Number Recognition System of Real time Indian Sign Language

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ABSTRACT

Too many research has been done in the field of Human Computer Interaction (HCI). One of the system called Hand Gesture Recognition (HGR) gives solution to build the HCI systems. Now a days, computer is used as a interpreter between humans. The proposed system is used to recognize the real time static hand gesture of Indian sign language number system zero to nine. In this paper we propose a system for hand gesture recognition which is simple and fast. Based on the proposed algorithm, this system can automatically convert the input hand gesture into the text and audio. The system first capture the image of hand gesture shown by user using a simple webcam then using our proposed algorithm it recognize the gesture. This system can use for real time application due to the use of simple logic condition applied to recognize the gesture. The proposed system is size invariant and implemented using OpenCV.

Keywords: Human Computer Interaction (HCI), Hand Gesture Recognition (HGR), Indian Sign Language (ISL), Feature Extraction, Active fingers, Region of Interest (ROI)

1 Introduction

Mostly In day-to-day life communication plays an important role. Communication is nothing but means of exchanging information, thoughts etc. A normal people can communicate among themselves easily but when they want to communicate with deaf and dumb people, they need to know the sign language or they need a interpreter. Here computer can act as a interpreter. Sign language is a set of signs which are used by deaf and dumb people to communicate each other or with a normal people. Sign language is different for different countries. Indian have its own sign language called "Indian Sign Language." [1] Figure 1 shows the Indian Sign Language numbering system from Zero to Nine.

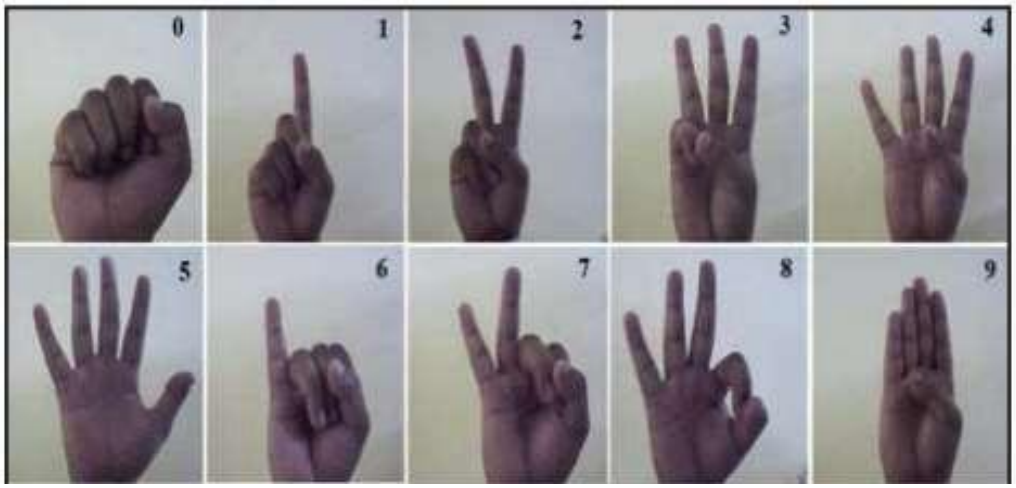

Figure 1. *Indian Sign Language numbering system-zero to nine*

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A system which act as a interpreter between the normal people and socially aided people called Sign Language Recognition system. It captures the gesture shown by the deaf and dumb people and convert the gesture into known language**.**

Hand gesture is of two types, static hand gesture and dynamic hand gesture [2]. Static hand gestures are constant over the time. For example, gesture gives the message 'Stop' is a static gesture which is constant gesture over the time. [4] Whereas dynamic hand gestures are changes over the time. Waving of hand is good example of dynamic hand gesture. The proposed algorithm is applicable for only static hand gestures. The algorithm does not use any database and compare with it, instead it uses a simple logic which make the system fast hence can be used for real time application.

The main aim of the proposed system is to develop a PC based system for automatic recognition of static hand gesture of Indian Sign Language numbers- zero to nine using image processing approach. The proposed system first captures the hand gesture shown by user by using a simple webcam and process it to count the number of active fingers. The background should be plain in order to get good segmentation result. Then by applying some logic conditions the gesture is recognized. The proposed system can recognize only Indian Sign Language numbers zero to nine and with uniform light condition. Using our proposed algorithm, we have recognized the Indian Sign Language numbers from zero to nine as shown in fig 1.

2 Proposed Methodology

The main aim of the proposed algorithm is to count the number of open fingers that is denoted by single handed gesture using image processing techniques. Figure 2 gives the layout of the proposed algorithm. It is mainly consist of three parts

1] Image preprocessing

2] Finger counting logic

3] Gesture recognition and display result

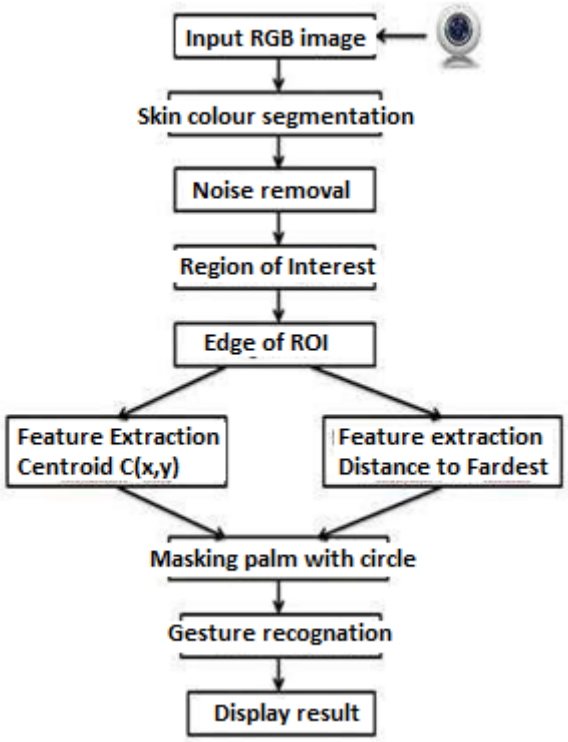


Figure 2. *flowchart of proposed algorithm*

2.1 Image pre-processing

Our main objective is to extract the boundary of the hand gesture from the captured image. It involved tracking signer's hand and extract it from background. This task can be achieved by using following steps:

Image capturing

A 12-megapixel camera is used to capture the input image which have a plain back background. The captured image is saved as a input image and it is in the RGB format. The captured image size is 640*480. Further we resize the image in order to get less computational time. A webcam is used to get a degree of freedom for hand movement which is very essential in natural means of communication with machines. In this paper we explain the proposed algorithm with the example of one, two and nine. Figure 3 shows the captured image of gesture one, two and nine.

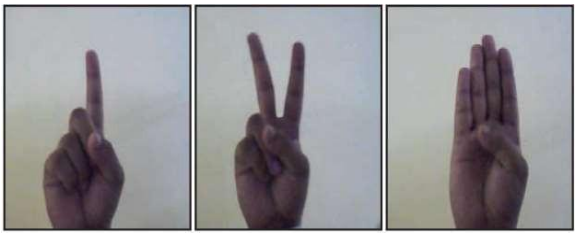


Figure 3. *captured input images of gesture one two and nine*

Skin color segmentation

In this phase, skin color pixel detector is used to detect the hand region. this gives the separation of hand pixel from non-skin pixel. Segmentation consist of some morphological operation like erosion and dilation in order to avoid incomplete segmentation of hand region. figure 4 shows the segmentation result where white pixel shows the hand region and black pixel shows the non-hand region, i.e background.

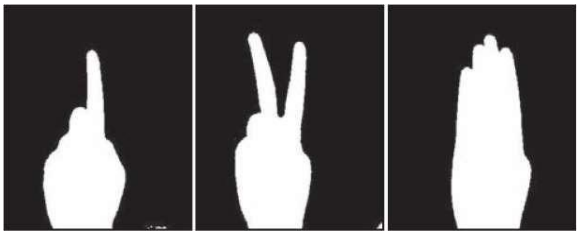
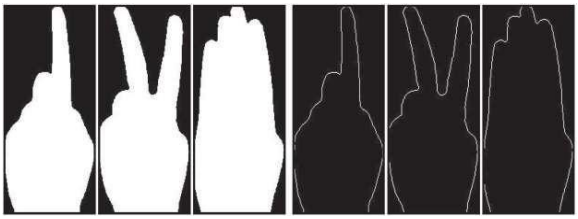


figure 4. *Segmentation result of captured gesture one, two and nine*

Region of Interest extraction

After skin color segmentation, the binary image contains hand as well as non-hand region. So, the objective is to select the object in the image having the largest connected boundary. This is done by 8-neigbourhood concept. Figure 5(a) shows the isolated hand region from the captured input image. The next step is to find the edge from the previously cropped hand region. for that we remove all the interior pixel inside the hand region to get the edge image. Figure 5(b) shows the extracted edge of ROI image.



(a)ROI binary image *b) Edge image*

Figure 5. *Region of Interest extraction and edge detection*

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2.2 Finger counting logic

After the image has been pre-processed, next stage is to count the number of active fingers involved in the gesture. This process is done in two steps. In first part of the logic, feature vector like Centroid C(x,y) and Maximum distance Dmax is calculated. Centroid point C(x,y) is calculated using following equation:

$$x = \frac{\sum_{i=0}^{k} xi}{k} \qquad y = \frac{\sum_{i=0}^{k} yi}{k}$$

Where Xi and Yi are x and y coordinates of the ith pixel in the hand region, and K denoted the number of pixels in the region. The maximum Ecludian distance 'Dmax' between two points, Centroid and farthest point from Centroid located on counter of edge image is calculated using following equation:

$$d(a,b) = \sqrt{(x1 - x2)^2 + (y1 - y2)^2}$$

Where d(a,b) is the distance between two point a(x1,y1) and b(x2,y2).

After calculation of Centroid and Dmax, the next step is to isolate the open fingers from palm region and then count them. To achieve this, we constructed a circle centered at Centroid C(x,y) and radius R in such way that it will intersect all the fingers that are in the count. The interior region of circle is then masked as a non skin region i.e. pixel value=0 and then these isolated fingers are counted as a number of active fingers.

3 Gesture recognition

In this phase, each ISL gesture is classified based on its count value and by using few logical conditions. The gesture one to five are recognized correctly. The gesture four and five can be recognized directly but the classification is needed for the gesture of zero, one, two, three, six, seven, eight, nine. For gesture one and six the count of finger is 1. Figure 6 shows the classification of count 1 into ISL 'one' and 'six'. To classify these two gesture the image is vertically divided into two quadrants then the number of active pixel in each quadrant is calculated based on which the gesture is classified as one or six. The remaining gestures are also classified by applying logic to the finger count.

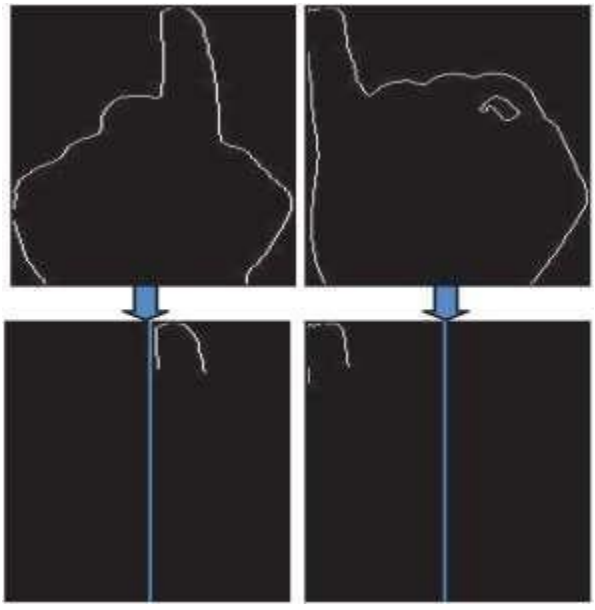

Figure 6. *logical condition for gesture one and six classification*

3.1 Display result

The recognized hand gestures are display in the form of figure and audio. Figure 7 shows the display result of gesture one, two and nine format.

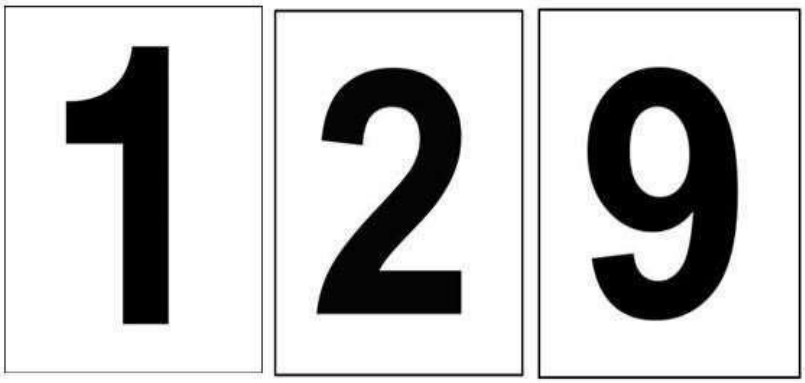

Figure 7. *shows the result of input gesture one, two and nine*

4 Conclusion

Using the proposed algorithm, the Indian Sign Language numbers zero to nine have successfully recognized. The coding is done in OpenCV and tested in real time environment with uniform light condition and plain background. The accuracy of the proposed system is 94%. The algorithm is simple and size invariant, but it is orientation dependent. It does not involved technique like feature extraction or the comparison with database images hence it required less computational time which make it use for developing real time HCI application.

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