

Real-Time System for Easy Communication between Normal and Dumb-Deaf People using Matlab

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ABSTRACT: -Sign language is widely used by individuals with hearing impairment to communicate with each other conveniently using hand gestures. However, non-sign-language speakers find it very difficult to communicate with those with speech or hearing impairment since interpreters are not readily available at all times. Many countries have their own sign language, such as American Sign Language (ASL) Indian Sign Language (ISL) which is mainly used in the United States and the English-speaking part of Canada. The proposed system helps non-sign-language speakers in recognising gestures used in Sign Language. In this approach, firstly, the signs are captured using a webcam. The images captured are then processed further and the features are extracted from the captured images using PCA. Comparison of the features is done using Euclidean Distance with the training sets. Minimum Euclidean distance helps to recognise the character. This system will enable non-sign-language speakers to better understand and communicate with those with impaired hearing.

KEYWORDS: Gesture Recognition, PCA, Euclidian distance.

I. INTRODUCTION

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language.

Earlier, Computer programmers were avoiding complex programs as the focus was more on speed than other modifiable features. However, a shift towards a user-friendly environment has driven them to revisit the focus area. The idea is to make computers understand human language and develop a user-friendly human computer interfaces (HCI). Making a computer understand speech, facial expressions and human gestures are some steps towards it. Gestures are the non-verbally exchanged information. A person can perform innumerable gestures at a time. Since human gestures are perceived through vision, it is a subject of great interest for computer vision researchers.

In our day to day life, communication plays important role for conveying information from one person to another person. But it becomes very difficult for the people who are deaf and dumb to communicate with normal people. Sign language is the only one way to communicate with them. But normal people are unaware of sign language. So, there is only one way and that is to convert sign language into text & speech & vice versa. That is known as sign recognition.

Sign language is a combination of body languages, hand gestures and facial expressions. Among those hand gestures are provides majority of the information and hence majority of the research is going on decoding the hand gestures. Normal people can communicate their thoughts and ideas to others through speech. The only means of communication method for the dumb and deaf community is the use of sign language. The dumb-deaf community has developed their own culture and methods to communicate among themselves and with ordinary person by using sign gestures. Instead of conveying their thoughts and ideas acoustically they convey it by means of sign patterns.

Sign gestures are a non-verbal visual language, different from the spoken language, but serving the same function. It is often very difficult for the dumb and deaf community to communicate their ideas and creativity to the normal humans. This system was inspired by the special group of people who have difficulties to communicate in verbal form. It is designed with the ease of use for the deaf and deaf people. The use of sign language is not only limited to

individuals with impaired person or speech to communicate with each other or non-sign-language speakers and it is often considered as a prominent medium of communication. Instead of acoustically conveyed sound patterns, sign language uses manual communication to convey meaning. The Figure 1 shows the American Sign Language.

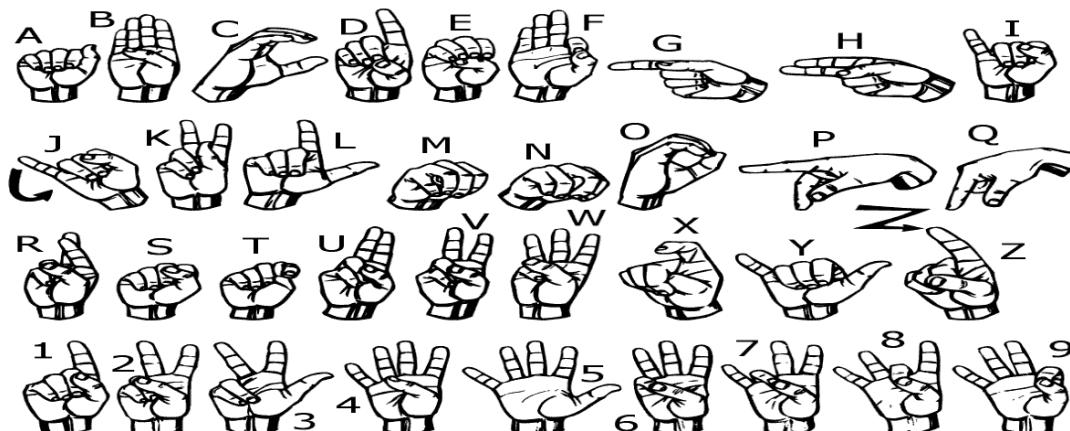


Figure 1: Hand Gestures used in American Sign Language

Paper is organized as follows. Section II similar works of the scheme. After detection of sign how sign image is converted and conversion of text to sign that is given in Section III. Section IV presents experimental results showing results of images trained and tested. Finally, Section V presents conclusion.

II. RELATED WORK

Many novel methods have been developed in past few years, to facilitate communication between the sign language users and those who can't speak sign language. Mrs.Neela Harish, Dr.S.Poonguzhali [1], proposed a system which depends on flex sensors, accelerometers output values such as, coordinates given by accelerometer and the bending values given by the flex sensors, for the interpretation of signs. Depending on the. Suganya R, Dr.T.Meeradevi, [2] implemented a system using Feed Forward Neural Network, for identifying hand gestures characteristics & to train gestures captured. Dhananjai Bajpai, et al. [4], proposed a system enabled to decode more than 36 gestures using 6 flex sensors, to recognise corresponding alphabets, or corresponding features. Pre-requisite for using this system to perform gesture recognition and store it in the database is not needed. Al-Ahdal and Tahir [7] proposed a method using data glove and EMG Sensors for designing SLR. Hand muscles electromyography signals are recorded, for allocating words from streams of characters in continuous SLR. Vision based systems mainly uses colour information for detection of hand. They use skin colour models or different colour gloves [10].

III. METHODOLOGY

The figure 2 shows the system architecture for the proposed method. Here we can see that the user action is captured by a camera and the image input is fed into the gesture recognition system, in which it is processed and compared efficiently. The virtual object is updated accordingly and the user interfaces with machine with the help of a user interface display.

The system which is being used currently performs the task in image recognition and classification of it. The input image (hand gesture) is matched with the images in the database using Euclidian distance value. So, the matched image with minimum value is recognized and classified to give the respective output.

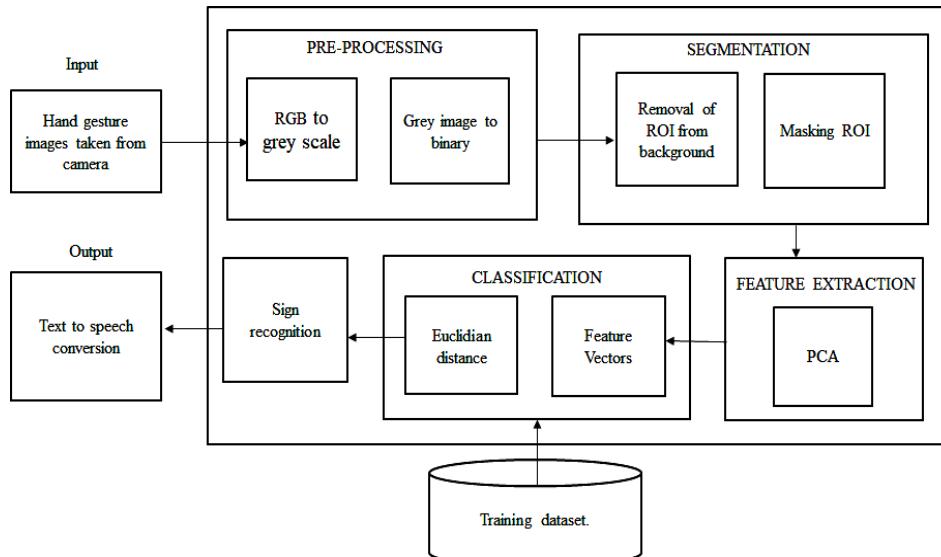


Figure 2: Architectural Diagram of the Proposed System.

Image pre-processing.

Input image through camera is captured and it can be used to store as dataset for training or as input image to recognize the character. The image is captured and stored in any supported format specified by the device.

on matrices. So, we convert the RGB image into Gray image using “rgb2gray” function and thus converting the Gray image into Binary image. Image segmentation technique is used on the Binary image to detect the hand region.

Segmentation

Segmentation is done to divide image into two regions, background and the foreground containing region of interest i.e. hand region. The segmented image has the hand region with the pixel value ‘1’ and the background as the ‘0’. The image is then used as a mask to get the hand region from the RGB image by multiplying the black and white image i.e. binary image with the original RGB image. The image is resized to reduce size of the matrix used for the recognition process. The images are then converted into column matrix for feature extraction.

Feature Extraction

Feature extraction is the most significant step in recognition stage as the size of the data dimensionality is reduced in this stage. Here, features are extracted using Principle Component Analysis (PCA), where we can get Eigen Values and Eigen Vectors. To calculate this Eigen Values and Eigen Vectors, column matrix of all the images is formed and concatenated to form single matrix, mean of this matrix is calculated and it is subtracted for normalization.

Principle component analysis is applied to segmented matrix to obtain Eigen values. An Eigen vector of a square matrix A is a non-zero vector v that, when the matrix is multiplied by v, yields a constant multiple of v, the multiplier being commonly denoted by λ . The number λ is called the Eigen value of A corresponding to Eigen vector v.

Eigen vectors are set of basic functions which describes variability of data. Also, Eigen vectors are also a kind of coordinate system for which the covariance matrix becomes diagonal for which the new coordinate system is uncorrelated. Eigen values measures the variance of data of new coordinate system. Eigen values and Eigen vectors are a part of linear transformations. Eigen vectors are the directions along which the linear transformation acts by stretching, compressing or flipping and Eigen values gives the factor by which the compression or stretching occurs. The more the Eigen vectors the better the information obtained from the linear transformation.

The mean of the matrix is calculated as:

$$\mu = \sum_{n=1}^M T_n \quad \text{where, } M \text{ is the number of column matrix.}$$

Mean from each of the column vector of the database T_i is subtracted as: $\text{Temp} = A - \mu$ Where, A is column matrix & μ is the mean.

Classification

Euclidean Distance is used to classify the gestures of hand. Feature vectors calculated for the dataset and the Feature vector calculated for the input image are used to classify the character related to the input gesture.

Classification of character is based on the maximum score. Maximum score is the maximum matching score i.e. minimum distance of input gesture with the dataset image of the corresponding character.

Sign recognition

The obtained feature vectors are matched with the values in the dataset. The minimum value between the input image and segmented image is obtained after matching. As a result thus, the sign is recognized.

Text to Sign Conversion:

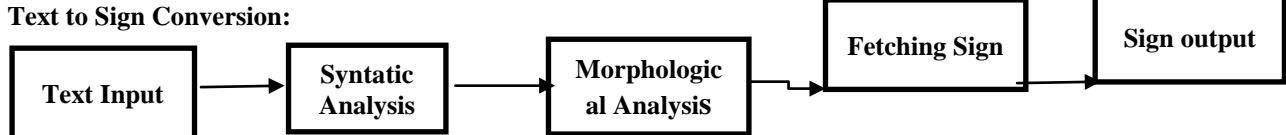


Figure 3: block diagram of Text to Sign language conversion.

Input Text:

Text or words is given as input through input devices like keyboard, and then which will transferred to parser for the next process.

Syntactic Analysis:

Syntactic analysis or parsing or syntax analysis is the important phase in NLP. The purpose of this phase is to draw exact meaning, or can say dictionary meaning from the text. Syntax analysis checks the text for meaningfulness comparing to the rules of formal grammar. Here dependency parser are used according to the grammar rules of the language.

Morphological Analysis:

In this step the sentences are divided into words, words are further divided into letters in order to match the letters with the sign language by creating root word to the given input. Here it uses linguistic theories for the process of the root word.

Fetching sign from database:

In this stage the output from the morphological analyzer is fed as the input to this stage. The letters are matched with the sign which are stored in the database for the particular letters using string matching algorithms.

Sign Output:

After matching the words the output as sign language images will display on the output devices.

IV. EXPERIMENTAL RESULTS

Figures below shows the results of sign and text conversion by using PCA, Euclidian distance, NLP techniques.

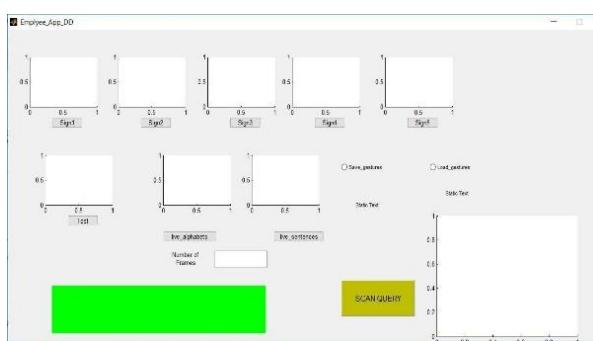


Figure 6.1: Real-time Video Processing

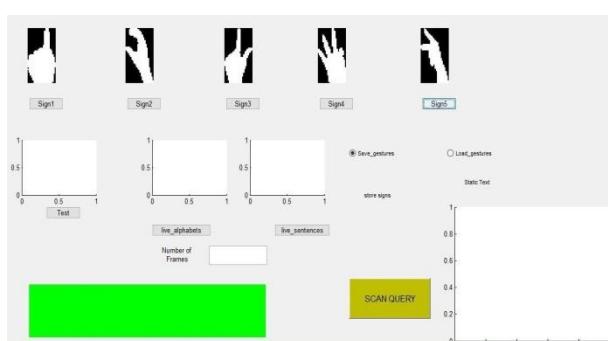


Figure 6.2 Real-time image capturing



Figure 6: Red Glove Detection

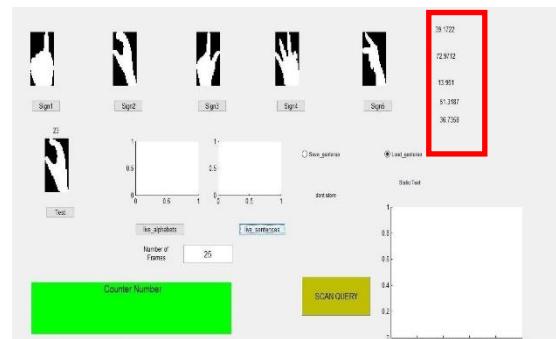


Figure 7: Percentage observation

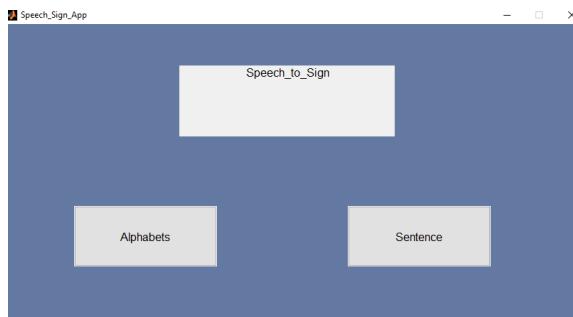


Figure 8: Real-time text to sign conversion.

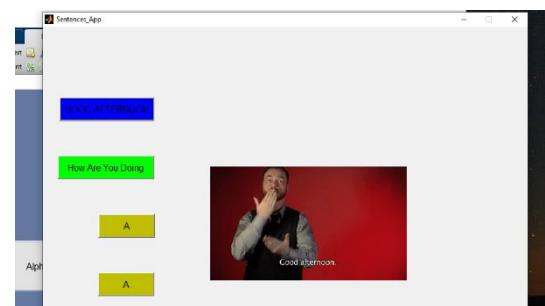


Figure 9: Real-time sentences to sign conversion.

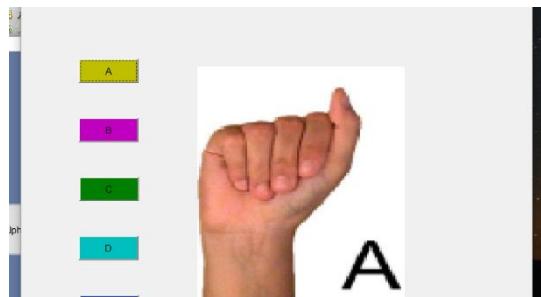


Figure 10: Real-time alphabets to sign conversion.

V. CONCLUSION

The proposed system presents a real-time, vision-based hand gesture recognition system that works precisely on a relatively small-restricted gesture space for single user robot control, track a player's hand or body position to control movement and orientation of interactive game, and human-computer interaction.

Signs, such as hand gestures are used in many sign languages, for the purpose of this project, American Sign Language has been used. Principle Component Analysis technique is used for Gesture Recognition. Using PCA Eigen and feature vector is calculated for finding minimum distance. Minimum Euclidean distance leads to character recognition for the input gesture. This project facilitates communication with ease for the deaf and dumb people. The accuracy of the system depends on the illumination conditions. Under good illumination and plain light colored background, the system achieves nearly 98% accuracy.

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