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*Thesis submitted to the*

**UNIVERSITY OF MOHAMED BOUDIAF – MSILA**

1985

جامعة محمد بوضياف - المسيلة

University of Mohamed Boudiaf-Msila

FACULTY OF MATHMATICS AND COMPUTER SCIENCE
DEPARTEMENT OF COMPUTER SCIENCE

*In partial fulfillment of the requirements for the degree of*

**Master**in **Computer science**

By


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*Title of the thesis*

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# Intelligence artificial for face recognation

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*Under the supervision of*

**First name Last name**

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*2022.*

# Dedications

***I dedicate this work:***

- ***To my dear father and mother.***
- ***To my dear brothers and sisters.***
- ***To my whole family.***
- ***To all who have sacrificed their time for science and to all who use science for the good and prosperity of humanity.***

# Acknowledgment

I would like to thank all the people who contributed to the success of my project and who helped me in writing this thesis.

I would first like to thank my thesis director Dr Mahdjoubi Roussafi , for his patience, his availability and above all his judicious advice, which helped fuel my reflection.

I address my sincere thanks to all the professors, speakers and all the people who by their words, their writings, their adevice and their criticisms guided my reflections and agreed to meet me and answer my questions during my research.

I thank my dear parents , who have always been there for me.

I thank my friends bwho have always been there for me. Their unconditional support and encouragement has been a great help.

Last but not least, I wanna thank me , I wanna thank me for believing in me , I wanna thank me for doing all this hard work , I wanna thank me

For having no days off ,I wanna thank me for, for never quitting

# Abbreviations

**AI** Artificial Intelligence

**RPA** Robotic Process Automation

**NLP** Natural Language Processing

**PCA** Principal Component Analysis .

**SVD** Singular-Value Decomposition .

**FNN** Feed-forward Neural Network

**RNN** Recurrent Neural Network

**IDE** Integrated Development Environment

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# Introduction

The current technology amazes people with amazing innovations that not only make life simple but also bearable. Face recognition has over time proven to be the least intrusive and fastest form of biometric verification.

Facial Recognition is a category of biometric software that maps an individual's facial features and stores the data as a face print. The software uses deep learning algorithms to compare a live captured image to the stored face print to verify one's identity. Image processing and machine learning are the backbones of this technology. Face recognition has received substantial attention from researchers due to human activities found in various applications of security like an airport, criminal detection, face tracking, forensic, etc. Compared to other biometric traits like palm print, iris, fingerprint, etc., face biometrics can be non-intrusive.

They can be taken even without the user's knowledge and further can be used for security-based applications like criminal detection, face tracking, airport security, and forensic surveillance systems. Face recognition involves capturing face images from a video or a surveillance camera. They are compared with the stored database. Face recognition involves training known images, classify them with known classes, and then they are stored in the database. When a test image is given to the system it is classified and compared with the stored database.

# Chapter 1 : Theoretical Background

## 1. Intelligence Artificial

All but the simplest human behavior is ascribed to intelligence, while even the most complicated insect behavior is never taken as an indication of intelligence. What is the difference? Consider the behavior of the digger wasp, *Sphex ichneumoneus*. When the female wasp returns to her burrow with food, she first deposits it on the threshold, checks for intruders inside her burrow, and only then, if the coast is clear, carries her food inside. The real nature of the wasp's instinctual behavior is revealed if the food is moved a few inches away from the entrance to her burrow while she is inside: on emerging, she will repeat the whole procedure as often as the food is displaced. Intelligence—conspicuously absent in the case of *Sphex*—must include the ability to adapt to new circumstances.

### 1.1 How does AI work?

As the hype around AI has accelerated, vendors have been scrambling to promote how their products and services use AI. Often what they refer to as AI is simply one component of AI, such as machine learning. AI requires a foundation of specialized hardware and software for writing and training machine learning algorithms. No one programming language is synonymous with AI, but a few, including Python, R and Java, are popular.

In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states. In this way, a chatbot that is fed examples of text chats can learn to produce lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples.

AI programming focuses on three cognitive skills: learning, reasoning and self-correction.

Learning processes. This aspect of AI programming focuses on acquiring data and creating rules for how to turn the data into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.

- **Reasoning processes.** This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.

- **Self-correction processes.** This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.

### 1.2 the 4 types of artificial intelligence

Arend Hintze, an assistant professor of integrative biology and computer science and engineering at Michigan State University, explained in a 2016 article that AI can be categorized into four types, beginning with the task-specific intelligent systems in wide use today and progressing to sentient systems, which do not yet exist. The categories are as follows:

- **Type 1: Reactive machines.** These AI systems have no memory and are task specific. An example is Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue can identify pieces on the chessboard and make predictions, but because it has no memory, it cannot use past experiences to inform future ones.
- **Type 2: Limited memory.** These AI systems have memory, so they can use past experiences to inform future decisions. Some of the decision-making functions in self-driving cars are designed this way.
- **Type 3: Theory of mind.** Theory of mind is a psychology term. When applied to AI, it means that the system would have the social intelligence to understand emotions. This type of AI will be able to infer human intentions and predict behavior, a necessary skill for AI systems to become integral members of human teams.
- **Type 4: Self-awareness.** In this category, AI systems have a sense of self, which gives them consciousness. Machines with self-awareness understand their own current state. This type of AI does not yet exist.

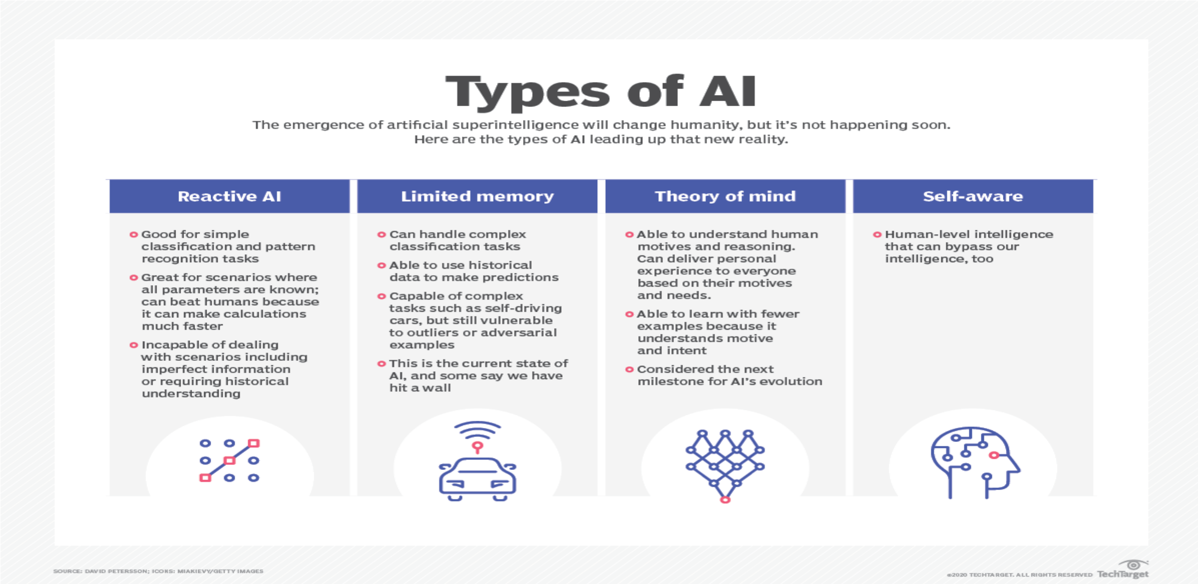


Figure 1.1: Types of AI

### 1.3 AI technology and how is it used today

AI is incorporated into a variety of different types of technology. Here are six examples:

- **Automation.** When paired with AI technologies, automation tools can expand the volume and types of tasks performed. An example is robotic process automation (RPA), a type of software that automates repetitive, rules-based data processing tasks traditionally done by humans. When combined with machine learning and emerging AI tools, RPA can automate bigger portions of enterprise jobs, enabling RPA's tactical bots to pass along intelligence from AI and respond to process changes.

- **Machine learning.** This is the science of getting a computer to act without programming. Deep learning is a subset of machine learning that, in very simple terms, can be thought of as the automation of predictive analytics. There are three types of machine learning algorithms:

    - **Supervised learning.** Data sets are labeled so that patterns can be detected and used to label new data sets.
    - **Unsupervised learning.** Data sets aren't labeled and are sorted according to similarities or differences.

- **Reinforcement learning.** Data sets aren't labeled but, after performing an action or several actions, the AI system is given feedback.

- **Machine vision.** This technology gives a machine the ability to see. Machine vision captures and analyzes visual information using a camera, analog-to-digital conversion and digital signal processing. It is often compared to human eyesight, but machine vision isn't bound by biology and can be programmed to see through walls, for example. It is used in a range of applications from signature identification to medical image analysis. Computer vision, which is focused on machine-based image processing, is often conflated with machine vision.

- **Natural language processing (NLP).** This is the processing of human language by a computer program. One of the older and best-known examples of NLP is spam detection, which looks at the subject line and text of an email and decides if it's junk. Current approaches to NLP are based on machine learning. NLP tasks include text translation, sentiment analysis and speech recognition.

- **Robotics.** This field of engineering focuses on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform or perform consistently. For example, robots are used in assembly lines for car production or by NASA to move large objects in space. Researchers are also using machine learning to build robots that can interact in social settings.

- **Self-driving cars.** Autonomous vehicles use a combination of computer vision, image recognition and deep learning to build automated skill at piloting a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians.

## 2. Machine Learning

Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. We need learning in case we cannot write the program to solve the problem, but we need example data or experience. So, we have the model defined up to some parameters and learning is the execution of the computer program to optimize the parameters of the model using the training data or past experience.

The model may be predictive to make predictions in the future, or descriptive to extract knowledge from data.

Machine learning touches computer science in two main uses:

First, in training: we do not only need efficient algorithms to solve the optimization problem, but to store and process the massive amount of data we generally have, as well. Second, once a model is learned, its representation and algorithmic solution for inference needs also to be efficient .[15].

### 2.1 Machine learning categories

Machine learning algorithms are categorized into taxonomy based on the desired output. Common algorithm types include [16] :

- Supervised learning.
- Unsupervised learning.
- Semi-supervised learning
- Reinforcement learning.
- Transduction.

- Learning to learn.

The next section will deal with the first three categories: Supervised learning , Unsuper- vised learning , Semi-supervised learning .

✓ Supervised learning: It is the type of learning that uses labeled training dataset,

i.e. where pre-classified examples are available for learning and the task is to build a classification or regression model that can predict the label of unseen data [17].

Classification : Classification techniques are used to build a model when the

desired output is discrete or categorical, for example, animals classification : Cats or Dogs .

Regression : Regression techniques are used to build a model when the desired

output is continuous, for example, estimating the temperature. The main differences between classification and regression are :

Classification models can predict a discrete class label whereas the regression models can predict a continuous quantity.

classification models can be evaluated by measuring accuracy or misclassified rate whereas the regression models can be evaluated by mean square error as an example.

Some Classification Algorithms:

Decision Trees.

Support Vector Machines.

Artificial Neural Networks.

Some Regression Algorithms:

Regression Trees.

Linear regression.

- ✓ Unsupervised learning.: Unsupervised learning uses processes trying to find regular data patterns , i.e. the training dataset are not labeled and the task is to find patterns based on Similarity of individuals in the training dataset [18]

**Types of Unsupervised Learning**

Clustering algorithms will run through the data and find clusters if they exist. This are , some of popular clustering algorithms :

K-Means Clustering.

Hierarchical Clustering.

Data Compression or Dimensionality reduction : this means combining parts of the data in unique ways to convey meaning. Here are, some popular dimension- ality reduction algorithms :

Principal Component Analysis (PCA).

Singular-Value Decomposition (SVD).

- ✓ Semi-supervised Learning:

Semi-supervised learning is a combination between supervised and unsupervised learning, a semi-supervised learner tries to find a better classifier from both labeled and unlabeled data.

## 2.2 Artificial Neural Network

Artificial Neural Network is a mathematical model or computational model inspired from the brain biological behavior (Biological Neural Network) [24] ,used to solve complex problems. First introduced by Warren McCulloch and Walter Pitts (1943) [19] as a simple neuron model. In this section it is about :

-The biological neuron.

The artificial neuron.

Artificial Neural Network Topologies.

Single-layer perceptron.

Multi-layer perceptron and Back propagation algorithm.

**The Biological Neuron**

In human nervous system, the neuron is the basic unit. All neurons are connected to each other to process data or inputs [25] .The main parts of a biological neuron are :

Dendrites that receive inputs and so called receptors [22] ,cell body (soma) where the cell nucleus (the central processing part) is located and the axon which transfers the output of the current neuron to other neurons, through the axon terminal or synapses that are considered as an interfacing areas. Biological neurons receive a short electrical impulses called signals from other neurons via the synapses. When a neuron receives a sufficient number of signals from other neurons within a few milliseconds, it fires its own signals. Note that the output of a neuron maybe an input to other neurons or maybe a final output [25]

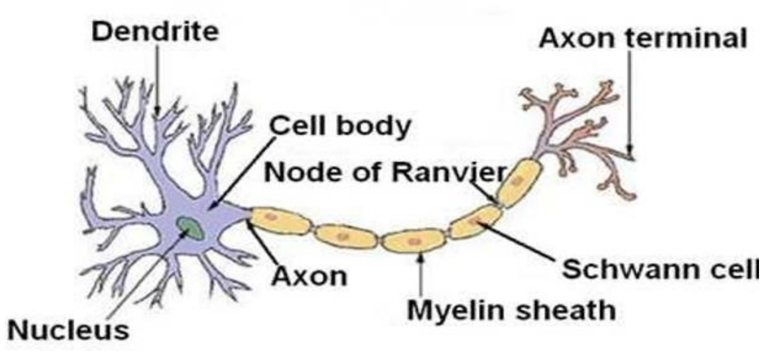


Figure 1.4: Schematic drawing of a neuron .

**The Artificial Neuron**

The neuron is the basic unit in an artificial neural network. It is a simple mathematical model that is composed of three rules : Multiplication, summation and activation. At the input of the neuron, the multiplication concerns the inputs and their associated weights. The sum of these results of multiplication and bias in the summation step must pass through an activion function or transfer function [22].

From the two definitions of the biological and artificial neuron, we can cite the differences in their terminologies.

Artificial Neural Network Topologies

The way in which all the neurons are interconnected is called a topology or an architecture or network graph of artificial neurons. There are two basic topologies of neural network: Feed-forward (FNN) and Recurrent (RNN) [20].

Feed-forward Neural Network: This topology of neural networks ensures that the information has a path from the input to the output without having cycles or loops. It does not pose any limitation on the number of layers, number of units, number of links between the neurons or the used activation functions types  [20].

Recurrent Neural Network: This topology of neural networksis similar to Feed- forward Neural Network ,but with no limitations on the back-loops. The information can take the previous path and also backwards. This kind of neural network is a dynamic system  [20].

Single-layer Perceptron

The Perceptron or Single-layer neural network is a binary linear classifier, i.e. used when the data are linearly separable, considered as the simplest neural network, introduced by F. Rosenblatt (1958)  [23].It consists of a single neuron with input weights and bias. The sum of the weighted inputs and bias passes through a hard limiter. Using Unit Step activation function

Multi-layer Perceptron

the Single-layer perceptron have a limitation where they are incapable of solving some trivial (Exclusive OR) problems or nonlinear classification

problems. However, it was found that some of the limitations of Perceptrons can be eliminated by stacking multiple Perceptrons.

Using an input layer, an output layer and one or more intermediate layers called hidden layers between the input and the output.

Activation Functions

As it was said before, the artificial neuron or node is composed of three rules : multipli- cation, summation and activation. It was mentioned that the multiplication step serves to multiply the inputs by their associated weights to make the weighted inputs, the sum- mation adds the weighted outputs and the bias. This step gives a value in $[-\infty, +\infty]$ and that the neuron has no information on this value and his bounds. As this value is the output of a neuron, we must know if this output is activated or not (inspired by the natural behaviour of biological neural network: the neuron fired or not), and that is the role of the activation function. Some of the most commonly used activation functions are,: Sigmoid, tanh, Softmax, ReLU [21]

## 2.3 Over fitting and Under fitting

### Over fitting

Over fitting refers to the phenomenon of learning model specialization, i.e. learning "by heart" all the training set and constructing a model with a learning error rate zero and a large test error rate. The Over fitted model is a complex model to describe a simple data. In other words, Over fitting is a problem that increase the gap between training error and test. This problem appears when the model is trained a lot . To avoid this problem, we use the regularization. There are many ways of regularization such as pruning in decision tree, Cost factor C in Support Vector Machines, Dropout in Neural Network [14]

**Under fitting**

An under fitted model is a model considered as simple to describe a set of complex training, a model that does not cover all the points. A model under learning is a model with poor performance. This problem occurs when there is a few of data or when the model has not been trained well [14]

# Chapter2 Face Recognation

## Introduction

Face recognition is an easy task for humans. Experiments in [5] have shown, that even one to three day old babies are able to distinguish between known faces. So how hard could it be for a computer? It turns out we know little about human recognition to date. Are inner features (eyes, nose, mouth) or outer features (head shape, hairline) used for a successful face recognition? How do we analyze an image and how does the brain encode it? It was shown by David Hubel and Torsten Wiesel, that our brain has specialized nerve cells responding to specific local features of a scene, such as lines, edges, angles or movement. Since we don't see the world as scattered pieces, our visual cortex must somehow combine the different sources of information into useful patterns. Automatic face recognition is all about extracting those meaningful features from an image, putting them into a useful representation and performing some kind of classification on them.

Face recognition based on the geometric features of a face is probably the most intuitive approach to face recognition. One of the first automated face recognition systems was described in [6] marker points (position of eyes, ears, nose, ...) were used to build a feature vector (distance between the points, angle between them, ...). The recognition was performed by calculating the Euclidean distance between feature vectors of a probe and reference image. Such a method is robust against changes in illumination by its nature, but has a huge drawback: the accurate registration of the marker points is complicated, even with state of the art algorithms. Some of the latest work on geometric face recognition was carried out in [4]. A 22-dimensional feature vector was used and experiments on large datasets have shown, that geometrical features alone don't carry enough information for face recognition.

The Eigenfaces method described in [9] took a holistic approach to face recognition: A facial image is a point from a high-dimensional image space and a lower-dimensional representation is found, where classification becomes easy. The lower-dimensional subspace is found with Principal Component Analysis, which identifies the axes with maximum variance. While this kind of transformation is optimal from a reconstruction standpoint, it doesn't take any class labels into account. Imagine a situation where the variance is generated from external sources, let it be light. The axes with maximum variance do not necessarily contain any discriminative information at all, hence a classification becomes impossible. So a class-specific projection with a Linear Discriminate Analysis was applied to face recognition in [2]. The basic idea is to minimize the variance within a class, while maximizing the variance between the classes at the same time .

Recently various methods for a local feature extraction emerged. To avoid the high-dimensionality of the input data only local regions of an image are described, the extracted features are (hopefully) more robust against partial occlusion, illumation and small sample size. Algorithms used for a local feature extraction are Gabor Wavelets [10], Discrete Cosinus Transform [3] and Local Binary Patterns[1, 7,8]. It's still an open research question how to preserve spatial information when applying a local feature extraction, because spatial information is potentially useful information.

## 1. Holistic Matching Methods:

In holistic approach, the complete face region is taken into account as input data into face catching system. One of the best example of holistic methods are Eigenfaces [12] (most widely used method for face recognition), Principal Component Analysis, Linear Discriminate Analysis [11] and independent component analysis etc.

### Eigenfaces

The first successful demonstration of machine recognition of faces was made by Turk and Pentland[13] in 1991 using eigenfaces. Their approach covers face recognition as a two- dimensional recognition problem. The flowchart illustrates the different stages in an eigenface based recognition system. The first stage is to insert a set of images into a database, these images are names as the training set and this is because they will be used when we compare images and when we create the eigenfaces.The second stage is to create the eigenfaces.

Eigenfaces are made by extracting characteristic features from the faces. The input images are normalized to line up the eyes and mouths. They are then resized so that they have the same size.

Eigenfaces can now be extracted from the image data by using a mathematical tool called Principal Component Analysis (PCA). When the eigenfaces have been created, each image will be represented as a vector of weights. The system is now ready to accept entering queries. The weight of the incoming unknown image is found and then compared to the weights of those already in the system. If the input image's weight is over a given threshold it is considered to be unidentified. The identification of the input image is done by finding the image in the database whose weights are the closest to the weights of the input image. The image in the database with the closest weight will be returned as a hit to theuser of the system [13]

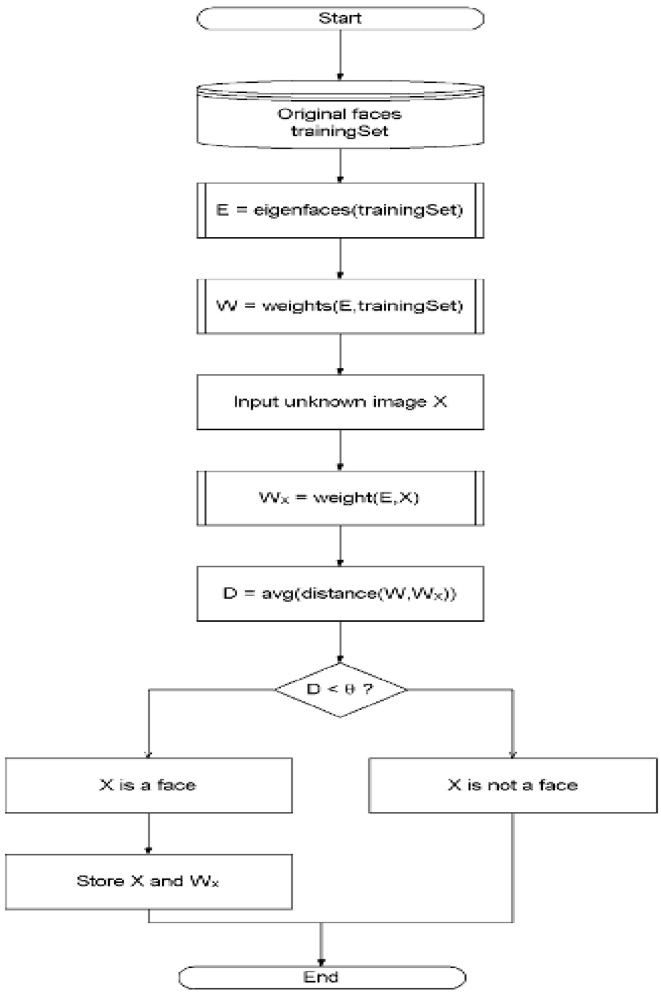


Figure 2.1: Flow chart of the Eigenface-based algorithm

## 2. Feature-based (structural) Methods:

In this methods local features such as eyes, nose and mouth are first of all extracted and their locations and local statistics (geometric and/or appearance) are fed into a structural classifier. A big challenge for feature extraction methods is feature "restoration", this is when the system tries to retrieve features that are invisible due to large variations, e.g. head Pose when we are matching' a frontal image with a profile image. Distinguishes between three different extraction methods:

- ✓ Generic methods based on edges, lines, and curves
- ✓ Feature-template-based methods
- ✓ Structural matching methods that take into consideration geometrical Constraints on the features.

## 3. Hybrid Methods:

Hybrid face recognition systems use a combination of both holistic and feature extraction methods. Generally 3D Images are used in hybrid methods. The image of a person's face is caught in 3D, allowing the system to note the curves of the eye sockets, for example, or the shapes of thechin or forehead. Even a face in profile would serve because the system uses depth, and an axis of measurement, which gives it enough information to construct a full face. The 3D system usually proceeds thus: Detection, Position, Measurement, Representation and Matching. Detection - Capturing a face either a scanning a photograph or photographing a person's face in real time. Position - Determining the location, size and angle of the head. Measurement - Assigning measurements to each curve of the face to make a template with specific focus on the outside of the eye, the inside of the eye and the angle of the nose. Representation - Converting the template into a code - a numerical representation of the face and Matching - Comparing the received data with faces in the existing database.

In Case the 3D image is to be compared with an existing 3D image, it needs to have no alterations. Typically, however, photos that are put in 2D, and in that case, the

3D image needa few changes. This is tricky, and is one of the biggest challenges in the field today.

| Factors for change | local feature | Global feature |
|---|---|---|
| illumination | very sensitive | sensitive |
| expression | not sensitive | sensitive |
| Pose | sensitive | very sensitive |
| noise | very sensitive | very sensitive |

**Table 1**: Comparison of methods based on local or global characteristics.

## 4. Face Recognition Applications

Face recognition is also useful in human computer interaction, virtual reality, database recovery, multimedia, computer entertainment, information security e.g. operating system, medical records, online banking., Biometric e.g. Personal Identification - Passports, driver licenses , Automated identity verification - border controls , Law enforcement e.g. video surveillances , investigation , Personal Security - driver monitoring system, home video surveillance system.

**Applications & examples**

- ✓ Face Identification
- ✓ Access Control
- ✓ Security
- ✓ Image database investigations
- ✓ General identity verification
- ✓ Surveillance

## 5. How does face recognition work?

Many people are familiar with face recognition technology through the FaceID used to unlock iPhones (however, this is only one application of face recognition). Typically, face recognition does not rely on a massive database of photos to determine an individual's identity — it simply identifies and recognizes one person as the sole owner of the device, while limiting access to others.

Beyond unlocking phones, face recognition works by matching the faces of people walking past special cameras, to images of people on a watch list. The watch lists can contain pictures of anyone, including people who are not suspected of any wrongdoing, and the images can come from anywhere — even from our social media accounts. Facial technology systems can vary, but in general, they tend to operate as follows:

- ✓ **Step 1: Face detection**

The camera detects and locates the image of a face, either alone or in a crowd. The image may show the person looking straight ahead or in profile.

- ✓ **Step 2: Face analysis**

Next, an image of the face is captured and analyzed. Most facial recognition technology relies on 2D rather than 3D images because it can more conveniently match a 2D image with public photos or those in a database. The software reads the geometry of your face. Key factors include the distance between your eyes, the depth of your eye sockets, the distance from forehead to chin, the shape of your cheekbones, and the contour of the lips, ears, and chin. The aim is to identify the facial landmarks that are key to distinguishing your face.

- ✓ **Step 3: Converting the image to data**

The face capture process transforms analog information (a face) into a set of digital information (data) based on the person's facial features. Your face's analysis is essentially turned into a mathematical formula. The numerical code is called a faceprint. In the same way that thumbprints are unique, each person has their own faceprint.

✓ **Step 4: Finding a match**

Your faceprint is then compared against a database of other known faces. For example, the FBI has access to up to 650 million photos, drawn from various state databases. On Facebook, any photo tagged with a person's name becomes a part of Facebook's database, which may also be used for facial recognition. If your faceprint matches an image in a facial recognition database, then a determination is made.

Of all the biometric measurements, facial recognition is considered the most natural. Intuitively, this makes sense, since we typically recognize ourselves and others by looking at faces, rather than thumbprints and irises. It is estimated that over half of the world's population is touched by facial recognition technology regularly.

## 6. Face Database

- **AT&T Facedatabase :** The AT&T Facedatabase, sometimes also known as *ORL Database of Faces,* contains ten different images of each of 40 distinct subjects. For some subjects, the images were taken at different times, varying the lighting, facial expressions (open / closed eyes, smiling /not smiling) and facial details (glasses / no glasses). All the images were taken against a dark homogeneous background with the subjects in an upright, frontal position (with tolerance for some side movement).
- **Yale Facedatabase A** The AT&T Facedatabase is good for initial tests, but it's a fairly easy database. The Eigenfaces method already has a 97% recognition rate, so you won't see any improvements with other algorithms The Yale Facedatabase A is a more appropriate datasetfor initial experiments, because the recognition problem is harder. The database consists of15 people (14 male, 1 female) each with 11 grayscale images sized 320 × 243 pixel There are changes in the light conditions (center light, left light, right light), facial expressions (happy,normal, sad, sleepy, surprised, wink) and glasses (glasses, no-glasses).
- **Extended Yale Facedatabase B** The Extended Yale Facedatabase B contains 2414 images of 38 different people in its cropped version. The focus is on

extracting features that are robust to illumination, the images have almost no variation in emotion , occlusion

**Face Image Databas:**

| Data Set | Location | Description |
|---|---|---|
| MIT Database [10] | ftp://whitechapelmediamitedu/ pub/images/ | Faces of 16 people, 27 of each person under various illumination conditions, scale and head orientation. |
| FEBET Database [39] | http://www.nist.gov/humanid /feret | A large collection of male and female faces Each image contains a single per-son with certain expression. |
| UMIST Database [40] | http://images.ee.umist.ac.uk/ danny/database.html | 564 images of 20 subjects. Each subject covers a range of poses from pro le to frontal views. |
| University of Bern Database | ftp://iamftp.unibesch/ pub/Images/Facelmages/ | 300 frontal face images of 30 people (10 images per person) and 150 pro le face images (5 images per person). |
| Yale Database [41] | http://cvc.yale.edu | Rice images with expressions, glasses under di erent illumination conditions. |
| AT&T (Olivetti) Database [35] | http://www.uk.research.att.com | 90 subjects, 10 images per subject. |
| Harvard Database [42] | ftp://ftp.hrl.harvard.edu/pub/ faces/ | Cropped, masked face images under a wide range of lighting conditions. |
| M2VTS Database [43] | http://poseidon.csd.auth.gr/ M2VTS/index.html | A multimodal dat4vacP containing var-ious image sequences. |
| Purdue AR Database [28] | http://rvILectpurdue.eduraleix/ aleixface DB.html | 3,276 face images with di erent facial expressions and occlusions under di er-ent illuminations. |

**Table 2:** Face Image Database

# Chapter3: Conception and Implementation

## 1. Introduction

In this last chapter, we will look at the application aspect of what we talked aboutin the previous chapters, where we will show the working environment, the tech- niques used, the interactive interfaces of the application shown in the web system,as well as the conception of the application, as well as the functions used in the background of the application

## 2. Work Environment

We will present the hardware and software environments of our work.

### 2.1 Hardware Environment

We used a computer which has the following characteristics:

**Type:** Toshiba satellite L855

**Processor:** Intel(R) Core(TM) i7-3610QM CPU @ 2.30GHz (8 CPUs)

**RAM:** 8.00 Go

**Hard Drive:** 700 Go

**System Type:** Microsoft Windows 10

### 2.2 Software Environment

We implemented the application in Python language under the PyCharm Community Edition 2022.1.1

**Python :** Python is an interpreted high-level programming language, multi paradigm which include functional, procedural, object-oriented programming, created by Guido van Rossum. It can be used in many contexts and adapted to any type of use through specialized libraries.

However, it is particularly used as a scripting language to automate simple but tedious tasks. It is also used as a prototype development language when a functional application is needed before optimizing it with lower level language. Python has a simple syntax that makes it easy to learn

**Pycharm:** is an integrated development environment (IDE) used in computer programming, specifically for the Python programming language. It is developed by the Czech company JetBrains (formerly known as IntelliJ).[5] It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes), and supports web development with Django as well as data science with Anaconda.

PyCharm is cross-platform, with Windows, macOS and Linux versions. The Community Edition is released under the Apache License, and there is also an educational version, as well as a Professional Edition with extra features

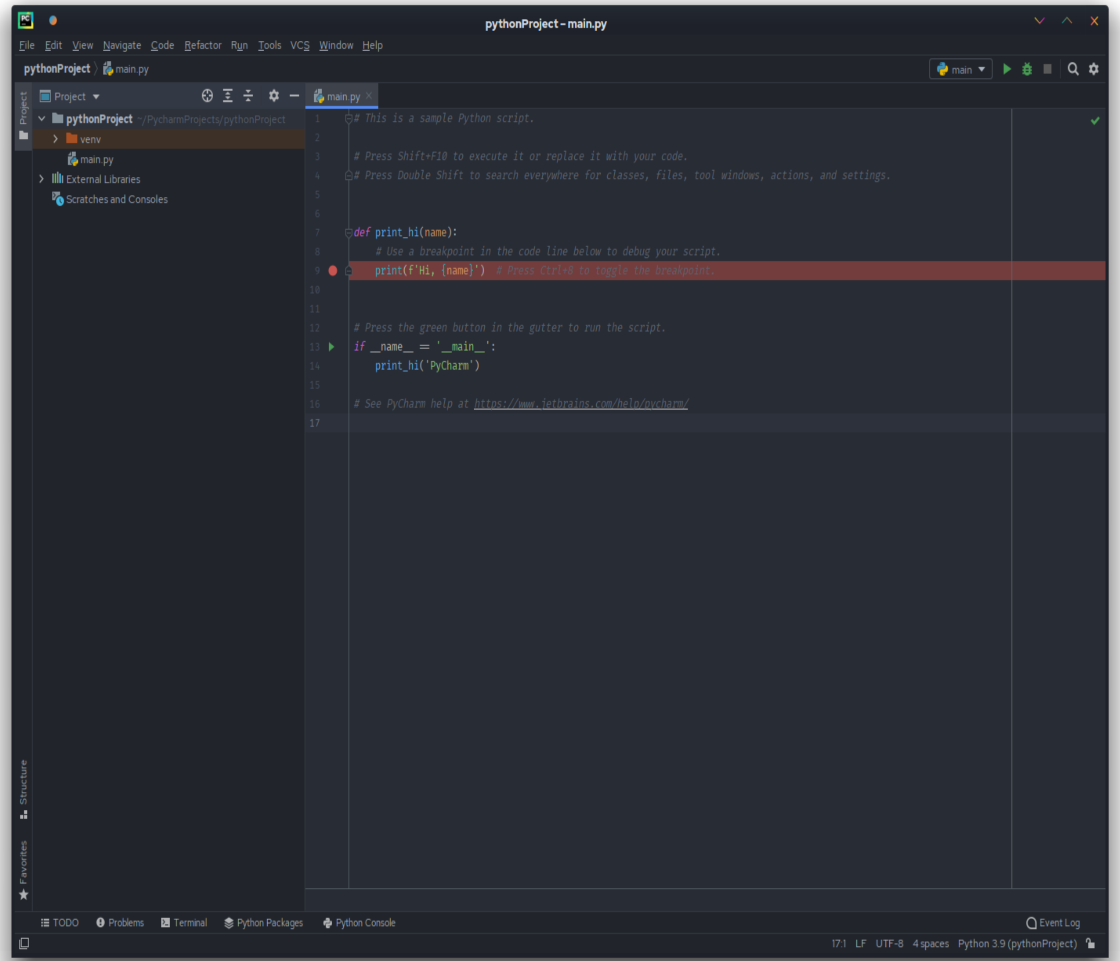


**Figure 3.1**: Pycharm Environment

**NumPy:** NumPy (Numerical Python) is a library for Python programming language. It provides an interface to store and perform operations on the data. In a way, NumPy arrays are like lists in Python, but NumPy makes operations much more efficient, especially on large arrays.

NumPy arrays are at the core of almost the entire Python data science system

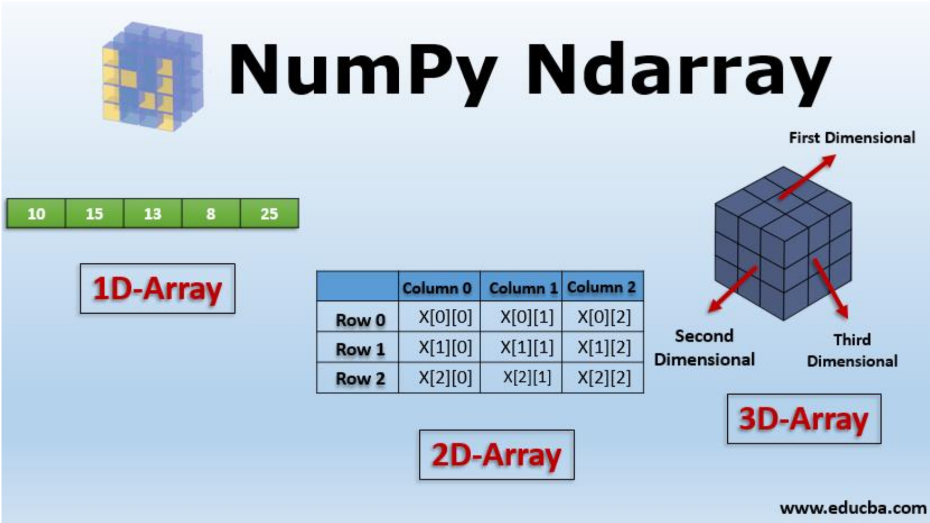


**Figure 3.2:** NumPy Ndarray

**CV2:** (old interface in old OpenCV versions was named as CV) is the name that OpenCV developers chose when they created the binding generators. This is kept as the import name to be consistent with different kind of tutorials around the internet. Changing the import name or behaviour would be also confusing to experienced users who are accustomed to the import cv2.

**OpenCV :** (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by In- tel). The library is cross-platform and free for use under the open-source Apache 2

License. Starting with 2011, OpenCV features GPU acceleration for real-time operations.

**Figure 3.3:** OpenCV Environment

**OS :** ( Miscellaneous operating system interfaces)

This module provides a portable way of using operating system dependent functionality. If you just want to read or write a file see open(), if you want to manipulate paths, see the os.path module, and if you want to read all the lines in all the files on the command line see the fileinput module. For creating temporary files and directories see the tempfile module, and for high-level file and directory handling see the shutil module.

Notes on the availability of these functions:

The design of all built-in operating system dependent modules of Python is such that as long as the same functionality is available, it uses the same interface; for example, the function os.stat(path) returns stat information about path in the same format (which happens to have originated with the POSIX interface).

Extensions peculiar to a particular operating system are also available through the os module, but using them is of course a threat to portability.

All functions accepting path or file names accept both bytes and string objects, and result in an object of the same type, if a path or file name is returned.

On VxWorks, os.popen, os.fork, os.execv and os.spawn*p* are not supported.

**Figure 3.4:** Miscellaneous operating system interfaces

# 3. Conception of the application

## 3.1 System Use Cases

**Recording**

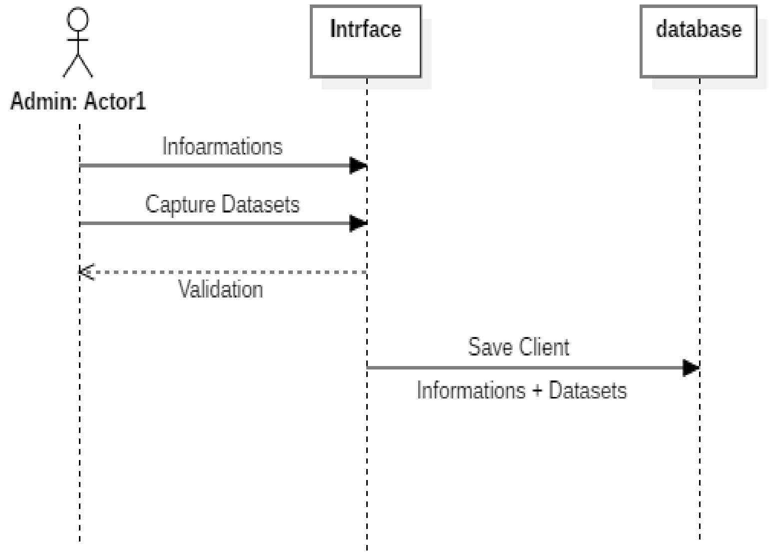


**Figure 3.5:** sequence diagram for registration of a client in the database

**Training**

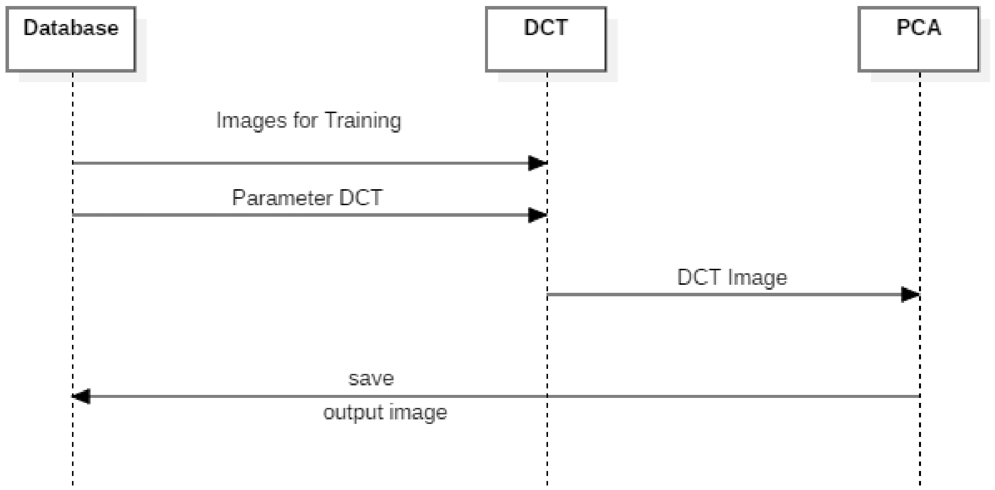


**Figure 3.6**: Sequence Diagram For Training

**Recognition**

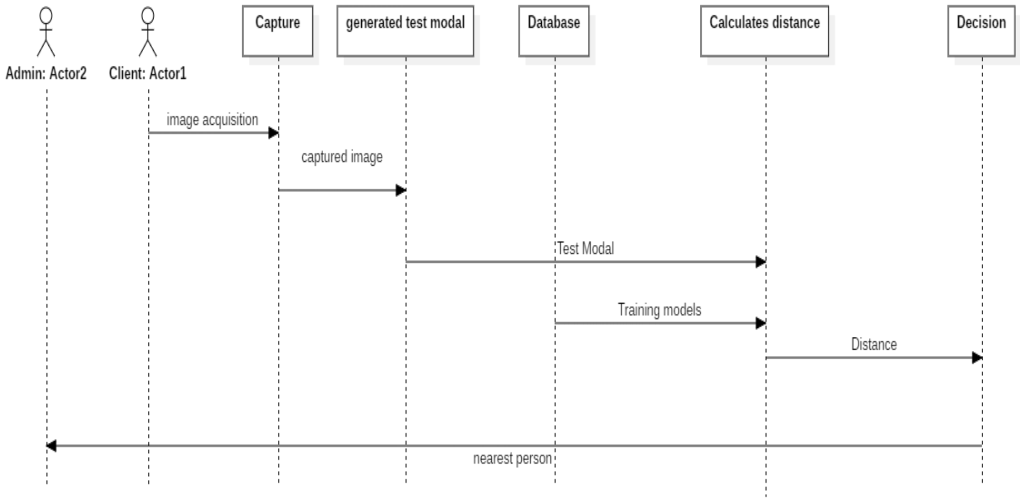


**Figure 3.7:** Sequence Diagram For Recognition

# 4. Data structure and Implementation

## 4.1 Detection and Recognition

### Methods

**Data_Collect:** Provides the information that’s needed to answer question , analyze business performance or other outcomes,and predict future trends , actions and scenarios.

**Face_Data_set:** Is large-scale face attributes dataset with more than 200k celebrity images.

**Face_Training:**This function update and save new photos.

**Face_Detection:** This function detects actual face.

**Face_Recognition:** Is a method of indentifying or verifying the identity of an individual using their face.

# Conclusion

Artificial intelligence has proved its efficiency in real world. Researchers are everyday trying to improve existing programs and inventing new ones .As a result, technology is bringing assistance and profit to Mankind.

In this work, we focused on face detection which is part of object detection and it was proven useful in transportation and security. As shown above, there are meany algorithms in face detection.

A face recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces, typically employed to authenticate users through ID verification services, works by pinpointing and measuring facial features from a given image.

Development began on similar systems in the 1960s, beginning as a form of computer application. Since their inception, facial recognition systems have seen wider uses in recent times on smartphones and in other forms of technology, such as robotics. Because computerized facial recognition involves the measurement of a human's physiological characteristics, facial recognition systems are categorized as biometrics. Although the accuracy of facial recognition systems as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless process. Facial recognition systems have been deployed in advanced human–computer interaction, video surveillance and automatic indexing of image

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## Abstract:

A face recognition system is a computer application capable of identifying or verifying a person from a digital image or video frame from a video source. We saw  the methode of Eigenfaces. And we talked about the aplications of the system ,as well as all the phases of their work. , The work presented in this project is the realization of the human face recognition system using paython



**Key words:** face recognition , Eigenfaces


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## الملخص:

نظام التعرف على الوجوه هو تطبيق كمبيوتر قادر على تحديد أو التحقق من شخص من صورة رقمية أو إطار فيديو من مصدر فيديو. لقد رأينا طريقة Eigenfaces. وتحدثنا عن تطبيقات النظام وكذا جميع مراحل عملهم. ، العمل المقدم في هذا المشروع هو تحقيق نظام التعرف على الوجوه البشرية باستخدام paython



**الكلمات المفتاحية :** face recognatin , Eigenfaces


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