Design & Implementation of Interactive Projector Screen Handling with Hand Gestures

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Abstract: In this paper we provide a multi-acting interactive touch sensing which overcomes many limitations of the existing system. Normally, many people interact with the projected screen with the help of external devices like mouse, keyboard and remote, etc. But, in this paper, we are providing you the various touch features without the help of these external devices. We are providing a wide range facility within less cost of the product as well as low maintenance costs. We can work on almost any surface including non-flat surfaces like canvas, curtains, etc.

Keywords: Touch Surface (Whiteboard/ Canvas), Ir Camera Device, Projector, Wearable Gloves

I. INTRODUCTION

In this information age, the computer is becoming a compulsory learning implement for the student to study. Also, interactive whiteboards are becoming more and more popular in schools, companies, and industries. The concept of interactive whiteboards is an easy one, the computer screen shown on a huge surface. And by touching that surface user can interact with the computer. In 2007, Microsoft introduced Microsoft surface which has a height of 22 inches, a depth of 21 inches, a width of 42 inches and a screen volume of 30 inches, which can provide direct interaction multi-touch contact, and multi-user experience.

Microsoft Surface is a multi-touch [3] tabletop in which input sense computer with a large boundary to students. Such natural user surface offered by Microsoft surface is ideal for students to learn instructive materials more effectively which possibly enhances students learning experience. However, such a system is only commercially available in the United States of America, Canada or the United Kingdom at a price of around USD 20k that includes product installation.

In this paper, we report an innovative use of Wiimote to create a cost-effective technology-enhanced teaching and learning platform. We are using an infrared camera inside the Wii Remote as well as an infrared light-emitting diode device as a high tech mouse.

II. RELATED WORK

A. Projection Based on Hci (Human Computing Interface) System using Image Processing
We use a camera attached to the projector to locate a frame shape marker embedded in the large image. Interactive public displays give access as an innovative media to promote enhanced communication between people and information. In this project, we proposed the idea to implement content with interactive elements for vision-based digital public display. Virtual objects, laser point detection, and projection installation are applied for attracting attention from the user. The preliminary study showed positive feedback on interactive content designing towards the public display. This project enables an effective low-cost touch interface [3] utilizing only a single camera and a projector. It embeds a small shape in the image generated by the user application (e.g. a touch screen menu with icons) and detects touch by measuring the geometrical distortion in the camera captured image.

B. Touch Sensing On Non-Parametric Rear-Projection Surfaces: A Physical-Virtual Heads For Hands-On Healthcare Training: We demonstrate a generalizable method for unified multi-touch discovery and response on a human head-shaped surface with a rear- projection animated 3D face. The method helps achieve hands-on touch-sensitive training with dynamic physical-virtual patient behavior. The method, which is generalizable to other non-parametric rear-projection surfaces, requires one or more infrared (IR) [5] camera, one or more projectors, IR light sources, and a rear-projection surface. IR light reflected off of human fingers is captured by cameras with matched IR pass filters, allowing for the localization of multiple finger touch events. These events are tightly coupled with the rendering system to produce auditory and visual responses on the animated face displayed using the projector(s),

resulting in a responsive, interactive experience. We illustrate the applicability of our physical prototype in a medical training scenario.

C. Applications of Steerable Projector-Camera Systems.

How can interactive computer interfaces be created anywhere in a space without wiring or modifying objects or people? We propose using steerable projector-camera systems employing computer vision to realize such "steerable interfaces." In this paper, we illustrate the potential of the new kinds of applications enabled by steerable interfaces and discuss the challenges imposed on computer vision through the presentation of four application prototypes: a collaborative [15] assembly task coordinator; a multi-surface presentation viewer; a ubiquitous product finder for retail environments; and an interactive merchandise shelf.

We have shown in this paper how possible ways to use computer vision in applications based on steerable projected interfaces. Our basic approach involves using motion data to identify the user's hand and path analysis to identify touch events, hand movements, and simple manipulative actions.

III. EXISTING SYSTEM

Whenever we implement a new system, it is developed to remove the shortcomings of an existing system. The existing system is based on the technology of interacting with the flat surface with the help of an LED pen [2]. It can interact with the hard surface but not with movable or soft surfaces like curtains, etc.

Fig 1: Interactive board with LED pen

IV. PROBLEM DEFINATION

4.1 Overview: In this paper, we proposed a new large surface multi-touch system, our solution uses only a single special IR camera, projection system and partial hand wearable system, which is easy to set up and has low entry cost. Our prototype system shows that the touch sensing is very robust and works flawlessly almost any surface including the non-flat surface. Our solution can effectively overcome several limitations existed in previous systems. The main challenge behind the projector, camera and wearable system set up is the proper placement of every component to give ease of system access.

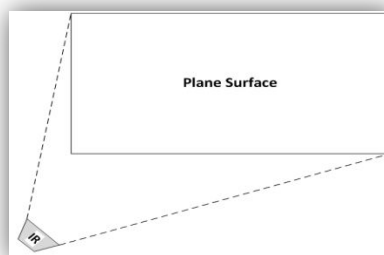### 4.2 Challenges Of Propose System

Fig 2: IR Plane

When the IR camera calibrates the screen manually then we get the plane surface as above called IR plane. Then after the calibration, we have to project our projector screen in between the calibration screen i.e. in between the IR plane surface, this view is called a projection view.
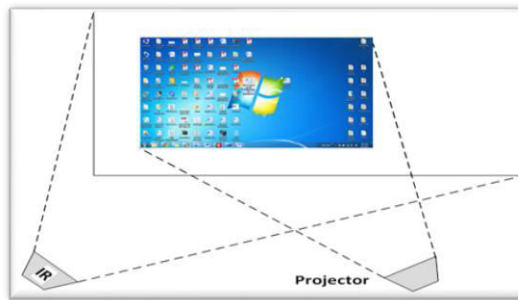
Fig 3: Projection View

Two screens are available one is IR screen means what IR can see and another is projector screen means what project can project. So we have two constant co-ordinates. When IR camera [14] returns the X and Y co-ordinate that co-ordinate is returned by considering IR screen but if we see our real touch is on the projector screen so the X and Y co-ordinate are different by considering a projector. And the real co-ordinates are different where the user exactly touches on the screen. So to find out the real co-ordinate for that following formulae are used.
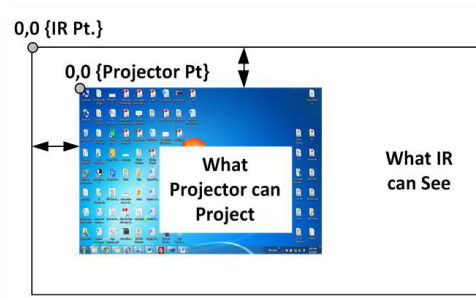

Fig 4: Finding the differential X and Y

V. PROCESS FLOW DIAGRAM

The process diagram is shown in the above diagram. After setting the hardware system first we have to calibrate the screen for smooth functioning. Calibration is nothing but just fix four boundary points. This field is called an IR screen within this field we have to project our projector screen. In the next step when user wants to interact with the computer then user press the button of IR transmitter that is of wearable device it will generates the IR rays this signal will be detected by the IR camera which includes X and Y now system software will take action and calculate the real X and Y for the computer screen once it did system will call Mouse API function of the operating system.
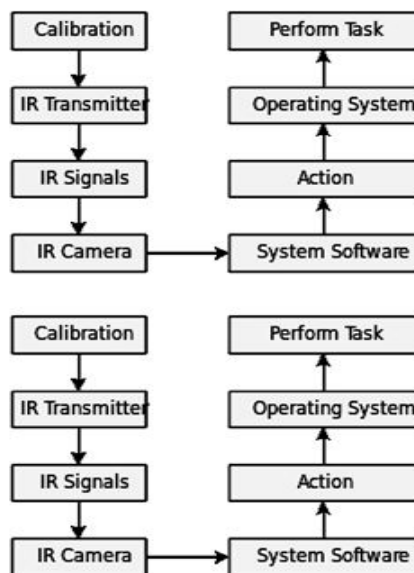

Fig 5: Process flow diagram

VI.   SYSTEM ARCHITECTURE

The Projector will be connected to the computer system via the USB interface. The USB interface provides multiple types of computer systems like Desktop Computer, Laptops, and Tablet Computers, etc. The IR Camera will be communicating with the help of the Bluetooth interface to the computer system. When the button of the IR Transmitter gets pressed, the IR signal sent by the transmitter, this transmitted signals captured by the IR camera and then send to the computer system. The computer system communicates with the operating system and performs the desired operation as per the position of the IR Transmitter. The Proposed system will consist of a Calibration Software.

Fig 6: System Architecture

The Software interface provides the user to calibrate the screen to draw the boundaries of the projected image. The IR Camera takes the inputs from the IR Sensor which is attached to the wearable gloves through which we can operate our system.

VII.   ALGORITHM

To find out the Real X and Y Co-ordinates:
To find out the X and Y Co-ordinates we are using the following procedure called Virtual to real point ratio Calculation.

Virtual to real ratio Calculation:
Step1: Assuming IR Camera Resolution (800*600)
Step2: Give the margin to get a workable capture area.
Step3: Calibration Captured Resolution (600*400)
Step4: Finding the maximum available display resolution Area.
Step5: To calculate X, Y Co-ordinates for Calibrated Operational area.
Step6: Calculate Cab x & Cab y
Cab x = Captured X – Left Margin   (1)
Cab y= Captured Y – Top Margin   (2)
  Where, Captured X & Captured Y is the X & Y co-ordinates of IR resolution.
Cab x & Cab y are the X & Y coordinates of the Calibrated operational area.
Step 7: Finding the percentage of Calibrated co- Ordinates in the calibrated area as follows % of X in calibrated =Cab x * 100/Total calibration   area X   (3)
% of Y in calibrated =Cab y * 100/Total calibration   area Y   (4)
Step 8: To find display screen co-ordinates using % Cab x and % Cab y.
  M_x = X co-ordinate of display screen * % Cab x/100   (5)
  M_y = Y co-ordinate of display screen * % Cab y/100   (6)
Step 9: The X & Y co-ordinate of a Display screen is achieved in terms of M_x and M_y. These co-ordinates are the actual position of a cursor on the projected screen.
Step 10: Utilized these M_x & M_y as per the application Requirement.

VIII. CONNECTIVITY AND DEVICE CALLIBORATION

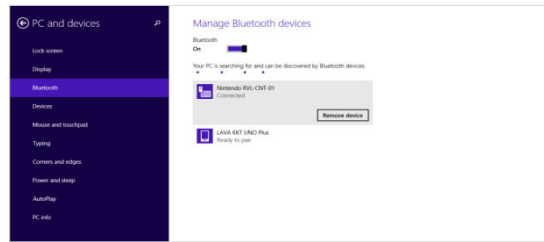### 8.1 Bluetooth Connectivity

Fig 7: Bluetooth Connectivity

The above figure 7 shows how the IR Wii Remote device is connected with the system by the Bluetooth connectivity which is in build in the device itself. As shown above, the IR device is connected to the system.

8.2 IR Device Detection for Calliboration

Fig 8: SS for IR Device Detection

In the above figure 8 as we can see that the software is detecting the IR Device which is connected with the system with simple Bluetooth connectivity in the system.

8.3 Calliboration Window

Fig 9: Calibration Windows

In the above figure 9, as we can see that the IR device is being connected and to start the calibration we need to click on the quick calibration button present in the window of the software.

8.4 Tools for Workspace

Fig 10: Additional Tools for Workspace

In the above figure, the additional tools which we are providing you which we can utilize for the presentations in the institutes or companies for the explanation of any diagrammatic topics.

IX. RESULT

9.1calibration Screen

Fig: 11 Calibrating IR with Projected Screen

In above figure 11, we are calibrating the end points of the IR device which is placed towards the projected screen for making the screen interactive.
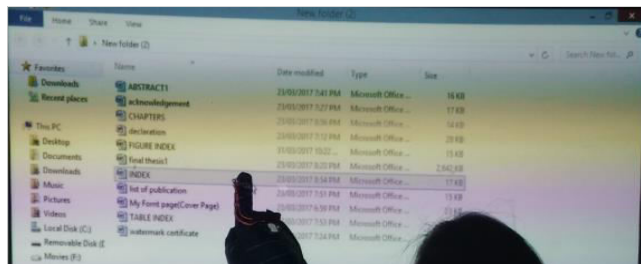
9.2 Opening Application

Fig: 12 Opening Application

The above figure 12 shows the double click feature in which we open any folder or icon on the desktop for any word.

9.3 Virtual Keyboard Typing

Fig: 13 Virtual Keyboard Typing

The image above figure 13 shows the use of virtual keyboard and typing using the wearable glove to type anything on the notepad in the wave as well as by hard touch.

9.4 Utilization of Tools

Fig 14 Tools Utility

The above figure 14 shows the working of the additional tools which are provided on the screen for explaining any topic diagrammatically.

X. APPLICATIONS AND ADVANTAGES

Applications:
- This technology provides enhanced and skillful features.
- It performs various operations on the touch surface without any external devices.
- It will Robustness and works as a flat and non-flat surface.
- The partial hand wearable gloves that facilitate natural writing and drawing and interaction for the user.

Advantages:
- Simple and Handy to use.
- It is an optimal solution for high-end technology implementation.
- It provides a low-cost substitute for interactive surface using a simple graphical user interface.
- The installation procedure is so simple so that anyone with computer knowledge can install it.
- It can control the entire computer operation with an interactive touch surface.
- An operating air mouse function is possible.

XI. CONCLUSION

To achieve high applicability, the proposed system primarily focused on the study of work done in the area of hand gesture recognition. This is achieved using a single camera, mini projection system, and partial hand wearable system which convert any flat surface in to touch screen system. Users can easily access the wall, desk, canvas, and etc. surface as a computer display system and control all the estimation action of the computer.

In this paper, we can implement the hand gesture reorganization to remove the barriers or the difficulties which we are facing by using the wearable gloves which are not hands-free to use.

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