Face Recognition

A report submitted for B-Tech course named Project II (CS-300)

By

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Abstract

In this work, Face recognition system is implemented for academic purpose. It is divided into the 2 parts consisting of Deep learning and normal simalrity function.
In the first part Landmark is detected and feature vector is made with the distance ratio. In the second part the a simarity is found with all the stored feature vector and the list of people have been identified who are simialr to it. The number of vector who clear there cutoff value for simalarity is displayed in the ranking order.
For, the first part a convolutional neural network was designed which give the position of the 4 landmark. The model was trained on 7049 frontal face images each of dimension 96X96. The output of the model was 8 coordinate ratio. which is further used to prepare the feature vector.

Declaration

I pronounce that this Report speaks to my thought in my very own words and where others' thought or on the other hand words have been incorporated, I have satisfactorily refered to and referenced the first source.
I additionally proclaim that I have clung to all standards of scholastic trustworthiness and honesty what's more, have not distorted or manufactured or adulterated anythought/information/certainty/sources in my Report. I comprehend that any infringement of the above will be a reason for disciplinary activity by the foundation and can likewise summon punitive activity from the sources which have accordingly not been appropriately refered to or from legitimate authorization has not been taken when required.

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To Whom It May Concern

This is to certify that the report entitled **"Face recognition"** submitted by **Mr. Gaurav Kumar Raghav,** has been carried out under my supervision and that this work has not been submitted elsewhere for a degree, diploma or a course.

Signature of Supervisor

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Department of Computer Science & Engineering
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To Whom It May Concern

This is to certify that the report entitled **"Face recognition"** submitted by **Mr. Gaurav Kumar Raghav,** has been Succesfully evaluated and that this work has not been submitted elsewhere for a degree,diploma or a course.

Signature of HoD

Dr. Kishorjit Nongmeikapam

Signature of Examiner 1: _____

Signature of Examiner 2: _____

Signature of Examiner 3: _____

Signature of Examiner 4: _____

Acknowledgement

It is my benefit to express my sincerest respects to my task facilitator, **Dr. Kishorjit Nongmeikapam,** for their significant information sources, capable direction, consolation, entire hearted participation and valuable analysis all through the term of our project. I profoundly express our genuine gratitude to our Computer Science Department for urging and enabling me to introduce the undertaking on the point "Face Recognition" at our area of expertise premises for the incomplete satisfaction of the necessities prompting the honor of B-Tech degree. I accept this open door to thank every one of our speakers who have straightforwardly or by implication helped our undertaking. We offer our regards and love to our folks and all other relatives and companions for their adoration and support all through our vocation. Last however not the least we express our gratitude to our companions for their collaboration and backing.

- Gaurav Kumar Raghav

Contents

List of Tables

List of Figures

Chapter 1

Introduction

“First of all, [face recognition] would help with client administration. In the event that a customer is remaining in a store and looking bombshell, a store partner could be dispatched to support that client. The innovation could likewise assume a job in item or choice help: Imagine a customer is waiting before a rack with 20 brands of cleanser seeming bewildered or frowning. A message on their telephone or a voice-initiated rack could inquire as to whether they need assistance finding an item or require help in settling on a choice that best suits their stain-battling needs.“

– Maya Mikhailov

In era of 20 century people uses ID card, key, pin, password as the identification verification. Humans have so many body characteristics such as face, and gait for many years to recognize each other. There are many jails and police department uses body measurement for identifying the criminals in 19-century. This practice was then carried out by identifying the each other with help of fingerprints. There are other biometric identification method like audio recognition, finger recognition, retina recognition and facial recognition.
There are points that decide biological measurement that can be used for biometric identification.

- **Universality:** every individual ought to have the trademark.
- **Distinctiveness:** any two people ought to be adequately extraordinary regarding the trademark.
- **Permanence:** the trademark ought to be adequately invariant (concerning the coordinating measure) over some stretch of time.
- **Collectability:** the trademark can be estimated quantitatively.

However, in a practical biometric system, there are a number of other issues that should be considered, including:

- **Performance:** which alludes to the feasible acknowledgment precision and speed, the assets required to accomplish the ideal acknowledgment exactness and speed, just as the operational and natural factors that influence the precision and speed.
- **acceptability:** which demonstrates the degree to which individuals are ready to acknowledge the utilization of a specific biometric identifier (trademark) in their every day lives;
- **circumvention:**which reflects how effectively the framework can be tricked utilizing deceitful strategies

Indeed facial recognition is one of the trending research area for the identification of the person identity. Facial Recognition is most widely used in surveillance camera in public place in order to improve the security measure. Facial Recognition's is one of the biometric identification technique in which we don't need the cooperation from the object . A signal is something which have a data. As indicated by this even a picture can be

considered as a flag which is made out of 2d cluster constant esteem. Also, Image handling is the way toward Enhancing or separating the data out of picture. Contribution to picture handling is the picture or arrangement of image(video) and the yield is the either picture or a lot of uniqueness or parameters identified with the Image. One is simple picture preparing used to printout or photo and the other one is picture handling is called advanced picture handling utilized for facial acknowledgment and so forth. Facial Recognition is the PC application used to distinguish any individual from picture or video outline. A standout amongst the most Human Vision is Facial Recognitions. Face is one of the element which is create more than quite a long while of youth. Face is significant need public activity, for example, the demeanor with which the general population appear while interfacing.

It is recommended that there are seven unmistakable kinds of data that we get from seen faces; these are marked pictorial, basic, outwardly determined semantic, personality explicit semantic, name, demeanor and facial discourse codes. One of the method for doing is coordinating the chosen facial element with the database highlight. This strategy is utilized in security framework and contrasted and the biometric finger sweep or iris examine. A human face uncovers a lot of data to a perceiver. It can tell about state of mind and expectation and mindfulness, yet it can likewise serve to distinguish an individual. Ofcourse, an individual can be distinguished by different methods than the face. Voice, body shape, step or notwithstanding dress may all set up personality in conditions where facial detail may not be accessible.

A standout amongst the best uses of picture investigation and comprehension, face acknowledgment has as of late gotten noteworthy consideration, particularly amid the previous quite a while.

No less than two reasons represent this pattern: the first is the wide scope of business and law requirement applications, and the second is the accessibility of doable advances following 30 years of research. Despite the fact that present machine acknowledgment frameworks have achieved a specific dimension of development, their prosperity is constrained by the conditions forced by numerous genuine applications. For instance, acknowledgment of face pictures procured in an open air condition with changes in light as well as posture remains a to a great extent unsolved issue. As such, current frameworks are still far from the capacity of the human observation framework.

1.1 Face Detection

Face recognition is a PC innovation being utilized in an assortment of uses that recognizes human faces in advanced pictures. Face discovery additionally alludes to the mental procedure by which people find and take care of countenances in a visual scene. Face recognition can be viewed as a particular instance of article class detection.
In article class discovery, the undertaking is to discover the areas and sizes of all items in a picture that have a place with a given class. Models incorporate upper middles, people on foot, and autos. Face-location calculations center around the discovery of frontal human appearances. It is similar to picture discovery in which the picture of an individual is coordinated a little bit at a time. Picture matches with the picture stores in database. Any facialfeature changes in the database will discredit the coordinating process.
A solid face-discovery approach dependent on the hereditary calculation and the eigen-face technique:
Initially, the conceivable human eye areas are identified by testing all the valley districts in the dark dimension picture. At that point the hereditary calculation is utilized to produce all the conceivable face districts which incorporate the eyebrows, the iris, the nostril and the mouth corners.Each conceivable face hopeful is standardized to decrease both the lightning impact, which is brought about by uneven enlightenment; and the shirring impact, which is because of head development. The wellness estimation of every applicant is estimated dependent on its projection on the eigen-faces. After various emphasess, all the face applicants with a high wellness esteem are chosen for further confirmation. At this stage, the face symmetry is estimated and the presence of the distinctive facial highlights is checked for each face competitor.

1.2 Feature Extraction

In AI, design acknowledgment and in picture preparing, include extraction begins from an underlying arrangement of estimated information and constructs inferred values (highlights) expected to be useful and non-repetitive, encouraging the consequent learning and speculation steps, and now and again prompting better human elucidations. Highlight extraction is a dimensionality decrease process, where an underlying arrangement of crude factors is diminished to increasingly sensible gatherings (highlights) for preparing, while still precisely and totally portraying the first informational index. At the point when the information to a calculation is too vast to ever be handled and it is suspected to be repet-

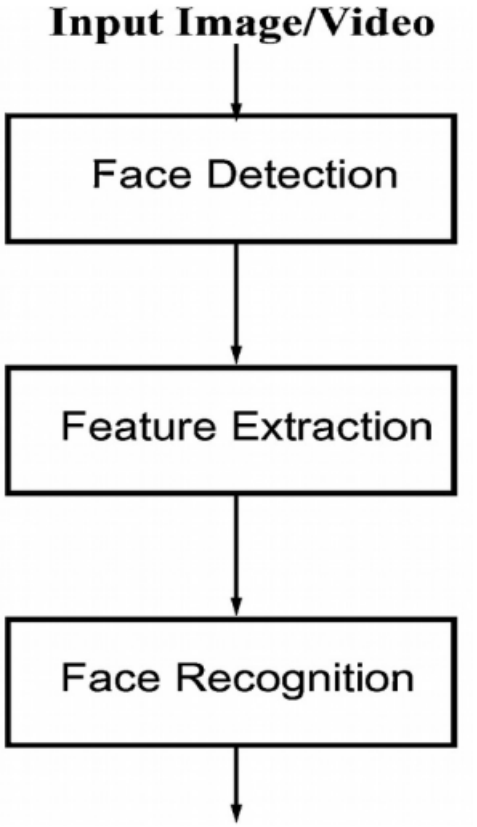

Figure 1.1: Flow of the Face Recognition System

itive (for example a similar estimation in the two feet and meters, or the redundancy of pictures exhibited as pixels), at that point it very well may be changed into a diminished arrangement of highlights (additionally named an element vector).
Deciding a subset of the underlying highlights is called include determination. The chose highlights are relied upon to contain the applicable data from the info information, with the goal that the ideal errand can be performed by utilizing this decreased portrayal rather than the total introductory data.
One significant zone of use is picture preparing, in which calculations are utilized to recognize and detach different wanted parts or shapes (highlights) of a digitized picture or video stream. It is especially significant in the region of optical character acknowledgment.

Low-level

- Edge Finding
- Corner Finding
- Blob Finding

- Ridge Finding
- Scale-invariant feature Change

Curvature

- Edge direction, changing intensity, auto-correlation,

Image Movement

- Motion finding, Area based, differential Method, Optical flow.

Shape Method

- Cut-off
- Blob Finding
- similarity matching
- Hough Change
  - Lines
  - Circles/ellipses
  - Arbitrary shapes (generalized Hough transform)
  - Works with any parameterizable feature (class variables, cluster detection, etc.)
- Generalised Hough transform

Flexible methods

- Deformable, parameterized shapes
- Active contours (snakes)

1.3 Facial Recognition

A facial acknowledgment framework is an innovation equipped for recognizing or checking an individual from an advanced picture or a video outline from a video source. There are various strategies in which facial acknowledgment frameworks work, yet as a rule, they work by looking at chosen facial highlights from given picture with appearances inside a

database. It is additionally portrayed as a Biometric Artificial Intelligence based application that can exceptionally recognize an individual by investigating designs dependent on the individual's facial surfaces and shape.
While at first a type of PC application, it has seen more extensive uses as of late on versatile stages and in different types of innovation, for example, mechanical autonomy. It is ordinarily utilized as access control in security frameworks and can be contrasted with different biometrics, for example, unique mark or eye iris acknowledgment frameworks. In spite of the fact that the exactness of facial acknowledgment framework as a biometric innovation is lower than iris acknowledgment and unique mark acknowledgment, it is broadly embraced because of its contactless and non-obtrusive procedure.
As of late, it has likewise turned out to be well known as a business recognizable proof and showcasing device. Different applications incorporate propelled human-PC communication, video reconnaissance, programmed ordering of pictures, and video database, among others.

1.4 TimeLine

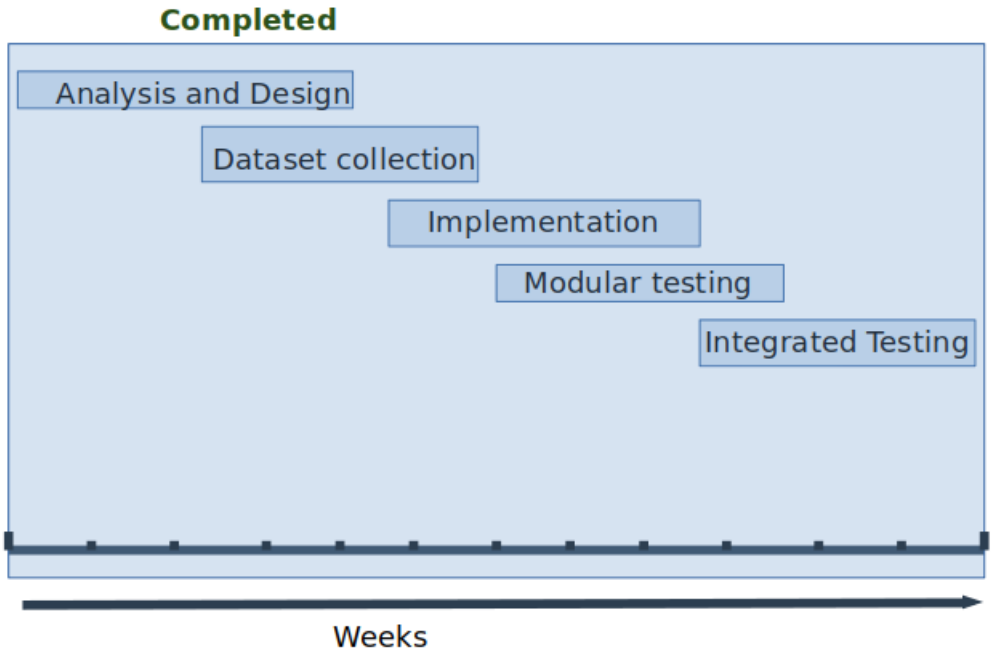

Figure 1.2: Gantt Chart

The Figure 1.2 shows the steps taken to implement the system. The area which is under shadow represent the work has been done untill that phase. The whole system implementation was divided into the five steps as shown in the figure. It is seen that some

part of each phase was parrallely done. **The unit on week axis move by 1 week in Figure 1.2**

Chapter 2

Analysis of Existing System

2.1 Introduction

Available Commercial Face Recognition Systems shown in Table **??** (Some of these Web sites may have changed or been removed.) (The identification of any company, commercial product, or trade name does not imply endorsement or recommendation by the National Institute of Standards and Technology or any of the authors or their institutions.)

Table 2.1: Commercial products Websites

1.	FaceIt from Visionics	http://www.FaceIt.com
2.	Viisage Technology	http://www.viisage.com
3.	FaceVACS from Plettac	http://www.plettac-electronics.com
4.	FaceKey Corp.	http://www.facekey.com
5.	Cognitec Systems	http://www.cognitec-systems.de
6.	Keyware Technologies	http://www.keywareusa.com/
7.	Passfaces from ID-arts	http://www.id-arts.com/
8.	ImageWare Sofware	http://www.iwsinc.com/
9.	Eyematic Interfaces Inc	http://www.eyematic.com/
10.	BioID sensor fusion	http://www.bioid.com
11.	Visionsphere Technologies	http://www.visionspheretech.com/menu.htm
12.	Biometric Systems Inc.	http://www.biometrica.com/
13.	FaceSnap Recoder	http://www.facesnap.de/htdocs/english/index2.html
14.	SpotIt for composite face	http://spotit.itc.it/SpotIt.html

2.2 Faceit from Visionics

Neighborhood FEATURE ANALYSIS Fundamental to any face acknowledgment framework is the manner by which faces are coded. FaceIt® utilizes Local Feature Analysis (LFA) to speak to facial pictures as far as neighborhood measurably determined structure squares.

LFA is a scientific strategy which depends on the acknowledgment that every facial picture (besides all mind boggling designs) can be combined from an unchangeable arrangement of structure components. These components are gotten from a delegate group of faces utilizing refined factual strategies.

They range various pixels (yet are as yet nearby) and speak to all inclusive facial shapes, however are not actually the regularly known facial highlights. Truth be told, there are a lot more facial structure components than there are facial parts.

Nonetheless, things being what they are, orchestrating a given facial picture, to a high level of accuracy, requires just a little subset (12-40 trademark components) of the all out accessible set. Personality is resolved by which components are trademark, yet in addition by the way in which they are geometrically joined (for example their relative positions). Thusly FaceIt® maps a person's character into a complex scientific equation that can be coordinated and contrasted with others.

2.3 FaceVACS and Cognitec Systems

Cognitec's FaceVACS Engine empowers customers worldwide to grow new face acknowledgment applications. It gives a reasonable and intelligent API for simple combination

in other programming programs.
Cognitec gives the FaceVACS Engine through modified programming advancement units, with a lot of capacities and modules explicit to each utilization case and registering stage, and in view of custom-made programming permitting understandings. Such explicit use cases include: picture quality check, confirmation for record issuance, and confirmation for access control.

Features

- face localization and face tracking from images and video live stream
- industry-leading matching algorithms for enrollment, verification and identification
- accurate portrait characteristics check for gender, age, pose deviation, exposure, glasses, eyes closed, uniform lighting detection, unnatural color, image and face geometry
- ISO 19794-5 full frontal image type checks and formatting as required for ePassports
- supports multiple algorithms to work with two-dimensional intensity data, or two-dimensional data and corresponding range data (3D data)

Programming and development

- advanced face recognition APIs: C++, Java, Microsoft .NET, BioAPI 2.0 Verification Engine (C API)
- documented examples for main use cases and customized implementations
- tools for biometric evaluations: e.g. generation of identification match lists, similarity matrix data

Android and iOS development

- Cognitec's innovation likewise underpins the advancement of compact face acknowledgment applications. Law implementation specialists utilize handheld gadgets to catch suspect photographs and contrast them with picture databases on the gadget or focal frameworks. Face acknowledgment can add security to login and confirmation techniques, for the gadget itself or by means of applications on the telephone or tablet. An application could be utilized to make versatile installments, take biometric photographs required for ID reports, to record photograph displays saved money on cell phones or in the cloud, or to speak with an entrance control framework.

2.4 FaceKey

Lyssy & Eckel, Inc. conveyed FaceKey's EntryGuard Biometric Time and Attendance System which uses fingerprints for distinguishing proof to computerize, track and oversee representative time and participation, bringing about a decrease in the authoritative time expected to gather worker time, physically figure representative time and physically input information into the finance framework.

2.5 Active Appearance Models

In the paper [1], they present another structure for deciphering face pictures and picture successions utilizing an Active Appearance Model (AAM). The AAM contains a factual, photograph reasonable model of the shape and dim dimension appearance of countenances. The methodology is broadly utilized for coordinating and following countenances and for medicinal picture translation. The calculation utilizes the contrast between the present gauge of appearance and the objective picture to drive a streamlining procedure. By exploiting the least squares methods, it can match to new pictures very swiftly.
This paper exhibits the utilization of the AAM's productive iterative coordinating plan for picture understanding. We utilize the AAM as a reason for face acknowledgment, acquire great outcomes for troublesome pictures. We show how the AAM structure enables character data to be decoupled from other variety, enabling proof of personality to be coordinated over an arrangement. The AAM approach utilizes the proof from either a solitary picture or 7 picture arrangement. Since we infer a total portrayal of a given picture our strategy can be utilized as the reason for a scope of face picture translation assignments.

2.6 Face recognition: features versus templates

In paper [2] is to analyze two basic yet broad methodologies on a typical database (frontal pictures of countenances of 47 individuals: 26 guys and 21 females, four pictures for every individual). We have created and executed two new calculations;

The first depends on the calculation of a lot of geometrical highlights, for example, nose width and length, mouth position, and jawline shape, and the second one depends

on nearly dark dimension format coordinating. The results got on the testing sets (about 90% right acknowledgment utilizing geometrical highlights and flawless acknowledgment utilizing layout coordinating) support our usage of the format coordinating methodology.

2.7 Unsupervised Feature Learning (UFL) Approach

In paper [3], they propose a face acknowledgment framework that utilizes joint element discovering that causes us gain include portrayal legitimately from crude pixels.
Unsupervised element learning empowers us to perceive faces even in unconstrained condition like changing postures and appearances. Right off the bat, they input a picture or video into our framework. At that point They pre-process it by changing over it into a dark scale picture. This is to diminish the unpredictability of the calculation. At that point we apply Face Detection calculation (Viola Jones Algorithm) to identify the countenances in the information picture. After this procedure, They got every one of the countenances in the picture alongside its check. At that point embrace Gradient Boost Algorithm (Feature Extraction) to separate the highlights from the countenances acquired in the past advance. This is trailed by Correlation coordinating in which, the highlights acquired are coordinated with a layout of the face to be perceived. On the off chance that it matches, it connotes that the face is accessible in the info outline. Or then again else the face to be perceived isn't accessible in the given picture. The last advance is utilizing Support Vector Machines classifiers that are utilized for the genuine confirmation process. In the event that this progression is finished, the perceived face is given as yield. Here, the use of Viola Jones Algorithm has appeared by and large increment in exactness and decrease in calculation time.

2.8 Understanding face recognition

An utilitarian model [4] is proposed in which basic encoding forms give depictions reasonable to the investigation of facial discourse, for examination of appearance and for face acknowledgment units. Acknowledgment of well-known countenances includes a match between the results of auxiliary encoding and recently put away basic codes portraying the presence of well-known appearances, held in face acknowledgment units. Character explicit semantic codes are then gotten to from individual personality hubs, and in this manner name codes are recovered. It is additionally suggested that the subjective

framework assumes a functioning job in choosing whether or not the underlying match is adequately near demonstrate genuine acknowledgment or simply a 'likeness'; a few components are viewed as impacting such decisions.
This utilitarian model is utilized to draw together information from assorted sources including research center analyses, investigations of ordinary mistakes, and investigations of patients with various kinds of cerebral damage. It is likewise used to elucidate likenesses and contrasts between procedures in charge of item, word and face acknowledgment.

2.9 Face recognition by elastic bunch graph matching

A framework [5] for perceiving human countenances from single pictures out of a huge database containing one picture for every individual. The undertaking is troublesome in light of picture variety regarding position, size, articulation, and posture. The framework crumples the vast majority of this difference by removing succinct face portrayals as picture diagrams. In these, fiducial focuses on the face (eyes, mouth, and so forth.) are depicted by sets of wavelet segments (planes). Picture chart extraction depends on a novel methodology, the group diagram, which is developed from a little arrangement of test picture charts. Acknowledgment depends on a straight forward examination of picture graphs.
They report acknowledgment probes the FERET database just as the Bochum database, including acknowledgment crosswise over posture.

2.10 Experiment of face recognition algorithm

Face Recognition starts with separating the directions [6] of highlights, for example, width of mouth, width of eyes, student, and contrast the outcome and the estimations put away in the database and return the nearest record (facial measurements). These days, there are a great deal of face acknowledgment systems and calculations found and created far and wide. Facial acknowledgment turns into a fascinating exploration subject. It is demonstrated by various number of distributed papers related with facial acknowledgment including facial component extraction, facial calculation enhancements, and facial acknowledgment usage. Fundamental reasons for this examination are to get the best facial acknowledgment calculation (Eigen face and Fisher face) given by the Open CV 2.4.8 by contrasting the ROC (Receiver Operating Characteristics) bend and

actualize it in the participation framework as the primary contextual investigation.
In view of the tests, the ROC bend demonstrates that utilizing the present preparing set, Eigen face accomplishes preferable outcome over Fisher face. Eigen face executed inside the Attendance System returns between 70% to 90% similitude for authentic face pictures.

2.11 Face recognition: A literature survey

The paper [7] gives a modern basic overview of still-and video-based face acknowledgment inquire about. There is two hidden inspirations for composing this overview paper: the first is to give a forward-thinking survey of the current writing, and the second is to offer a few bits of knowledge into the investigations of machine acknowledgment of appearances. To give a thorough review, we order existing acknowledgment methods as well as present nitty gritty depictions of agent techniques inside every classification. What's more, important subjects, for example, psychophysical ponders, framework assessment, and issues of brightening and posture variety are secured.

Chapter 3

System Design

3.1 Architectural Design

It is the way toward comprehension the condition in which a proposed framework or frameworks will work and deciding the necessities for the framework. The info or necessities to the examination movement can emerge out of any number of partners and incorporate things, for example,

- What the framework will do when operational (the useful prerequisites)

- How well the framework will perform runtime non-utilitarian prerequisites, for example, unwavering quality, operability, execution productivity, security, similarity characterized in ISO/IEC 25010:2011 standard.
- Advancement time non-utilitarian prerequisites such as maintainability and transferability characterized in ISO 25010:2011 standard.
- Business necessities and natural settings of a framework that may change after some time, for example, legitimate, social, money related, focused, and innovation concerns.

The yields of the investigation movement are those prerequisites that measurably affect a product framework's engineering, called compositionally huge necessities.

3.1.1 Context Diagram

In the setting graph yield and contribution to the framework is characterized. In this the information is the casing perused from the webcam introduced in the PC. The yield of the framework is the rundown of the general population resembaling the essence of the individual in the edge taken from the webcam. The Figure 3.1 represent the input and output of the system.

Figure 3.1: Input and Output of the System

3.1.2 1st level DFD

The Figure 3.2 shows the detail design of the system. The whole system is divided into 5 process and a databse is used.

Frontal face detetion:- It is a PC innovation being utilized in an assortment of utilizations that recognizes human faces in computerized images.Face identification likewise alludes to the mental procedure by which people find and take care of appearances

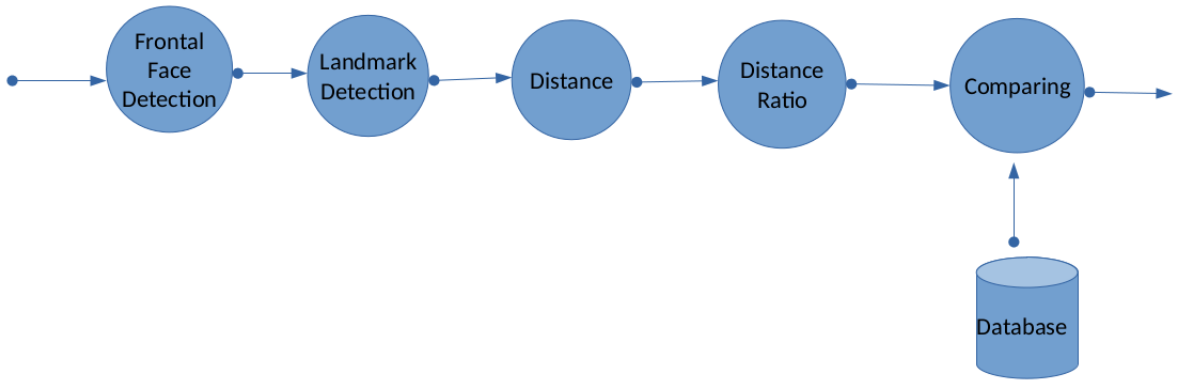

Figure 3.2: Detail study of System

in a visual scene. Face discovery can be viewed as a particular instance of article class identification. In article class recognition, the errand is to discover the areas and sizes of all items in a picture that have a place with a given class.

Models incorporate upper middles, people on foot, and vehicles. Face location calculations center around the identification of frontal human countenances. It is practically equivalent to picture identification in which the picture of an individual is coordinated a little bit at a time. Picture matches with the picture stores in database. Any facial component changes in the database will nullify the coordinating procedure. A solid face discovery approach dependent on the hereditary calculation and the eigen-face strategy. Right off the bat, the conceivable human eye locales are identified by testing all the valley areas in the dark dimension picture. At that point the hereditary calculation is utilized to produce all the conceivable face areas which incorporate the eyebrows, the iris, the nostril and the mouth corners. Every conceivable face competitor is standardized to diminish both the lightning impact, which is brought about by uneven brightening; and the shirring impact, which is because of head development. The wellness estimation of every competitor is estimated dependent on its projection on the eigen-faces. After various cycles, all the face hopefuls with a high wellness esteem are chosen for further confirmation. At this stage, the face symmetry is estimated and the presence of the diverse facial highlights is checked for each face hopeful.

In This venture I am Using the haar course calculation to identify the frontal face out of the entire picture. This will diminish the expense of calculation as we just have the face for distinguishing the milestone instead of the entire image.

Landmark identification:- Some face acknowledgment calculations recognize facial highlights by removing tourist spots, or highlights, from a picture of the subject's face. For instance, a calculation may break down the relative position, measure, or potentially state of the eyes, nose, cheekbones, what's more, jaw.These highlights are then used to

scan for different pictures with coordinating highlights. Different calculations standardize a display of face pictures and after that pack the face information, just sparing the information in the picture that is helpful for face acknowledgment. A test picture is then contrasted and the face information. One of the soonest fruitful frameworks depends on layout coordinating strategies connected to a lot of notable facial highlights, giving a kind of compacted face representation.

Acknowledgment calculations can be partitioned into two primary methodologies, geometric, which takes a gander at recognizing highlights, or photometric, which is a factual methodology that distils a picture into qualities and contrasts the qualities and formats to wipe out fluctuations. Some characterize these calculations into two general classifications: comprehensive and highlight based models. The previous endeavors to perceive the face completely while the element based subdivide into segments, for example, as per includes and examine each just as its spatial area as for different highlights. Well known acknowledgment calculations incorporate main segment examination utilizing eigenfaces, straight discriminant investigation, versatile bundle chart coordinating utilizing the Fisherface calculation, the shrouded Markov model, the multilinear subspace getting the hang of utilizing tensor portrayal, and the neuronal persuaded dynamic connection coordinating. A CNN model is trained to identify the 4 landmarks (left eye, right eye, nose, and mouth).

Distance between landmark Every human being has a different distance between the landmark which plays a major role in identifying the person. So the distance between the landmark is calculated.

Distance:- In mathematics, the Euclidean distance or Euclidean metric is the "ordinary" straight-line distancebetween two points in Euclidean space. With this distance, Euclidean space becomes a metric space. The distance between the two point x and y is the equation 3.1.

$$d = \sqrt{(x1-x2) + (y1-y2)} \tag{3.1}$$

Where:

d = Distance
$(x1, y1)$ = Coordinate of first landmark
$(x2, y2)$ = Coordinate of second landmark

Creating a vector of distance ratio:- The number of landmark are 4 and lengths of the vector will be 4X3 = 12. The ratio of distance with the size of the image

is used to create the vector.

Comparing the stored distance ratio with the query vector:- Cosine comparability a proportion of likeness between two non-zero vectors of an internal item space that estimates the cosine of the edge between them. The cosine of 0° is 1, and it is under 1 for any edge in the interim (0,] radians. It is in this manner a judgment of introduction and not extent: two vectors with a similar introduction have a cosine likeness of 1, two vectors situated at 90° in respect to one another have a closeness of 0, and two vectors oppositely restricted have a comparability of - 1, free of their greatness. The cosine closeness is especially utilized in positive space, where the result is conveniently limited in. The name gets from the expression "heading cosine": in this case,unit vectors are maximally "comparative" on the off chance that they're parallel and maximally "divergent" on the off chance that they're symmetrical (perpendicular).

This is practically equivalent to the cosine, which is solidarity (greatest esteem) when the fragments subtend a zero edge and zero (uncorrelated) when the sections are opposite. These limits apply for any number of measurements, and the cosine comparability is most ordinarily utilized in high-dimensional positive spaces.

For instance, in data recovery and content mining, each term is notionally alloted an alternate measurement and an archive is described by a vector where the incentive in each measurement relates to the occasions the term shows up in the report. Cosine comparability at that point gives a valuable proportion of how comparable two archives are likely to be regarding their topic. The system is additionally used to quantify attachment inside groups in the field of information mining. The inquiry vector is then contrasted and the put away vector as a portrayal vector amid enrolment. Cosine similitude is utilized and the rank rundown of the match is shown alongside the certainty. The cosine of two non-zero vectors can be determined by utilizing the Euclidean dab item recipe appeared in condition 3.2.

$$A \cdot B = ||A||||B||cos(\theta) \tag{3.2}$$

Where:

A = First Vector
B = Second Vector
θ = Angle between A and B

Given two vectors of attributes, A and B, the cosine similarity,cos( ) is represented using a dot product and magnitude as where and are components of vector and

respectively as shown in Equation 3.3.

$$similarity = cos(\theta) = \frac{A \cdot B}{||A||||B||} = \frac{\sum_{i=1}^{n} A_i \cdot B_i}{\sqrt{\sum_{i=1}^{n} A_i}\sqrt{\sum_{i=1}^{n} B_i}} \tag{3.3}$$

Where:

A = First Vector
B = Second Vector
θ = Angle between A and B
n = Length of Vector

The subsequent comparability ranges from -1 meaning precisely inverse, to 1 meaning precisely the equivalent, with 0 demonstrating symmetry or decorrelation, while in the middle of qualities show transitional closeness or disparity. For content coordinating, the trait vectors An and B are generally the term recurrence vectors of the documents.
Cosine likeness can be viewed as a technique for normalizing archive length amid examination. On account of data recovery, the cosine closeness of two archives will run from 0 to 1, since the term frequencies (utilizing tf– idf loads) can't be negative. The point between two term recurrence vectors can't be more noteworthy than 90°.

3.2 Control Flow

In this area, the control stream diagram(3.3) demonstrating the progression of the information. In the event of camera, there are two possibality that the camera is free and doled out for the work. The camera maynot be free and it isn't relegated for the work. If there should arise an occurrence of genuine the edge recorded is passed to next dimension. In any case, if there should be an occurrence of disappointment the camera module run

iteratively. In Face recognition, there are two possiblity that the frontal face is available or not. In the event of nonattendance the face discovery move the control back to the camera and if there should be an occurrence of quality the control is passed to the Landmark recognition. In the event of milestone identification there is again two

possibilty nearness and nonappearance of milestone. In the event of nonattendance, the control is once more

offered back to the camera. If there should be an occurrence of essence the diastance is determined and control is given to the examination. If there should arise an occurrence of likeness module the examination is made with put away vector and the inquiry vector. The rank rundown is obtanied for the given individual. The framework continue back to the camera once it has executed every one of the means succesfully.

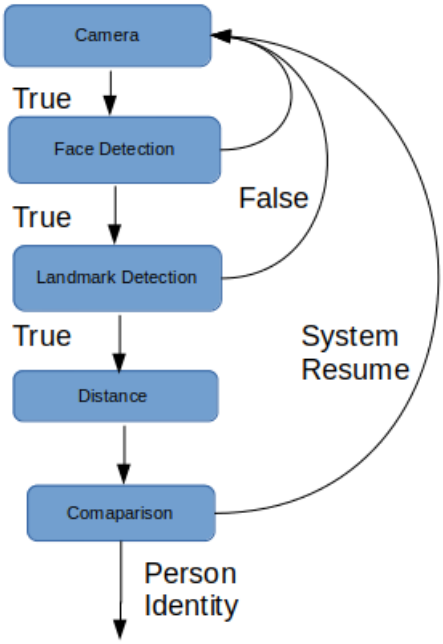

Figure 3.3: Control Flow of the System

3.3 Physical design

3.3.1 Input requirement

The input to the system is the image consisting the person to be idntified. In this case a live feed is taken from the webcam. The video frame is then analysed frame by frame.

3.3.2 Output requirements

The Program will be run from Command Line and the Output will be shown in the terminal and the Video stream will be shown along side. The output is shown in Appendix A.

3.3.3 Storage requirements

The Database is used to store the Vector obtained for the student during enrollment. The database used is PgSQL which is one of the relational database and it is open source. The database will consist of the single table with 13 columns. There are 16 feature columns and roll no(Primary key) columns. The ER diagram is shown in Figure 3.4.

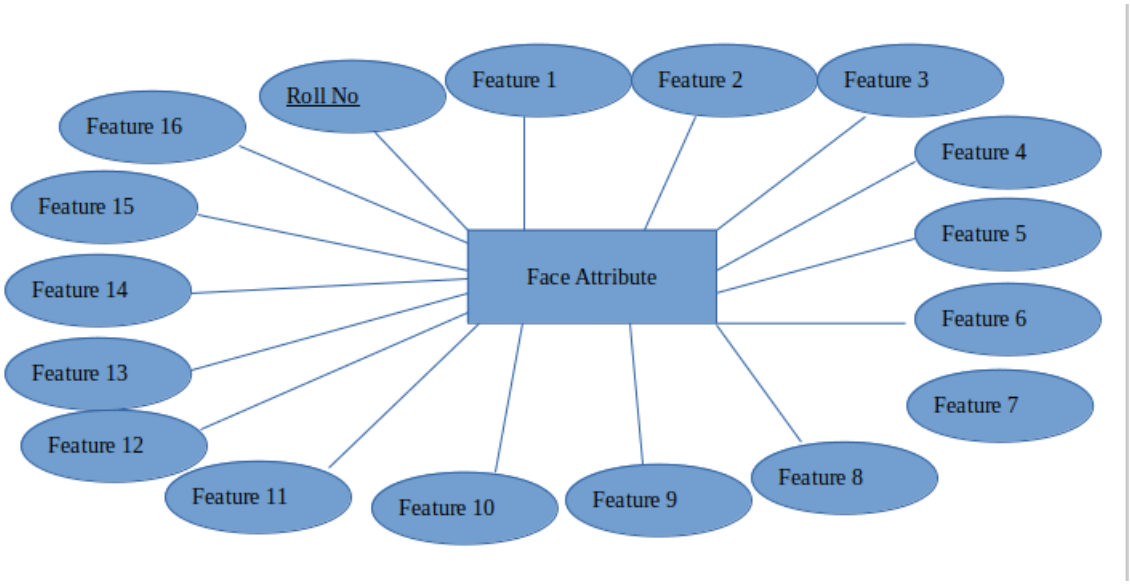

Figure 3.4: Output interface

3.3.4 Processing requirements

The system is build with the help of Neural Network. For Neural Network tensorflow is installed on GeForce 940MX GPU. The preparing should be possible on cpu however the framework won't that quick. The Nvidia GeForce 940MX is a mid range workstation designs card with DirectX support. It has been announched in the first quater of 2016 and is the invigorate of the GeForce 940M contrasted with the more seasoned card. This card depends on same chip however at this point bolsters quicker GDDR5.

3.4 Dataset

A dataset is from kaggle[1] named face-images-with-marked-landmark-points is downloaded and analyzed. The dataset consist of 7049 frontal face images each of dimension 96X96. The dataset contains 7049 facial images and up to 15 keypoints marked on them.
The keypoints are in the facial-keypoints.csv file. The image are in the face-images.npz file. The graph representing the number of marked landmark in dataset. From the Figure 3.5 we can find that the 4 landmark are present on all the images. So four landmark are selected.

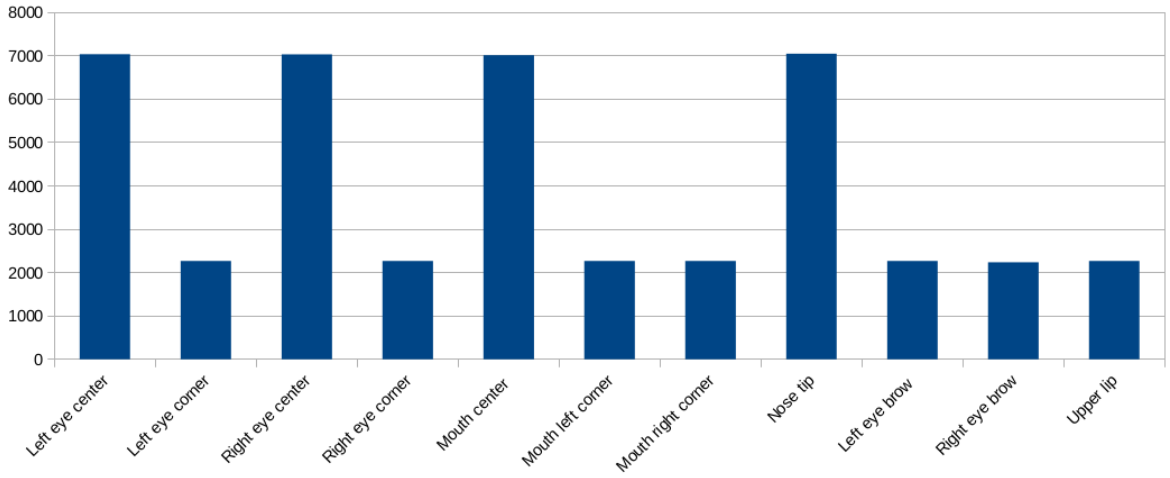

Figure 3.5: Data Visulization

3.5 Neural Network Architecture

First layer is the convlution layer of the measurement 32X3X3. Here the kernal measure chose is 3X3. It is trailed by the maximum pooling layer of part estimate 2X2. Next is droupout layer which droupout 25% of the maxpooling layer result. Smooth layer is accustomed to carry 2d cluster into the 1d exhibit comprising every one of the highlights. It is followd by thick layer comprising 256 hub. We cannot acquire the outcome fron these 256 hub so they are again decreased to the 8 hub with the middle of the road layer in the middle. The intermedate layer is droupout layer of 50%.

[1]https://www.kaggle.com/drgilermo/face-images-with-marked-landmark-points

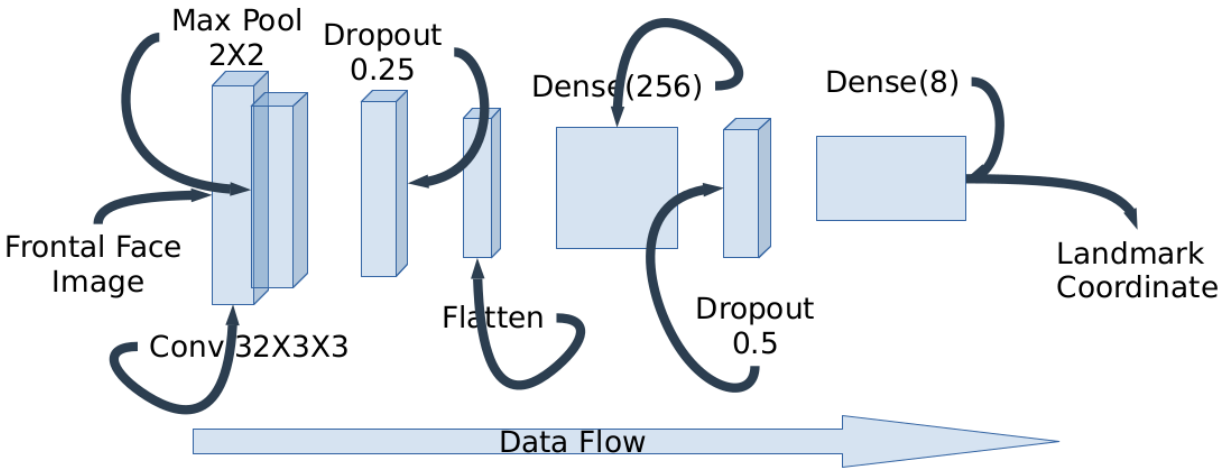

Figure 3.6: Convulation Neural Network Architecture for Landmark detection

3.5.1 Convulation Layer

The quantity of yield channels in the convolution layer is 32. The tallness and width of the 2D convolution window chose is 3X3. This layer makes a convolution portion that is convolved with the layer contribution over a solitary spatial (or fleeting) measurement to create a tensor of yields. Amid the forward pass, we slide (all the more definitely, convolve) each channel over the width and stature of the information volume and process dab items between the sections of the channel and the contribution at any position. As we slide the channel over the width and stature of the information volume we will deliver a 2-dimensional initiation map that gives the reactions of that channel at each spatial position. Instinctively, the system will learn channels that initiate when they see some sort of visual component, for example, an edge of some introduction or a smudge of some shading on the primary layer, or in the long run whole honeycomb or wheel-like examples on higher layers of the system.

3.5.2 Pooling Layer

Max pooling activity for transient information. Pooling layers decrease the elements of the information by joining the yields of neuron groups at one layer into a solitary neuron in the following layer. Neighborhood pooling consolidates little bunches, regularly 2 x 2(will divide the information). Furthermore, pooling may figure a maximum or a normal. Max pooling utilizes the greatest incentive from every one of a bunch of neurons at the

earlier layer. Normal pooling utilizes the normal incentive from every one of a bunch of neurons at the earlier layer.

3.5.3 Dropout Layer

Dropout comprises in haphazardly setting a division rate of information units to 0 at each update amid preparing time, which avoids overfitting. In first dropout layer the info is droped at the rate of 25%. In the second layer the info is droped at the rate of 50%.

3.5.4 Flatten Layer

On the off chance that inputs are formed (bunch,) without a channel measurement, at that point straightening includes an additional channel measurement and yield shapes are (cluster, 1). In this the yield of the Dropout layer is flaten to the single vector.

3.5.5 Dense Layer

A thick layer is only a standard layer of neurons in a neural system. Every neuron recieves contribution from every one of the neurons in the past layer, along these lines thickly associated. The layer has a weight lattice W, an inclination vector b, and the enactments of past layer a. A thick layer speaks to a framework vector increase. The qualities in the framework are the trainable parameters which get refreshed amid backpropagation. The yield of the principal Dense layer is of shape (*, 256). The yield of the Second Dense Layer is of shape (*, 8).

Chapter 4

Coding & Implementation

4.1 Introduction

There are some challenges faced by the development team while implementing the software. Some of them are mentioned below:

Code-reuse Programming interfaces of present-day languages are very sophisticated and are equipped huge library functions. Still, to bring the cost down of end product, the organization management prefers to re-use the code, which was created earlier for some other software. There are huge issues faced by programmers for compatibility checks and deciding how much code to re-use.

4.2 Code used for Training the CNN

```
model = Sequential()
model.add(Conv2D(32, (3, 3), padding = 'same',
activation='tanh', input_shape=(Spic, Spic,1)))

model.add(MaxPool2D(pool_size=(2, 2)))
model.add(Dropout(0.25))
model.add(Flatten())
model.add(Dense(256, activation='tanh'))
model.add(Dropout(0.5))
model.add(Dense(8, activation='sigmoid'))

sgd = SGD(lr=0.1, decay=1e-6, momentum=0.9, nesterov=True)
model.compile(loss='mean_squared_error', optimizer=sgd)

model.fit(Xtrain, Ytrain, batch_size=128, epochs=10,
validation_data = (Xtest, Ytest), verbose = 1)
```

This part of the code is used to design a CNN of particular Architecture describe in System Design. A sequential model is used and keras frame work is used to design the network. This will return the trained model and it is saved in ".hd5" extension. The trained model is then used for predicting the new upcoming frame.

4.3 Code used for Testing the Model

```
Ytrain_pred = model.predict(Xtrain)
Ytest_pred = model.predict(Xtest)


n = 0
nrows = 4
ncols = 4
irand=np.random.choice(Ytest.shape[0],nrows*ncols)
fig, ax = plt.subplots(nrows,ncols,sharex=True,sharey=True,figsiz
for row in range(nrows):
for col in range(ncols):
ax[row,col].imshow(Xtest[irand[n],:,:,0], cmap='gray')
ax[row,col].scatter(Ytest[irand[n],0::2]*Spic,Ytest[irand[n],1::2
ax[row,col].scatter(Ytest_pred[irand[n],0::2]*Spic,Ytest_pred[ira
ax[row,col].set_xticks(())
ax[row,col].set_yticks(())
ax[row,col].set_title('image index = %d' %(irand[n]),fontsize=10)
n += 1
plt.suptitle('x: Manual; + : CNN', fontsize=16)
```

This protion is used to check the model on the landmark image dataset. This is used to check the proper working of the model.

4.4 For generating a feature vector during Enrollment

```
filename = os.listdir("list")
model = load_model('landmark_model.h5')
for f in filename:
print f
img = cv2.imread("test.png",0)
fr=np.zeros((1,96,96,1))
gray = cv2.resize(img,(96,96))
fr[0,:,:,0]=gray[:,:]/255.0
pre = model.predict(fr)[0]
```

```
for i in range(0,len(pre),2):
cv2.circle(fr[0],(int(pre[i]*96),int(pre[i+1]*96)), 4,
(0,0,255), -1)

dist = []
i = 0
pts = []
while i < len(pre):
pts.append([pre[i],pre[i+1]])
i+=2
for item in pts:
j = 0
while j <len(pts):
dist.append(math.hypot(item[0]-pts[j][0],
item[1]-pts[j][1]))

j+=1
dist.append(f.split(".")[0])
dis = [dist]
my_df = pd.DataFrame(dis)
my_df.to_csv('data.csv', mode='a',index=False, header=False)
cv2.imshow('img',fr[0])
cv2.waitKey(0)
break
```

This portion of code is used to make the feature vector of the newly enrolled students. The trained model is loaded in this and executed on the new image which will give the 4 landmark. The distance ratio is used to make the feature vector out of it.

4.5 Code for Invoking the System

```
rol =[16010107,16010108,16010112,16010104,16010114,
16010116,16010223,16010103,16010101,16010111,16010124,
16010121,16010105,16010106,16010122,16010125,16010118,
16010117, 16010120,16010113,16010119,16010102,16010115]

face_cascade = cv2.CascadeClassifier('haarcascade_
```

```
frontalface_default.xml')

while(True):
ret, frame = cap.read()
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
faces = face_cascade.detectMultiScale(gray, 1.3, 5)
for (x,y,w,h) in faces:
fr=np.zeros((1,96,96,1))
cv2.rectangle(gray,(x,y),(x+w,y+h),(255,0,0),2)
roi_gray = gray[y:y+h, x:x+w]
roi_gray = cv2.resize(roi_gray,(96,96))
fr[0,:,:,0]=roi_gray[:,:]/255.0
cv2.imwrite("test.png",roi_gray)
pre = model.predict(fr)[0]
dist = []
i = 0
pts = []
while i < len(pre):
pts.append([pre[i],pre[i+1]])
i+=2
for item in pts:
j = 0
while j <len(pts):
dist.append(math.hypot(item[0]-pts[j][0], item[1]-pts[j][1]))
j+=1

sim = {}
for i in range(0,len(rol)):
cur.execute("SELECT * FROM persons where roll ="+str(rol[i]))
data = cur.fetchone()[0:16]
q = []
for x in data:
q.append(x)
#print q
sim[rol[i]]=cosine_similarity(q,dist)
#print "Operation done successfully";
sorted_x = sorted(sim.items(), key=operator.itemgetter(1))
```

```
print sorted_x[18:23]
```

This portion of the code will start the webcam and do all the preprocessing on each frame require. Haar-cascade classifer will be run on the frame and frontal face will be detected. The tranied CNN model is used to identify the landmark. A connection with the database is established and the cosine simalrity is found with each other. Top 7 rank of student matching the student is displayed.

4.6 Command used to create and insert data into table

```
CREATE TABLE persons(f1 REAL, f2 REAL, f3 REAL,
f4 REAL, f5 REAL, f6 REAL, f7 REAL, f8 REAL, f9 REAL,
f10 REAL, f11 REAL, f12 REAL, f13 REAL, f14 REAL,
f15 REAL, f16 REAL, roll INT PRIMARY KEY);
COPY persons(f1, f2, f3, f4, f5, f6, f7, f8, f9,
f10, f11, f12, f13, f14, f15, f16, roll) FROM
'/home/raghav/project/data.csv/' DELIMITER ',' CSV HEADER;
```

This will create a table name persons in the PgSQL database. It will dump the feature vector file named "data.csv" into the table.

4.7 Code to calculate Cosine Simalrity

```
def cosine_similarity(v1,v2):
"compute cosine similarity of v1 to v2: (v1 dot v2)/{||v1||*||v2|
sumxx, sumxy, sumyy = 0, 0, 0
for i in range(len(v1)):
x = v1[i]; y = v2[i]
sumxx += x*x
sumyy += y*y
sumxy += x*y
return sumxy/math.sqrt(sumxx*sumyy)
```

This function is used to implement the cosine simalarity between the 2 vector and result will be returned.

Chapter 5

System Evaluation

5.1 Introduction

The testing period of the product improvement lifecycle (SDLC) is the place you center around examination and disclosure. Amid the testing stage, designers see if their code and programming work as indicated by client necessities. And keeping in mind that it's most certainly not conceivable to settle every one of the disappointments you may discover amid the testing stage, it is conceivable to utilize the outcomes from this stage to lessen the quantity of blunders inside the product program.
Before testing can start, the undertaking group builds up a test plan. The test plan incorporates the kinds of testing you'll be utilizing, assets for testing, how the product will be tried, who ought to be the analyzers amid each stage, and test contents, which are guidelines each analyzer uses to test the product. Test contents guarantee consistency

while testing

5.2 Convulation Neural Network

Layer (type)	Output Shape	Param
conv2d_1 (Conv2D)	(None, 96, 96, 32)	320
max_pooling2d_1 (MaxPooling2d)	(None, 48, 48, 32)	0
dropout_1 (Dropout)	(None, 48, 48, 32)	0
flatten_1 (Flatten)	(None, 73728)	0
dense_1 (Dense)	(None, 256)	18874624
dropout_2 (Dropout)	(None, 256)	0
dense_2 (Dense)	(None, 8)	2056

Table 5.1: Network Summary

The Table 5.1 represent the summary of each layer that was trained. We can see that output of gradually decreased to 8.**Total params: 18,877,000, Trainable params: 18,877,000, Non-trainable params: 0**

5.3 Face Recognition

In the table 5.1 the rank of top 7 student who are matching the query image is shown. The underline Roll number represnt the rank and matching roll number.

Table 5.1: Face Recognition system Evaluation

Predicted Rank list	**16010115**	**16010111**	**16010107**	**16010113**	**16010122**	**16010125**	**16010118**	**16010117**	**16010104**
	16010104	16010122	16010104	16010113	16010104	16010125	16010107	16010117	16010115
	16010124	16010113	16010107	16010115	16010115	16010124	16010114	16010118	16010122
	16010115	16010117	16010115	16010117	16010104	16010114	16010117	16010115	16010125
	16010114	16010115	16010124	16010101	16010114	16010101	16010122	16010122	16010118
	16010107	16010118	16010101	16010104	16010125	16010117	16010125	16010125	16010104
	16010122	16010104	16010117	16010124	16010122	16010122	16010113	16010124	16010101
	16010125	16010101	16010125	16010125	16010124	16010115	16010118	16010104	16010114

Chapter 6

Conclusion

The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with automatic frontal face detection and automatic face recognition did not have a recognition accuracy over 90%, due to the limited number of Landmark that were chosen because of the dataset. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate.The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area.

The fully automated face detection and recognition system was not robust enough to

achieve a high recognition accuracy. The main explanation behind this was the face acknowledgment subsystem did not show even a slight level of invariance to scale, pivot or move mistakes of the sectioned face picture. This was one of the framework necessities. In any case, on the off chance that some kind of further preparing, for example, a more milestone discovery system, was actualized to additionally standardize the fragmented face picture, execution will increment to levels practically identical to the manual face discovery and acknowledgment framework. Executing a more milestone identification strategy would be a minor augmentation to the actualized framework and would not require a lot of extra research.

All other actualized frameworks showed excellent outcomes and think about well the deformable format and Principal Component Analysis systems. The most reasonable certifiable applications for face identification and acknowledgment frameworks are for mugshot coordinating and reconnaissance. There are better systems, for example, iris or retina acknowledgment and face acknowledgment utilizing the warm range for client access and client check applications since these need an exceptionally high level of precision.

The actualized completely mechanized face identification and acknowledgment framework (with an eye recognition framework) could be utilized for straightforward observation applications, for example, ATM client security, while the actualized manual face identification and mechanized acknowledgment framework is perfect of mugshot coordinating. Since controlled conditions are available when mugshots are accumulated, the frontal view face acknowledgment plan should show an acknowledgment exactness much better than the outcomes, which were acquired in this investigation, which was directed under antagonistic conditions. Moreover, huge numbers of the guineas pigs did not present a dull, frontal view to the framework. They would presumably be increasingly consistent when a 6'5" policeman is taking their mugshot! In mugshot coordinating applications, flawless acknowledgment exactness or a precise match isn't a necessity.

On the off chance that a face acknowledgment framework can diminish the number of pictures that a human administrator needs to scan through for a match from 10000 to even a 100, it would be of extraordinary reasonable use in law authorization. The computerized vision frameworks executed in this theory did not approach the execution, nor were they as strong as a human's intrinsic face acknowledgment framework. In any case, they give a knowledge into what the future may hold in PC vision.

6.1 Future direction

The dataset used have only 4 landmark marked in 7000 images. The dataset can be improved by marking more number of the images. This will increase the number of feature and offcourse the accuracy will increase. Template Matching and Landmark detection can be used sequentially and can also lead to increase in the accuracy. If we reduce the number of image in which the person to be looked then we can perform the template matching and find the person out of it.

Appendix A

Screenshot and Description of the Implemented System

A.1 Creating vector during Enrollment

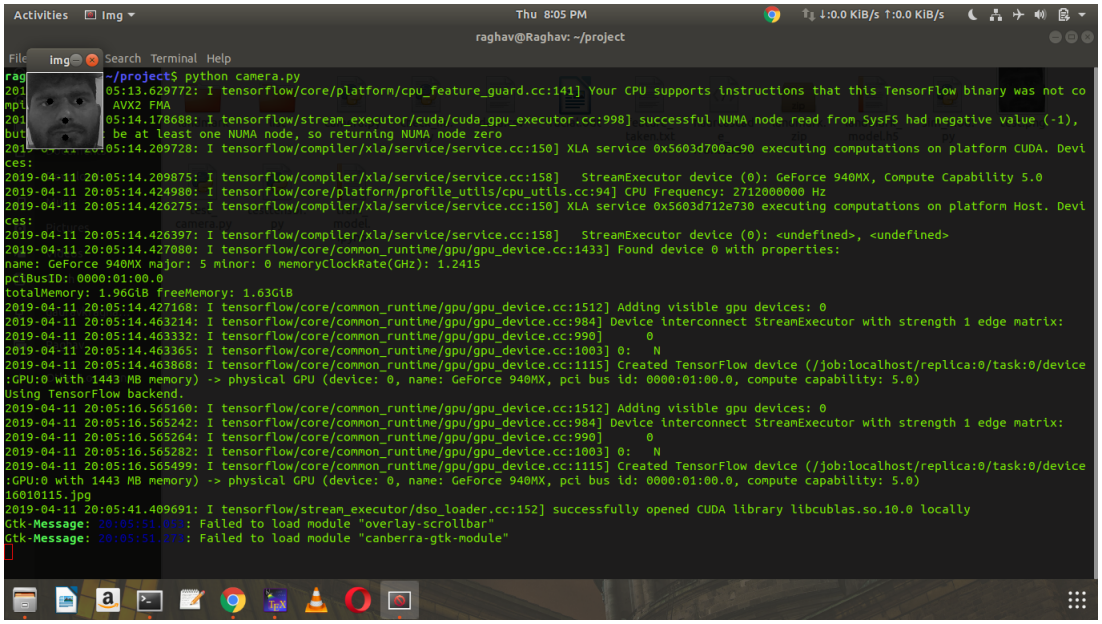

Figure A.1: Creating vector for 16010115

In the Figure A.1 we can see the four landmark are detected and shown in the image at the left most corner. Another example is also shown in Figure A.2.

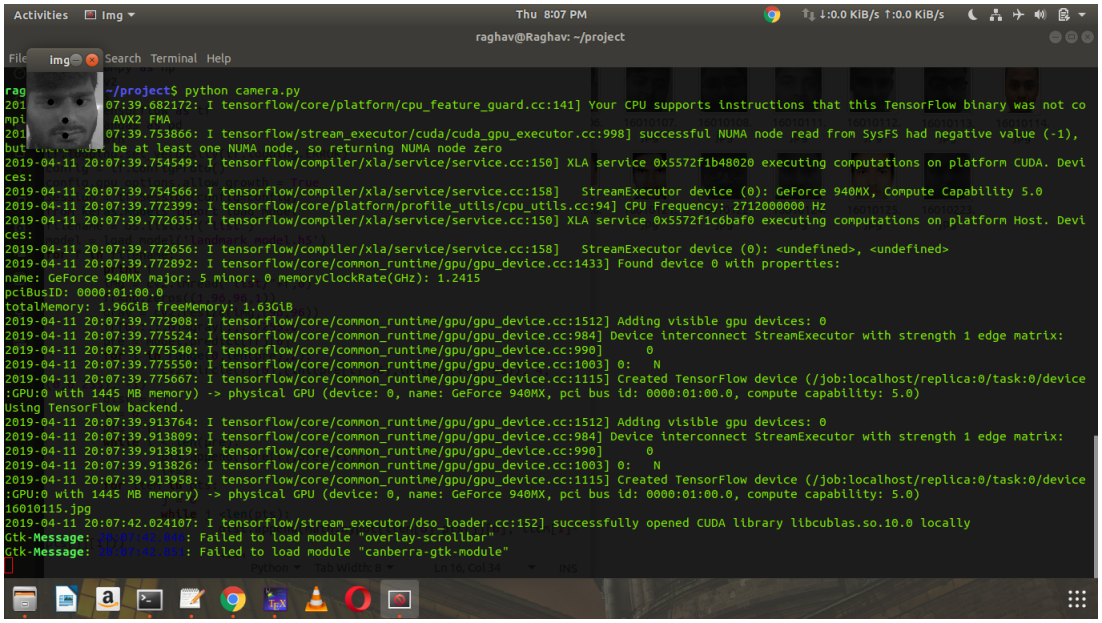

Figure A.2: Another Example Creating vector for 16010115

A.2 Pgsql Screen shot

The Figure A.3 shows the number of column and the value in each column. There are 16 feature column of REAL data type. There is a primary key called as roll.

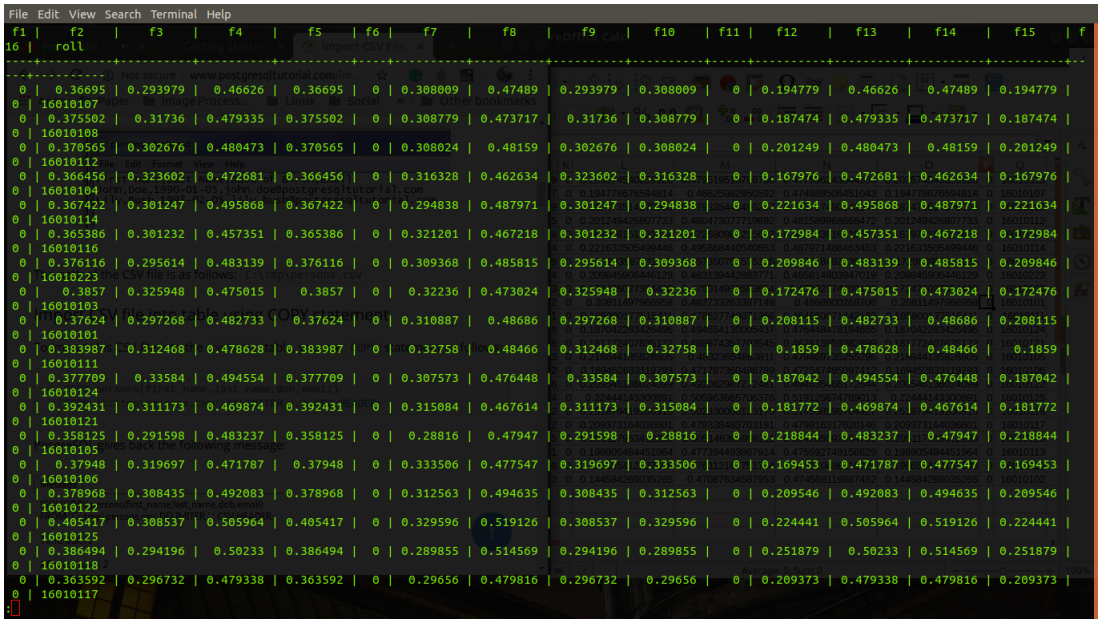

Figure A.3: Database table Screenshot

A.3 Working of Face Recognition System

In the Figure A.4, we can see that frontal face is identified and the top 7 student is shown in the terminal. The confidence level given along with the roll number in tuple format.

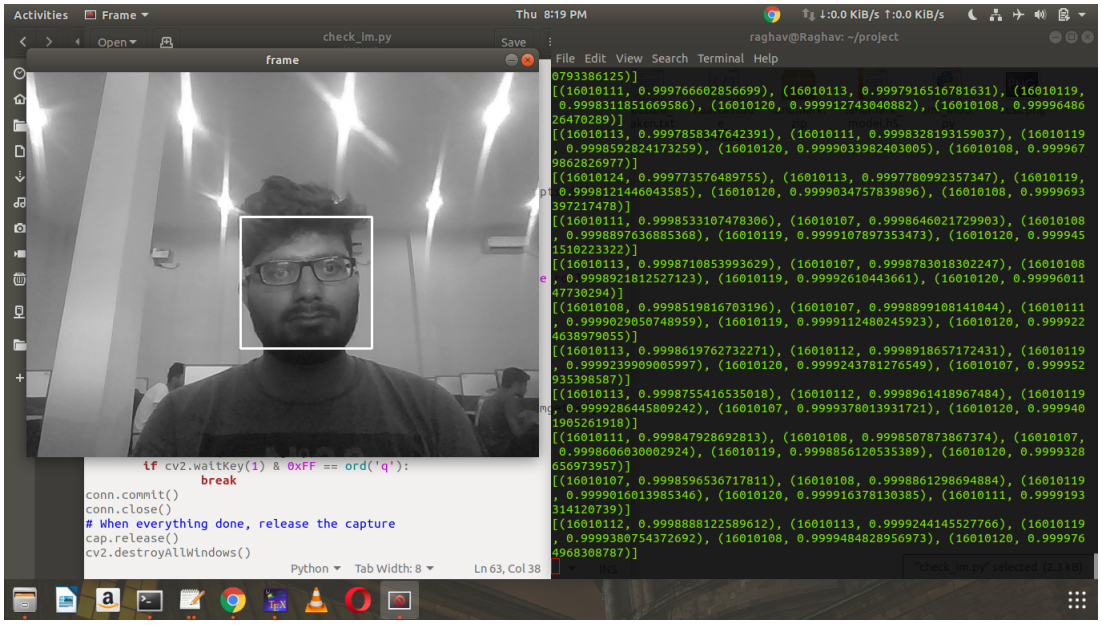

Figure A.4: Face Recognition System

Appendix B

User manual

B.1 Step to install your implemented system

- update the system
- upgrade the system
- install the CMAKE with suffient dependency
- install the cuda for suport of NVIDIA GPU
- install the machine learning library
- setup the necessary the library path
- install libprotobuf, protobuf, opencv on system
- install the tensorflow on gpu along with the keras
- run the file name check_name.py

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