HAND GESTURE BASED DEVICE CONTROLLING SYSTEM

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Abstract:- Human Machine Interface(or) HMI is a system comprising of hardware and software that helps in communication and exchange of information between the user and the machine. We normally use LED indicators, switches, Touch screens and LCD displays as a part of HMI devices. Another way to communicate with machines like Robots or Computers is with the help of Hand Gestures. Instead of using a Keyboard, mouse or joystick, we can use hand gestures to control certain functions of a computer like play/pause a video, move left/right in a photo slide show, and scroll up/down in a webpage and many more.

Keywords: Human Machine Interface, LED (light emitting diode), Hand gestures, LCD (liquid crystal display, Touch screens.

I. INTRODUCTION

Basic purpose of developing a new system of hand gesture module is to remove the need of hand held monitoring of switches and indicators. Gesture is an action of arms or any other body part which are made to emphasize speech. Basically, gestures include action of hands or face. A gesture can be divided into different categories: dynamic gesture and static gesture. Gesture recognition is movement of human actions by computing device. The basic purpose of this system is to control different functions of electronic devices with the help of hand movements. Thus, this system will work as a remote control for operating different electronic devices present in a daily use. We are using gestures of hand as a remote to controlled home appliances like Tube; fan etc. instead of using manually. Now a days, in each and every home all electronic equipment's like TV, CD player, air conditioner, DVD player and music system that can be operated with the help of RF module. Here we used our hand like Remote for controlling home appliances. All these home electronic devices can be controlled by transmitter- receiver system.

II. LITERATURE SURVEY

The main goal of gesture recognition research is creation of a system that can identify specific human hand gestures and use them ti convey information or for device control as well as applications control. Hand gesture is a Branch of Human Computer Interaction in which

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Human hand gestures are recognized by the computer system and then perform pre- defined task as per the application for controlling the hardware or software.

Mouse free:

An appealing option for replacing primitive human computer interaction (HCI) with the use of touchpad or mouse is the Vision-Based Human Computer Interaction through Real- Time Hand Tracking and Gesture. Recognition Vision-Based interaction. The proposed system makes use of the webcam for tracking the user's hand and to recognize the gestures for the purpose of interaction with the system. The contributions of our work will be to implement a system for hand tracking and simple gesture recognition in real time.

Many researchers in the field of robotics and human computer interaction have tried to control mouse movement using video devices.

III. SYSTEM ARCHITECTURE

Basic purpose of developing new system of hand gesture remote control is to remove the need of the hand held remote. Gesture is an action of arms or any other body part which are made to emphasize speech. Basically Gestures include motion of the hands and face. A gesture can be divided into different categories: dynamic gesture and static gesture. Gesture recognition is movement of human action by computing device. Gestures can obtain from any bodily motion but commonly obtain from the face or hand. The basic purpose of this system is to control different electronic devices with the help of hand movement. Thus, this system will work as a remote control for operating different electronic devices present in a daily use. We are using gestures of hand as a remote to controlled home appliances like Tube; fan etc. instead of using manually. Now a days, in each and every home all electronic equipment's like TV, CD player, air conditioner, DVD player and music system that can be operated with the help of RF module. Here we used our hand like Remote for controlling home appliances. All these home electronic devices can be controlled by transmitter- receiver system. Now days, it is impossible for living in a home without interacting with the home appliances. Due to evolution of technology in the field of gesture recognition for hand gesture or human computer interaction many Techniques are done.

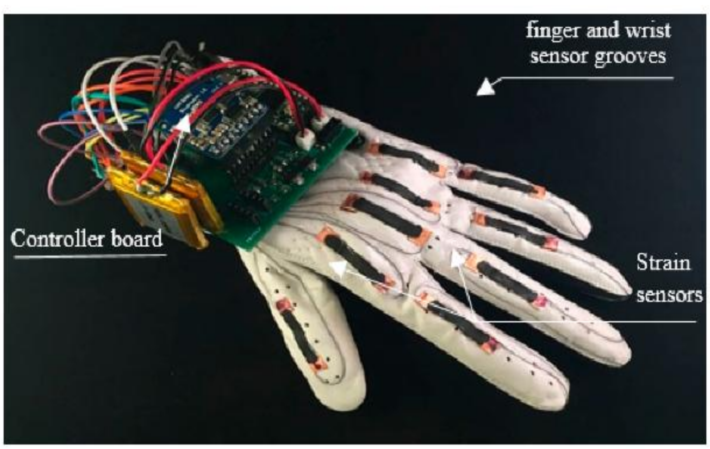

Fig 1 System architecture

IV. Design and Implementation

4.1 Concept behind the Project

The concept behind the project is, we place two ultrasonic sensors on top of monitor and will read the distance between monitor and our hand using arduino, based on this value of distance we will perform certain actions. To control the PC with hand gestures , we connect two ultrasonic sensors with arduino. Ultrasonic sensor work with 5V and hence they are powered by the onboard voltage regulator of arduino. The arduino can be connected to PC/laptop for powering the module and also for social communication. Once the connections are done , place them on the monitor. Leap motion controller is new interactive devices mainly aiming at hand gestures and finger position detection developed by Leap Motion. . The performance in selection task of leap motion controller is compared with a common mouse device [Bachmann et al. 2015]. Fitts' law is introduced in the evaluation system. It indicates the Leap Motion Controller's performance in general computer pointing tasks is limited compared with a mouse device given the error rate of 7.8% forLeap motion controller and 2.8% for the mouse device.

4.2 Data

Leap motion has kept updating their SDK after the first release. Currently the newest version is Orion Version 3.1.2. Leap motion provides preprocessed data through their Application Programming Interface. This data is accessed by a Frame object querying by per frame. There are several properties a frame object contains in the Orion version.

- ✓ Palm position Ppos, normal PN and velocity Pv.
- ✓ Hand direction PD.
- ✓ Fingertips position F i pos, direction F i D and velocity F i v where i starts from 0 to 4 representing thumb, index, middle,ring and arm direction.

4.3 Features

Based on previous raw data we collected from Leap Motion Controller API, we starts to build features to recognize hand gestures. These features could mainly be divided into two parts. One parts are associated with static gestures containing the positions and directions.

4.3.1 Static Features

Features for static gestures are mainly built based on palm and fingers relative distances. We calculated two types of distances. One type is distances between fingertips F i pos and palm center Ppos denoted by Di. The other type is distances between two fingers which are adjacent. For example distance between thumb and index, distance between index D01and middle denoted by D12. We have two standard gestures where the distance values are used as parameters to distinguish different static gestures.

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The other gesture features are built based on distances between fingers and palms. The distance between thumb and index is used to identify the OK gestures. The distance between index and middle finger is used to distinguish V gesture and Index and Middle pointing gesture. The rest gestures simply combined these two standard gestures. For example the index L gestures are index and thumb extended and the rest fingers bent.

4.3.2 Dynamic Gesture Feature

The dynamic gesture features are easily distinguished from static gestures features. We calculate the total value of velocity magnitude among fingers and palm. If the total movement value is greater than a user-defined threshold, we believe the hand is moving. Otherwise, we starts to recognize the static hand gestures.

Dynamic Gesture features mainly use the velocity of fingertips and palm to detect the movement patterns. Compared with the static gestures, dynamic gestures are much more complicated. We starts from the global movement and then go through the details of the fingers' movement. From the global movement, we try to detect hand translation movement, hand rotation movement, hand circle movement. Then we consider the fingers' movement. Since there are so many possible

4.3.3 Hand Rotation Feature

Palm rotation features contains two parts. One is the difference of current palm normal P t N and previous palm normal P t−1 N defined by DPN . The other parts is the angle between difference of current palm DPN and hand direction PD. We then calculate the cross correlation of DPN and hand direction PD.

4.4 Actions Involved

The arduino should be programmed to read the distance of hand from the Ultrasonic sensor.By reading the value of distance , we can arrive at certain actions to be controlled with gestures.

Action 1: When both the hands are placed up before at a particular far distance, the the Video in VLC player should play/pause.

Action 2: When right hand is placed up before the sensor at a particular far distance, then the video should fast forward one step.

Action 3: When left hand is placed up before the sensor at a particular distance, then the video should rewind one step.

Action 4: When right hand is placed up before the sensor at a particular near distance and then if moved towards the sensor the video should fast forward, and if moved away , the video should rewind.

Action 5: When left hand is placed up before the sensor at a particular distance and if moved towards the sensor the volume of video should increase, and if moved away the volume of video should decrease.

4.4.1 Generalized system

Gesture recognition solutions can be divided regard to the type of gesture used for controlling a computer. Gesture can be considered as a change of the hand position (hand movement) in a particular time interval with a given velocity or as a change of the hand shape (forming ellipse with thumb and the index finger). Gesture that belong to the first group are typically called dynamic gestures while there from the second group are often referred to as static gesture. To implement the algorithm and its logic for run time image processing, a PYTHON Processing environment is used. Processing is a python based programming structure. To process the images, an open source image processing library under GNL GPL v3 license named as Blob scanner processing library is used. Once the data or frame is taken from a video. After having the image in software, code will find the hand based on skin detection algorithm. If nothing is available then system will be ideal but if hand part is detected then system will start implementing the gesture recognition algorithm on the image to recognize the gesture.

4.4.2 Proposed Concept

A gesture based computer control system is the patent-pending interface based on subtracting the background of image displayed with the help of VLC video player from a video stream, and recognizing gestures in further processed output stream. There are basic dynamic gestures predefined in the system, i.e. moving one hand or both hands left/right and up/down, moving both hands further apart/close together, simultaneous movement of the left hand up and the right hand down and vice versa. Keeping one hand or both hands steady is also considered as two independent basic gestures. Each basic gesture is associated with a typical system action. For instance, moving left hand up and right hand down is interpreted as rotating the image right when browsing images. Additionally, mouse events handling is implemented.
We then install python gui library that helps in automation for human beings. The API is designed to be as simple for sensible defaults.

4.4.3 Fuzzy Rule Based-Concept

Image processing described above enables to obtain image containing user's hands only. Therefore, the hand detection algorithm is based on a simple feature vector containing the shape area threshold and the pixel intensity threshold. Detected hand positions are analyzed using Cartesian coordinates. Changes of detected hand positions can be interpreted as gestures using fuzzy rule-based processing. There are three linguistic variables proposed, i.e. velocity Vt , change of velocity 6 Vt and direction. Input values for the fuzzy system associated with the first two linguistic variables are calculated using Eqs. (1) and (2), respectively. The value of direction is denoted as an angle between the positive y axis and a vector constructed for two consecutive detected hand positions. Linguistic terms for Vt are {very small, small, medium and large}, for 6Vt {negative medium, negative small, no change, positive small and positive medium}. For directions the terms are described as {north, east, south, west} While analyzing natural human hand motions one can observe that moving hand in a particular direction is preceded by a short preparation phase (anticipation) during which the movement in the opposite direction occurs. Taking this feature into account fuzzy rules are created with regard to directions for time ti and time ti-1 and by analyzing change of speed. Thus, an example of a rule for a gesture from class gl denoting fast movement in the left direction with the anticipation phase can be described as: if vt-l is S and dt-1 is not NuS and vt is L and dt is W then g is gl (4) According to forms of fuzzy rules used, fuzzy operators are of a type min-max. The inference zero-order Sugeno model is used with singletons denoting gesture classes. The output of the system is the maximum of all rule outputs.

4.5 Steps Involved

Russification: To each sensor corresponds a linguistic variable, whose values are linguistic terms representing typical angles of joints and separations. For the joints in the fingers (linguistic variables F1J1, F1J2, F1J3 etc.) the linguistic terms are: STRAIGHT, CURVED and BENT. For the separations between fingers F1 and F2, F2 and F3, F4 and F5 (linguistic variable S12, S23, S45), the linguistic terms are: CLOSED, SEMI-OPEN and OPEN. For the separations between fingers F3 and F4 (linguistic variable S34), the linguistic terms are: CROSSED, CLOSED, SEMI-OPEN and OPEN.

The Recognition Process: The hand gesture recognition process is divided into four steps: (1) recognition of finger configurations, (2) recognition of hand configurations, (3) segmentation of the gesture in monotonic hand segments and (4) recognition of the sequence of monotonic hand segments.

Example: If F1 is BtBtSt and S12 is Cd and F2 is BtBtSt and S23 is Cd and F3 is BtBtSt and S34 is Cd and F4 is StStSt and S45 is Cd and F5 is StStSt Then HC is [G]

V. APPLICATIONS

- ✓ It can be used in Operating Room to pick and place the surgical instruments.
- ✓ It can be used to control Robotic arm.
- ✓ Industrial application
- ✓ Security and Surveillance.
- ✓ Search and rescue operations.

5.1 Advantages over Existing Systems

- ✓ Provides flexibility to the user and the system is portable.
- ✓ It does not involve template matching to identify the finger count. Rather, each image frame is

processed and the command is generated in real time.

- ✓ It is rotation, scaling and orientation invariant

VI. EXPERIMENTAL ANALYSIS

The developed methods for controlling a computer throuh hand gestures have been extensively tested in several real time situations. The focus of the conducted experiments was on the robustness and the performance of the supporting system.

The experiment concluded that hand gestures are easy to predict when compared to voice related gestures or motion related gestures. An additional advantage of the hand gesture set is the fact that, excluding mouse activation and deactivation, only one hand is required to operate the video . The users also found very intuitive the implementation of the various mouse clicks as a hand motion towards the camera, followed by a hand motion towards the torso because this is analogous to pressing an imaginary button.

VII. CONCLUSION

This paper confirms that there are a wide number of possible applications and potential benefits for non-contact hand gesture based leap motion. Gesture recognition will not be appropriate for all secondary controls, the challenge is to identify those controls which offer the most safety benefits by improving task classification from visual-manual to primarily manual, this will increase control and is likely to involve specific infotainment and integrity control functionality. For some applications hand gesture recognition offers the possibility of substantial safety benefits, for other applications gesture recognition potentially offers increased ease of use, and perhaps even increased emotional pleasure when carrying out certain tasks such as opening or closing the media player window.

However, conflicting data on user acceptability for using hand gestures remains a challenge. Future research by the author will involve detailed studies to investigate potential increased safety and ease of use benefits together with user acceptability for a wide range of non-contact hand gesture device control.

VIII. FUTURE ENHANCEMENTS

Gesture control technology shows a great potential in education. Although at this stage, practical usage of the technology in day to day activities are not widely acknowledged. There are two reasons for this. Firstly, education content differs from subject to subject. In order to use the gesture control product in academia, it requires extensive customization of software, often requiring developers. In most cases, the university does not have such resources to support the work. Secondly, the effectiveness of the gesture control products still need improving. It takes time to calibrate the product, and in order to control the product, users will need to spend time training and practicing. Gesture control products are not yet as intuitive as they claim to be or have the potential to be. In order to adopt gesture control technology in education, we will need specialized application developed for educational content, which will save the cost of individual development. The application should be easy to use and set up, and should provide an accurate gesture control. The hand gesture detection can be applied to automate home appliances with a remote control.

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