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Interactive White Board

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***Abstract* - Visual Screen uses an inexpensive technique to transform an ordinary screen into a touch screen[1] using an ordinary camera[2]. The system can fullfill many tasks such as controlling a remote large display, and simulating a physical keyboard[4]. Users can naturally use their fingers or other tip pointers to issue commands and type texts. In many intelligent environments, instead of using conventional mice[3], keyboards[4] and joysticks[5], people are looking for an intuitive, immersive and cost-efficient interaction device. We describe two vision-based interface systems[10]. The first, Visual Screen, uses an inexpensive technique to transform an ordinary screen into a touch screen[1] using an ordinary camera[2], and a user can use his/her finger to interact with the computer. Touch screens[1] are very convenient because one can directly point to where it is interesting. No conventional mice[3] are needed.**

Keywords* - *IWB, IR, TUI, TUIO, VS.

1. Introduction

How the world is making a transition from normal screens to touch screens**[1]** and multi-touch screens[1]. People want to manipulate basically any screen according to the way they want. They want the power to lie in their hands and we are here to provide them with that power. Our project[16] is mainly concerned with how one can convert almost any surface into a multi-touch screen[1]. A technology with no benefits is a waste. So we as engineering students want to make use of this touch enabled interactive surface, by implementing it in schools which will be tremendously helpful in teaching.

2. Basic Concept

An **interactive whiteboard (IWB)** is a large interactive display that connects to computer and projector[6]. A projector[6] projects the computer's desktop onto the board's surface where users control the computer using a pen, finger, stylus, or other device. The board is typically mounted to a wall or floor stand.

2.1 Operation of an infrared scan (IR touch) whiteboard

An infrared interactive whiteboard[12] is a large interactive display that connects to a computer and projector[6]. The board is typically mounted to a wall or floor stand. Movement of the user's finger, pen, or other pointer over the image projected on the whiteboard is captured by its interference with infrared light[9] at the surface of the whiteboard. When the whiteboard surface is pressed, software triangulates the location of the marker or stylus. Infrared IWBs may be made of any material, no dry-erase markers are involved, and may be found in many settings, including various levels of classroom education, corporate boardrooms, and training or activity rooms for organizations, professional sports coaching facilities, and broadcasting studios.

We are using concept of infrared (IR) light[9] pens and the Wii Remote[7], so that it is possible to create very low-cost multi-point interactive whiteboards[12] and multi-point tablet displays.

Basic concept of our project[16] is based on TUI that means Tangible User Interface[11].TUIO is an open framework that defines a common protocol for tangible multi-touch surfaces. This protocol encodes control data from a tracker application (e.g. based on computer vision) and sends it to any client application that is capable of decoding the protocol.

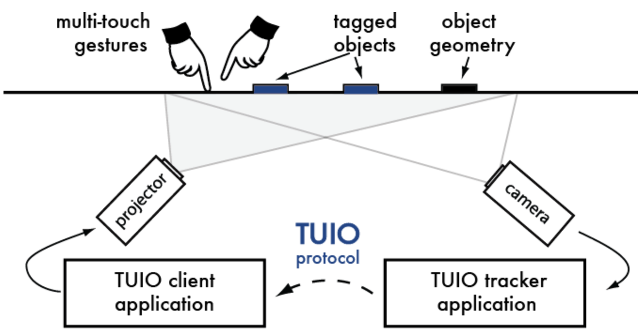

Figure 1: Tangible User Interface[11]

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3. THE VISUAL SCREEN SYSTEM

3.1 Overview

The system setup essentially involves only positioning a camera[2] so as to view the screen of a computer monitor. Ideally, the camera[2] views the screen from a point along a line normal to the center of the screen. However, as this will likely interfere with the user who typically sits in front of the computer monitor, the camera[2] can be shifted away from the normal line to get it out of the way of the user. The camera[2] should not be moved too far away from the normal line, however, or errors will be introduced in the process. It has been observed that the camera[2] can be positioned up to about 30 degrees off the aforementioned normal line in any direction and still provide error-free performance. Figure 2 is the diagram of the Visual Screen (VS in short) system. Four dash boxes represent four major parts of the system. From left to right, these boxes will b e referred as Calibration block, Model Extraction I block, Main block, and Model Extraction I Block, respectively. The Main block is the kernel of the system. Its functionality is to locate the tip point of the indicator and maps its image co ordinates to the screen co ordinates. The task of tip point location contains two processes, i.e., to segment the indicator from the background, and to find the tip point of the indicator. The segmentation requires color models for both the background and the indicator. The Model Extraction blocks I and II in Figure 2 are used to extract the background model and the foreground model, respectively. The Calibration block is used to establish the mapping between the image co ordinates and the screen co ordinates. This mapping is then used in the Main block to find the corresponding screen co ordinates for the tip point once its image co ordinates are estimated.

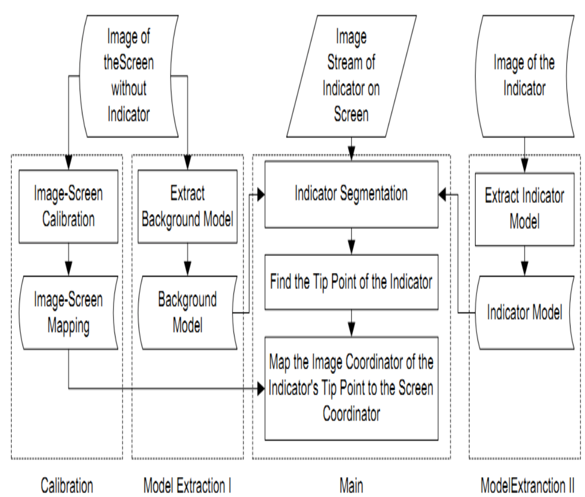


Figure 2: Diagram of the Visual Screen system.

From left to right, four major functional parts of the system include calibration, extraction of a background model, extraction of a foreground model and a main processing block.

3.2 Robust Finger Tip Locating

It is not trivial to define the tip point of an indicator. What is really desired is the consistency, or the invariance of the definition. In our current implementation, the tip point is defined as the intersection of the indicator's center line and its boundary along the direction that the indicator is pointing towards. In our prototype system, we have simplified the definition by allowing only the upwards pointing direction. We have developed an algorithm to robustly find the center line of the indicator, as well as its intersection with the upper boundary of the indicator. The boundary of the indicator can be found easily from the segmentation result mentioned above. The algorithm can be elaborated as the follows. A cumulative total of the numbers of pixels that belong to the foreground are calculated on a scan line by scan line basis starting at the top of the image containing the indicator. The resultant histogram will be referred as horizontal histogram. The horizontal histogram is next analyzed to determine the scan line where the foreground pixels first appear and increase in cumulative total thereafter (i.e., representing a step). The identified scan line roughly corresponds to where the indicator tip location may be found. Next, a number of lines above and below the identified line are selected and each is scanned to find the start and end of the foreground pixels in the horizontal direction. In addition, the center point of each series of foreground pixels along each of the scan lines is determined and a line is robustly fit through these points. The pixel corresponding to the indicator tip location is then determined by scanning all pixels within the previously identified indicator window to find the boundary pixels. The pixel corresponding with the tip of the indicator is the boundary pixel where the previously determined centerline intersects the boundary of the indicator.

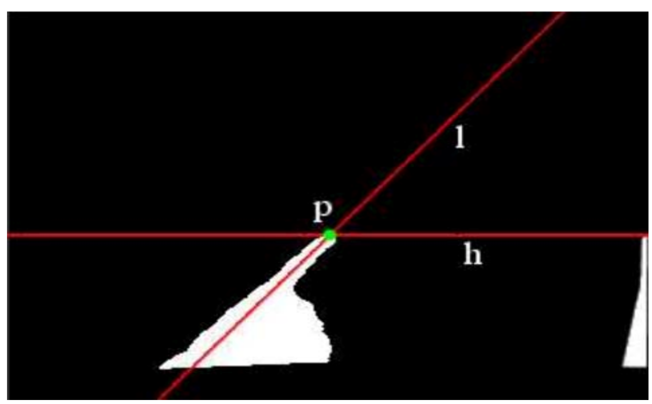


Figure 3: Tip point location.

Line is the center line of the indicator, and point is the tip point. Both of them can be reliably found with reasonable accuracy. Line indicates the scan line where the foreground pixels first appear in the direction of the y-axis. The horizontal histogram is shown on the right side of the image. The stability of the finger tip location is further improved by altering the location over time with a Kalman filter.

3.3 Survey of Wii-mote[7] /IR based Whiteboards.

A Wii-based IR system was invented by Johnny Chung Lee[12][13], PhD. in 2007.Lee claimed that the system "makes a technology available to a much wider percentage of the population" (Speaking at TED[17], April 2008) by using an ordinary Wii remote[7] control as a pointer and the IR camera[2] on the front of the remote control as tracking device sensing light from an IR light pen. Lee produced several videos on YouTube about this system to demonstrate its operability, flexibility, and ease of use, and pointing out its modest price — the most expensive part is the infrared LED of the pen. This is an approach with a shallow learning curve since the gaming system is already familiar to many. A large programming support community may be available, both in open source and commercial offerings.) However, the system cannot be used near direct sunlight, nor can it share the software of manufacturers of the IWB-types already mentioned. Certain considerations about the Bluetooth connection of the light pen also apply. Two lines of sight are involved (the controller and the pen) in the case of rear-projection case. Unlike many others). Wii Remote[7] IWB — A Wii Remote[7] is connected to a computer through its Bluetooth connection capabilities. Using open-source software and an IR-Pen (a pen made with a momentary switch, power source and an Infrared Led) any surface (desk/floor/wall/whiteboard/LCD) can be turned into an Interactive Whiteboard[12]. The Wii Remote[7] has a very accurate Infrared Light[9] tracking camera[2]. Once calibrated, the Wii Remote[7] detects a mouse click at the screen location of the IR-Pen. The Wii remote[7] was first adapted for use as an interactive whiteboard[12] by Johnny Chung Lee[12][13].

4. PROPOSED SYSTEM

4.1 Cost Cutting

We are trying to develop a device which is lower in cost in comparison with the present Commercial Whiteboards. IWB implemented by us is estimated to be 10 times cheaper than what mentioned above provided that the schools and colleges have projectors[6] with them. But with the addition of the projector[6] cost we still can say that our IWB is cheaper than the Commercial Whiteboards.

4.2 Surface Advantage

The domain of our project[16] is not only restricted to teaching, but also deals with any surface that you can project onto or not. Unlike the Commercial Whiteboard our project[16] is not restricted to just the special surface but now we can convert almost any surface into a touch screen**[1]** surface.

4.3 Software and Hardware Requirement

A) Software requirements:

Presently working on a code in Java[15] that is based on Johnny Chung Lee's[12] original "Wiimote[7] Whiteboard" tracks IR dot or finger blobs and reflects the movement of the cursor on the projected surface.

B) Hardware[18] requirements:

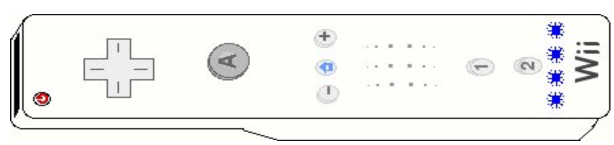
i) Projector[6].
ii) A Wiimote[7] (Manufacturer preferred: Nintendo games).
iii) Infrared Lights[9].
iv) Any surface that one can project onto.

i) Projector[6]

A device that projects a video signal from computer, home theater system etc.

We need it so that we manipulate that projected surface with the help of the software we are going to make. This will help us to project the computer signal to any surface e.g. table, wall and whiteboard. We mainly want to implement this for the teaching purpose so we name it as IWB.

ii) A Wiimote[7]



The Wii Remote[7], also known as the Wiimote[7], is the primary controller for Nintendo's Wii console. A main feature of the Wii Remote[7] is its motion sensing capability, which allows the user to interact with and manipulate items on screen via gesture recognition and pointing through the use of accelerometer and optical sensor technology.

iii) Infrared Lights[9]

Infrared (IR) light[9] is electromagnetic radiation with a wavelength longer than that of visible light, measured from the nominal edge of visible red light at 0.74 micrometres (µm), and extending conventionally to 300 µm. These wavelengths correspond to a frequency range of

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approximately 1 to 400 THz, and include most of the thermal radiation emitted by objects near room temperature.

An infrared pen[8] is a thing that you point at the screen to tell Wiimote[7] Whiteboard where to put the mouse[3]. It gives off infrared light[9] that the Wiimote[7] can see. Building the infrared pen[8] is very easy and it can also be purchased online from many sites.

CONCLUSION

Our project has certainly made way for the process of learning in a more interesting manner hence the name IWB. Also considering all above specifications and techniques we conclude that in future there is a chance to develop a system by which we can make any surface a touch screen surface. So, this project certainly has a very good scope in the future keeping in mind the technology boom taking place today.

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