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# INTERACTIVE WALL PROJECTION SYSTEM FOR CLASSROOM

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***Abstract***—This paper describes Interpersonal Interaction-based Education for Children. Also, introduces Kinesthetic Gesture Interaction technique for Interactive Wall Projection System using Video Mapping and Augmented Reality without the use of any display units. This system provides a multitude of different options. It includes integration of any type of graphics and stereo audio. The 3D camera makes smarter sense of gestures. This system is specially built by depth sensing technique and it will be providing high resolution display. This interactive wall system uses gesture recognition by the use of Tenser flow technique.

**Keywords-**Wall Projection; Projection Mapping; Video Mapping; 3D Camera; Dynamic Gesture

## I. INTRODUCTION

In this Digital Era, with the development of science and technology, our day-to-day life believes in Digital products. Now a days we are mostly fond on the mobile and internet for various purposes such as studies. Students have much more interest in these online classrooms. But once they went back to school, they might be seeing the different situation. This paper will give them more attractive and interesting way of learning. Since children can interact with their subjects. Here is the interactive wall system senses movements of people and gestures on the designed area of wall. The design of multi-touch surfaces on wall are commonly based on a point-based interaction (PBI) which uses a cursor in a graphical environment. This is implemented in Interactive Wall Surface using 3D Camera with the use of Depth Information Technology and Hand Gesture Control. Students can easily understand the concepts in 3D view without any use of display boards. So that there is no fear on damaged digital white boards. The only thing we are aiming is to provide a Presentation and Video projection.

## II. LITERATURE SURVEY

[1] *INTERACTIVE ACQUISITION OF RESIDENTIAL FLOOR PLANS*[11], Young Min Kim, Jennifer Dolson, Mike Sokolsky, VladlenKoltun, Sebastian Thrun developed a hand-held device for the real-time, interactive benefit of residential floor planning.The system includes a commodity range camera, a micro-projector and a button interface for the end user input and allows the end user to move freely through a building to capture its important architectural elements.The system uses the *Manhattan* world assumption, which postulate that wall layouts are rectilinear. The real-time depth sensing is the important input modality. They used the Microsoft Kinect, a lightweight commodity device that outputs VGA-resolution range and color images at moving images rates. The data is analyzed and processed in real-time to plan the floor plan by focusing on flat surfaces and ignoring clutter. The generated floor plan can be used directly for remodeling or real-estate

applications, or to produce a 3D model of the interior for applications in virtual environments. In particular Section, they have already demonstrated a greater number of residential wall layouts reconstructed with their system. This assumption allows generating floor plans in real time, which enables the operator to interactively guide the reconstruction process and to resolve structural ambiguities and errors during the acquisition.

[2] *AN INTERACTIVE FLOOR FOR SHAPE-BASED INTERACTIONS USING A CLIENT-SERVER ARCHITECTURE*[12],Gonzalo Luzardo Bruno Guam´ an Katherine Chiluiza, developed a three-folded interactive system:(i) how to implement a low-cost computer vision interactive-floor, based on a shape-based interaction approach sought to shed light (ii) the performance of the client-server system has been studied (iii) a usable study was set up, which examined the users' satisfaction and their interaction with that system. The results demonstrated in this paper is that a maximum of 4 persons can interact at a time compromising the CPU usage up to 50% on the server and up to 90% on the client. The network traffic was also analyzed by the team showing that due to the simplifications of the shapes sent from the server to the client, the traffic was between 127 Kbps and 759 Kbps. Moreover, the user experience and reality are enhanced using the approach proposed.

[3] *A PRESSURE SENSING FLOOR FOR INTERACTIVE MEDIA APPLICATIONS* [13], Prashant Srinivasan David Birchfield Gang Qian Assegid Kidane, explores the designing of a reconfigurable large-area high-resolution pressure sensing floor to help to understand human dance movement. By measuring the pressure of a user, who is interacting with the system, that device is capable of providing the real-time knowledge about both the location of the performer on the floor and the amount as well as the distribution of force being exerted on the floor. This paper describes the design and evaluation of a suite of motion-based games for gait rehabilitation with personalization based on gait characteristics. They used an 8/1-meter pressure sensitive interactive LED floor. With the interactive game's users can be able to attempt to steer different dimensions of people's gait, increase motivation, provide an enjoying experience, and create an additional platform for gait rehabilitation by physical therapists. They performed several days of exploratory user tests with the created set of games, in total 56 patients and 30 therapists were involved in their testing time. The set of games was received perfectly by therapists, who stated they could train a variety of game domains with it. Furthermore, it is different from more rehabilitants normal training exercises. The possibilities extend with their personalization and the variety of games allowed users with a wide variety of skills and limitations to train their gait, although not all rehabilitants could be offered an appropriate level of challenge. They do believe that the positive responses from the games can be adapted to the rehabilitants' gait characteristics with several settings in the games, and that a second reason seems to be that they can choose between games to target different aspects of rehabilitation suitable for the type of rehabilitant.

[4] *FUTUREGYM*: A gymnasium with interactive floor projection for children with special needs,Issey Takahashi, Mika Oki, Baptiste Bourreau, ItaruKitahara, Kenji Suzuki [14] develops an Interpersonal interaction, which is one of the basic factors for successive inclusion in education for every child with specially needs, children who is suffering from Autism Spectrum Disorders (ASD) and/or Intellectual Disabilities (ID). In order to increase offer for interpersonal interactions among children, an interactive school gymnasium called FUTUREGYM, which is with a larger-scale of interactive floor projection system in a school setting is proposed in this paper. As part of this research, high performance projectors and tracking cameras mounted on the ceiling were installed in the gymnasium of a school, which will be facilitated overlaying of individual visual aids for children with specially abled. Visual aids help the

children to gain a knowledge of social cues, a behavior that is considered important for the development of social interaction. Three key components of FUTUREGYM are (1) Group running by the students, called Circle-Run, provides an opportunity to feel a behavior that requires coordination with others (2) A group of exergame, called Constellation Game, will trigger helping behaviors by requiring them to be aware of other players' difficulties. The possibility of these activities has been confirmed in this study through viability tests with the school's children with ASD and/or ID.

[5] *INTERACTIVE FLOOR SUPPORT FOR KINESTHETIC INTERACTION IN CHILDREN LEARNING ENVIRONMENTS*, KajGronbaek, Ole Sejer Iversen, Karen Johanne KortbekKasparRosengreen Nielsen, Louise Aagaard[15] This paper introduces a novel kinesthetic interaction technique for interactive floors. The interaction idea uses a vision-based limb tracking on an interaction floor. It consists of a 12 $m^2$ glass surface at the bottom projection area. The kinesthetic interaction way has been developed for an interactive floor implemented at a school square. The paper works the kinesthetic interaction technique and its capabilities in the domain of learning applications: Kinesthetic interaction will support the body-kinesthetic learning as argued in the learning literature. Kinesthetic interaction is really funny and motivating thus capture the attention of children to explore and learn. Kinesthetic interaction on large area display surfaces supports collaboration, co-located play area and learning through communication and negotiation among the participants. Finally, the paper discusses possibility and challenges in development of kinesthetic interaction for interactive floors. The work reported was conducted in a project at the interactive school environments. The objective was to create new types of Information Technology (IT)-based learning experiences for school children. The work has been inspired from several sources namely empirical research in school environments, literature studies within multiple learning styles, and movement-based interaction techniques. Others have inform the fact that computer supported learning artifacts can stimulate learning through kinesthetic interaction. Under Koffler & Ishii's Illuminating Light workbench lets students learn about optical systems by designing them. In a use survey of the commercial Dance Revolution, Hoysniemi points to the fact that playing the kinesthetic interaction game has a positive effect on the social life and physically health of the players and increases the endurance, muscle strength, and sense of rhythm by the users.

[6] *IGYM: AN INTERACTIVE FLOOR PROJECTION SYSTEM FOR INCLUSIVE EXERGAME ENVIRONMENTS*, Roland Graf, Pallavi Benawri, Amy E Whitesall, Dashiell Carichner, Zixuan Li, Michael Nebeling, Hun Seok Kim, In traditional sports customizing, players with mobility disabilities typically do not contain opportunities to engage in physical plays with their team mates without mobility aids and vice versa. In this paper, they present an iGYM, it is designed to enable people with mobility disabilities to take part on standard with, and in the same physical environment as, their peers without disabilities. At the depth of iGYM are the idea of children circle interaction and adjustable play mechanics, which enable individualized play calibration and wheelchair accessible manipulation of virtual targets on the floor. Based on a pilot learn and research, we determined three adaptation levels designed to make the system (I) accessible, (II) more playable, and (III) more balanced. The team conducted a user study with 12 children testing the effects of different levels. Findings detect that larger adaptation levels were not always preferred. Children preferred multifactorial and also based on their desire to challenge themselves. Perceptions of fair were often generating the regardless of whether players used wheelchairs or not. CSS Concepts • Human-centered computing Accessibility technologies • Human-centered computing Mixed / augmented reality. Adaptive sports and the latest exergames,

have successfully involved people with mobility disabilities to enjoy the benefits of physical play.

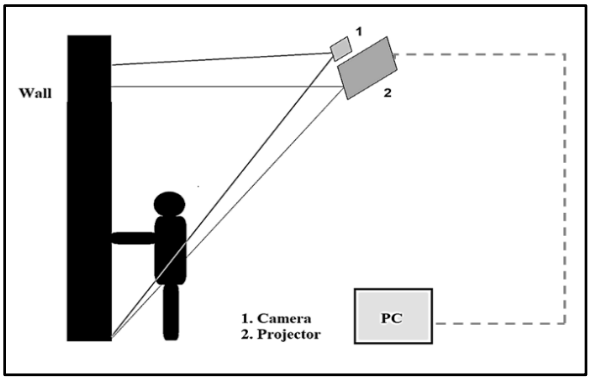



Figure 1. Physical design of Interactive Wall System

## III. SYSTEM ARCHITECTURE

### *A. Design of Wall System*

The main advantage of having Interactive wall is high resolution along with touch-sensitive display. By this technique we will be able to bring the real time experience in learning among students. The display will be as same as desktop computer but in large magnified area. This is completely user-controlled system by means of gestures. This system consists of 3D camera for smarter sense of dynamic actions. In *Figure 1* it shows the physical design of how interactive wall is working. The height and length of the placements will depend on the room that is used for installation. From the diagram we can see Camera is present at the top of the projector, to capture every motion or gesture of the teacher or faculty. There are numerous ways to fit the projections, but we prefer the Horizontal projection for classrooms. There is no need of any extra cost for the projection on wall, just a white painted wall is enough.

### *B. Embedded Single Board Computer*

This system is deployed with the new Zora Development Board, which is specifically built for Depth sensing. This is specially designed to work Supporting swappable eMMC module with expandable external storage. The Amlogic A311D Quad Core A73+ Dual Core A53 processor with NPU. Supporting operating systems are Android, Ubuntu 18.04. tandem with Orbbec 3D Cameras. It is an ideal platform for speed, accuracy, flexibility and cost. The Zora development board is an industrial demanding development board in recent days for long lasting solutions. The most powerful processor makes use of code burning through USB ports. And numerous numbers of output ports are used for muti-purpose applications. Since this board can specially designed for the depth sensing, we will be able to interact with the wall, in addition to the gesture control on the wall. Usually, two elements are important for depth sense, one is an Infra-Red (IR) projector and an IR camera. IR Projector projects an IR light on the object which can be mapped by the IR Camera, which will be like a sea of lights, but it is not visible to humans since it is the IR range [16].

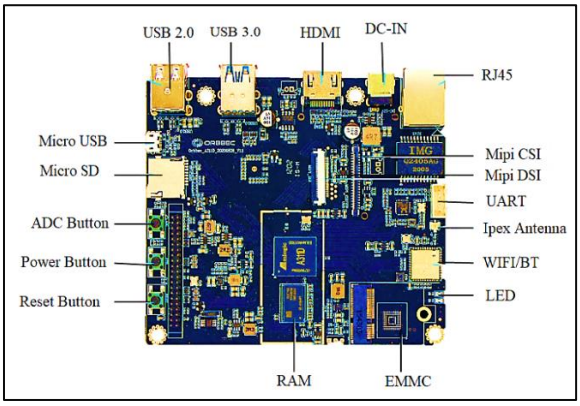



Figure 2. Zora P1 Development Board

### *C. Presentation Content*

In the Figure 4, it is displayed the sample output of the Interactive wall system. This sample output is done through tool called as Processing 3.5.3. Processing tool is a flexible software sketchbook since 2001, it also promotes software literacy within the visual arts and literacy with the technology. It has OpenGL integration for accelerated 2D and 3D, also have interactive programs with 2D, 3D, PDF or SVG output. Since, processing software is free and an open source, which can be run on Mac, Windows, Linux platforms. Processing is built and maintained by GitHub, which is the largest and most advanced development platform in the World. There are about 56 million of developers, with 3 million organizations and more than 100 million of Repositors. GitHub Education helps us to grasp software development with the software tools of GitHub platform and its community.

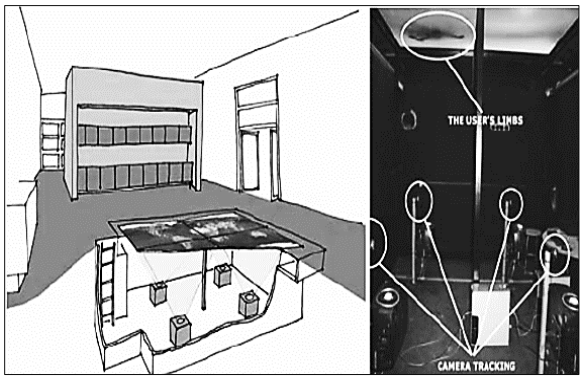



Figure 3: iGamefloor system setup beneath the surface

## IV. EXISTING SYSTEM

The existing system is designed for CAD models, high-resolution video, interactive simulations, game graphics, virtual gym, web browsing, etc.., Also, some of the applications have been deployed with video walls. The systems have been interfaced through a hand-held projector, touch sensitive displays. It will sense kinesthetic gestures, limb tracking, cursor tracking at multiple points in Point Based Interaction in the graphical environment. Since, some those products have been developed in the floor which is on tile surface or on an LED floor. For the interactive floor system, the common projection technique was in rear view projection. In that case they will be developing the floor in under working area, which is in need of more space. For gaming, there is in need of more than one projector and also a display in floor.

## V. PROPOSED SYSTEM

### 5.1 HARDWARE IMPLEMENTATION:

The processor used in Zora P1 development board is an Amlogic A311D Quad core with Neural Processing Unit. It supports all major deep learning frameworks including TensorFlow and Caffe [5]. Through this technique we will be able to capture the gestures. The animated video might live streaming in projector through a computer using Ipex antenna, which is an Omni-directional antenna with better signal transmission and reception of signals. Ipex's working frequency is 2.4 GHz at 6 dBi high gain [6]. The Orbbec 3D camera works based on the Structured light with IR sensor having third generation ASIC chip. So that, structured light at the one point in space, it sends different points (different sockets) like a face looks as real. Also, it is a computer vision type device just like using human binocular vision. It is all because of two cameras as like human eyes. In application with the IR sensor, we can also be able to use it in the outdoor application. It can be able to generate 60 frames per second and much more accuracy with short range accuracy up to 8 m.

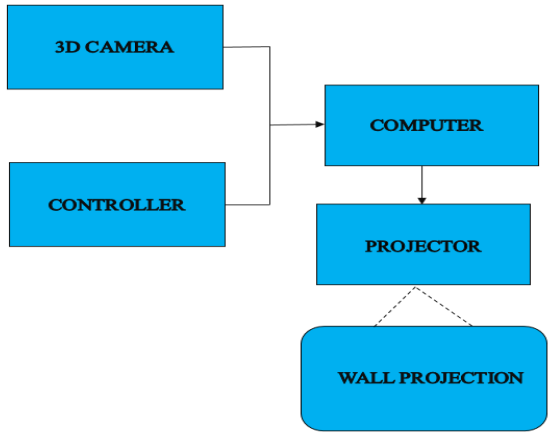



Figure 4: Block Diagram of Interactive Wall Projection System

### 5.2 GESTURE RECOGNITION:

Latest gesture recognition system will provide no physical contact between the user and the gesture enabled devices for recognition. This is simple and can be used by specially-abled persons. The integration of Internet of things can be done in this system. Here we will be using Dynamic gestures. *Dynamic Gesture*: It is temporal sequence of various pattern. It consists of various velocity, shape, location and orientation properties [9]. Specific gestures have been needed for the classroom those default gestures are listed below [7]. Dynamic gesture can be done by the hands and eyes an additional feature for the paralyzed persons to take their classes. The Eye gesture can be implemented using Open CV computer vision library. There are numerous numbers of Gazes available for eye gesture which includes diamond shape, plus symbol, vertical and horizontal

symbol. Mean frame rate (in fps) and maximum frame processing time (in ms) for tracking and recognition on the laptop and the mobile phone. The baseline corresponds to displaying the video on the screen without any processing.

| | LAPTOP | MOBILE PHONE |
|---|---|---|
| **Tracking** | 22.73 fps<br>174 ms | 3.95 fps<br>574 ms |
| **Recognition** | 11.65 fps<br>165 ms | 3.95 fps<br>219 ms |
| **Baseline** | 24.39 fps<br>108 ms | 7.52 fps<br>298 ms |

Table 1: Data Analysis of Frames per second in Laptop vs Mobile phone

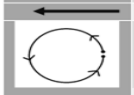
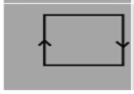
| Gesture | Keystroke | Function | Gesture Character |
|---|---|---|---|
|  | <Ctrl> + <Up> | Increases volume (VLC Media Player) | u |
| | <Ctrl> + <Down> | Decreases Volume (VLC Media Player) | d |
|  | <Down> | Scroll down | r |
|  | <Up> | Scroll up | l |
|  | <Space Bar> | Play/Pause (VLC Media Player)/Scroll down page in PDF Document viewer | o |
|  | - | Open Firefox browser (System Command: Firefox) | m |
|  | <Ctrl> + <q> | Exit an application or process | x |
|  | <Enter> | Open folder/ file or start an application | a |
|  | - | Start VLC Media Player (System Command: vlc &) | v |

Table 2: List of default Hand Gesture

## 5.3 METHODOLOGY

### 5.3.1 Algorithm

**Step 1:** Installation of the Interactive Wall Projection System
**Step 2:** Detection of Presence of a person in the mapping area of Smart Projection system
**Step 3:** If Step 2 is true, then Detection of face gets checked
**Step 4:** If Step 2 is false, then return to Step 9
**Step 5:** If Step 3, detection of face is true, then the detection of Gesture takes place

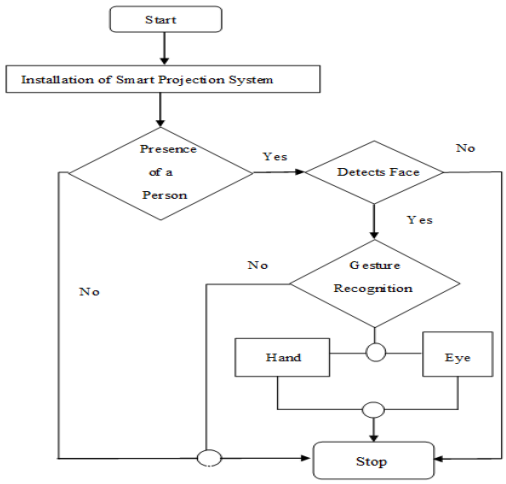



Figure 5: Flow Chart on Smart Projection System

**Step 6:** If Step 3 detection of face is false, Return to Step 9
**Step 7:** Analysis of movement through Hand or Eye
**Step 8:** If Step 5 is false, then return to Step 9
**Step 9:** End the process

## 5.4 SAMPLE PRESENTATION

### 5.4.1 PROCESSSING DEVELOPMENT ENVIRONMENT (PDE)

The sample presentation is the animated interactive program for interactive wall. It is done with the help of Processing 3.5.3, is used worldwide classrooms, which provide visual art programming, computer programming. Processing Development Environment is an open project initiated by Ben Fry and Casey Reas. Processing uses Processing Development Environment (PDE), and programs are written in the Text Editor. A Cmputer programming in processing is called Sketch.

### 5.4.2 SKETCH

Sketches can draw 2D and 3D graphics. The default renderer is used for drawing 2D graphics. The P3D renderer makes it possible to draw 3D graphics, which includes controlling the camera, lighting, and materials. P3D renderers are speeded up if the system has an OpenGL compatible graphics card. The abilities of Processing are stretched to *Libraries* and *Tools*. Libraries make possibility for sketches to do experiments beyond the *core* Processing code. There are hundreds of libraries contributed by the

Processing community that can be added to the sketches to enable new things such as playing sounds, doing computer vision, and working with advanced 3D geometry. Tools extended to the PDE to help make creating sketches easier by providing interfaces for tasks like selecting colors. The data frame can be done the formula [11],

$$\mathbf{X^t = \{D^t, P^t, F^t, T^t\}}$$

Where, $\boldsymbol{X^t}$is the depth sensor output is composed of a range of images for a Two-Dimensional array of Depth measurements.

$\boldsymbol{D^t}$is the Image color value

$\boldsymbol{P^t}$ is the value obtained during image acquisition process, which represents a relationship between the planes in the Mapping area.

$\boldsymbol{F^t}$ is the measurement in the current mapping area of a plane.

$\boldsymbol{T^t}$ is the transformation of the $X^t$, which is the value related to the current depth sensor position with respect to the mapping area.

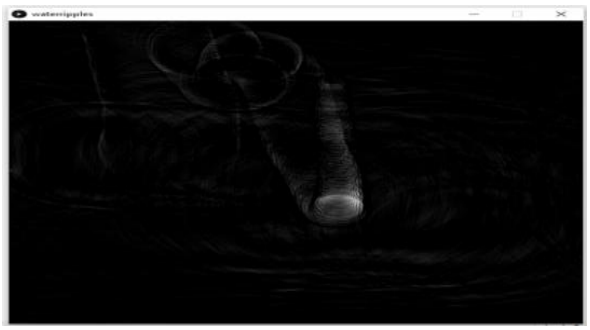


Figure 6: Sample Output on Interactive Screen shows water ripples

## VI. CONCLUSION AND FUTURE WORK

The proposed system allows teachers to interact with the students and also with their subjects. Currently, it is an idea about Interactive Class projection system. In future we will be developing a Chip which will perform the operations on Depth sensing, an Artificial Intelligence (AI) technique, a Deep Learning algorithm, cloud computing which will be able to Project a live video stream. Also, aiming to reduce the size of the Chip we will be using in interactive wall projection system. Future work also includes a development of game regarding their respected Subjects.

Also, we will be providing Multiple users to touch the interactive wall while playing with our own animated games. Also, we are moving towards the research on head movements too. This system combines a greater number of images for image processing. The images and the results given are only the possibility of the system, in future we will develop number of Application specific chips for gesture recognition using Artificial intelligence and in-depth sensing technique.

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