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Research Article

Design & Implementation of Low Cost Interactive Touch Surface

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Abstract

One of methods achieving Mixed Reality (MR) displays is the texture projection method using projectors. Another kind of emerging information environment is a wearable information device, which realizes ubiquitous computing. It is very promising to integrate these technologies. Using this kind of fusion system, two or more users can get the same MR environments. The wearable technology has been developed for general or special purpose information technologies and media development. Wearable computers are especially useful for applications that require more complex computational support than just hardware coded logics. Here we are proposing the system where using partial hand wearable system, mini projection system and special camera, we will convert any flat surface in to touch screen system. User can easily access wall, desk, canvas, etc. surface as a computer display system and control all the computation activity of the computer. Main challenge behind the projector, camera and wearable computer system set up is proper placement of every component in order to give ease of system accessing.

Keywords: *Mixed reality display, Wearable technology*

1. Introduction

In this information age, computer is becoming a compulsory learning instrument for student to study. also the interactive whiteboards are becoming more and more popular in schools, company and industries. The concept of interactive whiteboards is a simple one, The computer screen shown on large surface. And by touching that surface user can interact with the computer. In 2007,Microsoft introduced Microsoft surface which having height of 22 inches, a depth of 21 inches, a width of 42 inches and a screen size of 30 inches, which is able to provide direct interaction multitouch contact, and multi user experience(Microsoft corporation,2008). Microsoft surface is a multitouch table top in which input sensing computer with large interface to students (Scott S., Carpendale S.,)such natural user surface offered by Microsoft surface is ideal for students to learn educational materials more effectively which possibly enhance students learning experience. However, such a system is only commercially available in United State of America, Canada or United Kingdom at a price around USD 20k that includes product installation (www.thenakedscientists.com)

So, in this paper we report an innovative use of wimote to create cost – effective technology- enhanced teaching and learning platform. Here are using an infrared camera inside the wiimote as well as an infrared light emitting diode device as a high tech mouse.

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2. Problem Definition

In this paper a new large surface multitouch system propose, this solution uses only a single special IR camera, mini projection system and partial hand wearable system, which is easy to setup and has low entry cost. This prototype system shows that the touch sensing is very robust and works flawlessly almost any surface including non-flat surface. This solution can effectively overcome several limitations existed in previous systems. Main challenge behind the projector, camera and wearable system set up is proper placement of every component in order to give ease of system accessing.

List of feature

- Simple and Handy to use.
- Optimal solution for high end technology implementation.
- Low cost substitute for interactive surface using simple graphical user interface.
- Installation procedure is so simple so that anyone with computer knowledge can install.
- Can able to control the entire computer operation with interactive touch Surface.
- Operating air mouse function is possible.

3. Research Methodology to be Employed

3.1 IR camera

The sensor in a IR Camera is sensitive infrared (IR) radiation because it consists of visible light filter to stop the visible light. As shown in the Figure 1.1 In a normal camera view a candle is not very bright in the visible light and the all colors which is present in the background are also detected. But in case of IR camera view shown in Fig.1.2 the candle light is very bright because the candle light consists of infrared but not very efficient light source. we also observe that the background details are not detected because the visible light filter are attach to the IR camera.

Figure 1.1: A candle is not very bright in the Visible light source

Figure 1.2: But very bright in the infra-red not very efficient

Sensor chip is the part that convert the image projected on in into electrical signals. The camera consists filter, lens and aperture eg. In Fig. 2.1

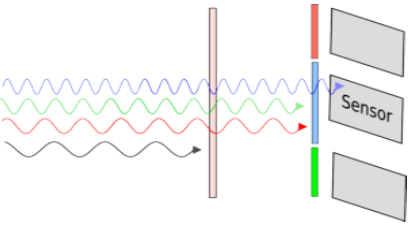

Figure 2.1 Normal Web Camera

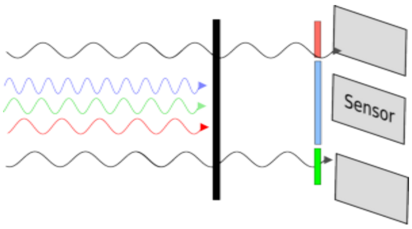

Figure 2.2 IR Camera

In a normal web camera has a sensor behind lens which is sensitive to most color of light and also IR. But it has a filter on the front which stops IR light. Then the series of filters on the sensor chip itself to only allow one color through each sensor on the chip so they can detect different colors. In a Figure 2.1 web camera the IR is stop by the filter and there are color filters in front of each pixels so the camera can determine color. Figure 2.2 IR camera, we have to just put the visible light filter on the normal camera so only IR can get through which goes through all color filters.

If we put visible light filter, then only IR can goes through all color filter. When we just let IR into the camera by putting our filter on the front it will pass through all the colored filters to slightly varying degrees. Cameras detect light by having lots of small sensors on a piece of silicon. Each of these sensors is a small diode - a one way valve for electricity, and the electronics is trying to push electricity the wrong way through this diode. This normally doesn't work because a diode is designed so that there are no free electrons to carry an electric current when you try and push electricity the wrong way. But if a photon of light with enough energy hits the middle of the diode it will knock an electron off a silicon atom which can now move and carry electric current. The electronics then measures this current and so how much light has hit the sensor. Most webcams use photodiodes as sensors, these have an area in the centre with no fee electrons to carry current. If light hits the photodiode it knocks an electron off an atom, which can now move carrying electric current. Any color of light above the mid infrared (so near IR, visible, UV etc) will have enough energy to do this, so your camera is sensitive to infra-red light.

3.2 The Wii mote based interactive whiteboard:

The IR camera based multi touch interactive whiteboard is designed to allow instructor to hand draw a write additional notes easily when conducting a class. Projector is used to project educational material from the CPU to the glass surface, tabletop, canvas or wall. The IR camera is used to trace IR sources on the table surface and is placed on top of projector lens for optimum IR detection. A Bluetooth dongle is added to the normal classroom PC to allow communication with the IR camera. The IR transmitter which having pen like structure is use to provide co-ordinate by instructor when it is touch on the wall ,tabletop or canvas and subsequently converted to mouse click. Once the IR camera deletes any IR sources on the wall, the position of the IR blobs will be continuously sent to the CPU as serial data. The processing of this data to support multi touch teaching module developed with various software libraries of different functionalities. The main components of the interactive teaching module are the IR camera whiteboard, the IR TUIO. The Wiimote whiteboard module maps any deleted blobs on the table surface in 3D space co-ordinate to computer desktop co-ordinate (http://www.cs.cmu.edu) while communicating with the IR camera using the WiimoteLib (Jingwen Dai and Ronald Chung,2012).

4. Architecture

The Fig: 4 show the architecture of the system. The Projector will be connected to the computer System via

USB interface. USB interface provides multiple type of computer system like Desktop Computer, Laptops, and Tablet Computers etc. The IR Camera will be communicating with the help of Bluetooth interface to the computer system.

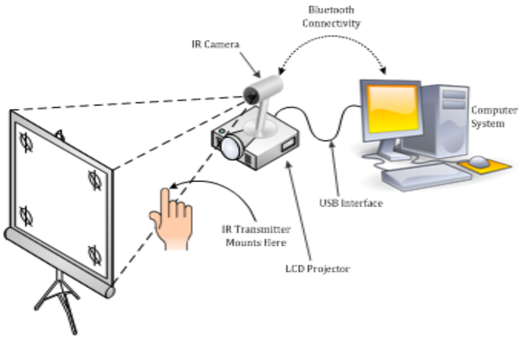

Figure 4: System Architecture

When the button of IR Transmitter get pressed, IR signal send by the transmitter, this transmitted signals captured by the IR camera and then send to the computer system. Computer system communicates with the operating system and performs the desire operation as per the position of the IR Transmitter. The Proposed system will consist of a Calibration Software Interface, a Projector and IR Camera. The Software interface provides user to calibrate screen to draw the boundaries of the projected image. The IR Camera takes the inputs from the IR Sensor which is attached with the wearable gloves through which we can operate our system.

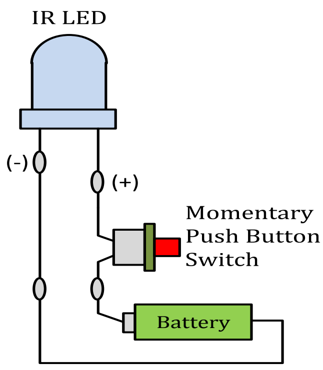

Figure 4.1: IR Transmitter

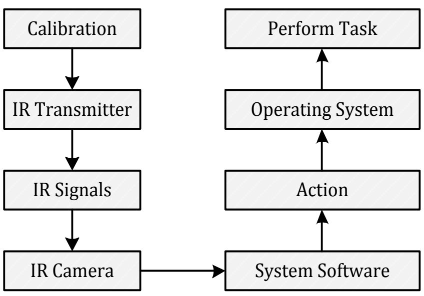

Figure 4.2 Process Flow Diagrams

The process diagram is shown in 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 as IR screen within this field we have to project our projector screen. In the next step when user want 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 done system will call Mouse API function of the operating system.

5. Challenges Of Propose System

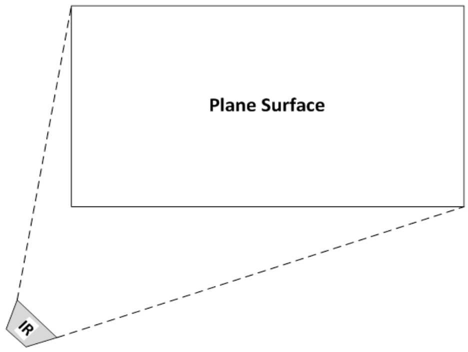

Figure 5.1: IR Plane

As shown in above Fig. 5.1 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 IR plane surface, this view is called as projection view. The arrangement will be seen as above.

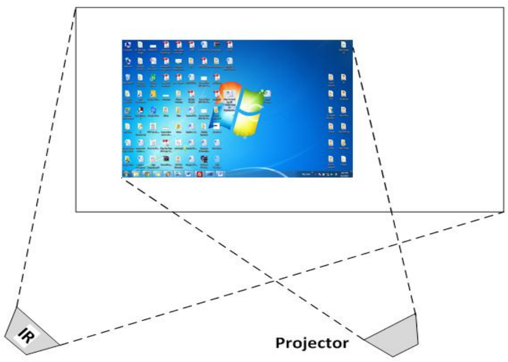

Figure 5.2: Projection View

As shown above Figure 5.2. two screen 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-ordinate. When IR camera returns the X and Y co-ordinate that co-ordinate is return by considering IR screen but if we see our real touch is on projector screen so the X and Y co-ordinate are different by considering projector. And the real co-ordinates are different where the user exactly touches on screen. So to find out the real co-ordinate for that following formulae are used.

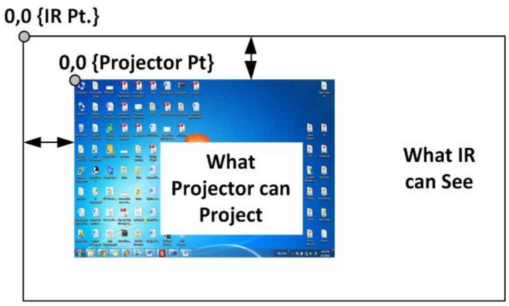

Figure 5.3: Finding the differential X and Y

To find out the Real X and Y Co-ordinates: First of all calculate the difference of the X co-ordinate value of IR and projector then from that value real X are found. Similarly do calculation for the Y co-ordinate and find out real Y.

To Find Out The Real X And Y Co-Ordinates

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

Virtual to real ratio Calculation

Step1: Assuming IR camera resolution.
Step2: Give the margin to get workable capture area.
Step3: Calibration Captured Resolution.
Step4: Finding maximum available display resolution Area.
Step5: To calculate X, Y Co-ordinates for Calibrated Operational area.

Calculate Real X & Real Y

Diff. X = IR X - Projector X (1)
Real X = Current X – Diff X
Diff. Y = IR Y - Projector Y (2)
Real Y = Current Y – Diff Y

Where, IR X & IR Y is the X & Y co-ordinates of IR resolution. Real X & Real Y are the X & Y co-ordinates of Calibrated operational area.

Step 6: Finding the percentage of Calibrated co-ordinates in calibrated area as follows:

% of X in calibrated = Real X * 100/Total calibration area X (3)

% of Y in calibrated = Real Y * 100/Total calibration area Y (4)

Step 7: To find display screen co-ordinates using % Real X and % Real Y.

M_x = X co-ordinate of display screen * %Real X /100 (5)

M_y = Y co-ordinate of display screen * % Real Y/100 (6)

The X & Y co-ordinate of Display screen is achieve in term of M_x and M_y . These co-ordinates are the actual position of cursor on the projected screen.

Step 8: Utilized these M_x & M_y as per the application Requirement.

6. Experimental Result

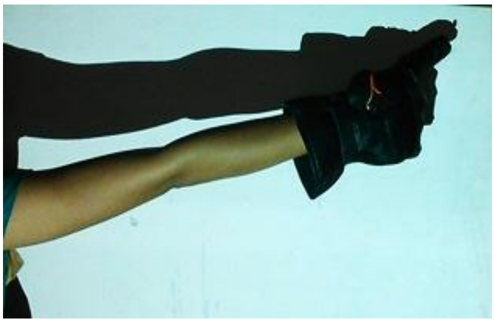

Figure 6.1: Calibration Window

Figure 6.2: Interaction Window

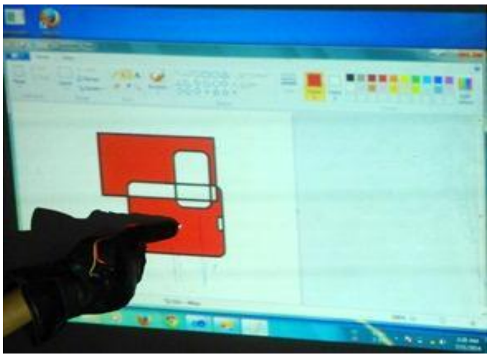

Figure 6.3: Operate projector screen (wall) as touch screen

Conclusion

Although there are various methods of multi-touch system proposed, it is difficult to be used as application because of high complexity of structure, high cost and low display capability. The proposed system is design of a cost-effective technology-enhanced teaching platform using IR camera. The platform consists of an IR-based multi-touch teaching station, an IR-based interactive whiteboard and an IR-based stylus input conversion tool that provides alternative solution to the functionality of the advanced technological hardware in universities. User can easily access wall, desk, canvas, etc. surface as a computer display system and control all the computation activity of the computer. This platform aims to deliver teaching materials to students with a minimum of upgrading cost.

References

Massimo Bosetti, Pietro Pilolli, Matteo Ruffoni and Marco Ronchetti(2011), Interactive whiteboards based on the Wii Mote: validation on the field, IEEE.

Microsoft corporation (2008), about Microsoft surface. http://www.aboutmicrosoftsurfaced.com/about.microsoftsurface.php

Scott S., Carpendale S., Guest editors' introduction: interacting with digital tabletops, IEEE Computer Graphics and Applications: Special Issue on Interacting with Digital Tabletops,26(5), 24-27

http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/make-an-infra-red-camera/Projects-Wii, http://www.cs.cmu.edu/~johnny/projects/wii/

Jingwen Dai and Ronald Chung (2012), Making any planar surface into a touch-sensitive display by a mere projector and camera, IEEE.

Bharath L, Shashank S, Nageli V S, Sangeeta Shrivastava, S Rakshit(2012), Tracking Method for Human Computer Interaction using Wii Remote, IEEE.

Lin, Nishino, Kagawa, and Utsumiya (2011), a Method of Two-Handed Gesture Interactions with Applications Based on Commodity Devices, IEEE.

Chao-Hsuing Tseng, Yung-Chiang Wei, Design and implementation of the Multi-Touch Table, IEEE.

Sinan S., Al Sheikh, Shawky M. Hanana, Yousif Al-Hosany, Bassel Soudan(2011), Design and Implementation of an FTIR Camera based Multi-Touch Display ,IEEE.

D Balakrishna, PV Sailaja, RVV Prasad Rao, Bipin Indurkhya (2010) A Novel Human Robot Interaction usingtheWiimote,IEEE.

PeekB.,Coding4FunManagedLibraryforNintendo'sWiimote, http:// blogs.msdn.com/ coding4fun/archive/2007/03/14/1879033.asp.

Chadwick A. wingrave, Brian Williamson, Paul D. Varcholik and Andrew Miller (2010), The Wii mote and Beyond: Spatially Convenient devices for 3D User Interfaces, IEEE,tutorial at University of central florid