Gesture Control Keyboard

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Abstract—Since the dawn of evolution of computer, each and every components evolved. Computing machines make our day to day life very convenient and easy. Nowadays, to control these machines a controller equipped with a number of keys. A keyboard requires a lot of resources and restriction but having diverse range of keys in physical features. However, in touch keyboard which evolved from a type form physical keyboard has many drawbacks. The interacting of physical touch makes the screen worn out by time, moreover it requires a substantial amount of space to be implemented over a particular device. This paper reviewed the current status of application of gesture recognition and commonly used hand gesture recognition methods, analysis their architecture, have detail information about the concept used for the hand gesture recognition

Index Terms— SVM, HMM, BWMorth Algorithm

I. INTRODUCTION

Now-a-days there machine plays a critical role in human computer interaction which also called as HCL. In past few years the evolution of HCL has gone through from drastic changes, from the physical keyboard and mouse to vision based hand gesture technology plays an important role in HCL. In particular field of speech recognition and hand gesture got great attention from the world. The rapid development has push the technology to a new curve where new types of HCL methods are evolving to fulfil the new requirement of the world.

Gesture is an expression of physical behaviour and emotion from a particular symbol which are either expressed by body or hand. The author develops the hand gesture recognition using three different concepts to develop a universal keyboard which can used under any circumstances. Gesture could be used as a tool which determines the user intent and communicate between human and computer. In past few year this concept has being evolved which can be seen in the field gesture recognition based technology. Hand gesture recognition is greatly differs from the traditional hardware based methods. Gesture which has been proposed has implemented differently different of different types of concepts, those concepts are as follows bwmorph algorithm, SVM, Neural network, HMM, continuous time recurrence neural network, aurdino coding etc. The concept is built on the basis of real world application where it can implemented properly. Novelty of the work is the usage of different type of concept to get less possible error in the result. The Hand gesture concept is segmented into three parts, those parts are as follows. First part consists of finger gesture. In finger gesture the image capture by the camera a passed through different level of processing in which the each level process the image to reduce an error or noise then those data are being passed through recognition algorithm or it also be used in bwmorph algorithm. Second part consist of static palm and figure recognition. This is vision based system which is designed to different hand gesture from a predefined algorithm. The accumulated data passes through different level of processing, extraction, recognition and execution.

II. LITERATURE SURVEY

To solve the hand gesture recognition problem, a number of solutions have been tried out before. Based on the literature survey conducted, the techniques used in the previously conducted experiments have been identified. Some of the methods found are as follows:

A. Skin Colour Detection and Background Subtraction

It detects the hand gesture from a monocular video image under complex background using a skin color detection and background subtraction algorithm. The arm removal and noise recognition have improved performance of the gesture recognition

B. K Means Clustering

A web camera which works on 20 fps with 7 mega pixel intensity has been used. On having the input sequence of images through web cam it uses some pre-processing steps for removal of background noise and employs K-means clustering for segmenting the hand object, so that only object is processed in order to calculate shape based features.

C. Usage of skin and background Gaussian Models

The method captures pixel values of the hand and the background then converts them into YCbCr color space. Secondly, skin and background Gaussian models based on the color space of CbCr are proposed. Lastly, these models are taken to segment the whole image respectively, and then required for the intersection.

D. Usage of Visual Memory

The use of a visual memory (Stored database) allows the system to handle variations within a gesture and speeds up the recognition process through the storage of different variables related to each gesture and it is user friendly.

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E. Usage of SIFT Mechanism

It only uses single sensing device to capture the hand gesture no need extra devices that reduce the cost of the process. The technology used (SIFT) are invariant to scale, orientation, and partially to illumination changes.

F. Depth based Segmentation

It supports a vision-based gesture recognition driven system capable of recognition in low-intensity environments. The algorithm processes video in real-time and generates instantaneous output in the system. Depth-based segmentation makes precise identification of the region of interest

III. METHODOLOGY

Most gesture recognition methods contain three major stages which includes: object detection, object recognition and analysis of sequential gestures to identify users' instructions or behaviour.

The target of the stage 1 is to detect hand objects in the digital images. In the second stage, the detected hand objects are recognised to identify the gestures. In the third stage, the gestures made by the users are analysed using a sequence of algorithms and techniques to identify the user's behaviour. The environment and image problems that need to be solved when the system is used in real time (to enhance the accuracy) are done by constructing an adaptive and robust gesture recognition system.

The working of this modernised approach is carried out through the help of certain phases which are as follows:

Image Frame Acquisition

The image in the frame is detected by the ultrasonic sensors and acquired.

Hand Segmentation and Tracking

The key of success towards any gesture recognition, is hand segmentation and tracking, however due to challenges of vision-based methods, such as varying lighting condition, complex background and skin color detection, the need for robust development of algorithm for natural interface has arised. So for the segmentation purpose color information is used.

Feature Extraction

Extracted features are clustered to produce discrete vectors as an input to the next step

Classification of features

Classification of the extracted features based upon hand gesture dictionary (database) is done

The hand gestures in front of the Ultrasonic sensors can be calibrated so that they can perform five different tasks on the computer.

Switch to Next Tab in a Web Browser

Switch to Next Tab in a Web Browser
Scroll Down in a Web Page
Scroll Up in a Web Page
Switch between two Tasks (Chrome and VLC Player)
Play/Pause Video in VLC Player

The following are the 5 different hand gestures or actions that have been programmed for different purposes:

Gesture 1: Place the hand in front of the Right Ultrasonic Sensor at a distance (between 15CM to 35CM) for a small duration and move your hand away from the sensor. This gesture will allow the user to Scroll down the Web Page or Decrease the Volume.

Gesture 2: Place the hand in front of the Right Ultrasonic Sensor at a distance (between 15CM to 35CM) for a small duration and move it towards the sensor. This gesture will allow the user to Scroll up the Web Page or Increase the Volume.

Gesture 3: Swipe the hand in front of the Right Ultrasonic Sensor. This gesture will allow the user to move to the Next Tab.

Gesture 4: Swipe the hand in front of the Left Ultrasonic Sensor. This gesture will allow user to move to the Previous Tab or Play/Pause the Video.

Gesture 5: Swipe the hand across both the sensors (Left Sensor first). This action will allow the user to Switch between Tasks

Output Gesture

The input is fed into the hand gesture interpreter, which then decides the command execution based upon the home device command stored in that database. This gives the output gesture to be performed.

The Serial data from Arduino needs to be read and needs to invoke certain keyboard key presses. In order to achieve this, a special Python Module called PyAutoGUI needs to be installed.

Algorithm : Extract the fingertip position in a frame Input:

Img = An input video frame
Output:
Img_out = the video frame with hint for fingertip v = horizontal position of fingertip
m = vertical position of fingertip
Procedure:
Begin:
Set ImgPre=Apply an Gaussian filter on Img to reduce noise Set ImgPrer = YCbCr Image of ImgPre
Set lx = horizontal coordinate of Img Set ly = vertical coordinate of Img
Set I = Empty Array with same size of Img
Set Filter = filter of selecting hand by setting range limit of YCbCr color value Set I = Apply Filter on ImgPrer
Set I = dilate I
Set I = erode I to avoid noise and refining result of color filte Set I' choosing largest selected part to be human hand in I
Set BW3 = using bwmorph to extract skeleton of I by using parameter of thin Set endPoints = all endpoints of skeleton
Set endpoint = the furthest endpoint of all endpoints as fingertip Set v = horizontal coordinate of endpoint
Take an input video frame from the user Then,apply an Gaussian filter on this frame and convert the filter to YCbCr type,After this,set the horizontal coordinate of frame equal to the vertical coordinate of frame .Set 1:Empty the array wit the same size of the frame, then filter the hand by setting the range limit,Then,dilate the previous set before eroding it,At the end,extract the skeleton of set 1 and set the end point as fingertip which is the furthest of all.

Fig. 1. Algorithm

Ultrasonic sensors are used for measuring distance by using the ultrasonic waves. When, the head of sensor emits an ultrasonic wave it receives the wave reflected back from the target. Then it measures the distance to the target by measuring

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the time between the emission and reception.

An Optical sensor has a transmitter and receiver, whereas an ultrasonic sensor has a single ultrasonic element which it uses for both emission and reception. In reflective ultrasonic sensor, emission is done by a single oscillator and receiving by ultrasonic waves alternately. This makes sure of miniaturization of the sensor head.

The distance can be calculated with formula:

$$\text{Distance L} = 1/2 \times T \times C \tag{1}$$

Where L stands for the distance, T for time between the emission and reception, and C for the sonic speed. (The value has been multiplied by 1/2 because T is the time for go-and-return distance.)

Applications Involving Ultrasonic Detection
Measurement of ultrasonic distance: Distance measurement shall be applied in a garage parking application, when it has to sense whether or not a vehicle is pulled completely into a garage
Ultrasonic Sensors for detecting the level of water: Measurement of tank level, Fuel gauging, irrigation control.
Ultrasonic Obstacle Detection: The UAV Sensors for Drones as well as our proximity sensors which are used for robots are for obstacle detection.

IV. SYSTEM DESIGN

The image of the hand in the frame is detected by the IR sensors and acquired.The features are then pre-processed and the features are extracted by using Hand tracking and segmentation .The Extracted features are clustered to produce discrete vectors as an input to the next step. Classification of the extracted features by using recognition techniques based upon hand gesture dictionary (database) is done. The input is fed into the hand gesture interpreter, which then decides the command execution based upon the home device command stored in that database. This gives the output gesture to be performed. Two Ultrasonic Sensors with Arduino are used, the hands are placed in front of them and calculation of the distance between the hand and the sensor is done. The distance information from Arduino is collected by a Python Program. Using this information, relevant actions in the computer can be performed by a special library called PyAutoGUI which shall convert the data into keyboard click actions. The hand gestures in front of the Ultrasonic sensors can be calibrated so that they can perform five different tasks on the computer.

1) Switch to Next Tab in a Web Browser
2) Switch to Next Tab in a Web Browser
3) Scroll Down in a Web Page
4) Scroll Up in a Web Page
5) Switch between two Tasks (Chrome and VLC Player)
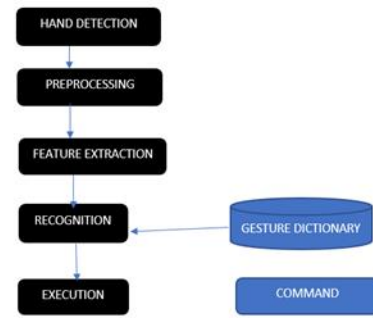6) Play/Pause Video in VLC Player

Fig. 2. System architecture

Hand Detection:
The image in the frame is detected by the IR sensors and acquired.
Pre-processing:
The features are then pre-processed.
Feature Extraction:
Extracted features are clustered to produce discrete vectors as an input to the next step
Classification of features & Recognition:
Classification of the extracted features based upon hand gesture dictionary (database) is done
Output Gesture:
The input is fed into the hand gesture interpreter, which then decides the command execution based upon the home device command stored in that database .This gives the output gesture to be performed.

V. IMPLEMENTATION

The hand gestures that are made in front of the Ultrasonic sensors need to be calibrated so that they can perform five different tasks on the computer:

Switch to Next Tab in a Web Browser
Switch to Next Tab in a Web Browser
Scroll Down in a Web Page
Scroll Up in a Web Page
Switch between two Tasks (Chrome and VLC Player)
Play/Pause Video in VLC Player

The following are the 5 different hand gestures or actions that have been programmed for different purposes:

Gesture 1: Place the hand in front of the Right Ultrasonic Sensor at a distance of 15CM to 35CM for a small duration of time and then move the hand away from the sensor. This gesture shall allow the user to Scroll down the Web Page or Decrease the Volume.

Gesture 2: Place the hand in front of the Right Ultrasonic Sensor at a distance of 15CM to 35CM for a small duration of time and move the hand towards the sensor. This gesture shall allow the user to Scroll up the Web Page or Increase the Volume.

Gesture 3: Swipe the hand in front of the Right Ultrasonic Sensor. This gesture shall allow the user to move to the Next

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Tab.

Gesture 4: Swipe the hand in front of the Left Ultrasonic Sensor. This gesture shall allow the user to move to the Previous Tab or Play/Pause the Video.

Gesture 5: Swipe the hand across both the sensors (Left Sensor first). This action shall allow the user to Switch between Tasks

Output Gesture

The input is fed into the hand gesture interpreter, which then decides the command execution based upon the home device command stored in that database. This gives the output gesture to be performed.

The Serial data from Arduino needs to be read and needs to invoke certain keyboard key presses. In order to achieve this, a special Python Module called PyAutoGUI needs to be installed.

Installing PyAutoGUI

With the help of PyAutoGUI, a Python Program has been written to mimic the actions of mouse like the left click, the right click, scroll, etc. and keyboard like the keypress, to enter text, multiple key presses, etc. without actually physically doing them.

Open Command Prompt with Administrator privileges and change to the directory where Python has been installed.
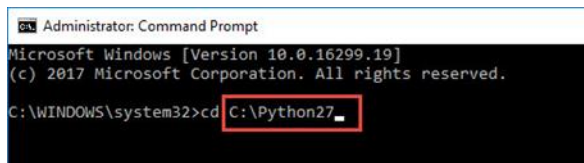

Fig. 3. Change to directory

If the latest version of Python has been installed, then pip (a tool for installing packages in Python) will already be installed. In order to check whether or not pip has been installed, type the following command:

Pip-V

To upgrade to the latest package of pip the following command, has to be used, however if pip is already in its latest version, then this step can be ignored.

Python-m pip install-U pip
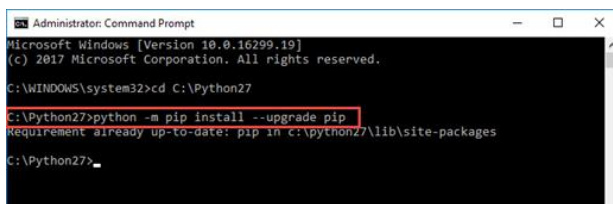   or
Python-m pip install-upgrade pip

Fig. 4. Install/upgrade the software

After upgrading pip, proceed to install PyAutoGUI. In order

to install PyAutoGUI, the following command needs to be typed:

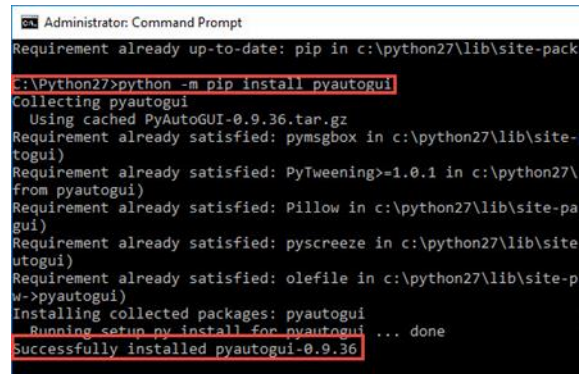Python-m pip install pyautogui

Or

Pip install pyautogui

Fig. 5. Installed successfully

As can be observed from the Arduino Code given above, after detecting the hand gestures, the Arduino sends out five different texts or commands through Serial Port. These commands include:

Next
Previous
Down
Up
Change

A simple python code needs to be written using these commands along with few functions in PyAutoGUI (like hotkey, scroll, keyDown, press and keyUp) so that the following tasks of mouse and keyboard can be executed:

When Data = "next" then Action = Ctrl+PgDn
When Data = "previous" then Action = Ctrl+PgUp
When Data = "down" then Action = Down Arrow
When Data = "up" then Action = Up Arrow
When Data = "change" then Action = Alt+Tab

VI. Result and Conclusion

The hand gestures made in front of the Ultrasonic sensors shall be calibrated so that they can perform five different tasks on the computer. The tasks that can be accomplished includes:

Switch to Next Tab in a Web Browser
Switch to Next Tab in a Web Browser
Scroll Down in a Web Page
Scroll Up in a Web Page
Switch between two Tasks (Chrome and VLC Player)
Play/Pause Video in VLC Player
Increase Volume
Decrease Volume

The following are the 5 different hand gestures or actions that have been programmed:

Gesture 1: Place the hand in front of the Right Ultrasonic Sensor at a distance (between 15CM to 35CM) for a small

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duration and move it away from the sensor. This gesture will allow the user to Scroll down the Web Page or Decrease the Volume.

Gesture 2: Place the hand in front of the Right Ultrasonic Sensor at a distance (between 15CM to 35CM) for a small duration and move it towards the sensor. This gesture will allow the user to Scroll up the Web Page or Increase the Volume.

Gesture 3: Swipe the hand in front of the Right Ultrasonic Sensor. This gesture will allow the user to move to the Next Tab.

Gesture 4: Swipe the hand in front of the Left Ultrasonic Sensor. This gesture will allow the user to move to the Previous Tab or Play/Pause the Video.

Gesture 5: Swipe the hand across both the sensors (Left Sensor first). This action will allow the user to Switch between Tasks.

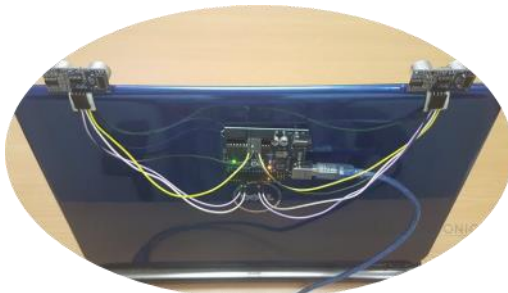
Fig. 6. Setup of ultrasonic sensors
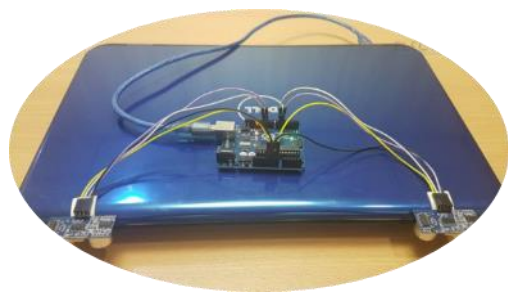

Fig. 7. Setup of Arduino UNO

Fig. 8. Setup

The results from four user studies validated the hypothesis

that using ultra sonic sensors and Arduino the hand gestures can be detected and recognized the best. In this, we have implemented Arduino based Hand Gesture Control , where few hand gestures made in front of the computer will perform certain tasks in the computer without using mouse or keyboard. A company called Leap Motion has been implementing this technology. This type hand gesture control can be used for VR (Virtual Reality), AR (Augmented Reality), 3D Design, Reading Sign Language, etc.

VII. FUTURE WORK

No requirement of extra hardware, just a touchscreen and some software. Infinitely customizable, any layout or design can be used and changed with the touch of a button. It reduces cost and improves robustness and uses algorithms and concepts of machine learning to implement the recognition techniques and it is convenient to use for the users i.e. it meets the requirements of the users. As these keyboards are smaller and easier to see all the keys (and may even have the full range of notes that a grand piano has), it is more efficient to use. And since it's digital, people have less to fear, as a "live" instrument sitting right in front of them is kind of scary. As It is much easier to use for the visually challenged and citizens with other disabilities and is uniquely recognizable   thus it shall help in bringing all the sections of the society at par with each other.

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