AN EFFICIENT APPROACH OF VIDEO BASED FACE RECOGNITION AND PEOPLE COUNTING SYSTEM

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APPROVAL

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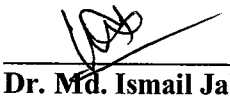

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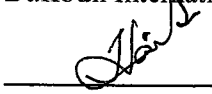

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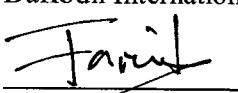

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DECLARATION

We hereby declare that, this project has been done by us under the active supervision of **Mr. Aniruddha Rakshit, Senior 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.

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ABSTRACT

In recent years, face detection is widely used in various fields, such as face recognition, image focusing, and surveillance systems. It makes another way in the biometrics field. A Support Vector Machine based multi-view face detection and recognition framework is described in this paper. This study proposes a real-time face detection system based on Support Vector classifier using CNN. The detection system divided into three main parts, first detect face, two CNN feature extractor that generates 128-d facial embedding, three train a support vector machine (SVM) on top of the embedding, four recognize faces in images and video streams. We'll be applied deep learning in two key steps, first to apply face detection, which detects the presence and location of a face in an image, but does not identify it, second to extract the 128-d feature vectors (called "embedding") that quantify each face in an image. These face embedding will be sufficiently different such that we can train a "standard" machine learning classifier SVM on top of the face embedding. In this paper, face recognition system to implement in CNN. The experimental results show that the accuracy rate is higher than 86.67% in face detection, which implies the proposed real-time detection system is indeed effective and efficient. We present experimental consequences of our implementation of SVM, and demonstrate the possibility of our methodology on face identification, issue that includes a data set of 10,000 data points. Detailed experimental results are presented in this report including tuning the parameters of the face detectors, performance evaluation, and applications to video based face detection and frontal-view 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. Over the previous decade, facial recognition has developed as a dynamic research area in computer vision with various potential applications including biometrics, surveillance, human-computer, video-mediated communication, and content-based access of images and video databases. 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).

Facial recognition is a classification of biometric software that maps an individual's facial features numerically and stores the information as a face print. The software uses deep learning algorithms to think about a live catch or digital picture to the stored face print so as to verify an individual's identity. Face recognition is mostly satisfied by learning the machine that learns by images and counting people on the basis of object detection.

1.2 Objectives

- 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.

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1.3 Motivation

In recent years, biometric-based techniques have developed as the most encouraging option for recognizing people. It is the era of digitization and Bangladesh is moving towards the digital world by implementing new innovations consistently. In any case, there is certifiably not an especially utilization of facial recognition in any sector of our country. Worldwide face recognition is mostly done in different Algorithms mostly in CNN, SVM, HOG, K-NN classification and so on, is used in different operations like entry and egress to secured speculative areas such as border crossings, military bases and nuclear power plants, also access to restricted resources like computers, networks, personal devices, banking transactions, trading terminals and medical records, airplane-boarding gate, face spoofing and anti-spoofing and forensic applications etc. There are extraordinary potential outcomes that can be achieved with face recognition which is yet to be seen in Bangladesh. Upon effective implementation of this innovation, we can plan to manufacture a smart and more secure city where the legislature can guarantee more assurance to the citizens and daily life ends up easier with different applications of Face Recognition. This project is built a Face recognizer and people counter to enrich our technology.

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. However, in machine learning to train a model it will require a large dataset for achieving better execution. 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.

Q.01: How can a machine detect a human face from an image?

Q.02: Can the system detect multiple faces in the same frame?

Q.03: How can a machine recognize a human face?

Q.04: What is Support Vector Machine and Convolutional Neural Network?

Q.05: What is the procedure of real time face recognition system?

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1.5 Expected Outcome

As we work for surveillance purposes with a sample and our own dataset for test basis, our aim is to detecting and recognizing known and unknown and counting people and also looking for a better accuracy rate.

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 belonging literature work, the scope of the problem, summary, and challenges we face. Chapter 3 represents the whole methodology like dataset creation, model training and classification, and implementation requirements. Chapter 4 discusses the result and at last Chapter 5 finalized the report with a conclusion and future work. In References, we use IEEE format. In Appendices, External information added if needed.

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CHAPTER 2
BACKGROUND

2.1 Introduction

Face recognition is the automated process of comparing two images of faces to determine whether they represent the same individual. Before face recognition can identify someone, an algorithm must first find that person's face within the photo. This is called face detection. Once detected, a face is "normalized"—scaled, rotated, and aligned so that every face that the algorithm processes is in the same position. This makes it easier to compare the faces. It is additionally described as a biometric Artificial Intelligence-based application that can uniquely recognize an individual by analyzing patterns based on the individual's facial surfaces and shape. The human face plays an important role in our social interaction, represent individual's identity. Using the human face as a key to security, biometric face recognition technology has received vital attention within the past many years because of its potential for a wide variety of applications in both social control (enforcement) and non-law enforcement. As compared with other biometric systems using fingerprint/palmprint and iris, face recognition has distinct advantages because of its non-contact method. Face images is captured from a distance while not touching the person being identified, and also the identification doesn't need interacting with the person. In any case, the way to achieve this stage isn't so natural and has a huge, resourceful and a strong foundation since 1961. From that point to till now many research works had presented a lot method. Among them, different machine learning methods or model demonstrates an immense success in this field and in some cases it achieves the accuracy rate near human accuracy. Machine Learning is that the science (and art) of programming computers so that they will learn from information. Machine learning is closely associated with (and typically overlaps with) machine statistics, which also focuses on prediction-making through the use of computers. It has sturdy ties to mathematical optimization that delivers strategies, theory and application domains to the sector. Here we mainly use CNN and the Support Vector Machines (SVM) for this project. The processes are discussed in the later sections.

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2.2 Related Work

In recent years many models have introduced for face recognition and image-based work. We review the literature in two parts: 1) video-based face recognition, and 2) deep learning methods for face recognition.

2.2.1. Video-based Face Recognition

Fan, Y., Lu, X., Li, D. and Liu, Y. [14] proposed a method for video-based emotion recognition in the wild. They used CNN-LSTM and C3D networks to simultaneously model video appearances and motions. Zhao, X., Delleandrea, E. and Chen, L. [13] have proposed a strategy for counting people based on the automatic classification of potential face trajectories. They use scale-invariant Kalman filter is proposed to deal with drastic changes in face scales.

2.2.2 Deep learning methods for Face Recognition

Alhindi, T.J., Kalra S. [10] conducted a recent study which compares Local Binary Pattern (LBP), HOG and deep features from VGG 19, a pre-trained deep network for feature extraction and Support Vector Machine (SVM), Decision Tree and Artificial NeuralNetwork for the classification of histopathology image dataset, KIMIA Path960. The classification accuracy obtained in the study with LBP and SVM is 90.52%. presented in this paper an integrated approach to multi-view face detection. In this paper Hassaballah, M. and Aly, S. [11] they have reviewed the achievements in face recognition and discussed several challenges and key factors that can significantly affect performance of the face recognition systems. Li, Y., Gong, S., Sherrah, J. [9] proposed a hybrid algorithm combining SVM and Eigenface methods for face detection which provides improved performance in terms of accuracy and speed. A novel approach to multi-view face detection, where pose information is explicitly estimated first, and is used to select an appropriate face detector. In this paper, Osuna, E., Freund, R. [15] have presented a novel decomposition algorithm that can be used to train support vector machines on large datasets (say 50000 data points). They demonstrated a applicability of SVM by embedding SVM in a face detection system which performs comparably to other state-of-the-art systems. IN this paper Agarap, A.F. [1] proposed an Architecture Combining Convolutional Neural Network (CNN) and Support Vector Machine (SVM) for Image Classification. The results of this study warrants an

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improvement on its methodology to further validate its review on the proposed CNN-SVM. Google TensorFlow was used to implement the deep learning algorithms in this study. In this paper, they proposed a face detection method based on deep learning, called Deep Dense Face Detector (DDFD). they showed that their detector is able to achieve similar or better results even without using pose annotation or information about facial landmarks. Face images can be seen as a composition of micro-patterns which can be well described by LBP [2]. For instance, their method achieved a recognition rate of 97%.

2.3 Research Summery

In this proposed paper, our goal was to experiment on our own created dataset using OpenCV, Caffe Deep Learning Model and CNN classifier for feature extraction and SVM classifier for classification in real time data for recognizing intruders for ensure security.

2.4 Scope of the Problem

This system can play a vital rule in the different field especially in 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 to many fields in our country.

2.5 Challenges

At first, the facial images for the dataset need to have good quality such as the need to take images avoiding noise as much as possible. Because if the images have too much noise, the model will not train as expected level, so the result will be hampered. In digital imaging face recognition ought to influence uncontrolled lighting conditions, massive pose variations, facial expressions, makeup, changes in facial hair, ageing. Some of these challenges are illustrated in Fig.2.5.2, which might be classified into 5 classes as follows:

- Illumination variations: At the point when the image is shaped, factors, for example, lighting (spectra, source distribution and intensity) and camera attributes (sensor response and lenses) influence some degree the presence of the human face. Light

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varieties can likewise do this due to skin reflection factor properties and because of the inside camera control [11] [23].

- Facial expression/facial style: The appearance of faces is directly affected by a person's facial expression as shown in Fig. 2.5.2(d) Facial hair will alter facial appearance. Moreover, changed in hair style can be change the appearance of the face image or hide facial features [21]. Aleix [22] formulates the problem of face recognition under facial expression as 'how can we robustly identify a person's face for whom the learning and testing face images differ in facial expression?'

For face recognition using machine learning a better configuration for better performance is must. For example, it needs more than 45 minutes just to feed the images to the network to train. So, by solving the problem it is possible to get more efficient performance.

Figure 2.5.1: Same face seen under varying light conditions can appear dramatically different [11].

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Figure 2.5.2: Examples of some Challenges[11].

a. Challences because of illumination variations

b. Challences because of pose variations

c. Challences because of ageing variations

d. Challences because of facial expression

e. Challences because of occilution

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CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

An automatic face recognition system may be a computer application capable of identifying or verifying an individual from a digital image or a video frame from a video source. The proposed system is meant for real-time to live streaming surveillance system to recognize the people and also detect known and unknown for informing the soul of the team connected with security purposes which is able to differ from the conventional system. Different technologies are getting used to create the system widely accessible through cross-platforms and to provide the most effective performance among limited resources. These facilitate to build system rapidly and facilitate to maintain the consistency that helps developers to satisfy their deadlines.

3.2 Machine Intelligence Library

OpenCV library was used to implement the deep learning algorithms in this study.

3.3 Research Subject and Instrumentation

We are working with Python and made a real time application which detect face and give us exact output. These command line needed for run our application.

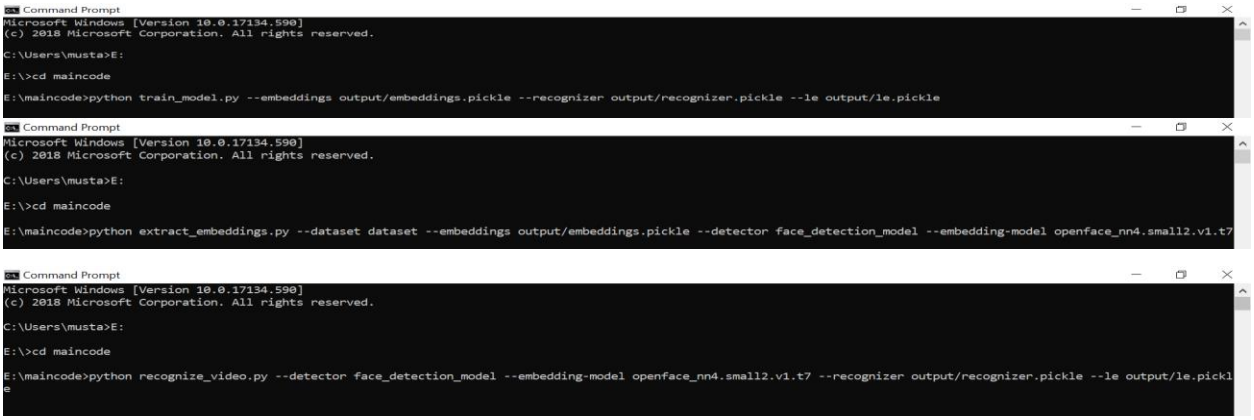

Figure 3.3.1: Command line for opening our application.

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The process of the FDFR demonstrates via figure step by step,

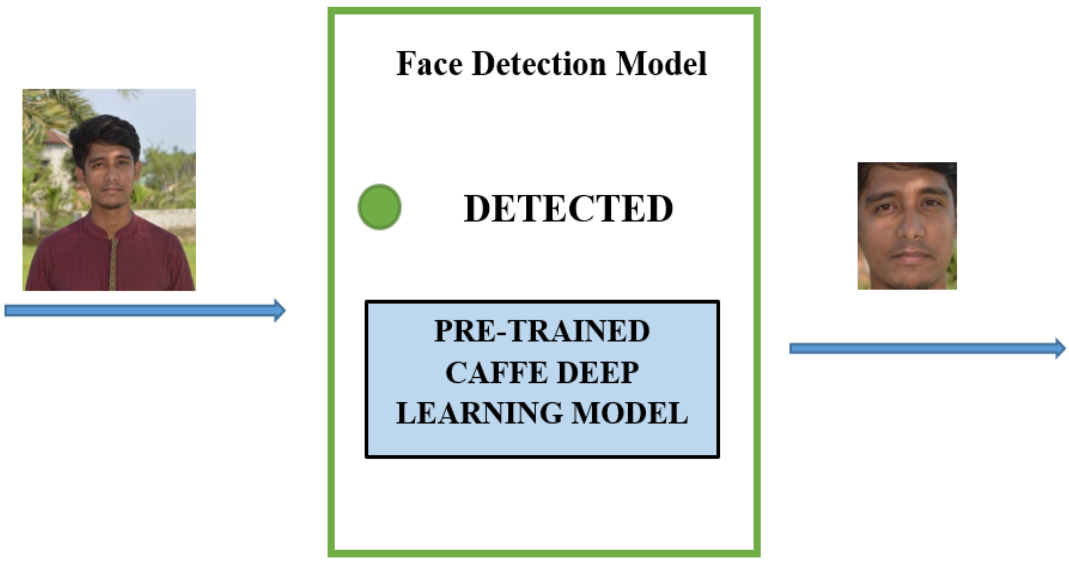

Figure 3.3.2: Detect the Face.

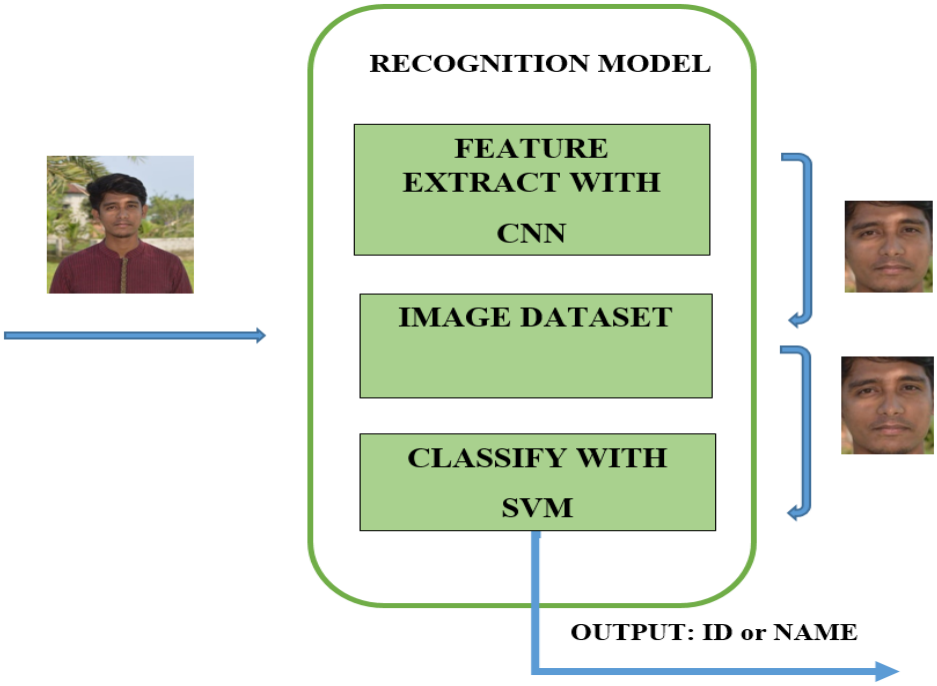

Figure 3.3.3: Recognize the image and given ID corresponding image.

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1. Python

We are using Python for building our system. Python is an open source programming language. Python is easy to read and powerful. Its high-level built in data structures, combined with dynamic typing,make it very attractive for rapid application development. For its simplicity, power, and availability of powerful modules and packages for modern technology like Data Analysis, Artificial Intelligence, IoT and many more, we are building our system on Python.

2. Face Detection

For detecting faces in images, pre-trained Caffe deep learning model is used here provided by OpenCv. This model detects and localizes faces in an image. We're using a Caffe based DL face detector to localize faces in an image.

3. Face Recognition

In face recognition part we are use two algorithms. First is Convolutional Neural Network (CNN) use to extract feature second is Support Vector Machine(SVM) classifier that is actually recognize face.

a) Convolutional Neural Network (CNN)

One of artificial neural network, CNN takes the image as input. CNN is a very power full network. In our project CNN use to extract feature compute 128-d embedding .It is very important part to further work. Convolutional formula may be represented as:

$$y_j^l = f\left(\sum_{i \in M} x_i^{l-1} * k_{ij}^l + b_j^l\right) \qquad (1)$$

$$f(x) = \max(0, x) \qquad (2)$$

After feature extraction of an image, 128-d embedding computes by the FaceNet deep learning model that quantifies the face itself. All of the faces in our dataset will be passed through the neural network to produce embeddings.

b) Encoding Faces:

To encode the faces, it is extracted in a few basic measurements. Then measuring the unknown faces the same way and find the known face with the closest

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measurements. These measurements are called embeddings. The embedding is represented by $f(x) \in \mathbb{R}^d$. It embeds an *x* image into a d-dimensional Euclidean space. Here we want to ensure that an image x^a_i (anchor) of a specific person is closer to all other images x^p_i (positive) of the same person than it is to any image x^n (negative) of any other person.

$$\|x_i^a - x_i^p\|_2^2 + \alpha < \|x_i^a - x_i^n\|_2^2$$

Where α is a margin that is enforced between positive and negative pairs.

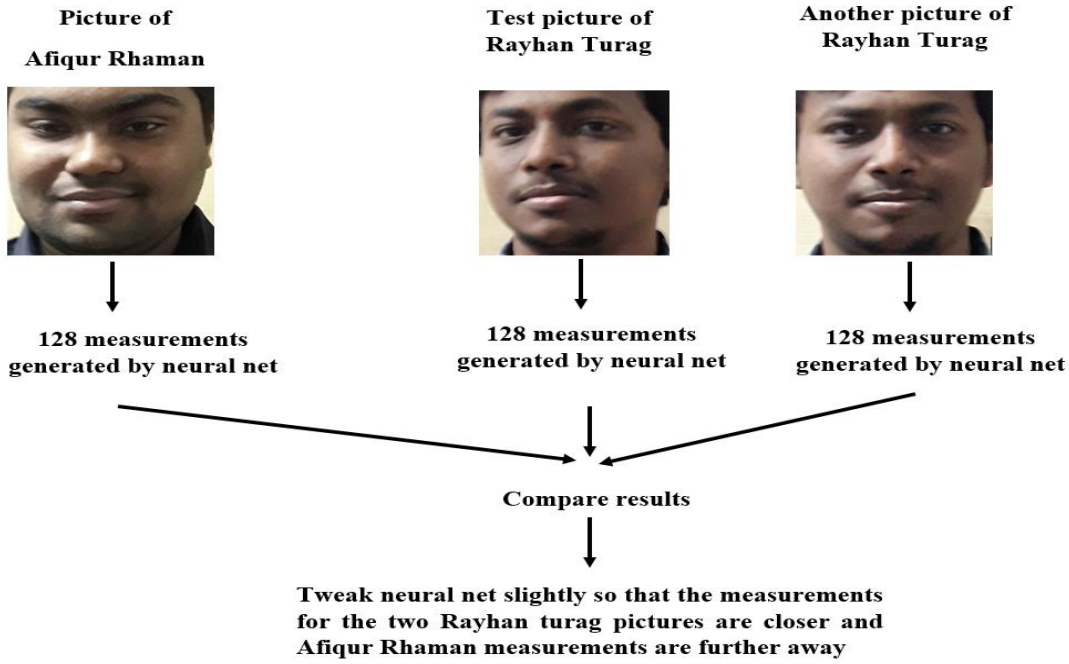

Figure 3.3.4: Facial recognition via deep metric learning involves a "triplet training step".

After repeating this step, a huge number of times for millions of images of thousands of various individuals, the neural network figures out how to reliably generate 128 measurements for every individual. Any ten different images of a similar individual should give generally similar measurements.

c) Support Vector Machine(SVM)

In this section we describe Support Vector Machine to recognize face as its excellent performance in solving linear problem. In our project SVM use to as a classifier that is actually

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recognize the face. In our project SVM are use to training section and classify the image. Support Vector Machine is provided by OpenCV to recognize face and weather image is known or unknown, if known the provided name and percentage if unknown tell this is unknown face and also provided percentage what percent are unknown. CNN is extract feature and SVM that can learn a better interface by the function SVC will be improve the recognition performance.

4. Find Individuals Informations from Encodings:

Now all it needs to find the known and unknown comparison faces from dataset. Basic classification algorithm is used here for classification. training a classifier that may take in the measurements from a new test image and tells which known individuals is that the closest match. The results of the classifier is that the "NAME or ID" of the individuals and other information that is required in dataase. Here SVM classifier is employed for classification.

5. People Count Using Opencv And Dlib

To execute our people counter we'll be utilizing both OpenCV and dlib. We'll utilize OpenCV for standard PC vision/picture preparing capacities, alongside the profound learning object finder for individuals tallying. We'll then use dlib in this task for its execution of correlation filters. We may use opencv here as well but the dlib object tracking implementation was a small amount easier to figure with for this project. we are also use centroid tracking algorithm that minimum Euclidean distance.

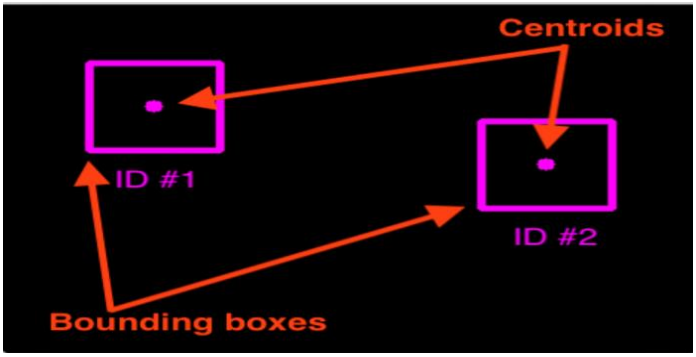

Figure 3.3.5: To build a simple object tracking via centroids script with Python.

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3.4 Data Collection Procedure

Here are the main purpose and most important part of the proposed study or system. The system is mainly proposed for the security purpose so for recognition and for training the network, the dataset is a must. In this dataset images of 500 subjects are taken in total including 10 individuals in different expression, light, and facial conditions. For making the dataset we focused on images and background to keep clean as much as possible, as well as proper light condition, must be kept in mind. For each person or subjects, the images are taken in four modes (Figure 3.4.1) happy, sad, normal mode and side view (left, right, top, bottom). The image a_1 is frontal face, while the image a_6 is frontal face image with smile, the image a_7 image in lower light and others are images with different pose.

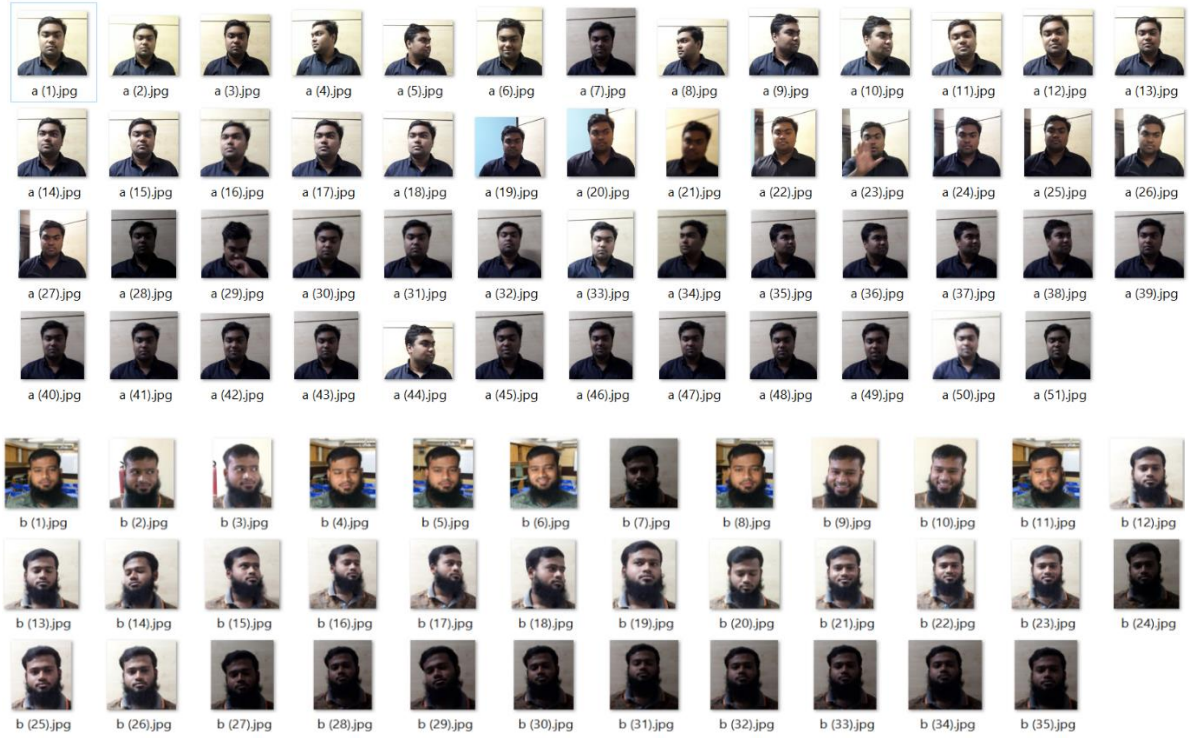

Figure 3.4.1: Dataset images from different individuals in different views and angle.

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.

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

In the time of data collection the ID or NAME of each individuals was taken with images for identifying individuals.

TABLE I: DATA COLLECTED FROM INDIVIDUALS

SL. No	Data	Description	Usability
01.	Id or Name	Individuals Id or Name	Identity
02.	Image	Individuals Image	Recognize

Here, Id of the individual is taken for identification which is corresponding with their images.

3.5 Statistical Analysis

We have used the OpenCv library that may be a toolkit containing machine learning algorithm for implementing our system. The FaceNet deep learning model computes a 128-d embedding that quantifies the face itself. For CNN and SVM 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. Now, we'd like to quantify the faces of our dataset in 128-d embeddings. So, we simply feed the pictures of our dataset to the network to construct 128-d embeddings to quantify the face. Figure 3.5.1 presents 128 emeddings values for a picture.

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[-0.23, -0.54, …., 0.27]

Figure 3.5.1: Facial recognition via deep learning and Python using FaceNet model that generates a 128-d real-valued number feature vector per face.

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.

Here the feature extraction and classification as well as the total system procedure shown in figure 3.5.2. When collection the information they're going to feed to the network, it'll convert it in 128-d embedding using Dlib library for processing. which will train the model. 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.

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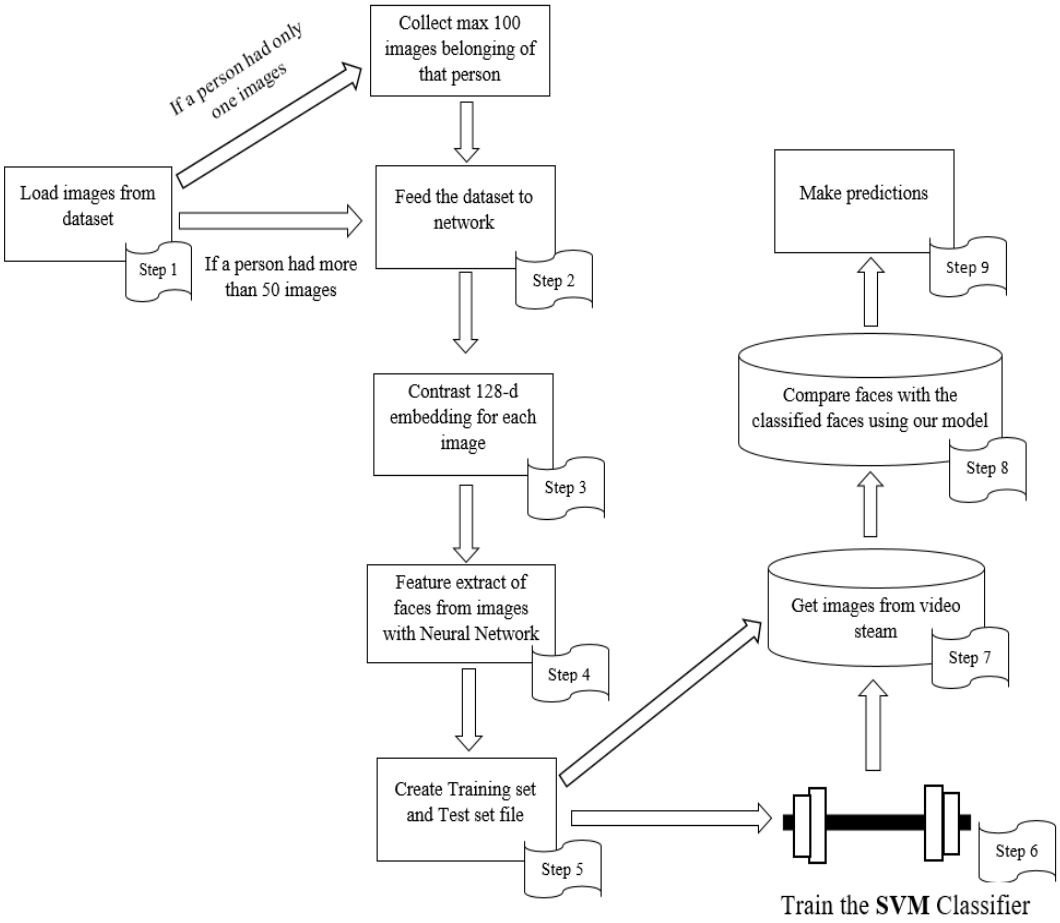

Figure 3.5.2: The process of our Whole model work.

3.6 Implementation Requirement

- Hardware
  - Graphics card 2GB
  - Ram 4GB and hardware requirements that usually we have. But for better performance need higher requirements than this. For implementing CNN, GPU is must.
- Software:
  - Operating System: Windows 10, Linux, Ubuntu
  - Development platform: OpenCV, CNN, FaceNet, SVM.

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CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

The Confusion matrix is used to measure the performance. We aslo 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 subjects to measure the performance is 30. Among them, 12 are known and 18 are unknown. The proposed system can perfectly recognize 26 people but for another 4 people it shows a little confusing result.

4.2 Experimental Result

TABLE II: CONFUSION MATRIX FOR MEASURING PERFORMANCE

	Prediction Unknown	**Prediction Known**
Actual Unknown	15 (TN)	3 (FN)
Actual Known	1 (FP)	11 (TP)

Now the equation for accuracy is:

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

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 $(11 + 15) / 30 = 0.8667 \times 100 = 86.67\%$. From here the error rate can also be calculated. The Equation for error is:

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

The error rate is 13.33%. The accuracy rate will increase more if can remove our constraint

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to implement the model. In the next part, we will discuss it. We use the facial features extracted from CNN to train the support vector machine, which equivalents to second extract features, hence, we might extract more facial features.

We also use SVM classifier to measure recognition rate. Here is the following table:

TABLE III: THE RECOGNITION RATE BASED SVM

Dataset Section	SVM
Test-1	85.36%
Test-2	90.36%
Test-3	88.90%
Test-4	91.90%
Test-5	84.90%
Test-6	89.00%
Test-7	92.90%

4.3 Training Time

Training time is the most important part in every project. We list the training time and recognition rate in Table III based on SVM. This SVM algorithm is sufficient than any other algorithms. In our Training time the recognition rate is 92.50%. We show the compsrition of training time between SVM and other algorithms in Table IV.

Table IV: COMPARISON OF TRAINING TIME BETWEEN ACNN AND SVM

Algorithm	Training Time(s)	Test Recognition Rate
Global Expansion ACNN[23]	275	87.30%
Global + Local Expansion ACNN[23]	343	88.30%
SVM	28	92.50%

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4.4 Descriptive Analys

Figure 4.3.1 shows the actual outcome of the system. two faces in left shows with Name and in right one recognized as unknown so we can say the system work perfectly.

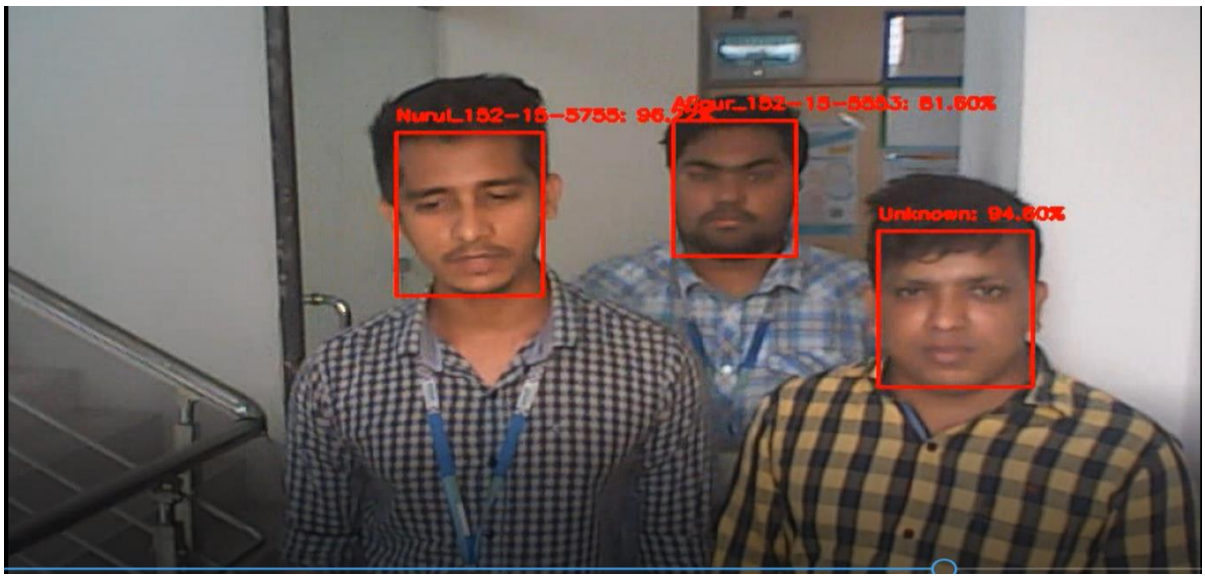

Figure 4.3.1: Determine known and unknown from real-time data.

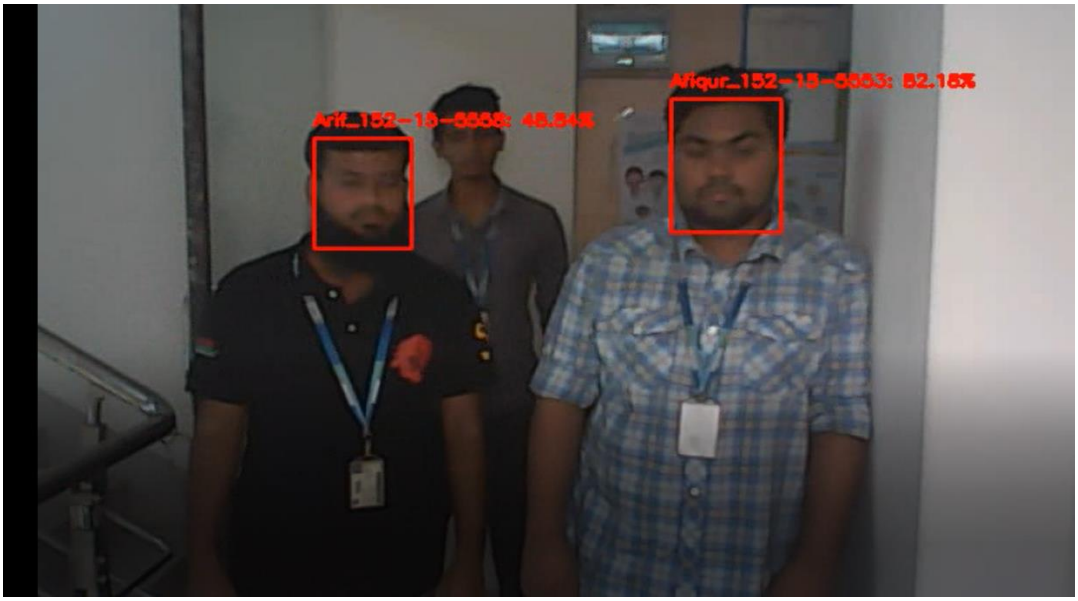

Figure 4.3.2: Determine known and unknown from real-time data.

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In figure 4.3.2 here the right and left one recognized with Id. But we would also see the middle one in screen but it is not show either Id or detected as unknown because of out of range.

4.5 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.

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CHAPTER 5
CONCLUTION AND FUTURE WORK

5.1 Summary

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. So, we just need to feed our images data in the network. To train Support Vector Machine, facial features extracted from CNN is used, hence we might extract more facial features. It needs to adjust some parameters when the CNN and SVM are trained. That makes our work quite easier.

5.2 Conclusion

In this paper, we implemented a basic real-time face recognition and people counting system. This system can be further improvised to create more complex and advanced system for reaching any particular goal. In our system, Caffe deep learning model is used for face detection. Moreover, there are now advance libraries more Machine Learning and Artificial Intelligence available.

Many Applications which require face recognition do not require perfect identification but just low error rate. So instead of searching large database of faces, it is better to work with small databases. By using SVM approach, this small set of databases for given images can be easily obtained.

We use 260 images as face database in the present work. The procedure we used is very good. It can recognize both the known and unknown images in the database in various conditions with accuracy rate 86.7% to 90%(depend on the database).

5.3 Recommendation

This document is intended to read by the Software Engineers, Operation Engineers, System Engineers or any Manager level employees who are interested in face recognition as well as machine learning. If this system would be implemented in a university or in an office, the following would be recommended:

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 The camera that would be used for the face recognition should be placed in front of the lecture theatre door at a distance of 3 feet and a height of 65 inches. This would assure a better accuracy from the face recognition system.

 The pictures that are added to face lists should ideally be the same as the pictures used for student or employee Name or IDs.

 The application should be hosted on the university's or company's servers to ensure consistency with the folders corresponding to each face list created and with the pictures in each folder corresponding to what faces each face list contains.

5.4 Implication for Further study

In this paper, we propose an effective face recognition and people counting system. Our future work plan is by using this face detection and recognition system find out a specific individual from a crowded spot like commercial center, occupied streets, fairs or from a stadium. This can be used to find out a wanted person. In future we also develop our system that can count people by identifying individuals face and cannot count anyone again if the individuals identifying once. 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

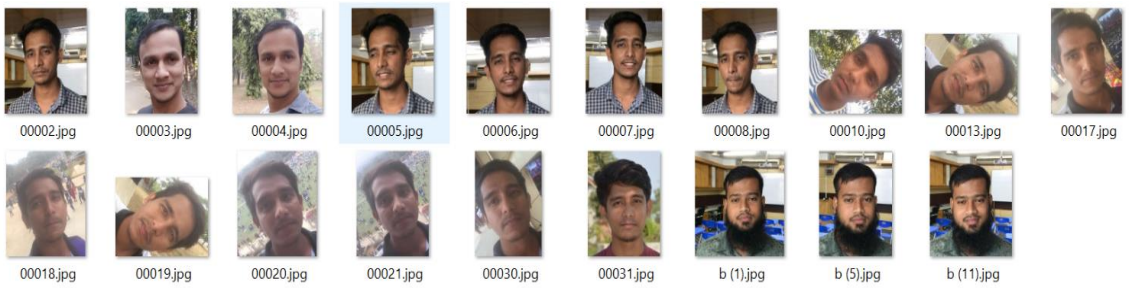

Figure A1: Image in Dataset(noise in background)

Figure A2: Image in Dataset(clear background)

Appendix B: Person's Image profile

TABLE V: Person's Image profile

Name	Age	Gender	Environment
NURUL	21	Male	Noisy Background
ARIF	21	Male	Clear Background
AFIQUR	20	Male	Noisy
RAYHAN	22	Male	Noisy & Moving
AWOLAD	21	Male	Clear & Moving
SAIFUL	22	Male	Low Light

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Appendix C: Related Issues

CNN:	Convolutional Neural Network
OpenCV:	Open source Computer Vision Library
SVM:	Support Vector Machine
GPU:	Graphical Processing Unit
Caffe:	Deep Learning Model provided by OpenCV

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