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Sign Languages are languages that use visual gestures for communication rather than spoken words. These languages are also considered natural languages, meaning they evolved over time according to the needs of the users of language. This means that they are very different from the verbal languages and have grammer and lexicon of their own. This makes communication between the users of sign language and verbal languages difficult. Thus there is a need for sign language recognition systems which can help bridge the barrier. With recent developments in computer vision there is room for models which are faster and easier to deploy on weaker hardware.

Sign Language Recognition using computers is a task with many obstacles. The high number of possible gestures means we need a recognition model which can distinguish between a myriad of classes. The gestures also look very similar which makes distinguishing them harder. Images tend to have a large number of features. But more features does not mean the model will give better predictions. To increase the accuracy of a recognition model, we need to extract features that are relevant to our predictions. Since hands are very complex, having a multitude of different skin types and tones; it is requisite to preprocess the input data to extract only necessary features.

The motivation for this project stems from need for communication between users of sign languge and verbal languages. This project aims to create a model which can give fast and accurate predictions. It should also be able to run on weaker hardware. Another goal was that the whole system is able to run on a single machine. The goal was to make the project more portable. This also means not using a server-client model; where client can send data to a server and a more powerful server can make predictions and send results back to client. Therefore, it is essential for the model and the user interface to be light weight. This project serves to show that a lightweight recognizer that can classify an image into one of a large number of classes and can be integrated into other applications is feasible with innovations in machine learning.

This project will focus specifically on the prediction of alphabets and digits of Indian Sign Language. A model that could translate the grammar and lexicon of the complete Indian Sign Language will need a recognizer, as well as a model which can translate gestures to written languages. Here, only the recognizer which can classify gestures into one of the thirty six classes (the alphabets and the digits). The project will also not focus on background removal and is trained on

dataset with background removed. In a practical system, another method which could isolate the hands from rest of the image will be needed. The recognizer which is built in this project is also integrated with live video input using OpenCV for demonstrating the portability of the model. To get correct predictions a camera with high resolution and an undecorated background (ideally a single color) is recommended.

This project has three components. The first component is used to extract features from the input image. This is done using the Sobel–Feldman operator or Sobel filter. Edge detection allows us to effectively isolate the hands from the rest of the input image. It also helps in avoiding features that are not useful such as skin color. The second component is the model which makes the prediction. This is a simple feed-forward neural network which has takes a 128 * 128 size matrix as an input and has 36 nodes (which represent the class of the gesture) as outputs. The final component is the openCV application which will take the video input using the webcam. This acts as the controller for the whole application. It will resize the input from the webcam, use the sobel filter, get the prediction using the model and finally output it to the user.

The user will interact with the OpenCV application, where they can see the video that is used as the input and it will also show the results of the prediction. The sequence diagram in Figure 1 shows how the application behaves during operation. A frame is taken from the video, which is resized to an 128 * 128 size image. This image is taken in as an input by the Sobel Filter. The filter application will return data in form of CSV. This data can then be given to model. The prediction is then returned to the main application, which shows result to the user and takes the next frame to repeat the process.

1.4 Related Work

There have been multiple articles and efforts for Indian Sign Language Recognition. Some of the related works which have inspired this project and their results will be presented in this chapter.

+ The first work is (3). This paper does Indian Sign Language (ISL) recognition using Euclidean distance. The goal of this paper was to create a recognition system for Humanoid Robot Interaction (HRI), therefore it works on real-time video input. The platform was a made using JAVA software. This study managed to get a recognition rate of 90%
+ The second work is (2). This paper used Histogram of Edge Frequency (HOEF) for feature selection. They took images as input, and used Support Vector Machine (SVM) for classification. They managed to get a recgonition rate of 98.1%
+ The third work is (1). They used artificial neural network (ANN) implemented using Matlab in this paper. They worked on real-time video input. The recognition rate they got was 93%.

A summary of results from these different works in shown in table below

Work	Input	Classification	Recognition	Platform
(3)	Video	Eucledian Distance	90%	JAVA

(2)	Images	SVM	98.1% N/A
(1)	Video	ANN	93% Matlab

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