Hand Gesture Recognition for Performing General Operations on Computer Machine

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Abstract:- In this paper we introduce a prototype of hand gesture recognition system to interpret single handed static human hand gestures for the purpose of performing operations on the computer machine. This system makes use of an external webcam to capture the single handed static hand gesture of the user, identify the hand gesture and perform the desired associated action after matching the input gesture with the ones present in the database. Our real time hand recognition system is three fold: 1) feature extraction, 2) enhancement and 3) recognition. Extraction of the feature is achieved with the help of background subtraction. For the purpose of feature enhancement and image processing OpenCV libraries are imported and used. For recognition, various features with their own objectives are constructed from hand postures and compared according to the similarity measures and the best- matched posture is used for performing the desired action after matching. We can also build application interfaces for devices running on Operating systems such as air conditioners, smart TVs and computers by using this system.

Index Terms: *Computer vision, HCI (Human Computer Interaction), Image processing, Background Subtraction, IT (Information Technology)*

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1. INTORDUCTION

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gesture recognition is gaining more and more significance and has found its application in various fields such as gaming, man machine interface, 3D animation and visualization as well as robotics. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interface or even GUIs (graphical user interfaces), which still limit the majority of input to keyboard and mouse. Hand gestures provide an interactive and a natural way of communication with the computer machine. Health related problems arising due to prolonged use of secondary devices such as mouse and keyboard such as Carpal Tunnel Syndrome, Parkinson's disease and acute pain in joints can be effectively reduced. There is no dire need of having any physical contact with the system since hand gestures can be provided as an input from a certain prescribed distance. In additional to this providing hand gestures as an input to the computer machine can make frequently used applications easily accessible. In this paper we will discuss an innovative technique of providing hand gestures as an input for performing general operations on the computer which include sleep, restart and shutdown and making frequently used applications easily accessible.

1.1 EXISTING SYSTEM

Generally, Hand gesture recognition systems are implemented using data gloves and colored markers on fingers which makes the whole system cumbersome for daily usage. Use of data gloves increases the overall maintenance cost of the system. Due to this the system is not popular among the masses thus largely constricting the scope of the system. Making use of skin color filtration has to a certain extent bypassed the above problems but has made the system very user specific. A skin color filtered hand gesture recognition system has to be calibrated by adjusting the HSV values which can vary from person to person depending on the color of their skin. In addition to this the system becomes erroneous if it encounters a background that is similar in color to the user's hand. In order to overcome this problem a black cloth is used as the background which again constricts the scope of the project.

1.2 PROPOSED SYSTEM

In our system we have made use of the concept of background subtraction in order to isolate the hand gesture from the background thus making the system flexible and

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useable irrespective of the color of the hand and independent of HSV calibration. We have made use of an external HD camera of 8 MP to capture the gestures. Web cameras are cheap and easily available and most of the laptops have a built-in integrated web camera. The web camera is used to capture images at a fixed interval of time. We have introduced a designated "learn" button in order to capture the background and then hand gestures are introduced and through background subtraction they are isolated. Image enhancement is performed on the isolated gestures to effectively remove noise and sharp edges. We have introduced a template learning feature to store hand gestures for particular actions and template editor feature to edit or remove these stored hand gestures. A blob size is set which acts as a threshold for filtering out other noises and disturbances. We have developed the GUI of the project using C# on the .NET framework and we have imported the OpenCV libraries for the purpose of image processing

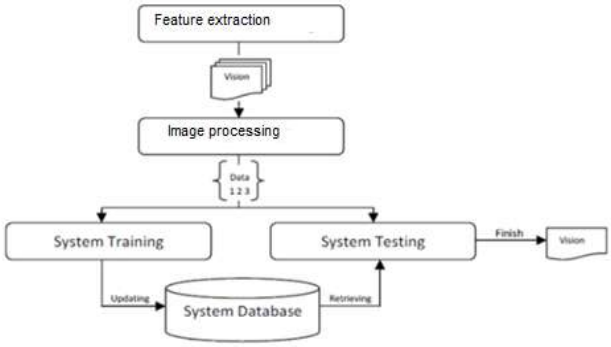

Figure 1: Architecture of Gesture recognition system

2. PROJECT OVERVIEW

Our proposed system can be divided into the following modules which include:

2.1 CAMERA INTERFACING

There is a designated button in our GUI in order to start the web camera and capture images at a particular rate and a "learn" button as well to capture the background. Similarly there is a "stop camera" button to end the session.

2.2 BACKGROUND SUBTRACTION

In this module the absolute difference between the image that has been learned and the ones that are being captured by the camera is carried out to isolate the hand gesture. It is necessary that the background remains unchanged during the entire session. In case the background changes it is necessary to "learn" the new background.

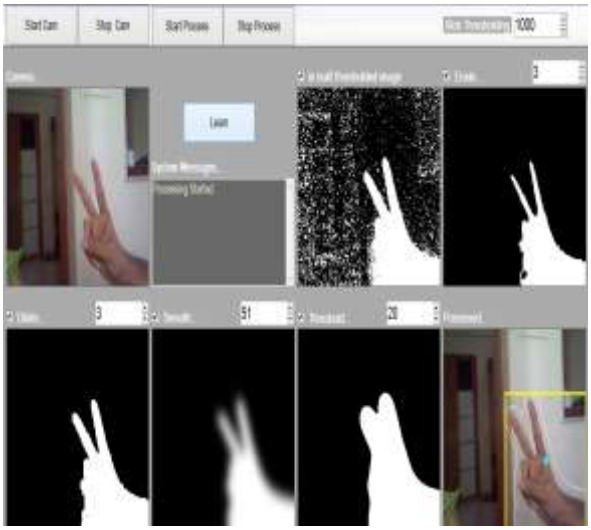

Figure 2: Background subtraction

2.3 IMAGE ENHANCEMENT

In this module the isolated hand gesture is enhanced with the help of in built OpenCV methods such as erode, dilate, smoothening and Thresholding

2.4 BLOB DETECTION

Blob detection is basically used to detect the hand gesture. In order to filter the noise a particular blob size is set below which the blobs that are detected are discarded.

2.5 CONTOUR ANALYSIS

This contour analysis module involves the following steps:

1. Binarization of the image and selection of contours of objects

2. Initial filtration of contours on perimeter, squares, crest factor and fractality.

3. Coercion of contours to uniform length and smoothening

4. Searching of all discovered contours and finding a template having maximum similarity to the given contour.

The discovery and matching of contours involves taking into account and calculating various factors such as elementary vectors, normalized scalar product, intercorrelation function (ICF) and autocorrelation function (ACF).

2.6 TEMPLATE LEARNING, ADDING AND EDITING

Buttons have been assigned for learning a particular hand gesture and adding it to the database as a template with a particular user defined name. Similarly the already added templates can be deleted and renamed.

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2.6 PERFORMING THE CORRESPONDING COMMAND.

In this step the user's gesture is matched with the templates present in the database. The best matched template is then identified by its name and the corresponding action is performed.

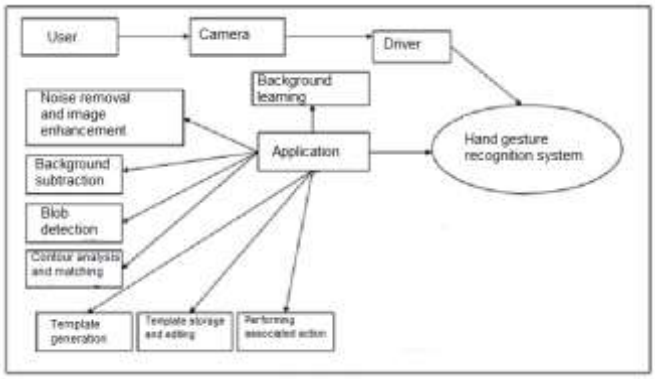

Figure 3: Data flow diagram of the system

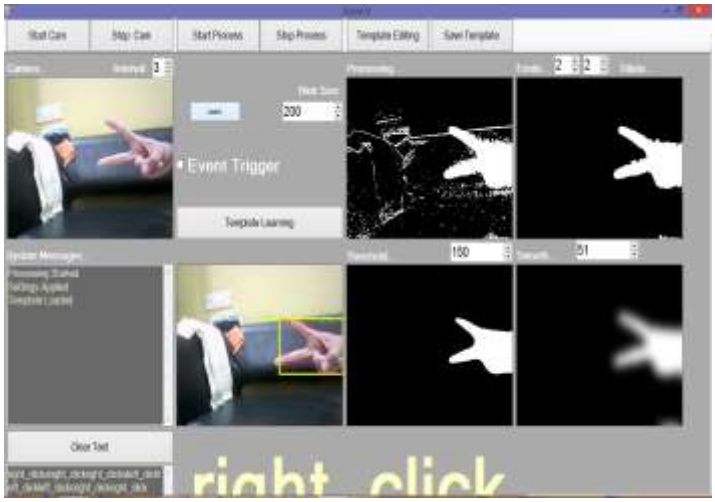

Figure 4: User Interface and hand gesture being identified and matched to the template "right_click"

3. CONCLUSION

By the realization of the above proposed system one can learn many aspects of Hand gesture recognition. This will provide knowledge for developing gesture controlled systems and implementing new gestures and their associated commands. We will also learn the camera interfacing strategies and various programming techniques for gesture recognition, gesture matching and execution of corresponding commands. Furthermore it will increase the popularity of hand gesture usage among the masses and provide impetus to a natural, healthy and better way of communication with the machines.

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