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Design and Development of Real-Time Sign Language Detection for Deaf People

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Abstract: *There is a need for a method or an application that can recognize sign language gestures so that communication is possible even if someone does not understand sign language. With this work, we intend to take a basic step in bridging this communication gap using Sign Language Recognition. In this project Deep-Learning approach was used for model training to recognize the signs used in real time. By using TensorFlow and Open-CV we can do the detection in real time. We make use of Convolution Neural Network (CNN) for training and to classify the images of the 5 gestures for the phrases used in American sign language and the average detection rate in real-time is above 90 Percent.*

Keywords: **Sign language, Deep-learning, TensorFlow, Open-CV, Convolution Neural Network (CNN).**

1. INTRODUCTION

Sign language has been constantly used to communicate with deaf people. But there's still a communication gap is present because of lack of knowledge of sign language. So, in this project we tried to recognize 5 signs of American Sign Language (ASL) using Machine learning. ASL is a globally adopted sign language and it has a variety of signs for the phrases we use in daily life. And it will be easier to communicate if there is a model which can recognize these signs in real time, and this will greatly reduce the communication gap. In this project we have used Jupyter notebook for coding. So, in this project we have used TensorFlow for object detection purposes and OpenCV for the capturing and processing of images. So, in the proposed system the dataset was created and using CNN trained the model to classify those images.

2. PROBLEM STATEMENT

Deaf people use hand signs to communicate, hence normal people face problems in recognizing their language by signs made. Hence there is a need for systems which recognizes the different signs and conveys the information to the normal people.

3. EXISTING LITERATURE

There are many projects available for this problem statement, but most of them are for recognizing the sign language alphabets and digits or some projects are recognizing their local sign language.

The first paper we studied was by Siming He [1]. He proposed a system having a dataset of 40 common words and 10,000 sign language images. To locate the hand regions in the video frame, Faster R-CNN with an embedded RPN module is used. It improves performance in terms of accuracy. Detection and template classification can be done at a higher speed as compared to single stage target detection algorithms such as YOLO. The detection accuracy of Faster R-CNN in the paper increases from 89.0% to 91.7% as compared to Fast-RCNN.

Then there is research done by Rekha, J [2]. which made use of YCbCr skin model to detect and fragment the skin region of the hand gestures. They used principle of curvature and extracted image features and classified with Multi class SVM, DTW and non-linear KNN. For training dataset of 23 Indian Sign Language static alphabet signs was used and 25 videos for testing were used. The experimental result obtained were 94.4%for static and 86.4% for dynamic.

Then another one is Real-Time Sign Language Gesture (Word) Recognition from Video Sequences Using CNN and RNN by Sarfaraz Masood, Adhyan Srivastava, Harish Chandra Thuwal and Musheer Ahmad [3]. To train the model on spatial features, they used inception model which is a deep convolutional neural network (CNN) and recurrent neural network (RNN) to train the model on temporal features. Our dataset consists of Argentinean Sign Language (LSA) gestures, belonging to 46 gesture categories. The proposed model was able to achieve a high accuracy of 95.2% over a large set of images.

Then let's take a look at work done by by Rung-Huei Liang, Ming Ouhyoung[4]. They implemented a prototype system with a lexicon of 250 vocabularies in Taiwanese Sign Language (TWL). This system uses HMMs (Hidden Markov Models) for 51 fundamental postures, 6 orientations, and 8 motion primitives. Their average rate of detection was 80.4%.
Then another one is done by Mehreen Hurroo, Mohammad Elham [5]. Their work was about Sign Language Recognition System using Convolutional Neural Network and Computer Vision they were able to detect 10 American sign gestures with the accuracy of 90%.

4. METHODOLOGY

The first part in the proposed methodology is to collect the data. Many researchers have been using different types of sensors and cameras for data collection, in this system web cam was used to capture images. So, there were 15 images captured for each sign and they were further divided into 80%for testing and 20% for training. Further feature extraction was done using labelling the gesture from the image using labelImg package in python. Then CNN was applied for training and classification. Then the model would be able to predict the signs after evaluation.

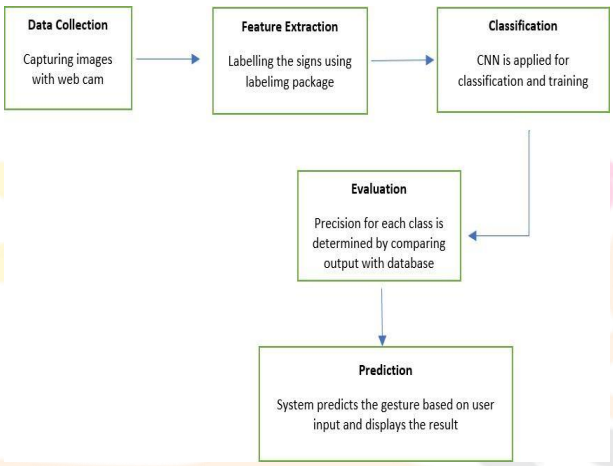

Fig -1: Block Diagram of System Architecture

4.1 Data Collection

Data collection is an important part of any system as the performance of the system is dependent on it. For this model the images were captured using webcam. A total of 75 images were captured out of which 80% were for training and 20% was for testing. The images were collected using the same background and were written in jpg format.

4.2 Feature Extraction

One of the crucial parts of data processing is to extract the features we need from an image data. There is only a specific part of the image that we need for this model. So, that part was done by labelling that part using the LabelImg package. So, this package generates the file in xml format which has the specific part we need.

4.3 Classification

In this proposed method, A 2-D CNN is applied with TensorFlow library. The layers of CNN scan the images with filters. This specific step extracts important features and passes them on further.

4.4 Evaluation

In this Method, Precision for Each Class is determined by comparing each and every output with our Database.

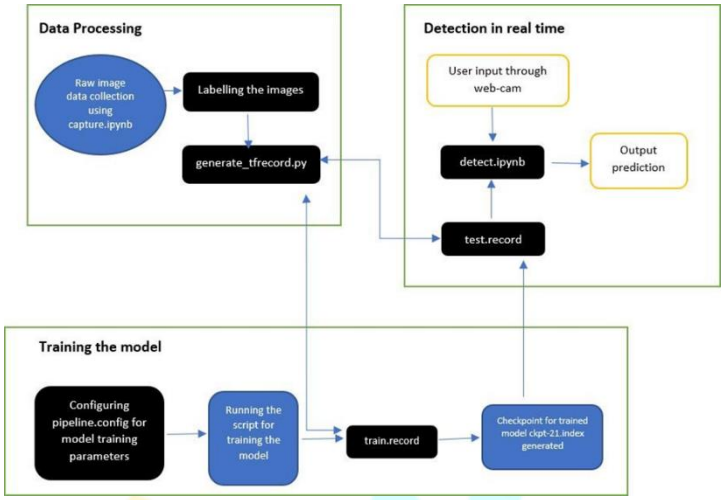

Fig -2: Block Diagram of Software Architecture

5. EXPERIMENTATION AND RESULTS

After Running the Project, The Detection was Successful. Models can Detect all Signs precisely with speed. We have taken 4-5 Signs, For NO Sign we got 86% Accuracy, ILOVEYOU Sign 73% Accuracy, YES Sign 94% Accuracy & HELLO Sign 85% Accuracy.

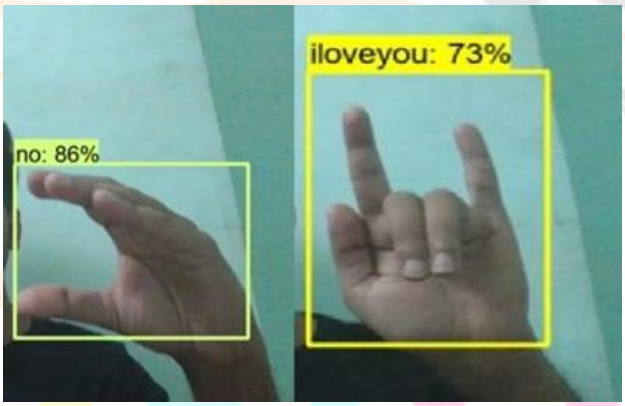

Fig -3: Result-I of Real Time Detection

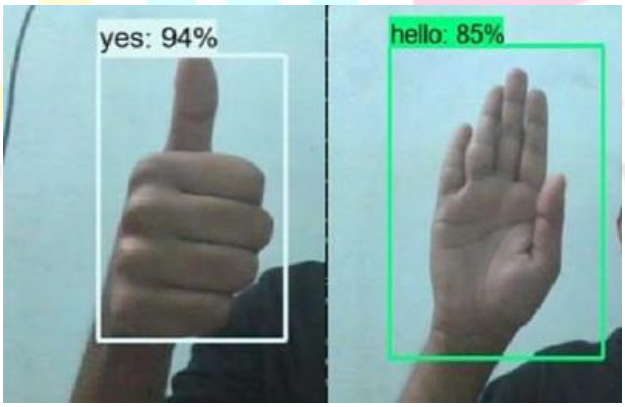

Fig -4: Result-II of Real Time Detection

6. CONCLUSION

It can be concluded that this project will help in closing the communication gap. Also, this will remove the need for a mediator or translator as this project will serve as the mediator while communicating. This model was able to detect all the signs with an average accuracy of 90% and the highest precision was 100%, which was relatively better than the previous work.

7. FUTURE SCOPE

Right now, this model works on image sequencing only in future we plan to make this model for video sequencing as well and, we will try to give speech as output of the detected sign so that blind people can take benefit of this system.

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