Human Computer Interaction Using Hand Data Glove and Wii Remote

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***Abstract*—**A real time Human Computer Interaction based on th e hand data glove for gesture recognition is proposed. The proposed system can capture hand gesture through the use of hand data glove which is equipped with sensor that senses the movement of hand and pass those movements to the computer through the use of Wii Remote's IR camera in the form of continuous signals. Using Wii Remote we can calibrate the area to work with and plot the output almost on any platform by using projector. Gestures are classified as clicking, double clicking, and dragging. Recognizing these gestures relevant actions are taken such as drawing using paint, sending message and call dialing using GSM modem and GUI application to interact. The results show that glove used for interaction is better than normal static keyboard and mouse as the interaction process is more accurate and dynamic in natural environment

Keywords- *Human Computer Interaction, Data Glove, Wi i Remote, IR camera, Virtual Reality, Hand Gesture Recognition.*

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I. INTRODUCTION

Virtual Reality [1] had made its way in increasing the power of computers making it realistic and interactive. Virtual Reality has replaced the traditional use of keyboard, mouse and joystick in HCI environment. Data glove is one such sensing device used in Virtual Reality for hand gesture recognition [2] in HCI and it is based on sensor based approach. Hand data glove [3] [4] is an electronic device which is equipped with sensors sensing the movements of fingers, and passes those movements to the computer in the form of signals continuously. Hand data gloves are used in applications including virtual reality [5], gaming [6], robotics [7], character recognition and verification, shopping applications and the most important use is in medical surgery where it is used for practical purpose because it is highly accurate. Here Hand data glove will be used to provide a user interface for painting, call dialing, message sending and also for opening any icon from the computer.

This paper represents a special interactive system which consists of a Bluetooth enabled computer running a calibration utility software, a projector connected to the computer, a GSM modem connected to the computer for the call dialing and message sending purpose, a whiteboard on which projection can be done, a Hand data glove equipped with sensor, Nintendo's Wii Remote for capturing the signals sent by the Hand data glove. Some recent works include i) Tarchanidis et al. [8] developed a data glove based on force sensors that are attached to each finger. This data glove was used to detect the tactile sensation, but it had limitations of precise recognition. ii) Johnny Chung Lee [9] described a classical IR pen or Stylus (shown in fig.1) which was used for educational purpose, but it had disadvantage of perceiving signals accurately from different distances. Also because of the wrong placement of the IR camera many blind spots were created on the whiteboard affecting the reflection produced by the IR camera. It had inconvenient button style for activating IR signals. Moreover, the Stylus had an inappropriate design and is not durable. With classical IR pen, many different reflection signals are sent to the IR receiver, which may accept some or all of these, because the IR LED is located on top of pen with the LED facing towards the whiteboard. On the other hand the LED in the Hand data glove is placed facing away from the whiteboard, sending IR directly to the receiver with no reflection. The IR LED of the Hand data glove is activated when the user touches the whiteboard unlike the classical IR pen which requires frequent pressing of the button to activate the IR LED. The Bluetooth enabled computer runs calibration utility software

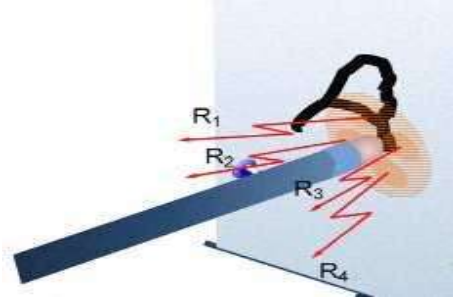

Figure 1. Classical IR pen

II. PROPOSED SYSTEM

A. *Hand Data Glove*

This is one of the sensor based device having touch capability. Finger touch position can be detected accurately by this data glove. Hand data glove is wireless and provides Graphic User Interface [12]. Mouse has only 3 degrees of freedom to move on the other hand human hands have 30 degrees of freedom [4] to move, due to this user get more flexibility to perform the computer operations than a mouse control. To recognize hand gesture accurately and successfully data glove is used. Here, glove is used to capture current position of the fingers. Operations like left click right click, and drag and drop are possible. Moreover this, applications like call dialing, message sending and drawing using paint is also achieved through the use of Hand data glove (shown in fig.2).

Figure 2. A typical Hand Data Glove

This Hand data glove is equipped with a switch and an IR sensor which uses LED for transmitting signal to the Wii Remote. Many materials are used for the glove, including leather, cotton, and plastic. The leather gloves prove to be efficient for this system, since the sensor is attached firmly and the glove can easily be removed without destroying the sensors.

B. *Nintendo's Wii Remote*

Nintendo's Wii Remote [10] [11] contains an accelerometer, an IR camera, a Bluetooth communication system. Wii Remote model (shown in fig.3) used is RVL- CNT- 01-TR. Pressing the sync button of the Wii Remote, the Wii Remote can be put in to discovery mode and then the device Nintendo (RVL-CNT- 01-TR) can be added. Here the passkey option should be set to 'Do not use a passkey'. Accelerometer [6] used in Wii Remote is ADXL 330 based on MEMS (Micro Electro Mechanical Systems) technology. It is 200 micrometers in diameter. The IR camera (shown in fig.4) is located at the end of the Wii Remote.

IR camera has a resolution of 1024 * 768 and has 45 degrees horizontal field of view. In contrast a normal web cam has a resolution of 640 * 480. For each point the reported X and Y co-ordinates range from 0-1023 and 0-767 respectively and Wii Remote can track up to four of these points at a frequency of 100 Hz. This is a major advantage because a normal web cam operates between 10 and 30 Hz.

Figure 3. Nintendo's Wii Remote

Figure 4. Wii Remote's IR camera

This camera cannot be used to take a conventional picture because the data is in the form of 0's and 1's. Thi s Wii Remote has four LED displays on it which blink when the battery is full. Wii Remote is able to send reports to the host with maximum frequency of 100 points per second.

A property of Light Emitting Diodes (LED's) (shown in fig.5) is that they produce a certain wavelength of light when an electric current is applied through a switch but they also produce current when they are subjected to the same wavelength light. Infrared light is not visible because its wavelength is too long to be detected by the human eye

Figure 5. IR LED

III. METHODOLOGY

The system process flow is shown in fig.6. The initial hardware setup contains a projector connected to the computer, a GSM modem connected to the computer for the call dialing application, Hand data glove equipped with sensor, Nintendo's Wii Remote [13] [14]. The initial software setup contains calibration utility software. Wii Remote's IR camera has a resolution of 1024*768, which is a large working area. Nowadays laptops have a screen resolution of 800*600. The working area in the system should be according to the laptop screen resolution. Therefore, the working area is specified by

means of calibration. Calibration [15] is also essential to make the glove measurements unaffected by the differences in user's hands, finger length and thickness. This calibration is performed by calibration utility software where the user have to flex their hand four times.

Whenever a click event is being performed by the Hand data glove, IR sensor [16] transmits signal to the Wii Remote's IR camera. IR camera receives the signal and wherever the click event is being performed, it changes the color of that particular pixel to black and rest all the pixels are set to grey. IR camera also finds out the X and Y co-ordinates of that particular pixel. Nintendo's Wii Remote's IR camera [17] [18] is capable of providing accurate positional information. IR camera is connected to the laptop via Bluetooth and sends the co-ordinate data to the Wii library or Wii drivers via Bluetooth. Wii library or Wii drivers returns the calculated X and Y co-ordinates to the calibration utility software which is connected to the Windows Operating System. The co-ordinate data is then sent to the O.S. The O.S hence controls the mouse cursor whose effects are seen in the form of output shown through the use of a projector.

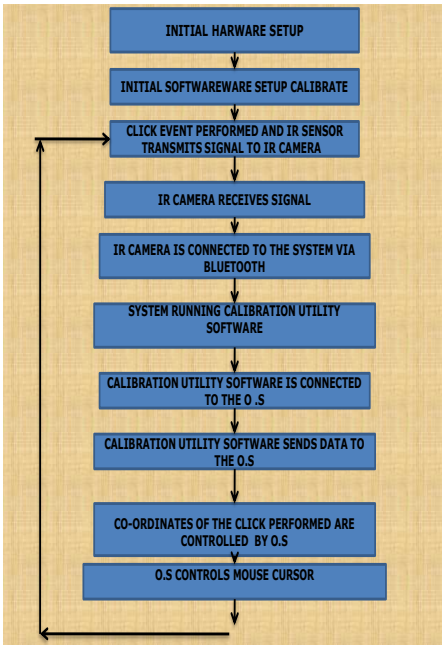

Figure 6. System Process Flow

IV. RESULTS

Figure 7. Before clicking on the Quick Calibration

Figure 8. After clicking on the quick calibration

Figure 9. User clicking on the first, second, third and fourth calibration points respectively and performing free hand drawing.

Figure 10. User running the call dialing application

V. CONCLUSION

In this paper an inexpensive interface approach is represented through which almost any surface can be made interactive using Nintendo's Wii Remote and gesture recognition is achieved through the use of Hand data glove.
This Hand data glove is capable of sending signals to the Wii Remote's IR camera via IR sensor. Nintendo's Wii Re mote is capable of sending data to the PC through Bluetooth facility. Nintendo's Wii Remote's IR camera is capable of pro viding accurate positional information.

Here the two applications, the call dialing application and the paint application are performed through gesture recognition by Hand data glove. It is found that human hands have greater Degree Of Freedom than a keyboard and a mouse control, providing better outputs in the field of virtualization, thus limiting the use of mouse and keyboard.

VI. FUTURE WORK

In the future, the data glove can be used to type characters, browse internet, making it completely independent of

keyboard and mouse. High dimensional applications could also be tried running on this system and all the main controls required for running the application can be achieved through the use of Hand data glove. Using the Hand data glove, a combination of two or more gestures can form a new complex gesture for a complex task.

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