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Sign language Recognition Using Machine Learning Algorithm

Prof. Radha S. Shirbhate[1], Mr. Vedant D. Shinde[2], Ms. Sanam A. Metkari[3], Ms. Pooja U. Borkar[4], Ms. Mayuri A. Khandge[5]

[1,2,3,4,5]*JSPM's BSIOTR – Wagholi, Pune*

Abstract – *An Sign Language is one of the way to communicate with deaf people. In this work sets, included features and variation in the language with locality have been the major barriers which has led to little research being done in ISL. One should learn sign language to interact with them. Learning usually takes place in peer groups. There are very few study materials available for sign learning. Because of this, the process of learning sign language learning is a very difficult task. The initial stage of sign learning is Finger spelled sign learning and moreover, are used when no corresponding sign exists or signer is not aware of it. Most of the existing tools for sign language learning use external sensors which are costly. Our project aims at extending a step forward in this field by collecting a dataset and then use various feature extraction techniques to extract useful information which is then input into various supervised learning techniques. Currently, we have reported four fold cross validated results for the different approaches, and the difference from the previous work done can be attributed to the fact that in our four fold cross validation, the validation set Correspond to images of a person different from the persons in the training set.*

Key Words: *ISL, DATA SET, Cross Validation, Artificial Neural Network, HU's moments, Skin Segmentation, SVM.*

1. INTRODUCTION

The sign language is used widely by people who are deaf-dumb these are used as a medium for communication. A sign language is nothing but composed of various gestures formed by different shapes of hand, its movements, orientations as well as the facial expressions. There are around 466 million people worldwide with hearing loss and 34 million of these are children. `Deaf' people have very little or no hearing ability .They use sign language for communication. People use different sign languages in different parts of the world. Compared to spoken languages they are very less in number[1][2]. India has its own sign language by the name Indian Sign Language (ISL). In developing countries there are only very few schools for deaf students. Unemployment rate among adults with hearing loss are very high in developing countries [3]. Data from Ethnologue[4] states that among deaf population in India, which is about 1% of total population, literacy rate and number of children attending school is very less. It goes on to state that official recognition of signlanguages, increasing the availability of interpreters and providing transcription in sign languages greatly improve accessibility. Signs in sign languages are the equivalent of words in spoken languages Signed languages appear to favor. The associate editor coordinating the review of this manuscript and approving it for publication was Weiyao Lin. Simultaneous sign internal modification [5], rather than the concatenation of morphemes. But learners in the initial stages of SL learning use iconicity as a mnemonic aid to remember new signs. Butthe lack of iconicity makes it difficult to learn new signs for those who learn SL as a new language. Finger spelling is the representation of the letters of a writing system and sometimes numeral systems. Sign Language (ISL) can represent English alphabets A-Z using finger spelling. It can be one handed or two handed and ISL follows two handed style. It issued to represent words that have no sign equivalent or used to emphasize a word Though finger spelling usage is less [7], [8] in casual signing, they are an important component in sign language learning. This project aims at identifying alphabets in Indian Sign Language from the corresponding gestures. Gesture recognition and sign language recognition has been a well researched topic for American Sign Language(ASL), but few research works have been published regarding Indian Sign Language(ISL). But instead of using high-end technology like gloves or kinect, we aim to solve this problem using state of the art computer vision and machine learning algorithms.

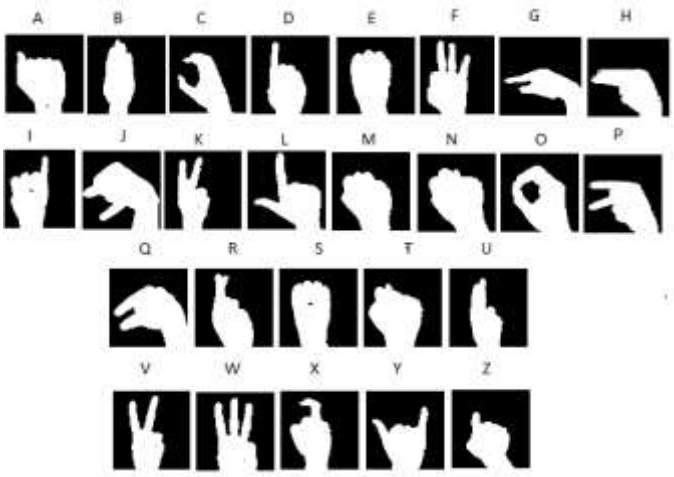

Figure 1: Indian Sign Language

2. MOTIVATION:

Communication is one of the basic requirement for survival in society. Deaf and dumb people communicate among themselves using sign language but normal people find it difficult to understand their language. Extensive work has been done on American sign language recognition but Indian sign language differs significantly from American sign

language.ISL uses two hands for communicating whereas ASL uses single hand for communicating. Using both hands often leads to security of features duet overlapping of hands. In addition to this, lack of datasets along with variance in sign language with locality has resulted in restrained efforts in ISL gesture detection.Our project aimsattaking the basic step in bridging the communication gap between normal people and deaf and dumb people using Indian sign language. Effective extension of this project to words and common expressions may not only make the deaf and dumb people communicate faster and easier with outer world, but also provide a boost in Developing autonomous systems for understanding and aiding them.

Challenges:

The Indian Sign Language lags behind its American Counterpart as the research in this field is hampered by the lack of standard datasets. Unlike American Sign Language, it uses both hands for making gestures which leads to occlusion of features. ISL is also subject to variance in locality and the existence of multiple signs for the same character. Also some character share the same alphabet (E.g V and 2 have the same sign, similarly W and 3 have the same sign) and the resolution of the sign is context dependent.

3. METHODOLOGY

On collected dataset, we divided our approach to tackle the classification problem into three stages. The first stage is to segment the skin part from the image, as the remaining part can be regarded as noise w.r.t the character classification problem. The second stage is to extract relevant features from the skin segmented images which can prove significant for the next stage i.e learning and classification. The third stage as mentioned above is to use the extracted features as input into var-ious supervised learning models for training and then finally use the trained models for classification.

Image Segmentation

Training on skin segmentation dataset

We used the skin segmentation dataset from UCI containing about 2,00,000 points for training using learning algorithms like SVM and Random Forest. The trained models are then used to segment out the non-skin classified pixels.

Feature Extraction

As describing our own features may not result in higher efficiency, we started with SIFT(Scale Inverse Feature Transform) features as it computes the key points in the image which is more apt than describing features manually. So, after the skin segmented images were ob-trained using the YUV-YIQ model, we used the following approaches for extracting feature vectors.

Machine Learning on Feature Vectors

But before we obtained those best results, we explored the following algorithms on the obtained feature vectors. Multiclass SVM with linear kernel was used with almost every feature vector. Overall the following approaches were tried.

Support Vector Machines

Multiclass SVMs were tried on all the feature vectors. Results obtained with linear kernel and four fold Cross Validated accuracies are reported for all feature vectors. The confusion matrices shown in the results sections below correspond to the different techniques tried using linear kernel Multi Class SVMs. The best accuracies were observed for this algorithm. Our try with 'rbf' kernel failed miserably on HOG feature vectors as only 4.76% accuracy was observed.

Random Forest

Since this was a 26 class problem, we tried our luck at Random Forest with HOG feature vectors on the compressed images. It fell a little short of the Multiclass SVM with 46.45% 4 fold CV accuracy. Our interpretation is that implementation of decision trees in python is monothetic which may have led to formation of rectangular regions whereas the actual boundaries may not have been rectangular.

Hierarchical Classification

One of the major reasons for the comparatively lower accuracy is the large number of classes(26). So one approach we tried was breaking the classification problem into multiple levels or hierarchical classification . First we train a linear kernel SVM model to classify alphabets as one handed or two handed.

This model performed with 95% accuracy. Then we trained linear kernel Multiclass SVM models to classify the one handed alphabets(56% accuracy) and two handed alphabets(60% accuracy) and then put the system together. An alphabet is first classified as one handed or two handed, and then depending on the classification, is put into the corresponding model and given a label. Even though the individual models performed better than the direct multiclass SVM on HOG features, overall the performance was nearly the same and four fold CV accuracy of 53.23% was observed.

4. PROPOSED METHOD

Following is a flowchart of proposed method for extracting gestures and convert into text

Fig.2. Block diagram of Proposed Method

A. Image Capture

This is the first step in sign recognition. Camera interfacing is a very critical part. Web camera is used to capture the hand gesture. Now web camera is also inbuilt in laptops & one can use external camera for interfacing. But captured images need to be in high definition. So selection of good webcam & its interfacing is an important task of this method.

B. Image Preprocessing

Image preprocessing contains cropping, filtering, brightness & contrast adjustment & many more. To do such process Image enhancement, Image cropping & Image Segmentation methods are used. Captured Images are in the form of RGB. So the first step is to convert RGB images to binary images then cropping of image is to be done so that unwanted part of images can be removed. And now enhancement can be done in certain selected area. In Image segmentation, Edge detection method is used which can detect the boundary of cropped images which is further used for feature extraction method.

C. Feature Extraction

Feature extraction is a very useful step to create the database of sign recognition. To characterize the diverse visual principles of letters in manual alphabet efficiently and effectively, both the global visual features and the local visual features are extracted for letter image similarity characterization There are mainly two types of feature extraction method involved in sign recognition, First is Contour-based shape representation and description methods & another is Region-based shape representation and description methods. Among those depending on application methods are selected. [1]In this proposed method, 7Hu moments technique is used & from that 7 moment are found. Data base of gesture has been made from those moments.

5. ALGORITHM:

SVM is a Support Vector Machine:

- According to Wikipedia, SVM is a supervised machine learning model with associated learning algorithm that analyses classification and regression analysis data.
- In this given a set of training example, we divide data into two classes on the basis of its labelling. If data is labelled it is put in category of supervised else in the category of unsupervised.
- When data is labeled then supervised SVM can be used, else SVM is not possible. In case of unsupervised data SVM clustering algorithm is used.

Uses of SVM:

- They are used in text and hypertext classification.
- SVM is used in hand written characters recognisation.
- They are used in image classification.

6. RESULTS AND DISCUSSIONS:

The data set divided into two groups, one used for training and other for testing. The training set consists of 70% of the aggregate data and remaining 30% are used as testing. We also perform experiments on same (30% or 70%) dataset which is training as well as testing for KNN classifier. The results on these experiments have a 100% accuracy rate. This means, if the user who is supposed to use this project has already contributed to our dataset earlier, the system will guarantee 100% recognition rate.

7. FUTURE WORK:

The system can be useful for static ISL numeral signs only. The ISL recognizer system cannot be considered as a complete system, as for complete recognition of sign language, we have to include ISL alphabets, words and sentences. These signs can be included in future. Also other feature extraction algorithms like Wavelet transform, Invariant moments, Shape lets descriptors and other existing methods can be included in conducting experiments for improvement in the results. Other classifiers like multi class Support Vector Machine (SVM), Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) or a combination of these classifiers can be included in conducting experiments to improve the recognition rate.

8. CONCLUSION:

In this work, we have gone through an automatic sign language gesture recognition system in real-time, using different tools. Although our proposed work expected to recognized the sign language and convert it into the text, there's still a lot of scope for possible future work.

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