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Sign Language Recognition

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ABSTRACT

There seems to be an issue between the communication of differently abled and others. That is why we have decided to make an application to mitigate this issue and reduce the dependencies on third parties like translators. We have studied different approaches taken and discussed them. Recognition of hand signs is a popular topic since the 90s and various findings have been uncovered in the following years. We have written about popular methods for this. For this application to work we have to weigh in feature extraction, object detection, and predictions using a machine learning model.

Keywords : Feature detection, Image Processing, CNN, HMM, K means, SVM.

I. INTRODUCTION

Hearing loss can be of any level and have mild to severe effects. This hearing loss can be attributed to anything including age, occupation, and exposure to extreme noise. In addition, hearing loss does not just make things quieter, it can distort sounds and cause normal speech to sound jumbled and garbled.

As we know that there are various languages used for speaking, there also exist different languages for hand signs like American Sign Language (ASL), Indian Sign Language (ISL), and Devanagri Sign Language (DSL). As the majority of people do not understand sign language, deaf people suffer many problems communicating with the masses. They heavily rely on translators to interpret the sign language and act as a bridge between them. This not only halts the progress of the physically disabled but also leads to heavy dependency on translators which is not optimal. As translators charge a hefty amount and are not always available at any hour, this option is heavily flawed and needs another dependable alternative.

Hence, we propose to develop an app that can detect the hand signs of a person and then convert them into sentences that we can easily read/listen to. This will not only dispose of any dependency on translators but will also cut the cost of translators. We plan to make this

application available on every smartphone so that no person feels disconnected from the rest of the world.
Hand sign recognition includes phases like image capturing, pre-processing, extraction of the region,

feature extraction, and feature matching for recognition, which will be further discussed.

II. EXISTING METHODS

A. Model Processing

The various Machine lEarning models are as follows:

1) Hidden Markov Model (HMM):

The HMM has rightfully enjoyed popularity since the '90s for hand sign recognition. HMMs are particularly suited for the problem of Sign Language Recognition. In the later years Parallel Hidden Markov Models (PaHMMs) were proven to be superior to HMM.ge due to the intrinsic parallel nature of the phonemes. The major drawback though is that regular HMMs are simply not scalable in terms of handling the parallel nature of phonemes present in sign. PaHMMs can be used as a better alternative for this problem by utilizing modeling parallel processes independently and combining output probabilities afterward. Its main advantage is it is easily extended to deal with strong TC tasks. Embedded re-estimation is possible, easy to understand and the disadvantage being it makes large assumptions about the data. A huge number of parameters needs to be set. Training data required is large.

2) Convolution Neural Network (CNN):

CNN takes an architectural approach as given below: According to the proposed CNN model, we can get an accuracy of around 90% which is great as compared to other techniques. Although it takes greater time to train the CNN model it predicts competitively less time than others.

3) Artificial Neural Network (ANN):

From the table, it is clear that we can use deep ANN to get better accuracy than regular ANN as we get a 5% better accuracy rate and 15% rate in testing speed.

4) K means:

The strategy used is to determine k points called centers as the sum of the distances of all data points to their respective cluster centers. Its main advantage is that it is computationally faster and produces tighter clusters. But it lacks in some areas as a prediction of K is difficult for a fixed number of clusters. Different initial partitions resulting in different final clusters seem to be an issue too.

5) K-nearest neighbors:

It uses the closest training of the feature space using instance-based learning and takes in the class of the nearest neighbor. It is easy to implement, lowest complexity and carefully chosen features give good results but are sensitive to arbitrary attributes. Hence it has the lowest accuracy rate of 78%.

6) Support Vector Machine (SVM):

It non-linearly maps the input data dimensional space, having linearly separated data for classification. It has a higher prediction accuracy of about 96% and is also robust for errors in training examples. It also has a fast evaluation of the learned target function and has a recognition time of 0.017

B. Image Processing

Sign Linguistic Features can be mostly divided into three categories namely Manual Features, Non-Manual Features and Finger Spelling [3].

1) Manual Features:

These features involve gestures done with hand employing hand shape and motion to interpret its meaning. These hand-shaped orientation poses or hand trajectories can be Tracking and Non-tracking based

[3]. Tracking of hands can be a crucial task as they may move faster and are often subject to motion blurring. Challenges are also faced when there is constant change in background and lightning which

may contribute to failure in recognition and be time-consuming. But usage of proper methods may offer accurate results. Hand signs are recognized rather than classified and traced as it can be a significant issue. Combination of images and binary skin-intensity images and derivatives are used. For this Sobel, filters may be applied [3]. Following this, some geometric features are combined with appearance-based features in the form of movements. This creates a system with both tracing and non-tracking-based approaches.

2) Fingerspelling:

Fingerspelling is an extension of manual features [4]. Demonstration of a robust finger tracking system that uses stereo cameras for depth, edges, and color is done. Using many different approaches, the system detects and tracks fingers and merges them into a model. These approaches or channels are combined using Bayesian networks.

3) Non-Manual Features

There is significant information in the non-manual channels as well [3]. These facial expressions include head poses and lip shapes used for lip reading. Computation of optical flow on local face features was done, to determine which regions of the face move to create each expression. This relies on facial movements but can be perplexed by insufficient or combined expressions.

Image-based Gesture Recognition is done in three steps as shown in the below Figure 1.

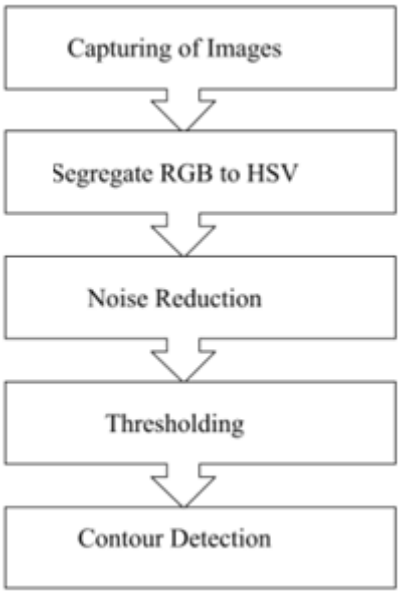

Figure 1. Gesture Recognition Steps

Firstly, capturing of images is done by a camera which detects the position and movements of the hand. The camera captures them into a set of frames which is in RGB format. But to separate the hand from its surroundings color filtering is done. The image is then segregated into hue (H) and saturation (S) values (V).

This helps in detecting skin and non-skin color with the help of brightness which in turn can provide the boundary of the hand [5]. The next step includes the removal of noise. Here, erosion which shrinks the boundaries of an image and enlarges holes, and dilation which adds pixels at the region of boundaries or to fill in holes are performed. The threshold used to convert grayscale images to binary images is to be done after converting each pixel in the image to black and white images depending on the intensity.

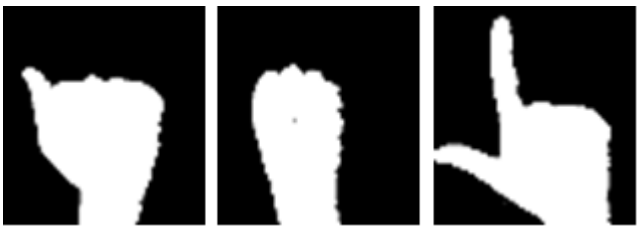

Figure 2. Thresholding

The Letters A, B, C, D, E, F, G, H from the below figure are convex defects which are the gaps between fingers while the points that join the boundary are called convex hulls [5]. So the radius of the inner defects circle should be less than the distance of convex hulls from the center point. Depending on this radius and distance, the opening and closing of fists or palm are detected.

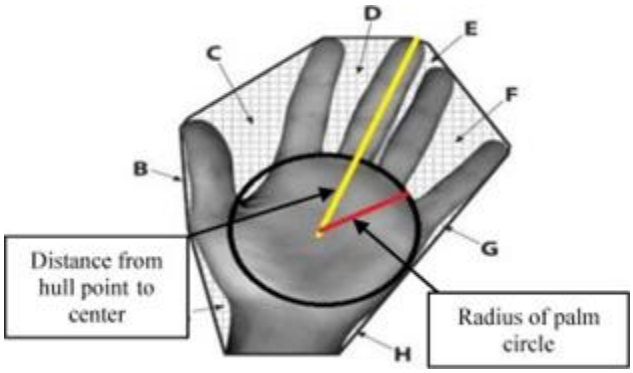

Figure 3. Contour Detection [5]

III. CONCLUSION

We have studied multiple techniques to recognize hand gestures and sign languages. It is presented based on fragmentation, feature extraction, feature matching used in HGRS.A comprehensive study of performances and different techniques have been made in this paper. These observations are noted to be used in further studies to try and improve the efficiency and accuracy of hand sign recognition which can further help hearing-impaired people.

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