iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VIII **Month of publication:** August 2020

DOI: https://doi.org/10.22214/ijraset.2020.31153

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

Quick Sign - A smart Indian Sign Language and Native Sign Gesture Interpreter

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Abstract: ***Sign Language is the most natural and expressive way for the hearing impaired. Sign Language is the medium of communication among physically impaired individuals who cannot speak or hear by expressing signs using hand shapes, orientation and movement of hands. Automatic Sign Language Recognition is a significant research area in the field of human computer interaction. Automatic Sign Language systems need fast and accurate techniques to identify signs with correct meaning. Many techniques have been developed with the development of image processing and artificial intelligence techniques. Most of signs Indian Sign Language (ISL) are double handed. It is more difficult to recognize compared to single handed signs like American Sign Language (ASL). This paper presents a methodology which recognizes the Indian Sign Language (ISL) and translates into a normal text.***

Keywords: Indian Sign Language, Gesture Recognition, Background Subtraction, Feature Extraction, Convolution neural network

I. INTRODUCTION

Sign Languages are a set of languages that use predefined actions and movements to convey a message. These languages are primarily developed to aid deaf and other verbally challenged people. They use a simultaneous and precise combination of movement of hands, orientation of hands, hand shapes etc. Different regions have different sign languages like American Sign Language, Indian Sign Language etc. We focus on Indian Sign language in this project.

Indian Sign Language (ISL) is a sign language that is predominantly used in South Asian countries. It is sometimes referred to as Indo-Pakistani Sign Language (IPSL). There are many special features present in ISL that distinguish it from other Sign Languages. Features like Number Signs, Family Relationship, use of space etc. are crucial features of ISL. Also, ISL does not have any temporal inflection. In this project, we aim towards analysing and recognizing various alphabets from a database of sign images. Database consists of various images with each image clicked in different light condition with different hand orientation. With such a divergent data set, we are able to train our system to good levels and thus obtain good results.

We investigate different machine learning techniques like Support Vector Machines (SVM), Logistic Regression, K-nearest neighbours (KNN) and a neural network technique Convolution Neural Networks (CNN) for detection of sign language. Here we have mainly used CNN for detecting the letters.

II. RELATED WORK

Sign language is a non-verbal language used by people with less or no hearing ability for everyday communication among themselves. It is not just a random collection of gestures; it is a full-blown language in its own right, complete with its own grammatical rules. This project focuses on minimizing the communication barrier between deaf-dumb people and normal people.

Anuja V. Nair and Bindu V, Thiruvananthapuram,Kerala, India have tried a similar sign language recognition system extracting and implementing the concepts Digital image processing, Markov models, Artificial neural networks and support vector machine

Deepali Kaushik, Ankur Bhardwaj,"Hand Gesture Recognition on Indian Sign Language Using Neural Network" . They have developed a user-friendly human computer interfaces (HCI) for feeding the data and converting it to text output. Making a computer appreciate speech, facial expressions and human gestures are some steps towards it. Human-Computer Interaction (HCI), patternrecognition, ANN are some of the algorithms implemented here.

Mansi Gupta, Meha Garg, Prateek Dhawan, Faridabad, India worked on the Indian sign language to text translation system with static data input. Usage of 3D model-based appearance and hand gestures on ANN,HMM and KNN.

There has been several previous works done in the field of sign language translation and analysis. There are several approaches that were followed by different researchers like vision based, Fuzzy Logic, Genetic Algorithm, Neural Network, Support Vector Machines and Hidden Markov Model etc. Some of the previous works are given below. A fair amount of research has been done on different aspects of this project domain.

III.METHODOLOGY

In this project, we propose a CNN based approach to detect the characters of Indian Sign Language and give relevant text and audio output to the user.

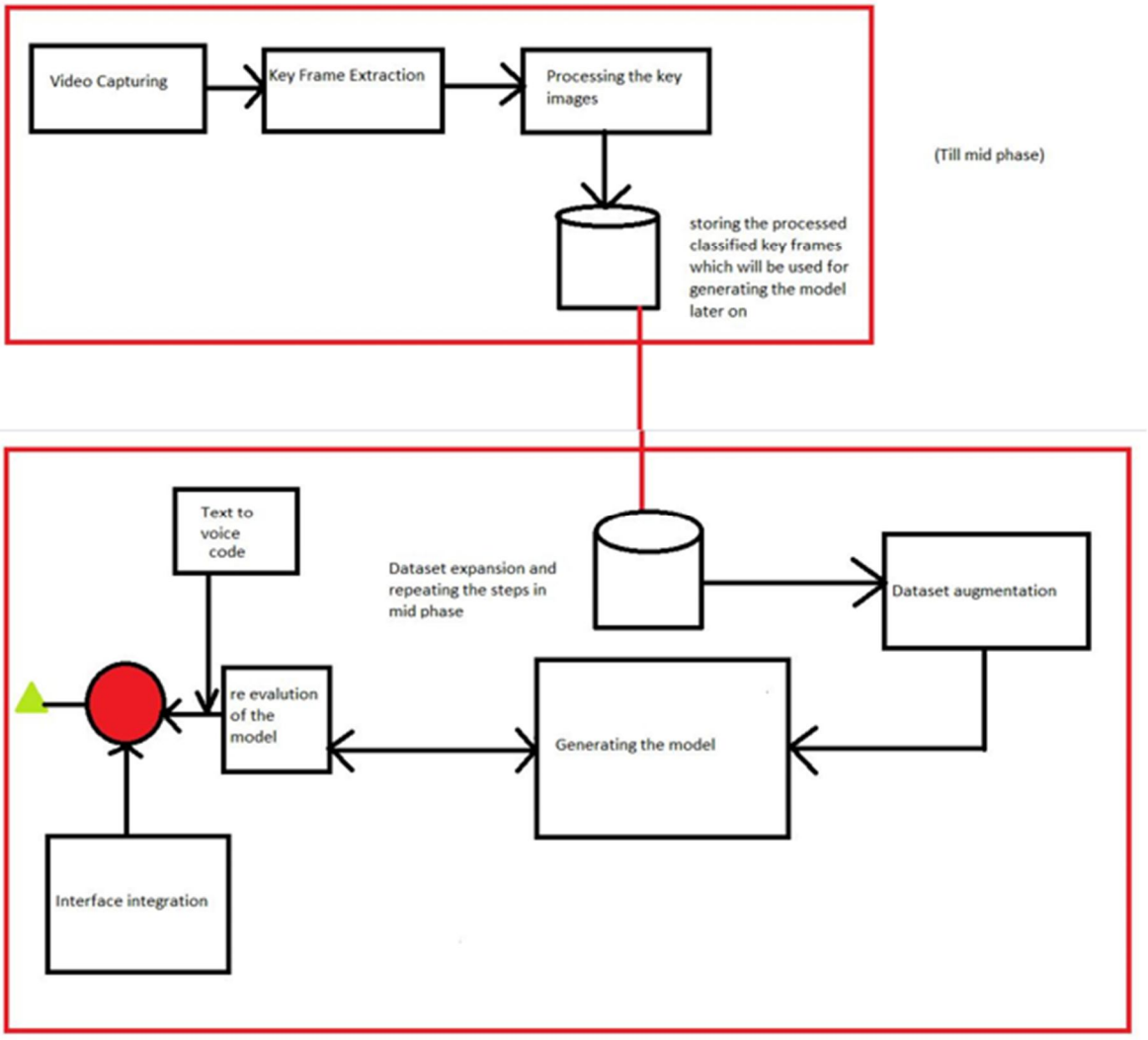

Fig.1 System Design

1) Capture videos of Indian Sign Language characters and words.
2) Convert the video to frames and extract the key frames from the video.
3) Process the key frames using various image processing techniques for background subtraction, smoothening and thresholding.
4) Perform data augmentation to increase the dataset size for better train accuracy and scalability.
5) Train the model using the dataset of Indian Sign Language using a CNN with 2 convolution layers to classify the characters.
6) Test the model thus obtained with unseen input from users in the UI to which relevant audio and text output is displayed.

A. Proposed solution for Indian Sign Languagedetection:

1) Video to frame conversion using OpenCV. Key frame extraction method is used which extracts the distinct frames from the video by calculating the difference between the current frame and previous frame pixels.
2) Image Preprocessing and Segmentation.The main objective of the segmentation phase is to remove the background and noises, leaving only the Region of Interest (ROI), which is the only useful information in the image.

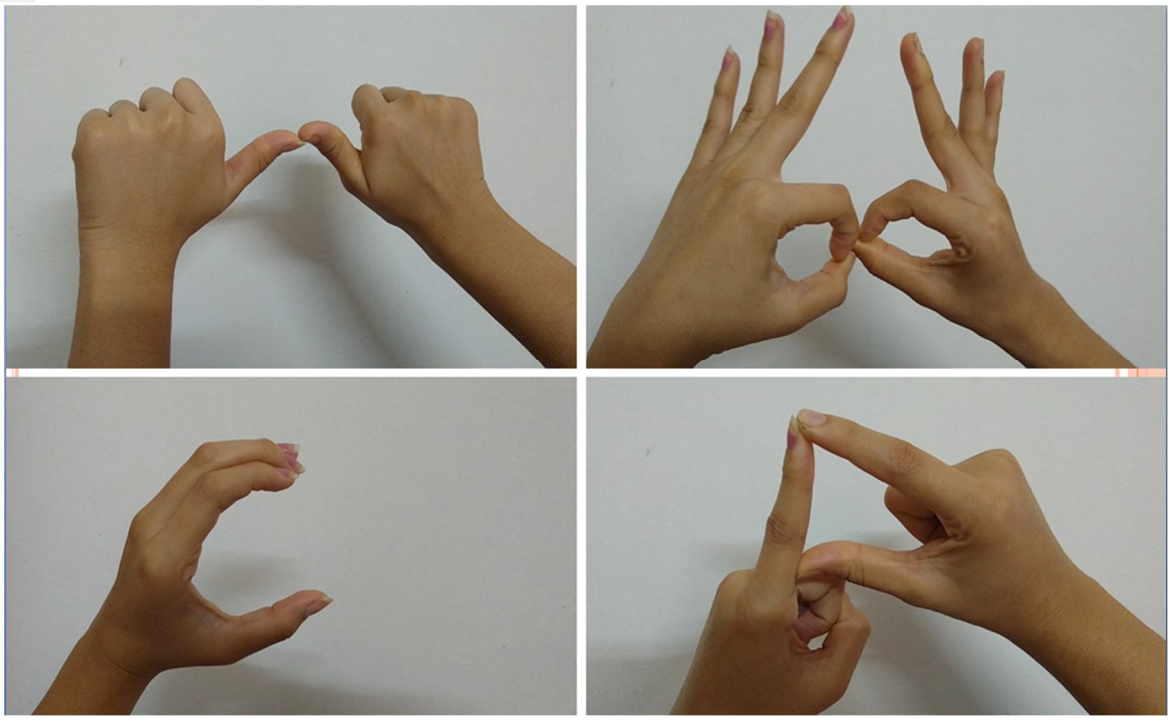

Fig.2 Indian Sign Language characters before background subtraction

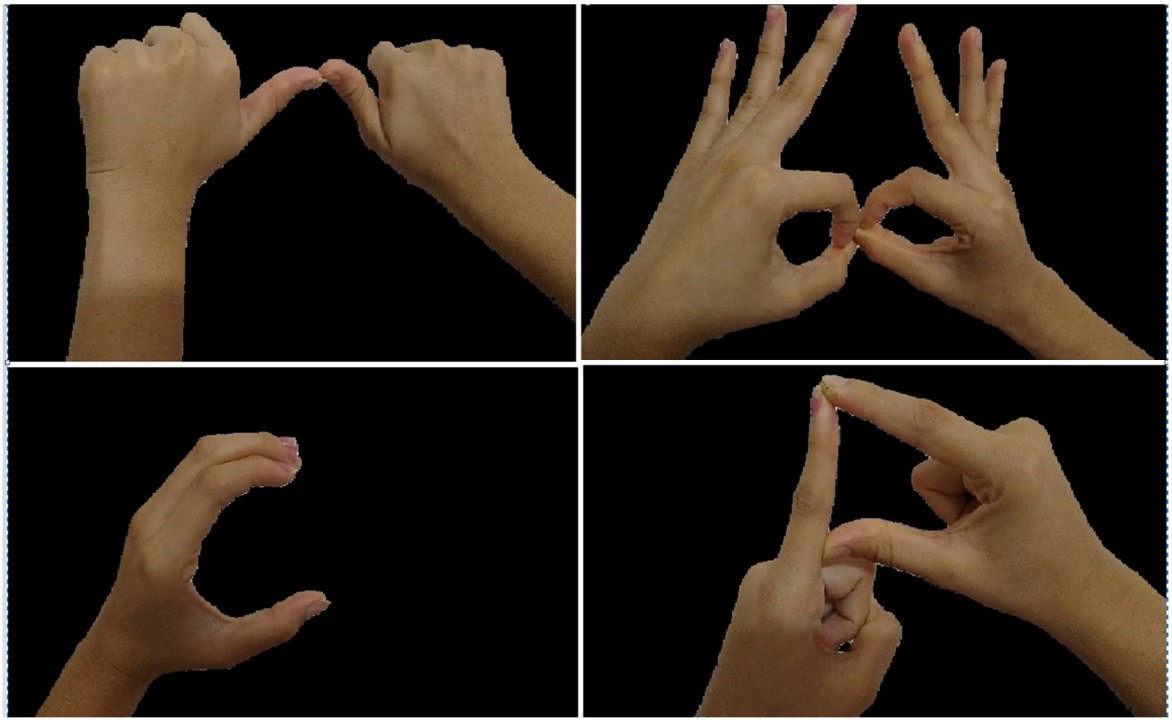

Fig.3 Indian Sign Language characters after background subtraction

3) Feature Extraction and Classification using Convolution Neural Network.The role of the ConvNet is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction

4) Obtaining the mapped letters and grouping them into words based on threshold. Later producing relevant audio output of the same detected word using gTTS.

B. Hardware Requirement

1) *Processor:* Quad core Intel Core i7
2) *RAM:* Minimum 16GB of RAM
3) *Storage:* Minimum 500GB HDD(SDD is preferable for better performance)
4) *GPU:* Premium Graphic cards like Nvidia 9x or 10x series(preferable to use graphic card that supports CUDA toolkit)
5) Webcam

C. Software Requirement

1) *Operating System:* Windows / Linux / MacOS
2) *Python 3+:* Programming language
3) *Keras 2.0+:* Library for neural network which uses TensorFlow as its backend
4) *Tensor Flow 2.0+:* Deep learning library in python
5) NumPy 1.18.2: NumPy is the fundamental package for scientific computing with python

IV. RESULTS AND ANALYSIS

Fig. Final Testing Result

CNN model was developed with 2763 images of Indian Sign Language alphabets which were extracted from the videos of 26 alphabets of Indian Sign Language. The model was trained with three convolution layers with the 39,405,956 parameters that were grouped to 26 classes. The model consisting of 2763 images were trained to an accuracy of 91.28%. The model was able to accurately identify the test video samples of Indian Sign language in the testing phase.

V. CONCLUSIONS

We have proposed a convolution-based model that detects the Indian Sign Language gestures in the video format and gives appropriate audio and text output. The model is trained to an accuracy of 91% and detects all 26 alphabets in Indian Sign Language.The model canbe scaled to recognize the sentences in Indian Sign Language in future. We also intend to train the model to recognize the native sign language gestures which will help layman understand the native sign language.

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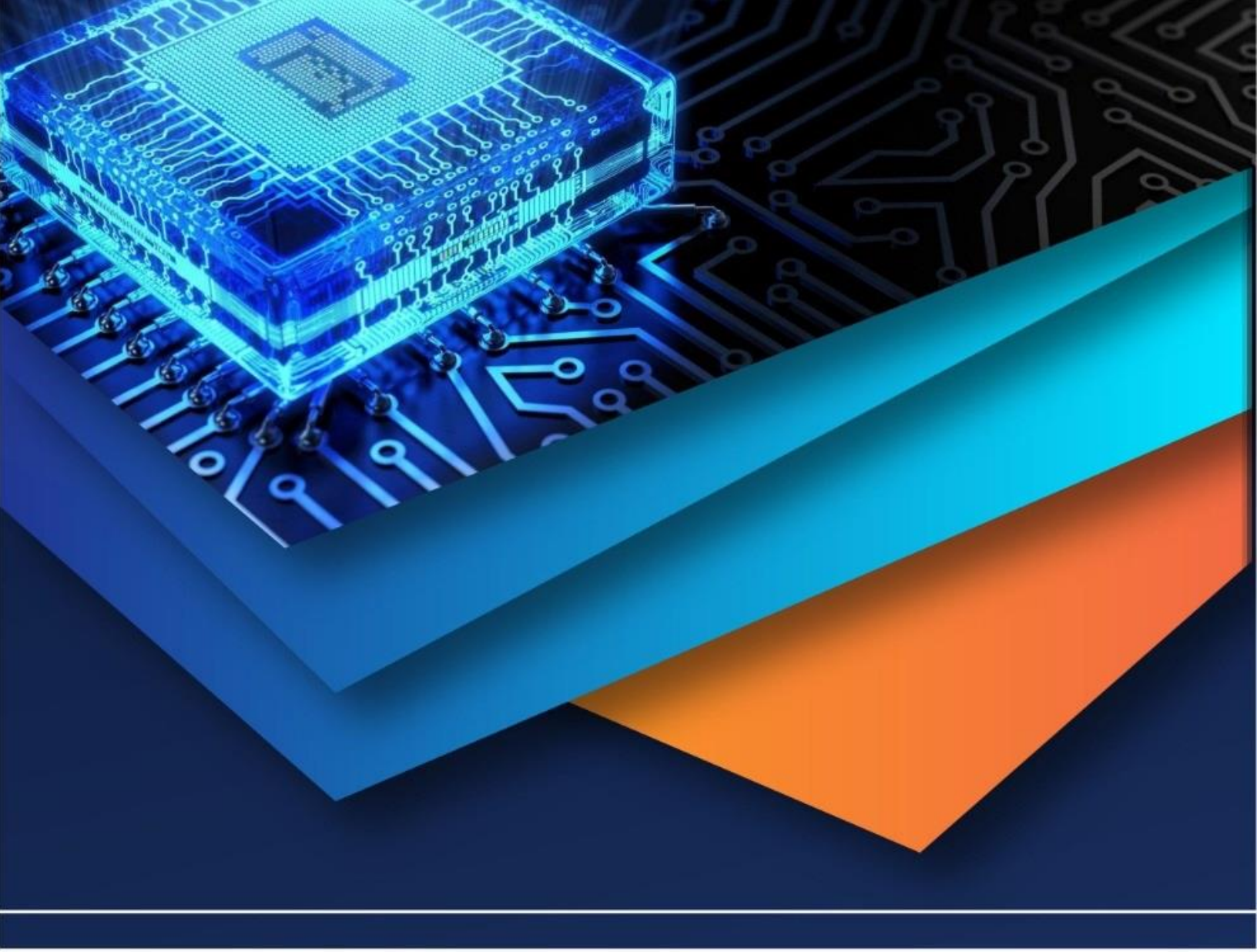

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