

# Hand Gesture based Query-Response System for Deaf and Dumb

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**Abstract** - Communication plays an important role to convey ideas among ourselves. One major way of communicating for humans is by the way of talking. Unfortunately, there are a few people who are unable to communicate this way due to loss of voice or hearing capability. Such people have to use sign language. However, abled people do not put much effort into learning the sign language to communicate with the disabled ones. An automatic application is proposed where in the system is trained to recognize the gestures used by the deaf and dumb people to answer their queries which they would otherwise have had to ask non-sign language users. The application is build using MATLAB and gesture recognition includes image segmentation, feature extraction using blob analysis and a database is created. Then gesture matching is done using convolution and cross-correlation and output is displayed stored in the database for the particular gesture related query. Audio and visual output is provided for the particular query.

**Key Words:** Gesture recognition, MATLAB, image segmentation, feature extraction, blob analysis, convolution, cross-correlation

## 1. INTRODUCTION

Sign languages are visual modality languages that are used for communication with speech and hearing disable people. It is a mode of establish proper communication with the abled people by the disabled people. As the issue with any language that both the parties need to know the language, the same issue persists with the sign language also. The most difficult part is abled people are least interested in learning the sign language due to its difficulty, inconvenience and not frequent usage. Thus, there is a need to establish a system to convert sign language to visual or audio format for helping in proper communication.

Sign language does not just consist of the hand gesture but also the body language of the individual. It is a difficult job to completely predict the body language and the mood of the person which would include facial pattern recognitions. Here only hand gestures are emphasized upon. The gestures are single handed and can be extended to both the hands.

An application is developed using MATLAB to help speech impaired people to get answers for their queries in a college

such as asking for a particular department floor. The application can be kept at any entrance point. The system is automatic and the user just needs to provide a gesture for the required query and get an audio and visual response based on the query. A catalogue of gestures is provided for each specific query. The user needs to refer to the catalogue and show the appropriate gesture as given in the catalogue to get a response. The response is the floor number where the particular department asked in the query is present.

## 2. RELATED WORKS

P Raghu Veera Chowdary et.al [1] studies different algorithms on MATLAB to detect the hand region and find the fingers count. Pixel count and detection of circles algorithms is studied but due to few limitation scanning method is later on considered for better results as the code is made independent of size and rotation of the hand.

In [2] a novel approach is suggested for hand gesture recognition based on shape dependent features. YCbCr color mode is used for skin detection and segmentation. Orientation of hand is detected using centroid and peak detection of fingers and classification is done using Euclidean distance. The algorithm does not depend of characteristics of the user.

The paper [3] proposes hand gesture recognition using MATLAB. The segmentation is done based of skin color and images are trained using feed forward neural network. The neural network consists of 200 neurons with 10 hidden layers. Image recognition is done using pattern matching of ANN.

In [4] ISL English alphabets are recognized based on gestures. HSI segmentation approach is adopted and multiple algorithms such distance transform, Angle detection, Finger division methods are used for classification and recognition. Mrs. Neela Harish et.al

[5] proposed Indian sign language symbols recognition system using hardware support. The movements of hand such as rotation, direction, angle tilt are recognized with the help of flex sensors and accelerometer fitted in a glove. A speaker is used for the output to produce voice words.

In [6] a novel method for Sign Language recognition system is proposed using EMG sensors combined with a data glove. It solves word segmentation problems using algorithms such as artificial neural networks (ANN) and Hidden-Markov model (HMM)

### 3. PROPOSED WORK

#### 1. Input Image

The webcam captures the hand gesture. The snapshot() function of the MATLAB is used for capturing the input image. The input images can then be resized to a particular n-by-n matrix of required size so that all the input images have the same matrix size.

#### 2. Image Pre-processing and segmentation

A red glove is worn so as to help in segregating the background from the hand gesture. A threshold value for the red color from the RGB is selected based on the surrounding lighting conditions. The RGB image is then converted to grayscale using the rgb2gray() function. To find the ROI imsubtract() function is used which helps in finding the pixels belonging to the red glove worn area from the grayscale image. This ROI is then masked to obtain a binary image using im2bw() function with the help of the threshold value of red color provided. The binary image acts as the segmented image which is further used for feature extraction.

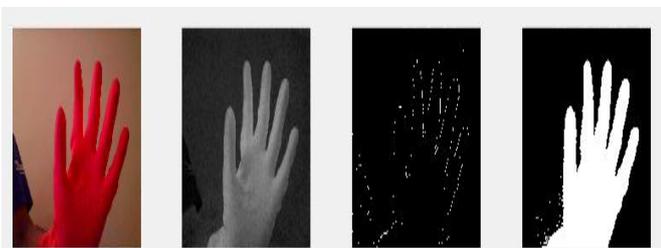


Figure -1: Image Segmentation

#### 3. Feature extraction from segmented image

Blob analysis in MATLAB is done using vision.BlobAnalysis() function. It returns a blob analysis object. The parameters used are

- i) Area – return blob area
- ii) Centroid – Return coordinates of blob area
- iii) MaximumBlobArea – Maximum blob area in pixels
- iv) MinimumBlobArea – Minimum blob area in pixels

The MaximumBlobArea and MinimumBlobArea are used to specify the size of blob, thus small blobs generated due to noises will be ignored. Next corners are detected of the segmented hand gesture using Harris-Stephens Algorithm. It is done by using the detectHarrisFeatures() function in MATLAB. It outputs a corner points object which contains

information about the feature points detected in 2-D input image.

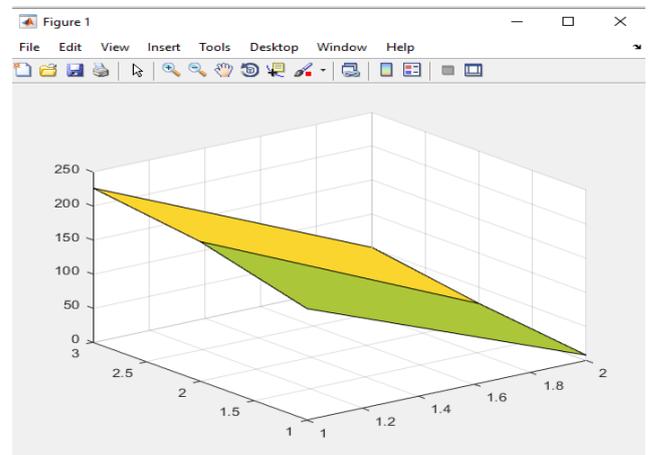


Figure -2: Surf plot of centroid and edge vectors

#### 4. Database creation

The features extracted from blob analysis and Harris-Stephens algorithm are converted into a common column vector using the conv() function in MATLAB which is a convolution function. A Convolution function takes different functions and overlaps them to generate one single function. In this project it is used to generate a single matrix which has both the features of blob analysis and corner points. The column vector is stored with the corresponding sign name provided.

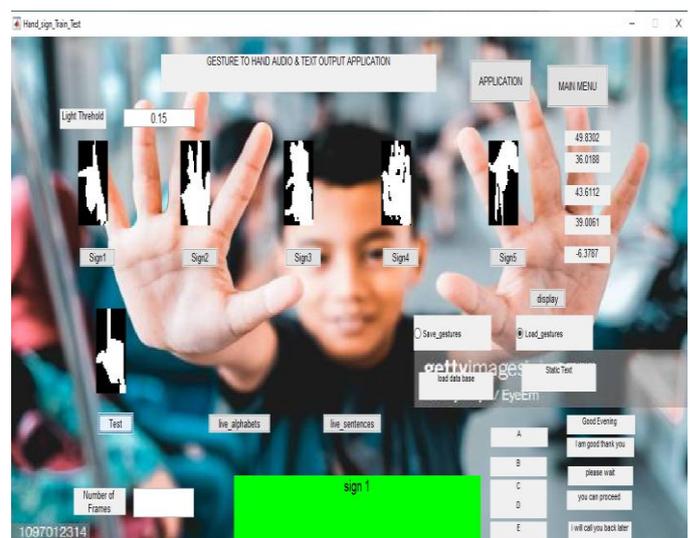


Figure -3: GUI of training and database creation

#### 5. Gesture Recognition

The application asks for a gesture. A frame rate can be provided in the application depending on the number of queries to be asked so that it is not required to restart the

system each time for each query. The gesture is captured and the same segmentation and feature extraction process is applied. Now, to match the gesture with the database cross-correlation is used. Cross-correlation measures the similarity between a vector  $x$  and a vector  $y$  as a function of lag (shifted). The MATLAB function `xcorr(x,y)` is used for finding the cross-correlation. The correlation coeff is then found out using `corrcoef()` function. The value ranges from -1 to +1 where +1 is exact match. The correlation coeff is found for each saved gesture in the database with the query image and the sign corresponding to the max value from the matches is selected as the matched image. Based on the matched image the corresponding query response is provided by the system in visual and audio format. The output is the floor number for the respective department in college.



**Figure -4:** GUI of Gesture Recognition System

## 4. CONCLUSIONS

An automated machine has been built to help deaf and dumb people to get directions. The work is done using MATLAB by capturing live images. The system works without the need for any operator as a self-help application. There is no need for any internet connection too. The problems related to gesture recognition systems such as lighting problems and hand region size and shape issues have been dealt with using a glove and red color threshold. Such an adjustment saves time in real time environment especially for a system which is to be kept in a public place where incorrect inputs can be a frequent misuse. The directions are provided based on floor numbers with audio and visual output. The system can be modified to input any gesture and corresponding output visuals can be saved in the database. The system can be further improved to keep it in railway stations, cafes, and banks etc. where huge public gathering is present. This research will greatly help in reducing the dependency issue of speech impaired persons on abled persons with query related issues.

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