Project Proposal

UNIVERSITY OF CENTRAL MISSOURI

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Project Title: Hand Gesture Alphabet Sign Language Recognition

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Problem Statement

In our modern world, it's necessary to socialize with all kinds of people either to gain knowledge on various aspects or to improve their communication skills. As per World Health Organization, there are around 5% of people who are deaf i.e., around 700 million. Of which 63% are deaf by birth and others were losing their hearing ability when they met with accidents[1]. It's the similar case with speech disability people. But as the world advances, they can communicate within each other with sign languages such as hand gestures. This Sign language is like a bridge that connects the hearing disabled and silent/speech disability people.

In our daily life we see that normal people are facing issues while communicating with deaf and dumb people. The sign language used to communicate, this includes actions like bodily gestures, face expressions, hand gestures, etc. are difficult to understand for the normal people. However, people who understand hearing and speech disabled are very limited to communicating with hand motions. People get depressed when they are not able to communicate with their loved one's who have speech/hearing disability.

Objective

In order to help the deaf-mutes and normal people to be able to communicate easily and understand each other, There is a need for an application which can help in analyzing and decode the hand gestures to produce data that can be understandable by all.

Hence, we are going to build a sign language recognition system with the help of machine learning algorithms so that this system can help the normal people by capturing all their hand gestures and process them to be able to predict the context of what they are trying to communicate and conveys the same information to the end user.

There are already many researchers working on the same sign language prediction systems with various machine learning algorithms from the past decade. In our work we are going to experiment the implementation of this Sign Language System with multiple machine learning algorithms and compare them with accuracy & efficiency in prediction of correct meaning to the hand questers.

Related Works

“A New Benchmark on American Sign Language Recognition using Convolutional Neural Network"(M. M. Rahman et. al.,2019). The above mentioned work gives us an idea on the detection of American Sign Language by using convolutional neural networks. About four datasets were considered with good reports.The performance of the proposed model is studied on each dataset when trained and tested.The model has an accuracy of 100% while recognizing both digits and alphabets and it has an accuracy of 99.90% with the digit and the sign language [2].

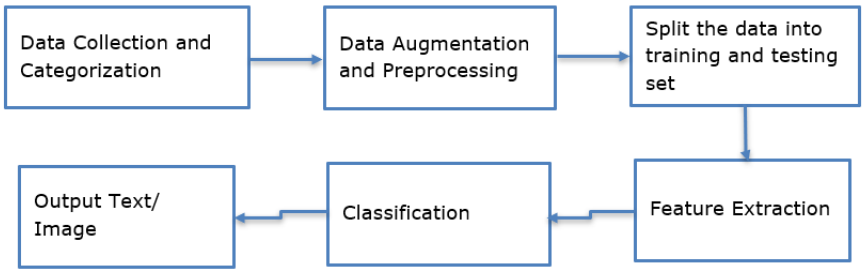
"ML Based Sign Language Recognition System" (K. Amrutha and P. Prabu,2021) This research talks about automated identification of SLR based on vision-based isolated hand gesture detection and recognition utilizing convex Hull feature extraction and KNN as classifier which yielded an 65% accuracy [3].

”Indian Sign Language recognition system using SURF with SVM and CNN”(Shagun Katoch et. at., 2022). In this work the Support Vector Machine and Convolutional Neural Networks are used for the classification.The training data used is 80% and 20% of the data is used for the purpose of testing.For the classification SVM with linear kernel is used.SVM has given an accuracy of 99.14% on test data and overall accuracy of 99%.Whereas CNN has given an accuracy of 99% on testing data and overall accuracy of 94% on training data [4].

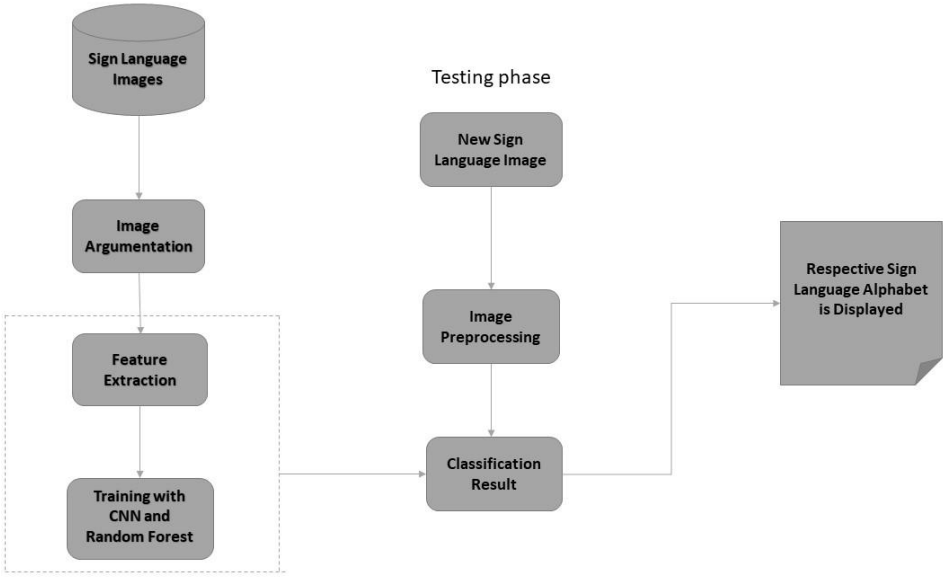
Methodology

First we will collect the data with all hand gestures images files and categorize them with labels either alphabets or some words so that on passing the image as input the respective context will result as output. In the second step we will augment the data and preprocess it before sending it to any of the classifiers. In the third step we will split the data into test and training in-order for the algorithm results to be efficient. Then depending on the dataset size we will decide whether we have to do cross folding or not. Because if our dataset is too large and then if we do cross folding it may lead to overfitting. We will

take training data and perform feature extractions, image processing etc. and then we will process it into the respective classifier. We will use the following Machine Learning algorithms to implement the Sign Language System



The respective process is clearly described in the given flow chart



Convolutional Neural Network:

Then in the training phase we will first apply image augmentation technique and write the CNN classification code which helps in understanding the feature extraction and then comes the testing phase where we will initially give the new sign language image and then image processing techniques are applied to it and the result is classified. After that in the deployment phase we will write html codes and create a web page and then when we input an image in the home page and run the code the respective sign language alphabet will be displayed.

Random Forest:

By using the random forest algorithm a group of decision trees are ensembled based on the dataset.In case of classification the class with more votes is selected whereas in regression the selection is based on the average or the mean. Drawn from a large group of models the prediction could be more accurate compared taking from one model alone. Uncorrelatedness is important for random forests and we can ensure uncorrelatedness with bootstrapping and bagging.

Apart from the above two, we will also implement the same in below two machine learning algorithms.

- **Support Vector Machine**
- **K-Nearest Neighbors**

Learning/Contributions:

Data Augmentations/Preprocessing, Splitting of Data using K Cross fold validation if required, Feature Extraction, Various Machine Learning Classifier algorithms like SVM, KNN, CNN, RandomForest and Checking accuracy and performance metrics of each algorithm based on predictions of Sign Language. All the work will be divided equally within group members based on their interested part.

Evaluation/Results:

We will load all the training data and testing data into the classifier and check the accuracy. In the final stage we will deploy the system so that we can test it on real time scenarios. On deploying the application an html link is generated, on clicking it, the user will be asked to provide the input of image browsing from the local system. On providing the image, the sign language recognition system will process the input and decode the sign into readable text - in our case it will be alphabets since we categorize each image with an alphabet. And Will compare the results based on most effective performance measurement Accuracy.

Reference

1. World Health Organization WHO, [Online] Available: https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss

2. M. M. Rahman, M. S. Islam, M. H. Rahman, R. Sassi, M. W. Rivolta and M. Aktaruzzaman, "A New Benchmark on American Sign Language Recognition using Convolutional Neural Network," 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI), 2019, pp. 1-6, doi: 10.1109/STI47673.2019.9067974. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9067974/citations#citations

3. K. Amrutha and P. Prabu, "ML Based Sign Language Recognition System," 2021 International Conference on Innovative Trends in Information Technology (ICITIIT), 2021, pp. 1-6, doi: 10.1109/ICITIIT51526.2021.9399594. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9399594

4. Shagun Katoch, Varsha Singh, Uma Shanker Tiwary, ”Indian Sign Language recognition system using SURF with SVM and CNN,” Array, Volume 14,2022,100141,SSN 2590-0056, https://doi.org/10.1016/j.array.2022.100141 (https://www.sciencedirect.com/science/article/pii/S2590005622000121)