HCI using Leap Motion Camera

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***Abstract*—** *In this paper, we describe the use of Leap motion camera using the gesture control. A simple and effective use of leap technology is used for greater efficiency. Leap motion camera renders the use of hand gestures combining different combinations of fingers and palm motion. Previously this technology was rendered using the Google 3D camera, which was not only expensive but also not accurate. In this project we will try to use the complete potential of leap motion by applying three applications that are controlling the mouse, controlling the game and a buggy robot. The general architecture consists of a PC which should have 1 GB RAM running on windows. For controlling game, mouse and a buggy we will be using JAVA ROBOT API. The buggy will have remote code written in embedded C. Buggy will consist of device controller, heat sink, transformer, motor and a device driver which will be connected in serial connection RS-232. The algorithm used will be Euclidean distance means and cosine similarity algorithm, this algorithm helps to identify and execute the gestures provided in the leap motion. There are total twelve element inputs which can be passed using fingers and the palm. The combination of gestures can be increased according to our use. The working of a Google 3D camera with reference to colored caps were in leap motion this doesn't affect. Accuracy of gesture recognition in leap motion increases up to 80 percent roughly. The cost of the 3D Google camera goes up to 22,000 approximately, comparing the cost of lip motion is 3,000 making it more cost efficient. Earlier the gestures were recognized using colored caps over the tip of the finger, making it hard to take the input, even after taking the input the processing needed more time making late response by the code. In leap motion colored caps not used to make it easier, the processing is fast with the leap motion camera as it is based on real time input/output system.*

Keywords— *3D Hand Gesture, HCI, Embedded, Leap Motion*

I. INTRODUCTION (SIZE 10 & BOLD)

This project deals with the concept of hand gesture recognition using leap motion. Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state, but commonly originate from the face or hand. Many algorithms are developed for hand gesture recognition, but they all have some drawbacks which we are trying to overcome in this project. Earlier the gestures were recognized using colored caps, which in this case were difficult to take the input and process it. In this project, we have used leap motion technology which can be implemented for both hardware and software. There are twelve events that can be performed using fingers.

This project deals with the concept of hand gesture recognition using leap motion. We are developing mouse control, game control and buggy control through different gestures. In this we are extracting 3-D coordinate points for recognizing different gestures. The aim is to detect proper hand gestures and perform the given events. In addition to image processing, we are using Euclidean distance and cosine similarity knowledge on the gestures structure in order to allow effective dimensional reduction, hand posture classification and detection schemes. The whole system can be helpful for handicapped people; with the help of our project those people can use different elements of a computer. We will be developing ore interactive gesture base system to reduce overall efforts. The proposed system approach is particularly useful to communicate with computers and other electronic appliances from a distance where the mouse and keyboard are not convenient to work with. The system also allows the user to interact with mobile devices using intuitive gestures without touching the screen or wearing/holding any additional devices. Evaluation results show that the system is a low power and able to recognize 3D gestures with over 98 precent precision in real-time.

II. LITURATURE SURVEY

The authors of "Vision-based Multi modal Human-Computer Interaction using Hand and Head Gesture", proposed implementation details of hand and head gestures. They introduced static and dynamic hand gestures. The objective of this paper is thus to use two of the important modes of interaction hand and head to control any application running on a computer using Computer Vision algorithms. The use of gestures to convey information is an important part of human communication. This exploratory survey aims to provide a progress report on static and dynamic hand gesture recognition (i.e., gesture taxonomies,

representations, and recognition techniques) in HCI and to identify future directions on this topic. They also explained that the proposed multi-modal approach is particularly useful to communicate with computers and other electronic appliances from a distance where the mouse and keyboard are not convenient to work with. This paper summarizes the surveys carried out in human–computer interaction (HCI) studies and focuses on different application domains that use hand gestures for efficient interaction.

The authors of "Future Human Computer Interaction with special focus on input and output techniques", introduced techniques and devices using the human hand gestures for the use with multi-touch tablets and video recognition and techniques for voice interaction. The fact that we are used to act with our hands and communicate with our voice will play a major role in our interaction with the computer. Thereby the gesture and speech recognition take an important role as these are the main communication methods between humans and how they could disrupt the keyboard or mouse as we know it today. Also the way how people interact with the computer is coming to a new dimension. In this paper he addresses some of the current trends such as touch, motion control and speech recognition. This paper mainly deals with new developments, how they should be implemented in the future and how they could influence and change the daily computer interaction.

The authors of "A Brief Overview of Hand Gestures used in Wearable Human Computer Interfaces", proposed that this technical report is to provide a brief overview of how human hand gestures can be used in wearable Human Computer Interfaces (HCI). This report is divided into two parts, one dealing with the different technologies that can be used to detect/recognize hand gestures in wearable HCI systems and another part focusing on one particular technology, namely the computer vision based technology. Also the purpose of this project is to bridge the gap between real and virtual worlds by enhancing the user's current working environment with virtual 3D objects. We describe a number of wearable HCI systems that use different technologies in order to include gestures into their interface. Through this paper, we are allowed to identify desirable characteristics of a technology used in wearable HCI.

"Real-time Eye Tracking Using a Smart Camera", refers to finding eye features in a single frame. Real-time eye tracking is important for hands off gaze-based pass- word entry, instrument control by paraplegic patients, Internet user studies, as well as homeland security applications. Also, it is important for research and development areas such as visual systems, psychological analysis, cognitive science and product design. A smart camera, Lab VIEW and vision software tools are utilized to generate eye detection and tracking algorithms. In this paper, a tracking algorithm optimized for the smart camera, and its implementation using Lab VIEW 8.5.1 and NI Vision Builder are discussed. It is achieved by detecting the same eye features across multiple image frames and correlating them to a particular eye.

The authors of "A Wireless Dynamic Gesture User Interface for HCI Using Hand Data Glove", introduced a DG5 handy data glove is used to design an intelligent and efficient human-computer interface to interact with VLC media player. Hand gestures are one means of interaction between computers and humans. A hand gesture interface device, the VPL Data Glove TM, provides real-time information on a user's hand movement. It also includes some function modules such as sensing of movements, recognition of gestures, mapping into particular symbolic features, and controlling actuators. In this paper, we propose a wireless hand data glove gesture recognition system to detect human dynamic gestures. The key element is a glove and the device as a whole incorporates a collection of technologies. This paper further supports the investigation of finding more suitable and flexible glove to be easier to put on and off reducing the computational cost mimicking a real human hand to solve high dimensional applications in the physical world and also in the virtual world.

III. PROPOSED ARCHITECTURE

Leap motion camera is a hardware sensor device that supports the hand and finger motions as input, analogous to a mouse, but requires no hand contact or touching. Leap motion camera is used to recognize hand gestures made by a person. It is based on real time systems.

- Initially the system will authenticate the user to give access to leap motion application. For that purpose separate GUI is created
- After getting login to the this system will allow the user to do some tasks like to control mouse events through the leap motion camera, online gaming which includes navigation keys function and movement of robotic buggy that is moving forward, move backward, turn right and turn left.
- The system will start by capturing the hand images via a leap motion camera. At this stage, pre-processing operations will be from this camera such as normalization, scaling.
- Normalization of values means converting the grabbed values from gesture image to right scale. We are going to convert values in between -300 to +300 to 0 to +600.

- Also, we are going to use two formulae first is a Euclidean distance measure and cosine similarity. After obtaining all the values, some mathematical calculation will be done on these values to compare the obtain results with exciting gesture in the system. This comparison will give nearby output, which user wishes to give.
- Once the gesture is matched, the corresponding operation will be performed that is a buggy will move or file will open or a game will start.

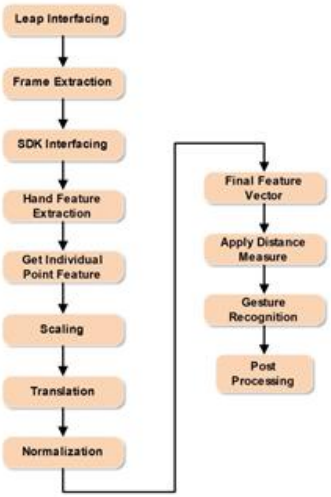


FIG 1: PROPOSED SYSTEM ARCHITECTURE

V. FEASIBILITY

1. System is designed for handicap people communication purpose so it is economically feasible.
2. Also complexity of our system is O(n), where n is number of pixels in image. As space and time complexity of system is able to find.

VI. IMPLEMENTATION CONSTRAINS

1. Proper light intensity is required to recognize hand gesture if some gestures are made in dark then system will unable to detect correct gesture.
2. Also hand gestures must perform at certain height.
3. The hand recognition process must be active all time so whenever gesture is made it should perform operation as soon as possible.

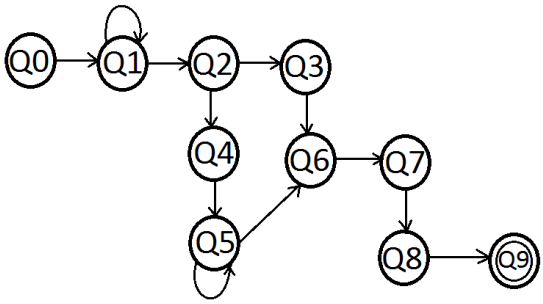
VII. APPLICATIONS

1. Physically impaired people are unable to use mouse, so it is very useful in a way that people can make hand signs to perform mouse events.
2. Also it is widely used in gaming field in such way that it replaces keyboards navigation key events with built in hand gestures.
3. It can be useful in industry where heavy materials need to load/unload in order to reduce manpower.

IV. MATHEMATICAL MODEL

LET THE M IS THE UNIVERSAL STATES WHICH CONTAINS,

M = {Q, S, F, Q1 , Q} where,
Q= States of system {Q0, Q1, Q2, Q3, Q4, Q5, Q6, Qf}
Q1= Initial State.
Qf= Final State (Output)
F= Failure State
Where ,
Q0= Checking the connections.
Q1 = Authentication user.
Q2 =Application access.
Q3 = Leap sensor initialization.
Q4 = Mouse control.
Q5 = Detection of manger
Q6 = Input Data.
Q7 = Micro controller.
Q8 = Buggy movements.
Q9 = Stop.



VIII. CONCLUSION

We are developing a system which will be able to render the technology of leap motion to access various components of computer. We are developing an application for computer through which leap motion applications are accessed. We aim to use mouse without practically holding the mouse. We aim to provide computer system to recognize hand gesture not for only commercial purpose but also social in order to make everyday life efficient.

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