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Real-Time Sign Language Translator

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Abstract— Sign language is a way of transfer feelings and our thoughts non-verbally. People who are hearing impaired, dumb or speechless use sign language as their primary means of communication. For communication these people apply gestures which are based on hand signals to share their ideas. Sadly, the overwhelming most of the individuals aren't awake to the linguistics of those gestures. In a try to overcome these gaps, we offer real time Sign Language identification system which is based on the American Sign Language (ASL) Dataset. The system we proposed uses the CNN (Convolutional Neural Network) algorithm to recognize and interpret static hand signals of letters relating to American Sign Language into written output. An Android based application is produced for this system and further it can convert the text into Speech. The text on the screen is translated into voice using a text-to-speech feature. Text-to-speech is frequently employed as an accessibility tool to aid individuals who struggle to read text on screens, but it is also practical for those who want to be read to. This feature has proven to be quite popular and helpful for users.

Keywords— American Sign Language Convolutional Neural Network, Deep learning, gesture recognition, hand gesture to speech.

I. INTRODUCTION

Sign language is very crucial way of communication for dumb and deaf or speech impaired people. In sign language each hand gesture and action have a particular definition. As a result, complex meanings are often explained by the employment of an addition of assorted symbols. Speech impaired persons use sign language to communicate. It's a gesture-based language. It is a non-spoken language that is commonly used to help impaired persons improve communication between people or with the general public. For expressing this language in effective way, it comprises certain rules and grammars. To recognize Sign Language, it can be performed using either Sensor-based or by image-based approaches. However, a lot of investigation is being done on techniques based on image solely for the benefit as it eliminates the need for wearing complicated gadgets like Hand Gloves or Helmet etc. In a variety of applications like multimedia, human interface, security and communication gesture recognition is becoming increasingly important. This project aims to upraise the people with speech impairments and supports them to integrate among ordinary people. Unlike spoken language, sign language is structured because each gesture represents a distinct element or character. Various Technologies were used like as CNN, KNN, YOLO for SLR. With the expansion of technology in science, a lot of researchers are engaged in various procedures which would push the event of Computer human interaction forward in future. This created and modeled system is being executed to recognize this type of language gestures. Using a mobile camera, the marks are captured and pre-processed. User can add letters after capturing the signs and clear. Text to speech conversion feature also added. Framed sentence or added letters are often converted into speech.

II. LITERATURE REVIEW

Various methodologies and ideas had been implemented to categorize the behavioral of the person.

1. Pankaj Sonawane, et al contributed to Create System which recognizes and interprets spoken language and then acts out the corresponding ISL gestures for which developed an end-to-end human interface framework. The Model uses the Microsoft Xbox Kinect 360s depth sensing and motion capture capabilities to capture motion data for all the various ISL gestures, uses Unity3D to set up all the animations, and finally binds everything into an Android application [1].

2. Aditi Dixit, et al contributed to "Audio to Indian and American Sign Language Converter using Machine Translation and NLP Technique" in 2022. The paper proposed a system that generates software that takes input in the form of speech which displays the appropriate sign language. Developed on the Python platform, this software converts speech to Indian and American Sign Language (ISL and ASL) and provides an assistant for the deaf [2].

3. Agnes Jacob and Nimisha K P contributed to "A Brief Review of the Recent Trends in Sign Language Recognition" This paper gives review of common techniques in SLR. It describes various algorithms such as CNN, PCA and YOLO that use feature extraction. It also describes the classification phase using algorithms such as SVM, CNN, and ANN classifiers [3].

4. Thamizharasi, Sruthi Upendran, contributed in "American Sign Language Interpreter System for Deaf and Dumb Individuals". The created system detects and recognizes the hand gestures from the ASL alphabet and converts them into text output. The concept of Principal Component Analysis (PCA) applies to gestural images of the ASL alphabet which are of static format. From the image the PCA features are extracted to categorize the image to get one of the ASL alphabet [4].

5. Prabu P, Amrutha K, contributed in "ML Based Sign Language Recognition System" taken from 2021 International Conference on Innovative Trends in Information Technology (ICITIIT). This article briefly describes the SLR model based on machine learning. This model is based on visual based recognition of hand gestures. With the support of four candidates, the evaluation of the ML-based SLR model was performed. Feature extraction is done using a convex hull and classification is done using a KNN. The tested model showed 65% accuracy [5].

6. Harini R, et al contributed to "Sign Language Translation" In this paper capturing images, preprocessing images, classifying images and predicting them are all components of the proposed system. Image processing is employed in the segmentation process. In order to make accurate predictions, the captured gestures were converted to grayscale images, resized, and the noise is filtered. The classification and prediction are carried out using convolutional neural network [6].

7. Aarti G. Ambekar, Ashish S. Nikam, ,"Sign Language Recognition Using Image Based Hand Gesture Recognition Techniques", presented in 2016 .paper describe due to the similarity of shape of human hand, which has four fingers and one thumb ,a real-time system was presented by the software for recognition of hand and with basis of acquisition of features based on the shape of the like orientation, shape of the fingers, the center of the mass, and thumb in the area of the raised or folded fingers.

III. EXISTING WORK

Sensor gloves are gloves with a number of sensors built into them. These keep track of the palm, finger, and finger movements. They have been used for a long time, but for other things like building virtual, three-dimensional settings. Sensor gloves have the significant benefit of not being impacted by outside disturbances such as changes in light, magnetic fields, or electric fields. The intricacy of using sensors for gesture identification is the system's main drawback. By detecting the motion of the object under examination, the Kinetic User Interface (KUI) allows users to interact with computers. Every time he wants to submit data, the user is expected to be wearing the gloves. These gloves can be very pricey and challenging to use. As a result, in this project, a different approach and software approach is recommended.

IV. METHODOLOGY/PROPOSED SYSTEM

The methodology of this proposed system for speech impaired people consists of three stages, first is the designing and training of the hand detection model and sign language detection model, second is the Recognition of Sign Language Alphabets and converting in the form of words or sentences and third is Text to Speech Converter.

In our system we design and test a model for images and as well as real-time applications. We have included the alphabets where user can form the required words or sentences.

In designing our system, we used Deep Learning, using CNN Algorithm as well as technologies like TensorFlow, Keras to train our model. For Implementation of our system is further divided into five sub-groups that include the collection of Datasets of 25 different classes, the Implementation of the Model, Extraction and training of the Datasets, Interfacing model with android application, and Text to Speech Conversion.

The first stage decided the base of the entire model and how it is to be implemented. Our system starts with capturing the video through a mobile camera, then processing the input, and then passing it through the deep learning architecture. It is further explained in detail.

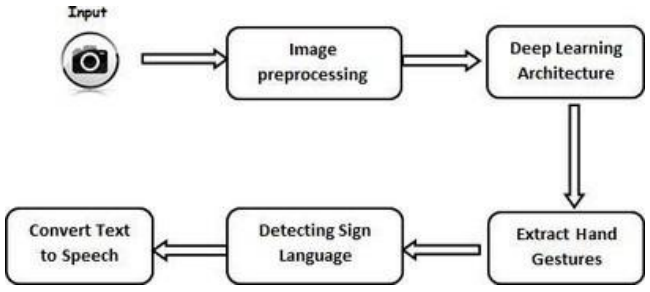

Fig. 1. Methodology of Sign Language Translator

A. COLLECTION AND CLASSES OF DATASETS

For training, our model American Sign Language dataset was used. The dataset contains images which belong to 25 classes. These are from A to W, Y and a space. Firstly, the dataset contains preprocessed images are of different size. The neural networks get inputs of the images which are of same size, they all need to be resized before inputting them to the CNN. Then we split the dataset into training and test sets.

B. IMPLEMENTATION OF THE MODEL

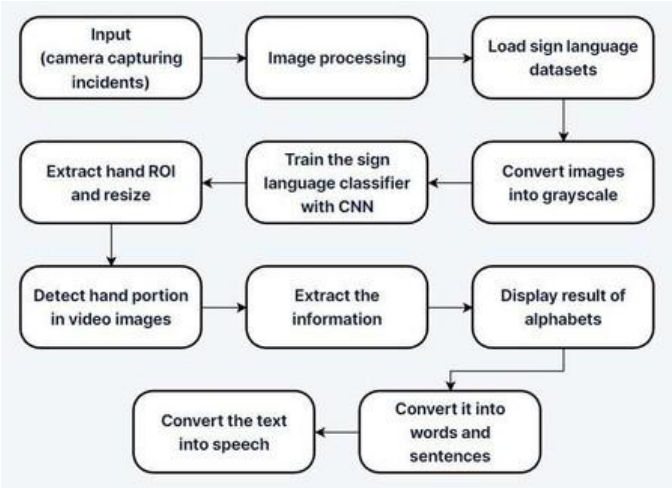

Fig. 2. Architecture For Detection of Emotions ofpeople via images/video-streams

For the live stream, we used Open CV which will help us to detect the border of hand section of a person and on that basis, it will detect which category the alphabet belongs to. The CNN architecture works as mentioned in the flowchart. Convolutional neural network (CNN) is used in image processing that is designed to process pixel data. After the images/Video stream is passed through the camera, the image is processed, and the datasets are loaded. A total of 2 convolutional, 2 Max Pooling, 1 flatten and 4 dense layers comprise the CNN.

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 126, 126, 32)      320
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 63, 63, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 61, 61, 32)        9248
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 30, 30, 32)        0
_________________________________________________________________
flatten (Flatten)            (None, 28800)             0
_________________________________________________________________
dense (Dense)                (None, 128)               3686528
_________________________________________________________________
dropout (Dropout)            (None, 128)               0
_________________________________________________________________
dense_1 (Dense)              (None, 96)                12384
_________________________________________________________________
dropout_1 (Dropout)          (None, 96)                0
_________________________________________________________________
dense_2 (Dense)              (None, 64)                6208
_________________________________________________________________
dense_3 (Dense)              (None, 27)                1755
=================================================================
Total params: 3,716,443
Trainable params: 3,716,443
Non-trainable params: 0
_________________________________________________________________
```

Fig. 3. Summary of CNN classifier

For initializing our CNN classifier an Adam optimizer was used. Loss function Categorical crossentropy is used as it includes more than two classes. The activation function RELU was used for hidden layers and for last layer activation function a function called softmax was used.

Rectified Linear Units (ReLU) function:

$$f(x) = \max(0, x),$$

x isinput to the layer.

C. TRAINING AND TESTINGOFMODEL

Main step after CNNarchitecture is to train the model. It is trained with the help ofKerasand Tensorflow. We have run it on 20 epochs and savedthemodel. We successfully plotted a graph of validation and training accuracy and loss per epochs, of detection of theSignLanguage model.

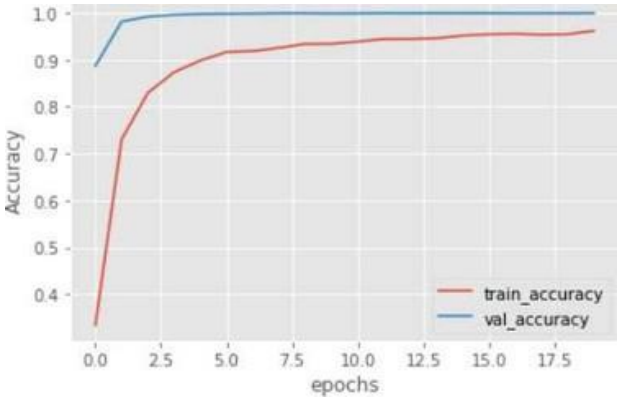

Fig. 4. Graph for Validation and training accuracy

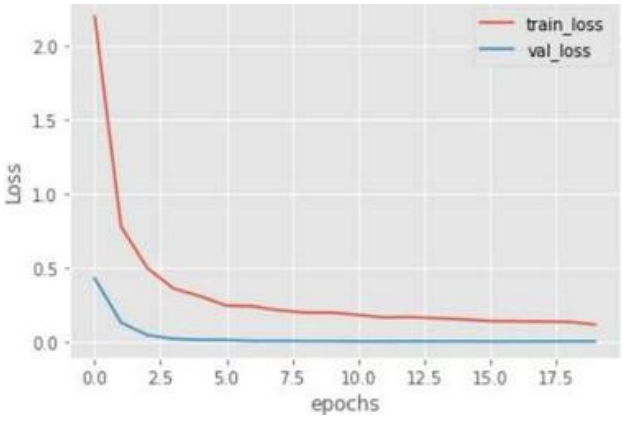

Fig. 5. Graph for Validation and training loss

D. INTERFACING MODEL WITH ANDROID APPLICATION AND CONVERTING SIGN LANGUAGE INTO TEXT

For interfacing with android, the Sign language model and hand model was imported in android. The trained model was converted into the tensorflow lite format before importing the

model. By detecting the sign language, we can convert it into wordor sentence format.

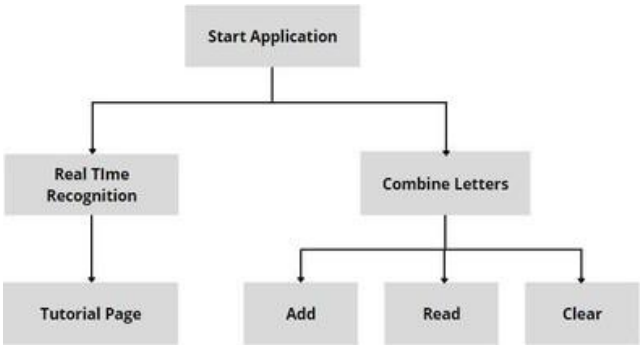

Fig. 6. Application Flow

E. TEXT TO SPEECH CONVERSION

After the conversion of Sign Language into the textual format, the next step is to convert it into the speech output where it becomes easier for a user to convey his message to another person with the help of the read button. import android.speech.tts.TextToSpeech inbuilt library in the android studio used for text-to-speech conversion. Generally, the android TextToSpeech instance can only be used to synthesize text once it has completed its initialization so implement TextToSpeech.OnInitListener to notify the completion of initialization.As, android provides a wide variety to speak in different languages, here we used the UK language. It provides TextToSpeech class for this purpose.

V. RESULTS AND DISCUSSION

This Model correctly analyses person's hand and gives a proper output. It was trained with 20 epochs with an over the accuracy of 96.18%. And, the validation accuracy was 97.95%.

Fig. 7. Start Interface

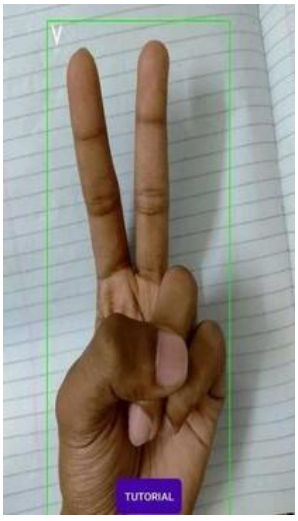

Fig. 8. Real Time Recognition

Fig. 9. Tutorial Page

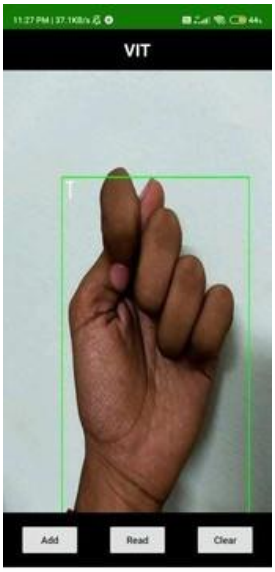

Fig.10.Combination of Letters

When the person'shandgesturesarecaptured in the camera, it successfully convertsSignlanguageintowords and sentences and further it is convertedintospeech.Foruser we provided three buttons add, readandclear.Usingaddbutton user can add letters which is detectedfromhandgesture.By using clear button user can deletetheaddedlettersandfunction of read button is to convert framedwordorsentenceinto speech.

VI. SCOPE OF PROJECT

The system will be extended to include the knowledge of facial expressions as well as of body movement too so that there is awhole understanding of the context and tone of the input speech. Further we can add word suggestion feature.

VI. CONCLUSION

The project is a straightforward illustration of how CNN may be used to tackle computer vision problems very accurately. It is possible to translate sign language using finger spelling for speech impaired people. The initiative can address a portion of the Sign Language translation challenge because sign languages are spoken more in context than as finger spelling languages. The primary goal has been accomplished, namely, the requirement for an interpreter has been removed. We illustrated the learning and overall performance of the model. Using basic tools and simplified techniques the strategy is far beneficial for Speech Impaired Person. The created model will make a contribution immensely to the people who want to express their thoughts with the people who don't understand the sign language. By using this android application, user can join the alphabets to make the sentences and with the help of Text to Speech it will read out loud for the other people.

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