ISSN NO. 2456-3129

International Journal of Engineering, Pure and Applied Sciences,
Vol.7, No. 3, September-2022

Hand Sign Recognition using MobileNet DeepNeuralArchitecture

Sauransh Bhardwaj, Amit Sharma, Aditi Singh, Narendra Kumar and Mandira R Singh

Email: amitshar@srmist.edu.in, sbhardwaj1418@gmail.com, aditisingh.hh777@gmail.com, drnk.cse@gmail.com

Abstract: Communication is one of the most crucial for each and every individual in their lives Sign Languages are visual languages Sign Languages are visual languages that use hand, facial signs as the key to communication that use hand, facial signs as the key to communication for deaf and mute. But due to lack of popularity the deaf and mute society falls behind. Now computer vision is a extensively developing field with several applications which seek to identify and automate tasks that the human visual system does. Henceforth in this paper, we present a Hand Sign Recognition System which can detect and tell the meaning of the hand signs which are used by deaf and mute to help them communicate. It detects hands and observes the sign. This project belongs to the domain of computer vision and machine learning, using a deep learning algorithm known as Convolutional Neural Network.

Keywords: Convolution neural network, hand sign recognition, mobilenet, real time detection, transfer learning.

1Introduction

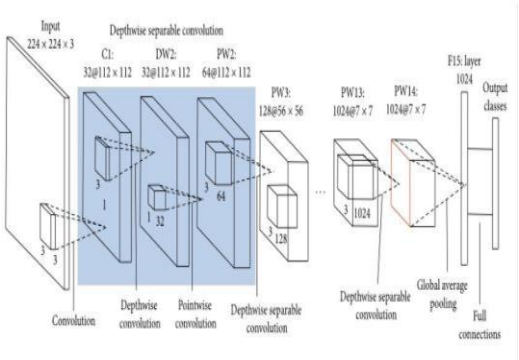
Sign language is the language of the deaf and mute. But the population of them is neglected due to lack of communication, it is a language which is not known and understood by most of the hearing population. Thus, there is a gap of communication which is unmanageable to add into the mainstream society because of which disabled are sidelined. Computer Vision has proved to be a boon to us in extending the horizons of the limit of computation in deep learning. It plays a big role hi places where there is pattern in the images, and we want to develop a model to identify its special meaning. The focus of our work is to create a vision-based system to detect hand signs of a sign language. It is an approach to aid the
communication for deaf and mute. Advancement in this field will help people from each community to stand together and understand each other. We intend to use thedevelopment done in computer vision to bridge the communication gap. We are using Transfer learning technique in machine learning along with MobileNetmodel which incorporates Convolutional neural network architecture to find the Patterns in the images fed to the model to train.
The model has been trained for real-time detection purposes. After detecting the hand sign, it displays the meaning of the sign.
The organization of this paper is as follows: Section II presents related works. Section III introduces the proposed methodology. Section IV provides discussion about the results obtained. Section V

concludes the paper.

2Related Work

To analyze driver's drowsiness levels and behaviors several systems have been built. Most of these solutions are backed by some predictive algorithms powered by statistics, machine learning, and deep learning.The Main goal is to develop a model which can recognize different hand signs and gestures to aid communication between dead and mute and the normal people. This will help to bring aware among people of learning and understanding the sign languages. Our survey includes different research papers and how hand is recognized.
Pinto and Paula Jr. [1] in 2019- Proposed using convolutional neural network for hand gesture recognition for performing computer operations. They used several feature extraction techniques and used CNN for classification.
Abed and Rahaman[2] in 2017 used a different approach by proposing using raspberry pie as the brains behind the hand gesture recognition but The database which they used for hand gesture recognition was to the mark.
DeepaliG.Mali [3] in 2019 worked on and Indian Sign Language Recognition by building a model using Support Vector Machine Classifier and Principal Component Analysis for feature segmentation.
Bhavsar and Trivedi [4] in 2020 worked on Hand Sign Alphabet recognition by using Correlation Coefficient Algorithm for feature extraction and Neuro-fuzzy algorithm for recognition on MATLAB to detect the alphabets with static images.
Ray [5] worked on a Hand gesture detector and proposed using basic modules from python which recognized the gesture based on number of fingers shown.
Ruchi and Premanand[6] in 2015 helped with working on finger tracking and contour recognition to detect gestures by using Haar like feature identification to recognize hand gesture and use Convex hull algorithm as well as Adabost to train the model.Wijayawickrama in 2020[7] converted

this project into a smart IoT project to show its application by using system which collect data with a help of sensors, while most of the Sign Language depended on Web cam, they proposed to collect data through smart gloves which will help them to know hand characteristics and then use neural network to



recognize the hand sign.
ManasaSrinivasa H S and LaxmiTyapi [8] was among one of the few early projects in this field and proposed using contours convex hull and convexity defects to detect hand gesture.

3Proposed System

Workflow
In this proposed system, we distributed the workflow into two parts-
Data Collection and Preparation-
The dataset is distributed into two folders train and test. After collection of datasets labeling techniques were used.
Training and Classification-
Deep convolutional network based on MobileNet architecture is taken to predict the object in the image.

Dataset and Preprocessing
The model for hand sign recognition is trained on created by us which contains the of images of hand sign from American sign language which conveys a meaning.
Dataset
The Hand Sign Dataset created contains of a total of

500 images. They are classified into five classes: hello, yes, no, I love you and thanks. Each class of word contains 100 images out of which 20 are testing images and 80 are training images.
Preprocessing the Dataset.

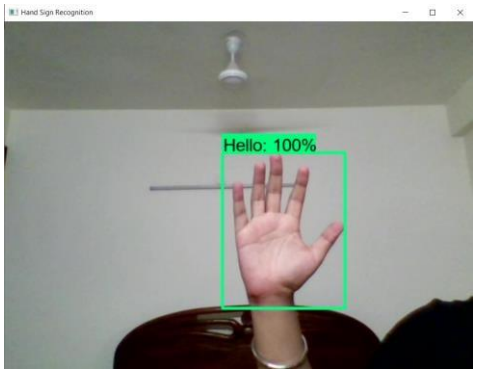
Data Augmentation is the process of performing various operations on images to create variations in order to expand the existing image data set. This helps in generalizing the data better and in turn, increases the performance of the model and reduces overfitting. A CNN model can identify objects even after certain variations and this property is called invariance. We have also labeled the images using labelImg to get xml files and tfrecord to get final dataset to be used.

SSDMobileNetv2
SSD MobileNet V2 is a model trained on COCO dataset for object detection with images of 320x320 resolution. This model is a single stage object detector model that goes from images pixels to bounding box coordinates and its architecture is based on CNN.
The base neural network extracts the features. Other neural networks make multi box for recognition and pattern identification in the pixels.
MobileNet implements a depth wise separable convolutions network. This remarkably reduces the number of parameters and data when compared to the network with regular convolutions with the same depth in the nets. Due to this the product formed results in lightweight deep neural networks which is suitable for mobile devices.

4 TransferLearning
Transfer Learning is defined as a learning technique to re-purpose or utilize the learning pattern of a model to a different model to suit the new condition problem. It is extremely popular in deep learning because we can train deep neural network with a smaller data which would otherwise take millions of image data points to be trained.We would be training a pre-existing model of SSD MobileNet v2 to create a model to detect Hand Signs and Gestures. The benefit of using is that it saves training time, has better performance and requires a smaller data.
5 Training
ThedataistrainedbyapplyingtransferlearningontotheSSDMobileNetv2 model to recognizethehandsign.
Itisobservedthatthelosskeepsonreducingwithincrease instepstilla point and then bounces to a stable area which makes the model moreeffective.

ThisCNNmodelnowformed.isthencalledinthemainpythonfileandimplemented.
Theinputis givenby passingeither imageorthrough webcam.

6 Results



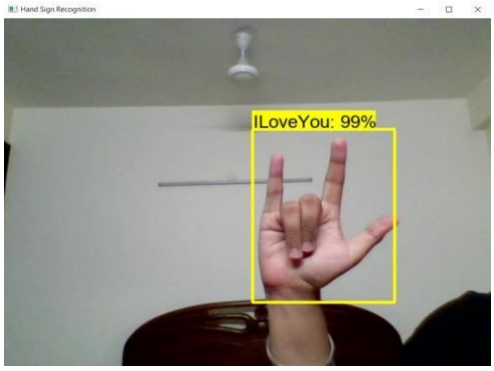


Fig.2andFig.3aresomeoutputsfromtheHand SignRecognitionSystem

The model was able to recognize the hand signs with an accuracy of98.9% regardless of this we had an accuracy of around 95% in real timeusageas thelightingconditions werenotalways ideal.

Precision:Precisionistheestimateoftotalpositivesthat areactuallycorrect.It iscalculated asfollows:

$$Precision = \frac{TP}{(TP + FP)}$$

Inourmodel,theaveragePrecisioncameouttobe0.919.

Recall:Recallistheestimateoftheproportionofactualp ositivesidentifiedcorrectly.It iscalculatedasfollows:

$$recall = (TP) / (TP + FN)$$

Inourmodel,theRecallcameouttobe0.928.

Discussion: As mentioned above, the results of the Hand sign language were very accurate. The system only failed to predict in when the camera was not able to focus on the hand. This limitation may be rectified by using a better vision camera which have a good focal length. CNN model that performs multi classification on the signs image dataset. The model achieved an accuracy of above 95%. Even though the model gave high accuracy on test data, the real-time predictions were not 100% accurate.
and sometimes the results were false positive. This model which identifies hand signs will aim to help commination between deaf and mute.

7 Conclusion

The Hand Sign Recognition system model deployed in the research work is productive and fast TensorFlow based identification model which can understand different hand signs and gestures using Transfer learning.
It can identify different signs like Hello, I love you, Yes, etc. which brings awareness of Hand Sign Language to be learned by more individuals.
Our work tried to find a mobile, fast and efficient approach to identify the hand signs and gestures. The system has achieved great accuracy with Hand sign recognition of these words, the only limitation being extreme dark background where features would be difficult to identify. We trained a robust CNN model which has above 95% accuracy. The model showed good performance in detecting Signs. In future work, we will improve the reliability and effectiveness of the system by using a night vision camera to counter the limitation. We also plan to improve the real time results of the CNN model by making the architecture more complex and increasing the dataset.

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