Message Display boards for communicating key notices or messages with regard to any emergency or disaster apart from the routine updates, 500 GPS devices for implementation of Solid Waste Management.

- To quote an example on the benefits of these systems, an incident where the Police nabbed a serial killer, who had committed 10 murders in the past, with the help of CCTV footages at Kumbh Mela, is noteworthy.

Current state of implementation

One of North India's Fully Integrated Smart City in India's Smart Cities Mission to be fully commissioned & Operational

- Fully operationalized Data Center and two Command Centers.
- Fully operationalized 24x7 Emergency and Civic – City Contact Center.
- Fully functional Dashboards and Analytics.
- 100 % Commissioned – Secondary Command Center and DR.
- 100 % Commissioned – CCTV, SWM, ANPR, RLVD, E-challan and VMD.

The Command and Control Center at Prayagraj was inaugurated by Honourable Prime Minister Shri. Narendra Modi and was also recently visited by Prime Minister of Mauritius Mr. Pravind Jugnauth accompanied by his wife Mrs. Kobita Jugnauth, and a 25-member delegation from Mauritius.

The project will be extended to the rest of the city and integrated to the ICCC in subsequent phases covering IOT, sensors, traffic, e-challan, smart parking, CCTV with 23 AI based special video analytics and other applications.

Inauguration Pictures



Project Pictures





About the author



Mr. R. Srinivasan currently heads Smart World & Communication Business Unit, comprising Integrated Security Solutions, Communication & Telecom Infrastructure and Smart Infrastructure Segments. With more than 30 years of experience in power transmission, distribution, industrial electrification and communication projects, he has headed the Renewable Energy Business Unit and held various important positions in Power Transmission & Distribution. Mr. Srinivasan has played a vital role in establishing L&T Construction's brand name as Technology & Digital Centric Company in India.

Mr. Srinivasan started his L&T journey as Graduate Engineer Trainee. He is having an Engineering Degree in Electrical & Electronics from College of Engineering, Guindy, and is an Alumnus of Administrative Staff College of India (ASCI), Indian School of Business (ISB) and INSEAD (France). Mr. Srinivasan holds several awards and plays vital roles on various industry bodies, forums and councils. He is Member of FICCI Smart City Council & Homeland Security; Chartered member- IEEE - IAS; Vice Chairman, Industrial Applications Society of IEEE; Member - IEEMA Renewable Energy Committee. He has been identified as one of the 50 Most Impactful Smart City Leaders (Global Listing).

IoT Edge Systems with IEEE 21451 Standards

A Perspective of Experiential Learning

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Overview of IoT

Internet of Things (IoT) and applications is an emerging field for both business and technology advancement. IoT is a new class of applications that require integration of several technologies. Industry is taking advantage of IoT to improve the bottom line as well as top line. Rolling out of IoT applications are quite challenging (integration of several technologies) and time consuming (finding appropriate technology and applications), resource intensive (R&D staff) etc. In this technical report, we focus on IoT Edge Systems with IEEE 21451 family of standards.

What Customers are looking for at the IoT Edge (Business Opportunities)

From our study, we find rolling out a generic IoT solution is not advisable. Also, it is difficult to provide a full solution from a single vendor or technology. IoT demands integration of products and services from different vendors and harmonizing business services, scaling of the deployments and securing the IoT deployments and more. IEEE 21451 family of standards enable IoT systems with a focus on interoperability and harmonization of services.

I would like to present a brief summary of several interactions with the customers and their requirements that influence the systems architecture and design of IoT systems.

#1 New Technology Adaptation

Understanding the new IoT technologies with a focus on the problem they are facing. Customers are not very interested to see a generic IoT solution in project proposals. For example, customer who are looking for IoT applications for CNC machines, want to see their problems in the project proposal. So, IoT Engineers have to study the customer domain and propose business viable solution.

#2 IoT Edge Software Infrastructure

Customer are looking for Software stack for their Engineering staff to develop IoT applications. Though developing a software stack for IoT Edge is not impossible, it is not easy though. Engaging right engineering staff to develop IoT Edge software is becoming expensive as it is not their (customers') focus. Customers are looking for some initial lead on using IoT Edge Software stack.

#3 Firmware and BSP for Smart Transducers

Customer are looking for Firmware, Board Support Packages stack for their Engineering staff to develop IoT applications. Though developing a Firmware stack for IoT Edge is not impossible, it is not easy though. Customers are looking for some initial lead on using IoT Edge Firmware stack.

#4 Dataflow Design at the IoT Edge

Designing the data collection from 'Things', streaming the data to service gateways (*NCAP of IEEE 21451-1*) and performing certain operations on the data at the Edge needs 'Design Thinking' approach. Every IoT deployment is unique - as far as Dataflows are concerned. Customer are looking for Dataflow designs at the Edge however there may be some exceptions and/or similarities.

#5 Mix in of Automation and IoT

Customer often mix Automation and IoT applications. It is quite natural to have excursions between Automation and IoT, however, IoT is predominantly information related. Customers often looking for some consultative approach in rolling out Digital technologies. IoT uses automation technologies to deliver *smart factory applications*. It should be noted that IoT is not a 'replacement' for Automation technologies until full roll of Industry 4.0.

#6 IoT Station for Edge Data Processing

In practice, there are Engineering Stations, Operator Stations in a factory environment. Deploying cost-effective data centric applications (data processing, visualization, dataflows etc.,) is quite challenging at the Edge. An IoT Station (Information Processing Station) is something that customers are envisioning in addition to Engineering and Operator stations.

#7 Information Audit Applications

IoT application are new and emerging with a focus on information processing and data driven decisions. Information auditing at the IoT Edge is increasingly in demand. For example, applications such as quality audit using IoT, smart

inventory, smart feedback, real-time profit control, cascade of operations performance loops, asset utilization, asset availability etc.

#8 Network Capable Applications at the IoT Edge

Customers are looking for network based applications that integrate with other systems easily (*harmonization of services*). Such applications require lot of effort even to build a PoC. Customers prefer piloting a smaller scale version before rolling out a sizeable IoT deployment.

#9 Scaling of IoT Edge Devices and Networks

IoT is emerging field and require careful planning to scale the IoT applications. Customers are looking for PoC with scale as objective - at least with simulations. For example, size of IoT nodes, network reliability, power distribution, remote servicing of IoT nodes etc. A careful design of IoT systems should address the scale issues.

#10 DevOps of the IoT Edge

Managing the IoT devices is quite challenging; unique for every IoT deployment. Customers are looking for solutions to manage IoT DevOps.

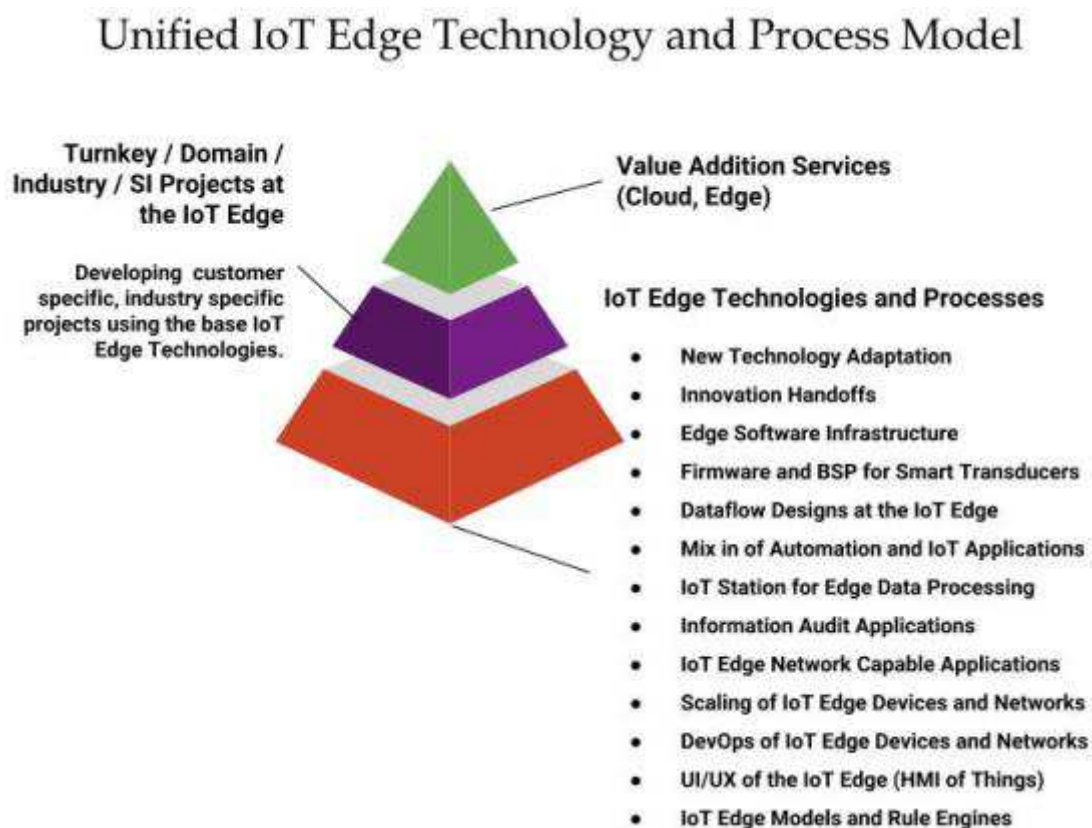
#11 User Experience at the IoT Edge

The current HMI of Automation was built with a focus on controllability of equipment whereas HMI of IoT is information centric; the HMI of IoT needs a fresh approach to deliver user experience (UX).

#12 Cyber-Physical Models, Rule Engines at the IoT Edge

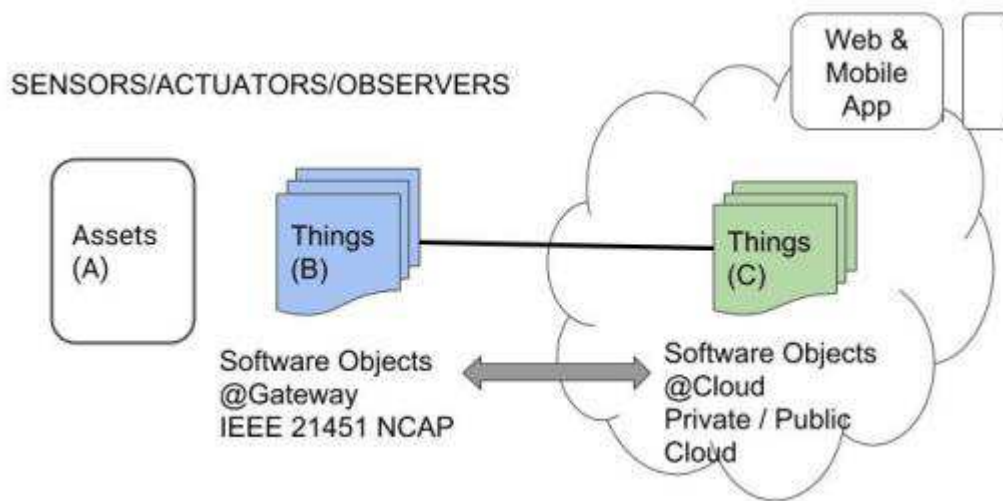
IoT is mainly for building connected applications. The outcome of connected applications depends on the information models that the Edge devices process.

The following diagram depicts mapping of the above requirements to an implementation model.



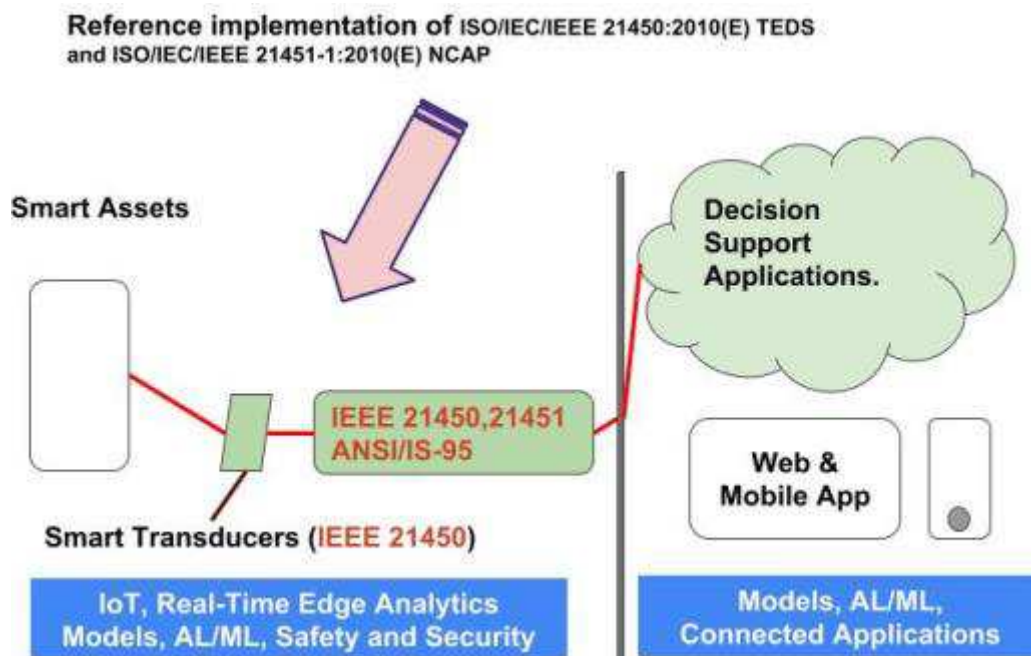
What to identify as “Things” in IoT? “Assets” are “ Things”

What do qualify as things at least in a business context? This is a question we often encounter in the design of an IoT Gateway while working on a reference implementation of the ISO/IEC/IEEE 21450:2010(E) TEDS and ISO/IEC/IEEE 21451-1:2010(E) NCAP. IoT is applicable to all business where “**assets**” are interconnected and interoperated with energy, material and **information**. The assets vary from business to business or event within a business itself. So, any '**asset**' that creates a business value is the primary candidate to become a '**thing**'.



The above diagram simplifies the overall concept of transforming 'assets' to 'things'. The Edge Gateway (IEEE 21451 NCAP) plays an important roles in enabling 'Things' and transacting with the assets in real-time.

Implementation Notes of IEEE 21451 NCAP as IoT Gateway



IoT Gateway (IEEE 21451 NCAP) consists of @Edge, @Cloud parts. @Cloud deals Digital Twins, User interactions, Visualization etc. IoT Edge Gateway is an 'intelligent agent' that provides smart asset data to @Cloud applications. Here is a list of open standards, open source software libraries to implement IoT Edge Gateway.

Edge Hardware Platform:

- Single Board Computers such as Raspberry Pi, Beaglebone or any Linux supported platforms.

Edge Architecture Standards and Specifications:

- ISO/IEC/IEEE 21450:2010(E) TEDS
- ISO/IEC/IEEE 21451-1:2010(E) NCAP (Gateway Architecture)
- ANSI/ISA-95 <- For interfacing with industry controls

Edge Communication Standards and Specifications:

- Websockets (RFC 6455)
- XMPP (open standard for messaging and presence)
- RESTful Web services with HTTP/1.1 and HTTP /2
- Open SSL / TLS
- Dynamic DNS (DDNS or DynDNS) (for discovering / accessing IoT Edge Gateway nodes).

- OSGi <- For Service life cycle management
- AMQP
- ZeroMQ (though it is not a full standard but widely used messaging framework)

Edge Smart Device Connectivity Standards and Specifications:

- I2C <- To connect smart transducers
- SPI <- To connect smart transducers and interface boards (Smart Assets)
- Modbus TCP and Modbus RTU
- RS-485 <- For multi-drop serial communication
- CAN

Edge Device Storage Standards and Specifications:

- HDF5 - Hierarchical Data Format (HDF) is a set of file formats (HDF4, HDF5) designed to store and organize large amounts of data.

Edge Data Security and Cryptography

- Libsodium - easy-to-use software library for encryption, decryption, signatures, password hashing and more

Edge Programming Languages

- C, C++11 / 14

Edge Open Source Software Libraries

- libmicrohttpd (Embedded webserver)
- libwebsockets (Websockets)
- cURL
- zmq (ZeroMQ messaging library)
- libsodium (Crypto library)
- hdf5 (<https://www.hdfgroup.org>)
- POCO C++ (Useful set of C++ libraries)
- GSL (GNU Statistical Library) for edge statistics
- BLAS for linear algebra and low level matrix operations.
- LAPACK - (a standard software library for numerical linear algebra)
- Silicon - A high performance, middleware oriented C++14 http web framework <http://siliconframework.org>
- uriparser ([RFC 3986](#))
- json11 (for handling JSON data)
- Vue.js (for web front-end interface)
- yaml-cpp (YAML for defining TEDS)
- Swagger (for API documentation and specification)

Edge Open Source Software IDEs

- [CodeLite](https://codelite.org/) (<https://codelite.org/>)

Conclusion

IEEE 21451 family of standards provide interoperable, and service harmonization framework and patterns. Implementing the full standards may not be required; good parts of the standard can be used designing IoT systems.

About the author



Maruthi is a founder director of Vidcentum R&D where he manages the following product lines: Picominer® - IoT Gateways and Edu-Fi® - Platform for online workshops. Prior to founding Vidcentum R&D, Maruthi worked in Airvana Networks, Telsima Communications, Satyam Computer Services. Maruthi is a Senior Member of IEEE and an active volunteer of IEEE. He served as Secretary, Treasurer, Chairman Computer Society Chapter, Vice Chair and Chairman of IEEE Hyderabad Section. Maruthi participates in development of IEEE 1451-99 Standard for Harmonization of Internet of Things (IoT) Devices and Systems. He also teaches Data Mining to Masters students of BITS Pilani Work Integrated Learning Programmes in Hyderabad. Maruthi can be reached at:

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Microsoft will release a software update for 'Windows 7' operating system with a warning, "After 10 years, support for Windows 7 is nearing the end." Microsoft had earlier said users can still use Windows 7 but PCs "will become more vulnerable to security risks" after all support ends on January 14, 2020. Windows 7 was first released in October 2009.

Artificial Intelligence's Journey from a "Value Optimizer" to a "Value Creator"

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The abundance of data, improved computing power at lower cost & the revival of interest in the AI field among the technology community has brought the spotlight back on AI in the last few years. Having worked in this field, one aspect that appears common is that most use cases are value optimizers and are not value creators. By value creators we are referring to those use cases that generates additional revenue to an enterprise via new customers or a new market segment all together. On the other hand, by value optimizers we are referring to those uses cases that optimize already existing processes by augmenting the capabilities of resources, thereby reducing complexity, time & FTE. It doesn't create any new market/revenue but rather aims to optimize already existing processes to reduce cost and increase savings.

The figure below (Figure 1) highlights our perspective of this point, where most of today's common use cases (in the AI space) represented by bubbles are falling on the left half of the value created parameter, leaving a huge void on the right side.

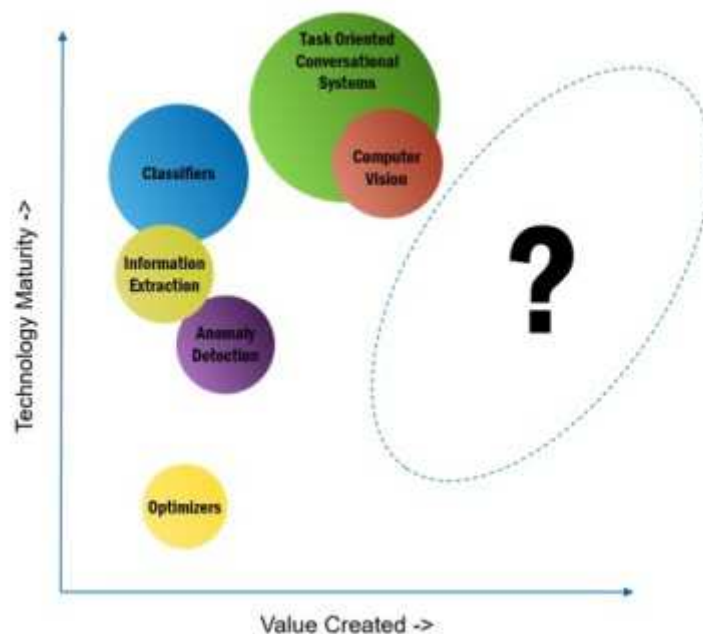


Figure 1: Perspective of Value Creation Use Cases

Why is AI consolidating as a Value Optimizer?

There may be many reasons why AI still predominantly remains a value optimizer in enterprises. In this article, we bring the spotlight to some of these reasons.

Hype v/s reality: Artificial intelligence is a buzz word today. AI today is often seen as a mysterious wand that can weave its magic to solve problems that other technologies have failed in. The truth, however, is that AI is not a magic wand and has its limitations. We are far away from a general AI solution that can think, learn & feel like a human being and mimic all cognitive behavior.

Natural language-based solutions often leverage AI concepts like ontology, NLP, NLG, summarization and semantic search. Just to highlight the gaps in these areas, we have provided some perspective through a few figures below that show our estimates of where the AI maturity stands today in these areas and where it will in a few years. Please note, we believe that as we move toward higher levels of maturity, the complexity increase exponentially, rather than linearly as depicted below.

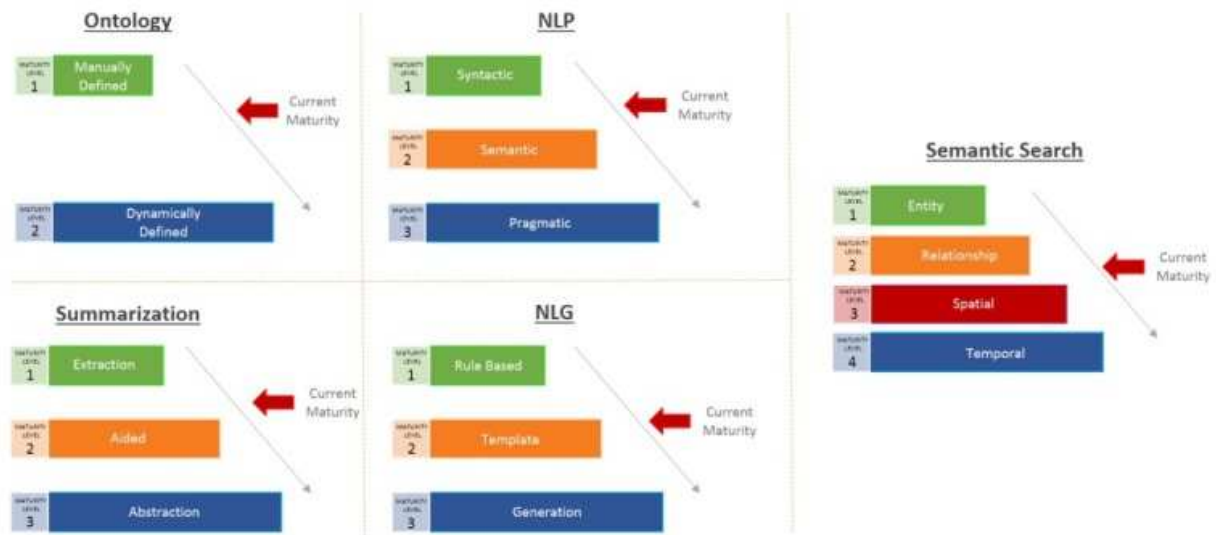


Figure 2: AI maturity for key AI concepts

The AI community needs to understand and manage customer expectations during this critical phase of time. Failure in over exuberant projects could send the wrong message to the business community thereby slowing down investments in AI and raising skepticism in the AI potential.

Need for standardization: The interest in AI has sparked off a race amongst the major global technology power houses in order to gain market share. This has resulted in multiple platforms and frameworks being available to the AI community to adopt and use. While having a plethora of options is not a bad thing, the lack of standardization and incompatibility of different framework certainly is. There arises a need to have a standards global body to ensure that we consolidate & bring global standards that would enable AI community to choose the strengths of all frameworks and have the ability to switch from one framework to another with minimum effort. The need for standardization holds good from both software and hardware perspectives.

Enough of white papers, time to execute: The pace at which an idea originates in a campus or a university and becomes an industrial use case is at its fastest ever. White papers often provide theoretical evidence that something can be achieved with a given technology. However, not all whitepapers findings are easily reproducible in the real environment.

Scarce AI resources: AI resources are one of the most sought-after resources in the IT industry. As such, building a team and more importantly retaining a team is a challenge that IT companies face today. True transformational, value creating AI projects often requires a strategic shift and needs individuals that share that vision to work on it. Unfortunately, there is a scarcity of such talent today

Availability of data remains a challenge: One of the first requirements for proving AI technology in the real world is getting access to real data. However, this remains a big challenge even today especially in the initial phases of the project where stakeholder commitment is relatively low. Localization of data in major countries has further created a challenge for global enterprises. Moreover, with more and more restrictions being put into place, on the handling and use of enterprise data, this challenge is expected to get even tougher.

Slower adoption from PoC to Implementation: The amount of time it takes to move from completion of a proof of concept to actual implementation is often large when it comes to AI related projects. The reasons are many. Firstly, very often machine learning / deep learning solutions are expected to take decisions that were otherwise done by human beings. For most processes in enterprises, there needs to be a reason attached to decisions taken, especially for compliance and audit purposes. However, in most AI solutions, especially, those linked to deep learning, such reasoning might not be possible. Secondly, there seems to be a growing concern of privacy and users are circumspect to share their information. Similarly, tighter data protection laws like GDPR increases the barrier for implementation of AI's complete potential. Finally, AI is often seen as an alternative to human work force, rather than a solution to augment human capabilities, leading to resistance from existing workforce.

Transformational Shifts To Power Artificial Intelligence's Next Move

Despite these challenges, Artificial intelligence needs to move from the role of a value optimizer to that of a value creator. The AI journey from value optimizers to value creators might be a challenging one but what awaits at the end of the

journey, will certainly be rewarding. AI is far from reaching its potential by any measures. The models of knowledge processing automation have matured and is nearing stability. Now we need to look forward to a world where AI creates value for enterprises and society as a whole. However, there are certain cultural & technological barriers that AI community faces in its journey. This is a critical phase in the journey and transformational shift is needed to overcome these challenges. By transformational shifts, we are referring to changes that disrupt the underlying assumptions and principles of today's processes and status quo.

AI Transformation Matrix

Today AI has achieved narrow intelligence based on the traditional outlook and technology concepts. For AI to attain its full potential, it is imperative for AI to undertake transformational shifts in both cultural outlook and technology. As depicted in the AI Transformational matrix, attaining transformational shifts in either one alone would not power AI to its true potential. Technology transformation without cultural evolution will lead to AI rejection similar to the AI winters already witnessed. Cultural transformation without the accompanying technology advancement would present us with a data overload which would at best be a handicapped version of true AGI.

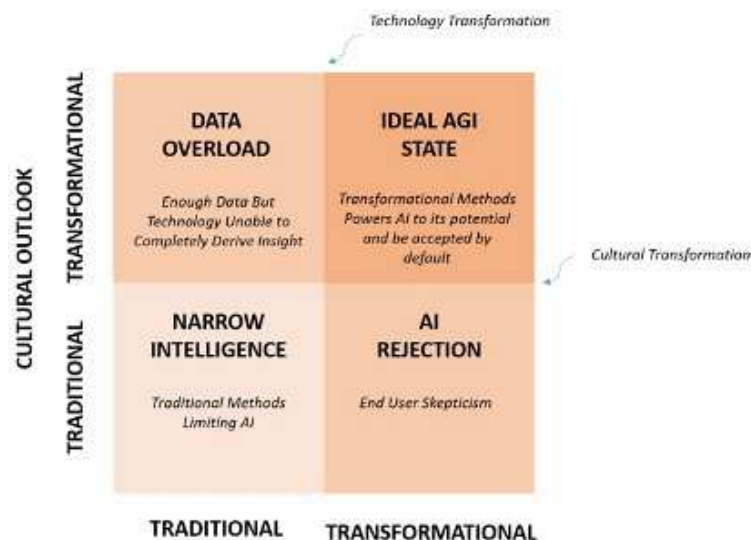


Figure 3: AI Transformation Matrix

In this article we highlight 4 transformational shifts needed culturally & technologically for AI to achieve its ideal AGI state. Given below (Figure 4) highlights the challenges that AI needs to overcome, its current state and transformed state. We believe that if the AI community is restricting itself to today's assumptions and fundamentals, AI will find it difficult to reach its true potential. As such, beyond a point, a transformational shift is needed to trigger the next sequence of advancements.

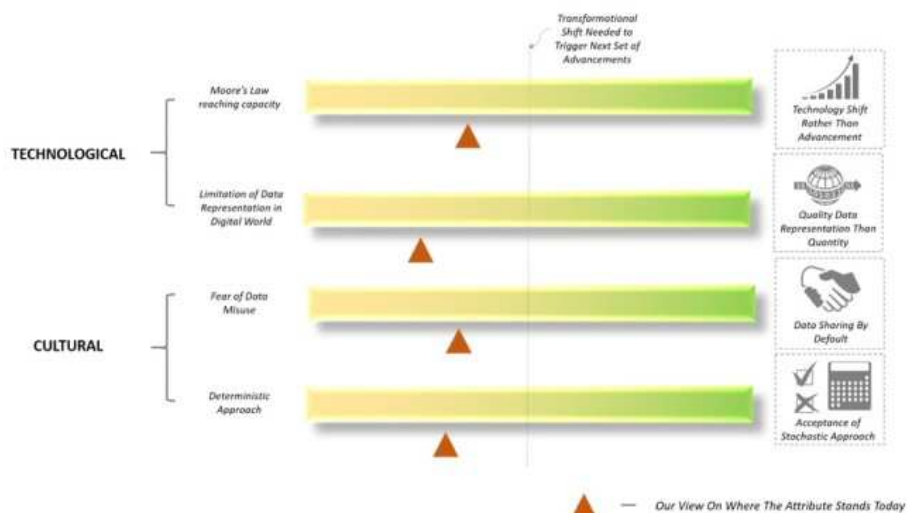


Figure 4: Transformational shift to trigger next phase of advancements

Technological Transformation:

Technology shift rather than advancement: There is no denying the fact that technology has advanced at a rapid pace over the last couple of decades. The increasing computing power at lower costs and architectural evolutions has enabled us to increase our processing capacity multifold. However, newer technologies like neuromorphic computing & quantum computing would provide a technology shift that would further augment the capabilities of current technologies. A break-through in these technologies would essentially get rid of most, if not all, of our computing worries. We might be a few years away from making a commercially viable break-through in either, however, it has the potential of changing the way we look at problems and how we build solutions.

Quality over quantity: Deep Learning and other advanced AI technologies/algorithms of today, requires a huge amount of data and lots of compute power to identify inherent patterns. Lack of labelled data, segregation of noise from data and time correlations are challenges that algorithms of today need to overcome. The current methods of data representation in the digital world is not how we humans store information. As such, if AI needs to mimic humans, it needs data representation closer to the real-life scenario. This is where we look forward to future advancements in task agnostic algorithms and better data representation in digital world, that would shift the focus away from solving problems via brute force (compute power) to smarter techniques that's relies more on quality rather than quantity.

Cultural Transformation:

Data Sharing by Default: Today, people are very circumspect of the intentions of enterprises when they collect data from their customers. Currently, the questions that people ask is, "How is my data used" or "Can it be misused" or "Is my life made easier by sharing my data?". The lack of transparency amongst enterprises have made it more difficult for people to trust them. However, a future is not far where this transparency will be provided and sharing data would be the norm. With tighter data protection laws (like GDPR), which governs both the ethical and privacy issues of end customers, people will begin to see value for sharing the data. The coming generations would provide data without a blink of an eye, because they would have been born into a data-driven world, which is based on trust and where reaping benefits of data analysis is the norm.

From deterministic to stochastic way of thinking: People tend to favor decisions that they understand and can derive. One of the major limitations of AI techniques that solve complex problems is that the derivation is not often part of the solution and it leaves human to trust the decision made by machines. Humans inherently are skeptical of blindly believing and trusting. However, a time is not far when this "lack of trust" barrier will be broken. People will begin to accept and trust heuristic approaches based on probability & statistics. The advancement of AI in life sciences like the use of AI powered machines for surgical operation and the excitement around autonomous car is a clear indication in this direction, as people are beginning to consider non-perfect solutions in even critical applications.

Conclusion:

Many believe AI is only a hype and will need many decades to reach it potential. This prediction is mostly based on the pivotal assumption that the status quo is maintained, that is, technology, algorithms, culture and the business environment will continue to grow linearly in future. However, we believe that transformational shifts are inevitable. A transformational shift has the potential to change the underlying assumptions and the rules of the game. The impact of such a shift can make existing AI methods obsolete and fasten AI's maturity. The utopian AI future may be a few years away but transformational changes can enable AGI to become a reality much earlier than expected.

About the authors



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Sensor Hub Environment for Autonomous Cars

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SensorHub is designed around a generic bus through which transits all events coming from and going to the connected sensors and processes. SensorHub drivers convert standard or proprietary sensor/actuators protocols to the SWE common format so that the data can be communicated through the bus and made available to all other SensorHub components.

All data sent through the bus is described using the SWE Common Data Model so that each message is auto-describing and can be decoded by any sub-function connected to it. The persistence engine is also connected to the bus and can archive the desired messages (data, commands, status info, etc...). Web services that use real-time data are also connected to the bus and can distribute any data through standard web interfaces such as the Sensor Observation Service from OGC.

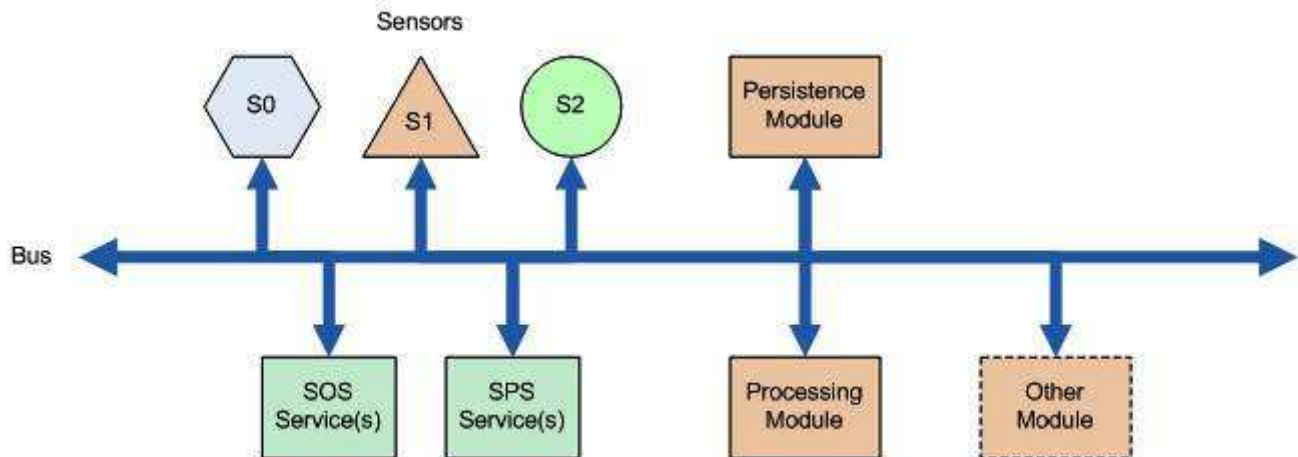


Figure1.Sensors with modules

Sensor Drivers

Drivers are responsible for converting data going to and from the sensors into SWE Common messages, as well as for building a SensorML description of the connected sensor. The sensor is then always represented by this description in the system. Whenever possible, this description is fully or partially generated automatically from information stored in the sensor device (i.e serial number, calibration tables, etc.). If the sensor does not contain any such information, the driver generates a very simple document containing only the sensor ID, type and measurement output structure. In any case, this SensorML description can be further completed by the user when installing the sensor (the user will have to input the sensor location for instance).

Sensor drivers can be programmed to send data to the bus in various manners. In 'push' mode, the sensor is programmed to make measurements at regular intervals or when certain conditions are met. In this case, the user does not request a reading explicitly. In 'poll' mode, the user requests a reading from the sensor everytime. If no requests are made, no data is read. Both modes can be mixed.

Persistence/Storage Modules

The persistence engine is able to store any data that transits on the bus in a persistent storage. A simple API and several storage implementations are provided as part of the Sensor Hub software. The PERST based storage uses a pure Java embedded object database which allows very efficient storage of data with a very small footprint (typically for embedded devices). The PostgreSQL/PostGIS storage allows storing of SWE Common data in a robust SQL database but requires more powerful hardware and a database server to run. In both cases, the database schema used is generic and can be used to store any data structure described in SWE Common and allows indexes on the specified fields. The administration console allows the user to select what messages are to be stored and how (i.e. table name, what indexes should be created, etc.).

Web Service Modules

Web services can be developed and connected to other SensorHub modules to provide remote access to the different functions.

Sensor Hub software already contains useful OGC services designed to communicate bi-directionnally with the connected sensors:

- The Sensor Observation Service (SOS) is connected to the bus and to the persistent storage and allows retrieval of historical data as well as real-time data measurements.
- The Sensor Planning Service (SPS) is connected to the bus and allows to send commands to the connected sensor.
- A simple Web Feature Service (WFS) is connected to the sensor registry and allows one to retrieve the full SensorML descriptions of all connected sensors as well as simplified features containing only the name and location of the sensors for display on a map.

All web services are configurable through the administration web interface but most of the configuration is extracted automatically from the SensorML description of the sensors. The user mainly selects what sensor outputs should be exposed through SOS and/or what sensor parameters should be able to receive commands from SPS.

Processing Modules

The processing module is connected to the bus and the persistent storage and allows deployment of several processing instances that can either process data transiting on the bus (aka event-based or streaming processing) or process data from the storage on-demand (aka on-demand processing). Process chains can be configured using the SensorML language so that new algorithms can be easily created without writing any code simply by connecting basic functions in the diagram editor (not currently available). However, the use of SensorML is not required and one can also write a plain Java plugin compliant with the processing API for implementing a particular algorithm.

The diagram below shows an example OSH instance configured with one sensor, one processing module, one storage module, SOS and SPS web services:

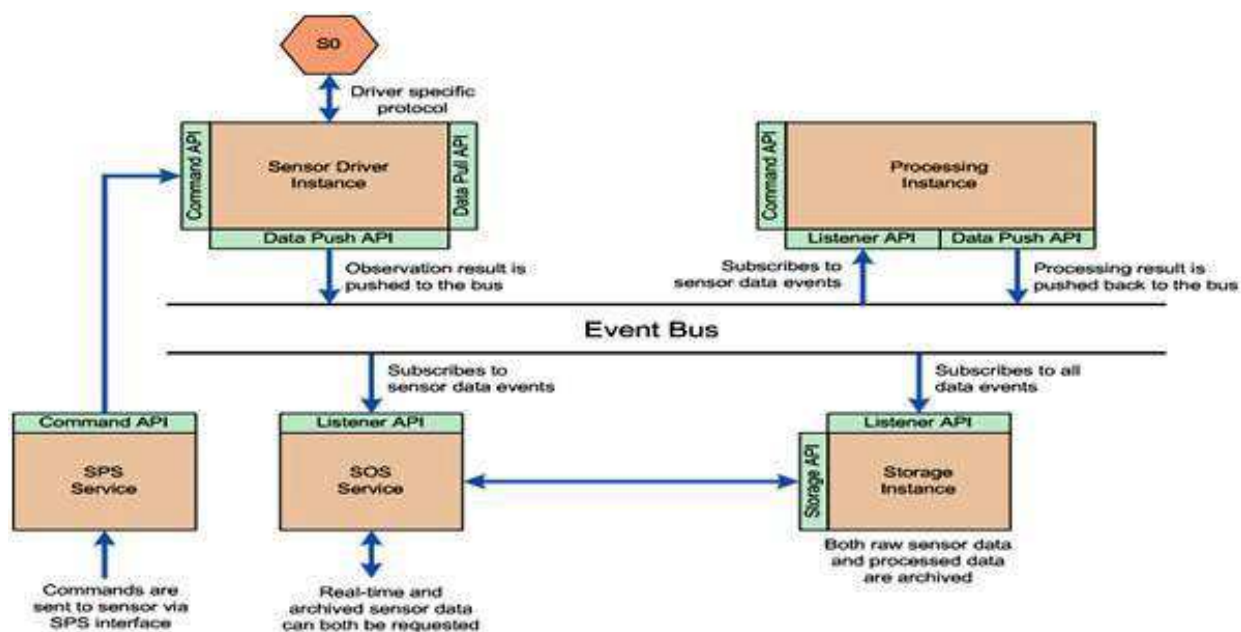


Figure 2. Deployment

- The sensor is connected via a proper sensor driver that pushes data to the bus as soon as it's available. Full description of the data structure is made available to other module via the sensor API.
- The processing module instance listens to new sensor data and processes it as soon as it's available. The result is pushed back to the bus. Inputs and outputs are fully described in SensorML.
- The storage module instance listens to both raw sensor and processed data and archives it all in a file or database. The archived data is then indexed and made available via the persistence API.
- The SOS service can subscribe to and stream real-time sensor data when a user requests direct connection to it. It can also fetch data from archive storage on demand. In this case, data can be filtered by time, location, etc.
- The SPS service is used to send commands to the sensor, such as turning the sensor on/off, changing the sampling rate, programming measurement triggers, etc.

Of course, this is just an example and there are many more ways of configuring SensorHub. In particular, it is possible to:

- Connect several instances of SensorHub via standard OGC services so that one can create a larger network.
- Implement feedback loops so that one sensor can be used to trigger different behavior of another sensor.
- Implement complex processing flows that fuse data from many different sensors

In SensorHub, sensor descriptions (or sensor metadata) are in the SensorML 2.0 format, an international open standard from the Open Geospatial Consortium (OGC). They are often generated (at least partly) from code using the java SensorML bindings included in lib-sensorml. These bindings are automatically generated from the 2.0 XML schemas and thus are a direct reflection of the types and properties that are defined by it.

The general rule is that each XML Schema Complex Type (except OGC Property Types) becomes a Java interface with appropriate methods to handle each property (get/set/isSet/unSet, getNum/add for multiplicity > 1, etc.).

There is one subtle difference compared to other bindings that could be generated with commonly used tools such as JAXB or XML Beans: OGC Property Types are not generated as separate objects thus removing many unnecessary layers in the generated object tree. Instead, properties are handled as a generic *OgcProperty* object, containing all info carried by the property such as name, xlink attributes, etc., and accessible via 'getProperty' methods. This means that calls to regular get methods would return the property value directly which makes constructing the object much more straight forward. This design allows for handling the entire content model from many OGC schemas without making the resulting object tree too complex.

About the author



Mr. V. P. Sampath works as a consultant that develops hardware/software co-design tools.

Among his publications are technical articles and papers on FPGA and Embedded systems and methods as well as textbooks.

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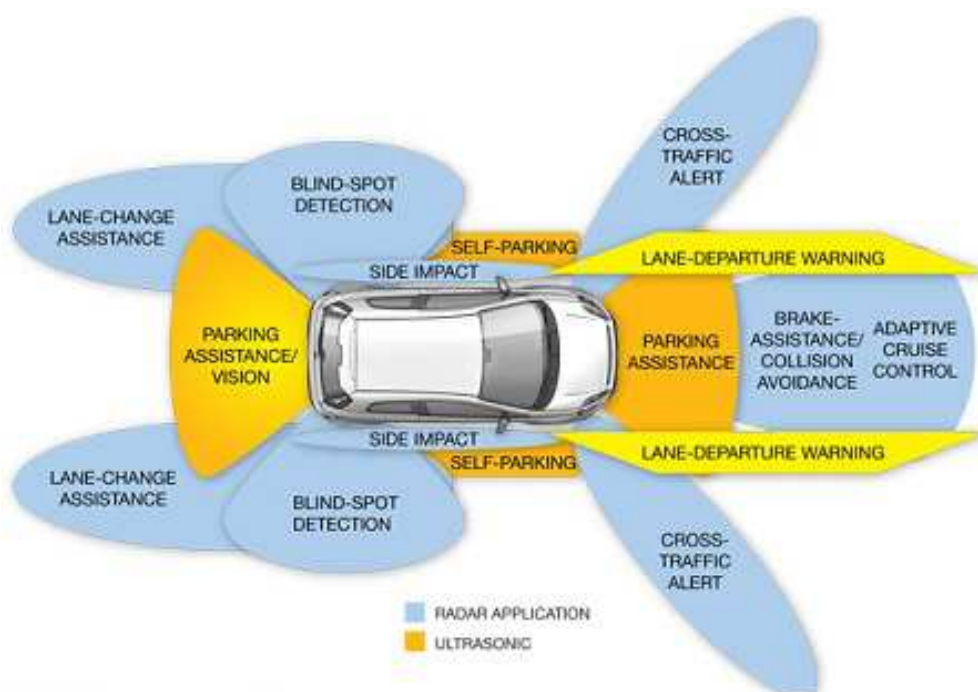


Figure 2 Several driver-assistance systems are currently using radar technology to provide blind-spot detection, parking assistance, collision avoidance, and other driver aids (courtesy Analog Devices).

Source & Courtesy: <https://engineering.stackexchange.com/questions/2176/is-the-reliability-of-automotive-sensor-technology-impeding-the-success-of-self>

Elliptic Curve Cryptography based Certification Authority

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Abstract

Elliptic Curve Cryptography (ECC) was proposed by Neal Koblitz and Victor Miller in 1985. The benefit of using ECC is that unlike RSA it gives a competitive security with a much shorter key size. ECC-based applications are supposed to be more efficient and faster than other asymmetric techniques like Elgamal and RSA. This article presents a glimpse on how a Certification Authority (CA) is designed and implemented using ECC.

1. Introduction

A Certification Authority (CA) is a trusted third party whose primary job is to issue digital certificates which is used for signing, authenticating, encrypting and non-repudiation purposes. A certification authority also generates a certificate revocation list (CRL) which contains a list of revoked certificates. A CA is a part of Public Key Infrastructure, popularly called PKI to enable secure, convenient, and efficient acquisition of public keys while ensuring sensitive data security, authenticating users and controlling the system by enforcing various policies to create, manage, store, distribute and revoke digital certificates [RFC 2822] [5].

Issues in ECC-based CA design

Design and realization of ECC-based applications for PKI services is an intricate task. Survey shows a large number of RSA-based CAs practicing in the market as compared to a very few ECC-based CAs. Companies like Thawte, Verisign, Global Sign, Comodo etc. are few names which provides ECC-based CA services. In case of India, no full-fledged ECC-based CA except for eSign services has been commercially implemented till date [1]. The root cause of scarce implementation of ECC-based CA is the interoperability issues. These issues are normally there due to complex elliptic curve mathematics as the basic operation involved in the product design as well as the issues due to ECC standards and schemes associated with the applications.

About Standards on Elliptic Curve Cryptography

Some of the ECC-based applications could be ECC supported dongle for user authentication, E-mail clients for E-mail facility with ECC support, ECC based Certification Authority for PKI services and a lot more. These applications support some standards and protocols due to elliptic curve. But mismatch of these standards in two applications taking place in communication leads to non-interoperability within the system. These standards given by different groups or bodies (refer Table 1) may not be compatible to work with each other. For say, the Public Key Cryptography Standards [9], PKCS#13, defined by RSA laboratory for ECC is not complete and is still under development. Applications usually do not support this standard at present and it often creates non-interoperability problem. In case of IEEE P1363 standard, it is fundamentally different from ANSI and FIPS 186-2 standards in the view that it does not mandate minimum security requirements. The IEEE P1363 standard also gives plenty of options to implement the public key cryptography schemes which definitely leads to interoperability issues. This is the reason to choose standards for particular scheme so that the system as a whole can be communicating seamlessly and reliably. Table 1 shows some of well-known standards recommended by standard bodies for elliptic curve cryptography.

Table 1. Standards Bodies and Working Groups [6]

Standard Body or Working Group	Standards	Abbreviated Title
ANSI	ANSI X9:62 ANSI X9:63	ECDSA Key Agreement and Key Transport. Covers ECDH, ECMQV and ECIES.
IEEE	P1363	In particular, it covers ECDSA, ECDH, ECIES and ECMQV
ISO	ISO/IEC 15946-1 ISO/IEC 15946-2 ISO/IEC 15946-3 ISO/IEC 15946-4 (draft) ISO/IEC 18033-2 (draft)	Techniques based on elliptic curves – Part 1 General Part 2: Digital Signatures Part 3: Key Establishment Part 4: Digital Signature giving message recovery Encryption Algorithm – Part 2: Asymmetric Ciphers

NIST	FIPS 186-2 FIPS 186-3	DSA, ECDSA Allows the generation of alternative curves using methods specified in ANSI X9:62
SECG	SEC1 SEC2	ECDSA, ECDH, ECIES and ECMQV Elliptic Curve listed
NESSIE	-	ECDSA, PSEC-KEM, ACE-KEM
IPA	-	ECDSA, ECDH, ECIES and PSEC-KEM
RSA Lab	PKCS#12	Elliptic Curve Cryptography

2. Overview of Elliptic Curve Cryptography

Neal Koblitz and Victor Miller in the year 1985 introduced elliptic curve mathematics to be used in cryptography. Elliptic Curve Cryptography (ECC) is considered one of the most secure mathematical crypto methods till date. One of the interesting aspects of Elliptic Curve Cryptography is the inability of mathematicians to solve the Elliptic Curve based Discrete Logarithm Problem [7].

2.1 What is an Elliptic curve?

Definition [3]. An Elliptic Curve over a field K which is either the field R of real numbers, the field Q of rational numbers, the field C of complex numbers or the finite field F_q of $q = p^r$ elements, is the set of points (x, y) with $x, y \in K$ which satisfy the equation,

$$y^2 = x^3 + ax + b, \quad (1)$$

together with a single element denoted O and called the Point at Infinity. Here we assume K as a field of characteristic $\neq 2, 3$. Let $x^3 + ax + b$ (where $a, b \in K$) be a cubic polynomial with no multiple roots. This is the short form of Weierstrass Equation with field characteristic $\neq 2, 3$.

2.2 Point at Infinity [3]

An elliptic curve E is given by (1).

We have its homogeneous form as,

$$y^2 \cdot Z = x^3 + ax \cdot Z^2 + bZ^3, \quad (2)$$

The point (x, y) in (1) corresponds to $(x, y, 1)$ in the projective coordinates form. To see the points which lie on curve E at the infinity, we set Z as zero.

Now, (2) becomes

$$0 = x^3 \quad \text{implies that} \quad x = 0$$

But $y \neq 0$ as $(0, 0, 0)$ is not allowed.

Rescaling by y , we find that $(0, y, 0) = (0, 1, 0)$ is the only *Point at Infinity* on E . The homogeneous formulation gives a clear interpretation of the Point at Infinity along with the finite points in a uniform manner. Since $(0, 1, 0)$ lies on every vertical line, therefore, they intersect E at the Point at Infinity. Point at Infinity is the identity of the group law.

2.3 Determining Order of the Group on an Elliptic Curve [3]

Hasse's Theorem. Let N be the number of q -points on an Elliptic Curve defined over F_q . Then

$$|N - (q+1)| < 2\sqrt{q} \quad (3)$$

Example: Counting number of points on an Elliptic Curve.

Let E be the elliptic curve $y^2 = x^3 + 7x + 1$ over F_{101} .

It can be shown that the point $(0, 1)$ has an order 116, so $N_{101} = \#E(F_{101})$ is a multiple of 116.

Hasses theorem says that

$$101 + 1 - 2\sqrt{101} < N_{101} < 101 + 1 + 2\sqrt{101},$$

which means that $82 < N_{101} < 122$.

The only multiple of 116 in this range is 116, so $N_{101} = 106$.

Theorem: Let E be an elliptic curve defined by $y^2 = x^3 + ax + b$ over F_q . Then

$$\#E(F_q) = q + 1 + \sum_{x \in F_q} (x^3 + ax + b/F_q) \quad (4)$$

Proof: For a given x , there are two points (x, y) with x -coordinate x_0 if $x_0^3 + ax_0 + b$ is a nonzero square in F_q , one such point if it is zero, and no points if it is not a square. Therefore, the number of points with x -coordinate x_0 equals $1 + (1 + x_0^3 + ax_0 + b/F_q)$. Summing over all $x_0 \in F_q$, and including 1 for the point ∞ , yields

$$\#E(F_q) = q + 1 + \sum_{x \in F_q} (1 + (x^3 + ax + b/F_q))$$

Collecting the term 1 from each of the q summands yields the desired formula.

Example: Let E be the curve $y^2 = x^3 + x + 1$ over F_5 . The nonzero squares mod 5 are 1 and 4. Therefore

$$\#E(F_5) = 5 + 1 + \sum_{x \in F_5} (x^3 + ax + 1/5) = 6 + 1/5 + 2/5 + 1/5 + 1/5 + 4/5 = 9$$

2.4 Order of a Point [3]

Let point $P \in E(F_q)$. The order of P is the smallest positive integer k , such that

$$k * P = O \quad (5)$$

where O is the identity element of the group, called Point at Infinity. The order of a point is determined by point doubling and point addition till the point at infinity (O) is achieved.

2.5 Points Addition and Point Doubling [3]

Let (x_1, y_1) , (x_2, y_2) and (x_3, y_3) denote the coordinates of P , Q and $P+Q$ respectively, then x_3 and y_3 is given by,

$$\begin{aligned} x_3 &= [(y_2 - y_1)/(x_2 - x_1)]^2 - x_1 - x_2 \\ y_3 &= -y_1 + [(y_2 - y_1)/(x_2 - x_1)](x_1 - x_3) \end{aligned}$$

If $P = Q$ then $P + Q = P + P = 2P$ and therefore x_3 and y_3 is given by,

$$\begin{aligned} x_3 &= [(3x_1^2 + a)/2y_1]^2 - 2x_1 \\ y_3 &= -y_1 + [(3x_1^2 + a)/2y_1](x_1 - x_3) \end{aligned}$$

2.6 Elliptic Curve Discrete Logarithm Problem (ECDLP) [3]

The security of an elliptic curve cryptography lies in the ECDLP. It is stated as below:

Given an elliptic curve E defined over a finite field F_q , a point $P \in E(F_q)$ of order n , and a point $Q \in (P)$, find the integer $k \in [0, n - 1]$ such that

$$Q = k * P, \quad (6)$$

for a certain k in $k \in 0, 1, 2, \dots, n - 1$:

The integer k is called Discrete Logarithm of Q to the base P , denoted by

$$k = \log_P Q \quad (7)$$

The elliptic curve parameters should be carefully chosen in order to resist index calculus attacks on the ECDLP.

When E and P are properly chosen, the ECDLP is thought to be mathematically infeasible to solve.

2.7 Security of Elliptic Curve Cryptography

The security of any elliptic curve cryptosystem lies in selection of those elliptic curves whose discrete logarithm problem (ECDLP) is thought to be mathematically infeasible to solve [4]. For suitably chosen curves, key advantage of EC Cryptosystems is that, only exponential attacks are known that breaks the system. NIST, Certicom, Brainpool etc. are some agencies who have published a set of standard elliptic curves with cryptographic key sizes in the public domain. ECC however, provides a competitive security with smaller key sizes and therefore, it is considered as a cheaper, faster, low bandwidth consuming, less memory and low power consuming technique than traditional Elgamal or RSA.

The running time [7] to crack RSA is estimated as

$$\text{Time}_{\text{RSA}} \approx \exp(\sqrt[3]{\log(N)}) \quad (8)$$

where N is the product of two large primes p and q. This is a sub-exponential time that RSA executes to crack the scheme.

However, the running time [7] of an elliptic curve is roughly estimated as

$$\text{Time}_{\text{EllipticCurve}} \approx \exp(c\sqrt{N}) \quad (9)$$

where N is the cardinality of the elliptic curve which being a large prime number.

Elliptic curve creates discrete logarithm problem (DLP) known as ECDLP that allows competitively strong security with smaller key and certificate sizes. Due to smaller key used in ECC, less EEPROM is required to store the keys and certificates. Also, less data needs to be passed allowing shorter transmission time.

Note that ECDLP is solvable in exponential time by (9) and therefore it provides much more security with a given key size than that of RSA as they have sub-exponential time solution by (8).

3. Performance Analysis of RSA and ECC

Asymmetric cryptosystems based on RSA have usually got sub-exponential time complexities by (8) for cryptanalysis. RSA is quite expensive in case we use large key sizes (refer Table 2). Since ECC gives same level of security with a much smaller key size, it may be a viable candidate for asymmetric cryptography. Table 3 gives a performance analysis of execution time for RSA and ECC. Clearly ECC-based CA would be much efficient in terms of security with much shorter key sizes, computational time & cost and less prone to cryptanalyst or hackers when high key sizes (256 bit) is taken into considerations.

Table 2. Security Comparison for ECC & RSA [8]

Symmetric Security Level	ECC	RSA	Protects to Year
80	160	1024	2010
112	224	2048	2030
128	256	3072	2040
192	384	7680	2080
256	512	15360	2120

Table 3. Performance Comparison ECC-256 and RSA 3072 [From Certicom]

Operations	ECC-256	RSA-3072
Key Generation	166ms	Too Long
Encrypt/Verify	150ms	52ms
Decrypt/Sign	168ms	8s

Table 4. Operational Speed-up Comparison by Certicom and RIM

Operations	Operation Time (in Seconds)	Speedup (ECC: RSA)
RSA 1024	10.99	1
ECC 160	0.81	13.6
RSA 2048	83.26	1
ECC 224	2.19	38

Most of the Certification Authorities uses RSA with 2048 bits key size which requires a lot of computational time (refer Table 4) in various cryptographic operations which can still be achieved by ECC using 224 bits key size.

ECC 521 bits key size gives security that is equivalent to the security given by 15360 bit of RSA key size (refer Table 2). To execute 15360 bits long keys in computation requires a dedicated hardware called a crypto co-processor which is very expensive to use. This is the reason why RSA-3072 bits key is used normally. However, ECC can be implemented in available ROM and there is no need of additional co-processor to perform strong and fast authentication [Certicom, 1998].

4. Interoperability Issues due to Elliptic Curve Standards

Implementation of elliptic curve cryptography (ECC) is never been a simple task due to ECC interoperability and compatibility issues associated with different applications. These issues are generally caused due to diverse standards available in ECC for the same purpose/schemes (refer table 1). Applications are usually developed keeping adherence to different set of standards and very often they cause non-interoperability while communicating with other applications. Some of the ECC standards do not mandate minimum security requirements and other is incomplete. These ECC standards are suggested by NIST, IEEE P1363, FIPS, ANSI etc. like well accredited institutions (refer Table 1). We discuss some of the interoperability issues of ECC-based CA especially with the mail client and browsers like Thunderbird and Firefox from Mozilla company here.

ECC Interoperability Issues. Following are the issues that encountered during CA implementation especially in the CA interaction with the mail client and during generation of the X.509v3 digital certificates with implementation of suitable ECC schemes:

1. **Incomplete Standard PKCS#13.** RSA laboratory has designed Public Key Cryptography Standards i.e. PKCS#13 for Elliptic Curve Cryptography. The PKCS#13 standard is still under development [9] that means it cannot be widely used and may lead to the interoperability problems.
2. **IEEE P1363.** The IEEE P1363 standard supports ECC but only issue is that it does not mandate minimum security requirements like ANSI and FIPS 186-4 [10] standards do.
3. **Selection of elliptic curve.** Most of the web browsers and mail clients don't support all the curves recommended by different agencies like NIST, Certicom, SECG, Brainpool etc.
4. **Key agreement and key storage.** PKCS#13 is not a good choice for storing the EC-keys as it is not supported by mail clients and web browsers in general. The mail client also does not support all the ECC-based key agreement schemes.
5. **Selection of hashing algorithm.** The X.509v3 digital certificate doesn't support all hashing algorithm.
6. **Selection of signing algorithm.** The X.509v3 digital certificate doesn't support all ECC-based signing algorithm.
7. **Selection of encryption scheme.** The X.509v3 digital certificate doesn't support all Encryption algorithm.
8. **Selection of key sizes.** Most of the web browsers and mail clients don't support all the curves over different prime sizes.
9. **Selection of certificate format.** The mail client does not support all the certificate formats.

Solution to the above issues. To address the issues given above, following recommendations are suggested to be considered for a hassle-free fully interoperable certification authority implementation as given in the following sub-sections.

4.1 Avoid PKCS#13 Standard.

Avoid PKCS#13 standard due to the fact that PKCS#13 is a new and incomplete standard and most of the applications do not adhere to this. Use PKCS#12 to store keys. PKCS#12 binds keys into the X.509v3 certificate and is able to communicate with mail client without any compatibility problem.

4.2 Taking FIPS Security Recommendations along with IEEE P1363

The minimum security requirement in CA design as specified under table 2 and use 256-bit ECC-key size as a minimum recommended key size for use. This 256-bit ECC-key size is supported by almost all the web browsers and mail clients with ECC-enabled feature.

4.3 Selection of Elliptic Curve

The CA should have support for the set of elliptic curves of different cryptographic sizes to achieve interoperability for seamless functioning of the system. These curves are thought to be having very hard ECDLP and recommended for cryptographic uses. The minimum prime size of the curve given by NIST and SECG is 256 which is safe to use by 2040 (refer Table 5). The choice of the ECC curve for the CA certificate public-key should be based on the following criteria, in order of preference: interoperability, performance, and strength. The curve that achieves maximum interoperability with browsers/mail clients is of 256 bits key sizes. A 256 bits curve may offer a better balance of features. For best interoperability, elliptic curves with prime size 256 bit is suggested for use with browsers and mail clients. Table 5 shows the available curves, their prime sizes and validity for safe use as given below:

Table 5. Selection of Elliptic Curve for CA Implementation

Elliptic Curve	Recommended by	Prime/Key Size	Validity
secp256r1	SECG	256	2040
secp384r1	SECG	384	2080
secp521r1	SECG	521	2180
P-256	NIST	256	2040

4.4 Suggested Standard for Key Agreement and Key Storage

Use PKCS#12 for packaging private key along with X.509v3 certificate. The protocols and standards given as per Table 6.

Table 6. Suggested Key Agreement and Private Key Storage

Scheme	Protocol/Format	Standard
Key Agreement	ECDH, ECMQV	ANSI X9.63
Key Generation & Storage	PKCS#12 file	PKCS#12

4.5 Suggested Hash Function

Use SHA-256 or SHA-512 with Elliptic Curve Digital Signature Algorithm (ECDSA) for signing certificates with different key sizes.

4.6 Suggested Signing Algorithm

Use Elliptic Curve Digital Signature Algorithm (ECDSA) as the only signing algorithm for interoperability with the mail client and OpenSSL.

4.7 Suggested Encryption Algorithm

Elliptic Curve Integrated Encryption Scheme (ECIES) is the only well supported encryption scheme to achieve interoperability.

4.8 Suggested Key Sizes

As per FIPS recommendation [8], key sizes including 256-bit, 384-bit and 521-bit are only used. ECC-enabled mail clients and web browsers usually support 256-bit key size nicely in general. With key sizes 256-bit is recommended for safe use (refer Table 5).

4.9 Suggested Standards for CSR, Digital Certificate

Table 7 gives the Suggested standards for CSR and digital certificate.

Table 7. Suggested Standards for CSR, Digital Certificate

Scheme	Protocol/Format	Standard/Reference
CSR	-	PKCS#10
Digital Certificate	X.509v3[PKIX]	PKCS#12, RFC 3280
Digital Certificate Format	PEM, CER, DER, CRT, PFX/P12	-
Private Key	-	PKCS#12

5. ECC-based Certification Authority Design

5.1 Design Requirements

Cryptosystem. The CA uses elliptic curve cryptography (ECC) as its public-key cryptosystem. The only signature scheme to be supported is the Elliptic Curve Digital Signing Algorithm (ECDSA).

Public Key Infrastructure. The CA generates X.509v3 ECC-based digital certificates with conformance to PKIX [2] [5]. The certificates are usable in PKI-enabled Internet protocols such as SSL/TLS, S/MIME etc.

CA Certificate. The elliptic curves defined over 256 bits prime field are most suitable for the CA certificate to avoid interoperability issues with mail clients and browsers. The certificate should be in X.509v3 format. The CA certificates should be downloadable and should also be available in CER, PEM, binary (DER), CRT and P12 or PFX format.

User Registration. User registers himself/herself with the CA server in order to request for a digital certificate.

User Information. CA includes a request page which will act as enrolment front-end and which will gather some basic information (and allow a legal click-through page) prior to taking the CSR upload or collecting certificate data. The data collected should include the requesters name and contact information.

Generation of Key Pair. CA gives a software to the user to generate their key pair. User keeps private key safely at his machine and sends public key binded with the CSR to the CA by uploading it to the CA server.

Requesting Certificate. A user requests CA for issuing him a certificate by uploading a PKCS#10 Certificate Signing Request (CSR) to the CA server.

PKCS#10 Certificate Signing Request (CSR). User sends his public key along with the request through the Certificate Signing Request (CSR) by uploading it to the CA Server. A user generates his CSR using OpenSSL in PKCS#10 format with public-keys and signatures using the NIST and Certicom specified elliptic curves. The CA is interoperable with CSR generated by the user. The CSR must contain the requesters name to be used as the Common Name (CN) in the Subject Distinguished Name (DN) of the certificate and must also contain the public key to be placed in the certificate. The CA supports CSRs that contain the Email Address attribute.

End-User Certificates. X.509v3 digital certificate format is best for interoperability. CA generates its key pair and a certificate to sign user's digital certificates from the user supplied information. CA provides a link to the Certificate Directory where it publishes users' certificates. Users can download their certificates as PKCS#12 file by clicking the link and downloading it to their machine.

CA Certificate Signing Type. It can be root CA signed, self-signed or another CA signed under root CA.

End User Certificate Signing Type. Only CA-signed certificates should be permitted to be used by the user to ensure trusted third-party assurance.

Certificate Validation. The CA checks if the CSR, keys and Certificates are perfect for use.

View Certificate. User can view its X.509v3 certificate in text format too.

Certificate Revocation List (CRL). The CA generates a full CRL daily and makes it available at the location pointed to by the primary CRL Distribution Point extension that the CA populates in all end-user certificates.

5.2 CA Design Policies

Open Source based Certification Authority. Open source crypto library like OpenSSL can be used in CA design for generating ECC-based X.509v3 digital certificates.

Root CA. The CA to be designed here would be a Root CA. A copy of the CA Root certificate should be stored in the Trusted Root Certificate Store for users to trust it.

Certificate Class. Class 1, Class 2 or Class 3 certificates can be used based on the user requirements.

Support for NIST and SECG Prime Elliptic Curves. CA supports both the NIST as well as SECG Prime Curves to avoid interoperability problems with Mozilla Thunderbird Mail Client and OpenSSL.

No Point Compression. There is no any point compression technique be used in CA implementation so as to avoid patent issues.

Keys Generation and Storage. Keys should be generated on the user's machine and should be kept inside a Hardware Secured Module (HSM) like secured ash or smart card or can be kept in .p12 certificate file and nowhere else.

Minimum Key Sizes. The minimum ECC-key sizes are 256 bits. It can be scalable up to 521 bits depending upon the compatibility with the mail client/web browsers and environment in which the digital certificate would has to be used.

Web-based User Interface. There should be a secure CA server and users can interact with CA through web-based interface.

5.3 CA Architecture Model

CA incorporates a certificate directory where it publishes certificates for users to retrieve it for use. CA has also a Certificate Revocation List (CRL) server where it publishes revoked certificates and user retrieves CRL information from CRL server. The CA architecture model is shown in Figure 1.

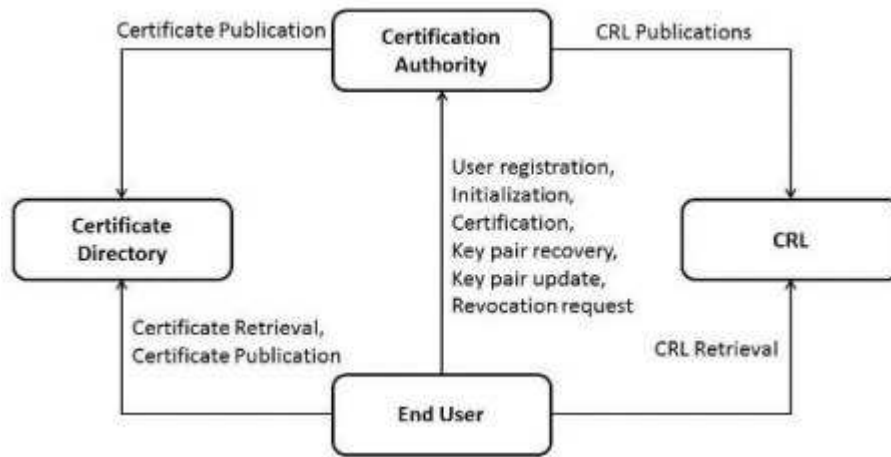


Figure 1: Certification Authority Architecture Model

6. ECC-Based X.509v3 Digital Certificate Generation

The X.509v3 digital certificate generation involves three steps: (i) key pair generation (ii) CSR generation and, (iii) certificate generation.

6.1 CA Certificate Generation

Keys Generation CA generates its key pair using OpenSSL with 521bit key size. The elliptic curve secp256r1 is recommended by SECG for certificate purposes.

CSR Generation CA generates its certificate signing request (CSR) (with self-sign certificate option) using its public key recently generated.

Certificate Generation Self signed root certificate is generated using CSR for the Root CA. This Root CA certificate is published in the certificate directory for the users to retrieve.

6.2 User Certificate Generation: User can have CA signed certificate for use. Following steps can be taken to get the user certificate.

Keys Generation User downloads a software from the CA to generate their key pair using OpenSSL crypto library with 521 bits key size.

CSR Generation User generates their certificate signing request (CSR) using his/her public key recently generated.

Certificate Generation CA takes CSR as input and generates certificate for the user as output and publishes it in the certificate directory.

Conclusion

This article covered the design and implementation aspects of a Certification Authority based on Elliptic Curve Cryptography. We discussed interoperability issues of ECC-based CA due to various ECC standards and schemes in general. As an implementation research, we believe that this work will motivate and inspire organizations to design and implement a fully interoperable ECC-based Certification Authority for trust based secure communication.

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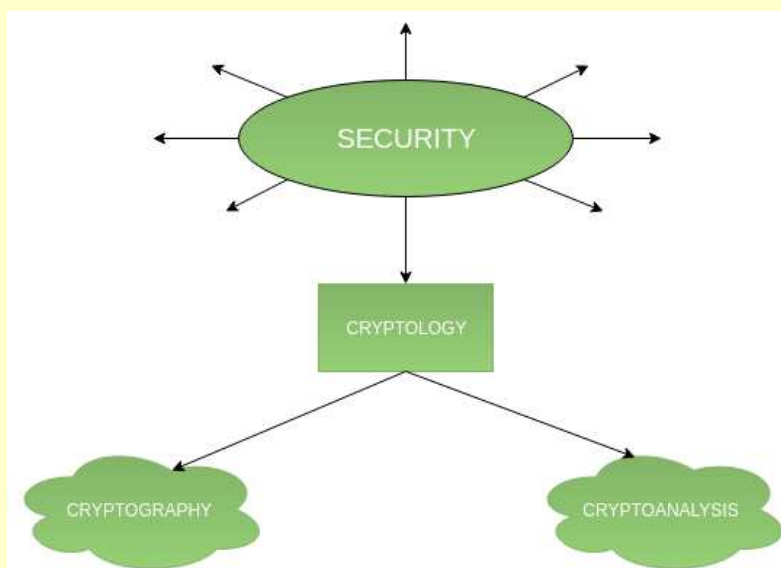
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Cryptography | Introduction to Crypto-terminologies

Cryptography is an important aspect when we deal with network security. 'Crypto' means secret or hidden. Cryptography is the science of secret writing with the intention of keeping the data secret. Cryptanalysis, on the other hand, is the science or sometimes the art of breaking cryptosystems. These both terms are a subset of what is called as Cryptology.

Classification –

The flowchart depicts that cryptology is only one of the factors involved in securing networks. Cryptology refers to study of codes, which involves both writing (cryptography) and solving (cryptanalysis) them. Below is a classification of the crypto-terminologies and their various types.



Read more at <https://www.geeksforgeeks.org/cryptography-introduction-to-crypto-terminologies/>

Cryptography is typically bypassed, not penetrated.
Cryptography products may be declared illegal, but the information will never be.
Cryptography is the ultimate form of non-violent direct action.
Without strong encryption, you will be spied on systematically by lots of people.
Privacy and encryption work, but it's too easy to make a mistake that exposes you.

The Smart Grid Computing: A Comprehensive View to Power Grid Systems

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Abstract

The development and integration of smart grid technology in current scenario is very crucial and useful. Involving the Smart Grid computing into electricity supply, yields a huge amount of monetary benefits which includes less emissions, better storage and high efficiency. Such grid based system is proving to be highly lucrative for customers using it. The Governments are highly investing in such technology to achieve independence especially into power sector. Deploying Smart Grid technology has been a priority for governments all around the world. It is having a revolutionising effects on existing conventional power grid systems. Smart Grid lies at the confluence or intersection where Computers and Electronics intersect. Both these things have been in their prime and have had far-reaching effects on the innovations off late. Smart Grid is the very new innovation possible with the contribution of former and latter and is proving to be boon not only for developing but developed countries too.

Introduction

The smart grid is an electricity supply system which functions under two-way communication channel. In this channel customer receives the electricity and also returns a feedback. This feedback is vital in cutting down the wastage of power and extra expenditure. It has also been breakthrough technology in reducing the effect of global warming. Consumers, using the smart grid devices, transmit information that is used to customise the supply according to the needs as seen in this information[1]. The presence of internet connection is very much needed to make the presence of smart grid technology possible.

Blackouts and brownouts were a severe headache for any country in its electrical grid system [2]. Normal grid systems are not equipped to handle additional load given the demand is high. It seriously affected the industrial and services sectors. These factors alone account for the need of a system that can handle all the failures effectively. In came the Smart Grid.

Smart grid technology became known in 1990s after drawbacks of its predecessors became prevalent. What makes smart grid smart, is its ability to track the power usage. It can very well identify the amount of power required over a varying time period of a given day. This was not possible in previous available arrangements. Smart grid can also efficiently detect the location and cause of fault. This detection was not possible previously. Smart Grid technology has achieved path breaking results in area of fraud detection. This drawback of previous systems is very well covered by the Smart Grid. The most advantageous and vital aspect of Smart Grid is that it is dominantly customer-driven. This feature helps the beneficiary to manage their consumption and expenditure.

What makes a smartphone smart? It is the in-built computer which makes the phone smart. Similarly, it is the computer which smartens our existing grids to make it Smart Grid. Some very obvious computer technologies involved in implementation of Smart Grid involves Database Management, Cloud Computing, Distributed Computing etc. Since customer preferences are constantly tracked, they are stored in database which are further very much useful to make prediction and track the behaviour. This database is very useful for the distributing company to cater to the needs their customers. Techniques of distributed computing is used at the distribution centre. This helps in switching between different sources of energy available. Smart Grid is equipped with a lot of sensors which are inter-connected in a network. Computer scientists invest huge fraction of their time setting up the sensors in a network.

Basic Elements of Smart Grid

Architecture is very important to manage the complexity and easily manages to achieve goals[4]. Architecture helps visualising the challenges which lie in implementation. Taking precautions prior to implementation helps reducing risks. Building infrastructure of Smart grid is pretty much sophisticated and complex. This also is very costly as compared to conventional electricity distribution systems available. The architecture of Smart Grid as depicted Figure 1 is majorly composed of following: -

- **Transmission Stations:** Transmission stations is where electric power is generated by different means. The power generated is sent to the distribution centres for further supply. They too make use of smart devices that make supply automatic and need-based.
- **Distribution Centres:** This is the place where majority of work takes place. Distribution centres receive power from transmission stations and redirect them to the consumers. Important tasks like fraud detection, load balancing and

distribution according to the need and switching between various transmitting stations of thermal, tidal, hydro-electric power plants.

- **IoT Devices:** Smart Grid, simply put, is not possible without IoT devices. These devices are installed at each and every step and part possible in the complete setup. Devices like sensors, actuators, smart meters etc. These devices are used in process of transmission, metering and distribution. It is these devices through which the needs and behaviour of consumption is reflected. The data collected in the devices is precious for future pattern predictions and customisation of supply.

Why do we need Smart Grid?

Smart grid is the utmost need of the currently existing out-of-date and obsolete electrical supply system which vulnerable to frauds and wastage of power. Building Smart Grid is the need of the hour not only because is almost fraud-proof but also cost efficient and eco-friendly. Bringing customer into the picture is what is the most prominent feature of Smart Grid. This technology also deploys renewable sources of energy like wind, tidal, solar etc. and blends it in with other non-renewable sources of energy like thermal. The system is smart enough to switch according to the demand and automatically lowers the load, hence saving money. Smart Grids have been found to save 30% more energy than conventional grids.

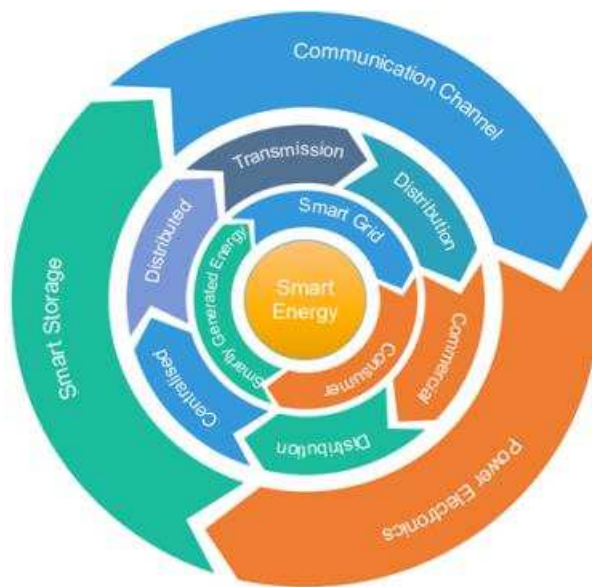


Figure 1: Different Elements of Smart Grid Architecture

Fault detection still remains one the grave area for conventional energy grids because, to detect the place and kind of fault is a very tedious task which is made pretty easy by Smart Grid. Smart Grid automatically detects the fault and itself tries to handle it with pre-defined measures. Other advantages of Smart grid are as follows [5]: -

- **Reduced Costs and Expenditure:** Managing and providing the load and power according to the demands lowers the cost and cuts expenditures.
- **Eco-Friendly:** Since Smart Grid makes use of both renewable and non-renewable sources, it lowers the harmful emissions and reduces the risk of global warming.
- **Robustness:** Smart Grids being more robust means that they are less prone to attacks and can manage themselves. It is also blackout and brownout proof.
- **Smart Storage:** If in case, somehow, the power generated is more than what was demanded; it also provides smart facilities, which can be utilised as and when required.
- **Interoperability:** The fact that Smart Grid utilises various smart devices and other technologies proves this technology is interoperable [6].
- **Load Balancing:** Balancing the load [5] with techniques like switch-configuration [7] and tie-line addition helps save power by storing it when not needed.

The technological revolution, started almost a century ago, has been a bang and is still has great momentum. The number of innovations coming up would never have been possible without electricity. These inventions when combined with the Smart Grid technology would completely revolutionise the way we see the world. As the large cities are growing larger, the challenges which lie ahead are too are becoming much bigger. Integrating the infrastructure according to the digital age is

where the major benefits of Smart Grid lie. This technology can be used to lay foundation of Smart City [8], whose other layers contain remote light monitoring, public safety, water and gas supply, traffic control. Nothing is possible until and unless the electricity distribution system is efficient and robust.

Deploying Smart Grid: From the perspective of Developing Nations

Developing countries like India, Iran, Brazil, Ukraine etc. find satisfaction in the fact that using technologies like Smart Grid would lead them to a path of development and rightly so. Developed countries like United States of America, China, South Korea, Japan and some European giants have proved that Smart Grid is the way to development. What all developing countries have in common is their productive expenditure. Their expenditure in the right direction is paying off. Smart grid is one such area where they must invest to bore fruits in future. Here are some of the techniques employed by some countries to integrate Smart Grid:

- **Smart Grid in China:** It is estimated that China may have 233% growth in electricity demands by 2050 [9]. Since its introduction in 2006, the Chinese have very much focused on this technology so much so that, they are investing around RMB 17 billion. They have also laid down separate ministry for power grid technology in Twelfth Five Year Plan. This will help create around 15 million jobs. Induction and realisation of the power of this technology has completely boosted the growth rate of China.
- **Smart Grid in India:** Smart Grid is a must inclusion in the Indian electricity system because India tops the list in terms of percentage of production lost to theft, around 26% [10]. India is bereft of poverty and this again is good reason to introduce Smart Grid Technology in India. Indian markets would benefit with this technology, because present distribution systems are weak and fragile. The energy planning and investment would definitely boost the Indian economy [11].
- **Smart Grid in Brazil:** Seeing the potential of growing economy, Siemens has invested around \$1 billion USD [12]. Brazil is big hydro-electricity producer and making use of it through Smart Grid technology would produce fruitful results. Brazil makes great use of pilot projects to induce this technology in their existing distribution system.

Conclusion

This article provides the broad view towards benefits of smart grid technology which is investing heavily in power enhancement for any country's development. It has been initiated with the efforts related to change in implementing the concept of smart grid computing and would have splendid results for the coming future generations.

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Driving disruption through innovation: The new business reality

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It's easy to see that digitization is upending traditional operations, blurring the lines between industries and creating new business models. Take, for instance, eCommerce giants such as Amazon and Google that offer payment services. Or consider companies like Uber, AirBnB, and Netflix that are flourishing - not because they offer revolutionary products - but because of their unique business models. All of these companies have become disruptors by innovatively changing the basic building blocks of their business models to capitalize on key lacunae in otherwise saturated markets. Clearly, the source of competitive advantage has shifted from products and services to how organizations create, deliver and capture value through rapid innovation.

The growing focus on innovation

Previously, organizations relied on innovation to infuse fresh ideas into product and service development. Today, rapidly changing demand patterns and market structures combined with fierce competition is pushing organizations to leverage innovation in order to capitalize on transformative opportunities. The focus has changed from 'breakthrough' innovation that happens - say once or twice in a year to 'sustained' innovation that happens continuously, enabling businesses to adapt and respond in real time. Fostering a culture of innovation will lay the foundation for an organization's success. Hence, organizations are also embracing a new trend - open innovation - that focuses on a collaborative approach to reduce the cost and speed of innovation.

Let's take a look at how Tata Consultancy Services (TCS), an innovation pioneer, is capitalizing on innovation to deliver better outcomes for all stakeholders.

TCS' approach to innovation

TCS believes that in today's post-digital world where servitization is gaining momentum across industries, businesses must leverage innovation as a fulcrum to evolve from product-oriented to service-oriented models that place the customer front and center.

From a services-centric business model, we need to evolve platforms and products that address client's business challenges. These need considerable amount of investments and high-risk appetite. As we move into the digital economy, we have to drive a considerable innovation on our services and prudently leverage new-age cutting edge technology to beat the competition and stay ahead of the curve.

At TCS, we believe innovation begins with the customer. Even fresh exploration of ideas is often done jointly with our customers; at other times, we develop our ideas and run these past our closest customers, to get their feedback and to help in tweaking these for the real world. These initiatives are designed to identify opportunities for driving superior efficiency, competitive advantage, and growth. The company has adopted a 'two-tier research and innovation' structure, driven by a corporate team in conjunction with corresponding unit-level teams. The goal is to embed research and innovation in each business unit and customer account.

Our Research and Innovation labs engage in joint research and incubation with clients to identify opportunities for business advantage, enhanced efficiency and growth. These ideas then go through a period of prototyping and engineering to ensure we have the best architecture for scalability and enterprise integration, after which they are picked up by industry-specific business units. These business units prepare solutions for client deployment and functional enhancement, if necessary.

Take for instance, the impact of Digitization on the IT industry. TCS has seized the opportunity provided by this new channel to increase the share of our digital revenues over the years. We have now put forth our thought-leading 'Machine First' philosophy that places digital front and center of all our client initiatives. This is an 'Age of Abundance', where we observe that organizations have more data than ever at their disposal today. Organizations are hence looking at formal ways of assessing their maturity on data, embracing analytics and AI, and using them as a key differentiator in driving their growth and transformation journey. Organizations that aspire to design an intelligent, data-focused ecosystem triggering real-time insights for decision making are likely to invest in this technology space. Also, the data-driven digital economy will propel organizations to create interesting monetization models that would further fuel these investments. For example, Tata Steel Europe (TSE), a leading European steel producer, is currently on a digital transformation journey with innovation, customer focus, and value chain excellence at its core. TCS is helping TSE in this journey using its Machine-First™ approach and cognitive automation software ignio™ to transform the underlying technology operations and deliver improve user support levels, enhance productivity, and reduce operational risks. With ignio™, TSE is empowered to build a Digital Twin of its IT landscape to maximize cognitive automation, which should result in higher operational efficiencies

and improved service levels. However, the ultimate goal in this partnership is to use ignio™ to automate end-to-end business operations.

Digital Re-imagination leverages digital technologies to create game-changing ways of executing business cutting across business models, products/services, customer segments, distribution channels, business processes, and workplaces.

TCS' new thought leadership framework Business 4.0™, designed for the Industry 4.0 era, focuses on four key levers of intelligence, automation, cloud, and agile to drive organizations' growth and transformation journeys. The Business 4.0™ framework is essentially about enhancing customer experience through mass personalization, bolstering innovation and growth. This is made possible by connecting collaborative ecosystems, fueling growth strategies by embracing risk, and redefining business models to create exponential value. TCS' Research and Innovation services cover critical areas such as: behavioral, business, and social sciences, computing systems, cybersecurity and privacy, data and decision sciences, deep learning and AI, embedded systems and robotics, physical sciences, and embedded systems and robotics.

Late last year, Newcrest Mining, one of the world's largest gold mining companies, partnered with TCS to create an Innovation and Digital Operations Centre in India. Newcrest will work with TCS' experts in engineering, research and development, data analytics and IoT, industrial process control and asset management to explore opportunities to innovate and transform various core business areas such as ore processing, predictive targeting, production optimization, and safer operations.

On a similar note, it is worth mentioning that Total and TCS have signed a partnership agreement to create a digital innovation center in India. The partnership will initially focus on refining. Real-time data analytics, the IoT, automation, AI and agile methodology will be used to improve industrial efficiency, energy performance and availability rates. With the help of digital technology, such as mobile apps, drones and robots, Total can optimize the way operators work and improve its safety. Applications have been developed to digitize certain tasks, including field check reports, maintenance requests and the consolidation of shift team reports, and drones and robots are now used to carry out inspections in places that are difficult to access, such as at height or inside equipment. From analytics perspective, numerous sensors were installed throughout its production sites (on pumps, turbines and compressors, for example), so that Total can anticipate operating incidents before they occur. Such initiatives could help Total achieve lower maintenance costs, greater equipment availability and a safer environment for everyone.

Fostering innovation at the grass roots level

Fostering innovation at the grass roots level has the potential to not only deliver better outcomes for businesses and consumers but also to the society at large. Internally, TCS conducts programs such as Innovation Forums, Ideathons and Hackathons, Innovation Days, and Custom COIN™ (Co-Innovation) to build a culture of continuous innovation.

Within TCS, we group innovation into time-based horizons, with H1 being immediate-term innovation (or derivative innovation) that is largely driven by industry business units. H2 (platform) innovations tend to be medium-term that are generally led by our Business and Transformation Services unit, that focuses on core technologies of interest to our global customers. H3 (disruptive) innovations are almost exclusively managed by our corporate research and innovation teams, in collaboration with leading academic and other research teams worldwide. For both H1 and H2 innovations, we also extensively involve our COIN™ teams that have deep connects with emerging-tech firms. Post incubation and prototyping, depending on the relevance to customers, these innovations get converted to TCS offerings – that could be products or solutions or frameworks – which will directly impact TCS' topline.

To foster the culture of innovation, TCS has annual TCS Innovista contest, where the best innovations get the opportunity to benchmark them self. Through a series of objective and thorough evaluation, the winners of each category are declared. Some of the key categories include focus on innovation in new products and services, innovations that are yet to be commercialized and best platforms. We also recognize those innovators who have tried but not been successful with our “dare to try” category.

TCS Innovista is designed and run much like Tata Group's namesake event. The best of TCS Innovista's entries often find their entries to Tata Innovista. Over the years, TCS has won multiple awards in the Tata Innovista.

Recently, TCS inaugurated Pace Port™ to drive next-level collaboration with customers through new disruptive ideas, digital technologies, solutions, processes, tools, and business models. The global network of TCS Pace Ports will ignite collaborative experimentation, research, rapid product prototyping, and continuous learning alongside customers, partners, academia, and analysts – pushing current boundaries and driving business transformations through the application of cutting-edge digital technologies.

In FY18 alone, TCS invested over INR 1500 crores in research and innovation, and currently works with more than 500 researchers across more than 30 innovation labs. TCS' various research initiatives include:

- **TCS IT Wiz:** School-level initiative aimed at conducting information technology quiz competitions for students in class 8-12 across India.
- **Digital Impact Square (DiSQ) at Nashik:** Mentorship program for students to help them grow into successful entrepreneurs.
- **TCS Academic Interface:** Designed to make engineering students 'job ready', the program has benefited over 700 institutions covering more than 12,000 faculty members, and 1.4 lakh students across the country. Aligned to the changes in the industry, TCS proposed a new undergrad BE curriculum on Computer Science and Business systems that is being piloted in three colleges, BVP COE at Pune being one of them. AICTE has approved this new curriculum for use.
- **TCS Innovator Program:** Promotes collaboration with premier technical education centers such as IITs and NITs to draw top talent for research and innovation roles across major industry domains.

Propelling organizations into the future

Research and innovation plays an important role in creating competitive differentiation for businesses today. IT has – and will continue to – digitally transform the way we live, interact, and do business. As technology evolves and becomes increasingly complex, businesses that explore emerging technologies with a spirit of scientific enquiry will devise innovative solutions and emerge as winners.

About the author



Dinanath (Dina) is the Vice President and Global Head of the Analytics & Insights business unit, which is part of the TCS Business and Technology Services. This unit enables businesses to realize the power of data and drive deep analytics-led, real time decision-making opportunities for global leaders. With more than 28 years of experience, Dina has managed and amplified business services, including the Business Intelligence practice. As a champion for diversity and inclusion, he has led TCS' All Women Centre in Riyadh and supports the Avasara Academy, which aims at developing leadership skills among young girls. Additionally, as the chairman of the Institute of Electrical and Electronics Engineers Pune section, Dina provides leadership on technical education and drives a special interest

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What is innovation? 15 experts share their innovation definition

Innovation is truly a confusing buzzword which many people love to hate.

Every business leader agrees that it is important. But nobody can quite seem to agree on what it actually is or what it means. If you ask Google for an innovation definition, it is less than helpful, coming up with over 300 million results with thousands of definitions. Its own definition is pretty much useless: "the action or process of innovating". Using the traditional sources for a definition such as the Oxford dictionary also doesn't help much, with their answer being "Make changes in something established, especially by introducing new methods, ideas, or products"

So I contacted a selection of my fellow innovation experts to see how they talk about innovation with their clients, and compiled the results for you here. I asked them all:

- What is your definition of "innovation"?
- What mistake do companies often make when they talk about innovation?
- What simple thing can a company do to change their conversation / perspective about innovation?

The results surprised me. Even amongst the group of industry insiders here who teach and author books on innovation methodologies, case studies and thought leadership, there was a huge variety between the responses. So in the last section of this article, I've analysed what everyone said to find the most common themes, to try and see if it is possible to use the common threads to determine the most effective definition you can use.

Read the full post at

<https://www.ideatovalue.com/inno/nickskillicorn/2016/03/innovation-15-experts-share-innovation-definition/>

Investigate the relationship between Lean and Industry 4.0 Technologies

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Purpose: Lean manufacturing is a comprehensive worldwide best practice methodology for continuous improvement focused on minimizing all kinds of waste with the objective to maximize customer perceived value of the product and its connected services. Industry 4.0 (I4.0) technologies easily mesh into standardized lean manufacturing processes and have the potential to achieve quantum leaps in breakthrough improvement; drastically reducing the cost of poor quality and chronic waste inherent in processes. The objective of this investigative study is to establish the linkages amongst current Lean tools-techniques and I4.0 technologies.

Methodology: This work is centered on a critical review of the extant literature and a qualitative questionnaire-based survey of industry leaders, policy makers, trainers, consultants and academicians

Findings: This study provides a linkage amongst the lean tools and I4.0 technologies by a relation diagram based on feedback given by experts.

Research limitations/implications: Limited experience at present with the application of I4.0 know-hows in engineering comes in the way of doing meaningful quantitative research. Considering this, our present research is qualitative in nature. This work does lead to in-depth hypothesis building. Subsequent research will help test hypothesis and lead to theory building.

Practical implications: The relations between Industry 4.0 technologies and learn techniques identified in this paper will support policymakers, researchers, academicians, and practitioner's to design and develop Industry 4.0 enabled lean factories.

Originality/value: The work done in Lean 4.0 is still conceptual and till now very few studies have been done to investigate the relationship between lean and I4.0. This qualitative study is primarily an attempt to map experts' feedback to establish the relationship between these two domains.

Key Words: Industry 4.0, Lean

1. Introduction

Lean manufacturing methodology achieves operational excellence through waste reduction, standardization of processes, instilling the ethos of constant improvement (Powell et al., 2012). Nevertheless, with the ever-increasing complexity of the business environment, numerous corporations are finding that lean manufacturing tools by themselves are not sufficient to overcome many operational challenges (Simpson and Power, 2005; De Treville and Antonakis 2006)

Global manufacturing industries are experiencing the 4th Industrial revolution, regarded as Industry 4.0 (I4.0). This is giving birth to smart factories, many of which are already producing smart products (Kagermann, 2015; Liao et al., 2017; Almada, 2016). The future will be dominated by companies which quickly transform current businesses into I4.0 smart manufacturing which will supply smart products and services across the world markets. (Liao, et al., 2017; Li, 2018)

Lean Production techniques are retaining their importance since they enable adding value by continuously reducing all kinds of waste. On the other side, I4.0 technologies focus on creating low latency; digitized artificial intelligence enabled real-time processes. To enable this requires the use of flexible and adaptable autonomous machines and equipment plus collaborating shop floor workers and top floor managers; all working together to produce smart products for smart customers. Organizations are looking for optimization of their processes by the deployment of I4.0 technologies to improve productivity, quality and reduce risks across the system. This study endeavors to establish the relationship between lean tools and I4.0 technologies.

2 Literature Review

2.1 Overview of Industry 4.0

"Industry 4.0 is digitalization of manufacturing built around cyber-physical systems and has the potential of the radical transformation of the manufacturing sector"(Chief Operating Officer of an Indian Manufacturing organization)

“I4.0 is the fourth industrial revolution”, made possible by disruptive internet technologies that are dynamically redefining the way organizations create, shape, deliver and service products (Liao et al., 2017) These systems monitor and augment practically all existing processes across the complete life cycle of products, Processes and devices have become inseparable in I4.0. The citation table of I4.0 technologies is given in table 1

Table 1: Summary of I4.0 technologies

Industry 4.0 (I4.0) technology	Overview	Citation
Advanced Robotics	Advanced industrial robots are designed to collaborate with supplementary systems and humans in real time. They have embedded electronic software, integrated sensors, actuators and standardized interfaces that enable them to wirelessly connect with the internet and interact in real time with other equipment and establish human collaboration	Bahrin et al., 2016; Almada,2016; Bloss 2016; Oesterreich &Teuteberg, 2016; Liao et al., 201; Lu, 2017; Jones & Pimdee, 2017
Additive Manufacturing	3D Printing used for rapid prototyping and production components. The focus is on creating in situ 3D centers to produce components so as to minimize transportation, inventory and other lean manufacturing defined waste.	Bahrin et al., 2016; Almada,2016; Oesterreich &Teuteberg, 2016; Park, 2016; Hofmann &Rüsch, 2017; Jones&Pimdee, 2017; Li, 2018
Augmented Reality	Interactive representation of the real-world environment. This is enlarged and improved by computer-generated interpretation of required information. Augmented reality is now possible across sensory perceptions, including auditory, visual, touch, smell, heat/cold and pressure. Innumerable applications are possible, including customer co-creation, remote maintenance, predictive maintenance, virtually guided self-service, and remote monitoring and control.	Almada,2016; Bloss 2016; Oesterreich &Teuteberg, 2016 ; Liao et al., 2017; Lu, 2017;Jones & Pimdee, 2017;
Simulation	Rapid experimentation and simulation methodologies are modeling tools that are used to predict and evaluate the potential of complex systems and give unique empowerment and autonomy to operators, machines and processes.	Almada,2016; Bloss 2016; Bahrin et al., 2016; Jones & Pimdee, 2017; Li, 2018
Vertical and Horizontal Integration	Horizontal Integration is a modular system that connects the data, information across entire value chain. Vertical Integration pulls together information from across all verticals and levels of the organization and seamlessly exchanges this across all levels of the organization. It covers all activities of the Manufacturing Execution System (MES).It links through Wi-Fi, in real time, all steps in the firm's internal processes using sensor-generated data which has been converted into decision-focused information.	Almada,2016; Park, 2016; Oesterreich &Teuteberg, 2016; Jones & Pimdee, 2017;Liao et al., 2017
Internet of Things (IOT)	IoT establishes inter-connections across objects and humans using internet technologies. Industrial IoT enables networking of machines, manufacturing operations, managers, engineers, plant workers, suppliers, products and customers. Real-time communication between all networked entities is an essential requirement.	Kagermann, 2015; Bahrin et al., 2016; Almada,2016; Park, 2016; Hofmann & Rüsch, 2017; Jones & Pimdee, 2017; Lu, 2017

Cloud Computing	Industrial cloud computing involves real-time computing and management of a very large amount of data using an open network for instantaneous availability of data through value chain.	Bahrin et al., 2016; Almada,2016; Jiafu et al., 2016; Jones & Pimdee, 2017;Liao et al., 2017; Li, 2018
Cybersecurity	Ensuring secure operations within connected networks and open systems is a challenging requirement of digitized industries and their supply chain operations.	Adam et al., 2016; Bahrin et al., 2016; Hofmann & Rüsck, 2017; Jones & Pimdee, 2017; De Sousa et al., 2018
Big Data and Big Data Analytics	This involves storing and retrieving unstructured, raw data which is being continuously generated in diverse formats and in huge quantities Big data analytics uses qualitative and quantitative techniques to make sense of raw big data and convert it into information which is used for arriving at autonomous as well as guided business decisions across all product development and manufacturing processes and other decision points.	Almada,2016; Liao et al., 2017; Hofmann & Rüsck, 2017; Jones & Pimdee, 2017; Liao et al., 2017

2.2 Lean Manufacturing

“Lean manufacturing is all about optimization of the process by reducing the wastages by better management of workplaces, just in time production by value stream mapping and pull production” (Head Operational excellence of an Indian manufacturing organization)

Lean manufacturing technologies have an objective of relentlessly curtailing unwanted wastages in the entire value chain and maximizing flow (Seth and Gupta, 2005; Alves et al. 2012). This philosophy focuses on satisfying customer needs, leading to a competitive advantage for the manufacturer (Storch and Lim, 1999). The objective is real-time optimization of products, services, internal processes and all the process steps across the supply chain. This enables matching supply and demand across all sub-processes (Haque and Moore, 2004; Simpson and Power, 2005). Lean comprises use a set of tools, such as Hoshin Kanri, the two lean pillars Jidoka and Just in Time, 5S and Visual Factory, Line Balancing, Continuous flow, Gemba, Single Minute Exchange of Die (SMED), Kaizen, Kanban, 3M (Muda, Mura, Muri), Total Productive Maintenance (TPM), Poka-Yoke, PDCA, Work Standardization, Value Stream Mapping, and Continuous Flow. (Mohanty et al., 2007; Powell et al., 2012)

2.3 Integrating Lean tools with I4.0 technologies

“I4.0 is a subdivision of lean methods, the whole lot Industry 4.0 can be perceived as the slice of the lean approach” (Director of a German organization)

“The smart industrial technologies of I4.0 focus to archive the same effects like lean i.e. waste elimination, continual improvements, value for customers” (Chief Operating Officer of a Taiwan company based in India)

“Lean tools and Industry 4.0 technologies work together to recognize the unexploited possibilities in manufacturing” (Director Minister of Industrial Promotion, Government of India)

“Industry 4.0 technologies are a stimulating concept for a new level of automation to improve efficiency in the lean plants” (V.P of an Indian manufacturing organization)

The authors have summarised the feedback received from 25 experts of Industry 4.0 and Lean to establish the relationship between these two concepts, given in figure 1

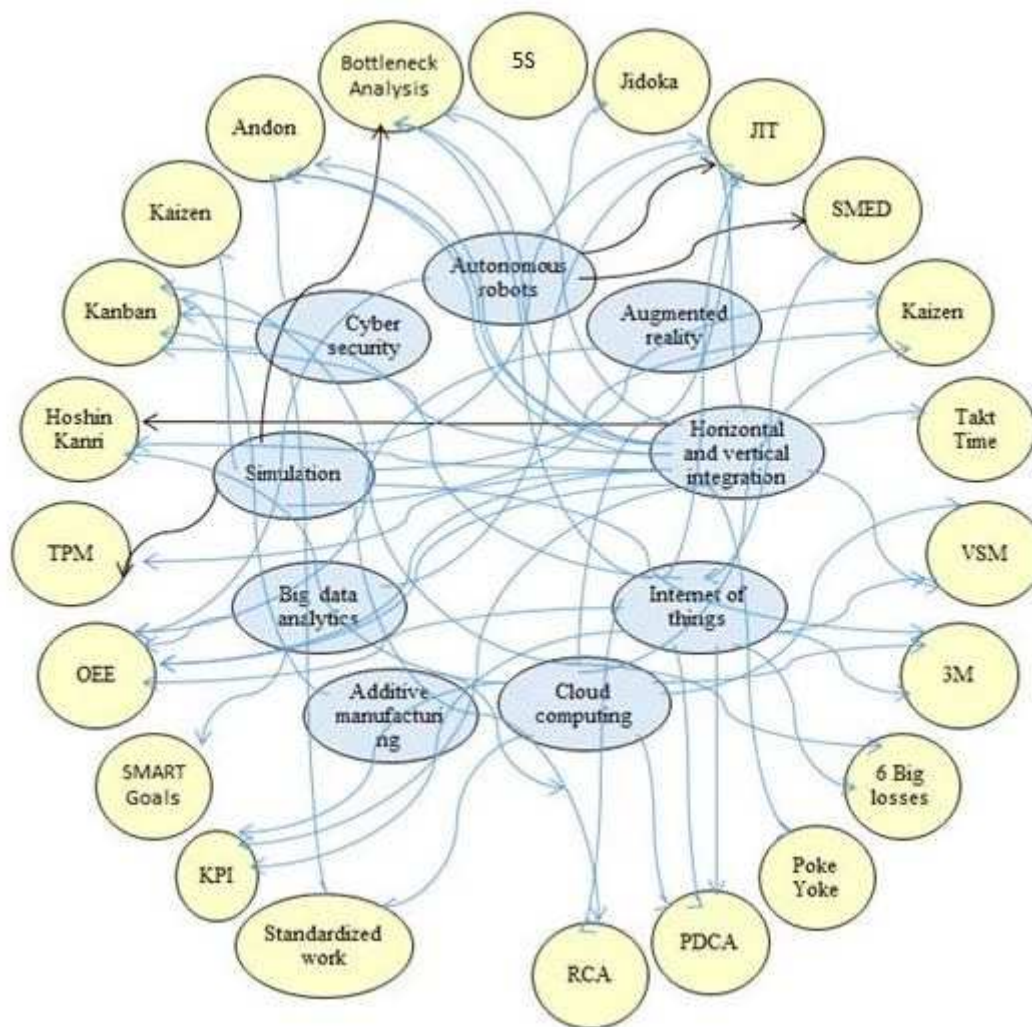


Figure 1: Relation between Industry 4.0 technologies and Lean tools

3 Conclusion

This study carried out a comprehensive literature review. This was followed by a qualitative survey of experts in the field of I4.0 and Lean. The objective of the survey was to establish a relationship between I4.0 technologies and lean tools. We found that both I4.0 and Lean in tandem to achieve common goals i.e. focus on process simplification, eliminating waste across the supply chain, optimizing customer value, quick product redesign and productionizing to meet emerging customer needs, and achieving mass customization at minimum cost.

Relationship diagram, as in Figure 1, is designed to serve as a ready reckoner for policymakers, industrialists and researchers in Asia to develop strategies for effective transformation of current lean plants into Industry 4.0 smart factories that will innovatively develop and supply smart products and services.

Going forward, validation of the relationship diagram by quantitative research is seen as a potential area for future research work.

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Making Innovation work for your company

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Several companies have invested significant resources in innovation related programs with very poor outcomes. This has made such companies walk away from further investment into innovation. It is important that they realize “doing the right things” has to be matched by “doing them right”. While innovation is the right thing to be pursued by any company it is important that they align their innovation related programs for realizing harmonious and stellar outcomes. Getting the Innovation Culture right, pursuing the innovation programs to realize the mission and vision of the company, engineering the Innovation DNA required to generate successful innovation outcomes and monitoring and managing Innovation Efficiencies are some of the aspects of “doing things right.”

Innovation Culture

Several companies have rushed into innovation projects without attempting to institutionalize an innovation culture. Any culture is often defined by shared vision and values by its community. The components of innovation culture include policies, programs, management and the Innovation DNA.

Key Innovation related factors

There are six key factors that any company should be clear about before they set out on their innovation journey and these are - Innovation Strategy, Innovation type, Value discipline, Innovation Leadership Style, Growth Strategy and Innovation Focus.

Innovation Strategy is a plan that a company can use for creating innovations. There are three popular types of innovation strategy – Market reader, Need seeker and Technology Driver. These are defined below.

Innovation Strategy Type	Objective
Market Reader	Create products customized to local markets and geographies
Need Seeker	Consult external sources to create need based innovations
Technology Driver	Use technology innovations to develop low cost innovations

All three of the above out together aim to deliver superior performance and quality

A company can define a portfolio of innovations wherein different innovation efforts can deploy any of the four innovation strategies.

Innovation Leadership Style: This is the emphasis that a company places when creating innovations. There are four possible leadership styles for a company to choose from. These are listed in the table below. A company can choose different leadership styles for different innovation projects. For example a new product or service will use growth orientation whereas service innovations that have short lifespan will choose agile leadership. A company's offering that is in a sunset stage may focus on profit maximization whereas a company focused on lowering its business costs could choose to adopt Asset Utilization approach

Innovation Leadership Style	Key Principle
Agile	Always ready to respond to changes in market
Asset Utilization	No new purchases until all assets are fully utilized
Growth Orientation	Delegated decision making in order to increase revenues
Profit Maximization	Increasing profits is the main management goal and innovations to achieve this goal

Value Discipline: This defines what is considered to be important in developing and delivering innovations. There are four value disciplines as shown in the table below. A contract manufacturing company might focus on operational excellence as the value discipline whereas a fast moving consumer goods company may choose customer intimacy as its value discipline.

Value Discipline	Characteristics
Customer Intimacy	Focus on life time value of customers
Operational Excellence	Standardization of operating procedures
Product / Service Leadership	Emphasize on constant innovation
Sustainability	Focus on environmental and reusability considerations

Innovation Types: There are four basic types of innovation, as given by the table below. A company with low risk appetite might choose use process and incremental innovations whereas startups, in general pursue disruptive innovations to upstage the industry leaders. Some companies may choose modify or replace their business models in order to deliver superior value to their customers.

Innovation Type	Main focus
Business Model	New ways of delivering value and making profits
Disruptive	Birth of new generation of products and services
Process	Improving quality and efficiency
Sustaining / incremental	Incremental improvements in cost, quality or function

Growth Strategy: Companies have four options for designing their growth strategies. They could enhance the functionality of their current offerings, or add new offerings to expand their product portfolio. Sometimes companies choose to extend their product offerings by entering a new line of business. Exit can be used as a growth strategy by redirecting resources used for maintaining an offering in a sunset industry to innovations that are in an evolving market.

Growth Strategy	Description
Enhance	Add functionality or features to current offerings
Exit	Drop an existing business or market – redirect
Expand	Add new offerings / enter new geographic markets
Extend	Enter a new line of business / add new business models

Innovation Focus: Companies can create innovations to improve the performance, safety and security of their customers or they could focus on creating innovations that meet the emotional needs of their customers. Generally speaking enterprises would be keen to purchase innovations that improve their own performance whereas consumers are more likely to look for innovations that satisfy their emotional needs. Safety and security will be of interest to both enterprises and consumers albeit at different levels of granularity.

Innovation Focus	Description
Performance	Innovations that deliver significantly higher performance
Emotion	Innovations that meet the emotional requirements of consumers
Security	Innovations that improves the security of an individual or enterprise
Safety	Innovations that improves the safety of an individual or enterprise

Innovation DNA and Business Transformation

A company's Innovation DNA is made up of six elements – three internal and three external. The three internal elements are the business organization, business goal and business strategy. The three external elements are market maturity, technology innovation deployed and the type of customer.

Business organization refers to decision making behavior and archetypes in a company. Business goal refers to whether a company is focused on topline growth or bottom line health. Business strategy refers to whether a company prefers to be a pioneer or a fast follower with regard to innovation opportunities. Markets can be either well developed or in early stage without a market leader. Customers can be either consumers or enterprises. Technologies used could be disruptive in nature or mature / incremental improvements.

Given three internal and three external factors, there can be sixty four innovation DNAs. The sixty four innovation DNAs or Innograms are discussed in detail in the Kindle ebook titled I Ching of Innovation [1]. The first step for any company is to clearly understand its current Innovation DNA.

Each Innovation DNA defines and to some extent constrains the type of innovation, leadership style and value discipline that can be pursued by a company. It also defines innovation strategy, growth strategy and Innovation focus. It is futile for a company to create innovations that are not aligned with its Innovation DNA. Such attempts are likely to result in wasted resources with no significant impact on a company's top and bottom lines. The following tables present an Innovation DNA and the corresponding six factors.

Innovation DNA 1	
Business Goal	Increase profits through increasing revenue
Business organization	Hierarchical Management
Business Strategy	Fast Follower
Type of Technology	Disruptive
Type of Markets	Well Developed
Type of Customers	Enterprises

Six factors defined by Innovation DNA 1	
Innovation Strategy	Market Reader
Innovation Type	Business Model Innovation
Value Discipline	Operational Excellence
Leadership Principle	Growth
Growth Strategy	Extend
Innovation Focus	Performance

Every company ought to critically assess whether its current Innovation DNA will help achieve its vision. If a company feels the need to change its Innovation DNA it then ought to examine which of the remaining sixty three Innovation DNA best suited for achieving its vision. Once the target Innovation DNA is clearly identified a company can take the steps to transform itself from its current state to the desired state.

A company can have teams that each work with a different Innovation DNA although that company might still have an overarching Innovation DNA.

Mission, Vision, Values and Innovation DNA

It is critical for every company to reexamine their mission and vision statements periodically to ensure that they are relevant with respect to progresses in technology and markets. Once their mission and vision statements are reviewed and revised, it is very important for companies to choose the right Innovation DNA that can help them achieve their vision. That company should align its core values to the chosen Innovation DNA.

The goals of a company should be derived from its desired vision. Each of the goals ought to be decomposed into sets of SMART (Specific, Measurable, Achievable, Relevant and Time defined) *Objectives*. These SMART *Objectives* should be the basis for defining the innovation policies, programmes, portfolios and projects of the company. SMART *Objectives* of

a company should be aligned with its Innovation DNA. For example if a company's Innovation DNA suggests a business model innovation then all *Objectives* should be driven by business model innovations.

The SMART Objectives of different parts of a company may require different facets of Innovation. For example, an *Objective* to create next generation products will demand a disruptive innovation, while a second *Objective* to expand a company's current product line will require an adjacent innovation, whereas a third *Objective* such as Offline to Online sales will require a business model innovation. Pursuing a disruptive innovation is the riskiest. It is important to assess whether the elements required to create a disruptive innovation are available and aligned. The Kindle eBook on Discovering Disruptions [2] describes a methodology that can be used to ensure that a disruptive innovation project is ready to take off. The Kindle eBook titled Adjacent Innovation Methods [3] describes how to go about identifying adjacent innovation opportunities. A means for constructing a business model innovation can be found in the eBook Business Model Buffet [4].

Innovation Efficiencies

Innovation Efficiency can be defined as how well a company is able to define, design, develop, market and service its innovations. It is measured in terms of the resources expended on each of the innovation projects. A company with high Innovation Efficiency will be able to create its innovations with minimal resources.

What is not measured cannot be managed. Hence companies should get their innovation offices to track the performances of their innovation projects. It is easy when a company practices Stage-Gate method to develop its innovations. The resources deployed at each stage gate pair and the number of revisions or iterations at a stage gate pair can be measured to better manage Innovation Efficiencies. More information on Information Efficiencies can be found in [5].

Summary

Companies can get better results from their investment into innovation related programmes if they can choose the right Innovation DNA required to realize their Vision, generate SMART *Objectives* from their vision and monitor and improve their innovation efficiencies.

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Desai has developed proprietary innovation opportunity identification and design methods for Adjacent Innovations, Business Model Innovations, Disruptive Innovations, Incremental Innovations and Service Innovations that were used by his students to start companies. Desai has also developed methods for designing and implementing innovation culture in large institutions. He had oversight and first hand responsibility in creating and nurturing innovation culture at Kent Ridge Digital labs and Singapore Management University. Industry / Corporate engagement: Desai has conducted innovation training for top level executives from Abbott labs, DuPont, Overseas Chinese Banking Corporation, Peter Tan Organization, Proctor and Gamble, Salim Group, Singapore Airlines, Singapore Telecoms and TATA Sons.

How To Win Customers And Influence Sales In Co-operative Banks Using Digital Transformation

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Over the last few years the transformative effect of Technology has touched every sector especially Banking and Financial Services, however though large institutions might have benefited from this, smaller banks especially those in the co-operative sector and those engaged in achieving the altruistic motto of financial inclusion, have been left far behind.

Powerful trends have been restructuring the banking industry since the 90's, Banking Automation has seen the implementation of Core Banking Systems (CBS), Automated Teller machines (ATM), followed by Phone Banking, Net Banking in early 2000 and then revolutionised by Mobile Banking in the last decade. While it has been easy for Private Banks and Public Sector Banks to implement these It has been several years of trials and tribulations for Co-operative banks trying to keep up with the evolution of technology. Just when we thought that Innovation has hit a plateau, Banks are faced with newer technologies like Analytics, Artificial Intelligence, Big Data, Blockchain, Business Process Management, Customer Relationship Management, Robotic Process Automation and several competing technologies in the Payments Space like the NPCI, PayTM etc.

Technology has not only improved the efficiency of operations but in certain cases has changed the Banking landscape by redefining the business model. Take the example of today's payment systems like PayTM that has dramatically reduced the cost of transactions involving small amounts enabling local grocers and tuck shop owners to accept payments without the need for exchanging cash. Technologies like these dramatically reduce the cost of doing business and should adopted by co-operative banks to keep their Operating costs low without even a slight deterioration in customer service.

Competing in an environment dominated by large players is difficult unless you provide a value proposition that can be unsurpassed in the short term. With the right approach co-operative Banks can harness the very technologies that are used by the big players to provide value and win customers and influence sales. To begin with Co-operative banks have to take three key decisions

1. What is the role they want to play in the society?
2. Which business' they want to transform.
3. How to digitise these business'

It's very important that the key stakeholders of the Co-operative Banks are involved when eliciting answers to these questions. Having the answers to these questions sets the direction for Digital Transformation. In our case the focus is on customer engagement platforms to increase sales.

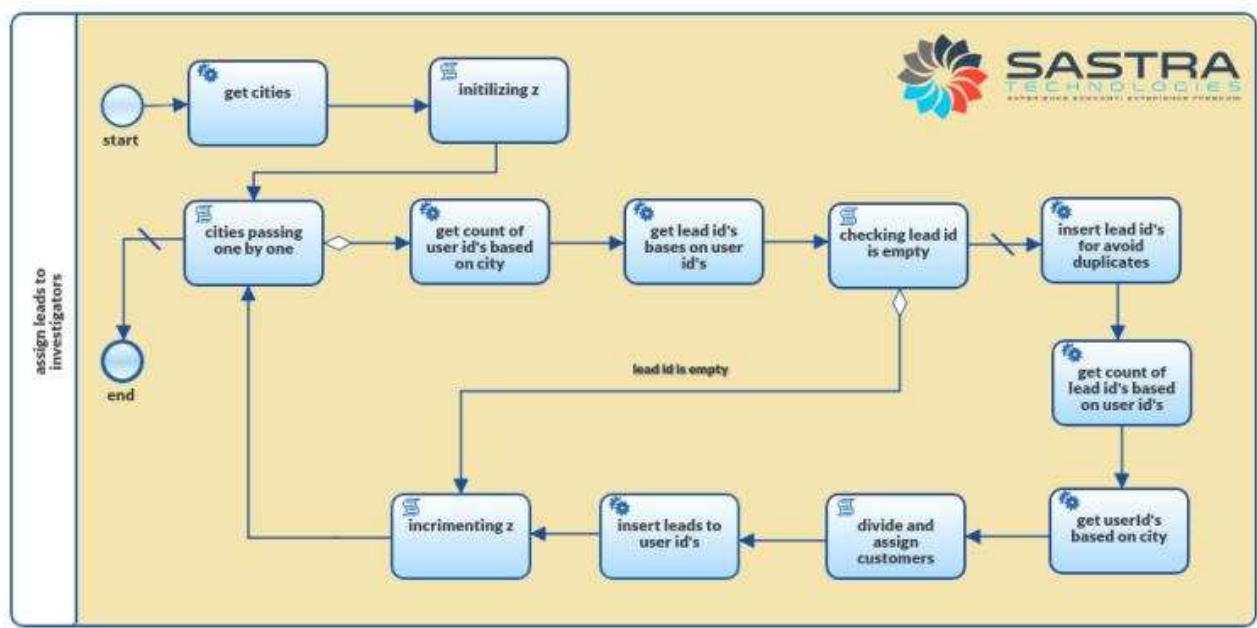
Bank customers can be very demanding and service requests can pour in at the Branches and stretch the abilities of your staff. Delays in servicing these requests can cause further strain in your relationships with the Customer. Its important that, no matter how big or small the customer is, your staff will need to

- Tackle customer complaints quickly
- Speed up transaction Processing

This is possible by implementing a Customer Centric Process to help your staff improve their Customer Engagement skills.

Begin with a lofty ideal of End to End digitisation, this will ensure that you will not have to change your platforms mid-way through the transformation journey. All sub and satellite systems should feed into this platform. This ensures that you have established standard semantics for information exchange. To achieve this you could evaluate platforms with BPM (Business Process Management) and Messaging Capabilities like Appiyo BPM, IBM WebSphere, Pega and TIBCO.

Then proceed to create highly decoupled systems for other customer functions like Customer Origination, On boarding, etc in the Bank. These systems should communicate to the platform using RESTful API's. You could take the automation one notch higher by creating a reusable rule repository that can be used for automatic credit Underwriting, Risk Assessment and other function that include a lot of processing and that which can be prone to human errors. The image below depicts the BPM workflow and rules for a Field Investigation.



Next automate routine activities like EOD jobs, Cheque Book Issuing etc using Robotic Process Automation this will free up Human resources for the other projects in your Digital transformation journey. The tools mentioned above have some RPA capabilities However you might want to evaluate additional tools like UI Path and Blue Prism for fine grained functionality and control.

Then look at Analytics and Big Data to deliver insights into your customer's exposure and relationship with the bank. This will give you sufficient information to Cross Sell products and achieve Customer delight. D3 Charts has a rich palette of visualisations that you might want to evaluate for this purpose.

You can then evaluate Artificial Intelligence, Bots and Complex Machine Learning algorithms that provide the first level of customer support or predict the behaviour of a customer as you traverse through your Digital Transformation journey.

While relentlessly pursuing automation in your digital transformation journey do remember to introduce safeguards in your automation tools that trigger when certain criteria are met. For example create alerts and notifications when you see a large number of loans being approved by a single person in a span of a few days.

Technology is an enabler not an inhibitor so it's essential that the fear of technology is removed from the minds of the bank staff. Train your staff to be comfortable with the new Technology. Enlist the support of local educational institutions to help you in your Digital Transformation journey. Technology does not just raise the bar, it is a game changer.

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Digital transformation: online guide to digital business transformation

Digital transformation is the profound transformation of business and organizational activities, processes, competencies and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way, with present and future shifts in mind.

While digital transformation is predominantly used in a business context, it also impacts other organizations such as governments, public sector agencies and organizations which are involved in tackling societal challenges such as pollution and aging populations by leveraging one or more of these existing and emerging technologies.

In some countries, such as Japan, digital transformation even aims to impact all aspects of life with the country's Society 5.0 initiative, which goes far beyond the limited Industry 4.0 vision in other countries.

This online guide explores the essence of digital transformation

- Digital business transformation – a holistic approach
- Digital transformation and the usual suspects – beware of hype
- Digital transformation happens everywhere
- Digital transformation myths and realities
- The evolution of digital transformation: towards a DX economy
- Pro-sponsiveness and pro-daptation: focus on future and outcomes
- Digital transformation, digitization and essential elements
- Digital transformation: getting strategic
- Digital transformation and the customer experience
- Digital transformation and marketing
- Digital transformation and hyper-connected optimization
- Digital transformation and the key role of data and information
- Digital transformation across various industries
- Digital transformation beyond technology: the human differentiator
- Digital transformation and linear management thinking
- Digital transformation – the inevitable definition discussions

Access the guide at <https://www.i-scoop.eu/digital-transformation/>

Machine Learning, the Next Milestone in Human Evolution

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The day by day developments pertaining to machine learning (which also includes deep learning) for Artificial Intelligence (AI) is keenly watched by Professionals, bureaucrats, top management of Fortune 500 companies and Governments all over the world since it is strategically important not to miss this new technology and to catch up early so as to reap the benefits of this determining technology of the future. This article addresses the various milestones in the evolution of Machine Learning and AI, Major Types of Machine Learning algorithms, widely used programming languages, some current applications, and future directions.

PREAMBLE

Human civilizations have been witnessing many path-breaking inventions since the Industrial Revolution of the 18th Century. Artificial Intelligence (AI) through Machine Learning is expected to be the next major milestone in Science and Technology. According to a Forbes report, world leaders in Information Technology including, Google, Microsoft, Spotify, IBM, Apple, Uber, Skype, Salesforce, Tesla, Shell, Netflix, Facebook, Amazon, Intel, and eBay are planning to invest US\$ 203 billion just for AI research [1].

During the past five decades, the lives of ordinary human beings have been undergoing continual improvements and quality of life has improved manifold. The IBM PC spearheaded the Information Technology bubble in the early 1970s. It enabled computer communications, chiseled by the DARPA project in the US, by many persons and organizations. Handheld mobile phones and later smart phones really took technology to each individual whether it is a street vendor or a multi-billionaire, thus giving a practical demonstration of Inclusiveness at one go, which National leaders could not achieve fully for centuries, but mobile technology achieved it in a short timeframe. Today, the total number of mobile phones in use is far greater than the human population in the world.

HISTORY

A century ago cognitive function comprising of the four steps namely perception, reasoning, learning and problem solving was the prerogative of human minds. Artificial Intelligence (AI) is a discipline created to mimic cognitive functions of the human mind in machines. Some of the technologies evolved to enable AI to solve business problems are Robotics, autonomous vehicle, and machine learning.

Machine learning is the technique by which one can predict the future with the past data. Amazing! There are many contributors to the emergence of Machine Learning as a practical technique with a large number of applications. Machine Learning algorithms were proposed decades ago. Artificial Neural Networks (ANN) was also proposed decades before. Then if we ponder over the question as to why Machine learning was not in the limelight much earlier and why suddenly everyone from students to Prime Ministers of countries are concerned about it? It is because the necessary computing power was not available ever before at affordable costs. For instance, when India entered supercomputing Research in the late 1980s the target was to build a supercomputer with peak computing speed of 1 Giga floating point operations per second (GFLOPS) at a cost of crores of Indian Rupees (INR). Today the Graphical Processing Units abbreviated as GPU with a speed of 16312.32 GFLOPs for single precision and 509.76 GFLOPS for double precision floating point numbers [2] are available off-the-shelf in thousands of INR. In fact, the availability of such enormous computing power at affordable costs is one of the drivers for accelerated growth of Artificial Intelligence through machine learning.

The next important reason for the current interest in Machine Learning (ML) is the explosion of the Internet and later social media. Social media produces exabytes of data every day. What is an exabyte? It is 10^{18} bytes. Try to express this in decimal number format and see the number of zeros after 1. (It is 1 followed by 18 zeros.). Since the inception of computers and till the year 2005, 130 Exabyte of data were created by human beings; by the year 2010 it was 1200 Exabyte, by the year 2015 it was 7900 Exabyte and by the end of the year 2020, it will be 40900 Exabyte of data that would have been created. Don't underestimate this phenomenal growth of data creation. An intelligent Data Scientist can derive innumerable hypotheses with this data and earn billions of dollar profit. This can determine the future of peoples and Nations. Essentially the growth of speed of computing and generation of the phenomenally high volume of data are the prime movers of Machine Learning.

It is interesting to view the timeline in the evolution of AI and Machine Learning [3].

- 1805: French Mathematician Adrien-Marie Legendre publishes the least square method for regression. The method is still used popularly in supervised ML and Software Reliability Engineering.
- 1958: French Mathematician Frank Rosenblatt develops the Perceptron algorithm, an early type of artificial neural network (ANN).
- 1959: American computer scientist Arthur Samuel coins the term “machine learning”.
- 1965: Birth of Deep Learning - Ukrainian mathematician Alexey Grigorevich Ivakhnenko develops the first learning algorithms for supervised multilayer artificial neural networks (ANNs).
- 1989: French computer scientist Yann LeCun, now director of AI research for Facebook, and others publish a paper describing how a type of artificial neural network called a convolutional neural network (CNN) is well suited for shape-recognition tasks.
- 1991: The European Organization for Nuclear Research (CERN) opens up the World Wide Web to the public.
- 1997: Recurrent Neural Networks were used to make improvements in the conversion of speech to text.
- 2002: Amazon launches its cloud-based storage and computing power to users.
- 2004: Facebook launched
- 2004: Computer scientist Jeff Dean (current head of Google Brain) and Google software engineer Sanjay Ghemawat develop MapReduce to deal with immense amounts of data by parallelizing processes across large data sets using a substantial number of computers.
- 2005: YouTube launched
- 2006: Inspired by Google’s MapReduce, computer scientists Doug Cutting and Mike Cafarella develop the Hadoop software to store and process very large data sets.
- 2006: Geoffrey Hinton proposes a methodology to accelerate backpropagation algorithm in Deep Neural Networks
- 2007: Apple launches the smart phone
- 2017: Google announced an upgraded version of the tensor processing unit (TPU) with 180 million teraflops of computing power.

The above [3] gives not only the evolution of ML but computers in general. ML already finds its applications in smart mobile phones and it is not far off when ML becomes highly pervasive even among non-programmer professionals.

ML TYPES

The major categories of ML are listed below:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

We briefly discuss the salient points about them now.

Supervised Learning (SL)

The goal in SL is to learn a mapping from inputs X to outputs y , given a labeled set of input-output pairs as expressed below [4]:

$$D = \{(X_i, y_i)\}; i=1 \text{ to } N.$$

- Here D is called the training set and
- N is the number of training examples.

Each training input X_i is a D - dimensional vector of numbers, representing, say, the height and age of a person. These are called features, attributes or covariates. In general, however, X_i could be a complex structured object, such as an image, a sentence, an email message, a time series, a molecular shape, a graph, etc.

The form of the output or response variable y_i could be a categorical or nominal variable from some finite set, $y_i \in \{1, \dots, C\}$ (such as male or female), or a real-valued scalar (such as the height of a person). When y_i is real-valued, the problem is known as regression. When y_i is categorical, the problem is known as Classification or pattern recognition. Another variant, known as ordinal regression, occurs where label space y_i has some natural ordering, such as grades A–F.

Some common regression problems are given below:

- Weather prediction
- Estimating the selling price of a house

Linear regression, Polynomial regression and classification and regression trees (CART) are widely used SL algorithms.

Some examples of Classification follow:

- Facial Recognition System
- Handwriting Recognition System

The popular classification algorithms are given below:

- Logistic Regression
- K Nearest Neighbour
- Naïve Bayes
- Support Vector Machines
- Random Forest
- Artificial Neural Networks
- Convolutional Neural Network

Unsupervised Learning

Unsupervised learning algorithms analyze the features without being given an explicit response variable. The Unsupervised ML algorithms identify groups of data that exhibit similar behavior. For instance, there are a collection of children. The features known are their age, their height and their weight at birth. If we plot the three features in a scatter plot we will get distinct patterns. We may find three clusters. We may identify the clusters as obese children, average children, and thin children. We do this labeling after we plot the features whereas in classification the labels are predetermined. This is an example of Unsupervised Learning. Some examples of unsupervised learning are given below:

- E-commerce User Groups
- Biological cells or specimen clustering
- URLs clustering

The popular clustering algorithms include the following [5]:

- K means clustering
- Hierarchical clustering
- K Medoids clustering

Reinforcement learning

These algorithms are used when there is insufficient data. So the learning in Reinforcement algorithm is by trial and error. The goal is to maximize rewards it receives for its actions. The only way to learn about the environment of the business problem is to interact with it. For instance, in advancing loans to customers in a financial institution calls for Reinforcement Learning. This is the area of the future. Google Deepmind uses Reinforcement Learning to play games.

PROGRAMMING LANGUAGES FOR MACHINE LEARNING

Python and R languages are preferred for ML applications. It may be noted that both these languages are open source i.e. they are available free for download from the World Wide Web (www). Brief notes on these two languages which contain rich libraries to carry out complex tasks are given below.

Python

Python is a powerful, flexible, object oriented and interpreted language that is easy to learn, easy to use, and has powerful libraries for carrying out complex machine language tasks in concise codes. Estimating parameters or weights of machine learning model is critical, challenging and interesting task. The following 2 lines of Python code can be used to train an Artificial Neural Network (ANN) to find the weights of already specified ANN. The total number of weights of the ANN could be as large as needed and the code is independent of the same.

```
classifier.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])
classifier.fit(X_train, y_train, batch_size=10, nb_epoch=100)
```

The reader need not try to understand the code. But what is intended to be conveyed is that because of the open source libraries available in Python compact code can be written.

Its simple syntax is very accessible to programming novices and will look familiar to anyone with experience in C/C++ or Java. For over a decade, Python has been used in scientific computing and highly quantitative domains such as finance, oil and gas, physics, and signal processing. It has been used to improve Space Shuttle mission design, process images from the Hubble Space Telescope, and was instrumental in orchestrating the physics experiments which led to the discovery of the Higgs Boson (the so-called "God particle").

The R language

R is one of the statistical packages such as SPSS, SAS, and NCSS. Like Python, it is compatible with Windows, Macintosh, UNIX, and Linux platforms and offers extensible, open source libraries and computing environment. The R environment provides similar functions as Python offers. It also results in compact code due to its large number of libraries. There are no license requirements both for R and Python. At the same time, they provide a large number of libraries for data analytics and machine learning. Therefore the Machine Learning architects can convert their algorithms to machine code with ease and with no surprises by using any of the two languages.

APPLICATIONS

There are many applications of Machine Learning and Artificial Intelligence. For instance, a machine learning powered computer could defeat the world chess champion. In another instance, Machine Learning negated the diagnosis of the world's leading doctors of malignant cancer in a patient. Driverless cars are going to be seen on the road soon. The Business to Customer (B to C) segment is witnessing fast growth with Amazon and NetFlix generating huge income through their eCommerce worldwide. As a corollary to this, independent Recommendation systems sector is expected to catch up. Recommending what books or Television Receiver consumers may buy based on preferences of other customers with similar attributes is what Recommender System does [6]. The disciplines of Software Reliability Engineering and ML are both branches of Statistical Learning and ML has already been applied to Software Reliability Growth Modeling [7]. Some applications where AI has already made inroads are given below:

- Facial Recognition
- Speech Recognition
- Speech to text and vice versa
- Recommendation Systems
- Medical Diagnostics
- Selection of most attractive advertisement, given many variants of the same with Reinforcement Learning

There are many other applications where AI will be increasingly used:

- Healthcare
- Retail business
- Travel
- Transport and logistics
- Media and Entertainment
- Education
- Agriculture

The list is neither complete nor exhaustive and an intelligent mind can identify many innovative applications of Machine Learning and AI.

SUMMARY AND CONCLUSION

The gainful usage of machine learning for Artificial Intelligence has been facilitated by growing computing power and explosion of data. It will gain further momentum with increasing computing power and development of new algorithms.

Reinforcement Learning is an area to be watched for its further stride and penetration in new sectors such as aerospace and defense. The concern at the moment is the accuracy levels achieved by various machine learning algorithms and therefore it will attract more research in this area. Machine learning discipline has grown very large with many disciplines and aggressive research programs by business leaders worldwide. It is going to change our way of thinking and make life more and more productive and efficient thereby improving quality of life.

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Seasons of Code

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Introduction

“There are two parts to learning craftsmanship: knowledge and work.” ~ Robert C. Martin

Free (Libre) and Open Source Software (FLOSS) provides the users the freedom to execute, study, distribute and make modifications to the software source code. It is licensed software, and the license permits these four freedoms as mentioned in the definition of Free Software [1]. The experience of working in a FLOSS project will open up your minds to endless possibilities. Apart from improving your technical and non-technical skills, it gives you an opportunity to work with team members from different parts of the world. There are a number of “Seasons of Code” programs for FLOSS projects that students can participate for free to enrich their work experience. This is more than an internship opportunity that one gets from working in a company. In this article, we will explore some of these programs that are held during the Summer or Winter months in a calendar year.

Google Summer of Code

The Google Summer of Code, or GSOC [2], is the most popular program in the community that began in 2005. It is held annually, worldwide, between the months of April and May. A number of FLOSS projects participate in the program, and the software artifacts are released under a FLOSS compatible license. The “Help” link [3] in their web site provides useful resources for both students and mentors about the program. A timeline exists from the announcement of the program to selection of participating organizations, submission of student application and accepting the student proposals. Project evaluations are done periodically, and the results of the pass/fail status are announced at the end of the program. The student participant is given a stipend on successful completion of the project. Over 14,000+ students from 109 different countries have participated in the program over the years.

Dgplug Summer Training

The Linux Users’ Group of Durgapur (Dgplug) [4] follow the “learn and teach others” principle, and meet online at #dgplug on irc.freenode.net (Freenode server) [5]. They organize a summer training program [6], every year, starting in the month of June. Unlike other training programs, this never ends, and the participants continue to interact with the Dgplug members even after a three month period. The training is conducted through Internet Relay Chat (IRC) [7], and thus requires a basic Internet connection. Using a GNU/Linux distribution for hands-on exercises is highly recommended. A number of topics ranging from communication guidelines, shell commands, editors, documentation, licensing, and FLOSS tools are taught as part of the foundation training. After the three month time frame, students are equipped to work on FLOSS projects. This program has been running online since 2008.

Kharagpur Winter of Code

The Kharagpur Open Source Society at the Indian Institute of Technology, Kharagpur organizes the Kharagpur Winter of Code, or KWOC [8], every year in November. It is a five week long program for students to contribute to FLOSS projects. Mentors can register their projects and interested students can engage with them. The prime audience are freshmen and sophomore students who need one-to-one mentorship in working with FLOSS projects. A Mentor’s Manual [9] is available on their web site for reference. The actual project development starts in the first week of December. The final reports are submitted by the first week of January for evaluation. Program managers oversee the communication between the mentors and the participating students. This program was started in 2016.

Rails Girls Summer of Code

The Rails Girls Summer of Code [10] program is to encourage women to participate in Free (Libre) and Open Source Software projects. It is a not-for-profit organization that relies upon donations from sponsors and the community. The participants work in two-person teams along with the guidance of a mentor. The program is suitable for those who are interested in taking up programming as a full-time profession, and also to improve their knowledge and skills. The participants get a stipend for the three-month project work. This program runs between the months of July and September, annually and worldwide. You can engage with the program as a student, sponsor, coach, mentor, or supervisor. The program has been running since 2013.

Outreachy

Outreachy [11] program is a three-month, paid internship program, which was formerly known as the Free and Open Source Software Outreach Program for Women. The program is not just limited to students and developers, but also for

people interested in changing careers or who are returning from a break or a long leave of absence. A stipend of \$5,500 USD is given to the participant and remote work is allowed. Interns are also provided \$500 USD for attending conferences or events. A detailed Call for Outreachy Community Participation guideline document is available on their web site [12]. The program runs between May and August, every year and worldwide. It first began in 2006, and is today organized by the Software Freedom Conservancy [13] and funded by the GNOME Foundation [14], Google, participating organizations and other software companies.

Conclusion

“Never stop learning because life never stops teaching.”

Learning is a continuous process, and in our field it is important to keep reading and studying to improve ourselves periodically. The different Season of Code programs give participants an opportunity to gain knowledge and work experience that can greatly broaden their horizons. It is also important that students continue to engage with the FLOSS project after the end of the program, for not just the time that they have spent, but also a way to continue to give back to the community. In the long run, the experience gained is valuable to help the participants grow professionally, and it also helps the sustenance of FLOSS projects.

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Shakthi Kannan is a Free Software enthusiast who blogs at shakthimaan.com [1]. He has been organizing numerous Free (Libre) Open Source Software (FLOSS) workshops in India over the years [2], and also writes for Open Source For You (OSFY) [3] magazine. Apart from the large volume of FLOSS documentation and presentations that he has created [4], he has also written a book for students and IT professionals on getting started in working with FLOSS projects titled "i want 2 do project. tell me wat 2 do." [5] At present, he plays a Senior DevOps Engineer role at Aerospike Inc. in Bengaluru. His online presence goes by the name @shakthimaan, and his documented photo gallery is accessible [6]. He holds a Master of Science in Information Technology degree from Rochester Institute of Technology,

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Techniques for efficient ETL Jobs using Apache Spark

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Introduction

Apache Spark offers a rich programming platform for big data processing. The platform is highly scalable and resilient against failures. The programming interface is available as an extension of high level languages – Scala, Python and Java. The programming is modeled after traditional idioms of those languages plus on Structured Query Language (SQL).

One of the important class of applications for this platform is what is known in Data warehousing Industry as Extract, Transform and Load or ETL. In this article we present three unconventional techniques that enhance the traditional methods of ETL, under certain circumstances. These techniques individually improve the efficiency of ETL, but since they are complementary they offer even more benefits when applied together.

Traditional techniques and their limitations

Traditional ETL methods require the programmer to specify as a code snippet what should happen on each data row. Occasionally one would want to drop the row because it does not meet certain criteria. Otherwise it is a one-to-one mapping of input row to an output row. This works fairly well in most situations. But problems arise when one or more of the following situations are encountered:

- The input files are not partitioned in the right size or partitioned in a non-uniform fashion. When this happens the output is also organized in the same pattern as input leaving the output also in a suboptimal way. Big data systems work well when the files are organized as a small to medium number of fairly large files (256 MB is typical). A “large number of small files” kills the system performance.
- It is true that Spark allows to coalesce any data into desired number of partitions. This operation is relatively cheap, but it does not allow the programmer to choose the size of the partition but rather the number of them. Unless the input size is fairly predictable, it is difficult to achieve correct partition size across job runs. Typical workloads generate data that varies with the time of the day and/or day of the week and, in general, not predictable.
- The other method to “repartition” using “partitionByKey” is even less performant and less predictable in terms of resource needs.
- Sometimes, one needs to produce ETL outputs in more than one format. For example, in a data lake one would like to keep data sets in both Apache Avro and Apache Parquet format. Apache Avro is a row-oriented storage and optimized for bulk processing of data in the data lake. On the other hand Apache Parquet is a columnar format optimized for ad-hoc querying using SQL using products like Impala or Presto. In traditional ETL methods, if more than one format needs to be produced, then one has to scan the entire data sets as many times as the number of output formats. If there is not enough memory to hold the entire data set, then the data is serialized into temporary persistent store and deserialized when needed.
- Spark has excellent support for writing different file formats such as Apache Avro and Apache Parquet. But the code is optimized for generality rather than performance. So there are several layers of data transformation between the in-memory representations and on-disk representation. This in turn consumes more memory and CPU.
- Spark, like many other big data platforms, requires the user to specify ahead of time the number and size of executors. Getting these two numbers is not straightforward. One has to essentially guess something that would work. If the guess is too small, the job may fail to execute stating “OutOfMemoryException”. If the guess is too large, the resources will go unused. In today’s cloud computing environments, unused compute resources directly translate to money left on the table.
- The above problem is even more challenging if the size of data changes from one job execution to another.

Our techniques

As mentioned earlier, our techniques consist of three ideas. They are:

- Use custom low-level serialization routines
- Produce output as side effect rather than as a global operation
- Use block-level file merge for file size optimization

We describe these ideas in detail in the following sections. These ideas are fairly independent of each other and hence can be employed either individually or collectively depending on your taste, your team’s expertise and nature of your workload.

Low-level serialization

Spark offers excellent support for serializing data into several popular formats. However, it involves some form of “generalization” before serialization. By generalization, we mean conversion of data objects into a single generic form so that the serialization libraries can handle them. (An alternative to this approach is to use reflection which is worse in terms of performance). Since the primary language of Spark is Scala and the underlying runtime environment is JVM, this generalization step typically mean converting into some combination of maps and lists and conversion of primitive types into their corresponding wrapper classes. Both these operations increase memory footprint and processing time. It also puts pressure on JVM’s garbage collector.

All these problems can be solved by writing one’s own custom serialization code which converts Scala objects directly into serialized byte streams. (All modern file formats offer pretty good support for low-level operations in their libraries). Such code is extremely efficient. But here we are trading programmer time execution time, which is a controversial decision. Often, critics point out that the cost of maintenance of this custom code is prohibitive. In our case, it did not prove to be so. The output schema for the ETL jobs has been robustly stable and we didn’t need to spend a lot of effort in maintaining this code. But that is a valid concern for many organization.

One option to overcome this criticism is to use code generators which generate the custom code based on the schema. But then, the skills required to write code generators is not commonplace.

Output as side-effect

This is perhaps the most important idea of the three. Here, first, instead of handling each input row at a time, we look at one partition at a time. Typically a single input partition corresponds to either a single input file or (if the file is block structured) a block. We then use the low-level IO routines mentioned above (or generic routines provided by serialization libraries) to save the records in the partitions into a output file. If multiple output formats are required, all those formats can be written at once. By this we ensure that the same record need not ever be seen more than once.

So when a single input partition has been processed, we end up writing one file per output format and nothing is left in memory. That is why we call this technique “producing output as side effect”. Thus we can process a very large amount of data without using a large amount of memory – at most one partition is kept in memory at a time. A larger amount of input data means more time to process it – there is no nasty OutOfMemoryException.

There could be two objections to this method:

- We end up having one file per input partition per output format. There are a lot of them and Big Data hates a “large number of small files”. So this is an anti-pattern. The answer to this objection is the next idea described below.
- Side effects are harmful in functional and/or distributed programming because, when a portion of work needs to be rerun because of runtime errors, side effects cease to be atomic. So if a portion of task is rerun, then you end up having more than one output file per input partition per output format. The output thus may not even be correct. A simple way to overcome this problem is to ensure that the file produced for each input partition and output format is deterministically and uniquely chosen so that if work is repeated for the same input partition, the output files are also the same. When writing such output files, we must ensure that we overwrite any existing file with the same name. This ensures that exactly one file is produced per input partition per output format.

File merge

Spark’s default way to combine large number of small files into small number of large files is to load the data into a data frame or data set and repartition (or coalesce) into the desired number of partitions and save it back. Obviously this is resource intensive as each row is deserialized to its fullest detail and reserialized. As mentioned earlier, there is no simple way to decide the number of partitions even though we know approximate size of output partition.

Fortunately for us all popular file formats – Apache Avro, Apache Parquet and Apache ORC are organized as blocks internally. CSV can be split into block cheaply. Compressed CSV could be troublesome. Fortunately for us ETLs do not produce CSVs as often as other file formats. Even otherwise, CSV (compressed or otherwise) entire files can be treated as blocks, provided there are no header rows. Compressed CSV files with header rows is hard-luck.

Typical block sizes are in the order of a few megabytes to tens of megabytes. For example, for Parquet typical block size is 2 to 3 MB and for Avro it is 64 MB. Also in all these file formats, one can deconstruct files into blocks and reconstruct files again from the blocks without ever looking into the blocks themselves. The algorithm to pack such files is the standard distributed bin-packing algorithms which are well-known. This method is three to four orders of magnitude faster than naïve Spark technique. Since the bin-packing algorithm can take the size of the “bin” instead of the number of bins, we end up having relatively uniform sized output files. All these file formats compress the contents inside the blocks and never

across the blocks. So the files size extremely predictable given the sizes of blocks inside them. As a bonus we don't have to un-compress or recompress the blocks.

All these files are generated in a temporary location instead of their final location in order to prevent potential consumers of these "work in progress" files. When the final version is ready they are moved into the final output location.

Performance improvements

With successive implementation of the above techniques, we could achieve up to six-fold improvement in performance when saving data into two format. Of the three techniques, low-level serialization provided up to 2x performance improvement and saving output as side effect improved performance by about 3x and hence 6x improvement overall. We have been using these methods over 3 years in production with no significant problems.

Pitfalls

No set of techniques will work in all situations. Here are some potential problems of these techniques and possible ways to work around them:

- Fragmentation. If the input partitions are too small or if the output is partitioned on keys whose cardinality is big, we end up having output files each with a single small block. Because we do not merge more than one block into a larger block, we may end up with output files with a large number of small blocks. Even though the situation is not as bad as large "number of small files", the effect is not zero. The of fragmentation is varied across file formats:
 - Almost all file formats do poor compression when block size is small and hence will need more storage and more processing
 - Performance improvement seen when using columnar storage is diminished when the blocks are too small. Pruning is a technique used by query systems to skip blocks altogether when it can be proven that the blocks are not going to contribute to the query. Pruning is less effective during query execution if the blocks are small or numerous.
- One way to avoid fragmentation is to detect when fragmentation happens and then use the standard spark load-and-repartition method to remove it. If we do that, we may discover that certain jobs are not suitable for the improvements described in this article and simply abandon them.
- Not easy to implement. These ideas are neat and produce excellent results, but most Spark teams may not have the required skill set to write low-level serialization code or block level file merge operations. Even if the teams produce such code, maintaining them may be expensive. Of course this drawback can be alleviated by publishing open source code for file merge and code generators for custom serialization. If we do that, the users of these need not spend a lot of time developing or maintaining it. We never found time to open source our work.

Note: We presented the technique in Strata Data Conference in New York in Sep 2017:
<https://conferences.oreilly.com/strata/strata-ny-2017/public/schedule/detail/60729>

About the author



Thiru has been building software systems for three decades. Apart from his day job, he is presently the PMC Chair of Apache Avro Project, which he helped found in 2009. His current interests include large scale distributed systems for batch and low-latency web services. He has built some innovative performant and resilient products on top of the current and past crop of Big Data platforms. In the past he worked on desktop search, web search and advertising platforms, cloud platforms and deployment automation in Yahoo! He has been developing and using cloud product for the past 10 years and has been in the forefront of server-less computing. In his current job, among other things, he has put Content Delivery Network into innovative use for beaconing solutions.

US FDA has helped develop a free-to-play horror video game in a bid to curb smoking among youth aged 12 to 17. Part of FDA's "The Real Cost" youth tobacco prevention campaign, only one out of four players can escape the game. 'One Leaves' is inspired by statistics depicting three out of four high school smokers continue on to adulthood.

Swedish luxury automaker Volvo announced vehicles starting 2021 will come with a "Care Key" that lets users set speed limits on vehicles when powered on with it. This follows the automaker's recent announcement that it will limit top-speed of all vehicles starting 2020 to 180 kmph. Volvo had also announced a camera monitoring system to detect drunk or distracted driving.

DeepVoice & DeepFakes: Exploiting AI-Generated Audio & Video – Boon & Bane

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Introduction:

We all are aware of the fast-pace that AI is exploiting various domains. All of those can never be enumerated in a single article yet; the most trending advancement is discussed in this article in a bipolar view point. Ardent followers of Artificial Intelligence & Machine Learning will be well aware of the raising upswing in the technology in the early 2018 – AI generated audio and video. It enthrals many at the same time, intimidates most. Let us discuss this in both the viewpoints.

It was bone-chilling shock catered by the Chinese technology giant Baidu in mid-March 2018. They released a white-paper in Arxiv[1], where they claimed that they can clone the voice of any Homo-Sapien with a training audio of less than five seconds, with implications for both trust and security. According to the article published, the AI algorithm developed named “Deep Voice” was capable of cloning the voice of any individual to believable extent such that, many human subjects as a part of study experiment conducted during the beta test considered it truthful.

Deep Voice - Evolution:

Almost a year ago, the system required about half an hour of audio input to generate, a fake audio clip. But, now after much effort of the developers, the technology is now able to create much better results with training input of just 3.7 seconds that accounts for shorter than a whole sentence, especially just one sample to learn from.

Baidu did not stop this interesting evil inside their labs; they uploaded an array of code and system demos into Github[2], demonstrating the capabilities of Deep Voice (the sample demos, range from hilarious to creepy). These include voice cloning and various manipulations, such as changing the voice from male to female or even British to American.

Soon, it stimulated many artistic Machine Learning enthusiasts to fork on their versions. Deep Speech[3], that asks to you to speak less and makes you speechless. It was a work of Mozilla, of about 1400 commits and 63 contributors in GitHub, based on Baidu's work.

One of the most notable work, is of Lyrebird.ai, a Montreal-based start-up that kick-started in 2017, with a team of four individuals (including an Indian guy), in a small rental room in the other side of a coffee shop will make you stunned with their artefact. The growing start-up asks the user to under a three step process: First, the user is required to provide a voice clip for just a minute; then, processes it in the next minute; finally, the user can type all that he wants the AI to speak. Their awesomeness upraised them to feature in Bloomberg [4].

Negative Outlook:

While Baidu writes that ‘Voice cloning is expected to have significant applications in the direction of personalisation in human-machine interfaces’, but there arises natural concerns about identity theft and privacy.

Tom Harwood, CPO and co-founder at voice security solutions provider Aeriandi, said: "This technology is poised to transform personalisation in human-machine interfaces, but it raises serious concerns about voice biometric security systems. Soon, criminals will need just a few seconds of someone's voice to cheat a voice recognition security system - voice biometric authentication will be rendered useless. Organisations need to be thinking now about how they can implement new technologies to ensure they stay ahead of the curve. Voice fraud detection technology is the primary candidate, as it looks at far more than the user's voice print; it considers hundreds, if not thousands, of other parameters. For example, is the phone number being used legitimate? Has it been used fraudulently before? Increasingly, phone fraud attacks come from overseas. Voice fraud technology has been proven to protect against this as well as domestic threats."

Positive Usages:

But where can we implement Deep Voice, where it results in no harm to either the society or an individual? It can be used to create the best experience of late actors, in case if we want them to play any role in future movies. As, we know, their visual imagery can be generate with motion capture, the AI concocted voice of the dead actor can provide the most realistic experience to the audience, if and only if, we accept that it hits badly at the daily bread of mimicry and voice actors.

DeepFakes – Real fake face of AI:

The development of Deep Voice to require only minimal training speech could further raise distrust in internet media - mimicking the ‘deepfakes’ fake celebrity porn videos that began popping up earlier this year. Moreover, earlier in April

2018, Barack Obama called President Trump a “total and complete dipshit?”. Okay, that was an AI generated video, that exacted the former President of the United States. It was enacted by Jordan Peele, with BuzzFeed as a warning to us all about how deep fakes could be used to distort reality, and it has been a constant topic around political and societal stability, how we can all protect ourselves against being duped, and the potential consequences if we can’t.[5]

Fake videos can now be created using a machine learning technique called a “generative adversarial network”, or a GAN. A graduate student, Ian Goodfellow, invented GANs in 2014 as a way to algorithmically generate new types of data out of existing data sets. For instance, a GAN can look at thousands of photos of Barack Obama, and then produce a new photo that approximates those photos without being an exact copy of any one of them, as if it has come up with an entirely new portrait of the former president not yet taken.

The use of this machine learning technique was mostly limited to the AI research community until late 2017, when a Reddit user who went by the moniker “Deepfakes” – a portmanteau of “deep learning” and “fake” – started posting digitally altered pornographic videos. He was building GANs using TensorFlow, Google’s free open source machine learning software, to superimpose celebrities’ faces on the bodies of women in pornographic movies.

A number of media outlets reported on the porn videos, which became known as “deep fakes”. In response, Reddit banned them for violating the site’s content policy against involuntary pornography. By this stage, however, the creator of the videos had released FakeApp, an easy-to-use platform for making forged media. The free software effectively democratized the power of GANs. Suddenly, anyone with access to the internet and pictures of a person’s face could generate their own deep fake.

Negative Concerns:

“The marketplace of ideas already suffers from truth decay as our networked information environment interacts in toxic ways with our cognitive biases,” a report reads. “Deep fakes will exacerbate this problem significantly.”

In August, an international team of researchers affiliated with Germany’s Max Planck Institute for Informatics unveiled a technique for producing what they called “deep video portraits”, a sort of facial ventriloquism, where one person can take control of another person’s face and make it say or do things at will. A video accompanying the research paper depicted a researcher opening his mouth and a corresponding moving image of Barack Obama opening his mouth; the researcher then moves his head to the side, and so does synthetic Obama.

Positive Perspective:

Christian Theobalt, a researcher involved in the study, told that he imagines deep video portraits will be used most effectively for accurate dubbing in foreign films, advanced face editing techniques for post-production in film, and special effects. In a press release that accompanied the original paper, the researchers acknowledged potential misuse of their technology, but emphasized how their approach – capable of synthesizing faces that look “nearly indistinguishable from ground truth” – could make “a real difference to the visual entertainment industry”.

Hany Farid, professor of computer science at the University of California, Berkeley, believes that although the machine learning-powered breakthroughs in computer graphics are impressive, researchers should be more cognizant of the broader social and political ramifications of what they’re creating. “The special effects community will love these new technologies,” Farid told[6].

New Problem to face for Cyber Security Specialists:

Farid, who has spent the past 20 years developing forensic technology to identify digital forgeries, is currently working on new detection methods to counteract the spread of deep fakes. One of Farid’s recent breakthroughs has been focusing on subtle changes of color that occur in the face as blood is pumped in and out. The signal is so minute that the machine learning software is unable to pick it up – at least for now.

Isn’t this new opening, in cyber security a positive perspective? It really is, for passionate cyber security enthusiasts.

Conclusion:

It is not the first time, the world encounters forgery, it has been there for eras. Every technology has its own pros and cons. Though in this concern, the negativity outweighs the positive aspects, if people are enlightened and if proper solutions are attained such that, if another AI could possibly differentiate a legitimate video and fake one, then that should be called a true development.

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About the Author:



Ms. K. Visalini is a five World Records and 13 International Certifications holder. She was directly admitted in the B.Tech program as an Exceptional Candidate, after her 8th grade at school. She had completed the four year B.Tech degree programme in three years with a GPA of 9.6 out of 10 and excelled with Honours.

The Indian Prime Minister Shri. Narendra Modi lauded her with the quote "Visalini, Whatever you have achieved in this young age is a great service to our country India" and wished her luck for her future endeavours. She was honoured twice at the age of 3 and 14, for her achievements by the former President of India, Dr. APJ. Abdul Kalam.

At the age of 15, Visalini was invited by the Director – ISRO (Indian Space Research Organization), to deliver a technical lecture to 700+ ISRO Scientists on "Big Data & AI for ISRO". Her lecture received huge applause & standing ovation from the scientists and a model of the Mangalyaan Satellite (Sent to MARS by ISRO) was presented to her. She was entrusted with a vital project for ISRO: ISAC-VNMS (ISRO Satellite Center – Visalini's Network Management System) and was provided two years duration, but she had completed within 35 days & dedicated to the Nation at the age of 15.

From the age of 11, Ms. K. Visalini was invited as a guest/invited speaker to deliver keynote addresses in 12 International Conferences, including two TEDx & Google India Summit. She is well described as an Enthusiastic & Passionate Researcher, working in Artificial Intelligence, Cognitive Neuroscience, Virtual Reality & Autonomous Navigation Agents. She is also working in multiple projects simultaneously, of which the most vital are: Emergency Rescue Equipment for Indian Soldiers, Rescue Equipment for Fishermen during Natural Calamities, SOS Equipment for Women, Assistive Technology for Mentally-Challenged and Visually-Impaired Students.

For more info pl. visit www.kvisalini.com

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SUNIL AGARWAL & AJIT NINAN



Social Listening through Sentiment Analysis

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Abstract

Sentiment analysis, otherwise known as opinion mining is a much quoted but often misunderstood term. Sentiment is a feeling or emotion, an attitude or opinion conveyed. In this article we are looking at methods and procedures to understand the sentiment with special reference to social media. The challenges and the commonly used tools are also discussed.

Sentiment Analysis – An introduction

The exponential growth of World Wide Web and social media is generating massive volume of unstructured data through social interactions. This has increased the need for analysing the content shared over the media. This channel opened up new areas to explore by addressing the core questions in social sciences with the ability to collect and process data. Social media channels like Twitter and FaceBook engage users and influencers and these interactions have become a part of our daily life routine.

Sentiment analysis, otherwise known as opinion mining is a much quoted but often misunderstood term. This is the process of understanding the emotional tone beneath an expression, for understanding of the attitudes, opinions and emotions expressed. Sentiment analysis is extremely useful in social media monitoring as it allows us to gain an understanding of the wider public opinion behind the topics. The ability to understand insights from social data is found helpful and is being widely adopted by organisations world wide.

Social Sentiment analysis uses natural language processing (NLP) techniques to analyse social conversations online and determine deeper context as they apply to a topic, brand or theme. This computational task of automatically determining the feelings behind the expression can be a simple distinction (positive vs. negative), or can also be more fine-grained by identifying the emotion like fear, joy or anger expressed. Our net sentiment score and brand passion index show how users feel about your brand and compares across your competitors.

Like all the other fields, advances in machine learning and Deep learning in particular, has brought significant advances in the area of Sentiment Analysis also. The natural language processing methods including statistical methods and text analysis are used to extract the general sentiments into positive, negative or neutral sentiments.

Users share posts, photos, videos, comments, live events etc. through social media. Companies and organisations use this channel to promote products and engage with customers. Social sentiment analysis accepts these contents like posts, tweets, status updates etc., analyses the sentences and tries to find the sentiment to a given set of documents. The comments and reviews can be categorised as positive, negative or neutral.

Sentiment Analysis Methods

The sentiment analysis system can be classified under one of these three mentioned below:

- 1) Rule-based systems
- 2) Machine learning techniques
- 3) Hybrid systems that combine both rule based and machine learning approaches.

Rule Based Systems

The rule based system uses a dictionary of words labelled by sentiment to determine the sentiment of a sentence. To make it better sentiment scores will be combined with additional rules to mitigate sentences containing negations, sarcasm, or dependent clauses. The rules-based sentiment analysis are very simple, hence makes it a good option for basic document-level sentiment scoring of predictable text documents.

The rules are made using inputs like:

- NLP techniques like *stemming*, *tokenization*, *part of speech tagging* and *parsing*.
- Dictionary resources like lexicons (i.e. lists of words and expressions).

A simple rule-based implementation is as follows:

- The list of definite polarised words are defined (e.g. negative words like *bad*, *worst*, *ugly*, etc and positive words like *good*, *best*, *beautiful*, etc).
- In a document, the number of positive words and negative words that appear in the text are counted.
- The sentiment is calculated based on the count. If the count of positive word appearances is greater than the number of negative word appearances, it is treated as positive sentiment, or else it is treated as a negative sentiment. Otherwise, return neutral.

This system is very naïve as the combination of words are not considered in a sequence. But the challenge is that a rules-based system must contain a rule for every word combination in library which needs manual intervention. The advanced processing will make this system get very complex quickly. It is difficult to maintain due to addition of new rules to support new expressions and vocabulary.

Machine Learning Models

It is practically not possible to create a sentiment analysis rule set to account for every potential meaning. Hence to overcome the above said difficulties, machine learning techniques are used to automate the low-level text analytics functions including Part of Speech tagging. Machine learning models are trained to identify nouns by feeding it a large volume of text documents containing pre-tagged examples. The model learns using supervised and unsupervised machine learning techniques. This is a data driven approach using labelled corpus of their text and their sentiments to predict. Machine learning models create model by training with large amount of data

The classification step usually involves a statistical model like Naïve Bayes, Regression, Support Vector Machines, or Neural Networks like Deep Learning methods:

Hybrid Models

A combination of machine learning with traditional rules to make up for the deficiencies of each approach is Hybrid model.

Rules-based sentiment analysis is an effective way to build a basis for PoS tagging and sentiment analysis. But the disadvantage is that these rule sets quickly increase in size to become unmanageable. This is where machine learning can step in to shoulder the load of complex natural language processing tasks, such as understanding double-meanings.

Most hybrid sentiment analysis systems combine machine learning with software rules across the entire text analytics function stack, from low-level tokenization and syntax analysis all the way up to the highest-levels of sentiment analysis.

Sentiment Analysis- procedure

Information Extraction, the basic step in the processing of textual information for extracting main components and relationship. Each document is tokenised and annotated. These processed words are basic lexical units and denoted as tags. A configurable stop word list and syntactic filter is applied to refine the selection to most relevant lexical unit. A graph of tag co-occurrences are created.

The steps involved can be describes as shown below:

Data Collection and Pre-processing

Users express their opinions at various social network sites, blogs, review sites etc. in different format.. The large temporal data is generated through social conversations. These data are from different sources and hence is heterogeneous in nature. This need to be cleaned and should be converted to structured format from unstructured format. Data cleansing includes reformatting, de-duplication, merging and filtering.

The text undergoes pre-processing task where the text is prepared for processing with the help of linguistic tools like tokenisation, sentence spitting, morphological analysis etc. The text document is broken down into its component parts like sentences, phrases, tokens and parts of speech. Part of Speech tagging is the process of identifying the structural elements of a text document, such as verbs, nouns, adjectives, and adverbs.

Sentiment Detection and Classification

Sentiment analysis, an NLP task, can be modelled as a classification problem by subjectivity classification and polarity classification. A sentence may be classified as subjective or objective. Subjective sentences express information as

opinions, judgement or speculation. Objective sentences are factual, hence may be ignored in this context. Polarity classification is the process of classifying a sentence expression as positive, negative or neutral opinion. The scope of Sentiment analysis can be at different levels – document level, sentence level or aspect level.

Challenges

The human language is complex. People express their opinions in multiple ways, which are complex at times. The challenge of Sentiment Analysis is the language technologies. It is extremely difficult to teach a machine to analyse the grammatical nuances, cultural variations, slang and misspellings that occur in online mentions. A machine understanding the context, while analysing is also needed many times. The main challenges are :

- **Sarcasm, irony and implications** - Expressions where negative comments using positive words could be wrongly interpreted as a very positive expression
- **Anaphora resolution** – referencing back, resolving what a pronoun or noun phrase is referring to eg - It is his product.
- **Negation Handling** – eg- Fuel consumption is slightly high (double negation)
- **Abbreviations and Emojis** new social media expressions or short ungrammatical utterances like Lol etc.
- **Word ambiguity** - the word sentiment changes with context. Eg; that was not a comedy

Sentiment Analysis Tools

Sentiment analysis used the combination of natural processing tools, text analytics, computational social sciences to understand the feelings as already mentioned. There are a variety of open source text analytic tools used in NLP for information extraction and classification which can be applied to Sentiment Analysis. Some of the popular open source tools are :

- **Stanford's CoreNLP** - in a cohesive library which provides a part-of-speech (POS) tagger, a named entity recognizer (NER), a parser, a coreference resolution system, sentiment analysis, and bootstrapped pattern learning tools.
- **Python's NLTK** – Natural Language Toolkit - is a platform available for Python which is capable of doing textual tokenisation, parsing, classification, stemming, tagging, semantic reasoning and other computational linguistics.
- **R packages** - The RSentiment package helps in analyzing the sentiment of a sentence and assign a score to it. The function `calculate_sentiment` predicts the sentiment of sentences which may be classified into six categories: positive, negative, very positive, very negative, sarcasm and neutral.
- **Weka** – An open source software, which is a collection of machine learning algorithms for data mining tasks

Applications

The business applications of sentiment analysis are very broad and extremely powerful. The ability to extract insights from social data and giving feedback is currently a part of customer service.

Sentiment Analysis or opinion mining is becoming an essential part of the market research and customer service. This gives an insight into opinion of the products or services and a comparison with competitors too. Sentiment analysis reveals the overall customer experience and get into more granular level responses.

This helps in understanding your brand, product, or company as viewed by your customers and stakeholders. Commercial organisations can also use sentiment analysis to measure the impact of a new product, ad campaign, or consumer's response to recent company news on social media.

Simple examples of usage can be:

- Movie review: Is this review positive or negative?
- Product review: What do people think about the new product?
- Politics: How do people view about an issue? What is the opinion about this candidate?
- Prediction: Predict stock markets or election outcomes or market trends

Future and Way forward

Sentiment Analysis is hot trending topic in the field of Natural Language Processing (NLP) and Machine Learning. Sentiment analysis has come a long way from the simple keyword matching to interpret its tone. Initial implementation

was simple logic-based algorithms to identify words as either positive or negative. The current automated systems understand the context and attribute true meaning, learning and getting smarter over time.

It is understood that in the "next-generation" of sentiment analysis, along with emotions in the written content, voice and facial expressions are also measurable. This can lead to personalisation based on facial recognition with the image of customer.

Despite all the challenges and potential problems, the application of artificial intelligence in sentiment analysis is helping in improving communication which provides businesses with more intelligence to act proactively. Some of the current problems faced in Sentiment analysis can be overcome by improved accuracy and consistency in text mining techniques.

In conclusion, sentiment analysis matters a lot to business as it makes your communication smarter and more efficient, helps to make better decisions and measure the impact customer communication. Sentiment analysis has evolved from a simple naive technology to a mainstay in customer service, with more business adding sentiment data into their routine processes.

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About the author



Ms. Mini Ulanat is a technology evangelist with a career spanning about three decades in software & infrastructural development, implementation and management of enterprise IT projects. She is a recipient of several awards and accolades including three prestigious international fellowships -- Chevening Fellowship (UK), Fulbright Scholarship (USA) and CICC Scholarship (Japan). Active in Professional organizations, she has held leadership positions in the local and national committees. She is currently the chair of Women in Engineering (WIE), IEEE Kerala Section. Prior to that she was the chair- IEEE Kochi Sub section, IEEE Computer Society, Kerala Section and National Student Coordinator of Computer Society of India.

Her off the job activities involve driving diversity of leadership in technology by promoting and encouraging women in technology to aspire and reach greater heights through many voluntary activities. She is also a part of other communities and initiatives like Women Techmakers, GDG. She is philanthropically engaged by supporting organization working towards making positive difference in the life of less privileged girls as a mentor and teacher. She is a speaker, moderator, sessions chair for numerous forums and has been serving in various program committees for national and international conferences, workshops and seminars. Ms. Mini Ulanat has been actively involved in organizing and co-coordinating conferences. She is a resource person at all levels from community development programmes at grass root to the scientist of national institutions, involved in reshaping and continuing education programmes to train and retrain outside traditional channels using innovative techniques.

Microsoft and Washington University scientists have developed the first fully automated DNA data storage system that codes digital information into manufactured DNA. The \$10,000 prototype encoded "hello" into DNA in liquid form and translated it back into digital information in 21 hours. Microsoft said that natural DNA found in old bones preserved information for several thousands of years.

A 'robot watchman' is being tested in a residential community in Beijing since December 2018 to replace human night patrol. The 'first-of-its-kind' robot "Meibao" integrates facial recognition, man-machine communication and infrared thermal imagery to monitor illegal activities and also provides useful information like weather updates. Chinese media reported the robot was welcomed by watchmen.

The Neoskilling Imperative for Fostering Innovation

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"And you? When will you begin that long journey into yourself?" (Rumi)

The Diagnosis

For decades, the buzzword in Indian companies and government has been *innovation*. Unfortunately, nothing much emerges from these futile efforts to foster development of indigenous technology. Why?

The Cure

What should Indian companies do to become innovative? The answer: Double and Triple-loop learning, Thinking Obliquely!, and making a Mental Metamorphosis.

Introduction

The rate at which emerging technologies are bringing about sweeping changes in the business scenario is unprecedented. Digital technologies are a key driver for innovation today, in the corporate world and for the overall society. No innovation today is complete without looking at the digital perspective. It is not feasible for the formal education sector to catch up with this pace in making the graduating students industry-ready.

In an interaction with media on the steps taken by AICTE (All India Council for Technical Education), Chairman Prof Anil Sahasrabudhe spoke about transformation in the education sector and steps taken for periodic revision of the curriculum to suit industry needs. According to him, 60% of graduates from technical institutions were not industry ready, pushing AICTE to revise the curriculum at regular intervals. Autonomy is provided to educational institutions. But it will continue to be a game of catching up.

Industry-academia collaboration becomes vital to bridge this gap between demand and supply. Learning & Development is a vital function in this fast paced industrial world, offering a competitive edge to organizations that are proactive in identifying skills and imparting them. We call this skill identification and training of employees as '**Neoskilling**'. Neoskilling is not just the classroom based imparting of digital skills such as programming. It also involves several soft skills such as critical thinking, negotiation, working coherently as a team, with humans and sometimes machines, algorithms and bots, and most importantly innovation.

The corporate world is relatively more nimble and agile when compared to the academia when it comes to matching the pace of disruption due to technologies or 'digital transformation'. Although much of the content and several channels of delivery are made available, the rate at which Neoskilling reaches the masses is found wanting.

Neoskilling in the skill development continuum

Neoskilling is all encompassing for the training department and forward looking. It is at the apex in the continuum of different skill development initiatives, as shown in Fig 1. Skilling is the basic imparting of training where the new workforce is taught practical skills it will need for their day-to-day work and employability. Upskilling is incremental improvement in what one does – a conventional machine tool operator learning to operate a numerically controlled machine for example. Reskilling is a complete shift in one's domain of work by picking up new subject matter knowledge along with the tools required for it. In the automotive industry, the replacement of Internal Combustion (IC) engine driven vehicles with Electric Vehicles (EV) would mean a mass shift in the type of skill sets required for vehicle design and manufacturing, making several traditional competencies obsolete. General Motors recently shifted 75% of its power train engineers to EV development. For organizations that do not focus on Neoskilling, the demand-supply gap in emerging areas will become a roadblock for innovation.

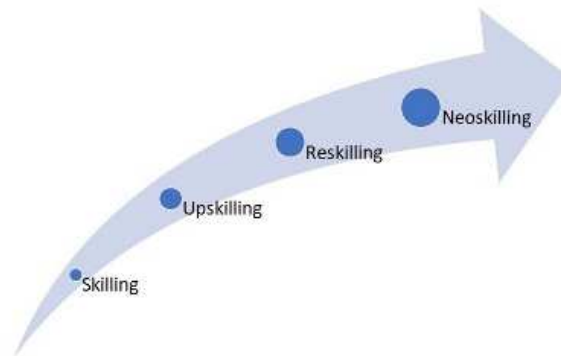
At a macro level, Neoskilling will be required for 'data scientists' to manage and make sense of the large amounts of data that flows in from multiple products and systems. In the automotive industry, its manifestation would be for connected and autonomous driving to guide a vehicle and its performance using inputs from sensors and radars. In healthcare, this would mean the diagnosis of human conditions from x-rays and scans.

For Neoskilling to be successful, leaders planning and implementing it should keep sound incentive plans in place before starting the journey. One of the strong motivating force in the work place for the young working population today is not

just pay or designations but the opportunity to learn and more importantly apply what is learnt in real life, impactful projects. Neoskilling should not stop with imparting the training but go ahead to give opportunities to practice and excel in what is taught. That is the best incentive for skill development in emerging areas.

Neoskilling instills higher-order thinking, including the usage of technology and tools and working with various combinations of digitally driven workforces of the future – robots, collaborative robots, algorithms, bots, virtual colleagues and bosses. It brings about a mental metamorphosis starting from belief in life-long learning to working as coherent teams. It makes a cultural transformation to happen in organizations where the individuals are self-motivated in picking up new skills and putting them to use.

Fig 1. The Neoskilling continuum



According to recent media reports, the Government of India is planning to issue skill vouchers instead of subsidies for its skill development initiatives. These vouchers can be encashed with approved service providers to pick up specific skills ultimately leading to an employment opportunity the individual is aspiring for. Neoskilling is driving democratization of education and employment. Diverse channels of communication from MOOCs, TVs, smart phones, hand held devices and large scale class rooms are used to deliver the content to the masses. No prior experience is required to pick up these skills, attitude to learn being the only requirement.

Recently, a KPMG study found that in 60% of Indian companies, organizational culture was the top barrier to digital transformation. This is not surprising, since in most companies, both managers and employees don't know how to work in *organic, matrix structures* that emphasize an *innovative problem-solving orientation*, and not an *operations orientation*. The result is *risk-averse* sheep and donkeys, but no thorough-bred stallions.

Changing such a mindset calls for fundamental rethinking on the part of both employees and management. While creativity is the conversion of money into ideas, innovation is the conversion of ideas into money. Unless these two activities coexist harmoniously and work together seamlessly, companies will not be able to create value, capture value and deliver value. It helps to understand how and where our companies are failing, and how to rectify this.

Double/Triple-loop Learning

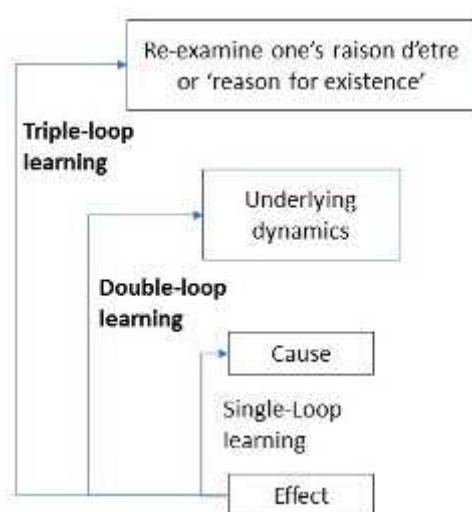
The need of the hour is to eschew the reflexive, knee-jerk, fire-fighting, operations orientation that most managers and administrators excel in, where the emphasis is on short-term *satisficing* to find a course of action that meets minimal requirements to attain a goal. What is needed is a more deliberative, optimized approach.

Single loop is the most commonly used way of learning in which the system works according to set rules in a closed-loop fashion with ongoing feedback, root-cause analyses for issues, solutions, and continuous improvement to operations. Double-loop learning questions the rules, assumptions, and beliefs based on which a system is designed to run. Triple-loop learning questions the very learning process itself and how it happens – learning how to learn, in an effective manner, as shown in Fig 2.

What is lacking in today's organizations is Double and Triple-loop learning, where the feedback goes beyond just day-to-day operations to question the rules and regulations that play a role in the operations. Whistleblower policy will be an example of Double-loop learning. Employees should be given an opportunity to question the policies in an organization. Unfortunately, most of the issues reported in examples of whistleblowing in India are related to financial irregularities and improper conduct in the workplace. They are reactive, after the incident has happened. What is required is proactive reporting of the health of the business in a bottoms-up manner – how well are new products performing in the market, what customers think about them, how relevant are newly introduced policies, how effective are newly signed up partners?

Good organizations should have employee friendly policies that encourage whistleblowing, not just for irregularities but for the performance of the organization, as an opportunity to question the rules. There should be no fear of retaliation.

Fig 2 Double and Triple-loop learning



Another example of Double-loop learning is the Balanced Scorecard approach, proactive in nature, with a 360 degree perspective of a business. It does a roll-down of the strategic objectives of the organization decided at the top most level to metrics at the bottom most level in an organization so that all employees can contribute. It complements financial measures with operational measures⁴.

Madurai based Aravind Eye Care Systems (AECS) was established with the mission of “*Preventing Needless Blindness!*” Around 12 million people in India are blind; 80% of which is needless and could be cured by a simple cataract operation. After a few years, its founder, Dr. G Venkataswamy and his team of Ophthalmologists pondered: “Why do people become blind?”

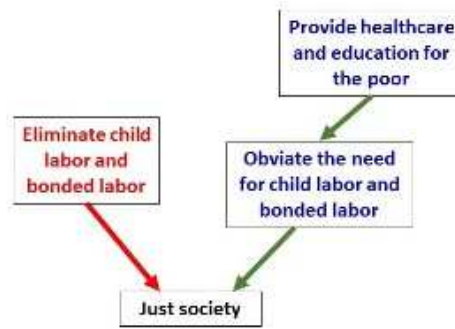
The answer: inadequate nutrition, particularly during childhood. So they established a program of providing nutrition schemes in villages, hoping to obviate the problem of blindness. Aravind is a good example of moving from **curative** - cataract operations (Single-loop), to **preventive** care - nutrition program (Double-loop).

Padma Shree awardee and winner of the Right Livelihood Award, widely known as the 'Alternative Nobel Prize', Dr H Sudarshan's integrated approach to tribal development, with health, education, livelihood, and biodiversity conservation as means to sustainable development and empowerment, is an example for Double and Triple-loop learning. Inspired by Swami Vivekananda (“...they alone live who live for others, the rest are more dead than alive.”), and desiring to emulate Dr. Albert Schweitzer, who went from Germany to Africa, Dr. Sudarshan decided on “Reaching the Unreached!”, in order to ensure a **Just Society**.

The community service he wanted to offer the Solinga tribals in BR Hills near Mysore, was met with resistance initially. He had to win their trust to start offering healthcare services that transformed into preventive care. Preventive healthcare later matured into education and means of livelihood that were skill based. These programs evolved, because it gradually dawned on him that: “...I have no pills to cure poverty!”

Dr Sudarshan's experience in practicing community medicine revealed that the root cause for most of the issues was lack of education. He also realized that merely delivering preventive and curative health care alone was not sufficient to help the impoverished people. So, he started diversifying into community-building and vocational training for skill development, to empower tribals. His underlying philosophy was that poverty should be removed to eliminate diseases. His way of removing poverty was to organize people for their rights, and by fostering self-reliance, as shown in Fig 3.

Fig 3. Making communities self-organizing for a Just Society



A few years ago, an Indian was given the Noble Peace Prize for his efforts at combating child labour. While this is laudable, the laureate did little to address the root causes. Dr. Sudarshan had the intellectual wherewithal to transcend such tunnel vision, and did so through the Vivekananda Girijana Kalayana Kendra (VGKK) that focused on schooling tribal children, and the Karuna Trust that provides primary healthcare in rural India.

Then Dr. Sudarshan asked the logical question: Why is the Government unable to provide education and healthcare to alleviate poverty. Practically every effort, except for a few notable exceptions, is vitiated and stymied by vested interests and bureaucratic inertia. The primary reason: **Pervasive Corruption**, as crooked politicians and venal bureaucrats siphon off the allocated funds. (See Fig. 4)

Fig 4. Ensuring proper flow of funds to alleviate poverty



Corruption in Government, at both Central and State levels is not just pervasive, but very deep rooted. Even a former Prime Minister ruefully noted that not more than 15% of the money allocated goes to the actual recipients or intended beneficiaries.

Dr. Sudarshan therefore became a member of the Kanataka Lokayukta. As the Vigilance Director, he conducted regular visits to government hospitals to take stock of how they were performing and was appreciated for it. He found that the rot started right at the top, and permeated throughout the department. He reported Corruption as the top most concern in his report on Health and Family welfare. He also suggested reforms for good governance and people's movement as a way of preventing corruption (in the form of citizen charters, forums, networking of people with integrity, value based education, using Right to Information Act for transparency, electoral reforms).

In IT, a number of Indian companies like TCS and Infosys, and Cognizant, have made a mark in the ITeS (Information Technology enabled Services) space. They were able to leverage time shift advantage due to the location of the subcontinent, and utilization and deployment of a qualified, low cost, English speaking work force, for onsite or offshore assignments. Now in the face of numerous non-tariff barriers, like H-1B and H4 visa restrictions, they have to re-examine their Theory of Business⁶ – the assumptions based on which a business is built, driving its behavior, decisions and results.

They have to be capable of “Providing comprehensive solutions, not just products & services.” For this they must strive to:

- ** Become a “one-stop shop” or full services provider;
- ** Eschew price-based competition;
- ** Differentiate themselves using the “value offered” proposition.

In other words, this calls for Triple-loop thinking. The industry can no longer be limited to working efficiently as per standard operating procedures. What is expected is a collaborative way of working, encouraging two-way communication with customers, decision makers and technology architects, brainstorming for the best possible solution, questioning the rational and finally deciding the best possible approach to a business challenge or opportunity leveraging software and hardware.

Thinking Obliquely

Thinking Obliquely! is best captured in the book '*Obliquity: Why our goals are best achieved indirectly*', by John Kay (published by Profile, 2010, as reviewed in the UK newspaper The Independent).

“Obliquity is the idea that complex goals are often best pursued indirectly. In general, oblique approaches recognise that complex objectives tend to be imprecisely defined. These objectives contain many elements that aren't necessarily or obviously compatible with each other. Furthermore, we learn about the nature of the objectives and the means of achieving them during a process of experiment and discovery.

“Obliquity recognises that there are no predictable connections between intentions and outcomes. Problem solvers cannot evaluate all available alternatives: they make successive choices from a narrow range of options. Problem solving is iterative and adaptive, rather than direct. Good decision-makers are balancing incompatible and incommensurable objectives. They are eclectic and tend to regard consistency as a make of stubbornness, or ideological blindness, rather than a virtue.

“Effective decision makers are distinguished, not so much by the superior extent of their knowledge, as by their recognition of the limitations of that knowledge. Rationality is not defined by good processes, irrationality lies in persisting with methods and actions that plainly do not work – including the methods and actions that commonly masquerade as rationality.”

In its heydays before independence, Presidency College, Madras, had a unique approach of selecting students for the coveted Honours program. When the candidates walked into an airy interview room, cooled by an open window to let in the sea breeze, one of the things that caught their attention was a large map of the Indian subcontinent. After being grilled on the usual and expected subjects, the head of the interview panel bowled the googly: “Where is the Bay of Bengal?”

If the candidates pointed to the map, they were admitted into the regular stream; if they pointed to the azure blue waters framed by the window, they were admitted to the Honours stream.

Aravind Eye Care Systems has its own way of selecting candidates with a “service orientation” for the nursing cadre. Since *empathy* is critical in its industry, AECS hires young women from villages only, as those from cities cannot relate to those poor and impoverished individuals from rural areas who are the majority of the patients.

The short-listed candidates are usually accompanied by multiple family members, often parents, a common practice in India. They are first asked to come into the interview room individually, with their relatives. If the young woman was dressed grandly, like a minor film star for this special occasion, while her parents are rather plainly dressed, she is likely a spoilt child, a narcissist who won't fit into the organization's work ethos.

On the other hand, if the candidate was dressed simply, in keeping with her socioeconomic status, she has the maturity to know how to live within the constraints of her family income. The parents were thanked and asked to leave the room so that their daughter could be interviewed.

After questions to test subject matter expertise, near the end the young woman is asked: “How much was the bus/train fare to come from the village to the city for the interview?”

Those who don't know, because their parents or relatives purchased the tickets, are excused. Those who give the correct answer (Rs. XX), are more likely to be given appointment letters. This was because of their awareness of worldly realities and they would appreciate the opportunity costs even “free” patients may incur.

The founder of the TVS empire, hit upon a novel idea to distinguish his bus company, TVS Motors, from its competitors. In the Kaveri delta and other southern regions around Madurai, a major rival was TST. The rib-tickling joke percolating within the company and the general public was, that TVS stood for “*Thalla vaendam, sar!*” (No need to push [the bus], sir!), while TST meant “*Thallunga sar, thallunga!*” (Please push [the bus] sir, please push!) due to a breakdown.

The message to employees was clear: **Don't inconvenience customers.** Since the omnibus is a complex mechanical and electrical contraption, no one could guarantee perfection. Therefore, when the vehicle leaves the depot, it must do so in the best condition possible so as not to breakdown unexpectedly, especially on a scorching summer afternoon, on a desolate

rural road, miles from the nearest village or town, thereby unnecessarily inconveniencing paying passengers and giving them a harrowing time.

This slogan became such a part of TVS's DNA that conductors would often stop the bus some distance from the regular stops, so elderly passengers found it easier to alight and walk home. Because of such a customer friendly attitude of the staff, many passengers would rather wait for a TVS bus they knew was coming shortly, rather than take an earlier one by a competitor.

In his book "Shoe Dog", Phil "Buck" Knight, the founder of Nike tells about a *crazy idea* he had while doing graduate studies at Stanford. If the Japanese could produce high quality, inexpensive cameras and make deep inroads into the US market once dominated by Germans, why couldn't they do the same thing in athletic and running shoes? He then went to Japan and found a shoe company that went along with his crazy idea. He convinced a group of Japanese businessmen to export their popular Tiger sneakers to the United States and grant him exclusivity in selling them. The rest, as they say, is history.

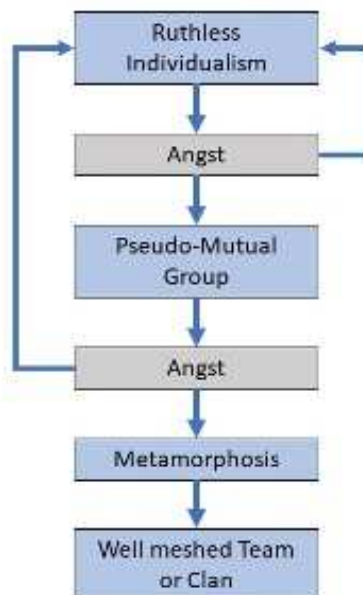
Making a Mental Metamorphosis

To work in *organic, matrix structures*, where the emphasis is on being *innovative problem-solving orientated*, calls for new ways of thinking and behaving. Fig 5 shows the stages of going through the mental metamorphosis from self-centric individuals with strong points of view to becoming an integrated part of a well-meshed team or a clan.

An analogy is the transformation a caterpillar undergoes to become a butterfly, as explained in Trina Paulis' fable "Hope for the Flowers". Individuals believe one could accomplish anything worthwhile only by just working along. Gradually, as they begin to realize their limitations, a sense of *angst* grips them. Some shrug off any doubts and go back to their preconceived notion that only individual efforts succeed. Others, realizing the importance of working with colleagues, succumb to reluctant membership of Pseudo Mutual Groups. As the futility of working in such groups becomes obvious, some revert to their "dog-eat-dog", zero sum views of the world, and seek refuge in Ruthless Individualism.

Others experience the "Road to Damascus!" revelation, and it dawns on them that unless one undergoes a fundamental shift in their view of the world – an attitudinal transformation, it is not possible to work in well-meshed teams of clans, so essential for Neoskilling in this era of digital transformation and the accompanying AI revolution.

Fig. 5 The stages of metamorphosis – from individualism to a team player



Bridging the Chasm

However, not everyone is capable of being proactive, thinking holistically and going to the root cause of the issue. Most tend to be reactive, have a piecemeal approach and address the symptoms rather than the underlying causes!

How does one know what it takes to be the former? Fortunately, there are a number of litmus tests. How could trundling plebeians shed their blinkers and become transformational patricians?

There are some steps:

- First, read the Apple “Graphing calculator” case study.
- Second, read Leo Lionni’s children’s classic **Frederick**.
- Finally, by watching the video “Infinite Vision,” learn from Dr. G Venkataswamy of AECS, how to manage paradoxes and imbibe the wisdom to:
 - Visualize,
 - Organize, and
 - Energize people.

Then you will begin to understand why it took Corning Inc, USA, decades to find a market and applications for its “Gorilla” glass technology developed nearly fifty years ago⁵ (when there were no MBAs around to micromanage Scientists and Engineers), in today’s touch-screen tablets’ displays and high-end TVs, as well as a protective layer over the screens of millions of cell phones and other mobile devices.

Concluding comments

When IBM realized that its performance management system was traditional in approach², it had to be reimagined to favour speed, innovation and high-performance culture. Innovation and speed were becoming important in the new business model over and beyond efficiency. The new system emphasized beyond project management to ‘how’ it was done including the application of new skills and ongoing, continuous feedback, not the annual style of setting up goals and measuring progress against them at the end of the year. Such an approach stressed upon the importance of not just innovation and agility but on reskilling and life-long learning.

As lifelong learning becomes the economic imperative in the digital world, making it a part of our daily work is what the authors³ refer to as “learning in the flow of work”. It is an approach where learning is integrated as part of regular work, invisible and aligned to our corporate lives by leveraging technology.

Technologies and business models which leverage them are changing at a rapid pace for any individual or even a team to keep track of. Large enterprises can think of three roles to manage this pace of change – Gardeners focused on today’s needs for training new employees in skill sets required today, Farmers focused on the medium term at upcoming skills and Foresters who have the big picture and long term in mind for futuristic skills and roles, some of which may not be apparent today.

Beyond all these management ideas, it takes a self-motivated work force aware of what Neoskilling is and practicing it day in and day out, believing in and practicing life-long learning. This work-force of the future is keenly watching emerging trends, knows where and whom to reach out to learn new areas and then put them to good use for the betterment of their own professional career, the parent organization and the overall ecosystem.

Deep down in all of us are two opposing personalities – a Steve Jobs or Dilbert’s pointy-haired boss! Depending on who triumphs, the nation either has a vibrant future or is destined to wallow in the cess pool of perpetual mediocrity!

To ensure the former, one must heed the clarion call of the great sage, Swami Vivekananda: “**Come on, O lions, shake off the delusion that you are sheep...**”

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About the authors



Professor Prasad combines solid academic credentials with the ability to integrate theory with practice, using an interdisciplinary approach that combines the behavioral, structural, marketing and strategic perspectives. When interacting with senior and top management, he emphasizes Triple-loop learning, by getting them to rethink their organization’s *raison d’être*, while focusing on Theory of Business and Symbolic Leadership. For middle management, he facilitates Double-loop learning, i.e., how to be proactive leaders who understand the underlying dynamics of various organizational phenomena. Prof. Prasad has more than 40 years of experience in the USA and India. His professional activities encompass teaching, research, consulting and training, center on the themes: ‘Achieving a

Competitive Edge through People!’ and ‘Leadership in a VUCA World.’ His passion is ‘high impact leadership’. He now prefers to explore new horizons as a change agent and facilitator, to assist managers in applying the concepts presented in the classroom. He has therefore begun de-emphasizing one-off programs in favor of greater involvement and long-term partnerships. Prof. Prasad graduated from IIT Madras, has a Postgraduate Diploma in Management from IISc, and PhD from Northwestern University, USA.



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ICT Quiz – ICNL19q1

This ICT Quiz has 10 questions. Select the correct answer from one of the two the options or provide the answer depending on the question statement.

1. The brand ambassador of PhonePe, a mobile payment service is Sharuk/Aamir Khan
2. Google : Stadia = Apple : -----
3. 178 is a valid Octal number True/False
4. The most popular 4Vs of Big Data are -- Volume, Variety, Velocity and -----
5. IBM : Red Hat = Microsoft : -----
6. "Invent" was the old tagline of the IT major HP. What is its new tagline?
7. Both Yahoo and Google had their roots at Stanford/Harvard University. True / False
8. In COD, D stands for Demand/Delivery/Despatch/None
9. Amazon/Apple is the first company to be valued over \$ one trillion
10. QR Code was first designed for Retail/Auto Industry

Participate in this quiz and win a book. If many qualify with all correct answers, a draw will select the winner.

Send your answers by email to ieee.icnl@gmail.com

Pl. keep the subject of email as “ICT Quiz – ICNL19q1”. Mails with any other subject may miss our attention.

Enter the question no and the related answer (in each line)

After answering all the questions, pl. provide your

- Name,
- Affiliation (Designation if employed / mention as Student is studying)
- Company / Institution Name
- Full postal address
- Mobile no

Responses without these info will not be considered.

Jobs and Careers in the New Era

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In this article, we look at the changing job scenario and the hiring process that we have witnessed over the past few years. We then look at the major drivers of the new job roles and the skill sets required for success in this scenario. We conclude with what an aspiring candidate can do to increase his/her chances of success. This article is the first in a series where we look at how facets of life – jobs, education and learning, communication and social life – have changed thanks to innovations in technology.

In the last decade, the job scenario has undergone a sea change. The hiring process, job roles and skill sets needed have all undergone significant changes. Convergence of communications and computers, Artificial Intelligence, Machine Learning, Social Media, Cloud Computing and Big Data and Analytics has changed not only the profile of jobs, but also the process of hiring. Let us look at each of these in details.

Changing hiring processes

Use of “RPO”: Recruitment is becoming a specialized activity that is also extremely time consuming. With rapidly decreasing product life cycles and the pressure of reaching the product faster, organizations find it difficult to devote the amount of quality time that recruitment needs and deserves. Hence the move towards “Recruitment Process Outsourcing” (RPO) is becoming increasingly common. This enables the organization to focus on its core activities without diluting the quality of people coming on board by outsourcing the key recruitment activities to people who specialize in recruitment. The organization to which the recruitment process is outsourced does all the preliminary work – resume screening, the preliminary rounds of interviews before shortlisting the candidates to be sent to organization that is actually recruiting. This would not be the same as interviewing directly with the organization that is actually recruiting because the candidate may not get as much direct information about the nature of the job.

Inclusion and Increasing diversity in work place: Diversity and Inclusion in the workplace are becoming extremely important. While gender diversity and racial diversity have been well understood and implemented for a long time, the importance of inclusion of differently abled or special needs people into the workplace has seen a tremendous rise in the past decade. Inclusion of differently abled is no longer considered as a “CSR activity”. Rather, the talents of the special needs people have been found to be a very compelling reason to include them in the workplace. Indeed, in certain cases, the “disability” or “difference” can make them even more productive than “normal” candidates. Just to cite two examples: People with autism have tremendous patience and speed and don’t get “bored” with routine work. Their productivity and attention to detail in these types of activities actually work in their favor. As a second example, hearing impaired people can be a great asset in noisy environments where the people without such impairment would find difficult or impossible to work. Diversity and inclusion are also been demanded by legislative frameworks making it no longer an optional, “nice to do” thing.

Social Media inputs: Organizations find a lot of valuable and very relevant information in social media platforms like LinkedIn, Facebook, Twitter, etc. Tools are available to aggregate information from these multiple sources and construct a very accurate profile of the candidate even before they see the resume. As this information is provided on less restrictive conditions, weightage is given to these. A candidate’s resume and credentials are compared with the information available. Hence the organization is better armed in evaluating the candidate’s resume when the candidate goes to face the interview.

More objective candidate – job matching at first level: Following through on the point above about social media inputs, today there is a much better preliminary work done – more often by automated tools using artificial intelligence and machine learning – to short list the right candidates for the next stage of recruitment. So, when a candidate clears this level and gets through to the next stage, he/she should expect an even more focused assessment of the match of his / her skill sets and experience to the organization’s needs.

Problem solving vs. “programming” assessment: Until a few years ago, purely programming assessments were part of the selection process. The trend now is to have assessments that evaluate generic problem solving skills. And the problem to be solved need not necessarily be a programming problem. In some cases, even “take home problems” are used. The purpose of such assessments is to evaluate the “out of the box” thinking and analytical capabilities of the candidate.

Emerging job profiles

Changing job profiles are reflected by the changes in the computing environment. Social – Mobile – Analytics – Cloud technologies (SMAC for short) has revolutionized how computing is done and consequently what is required of job

applicants. This has resulted in some of the traditional job functions being lost or rewritten. For example, as the computing resources move from “in house resources” to resources hosted on the cloud and managed by a service provider, the job function of an in house administrator is either not required or has changed value dramatically. Similarly, the job of “GUI Designers” has changed substantially owing to the new interfaces brought up by mobile phones and tablets and the need for these devices to work over potentially low bandwidth signals. Also, with the increased emphasis on accommodating people with special needs, user interfaces that are usable by people with vision, hearing or mobility impairments have become a necessity. With all these changes in the environment, new job functions are emerging. Some of these new jobs and the demands that these jobs place on aspirants are given below:

Social Media: As discussed earlier, social media such as Facebook, LinkedIn are important for job fitting. They are also important as means of revenue increase and targeted marketing for an organization. Social media professionals try to make the social media presence of an organization more profitable. Their job would entail designing advertisements and campaigns with the right text and images with appropriate tagging by the right keywords and hashtags so that the page appears on top of user’s searches (Search Engine Optimization), appealing to the right set of audiences who would eventually end up buying the organization’s products. Their job would require being good at customer relations and data analysis. Also, it requires drawing the right set of inferences about customer behavior. Thus social media related jobs would require skills in language, graphics design, user interface design, knowledge of how to get the best out of Search Engine Optimization and the ability to draw the right conclusions from all the results that can enhance an organization’s revenue. These jobs would also require good articulation of the findings to the top rungs of the organization, who are typically the decision makers on marketing campaigns and responsible for sales and profits.

Mobile app development: Before the advent of SMAC, we had different user interfaces. Web interfaces, native GUI interface for each of the platforms and so on. Today, mobile app interface is essential for market success of a product. The first aspect of a good mobile app developer is to be able to design a “good” user interface. Some of the aspects that constitute a “good user interface” are having elements like activity indicators, unified color scheme and providing for quick loading of the pages and being responsive. This leads to the second aspect of mobile app development which is the increased focus on performance. Given that mobile apps have to operate over networks where bandwidth may be limited, performance optimization and minimizing network traffic would become very crucial. This is indeed a specialized skill. The third aspect of mobile app user interface is to be cross platform. The app has to work on at least three of the major platforms – iPhone, Android and Windows phones. In order to be successful, an App Developer has to be able to create apps that run on all these platforms with minimal changes.

Analytics: For a long time, information technology is used to “structured data” (like tables in relational databases). Knowing the structure made it relatively easy to access the information. Today, with data generated by mobiles, mouse clicks in web sites, etc., data is essentially unstructured. But this unstructured data, if mined and analyzed can lead to a wealth of useful information that no structured data can produce. Analytics is the art of mining these huge volumes of unstructured data and glean some inferences, conclusions and predictions from them. This includes (but not restricted to) the role of data scientists. While tools like SAS are available for analytics, success in the analytics line requires a good grasp of statistics and mathematics fundamentals, an appetite for curiosity and being able to look at different perspectives, with a thorough understanding of the domain. Analytics requires working with large volumes of data. Hence it is important to deep dive into details with a toothcomb. Numbers that present themselves would not mean anything unless the person is able to interpret the numbers and the relationships among them in a way that makes business sense. Hence, while being detail oriented, the person at the same time not lose sight of the big picture of the business and the issues involved in the business as a whole. This leads to another important skill required for analytics: That of presentation, communication and team work. All the relationships conjectured across data have to be discussed with people from different job functions and presented and communicated to people at different levels in an organization. Indeed, the “hard skills” of mathematics and analytical methods have to be effectively combined with “soft skills” of presentation, communication and team work! Such a combination is a rare gift!

Cloud: In organizations using the traditional “in house” resources model, the hardware and software required for running the applications of the organization had to be installed and managed in house by a set of system administrators. Their hands were full to upgrade all the software to supported versions, handle all the compatibility across the various pieces of software and hardware and to ensure optimum performance of the various systems. This job was highly specialized and often not directly related to the organization’s core business. Thus the move towards cloud computing over the past decade, With Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS), an organization would not have to worry about acquiring and installing the various components of hardware and software and ensuring their interoperability. All that is done by the cloud hosting specialists organization.

In addition to the above, Artificial Intelligence and Machine Learning are getting intertwined into many of the functions. As Internet of Things (IoT) becomes more and more pervasive, it is to be expected that there will be further convergence of all these domains, thus blurring the line separating these various job functions.

Changes in skill sets

Increased emphasis on soft skills: As we saw earlier, every one of the SMAC components and Artificial Intelligence involves both “hard skills” and “soft skills”. In Social Media work, one needs to know and harness Search Engine Optimization methods. This will be possible only when he or she has a good command over language and an aesthetic sense to design pages advertisements and marketing campaigns effectively. Then, upon getting the results, he or she should be able to present to the appropriate levels of management to achieve the desired impact. Similarly the Analytics component too requires a good balance of hard and soft skills – to be able to creatively do the analysis and to be able to present the results of the analysis in an effective manner. In all these cases, communication has to be done to various levels of management, thus requiring proper audience analysis and tailored presentation. Also, all these jobs would require working with different sets of people with varied skills, so teamwork becomes vital to success.

Increased focus on mathematics and statistics knowledge: Analytics, machine learning and artificial intelligence all require a strong foundation in statistics and mathematical modeling. For a long time, when the focus was on programming, skills in mathematics and statistics were not essential for success. But the current trends have reignited the need for basic mathematics and statistics skills.

New programming languages: Many of the conventional general purpose programming languages like C are being rapidly replaced by new, specialized programming languages like Python and R. Also, with the increasing complexity and diversity of systems, automated testing and test scripting languages are becoming more common.

Tips to cope up with the changes

Keep your social media profiles current: Profiles in sites such as LinkedIn are becoming the first point of check for many organizations. Hence this has to be kept current. Make sure that all the academic qualifications, certifications you have earned, job positions you have held, all the responsibilities and accomplishments and the corresponding time frames are kept up to date. If you have any publications or books to your credit, make sure you give relevant information on the site and provide pointers to get more information. Also, try to get as many testimonials and references shown on your profile. This will substantially enhance the chances of your being called in for an interview.

Be careful about what you put on social media: Sometimes we go under the belief that what we put on “friendly” social media like Facebook are our “personal views” and have nothing to do with our job search. Unfortunately this is not always true. A lot of information about you can be gleaned from your posts – your stand on various social issues, your political views, your travel preferences, your friends, just to name a few. Some of these could have a bearing on your chances of getting through to the next stage.

Do some research about the organization where you are applying: Getting a job is as much about the match between your skills and the organization’s needs as it is about your skills and experience per se. Hence, more the information you have about the organization, what they do and what is the job position they are looking at you for, the better you can project about how you are best suited to fulfil the organization’s need.

Have a brief, punchy resume: The resume that you prepare has to be short and punchy and highlighting right up front what is relevant to the organization to which you are applying. It is a good idea to customize the resume for the organization to fine tune the content and order of information in your resume, especially if you have acquired multiple skills or have a very diverse background of skills and experience

Make sure you constantly upgrade your skills (and correspondingly update your resume): Thanks to changes in technology and innovation in processes, what you do and how you do it are constantly undergoing rapid changes. Hence it becomes very important –more important than ever in the past – to keep your skills and knowledge current all the time. The availability of so many online resources in the form of MOOC (Massively Open Online Courses) brings the current courses taught by the most eminent professionals and academicians right to your door step, giving you substantial flexibility and power to embark on a journey of lifelong learning

Sensitize yourself in working with a diverse set of people: As mentioned earlier, diversity and inclusion is very important these days. As a result, a job aspirant must reorient himself or herself to succeed in this changing environment. They will have to develop a proper *attitude* and mindset about respecting diversity. For example, one should develop and express empathy when working with people with special needs. This correct attitude would have to be supported by proper *communication*. For example, racist and gender-specific jokes – which are very common in colleges – are absolute no-no at work place. It would be useful to learn skills like sign language to facilitate communication with people with hearing difficulties. Communication skills have to be fine tunes and sharpened with *etiquette* to integrate well into the workplace. Some of the etiquette issues include understanding the culture and customs of the location where you work and adapting yourself to that, without sacrificing your basic individuality, customs and beliefs.

Conclusions:

Technology has brought about significant changes in not only job profiles, but also in the way the job positions are filled and the skill sets needed. But what is discussed in this article is just the tip of the iceberg. As Internet of Things (IoT) picks up speed and artificial intelligence gets more entrenched in the day to day life, it is quite possible that even more changes are on the anvil. It is important that one keeps current with all the developments and innovations. This aspect – namely, training and learning – is the topic for the next article in this series.

About the author



Mr. Gopalaswamy Ramesh is an independent consultant and an eminent author, with close to four decades of experience in industry, consulting and teaching. He has taught courses on Software Project Management, Software Testing and Soft Skills in several leading institutions like IIT/Madras, Anna University, IIIT-Bangalore as well as to several leading multi nationals in India and abroad

He played a key role in establishing Oracle's India Development Center at Bangalore and grew it from zero to close to 500 people. When he left Oracle in 2002, he was their Senior Director. Earlier, Ramesh worked in Oracle Headquarters in Redwood Shores, California, holding several technical and management positions. He also headed pre-sales and post-sales support of Oracle products in the ASEAN countries while working at Far East Computers, Singapore from 1982 till 1988.

Ramesh has written eight books which have become best sellers and two of them being also translated to Chinese language. The book *Managing Global Software Projects* won the National Award for the Best Book.

Ramesh has been an active invited participant in several well known conferences and workshops. He was part of the Academic Advisory Board of PMI India from 2009 to 2014, during which time he was the TC Chair for first two Research and Academic Conferences (RAC) on Project Management in India.

Ramesh is socially conscious, with particular interest in people with special needs and economically disadvantaged people. He has taught Mathematics in a school for economically disadvantaged children, wrote books on moral education for children (in English and Tamil) and has also translated to Tamil the book GIFTED (by V R Feroze and Sudha Menon) on the accomplishments of fifteen differently abled individuals

Ramesh holds a BE Degree in Electronics and Communication Engineering from IISc, Bangalore, a MS in Computer Science from IIT, Madras and MS in Engineering Management from Stanford University, California.



Inclusion begins at Home

It is important to unlearn as much as it is important to learn to be truly inclusive.

Dr Saundarya Rajesh

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Often during childhood, parents or adults at home with their well-meaning intentions set biases in childrens' minds. They could be as simple as adhering to be non-communicative with a particular community, religion or a sect. These conditioning statements or "biases" get set in our minds as if they were carved on stone and become guidelines by which we lead our lives.

As we grow older, these biases become rules. We judge others basis these rules and sometimes even believe that they are our value systems. Even when the so-called family-inflicted biases are no longer relevant, we unconsciously base our opinions on the pre-determined judgements that have permeated in our minds early.

Unintentionally and unknowingly, we human beings are wired with unconscious biases right from the day go! We tend to see what is different among each other and not seek commonalities. As humans we forget or rather not make a conscious effort in accepting the fact that different people can have different perspectives. And, it is important to accept differences to be more inclusive. In fact, while in the corporate arena, leaders, managers and decision makers have begun to realize the importance of de-biasing and creating an inclusive workplace, it is at homes that most biases are prevalent.

It is no surprise that families disintegrate because there is no inclusion at home. There are different types of biases. Let us begin with understanding what a bias is and take a look at the different types of biases that have permeated in our society.

Bias is an inclination towards or against one thing, person, or a group compared with another, usually in a way considered to be unfair. Unconscious bias happens when our brains make some incredibly quick judgments and assessments of people and situations without us realizing it. Sometimes people in their personal or professional lives, tend to lean towards a certain direction influenced by the unconscious biases, often leading to one-sided approach and impaired decisions. Our biases are influenced by our background, cultural environment and personal experiences. In fact, it is said that if you have a brain, you will have biases. So all of us have unconscious biases and it happens automatically.

Given below are some of the common types of biases that we unconsciously deal with in our day to day lives:

1. **Affinity Bias-** Affinity Bias refers to the predisposition to unconsciously prefer, advocate for, or help people who are like us, i.e. with whom we have commonalities or shared experiences. *For example, Tendency to take decisions to hire people from one's same college or same city.*
2. **Anchoring Bias-** Anchoring Bias refers to the common human tendency to rely too heavily on the first piece of information offered (the "anchor") while making decisions. *For example, the initial price offered for a used car sets the standard for the rest of the negotiations, so that prices lower than the initial price seem more reasonable for a buyer even if they are still higher than what the car is really worth.*
3. **Availability bias-** Availability bias refers to the tendency to unconsciously make decisions, judgements or assumptions based on the data/information that is most memorable or most easily accessible or available. *For example, after you see a movie about a nuclear disaster, you might become convinced that a nuclear war or accident is highly likely.*
4. **Confirmation bias-** Confirmation bias refers to the inclination to unconsciously filter evidence to support one's already held points of view and ignore or overlook new information or evidence that disproves them. *For example, when in a relationship, we usually tend to undermine things that we want to ignore, and overstate the things which we tend to see or form a conclusion.*
5. **Framing bias-** Framing bias refers to the tendency to behave differently depending on how a situation/choice is presented to us. *For example, during the elections, politicians may emphasize on the positive developments carried out by them to attract more votes. They may try to malign the opposing party, to put the opposition in a negative frame in the minds of the citizens.*
6. **Halo bias-** Halo bias refers to the tendency to unconsciously evaluate someone based on a single positive trait that we like in that person and overlook their shortcomings. *For example, sales people who are able to achieve the numbers/targets are often loved by managers for their ability to achieve tough targets. But behind the scenes, this employee might not be great team player or might not respect co-workers or might not be organized. But because they are good in one thing all other shortcomings are overlooked.*

7. **Horn Bias-** Horn Bias refers to the tendency to unconsciously evaluate someone based on a single negative trait that we dislike and disregard their strengths and potential. *For example, the administrative assistant who is great at everything but filing. It piles up because he puts it off – resulting in the company hiring a temp to get the filing caught up. In all other areas, he/she might be a great performer. But here this person might be evaluated on a single negative trait and his/her potential might be overlooked.*

8. **Negativity Bias-** Negativity Bias refers to the notion that, even when of equal intensity, things of a more negative nature, such as unpleasant thoughts, emotions, or social interactions have a greater effect on one's psychological state and processes than do neutral or positive things. *For example, when it comes to client feedback, we usually give a lot of importance to the negative feedback that we get. We tend to overanalyse and ruminate over it.*

9. **Projection bias-** Projection bias involves overestimating the degree to which other people agree with us. *For example, one thing that we have all encountered is when grocery hopping on an empty stomach we buy more food than we need, we incorrectly anticipate our future hunger preferences based on the preferences we held while making purchase decisions.*

10. **Recency bias-** Recency bias is the tendency to focus on "what has happened lately/recently" when evaluating or judging something. *For example, sometimes in performance reviews only the recent performance of an employee is considered during his/her appraisal.*

11. **Social comparison bias-** Social comparison bias is having feelings of dislike and competitiveness with someone that is seen physically, or mentally better than yourself. *For example, when siblings compare themselves to each other or when colleagues compare each other's performance.*

12. **Status quo-** Status quo bias is evident when people prefer things to stay the same by doing nothing or by sticking with a decision made previously. *For example, most of us prefer a particular brand for various daily essentials, like cosmetics, food and drinks, clothing, etc. Even though there is plenty of choice, people tend to demand a specific product, for years.*

To a large extent, all of us are all guilty of unconscious biases in our daily lives. The antidote to bias is awareness. A greater awareness coupled with practical approach can help individuals to overcome biases and create a more inclusive home and thereby society as a whole!

About the author



Dr Saundarya Rajesh is one of India's most respected thought leaders on Diversity & Inclusion. An award-winning social entrepreneur, she is best known as the pioneer of Second Career opportunities for women in Corporate India. She has been recognised as a "#100Women Achiever" by India's Ministry of Women and Child Development as also listed in the United Nation's "Women Transforming India". Recently Dr Saundarya Rajesh has been selected to receive the Prestigious "Winds of Change" Award by the Forum on Workplace Inclusion, University of St. Thomas, Minneapolis, Minnesota, USA. She is the first International as well as the first non-US-resident recipient of the Winds of Change award.

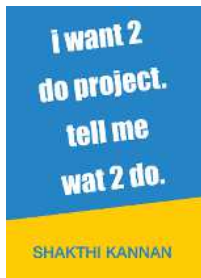
An entrepreneur who has created successful, growing enterprises such as AVTAR Career Creators, FLEXI Careers India and AVTAR Human Capital Trust, Saundarya has recently entered the Artificial Intelligence domain by setting up India's first 'AI in Talent Acquisition' company – Bruhat Insights Global. Bruhat provides cutting edge predictive and prescriptive analytics for selecting the right hire, through job selection patterns and career engagement insights via big data drawn from over a million successful job placements.

Widely quoted on women's careers, entrepreneurship and inclusive leadership, Saundarya is a highly sought-after speaker at conferences -- both national and international -- and a firm believer in integrating work and life. In her pursuit to develop and inspire people to grow to their full potential, she has made her debut in through the book – "The 99 Day Diversity Challenge™" published by SAGE that hit the stands on October 30, 2018.

US has said its first exascale supercomputer will be functional by 2021 that will be capable of carrying minimum one 'exaFLOPS' or a billion-billion calculations per second. 'Aurora' supercomputer, combined with artificial intelligence-based abilities, is aimed to be seven times faster than most powerful system built to date. China is expected to unveil its first exascale supercomputer in 2020.

A Karnataka boy failed his first-year pre-university exam after he wrote only about 'how to play PUBG game' in the Economics answer sheet. He had secured distinction in his SSLC exam last year but lost track of his studies this year after getting addicted to the game. He now has a chance to appear in the exam scheduled for June.

Project Guidelines



Excerpts from the Chapter 4 of the book

i want 2 do project. tell me wat 2 do
by Shakthi Kannan

2014 / 135 pages / Paperback / Rs. 398 (at Amazon india) / Self Published

Adding manpower to a late software project makes it later.

~ Brook's Law

Write abstract, code, documentation and presentations

If you really want to do something, you'll find a way. If you don't, you'll find an excuse.

~ Jim Rohn

A student approached me for help in creating an abstract for a project. After an initial discussion on his idea, I provided him a brief write up. Few weeks later, he pinged me online on Internet Relay Chat (IRC) for help in coding the project. I had worked out a proof of concept (POC) implementation for him. Later, the faculty wanted him to write some documentation for the project and he approached me again for help. I wrote a page explaining the idea and citing reasons for the design and implementation. After a month, the student again came back to me asking for a presentation! Mentors are there only to guide you in your project. They cannot write abstract, code, documentation and make presentations for you! Even if you are time bound, you need to learn to plan your work. It is very important to be clear on what you must do and what mentors can do for you. The effort has to come from you, and that is when you actually learn. Self-motivation is thus very important when working with free and open source software projects.

Small tasks before handling big tasks

Little drops of water make the mighty ocean.

~ Julia A. Fletcher Carney

Newbies with little practical experience can feel daunted by any task given to them. Handling complex problems or making an assessment can be hard. It is thus important to break a task into smaller sub-tasks and work on them individually. You can also request the project team members for beginner tasks to be worked upon stating that you are new to the project. This approach can get you started on a project. Working on smaller problems can also help you understand the tools used in the project and the workflow. It is also convenient for the team members to take time to review and correct smaller mistakes rather than having to go through a larger modification. Correcting smaller mistakes at an early stage is easier than to undo or redo a lot of changes before a project delivery. The scope of smaller tasks also helps you to focus and understand a module, its design and implementation without having to worry about the larger pieces of a project.

Last minute work

The early bird catcheth the worm.

~ John Ray

I always ask a question in my lecture sessions to know how many students study just a few days before an examination. Most of them raise their hands. Some of them ask for important questions that may appear in an examination, and study only those relevant topics. Some students study only to obtain a pass mark and hence feel that whatever is sufficient to study can be done just days before the examination. This approach doesn't work in real life though. To manage your work--life balance, you need to plan early and work systematically. Only this will help you manage both time and resources. If you work every day, sharing the workload over a period of time, you will reap the benefits before a deadline. You will also not feel the burden of it. Any last minute work done under pressure will not be a whole-hearted effort, and that will reflect on your work. It will be very obvious. The human body has a biological cycle and rhythm. If you allot time every day for your tasks, you will automatically fall into the cycle of doing work regularly. Study every day and do your homework daily. Avoid any last minute work!

Steep learning curve

The students should be reaching up to it because success in life demands the use of intellect under pressure.

~ Bill Cosby

The methodology, tools and approach in free and open source software can be entirely new or different from what you are used to. You may not understand everything when you are starting. You will feel frustrated at times. It is very important to be patient, and reason why things do not work the way you expect them to. When you learn to ride a bicycle, you will fall and hurt yourself. Only when you fall, you will learn through your mistakes. The learning curve is very steep. But, learning indeed is hard. It is thus important to persevere and understand if you wish to receive the benefits of free and open source software. If it becomes overwhelming, take a break and do some other work. You can return to the task with a fresh mind, and you may be able to see the problem from a newer perspective. Persist and survive. Everyone has gone through the same steep learning curve, and you are no different.

No blunt info

If you can't explain it simply, you don't understand it well enough.

~ Albert Einstein

The free and open source software mailing lists are usually run by volunteers. If you have a problem in your work and need assistance, you must give as much information on the same, stating what you are trying to solve. If you are working on a specific feature request or bug, provide a link to the same. You should give a context to the problem, some background information on the task that you are working, any prior relevant communication with the project team members, the approach you have taken and any errors or output that you have observed. This can serve as documentation for you and others involved in the project. If people face a similar issue in future, a search in the mailing list will return these relevant discussions. Try to give detailed technical information when posting a question related to your work.

Journal or log of activities

The errors in our own history make us open to new ideas, open to unusual ways of doing things.

~ Neil Lewis

Contributors to free and open source software projects may have a day job and they may be able to work on their projects only during weekends. Their job may require them to be online during weekdays, but that does not necessarily mean they are available for a discussion. Depending on the nature of work, they may or may not be able to answer your queries during weekdays. It is thus very important for you to keep a journal of your activities. You can create and update your journal as and when you complete your tasks. Even if you are stuck with a problem, you can write about it in the various communication channels and people might give you solutions. Mentors who are busy during weekdays can see your blog post when they have time and know about your progress. If there aren't any frequent updates, then it is a sign that there is a problem. Also, the blog acts as a tool to showcase your work. You will need to have accomplished some task before you can write something. Search and archives of the posts serve as documentation for you and others. An update must be provided at least once every week.

Never make your own decisions

We promise according to our hopes and perform according to our fears.

~ François de la Rochefoucauld

When you are young and energetic, you have a lot of enthusiasm and interest. But, you have to be cautious about being over-confident. People with experience have immense knowledge that they can guide you well. It is very important to see different points of view before making a decision. Never commit to something without thoroughly analysing the scope and impact of your changes. Always try to seek a second or third opinion. If you have made a decision, you must be 100% sure that you can defend yourself no matter what questions are asked. Research well and do your homework. Some projects have maintainers for specific modules and they are responsible for it. You will need to get their approval before the project can accept your changes. It is thus very important to have a good rapport with your team members. The more you deviate from the goals of the project and make your own decisions, the more you will feel left out. Always consult others when you are new to a project. It takes years of experience to become a master and commander of a project.

Forget to CC members

Everybody knows everybody, and there is a very high degree of transparency.

~ Yossi Vardi

Free and open source software development is a double-edged sword. The openness in the communication tools provides transparency for any dispute that may arise. It is thus very important to have all the project discussions in the respective project mailing lists. You can use private discussions only if you wish to discuss personal matters. If a project team is small and they prefer to use e-mails for communication, it is important to CC every one in the discussion. Forgetting to include

members in the discussions will cause confusion among the team members. It is very important for everyone to be on the same page. If your development module affects other projects or consumers of your software, it is important to inform them about any upcoming changes. Always keep everyone informed!

Repeat same mistakes

Go ahead and do what you think is right. If you make a mistake, you will learn from it. Just don't make the same mistake twice.

~ Akio Morita

Working with free and open source software does require you to be a self-starter. The methodology of work is not suitable for everyone. Some people like to be given tasks to work on, and they will follow that strictly. There is nothing wrong with that. But, you should know what your strengths and weaknesses are. Only by accepting your mistakes can you start to think of a solution for the same. You can write about them in your journal or blog so you remember not to repeat them in future. If you do keep committing the same mistakes repeatedly, then the task may not be suitable for your style of work. It is perfectly fine to move on to other tasks or even a different project after informing the respective project team members. It is very normal for people to change projects and domains if they feel there is a need to do so. Repeating the same mistakes is a concern for you and the project.

Can friends also join the project?

"Me and my friend studied in the same school. We went to the same tuition centre. We joined the same college and department. Can we work on the same project?"

The friends circle vary in numbers in an institution. It is very common for a group of friends in a class to decide to work together on a project. They usually decide among themselves as to who will work on which part of the project. It might also be the case where only one person actually does the work, and the other team members just support the cause. The transparency in free and open source software projects doesn't encourage the above behaviour. Every project team member's contributions are visible. Each individual has his own clone of the project repository in a decentralized version control system. The individual commits made by them can be observed. The pull requests will let us know whose changes were absorbed, if the work is a contribution to a larger project. While it is fine with friends to work together on a project, it is important to learn to work with people outside your comfort zone. The free and open source software projects enable you to network and work with people from different backgrounds and countries. You need to make the best use of this opportunity. This experience will teach you how to build relationships with newer people in a project. It is acceptable for a group of friends to work together, but, make sure that everybody learns and contributes to the project.

Commit early, commit often

"Code, code, code your way,
Gently down the screen,
Commit early, commit often,
And life is but a dream."

One of the main principles of working in free and open source software development is to commit early and commit often. It is easier to correct mistakes at an early stage rather than having to complete the project and present it to users, only to realize that it is not what they had asked for. Project team members who are voluntarily contributing to the project will be able to take time to review smaller changes. If a project has test suites, then the small changes can trigger invocation of test runs and you can detect any failures immediately. When you return from vacation, it takes time for you to recollect what you have been working on the project. If you made commits often, then it will be easy for you to review the changes. If there are dependency modules in a project, then committing often and checking the test runs early can help detect any issues. The concerned users of the project will be able to review the changes and provide any feedback. This also helps avoid doing any last minute work. Being able to detect problems at an early stage also gives you an opportunity to rectify them, and helps you plan your time and project deliverables.

Never make assumptions

Question your own assumptions and the assumptions of others.

~ Alan Kelly

It is very important to do your homework and provide justification wherever necessary. You should be able to give sufficient arguments in case of a dispute. When building a solution, you must review the steps to ensure that you have all the corner cases addressed. It is also important to be honest, and say "no" if you are not sure. If you decide to work on a

new feature request, first attempt a proof of concept (PoC) implementation. Research on the available approaches and do a feasibility study. Learning from others' experience on something which does not work can save you time and effort. In free and open source software development, you are encouraged to use open standards since the specifications are freely available. What works in one proprietary system, may or may not work in other systems. It is thus very important to run tests before you provide a solution. Proofs are not the same as tests though. Review your work to make sure you haven't made any assumptions. If you have, note them down as constraints for the specific implementation.

Never hesitate to ask questions

The scientist is not a person who gives the right answers, he's one who asks the right questions.

~ Claude Lévi-Strauss

There is no question as a stupid question. The more questions you ask yourself, the more you will learn. But, free and open source software project team members may be working voluntarily in a project. It will be wise to do your homework before you ask questions. You can mention the various sources and links that you had referred to, and what you didn't understand in them. It gives an indication that you are serious about solving the problem and are eager to seek answers. You should avoid making direct requests in a mailing list asking for an immediate answer. The list members have no obligation to answer them. They may refer you to an appropriate source of information, or provided you useful links. It is also good to think in terms of the Five Ws and one H (Who, What, When, Where, Why, and How) when researching on a given problem. Always reason, and never hesitate to ask questions.

Priorities

The most important and basic thing is to learn and understand the needs of a customer.

~ Vinod Gupta

Developers working on free and open source software projects work with a lot of passion and interest. They are more concerned about doing things right even if it takes time. A project may have release schedules where users may expect certain features. In such scenarios, it is necessary to note the priorities of the tasks. Measuring complexity is indeed very hard. Every individual will have a different opinion on the time it will take to complete a task. But, if it is a customer-facing project, understanding the priorities helps in planning your work. You can also assign priorities for sub-tasks that you work on, on a daily or weekly basis. Understanding the users, project requirements, and their importance can help set your priorities right.

GTD

A bitzui'ist is someone who just gets things done.

~ Dan Senor and Saul Singer

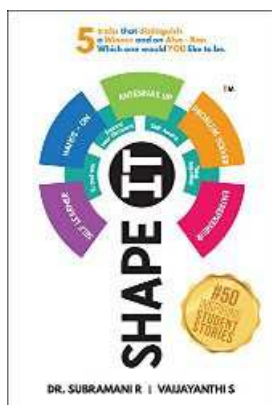
It is very important to do what it takes to get the work done. You should have, of course, done your research and home work before starting on your work. Planning and time management are crucial to keep track of your project work. Doing things in the last minute will reflect poorly. A well thought and planned work can be showcased to others as an example. The following are good books that I recommend on managing your time and work:

- Stephen R. Covey. "The 7 Habits of Highly Effective People." [1]
- Fergus O'Connell. "How to Get More Done: Seven Days to Achieving More." [2]
- Chad Fowler. "The Passionate Programmer." [3]
- Andrew Hunt, and David Thomas. "The Pragmatic Programmer: From Journeyman to Master." [4]
- Kevlin Henney. "97 Things Every Programmer Should Know." [5]

As much as you can do advocacy for a project, you should equally work on the project tasks and get things done.

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Excerpts from the Chapter 1 of the book

ShapeIT: A Perfect Gift for Budding Engineers to Become Industry Ready

By Subramani R. & Vaijayanthi S

2017 240 pages / Softcover / Rs. 250

ISBN: 978-1946869166 / Notion Press

Sep 2016 – The campus placement events had just started across India. Unlike Europe and US, where there are two intakes in a year for the admission process (Summer/Winter or Spring/Fall), in India, there is only one intake season. The academic calendar begins typically in the month of June, and the graduation happens in the month of May.

The campus placement events are something that all recruiters, students, parents and campuses eagerly look forward to. Each year, these events create a lot of buzz, and the local newspapers are filled with articles about placement records of corporates, campuses, highest pay package offered and so on.

The campus placement events generally start with a pre-placement talk. In this pre-placement talk, the recruiter talks about their organization and the career opportunities that they offer. The pre-placement talk is then followed by the selection process – which includes a whole gamut of tests – analytical and quantitative aptitude tests, oral and/or written communication, group discussion, hands-on application challenges, hackathons and many more.

In one such campus event, after our pre-placement talk, we opened the session for questions. In these sessions, the typical questions would be centered around compensation, work-location, nature of work, company's vision and the like. We had well-prepared and rehearsed answers for these. But one of the questions caught us off-guard. The question was, **“How much of what you learnt in college are you still using today at work?”**

Well, that set us thinking. We had done our Bachelors in engineering about twenty years ago and could not recall exactly how much of our college education we applied at work.

It was a difficult thing to quantify, but the larger question in front of us was: **What skills are being taught today that will have little or no value in the future?** There is a risk of usefulness of a college education wearing out even before the educational loan repayments end.

We managed to give an answer to the student, but it was not convincing to us. As we left the event, the question raised by the student was still bothering us and triggered us to explore further, and the result is what you see, the **SHAPE IT** book.

Half-life of Knowledge

In 1962, Fritz Machlup, an economist, coined the expression **‘half-life of knowledge’** to describe the amount of time that has to elapse before half of the knowledge in a particular area is superseded or shown to be untrue. The various articles in IEEE (Institute of Electrical and Electronics Engineers) journals over the last few decades show a steady dropping of the ‘half-life of knowledge’. The half-life of an engineering degree in the late 1920's was about 35 years; for a degree from 1960, it was thought to be about a decade.

According to an **International Labor Organization report**, the **“half-life” of an engineer's technical skills** was estimated to vary from 7.5 years for mechanical engineers and 5 years for electrical engineers, to 2.5 years for software engineers.

Russ LeFevre, President, IEEE-USA (2008) adds, **“When the half-life of an engineer is five years, it's quite clear that the days when an engineer could spend his or her career shepherding a specific computer program are long gone. You must be able to move from one discipline to another discipline, and you must be able to do it quickly.”**

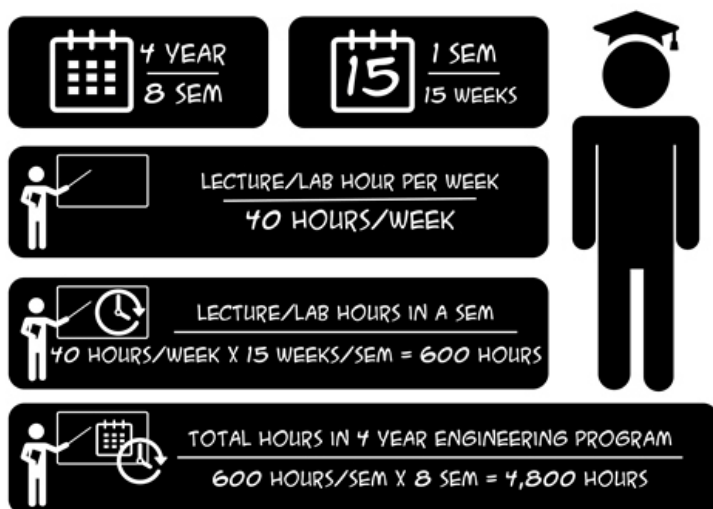
The depth of the question, which the student asked us in the pre-placement talk was sinking in, and we thought the ‘half-life of knowledge’ partly answered the question.

“The half-life of an engineer, software or hardware, is only a few years.”

Craig Barrett,
President, Co-Founder, Intel Corporation (1996)

Many of the basic skills and much of the knowledge that people acquire while they are at school, college or university are becoming 'out of date' at an alarming rate. This means one has to be a 'life-long learner' to succeed in the industry. We started calculating the amount of time one should spend on acquiring new knowledge.

UNDER GRADUATE ENGINEERING PROGRAM



Well, this is for the IT profession, and for other engineering disciplines, time to be spent on acquiring new knowledge may be lower; nevertheless, **an engineer MUST spend 1-2 hours learning every day to stay current.**

Now, we had two more questions:

1. How long should one keep learning?
2. How does this learning happen?

The end of the three-stage life

We continued our search on how long one should continue this learning. There is good news and bad news.

The good news first. In the last two centuries, the life expectancy has increased at the rate of more than two years every decade. And if this trend continues, a child born today has more than a 50% chance of living to 105 years. On an average, most of these extra years of life will be healthy ones. It is as if the arc of life has been extended.

And the bad news. One has to keep learning that much longer.

With longevity extending, the way we work is getting transformed, a new work-life model is replacing the traditional career path of the past. Those 55 to 65-year-old employees, currently part of the industry, followed a typical three-stage path: get educated, work and retire. Lynda Gratton, professor at London School of Business, believes this pattern is about to be smashed to pieces.

"The life structure that emerged in the 20th century – a three-stage life of education, work and then retirement – is unlikely to survive the life elongation.

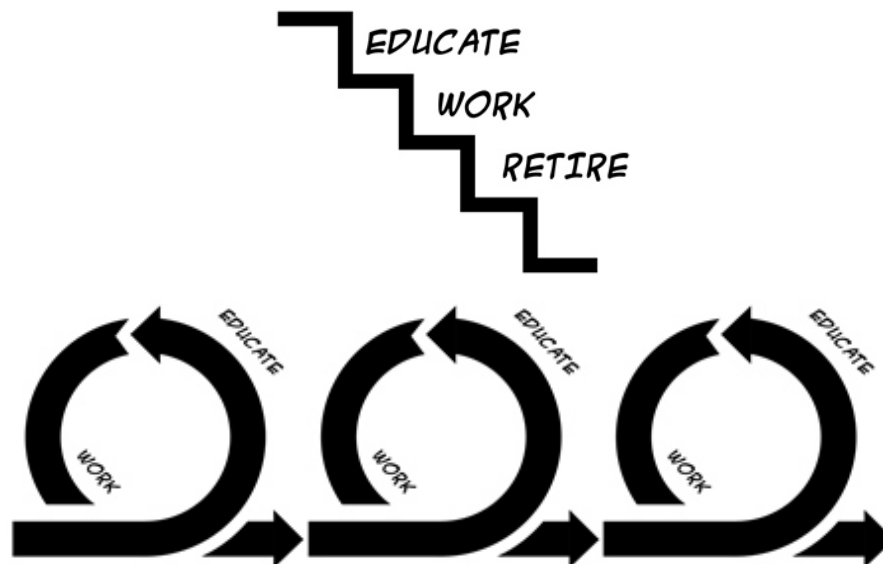
How can you maintain and build productive assets when most education takes place in your 20s? How can what you have learned remain relevant over the next 60 years against a backdrop of technological upheaval and industrial transformation?"

Lynda Gratton and Andrew Scott,

The 100 Year Life : Living and Working in an Age of Longevity

The three-stage life of educate, work and retire can be likened to the traditional, sequential approach to the 'water-fall' model in the software development parlance.

The half-life of knowledge necessitates taking an 'agile' approach to life, and drawing a parallel with Scrum (an iterative and incremental agile software development framework). One has to plan for multiple 'sprint' cycles of *educate* → *work* → *educate* → *work* → *educate* → *work* and the iteration continues till one can sprint (pun intended) in life.



Well, it's getting tougher now. Based on half-life of knowledge and expected longevity of life, one needs to plan for spending 1-2 hours/day for at least forty years, and this is after the formal education.

Sounds tough and grueling, huh?

But wait, let's see if there is some good news, and we still haven't answered the second question about how this learning happens. Is it going to be formal classrooms and grades?

"Life-long learning of engineering is possible only by disciplined life-long study and thought."

Thomas Jones,
Former President, University of South Carolina

The life-long learning, if it takes place, will have little or no resemblance to the formal college education that you have gone through. Based on our experience, adult learning models adopted in the industry suggests that the life-long learning will be:

- Less formal and more experiential
- Less classroom-centric and more pervasive

70:20:10 Model

70:20:10 is a learning and development framework, which sets out a rationale for how employees learn. The framework is attributed to Morgan McCall, Michael Lombardo and Robert Eichinger at the Center for Creative Leadership in North Carolina. This is based on the results of research they conducted with senior business executives about the factors they felt made them successful. In their publication, *The Career Architect Development Planner*, they presented the 70:20:10 model, which sets out the ways in which people learn.

They found that over the course of their careers, the most successful executives had gained their most valuable learning in the following ways:

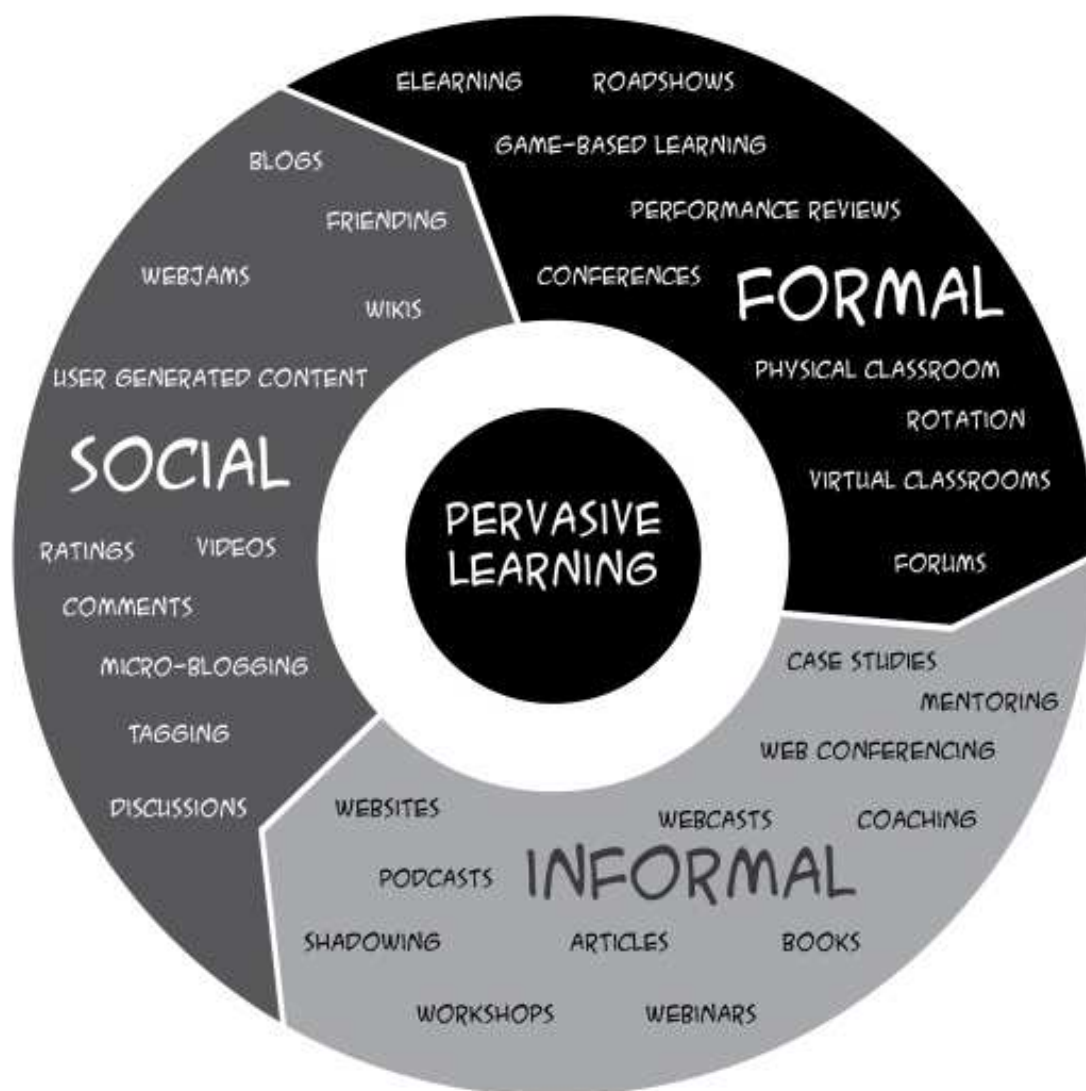
- 70% from challenging assignments and on-the-job experiences
- 20% from other people (mainly their manager), networks and the feedback received
- 10% from formal training, such as courses and workshops



At its heart, 70:20:10 highlights that people get most of the skills and knowledge they need to do their job from on-the-job learning experiences, rather than from classroom or course-based learning.

3:33 Model

Dan Pontefract, in his book *Flat Army*, talks about how learning happens in an organization. It is all about a collaborative culture, which will engage, empower and encourage all employees.



“70% of all learning projects are planned by the learner himself.”

Prof. Allen Tough,
The Adults Learning Projects (1971)

Pontefract’s 3:33 model of pervasive learning presents a perspective on the reality of how we learn and how leadership is formed. It suggests that:

- 33% of learning happens by formal means (e.g. in a physical or virtual classroom, at conferences and roadshows and via e-learning)
- 33% is informal (e.g. via mentoring, coaching, webinars, reading books and case studies, listening to podcasts and role shadowing)
- 33% is social (e.g. via user-generated content, wikis, blogs, videos, discussions, comments, ratings and instant messaging tools)

The concept of 70:20:10 and 3:33 learning was refreshing, and we thought we had answers for the questions raised in the pre-placement talk.

HOW MUCH OF WHAT YOU LEARNT IN COLLEGE ARE YOU STILL USING TODAY AT WORK?	
WHY IS OUR LEARNING AND KNOWLEDGE BECOMING REDUNDANT?	RAPID TECHNOLOGY ADVANCEMENT IS LEADING TO CONTINUOUS REDUCTION IN THE HALF- LIFE OF OUR KNOWLEDGE
HOW LONG SHOULD ONE KEEP LEARNING?	LIFE-LONG. BE PREPARED TO BE A LIFE-LONG LEARNER.
HOW DOES THIS LEARNING HAPPEN?	LESS THROUGH FORMAL MEANS AND MORE OF IT THROUGH INFORMAL AND SOCIAL MEANS

“Learning is Pervasive, which is the switch from a ‘training is an event’ fixed mindset, to ‘learning is a collaborative, continuous, connected and community-based’ mindset.”

Pontefract, D.

Flat Army: Creating a Connected and Engaged Organization (2013)

Learning in the Corporate World

Gone are the days when individuals were trained when they joined the organization, and the training would last them their whole careers. The technology and processes are changing, and job roles are becoming sophisticated, and there are full-fledged learning and development departments within the organizations that are tasked with the responsibility to keep workforce knowledgeable, skilled and up-to-date. But the world is changing so fast that even learning and development departments are not able to keep pace and ensure that every employee is trained for current and future jobs.

According to the Deloitte’s *Global Human Capital Trends 2016* report, employees at all levels expect dynamic, self-directed, continuous learning opportunities. The report is based on more than 7,000 responses from over 130 countries. As per the survey, eight in ten executives mention learning as important, while four in ten regard learning as a very important issue.

Advances in technology, shifts in demographics, and the constant competitive necessity to upgrade workforce skills are the major disruptive drivers in corporate learning. These forces are pushing companies to develop new ways to **put employees in charge of the learning** and foster a culture of self-directed learning throughout the organization. The mobile devices make anytime anywhere learning possible. From content-centric ‘push’ approach, the learning is moving towards a learner-centric ‘pull’ approach.

Companies are adopting new technologies and new learning models, for e.g., 43 per cent of companies surveyed feel comfortable incorporating massive open online courses (MOOCs) into their learning platforms compared to 30 percent the previous year.

Corporates stress the importance of employees to learn continuously and keep abreast of the latest in their field of work – and this is through Self Learning, complemented with a social approach of collaborative learning with peers, teams and professional networks.

‘I am a lifelong learner’, Satya Nadella says

It is refreshing to hear Satya Nadella, CEO, Microsoft Corporation speak about his passion for and commitment to continuous learning.

“I think the thing that I realized is, what excites me is that I’m learning something. I can learn something about some area. I can learn something from people. I can learn something from doing things differently. And I admire that in other people, too. I fundamentally believe that if you are not learning new things ... you stop doing great and useful things. So family, curiosity and hunger for knowledge all define me.”

Satya Nadella started his career as a member of the technology staff at Sun Microsystems. In 1992, he joined Microsoft. He was on his way to get a master’s degree in business when the Microsoft job offer came. The company was building an operating system that ultimately would be known as Windows NT and needed team members who understood UNIX and 32-bit operating systems. Nadella wanted to complete his master’s degree and take the Microsoft job. He did both.

"I used to fly to Chicago Friday nights, attend classes Saturdays and come back to Redmond to work during the week." It took him two-and-a-half years, but he finished his master's degree.

"What defines me ... I'm a lifelong learner. I buy more books than I read or finish."

Satya Nadella, CEO Microsoft

THINK 40: Self-Initiated Learning Program at IBM

To foster the link between IBMer engagement and client experience, IBM launched a broad range of tactical activities, and one of the flagship learning program has been THINK40, a self-initiated learning program of at least 40 hours of professional development that every IBMer undergoes each year. According to *2013 Corporate Responsibility Report* of IBM, IBMers completed more than 25 million learning hours in 2013, and this number only keeps growing every year.

IBM's Think Academy is a new method of sharing and learning that the entire company does together. This online, easy-to-digest approach to learning allows employees to gain insight in areas critical to the business where new knowledge is being rapidly created. This allows employees to become experts in and advocates of rapidly changing areas such as cloud, Big Data and analytics, mobile and social computing. Courses called Think Friday sessions begin on the first Friday of each month, but employees can choose when and how they access content. IBM CEO Ginni Rometty begins each Think Friday session by framing a given topic, its importance and key concepts to explore. She also regularly interviews clients to gain insight into how a topic affects their business and what they are learning about it. Think Academy curates and houses each new topic in an interactive learning environment.

We looked at IBM and Microsoft, as the software engineering field experiences a half-life knowledge of two and a half years.

It is becoming increasingly evident that employees are working in a volatile, uncertain, complex and ambiguous environment (VUCA). Organizations are trying to create a learning culture that

- Focuses on self-directed learning, i.e., encouraging employees to develop themselves
- Blending the learning environment with the work environment

All the above discussion leads us to conclude that '**Self-Learning**' is a trait every budding engineer must cultivate and nurture to survive and succeed in their career.

Now, as students and budding engineers, the question you may have in your mind:

What is Self-Learning?

What are the opportunities available for you to do self-learning?

"Learning never exhausts the mind" – Leonardo Da Vinci

All of you may recall Ekalavya, probably, the earliest Self-Learner recorded in the history of mankind.

Ekalavya – the story of an early self-learner from India

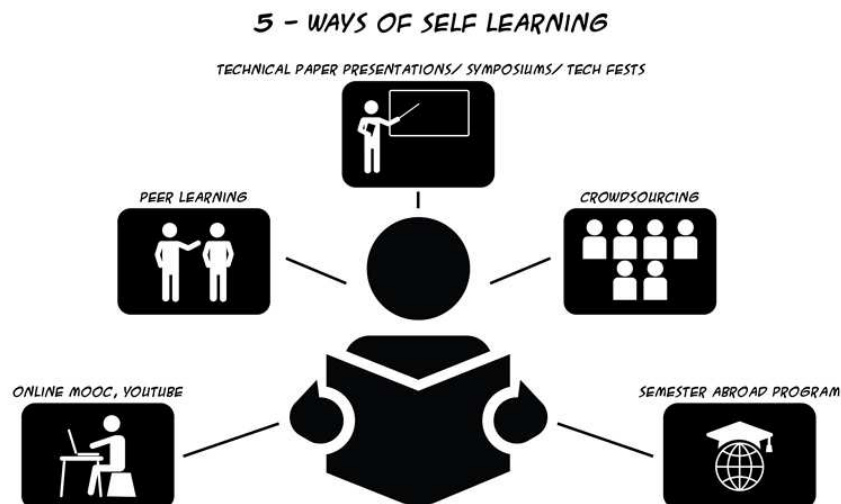
Ekalavya was a young prince of the Nishadha, a confederation of jungle tribes in ancient India. Ekalavya aspired to study archery from Guru Dronacharya. Guru Dronacharya, Guru to the royal family, imparted various skills to the Kauravas and Pandavas. Ekalavya approached Dronacharya, who was very impressed by his sincerity. Upon enquiring about his lineage, Drona rejected him on the grounds of tribal parentage.

Deeply hurt by Drona's rejection, Ekalavya did not give up on his resolute will to master archery. He once stayed hidden in the forest while Guru Drona was teaching the Kaurava and Pandava brothers. After they left to the ashram, Ekalavya collected the mud on which his Guru walked as a symbolic gesture of his want to follow his knowledge and footsteps. He later went into the forest and made a statue of Drona. He began a disciplined program of self-learning over many years. Eventually, Ekalavya became an archer of exceptional prowess, greater than Drona's best pupil, Arjuna. He accepted the statue as his guru and practiced in front of it every single day.

After many months, Drona, along with the Pandavas and the Kauravas, camped in the very forest where Ekalavya resided. At night, their sleep was disturbed by the incessant barking of one of their own hunter dogs. As it was a new moon night and pitch dark, none of the royal pupils ventured out to drive the dog away. All of a sudden, the barking stopped. The royal pupils came out and saw the dog was unable to bark due to an amazing construction of arrows in and all around his mouth. This construction was harmless to the dog, but prevented the dog from barking.

Drona was amazed, but also distressed: he had promised Arjuna that he would make him the greatest archer in the world. Drona and his students investigated, and came upon Ekalavya. Upon seeing Drona, Ekalavya came and bowed to him. Drona asked Ekalavya where he had learnt archery. Ekalavya replied "Under you, Guruji", and showed Drona his statue while explaining what he had done.

Well, that's how self-learning happened thousands of years ago. As we set out on our conversation with the millennials on how they do their learning, we saw a pattern emerging. The students, today, have at least five distinct opportunities to pursue self-learning:



1. **Online Learning** – Leverage MOOCs, YouTube videos and tons of material available on the net to pursue topics of your interest. **Malvika Joshi** and **Tanmay Bakshi** stand out as great examples of self-learning, and they made it to the headlines.
2. **Peer Learning** – Forming special interest learning groups is another way by which students motivate and learn from each other. The stories of **Ishita Joshi**, who acquired new skills through peer learning and secured a job-role of her choice, or **Mohammad Anwar** and his team who realized their dream of designing aircraft, are fascinating stories of what one can achieve in a peer group.
3. **Technical Paper Presentation** – Technical Paper Presentation refers to presenting your research work in an invited conference/workshop/symposium. In addition to helping the students gain an in-depth knowledge, this also helps them to improve their communication skills, share their knowledge and encourage them to read existing body of knowledge and make incremental original contributions. Almost all major engineering colleges host technical symposiums, and it was refreshing for us in our field work to listen to **Anjali Mishra**, **Aphurvika Mani** and **Debayan Mandal** on how they derived their inspiration to seek knowledge and went about publishing papers in international conferences.
4. **Crowdsourcing** refers to the practice of obtaining information or input into a task or project by enlisting the services of a large number of people, either paid or unpaid, typically via the Internet. There are many portals that offer opportunities for students to bid and work in real-life industry projects. The learning one gets from crowdsourcing projects are immense, and it was exciting to see how **Joseph Chacko** started with freelancing and gained experience in mobile-app development, that landed him with a job at the Apple Garage at IBM.
5. **Cross-cultural Learning Opportunities** – Travel is a great teacher, and there are campuses that offer opportunities to students to pursue a semester or their project-work or internship in a university outside the country. **Malavika Suresh**'s story makes an interesting read of how spending a semester abroad helped her to hone her technical skills and how the cross-cultural exposure made her a more holistic individual.

Less than a decade after directing workers to communicate in English at work, billionaire CEO of Japanese IT giant Rakuten, Hiroshi Mikitani, has now asked his 17,000 employees to learn basic coding. "If you're working for Toyota, you know how the automobile works...So if you work for an IT company, you need to know what's in the computer," Mikitani said.

The International Olympic Committee has unveiled robots designed to help workers and attendees, specifically wheelchair users, at the 2020 Tokyo Olympics. Made by Toyota, the 'Human Support Robot' and 'Delivery Support Robot' will perform tasks like carrying food, and guiding attendees to seats. Further, Panasonic-made 'Power Assist Suits' will help workers lift heavy objects with less strain.

Announcements

Call for Volunteers for IEEE India Council Student Coordination Team

The Student Coordination Team will comprise of students & young professionals who give their commitment to volunteer for next one year.

The team will mainly focus on

- Industry Relations
- Webinar & Online Training
- Social Media Coordination
- Editorial & Newsletter Coordination
- SB Networking Coordination
- Graphic Design Coordination
- Young Professionals Coordination
- WiE Coordination

Link for Nomination: bit.ly/ICSCTCFV

The deadline for nominations would be till: 31st March, 2019. *For any queries, they can be routed to vamshikrishnaj@ieee.org*

Workshop on Connecting World through Electromagnetics at IIT Kharagpur during 28-28 Apr 2019

The workshop being organized by IEEE AP-MTTS Student Branch Chapter, IIT Kharagpur will introduce the participants to the cutting edge technologies like Millimeter Wave Communication, RADAR Communication, Plasmonics, Optical Metamaterials etc. Some important modules of a transceiver system will also be presented in detail, i.e., from concept to simulation, fabrication, and packaging. Simulating various electromagnetic scenarios using HFSS, ADS, MATLAB, Python etc. will also be covered. Apart from these, there will be talks from IIT Kharagpur faculties and interactive sessions with technical experts from DRDO and other defense organizations. More at <http://ewh.ieee.org/sb/kharagpur/iitkgp-mtt/>

IEEE TENSYP-2019 at Kolkata during 7-9 Jun 2019

The IEEE Kolkata Section will host the IEEE TENSYP-2019 on the theme “Technological Innovation for Humanity” during 7-9 Jun 2019 at Biswa Bangla Convention Centre, Newtown, Kolkata.

The Early Bird Registration Deadline is 10th Apr 2019. More at <http://ewh.ieee.org/r10/calcutta/tensymp2019/index.html>

‘IEEE Region 10 Conference Leadership Program at Goa during 17-18 Aug 2019

This program aims to train volunteers from the sections of Region 10 to organize and guide IEEE conferences efficiently and effectively ensuring the quality as per IEEE standard in their respective sections. The topics to be covered will include: IEEE Conference History and Context Setting, Why Run a Conference? Benefits and Value of Conference Organizing, Measurement and Success Criteria for Events, Getting Started: Creating a Plan of Action, Sponsorship: Definitions, Roles and Accountability (Including MoUs and MGA Sponsorship Approval Process), Organizing Committee: Roles and Formation, Technical Program, Peer Review and Conference Quality, Conference Publications Start to Finish (IEEE Conference Publications Program, IEEEExplore, Plagiarism Checking, eCopyright, etc.), Financial Management of Your Conference: What You Need to Know, Event Planning / Running the Event, Closing Your Conference, Best Practice Discussions / Case Studies, IEEE Meetings, Conferences & Events Overview. All Sections requested to encourage participation and nominate one delegate (maximum two) from your section by 6th April 2019. For additional info, pl. contact Mr. Deepak Mathur, Director - Elect 2019-2020 - IEEE Region 10 (Asia Pacific), deepakmathur@ieee.org

ILS-19 WIE International Leadership Summit at Bangalore during 30-31 Aug 2019

IEEE Bangalore Section and WiE AG Bangalore Section will conduct the WIE International Leadership Summit (ILS19) during 30-31 Aug 2019 at Hotel Sterlings Mac Bangalore. WIE ILS19 will provide regional opportunities to foster networking, mentorship, and possible collaboration. This program is part of the portfolio of global initiatives that focus on Empowerment, Entrepreneurship, Leadership, and Future Technology. The theme of the Summit will be “Redefining the Defined” More at wie-ils2019.org

IEEE TENCON-2019 at Kochi during 17-19 Oct 2019

TENCON is the flagship premier international technical conference of IEEE Region 10. The Theme for TENCON-2019 is "Technology, Knowledge, and Society". It will be held during 17 – 20 Oct 2019 at Hotel Grand Hyatt, Bolgatty, Kochi, Kerala.

Paper submission deadline: 29th Apr 2019. More at <http://www.tencon2019.org>

IEEE INDICON-2019 at Marwadi University, Rajkot, Gujarat during 13-15 Dec 2019

IEEE INDICON-2019, the flagship conference of the IEEE India Council will be held at Marwadi University, Rajkot, Gujarat from December 13 to 15, 2019.

Paper submission deadline: 17th Jun 2019. More at <http://indicon2019.in/>

Acknowledgements: ICNL wishes to acknowledge various internet sources for the information presented in this issue of the newsletter. Our exclusive thanks to inshorts (<https://www.inshorts.com>) – a content discovery and distribution application, which aggregates the news across the world and presents them in a concise manner. We also thank Mr. Sunil Agarwal and Mr Ajit Ninan for the permission to use their thought provoking cartoons appeared in Times of India. .

Guidelines for IEEE India Council Newsletter Article

Please follow the general guidelines given below for the articles sent to IEEE India Council Newsletter.

Article content: The article should be of general interest, explaining the concepts, using cases, and/or illustrating technological trends or other areas of interest to IEEE.

Length: 4-5 pages in about 2500 words. (longer articles will also be considered)

Format:

- Word document file format.
- Single Column
- Single Spacing
- Times Roman Font in size 10 Point.

Please keep minimum level of indentations while formatting the article. Aligning to the left is always welcome.

Pictures: Apart from embedding the pictures in appropriate places in the article, please send them additionally as individual jpg files.

References: To be listed at the end of the article (please do not include in individual pages)

Please provide also, the following for inclusion in the article.

1. Full affiliation of the author(s) with email id.
2. Author(s) picture(s) in jpg.
3. Author(s) profiles (as running text), a brief one in about 150-200 words.

Please note the articles provided are re-formatted to suit the newsletter page layout.

The articles are not peer reviewed and also not checked for plagiarism from our end. Hence please verify the facts presented and check your material for potential copyrights and intellectual property rights violation.

To get an idea of the type/nature of articles and the publishing style, please refer to past issues of the newsletter at http://sites.ieee.org/india_council/newsletter/

If further clarifications are required, pl. contact the editor HR Mohan by email at ieee.icnl@gmail.com

Please send the article along with the requested info by email to ieee.icnl@gmail.com, the exclusive email id for the newsletter.

The Editor's decision is final

Guidelines for submitting reports to get published in the IEEE INDIA INFO, the India Council Newsletter (ICNL)

- Please submit the event reports within TWO months of its happening. Older events reported may be ignored.
- The matter may be in doc / rtf / txt format. Please avoid other formats such as pdf, jpg as they will not be considered.
- Please use SINGLE column format (while the report is prepared).
- Please avoid embedding the photos in the document relating to event reports. However, images referred in articles alone may be embedded at appropriate places in the article document in addition to sending them separately.
- Please send the event photos (typically one/two best) separately (even in they are included in the report).
- Preferred format for photos is “jpg”. Please avoid sending the photos in “bmp”, “png” formats.
- Photographs in digital form should not to exceed 1024 pixels in width. You may use any photo editing software (MS Office Picture Manager is quite useful) to re-size the image. This will reduce the file size of the images considerably. Pl. avoid sending large size photos (Sometimes we get files even up to 6 MB size). We generally recommend file sizes less than 500K.
- Provide your name, full affiliation, membership no. and email id at the end of the document.
- Send the matter by email with the subject: From <Section / College Name in short form> -- Report on <Event Name (short name is OK) & Date> eg: “From Madras Section / SSNCE -- Report on Conf on Wireless Networking dt. 10-11, Feb 2017”
- Please send the matter by email to ieee.icnl@gmail.com
- Please note that the matter sent to other email ids may get ignored and may not be considered.
- Please submit the matter for publication latest by 8th of the publication month (currently Mar, Jun, Sep, Dec as ICNL is a quarterly) to facilitate inclusion in that quarter’s issue of IC Newsletter.
- Please note that while all efforts will be made for publishing, due to certain practical constraints, the actual publishing may be delayed.
- We will be constrained to ignore the submitted materials, if they do not follow the above guidelines.
- Please co-operate with us by adhering to the guidelines specified.

IEEE India Council Website

The website of the IEEE India Council (IC) has been redesigned using the Wordpress content management system and is hosted on the IEEE webserver at <http://sites.ieee.org/indiacouncil/> with the efforts of the web master Dr. Suryanarayana Doolla of IIT Bombay. The readers may find the following links of the IC useful.

Home: <http://sites.ieee.org/indiacouncil/>

Executive Committee: <http://sites.ieee.org/indiacouncil/about-ieee/executive-committee/>

Sections: <http://sites.ieee.org/indiacouncil/about-ieee/sections/>

Chapters: <http://sites.ieee.org/indiacouncil/about-ieee/chapters/>

Announcements: <http://sites.ieee.org/indiacouncil/category/announcements/>

Events: <http://sites.ieee.org/indiacouncil/events/>

Newsletter Archives: <http://sites.ieee.org/indiacouncil/newsletter/newsletter-archives/>

Conference Norms: <http://sites.ieee.org/indiacouncil/conference-norms/>

INDICON: <http://sites.ieee.org/indiacouncil/indicon/>

Student Activities – Awards: <http://sites.ieee.org/indiacouncil/student-activities/awards/>

M V Chauhan Student Paper Contest: <http://sites.ieee.org/indiacouncil/student-activities/mvc/>

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