FACIAL EMOTION RECOGNITION WITH SENTIMENT ANALYSIS FROM REAL-TIME IMAGE: A DEEP LEARNING APPROACH

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

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APPROVAL

This Thesis titled **"Facial Emotion Recognition with Sentiment Analysis from Real-Time Image: A Deep Learning Approach"**, submitted by Azlina Tanha, ID: 182-15-993 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 approvedas to its style and contents. The presentation has been held on 04/02/2023.

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We hereby declare that, this project has been done by us under the supervision of **Afjal Hossan Sarower. Lecturer, department of Computer Science and Engineering.** 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.

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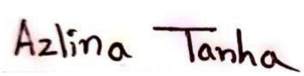

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We really grateful and wish our profound our indebtedness to **Afjal Hossan Sarower Lecturer**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "**Human Emotions Recognition with Sentiment Analysis in Real Time**" 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.

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ABSTRACT

Deep learning and machine learning have become more important in current technologies. AI-based computer technology is used for facial detection, identification, and the detection of facial emotions. "Deep Learning" is a subfield in machine learning (DL). It takes a variety of techniques to track and categorize the human face. In computer vision tests, deep learning algorithms have been beating conventional approaches. In many different sectors, applications for facial recognition and detection are utilized to provide identity, security, and verification. Facial emotion recognition makes it easier to determine a person's feelings based on their facial expressions. I focused on successfully identifying faces, detecting human faces, and categorizing facial emotions using sentiment analysis in this paper. To properly recognize and categorize facial expressions using deep learning techniques. I also divided our work into three parts: first, we will accurately detect faces in real-time by using the Haar-Cascade detection algorithm in the first segment; second, the input from the first part will be processed based on the features of the faces as well as the dataset we used in the first segment (CNN, KNN, and RF). In the last section, the face is verified so that the various facial expressions—such as happy, sad, disgusted, surprised, angry, and neutral—can be classified. The goal of the proposed study is to make face detection, recognition, and emotion recognition simpler. I wanted to make sure that the automatic face expression detection and identification algorithms functioned with dignity and accuracy

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Image processing now plays a big part in human-computer interaction, which is a prevalent trend these days. s of In addition, it was difficult to read facial emotions. We have made great strides in solving concerns with light, aging, and other challenges as a result of the development of contemporary technology and the quick adoption of novel solutions. Nowadays, persons can be quickly and reliably identified using these tools, and in certain cases, their emotions may be determined by analyzing their facial. We can detect someone's emotional state by analyzing their facial characteristics and their activities. First, the technology instantly recognizes the human face throughout the identification procedure. The process of recognition begins after the system has appropriately identified it. To simplify feature selection and surpass existing deep and machine learning techniques, Convolutional Neural Networks (CNN), K-Nearest Neighbor (KNN), and Random Forests (RF) were developed. Several terminologies are used in the facial expression recognition and categorization process. Pre-processing, orientation, detection, feature extraction, and other processes come to mind. The deep learning model may be used to carry out each of these processes. It outperforms practical calculations.

1.2 Objective

Once a human facial expression has been detected and identified, the objective of the emotion detection and recognition system is to accurately identify it. That is to say, the system needs to be able to tell the difference between neutrality, surprise, fear, rage, and other feelings.

1.3 Motivation

Face detection and recognition technologies are employed in the sectors of school and college attendance systems. They can also apprehend terrorists and criminals. It can be taken into account for both the general public's safety and the vital security of the nation.

Face recognition technology may be used by the government to check voter registration lists, find persons who are missing, estimate the population, or conduct a census, as well as to prevent online fraud, secure e-commerce, and be extensively used in the medical and healthcare fields. The identification of facial expressions to identify emotions is another important field of research for human-computer interactions. Face expressions and different movements are examples of nonverbal communication cues.

1.4 Summary

I would be categorized objects and image processing as having received a lot of attention, while face expression categorization has undoubtedly received less. Our study is a cutting-edge method that uses many models to ease the challenging problems of human-machine interaction. I strive to improve the precision and effectiveness of our categorization using our pre-trained model.

1.5 Expected Outcome

The end result of this project:

- Capable of detecting and recognizing human faces in real time,
- It is capable of detecting human emotions in real time.
- Capable of distinguishing between seven different emotions in human beings.

1.6 Report Layout

The first part of this report provides an overview of our project's goals, motivations, synopsis, research questions, and anticipated results. The background research for the linked work, a comparison of our work to that of others, and the project's difficulties were covered in Chapter 2. Our research methodology is presented in Chapter 3, in addition to the subject of the research and the instruments, data collection, statistical analysis, an explanation of our proposed method, the design, flowchart, and design classification of our proposed method, and finally the implementation requirements. The experiment's results and the discussion portion are illustrated in Chapter 4. Chapter 5 details the project's social impact, whereas the entire focus of Chapter 6 is a summary and conclusion.

CHAPTER 2
BACKGROUND

2.1 Related Works

Several papers on face-emotion categorization and identification have been published in recent years. In 2020, Shaik Asif Hussain and Ahlam Salim Abdallah Al Balushi published a paper on "real-time face emotion classification and recognition using deep learning models." [1]They use the VGG-16 model. Also, by using convolution neural networks (CNN), they generated facial encoding. They worked on six types of facial expressions. The work of C. Shan, S.G.a., P.W.M, 2009. ([2] This work experimentally evaluates facial representation based on statistical local features and local binary patterns for person-independent facial emotion identification. There is another work by Bin Li (2009), [3] which presents an overview of steganography and steganalysis for digital photos, with a focus on the underlying principles, the evolution of steganographic approaches for images in spatial representation and JPEG format, and the creation of associated steganalysis systems.

2.2 Comparative Analysis and Summary

I used the CNN architecture and multiple deep CNN models. We achieved an accuracy of about 97% with the Random Forest (RF) model, but I was unable to locate a real-time implementation that performed that much better at the expression categorization stage. We also used KNN, and the result was 62% accuracy.

To increase accuracy, I employ the "deep CNN model," which refers to the number of layers in the neural network. There are more convolutional layers in a deeper network. I just increase the number of convolutional layers. With our modified CNN model, we achieved 91% accuracy. Moreover, get an accurate detection system for real-time facial emotion recognition with sentiment analysis.

2.3 Challenges

For me, this work is difficult. When trying to complete the project as planned, we ran across a number of obstacles. It takes a long time to finish the procedure, particularly in the training process. We must devote a lot of effort to this in order to recognize human emotions.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

I made an effort to include all of the information that I learned while working on this project in this part. Our major areas of focus were seven human emotions. We need to gather a variety of data in order to complete our research. We must process the data before we may use them in accordance with our needs.

3.2 Research Subject and Instrumentation

In my study, which focuses mostly on human face detection and expression recognition, I utilise a deep CNN model, Random Forest (RF), and KNN. We employed the "Windows" operating system to carry out our project, and we decided to use the Python programming language. A few other packages need to be installed. In addition, I utilised the following other instruments, which are listed below:

- PC
- Image dataset (for testing)
- Internet Connection
- Several journals for references
- Web Camera
- Human face to check my project's accuracy

3.3 Data Collection

Multiple stages of functional evaluation are performed on the system design model. 1) In order to identify emotions using neural network architecture, we need to create a dataset (CNN, RF, KNN).

I used Kaggle datasets for the research I suggested. 35887 pictures in all make up this collection. The test folder has 7178 photographs, whereas the train folder has 28709 images.

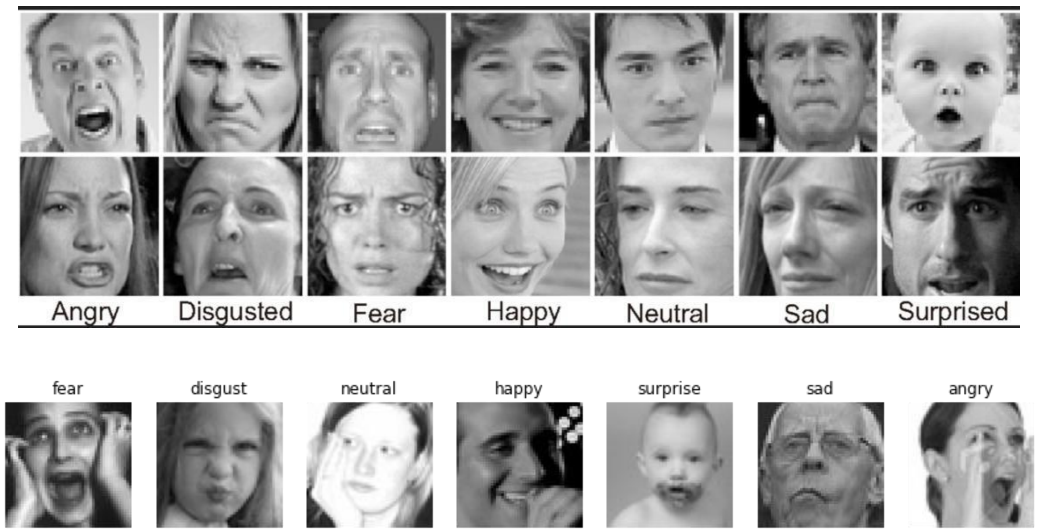

Fig-3.3.1: Sample kaggle dataset

3.4 Workflow

Data Processing: However, in order to create our own dataset, we must gather a large amount of raw data, resize all of the raw data, and, if necessary, go through the data augmentation procedure. Working with raw data may be challenging since many of the photos there may have noise and inaccuracies. Therefore, we must first manually process such photos. We do not need to undertake data augmentation because we acquired the dataset online. However, we reduced the size of the photos in our dataset to 50 by 50 dimensions before modeling them.

Selecting Model: There are several CNN model options. After investigating several model types, we made the decision to use the deep CNN method for our project. On them, we receive various levels of precision. In the end, I decided to use the deep CNN model for my project, and I achieved 91% accuracy.

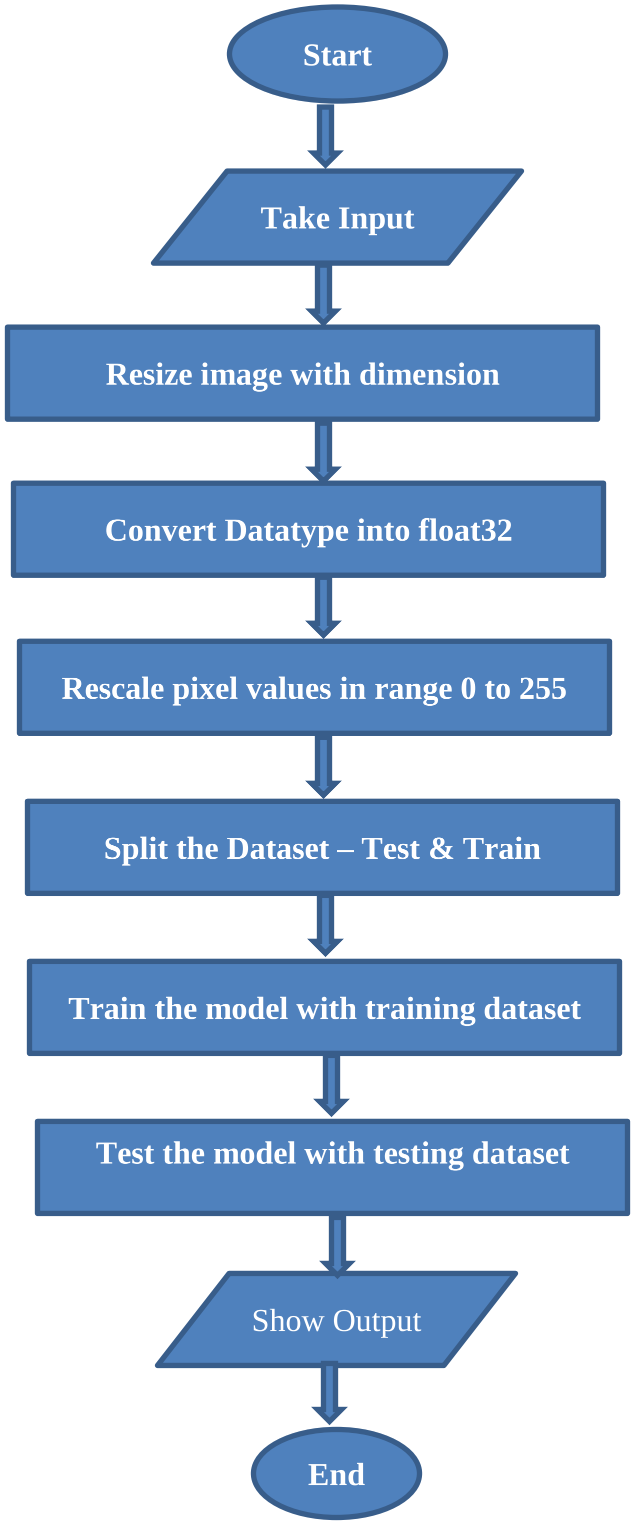

Figure 3.4.1: Model workflow

3.5 Proposed Methodology

The subject of the proposed study is human face detection, emotion recognition, and classification using Python. Three steps are taken to complete this task. The procedure is as follows: the first phase is face detection, the second is real-time face recognition, and the third is facial emotion classification. We worked on our database, which we gathered from web sources before we started the procedure. The photos were scaled to 50x50 pixels. Following this procedure, the face may be recognized by the camera. The Haarcascade method is used to recognize faces in the first stage. Utilizing free and open-source computer vision technologies, this method was developed. To detect faces, two algorithms are integrated with distinctive traits. The pictures are capable of detecting buildings, objects, etc. A human face is recognized and the images are retrieved in this stage. They are then saved in the database for the subsequent stage, which is facial recognition. Using the name of the detected or identified face, the deep CNN model matches human faces that are stored in a data collection. The data set allows for the recognition of the faces. Software such as Anaconda and Python are employed to carry out the intended job. The emotions include anger, fear, disgust, joy, neutral, and surprise.

3.5.1 Proposed Model (CNN Layer)

A component of DNN, which is used to evaluate visual data, is convolution neural networks. We employed a deep CNN model with 10 convolutional layers in our suggested study. In addition, it features one completely linked layer and four layers with maximum pooling. It is a crucial stage and a capability for object recognition. Three layers make up CNN: the input layer, the hidden layer, and the output layer. The input layer is the first layer. These models monitor image border functions using kernels. The most popular colour space is RGB, which mixes three different types of light to create a wide range of colours. It decodes the RGB (red, green, and blue) colour components of each pixel.

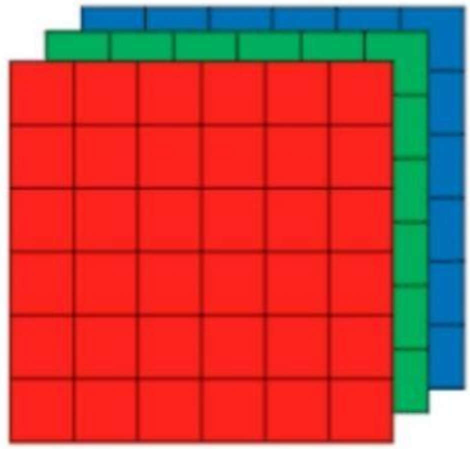

Fig-3.5.1(a): RGB image

In order to separate functions and reduce the number of training parameters, the local field of sight, weight arrangement, and time or space subsampling are the most important technologies in CNN. The CNN algorithm offers the advantages of clear function separation and avoiding direct learning from training data. Stability, size, and speed are produced by using the sub-sample structure in time or space. The advantages of image and audio processing suggest that network entry and topology can be rather excellent.

In order to acquire the optimal solution for a certain CNN application architecture, the CNN algorithm needs more project design knowledge and must allow for application practice errors on a regular basis. This, after pre-processing, produces 32*32, which has 17 different photos, based on an input gray value of 96*96 atthe pre-processing stage. The total processing of CNN in training faces is determined byfig-3.5.1 (b).

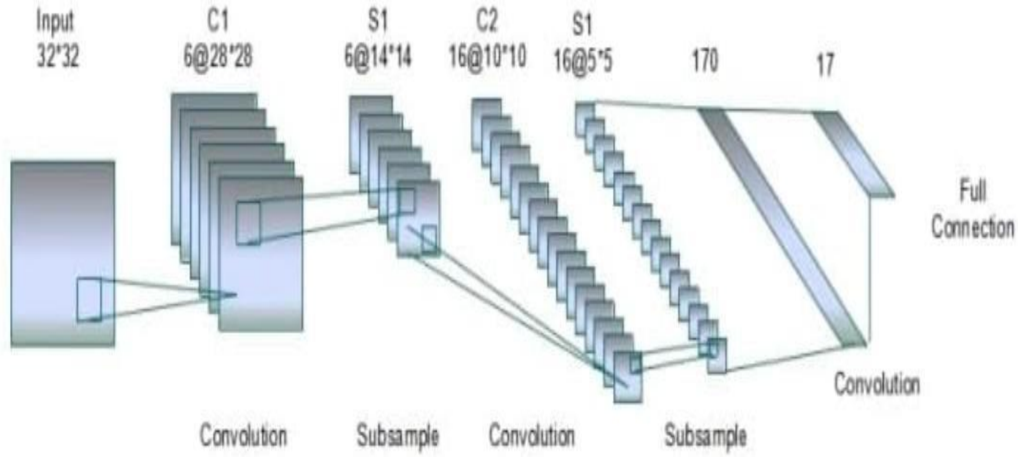

Fig-3.5.1(b): CNN model stages

We used 2*2 filters in our modified CNN and added more layers as we went deeper, as well as a 2*2 max-pooling layer that selects the maximum value at a specified area. To avoid linearity and learn complicated characteristics, we employed the RELU activation function. We utilized dropout regularization, which selects a node based on a probability that we specified, and it prevented the model from becoming overfit. To categorize and find the loss function, a softmax unit was employed.

3.1.1 Max Pooling Layer

In the CNN system, this layer is employed as a degenerating testing step. This layer's primary purpose is to determine the highest value from the feature map that the filter has covered. The pooling layer is regarded as a building component of CNN. The brighter pixels in a picture are counted using the maximum pooling layer.

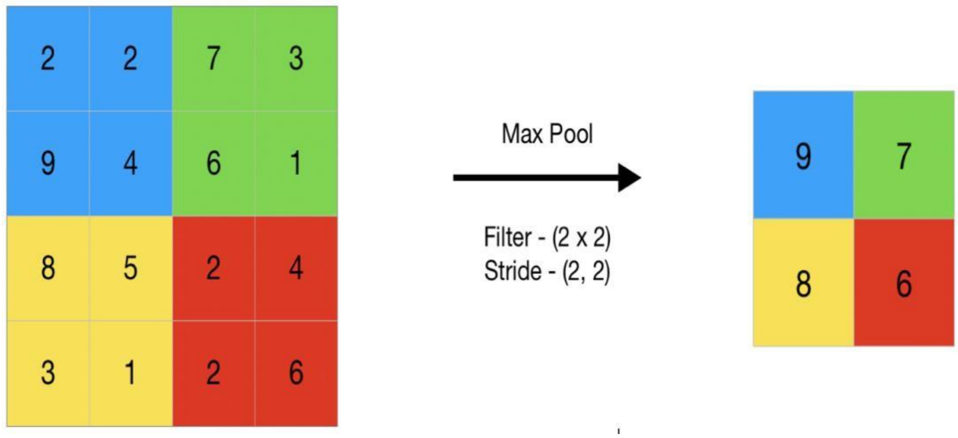

Fig-3.5.2: Maxpooling Layer

3.1.2 Dense Layer

This layer is typically used in artificial neural networks. This layer's neurons get input from the layer above it. The neurons in the dense layer do linear transformation there. The output of the dense layer's column vector and the row vector from the previous layers are equivalent in matrix-vector multiplication. The row vector must have the same number of columns as the column vector when multiplying matrices with vectors.

$$A\mathbf{x} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n \\ a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n \\ \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n \end{bmatrix}. \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Fig-(3.5.3): General formula for a matrix-vector

3.1.3 Soft Max

In our project, I applied the SoftMax layer, which is normally utilised as the final output layer. In order for this layer to effectively perform multi-class classification tasks, sigmoid activation functions are required. This function aids in the activation of additional processes required for our model's output layer. Below is a formula for SoftMax activation probability dissemination:

$$\sigma(\vec{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}} \qquad \text{……………….. (2)}$$

Where

σ = softmax

$\vec{z}$ = input vector

e^{z_i} = standard exponential function for input vector

K = number of classes in the multi-class classifier

e^{z_j} = standard exponential function for output vector

e^{z_j} = standard exponential function for output vector

3.2 Proposed Methodology Design

The functional blocks each have their own unique set of operations. Before the camera is put into the neural networks that gather pictures, additional preprocessing occurs. The image is altered utilising network architecture to create and train the dataset for identification and classification. The function's stages are listed below:

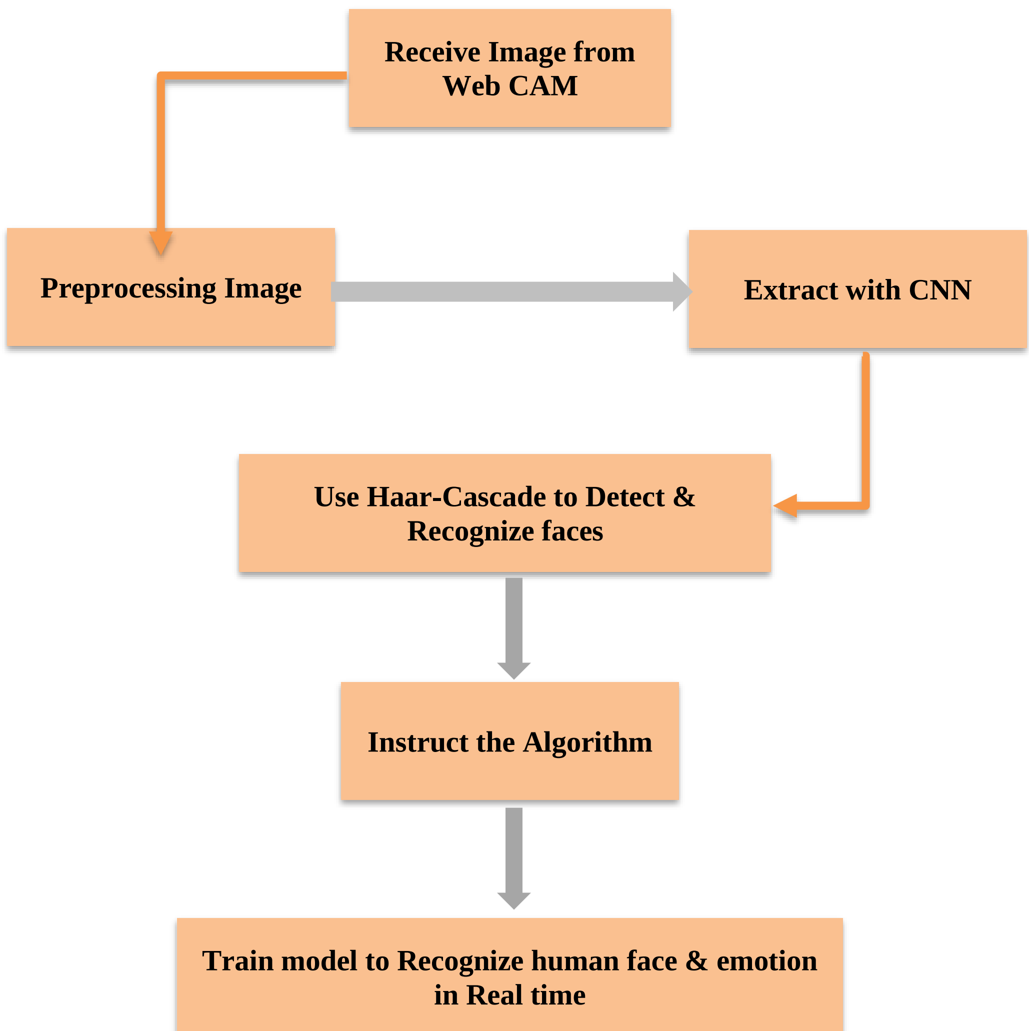

Fig-3.6: Block diagram of face detection, recognition and emotion classification

3.2.1 Chart and design specification

A real-time face detection, recognition, and classification flowchart are shown in Figure (3.6.1). The photos are boxed, after which they are converted into binary patterns known as feature vectors and saved in a database. Images are trained to recognize different facia expressions in input photos and categorize them as neutral, pleased, furious, excited, or disgusted. Importing the dataset, processing it, adding more information as a feature vector, building and assembling the design model, training and storing the feature vector, and testing the test model are the seven steps that make up the training process.

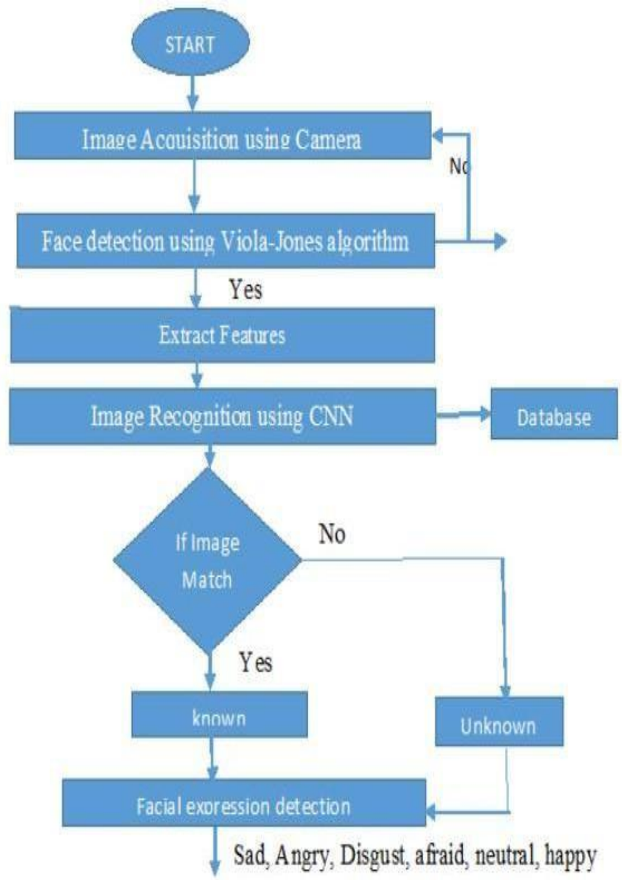

Fig-3.6.1: Face detection and recognition flow-chart

3.3 Implementation Requirement

After carefully examining all statistical and theoretical ideas and methods, we have investigated a list of requirements for face detection, identification, and emotion categorization.

Software/Hardware:

- Operating system (windows 10 or above)
- Hard disk (minimum 500GB/128gb SSD)
- RAM (minimum 4GB)

Developing tools:

- Colab environment
- Visual Studio
- Good internet connection.

CHAPTER 4

EXPERIMENTAL RESULT AND DISCUSSION

4.1 Experimental Setup

The required libraries we used:

```
[ ] import numpy as np
    import pandas as pd
    import os
    import tensorflow as tf
    import seaborn as sn
    from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img
    from tensorflow.keras.layers import Conv2D, Dense, BatchNormalization, Activation, Dropout, MaxPooling2D,
    from tensorflow.keras.optimizers import Adam, RMSprop, SGD
    from tensorflow.keras import regularizers
    from tensorflow.keras.callbacks import ModelCheckpoint, CSVLogger, TensorBoard, EarlyStopping, ReduceLROn
    import datetime
    import matplotlib.pyplot as plt
    from tensorflow.keras.utils import plot_model
    from sklearn.metrics import confusion_matrix, classification_report,roc_curve,auc,accuracy_score
```

Fig: 4.1(a)-Required library

We mount our Google Drive to attach our directories and connect to the Kaggle dataset using Kaggle.Jason:

```
[ ] !mkdir -p ~/.kaggle
    !cp kaggle.json ~/.kaggle/
    !ls ~/.kaggle
    !chmod 600 /root/.kaggle/kaggle.json

    kaggle.json

[ ] !kaggle datasets download -d msambare/fer2013
    !unzip /content/fer2013.zip
      inflating: train/sad/Training_65563105.jpg
      inflating: train/sad/Training_6558295.jpg
      inflating: train/sad/Training_65586139.jpg
      inflating: train/sad/Training_65591252.jpg
      inflating: train/sad/Training_65626778.jpg
      inflating: train/sad/Training_65701260.jpg
      inflating: train/sad/Training_65707197.jpg
      inflating: train/sad/Training_65720898.jpg
      inflating: train/sad/Training_6573454.jpg
      inflating: train/sad/Training_65749670.jpg
      inflating: train/sad/Training_65756896.jpg
      inflating: train/sad/Training_65792953.jpg

[ ] train_dir = '/content/train'
    test_dir = '/content/test'

    row, col = 48, 48
    classes = 7
```

Fig: 4.1(b)-Connected directories

Class labels after loading data:

```
{'angry': 0,
 'disgust': 1,
 'fear': 2,
 'happy': 3,
 'neutral': 4,
 'sad': 5,
 'surprise': 6}
```

Fig: 4.1(c) - class labels

The training parameters for the classical model can go up to 157,292,935. The upgraded training parameters are 157,292,935, and the upgraded model parameters are 0. As a result, more models may be trained faster while utilizing less computer resources.

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 48, 48, 32)        320
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 48, 48, 64)        18496
_________________________________________________________________
batch_normalization (BatchNo (None, 48, 48, 64)        256
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 24, 24, 64)        0
_________________________________________________________________
dropout (Dropout)            (None, 24, 24, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 24, 24, 128)       73856
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 24, 24, 256)       295168
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 24, 24, 512)       1180160
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 24, 24, 1024)      4719616
_________________________________________________________________
batch_normalization_1 (Batch (None, 24, 24, 1024)      4096
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 12, 12, 1024)      0
_________________________________________________________________
dropout_1 (Dropout)          (None, 12, 12, 1024)      0
_________________________________________________________________
flatten (Flatten)            (None, 147456)            0
_________________________________________________________________
dense (Dense)                (None, 1024)              150995968
_________________________________________________________________
dropout_2 (Dropout)          (None, 1024)              0
_________________________________________________________________
dense_1 (Dense)              (None, 7)                 7175
=================================================================
Total params: 157,295,111
Trainable params: 157,292,935
Non-trainable params: 2,176
```

Fig: 4.1(d)-Sum of total prams, trainable prams and non-trainable prams

4.2 Performance Evaluation

A demonstration's approval accuracy is increased when it is connected to video from a different class. In our model, we have a propensity towards advanced planning. The initial dataset was used to run the network for 60 epochs. It was also put to the test.

The training loss, on the other hand, happens when a set of data is not ready before to the training phase. The application of the approval set of knowledge incorrectly across the ready network is the approval challenge.

The model that matches to the data the model produced is plotted in the following graph along with the training and validation losses vs epochs.

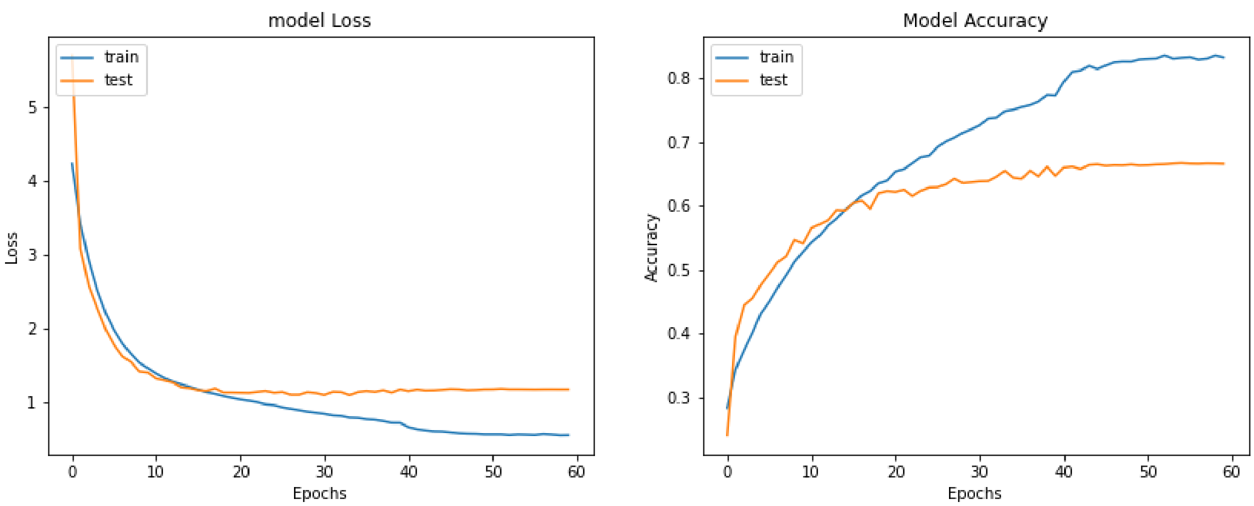

Fig: 4.2(a) - Accuracy and loss of our model

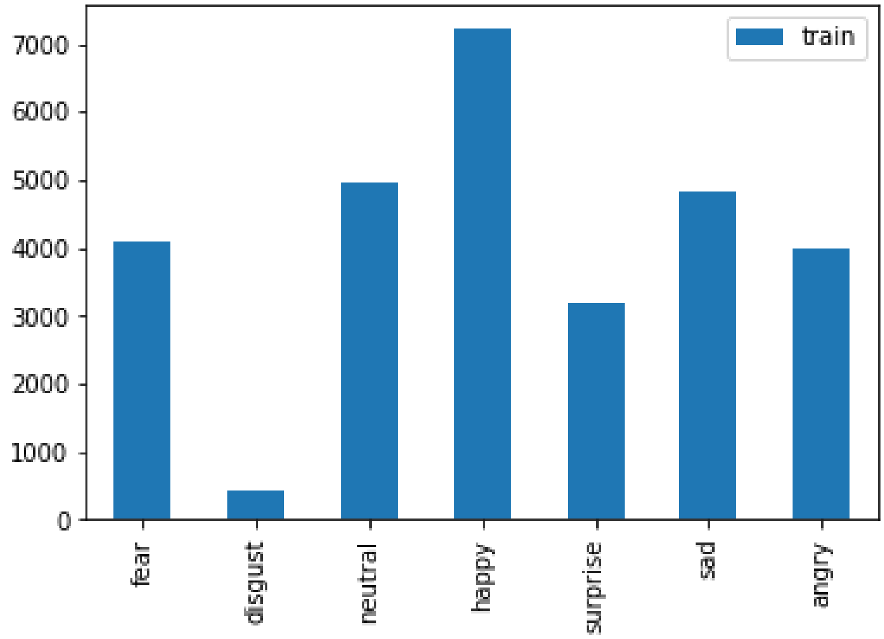

Fig: 4.2(b)-Bar chart of training phase

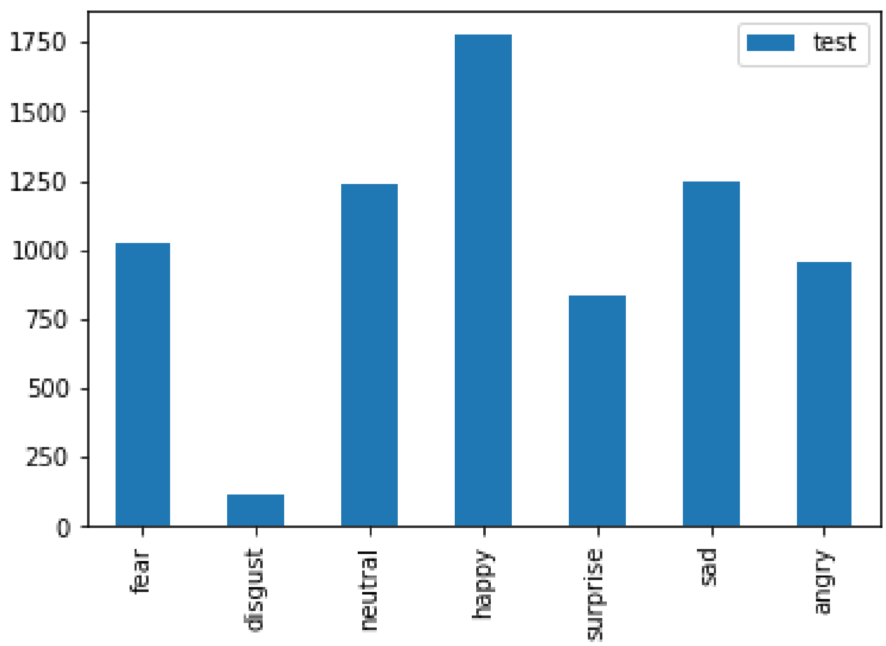

Fig: 4.2(c)- bar chart of testing phase

4.3 Experimental Result and Analysis

From the test dataset of images, we calculated precision, recall, and F1 score. We can observe from the classification report that the F1- score is 0.18 and that the accuracy normal is 0.91, the recall normal is 0.14, and. Our categorization is being used in an average way.

Precision: One of the performance metrics for machine learning models, precision describes the accuracy of the model's positive prediction. The total number of true positives is divided by the total number of accurate forecasts.

$$\text{Precision} = \frac{tp}{tp + fp} \quad \text{.................. (3)}$$

Recall: The recall is the percentage of recovered relevant events to all recovered relevant occurrences. Since the majority of the many outcomes were computed, the high recall implies.

$$\text{Recall} = \frac{tp}{tp + fn} \quad \text{.................. (4)}$$

Accuracy: Accuracy is the degree to which a measured value is comparable to a certain value. The overall number of true positives, true negatives, false positives, and false negatives is divided by the total number of true positives, true negatives, false positives, and false negatives to determine the accuracy of a machine-learning model.

$$\text{Accuracy} = \frac{tp + tn}{tp + tn + fp + fn} \quad \text{.................. (5)}$$

Below are provided for CNN the confusion matrix and classification report:

Classification Report

	precision	recall	f1-score	support
angry	0.14	0.13	0.14	3995
disgust	0.00	0.00	0.00	436
fear	0.15	0.13	0.14	4097
happy	0.25	0.26	0.26	7215
neutral	0.17	0.19	0.18	4965
sad	0.17	0.18	0.18	4830
surprise	0.11	0.11	0.11	3171
accuracy			0.18	28709
macro avg	0.14	0.14	0.14	28709
weighted avg	0.18	0.18	0.18	28709

Fig: 4.3(a)- classification report base on train set

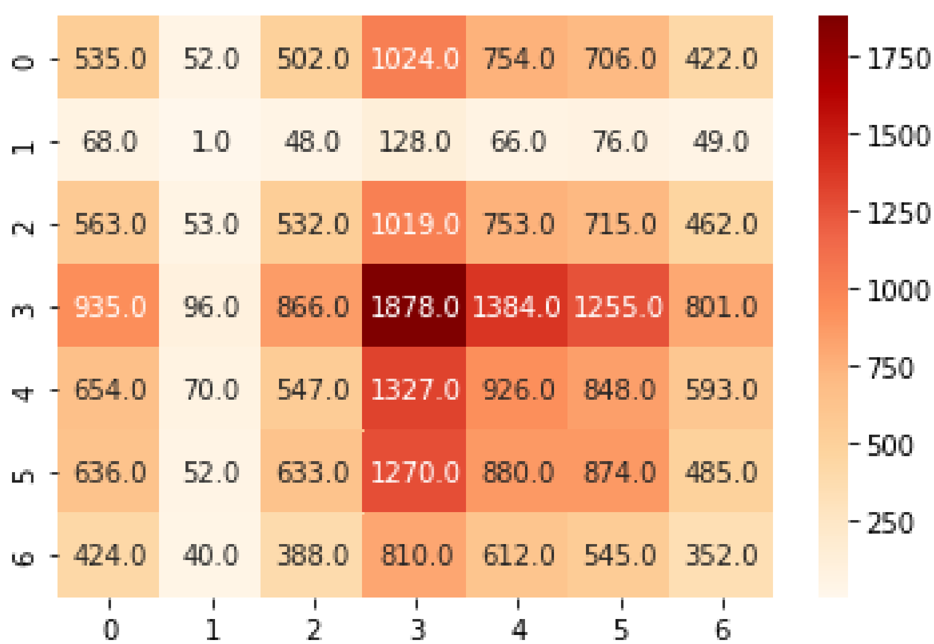

Fig: 4.3(b)- Confusion matrix base on train set

Classification Report

	precision	recall	f1-score	support
angry	0.13	0.15	0.14	958
disgust	0.03	0.02	0.02	111
fear	0.16	0.13	0.15	1024
happy	0.25	0.25	0.25	1774
neutral	0.17	0.19	0.18	1233
sad	0.17	0.16	0.17	1247
surprise	0.11	0.12	0.12	831
accuracy			0.17	7178
macro avg	0.15	0.15	0.15	7178
weighted avg	0.17	0.17	0.17	7178

Fig: 4.3I- classification report base on test set

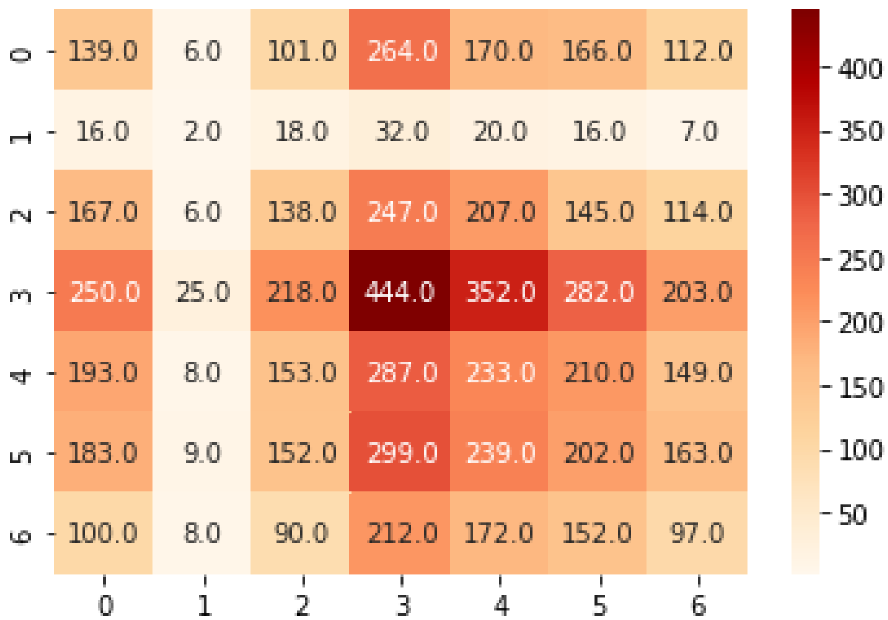

Fig: 4.3(d)- Confusion matrix base on test set

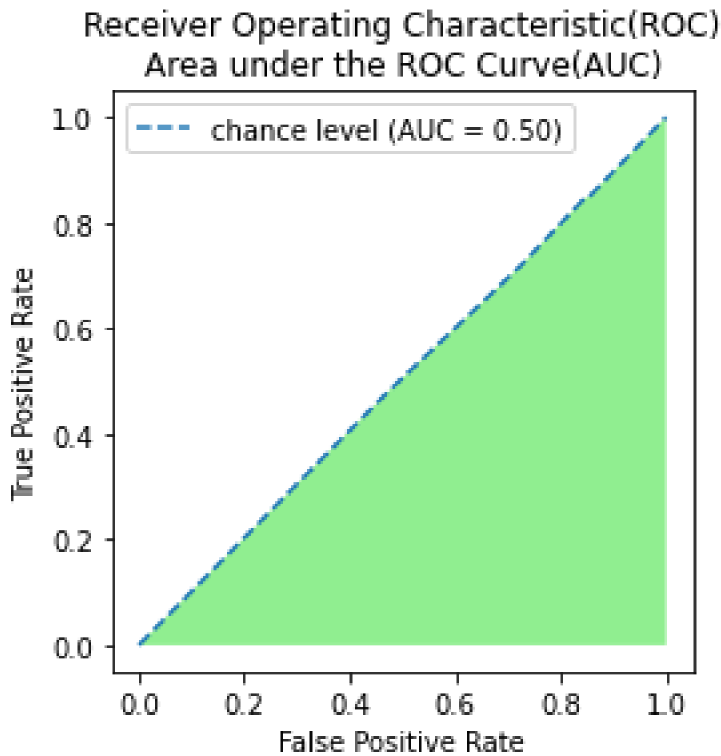

Fig: 4.3I- Receiver Operating Characteristic (ROC)\Area under the ROC Curve (AUC)

Model Evaluation:

high accracy is achieved on training set but accuracy on validation set is stuck at 66% also no overfitting can se seen in the dataset hence is can be concluded that the inefficiency may be due to the unbalanced dataset

Model evaluation

```
[ ] train_loss, train_accu = fernet.evaluate(training_set)
    test_loss, test_accu = fernet.evaluate(test_set)
    print("final train accuracy = {:.2f} , validation accuracy = {:.2f}".format(train_accu*100, test_accu*100))

449/449 [==============================] - 30s 67ms/step - loss: 0.3737 - accuracy: 0.9103
113/113 [==============================] - 4s 38ms/step - loss: 1.1666 - accuracy: 0.6658
final train accuracy = 91.03 , validation accuracy = 66.58
```

Fig: 4.4: Model Evaluation for CNN

The confusion matrix and classification report are given below for KNN:

```
print(classification_report(y_test, predict))
```

```
              precision    recall  f1-score   support

           0       0.13      0.21      0.16       958
           1       0.00      0.00      0.00       111
           2       0.14      0.13      0.13      1024
           3       0.24      0.33      0.28      1774
           4       0.17      0.15      0.16      1233
           5       0.17      0.11      0.13      1247
           6       0.12      0.05      0.07       831

    accuracy                           0.18      7178
   macro avg       0.14      0.14      0.13      7178
weighted avg       0.17      0.18      0.17      7178
```

Fig: 4.5(a)- classification report for KNN

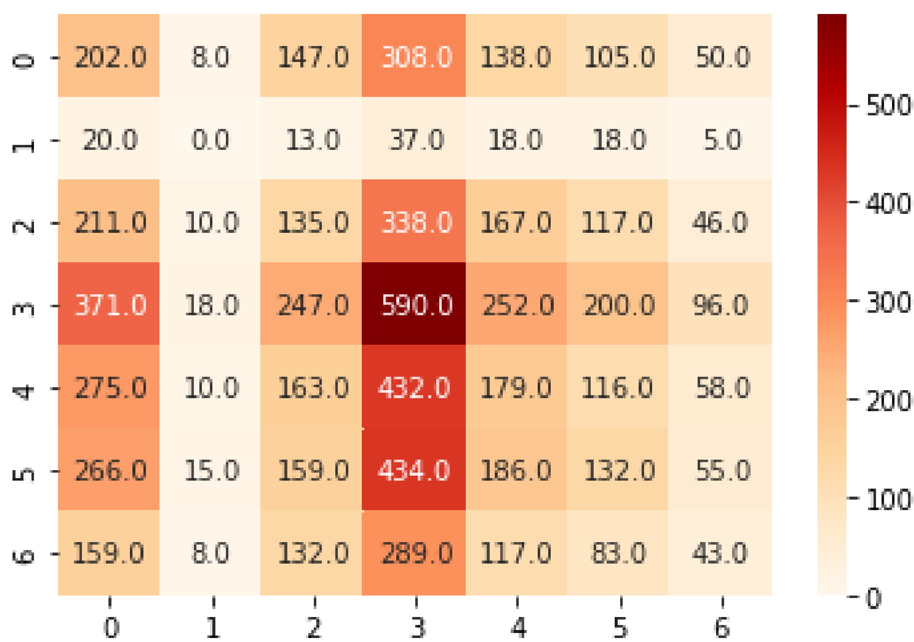

Fig: 4.5(b)- Confusion Matrix- KNN

Model Evaluation:

This accuracy score is based on the test.

```
[ ] #AccuraCY SCORE
    accuracy_score(y_test, predict)

    0.17846196712176093
```

The confusion matrix and classification report are given below for RF:

```
print(classification_report(y_test, predict))

              precision    recall  f1-score   support

           0       0.12      0.04      0.06       958
           1       0.00      0.00      0.00       111
           2       0.13      0.05      0.07      1024
           3       0.25      0.66      0.36      1774
           4       0.15      0.10      0.12      1233
           5       0.15      0.09      0.12      1247
           6       0.12      0.02      0.03       831

    accuracy                           0.21      7178
   macro avg       0.13      0.14      0.11      7178
weighted avg       0.16      0.21      0.15      7178
```

Fig: 4.5I- classification report for RF

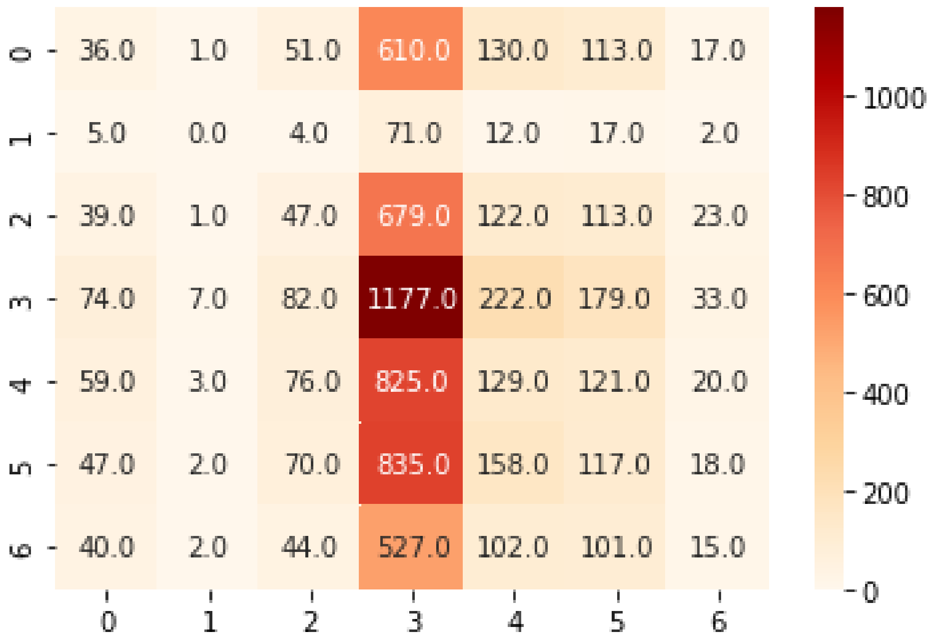

Fig: 4.5(d)- Confusion Matrix- RF

Model Evaluation:

This accuracy score base on test.

```
[17] #AccuraCY SCORE
     accuracy_score(y_test, predict)

     0.21189746447478405
```

This accuracy score is based on train

```
[20] print(classification_report(y_train, predict))

              precision    recall  f1-score   support

           0       0.97      0.96      0.96      3995
           1       0.97      0.94      0.96       436
           2       0.97      0.97      0.97      4097
           3       0.97      0.97      0.97      7215
           4       0.96      0.97      0.97      4965
           5       0.97      0.96      0.96      4830
           6       0.97      0.96      0.96      3171

    accuracy                           0.97     28709
   macro avg       0.97      0.96      0.96     28709
weighted avg       0.97      0.97      0.97     28709
```

```
[21] accuracy_score(y_train, predict)

     0.9660385245045108
```

Real Time Facial Emotion Recognition:

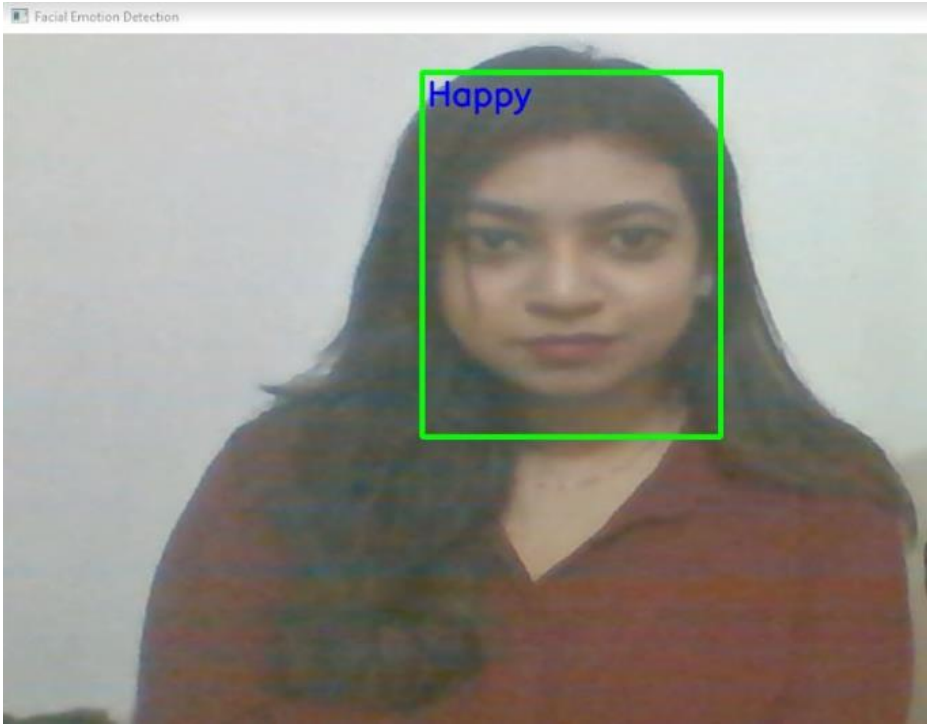

Fig-4.6(a): Emotion Recognition from single face (happy)

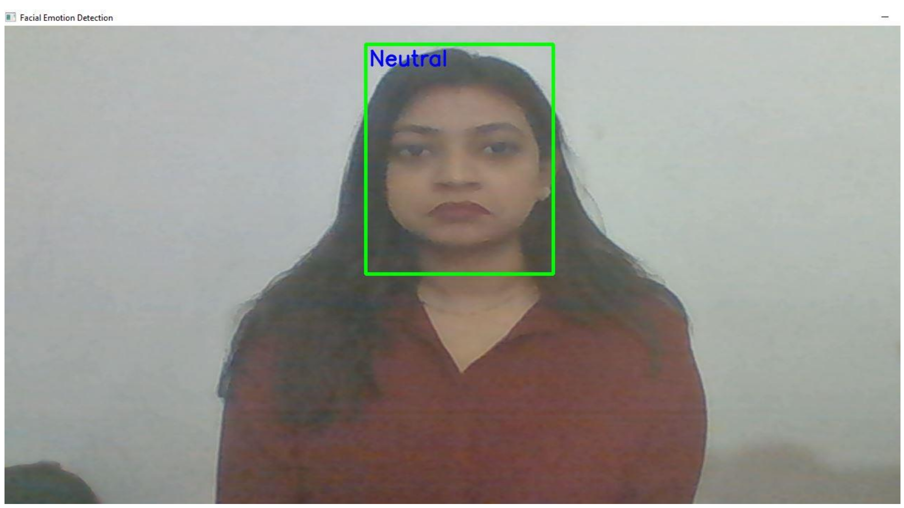

Fig-4.6(b): Emotion Recognition from single face (neutral)

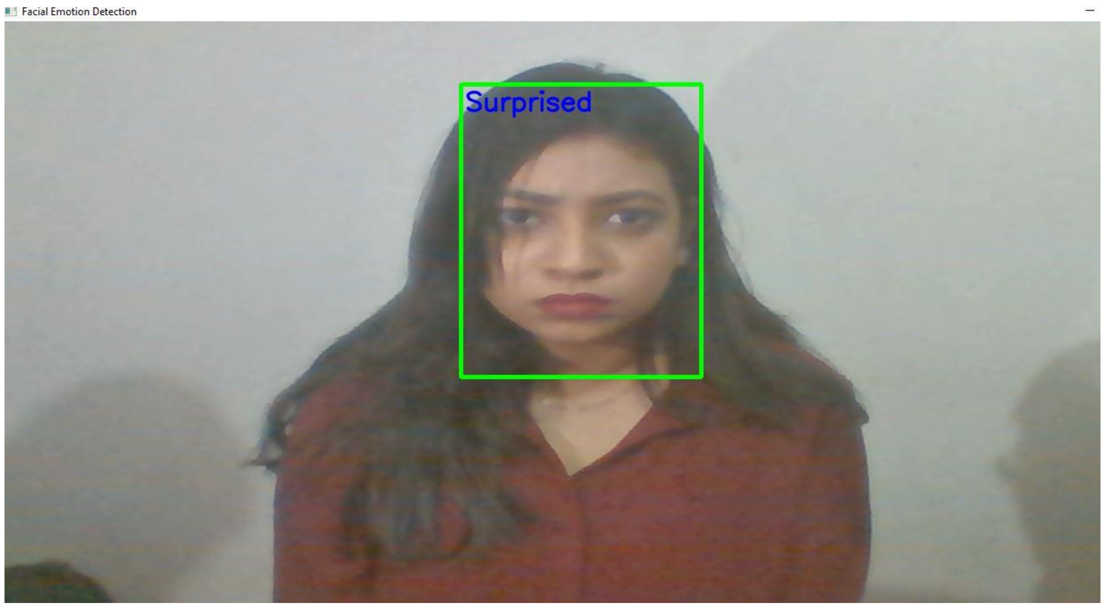

Fig-4.6I: Emotion Recognition from single face (surprised)

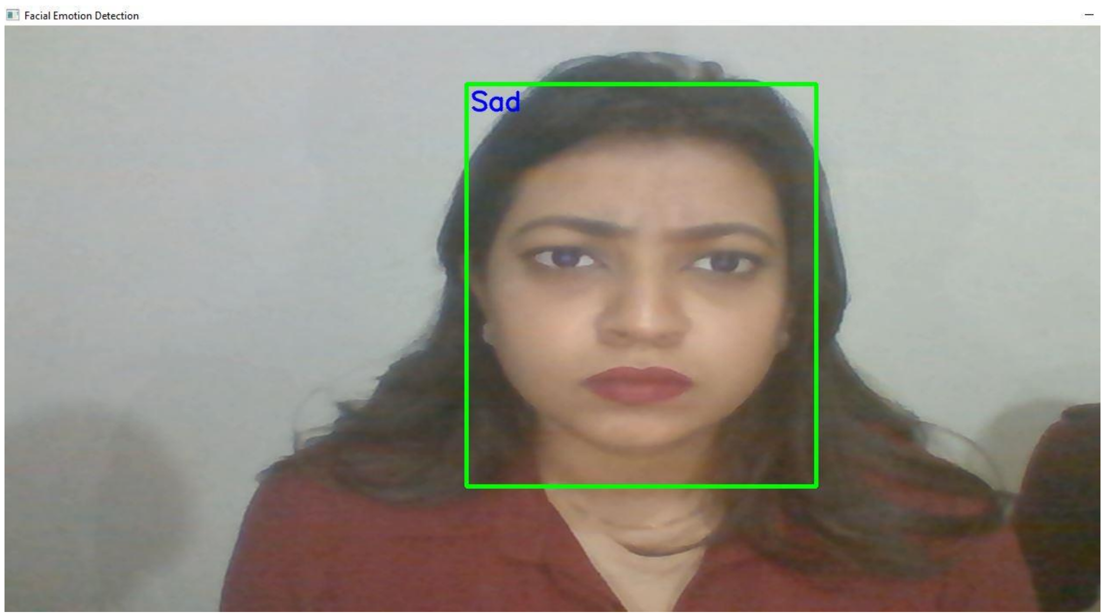

Fig-4.6(d): Emotion Recognition from single face (sad)

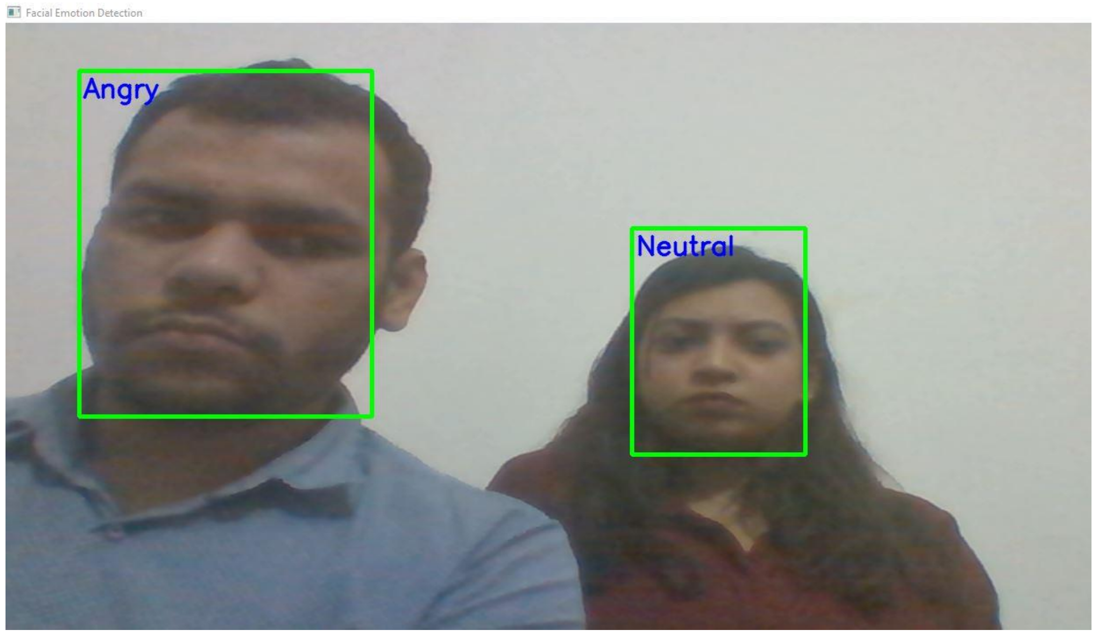

Fig-4.6I: Emotion Recognition from multiple faces

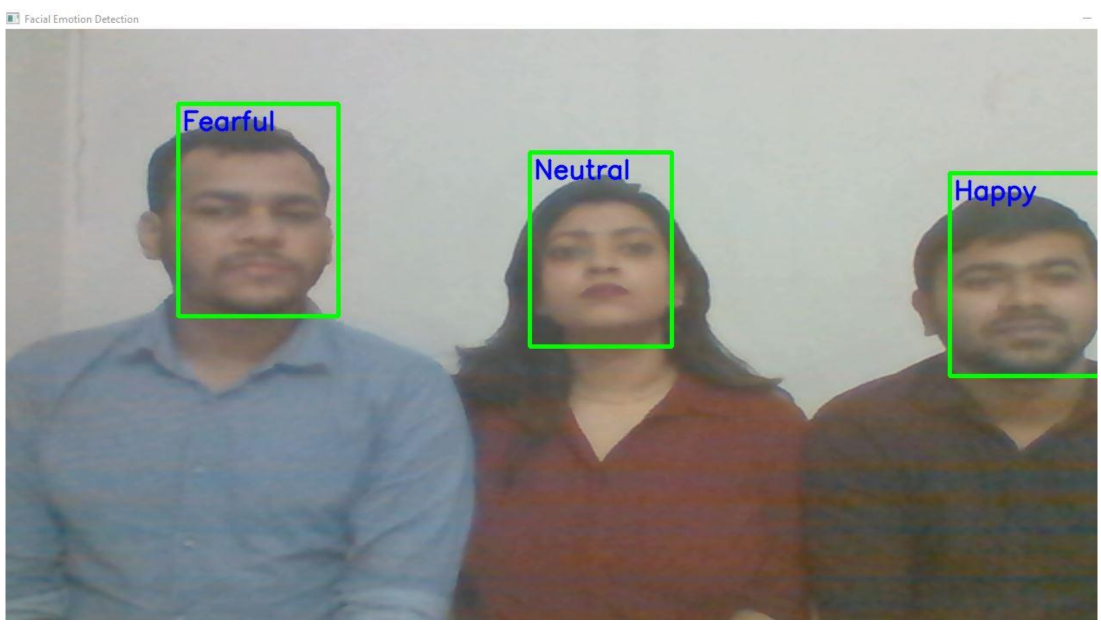

Fig-4.6(f): Emotion Recognition from multiple faces

As I have already mentioned, the KNN algorithm, Random Forests, and CNN’s categorization are all practically perfect. Also noted was the result. Now that we know how the project functions, we can get results that are almost exactly right. Researchers are currently exerting significant effort to identify the issue and discover a solution. Some searchers also apply a Gabor filter to complete other datasets. Deep learning and convolutional neural networks have produced a wide range of innovative ideas.

4.4 Result Discussion

There are still several restrictions, including those related to bands, facial hair, cosmetics, and ageing. The procedures for routinely assessing emotion detection experiments are described in this study. I captured some photographs and put them into action for testing. The vast majority of the time, it delivers nearby results. My databases do not contain such photographs. The user benefits when they experience the desired emotion. Typically, the user builds their own datasets, and they are free to edit the photographs any way they choose.

In my project, I am using a dataset with seven different emotions in the test section.

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT, & SUSTAINABILITY

5.1 Impact on society

The intention, state of mind, and attitude of a person may be revealed by their facial expressions. Psychopathology and personality might also be used for communication. When individuals converse all therapeutic modalities, natural human-machine interactions, and behavioral science can all benefit from automatic facial expression recognition. Many people in the current age make use of technology. Artificial intelligence played a big part in making our day easier. Everybody owns a smartphone these days. Selfies are popular among young people. We can recognize specific facial expressions using software for emotion detection.

5.2 Impact on Environment

According to my project, I can instantly determine a person's expression from their picture. I can also deduce details about a person's true face expression by instantly recognizing his photograph. My system might not work in a hostile environment since the natural world is always changing. In dangerous situations, it is usually hard to clearly distinguish a human face. We need a calm atmosphere so that my system can detect effectively. We can only tell how someone is feeling when we can identify his or her face. Our technology might not function as effectively and give different outcomes in environments with a lot of movement since the inside and exterior environments are different. As a result, the environment has a special influence on my project.

5.3 Ethical Aspects

There is an ethical component to every scientific project. The following are my ethical considerations:

- Honestly used all of the information.
- When I choose this work, I research this type of project to understand more aboutit.
- I am attempting to avoid plagiarism.

5.4 Sustainability Plan

I employed a variety of previously trained algorithms in the project. I develop a strategy for the kind of algorithm we will need. I had to use a variety of ways to figure out which model performed what because I was mixing numerous models. In order to determine which models are suitable for use with our system, I tested them against five distinct model kinds. The face detector model, face recognition model, and facial expression recognition model are some examples of these models. I have also used the small face model to find many faces at once.

There are several tasks, including the identification of faces and the use of facial expression recognition models to identify facial expressions.

CHAPTER 6
SUMMARY & CONCLUSION

6.1 Summary of the study

Use of Colab and Visual Studio was used to execute all of the internal code. Here, I dealt with a good deal of human faces. I'm trying to read the actual expression of the individual. One of the strongest and earliest forms of communication and display of emotion is considered to be the scientific culture of facial expression. Facial expressions may alter a person's emotional state, including sadness, surprise, happiness, or fury. We want to introduce the animus to modern techniques and system operations that face image specialists will find particularly fascinating. The domains on which future research trends will be based globally may be determined by that finding.Facial expressions of people are crucial in man-to-man communication. Through their facial expressions, people may convey their feelings or moods, such as sad, happiness, or rage.

6.2 Conclusion

The study classifies human facial emotions into happy, sorrow, surprise, fear, wrath, disgust, and neutrality using a deep convolution neural network architecture. This article's objective is to provide a summary and opinion on recent advancements in facial expression recognition technology. I developed and improved a comprehensive framework for creating CNN in real-time. To decrease the amount of pieces, we methodically produced our offered proposals. In order to minimize the amount of parameters in the remaining convolutional layers, we started by deleting all completely connected layers. We have shown how to preserve real-time inference capabilities while stacking our recommended multiclass classification models. We have developed a vision system that can distinguish between faces in particular.

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Appendix

At first, our understanding of artificial intelligence detection, identification, and classification was limited. We conducted an extensive study on this topic and several publications pertinent to our project concept in order to get this understanding. We received helpful advice from our supervisor, who also greatly assisted us with our study. Through this investigation, we discovered several new methodologies, a wealth of data, and expertise in various algorithms and approaches. We also gained knowledge of a few fresh software tools, like Python programming, Visual Studio Codes, and Google Colab. We were concerned about our data collecting because it was challenging to get a significant amount of information for our dataset during this pandemic circumstance. So, for our study, we chose to use an online dataset. We eventually learned some new methods to find our answer after conducting a good amount of study.

Finally, the study we conducted has motivated us to improve and expand on our idea in the future.

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