

**SMART SECURITY SYSTEM**

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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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**DHAKA, BANGLADESH**

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## **APPROVAL**

This Project titled “**SMART SECURITY SYSTEM**”, submitted by Md. Saiful Islam, ID No: 152-15-5629 and Md. Muhaiminul Islam, ID No: 152-15-5628, 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 3<sup>rd</sup> May.

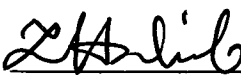
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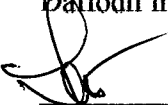
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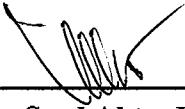
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## DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Dr. Syed Akther Hossain, Professor & Head**, 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.

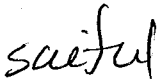
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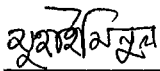
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## **ABSTRACT**

Human has an extraordinary capacity to identify a person in an alternate expression, condition, in light variation. Presently artificial intelligence is produced which will work like human known as Face Recognition and still now many works are processing in this field for discovering better performance. In the present time's the major problem in our society is security issues so, they need various apart trained personnel to join the best security. These personnel, as human beings, make fault that might affect the level of security. A proposed solution to the aforementioned matter is a Face Recognition Security System, Face recognition are play an important role in difference of applications from biometrics, surveillance, security, identification to the authentication. In this paper we are make a smart security system for restricted zone where access is limited people whose faces are available in the training database. This system is composed of two parts are hardware part and software part. The hardware part consists of a Raspberry Pi, PIR sensor, Buzzer and camera, while the software part consists of face detection and face recognition algorithms software. When a person enter the Zone then Camera take a photo and software compare the trusted people. If the people are allow the zone the system are silent otherwise the system star the alarm. Experimental results explain the effectiveness of proposed security system in order to sensitive the disallowed access and authenticity by use of face recognition.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Human has an extraordinary capacity to identify a person in an alternate expression, condition, in light variation. Presently artificial intelligence is produced which will work like human known as Face Recognition and still now many works are processing in this field for discovering better performance. Face acknowledgment framework essentially work for identifying faces by matching it with facial datasets. In live streaming, video surveillance system captures every one of the people in range. When there occurs something unexpected then check the video streaming data. Using face recognition, we can discover the people as his information is gotten by machine. Face recognition system can be used mainly in many ways, (for Ex: Determine one and his details using his images from a huge dataset of facial images. Here one's data is stored away in a database with his images. One can discover him and his data via seeking him with his images). Face recognition is mostly satisfied by learning the machine that learns by images.

### 1.2 Objective

The list of objectives of ours project are

- To understand and explore the knowledge in the area of Machine Learning.
- To study face detection and recognition techniques.
- To understand and explore different computational techniques associated with Machine Learning and Image processing.
- To experiment with different open source image processing tools.
- To design a system that can detect and recognize faces in real time.
- Simulate the algorithms and obtain results using OpenCV with python.

### **1.3 Motivation**

The motivation of working on this project originated from the urge to increase the safety of the citizens of this country by using available technology. Additionally, there is always room for improvement in security and surveillance which can assist law enforcement in investigation processes, just like it is seen overseas. According to Number world's largest user contributed database, the concern for homes being broken into and things getting stolen is 68.82 which is considered high. Implementing a system like this has the chances of deterring the number of breaking and entering offences and will definitely increase the rate of solved cases like this due to high probability of prompt action by user and easier identification of the perpetrators. Overall, combining previous knowledge with newly acquired skills over the course of the time given to assemble this project to create something that can be used to make the lives of people easier or safer was the crux behind this idea.

### **1.4 Research Question**

Everyday lifestyle, product, software, hardware updated. They updated by some research and develop them later. Now we research on Automatic Face detection and recognition and face some problem and understand the problem and solve them via some research. The problem we face are replied with proper way given below, we already noticed that many published works mention numerous application on face recognition technology. It has so several applications in analysis field and it additionally received importance within the sensible or universe application inside the past few years. Among them, some model gives an unprecedented act. However, in machine learning to train a model it will require a large dataset for achieving better execution. Then again models like Convolutional Neural Network (CNN) which it needs high-level Hardware requirements. Again the greater part of the work was done on a unique dataset. Presently the speculation is the manner by which the model SVM perform in our own dataset. It ought to be remembered that here we work with a small dataset in test premise.

## **1.5 Expected Outcome**

This system will be capture image which is authorized by the user and store it in a folder on the hard disk. Based on the known picture it continuously compare with the face which is appear on the CCTV camera. If any face found which is not stored in database, the system start alarm and inform the user by it. When the known person run away from the selected area the alarm turn off and start monitoring again. If any person encounter which face is store in data base its just show his or her name on the display. The alarm remain deactivate then.

## **1.6 Report Layout**

All reports are broadly organizing in three sections:

- Preliminary matter
- Test
- Back matter

The purpose of this project report is to provide a detailed description along with charts, graphs. The format of this report is simple. Boldface is used on a general topic or specific points of interest. The remainder of the document will be written using the standard font, Times New Roman with font 12. The remainder of this report as follows. Chapter 2 describes the background Introduction, Existing Solutions, Related Work, Research Summery, and Scope of the Problem and Challenge. Chapter 3 represents the whole Requirement Specification like Raspberry Pi, Camera Module, PIR Sensors and Buzzer. Chapter 3 represents the whole methodology like Python and Python IDLE, OpenCV, Face detection, Face recognition and Data Collection Procedure. Chapter 5 discusses the implementation, Parts list with cost estimation, testing and results. Chapter 6 finalized the report with a limitation, conclusion and future work. Chapter 7 In References, we use IEEE format. In Appendices, External information added if needed.

# **CHAPTER 2**

## **BACKGROUND**

### **2.1 Introduction**

In this modern earth offense has become ultra-modern dizzy! In this moving time a lot of fact occurs like robbery, stealing, unwanted entrance happens suddenly. So the security does incident in our daily life. People always be busy in their day to day work also wants to secure their safety of their beloved things. Today's, we use of closed-circuit television (CCTV) has tumid to secure the premises with the reducing in installation and video storage cost. The excess of terror and offense makes the elective access to place a major concern for many institutions. Current methods e.g., password and smart card are apocryphal and fallible. Comparably, face recognition is a reliable identification method. A face distinguishing proof and acknowledgment framework is a framework that takes a picture or a video of a human face and contrast this picture with other picture faces in a database. The formation, shape and ratio of the faces are compared by the face recognition steps. Moreover, distance between the mouth, nose, eyes, and jaw, upper outlines of the eye sockets, location of the nose, eyes the sides of the mouth, and the area adjacent the cheek bones are also compared. When we utilizing a face acknowledgment program, few image of the individual must be taken at various edges and with various outward appearances. At the season of recognizable proof and confirmation the item remain before the camera for a couple of moments, and after that the picture is take to those that have been recently recorded.

### **2.2 Existing Solutions**

We survey seventeen research paper in the accompanying article lastly outline us discoveries in the end pursued by affirmation. The procedure executed to distinguish interruption has been obviously characterized and clarified.

Many face discovery and acknowledgment programming have been actualized amid the past time. Every product utilizes diverse calculation and unexpected techniques in comparison to other programming. Some face acknowledgment programming separates the face shape from the information picture to recognize the face. Different calculations standardize a lot of face pictures, cosmetics on picture and afterward pack the face information, the recovers the information in one

picture that can be utilized for face acknowledgment. The camera take picture is contrasted and the face picture information.

## **2.3 Related Work**

A great part of the include pc acknowledgment of countenances has focused on sleuthing singular alternatives like the eyes, nose, mouth, head characterize and process a face demonstrate by the position, size and connections among these highlights. Starting with Bledsoe's and Kanade's early frameworks, style of computerized or semi-robotized face acknowledgment manners by which have sculptural and ordered countenances bolstered standardized separations and proportions among highlight focuses. As of late this general methodology has been proceeded and improved by the ongoing work of Yuille et al. Such methodologies have very much attempted extreme to increment to numerous perspectives and have normally been very delicate.

Research in human manners by which of face acknowledgment, besides, has appeared singular highlights and their close connections involve a lacking portrayal to represent the execution of grown-up human face distinguishing proof. In any case, this way to deal with face acknowledgment remains the most prominent one in the PC vision writing [13][14].

Connectionist ways to deal with face distinguishing proof search for to catch the structure or gestalt-like nature of the errand. Fleming and Cottrell expanding on prior work by Kohonen and Lahtio, utilize nonlinear units to show a system by means of back engendering to arrange face photographs. Stonham's WISARD framework has been connected with some accomplishment to parallel face photographs, perceiving every character and appearance. Most connectionist frameworks tending to faces treat the information picture as a general 2-D design and may manufacture no express utilization of the plan properties of a face. Just awfully direct frameworks are investigated up to this point and it's vague anyway they're going to scale to bigger issues. Ongoing work by Burt et al. utilizes a "savvy detecting" approach bolstered multiresolution precedent coordinating. This coarse-to-fine technique utilizes an exceptional reason pc designed to compute multiresolution pyramid pictures rapidly and has

been incontestable trademark people in close constant. The face models square measure worked by hand from face pictures [13][14].

## **2.4 Research Summery**

In this proposed paper, our goal was to experiment on our own created dataset using OpenCV, Dlib, Face Recognition library and conventional neural network classifier for feature extraction and classification in real time data for recognizing intruders for ensure security.

## **2.5 Scope of the Problem**

Face detection and recognition system is a very modern technology which is a combination of Image Processing and Artificial Intelligence. This system can play a vital rule in the different field especially in robotics, medical science, bio-technology, banking system, and scientific research work and security issues. Besides this, it can be implemented in the classroom for taking attendance. For time maintaining in institutions that have a huge staff. It can also be implemented in the medical sector for identifying the patient and also be implemented in surveillance system. A lot more problem we can solve by this system. However, if the system is applied practically once, many fields can fix up related with this and can contribute too many fields in our country.

## **2.6 Challenge**

This system is implement on raspberry pi which is low power microprocessor based device. It have many limitation it can't handle heavy processing like train image to make a neural network or HAAR cascade. This system will capture image using raspberry camera module which is also low quality devise and can't get full hd video or picture. Image quality is the key factor of the result of an image processing based system. Although it have limitation, it can work almost accurately. Another challenge will, if any face found which have only side part of face then system can't identify the person. If any person move very fast then camera can't detect his face.

The main challenge will be the lighting condition. In low light condition the camera cannot perceive any human face or present. So lighting condition sustain same as day light. An additional light can be used in selected area. There will be another challenge to maintain the alarm system because some time it will be active when any animal arrive in the secure area. We have to take care of the system and always control temperature using cooler.



Figure 2.1: Examples of some challenges that may be existing in a human face[10].

- a) Challenges on account of brightening illumination variations
- b) Challenges as a result of posture/perspective varieties
- c) Challenges as a result of ageing variations
- d) Challenges in view of outward appearance/facial style
- e) Challenges as a result of impediment



Figure 2.2: Same face seen under varying light conditions can appear dramatically different [10].



## CHAPTER 3

### REQUIREMENT SPECIFICATION

#### 3.1 Hardware Introductions

This project is a compilation of different hardware products and their related software components to run the hardware perfectly.

These are listed and described below:

##### 3.1.1 Raspberry Pi

##### 3.1.2 Overview

The Raspberry Pi (RPi) is a solitary board PC fitted with a processor, memory, input/output and different highlights normally found on a useful PC. The RPi was created by the Raspberry Pi establishment in the United Kingdom in 2012. A few models of the microcontroller have been discharged throughout the years varying in cost and functionalities. All models highlight a Broadcom framework on a chip ARM focal handling unit illustrations preparing unit Video Core (SoC), which incorporates a perfect (CPU) and an on chip (GPU, an IV). The working framework and program memory are put away on Secure Digital (SD) Cards. USB, HDMI, Composite video yield and 3.5mm sound jack is fitted on the board also. Lower level yield is given by GPIO pins which bolster regular conventions. Raspbian, a Debian-based Linux conveyance and outsider Ubuntu and Windows is given by the establishment to download. The form utilized in this proposal venture is Raspberry Pi 1 Model B+ discharged in 2014. All specialized data on the Raspberry Pi and Camera Module is taken from the official site of Raspberry Pi [2].



Figure 3.1: Raspberry Pi Module

### 3.1.3 Hardware

The Broadcom BCM2835 SoC used in the first Raspberry Pi is genuinely indistinguishable to the chip used in unique propelled cells (its CPU is a progressively prepared ARMv6 plan), which joins a 700 MHz ARM1176JZF-S processor, Video Core IV outlines taking care of unit (GPU), and RAM. It has a measurement 1 (L1) save of 16 KB and a measurement 2 (L2) store of 128 KB. The measurement 2 hold is used primarily by the GPU. [1] The accompanying square chart speaks to the equipment setup on the board:

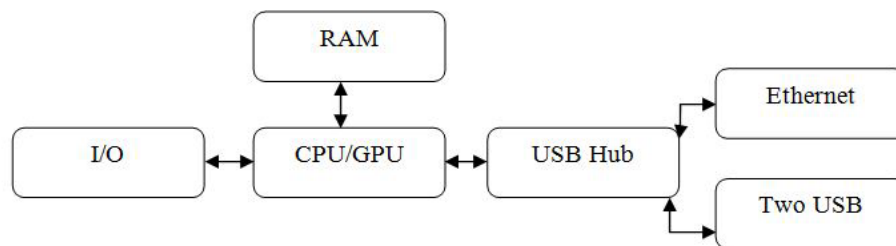


Figure 3.2: Hardware on board

### 3.1.4 GPIO, Interfacing and other Ports

Raspberry Pi has got 40 broadly useful information/yield sticks otherwise called GPIO. They are the methods by which a Raspberry Pi can cooperate with different gadgets. These pins can be modified in approaches to suit the gadget it is been associated with. Each stick has its very own assigned work. There are 4 USB 2.0 ports for associating USB gadgets. Beyond what 4 USB gadgets can likewise be associated utilizing USB HUB. An Ethernet port (RJ45 10/100 MBit/s) is manufactured on the board too. It very well may be utilized to associate with the web as opposed to utilizing USB Wi-Fi dongle which results in quicker web speed. Different gadgets which have Ethernet availability can likewise be associated by means of this port. For video contribution, there is a 15-stick MIPI camera interface (CSI) connector through which a Raspberry Pi Camera can be associated. For video yield, there are various ports. HDMI port is utilized to associate with HDMI upheld screens, TRRS jack for composite video yield and MIPI show interface (DSI) for crude LCD board shows. Raspberry Pi does not have any sound line-in alternative. In any case, for sound yield it has a free simple yield by means of a 3.5mm telephone jack. The HDMI port additionally fills in as a sound yield for links supporting both sound and video. There is a small scale SD card opening

which when stacked with a memory card goes about as a capacity vehicle for the Pi and furthermore the working framework expected to run the Raspberry Pi is put away in that card.

### 3.2 Camera Module

The Camera Board on the Raspberry Pi is a little printed circuit board with a camera on it. The PCB is related with a trim connection which interfaces with the Pi itself in solitude port. The ribbon can be extendable. The camera on the board is pretty much nothing (5MP camera). As for now it is the fundamental Camera made expressly for the Pi thusly these specifics can't be invigorated. Since it uses 250mA, remotely energizing the Pi should be adequately satisfactory for the camera. Express plan settings are required to instate the camera notwithstanding a Python substance to engage it take pictures.

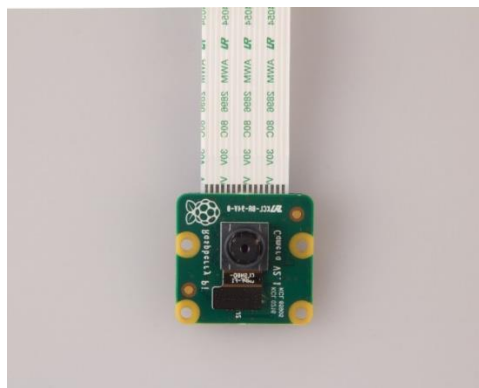


Figure 3.3: Raspberry Pi Camera

### 3.3 PIR Sensors

The PIR movement sensor is perfect to identify development. PIR mean "Latent Infrared". Essentially, the PIR movement sensor estimates infrared light from articles in its field of view. In this way, it can recognize movement dependent on changes in infrared light in the earth. It is perfect to identify if a human has moved in or out of the sensor go. The sensor in the figure above has two worked in potentiometers to alter the postpone time (the potentiometer at the left) and the affectability (the potentiometer at the right).



Figure 3.4: PIR Sensors

### 3.4 Buzzer

Early contraptions relied upon an electromechanical structure unclear to an electric ringer without the metal gong. Along these lines, a hand-off may be related with barge in on its own inciting current, making the contacts buzz. Consistently these units were secured to a divider or rooftop to use it as a sounding board. "Ringer" begins from the scratching upheaval that electromechanical signs made. In the present day, the flag is ordinarily used for interest uses, condemning Panels, informational purposes, electronic metronomes, microwaves and other family devices, electrical alarms and various other electronic devices.



Figure 3.5: Buzzer

# CHAPTER 4

## RESEARCH METHODOLOGY

### 4.1 Introduction

This system capture image when any person stand in front the camera using haar cascades and store face image from video in a folder. Haar cascades is a classifier which is use for detect any object or human face. The cascade is trained by lots of positive and negative face to detect human face. Then using the histogram of oriented gradient or HOG method to find the face and separate it from the whole image. The face can be turned in different direction, the face landmark estimation algorithm is use to solve this problem. A pre-trained neural network get 128 measurements from each of the face to encode. When it get a new face we have to find the face in the database of known person which have the closet measurement using any simple classifier like SVM classifier. If don't match with any face in database it will wait for PIR sensor. When the person get in the selected area the buzzer will active. After the unknown person ran away from the place the buzzer will turn off.

### 4.2 Research Subject and Instrumentation

We are working with Python and made a real time application which detect face and give us exact output.

#### 4.2.1 Python and Python IDLE

The codes used in this system for running the RPi and most of the image dealing with has been written in Python language totally. Python is an extensively used unusual state generally valuable programming language. Python supports various programming gauges, including object-orchestrated, essential and valuable programming or procedural styles. It incorporates a dynamic sort structure and customized memory the officials and has a generous and complete standard library. Most Python use (checking CPython) can fill in as a heading line interpreter, for which the customer enters clarifications continuously and gets the results immediately.[11]Python IDLE is a progression circumstance with limits past that, for instance, auto completing and etymological structure including. This endeavor required the usage of NumPy and

Open CV joined with Python IDLE to work. NumPy is the key pack for consistent preparing with Python. It contains notwithstanding different things: [12]

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

## 4.2.2 OpenCV

(Open Source Computer Vision) is a library of programming capacities chiefly went for constant PC vision. The zones of Facial Recognition and Motion Understanding applications were the principle focal point of utilizing OpenCV. OpenCV is written in C++ and its essential interface is in C++. There are ties in Python, Java and MATLAB/OCTAVE. This framework utilizes Open CV imported to Python IDLE to keep running on Raspberry Pi.

```
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2018, 23:09:28) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> import numpy
>>> print(numpy.__version__)
1.16.1
>>> import cv2
>>> print(cv2.__version__)
4.0.0
>>> |
```

Figure 4.1: Importing NumPy and OpenCV

## 4.2.3 Capture image

The system is based on machine learning so we need input data to process the hole work. Here data is sample image of human face and their identity also. By using raspberry pi camera module we capture image. Image should not be blank or empty that's why we use face detection method to capture only face image. After successfully run the pi camera it search for face in capture frame using haar cascade classifier. After detecting any human face, it start capturing the face image from the frame which is continuously receive from raspberry pi camera module. When the user stop capturing image the computer start saving those image with its name which is receive from the user.

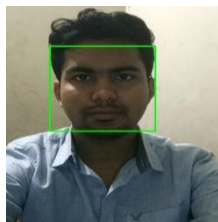


Figure 4.2: Capture image and identify the face

#### 4.2.4 Face detection

All Face identification could be an innovation getting utilized in a very style of utilizations that distinguishes human faces in advanced pictures. The Face recognition likewise alludes to the mental procedure by which people find and take care of appearances in a visual scene. The HAAR Cascade Haar-like highlights are advanced picture highlights utilized in article acknowledgment. They owe their name to their natural similitude with Haar wavelets and were utilized in the essential timeframe face indicator. The absolute first procedure in this framework is object ID. The camera module is to identify a face from a running feed and catch a photo right then and there. Item Detection abuse Haar highlight based course classifiers is a proficient article discovery system anticipated by Paul Viola and Michael Jones. It is an AI based methodology where a course work is prepared from a ton of positive and negative pictures which is then used to identify questions in different pictures. For distinguishing a face, the program needs pictures with appearances in them (positive pictures) and pictures without faces (negative pictures). The program at that point separates the highlights from them. Each element is a solitary esteem acquired by subtracting total of pixels under white square shape from aggregate of pixels under dark square shape. [15]

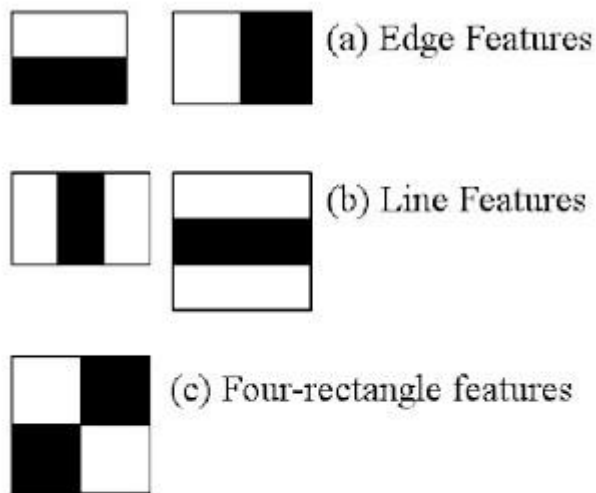


Figure 4.3: Extractable Features [15]

A lot of highlights are determined by utilizing the conceivable sizes and area of every bit. This is finished by utilizing indispensable pictures which streamlines the estimation of pixels to an activity that requires just four pixels. Among the gigantic number of highlights that can be

determined, not every one of them are valuable for identification of articles (faces) for each situation. The most pertinent highlights should be extricated from the accumulation. This is finished by applying every one of the highlights to the majority of the preparation pictures. The highlights with the least blunder rate are picked which implies they are the highlights that best groups the face and non-face pictures. Indeed, even after further grouping, the last number of highlights that is expected to distinguish a face in a picture is still vast which makes the procedure tedious. In any case, an answer for this issue is conceivable in light of the fact that in a picture, the greater part of the picture locale is non-face district. For this, the idea of Cascade of Classifiers has been presented. The highlights are gathered into various phases of classifiers and connected one-by-one on the window. In the event that the main stage is a disappointment, the window is disposed of totally. Remaining highlights on it are not thought about. On the off chance that it passes, the rest of the phases of highlights are connected and the procedure is finished. The window that passes all stages could be a face locale. The means to finish this procedure in Open CV are disentangled in the accompanying square chart:

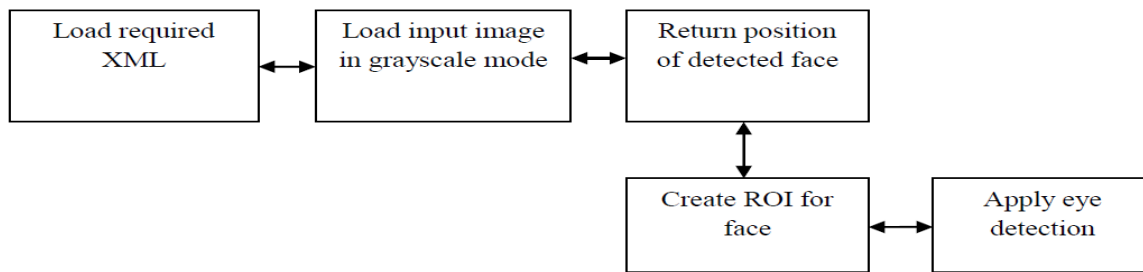


Figure 4.4: Haar Cascade process

Once a face region is detected, the image is immediately passed on to the next step of the process to identify if the face detected is that of a permissible individual or an intruder.

$$f_i = \text{Sum}(r_{i, \text{white}}) - \text{Sum}(r_{i, \text{black}})$$

$$h_i(x) = \begin{cases} 1 & \text{if } f_i > \text{threshold} \\ -1 & \text{if } f_i < \text{threshold} \end{cases}$$



### **4.2.5 Face recognition**

Facial Recognition is a computer application or process which is capable of identifying a person from an image or video feed. This is achieved by cross examining a given picture with an already available image on a database. The Face Recognizer class for face recognition that comes with OpenCV includes the following algorithms:

- a) Histogram Of Oriented Gradients (HOG)
- b) Support Vector Machine (SVM)

#### **a) Histogram of Oriented Gradients (HOG)**

The histogram of orchestrated edges (HOG) likely could be a component descriptor utilized in flexible PC and picture system for the purpose of affirmation the method incorporates occasions of incline presentation in limited portions of an image. This framework is, for instance, that of edge presentation histograms, scale-invariant component change descriptors, and shape settings, yet shifts in that it is enlisted on a thick cross section of reliably separated cells and usages covering neighborhood refinement social control for improved precision. The crucial thought behind the bar framework of headed tendencies descriptor is that neighborhood article look and structure inside a picture is depict by the spread of intensity slants or edge headings. The image is part into insignificant related locale known as cells, and for the pixels inside each phone, a histogram of tendency course is fused. The descriptor is the connection of these histograms. For improved accuracy, the nearby histograms are regularly separate institutionalized by plotting a live of the control over a more noteworthy locale of the image, known as a square, along these lines misuse this expense to institutionalize all cells inside the square. This social control prompts higher steadiness to changes in lighting up and shadowing. The last development in watching abuse visual chart of headed tendency descriptors is to empower the descriptors into some affirmation system supported regulated.

### **c)Support Vector Machine (SVM)**

The support vector machine (SVM) classifier is a parallel classifier which scans for a perfect hyper plane as a decision limit. At the point when arranged on photos containing some specific thing, the SVM classifier can settle on decisions as for the proximity of an article, for instance, a human, in additional test pictures. Even more formally, an assistance vector machine constructs a hyper plane or set of hyper planes in a high-or wearisome dimensional space, which can be used for portrayal, backslide, or diverse endeavors. Normally, an incredible separation is cultivated by the hyper plane that has the greatest division to the nearest getting ready data reason for any class since when all is said in done the greater the edge the lower the theory misstep of the classifier.

As a human, we would recognition be able to confront naturally and in a flash with higher precision. In any case, a PC framework can't ready to do this abnormal state speculation. We need to show them how to do this well ordered. We need to manufacture a pipeline where a procedure is done, get result and go to the subsequent stage. The progression ought to be keep up consecutively else we can't get the outcome.

- First, Find the all face in image and normalize
- Second, Analysis face ad extract unique features
- Third, Compare against known face with it's unique features
- Fourth, Make a Prediction

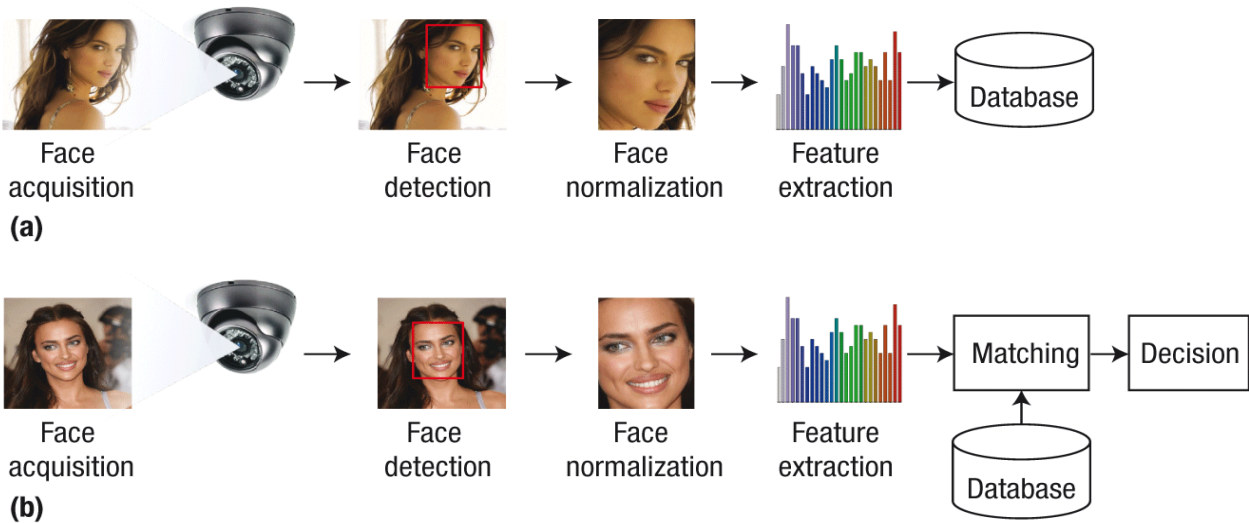


Figure 4.5: The process of our Whole model work[15]

### Step 1: Find the face and normalize

First we have to detect face which is already describe in Figure 12. After successfully detecting face we have to normalize the face that's mean we have to crop the picture and store only the face area. In some picture the face can be positioning in different direction that's is not problem for us but two picture of same person which is turn into different direction look totally different to a computer.



Figure 4.6: Different looking of face[15]

*Humans can easily recognize that both images are of Will Ferrell, but computers would see these pictures as two completely different people.*

We take care of this issue to get ideal outcome for following stage by utilizing calculation which is called face milestone estimation. It determine the 68 points exist on each face which is called

milestone. Here we just pivot, scale and shear the picture so the eye and mouth can be in focus position. We don't do any 3d activity simply utilize fundamental picture change like turn and scale which is called relative change.

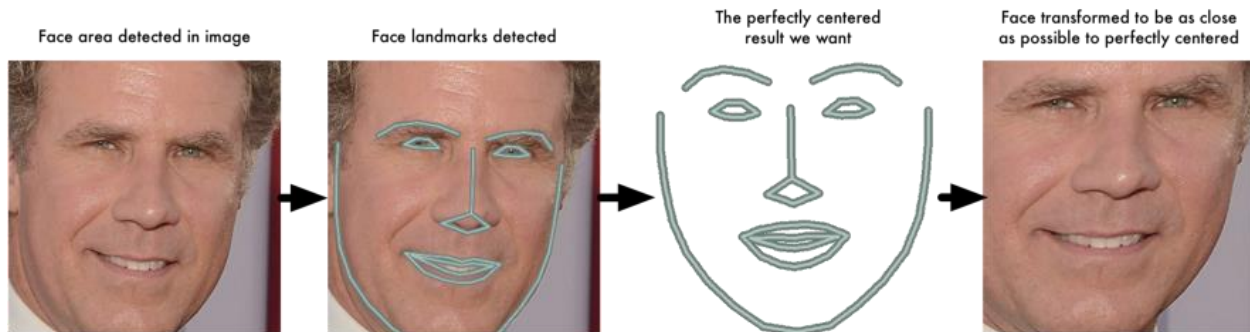


Figure 4.7: Face transformed steps[15]

### **Step 2 : Analysis face and extract unique features**

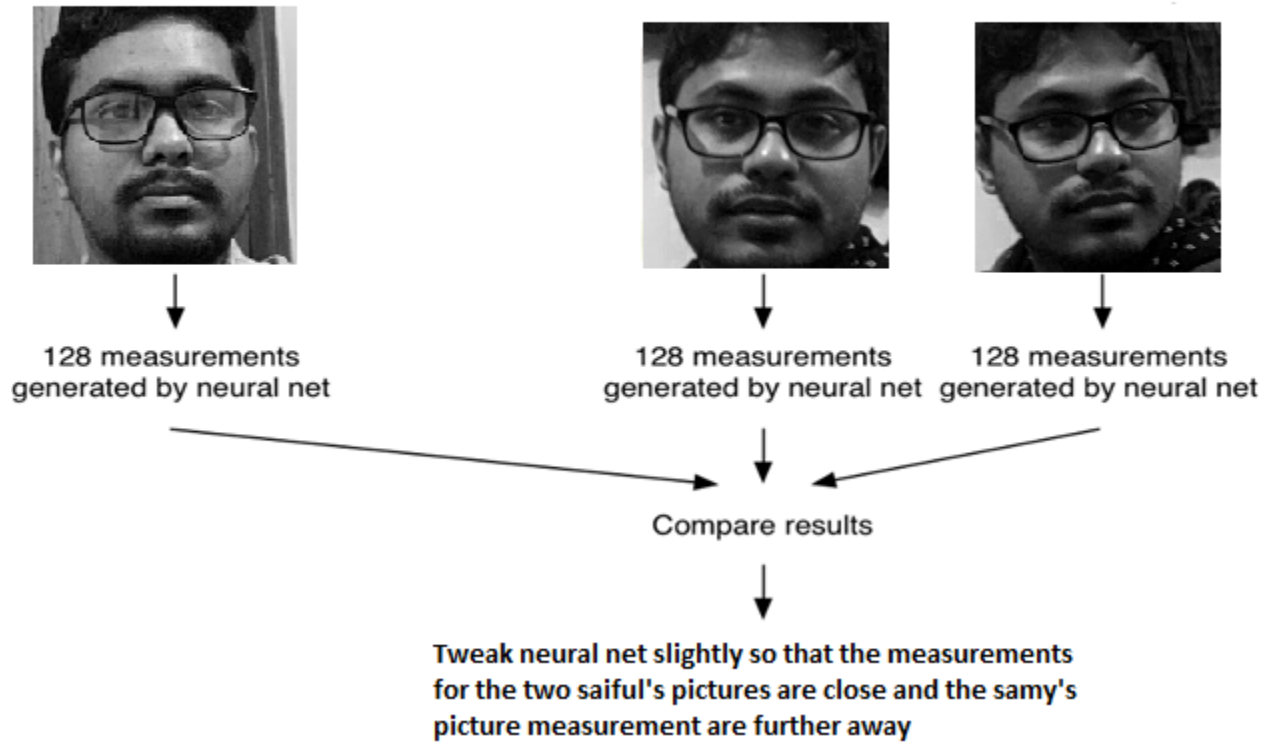
It appears that the estimations that appear to be obvious to us people (like eye shading) don't totally sound good to a PC taking a gander at individual pixels in a picture. Specialists have found that the most precise system is to give the PC a chance to decide out the estimations to gather itself. Profound learning information of completes a superior procedure than individuals at making sense of which parts of a face are essential to gauge.

The appropriate response is to prepare a profound ordinary neural system. Anyway in inclination to training the system to perceive picture object as we did last time, we're going to instruct it to create 128 estimations for each face.

The training system works through searching at 3 face image at a time:

1. Load a known person face image which is already trained
2. Load another face image of same known person
3. Load a picture of any other unknown person

## A single 'triplet' training step:



After run this process millions of time, it can successfully measure 128 point of our face partially accurately. The measurement will be same at any ten different picture of the same person. The 128 measurement of any face is called embedding. This process needs lots of computer power and time to build a neural network but once it done, it can measure easily and fast even for a new face. We are use a pre train neural network and result will like this.

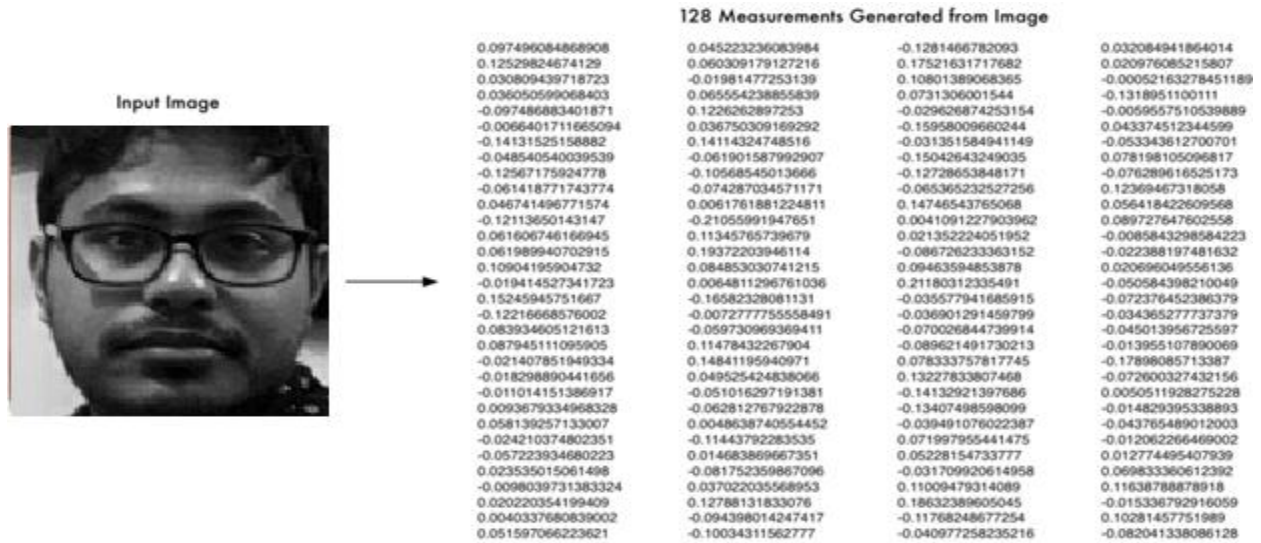


Figure 4.8: Calculate the Image value

### Step 3 : Compare face with its measurement point

After successfully measuring all the picture in data base, we store only the measurement point against its name. When a new picture come on the system, it identify the face from it and measure its 128 point value using pre-train neural network. Then compare the value with the stored value.

### Step 4 : Make a Prediction

After successfully measure the new picture and compare with the stored data, if it don't match with anyone then its means the new picture person is a unknown person. When new picture match with the stored value that's mean the person in known and his/her name is stored so computer can easily predict his name.

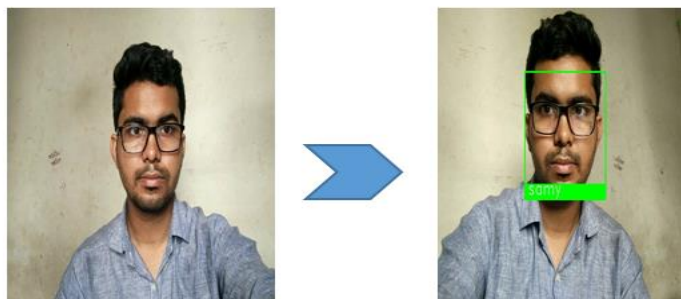


Figure 4.9: Recognize the image and given corresponding image.

### 4.3 Data Collection Procedure

Here are the primary reason and most essential piece of the proposed examination or framework. In our dataset is utilized to assess our strategy, which is made out of 1000 pictures, including 10 people, every one of which has hundreds pictures under the diverse articulation, light, and stance conditions. For making the dataset we concentrated on pictures and foundation to keep perfect however much as could reasonably be expected, just as appropriate light condition, must be remembered. We veil the some picture in lower light and others are pictures with invariant posture.

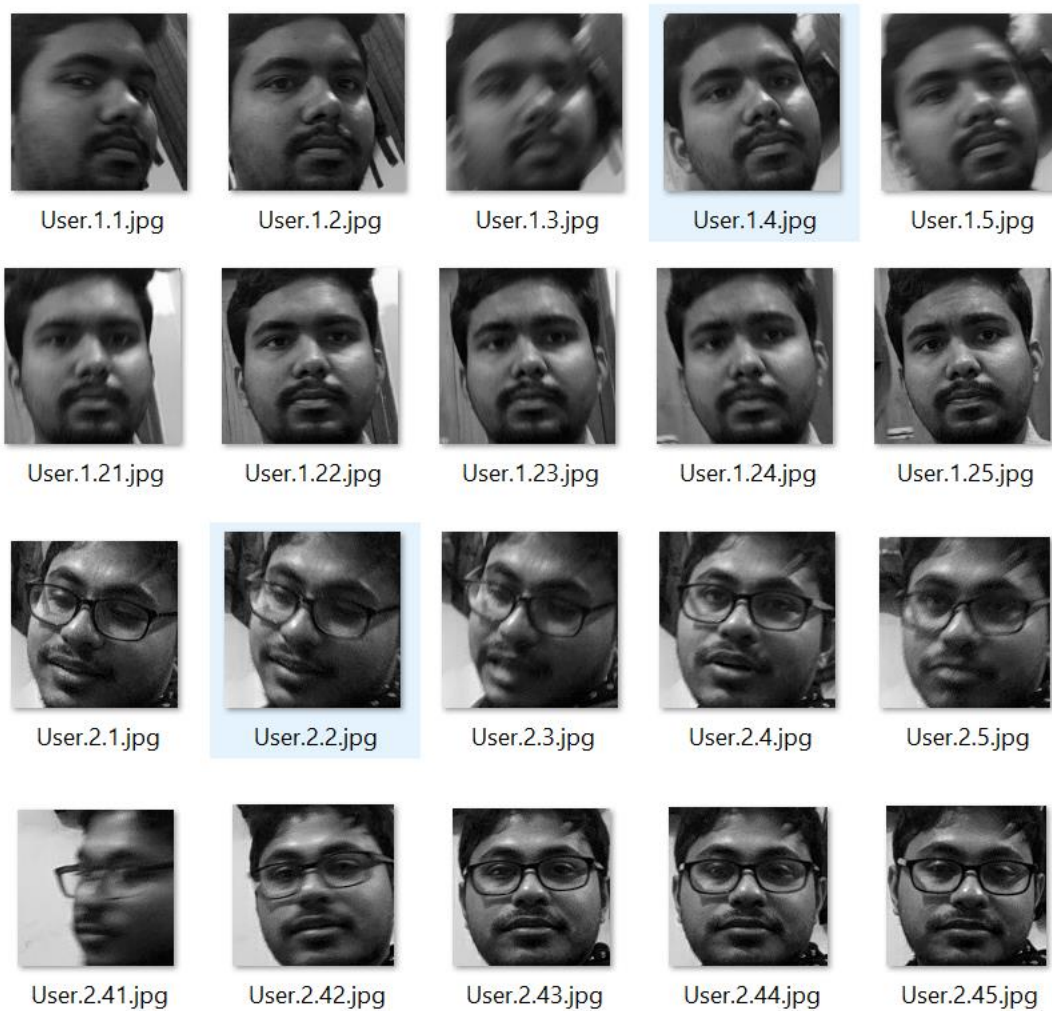


Figure 4.10: Dataset images from different individuals in different views and angle

For achieving a better and more accurate outcome as well as to train the model or network, a well-formed dataset is needed. So, here we used our own dataset to see not only the accuracy rate but also applied it in real life for security purposes in the university campus.



Source of data: The source of images for the dataset and also the credit goes to Daffodil International University (Batch: 41<sup>th</sup>, Section: F).

#### **4.4 Statistical Analysis**

We have already mentioned earlier in Technology part that we used the dlib library that may be a toolkit containing machine learning algorithm for implementing our system. For dlib automatic face recognition, the output feature vector is 128-d means that a list of 128 real-valued numbers that's used to quantify the face. So, at first, pictures need to be processed for dlib compatible.

For processing the pictures at first OpenCV is used here to convert the pictures from BGR to RGB. Now, we'd like to quantify the faces of our dataset in 128-d embeddings. In dlib, a network has already been trained to make 128-d embeddings on a dataset of ~3 million pictures. So, we simply feed the pictures of our dataset to the network to construct 128-d embeddings to quantify the face. Figure 15 presents 128 embeddings values for a picture.

After that, we get the facial feature or location from input pictures then its ought to encode faces. in the encoding method, two arrays are used, named identified Encodings and identified Names. In identified Encodings face locations according to id and in identified Names, Id is being stored. Then pickle package is used for serializing the encoded data. For classification, votes are used. Comparing face locations between test and train dataset matching points square measure called the vote. The system can establish exploitation the most variety of votes matched with that embeddings. For better performance, the tolerance should be kept below 0.5.

In this part, we will discuss how the system will work. Basically, it'll work like another machine learning method. But we utilized it as our requirements. Now we collect images from live streaming as test data and compare them with classified faces using our model. At last, it provides the result based on votes.



## CHAPTER 5

### IMPLEMENTATION, TESTING & RESULTS

#### 5.1 Setup

Setting up and running the system is a fairly simple and is needed to be done only once. The user chooses the area that needs to be under surveillance first. The camera module connected with the board is placed strategically near the point of entry to capture the best angles of visitors' faces. It is definitely preferable that the area under surveillance be well illuminated and there isn't any obstruction between the camera and the point of entry for the visitors. Board power is a direct connection provided by main power supply or batteries. The programs required for the functioning of this system can be made available online or can come pre-installed on the RPi. This step can prove to be difficult because it will involve thorough and extensive instructions the users have to follow. The user needs to input information about the network the board will be connected to. However, once the program is running the system will be up and should keep on running without delay.

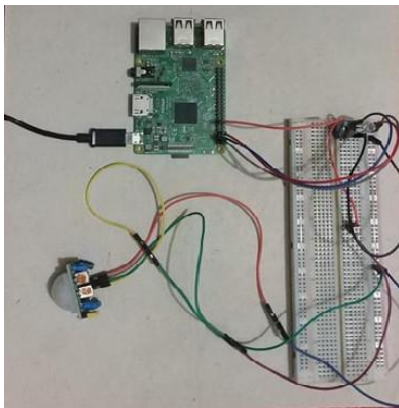


Figure 5.1: Raspberry Pi Setup  
Camera Module

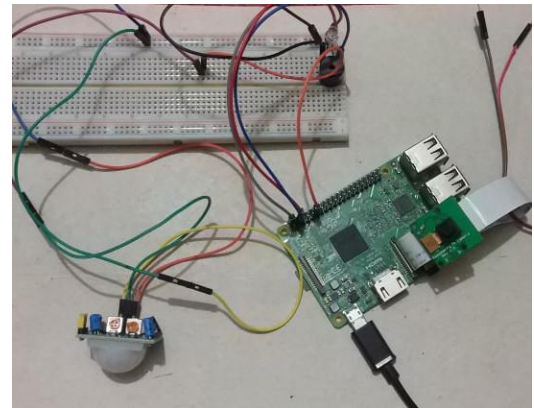


Figure 5.2: Complete connection with

## 5.2 Parts list with cost estimation

The expenditure in setting up and running this system is illustrated in the following table:

TABLE 1: Parts list with function and price.

Name	Quantity	Function	Price
Raspberry Pi Model B+	1	Processing and uploading the images.	3200tk
Raspberry Camera Module	1	Taking photographs	800tk
SD Card	1	Storing OS for Pi board and images taken by camera.	1050tk
PIR Sensor	1	Motion Detector	200tk
Buzzer	1	Audio signaling device	50tk
Jumper wires	1pkt	jump wire is an electrical wire	30tk
Resistors	1pkt	control the flow of current	40tk
Ethernet cable	1	connect computing devices together directly that would normally be connected via a network switch	50tk
Adapter	1	An adapter is a device that converts attributes of one device or system to those of an otherwise incompatible device or system.	200tk

The total expense of setup may vary depending on the specifications of the hardware listed above. Latest Raspberry Pi boards are capable of handling more complicated processes and hence cost more. Likewise, camera modules with image sensors of higher quality and SD cards of bigger size will increase the overall cost of the project but also add to the efficiency of the system.

### 5.3 System testing

We utilize the facial highlights removed from HAAR Cascade Haar-like highlights to prepare the help vector machine, which reciprocals to second concentrate highlights, thus, we may separate progressively facial highlights. It needs to modify a few parameters when the HAAR Cascade Haar-like highlights and SVM are prepared. In SVM, the most imperative parameter  $\gamma$ . We can find that the last characterization of SVM is increasingly precise, as the Table 2 appears,

TABLE 2: Recognition rate based SVM

Dataset Section	SVM
Test-1	86.36%
Test-2	87.36%
Test-3	88.90%
Test-4	87.93%
Test-5	90.10%
Test-6	91.00%
Test-7	90.50%
Test-8	92.00%
Test-9	91.20%
Test-10	92.50%

### 5.4 Experimental Result

We also use Confusion matrix to measure the performance. The Confusion matrix is used to justify the classification model whatever it is true or false. Here in this study true is considering as known and false as unknown. The Total number of persons to measure the performance is 40. Among them, 22 are known and 18 are unknown. The proposed system can perfectly recognize 37 people but for another 3 it shows a little confusing result.

TABLE 3: Confusion matrix for measuring performance

	<b>Prediction Unknown</b>	<b>Prediction Known</b>
<b>Actual Unknown</b>	16 (TN)	2 (FN)
<b>Actual Known</b>	1 (FP)	21 (TP)

Now the equation for accuracy is:

$$\text{Accuracy} = (\text{TP} + \text{TN}) / \text{Total number of subjects}$$

Here, TP formed for True Positive which means the face is actually known and the model prediction is also known. On the other hand, TN considers as True Negative which means that the face is actually unknown and the model also predicts the face as unknown. So, the accuracy rate of our model is  $(16 + 21) / 40 = 0.925 \times 100 = 92.50\%$ .

From here the error rate can also be calculated. The Equation for error

$$\text{is: Error rate} = 100 - \text{Accuracy}$$

The error rate is 7.50%. The accuracy rate will increase more if can remove our constraint to implement the model. In the next part, we will discuss it.

## 5.5 Descriptive Analysis

This system will be capture image which is authorized by the user and store it in a folder on the hard disk. Based on the known picture it continuously compare with the face which is appear on the cctv camera. If any face found which is not stored in database, the system start alarm and inform the user by it. When the known person run away from the selected area the alarm turn off and start monitoring again. If any person encounter which face is store in data base its just show his or her name on the display. The alarm remain deactivate then.

## 5.6 Summary

Here we can see the system work perfectly and gives a better accuracy rate. But still, now it has some constraint. As we can see a face that was partially detected that was not perfectly recognized. Again faces that are not in range limit also cannot be recognized. So, need to work with this area to fix up those issues. But it can surely be said that the system has done better with our own dataset.

## CHAPTER 6

### SUMMARY OF THE STUDY, CONCLUSION & FUTURE WORK

#### 6.1 Summary of the Study

In this study, our approach was to apply the system to our own dataset and experiment the possibility to apply it to detect known and unknown in real time live streaming of surveillance system. For maintaining and saving the time and reducing the difficulties to implement the network we use the Dlib library which provides us the facility to use several model or network that has created a network. So, we just need to feed our images data in the network

#### 6.2 Limitation

The Raspberry Pi based security system was formulated in a short period of time while also under a limitation of funding. Despite being a complete and functioning system, there are multiple performance limitations in the design. The limitations, however, can be overcome by adding new features and components which unfortunately may increase the total expense of the project. The most significant problems that may emerge while using this system were identified and analyzed. The problems, their solutions and ways to further improve this design are summarized in the following points:

**Load Shedding:** A prevalent problem in the country, load shedding is the obvious and recurring problem with using a system based on Raspberry Pi as it is powered through main line electricity. The solution to this problem is Instant Power Supply during load shedding which will ensure uninterrupted connectivity.

**Photo Quality:** In order to identify the faces in the photographs taken, there are particular features that need to be prominently visible in them for the Pi to process. If for some reason the required pointers are not available, the RPi will not be able to perform recognition. This complication will occur most in low to no light and during night time.

The solution to this problem is to illuminate the target area of the system while also using high resolution camera with the board.

**Sensors Damage:** If sensors are damaged or not working properly there will be occurred serious site effect. The solution to this problem is very carefully to reserve the sensor.

### **6.3 Conclusion**

In our paper, a face recognition framework utilizing Raspberry Pi was built up an ongoing security framework. There are existing models of security but none of those let the user receive real time image of the intruder especially in Bangladesh. The other applications are also very much required and practical for the context of educational institutions and work places to reduce the hassle everyone is facing now days. In this era of extreme chaos, we need one less thing to worry about and that is about our security. It is time to move forward and include more features and mobility to our security systems so we can get updates on the go. Though our project is now seen to be a bit expensive but which more time the costs can be reduced much more so that this can be a practical system so more people can have access to an advanced security model.

### **6.4 Implication for Further study**

In this paper, we propose an effective face recognition system. This system can be further improvised to create more complex and advanced system for reaching any particular goal. In the proposed system, SVM is used but using CNN more perfect result will be found.

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## APPENDICES

### Appendix A: Research reflection

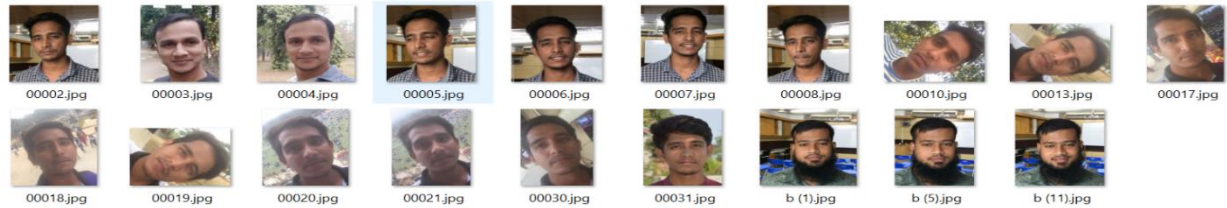


Figure A1: Image in Dataset(noise in background)



Figure A2: Image in Dataset(clear background)

### Appendix B: Related Issues

HOG: Histogram of Oriented Gradients

CNN: Convolutional Neural Network

OpenCV: Open source Computer Vision Library

SVM: Support Vector Machine

AI: Artificial intelligence

XML: Extensible Markup Language

3-D: Three dimensions or Three-dimensional

CCTV: Closed-circuit television



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