

**FACE DETECTION AND RECOGNITION SYSTEM**

**BY**

**MD.MEHEDI FARUK**

**ID: 153-15-6432**

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

Supervised By

**Dr. Fernaz Narin Nur**

Assistant Professor

Department of CSE

Daffodil International University

Co-Supervised By

**Ms. Nazmun Nessa Moon**

Assistant Professor

Department of CSE

Daffodil International University



**DAFFODIL INTERNATIONAL UNIVERSITY**

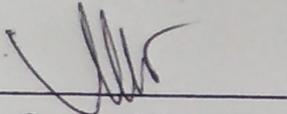
**DHAKA, BANGLADESH**

**DECEMBER 2018**

## APPROVAL

This Project titled "Face Detection and Recognition System", submitted by MD.MEHEDI FARUK ID: 153-15-6432 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 (BSc) and approved as to its style and contents. The presentation has been held on 10<sup>th</sup> December 2018.

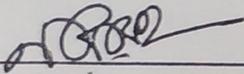
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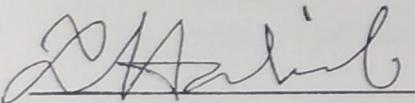
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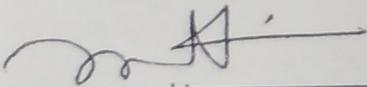
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**Assistant Professor**

Department of Computer Science and Engineering  
Faculty of Science & Information Technology  
Daffodil International University

**Internal Examiner**



**Dr Mohammad Shorif Uddin**  
**Professor**

Department of Computer Science and Engineering  
Jahangirnagar University

**External Examiner**

## DECLARATION

I hereby declare that, this Intern has been done by us under the supervision of **Dr. Fernaz Narin Nur, Assistant Professor**, 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:**

Fernaz Narin Nur

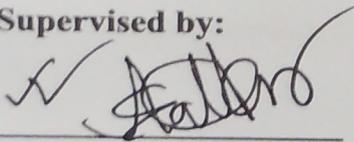
**Dr. Fernaz Narin Nur**

Assistant Professor

Department of CSE

Daffodil International University

**Co-Supervised by:**



**Ms. Nazmun Nessa Moon**

Assistant Professor

Department of CSE

Daffodil International University

**Submitted by:**

Md.Mehedi Faruk

ID: - 153-15-6432

Department of CSE

Daffodil International University

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

Finally, I must acknowledge with due respect the constant support of our parents.

## **ABSTRACT**

To prepare this report too many information from different sources are required especially primary and secondary data. The primary one is many of da and information were collected from my practical experiences, queries and supervisor guideline and secondary data is collection information from different websites, reading books, journal etc. The report is prepared on the base of Computer Vision. My Project title is , “Face Detection and Recognition system “

Desktop application design and development is a study or field where we can learn about how to Detect faces, train dataset, recognize face and implement the system for various application . The people of Bangladesh are engaging with the technology day by day. But most of the organization of the country still running their security and other system in traditional way. The aim of the project is to understand the computer vision and image processing. That could be helpful for universities and organization to enhance their system.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Nowadays technology took place everywhere, this is the era of Information system.

Security become the most important thing in Technological world.

The idea of Detecting human face and Recognize the person came from lack of security in real-time. As an important branch of biometric verification, HFR has been widely used in many applications, such as video monitoring/surveillance system, human-computer interaction, and door access control system and network security. This project is all about Face Detection and Recognition with attendance system for student's .Maintaining attendance is very important in all learning institutes for checking the performance of students. In most learning institutions, student attendances are manually taken by the use of attendance sheets issued by the department heads as part of regulation. The students sign in these sheets which are then filled or manually logged in to a computer for future analysis. This method is too old. In this project, I propose the design and use of a face detection and recognition system to automatically detect students attending a lecture in a classroom and mark their attendance by recognizing their faces.

### 1.2 Motivation

Most of the University already has student database and a powerful management system. Almost every campus also covered with CCTV system. Face recognition and auto attendance system will make the existing system more efficient and intelligence. According to my research, not a single University in Bangladesh is using any intelligence system for their students.

### 1.3 Objective

This project are depending on two things, Face detection and Face recognition.

Face Detection has been one of the hottest topics of computer vision for the past few years. This technology has been available for some years now and is being used all over the place.

To complete this project, I have to perform the following task

- 1- Detecting face in real time.
- 2- Recognize the detected face with satisfactory algorithm.
- 3- Register class attendance after successfully match.
- 4- Design a system which can be integrated with other application

#### **1.4 Expected Outcome**

After completing the project, We will be able to detect face and recognize persons individually in real time. We can use it for Auto Attendance for Students, Teacher, and Employees at any organization. Any organization can enhance their security system with this project!

## **1.5 Report Layout**

### **Chapter 1: Introduction**

In this chapter I tried to discuss about introduction, motivation of the work, objectives and expected outcome of this project. Lastly the report layout to give the whole idea.

### **Chapter 2: Background**

In this chapter, I have discussed the background of the application. I also find and explain the related works and scope of our project. The challenges also explain here.

### **Chapter 3: Requirements Specification**

In this chapter all the discussion will be about requirements specification. Business process modeling, analysis on collected requirements, use case model of the project and description of them, Logical data model and finally design requirements.

### **Chapter 4: Design Specification**

This chapter will explain the design of this project. Front-End, Back End design interaction design, UX and implementation requirements are explain here.

### **Chapter 5: Implementation and Testing**

In this chapter I will discuss about implementation of database, front-end, back-end design, interaction, test implementation and test result of the project.

### **Chapter 6: Conclusion and Future Scope**

We conclude all the things about the project here. Also write down some of our future work on there.

# CHAPTER 2

## BACKGROUND

### 2.1 Introduction

In this chapter I will talk about related work of face detection and recognition and my idea about future. I will compare other system with my system. I will describe problem of existing system and my challenges.

### 2.2 Related Work

Face detection and recognition system are not a common idea in this technological era. Most of the giant tech company using it around the world. Tech giant “Facebook” is using it for their picture tagging system. Another tech giant “Apple” using it to unlock iPhone with valid user face. Implementation of face detection and recognition in our country is not that popular. Few security system using this technology for their door protection. The biggest e-commerce site “Amazon” is using this technology for their payment system. They called it ‘Selfie-payment’[4]. Macau's ATMs Are Using Facial Recognition to Help Follow the Money[5]. Federal Bureau of Investigation is using facial recognition to identify criminals [6]. In our country there are no university using this technology for student’s attendance.

### 2.3 Comparative Studies

Peking University is a major Chinese research university located in Beijing using face detection and recognition system for their student and staff. They take auto attendance using this technology.

### 2.4 Scope of the Problem

No University in country isn’t using face detection and recognition technology for their students. I think this a beautiful opportunity to build a face detection and recognition system for achieving something and bring something new to this generation. Not only for universities, but also other organization could use it for several purposes.

### 2.5 Challenges

The main challenge for me was selecting programming language, Because it’s too difficult to create graphical user interface with python. I only good at Python and I decided to go on with it.I had to spend a lot of time to understand Algorithms and several Python libraries. Another challenge was to train dataset to recognize face because of scalable library syntax.

## CHAPTER 3

### REQUIREMENT SPECIFICATION

#### 3.1 Business Process Modeling

Business Process model is a technique through which process of the system is define. Here I will explain my business model using Data Flow Diagram. Data flow diagram show the flow of data through the system. Here we draw DFD level 0. And this can be update, improved.

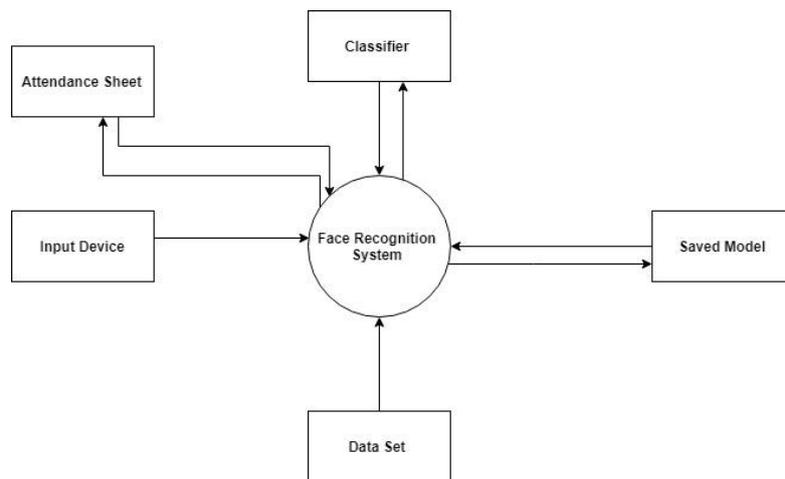


Figure 3.1 Data flow diagram of face recognition system for auto attendance

Figure 3.1 represents the data flow diagram of the face recognition system .It's showing the attributes like Classifier, Attendance sheet, Saved model, Data set connected to the system.

#### 3.2 Requirement Collection and Analysis

Requirement is very important part of developing any system. There are two types of requirement on software development. One is functional requirement, and another is non-functional requirement. Functional requirements is kind of requirements which is focus on those activity which can easily perform by the system. Non-functional requirements is something that can make system efficient.

#### 3.3 Functional Requirements

There are several functional requirement on this project. Like establish input device, detecting face, collecting model data, creating the dataset, train the data set.

#### 3.4 Non-Functional Requirements

Non-functional requirements help to increase the efficiency of the system. Like camera, storage for dataset, enough memory, high speed processor, how much user friendly the system is.

Non-functional requirements is so important for the system to give an efficient output on time.

### 3.5 Use case modeling and Description

Use case explain the communication of activity on the system with the actor / user. This is the process how user will complete any operation on the system, this can be describe from this.

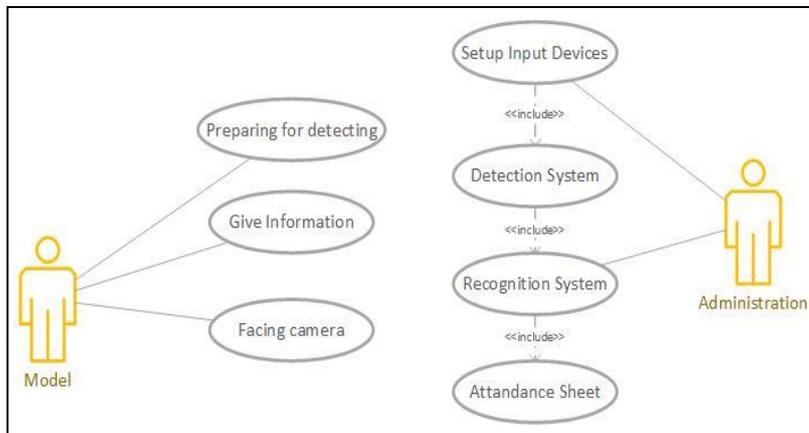


Figure 3.2 Use Case model of the system

### 3.6 Logical Data Model

Logical data model is the process to represent the domain structure. My project don't have any database and also don't have any interaction with user. An xls format file is enough for taking attendance.

### 3.7 Design Requirements

#### 3.7.1 Face Detection

A face detector will tell the system, whether there is a face or not on the screen. Face detection can be done by few parameters. Most of the face detection algorithms are follow Viola Jones object detection framework, and it's based on Haar Cascades.

In this project I implement HAAR CLASSIFIER. The Haar Classifier is a machine learning based approach, an algorithm created by Paul Viola and Michael Jones; which are trained from many positive images (with faces) and negatives images (without faces).

#### 3.7.2 Understanding Haar Cascade

The Haar feature starts scanning the image for the detection of the face from the top left corner and ends the face detection process bottom right corner of the image. The image is scanned several times through the haar like features in order to detect the face from an image.

To compute the rectangle features rapidly integral image concept is used. It need only four values at the corners of the rectangle for the calculation of sum of all pixels inside any given rectangle. In an integral image the value at pixel (x,y) is the sum of pixels above and to the left of (x,y). Sum of all pixels value in rectangle.

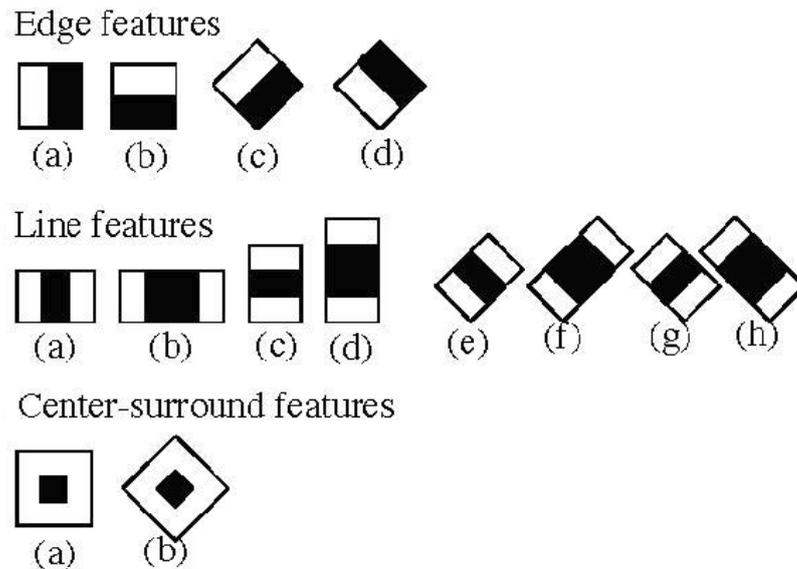


Figure 3.3 : Haar cascade Features

To compute the rectangle features rapidly integral image concept is used. It need only four values at the corners of the rectangle for the calculation of sum of all pixels inside any given rectangle. In an integral image the value at pixel (x,y) is the sum of pixels above and to the left of (x,y). Sum of all pixels value in rectangle.

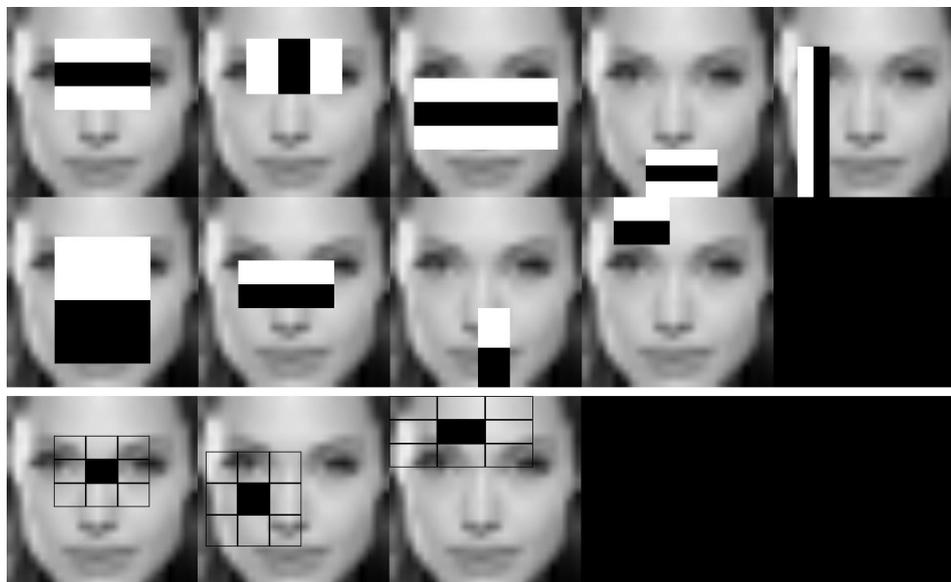


Figure 3.4: Applying Haar Cascade features on single image

One Haar feature is however not enough as there are several features that could match it. A single classifier therefore isn't enough to match all the features of a face, it is called a "weak classifier." Haar cascades, the basis of Viola Jones detection framework therefore consist of a series of weak

classifiers whose accuracy is at least 50% correct. If an area passes a single classifier, it moves to the next weak classifier and so on, otherwise, the area does not match.

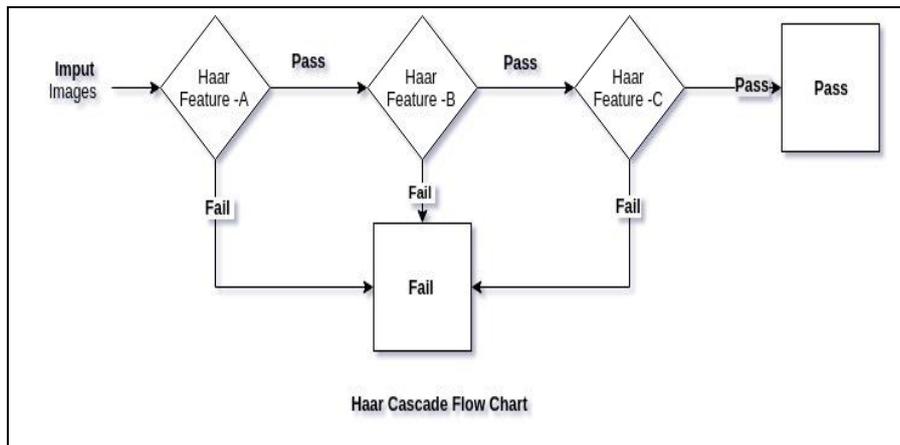


Figure 3.5 : Flowchart of Detecting Face

Figure 3.5 Shown how an input image use in face detection .It's inappropriate to detect a face with using only one Haar feature. Every imported image has to go through every feature to detect face. To get more accurate result in detection process, the imported image has to fulfill several criteria or has to pass through the several Haar features.

### 3.7.3 Integral Image

The Integral image also known as the “summed area table” developed in 1984 came in to widespread use in 2001 with the Haar cascades. A summed area table is created in a single pass. This makes the Haar cascades fast, since the sum of any region in the image can be computed using a single formula.

The integral image computes a value at each pixel (x, y) that is the sum of the pixel values above and to the left of (x, y), inclusive. This can quickly be computed in one pass through the image.

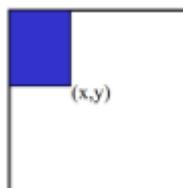


Figure 3.6 Pixel Coordinates of an integral image

Let A, B, C D be the values of the integral image at the corners of a rectangle .The sum of original image values within the rectangle can be computed.

$$S u m = A - B - C + D \quad - (2.1)$$

Only three additions are required for any size of rectangle. This face detection approach minimizes computation time while achieving high detection accuracy. It is now used in many systems.

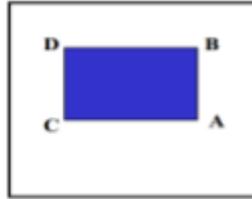


Figure 3.7 Values of the integral Image on a rectangle

### 3.7.4 Face Recognition Algorithm

There are several Algorithms in OpenCV to recognize face after detecting . I'm using Eigenfaces for recognizing face.

Here is the steps I follow to implement it with my project .

- 1) Load your training faces.
- 2) Convert your images into column vectors.
- 3) Calculate the mean
- 4) Reduce your matrix created in step2 using mean from step3.
- 5) Calculate Covariance Matrix C
- 6) Calculate SVD on matrix C
- 7) Visualize Eigenfaces
- 8) Reconstructing Faces
- 9) Recognition

### 3.8 NumPy

NumPy is the fundamental package for scientific computing with Python. It contains among other things:

- a powerful N-dimensional array object
- sophisticated (broadcasting) functions
- tools for integrating C/C++ and Fortran code

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary data-types can be defined. This allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

### 3.9 OpenCV

OpenCV (Open Source Computer Vision Library) is released under a BSD license and hence it's free for both academic and commercial use. It has C++, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. Written in optimized C/C++, the library can take advantage of multi-core processing. Enabled with OpenCL, it can take advantage of the hardware acceleration of the underlying heterogeneous compute platform.

Adopted all around the world, OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 14 million. Usage ranges from interactive art, to mines inspection, stitching maps on the web or through advanced robotics.



Figure 3.8 : Screenshot of taking input from camera.

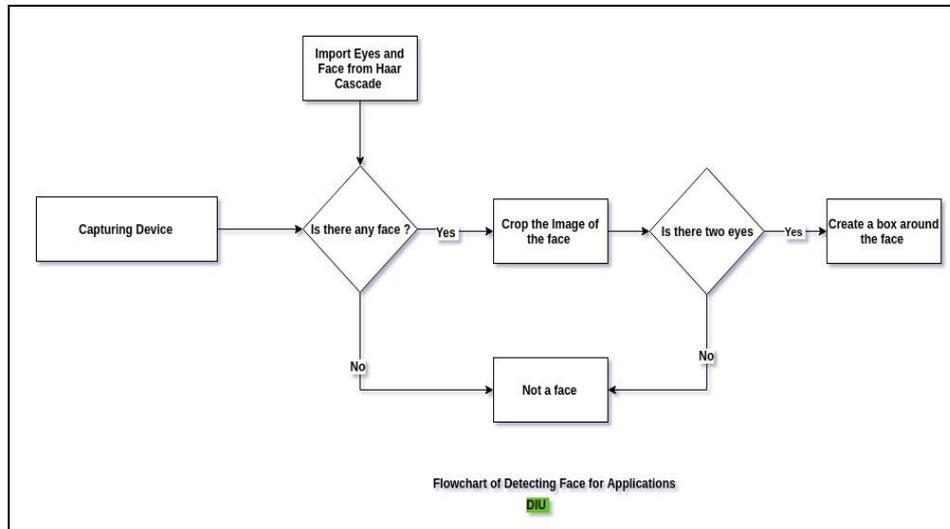


Figure 3.9 Flowchart of detecting face for application.

This figure shown us Haar Cascade successfully detect the face and Draw a box around the face.

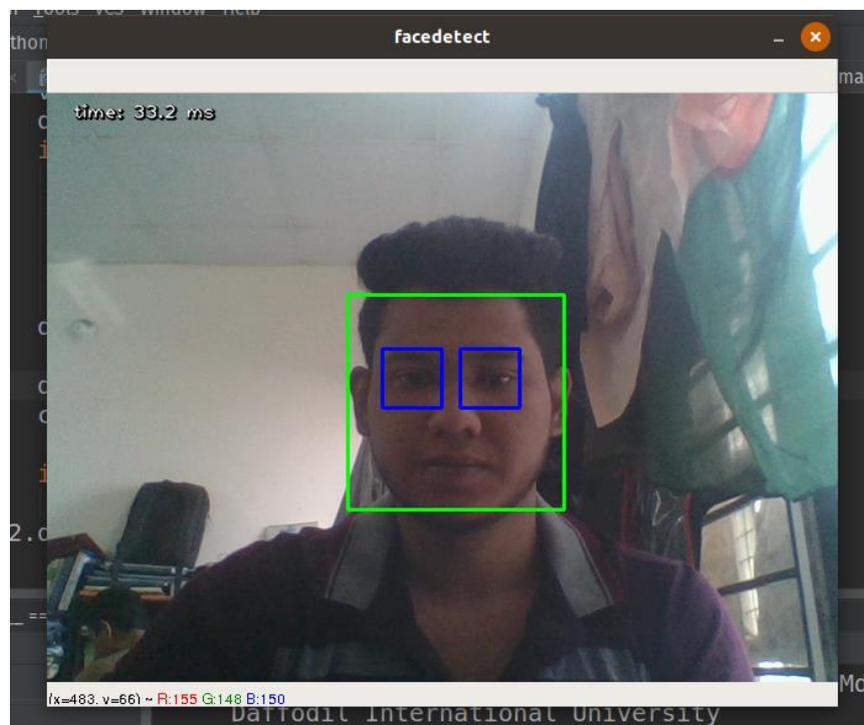


Figure 3.10 : Screenshot of Detecting face from input device.

Another Haar Cascade features like (Eyes,Nose,Mouth) can be shown individually on display . After successfully detecting a human face, now we can go to the next step! The Face Recognition.

### 3.10 Data Set

A data set is a collection of related, discrete items of related data that may be accessed individually or in combination or managed as a whole entity.

A data set is organized into some type of data structure. In a database, for example, a data set might contain a collection of business data (names, salaries, contact information, sales figures, and so forth). This project need lots of photos as data set.

### 3.11 Creating Data Set

To recognize individual face, we need to train our classifier (Haar Cascade). To train our classifier we need huge amount of data .That collection of data called as Data Set.



Figure 3.11: Taking input for creating Data Set

To store individual person's data from data set, we need to set their identity unique. Therefor before collecting data from user to recognize face, I have taken an input from user or administrator.

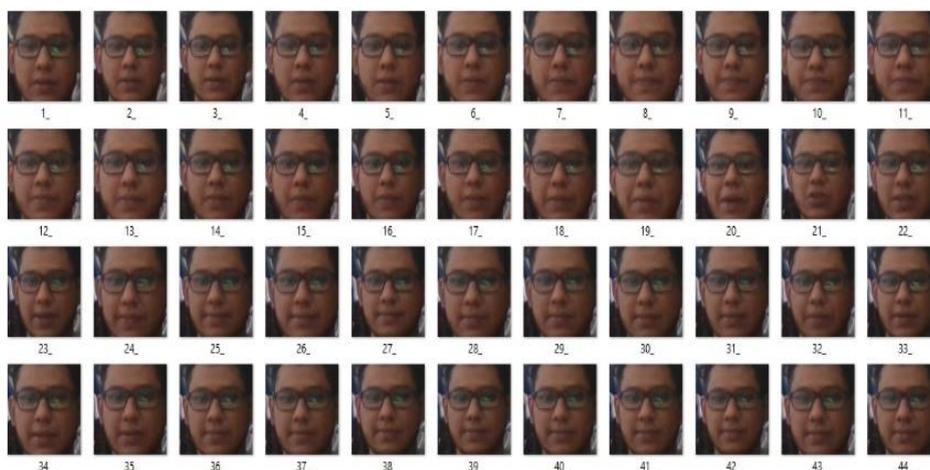


Figure3.12 showing the dataset of a training model

To get most efficient result from data set, I have taken minimum 100s of face photo from a single person. The figure showing below the face dataset of a person. These images of user will be needed for training the machine.

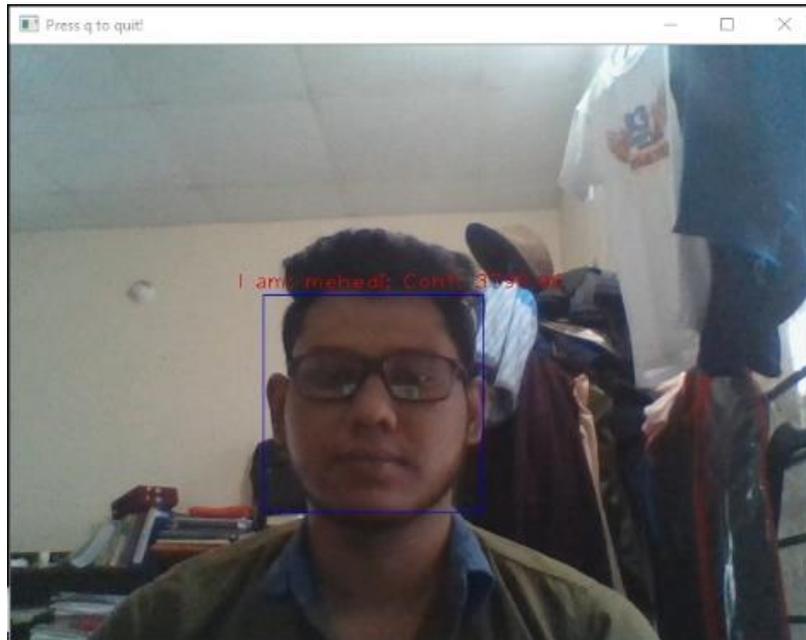


Figure 3.13 showing the person after training the data set

## CHAPTER 4

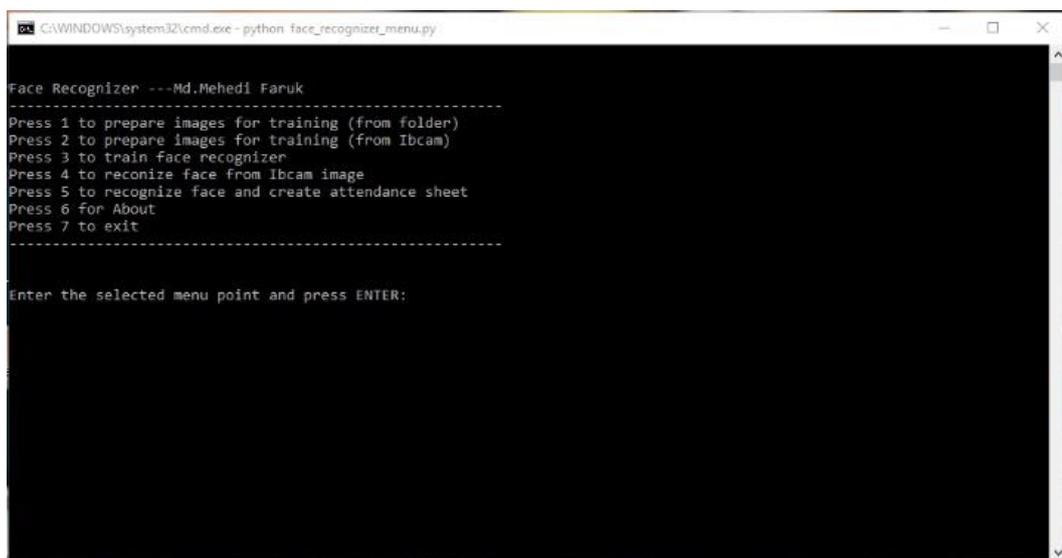
### DESIGN SPECIFICATION

#### 4.1 Front End Design

Front end design is for user, this is the part of visual representation of a system. But my project don't have any front end design. Because user don't have to interact with system.

Only administration can see the interface, project like this is basically based on command line.

Therefore I create a command line interface for this project.



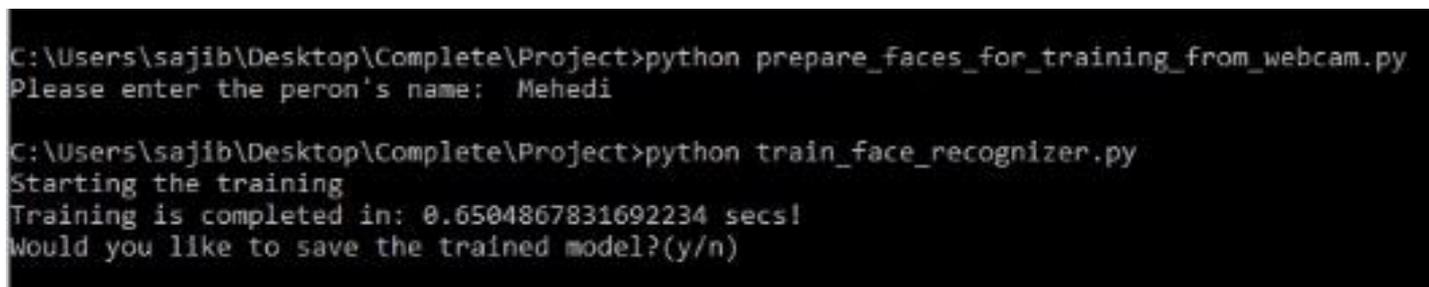
```
C:\WINDOWS\system32\cmd.exe - python face_recognizer_menu.py
Face Recognizer ---Md.Mehedi Faruk
-----
Press 1 to prepare images for training (from folder)
Press 2 to prepare images for training (from Ibcam)
Press 3 to train face recognizer
Press 4 to reconize face from Ibcam image
Press 5 to recognize face and create attendance sheet
Press 6 for About
Press 7 to exit
-----
Enter the selected menu point and press ENTER:
```

Figure 4.1: Screenshot of command line interface

#### 4.2 Back-End Design

Back end design where user don't see anything, where users don't know what's happening behind the system. Only administrator can see back end design. This project is based on back end design.

Training model to dataset and attendance sheet everything will seen to administrator.



```
C:\Users\sajib\Desktop\Complete\Project>python prepare_faces_for_training_from_webcam.py
Please enter the peron's name: Mehedi

C:\Users\sajib\Desktop\Complete\Project>python train_face_recognizer.py
Starting the training
Training is completed in: 0.6504867831692234 secs!
Would you like to save the trained model?(y/n)
```

Figure 4.2 shown the training model process

cascaides	10/29/2018 5:10 PM	File folder	
input_images	10/30/2018 3:52 PM	File folder	
output_images	10/30/2018 4:02 PM	File folder	
saved_model	10/29/2018 5:58 PM	File folder	
Camera	10/26/2018 12:59	Python File	1 KB
detector	2/27/2018 8:50 PM	Python File	1 KB
face_recognizer_menu	10/29/2018 8:10 PM	Python File	3 KB
prepare_faces_for_training	10/30/2018 3:59 PM	Python File	3 KB
prepare_faces_for_training_from_webcam	10/29/2018 7:28 PM	Python File	3 KB
recognize_face_create_attendance_sheet	10/29/2018 7:28 PM	Python File	5 KB
recognize_face_on_camera	10/29/2018 7:28 PM	Python File	3 KB
settings_for_recognition.json	1/4/2017 1:56 AM	JSON File	1 KB
train_face_recognizer	10/29/2018 7:37 PM	Python File	4 KB

Figure 4.3 Screenshot of structure of the back end

### 4.3 Implementation Requirements

To implement this project , here some tools and components which will help me to develop the project successfully . I will describe all tools in this part which I use to develop this system.

### 4.4 Pycharm IDE

Pycharm is one of the best IDE for Python developer, Is has lots of feature which help me to write code and debug the code.

### 4.5 OpenCV

This is one of the powerful open source library to work with computer vision. Python and C++ is the supporting programming language. It has hundreds of algorithm for computer vision. Without this library it would be impossible to create a project like that .

### 4.6 Camera

The most important part of the project is camera. To take picture of a model and training it for the system we need camera for capturing picture . Recognition part also need camera for take real time video and analyze it .

## CHAPTER 5

### IMPLEMENTATION AND TESTING

#### 5.1 Test Case

Testing part is one of the hard task for developer. I have to test every bit this system to make sure that everything I did works fine.

Here is the test table of my project, this table is shown the test case, test input, expected output, actual output, result and tested date.

Test Case	Test Input	Expected Output	Actual Output	Result	Tested On
1. Capturing Frame from input device	Take frame from camera	Display a new window on screen	New window on screen	Passed	10/9/2018
2. Detect face	Take real time video from camera	Detect a human face	Detected	Passed	13/9/2018
3. Detect different part of a face	Take real time video from camera	Detect nose, eyes, Mouth	Detected	Passed	15/9/2018
4. Creating dataset	Take input from camera	Creating a dataset for model	Dataset successfully created	Passed	20/9/2018
5. Training	Train model from dataset	Saved trained model	Training successful	Passed	22/9/2018
6. Recognition	Trained model	Recognize the trained model	Recognize model successfully	Passed	25/9/2018

## CHAPTER 6

### CONCLUSION AND FUTURE SCOPE

#### 6.1 Discussion and Conclusion

Face detection and recognition system will be very helpful for universities to take auto attendance. It would be very smart and easy for both teacher and students. This system can be implemented for home security, car security, and various authentication system.

I did this project to use face detection and recognition system in different application. It's not that only auto attendance application can be created by this system. This system could be useful to other applications. Using this system any organization can enhance their security in real time.

#### 6.2 Limitation

Nothing is perfect in this world, when it's all about implementing Algorithms, there is a possibility not to get correct answers.

Few major limitations are:

- If input device is broken or lose signal , the whole system is garbage
- Fake face can be detected
- Fraud could make a duplicate face frame and do something wrong

#### Future Scope and Development

I have some huge future plans about my project. Here is the list

- Fully implement with GUI
- Use Face Recognition with other applications
- Make few android apps with this technology

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