3D HCI: Human Computer Interface System using 3D Leap Motion Camera

Hetal Mandviya¹, Anjali Patil², Trupti Nanavare³, Sharmily Bhoite⁴, Sneha M. Ramteke⁵
Student¹, ², ³, ⁴, Assistant Professor⁵
Department of Computer Engineering
ABMSP’s APCOER, Pune, Maharashtra, India

Abstract:
In last few years, many researchers and organizations are interested to provide more natural, human-oriented means of interacting with computers. A particularly vital field of that trend is hand gesture recognition. These systems have received great attention in the recent few years because of their countless applications such as gaming, robotics, education, physical therapy etc. In this paper we present our implementation of using a motion controller to control the motion of a robot via simple human gestures. We have used the Leap motion camera and robot is connected to the ground station and the Leap is connected to the system via USB port. The leap Motion Camera recognizes the hand gestures and relays it on to the ground station. The ground station runs the software for interaction with the robot in order to convey the simple hand gestures. In our implementation, we have written codes to interpret the hand gestures captured by the LEAP Camera, and transmit them in order to control the motion of the robot. Also we present our implementation in the field of gaming in which we are going to control the game with the help of hand gesture.

Index Terms: Hand gesture recognition, HCI, LEAP MOTION CAMERA, Robot

I. INTRODUCTION
Gestures play a vital role in human communication. It has been found that gestures present an appealing way to interact with computers as they are natural part of body. Gesture includes movement of body parts like hands, face, head, or other parts of body to express an idea or feeling. Gesture Recognition enables humans to communicate with machine and interact naturally without any physical devices. With help of gesture recognition we can point a finger at the TV screen so as to change the channels without using remote or any other device. Gesture recognition is widely used in applications involving interaction between human and robot. Human Computer Interface is interaction between human and computer. Basically HCI is a technology which reveals the study of how human can interact with computer. HCI has wide range of applications in the field of computer science, psychology, communication, education and design (graphic and industrial). HCI mainly focuses on user's working with computer irrespective of other kinds of machines. 3D technology has gained significant importance in the world of research. Leap motion controller is equipped with infrared stereo cameras as tracking sensors. The leap motion camera captures image of hand movements performed in front of it and these images can be used for controlling various applications. Leap motion is user-friendly. It simply consists of 2 cameras and 3 infrared LEDs with help of which it is able to track infrared light with a wavelength of 850 nanometers.

Figure 1. Wavelength of 850 nanometers.

II. EXISTING SYSTEM
1. Specialized Glove
Specialized Glove technique is basically based on man-machine interface. This technique uses sensors to analyze data. The analyzed data is then processed by machine learning technique.

SVM (Support Vector Machine) is used as a classifier so as to yield more accurate result. The best classifier achieved the sensitivity equal to 98.32%.[1]

2. Skin Filtering Technique
As existing system overcomes the use of gloves, it does not require any special device or mark, and users are free to move their hands in front of the camera. For hand region segmentation, system adopts dense optical flow for the whole captured frame and constructed a skin filter with a narrow ribbon to eliminate the influence of a complex background and other skin-colored regions [2].

The existing system performs hand region segmentation in complex environment by using dense optical flow and skin filter. It uses effective method for fingertip detection without actually coloring the finger.

3. WTA code based sensor fusion algorithm
Also in some systems whenever the user needs to interact with any electrical gadget, he has to raise hand with open fingers in front of camera.

To stop the controlling action user needs to make a fist due to which the system goes to standby mode. In addition to this, if the user wants to continue then he needs to activate the system again. [3]
III. PROPOSED METHOD

Our proposed system is divided into two parts:
In hardware part we have developed a robot which can be moved in four directions i.e. Forward, Reverse, Left, Right. In software part we have designed Dots and box game for two players.

A. HARDWARE:

Robot:
The word robot is derived from the Czechoslovakian term “Robota”, which means “to do work”. It is a mechanical device or physical agent which is used to perform complex tasks like talking, walking etc. under human control. To perceive the environment automatically, sensors are provided to robot. Robotic sensors are used to estimate a robot’s condition and environment.[5]. These signals are passed to controller to perform next tasks.

Zigbee:
Zigbee is low cost, low power IEEE 802.15.4 standard for a suite of high-level communication protocols used to create personal area network with small, low-power digital radios[4]. Zigbee technology is much simpler than other wireless personal area network like WiFi or bluetooth.

PIC16f877A:
The PIC microcontroller PIC16f877A is one of the most prominent microcontrollers. Coding of this controller is easy. We can erase code many times because FLASH memory technology is used in this microcontroller. It has total 40 pins and there are 33 pins for input and output. PIC16f877A used in many fields like home automation, industrial instruments and sensors. It is easy to handle and cost efficient.

LCD Screen:
LCD means “Liquid Crystal Display”. It is made up of solid and liquid. LCD have properties of both solid and liquid. LCD has advantages over LED. LCD consumes low power and it has low cost compared to LED. A Liquid Crystal cell consists of a thin layer of a liquid crystal sandwiched between two glass sheets with transparent electrodes deposited on their inside faces. With both glass sheets transparent, the cell is known as transitive type hcell. When one glass is transparent and the other has a reflective coating, the cell is called reflective type.[6]

B. SOFTWARE:

Game Application
Dots and Boxes is pen-paper based game. This game requires at least two players. Also it can be played by more than two players. Players’ starts game with empty mesh of dots and one by one add single horizontal or vertical line between two adjacent dots which are not joined. If the player’s move completes fourth side of a box then it will gain one point.
By earning one point the player takes another turn. One who has more points is the winner of the game. The game ends when there is no place to put a line. Instead of using pen and paper for playing game, we can play this game on computer. To make this game more interactive we are providing 3D interface by playing the game using hand gestures.

IV. IMPLEMENTATION WORK

Human performs the hand movements in front of leap motion camera which is connected to the system via USB cable. Camera will capture the hand movements and generate the appropriate signals which would be send to the computer. These signals are displayed on the computer screen with its X, Y, Z coordinates and speed and also get stored in database. In proposed method we have used zigbee transmitter and receiver. Zigbee transmitter is connected to computer via USB cable. The signals which are stored in database are sending to zigbee receiver through zigbee transmitter. These signals are then send to PIC16f877A microcontroller chip. When we perform hand movements like up, down, left and right in front of leap motion camera that will be displayed on LCD screen which is attached to microcontroller chip externally used to move robot in forward, backward, left and right direction.

Algorithm:
Forward and backward Algorithm:
1. Perform gestures in front of camera
2. for (int i=0;i<gestures.count();i++)
   {
       Gesture gesture=gesturer.get(i);
   }
3. if(Horizontal)
   {
       If(swipe.direction().getX()>0){
           Swipe Direction="right";
       }else
       swipeDirection="left";
       if(Vertical)
       {
           If(swipe.direction().getY()>0){
               swipeDirection="up";
           }else
           Swipe Direction="down"

List of modules:
Module 1: Login GUI and validation for controlling user access

This module checks for valid username and password. If username and password matches then it will login otherwise it fails.

Module 2: Options for controlling hardware and software

Selection of process from 2 options
i. Monitoring (Game Application)
ii. Motion Direction (Robot Control)

Module 3: Monitoring Game Application

Game application includes extraction of raw data from the camera and control of game and desktop using API’s. In this game we are having 2 players, player 1 is represented by yellow color and player 2 is represented using green color.
Module 4: Motion direction for robot control

Hardware control includes extraction of raw data from camera and then sending appropriate signals to robot via UART.

V. FUTURE SCOPE

The proposed system has been used to implement a simple game. The future research can proceed with implementation of more exciting and interactive game. Moreover, robot can be improved so as to perform hard man labour automatically.

VI. CONCLUSION

Thus, we have presented a method to recognize the unknown input gesture. We applied this system to recognize the single gesture. Our system is also able to handle complex environment efficiently. Using this model we are able to handle software and hardware application using hand gesture.

V. REFERENCES

[1]. Hand Body Language Gesture Recognition Based on Signals From Specialized Glove and Machine Learning Algorithms Paweł Pławiak, Tomasz So’nicki, Michal Nied´ zwiecki, Zbislaw Tabor and Krzysztof Rzecki


[3]. Hand Gesture Based Remote Control System Using Infrared Sensors and a Camera FatihErden and A. EnisÇetin, Fellow, IEEE


[6].www.circuitstoday.com/liquid-crystal-displays-lcd-working