FACE EMOTION DETECTION COMPARATIVE STUDY USING DEEP LEARNING

BY

MD. ZANNATUL FERDOUS
ID: 191-15-12878

MST. UMME NISHAT
ID: 191-15-12703

RADDIA AKTER HRIDE
ID: 191-15-12631

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Ms. Asma Mariam
Lecturer
Department of CSE
Daffodil International University

Co-Supervised By

Sharun Akter Khushbu
Lecturer
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

JANUARY, 2023

APPROVAL

This Project titled **"Face Emotion Detection Comparative Study Using Deep Learning"**, submitted by MD. Zannatul Ferdous, ID No:191-15-12878, Mst. Umme Nishat, ID No:191-15-12703, Raddia Akter Hride, ID No:191-15-12631 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 24 January 2023.

BOARD OF EXAMINERS

Chairman

Dr. Touhid Bhuiyan
Professor and Head
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Dr. Mohammad Shamsul Arefin
Professor
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Md. Sabab Zulfiker
Senior Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

External Examiner

Dr. Ahmed Wasif Reza
Associate Professor
Department of Computer Science and Engineering
East West University

DECLARATION

We hereby declare that,this project has been done by us under the supervision of **MS. Asma Mariam, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

Asma 26.01.2023

Ms. Asma Mariam
Lecturer
Department of CSE
Daffodil International University

Co-Supervised by:

25.01.23

Sharun Akter Khushbu
Lecturer
Department of CSE
Daffodil International University

Submitted by:

Ferdous

MD. Zannatul Ferdous
ID:191-15-12878
Department of CSE
Daffodil International University

Umme Nishat

Mst. Umme Nishat
ID:191-15-12703
Department of CSE
Daffodil International University

Raddia Akter Hride

Raddia Akter Hride
ID:191-15-12631
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 year project/internship successfully.

We really grateful and wish our profound our indebtedness to **Ms. Asma Mariam**, **Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Machine learning*" 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 project.

We would like to express our heartiest gratitude to **Dr. Touhid Bhuiyan**, Professor, and Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member 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 patients of our parents.

ABSTRACT

People usually express their feelings and communicate with each other through facial emotion. Through face emotion detection we can easily understand the language of a person's mind. Generally, face emotion detection is used in many cases. Among them, it is usually used by the police to catch criminals. Doctors often use face emotion detection to monitor a patient's condition. Sometimes it is used in super shops to find out special customers so that they can give them special discounts. Here we detect face emotion using deep learning. There are two types of algorithms we use here. The algorithms are CNN and VGG16.We are collecting dataset from kaggle. Then we are preprocessing the dataset. Then we apply an algorithm in this dataset and find which algorithm can get better accuracy. Usually we can easily detect people's emotions through CNN algorithm and VGG16 algorithm. Here we compare the two algorithms and find out which algorithm works better. Usually the two algorithms produce two different accuracy. Using face emotion detection the number of crimes in the society will decrease. it provides more security in society. Many researchers have research on it. We will use it to detect human face emotions and open it in the future so that everyone can use it and bring better results.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
Introduction

1.1 Introduction

Face emotion is the process where people reflect on their facial expressions through facial gestures. Emotion is a nerve system-based mental state that includes feelings, perceptions, behavioral responses, and a level of pleasure or annoyance. We can express our emotions in many ways such as writing, singing or through facial expression. Most of the time we express our emotion through facial expression. Facial expression is one of the most crucial methods of interpersonal communication, identification of a person's emotions based on their face is a natural representation of their emotional state.. We can fully comprehend the human psyche and interact with each other quite readily through facial expressions. Seven different expressions can be made on the face. The expressions on the face include sadness, joy, rage, fear, disgust, surprise, and disdain. Human-robot communication also involves facial expressions. Face emotion detection is being employed in biometric, security, tracking, and other websites. Criminals were also found using it. If any thief wants to steal anything or a document, we can catch him easily by emotion detection. Our objectives include better understanding and enhancing the functionality of emotion recognition models as well as applying them to actual circumstances.

The use of machines in our society has increased so widely. We use machines to improve our daily life. Nowadays, machines are used in many different sectors. We can learn about our mental and emotional state through machines. For that reason we are implementing our work through machines. We detect facial emotion by using a computer device.

Deep Learning is a good way for using image processing to identify human facial expression. We look at recent advances in deep learning-based feature extraction and classification techniques, as well as picture-based emotion research. This review will

update real-time emotion detection systems in order to learn about the most recent advancements in this technology.

CNN is utilized in projects like language processing, picture analysis, and other challenging image classification issues. We are using CNN algorithm hare to detect emotion and find the accuracy. It automatically detects things without any help from humans. Convolutional neural networks are frequently employed to address recognition problems, and are now among the most widely utilized deep learning techniques. We can apply CNN in many ways. Here we also use the VGG16 algorithm. Using the Convolutional network (VGG16) we also can detect facial emotion.

We collect dataset from Kaggle. Kaggle is a Google site. Which helps us to find appropriate dataset. It also helps us to publish dataset. Kaggle is helpful for beginners and also for the expert. There are many images in this dataset. First we are preprocessing this dataset. After collecting data we delete some useless data and add some appropriate data from our own collection. Then we apply algorithms in this dataset. We apply two algorithms here.The algorithms are CNN and VGG16. Then we get accuracy for each algorithm. We then compare two algorithms and find out which algorithm works better.

1.2 Motivation:

Face emotion detection systems now play a significant role in society. Facial expressions are a simple way for people to convey their feelings to one another. We are able to recognize emotions through facial expression recognition, which is also employed on many other sites. The primary drivers behind this are:

1. Detect face emotion like sadness, happiness, anger etc.

2. To reduce criminal activity.

3. Through pictures to understand others' feelings and provide them with a solution.

4. Used face emotion detection in bioinformatics to identify humans.

5. To enhance security.

The majority of studies used machine learning, but in this case, deep learning was applied to achieve greater accuracy than other papers. Utilizing the CNN and VGG16 algorithm, here we are finding out which algorithm gets better accuracy. Our system is quite good at identifying human face expressions. Others will adopt our suggestion, study it, and discover additional useful solutions.

1.3 Rationale of the study:

Currently, many types of crimes are being organized around the world. Though face emotion detection we find the criminal easily. We discuss why we are doing this in 1.2. Our main goal is processing the image and detecting the emotion and finding the accuracy.

We know that most of the work is done on image processing. To detect face emotion detection we are using deep learning. First we get the dataset in kaggle. Then we compressed the images and later applied the algorithm. We are preprocessing the data and applying CNN algorithm(Deep learning) and VGG16 algorithm. After applying the algorithm we extracted accuracy from there. Then we increased the number of images and used an algorithm to find the accuracy and find out which algorithm performs face detection very well.

1.4 Research Question:

We had to face many problems while doing this research. We also faced many difficulties and challenges. There are a lot of questions that we are faced with here. Some questions are given below:-

- Can I collect a dataset from kaggle?
- Which type of dataset are used?

- Which developer platform would you pick?
- Which algorithm is used?
- Can deep learning be good for detecting emotion?
- How many emotions can be detected?
- How many algorithms can we apply here?
- Does it have a full accuracy rate?

1.5 Expected output:

We are trying to publish a paper which reduces criminal activity and knows the feelings of people. Additionally, we should provide them with emotional support.

So some expected outcome are :-

1) We can identify human emotion from any facial angle of a person.
2) We can detect emotion by looking at the face of a human.
3) Crime rate reduces.
4) Friendly relationships increase.
5) People can understand other feelings easily.
6) Increase security.
7) Provided more accuracy than other papers.

1.6 Project Management and Finance:

As we collect data from kaggle so that we don't invest any money to collect data. We implement our project on the Colab platform. This tool is totally free. Everyone can use this platform. This is an unpaid tool. So that this project is free of cost.

1.7 Report Layout:

There are 6 chapters in our thesis report. Each chapter we discuss different types of things. All these chapters are very important. Below is a brief description of what we covered in each chapter. The chapter are:-

Chapter 1 (Introduction):- In this chapter 1 we go over everything about our report. We have a brief discussion about the thesis paper. How to prevent the emotion. We discuss which algorithm we can use to get an accurate project result. We also discuss our primary motivation. We're talking about what our goal is, what problem we're having, and how to solve it. We also talked about how much money we spent on this report.

Chapter 2 (Background):- In this chapter 2, we compiled the previously completed relevant work. We contrast our study with other analyses as well. We also talked about how many preliminary issues, difficulties, and hurdles we encountered.

Chapter 3 (Research Methodology):- The research topic, development tools, data collecting, cleaning, analysis, and processing, suggested technique and proposed methodology, and proposed algorithm are all covered in this chapter 3.

Chapter 4 (Experimental Results and Discussion):- Here we discuss all the experimental setup and we find out the experimental result. We also analyze all the things.

Chapter 5 (Impact on Society, Environment and Sustainability):- We will discuss how much influence there is on social, environmental, and ethical aspects, as well as sustainability in chapter 5.

Chapter 6 (Summary, Conclusion, Recommendations and Implication for Future Research):- Here we summarize the entire study and reach a conclusion. We also encourage others to obtain our research and use it in future studies in chapter 6.

CHAPTER 2

Background

2.1 Preliminaries:

Computers can identify any person's facial expression. Face emotion recognition is now a crucial technology in today's society. Face expressions are a common way for us to communicate with one another. Emotion recognition makes it simple to comprehend another person's thoughts. The mental states of individuals vary constantly. Usually, he must convey his thoughts to someone before they can be understood. People occasionally experience sadness, joy, sadness, fear, rage, astonishment, and disgust. It is fairly simple to determine a person's emotional state by facial expression recognition, whether that be happiness, sadness, fear, rage, surprise, or disgust.

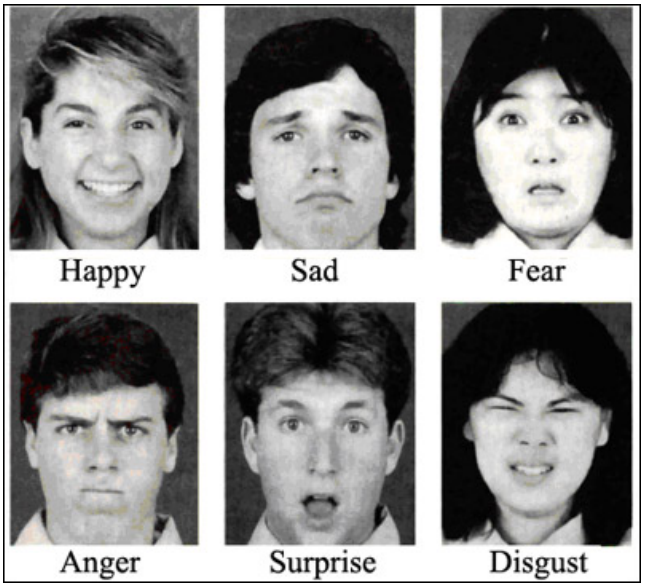

Figure 2.1.1 : Types of face emotion

Usually we use emotion detection in many cases. Face emotion detection is used to identify human emotion. It is also used to communicate with each other and police can easily detect and catch criminals. It is also commonly used in the medical sector. Though face emotion detection doctors usually monitor patient condition. It is also used in super shops to detect special customers so that they can give them special discounts. There are

many ways to detect facial emotion. Hare we used deep learning and the language is python. We are using CNN and VGG16 algorithms here and the platform is colab. Here we are trying to get better accuracy.

2.2 Related work:

Face emotion detection is now used all over the world. Because detecting emotions is a difficult task. Face emotion detection is a process that allows human emotions to be easily understood. Face emotion detection will be extremely useful in all professions. It is now a popular application. This application has received a great deal of attention. To compare, we looked at some related papers. Now, we will go over our related work in detail below-

Yadan Lv, Zhiyong Feng and Chao Xu* are detecting facial expressions using deep learning. They are experimenting with some Japanese female facial expressions and their database is JAFFE and CK+. They use algorithms in their dataset. The algorithms are geometric feature-based method and appearance-based method. They detect the shape and location of facial components using geometric feature-based methods. They extract features using an appearance-based method by applying an image filter or filter banks. Also they use more methods. They got different accuracy for each method. For method Boosted-LBP with SVM they got 81% accuracy. For method LDP with template matching they got 82.6% accuracy. For method LDP with SVM they got 85.4% accuracy. For method Gabor with LVQ they got 87.51% accuracy. For method Gabor with FLD they got 86.1 % accuracy. For method Log-Gabor with FDL they got 85.72% accuracy. And for method FP with SAE they got 90.47% accuracy. Which is higher accuracy than the other method.

Harisu Abdullahi Shehu, Md. Haidar Sharif and Sahin Uyaver are working on face emotion detection using deep learning. In this paper they apply the Haar Cascade (HC) classifier to crop faces of their project. They also apply label smoothing and analyze.

They use the KDEF dataset. Also they used the aligned images of the RAF dataset. They work on 7 expressions. From 7 expressions 6 expressions are basic and 1 is contempt. They use 4900 images for human expression.Their test set consists of 3068 images, the training set comprises up to 12271 images. For detecting facial expressions they use 2 different methods. The 1st method is analyzing the expression from raw images to the ResNet model. The 2nd method is applying the Haar Cascade (HC) classifier to detect faces. But their HC classification failed to get results. But the full image is fed to their model. Their accuracy is up to 98.78%, 96.67%, and 81.68% on the CK+, KDEF, and RAF, respectively. They want to recover their model in future by applying a more robust model.

Chowdhury Mohammad Masum Refat and Norsinnira Zainul Azlan are working on face emotion detection by using deep learning algorithms. They use a Japanese Female facial expressions database. This dataset is from anaconda software. In their work they use 2 different methods. Those are deep belief networks and convolutional neural networks. And for these 2 algorithms they got 2 different accuracy. For their deep neural network method they got 72.78% accuracy and for convolutional neural network method they got 97.1% accuracy. which is higher than DBN.

Madhumita A. Takalkar, Min Xu work on face emotion detection by using deep learning. In their work they use synthetic images. They use CNN algorithm on micro-expression images. They use 2 microexpression databases. The first one is Chinese Academy of Sciences Micro-Expression (CASME) and the last one is CASME II. They also augment their database. For the CASME database they got 74.25% and for CASME II database they got 75.57%.

Dharma Karan Reddy Gaddam, Mohd Dilshad Ansari, Sandeep Vuppala,Vinit Kumar Gunjan, and Madan Mohan Sati work on face emotion detection using deep learning. In their work they use CNN algorithm and MTCNN algorithm. They take a dataset from

Kaggel. In their work they use the FER2013 dataset. For their CNN algorithm, training accuracy is 75% and test accuracy is 55%. They also use some methods. The methods are Alex Net, Vgg 16, ResNet50. For method AlexNet accuracy is 14.9%, for method Vgg 16 accuracy is 38.2%, for method ResNet50 accuracy rate is 46.6%.

Ching-Da Wu and Li-Heng Chen are working with face emotion detection using deep learning. In their paper they worked with real time images. They collect their image with a laptop camera.They collect their dataset from the internet. They work on multiple algorithms for better accuracy. The algorithms are- VGG16, VGG19, ResNet50, DenseNet121, DenseNet169, Mobile Net, Mobile NetV2. Their accuracy respectively- 0.671, 0.666, 0.618, 0.493, 0.292, 0.479, 0.533. The highest accuracy is from VGG16 and that is 0.671.

Xiaoming Zhao, Xugan Shi and Shiqing Zhang are working on face emotion detection using deep learning. In their paper they use deep learning methods. Deep belief network, multi-layer perceptron, NN, SVM, NS, SRC. They experiment on 2 databases. Those are the JAFFE database and Cohn-Kanade database. They got the highest accuracy for the Cohn-Kanade database. DBNs with MLP have the highest accuracy. Their accuracy is 98.57% for 64 × 64 images.

Hong-Wei Ng, Viet Dung Nguyen, Vassilios Vonikakis, Stefan Winkler are working on face emotion detection. For their work they use deep learning algorithms. They use the CNN method. They use the FER-2013 dataset. Got 55.6% accuracy.

2.3 Comparative Analysis and Summary:

Table 2.3.1: Reference paper analysis and summary

No	Author	Approach	Performance	Ref
1	Yadan Lv, Zhiyong Feng and Chao Xu*	For face emotion detection they use deep learning algorithms on geometric feature-based methods,appearance-based methods, Boosted-LBP with SVM, LDP with template matching, FP with SAE and other methods. Databases are JAFFE and CK+.	Got 90.47% accuracy for method FP with SAE method.	[1]
2	Harisu Abdullahi Shehu, Md. Haidar Sharif and Sahin Uyaver	In their work they use deep learning algorithms on Haar Cascade and ResNet methods to get their desirable accuracy.	And they got 98.78% accuracy.	[2]
3	Chowdhury Mohammad Masum Refat and Norsinnira Zainul Azlan	For facial expression recognition they use a deep learning algorithm on DBN and CNN method.	They got the highest accuracy for DBN method and that is 97.1%.	[3]
4	Madhumita A. Takalkar, Min Xu	For their face emotion detection they use a deep learning algorithm on CNN method. They use 2 types of databases.	75.57% accuracy from CASME II database.	[4]
5	Dharma Karan Reddy Gaddam, Mohd Dilshad Ansari, Sandeep Vuppala,Vinit Kumar Gunjan,	To get better accuracy they use many methods on their paper by using deep learning algorithms. methods are CNN, MTCNN, Alex Net, VGG16, ResNet50.	From the CNN method they got the highest accuracy that is 75%.	[5]

	and Madan Mohan Sati			
6	Ching-Da Wu and Li-Heng Chen	In their paper they work on many methods by using deep learning algorithms. The methods are VGG16, VGG19, ResNet50, DenseNet121, DenseNet169, Mobile Net, Mobile NetV2.	The highest accuracy is from VGG16 that is 0.671.	[6]
7	Xiaoming Zhao, Xugan Shi and Shiqing Zhang	Working on face emotion detection by using deep learning algorithms. They use some method for better accuracy. The methods are- DBN, MLP, NN, SVM, NS, SRC. And they use 2 types of databases.	DBNs with MLP have the highest accuracy and that is 98.57% for 64 × 64 images.	[7]
8	Hong-Wei Ng, Viet Dung Nguyen, Vassilios Vonikakis, Stefan Winkler	Use deep learning algorithms for detecting facial expression. Their method is CNN.	Got 55.6% accuracy.	[8]

2.4 Scope of the problem:

We have a lot of issues here. Sorting the data is a challenge we confront. So, we don't achieve the right precision in this case. Salting data was a time-consuming process. We use a limited number of photographs here, so the emotion may not always be clear. In the future, we should find higher accuracy and increase the amount of images. Because the facial expressions might occasionally be quite similar, it sometimes struggles to identify the appropriate emotion.

2.5 Challenges:

We all know that all types of work face difficulties. We face a variety of challenges while performing our work. The difficulties we encountered are detailed below:

1) Many problems have to be faced while collecting data. It took us a lot of time to get a proper dataset.
2) Due to the large size of the dataset we had to run it very hard and took a lot of time. So we have to preprocess the dataset first.
3) We had to read many papers due to lack of knowledge about it.
4) Sometimes we face many bugs when we apply deep learning algorithms in our dataset. We have had to go to great lengths to find these errors and fix them.
5) Having to do the same thing over and over to get so much better accuracy.
6) For better accuracy we have to use 2 types of algorithm.
7) It took us a long time to learn how to use various types of algorithms.

CHAPTER 3

Research Methodology

3.1 Research Subject and Instrumentation

This section is referred to as the recommended methodology. Now, we are going to discuss the proposed methodology for this model. This chapter is divided into six sections: Workflow, Pre-Processing, Feature Extraction, Learning, and Classification.

3.1.1 Hardware and Software

•AMD Ryzen™ 5 3400G with Radeon™ RX Vega 11
•2TB Hard Disk
•16GB RAM
•250GB SSD
•Jupyter Notebook
•Kaggle
•Google Colab

3.1.2 Development Tools

• Windows 10
• Python 3.8
• Numpy
• Pandas
•Tensorflow
• Seaborn
• Matplotlib
• Scikit-Learn

3.2 Data Collection

Since the research project that we are working on is centered on deep learning, we need a large dataset in order to conduct our research. We get a large CSV dataset from kaggle that is referred to as the FER2013 dataset. This dataset specializes in facial expression recognition. [11]

3.3 Statistical Analysis

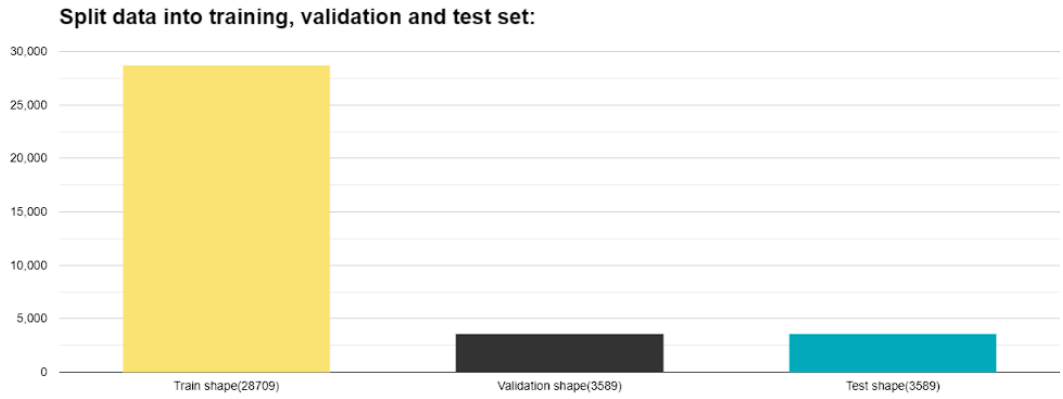

Figure 3.3.1: 80% training, 10% validation and 10% test

We need a large number of photos to properly analyze face expressions. Therefore, we started by downloading the data from Kaggle. After obtaining the data from this location, the dataset is initially preprocessed by our team. We created three distinct sections for the dataset[Figure 3.3.1:]. The train shape, the validation shape, and the test shape make up the three components. The test shape has 3589 data, the validation shape contains 3589 data, and the train shape contains 28709 data. The percentages of training data, validation data, and test shape data are as follows: 80%, 10%, and 10% respectively.

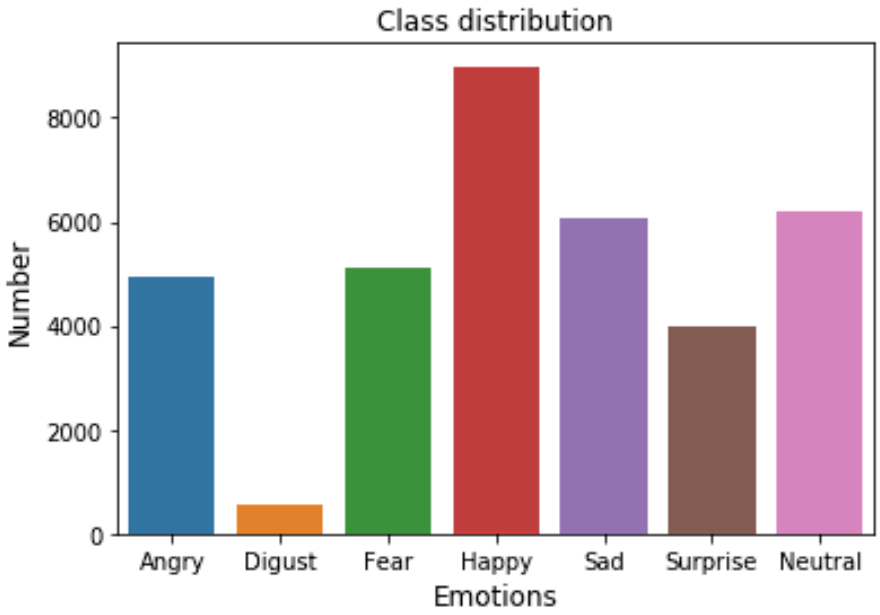

Figure 3.3.2:Bar graph of the class distributions

Within this section, the whole dataset is partitioned into seven categories. Anger, disgust, fear, happiness, sadness, surprise, and neutral are the classifications available.[Figure 3.3.2:]

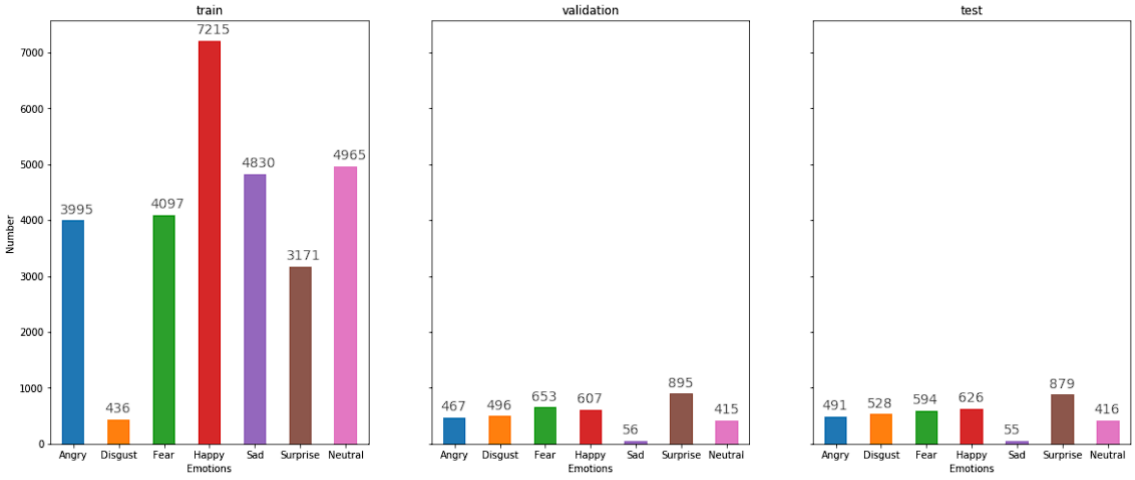

Figure 3.3.3: Bar graph class distribution of train, val and test

In this section, the whole dataset is broken down into seven categories, each of which has a corresponding number of records.[Figure 3.3.3]

3.4 Applied Mechanism

Since the project we're working on is about deep learning, we need a large dataset to do our research. We get the FER2013 dataset from kaggle, which is a large CSV file.Firstly, split the dataset into three parts: train, validate, and test.The next step is to transform the strings into arrays of numbers.After that, reshape to 48x48 and normalize the grayscale to 255.0.In the end, encode the label with a single pass, like class 3 to [0,0,0,1,0,0,0].After that, we apply CNN (without transfer learning) and VGG16 to evaluate the results. [Figure 3.4.1]

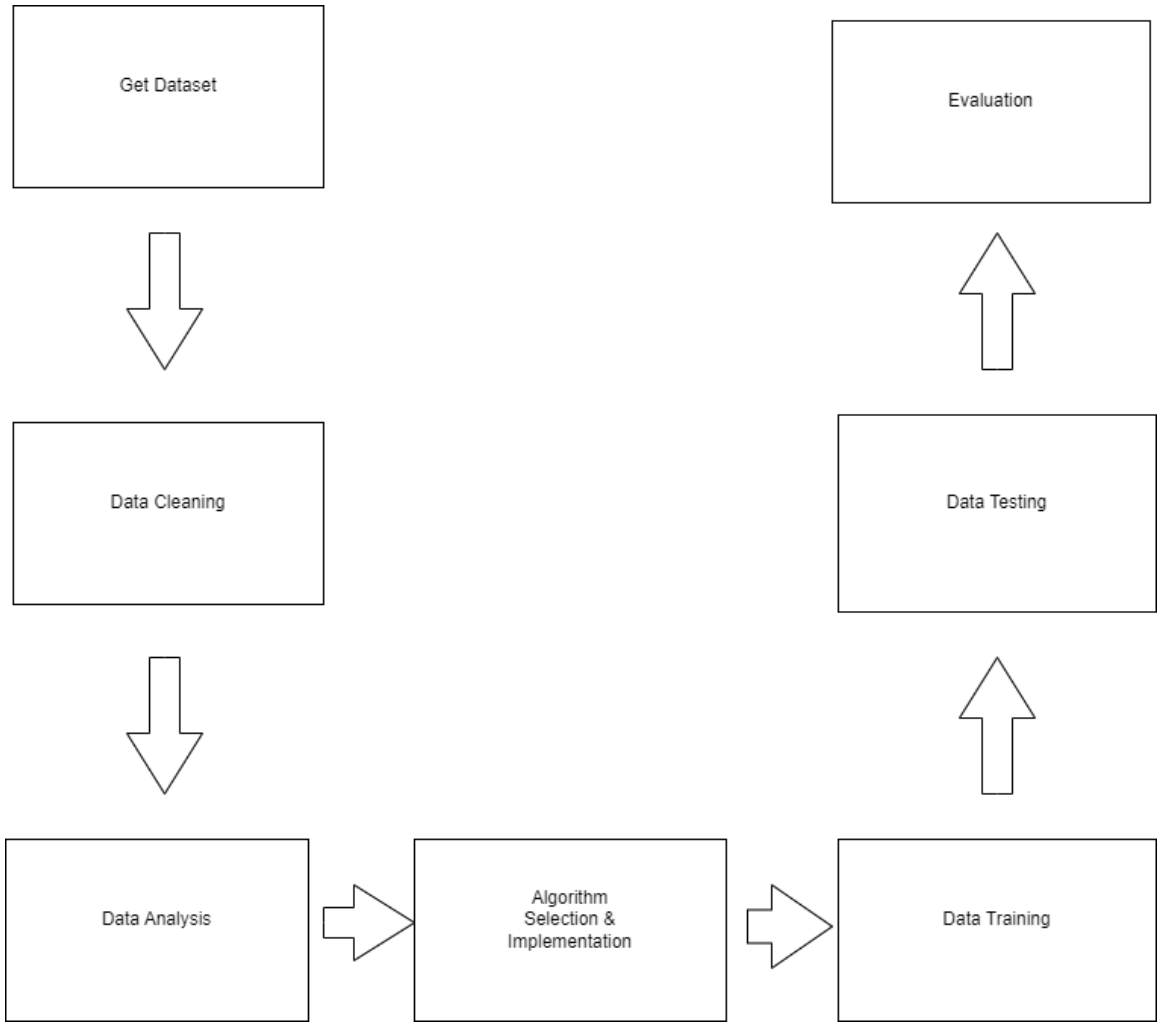

Figure 3.4.1 : Diagram of Applied Mechanism

3.4.1 Algorithm Selection and Implementation

CNN: A convolutional neural network (CNN) is a kind of network design for deep learning algorithms that is used primarily for image recognition and other tasks that require the processing of pixel input. There are a variety of neural networks that may be used in deep learning; however, convolutional neural networks (CNNs) are the networks of choice when it comes to recognizing and identifying things. After data preprocessing we build a model in Convolutional Neural Network(CNN) which is used for image or object recognition. We create three modules, flatten and three dense in the model. In the Output Layer we use categorical_crossentropy for data loss and added optimizer. In this model we found the result of Total params which is 2,137,991, Trainable params is 2,134,407 and the number of Non-trainable params is 3,584.

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================

conv2d_1 (Conv2D)            (None, 46, 46, 256)       2560
_________________________________________________________________
batch_normalization_1 (Batch (None, 46, 46, 256)       1024
_________________________________________________________________
activation_1 (Activation)    (None, 46, 46, 256)       0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 46, 46, 256)       590080
_________________________________________________________________
batch_normalization_2 (Batch (None, 46, 46, 256)       1024
_________________________________________________________________
activation_2 (Activation)    (None, 46, 46, 256)       0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 23, 23, 256)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 23, 23, 128)       295040
_________________________________________________________________
batch_normalization_3 (Batch (None, 23, 23, 128)       512
_________________________________________________________________
activation_3 (Activation)    (None, 23, 23, 128)       0
```

```
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 23, 23, 128)       147584
_________________________________________________________________
batch_normalization_4 (Batch (None, 23, 23, 128)       512
_________________________________________________________________
activation_4 (Activation)    (None, 23, 23, 128)       0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 11, 11, 128)       0
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 11, 11, 64)        73792
_________________________________________________________________
batch_normalization_5 (Batch (None, 11, 11, 64)        256
_________________________________________________________________
activation_5 (Activation)    (None, 11, 11, 64)        0
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 11, 11, 64)        36928
_________________________________________________________________
batch_normalization_6 (Batch (None, 11, 11, 64)        256
_________________________________________________________________
activation_6 (Activation)    (None, 11, 11, 64)        0
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 5, 5, 64)          0
_________________________________________________________________
flatten_1 (Flatten)          (None, 1600)              0
_________________________________________________________________
dense_1 (Dense)              (None, 512)               819712
_________________________________________________________________
batch_normalization_7 (Batch (None, 512)               2048
_________________________________________________________________
activation_7 (Activation)    (None, 512)               0
_________________________________________________________________
dense_2 (Dense)              (None, 256)               131328
_________________________________________________________________
batch_normalization_8 (Batch (None, 256)               1024
_________________________________________________________________
activation_8 (Activation)    (None, 256)               0
_________________________________________________________________
dense_3 (Dense)              (None, 128)               32896
_________________________________________________________________
batch_normalization_9 (Batch (None, 128)               512
```

```
_________________________________________________________________
activation_9 (Activation)    (None, 128)           0
_________________________________________________________________
dense_4 (Dense)              (None, 7)             903
=================================================================
Total params: 2,137,991
Trainable params: 2,134,407
Non-trainable params: 3,584
_________________________________________________________________
```

Figure 3.4.1.1:Sequential(CNN)

VGG16 is an algorithm for detecting objects and classifying them.This algorithm is able to load a pre-trained version of the network that has been trained on more than a million photos that are stored in the ImageNet database.In this model we found the result of Total params which is 14,718,279, Trainable params is 14,718,279 and the number of Non-trainable params is 0.

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
vgg16 (Model)                (None, 1, 1, 512)         14714688
_________________________________________________________________
global_average_pooling2d (Gl (None, 512)               0
_________________________________________________________________
dropout (Dropout)            (None, 512)               0
_________________________________________________________________
dense (Dense)                (None, 7)                 3591
=================================================================
Total params: 14,718,279
Trainable params: 14,718,279
Non-trainable params: 0
_________________________________________________________________
```

Figure 3.4.1.2: Sequential (VGG16)

3.5 Implementation Requirements:

Due to the fact that our project is based on deep learning, we need a reliable configuration in order to successfully run all applications. According to the specifications of our project, the bare minimum required is blow down:

Table 3.5.1: Requirements

CPU- Cores 4 Threads 8 3.6GHz (minimum)	(Intel® Core™ i5-9100E, AMD Ryzen™ 5 2400G, or higher) (minimum)
GPU - Nvidia GPU 8GB VRAM and CUDA architectures 3.5, or higher	(Nvidia GeForce® GTX 1050) (Radeon RX 550) (minimum)
RAM - 16 GB	

CHAPTER 4

Experimental Results and Discussion

4.1 Experimental Setup

In the main objective is to design, we discussed the algorithms we use in our work. Now, in this part, we will determine the correctness of these algorithms and assess their degree of precision. We will compare the precision of each algorithm. The actions we took to accomplish the project are listed below:

Step 1: Collect the data and save in a csv file.

Step 2: Imports all the libraries that required

Step 3: Processing stage

Step 4: Data visualization

Step 5: Split the data

Step 6: Model creation for algorithms

Step 7: Train the data with two different Deep learning algorithms

Step 8: Getting the accuracy of VGG16 and CNN algorithms

4.2 Experimental Results & Analysis

In our study, we implemented two algorithms. These algorithms VGG16 and CNN are utilized.

Here is the result of our most accurate accuracy:

	precision	recall	f1-score	support
0	0.5858	0.6408	0.6120	991
1	0.8060	0.4954	0.6136	109
2	0.5632	0.4609	0.5070	1024
3	0.8960	0.8721	0.8839	1798
4	0.5895	0.5444	0.5661	1216
5	0.7880	0.7712	0.7795	800
6	0.5890	0.7282	0.6513	1240
accuracy			0.6842	7178
macro avg	0.6882	0.6447	0.6591	7178
weighted avg	0.6873	0.6842	0.6828	7178

Figure 4.2.1: Accuracy using confusion matrix.

Table 4.2.1: Accuracy table

Algorithm Name	**Accuracy**
CNN Algorithm	0.6495
VGG16 Algorithm	0.6842

The outcomes of our efforts to make predictions are shown in table 4.2.1. The two models together with their corresponding results of the algorithm are shown in the following columns. The CNN Algorithm provided a prediction rate of 64.95 %.

This particular algorithm is the one that generates the most algorithms in the realm of deep learning. Whenever the VGG16 Algorithm was applied to our dataset, we were able to attain an accuracy of 68.42%. After analyzing the performance of both algorithms, we came to the conclusion that the VGG16 Algorithm was higher when it came to predicting face emotion.

4.3 Discussion

In the end, we will be able to summarize our efforts by stating that we did all in our ability to figure out which of two algorithms for face emotion detection yielded the highest level of accuracy. The VGG16 Algorithm produces the most accurate results, whereas the CNN Algorithm produces the least accurate results.

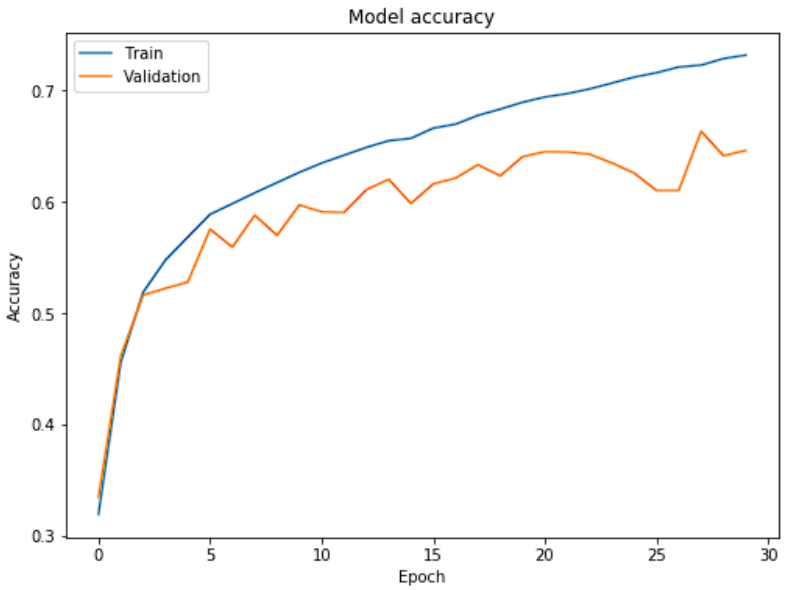

Figure 4.3.1: Training & validation accuracy values(using CNN algorithm)

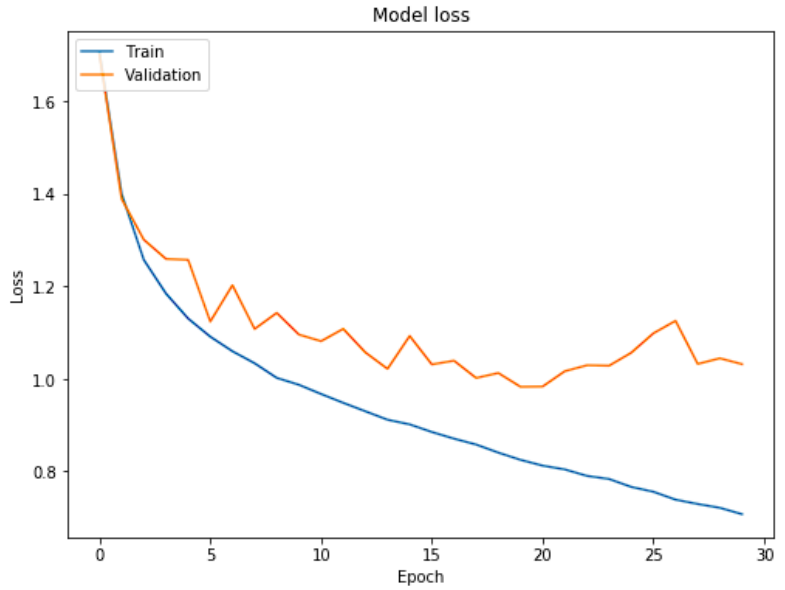

Figure 4.3.2:Training & validation loss values(using CNN algorithm)

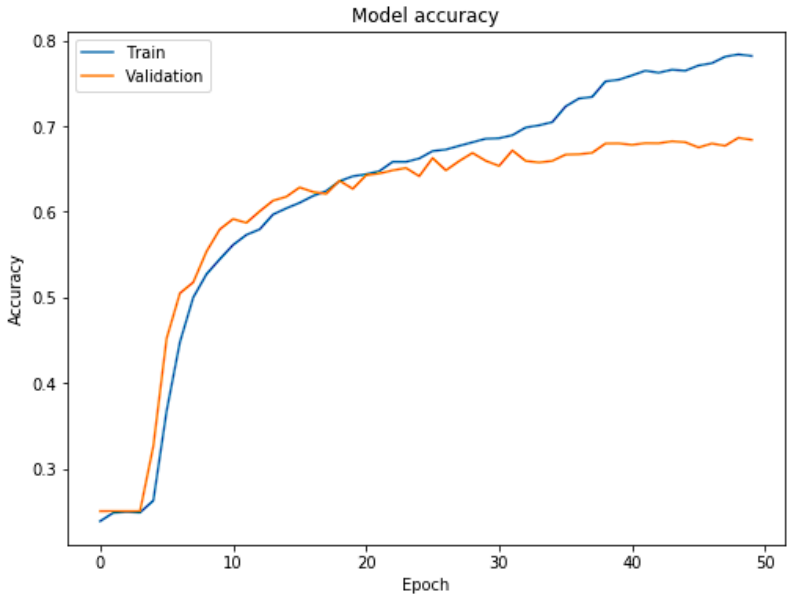

Figure 4.3.3:Training & validation accuracy values(using VGG16 algorithm)

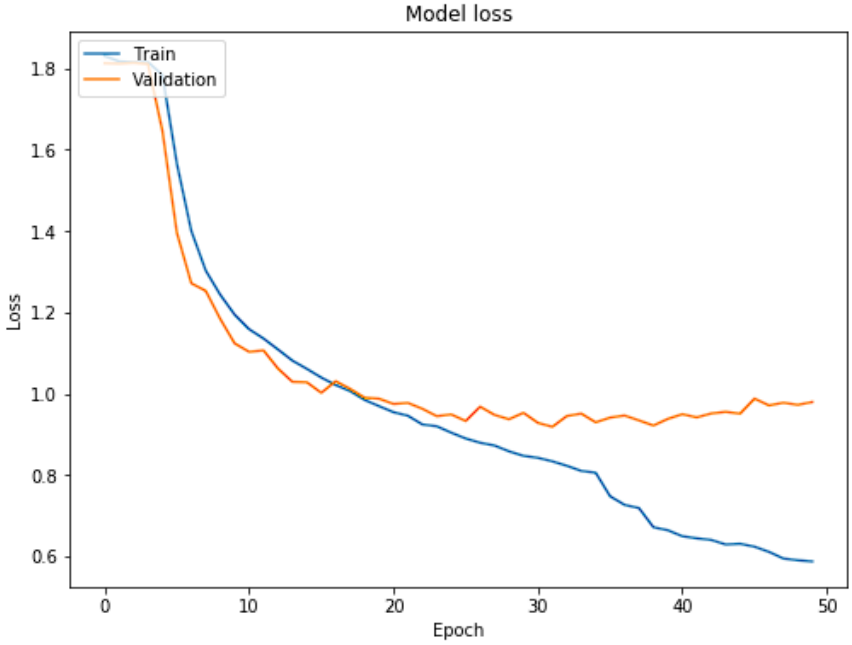

Figure 4.3.4: Training & validation loss values(using VGG16 algorithm)

The Confusion Matrix is used and plotted in order to determine which emotions are most often confused with one another. . In this project, we make advantage of the Confusion Matrix to display the graph of the normalized Confusion Matrix while simultaneously emphasizing accuracy.

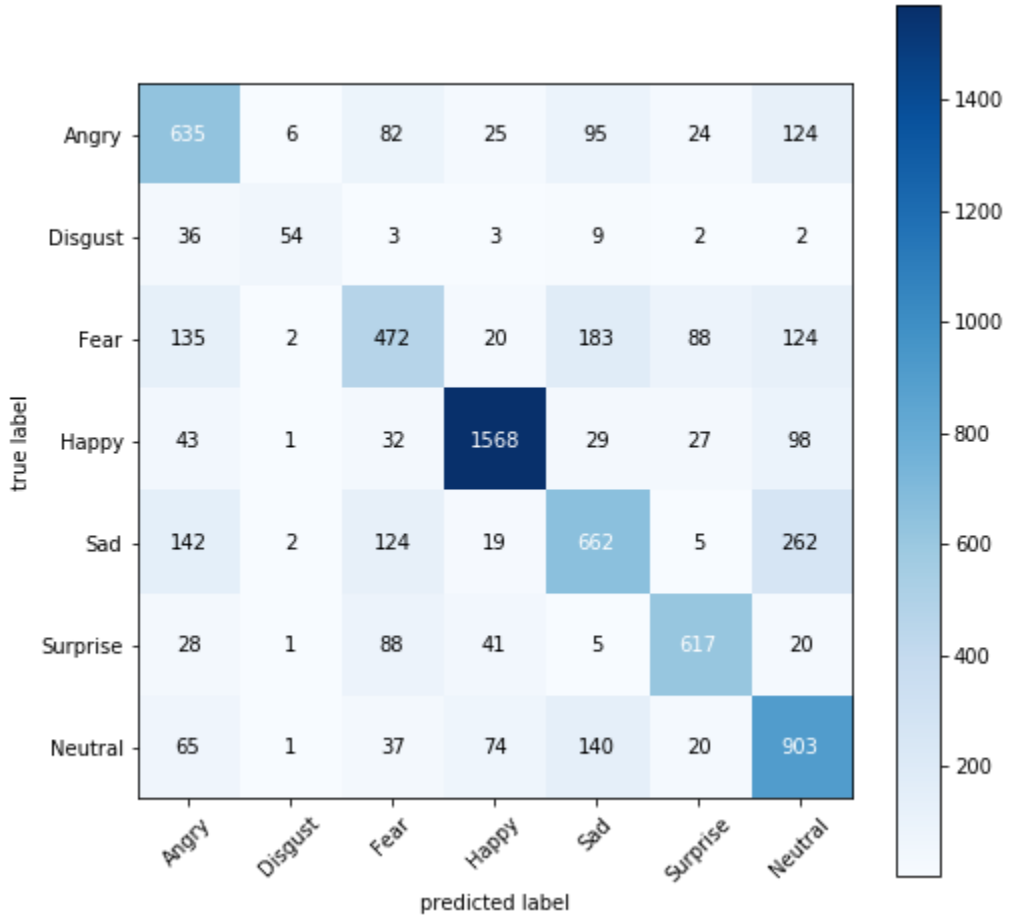

Figure 4.3.5:Normalized confusion matrix

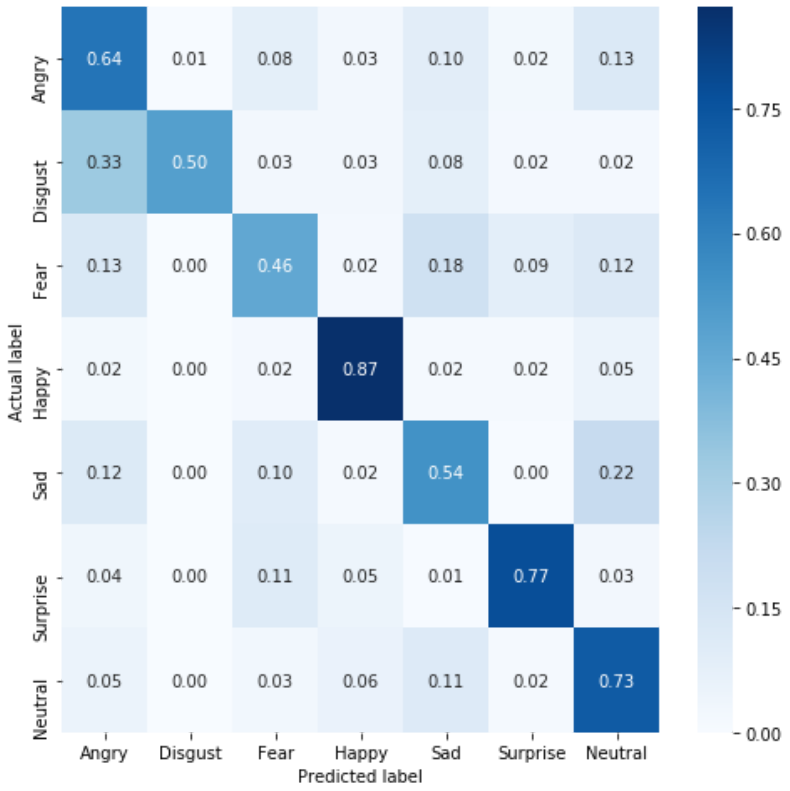

Figure 4.3.6 :Normalized confusion matrix with accuracy

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Impact on society:

Humans are Social beings. Humans cannot be imagined without emotions or feelings. We are all members of society. To live in society, we must abide by certain rules. In society, there are many different types of people.Though facial expressions humans can communicate with each other. Through facial expressions we can understand the mind of people.

Face emotion detection has many important implications in today's society. In today's society, the number of crimes is increasing day by day. We often say many things without understanding anything, it has a harmful effect on them mentally.Using face emotion detection we can easily detect any person's feelings. It also removed crimes which were held in society. It also provides security in our society. It also applies in bioinformatics to improve medical science.

1. It was to apply healthcare to monitoring the patient so that it improves the patient's condition.
2. Reduce the crimes.
3. Identify special customers to give them discounts.
4. provides security.

5.2 Impact on Environment:

While some conditions are detrimental to our nation's ecosystem, others are absolutely necessary. Understanding people's emotional states is essential for maintaining the equilibrium of the environment. We understand facial emotions through facial expressions. This Face emotion detection system has an impact in our environment. It had a positive impact on the environment. It was used in healthcare to monitor and diagnose the patients. Police can easily identify the criminals so that police can arrest

criminals and the number of criminals will decrease. By using this, people can lead a more secure life.

5.3 Ethical Aspects:

We Know that ethics is the barrier between right and wrong behavior. When we do any work we must follow ethical rules. Here we don’t do any unethical work. We are downloading the dataset from kaggle. This dataset can be used by all people. When we write this thesis report we do not copy anything in other thesis papers.We are sure that if any person was using it to detect face emotion it will not cause any harm to anything. We don't use anyone's trademark hare.

It was a totally secure platform. We don't use any bad photos which make a person so sad. We don't do any illegal activities here. So we can say that here we follow all the ethical rules.we don’t break any ethical rule here.

5.4 Sustainability plan:

Here, we use image processing to identify facial expressions. Image processing allows us to identify facial expressions. Here we only use two algorithms. In the future, we will use more algorithms and find better accuracy and we'll conduct more research and create a solid thesis paper. We will open it out to everyone so that they can all conduct study on it and produce more beneficial outcomes.

CHAPTER 6

Summary, Conclusion, Recommendation and Implication For Future Research

6.1 Summary of the study:

We began our work with the goal of better understanding human emotion and reducing criminal activity.

We're working on detecting facial emotions. This allows us to detect a person's emotional state. CNN and VGG16 are used in a deep learning algorithm to detect emotional states. Deep learning is a popular algorithm right now. We gathered a dataset from Kaggle. When we collected our data from Kaggle, we encountered numerous challenges. The dataset was insufficient. As a result, we must process our data in order to obtain an accurate result. We use CNN and VGG16 in a deep learning algorithm for more accurate results. The total number of data in our data set is 16800. Our work performed exactly as we wanted it to. Our algorithm worked well and gave the accurate result that we wanted. Applying CNN and VGG16 algorithms we get CNN algorithm accuracy is 0.6495 and VGG16 algorithm accuracy is 0.6842. So, we can say that here VGG16 algorithm can detect facial emotion better then CNN algorithm.

6.2 Conclusion:

We have achieved our desired accuracy through our work. Our selectable algorithm aids in obtaining a close value. To obtain an accurate result, we used an algorithm. We believe that our emotion detection system will be beneficial for all kinds of sector people. We know that human beings can not be imagined without emotions. Emotion is present in nearly all human speech styles, including facial expression, movement, voice tone, sentence, and so on. In some cases emotions take a long time to change and in some cases emotions change very quickly.

We are hoping that our system will be very useful and helpful for common people. And it will work very well for people of all sectors. As our country has a large population, criminal activity is also high. So it is a very beneficial system for our defense people. So we can finally say it will work very well for all sectors. And our system accomplished our primary goal of comprehending people's emotional states. We also find out which algorithm can better work.

6.3 Implication for Further Study:

Through our work, we hoped to gain a better understanding of people's emotional states. We have accomplished what we set out to do with our work. For our work, we only used two algorithms. We intend to work with more algorithms in the future, and we intend to implement the desired algorithm based on each algorithm. In our project, we worked with some data. However, in the future, we hope to work with much more data. We will make our work available to the public. As a result, people from all walks of life will benefit from our efforts. As we are currently implementing our work through computers, we want to implement our work through mobile apps in future. then it will be beneficial for all people.

References

[1] Lv, Y., Feng, Z. and Xu, C., 2014, November. Facial expression recognition via deep learning. In *2014 international conference on smart computing* (pp. 303-308). IEEE.

[2] Shehu, H.A., Sharif, M.H. and Uyaver, S., 2021, March. Facial expression recognition using deep learning. In *AIP Conference Proceedings* (Vol. 2334, No. 1, p. 070003). AIP Publishing LLC.

[3] Refat, C.M.M. and Azlan, N.Z., 2019, October. Deep learning methods for facial expression recognition. In *2019 7th International Conference on Mechatronics Engineering (ICOM)* (pp. 1-6). IEEE.

[4] Li, X., Yu, J. and Zhan, S., 2016, November. Spontaneous facial micro-expression detection based on deep learning. In *2016 IEEE 13th International Conference on Signal Processing (ICSP)* (pp. 1130-1134). IEEE.

[5] Gaddam, D.K.R., Ansari, M.D., Vuppala, S., Gunjan, V.K. and Sati, M.M., 2022. Human facial emotion detection using deep learning. In *ICDSMLA 2020* (pp. 1417-1427). Springer, Singapore.

[6] Wu, C.D. and Chen, L.H., 2019. Facial emotion recognition using deep learning. *arXiv preprint arXiv:1910.11113*.

[7] Zhao, X., Shi, X. and Zhang, S., 2015. Facial expression recognition via deep learning. *IETE technical review*, *32*(5), pp.347-355.

[8] Ng, H.W., Nguyen, V.D., Vonikakis, V. and Winkler, S., 2015, November. Deep learning for emotion recognition on small datasets using transfer learning. In *Proceedings of the 2015 ACM on international conference on multimodal interaction* (pp. 443-449).

[9] Kuo, C.M., Lai, S.H. and Sarkis, M., 2018. A compact deep learning model for robust facial expression recognition. In *Proceedings of the IEEE conference on computer vision and pattern recognition workshops* (pp. 2121-2129).

[10] Said, Y. and Barr, M., 2021. Human emotion recognition based on facial expressions via deep learning on high-resolution images. *Multimedia Tools and Applications*, *80*(16), pp.25241-25253.

[11]FER2013 dataset, available at

<<https://www.kaggle.com/datasets/nicolejyt/facialexpressionrecognition>>;, last accessed on 3-01-2023 at 12:00 PM.

Face Emotion Detection

ORIGINALITY REPORT

23%	22%	9%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	dspace.daffodilvarsity.edu.bd:8080 Internet Source	13%
2	github.com Internet Source	4%
3	www.researchgate.net Internet Source	1%
4	www.coursehero.com Internet Source	1%
5	"ICDSMLA 2020", Springer Science and Business Media LLC, 2022 Publication	1%
6	hal.archives-ouvertes.fr Internet Source	<1%
7	"Illumination Invariant Facial Expression Recognition using Convolutional Neural Networks", International Journal of Recent Technology and Engineering, 2019 Publication	<1%
8	www.kaggle.com Internet Source	<1%