Sign Language Recognition Using Machine Learning

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Abstract: According to a survey, more than one billion people in the world are disabled with hearing or speaking impairments. One of the only way they can communicate with those who do not have this disability is through sign language. SLR is called sign language recognition, which is a computational task that involves recognizing actions from sign language. This is a critical issue to address, especially in digital age, in order to overcome the communication gap that persons with hearing impairments confront. Factors like hand movements, body movements and also facial expression helps a person in communicating or expressing one's thoughts clearly. But the person standing on the other side will not be aware of this sign language. Even if they are aware , majority of them do not know how to use it. Through our software , we not only want to bridge this gap but also create an awareness towards sign language by creating a sign language interpreter that recognizes hand gestures.

Keywords: Sign Language Recognition; Mobile Application; Convolutional Neural Network; Machine Learning

I. INTRODUCTION

Sign language is a method of communication for the hearing and speech impaired, and Sign language recognition is a method of recognizing hand motions in sign language using photos or videos.

Every country has its own sign language. There exists greater than 300 sign languages which are under usage across the globe, which differ from each other depending on the part of the world to which they belong. Depending on the accent or region, sign language may be slightly or completely different even in the same country or area etc. One of the most well- known and globally used sign language systems is the American Sign Language, ASL. ASL is a natural language with a unique structure and is different from spoken English. ASL is a visual language that conveys the meaning of words using hand movements and gestures. Facial expressions and body movements also play important roles in this language.

In India, ISL, Indian Sign Language is used. It differs from ASL because it uses its own set of vocabulary and grammar. Although ISL is used in India, ASL was chosen for this proposed system because major parts of the deaf-mute community still use ASL.

II. LITERATURE SURVEY

[1] This system works with ASL, American Sign Language. It also compares various works done by American Sign Language researchers. Microsoft Kinect is used for image acquisition and PCAnet is used for feature extraction. The algorithm uses Convolution Neural Network(CNN). Statistical modelling techniques like PCA and support vector were used to reduce sign language and gesture identification problems.

[2].This paper tells us about a real time system that translates sign language into text. Convolution Neural Network is used to classify the frames in the video to a letter and GoogleNet is used to train the data. This model correctly identifies letters from a-e and a-k. The few cons of this model would be the poor letter segmentation and the need for a more effortless photograph retrieval speed.

[3].This system deals with the Indian Sign Language. It uses Eigen value weighted Euclidean distance as a way to classify the different signs. Various aspects like classification, skin filtering, feature extraction and hand

cropping are used. Signs that are done using both the hands can be recognized in this system with a recognition rate of 97 percent.

[4].This paper is about a system that recognizes ASL alphabet with an accuracy of 90.04 percent using a skin color modeling technique known as explicit skin-color space thresholding. Convolutional Neural Network was used for image classification and for image training Keras was used. It can also recognize numbers and static words with an accuracy of 93.44 percent and 97.52 percent respectively.

[5].The system described in this paper talks about a sign language recognizing method based on RGB videos from which skeletal aspects of the body and hand are determined. Gesture detection is possible without any external equipment. Data gloves and other sensors are not used in this system as it is a vision based technique. It tries to address the shortcomings of previous techniques.

[6].This paper talks about a computer vision system used to recognize Mexican Sign Language. Artificial neural networks is used for pattern recognition. Digital cameras and LED reflectors are used for capturing images. 21 out of 27 signs in MSL are being recognized in this system. To represent the frames and recognize the signs normalized central moments and multi-layer perceptron are used respectively.

[7].Different sign languages like Indian, Italian, Turkey and American are recognized by this system. It uses Media pipe which is a cross platform used in developing audio and video data, and Support Vector Machine to recognizer the sings. The system comprises of three stages which includes detection, extraction, cleaning and analyzing sign languages.

[8].The system described in this paper proposes a method of recognizing Indian Sign Language, ISL by using machine learning algorithms like SVM and random forest. The process in recognizing sign language involves capturing the image, processing it, extracting the features and then classifying them.

[9].This paper describes a system used to detect Italian Sign Language by using the dataset ChaLearn Looking at People 2014 which comprises of 20 gestures by different people. It uses Convolution neural network to process the video data. Microsoft Kinect and GPU acceleration is also used. To reduce overfitting during training, data augmentation is used. The rate of accuracy is 91.70%.

[10].This paper is about a system that recognizes gestures and signs by the use of smart gloves. Not only gestures but also sentences are recognized with the help of the gloves talked about in this system. This accomplishment is also done by using the methods of segmentation and non-segmentation, which are aided by the deep learning model. The overall accuracy rate is 86.87 percent.

III. WORKING

HandSpeak is an android app which recognizes the sign language. Each User registers in the application using their credentials. Once successfully registered, the user can login to the Application. The user can open the Interpreter and show the signs to be recognized. The app opens to camera which detects the hand movement of the signer. Then the type of gesture is recognized. The obtained results of the sign language are displayed on the mobile application screen.

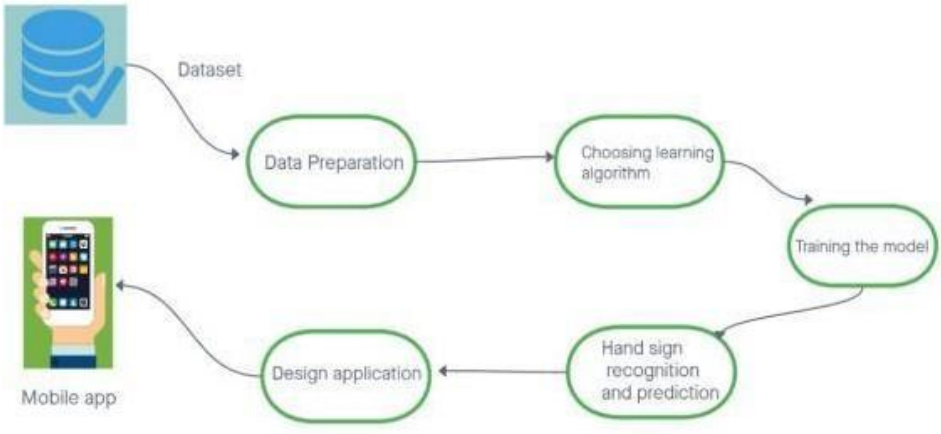

Fig 1. Structure chart for the working of app

- The computer system is connected to an android device. The application would run on the Android Studio software and the application gets installed on the respective android device.
- After installing the application on the android device, the user then registers into the \application by entering the required user credentials such as username, email, and password.
- After registering to the application, the user has to login by entering the username and password which they entered while registering.

- When the user logs in with correct user credentials the dashboard appears which has the scan, account, about and settings.
- The sign guide allows user to learn various sign gestures which allows the user to learn about the sign language.
- Once the user is done with all the trial he/she can logout from the application, which is redirected to the login page. From which you can exit the application.
- When the user selects the scan option, user can show different signs. These are detected by the camera and the results are displayed on the application.
- The add feature in the combine letter page allows the user to add letters and a make word.

IV. IMPLEMENTATION

ResNet50, Xception and EfficientNetB0 are pretrained architectures which we used. A pre- trained model is a saved network that was previously trained on a large dataset, typically on a large-scale image-classification task. The mentioned models are trained using ImageNet database.

(i) ResNet50: A convolutional neural network with 50 layers is called Resnet50. The network has image input with a resolution of 224 by 224.

(ii) Xception: A convolutional neural network with 71 layers is called Xception. The network can accept images up to 299 by 299 pixels.

(iii) EfficientNetB0: A convolutional neural network named EfficientNet-b0 was trained using more than a million photos from the ImageNet collection. The network accepts images with a resolution of 224 by 224.

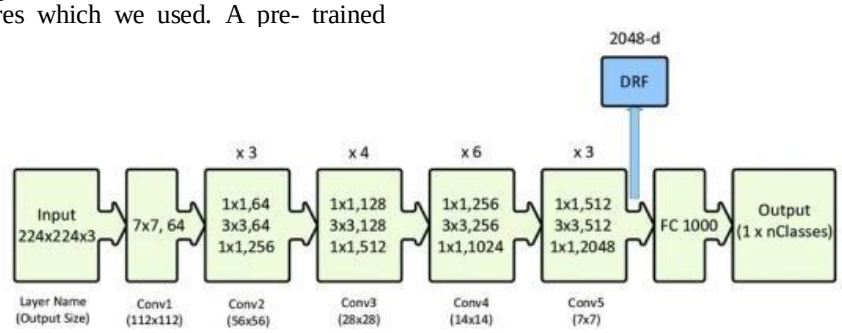

Fig 2. ResNet50

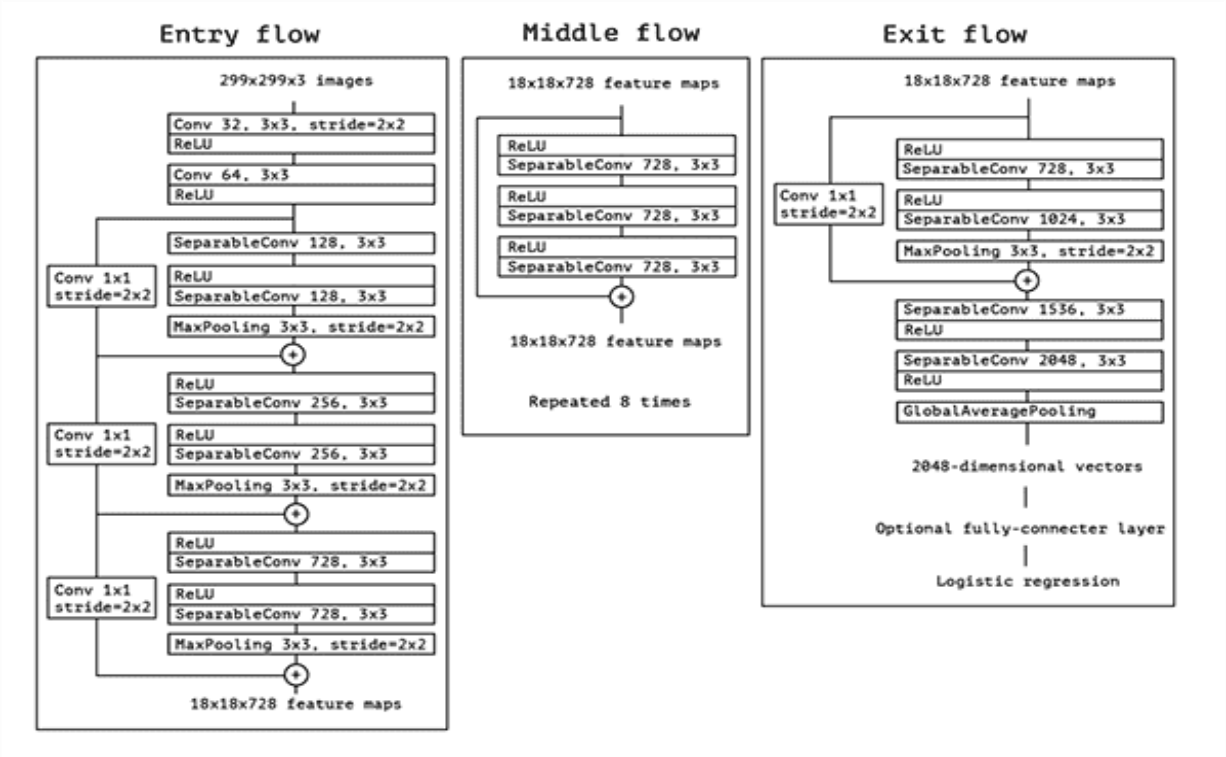

Fig 3. Xception

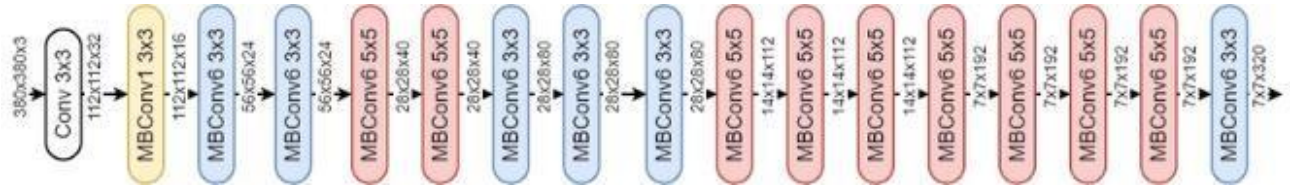

Fig 4. EfficientNetB0

These pretrained models were further trained with a standard database by adding extra layers. We then proceeded to build our own model based on CNN algorithm to get a similar accuracy. We made our own dataset which consisted of numbers and a few static words and added it with our existing data We created a model by adding different layers like MaxPool2D, Dropout, Dense, etc., and applying techniques like Image Augmentation.

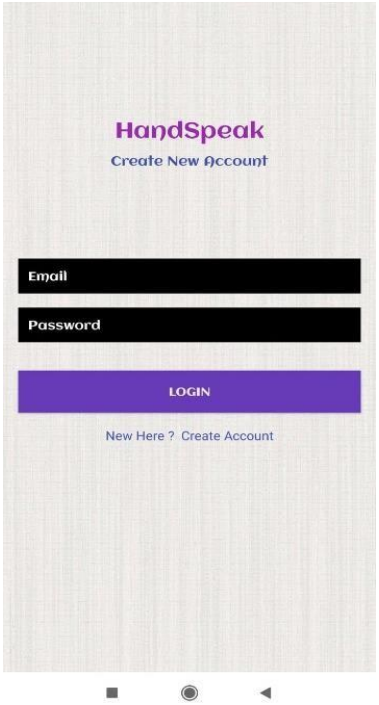

Fig 5. Login page

The user logs in with his previously registered credentials.

If he/she is new to this app then they have to sign up by providing the required user credentials such as username, email and password.

Once the user is successfully logged in the home page appears.

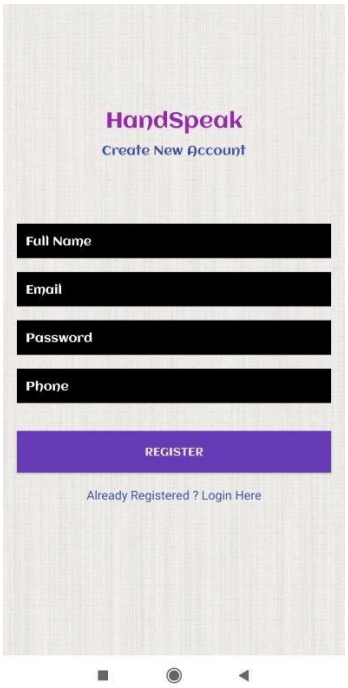

Fig 6. Register Page

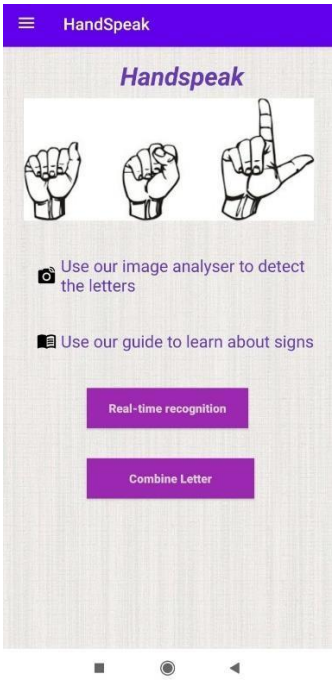

Fig 7. Homepage

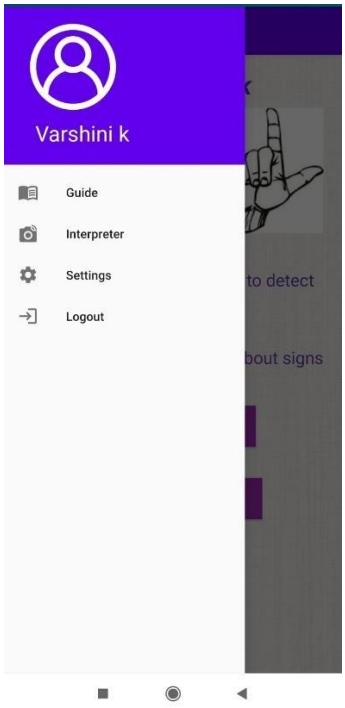

Fig 8. Menu

Menu consists of list of options that the user can use to navigate to different pages. Logout button logs off the user and navigates to the login page again.

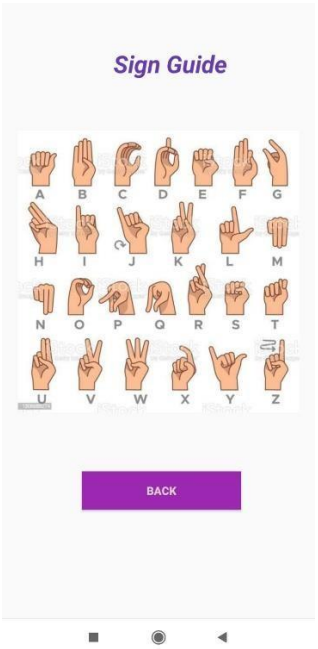

Fig 9. Sign Guide

Sign Guide consists of hand signs that helps the user to learn the sign language.

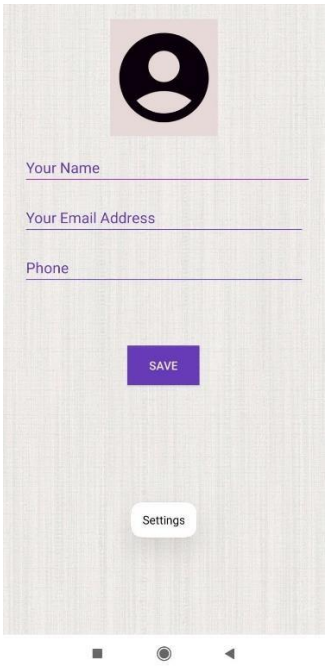

Fig 10. Settings

This is the settings page that allows user to change his/ her credentials.

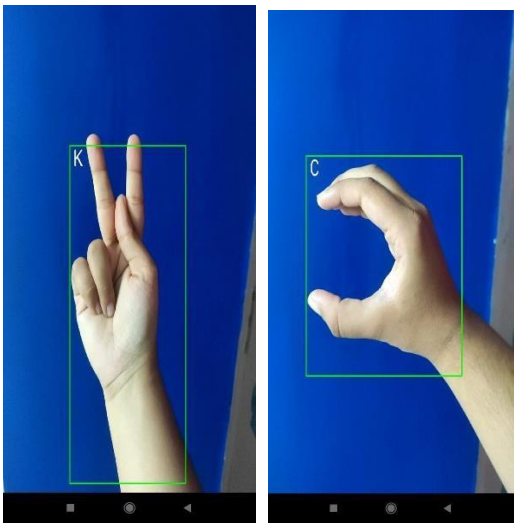

Fig 11. Real time recognition

The real-time recognition button in the home page opens to a scanner that scans the hand signs and shows the letter.

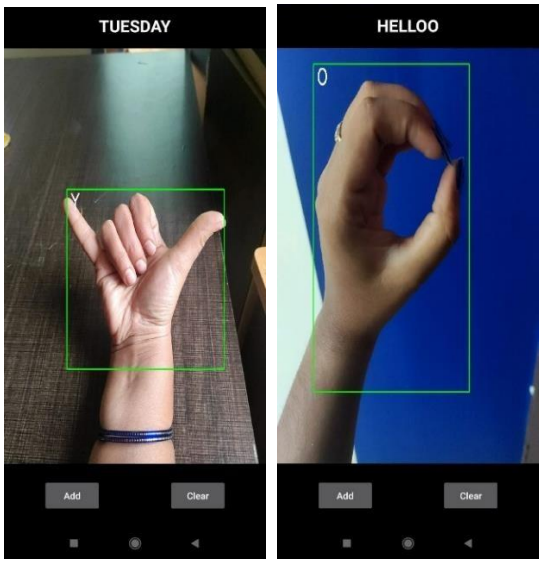

Fig 12. Combine letter

The combine letter button in the homepage leads to a scanner that also has add and clear feature. The add button lets the user to scan add the letters being scanned and a meaningful word. The clear button clears the word.

V. CONCLUSION

The unfamiliarity and lack of knowledge with respect to sign language in today's world is causing a gap between communities. This paper proposes a solution to that problem in the form of an android application.

This application is a sign language recognition application through which able bodied people will be able to decipher the various signs made by a native sign language user. The users can open the application and scan the signs and the application is built to recognize them and display the same on the screen. Not only this but the application also has features that can guide anyone who wants to learn more about sign language.

CONFLICT OF INTERESTS

The authors declared no conflict of interests with respect to authorship, work and publication of this paper.

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