A Robust Hand Gesture Recognition System using Shape Parameters

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1. Abstract: Hand gesture recognition is most emerging field of image-processing. It can be used in numerous applications. There are many patients who cannot walk due to problem in their lower limb, due to paralysis or some other reason. They need a permanent attendee for their day to day works which is quite difficult in today's busy schedule. There is not so much advancement on hand gesture recognition for a patient which is the need of hour. So, this paper explains a system of *A Robust Hand Gesture Recognition system using Shape Parameters.* The work is mainly divided in three parts as Hand detection, Gesture Recognition and Displaying Message. The patient performs gesture in front of webcam. The system does various pre-processing steps like converting image to binary image, filtering, erosion and dilation etc. and then by calculating the parameter of the image recognized; displays the message accordingly. If gesture is not recognized, then message of Gesture not Identified is displayed.

2.Introduction: Gestures are simply body movement used to deliver some message or can be used as Human Computer Interface(HCI).Gesture recognition is the process of identifying gesture so that the computer(machine) can perform the action accordingly. Hand gesture recognition is very important for HCI and efficacious field of research at present. Basically, with the help of Hand Gesture Recognition and HCI we are making an interference free system. In normal communication system, Interference may be caused by the sender of media or audience [1].This system can be used for many patients who cannot speak or hear. Such people have difficulty in communication whereas communication is very important. The care of such patients have become an obligation and getting complex each day. Now a day's number of technologies have been developed a lot to help and facilitate the medically impaired people [2]. A number of technologies are available today but most of them cannot help the patients who have problem with the lower limbs (cannot walk) and communications (cannot speak). They need a permanent attendant for monitoring. So we are proposing a system that uses hand gesture for sending the message notification and follow needs of the patient who is not able to communicate. Hand gesture is taken by installing the webcam in the bed of the patient. The webcam will receive the hand gestures from the patient that will display on the system. The system then processes the request and detects hand gestures and does postures recognitions. This system presents a method to messages notification according to posture recognition.

3. Literature Survey: Hand gesture recognition is divided as Glove Based and Vision Based techniques. In Glove based techniques, sensors are used for getting hand configurations and digitizing finger and hand motion in multi-parametric data. It is quite complex and costly technique due to hardware part like sensors etc. Glove also limits the hand movement. In vision based techniques, a camera is needed as input device. Here, hands movement is also not limited and system is cost effective. The input can be in the form of database or real time. Furthermore, gesture can also be classified as Static Hand Gesture and Dynamic Hand gesture. In Static Hand Gesture, still frame are used with no movement as a symbol. For example, a thump's up sign is used for motivating someone and as a symbol of victory. In the same way, a waving hand is an example of good bye symbol where frame are changing and it is the case of Dynamic Hand Gesture. Elakkiya et al [2] proposed the strategy in which the pre-processed information of the identified hand is changed into a fuzzy hand-posture feature model utilizing fuzzy neural systems. At that point, the real hand pose is controlled by applying fuzzy inference from which the hand motion is perceived. Hand signal acknowledgment calculation in view of the fingertip structure recognition is proposed [3] in which 10 distinct motions are perceived. Igorevich et al [4] proposed the technique in which grey scale histogram is utilized to characterize depth threshold limit of computed divergence outline. The distinguished outstretched hand is filtered out then. Shah et al [5] proposed the signal acknowledgment technique in which the colour marker is stuck on the finger and is utilized to track the development of the finger. operations, for example, Thresholding are utilized to discover the shading and six distinct motions are distinguished utilizing the technique. In the strategy proposed by Park picture is caught utilizing the camera, the RGB color space is changed over to YCbCr, and then the hand locale is sectioned utilizing the skin shading range. At that point, the fingertips are recognized utilizing the convex hull algorithm [6]. In the technique proposed by Umadevi and Divyasree, from video securing, the hand locale alone is sectioned utilizing skin shading based foundation subtraction and after that morphological separating activity is done to distinguish five distinctive hand motions [7]. Elsayed et al. proposed the technique for versatile foundation subtraction with skin shading based limit took after by morphological tasks [8]. In the strategy proposed by More and Sattar, the distinctive hand stances are perceived precisely utilizing Scale Invariance Feature Transform (SIFT) and tried for every sign letter set [9]. Jingbiao et al. proposed the dynamic motion acknowledgment calculation in which the minimum square strategy is utilized to fit the direction of hand gravity movement and 80 hand motions are tried [10].

3.Proposed Methodology: Proposed system consists of seven steps which include Gesture Input,Pre-processing,Enhancement,Morphology,Segmentation,Gesture Recognition and Display message.The general work flow of proposed system is as shown below in fig 1.1:

3.1 Gesture Input:

Gesture is given by the patient in front of Camera. Camera may be used externally or direct webcam can be used. Keeping the system cost effectiveness in mind, we used direct webcam from the camera. We can also use USB camera or our Smartphone camera for taking input.

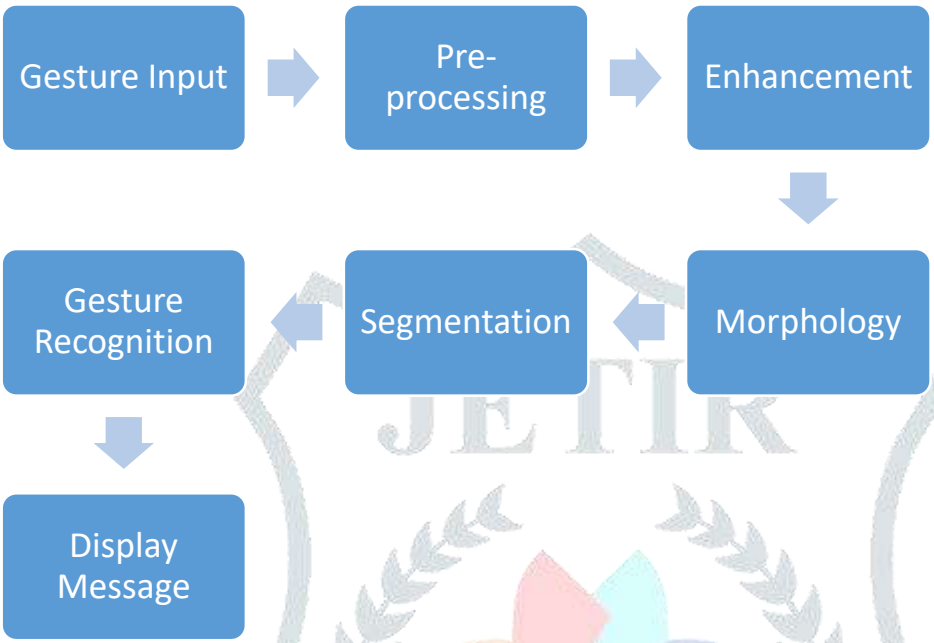

Fig. 1.1 Flow Diagram of Implementation

Real Time Input:

Directly video from patients is taken with webcam and then frames are extracted from the video which are taken as input.

Static Time Input:

Our system works for both static and real time system. To work for static time, we input any hand image directly from our computer.

3.2 Pre-processing: There are various pre-processing steps in our project which include Skin Segmentation, Image conversion; Image Size to be set **.**Skin segmentation is most important step. Because the system should respond only for Hand. Fake gesture should not be taken such as if any stick or non-living object of same shape comes in front of camera then system should know that it is not hand. Now, input from the webcam is in RGB format but many image-processing operations cannot be applied in RGB format. From the literature survey we come to know that YCbCr format is best suited for systems like ours. So, RGB image is converted to YCbCr format. Then, Image is converted to Binary form. Image resizing is also required to fit the image for displaying on the screen so resizing of image is done with the help of command imresize.

3.3 Enhancement: Image enhancement is done for getting the better output. In this system, for enhancing the image, noise is removed with the help of removing small areas and by connecting the boundary will the help of command imfill.

3.4 Morphology: There are several morphological operations in image-processing. We are explaining here only those which are used in our code. Here, we are performing Dilation and Erosion of the gesture image.

Dilation: The two basic operations used in mathematical morphology are Dilation and Erosion typically applied on binary image. Dilation enlarges the boundaries of foreground pixels, due to this size of foreground pixels grows holes in that region become smaller. Mathematical equation of dilation is as follows:

$$A \oplus B = \{x \mid (B\hat{})_x \cap A^c \neq \phi\} \qquad \text{(Equation 1.1)}$$

Erosion: Erosion is a basic mathematical morphological operation applied on binary or dilated image. Erosion enlarges the boundaries of background pixels by eroding the boundaries of foreground pixels. Due to filling of hole in Dilation, boundaries are mixed up. Erosion separates the boundaries by thinning. Mathematical equation of dilation is as follows:

$$A\Theta B=\{x|\ (B)_x \cap A^c \neq \phi\} \qquad \text{(Equation 1.2)}$$

Where A=Set of input image co-ordinate
B=Set of structuring element co-ordinates
B_x =Translation of B with center x

3.5 Segmentation: Segmentation is used for extracting only the ROI (Region of interest).Here, ROI are our fingers. So, first of all we remove the palm from the hand image. Then, we are left only with fingers in the image which are our ROI here.

3.6 Gesture Recognition: After Segmentation, various parameters of fingers such as Area, Perimeter, Centroid. From the calculation of above parameter gesture is recognized by comparing the specified values of parameters and calculated values of parameters. In this way, we can recognize the gesture if parameters are in the range of specified values and if parameters are not in specified value range, then gesture cannot be recognized.

3.7 Display Message: It is the final step of our system. According to the values of parameter (Area, Perimeter, Centroid) calculated, corresponding message is displayed at the screen. The table 1.1 shows the details of gesture with their corresponding message along with accuracy for both static and real-time hand gestures.

4. Results: Our system is designed for both real and static time images. In table1.1, we are representing the details of gestures and message to be displayed with their accuracy in static and real time.

Table1.1 Details of Gestures and Messages displayed

No. of Fingers	Message Displayed	Accuracy	
		Static	Real
1	Hungry	99%	98.5%
2	Need Doctor	99%	98.5%
3	Emergency	98.8%	98.3%
4	Want to go washroom	98.8%	98.3%
5	Need Medicine	98.6%	98.1%
6	Need Attendant	98.5%	97.8%
7	Thirsty	98.3%	97.8%
8	Need Injection	NA	97.6%
9	Need Help	NA	97.6%
Not countable	Gesture not recognized	NA	100%

4.1 Results of Static Hand Gestures:

The below mentioned figure 1.2 shows the output of static hand gesture for one and two fingers. In case of finger 1, when gesture is recognized; message of '*Hungry*' is displayed and when two fingers are found gesture is recognized and message of '*Need Doctor'* is displayed.

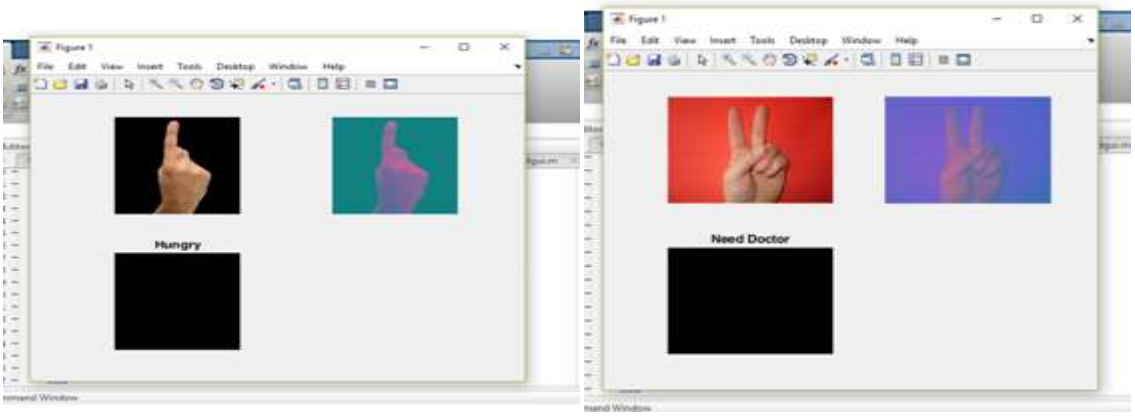

Fig.1.2 Output of static hand gesture for one and two fingers

The below mentioned figure 1.3 shows the output of static hand gesture for three and five fingers. In case of three fingers, when gesture is recognized; message of '*Emergency*' is displayed and when five fingers are found gesture is recognized and message of '*Need Medicine'* is displayed.

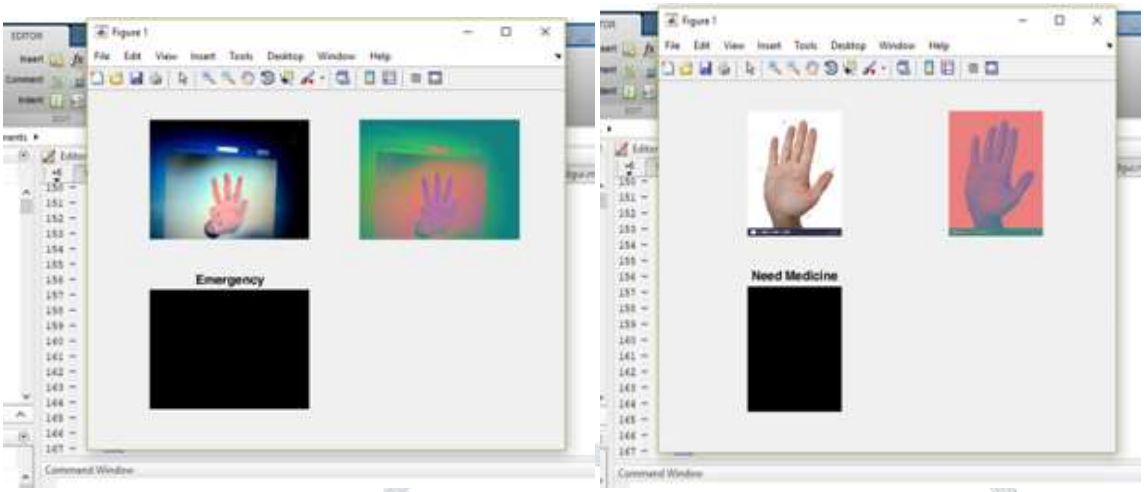

Fig.1.3 Output of static hand gesture for three and five fingers

The below mentioned figure 1.4 shows the output of static hand gesture for six and seven fingers. In case of six fingers, when gesture is recognized; message of '*Need Attendant*' is displayed and when seven fingers are found gesture is recognized and message of '*Thirsty'* is displayed.

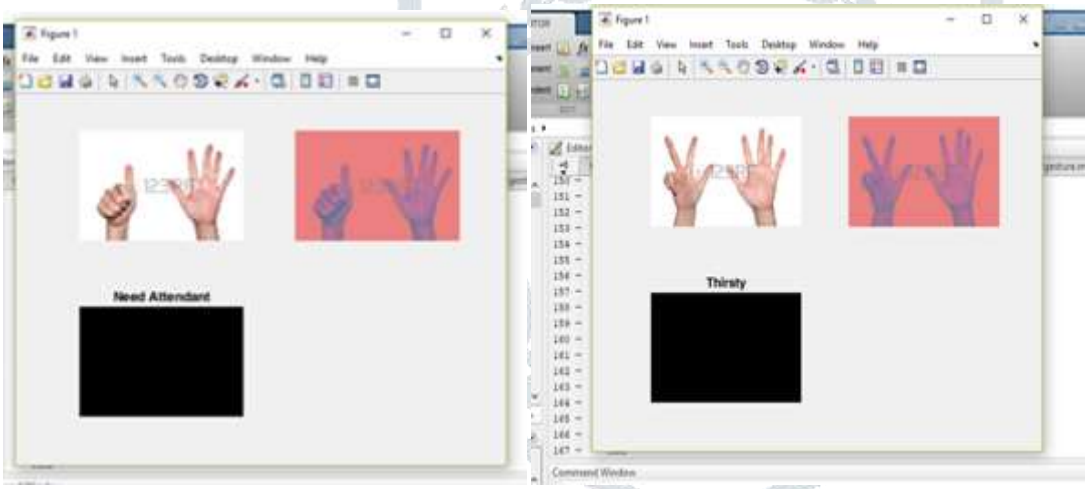

Fig.1.4Output of static hand gesture for six and seven fingers

4.2 Real Time Output:

The below mentioned figure1.5 shows the result of real time hand gesture for two and three fingers. In case of two fingers, when gesture is recognized; message of '*Need Doctor*' is displayed and when three fingers are found gesture is recognized and message of '*Emergency'* is displayed.

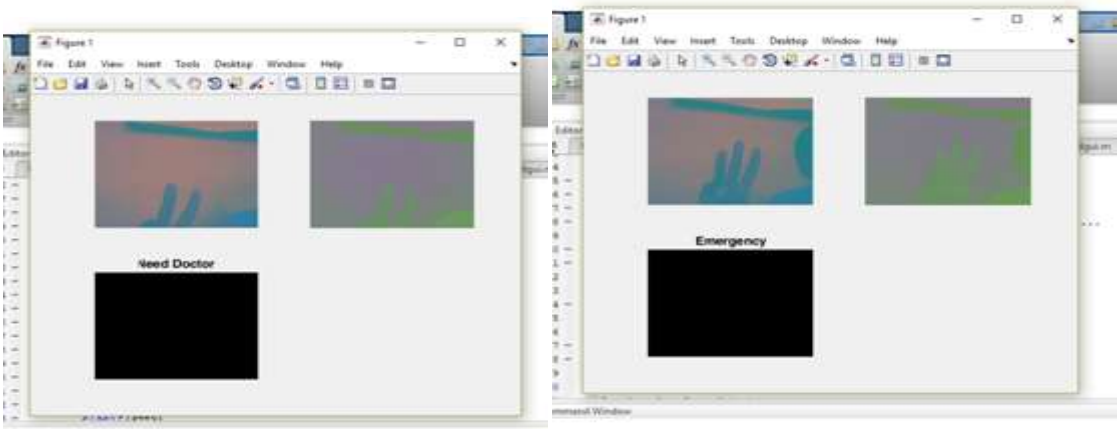

Fig.1.5 Output of real time hand gesture for two and three fingers

The above mentioned figure1.6 shows the output of static hand gesture for four and one finger. When there are four fingers message of '*Want to go washroom*' is displayed and when one finger is found gesture is recognized and message of '*Hungry'* is displayed.

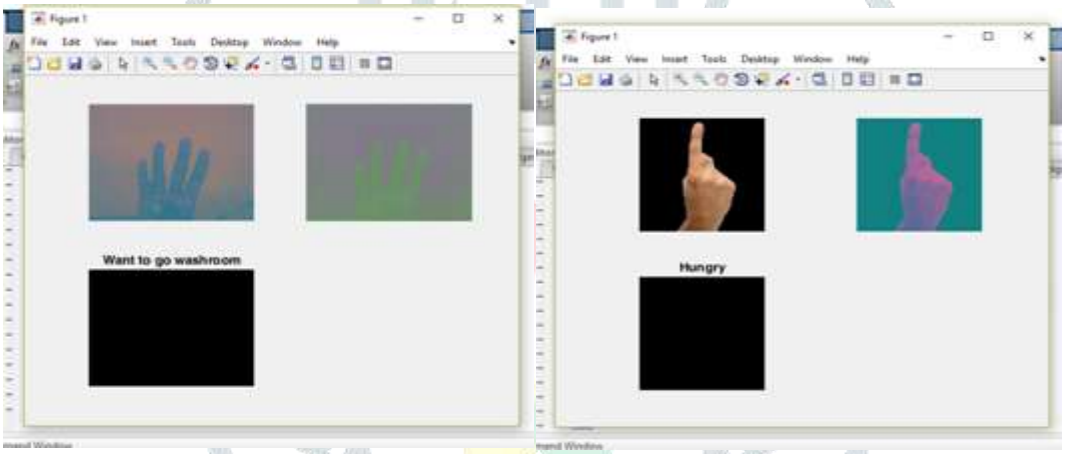

Fig.1.6Output of real time hand gesture for four and one fingers

The below mentioned figure1.7 shows the output of real time hand gesture for five and seven fingers.In case of five fingers, when gesture is recognized; message of '*Need Attendant*' is displayed and when seven fingers are found gesture is recognized and message of '*Thirsty'* is displayed.

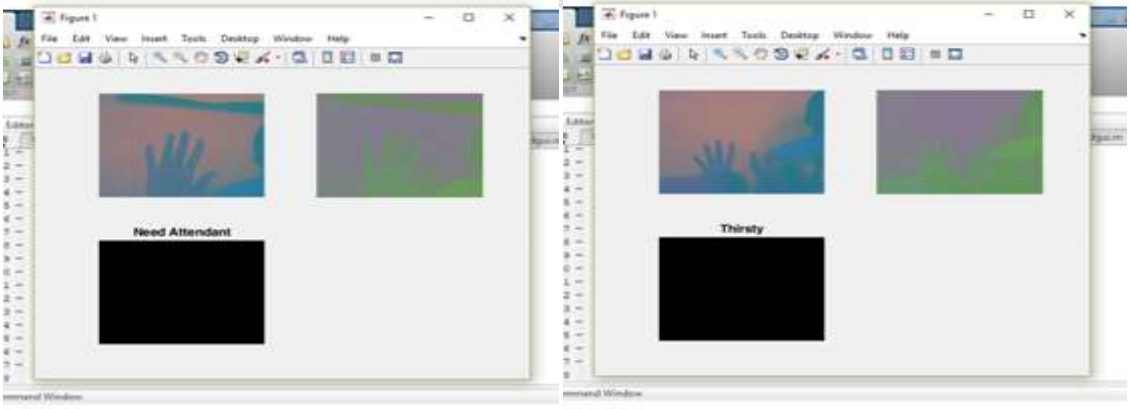

Fig.1.7 Output of static hand gesture for five and seven fingers

The below mentioned figure1.8 shows the output of real time hand gesture for eight fingers. In case of eight fingers, when gesture is recognized; message of '*Need Injection*' is displayed.

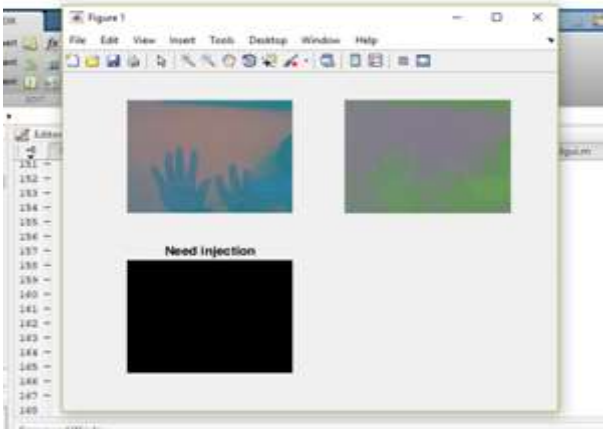

Fig.1.8Output of real time hand gesture for eight fingers

The below mentioned figure1.9 shows the output of real time hand gesture for arbitrary hand gesture positions which are not mentioned in programming of the system. In such a case message of '*Gesture not recognized*' is displayed.

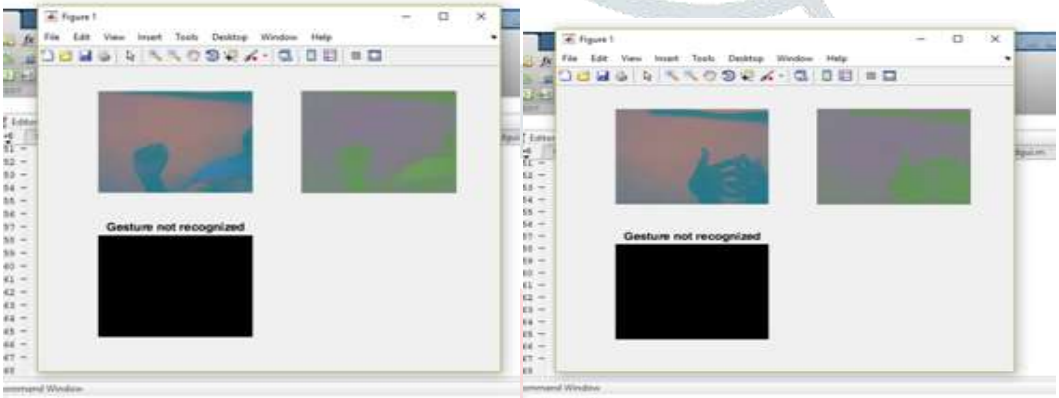

Fig.1.9 Output of real time hand gesture for arbitrary hand gestures

5. Conclusion: Our system is designed for both static and real time systems. Patient who cannot walk due to some problem (like in lower limb), they need continuous attendant with them for their daily needs. This is not possible in today's busy schedule for anyone. So, system is designed for such people to make their life easy by providing them some medium for communication. Keeping the cost point in mind we are using direct webcam. We made our gestures very simple for the ease of user. In worst case, if webcam not works then there is option for selecting the static image which can be stored in computer. Patient can choose static image for delivering his/her message. In case gesture is not recognized, a message of 'Gesture not recognized' is displayed.

6. Future Scope: Gesture recognition can be used in combination of voice recognition, lip movement recognition, facial recognition and iris recognition to create Perceptual User Interface (PUI), which is different method of interacting with computer to improve creativity and usability to large extent. Gesture recognition can reduce the necessary resources by incorporating it in homes, offices, transport vehicles and more. Gesture recognition technology can reduce a lot of human labor and cost. The people who are not as fortunate as us, gesture recognition can make their life such easier.

7.References:

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