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Sign Language Recognition System

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***Abstract*— Sign language is the preferred method of communication among the deaf and the hearing impaired people all over the world. Recognition of sign language can have varying degree of success when used in a computer vision or any other methods. Sign language is said to have a structured set of gestures in which each gesture is having a specific meaning.**

***Index Terms*—** sign language, neural networks, classification.

I. INTRODUCTION

Communication is a method of exchanging ideas or messages through speech gesture or text. Sign language is a research area which will help in removing barriers faced by differently disabled persons in communicating with the world. Hand gestures are a powerful human communication channel, which is used for information transfer in our everyday life. Gestures can be classified into two types: static gesture and dynamic gesture[2]. A static gesture involves the hand shapes and the dynamic gesture involves the hand movements made when used in a communication.

A functioning sign language recognition system can provide an opportunity for a muted person to communicate to the non-signing people without the need of an interpreter. It can be used to generate speech or text making a mute more independent. Unfortunately there has been no system with these capabilities so far. All researches on this filed have limited to small scale systems capable of classifying and recognizing only a minimal subset of a full sign language with stable accuracy rate.

II. OVERVIEW OF THE SYSTEM

The sign language recognition system can be a glove based system or a vision based system. The proposed system does not involve any complex devices like a glove and is purely a vision based system where a user need not wear any type of cumbersome components for the recognition purpose[2]. The system involves a web camera which is used to capture the image of the hand, a processor for the classification and recognition purpose and an output unit which can be a speaker.

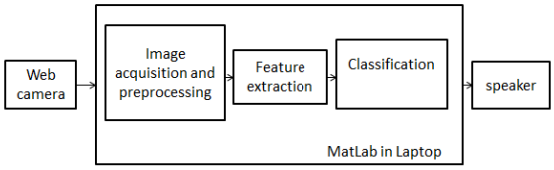

Fig: 1 Frame work of the hand gesture recognition system

The system consist of a webcam to capture the real time image of the hand and a system to process and identify the sign and a speaker to give the output in the form of an audio.

The classification of the sign is done using artificial neural network method. In this method the images are trained in order to achieve the required output. The database created for the artificial neural network classification will help the real time images to be compared and to provide the closely matched output.

A database is created for the classification of the hand gestures taken through the web camera. This database may consist of several numbers of poses associated with the same gesture. The ANN method used here is a supervised learning method [3]. This method involves pattern recognition. The patterns of the hand have to be recognized in order to identify the sign. The static gestures are used here for the recognition process.

III. PROPOSED SYSTEM

The system performs different stages of image processing steps. The captured image has to be identified by the system accurately of the best results. The ANN will help the system to identify the image without any complex calculations and without involving any cumbersome components.

A. Capturing the image in real time

An image is extracted from a captured real-time video using a webcam. The obtained image has to be preprocessed in order to make the image into a compatible one for the image processing to be applied to it. The image processing stages include gray scale conversion and the thresholding. The morphological operations such as erosion, dilation etc. is also performed. The web camera has to be installed in such a way that the hand should be totally visible with all its edges totally visible.

The video input objects are captured using the normal web camera. Here YUY_640 × 480 resolution input frame image is used. Input is taken from the current selected source. According to the camera used in different devices, the camera ID will change and it should be selected before capturing the video. 5 frames per trigger is taken using the selected source. The system camera initially captures a frame every second. A snapshot is taken for further processing

B. Skin Segmentation

In order to identify the hand gesture the skin region has to be identified from the obtained image. For this skin segmentation is performed. Since the captured image is of RGB color domain and it is not useful for the effective skin segmentation. So the image is converted to YCbCr domain. Even though YCbCr domain facilitates skin segmentation it always results in noisy spots with the variation of the light intensities. This phase detects and segments the hand data from the captured image. The hand region is detected using skin color pixels. The background is restricted such that the hand is the largest object with respect to skin color. The detection results in binary image which will have other objects also. The other components are the filtered by comparing the area of the detected binary objects. The resultant is subjected to morphological closing and dilation operation with disk shaped structuring element in order to obtain a well-defined segmented gesture image.

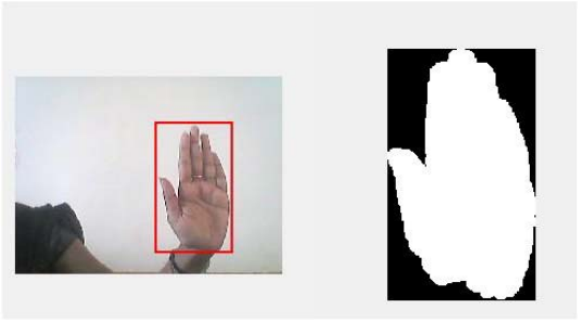

Fig 2. Segmented Input Image

C. Hand Tracking

A user who issues a command to a hand gesture recognition system may move his/her hand intentionally or unintentionally during the course of gestures. It is vital for an effective system to track the hand so that finding the ROI will be fast and error free. Calculating the boundary of hand and determine the centroid point of the hand region helps to track the motion of the hand. Hence an eye can be on the location of the hand in the region and also detect the change in the gesture also. If the captured image is not changing for a particular point of time then the gesture is taken as an input to the system. And the recognition of that particular gesture is done.

D. Feature Extraction

There are many methods to use variety of features for gesture classification most of the features used for this type of classification are edges, template matching, moment invariant based features etc. One of the widely used feature and the simplest feature are edge detection. Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. There are several algorithms which help us in extracting the edge feature like canny, sobel, prewitt etc.

Here in this project the edge feature is extracted using canny edge detector. A canny edge detection algorithm is a multistage detection algorithm which helps in detecting a wide range of edges in an image. The main reason for choosing the Canny algorithm was that because it is adaptable to various environments.

E. Artificial Neural Networks

The ANN is used for the recognition of the gestures obtained through the web camera in real time. Gesture recognition is the task of matching the segmented gestures against a library of predefined gestures. The main goal is to recognize gesture patterns by creating an ANN with good learning capabilities and with the ability to generalize and produce results from all kinds of input data from the glove, even if they are relatively different from the trained input patterns. The back propagation algorithm is used as a learning/training algorithm to determine the weights of the network [2].

The ANN architecture used here is of a feed forward type. The image is then taken as a frame of 6x7 which makes 42 input to the artificial neural networks input layer. The ANN is then comparing the inputs with the desired outputs and then the output will be between the ranges of 0 to 1. If the output value is above 0.6 the desired output will be obtained.

IV. IMPLEMENTATION

The system is implemented in Matlab 2014 version which supports the neural network toolbox which made the coding easier.

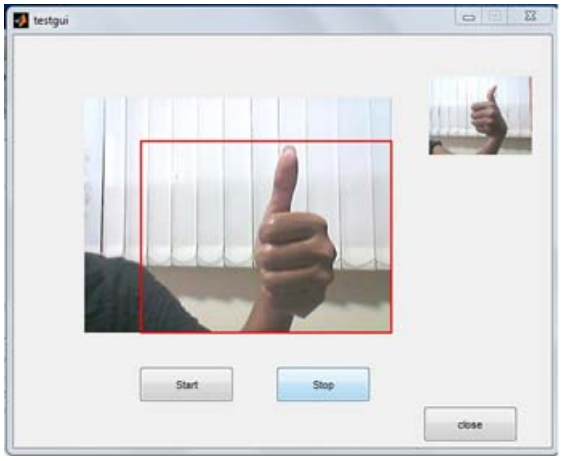

Fig 3. Real time gesture capturing and matching it with images in the database

V. CONCLUTION

A system for gesture recognition using Artificial Neural Networks for classifying the hand gestures is developed. The system is robust under various lighting conditions when trained with a small amount of samples. Neural Networks system can be applied for extracted features from the input image gestures after applying segmentation, to extract the shape of the hand. An image is taken and the preprocessing, and morphological operations are performed for the betterment of the image. The edge detected image with canny edge detector is obtained. The image is then taken as a resized frame and then the individual points are given as input to the artificial neural networks. The ANN is then comparing the inputs with the desired outputs and then the output will be between the ranges of 0 to 1. If the output value is meeting the target value the desired output will be obtained, which the voice output of the hand gesture is shown in front of the camera.

A database of 25 images is created for 5 types of gestures which are captured through the web camera. These are the images which will be compared to the real time image to get the identified gesture output voice. These images are normal RGB images.

The system proposed in this paper can be implemented in a hardware which supports image processing applications. They can be either raspberry pi or a beagle bone processor.

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