A Project/Dissertation Final Review Report

on

FACE DETECTION AND ROBOT INTERACTION

Submitted in partial fulfilment of the
requirement for the award of the degree of

Bachelor of Technology(CSE)

Under The Supervision of
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled **"Face Detection and Robotic Interaction "**in partial fulfilment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING** submitted in the **School of Computing Science and Engineering** of Galgotias University, Greater Noida, is an original work carried out during the period of month, **JULY-2021 to DECEMBER-2021**, under the supervision of **Mr. Ravinder Ahuja, Assistant Professor, Department of Computer Science and Engineering** of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

Aditya Kumar, 18SCSE1010699

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor

(Mr. Ravinder Ahuja , Assistant Professor)

CERTIFICATE

The Final Project Viva-Voce examination of **Aditya Kumar: 18SCSE1010699, Akash Vishwakarma : 18SCSE1010657** has been held on _____ and his/her work is recommended for the award of **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING.**

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date:

Place:

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The success and final outcome of this project required a lot of guidance and assistance from many people and I am extremely privileged to have got this all along the completion of my project. All that I have done is only due to such supervision and assistance and I would not forget to thank them.

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Abstract

The field of human-robot interaction (HRI) addresses the design, understanding, and evaluation of robotic systems, which involve humans and robots interacting through communication. Artificial Intelligence Markup Language (AIML) is derived from Extensible Markup Language (XML) which is used to build up conversational agent artificially. As the field matures, education of students becomes increasingly important. Courses in HRI provide the canonical set of knowledge and core skills that represent the current state of the field and permit the evolution of knowledge and methods to be transferred from research to a broad set of students. Furthermore, HRI coursework creates a workforce willing to pass the theory of HRI to reality. However, HRI courses are mostly ad hoc, as would be anticipated for an emerging sector. This article summarizes the discussion and results from the workshop on the creation of an HRI course for computer scientists and engineers, Educating Humans About Human-Robot Interaction. A lot of work has been done to create a conversational agent. But in different applications, low cost, configuration and availability make it possible to use it. Cultural heritage, e-learning, e-government, interaction platform, humorist expert, network management, adaptive modular architecture are all related to these applications. There are developed a lot of works to make conversational agent. But low cost, configuration and availability make possible to use it in various applications. They are not only providing useful services but also interact with customers and give solution of their problems. We draw a careful conclusion that people interact differently with systems that show human-like attitudes, then they would in response to similar attitude expressed by other person. These findings need to be investigated further with dominant/submissive nonverbal behaviors that are then simulated on a humanoid robot.

Keywords:
Robotic, Machine Learning, Conversation.

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Acronyms :

AI	Artificial Intelligence
ML	Machine Learning
OpenCV	Open source Computer Vision Library
Pycham	Code editor

CHAPTER 1

INTRODUCTION

The purpose of this research is to develop an efficient face recognition system for real-time applications.

The face is our primary focus of attention in social life playing an important role in conveying identity and emotions. We can understand a number of faces found out at some point of our lifespan and pick out faces at a glance even after years of separation. This talent is pretty robust regardless of-of massive variations in visual stimulus due to converting circumstance, ageing and distractions inclusive of beard, glasses or modifications in coiffure.

Face popularity is an intrinsic part of the human visible perception and truly considered one of our core abilities. Imagine searching for a portrait photograph of yourself without noticing that it is you in the picture. Even worse, in your daily lifestyles you meet familiar humans and spot faces day in, day trip absent of the capability to apprehend these without different to be had cues as voice, coiffure, gait, clothes and context information. In the human brain, there are dedicated regions that offer us our awesome face popularity capabilities.

CHAPTER-2

Literature review

Research into human-robot interaction, the use of robots as tools, robots as guides and assistants, as well as the progress being made in the development of humanoid robots, are all examined. Finally, a variety of efforts to use robots in collaboration are examined and analysed in the context of the human-human model presented. The simplest way robots can be used is as tools to aid in the completion of physical tasks. Although there are many examples of robots used in this manner, a few examples are given that benefit from human-robot interaction. For example, to increase the success rate of harvesting, a human-robot collaborative system was implemented for testing by (Bechar and Edan 2003). Results indicated that a human operator working with a robotic system with varying levels of autonomy resulted in improved harvesting of melons. Depending on the complexity of the harvesting environment, varying the level of autonomy of the robotic harvester increased positive detection rates in the amount of 4.5% – 7% from the human operator alone and as much as 20% compared to autonomous robot detection alone. Robots are often used for hazardous tasks. For instance, the placement of radioactive waste in centralized intermediate storage is best completed by robots as opposed to humans (Tsoukalas and Bargiotas 1996). Robotic completion of this task in a totally autonomous fashion is desirable but not yet obtainable due to the dynamic operating conditions. Radiation surveys are completed initially through teleoperation, the learned task is then put into the robots repertoire so the next time the task is to be completed the robot will not need instruction. A dynamic control scheme is needed so that the operator can observe the robot as it completes its task and when the robot needs help the operator can intervene and assist with execution. In a similar manner, Ishikawa and Suzuki (Ishikawa and Suzuki 1997) developed a system to patrol a nuclear power plant. Under normal operation the robot is able to work autonomously, however in abnormal situations the human must intervene to make decisions on the robots behalf. In this manner the system has the ability to cope with unexpected events.

Who uses facial recognition software?

Companies like Mastercard are already using FRS as an identifier during payments and for building security. FRS has potential uses in retail, the hospitality sector, banks, ATMs, and airports. Mobile commerce-oriented companies will benefit largely from FRS. Marketing firms are looking into using FRS for personalized customer service.

For example, some ecommerce businesses selling eyewear are working on using FRS to recommend glasses that look good for your facial structure. This negates the need to visit a store to try them on. Today's most significant use cases of FRS, however, lie in security.

How does facial recognition software work?

Any good FRS has three key components:
Hardware to capture the images. These images can also be fed into the software from independent devices.
Intelligence to compare the captured faces with existing data.
Database, i.e., an existing collection of identities. These can be anything from employee databases to images scrubbed from social media. *(Please note that scrubbed social media images are unethical.)*

Detection: Detection begins with the extraction of the face out of the image fed into the system. Subsequently, various features on the human face are marked. Certain features of the face do not change with age or size. These include the distance between the eyes, the depth of the eye socket, and the shape of the nose. There are around 80 such features called ‘landmarks.’ The measurements of these landmarks are then put together to create a code. This code is called a ‘faceprint,’ and it is unique to every person.

Matching: This faceprint is then matched with the prints stored in the system. At this stage, the image goes through several layers of technology to ensure accuracy. Since most of our databases are currently 2D photos, the database images need to be processed by a layer of technology. This processing usually involves pulling out the facial landmarks to resemble their 3D counterparts. If the subject image is low resolution, it must be encoded and decoded to produce details with the desired resolution. The algorithms need to consider the differences in lighting, facial expression, and angles.

Identification: The goal of this step depends on what the facial recognition software is used for — surveillance or authencation. This step should ideally produce a 1:1 match for the subject. This may be done in multiple ways, a quick pass to narrow down the options, then enable the more complex layers to take over. Some companies analyze skin texture along with facial recognition algorithms to increase accuracy.
Each facial recognition software provider focuses on different aspects of the technology layers to provide almost-flawless service. For example, one software may focus on correcting lighting conditions while another can focus on skin texture analysis.

CHAPTER-3

Problem Formulation

Higher Maintenance and Installation Costs

Unlike digital and software-based automation which may be setup with minimal overhead, making the switch from a conventional workforce to a robotic one often entails considerable expense. While commercial and industrial-grade equipment will no doubt fall in price as it becomes more commonplace, the total costs needed to bring automation into a working environment continues to create obstacles for smaller organizations and those that have only limited financial resources. Purchase, installation and long-term upkeep costs are all something that employers and business owners would do well to consider carefully prior to investing in the resources needed to automate even small-scale workflow processes.

Enhanced Risk of Data Breach and Other Cybersecurity Issues

Replacing conventional workers with software applications or equipment that may be accessed wirelessly may result in an increased risk of a data breach. Enhanced automation is not without risk and businesses that utilize smart-devices and computer controlled equipment to manage or perform the bulk of their operations and workflow can often become an inviting target. While new digital technologies that will be able to address security concerns will continue to be developed, businesses that elect to automate without addressing safety concerns and those who fail to make digital security a top priority could be making a costly misstep.

Reduced Flexibility

While a robotic workforce may have vastly improved efficiency, enhanced productivity is not without its cost. Automated equipment is often very limited in terms of its scope of use and businesses that need to quickly respond to changing circumstances or new developments may find themselves at a real disadvantage. While employees may be able to shift their focus and attention without issue, an automated workflow process may be little more than a liability should change occur too quickly.

Occlusion

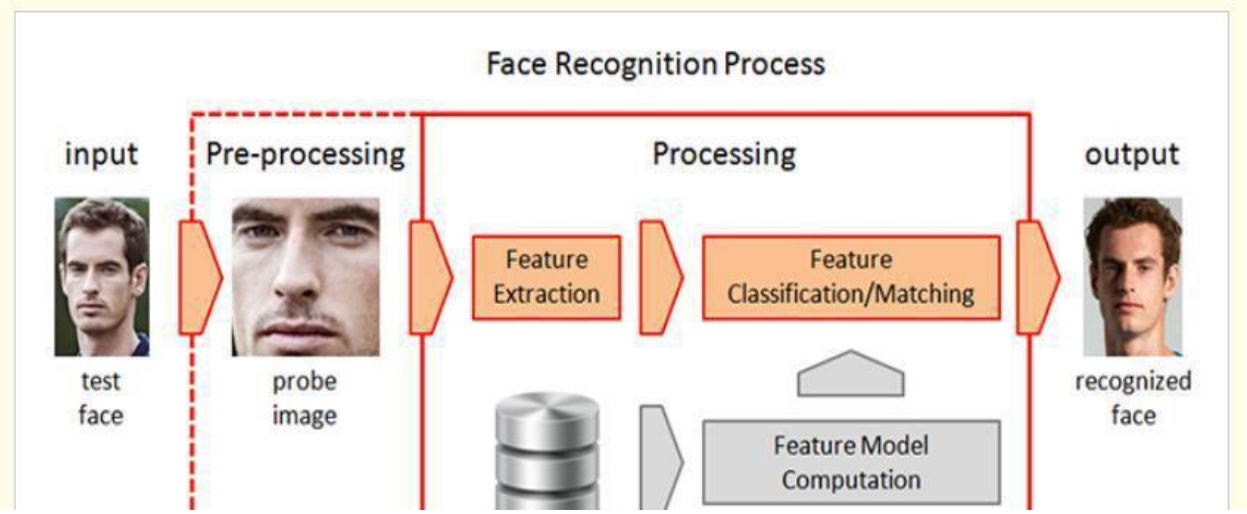
Occlusion implies blockage, and it happens when one or different pieces of the face are hindered and entire face isn't accessible as an information picture. Impediment is viewed as one of the most basic difficulties in face acknowledgment framework.
It happens because of facial hair, mustache, adornments (goggle, cap, cover, and so on), and it is common in true situation. The presence of such parts makes the subject assorted and consequently making computerized face acknowledgment measure a difficult one to figure out.

Model Complexity

An ideal face acknowledgment framework ought to be open minded toward varieties in enlightenment, appearance, posture, and impediment. It ought to be adaptable to an enormous number of clients with a requirement for catching insignificant pictures during enlistment while getting rid of mind boggling design simultaneously.

Feature extraction

Facial features are representing the face in a codified way which is computationally efficient for further processes such as matching, classification or other machine-learning techniques, in order to perform AFR. On the other hand, computing facial features in an image could serve to detect a face and to locate it within the image.



Solving the illumination problem

As a fundamental problem in image understanding literature illumination problem is generally quite difficult and has been receiving consistent attentions for face recognition many good approaches have been proposed utilizing the domain knowledge i.e all faces belong to one face class These approaches can be broadly divided into four types heuristic methods including discarding the leading principal components image comparison methods where various image representations and distance measures are applied class based methods where multiple images of one face under axed pose but different lighting conditions are available and model based approaches where D models are employed.

Heuristic approach

To handle the illumination problem researchers have proposed various methods Within the eigen subspace domain it has been suggested that by discarding the three most significant principal components variations due to lighting can be reduced And it has been experimentally verified in that discarding the rest few principal components seems to work reasonably well for images under variable lighting However in order to maintain system performance for normally lighted images and improve performance for images acquired under varying illumination we must assume that the rest three principal components capture the variations only due to lighting In a heuristic method based on face symmetry is proposed to enhance system performance under different lightning.

Model based approach

In their paper the authors suggest using Principal Component Analysis PCA as a tool for solving the parametric shape from shading problem i.e obtain the eigen head approximation of a real head after training on about laser scanned range data of real human heads Though the ill posed SFS problem is transformed into a parametric problem they still assume constant albedo This assumption does not hold for most real face images and we believe that this is one of the major reasons why most SFS algorithms fail on real face images.

Challenges faced by Face Recognition System

Generally, the images of our faces are dynamic in nature, due to which a face recognition system faces several complexities during the recognition. Any face recognition process may be classified as either "robust" or "weak" based on its recognition performances under various challenging circumstances. The following statement about face recognition has been made by Zhao et. Al in 2003,"Given still images or video of a scene, identifying one or more persons in the scene by using a stored database of faces." This type of problem is considered as the classification problem. When we select some of the images from our database and take them as Training images and classify the newcomer images as Test images into any of the given classes is the main step of face recognition system. The topic seems to be easy for a human, whereas in actuality it is a really difficult task due to the limited memory of the system; additionally, the problems in machine recognition are manifold.

The Challenges are:

- Identify similar faces (inter-class similarity)
- Scale Invariance
- Shift Invariance
- Noise Invariance
- Accommodate intra-class variability due to:
- head pose
- illumination conditions
- expressions
- facial accessories
- aging effects
- Cartoon Faces

So, it is clear that a single system cannot be perfect for every condition recognition purpose, that's why instead of creating a universally applicable system our researchers aim to make an effective and good system for face recognition in the real world with computer vision. Due to this, Automated face recognition has become the most valuable and interesting research area for the various fields

people who are continuously trying to rem0ve all its problems and apply it in our real world.

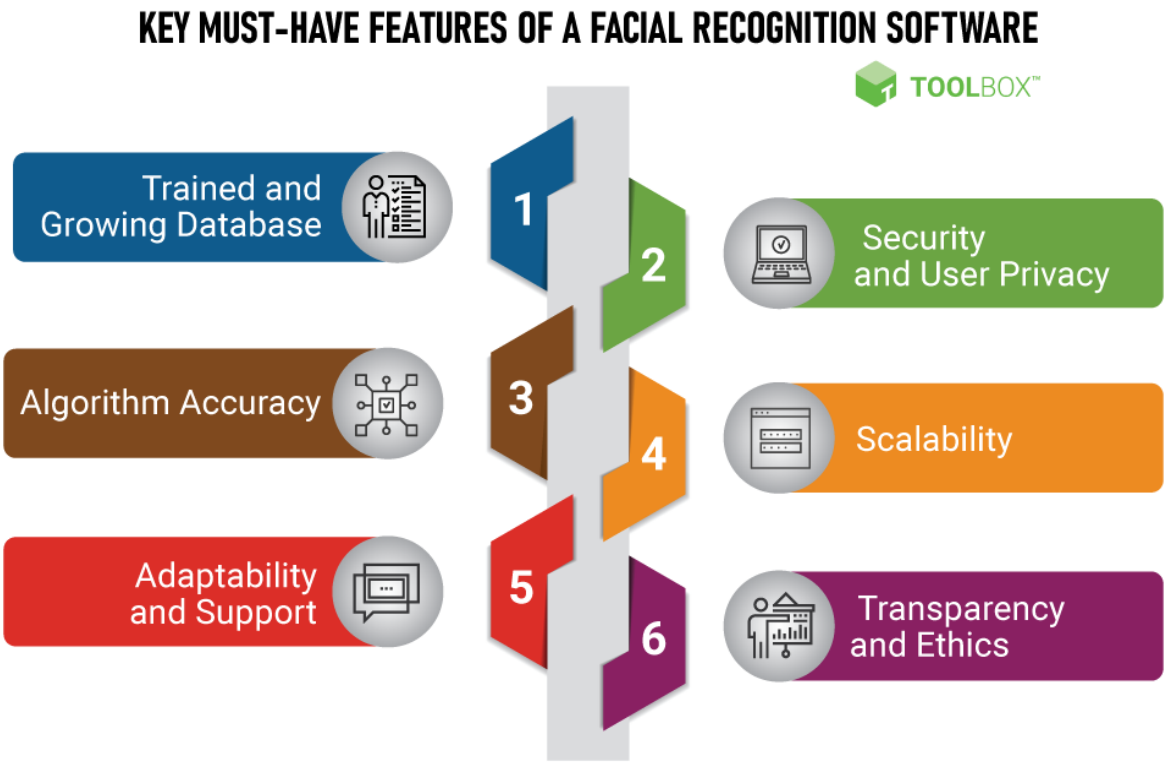
Solving the pose problem

Researchers have proposed various methods to handle the rotation problem Basically they can be divided into three classes multiple images based methods when multiple images per person are available hybrid methods when multiple training images are available during training but only one database image per person is available during recognition and single image shape based methods when no training is carried out We have in the first type and in the second type Up to now the second type of approach is the most popular one The third approach does not seem to have received much attention.

Database

A database is a collection of records that is organized so that it may without difficulty be accessed, managed, and up to date.

Key Must-Have Features of a Facial Recognition Software



Trained and growing database: The accuracy rate of any FRS depends on the database that its artificial intelligence was trained on. The data needs to be continually growing, with diversity in terms of gender and ethnicity. The training data also needs to have a variance in lighting, angles, and facial expressions. A good database also carries different resolutions of images for the system to work with. Machine learning programs are only as good as the database they use to learn, and the FRS is no exception.

Security and user privacy: Any biometric software is closely tied to a person's identity. This means that data (in this case, faceprints) accumulated by the FRS is highly sensitive. User data must be encrypted and purged at regular intervals. Software providers must have a robust plan in place in case of a data breach.

Algorithm accuracy: The key metrics to look at while considering an FRS are false acceptance rate (FAR) and false rejection rate (FRR). FAR is when different

images are falsely matched as identical. In this case, if you're using it for security, the wrong person may be allowed access. In FRR, exact images are falsely mismatched as different. In this case, the right person may be denied access. In a practical security scenario, the FAR must be low and the FRR high.

Scalability: For large enterprises looking to use FRS for authentication, scalability is essential since the software needs to be deployed across multiple locations.

Adaptability and support: FRS providers must offer fallback options into account. In case of system failure, human support and oversight might be required while the system returns to normal. Support is also needed for setting up the hardware, particularly cameras, for maximum accuracy.

Transparency and ethics: FRS has been called out several times in the last year alone for the lack of transparency involved. Ensure that the software you use does not resort to unethical practices like social media scrubbing to collect training data or violate user privacy.

CHAPTER-4

Required tools

- **Python**
- **AI ML**

As AI and ML are being applied across various channels and industries, big corporations invest in these fields, and the demand for experts in ML and AI grows accordingly. Jean Francois Puget, from IBM's machine learning department, expressed his opinion that Python is the most popular language for AI and ML and based it on a trend search results on indeed.com.

A great choice of libraries is one of the main reasons Python is the most popular programming language used for AI. A library is a module or a group of modules published by different sources like Py Pi which include a pre-written piece of code that allows users to reach some functionality or perform different actions. Python libraries provide base level items so developers don't have to code them from the very beginning every time. ML requires continuous data processing, and Python's libraries let you access, handle and transform data.

PARAMETERS OF FACE RECOGNITION SYSTEM

- True positive measures the proportion of positives that are correctly identified.
- It is defined as the face is correctly detected.
- True negative measures the proportion of positives that are correctly identified.
- A non-face is correctly recognized as a non-face region.
- False positive Sensitivity which means wrongly matching innocent people with photos in the database.
- False negative Sensitivity not catching people even when their photo is in the database.

Note: If a subject's face is stored in the database, a disguise or a minor change in appearance or even an unusual facial expression can confuse the system.

CHAPTER-5

TECHNNICAL MODULE

Face recognition

PIN gains access, but the user of the PIN is not verified. When credit and ATM cards are lost or stolen, an unauthorized user can often come up with the correct personal codes. Despite warning, many people continue to choose easily guessed PIN's and passwords: birthdays, phone numbers and social security numbers. Recent cases of identity theft have highten the need for methods to prove that someone is truly who he/she claims to be.

Face recognition technology may solve this. The information age is quickly revolutionizing the way transactions are completed. Everyday actions are increasingly being handled electronically, instead of with pencil and paper or face to face. This growth in electronic transactions has resulted in a greater demand for fast and accurate user identification and authentication. Access codes for buildings, banks accounts and computer systems often use PIN's for identification and security clearences.

Using the proper s problem since a face is undeniably connected to its owner expect in the case of identical twins. Its nontransferable. The system can then compare scans to records stored in a central or local database or even on a smart card.

It requires no physical interaction on behalf of the user.
It is accurate and allows for high enrolment and verification rates.
It can use your existing hardware infrastructure, existing camara and images capture device will work without any problem.

Real Time Face Recognition System

Real-time face recognition involves detection of a face from a series of frames from a video- capturing device. While the hardware requirements for such a system are far more stringent, from a computer vision standpoint, real-time face detection is actually a far simpler process

than detecting a face in a static image[29]. This happens due to the continuous motion of people in our surroundings. We walk here and there, blink, play, wave our hands about, etc.

Since in real-time face detection, the system is presented with a series of frames in which to detect a face, by using spatiotemporal filtering (finding the difference between subsequent frames), the area of the frame that has changed can be identified and the individual detected (Wang and Adelson, 1994 and Adelson and Bergen 1986)

Furthermore, as seen in , exact face locations can be easily identified by using a few simple rules, such as, the head is the small blob above a larger blob -the body head motion must be reasonably slow and contiguous -heads won't jump around erratically (Turk and Pentland 1991a, 1991b)

So we can say that Real-time face detection has now become a simple problem as compared to past times and now the face of a person can be recognised in even unstructured and uncontrolled environments using the very simple image processing techniques and reasoning rules.

Facial Recognition

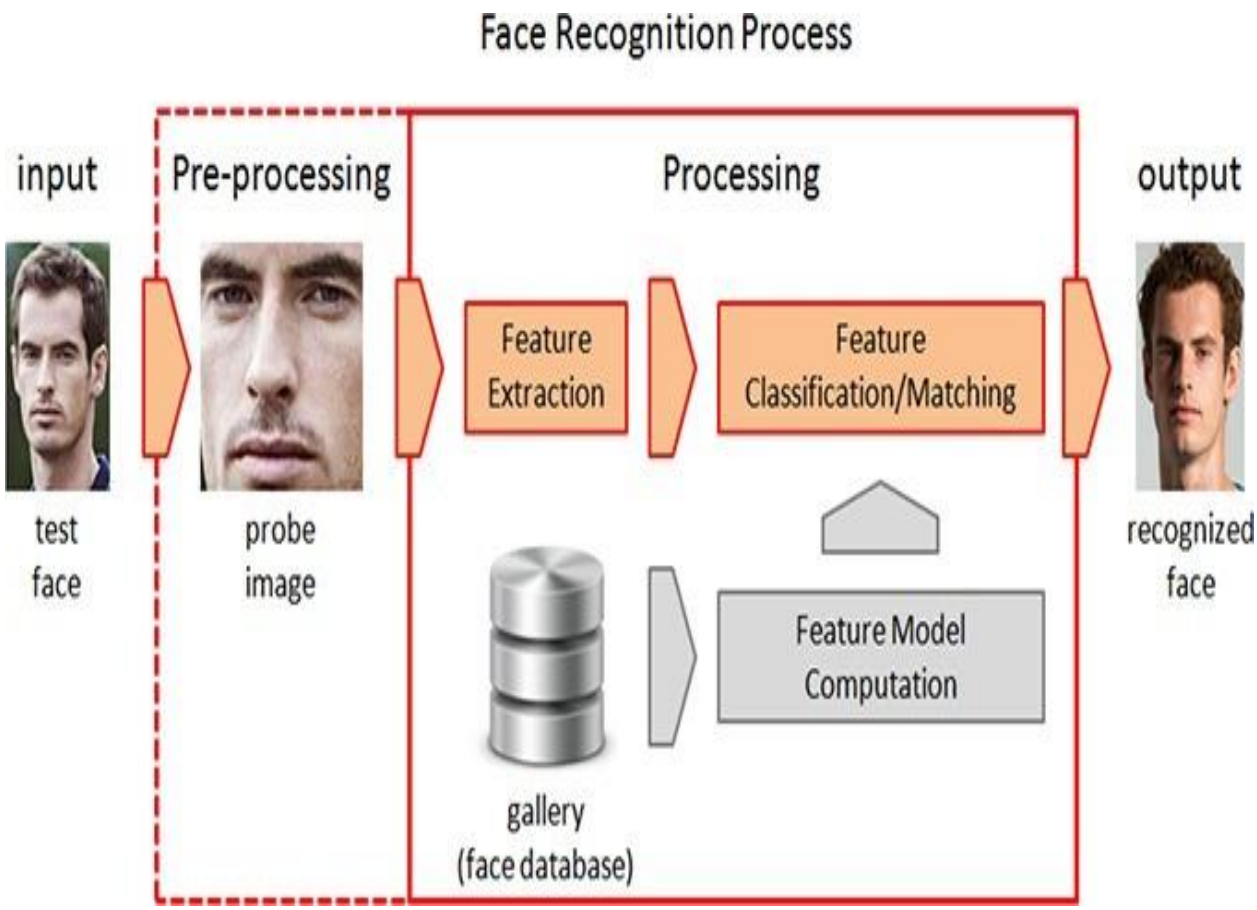
In Facial recognition there are two types of comparisons:-VERIFICATION- The system compares the given individual with who they say they are and gives a yes or no decision.
IDENTIFICATION- The system compares the given individual to all the Other individuals in the database and gives a ranked list of matches.

Implementation

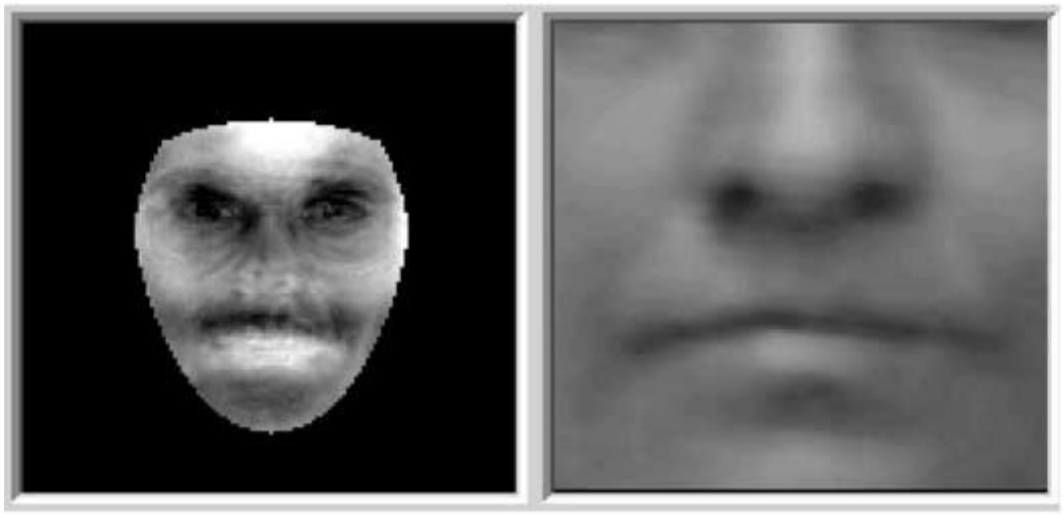
The implementation of face recognition technology includes the following four stages:
a. Image acquisition
b. Image processing
c. Distinctive characteristic location
d. Template creation
e. Template matching

Image acquisition

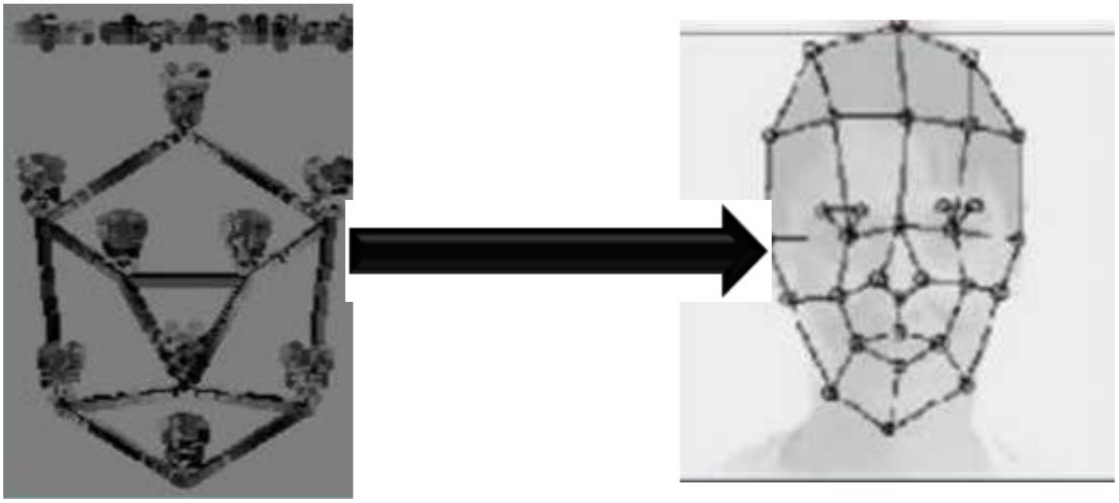
Facial-scan technology can acquire faces from almost any static camera or video system that generates images of sufficient quality and resolution. High-quality enrolment is essential to eventual verification and identification enrolment images defines the facial characteristics to be used in all future authentication events.


Face Recognition Process
input
Pre-processing
Processing
output
Feature Extraction
Feature Classification/Matching
Feature Model Computation
test face
probe image
gallery (face database)
recognized face

High-Quality Enrollment Image



Low Quality Enrollment Image



Face Detection using Haar Cascades

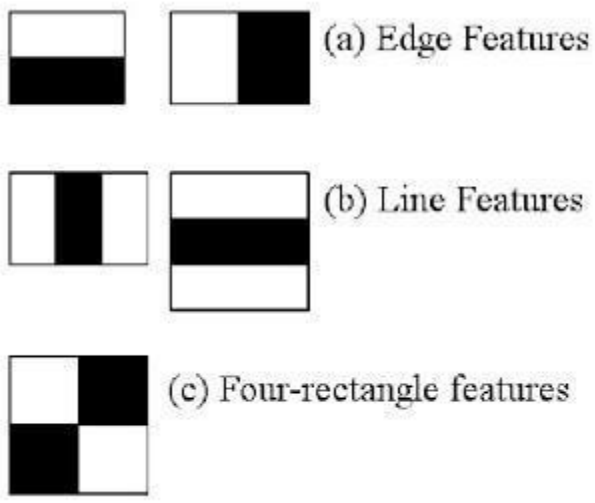
Goal

In this session,

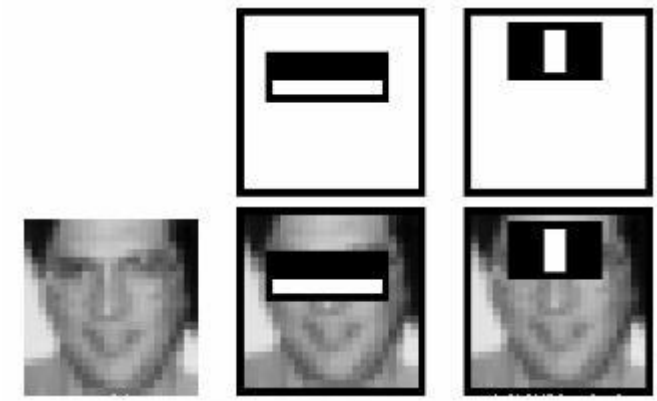
- We will see the basics of face detection using Haar Feature-based Cascade Classifiers
- We will extend the same for eye detection etc.

Basics

- Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.
- Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. For this, haar features shown in below image are used. They are just like our convolutional kernel. Each feature is a single value obtained by subtracting sum of pixels under white rectangle from sum of pixels under black rectangle.
-
- Now all possible sizes and locations of each kernel is used to calculate plenty of features. (Just imagine how much computation it needs? Even a 24x24 window results over 160000 features). For each feature calculation, we need



- Now all possible sizes and locations of each kernel is used to calculate plenty of features. (Just imagine how much computation it needs? Even a 24x24 window results over 160000 features). For each feature calculation, we need to find sum of pixels under white and black rectangles. To solve this, they introduced the integral images. It simplifies calculation of sum of pixels, how large may be the number of pixels, to an operation involving just four pixels. Nice, isn't it? It makes things super-fast.
- But among all these features we calculated, most of them are irrelevant. For example, consider the image below. Top row shows two good features. The first feature selected seems to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is irrelevant. So how do we select the best features out of 160000+ features? It is achieved by adaboost.



- For this, we apply each and every feature on all the training images. For each feature, it finds the best threshold which will classify the faces to positive and negative. But obviously, there will be errors or misclassifications. We select the features with minimum error rate, which means they are the features that best classifies the face and non-face images. (The process is not as simple as this. Each image is given an equal weight in the beginning. After each classification, weights of misclassified images are increased. Then again same process is done. New error rates are calculated. Also new weights. The process is continued until required accuracy or error rate is achieved or required number of features are found).
- Final classifier is a weighted sum of these weak classifiers. It is called weak because it alone can't classify the image, but together with others forms a strong classifier. The paper says even 200 features provide detection with 95% accuracy. Their final setup had around 6000 features. (Imagine a reduction from 160000+ features to 6000 features. That is a big gain).

- So now you take an image. Take each 24x24 window. Apply 6000 features to it. Check if it is face or not. Wow.. Wow.. Isn't it a little inefficient and time consuming? Yes, it is. Authors have a good solution for that.
- In an image, most of the image region is non-face region. So it is a better idea to have a simple method to check if a window is not a face region. If it is not, discard it in a single shot. Don't process it again. Instead focus on region where there can be a face. This way, we can find more time to check a possible face region.
- For this they introduced the concept of Cascade of Classifiers. Instead of applying all the 6000 features on a window, group the features into different stages of classifiers and apply one-by-one. (Normally first few stages will contain very less number of features). If a window fails the first stage, discard it. We don't consider remaining features on it. If it passes, apply the second stage of features and continue the process. The window which passes all stages is a face region. How is the plan !!!
- Authors' detector had 6000+ features with 38 stages with 1, 10, 25, 25 and 50 features in first five stages. (Two features in the above image is actually obtained as the best two features from Adaboost). According to authors, on an average, 10 features out of 6000+ are evaluated per sub-window.
- So this is a simple intuitive explanation of how Viola-Jones face detection works. Read paper for more details or check out the references in Additional Resources section.

Haar-cascade Detection in OpenCV

- OpenCV comes with a trainer as well as detector. If you want to train your own classifier for any object like car, planes etc. you can use OpenCV to create one. Its full details are given here: Cascade Classifier Training.
- Here we will deal with detection. OpenCV already contains many pre-trained classifiers for face, eyes, smile etc. Those XML files are stored in opencv/data/haarcascades/ folder. Let's create face and eye detector with OpenCV.
- First we need to load the required XML classifiers. Then load our input image (or video) in grayscale mode.

- import numpy as np
- import cv2
-
- face_cascade cv2.CascadeClassifier('haarcascade_frontalface_default.xml')

```
    eye_cascade = cv2.CascadeClassifier('haarcascade_eye.xml')

    img = cv2.imread('sachin.jpg')
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
```

- Now we find the faces in the image. If faces are found, it returns the positions of detected faces as Rect(x,y,w,h). Once we get these locations, we can create a ROI for the face and apply eye detection on this ROI (since eyes are always on the face !!!).

```
    faces = face_cascade.detectMultiScale(gray, 1.3, 5)
    for (x,y,w,h) in faces:
        img = cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2)
        roi_gray = gray[y:y+h, x:x+w]
        roi_color = img[y:y+h, x:x+w]
        eyes = eye_cascade.detectMultiScale(roi_gray)
        for (ex,ey,ew,eh) in eyes:
            cv2.rectangle(roi_color,(ex,ey),(ex+ew,ey+eh),(0,255,0),2)

    cv2.imshow('img',img)
    cv2.waitKey(0)
    cv2.destroyAllWindows()
```

Image recognition code :

```
import cv2

# Load the cascade
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')

# Read the input image
img = cv2.imread('test2.jpg')

# Convert into grayscale
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# Detect faces
faces = face_cascade.detectMultiScale(gray, 1.2, 9)

# Draw rectangle around the faces
for (x, y, w, h) in faces:
    cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 3)

# Display the output
cv2.imshow('my_img', img)
cv2.waitKey()
```

Code for video recognition :

```
import cv2
# Load the cascade
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
# To capture video from webcam.
cap = cv2.VideoCapture(0)
# To use a video file as input
# cap = cv2.VideoCapture('filename.mp4')
while True:
    # Read the frame
    _, img = cap.read()
    # Convert to grayscale
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Detect the faces
    faces = face_cascade.detectMultiScale(gray, 1.1, 5)

    # Draw the rectangle around each face
    for (x, y, w, h) in faces:
        cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 1)

    # Display
    cv2.imshow('img', img)
```

```
    # Stop if escape key is pressed
    k = cv2.waitKey(30) & 0xff
    if k == 27:
        break
# Release the VideoCapture object
cap.release()
```

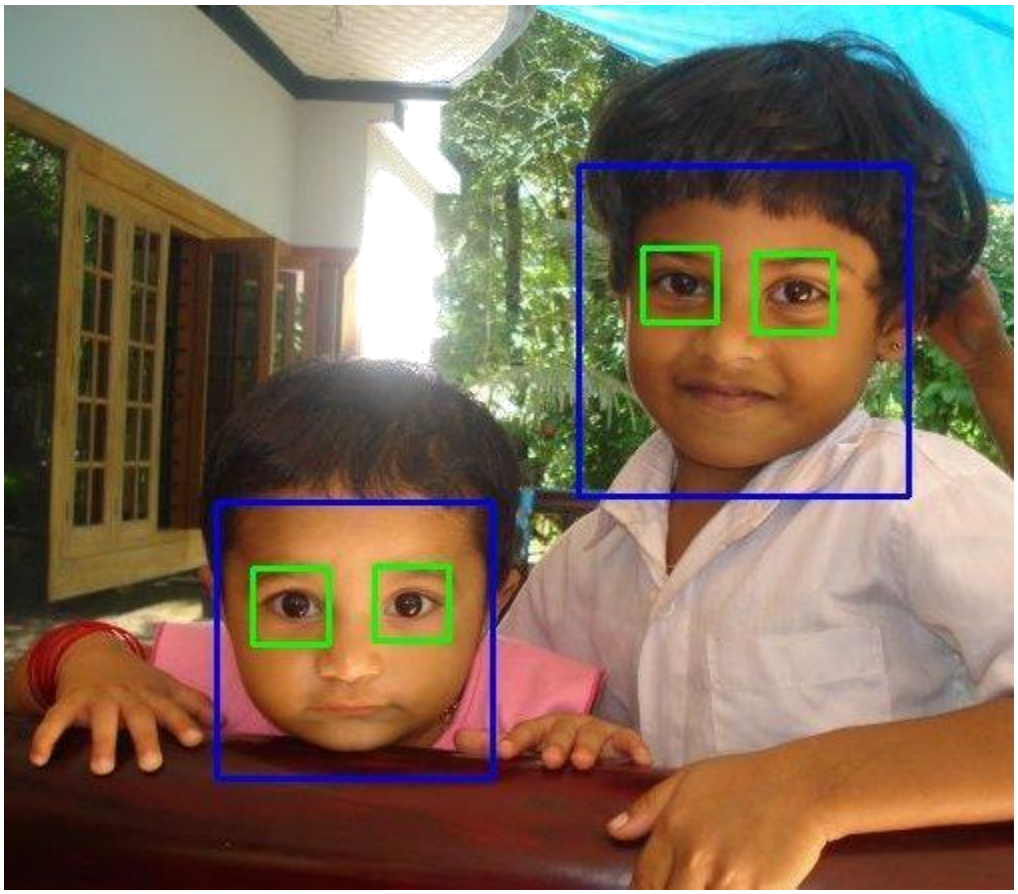
Code for Mail sender to the user :

```
import smtplib,webbrowser
print("HELLO!!!")
print("YOU CAN SEND WARNING MAIL USING THIS...")
def get_mail():
    server_available = ["hotmail", "gmail", "yahoo", "outlook"]
    while True:
        mail_id="adityakumar9939@gmail.com" # id
        if "@" and ".com" in mail_id:
            symbol_pos=mail_id.find("@")
            dot_pos=mail_id.find(".com")
            sp=mail_id[symbol_pos+1:dot_pos]
            if sp in server_available:
                return mail_id,sp
                break
            else:
                print(f"WE CAN NOT PROVIDE SERVICE FOR '{sp}'")
                print('ONLY SERVERS ARE ["hotmail", "gmail", "yahoo",
"outlook"]')
                print("try again...")
                continue
        else:
            print("INVALID MAIL")
            print("try again...")
            continue
def set_smtp_domain(service_provider):
    if service_provider=="gmail":
        return "smtp.gmail.com"
    if service_provider == "outlook" or service_provider=="hotmail":
        return "smtp-mail.outlook.com"
    if service_provider == "yahoo":
        return "smtp.mail.yahoo.com"
usermail,service_provider=get_mail()
password="Aditya1233" #pass
while True:
    try:
        smtp_domain=set_smtp_domain(service_provider)
        connection=smtplib.SMTP(smtp_domain,587)
        connection.ehlo()
        connection.starttls()
        connection.login(usermail,password)
    except:
        if service_provider=="gmail":
            print("LOGIN UNSUCESSFULL,There are 2 possible reason!!!")
```

```
            print("1.) Wrong username or password.")
            print("2.) Your Gmail is very secure to use this.You can change
it to less secure.")
            print("Do you want your mail account less secure for sometime to
enable the working by opening a webpage?")
            answer=input("'yes' or 'no'? : ")
            if answer=="yes":

webbrowser.open("https://myaccount.google.com/lesssecureapps")
                print("You can retype your email and password...")
                usermail, service_provider = get_mail()
                password = input("password : ")
                continue
            else:
                print("You can retype your email and password...")
                usermail,service_provider=get_mail()
                password=input("password : ")
                continue
        else:
            print("LOGIN UNSUCESSFULL,you may have write wrong username or
password...")
            print("Please retype your email and password")
            usermail,service_provider=get_mail()
            password=input("password :")
            continue
    else:
        print("LOGIN SUCCESSFULLY!!!")
        break
reciver_address,reciver_service_provider=get_mail()
print("Please enter Subject and Message")
Subject=input("Subject : ")
Message=input("Message : ")
connection.sendmail(usermail,reciver_address,("Subject: " + str(Subject) +
"\n\n" + str(Message)))
print("EMAIL SEND SUCCESSFULLY")
connection.quit()
```

Result looks like below:



How Facial Recognition System Works

Facial recognition software is based on the ability to first recognize faces, which is a technological feat in itself. If you look at the mirror, you can see that your face has certain distinguishable landmarks. These are the peaks and valleys that make up the different facial features.

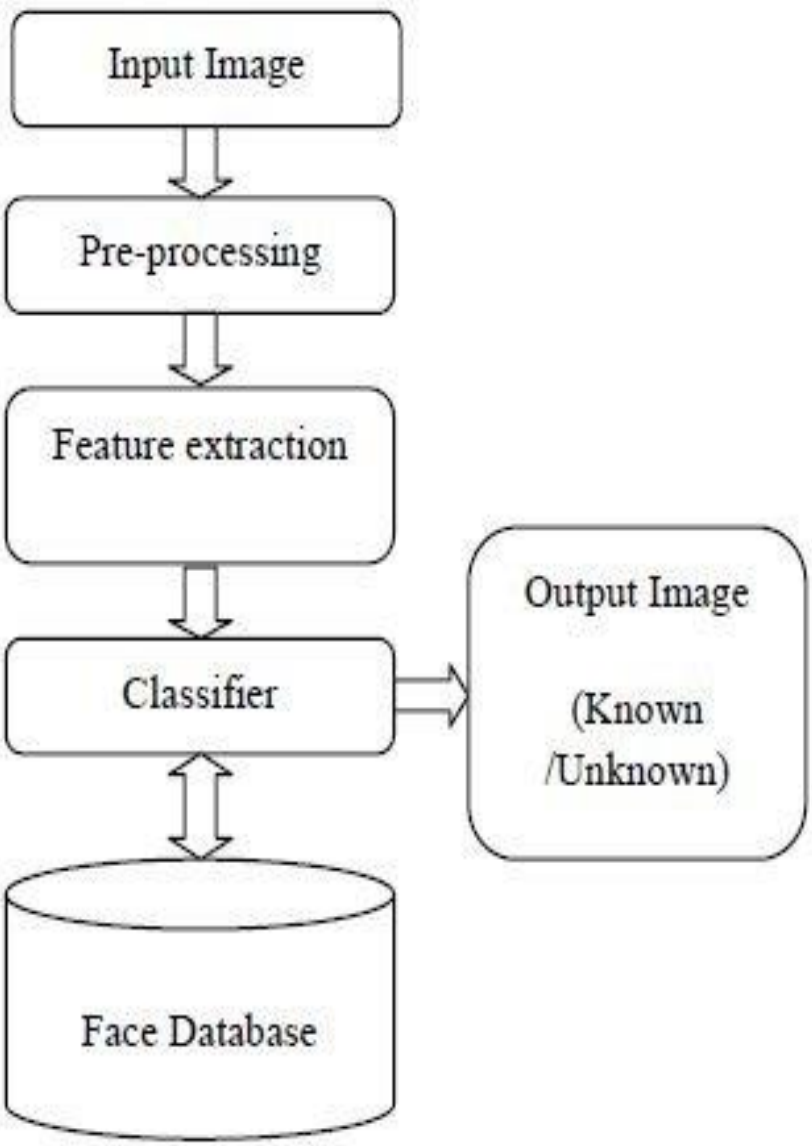
VISIONICS defines these landmarks as nodal points. There are about 80 nodal points on a human face.

Block Diagram :

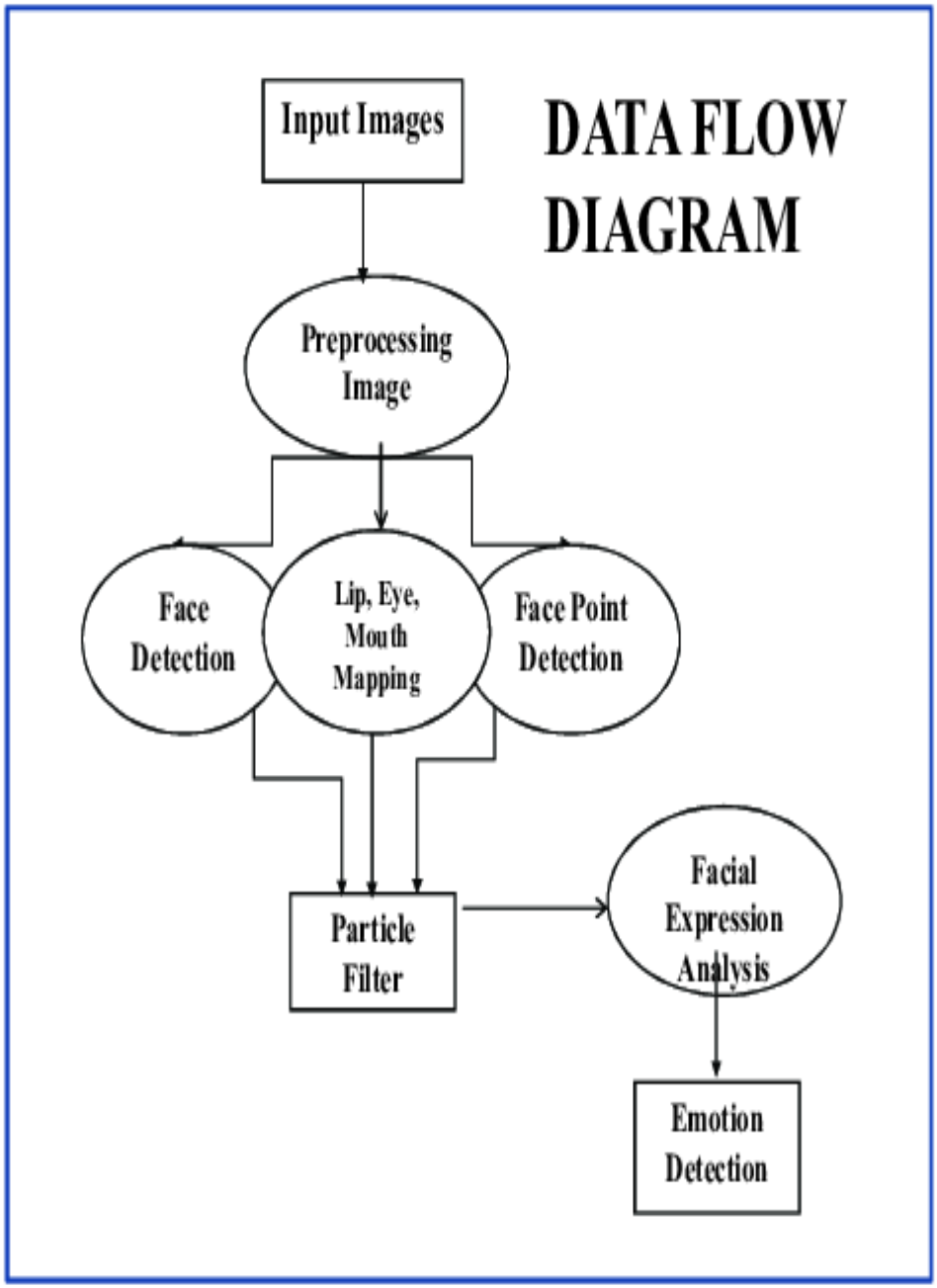
Our face is the primary centre of attention in social interaction, as it plays a major role in conveying our identity and emotions through our expressions. Although the ability to conclude intelligence or character from facial appearance is suspected, the human ability to recognise faces is very remarkable. We can recognise many of faces seen throughout our lifetime and identify familiar faces at a glance even after years of separation such as our friends or our family members. Face recognition has become an important issue in many applications such as security systems, credit card verification and many others such as at entrance in examinations. For example, the ability to recognise a particular face and distinguish it from a large number of stored face models would make it possible to greatly improve criminal identification. Although it is clear that human beings are excellent at face recognition, it is not at all known till now how faces are encoded or decoded by the human brain. Unfortunately the development a computational model of face recognition is quite difficult, because faces are really complex, multi-dimensional visual stimuli. Therefore, face recognition is not that simple rather it is considered as a high-level computer vision task, in which many early vision techniques can be involved.

The first and foremost step of human face identification is to extract some of the relevant features from facial images. Research in the field of face recognition primarily intends to generate sufficiently reasonable familiarities of human faces so that another human can correctly identify the face. The query which comes in mind here is how well the facial features can be quantized. If such a quantization if possible then a computer should be capable of recognising a face given a set of features. Surveys by many of famous researchers over the past some years have indicated that certain facial characteristics are used by human beings to identify faces.

The block diagram of face recognition system is shown in above explains about the step-by-step procedure for Training and Testing of face images. The initial step is the Registration of images present in the database. Once all images are registered they are applied to dimension reduction block where the most important dimension are kept and then for classification, it goes to classification block where different similarity measures are used to classify the test image.



DFD :-


DATA FLOW DIAGRAM
Input Images
Preprocessing Image
Face Detection
Lip, Eye, Mouth Mapping
Face Point Detection
Particle Filter
Facial Expression Analysis
Emotion Detection

Government Use:

Law Enforcement: Minimizing victim trauma verifying Identify for court records, and comparing school surveillance camera images to know child molesters.

Security/Counterterrorism: Access control, comparing surveillance images to Know terrorist.

Immigration: Rapid progression through Customs.

Voter verification: Where eligible politicians are required to verify their identity during a voting process this is intended to stop "proxy" voting where the vote may not go as expected.

Commercial Use:

Residential Security: Alert homeowners of approaching personnel.

Banking using ATM: The software is able to quickly verify a customer's face.
Physical access control of buildings areas, doors, cars or net access.

Strengths:

It has the ability to leverage existing image acquisition equipment.
It can search against static images such as driver's license photographs.
It is the only biometric able to operate without user cooperation.
There are many benefits to face recognition systems such as its convinience and Social acceptability. all you need is your picture taken for it to work.
Face recognition is easy to use and in many cases it can be performed without a Person even knowing.
Face recognition is also one of the most inexpensive biometric in the market and Its price should continue to go down.

Experiments :

We present an effective and efficient approach using advanced image processing techniques to improve face recognition accuracy based on local binary patterns algorithm. In this section, we'll give experiment results from two interconnected parts to demonstrate our method. In the first part, the LBP cascade classifier is employed for multiple face detection and tracking. first, we'll capture faces from a live digital camera or sourced from a digital image and apply the LBP cascade classifier algorithm to detect faces. To improve the accuracy of the LBP face detection algorithm to the level of Haar cascade classifier face detection algorithm. or even better while maintaining speed, we used image processing techniques. Our experiment result for this part is shown Using our approach, we were able to improve the face detection accuracy rate, which is an integral part of the overall face recognition accuracy rate, while at the same time reducing the number of false positives and false negatives. In this experiment, the Haar classifier algorithm is used to detect faces in an image. The Haar classifier algorithm consist of our phases; integral image, Haar-like features. AdaBoost and Cascading Classifier, in which the input face images will be represented as integral images first, to compute Haar-like features, for optimization reason, the AdaBoost will be used for feature selection, then the selected features will be passed through a cascading classifier to classify faces in an image. Aside the Haar Classifier algorithm, our proposed improved LBP method is also used to detect faces in an image as shown in Comparing the two methods, it is shown that our proposed method outperformed, the Haar Classifier algorithm for Face Detection and also in the number of detected faces, represented as true positive or false positive, represented as features that are incorrectly detected as faces or false negative, represented as faces that are not detected as faces in an image for face detection, the Haar algorithm, the original LBP and the improved LBP using our method are compared using a dataset of images, which our method perform better in all case

Literature Survey :

We first review the development of face recognition approaches, followed by a review of face modelling and model compression methods. Finally, we will present one major application of face recognition technology, namely, face retrieval. We mainly pay attention to the methods that are employed in the task-specific cognition or whose behaviour is specified by humans (i.e., artificial intelligence pursuits), although there are developmental approaches for facial processing (e.g., autonomous mental development and incremental learning methods) that have emerged recently.

Feasibility Analysis :

The purpose of this research is for education and research advancement. AI is an exploding field of research with new research depths on current and historical topics. This paper extends such research testing the feasibility of an artificial intelligence application in a bartering framework.

CHAPTER-6

Conclusion and Future goals

Face is the most essential part of the human body, and its unique features make it even more crucial in identifying humans. Various algorithms and technologies are used worldwide to make the face recognition process more accurate and reliable.

The applications of this ever-growing technology are also expanding in healthcare, security, defence, forensic, and transportation, requiring more accuracy. However, some challenges are ubiquitous while developing face recognition technology such as pose, occlusion, expressions, ageing, etc, which have been discussed above in the article.

Result

The future of facial recognition technology is bright. Forecasters opine that this technology is expected to grow at a formidable rate and will generate huge revenues in the coming years. Security and surveillances are the major segments which will be deeply influenced. Other areas that are now welcoming it with open arms are private industries, public buildings, and schools.

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