Indian Sign Language Character Recognition

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Overview

Recognition of English alphabets in Indian Sign Language.

Challenges

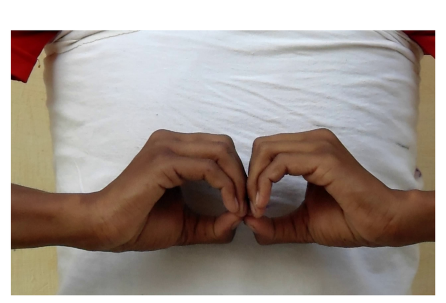
Not much work has been done on Indian Sign Language(ISL) unlike its counterpart American Sign Language(ASL) due to the following constraints.

- **Lack of standard datasets** for ISL.
- ISL uses both hands which leads to **occlusion of features**.
- **Variance with locality** in sign language and existence of multiple signs for the same alphabet

Dataset Creation

Since no standard dataset was available, we went to **Jyothi Badhir Vidyalaya**, a school for deaf in a remote section of Bithoor.We made around 1 minute video of every alphabet taken from over 8 students using a 30 fps camera, which roughly evaluates to **1800 frames per alphabet**.

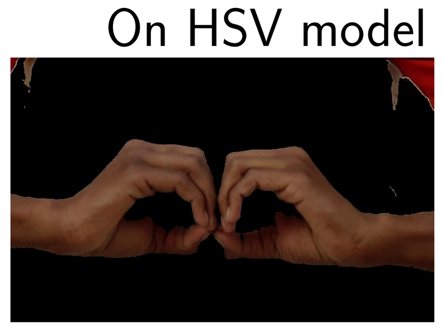
Segmented Images



Original Image

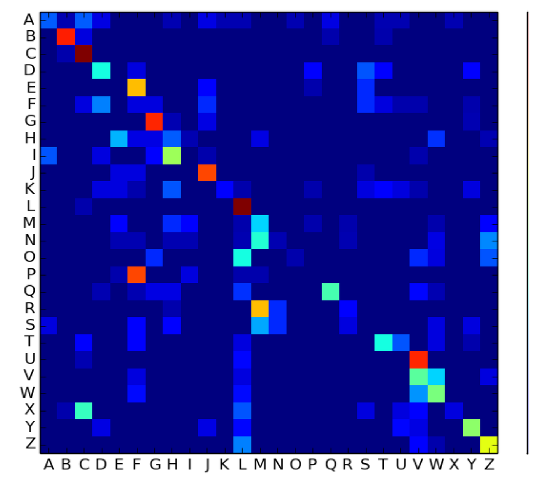
On HSV model

On Skin Dataset

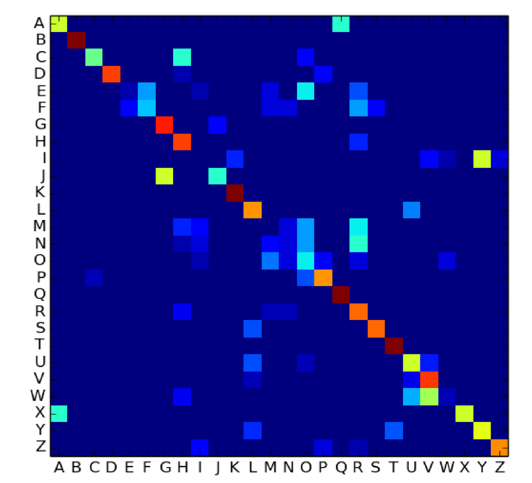


On YUV,YIQ model

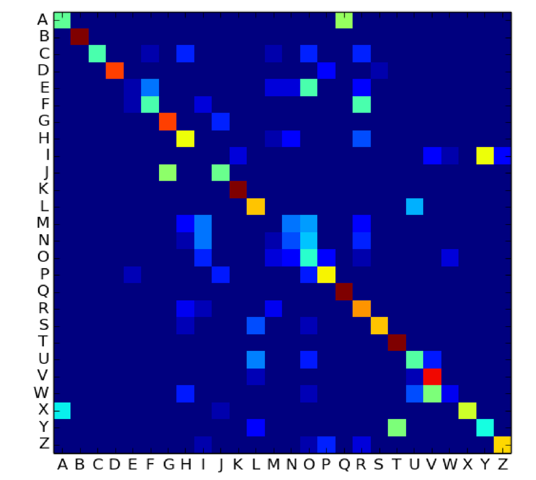
Results



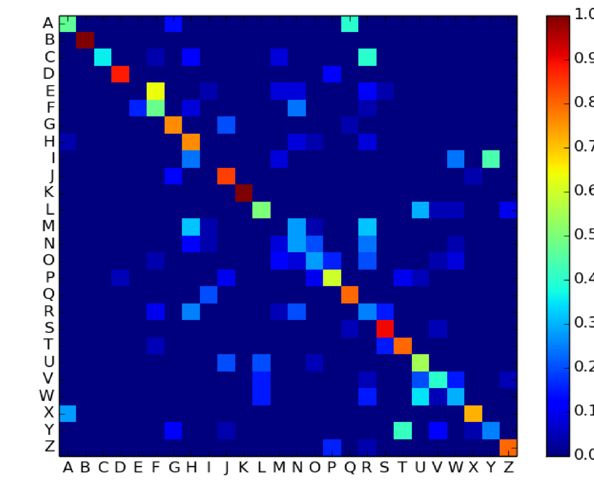
Bag of Visual Words



HOG



Random Projection



Hierarchical Classifier

Methodology

Image Segmentation :

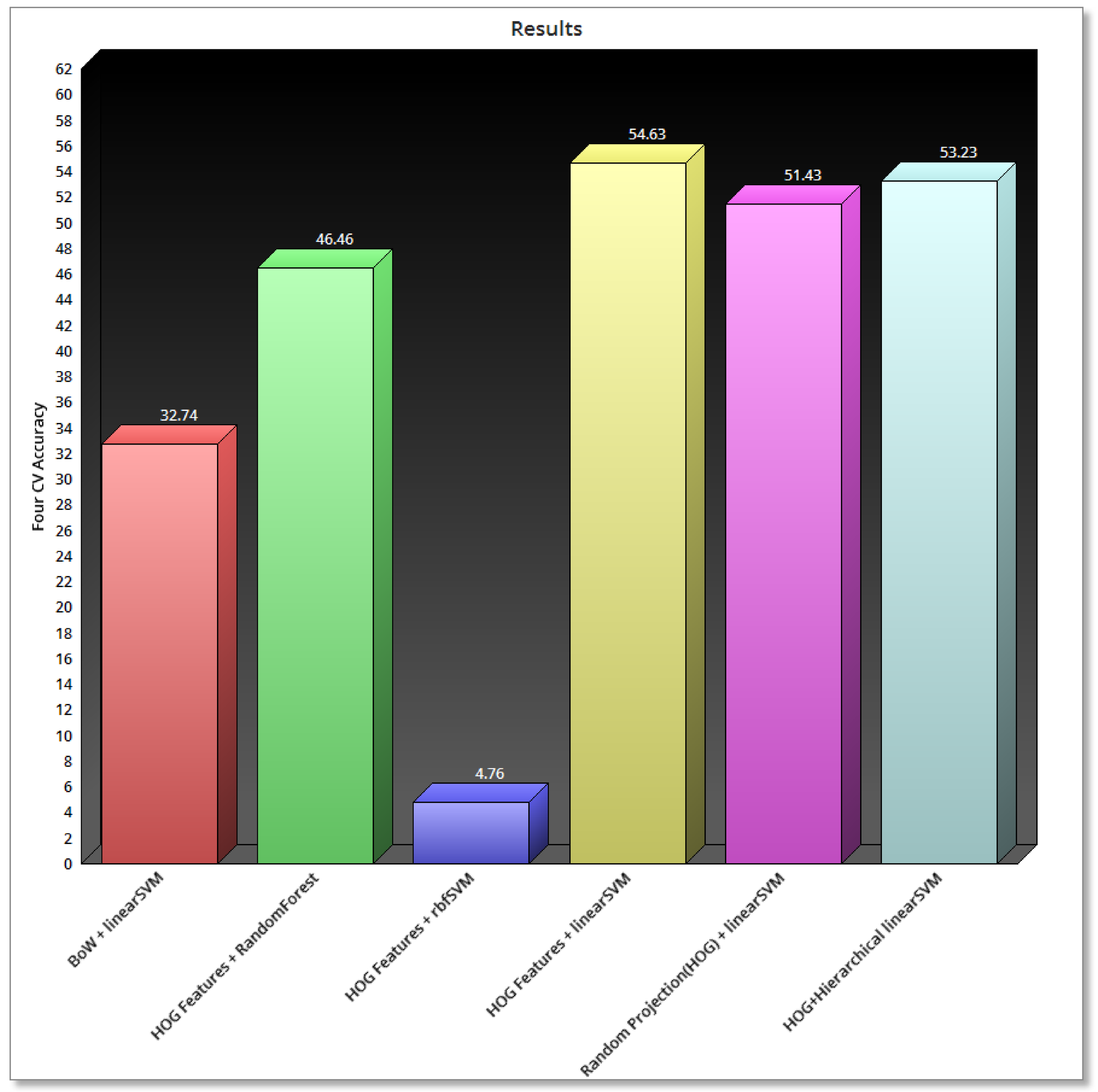
- **Training on skin segmentation dataset :**Tried machine learning models like SVM, random forests on the skin segmentation dataset from uci data set.
- **HSV model :**Convert Image from RGB to HSV model and retain pixels satisfying 25<H<230 and 25<S<230.
- **YIQ and YUV model :**we transform the image from RGB space to YIQ and YUV space. We retain pixels with 30<I<100 and 105< $\theta < 150.(\theta = tan^{-1}(U/V))$.

Feature Extraction :

- **Bag of Visual Words :** This approach represents each image as a bag of words on vocabulary of k-codewords(vectors) which are obtained by applying k-means on set of all sift features(128 dimensional vectors) for images in training data set.
- **Histogram of Oriented Gradient(HOG) Features :** We first scale down the images to 240 X 135 while maintaining the aspect ratio and use the HOG feature descriptors(32000 length vector) for training.
- **Gaussian Random Projection :** The HOG features are projected onto a lower 3000 dimensional subspace to obtain new feature vectors.

Machine Learning on Feature Vectors

- **Support Vector Machines(SVMs) :** The feature vectors obtained from the methods obtained are fed into SVMs with linear kernels to learn and four fold cross validated(CV) accuracies are reported. For HOG features, SVM with rbf kernel and random forests were also tried.
- **Hierarchical Classification :** Instead of directly classifying the HOG features into 26 classes, we first classify into one and two handed signs and then classify within the two groups using linear kernel SVMs and four fold CV accuracies are reported.



Four CV Accuracies Obtained

Conclusions

From the previous work and our current work on this problem, we conclude as follows :-

- **Variation in Dataset :** In the previous work, training and test set was generated from the same person which resulted in higher accuracies, here we train on three people and test on 4th which resulted in significant drop in accuracy.
- **Misclassification among similar alphabets :** The major misclassification is among similar looking alphabets e.g: E,F and M,N and U,V,W which may be resolved using better heirarchical classification.
- **Need for better data:** Better dataset would have resulted in richer features and accuracies could have been higher.

References

[1] Tavari, Neha V., and A. V. Deorankar. "Indian Sign Language Recognition based on Histograms of Oriented Gradient." International Journal of Computer Science Information Technologies 5.3 (2014).

[2] Teng, Xiaolong, et al. "A hand gesture recognition system based on local linear embedding." Journal of Visual Languages Computing 16.5 (2005): 442-454.

[3] Ajith S., Karthik. KS, Niranjan.M, et al. "Indian Sign Language Character Recognition, Final Presentation" . Amrita Vishwa VidyaPeetham, Coimbatore (2014)