HAND GESTURE CONTROLLED INTERFACES

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ABSTRACT

Hand gesture recognition is widely used for Human Computer Interaction in the recent years as it provides an user friendly way of interaction with the computer. Touch-less user interface is an emerging type of technology in relation to gesture control through which the computer can be controlled via body motion and gestures without touching the input devices like keyboard, mouse, or screen. Gesture recognition is applied in areas like sign language, gaming, home automation, robot control and other aspects. This paper aims to provide the users to control the computer devices with their simple hand gestures. This project involves detection and identification of live motion. This application makes use of the inbuilt webcam to detect the gestures of the users and perform some basic operations. When the user performs a particular gesture, the webcam captures those images, identify and recognizes against a set of known gestures then performs the corresponding action. This application can run in the background while the users run other programs. The main objective is to enable the user to control media player, YouTube using simple gestures to increase or decrease the volume, seek forward, backward while sitting far from the computer screen without touching the input devices. This is done by extracting the hand region from the background with the background subtraction method. Then, the palm and finger regions are segmented so as to detect and recognize the fingers. Finally, a rule classifier is applied to predict the labels of hand gestures, then the respective operation is performed.

Keywords: *—Hand gesture recognition, Human computer interaction, Touch-less user interface, background subtraction method, rule classifier*

1. INTRODUCTION

In today‘s world, the computers have become an important aspect of life and are used in various fields however, the systems and methods that we use to interact with computers are outdated and have various issues, which we will discuss a little later in this paper. Hence, a very new field to overcome these issues has emerged namely HUMAN COMPUTER INTERACTIONS (HCI). Although, there are numerous advancement in both fields of Software and Hardware, still the basic way in which Humans interact with computers remains the same, using basic pointing device (mouse) and Keyboard or advanced Voice Recognition System. Our proposed project is about the Hand gestures recognition system to replace the basic pointing devices that are used in computer systems in order to reduce the limitations such as mouse and Touchpad. The proposed system uses the hand gesture, mostly number of fingers raised within the region of interest to perform operations like increase and decrease the volume, seek forward, seek back word in video player (for instance YouTube). A static control board hinders the versatility of client and limits the capacity of the client like a remote can be lost, dropped or broken while, the physical nearness of client is required at sight of activity which is a limitation of the user. The proposed system can be utilized to control many soft panels like HMI systems, Robotics Systems, Telecommunication System, using hand gestures with python programming using pyautogui module to facilitate interaction with computer through the Camera to capture video frames.

2. RELATED RESEARCH

In the recent decades, gesture recognition emerged as an influencing term. There were many gesture recognition techniques that have been developed for tracking and recognizing various hand gestures. Each one of them has their own advantages and disadvantages. The older one is the wired technology, where users need to tie up themselves with the help of wire in order to connect with the computer system. In wired technology user cannot freely move in the room as they are connected with the computer system via wire and are limited with the length of wire. An example of wired technology is instrumented gloves also called electronics gloves or data gloves. These instrumented gloves are made up of some sensors, which provide the information related to hand location, finger position orientation etc. These data gloves give good results but they are extremely expensive to utilize in wide range of common application. Data gloves are then replaced by optical markers. These optical markers project Infra-Red light and this light is reflected on the screen to provide the information about the hand location or tips of fingers wherever the markers are wear on hand, the corresponding portion will be displayed on the screen. This systems also provide good result but it require very complex configuration.

Later on some advanced techniques are introduced like Image based techniques which need processing of image features like texture, color etc. If we work with these features of the image for hand gesture recognition, the result may vary because the skin tones and texture changes rapidly from person to person from one continent to other. And also under different illumination condition, color texture gets modified which results in changes in the observed results. For using various hand gestures to promote real time application we choose vision based hand gesture recognition system which work on shape based features for hand gesture recognition. Typically, to make the hand gesture images independent of illumination variety like light exposure, light position and shading, this paper does some preprocessing by canny edge detection [10]. This is universal truth that every one poses almost same hand shape with one thumb and four fingers under the normal condition.

The success of approach discussed in paper [1] for Hand Gesture Recognition Based on Deep Learning is that the hand is segmented and the gesture tracking is done using CamShift algorithm and the background subtraction method is used here. In paper [2], Hand Gesture Recognition Using Deep Learning, commands the computer by using six static and eight dynamic hand gestures as recognized in [1].

3. PROPOSED METHOD

HAAR CASCADE:

Haar features can easily be scaled by increasing or decreasing the size of pixel group being examined, this allows to detect features on specific gestures. The variances of contrasts between the pixel groups are used to determine relative light & dark areas. Haar like feature based classifier can provide both high accuracy & speed. It needs less microprocessor instructions & has much less false detections. Use of integral images causes high speed of evaluation while rectangular property of the haar like features characterize non symmetrical properties of Gesture appearance , so it is perfect for Gesture detection procedure.

The algorithm implemented in this paper is divided into four main steps. First one is image pre-processing and segmentation of hand in the image. The second step includes background subtraction detection. In the third step it calculates some of the essential shape based features required for hand pattern detection. Finally, after the hand gestures are recognized, definite hand gestures are mapped to specific mouse functions. This proposed approach is designed and implemented for working on single hand gesture with different background. Fig. 1 shows the defined hand gestures according to the VLC player,youtube control function.

Fig.1: Different gestures used for different commands

4.ARCHITECTURE DESIGN

Different image pre-processing techniques, feature extraction and classification tool have been used for recognizing the gesture in the real time and applying the corresponding command. Feature extraction is one of the crucial tasks as it helps to detect accurate hand gesture, in [9] combination of color and edge map feature extraction method is used. Fig.2 shows the basic architecture diagram of the system according to different phases of the system.

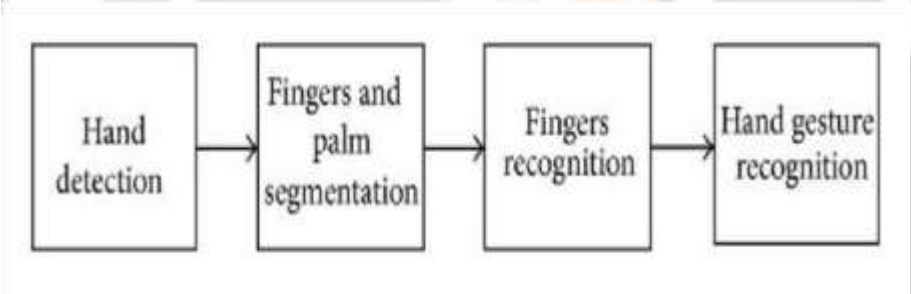

Fig.2: Architecture diagram

DATA ACQUISITION

In this approach different hand gestures have been captured by using the inbuilt webcam with the laptop as shown in fig.1. The data was captured with different persons (with the age range from 20-23) with different backgrounds.

HAND DETECTION

The original images used for hand gesture recognition in the work is demonstrated in fig.1, these are captured with the normal camera with different backgrounds. The hand region from the original image is detected using the background subtraction method. In some cases, moving objects will be included in the background subtraction result. To reduce the noise from the image, a median filter is used. Then the image is converted into a grayscale image [3]. The skin color can be used to discriminate the hand region from the other moving objects as shown in fig.3. In terms of hand gesture segmentation, it is realized by cutting the relevant specific hand gesture from one frame of video, which is also the first step for the hand gesture recognition [1].

Fig.3: Background subtracted images

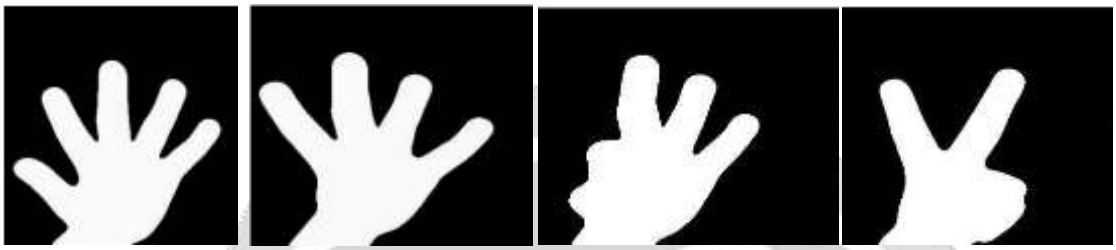

Fig.4: Binary image

FINGERS AND PALM SEGMENTATION

The output of the hand detection is binary images as shown in fig.4 where the white pixels are the members of the hand region, while the black pixels belong to the background. Here, the labeling algorithm is applied to mark the regions of the fingers. The detected regions in which the number of pixels is too small is regarded as noisy regions and are discarded.

HAND GESTURE RECOGNITION

When the fingers are detected and recognized, the hand gestures are recognized employing a simple rule classifier. Here the gesture is predicted according to the number and content of fingers detected. The content of the fingers indicate what fingers are detected as in fig.5. The blue dots between the fingers indicate the number of fingertips. The following table.1 shows the operations performed depending upon the number of fingers detected. The fig.6 shows the flowchart of the system according to the different phases of the system.

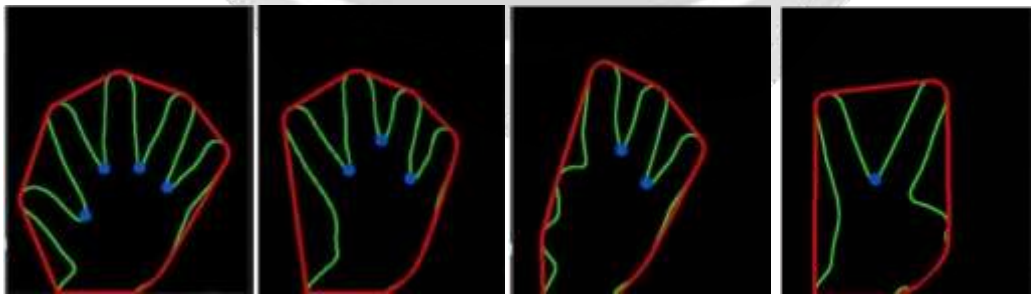

Fig.5: Filtering convexity defects

Table.1: Operations performed

NUMBER OF FINGERTIPS DETECTED	OPERATIONS PERFORMED
ONE	FORWARD
TWO	VOLUME DOWN
THREE	BACKWARD
FOUR	VOLUME UP

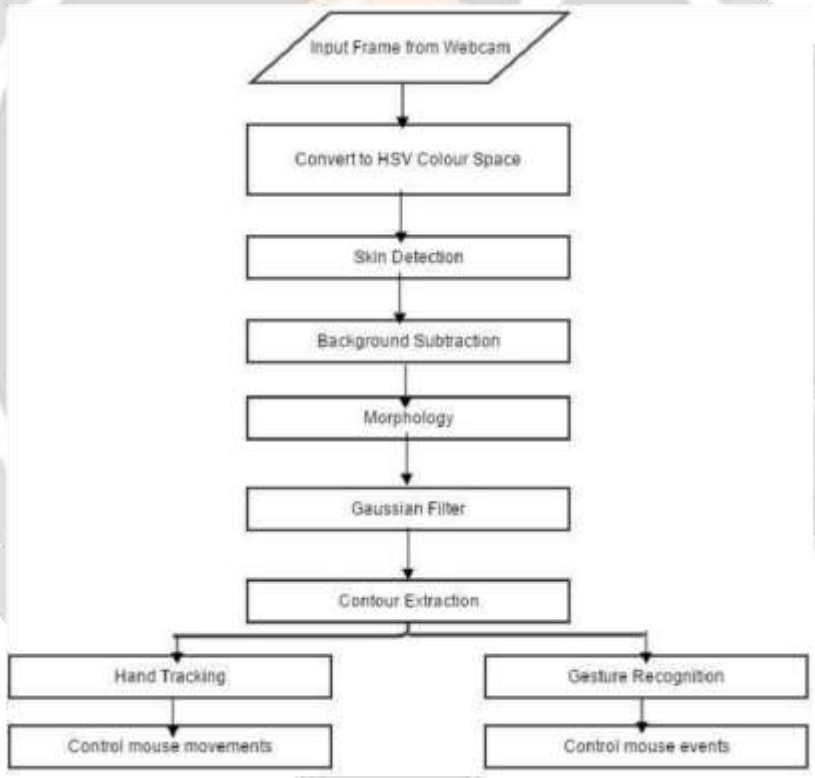

Fig.6: Flowchart that describes the different phases of gesture recognition and control

5.RESULT

We tested this system in real time and achieved very promising results. We have tested our system for different gestures with ten different people for many numbers of times. The following table.2 shows the average recognition rate for recognizing the hand gestures in respect to the defined operations. In Fig.7-loss curve and the accuracy are shown, the average accuracy of hand gesture recognition is 97.8%, the recognition rate for number 3 is not high because the hand gestures of them are complicated to recognize. The fig.8 shows the snapshots of our system performing backward operation. The changes in the result are due to different light illumination and various noisy backgrounds.

Table.2: Recognition rate for the four gesture operations

GESTURES	RECOGNITION RATE(%)
Forward	99%
Volume down	96%
Backward	98%
Volume down	98%

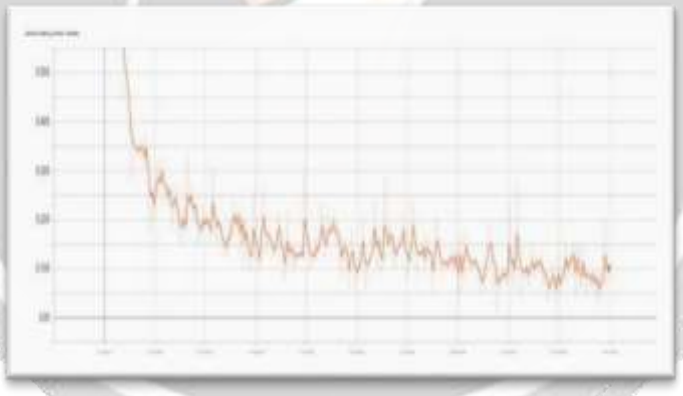

Fig.7: Loss curve

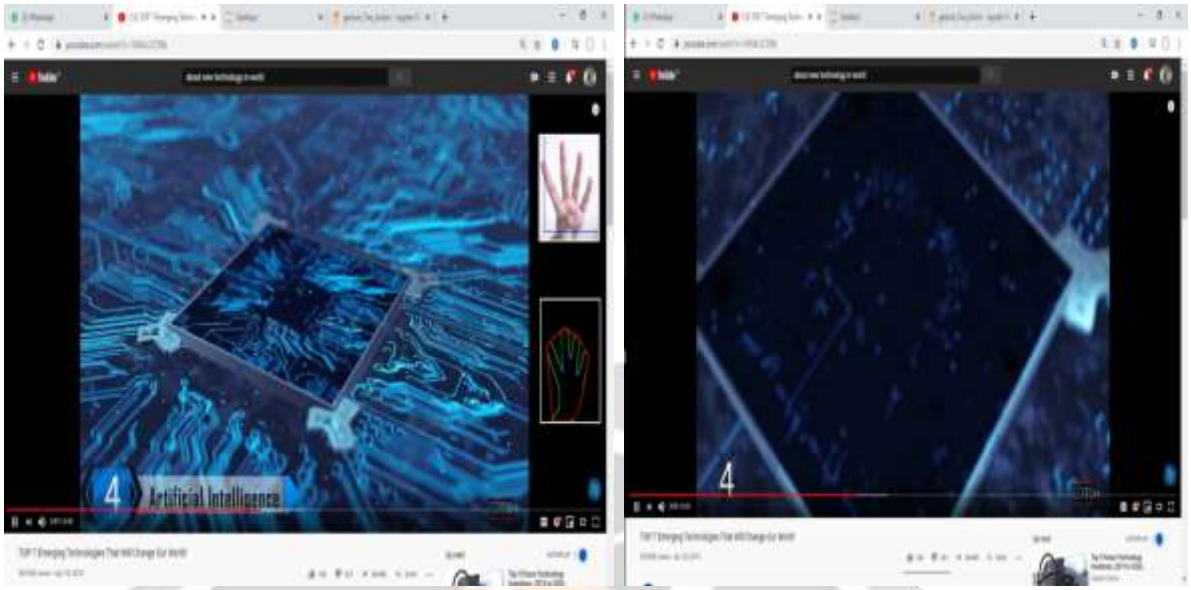

Fig.8: Performs backward operation

6.CONCLUSION

We proposed a shape based approach for hand gesture recognition with several steps including background elimination, finger detection, palm detection, finger counts etc. Physically affected people can use hand gestures for accessing VLC media player, YouTube, browse webpages etc. The advantage of this approach is its simplicity, implementation ease, and it do not require any amount of training or post processing, also we can train more amount of data. It provides us with the higher recognition rate. The disadvantage is that we define some parameters and threshold values since it does not have any systematic approach for gesture recognition. This paper shows how we can use dynamic hand gestures as computer interaction in a natural and intuitive way. This application defines some gestures for performing operations of VLC media player, YouTube. We have used simple features and recognition techniques in this system to work in a real time environment. The future prospect of this approach may include investigation with the large number of gestures with many persons and the effect of the performance of the system.

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