MANET AND IT'S PERSPECTIVE VIEW TO REPLICA ALLOCATION

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Abstract: *This Human-Computer Interaction (HCI) is a field in which the developer makes a user friendly system. In this paper, a real-time Human-Computer Interaction based on the hand data glove and k-NN classifier for gesture recognition is proposed. HCI is becoming more and more natural and intuitive to be used. The important part of body that is hand is most frequently used as interaction in digital environment and thus complexity and flexibility of motion of hand is a research topic. To recognize hand gesture accurately and successfully data glove is used. Here, glove is used to capture current position and angle of hand and fingers, and further classify it using k-NN classifier. The gestures classified are clicking, dragging, rotating, pointing and ideal position. Recognizing these gestures relevant actions are taken, such as air writing and 3D sketching by tracking the path. This can be also used in the controlling of an image browser tool using data glove. The results show that glove used for interaction is better than normal static keyboard and mouse as the interaction process is more accurate and natural. Also it enhances the user's interaction and immersion feeling.*

1. INTRODUCTION

The new generation computer technology is expanding and surrounding humans and computers communicating as naturally as a human with other human. The Ubiquitous systems are more common and controlling them is a challenging task. The technology in user-interfaces has changed to gesture interface, capturing the motion of our hands and controlling the devices. Hand gesture may include multi- touch screen interface, MS Surface computing, or camera based gesture recognition, adding new interactions in shopping applications and even in gaming industries [1]. Gesture recognition is more common to Augmented Reality (AR) as the main input device and has become more popular with films like Minority Report [2].

Human-Machine Interaction time-to-time keeps moving more closely to natural and intuitive user interfaces. Human beings have a good grasping and manipulating ability with their hands and thus interfaces like keyboard and mouse are more popular. Currently, in some of the HCI interfaces hand is also used including static gesture recognition [3] and dynamic gesture recognition [4]. The gesture based on data glove is been used in signal language processing and training [5], but now it is also used in robotics to control the robot arms wearing the glove [6]. The Gesture-Based Computing is also discussed in the Horizon Report of 2011 edition [7]. In this edition it describes the interacting devices with the computer as Nintendo Wii, the Apple iPhone and the iPad, SixthSense device of MIT lab, the Kinect system for the Xbox and Time- to-adaptation [7].

In this paper, we mainly focus on the real-time input and output of the data from the data glove and accurately and successfully grasp the action. Hand Data glove is an electronic device equipped with sensors that senses the movements of hand and finger's individually, and pass those movements to computer in analog and/or digital signal. Now a day's hand data gloves are used in many research fields such as virtual reality, gaming [1], robotics [6], character recognition and verification, and in shopping applications. Even iPod/iPhone/iPad is using gestures in mobile video game platform. Data glove can be used for motion animation and offered to work on multiple degrees of freedom for each finger [8]. Here we will use hand data glove to make paintings and air-write characters in more real-time environment and with less complexity.

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The rest of the paper is divided into six headings. The next heading is literature review, in which it has given some concepts and approaches by others and it is followed by the proposed research. The fourth heading describes the experimental setup. The fifth section is the results continued by the conclusion and then future work

II.LITERATURE REVIEW

In 2006, the Nintendo has released their gesture controller device. These arise a new era in the area of gesture recognition using interface hardware. Nintendo released a new technology in the field of game controller, i.e. Wiimote, in which included three axis accelerometer [1], [7]. In the paper Shiratori et al. [1], uses a large variety of novel and intuitive applications for these controllers have been developed by both: it may be individual and commercial developers. Here, the authors add this growing library three interfaces that control the motion of dynamically simulated, animated character using his or her arm, legs, or wrists. In this type of motion controller hardware, it controls a graphical bird by physically simulator. The author used 2 to 3 wiimote for controlling a physically simulated biped bird character [1]. The authors performed many types of controller just like walking controller, stepping controller, running controller, and jumping controller [1]. In this simulator the controllers were calculated from the body velocity.

The interface hardware is also used in the field of Hollywood. In the movie "The Minority Report" produced by Dick et al. [2] and Tom Cruise, who was actor in this movie, uses the data glove for the people content. Tom Cruise standing in front of a large screen glass panel, watching images and data flicker before him. With precise gestures, Cruise zoomed in on images, moved them around with a flick of his wrist, and dragged up new ones. With an inadvertent gesture to shake a man's hand, he take a row of pictures in the side of display. Cruise's gloves even have lights glowing on each fingertip [2].

The hand gesture recognition is a spatio-temporal pattern which can be static and dynamic or both. Priyal et al. [3] define that the study behind the static hand gesture recognition using moments. In this paper, the authors show that the static hand gestures are the very essential part of the gesture recognition field. The view point invariance and user independence are the two most important requirements for realizing a real time hand gesture recognition system. The system detects the hand region through skin colour identification and obtains the binary silhouette, and takes the images and normalized for rotation and scale changes. The features of the normalized hand gestures are classified using a minimum distance classifier. This result (91% - 93% accuracy) suggests that the features of the Krawtchouk moment are comparatively robust to view point changes and also exhibit user independence [3].

On the other hand, Jong et al. [4], and X. Zabulis et al. [9] used the dynamic gesture recognition for the robot interaction. In these papers, a real time dynamic hand gesture recognition system allows a natural and intuitive interaction with a service robot in the dynamic environments. The authors' approach is to use of the temporal statistics about the hand's positions and velocities as initial information and details to recognize the gestures. The final recognition section carrying out using a standard Bayes classification [4], instead of the traditional Hidden Markov Model (HMM) [9], and also it can be resulted in the comparison of Neural Network with Multi-Layer approach [10]. The author applied his proposed method on segmented gestures only. Taking this into account, the system was able to detect and track hands in 266 of the 300 sequences (89%), while tracking 266 sequences of track hands and prepare a confusion matrix [4].

Bhuiyan et al. [11] present a review of the history of the Gesture Controlled User Interface (GCUI) and identify it in the emerging technology, applications, functionality and the usability. In this paper the author investigate the different types of gestures, and its users, an application, emerging technologies, issues addressed, their results and interfaces from existing research. The author consider the next direction of gesture controlled user interfaces (GCUI) as rich user interface using gestures, and it seems appropriate for present and future ubiquitous and ambient devices. Now a day, [12] the hand tracking system lets you control multi-media in different ways which can be never imagined by anyone easily, the transformation in an ordinary surface into an interactive multi-touch screens and multi-touch surface computing platform. To illuminate the multi-touch surface, now available as interactive and interfaces techniques with multi-touch display panels and windows, interactive kiosks and multi-touch tables. Multi-touch interactive surface displays come turn key or can be customized to virtually any shape or size. GestureTek's [13] illuminate 'point to control' and touch screen computing surfaces are popular in bars, nightclubs, retail stores, museums, science centres, real estate showrooms and corporate presentation centres - anywhere menu-based multi-media content is used for edutainment, entertainment, or to present advertising and corporate information.

III. METHODLOGY

In this paper, the mapping of finger motion with the 3D mouse pointer to sketch something on computer is performed. Basically the mapping is between the real world and the digital world. The data glove is an electronic device with motion capture sensors, i.e., flex sensors, capturing the movements of each individual finger from physical world and converts them to digital signal using analog-to-digital convertor. This digital signal is then passed to the computer to further process and paints the digital or virtual world, as it is the mimic of physical or real world.

To mimic the virtual world, the application has to recognize all the gestures performed in the real world wearing the data glove. This paper has achieved to generate and train the various gestures to the system successfully. These gestures are clicking, dragging, rotating and the most important is pointing. These gestures are explained in the next section. The main task is to map the digital signal with the task performed or wanted to perform in the virtual. The mapping system used in this paper is simple classifier based gesture recognition. The data is received and passed to k-NN classifier algorithm. The k- NN classifies the numeric data, which is generated of the hand movement data by the data glove. These data are classified based on Euclidean distance formula and on the basis of the result the gesture is recognized and so the related action is performed.

The complete block diagram of the proposed system is shown in Figure 1. Gesture is a way of communication used to communicate without speech in which body communicates. Gesture can be performed with or without spoken words. It includes movements of hands, face, or whole body. In this paper, hand gesture is only considered for experiment. The basic goal of gesture recognition is to have an automated system that can identify specific human gestures and use them to control the devices.

Gesture is building a very richer bridge between the human beings and machines without any limitations. It enables human to interact and interface with machines as friendly as with other human being. The online gestures used in this research are: clicking, dragging, rotating, pointing and air- writing (path tracking).

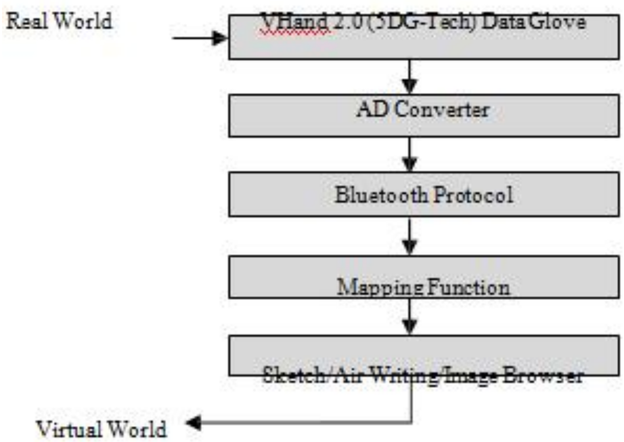

Figure 1.Hand Data Glove-Based Digital Sketching and Air-Writing System.

A. Clicking Operation

The gesture performed for clicking is very simple and straight forward. The finger should bend downwards to make an angle of ≈90o or in general,

$$xy\_angle1^o < click\_angle > xy\_angle2^o$$

Figure 2 clearly shows the click operation. In mouse there are two different click operations, i.e., Left Click and Right Click.

Figure 1. Simple click operation gestures.

1) Left Click Operation: For the left click gesture as shown in Figure 3 the threshold angle must be between 45o - 90o. And the fingers used in left click are thumb or index finger.

$$45^o < the\_left\_angle\ (thumb/index) > 90^o$$

The left click pattern has some error from the starting data samples due to the wrong numeric data. When bend the index finger for performing the left click operation, the controller sensor circuit of the glove starts working. In the starting of the numeric data of the data glove, it has given some data for nearly 75 samples while controlling by the sensorial circuit of the glove. These data are totally different from the estimating data of the bending of index finger.

Figure 2. Left click operation gesture.

2) Right Click Operation: Similarly, for the right click the finger as shown in Figure 4, used is middle finger bending more than 50o. The limit is defined such that the middle finger can bend properly and the change in the numerical value is clear. And also bending the middle finger more than 80o is not common with all the users.

$$50^o < the\_left\_angle\ (middle\ finger) > 80^o$$

Figure 3. Right click operation gesture.

B.Dragging

To define the gesture for dragging in 2D as shown in Figure 5, again we need to do the gesture of left click and need to change the x-axis and y-axis together in either direction. Only changing the x-axis results in dragging and similarly in case of y-axis. In initial position the x-axis and y- axis are the same that of middle of window defined of size 640x480, in 2D graphics. In this operation the value of the z- axis is always equal to zero.

Figure 4. Simple drag left/right operation gestures.

In the Left/Right side dragging operation performed by the data glove has used index finger with y-axis direction.

C. Rotating

Rotation is a three dimensional operation as shown in Figure 6 (anti-clockwise rotation) and Figure 7 (clockwise rotations) is always performed around an imaginary axis called a rotation axis. A rotation is a translation keeping a fixed point or line. Rotation about any new imaginary axis can be performed by taking a rotation around x-axis and then around y-axis followed by the z-axis in 3D space. In 2D space z-axis is neglected. To define this gesture the fingers are kept straight and only the axes are changed. As the bend in figures disturbs data glove value and results in conflict. Rotating in this manner the 3D/2D virtual object rotates in the virtual environment. Use of 3D rotation is mainly in animation and designing and the packages used for this are Maya, 3D Max, CAD, and 3D Studio.

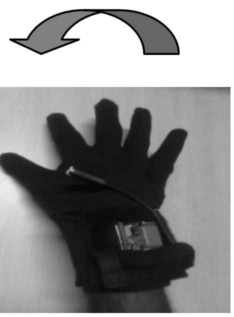

Figure 5. Rotating anti-clockwise peration gesture.

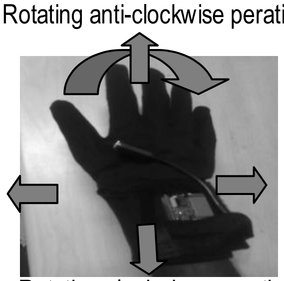

Figure 6. Rotating clockwise operation gesture.

D. Pointing

The gesture defined for the pointing as shown in Figure 8 is very simple and easy. All the fingers are folded and only the index finger is straight. This deactivates all the other gestures like left click and right click and only tracks the path of the x- axis, the y-axis and the z-axis. The old axes position is changed with the new axes position and this shows that the pointer is pointing the object in that environment. The main application of this gesture is in presentation where a large gathering is collected and we need to present and point out something on the screen.

Figure 7. The pointing operation gesture

IV. EXPERIMENTAL SETUP

This section gives a brief outline of how the data glove is installed, trained and tuned according to our gestures defined above. The data glove used in this experiment is DG5 VHand 2.0, which is a wireless data glove based on the latest Bluetooth technology for high bandwidth. VHand data glove works on a single chargeable battery of 3.5V – 5V and has connectivity up to a range of 10 meter. In this data glove the number of sensors used is 5 proprietary flex sensors for a high sensibility. The Bi-Flex Bend Sensor is a sensor that changes resistance when it bends [11]. The bending can take place in either direction. There is 3 degrees of integrated tracking with 3 axes, i.e., roll, pitch and yaw, measuring each movements of figure having 1024 different position per figure. Each position is represented with 10 bit data. The VHand data glove is totally platform independent. The device is connected via a COM port to a computer and at backhand a driver is running to read the data from sensors and control the actuators.

The number of data samples collected per minute is around 2000. The next step is to cluster these data values into various different gestures defined. The clustering is done by simply using k-NN classifier algorithm written in C++.

k- Nearest Neighbour is a method for classification of objects based on the closest features. k-NN is used in this experiment as it is very simple and is easy to implement among all machine learning algorithms. Here, k is the number of clusters formed. An unlabeled test vector is classified by assigning the label which is most frequent in k training. For example, the data value for left click is different with the data value of right click as in left click thumb and/or index finger is used and in right click operation gesture of bending of the middle finger is used. Collecting these values and forming clusters. Label these clusters by users at the time of training only. Then when test feature vector is present in the same feature space it is classified using a simple Euclidean Distance formula. Similarly, the same process is followed for the other gestures too. It has a very good accuracy rate in recognizing these gestures.

After training and classification the last step is the sketching and air-writing action performed in the virtual environment. The graphics library used to program the graphics are 'bgi' – C graphics library and 'OpenGL' – graphics library. The C graphics library is used to test the data glove in 2D environment, air writing in our case and OpenGL graphics library is used for testing the hand data glove in 3D virtual environment, painting in our case.

The testing part of this system is relative to each other operations. The click operation using dataglove is tested with another operation. The operations are tested using a confusion matrix. The right clicks and left clicks operations are comparing with the other operations just like it can affect by pointing and rotating. The dragging operation can be easily affected by the left click operation because of the use of the same finger (index finger). But in the dragging operation the dragging operation has also used pitch with the index finger.

In the rotating operation, this is affected by the dragging operation. The pitch movement is done in the XZ-axis and the roll is being in between Y and Z axis, here the Z axis is common due to this reason, it is interfered. Similarly, it can be compared with all the operations of the mouse replacement.

The gestures are chosen in such a way that they conflict very less with the other gestures used. See the Table I. below for detailed information about the gesture and gesture conflict. The matching matrix clearly shows that the gesture used is independent from the other fingers gesture having a good accuracy rate.

Table I.Matching Matrix For Different Gestures Used. Each Gesture Is Performed 10 Times.

Confusion Matrix	Ideal Position	Left Click	Right Click	Drag ging	Rotat ing	Poin ting
Ideal Position	8	0	0	0	1	1
Left Click	0	9	0	1	0	0
Right Click	0	0	10	0	0	0
Dragging	0	3	0	7	0	0
Rotating	0	0	0	1	9	0
Pointing	4	2	0	0	0	4

According to this Table I, the left click, right click, dragging and rotation operation gestures are more accurate and efficient then other gestures.

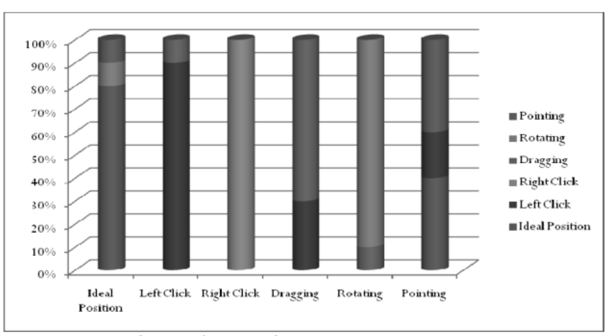

Figure 8. Graph for the Gestures used in the applications

As shown in the Table I, the Figure 9 describes the graph of the gestures used. There are some gestures which affect to other gesture when perform operations.

V. RESULTS

The hand data glove is used to replace mouse for controlling various applications. Figure 10 and Figure 11, show the actions performed by the glove for air writing and sketching in 2D environment. In this application the user can write and sketch with using dataglove without the use of mouse.

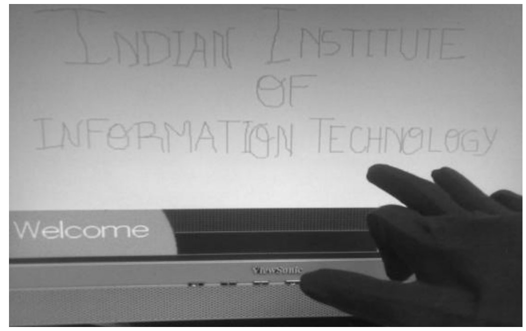

Figure 9. Air writing in BGI 2D graphics environment.

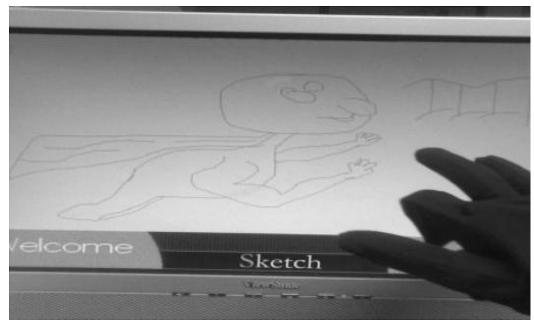

Figure 10. Sketching in OpenGL graphics environment.

Another application using data glove is image browser as shown in Figure 12 and Figure 13. The images is browsed using dataglove like next, previous, rotate image etc are performed. The next/previous operation is not affected by any other operations, because this operation is performed by only single left click operation on the next or previous buttons.

Figure 11. Image browsing using Data Glove.

Figure 12. Movement of Image from Data Glove.

VI. CONCLUSION

This paper deals with interaction with computing devices using DG5 VHand Data Glove using hand which acts as an interface. As the previous research shows that the static keyboard and mouse have many limitations with them whereas the data glove can be used for the same purpose without many limitations. The degree of freedom of data glove is more than mouse and so results a better input device in virtual world. k-NN was used to train the data and recognized the gestures and takes the appropriate actions. This experiment proves that the data glove used can be good technological device for doing gesture and interacting and controlling the devices, software or hardware. The air writing and sketching were the software applications that involved data glove as input device.

VII. FUTURE WORK

In future work, the data glove can be used to type the characters and operate all the applications of computer making it keyboard and mouse independent and many high dimension applications can run on the system or in the virtual environment. Also there can be a combination of two or more gestures to form a new complex gesture for a complex task to perform. In this experiment we have used only one hand data glove for gesture definition but in future both data glove can be used for more realistic interaction.

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