Spectre: An Approach to Detect Human Intention Using Convolutional Neural Network

BY

Debashish Das
ID: 161-15-7510

Sanjida Akter
ID: 161-15-7479

&

Samit Protim Das
ID: 161-15-7262

This Report Presented in Partial Fulfillment of the Requirements for

The Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Ms. Afsara Tasneem Misha

Lecturer

Department of CSE

Daffodil International University

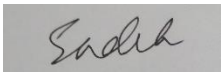
DAFFODIL INTERNATIONAL UNIVERSITY
DHAKA, BANGLADESH
DECEMBER 2019

APPROVAL

This Project/internship titled Spectre: An Approach to Detect Human Intention Using Convolutional Neural Network , submitted by Debashish Das, ID No: 161-15-7510, Sanjida Akter ID: 161-15-7479, Samit Protim Das, ID: 161-15-7262 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 8 October 2020.

BOARD OF EXAMINERS

Dr. Syed Akhter Hossain — **Chairman**
Professor and Head
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University



Md. Sadekur Rahman — **Internal Examiner**
Assistant Professor
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Subhenur Latif — **Internal Examiner**
Assistant Professor
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Dr. Md. Saddam Hossain — **External Examiner**
Assistant Professor
Department of Computer Science and Engineering

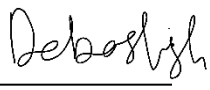
DECLARATION

We hereby declare that, this thesis has been done by us under the supervision of **Ms. Afsara Tasneem Misha,Lecturer, Department of CSE,** Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

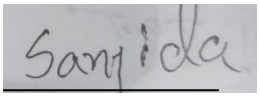
Supervised by:

Ms. Afsara Tasneem Misha
Assistant Professor
Department of CSE
Daffodil International University

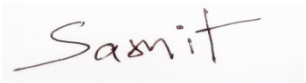
Submitted by:



Debashish Das
ID: 161-15-7510
Department of CSE
Daffodil International University



Sanjida Akter
ID: 161-15-7479
Department of CSE
Daffodil International University



Samit Protim Das
ID: 161-15-7262
Department of CSE
Daffodil International University

ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final thesis successfully.

We really grateful and wish our profound our indebtedness to of **Ms. Afsara Tasneem Misha**, Lecturer, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "Computer Vision" to carry out this project. His endless patience ,scholarly guidance ,continual encouragement , constant and energetic supervision, constructive criticism , valuable advice ,reading many inferior draft and correcting them at all stage have made it possible to complete this thesis.

We would like to express our heartiest gratitude to **Pro. Dr. Akhter Hossain, Professor, and Head,** Department of CSE, for his kind help to finish our thesis and also to other faculty members and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and passion of our parents.

ABSTRACT

In the past few years Bangladesh has experienced a tremendous growth in the field of ICT. We are becoming tech-dependent generation day by day. Though we need more development in the security sector of Smart Home to ensure more safety. As some lacking are still present in this area. There are many cases available which are related to home invasion. We can decrease the rate and avoid these misfortune situations by using advanced technology and digital devices. Traditional security systems are very weak to fight these problems as those doesn't include advanced technology. So most of our homes are not really well secured and its not easy to stay alert about the upcoming event to avoid unwanted situation. Our goal is to make this system available for people to get the facilities of advanced security system. We will involve more ICT based application and advanced technology in our doorbell or CCTV to upgrade the security system. Our research-based project mainly focuses on predicting human intension. It will collect data by reading human facial expression and body language. Thus, our system will send alert to the user so that the user can easily detect the possibility and become aware of the situation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TABLE NO. **PAGE NO.**

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, in this new world of science & technology Smart Home became one of the most important essential of our life. Predicting human intention will help to develop the security sector of Smart Homes. Our system will predict intention of a person based on his/her facial expression and body language data, collected from CCTV. The system will make sure that the user is warned about the sudden presence of stranger at the door.

Home invasion is one of the most occurred crime in our country. Beside this there are many more unwanted occurrences that happens for the lack of a strong security. Technology always make things easier for us. Implementing of new technology and ideas will help improve the security system. First, we have to collect data of human expression and body language. Then we will apply these in our system.

We don't know what's going on in someone's mind. But we can guess observing their facial expression and body language. So we will collect these data from real life pictures and movies. Then we'll study those data and implement it in our system. Suppose there is a stranger in front of our door with angry facial expression. Then there must be a negative possibility behind this. Our system will predict some negative consequences and warn the user about the person and consequences. There will be different prediction for different expression and body language.

We will be able to apply this type of technology in our doorbell or CCTV to secure our home. People will be able to be prepared for what's coming next by receiving those alerts. This is how we can implement this in our real life.

1.2 Motivation

Nowadays whenever we open news channel or read newspaper, we get many news related to home invasion, robbery. Worries of home invasion and things stolen raised up to 59.76% and the rate of being mugged or robbed increased up to 67.02% in our country in the past few years. And this rate is increasing day by day so as the suffering of people. So if we can build a system that will read real time facial expression of people form CCTV footage and predict their intension as accurate as possible then it will be easier for us to stay alert. Our system will send alert via massage to the user to make them aware about the possible intension of the person at the door. Thus, we will be able to reduce the rate of those unwanted events.

In the past few years Bangladesh has experienced a tremendous growth in the field of ICT. We are becoming tech-dependent generation day by day. Though we need more development in the security sector of Smart Home to ensure more safety. As some lacking are still present in this area. There are many cases available which are related to home invasion. We can decrease the rate and avoid these misfortune situations by using advanced technology and digital devices. Traditional security systems are very weak to fight these problems as those doesn't include advanced technology. So most of our homes are not really well secured and its not easy to stay alert about the upcoming event to avoid unwanted situation. Our goal is to make this system available for people to get the facilities of advanced security system. We will involve more ICT based application and advanced technology in our doorbell or CCTV to upgrade the security system. Our research-based project mainly focuses on predicting human intension. It will collect data by reading human facial expression and body language. Thus, our system will send alert to the user so that the user can easily detect the possibility and become aware of the situation.

1.3 Objective

It's true that technology won't be able to prevent unwanted events completely. But it will at least minimize the chance. Home is one of the human's fundamental right and people deserves to live there safe and secure. Most of the people uses traditional systems to secure their home. Which doesn't really ensure the security. With the help of advanced technology, we're trying to help people achieve the upgraded security system.

To predict the human intension, we used the seven most basic real time human facial expression: SURPRISE, FEAR, ANGER, SAD, DISGUST, NEUTRAL, HAPPY. The CNN which runs our project is built with the assistance of Keras whose backend is TensorFlow in Python. We also have developed an android application which will collect input from camera to predict the intension of a person.

Our application works well both on android and iOS.

The user will realize that our application is very user friendly as its very easy to operate and very understandable.

1.4 Expected Outcome

- The app or system will predict the intention perfectly.
- The prediction will be shown instantly.
- Alert the user about the possible outcome.
- User Changeable Language
- Will Provide instant notification through GCM
- No Internet will be required in case of android app.

1.5 Report Layout

- The examination of the idea of standards, hypotheses and strategies enlisted by jurisdiction.
- The vital investigation of idea has been placed inside the order.

CHAPTER 2

BACKGROUND

2.1 Introduction

There is no similar work has been done which can predict intention with user image. Not only in Bangladesh, predicting intention is not done widely even in foreign countries. Because Human can fake the face expression. We are doing this because if someone don't know that they are being recorded than they may not change their face expression. That's why we will use CCTV footage to examine.

2.2 Related Works

There are a lots of works available for human face expression. But there are none with real life implementation. Some big companies like Xiaomi are using some technology in their Camera but not widely available. We have read some paper about CNN Image Classification which we have used for classified the image to predict intention. Here are some.

Yao, P., Wu, H., Gao, B.et.al [1] they have classified human faces using electronic synapses. They have Grey-scale faces for parallel online training. They have used low end hardware for the result. Their main focus was using this method on IoT Devices like door.

Khan, F. et.al [2] The proposed method has the essential target of grouping the outward appearance appeared by an individual. These classifiable articulations can be any of the six widespread feelings alongside the unbiased feeling. After the underlying facial limitation is performed, facial milestone identification and highlight extraction are applied where in the tourist spots are resolved to be the fiducial highlights: the eyebrows, eyes, nose and lips. This prompts age of information highlight vectors being defined utilizing Euclidean separations and prepared into a Multi-Layer Perceptron (MLP) neural organization so as to arrange the articulation being shown.

Rao A., Ajri S., Guragol A., Suresh R., Tripathi S. [3] This paper shows the feeling acknowledgment procedures in kids and grown-ups and recognizes the separating highlights.

There is conventional writing investigated f facial emotion recognition (FER) in grown-ups however restricted spotlight on youngsters. They have used a mathematical based methodology known as facial landmarks combined with a basic Deep Neural Network (DNN).

S. Mishra, G. R. B. Prasada, R. K. Kumar & G. Sanyal,et al. [4] has shown various feelings and their power level in a human face using Deep CNN. They have worked with the exactly same emotion we have chosen happy, sad, fear, anger, surprise, disgust and neutral.

S. Turabzadeh, H. Meng, R. Swash, M. Pleva and J. Juhar, et al. [5] has shown real time face expression using VmodCAM. They have tested the System on MATLAB. They have built that FER system on the field-programmable gate array (FPGA).

Trupti S. Bodhe et al. [6] proposed a model for RGB data classification by using class for image classification to find out color space component. Substitute color space is used, like HSI, RGB, YIQ, YUV, HSV color system for suitable change activities. They have clustered pixel into salient image regions to find out better result.

Ko, Byoung Chul, et. al [7] have used CNN to extract facial features and detect human emotion. For an individual frame they have chosen long short-term memory (LSTM).

2.3 Bangladesh Perspective:

In Bangladesh's there are a lot of crime happened in house even they have CCTV camera. Because those cameras are not smart. They can't predict human intention. So, robbers break into house and make the headlines. Everyday we show those in newspaper. In Dhaka there are very few houses without CCTV camera. If we can make them smart enough using our proposed system the owner of the house will get notified within second when someone tries to break into the house. So the owner can take action like call for police. So at this moment our system will be really very helpful to those house owner who cant keep a individual person on monitor.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Using Convolutional Neural Network with Dense, Flatten, Conv2D layers we have achieved 93% accuracy.

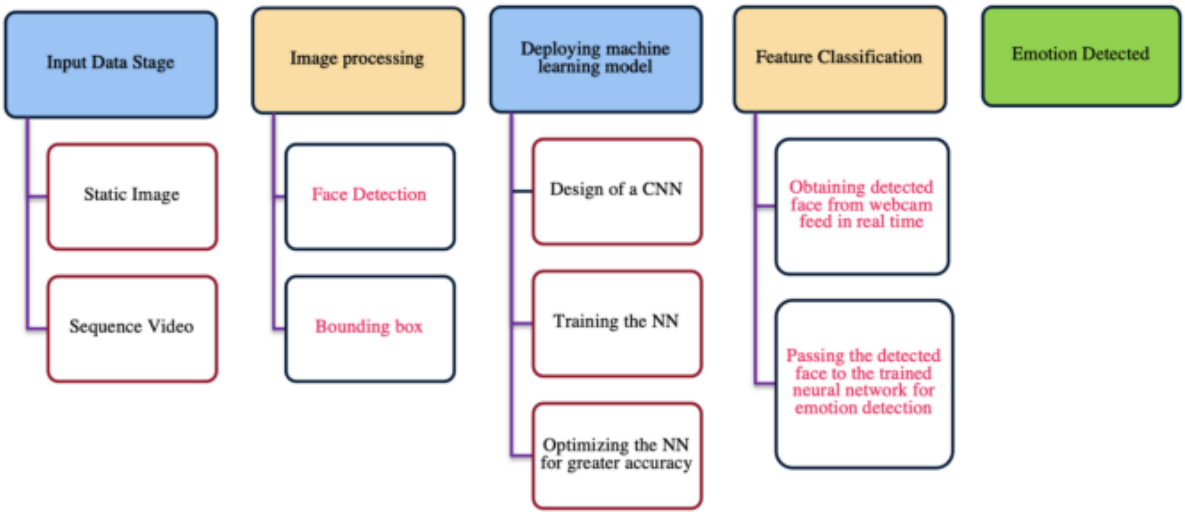


Figure 3.1.1. Steps of Data Collecting and Processing

3.2 Experiment Data Set:

We have collected data from both online and offline. From Kaggle and face database, we have got 30000+ Images. But some images were not appropriate for our listed emotion. So we have reduced the images into 25000.

Figure 3.2.1 Collected Face Images

3.2.1 Data PreProcessing:

All the data we have used here is collected from Face Data base and Kaggle. We have also collected some data from our friends. The training period was very hard to maintain. This rendition of the face images containing a fixedsized of pictures. As per our undertaking necessities, we've changed over all pictures into a 48X48 pixel size. We have use Photoshop, Photoscape to pre-process the face images.We have chosen for Color Training mode

3.2.2 Architecture of our proposed Model:

Our model is made to predict the human intention directly collected from face data and expression and we've used 4 CNN layers to build the system and it also has 2 connected layer. The first connected layer, in which we have included normalization layer, dense2d layer & dropout layer will assist to get better accuracy. The layer which will take input and it has the kernel size of 3. The kernel also take input in shape 48x48 of Red Green Blue Color mode. The filter of the kernel is 32 as we have found optimized in internet. The input layer use ReLU function with strides. The ReLU function it restores that incentive back when it get input positive value and likewise when get input negative worth it brings 0 back.

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

The CNN Layer1 output goes to the input of the first max-pooling2D layer. To make sub-regions binned max-pooling reducing the number of parameters and here the max-pooling layer containing pool size 2 with strides 2. In the second layer, the filter size is 64 with kernel size is 3 and the stride is 1. In this layer has batch normalization to regularize the convolutional network which is

vanishing gradient during training and can make better performance and minimize the training time. Here batch normalization is using to makes the learning process quicker and can use the higher learning rate. The result of convolution layer 2 is connected with the next pooling layer. The layer has also same pool size 2 with strides 2.

Layer 3 have one twenty eight filter with other characteristics of kernel, strides and batch normalization same as like as layer 2. Layer 3 gives output and the output is associated with the third pooling layer and the pool size, strides is 2. Layer 4 has filter size 256 where it is containing the same feature as like as layer 3. But here in this layer, 25% dropout used to make the model more stable during training and this can be too strong of regularized.

After those 4 layer we have added are two dense_layers which speak to a framework vector duplication. In the principal dense layer have 256 hidden units and drop out is 25% with initiation esteem. To handle the over fitting dropout method is utilized here. In the second dense layer, the dense is 6 without drop out to standardize the model and the initiation is sigmoid. This how the model is fabricated. In the wake of including this layer in the model the outcome is turning out to be smooth and boisterous free and afterward including two completely associated dense layer for improving an exhibition of the grouping task where there are likewise bunch standardization and drop out the property. At that point by applying a sigmoid to it, it will change over the information to probabilities for each class. A sigmoid function-

$$(z)=1/\ (1+e-z)$$

The binary cross-entropy is helped to define the loss which acts as a loss function for binary classification problems. then , the optimizer, which can help to perform gradient descent and therefore the metrics set accuracy since this is often a classification problem.

Figure 3.2.2.1 presenting the design of Convolutional neural network model: -

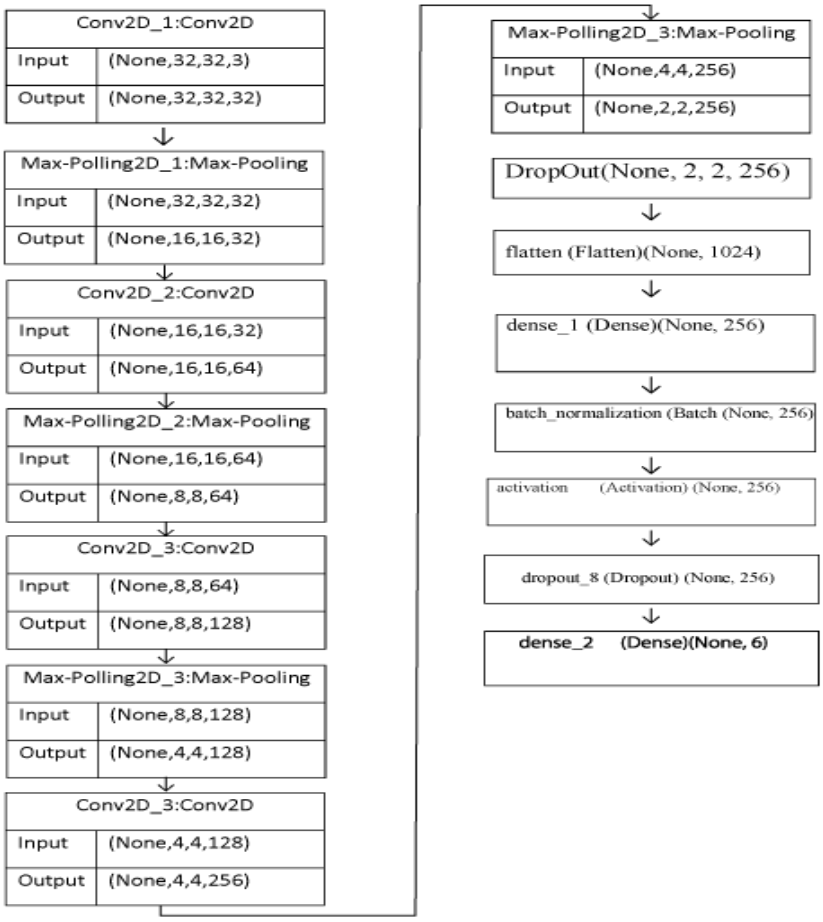


Figure 3.2.2.1 Representation of model summary

3.2.3 Learning rate and Adam Optimizer:

Our training data has used the popular Adam Optimizer which has learning rate of 0.001 updates network weight and help the model to learn faster in the starting learning postion with better accuracy. In their specialized expressions of the paper they changed the net loads by going starting with one cycle then onto the next repetition. Weights are being changed with k, Here k is the repetition index.

$$w_{lij}(k+l) = w_{lij}(k) - \mu g_{lij}(k) \qquad l= 1,2,\ldots L$$

Adam Optimized Lear rate which is 0.001 performs the suitable for both 1x size and 10x model size the samewhich implies it doesn't rely upon model size. Choosing learning rate is the most

groundbreaking hyper boundary for the model. The system of calculation of each update with learning rate decay as bellow:

$$LR = initial\_lrate \times (1 / (1 + decay \times iteration))$$

We've tried using min learning rate of 0.00001 and found out that this learn rate quickly reduce the error. We have used to callback function to check the learn rate, provided by Keras and tensorflow. The function is designed to make a fine-tuning model, which we have ignored due to less accuracy it was providing, weight to reduce the learning rate when the model stops increase its mode.

3.2.4 Face Data Augmentation:

We have augmented our traindataset and testdataset by changes their shape and crop some of them due to all images were not in same size. Therefore the face images width and height shift range 0.2 where the zoom range is additionally an equivalent. Changing train face images so that valaccuracy and robustness can enhance the multiclass classifier by the help of data augmentation can generate for each sample x_i the network outputs the selected class label y_i, as well as a probability p_{ij} for each class j [13].

Using the prediction of the sample the classifier is most sure about:

$$y = \text{argmax}_j \max(\{p_{ij}\}_{1 \le i \le r}) \quad (5)$$

$$\text{Averaging all predictions: } y = \text{argmax}_j \frac{1}{r} \sum_{i=1}^{r} p_{ij} \quad (6)$$

For this paper, information enlargement has assumed a functioning part in getting later most wondrous outcomes in many leaf ailment discovery assignments and it is utilized so as to upgrade speculation highlight. Even flipping, brilliance movements and irregular RGB shading are utilized with rescaling the picture. Prior to some other handling, we need to increase the information then it creates an outcome is known as rescaling esteem.We have chosen R G B and the limit of color from 0 to 255 but the situation we are working like facial expression, this high value will take too long time training the model. That's why we have reshaped the image (reshape=1. /255).

3.2.5 Training the model:

As our tested four CNN layers & two connected CNN layer. When we were training the proposed model with the new face data which was not included in training or validation sets that was giving a more desirable performance. In Training the Batchsize 512 was used with 20 epochs. As we have huge face image dataset we have used less EPOCH so that our model trains fast. The model we have built with 20 epoch anb 512 batch size provied a marvelous awesome accuracy though our train accuracy is 93.62% and validation accuracy is 73.44%. The inputed size of the face data is 48 × 48 . We have chosen same face data image size for train and validation. The convolutional neural network model, we have used here can organized the image with better accuracy.

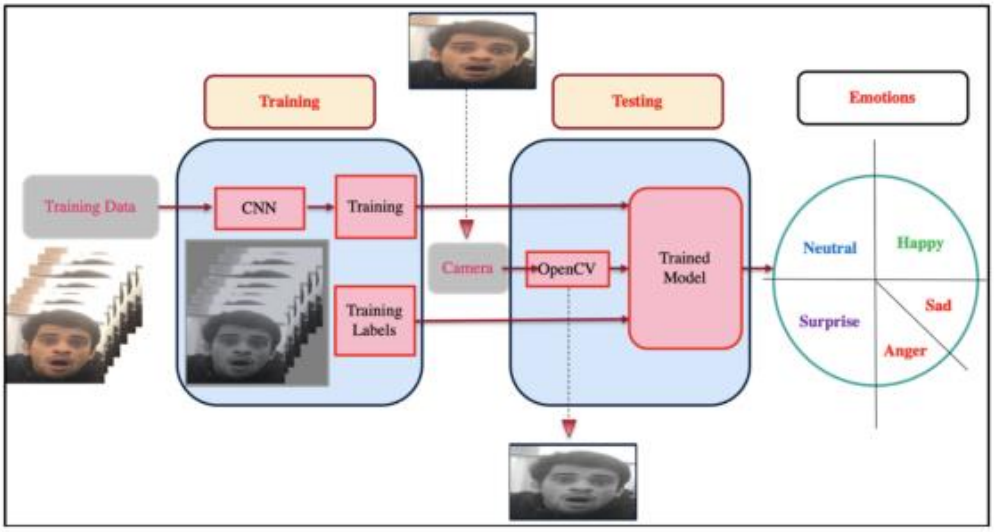


Figure 3.2.4.1 Convolutional neural network layer

3.3 Data Collection Procedure

All the data we have used here is collected from Face Data base and Kaggle. We have also collected some data from our friends. The training period was very hard to maintain. This rendition of the face images containing a fixedsized of pictures. As per our undertaking necessities, we've changed over all pictures into a 48X48 pixel size. We have use Photoshop, Photoscape to pre-process the face images.We have chosen for Color Training mode

CHAPTER 4

TEST & VALIDATION PERFORMANCE OF THE MODEL

4.1 Train, Test and Validation of the model:

We've divided train faces and validation faces and some other to for testing.The total number of face data are around 25000. The 70% of the total data (17000 total face image data) has been used for train and validating and 30% data (7000 Face Data image) has been used for test for the model. We have divided 80-20 data from training to validation. TensorFlow and Keras is used as backend. We have used CNN with four layer to train the model. We've used Multiclass classification with RGB.The batch size defined in colab is 512 for train and test face image dataset. This model we have built using CNN in the test showing a marvelous performance. Our test face image dataset contains the expression such as anger, sad as our training and validating data set.

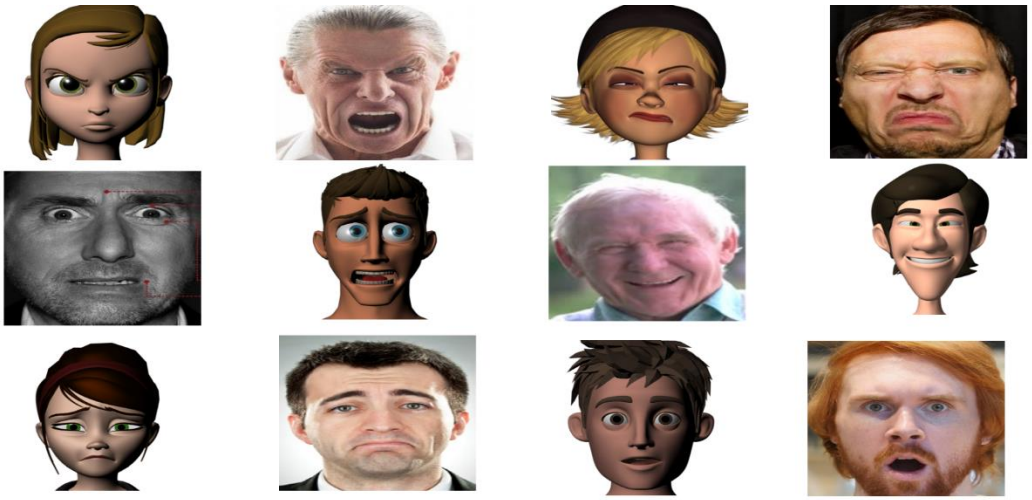
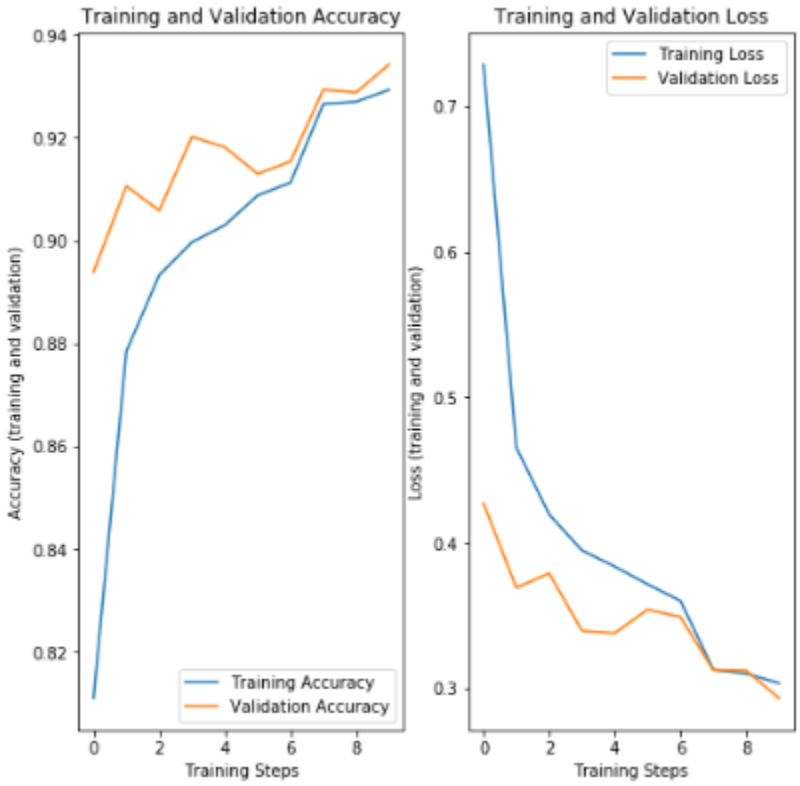


Figure 4.1.1 Validation data

4.2 Model efficiency:

We have rab about 20 epoch and our trained model have gained 93.62% accuracy during checking the validation face image data and gained 73.44% accuracy from the test face image data. After completing the Train and Test period both on Validation and Test face dataset we have achieved a great accuracy rate. As we have shown below our training and validation accuracy and training

and validation loss with two connected layer model is good enough for the predict the intention from the facial expression. The result we have got from Colab Test is given here.



(I) (II)

Figure 4.1.2. (I) Showing train accuracy and validation accuracy. (II) Showing train loss and validation loss.

CHAPTER 5

SOFTWARE REQUIREMENT SPECIFICATION

5.1 Business Process Model

Disregarding business measure the executives inside and out is a surefire approach to deteriorate or, more awful, fall behind in the opposition. Be that as it may, we don't consider business here. Both our courier and talk will be liberated from cost. There will be a free application on google play store as well. Where client don't need to pay anything to download and utilize the application. Using in CCTV may be implemented by companies

5.2 Use Case Model

We have designed our Intention prediction as minimal as we can. We have made it simple for android application, So that user can use it Easily.

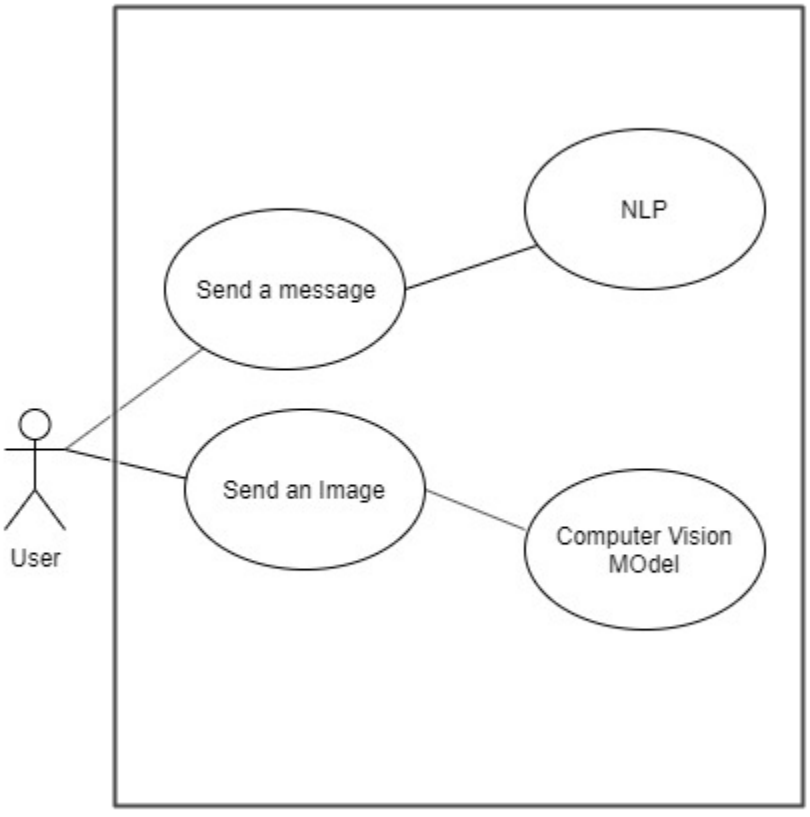


Figure: 5.2.1 Use Case Diagram of CCTV

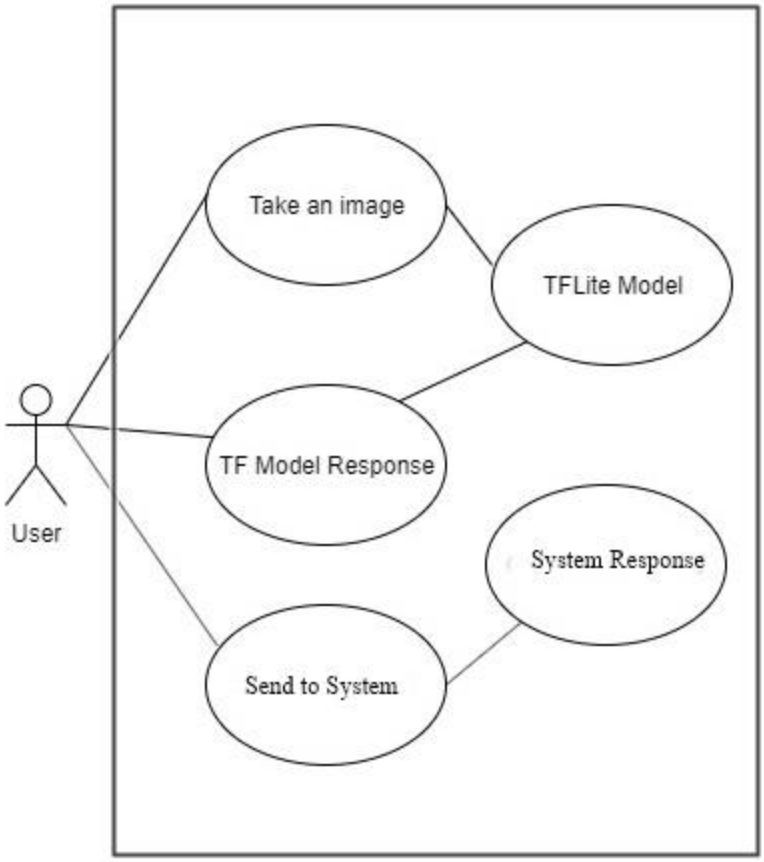


Figure: 5.2.2 Use Case Diagram of Android App

5.3 Design Requirements

We have used Keras and Tensorflow with CNN to develop the main model to detect emotion and intention. We have converted the model to TFLite so that it can be used in Android App.

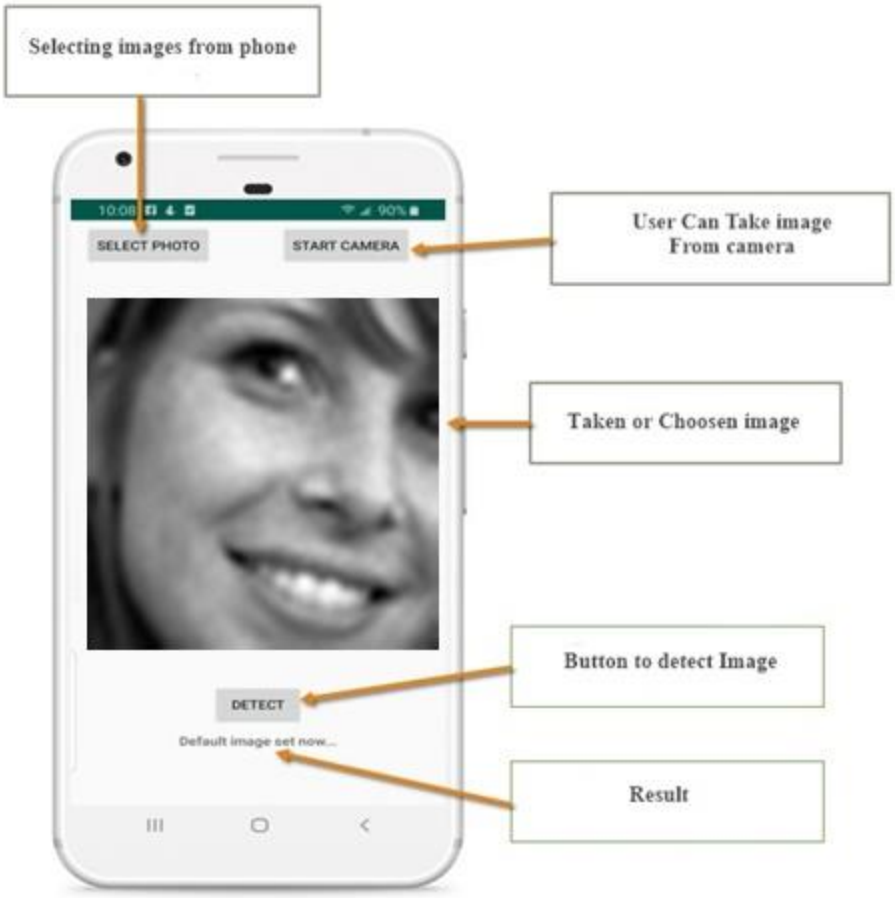


Figure: 5.3.1 Android App Design

5.3.1 Front-End-Design (XML):

We have used Java and XML to design our android app. Java is used to write the application.

5.3.2 Tensorflow Backend:

We have used Keras and TensorFlow to train our model and converted it to TF Lite using Keras Convert in google colab so that we can use it for android.

Figure: 5.3.2 Tenforflow Backend

5.4 Logical Data Model

The following figure depicts the Logical Data Model or Diagram of this undertaking which speaking to the relationship among the substances. This outline connection between client to our AI Model.

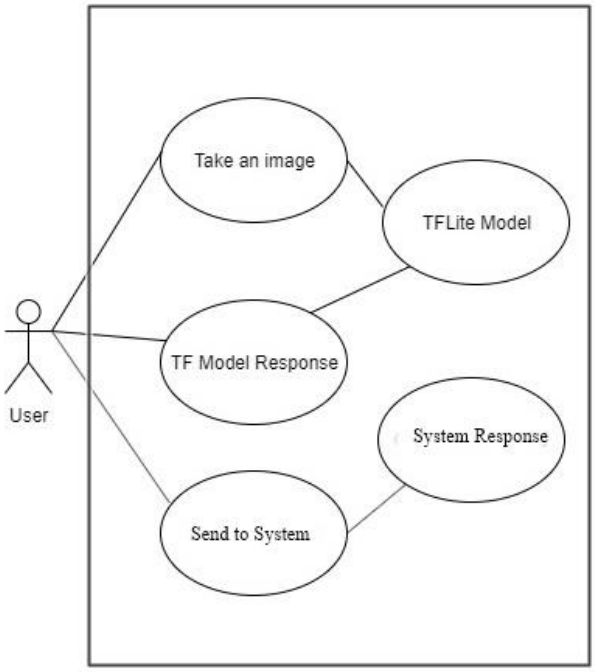


Figure: 5.4.1 Logical Data Model

CHAPTER 6

DESIGN SPECIFICATION

6.1 System Environment

Our Android directly connect user TF Lite Server when they send any image. It works without internet. The process actually happens into the mobile without any kind of connectivity in case of the CCTV camera they will need internet to connect.

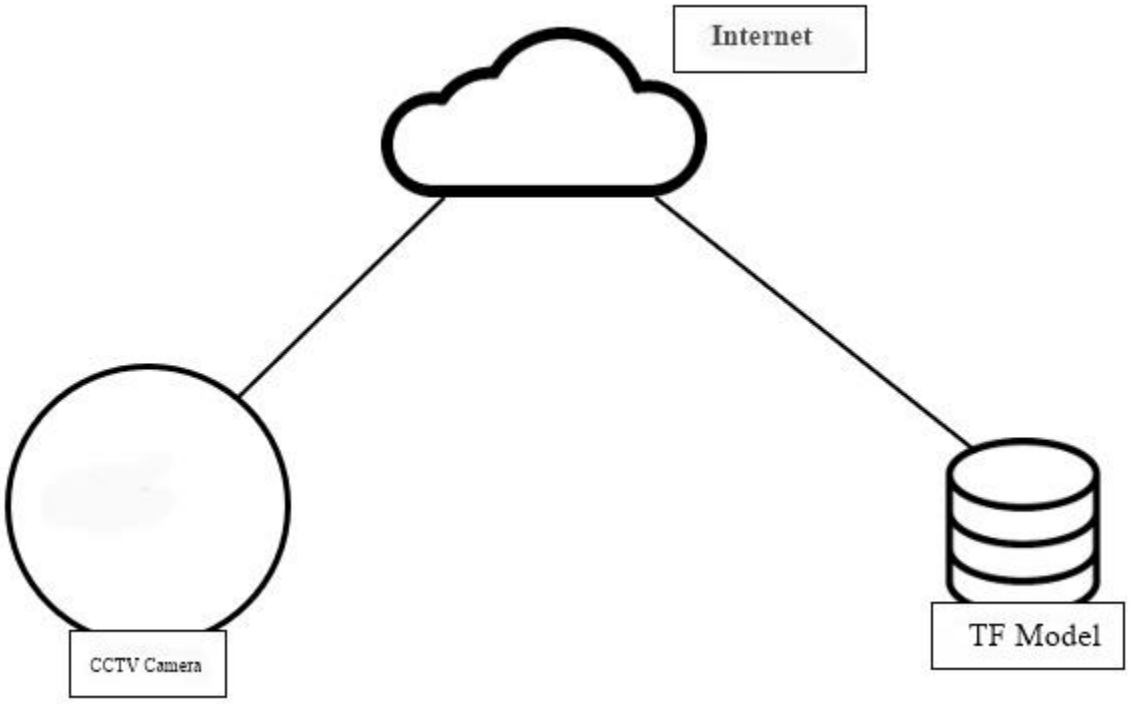


Figure: 6.1.1 System Environment

6. 2 Front-End Design

We have used Java language to build the android app and used TF Lite so that It can works without any kind of connectivity. The XML is used to design the user Interface of the android application.

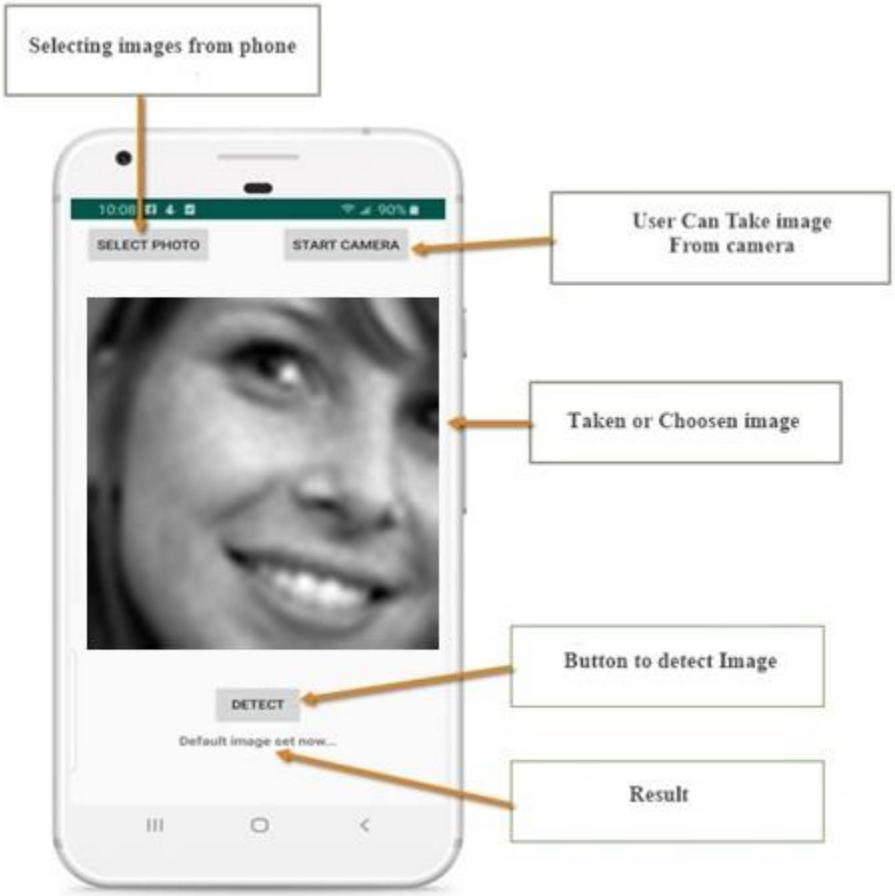


Figure 6.2.1 the Home Page of the system

6.3 Back-end Design

We have used Keras and TensorFlow to train our model and converted it to TF Lite using Keras Convert in google colab so that we can use it for android.

```
[ ]  for idx, filename in enumerate(random.sample(validation_generator.filenames, 5)):
         print("SOURCE: class: %s, file: %s" % (os.path.split(filename)[0], filename))

         img = load_image(filename)
         prediction = predict(img)
         print("PREDICTED: class: %s, confidence: %f" % (list(prediction.keys())[0], list(prediction.values())[0]))
         plt.imshow(img)
         plt.figure(idx)
         plt.show()
```

Figure: 6.3.1 Checking prediction accuracy

6.4 Mask Detection

Due to covid-19, peoples are wearing mask regularly. Which is good for people. It will reduce the spreading the virus but we can't compromise our house security. People can take advantage of the situation and break into houses wearing mask so that no one can suspect them or they cant be detected even we have footage. We have solved this problem too . As our supervisor advised during pre-defense, we have added a new class to our model. In this class our model will check if the person wearing a mask or not. If the result come positive then our application will ask the person to remove the mask. After removing the mask, the model will re check the image. If we use this model on smart door then those instructing can be provided by Speaker. Also we can send warning notification to the client application that someone is trying to get inside with a mask on. As those can trigger false alarm that's why currently we are only asking the person to remove mask. We might put a Toggle on CCTV option that if the house owner or the admin wants waning to application or just asking the person to remove mask.

6.4 Testing and Integration

We have used a separated dataset, which wasn't used to train our tensorflow model to test our model. Here We have found 93.62% accuracy.

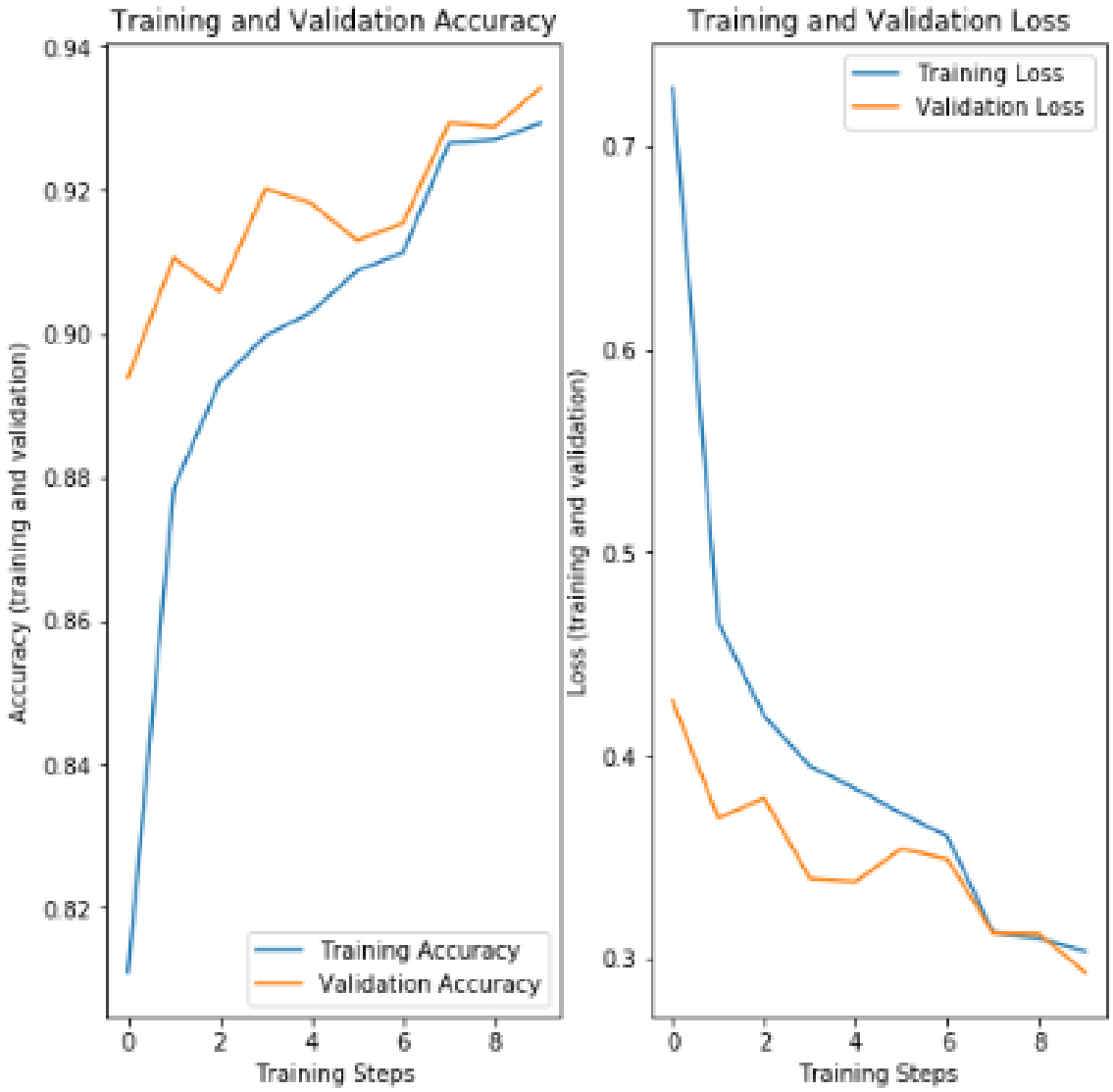


Figure: 6.4.1 Accuracy and Loss Chart.

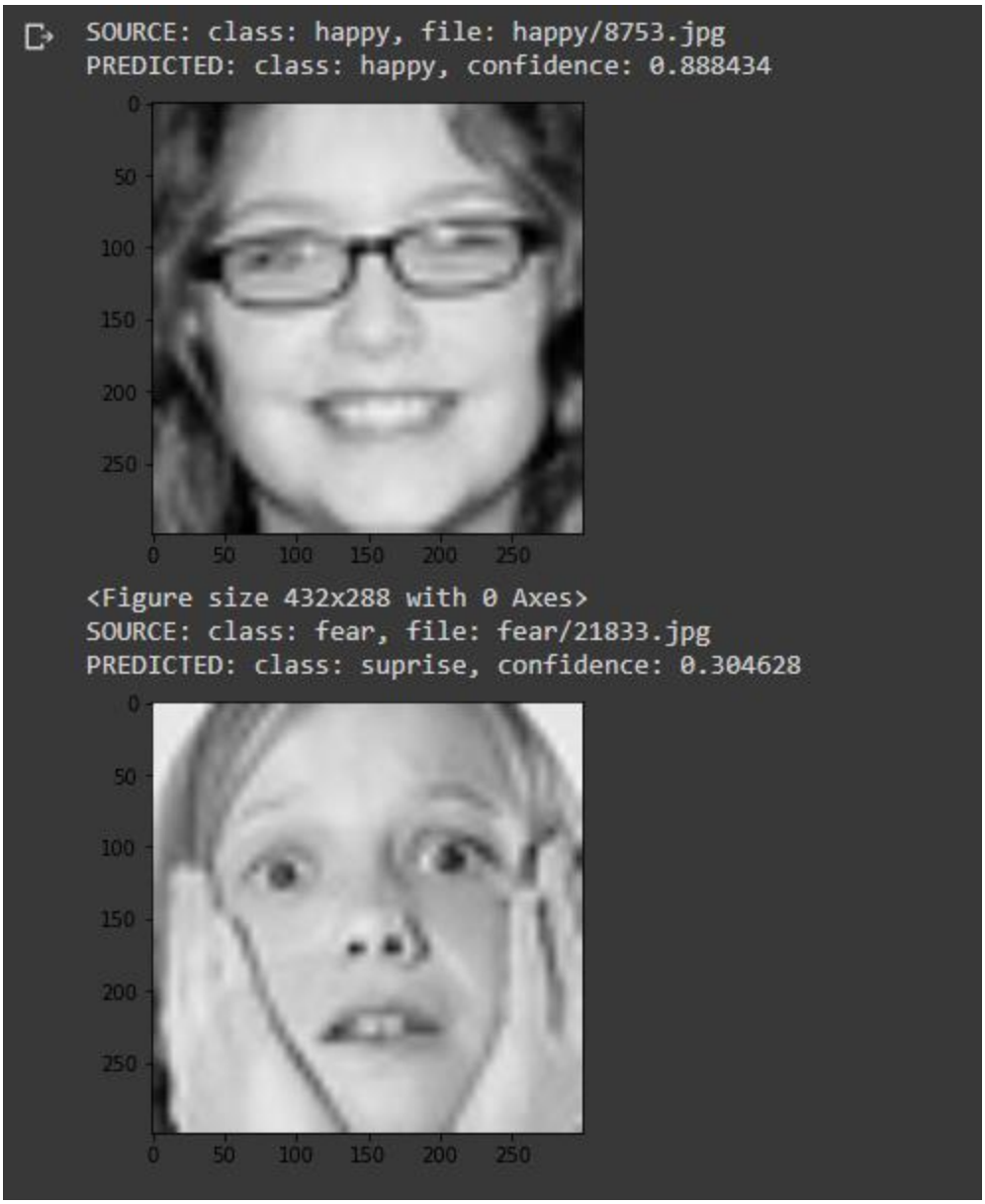


Figure: 6.4.2 Testing Model

CHAPTER 7

CONCLUSION & FUTURE SCOPE

7.1 Conclusion

This work mainly on predicting human intention from face expression after getting face data from Mobile Camera and CCTV by using Convolutional Neural Network. We have proved that Convolutional Neural Network is so far the best system to find out human intention using multiclass image classification. Though, we have gains 93.62% validation which say that we can predict almost all human intention using facial expression. Though we hadn't enough face data , and max of them were Non-Bangladeshi. We have tried to collected Bangladeshi data but it was not as expected. There is not a single dataset of Bangladeshi people available online. If we could find one that would be really helpful for us. We believe predicting human intention using facial express will be found useful in Home Security for Bangladesh. All the house owner can be aware of what's happening in their house without looking at the monitor all the time.

7.2 Future Scope

Currently, we can detect only some emotion. We hope we will find some more data about Bangladeshi people so that we can predict better. We also want to implement those into CCTV with help of come CCTV Companies.

REFERENCE

[1] Yao, P., Wu, H., Gao, B. et al. “Face classification using electronic synapses.” Nat Commun 8, 15199 2018,

[2] Khan, F. “ Facial expression recognition using facial landmark detection and feature extraction on neural networks.” arXiv:1812.04510v2 [cs.CV] (2018).

[3] Rao A., Ajri S., Guragol A., Suresh R., Tripathi S. “Emotion Recognition from Facial Expressions in Children and Adults Using Deep Neural Network.” In: Thampi S. et al. (eds) Intelligent Systems, Technologies and Applications. Advances in Intelligent Systems and Computing, vol 1148. Springer, Singapore 2020.

[4] S. Mishra, G. R. B. Prasada, R. K. Kumar, and G. Sanyal, “Emotion recognition through facial gestures - a deep learning approach,” Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), vol. 10682 LNAI, pp. 11–21, 2017

[5] S. Turabzadeh, H. Meng, R. Swash, M. Pleva and J. Juhar, "Facial Expression Emotion Detection for Real-Time Embedded Systems", Technologies, vol. 6, no. 1, 2018.

[6] Ko, Byoung Chul. "A brief review of facial emotion recognition based on visual information." sensors 18.2 (2018): 401.

[7] Nguyen Tuan Nam, Phan Duy Hung “Pest detection on Traps using Deep Convolutional Neural Networks” *ICCCV '18*, Singapore, Singapore. © 2018 Association for Computing Machinery, June 15–18, 2018.

APPENDIX

Appendix A: Survey form for House Owner

Respondent Information:

Respondent Name :
Address :
Date :
Time :

Expression Name	Visibility			Solution	
	Clear	Blurry	Very Blurry	Known	Unknown
Sad					
Angry					
Natural					

SPECTRE: AN APPROACH TO DETECT HUMAN INTENTION USING CONVOLUTIONAL NEURAL NETWORK by Debashish Das, Sanjida Akter Shimu and Samit Protim Das

ORIGINALITY REPORT

13%	0%	12%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Md. Imran Hossain, Bidhan Paul, Abdus Sattar, Md. Mushfiqul Islam. "A Convolutional Neural Network Approach to Recognize the Insect: A Perspective in Bangladesh", 2019 8th International Conference System Modeling and Advancement in Research Trends (SMART), 2019 Publication	12%
2	Helang Lai, Hongying Chen, Shuangyan Wu. "Different Contextual Window Sizes Based RNNs for Multimodal Emotion Detection in Interactive Conversations", IEEE Access, 2020 Publication	<1%
3	core.ac.uk Internet Source	<1%
4	Niti Naik, Mayuri A. Mehta. "An Improved Method to Recognize Hand-over-Face Gesture based Facial Emotion using Convolutional Neural Network", 2020 IEEE International	<1%

Conference on Electronics, Computing and Communication Technologies (CONECCT), 2020

Publication

---

5 Thara S, Sampath E, Venkata Sitarami Reddy B, Vidhya Sai Bhagavan M, Phanindra Reddy M. "Code Mixed Question Answering Challenge using Deep Learning Methods", 2020 5th International Conference on Communication and Electronics Systems (ICCES), 2020 <1%

Publication

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	Off		