International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 09 | Sep 2021 www.irjet.net p-ISSN: 2395-0072

SIGN LANGUAGE RECOGNITION AND TRANSLATOR APPLICATION

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Abstract - *In Today's world, Communication is very important for every single person to allow others and ourself to understand information more accurately and quickly, but it is very difficult for the deaf and dumb people to communicate with normal people. They convey their message using Sign Language which is a combination of gestures, orientations, movements of hands, arms or body and facial expression, but not every normal person can understand that language. Our System is used to help those people who are unable to hear and unable to speak to make conversation with other normal people. Creating an Android Application which is used to translate Sign Language into normal language. People just need to capture image word by word then after a single click a background process is executed which can process images using libraries of TensorFlow and within few seconds it is converted into meaning full sentence or phrases. Outputs are in two modes i) Text & ii) Audio. Our system can also handle with all type of sign languages (i.e., Indian Sign Language, America Sign Language, etc.) and translates it to every language (i.e., English, Hindi, etc.). Other main feature our system provides is frequent phrases which consists of various frequently used phrases so that, there is no need of capturing photos, just click button to play audio of visible phrases.*

Keywords: Sign Language Translator, Hand Sign Recognizer, Hand sign Translator, Hand Sign to Speech and Text, Deaf & Dumb Language Translator.

1.INTRODUCTION

Sign Language is the visual manner to convey the message for Deaf and Dumb Peoples. It is a combination of gestures, orientations, movements of hands, arms or body and facial expression. Like a normal language, Sign Language is also varying considering different factors. Various standard sign languages available in the real world are Indian Sign Language (ISL), American Sign Language (ASL) etc.

According to a great Author Paul J. Meyer, Communication – the human connection is the key to personal and career success [10]. Communication is the important term in real world to allow others and ourself to understand information more accurately and quickly. But it is not easy for the Deaf and Dumb peoples to communicate with the normal peoples as they all can't understand this Sign Language.

This project provides one of the solutions to increase the communication of Deaf and Dumb peoples with the normal peoples. In this digital era, Mobile application is the best solution for everyone to use, so by using the capabilities of Machine Learning and Image processing algorithms available in TensorFlow Library we make the working mobile application. In which, user has to capture image as input and got the output in terms of text and audio. This will ease the medium for those special peoples and in some cases using the Frequent Phrases feature of our application, there is no need of capturing the photos just they need to press single button.

2. LITERATURE SURVEY

Table-1 : Related Work

Sr no.	Title	Methodology
1.	**A real-time portable sign language translation system[1]**	It uses the wireless system to process the data. To differentiate hand motion, they have inner sensors put into gloves to show the parameters as given by, posture, orientation, motion, defined of the hand in Taiwanese Sign Language could be recognize in no error. The hand gesture is considered by flex inner sensor and the palm size considered using the g sensor and the movement is considered using the gyroscope. Input signals would have to be consider for testing for the sign to be legal or not periodically. As the signal which was sampled can stay longer than the pre-set time, the legal gesture sent using phone via connectivity like Bluetooth for differentiating gestures and translates it. With the proposed architecture and algorithm, the accuracy for gesture recognition is quite satisfactory. As demonstrated the result get the accuracy of 94% with the concurrent architecture.

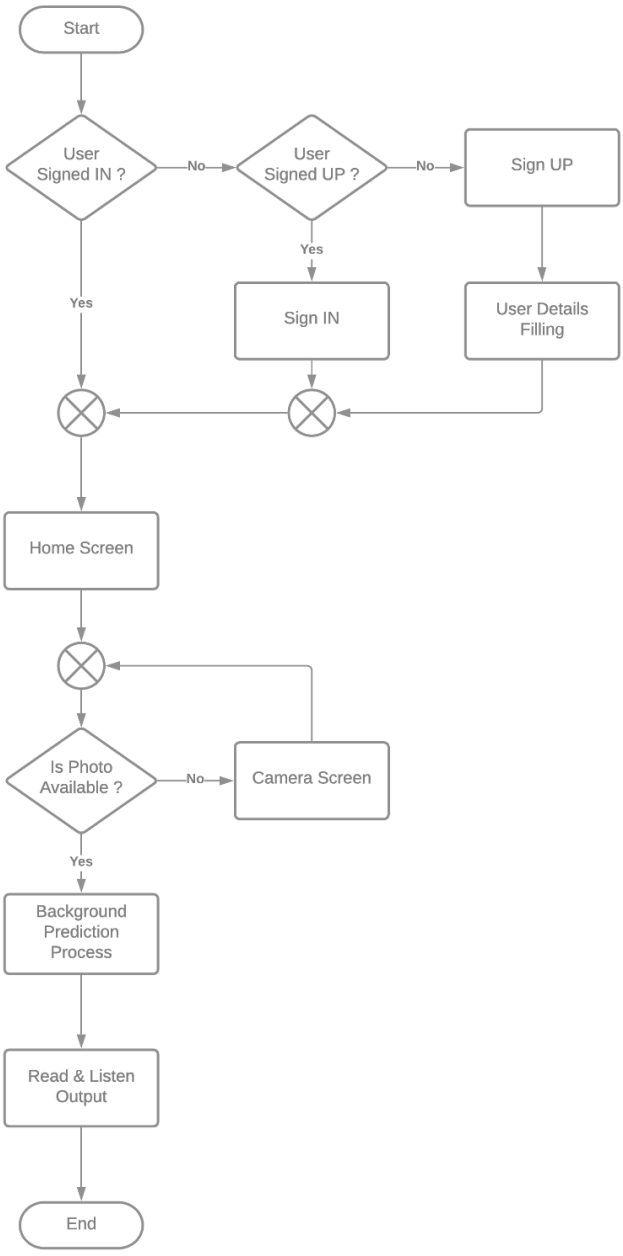
2.	**Automated Sign Language Interpreter [2]**	It demonstrates Instrumented gloves with audio out are the solution here. The gloves attached with various sensors are worn for sign interpretation. Hence, the proposed system solves the problem and helps the dumb people in communication with the rest of the world at low cost.
3.	**Vision-based sign language translation device [3]**	The proposed system which is an interactive application program developed using LABVIEW software and incorporated into a mobile phone. The sign language gesture images are acquired using the inbuilt camera of the mobile phone; vision analysis functions are performed in the operating system and provide speech output through the inbuilt audio device thereby minimizing hardware requirements and expense. The experienced lag time between the sign language and the translation is little because of parallel processing. This allows for almost instantaneous recognition from finger and hand movements to translation. This is able to recognize one handed sign representations of alphabets (A-Z) and numbers (0-9). The results are found to be highly consistent, reproducible, with fairly high precision and accuracy
4.	**Sign language interpreter using a smart glove [4]**	It demonstrates a novel approach of interpreting the sign language using the portable smart glove. LED-LDR pair on each finger senses the signing gesture and couples the analog voltage to the microcontroller.
5.	**A machine learning based approach for the detection and recognition of Bangla sign language [5]**	It demonstrates Hand Gesture recognition which is performed using HOG (Histogram of Oriented Gradients) for extraction of features from the gesture image and SVM (Support Vector Machine) as classifier. Finally, predict the gesture image with output text. This output text is converted into audible sound using TTS (Text to Speech) converter.
6.	**Speech Recognition Automation by ASR[12], [13]**	Author have presented multiple experiments to design a statistical model for deaf people for the conversion to sign language from the speech set. They have further made the system that automates the speech recognition by ASR by the help of animated demonstration and translation statistical module for multiple sets of signs. As they went ahead, they used the following approaches for the translation process, i.e., state transducer and phrase defined system. As of evaluation certain figures type have been followed: WER, BLEU after that comes the NIST. This paper demonstrates the process that translates the speech by automation recognizer having all three mentioned configurations. The paper came up with the result with finite type state transducer having the word error rate among the range of 28.21% and 29.27% for the output of ASR.
7.	**Indian Sign Language (ISL) Translation System For Sign Language Learning[6]**	It works in a continuous manner in which the sign language gesture series is provided to make a automate training set and providing the spots sign from the set from training. They have proposed a system with instance learning as density matrix algorithm that supervises the sentence and figures out the compound sign gesture related to it with a supervision of noisy texts. The set at first that they had used to show the continuous data stream of words is further taken as a training set for recognizing the gesture posture. They have experimented this set on a confined set of automated data that is used for training of them, identification for them and detection stored a subtle sign data to them. It has been stored around thirty sign language data that was extracted from the designed proposal.

3. METHODOLOGY

3.1 System Design

The basic flow of our system shown in below flowchart which is starting from the basic step of authentication → filling user details → home screen → capturing image → background prediction process → output.

Figure-1 : Flow of System working



For the best outcome of a project, it's necessary to have a good backend processing and a pleasant front-end design which is preferred to be interactive. For this project the major requirements in back-end and front-end are as follows:

Machine Learning and Image Processing :

The main heart and logic of the project lies on the Machine Learning and Image Processing Algorithms which are used from the platform provided by TensorFlow. With good understanding of theoretical concepts every minute information has kept in focus and with strategy it is tried to recognize the signs from input image using the training data set which consists classes of every required phrases. Final trained and tested model is saved in supportive format which can be used in Application Project.

TFLITE Model Maker :

As mentioned in [7] TensorFlow provides various types of format of models. In which TensorFlow, TensorFlow Lite, TensorFlow.js, TensorFlow Extended are used for Software, Mobile and IOT, Web, Production based application respectively. As our project is Mobile Application based, we are using tflite-model-maker to train and test model in few line of code.

Teachable Machine :

As mentioned in [9] Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone. Any one can train their model by using three simple steps :

i) Upload or Add Sample Data according to Class
ii) Train model by selecting proper epochs, batch size learning rate.
iii) Export the model with required format.

Here with this there is no prerequisite machine learning knowledge required.

Android Studio :

This platform is used to design interactive interface that can easily reach to lots of needy peoples. Designed a mobile application integrated with TensorFlow library that have a minimalistic UI design which leads to an easy-to-use behavior. All views are at their standard defined positions helping user not to memories anything for performing a task. It consists of simple click button which transfers to Camera and after Images clicked user have to press Ok button which takes back to main screen and in that screen, recognized text is visible and audio is also generated which can be hear on simple button click.

3.2 Analysis

The project begins by first forming the back-end process using Machine Learning and Image Processing Algorithms written in Python. Model training is required to predict the

hand signs and we supply it with a Image data set which is categorized in different Sign classes. Then a customized model is created and exported in required format.

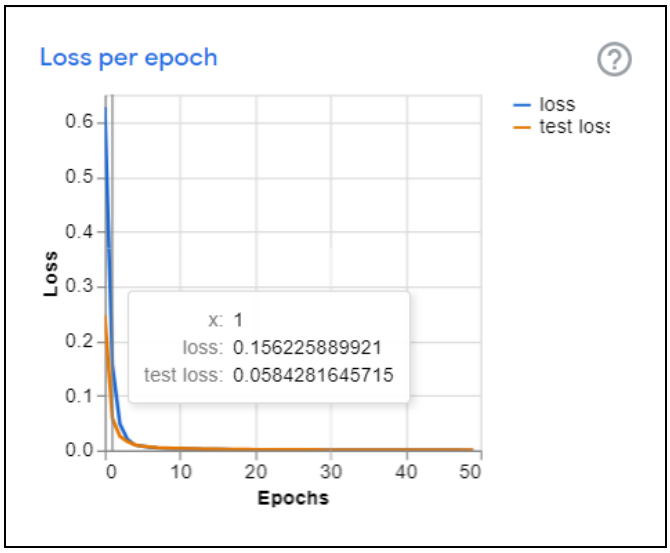
Post Training quantization is a conversion technique that can reduce model size and inference latency, while also improving CPU and hardware accelerator inference speed, with a little degradation in model accuracy. Thus, it's widely used to optimize the model.

We can achieve the better accuracy of model by tweaking some the training hyperparameters.

- → **Epochs :** more epochs could achieve better accuracy until it converges but training for too many epochs may lead to overfitting.
- → **Dropout - rate :** The rate for dropout, avoid overfitting. None by default.
- → **Learning - rate :** The rate to train the model.
- → **Batch - size :** A batch is a set of samples used in one iteration of training.
- → **Samples – Amount :** Amount of sample input data for training.

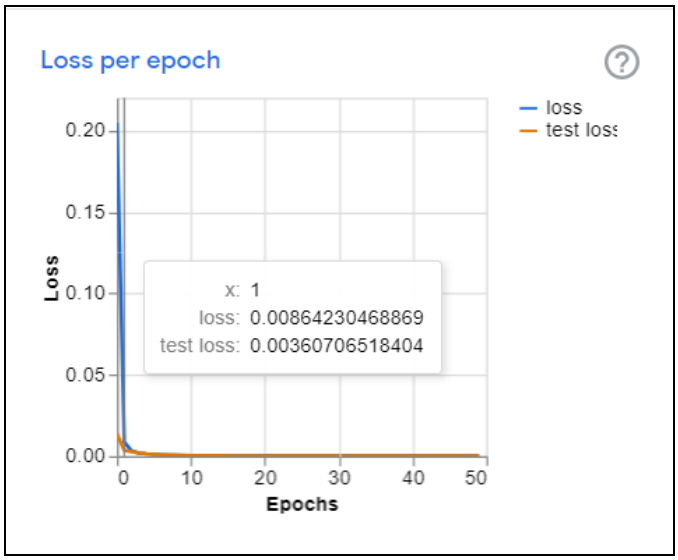
Here, we are using 85% of input data for training purpose and 15% for the test purpose. The loss of model decreases by increasing the samples per classes as shown in below given graphs.

Chart -1 : Loss per epoch with approx. 60 samples per class



We can see that in first graph (chart 1) containing approximately 60 samples in all class gives loss of 0.156 where as in second graph (chart 2) containing approximately 200 samples in all class gives loss of 0.008,

Chart -2: Loss per epoch with approx. 200 samples per class



which can say that with increasing the input samples loss decreases. Similar thing happens in Accuracy factor by increasing samples accuracy will increases (chart 3 and 4).

Chart -3 : Loss is 0.069 at 1st epoch

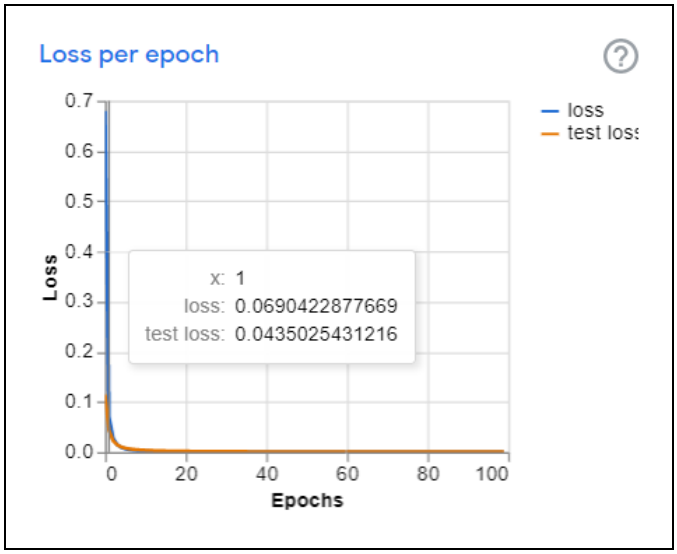


Chart -4 : Loss is 0.00014 at 74th epoch

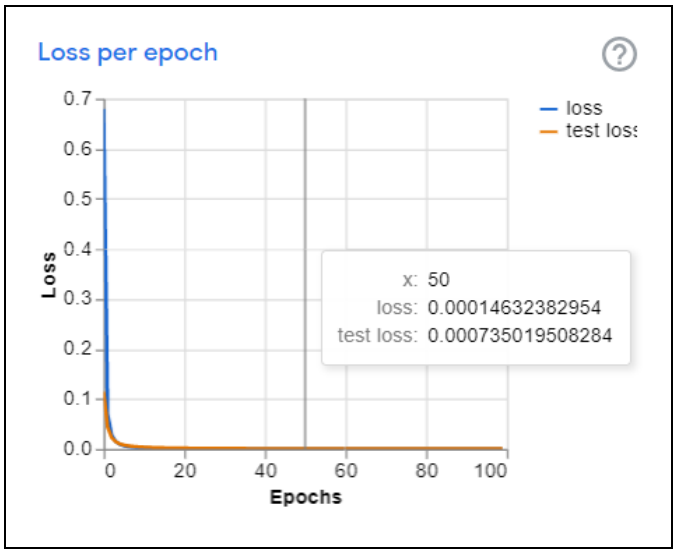


Chart -5 : Accuracy is 0.996 at 1st epoch

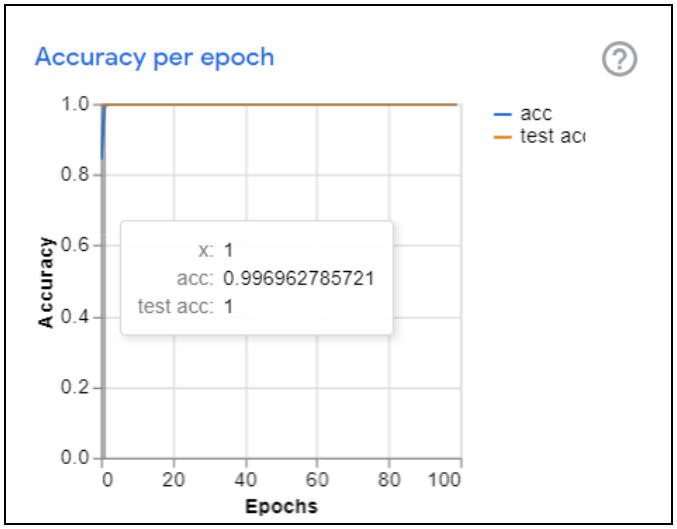
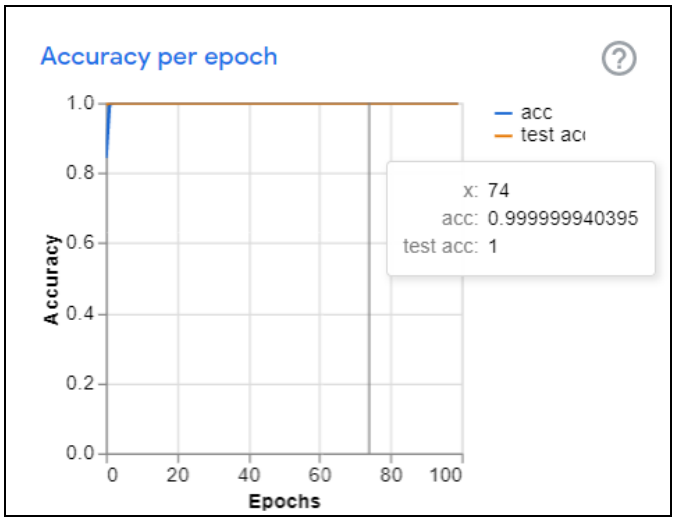


Chart -6 : Accuracy is 0.999 at 74th epoch



As shown in graphs (chart 5 and 6), with increase in the epochs loss will decreases and accuracy will increases.

3.3 Implementation

For the project implementation first of all back-end is implemented by going through the following functions explained in a brief manner:

Data Collection :
For this project, we use real images taken from webcam and then it can be categorized into different classes according to their signs, some of them are shown below (figure 2).

Figure -2 : Dataset according to class

Model Building :
For model building, we use Teachable Machine web-platform in which we add the images according to the classes and then by changing some of the attributes like epochs, batch-size etc. And the last stage is of exporting model with given types i) Tensorflow ii) Tensorflow.js & iii) Tensorflow Lite.

Integrating model with Android App :
The TensorFlow Lite Android Support Library makes it easier to integrate models into application. It provides high-level APIs that help transform raw input data into the form required by the model, and interpret the model's output, reducing the amount of boilerplate code required. It supports common data formats for inputs and outputs, including images and arrays. It also provides pre- and post-processing units that perform tasks such as image resizing and cropping.

For front-end implementation of the project is as follows :

Camera 2 API :
As mentioned in [8] This package provides an interface to individual camera devices connected to an Android device. Package gives camera developers options to do more with the camera. Control the shutter speed(ISO), focus, RAW capture etc. This helps third-party developers to include more features

in their applications with the tools they are given through the API.

Developing Android Application :
An interactive and operable android application is developed with minimalistic UI design so that all the operations are in approach to the user easily. User just need to capture images per words and then click single button to see the recognized text and single click to hear the audio of corresponding text.

4. RESULT AND DISCUSSION

The project reflects a potential solution towards Hand Sign Language Recognition and Translation to Audio and Text. It is preferred that hand signs are made on plain background and it neither too far nor too nearby camera, so that the predicted output is accurate. Currently project works on some the statements or words but for the real-world purpose, we have to add more classes and more samples to get accurate output.

Hypothesis for the behaviour of application can be made as, the input data provided for training model is not considering in all circumstances and it might be possible that user can use this with abstract background and also it is possible that all users has their own different shape and size of hands, so the output may be inaccurate.

Despite of above hypothesis that presents special conditions, this project puts light over a great solution against the problem. It showcases the way of using the current technology, the algorithms within it and how to train the machine for such scenarios. The various algorithms that are capable and can also be developed to increase their efficiency for better prediction. In the control testing environment, they have shown a great accuracy. Way of presenting it make it more operable for the user by providing good UI design and controlled options over the application. With more advancement the predictions can be taken close to reality.

Photo (figure 3) shows home page, where the capture preview box is empty initially. To give an input as image user needs to click on Capture button.

Next images (figure 4) are about the capture screen in which user has to click the image with his / her conviniency with front or back camera, flash light, timer by phrase – phrase.

At the end, user came back at home screen by clicking OK button and their the predictable output is available in text form as well as in audio form which can be played by clicking Audio button at the bottom of screen (figure 5).

Figure – 3 : Initial Home Screen

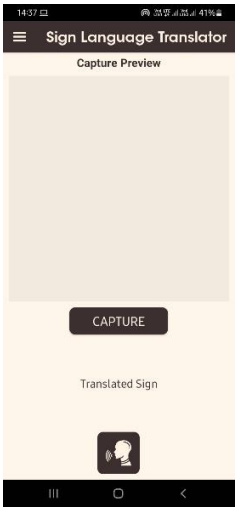


Figure -4 : Capture Screens

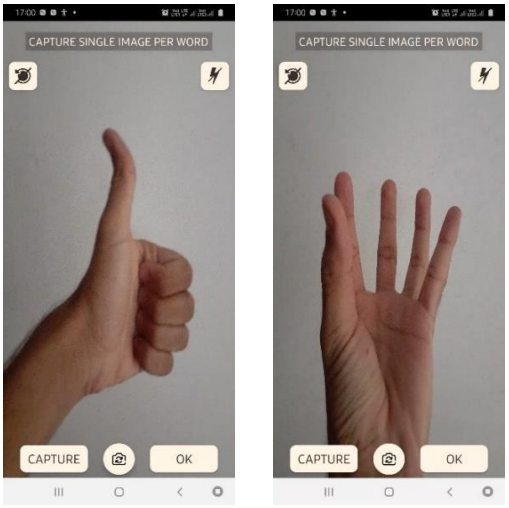
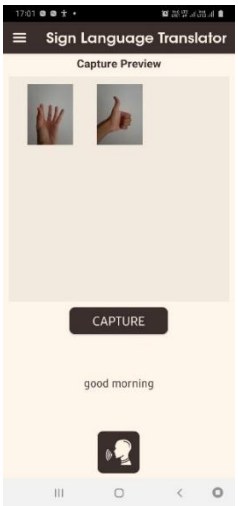


Figure – 5 : Output Home Screen



5. CONCLUSIONS

Our project is about a system which can support the communication between deaf and ordinary people. The aim of the project is to provide a complete dialog without knowing sign language. Earlier communication is not so important, but today in the growing world communication is the important term for personal and career success. So this is a project which help Deaf and Dumb people to communicate with others and put their thoughts in the real world.

This project provides portion of most effective and a reliable solution as per current technology advancements by providing a mobile application where user can capture the hand signs and that is translated to Text and Audio with the help of Machine Learning and Image Processing.

Considering today's technology and needs this project may overcome the problem but an effective solution must be required by improving this project which is helpful to this needy people. Because every person has their opinion about the real-world problem and it might be possible that this people can give an idea to solve this real-world problems. So, it is good for us to make a communication between these people's and normal peoples.

ACKNOWLEDGEMENT

I am indebted to a number of people who have helped and supported me in successful completion of the Project work with their constant guidance and encouragement.

I am thank full to all, who contribute in my new journey of where I got a chance to reflect my skills. I would like to express my gratitude to my internal guide, Prof. Avneet Saluja, for her hard work, dedication, guidance, availability and many more. Apart from this, I would like to express my recognition to the rest of the Faculty members of Computer Science and Engineering Department who helped me to reach at this stage by their continuous assistance, guidance and motivation. Also, I would like to thank all the members of ITM Universe Baroda for their hard work and dedication towards the growth of students as well as the faculty members. And at last, I will be thank full to my friends who always motivate and help me to give my best.

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