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**Attendance System Based on Face Recognition**

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## **ABSTRACT**

The participation of students in a huge class is difficult to handle by the normal system using nowadays, because it both creates a waste of time and there is a chance that various errors may occur at the stage of entering the system. It is also advantageous because it provides both convenience and security. We can say that biometric methods for face recognition are the fastest and least erroneous security verification. In this project, a face recognition system and an automatic attendance system system have been proposed. Automatic identification and verification of people in the digital environment is provided in the system. The face is first taken from the camera, and its coordinates are recorded in the database. Then, the data in the database is taught to the system by using the LBPH (Local Binary Pattern Histogram) algorithm. The Python programming language will be used in the project and the OpenCV library is intended to be used.

In this system, some features are intended that should be completed. First of all, it is necessary to ensure automatic and real-time participation in our project, and the system in which facial features are recognized must have high accuracy.

## 1 INTRODUCTION

Today, there are systems aimed at determining the participation of people in many fields such as public sector and private sector. Due to the Covid-19 pandemic that is being seen in the world, new systems are being developed to address the need to reduce contact and increasing security needs in the transitional processes of institutions such as companies, educational institutions and hotels. One of these systems, facial recognition system, is developed on the basis that each person's facial structure is different from each other, provides higher security than other biometric methods and minimizes contact in attendance operations. Universities are one of the institutions that use many systems to track the participation of individuals. Universities set a number of rules to encourage students to participate in the course, and these rules are one of the main factors that enable students to participate in the course. A study by Stanca [1], which studies the impact of students' participation in the course, also mentioned that there is a linear relationship in increasing the learning and success rates of the subject if the students attend the course. In most universities today, attendance systems for detecting students' participation in the course are usually obtained through a list of students' signatures or card reader systems in classrooms. However, these systems do not make this system efficient enough, as the deceptions that may occur in the attendances taken independently of the instructor and the glitches in the card reading system do not make this system efficient enough, and these processes take time and are conducive to error because the attendance lists received should be transferred and stored in the digital environment of the universities. With this thesis, it is planned to develop software that enables higher security and faster results by taking facial pictures of students in universities. With this planned facial recognition system, students are expected to record themselves with their personal information and face pictures taken from the camera in the courses where they will be enrolled in the system. After the face images are taken from the students who enroll in the system, a data set will be obtained by training these images to artificial intelligence. Students should be paused in front of the cameras before entering the course and face pictures should be taken from the students. After the face regions are identified from the images taken, the face will be found by matching the faces of the students enrolled in the database. After the student is identified, the system will successfully add the student to the attendance list.



## 1.1 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
FRAS	Face Recognition System
AI	Artificial Intelligence
ML	Machine Learning
ANN	Artificial Neural Network
GUI	Graphical User Interface
LBPH	Local Binary Pattern Histogram
OPENCV	Open Source Computer Vision Library
SQL	Structured Query Language
ID	Identification
CSV	Comma-separated values
FKP	Facial Keypoints
MSE	Mean Square Error
HOG	Histogram of Oriented Gradient
PCA	Principal Component Analysis
LDA	Linear Discriminant Analysis
EBGM	Elastic Bunch Graph Matching
ICA	Independent Component Analysis
Use Case Diagram	Illustrates the relationships between use cases
Activity Diagram	Describes activities and actions taking place in a system
Statechart Diagram	Expresses possible states of a class (or a system)

**Table 1.List of Abbreviations**

## 1.2 PURPOSE

In universities, the process of determining the participation of students in the course is usually followed by the signature paper form signed among the students. However, the data in this manual attendance system must be recorded in the school's electronic system. It is a time-consuming and error-prone system for teachers to transfer this data to the electronic system. With the facial recognition system we will develop, our goal is to recognize the students from their faces when they enter the classroom and to ensure that the students are quickly added to the attendance list and to save the teachers from the process of transferring the attendance system to the system.

## 1.3 SCOPE

### ➤ What's our system ?

The facial recognition and attendance system is a system that allows students to enter their personal information into the courses that students should take from the system, then take the student's face pictures through cameras and apply machine teaching with facial recognition algorithms to recognize the students before participating in the courses.

### ➤ What's our system going to do?

Our system will first take the student's information about the course to be attended and the personal information of the student and then move on to facial detection. The points of the facial coordinates of the student whose face area is detected will be determined with the help of algorithms and a data set with the face data of the students will be obtained. When students show their faces to the system before entering the course, the system will compare the values in the database and find the matching student and then add the student to the attendance list.

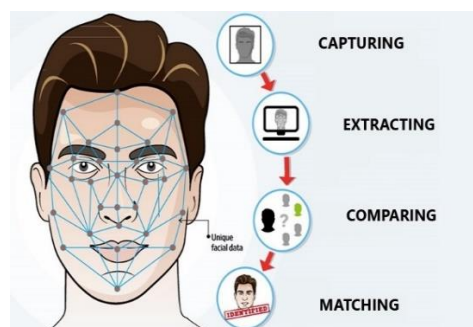


Figure 1.Face Recognition

	A	B	C	D	E	F	G
1	Weekly Attendance Record						
2							
3	Teacher:	Mr Brown				Group Name:	
4	WEEK BEGINNING: (dd/mm/yyyy)	04/01/2010				Level:	
5	Monday						
6							
7	Student Name	Monday 04 Jan-10	Tuesday 05 Jan-10	Wednesday 06 Jan-10	Thursday 07 Jan-10	Friday 08 Jan-10	
8	01 BROWN, John	PR	PR	PR	PR	PR	
9	02 BLACK, Lucy	PR	PR	PR	PR	PR	Monday abs
10	03 BLACK, Neil	PR	PR	PR	PR	PR	
11	04 BROWN, Simon	AB	PR	PR	PR	AB	See note page
12	05 DOWNS, Paul	PR	PR	PR	PR	PR	
13	06 GREEN, David	PR	PR	PR	PR	PR	
14	07 GREY, Michael	PR	PR	PR	PR	PR	
15	08 SKY, Maria	PR	PR	AB	PR	PR	Wednesday
16	09 JUPPER, Richard	PR	PR	PR	PR	PR	
17	10 WHITE, Susan	PR	PR	PR	PR	PR	
18	11						
19	12						
20	13						
21	14						
22	15						
23	16						
24	17						
25	18						
26	19						
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35	28						
36	29						
37	30						
38	31						
39	1						
40	2						
41	3						
42	4						
43	5						
44	6						
45	7						
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47	9						
48	10						
49	11						
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130	30						
131	31						
132	1						
133	2						
134	3						
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281	26						
282	27						
283	28						
284	29						
285	30						
286	31						
287	1						
288	2						
289	3						

Figure 2.Attendance File

➤ **What are the benefits and objectives of the system?**

- Shortening attendance time at the start of the course
- Preventing the deceit that students may perform on the signature paper
- Preventing errors that may occur when transferring the signature list of teachers to the digital system
- To allow the teacher to devote more time to the lesson and concentrate
- Preventing non-enrollees from being included in the class
- An interface for parents to check if their students are going to school
- Our system has many features and advantages, such as providing a ready-made report system that teachers can transfer to the system.

➤ **What are the security risks associated with the system?**

- **Misuse of Facial Recognition Data**

Facial recognition is considered sensitive data because it uses facial images, which is one of people's biometric data, and the person must have permission to use this data, but they are concerned that their personal information will be stolen and financially damaged by malicious individuals.

- **Data Storing**

In order to produce successful results in facial recognition systems, we need to define large data sets with machine learning. In this way, the accuracy of the system is reduced to a higher level. However, large areas are required to store these large data sets, and a good resource is required to securely protect these data sets.

- **Security Breaches**

A number of potential breaches of the facial recognition project that may be intended to deceive the system can be considered vulnerabilities. These are attempts to illegally log in by showing a picture of that person from a card belonging to another person against the camera, attempts to log in by showing a video of another person's face from the phone, and finally, these violations of malicious individuals who present themselves as someone else in the system using a 3D mask are considered vulnerabilities, but many studies have been carried out today on the solution of this issue.

## **1.4 OVERVIEW**

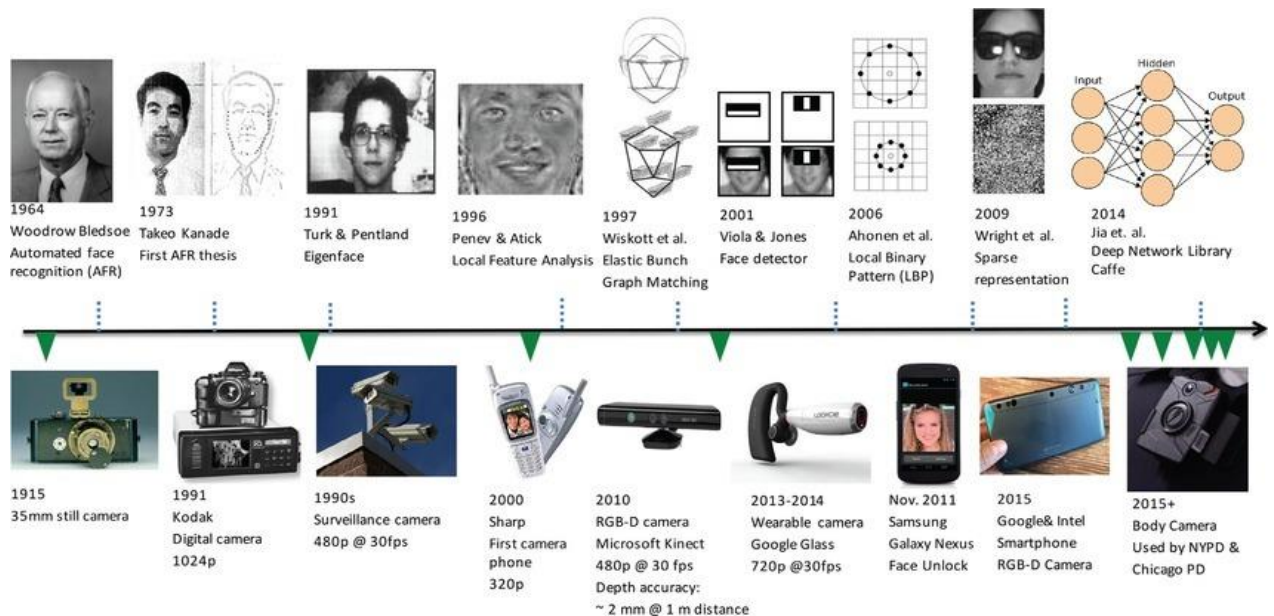
- /1 In Section 1, what are the steps taken to solve a problem in life that is one of the basic principles of engineering in the project is mentioned in Section 1. In one of these steps, preliminary information about what are the problems in the attendance system in schools and how to solve this problem is given in the introduction. Then it was explained what this problem is in general, the services offered by the system to us, the advantages of the system and the security vulnerabilities that may occur with this system.
- /2 Section 2 provides a literature review.

## 2 LITERATURE REVIEW

### 2.1 HISTORY OF FACE RECOGNITION

Facial recognition technology, one of the technologies that was considered difficult to do in the past years, has become increasingly popular due to the fact that it is one of the methods where contact is minimal in today's epidemic conditions. Many companies use this technology to speed up operations instead of calling their customers to their offices or workplaces.

While facial recognition technology is expected to go further over the years, we will examine how this technology has evolved from the past to the present.



**Figure 3. History of Face Recognition**

#### The Emergence of the Facial Recognition System – 1960s

Woody Bledsoe, Helen Chan Wolf and Charles Bisson are the first people to work in the field of facial recognition technology. They have been working with the help of computers to perform recognition operations from people's faces. In these studies, they primarily marked the distances between the human face, such as the distance between the eye centers, mouth measurements. After receiving help from a computer for problems such as pose variation, they tried to decode it by comparing the images they measured to determine the identity.

### **Advancing the accuracy of Facial Recognition – 1970s**

Goldstein, who conducted research on Bledson's work in the 1970s, added 21 specific features to the system, such as hair color and lip thickness, to ensure that the recognition rate of faces increases. With these added features, the accuracy rate increased, while manually drawing and calculating the features on the face increased the difficulty of the job.

### **Using linear algebra for Facial Recognition – 1980s/90s**

Towards the end of the 1980s, advances were seen in the field of biometric development of facial recognition technology for enterprises. Sirovich and Kirby began to use linear algebra for the problem of facial recognition, which became one of the problems in the system. In this system, called Eigenface, he suggested that an inference could be made by analyzing features from facial images. They found that less than 100 features are required to get the right facial image in this system. In 1991, Turk and Pentland, who were working in the field of facial recognition, discovered how faces should be perceived through the latest studies conducted in this field, and the first steps of this automatic facial recognition system were taken. However, due to the external factors brought by the period, their projects were blocked.

### **FERET Programme – 1990s/2000s**

In the early 1990s, the Defense Advanced Research Projects Agency (DARPA) and the National Institute of Standards and Technology (NIST) began using the FERET program to support work in the field of facial recognition technology. The project included a database that allows storing facial images. In the project, 2413 face images were taken from 856 people from different angles and a test set was obtained. By obtaining comprehensive test images with this process, it is aimed that the database will be exemplary information for people who will work in the future and that the system will detect faces at a higher rate.

### **Face Recognition Vendor Tests – 2000s**

Face recognition vendor tests were first used by the National Institute of Standards and Technology (NIST) in the early 2000s. The mechanism was introduced to the already existing FERET system to ensure that independent governments can profit commercially from this technology. This system is meant to make the most efficient use of facial recognition technology for law enforcement agencies and the US government.

### **Face Recognition Grand Challenge – 2006**

The purpose of the Great Facial Recognition Challenge, which appeared in 2006, was to contribute to the facial recognition system that the US government was also working on and to introduce and further develop facial recognition technology. The FRGC evaluated the system, which is the newest of the facial recognition algorithms developed so far. Within the scope of this evaluation, high-resolution images, 3D face scans and iris images used for the test were examined. As a result of the study, it was observed that the newest algorithms developed have a recognition rate of 10 times higher than the algorithms in 2002 and a recognition rate of 100 times higher than the algorithms in 1995.

### **Social Media – 2010-Current**

In 2010, Facebook began using a facial recognition system that allows people to be identified from facial photos shared by its members on their accounts. This has been discussed in terms of the violation of personal data, but Facebook has not taken any steps back on this issue. More than 350 million photos updated every day become new data for the face recognition system.

### **iPhone X – 2017**

Facial recognition technology, which was advancing rapidly until 2010, became one of the first face recognition applications in the industry when Apple unlocked the phone on its iPhone X device by recognizing the person's face in order to provide convenience in people's personal lives as of September 12, 2017.

## 2.2 PUBLISHED ARTICLE REVIEWS

In this part of our project, the studies of facial recognition and attendance system are examined. With the advancement of artificial intelligence technology, it has been observed that the detection of people from facial images can control the attendance process of institutions more quickly and safely. What are the projects about the facial recognition and attendance system, how these projects reach the goal, what are the problems they face are examined and it is aimed to start in the light of this information in the project we will do.

- Kennedy Okokpujie who created a study called “ A Face Recognition Attendance System with GSM Notification” uses the Fisher face algorithm [2], which Viola Jones developed for use in face detection and diagnostics, in her system. It has created a database in which photos of people are collected through a webcam and data is collected for processing. Kennedy Okokpujie in his study emphasized the conclusion that lighting conditions are important for the good operation of the system. He observed that according to the lighting conditions of the environment, the system has an effect such as a decrease of up to 54% in detecting faces.
- Sathyanarayana, who created a study called “Automatic Student Attendance Management System Using Facial Recognition “,[3] used Jones' Purple algorithm for face detection and MSE algorithms for face recognition in his system. The result obtained in the study ; as the training levels of the photos in the system increased, it was revealed that there was a linear result between the security and the correct result dec level of the system. In his system, he took facial images from different angles from students and found that an alignment of up to 60 degrees could be detected from these images. When 10 students trained at the application stage of the system ran the application with their face pictures, it was concluded that the system recognized 7 students with a 70% accurate result.



- E. Varadharajan , who created a study called “Automatic attendance management system using face detection,"[4] explained in his research how the system detects faces before removing backgrounds from images taken from students, and the performance of the system increases by providing operations to cut out detected faces. The author recommended the use of the EigenFace method for convenience and high efficiency of face recognition operations. The experimental results of the research are ; he observed that the face recognition rate of dec decisively veiled women ranged from 10% to 45% according to their religious beliefs, and the recognition rate of non-veiled women ranged from 87% to 93%
- Firoz Mahmud, who created a study called ““Face Recognition using Principle Component Analysis and Linear Discriminant Analysis"[5] used UMIST AND ORL databases as 2 different databases in her project. In their projects, they applied the principal component analysis and linear discriminant analysis techniques, which they considered successful in detecting facial images. They examined these pictures by taking pictures from different angles from the students. As a result of their research, they observed that the accuracy rate of the front-aligned images is higher than the side-aligned images.
- Jyotshana Kanti, who created a study called “Study of Implementing Automated Attendance System Using Face Recognition Technique,"[6] which aimed to use the PCA and ANN algorithms together in its attendance project. The author aimed to solve the time loss caused by the classical attendance method with the system that it will create. He planned to obtain inferences from the images using the PCA algorithm and match these inferences with the similarities in the database. ANN has planned to use the algorithm to solve the inputs given to the system at the expected value. A combination of mathematical operations that will be used in the system dec has argued that it can be done.As a result, it has been shown that the system can work in face recognition processes by combining different algorithms.

- Priyanka Wagh, who created a study called “Attendance System based on Face Recognition using Eigen face and PCA Algorithms,”[7] conducted research on several facial recognition systems such as principle component analysis (PCA), Eigenface, Support Vector Machines (SVM) and neural networks. In these studies, he compared the success rates that algorithms return as a result. He also explained how these algorithms are architectures , what kind of methodologies they contain. It has revealed in a mathematical model for users about the subject they are working on.
- E.Varadharajan, R.Dharani, S.Jeevitha, who created a study called “Automatic attendance management system using face detection”[8] eigenfaces method for facial recognition system in his work. After identifying faces with the Eigenface method, they performed cropping the backgrounds of binary and grayscale-type images. The author proposes this method for facial recognition system in terms of speed, efficiency and simplicity.
- K.Senthamil Selvi1, P.Chitrakala, A.Antony, Jenitha who created a study called “Face recognition based attendance marking system”[9] used skin technique for facial detection. After detecting faces with skin technique, it only trims the skin pixels on the faces and makes the rest of the part black. After the skin technique and cropping procedures in the picture, the author chose to store the students' facial images and information in 2 different databases.
- A. Raghuwanshi and P. D. Swami who created a study called “An automated classroom attendance system using video based face recognition” [10] PCA and LDA algorithms from facial recognition techniques were discussed in the research. Eigenfaces and fisherfaces methods were also used for feature extraction in the research. They suggested that the PCA and LDA algorithms would work best if the normal light conditions, without pose changes and if the distance between the camera and the student was 1-3 feet, would work best. They found that high-resolution images would be needed for the two algorithms to base pixels when calculating. It is understood that the PCA algorithm and facial recognition time are defined in a shorter time than the

LDA algorithm. The LDA algorithm, on the other hand, has a higher rate of recognition than the PCA algorithm, although it identifies over a longer period of time.

- P. Wagh, R. Thakare, J. Chaudhari and S. Patil who created a study called “Attendance system based on face recognition using eigen face and PCA algorithms”[11] they decided that there are many biometric methods for detecting the participation of people, but the face attendance system is the system with the highest performance. They suggested that in order for the system to work at the highest efficiency, it should be able to detect faces in the environment at a single time. At this stage, they encountered some technical problems such as light intensity and posture of head positions when taking pictures from students. As a solution to this problem, they used the Illumination Invariant algorithm.
- S. Dev and T. Patnaik who created a study called “Student Attendance System using Face Recognition”[12] they have covered 3 different facial recognition algorithms. In order to compare the performance of the algorithms, they discussed various parameters such as the light intensity of the environment, the head positions of the students in the photos, and the distance of the students to the camera. Among the algorithms tested on these parameters, the K-nearest neighbor algorithm made 97% accurate recognition, while the Convolutional neural networks algorithm had 95% accuracy and the Support vector machine algorithm had 88% accurate facial detection rates.
- Anil Kumar Sao and B. Yegnanaarayana who created a study called “Template matching Approach for Pose Problem in Face Verification Speech and Vision Laboratory” [13] preferred the template matching method, which is one of the face recognition algorithms. The reason why this algorithm is used in the project is that it can solve the problem of poses that may be difficult to recognize faces from photos taken from students. In the technique here, the face images taken are kept in the edge view. After this process, it has been recommended to make a template matching application on these images that are kept. The performance of the system has been tested according to the number of matched people from the system.

- A. Jha who created a study called “Class Room Attendance System Using Facial Recognition System.”[14] aimed to increase the recognition rate of the system by using PCA and LDA analysis methods in addition to the idea of comparing the photos taken during the attendance process with the previously recorded photos. They provided a framework for determining photos in a certain way so that scores could be matched.
- V. Kurniawan, A. Wicaksana and M. I. Prasetyowati who created a study called " The implementation of eigenface algorithm for face recognition in attendance system," [15] in their face identification and attendance projects, they used the Euclidean distance method together with the eigenface algorithm. As a result of what they saw in the operating tests of the system, they observed that it did not increase the face recognition rate by training the images to the machine more than once. They found that not only did it not increase the recognition rate, but also that the process of training the pictures more reduced the accuracy rates. They have proved by their experiments that 87% of the images trained 5 times and 68.89% of the images trained 10 times have accuracy rates.
- Nilesh D. Veer who created a study called “An automated attendance system using video surveillance camera” [16] in his attendance project, he provides input information to the system via video. He used the Viola Jones algorithm, which he uses to detect faces when a human face is detected in a video. He found the threshold values of the detected faces and performed face identification operations with the PCA algorithm from these values. He stated that with these techniques that he uses, he can recognize students and successfully record their entry and exit times in the system with an accuracy rate close to 100% in places where the number of students is small.

### **3 SYSTEM METHODOLOGY**

This section discusses the software development methodology and its technologies used for our face recognition based attendance system. Considering the construction process of our project, it has been observed that the most appropriate method is the waterfall model.

The waterfall technique is a project management methodology that divides a project into sequential linear phases. The software development process under the waterfall technique is divided into stages like analysis, design, coding, testing, release, and maintenance. As seen in the methods used in software development processes, the methods are carried out linearly in the waterfall model. From the initial stage to the final stage of the development process, each section continues to work on what the previous stage produced.

#### **ADVANTAGES OF WATERFALL MODEL**

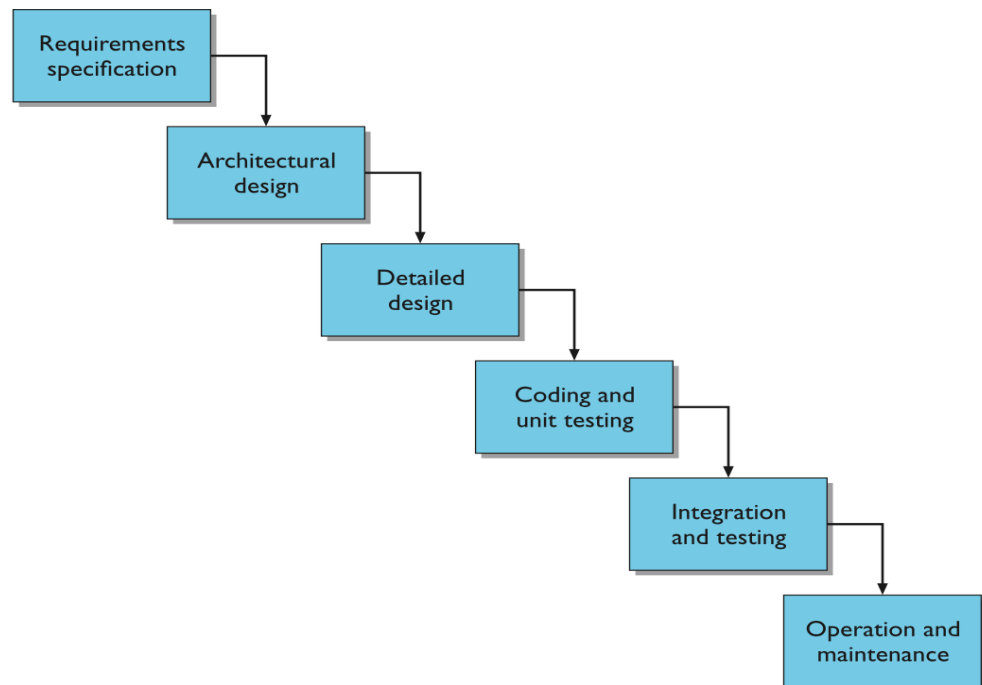
- The approach is simple to comprehend and implement.
- All stages are done one by one.
- Managing the system is easy.
- It's a simple procedure to implement.
- With the Waterfall technique, results and progress are meticulously recorded.

#### **DISADVANTAGES OF WATERFALL MODEL**

- It is a waste of time to have to wait for the completion of tasks in all departments for the project to emerge.
- Changes that the customer may request later cannot be met in the project.
- Since it does not allow the departments to work simultaneously with each other, it reduces efficiency.
- Projects that are more difficult and hazardous are less appropriate.

### 3.1 IMPLEMENTATION OF WATERFALL MODEL

The waterfall technique is a project management methodology that divides a project into sequential linear phases. The software development process under the waterfall technique is divided into stages like requirements specification, architectural design, detailed design, coding and unit testing, integration and testing, and operation and maintenance. As seen in the methods used in software development processes, the methods are carried out linearly in the waterfall model. From the initial stage to the final stage of the development process, each section continues to work on what the previous stage produced.



**Figure 4. Waterfall Model Methodology**

**Requirements Specification:** At the needs stage, which is one of the first steps of our software development method, the project members meet in order to determine the applicability of the given task in the software world. They work on what the customer wants for the product to be developed in the project, what the needs of the users are, the conditions under which it will be developed and the risks of the project. they combine all the documents they have obtained into one document.

**Architectural Design :** In the design phase, which is one of the first steps of our software development method, the requirements phase is studied and the design of the system to be created after the end of the examinations is designed. The design features at this stage are designed to run the code to be written in the real environment. The team designs the system with all these reviews, but coding is not done at this stage. It determines the requirements such as the programming language to be coded and which editor it will be written in.

**Coding and Unit Testing:** The design is put into action at this phase. When the SDD is done, the implementation or coding process runs easily since the SDD has all of the information that software developers require. The code is extensively checked and updated throughout testing. At first, little units are put through their paces independently. The modules are then put to the test by writing further code to see how they interact with the intermediate output stream.

**Integration and Testing:** At this stage of our methodology, with the completion of the coding process, it is necessary to test whether the written software has any errors. After these test processes, the project delivery process to the customer begins. Some software companies may also choose to have the UAT test applied by the users themselves.

**Operation and Maintenance:** The last stage of our software development method is the delivery of the prepared project or product to the customer and the customer starts to use the project. At this stage, as the customer starts using the project, problems arise over time depending on the needs that the customer wants to be in the project. Project teams are the stage where these problems are resolved and the system updates.

### 3.2 CHALLENGES IN FACE RECOGNITION SYSTEMS

With the development of facial recognition technology, the area of its use in everyday life has become quite large, and the system may also have some complexities that arise as a result of users or external factors. These difficulties directly affect the correct operating performance of the system. In this part of my thesis, we will discuss what difficulties the system in facial recognition technology may have when detecting people's facial images. There are many factors in detecting facial images. If it is necessary to study them in two different headings ;

**Intrinsic factors:** It arises due to the natural structure of the face and does not depend on the observer.( facial hair, cosmetics, glasses)

**Extrinsic factors :** This is due to changes in the face pictures due to the environment between the person trying to decipher the face picture and the light.

#### A- POSE VARIATION



**Figures 5.Pose Variations**

When using facial recognition technology, changes in users' poses while taking facial images from users cause problems for the system during the face detection phase.

While the system can tolerate small-degree exposure differences, it is sensitive to large-degree exposure changes, so this appears to have a significant impact on facial recognition rates. Most of the face images stored in the database are data taken from the front angle. If the exposure change rate is high in the image provided as an input to the system, the photo should be corrected with techniques that try to align the image.



## B- EXPRESSION VARIATION



**Figure 6. Expression Variations**

Facial expression, which is one of the biometric data that allows people to have a unique identity from each other, is one of the most important biometrics in terms of showing people's identity as well as their emotions. Changes in facial

expressions can occur due to the positive and negative situations that people experience in their daily lives. Such as happiness, sadness, irritability, excitement, fear.

The differences in facial expressions that may occur according to people's mental states make it difficult for facial recognition technology to capture one-on-one matches compared to facial expressions found in the database when it tries to determine who is one of the human faces.

## C- OCCLUSIONS



**Figure 7. Occlusions**

Occlusion means obstruction. It is cited as one of the biggest challenges facing the Facial Recognition System. Occlusion occurs when the images in the face area and other parts of the face are turned off in the face image that the system receives from the user.

Examples of these include glasses, hats, masks.

As a result of the closures in this face area, it becomes difficult for the system to classify the person's image. It has been observed that when such blockages occur from facial images taken from people, the system will see a decrease in the recognition rate of these people.

#### D- ILLUMINATION VARIATION



**Figure 8. Illumination Variation**

The lighting problem, it arises in the changes experienced by the light present in the environment. In conditions where the lighting conditions of the environment change, the system's ability to recognize people's faces will be affected. It will be seen that different face models are obtained if the same

camera captures the same individual in different lighting environments. In order to overcome these lighting problems, some synchronization techniques are applied. But it is recognized that this is also difficult to use for both humans and algorithms. As a result, optimizing the lighting conditions will bring you closer to the most accurate result for automatic facial recognition systems.

#### E- LOW RESOLUTION



**Figure 9. Low Resolution**

The size of the standard image should be at least 16\*16 pixels. Images below this resolution are called low-resolution images.

Examples of these low-resolution images are images

obtained from environments such as CCTV cameras on the streets, supermarket cameras. Since details in the face area cannot be analyzed in photos with a resolution lower than 16 \*16, it can be seen that the system will have a low rate of recognizing people from photos of this scale. In cases where the resolution is high, it is seen that the recognition process will be an easy and fast process that can be obtained. From this, it is concluded that the resolution directly affects the face recognition rate.

## 4 SYSTEM OVERVIEW

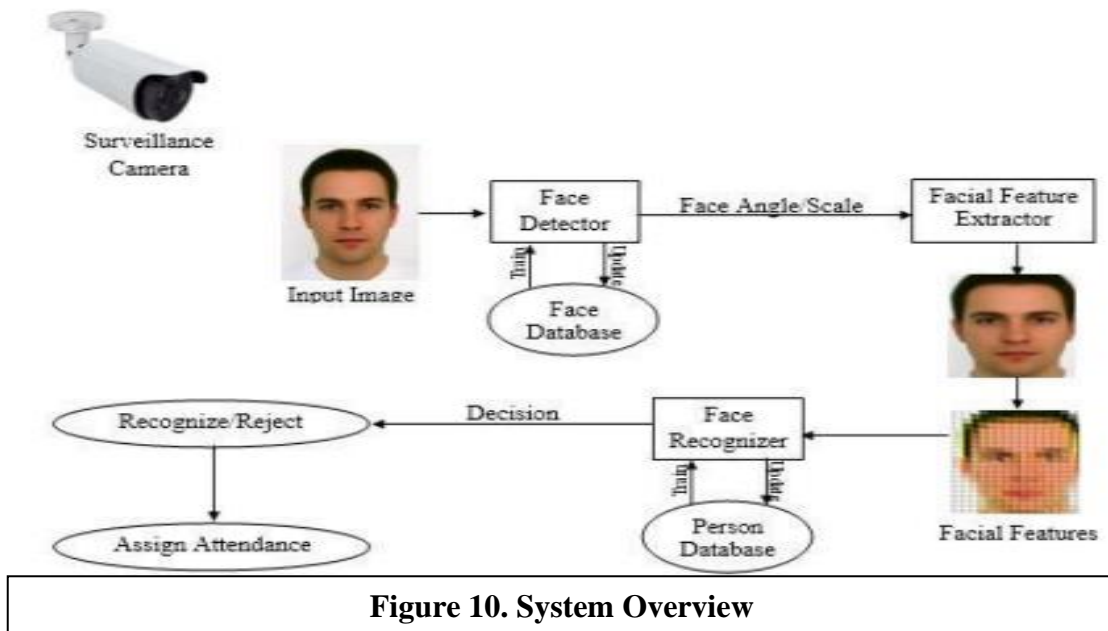


Figure 10. System Overview

"In our face identification and attendance system, the design of our desktop application was carried out with tkinter, one of the python in interface applications, by design. The system is divided into many categories in order to provide the user with an easy-to-understand interface. In the student category there is a page where students can register for their courses and save their face images

**Figure 3. Face Recognition System Overview** to the system and update them at any time. The information of these registered students will then be stored in the Mysql database for use in face identification and will allow students to log in to the system by checking their faces from here every time during the login phase. There is a photos category that allows students to store their completed photos from their own category, where there are many photos of each user taken from different angles. A lot of each student we will increase the accuracy rate of the algorithm by taking photos. In our Train category, there will be a section where we provide images taken from students to be trained using artificial intelligence algorithms. After the information and face pictures were taken from the students, their photos were stored. After the stored photos are trained to artificial intelligence, the sequence of operations in the system will be transferred to the face recognition category. Here, the system compares the faces of the students who are facing the camera with the data found in the system in a trained way and compares the information with the matching students who what time does it take to attend class in the Attendance category.it will store it in a csv file in the form of a list.

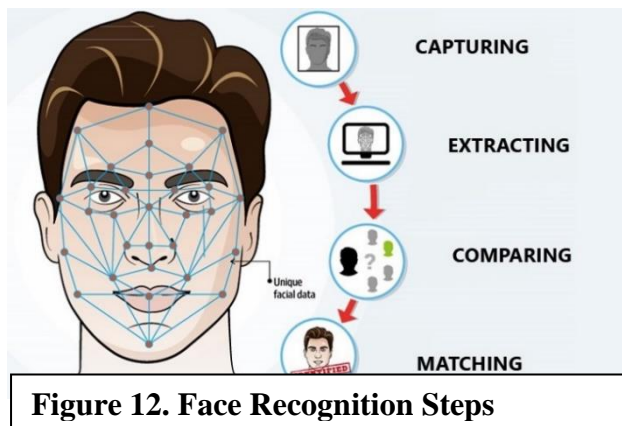
The mobile application is very simple to use. Users do not need any technical information; all they need to do is get information about the restaurants they are interested in. Many users can log in and use the application at the same time. Nothing different has been done to protect users' data. The reason why this is not done is that important information of users is not required in the application. The app does not have any special backup feature to protect your important data. And finally, the application is extremely flexible and error-resistant, as well as scalable and easy to maintain and add new features in the future.

In facial recognition systems, people's face pictures are taken through a webcam. Then, using features such as the distance between the nose, mouth and chin, and the distances between the eyes, which are specific features of these faces taken, the system measures the person's facial structure. These measured data are stored in the database and then used to compare them with the facial images in the system when people are standing in front of the camera. There are 80 different nodes on people's

faces. These ; nose width, distance between the eyes, depth of the eye dec are measures such as. According to studies, although there are changes in people's physical appearance, these rates always remain the same.

### 4.3 WORKING STEPS OF FACE RECOGNITION

We can examine the facial recognition system in 4 steps.



**Figure 12. Face Recognition Steps**

**CAPTURING** : First of all, pictures of a person's face are taken using a camera. Since the system will analyze these captured images later, getting quality images from people is an important criterion at this stage.

**EXTRACTING**: To give exact data that can be used to discriminate between the faces of different persons.

#### **COMPARING**

Comparing the face data of people who have already been registered with the system with the data of the person who is trying to log in to the system

**MATCHING**: The software then checks to see if the sample matches any of the photographs in the database.

After face detection, the background correction of the resulting images is first started. The values of the dimensions determined by the percentage are normalized. Accurate detection of the face the image is standardized as a pose. In these standardization processes, it is important to identify certain areas of the face. Mathematical identification of image data in a digital environment occurs thanks to algorithms.

## 4.4 SYSTEM REQUIREMENTS

When developing applications in the field of software and hardware, certain system requirements are needed to ensure the highest level of operating performance and impact from this area. It is known that in cases where the needs in the field of software and hardware are missing in the system, the work developed can cause installation problems and performance loss. At the same time, there will be shortcomings in system requirements ; it may cause the developed applications to be run at a level that will be below the expectation.in order not to encounter such problems, developers need to determine the software and hardware systems well.

### HARDWARE REQUIREMENTS

<b>Processor</b>	INTEL CORE i5 8th GEN
<b>Graphics Processing Unit (GPU)</b>	NVIDIA GEFORCE
<b>Random Access Memory(RAM)</b>	8 GB
<b>Hard Disk</b>	1 TB

**Table 2.Hardware Requirements**

### SOFTWARE REQUIREMENTS

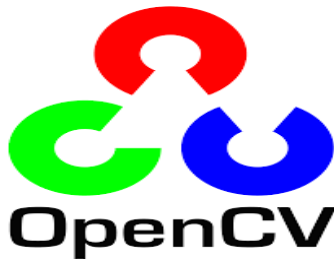
<b>Operating System</b>	Windows 11
<b>Language</b>	Python 3.8
<b>Editor</b>	PyCharm2021.2.3
<b>Design Tool</b>	Star Uml

**Table 3.Software Requirements**

## 4.5 LIBRARIES AND PLATFORMS

The programs and libraries that I intend to use in our attendance project with the Face Recognition System are Python, OpenCV and the Tkinter interface.

### 1- OPENCV



- OpenCV (Open Source Computer Vision) is an image processing library that is free and open source.
- The library, which was started to be developed by Intel in 1999, is constantly updated by many companies contributing to the development environment.
- Due to the fact that the license distribution is provided by BSD, no fees are expected for academic projects and commercial uses.
- Because OpenCV is an independent library, it can also work on devices such as Windows, Linux, FreeBSD, Android, Mac OS, which are various operating systems.

### What can be done with OpenCV

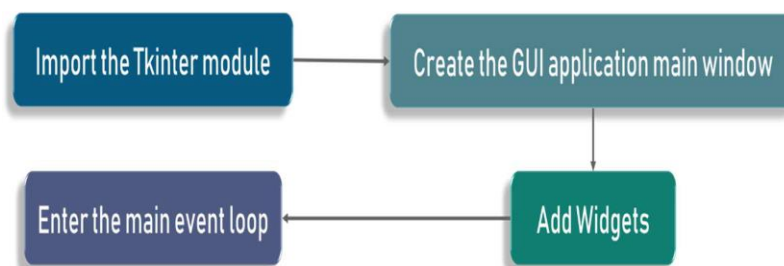
- Face recognition
- Object classification
- License plate recognition
- Image comparison
- Ability to detect human movements

### 2- Tkinter GUI interface

One of the programs included in the Python program to make a graphical user interface is Tkinter.

The Tkinter interface is one of the most widely used interfaces. As a result of this, it has become widespread for users to understand the interface very easily and use it with its simplicity. GUI applications for users are made with this interface.

There are 2 structures used in the use of Tkinter.



**Widgets** are features similar to HTML elements, which are one of the types of web programming. They allow us to use features such as checkboxes, buttons, forms that can be used to interact with users.

**Main event loop:** It is an infinite loop that allows us to start running our program with the interface we have designed, and the interface to be displayed continuously until the user does not give the command to close the window with the interface.



### 3-PYTHON



Python is a programming language developed in the 1990s as a result of the work of Guido Van Rassum. This new programming language was named after Monty Python, a British comedy group. Python programming language is a high-level language with a lot of object-oriented, interpretative, modular features in terms of its features.

We have said that Python is a high-level programming language, but what is this high level? A high-level programming language is a language that users can easily understand when they study codes. For example, when you look at Assembly code, most people may not understand something because it is closer to machine code. That is why assembly is instantiated as a low-level language, not a high-level language.

#### Python Features

**Easy-to Read:** The reason why the code readability of the Python programming language is higher than other programming languages is that whitespaces are also calculated in the structure of the language.

**Problem resolution speed :** Due to the fact that there are many active users and developers of the Python programming language in the world, it is an important feature that there are communities of users and that developers' problems are solved in a short time, especially in terms of finding solutions to the problems of people who are engaged in individual work.

**Extensive Library :** Python is a programming language that can run on different platforms and appeals to many users in terms of the libraries it contains. In computational systems such as SciPy and NumPy, Scikit-learn provides convenience by preventing developers from rewriting every code by having libraries in areas where machine learning is applied.

**Reliable and Effective:** One of the important reasons for choosing for developers is that the code written in Python does not experience a performance loss when run on any different platform.

**Extendable :** Developers of the Python programming language can add modules to the system that will increase the efficiency of codes and allow them to customize this system.



## 5 SYSTEM DESIGN

### 5.1 SEQUENCE DIAGRAM

The sequence diagram, which is one of the diagrams available in the Uml language, is mainly used to study the communication of objects with each other. In the sequence diagram, the instance name of the object consists of a timeline with synchronous or asynchronous messages in the messages section, which is the most important part of the diagram. The timeline is shown from top to bottom, as in our example

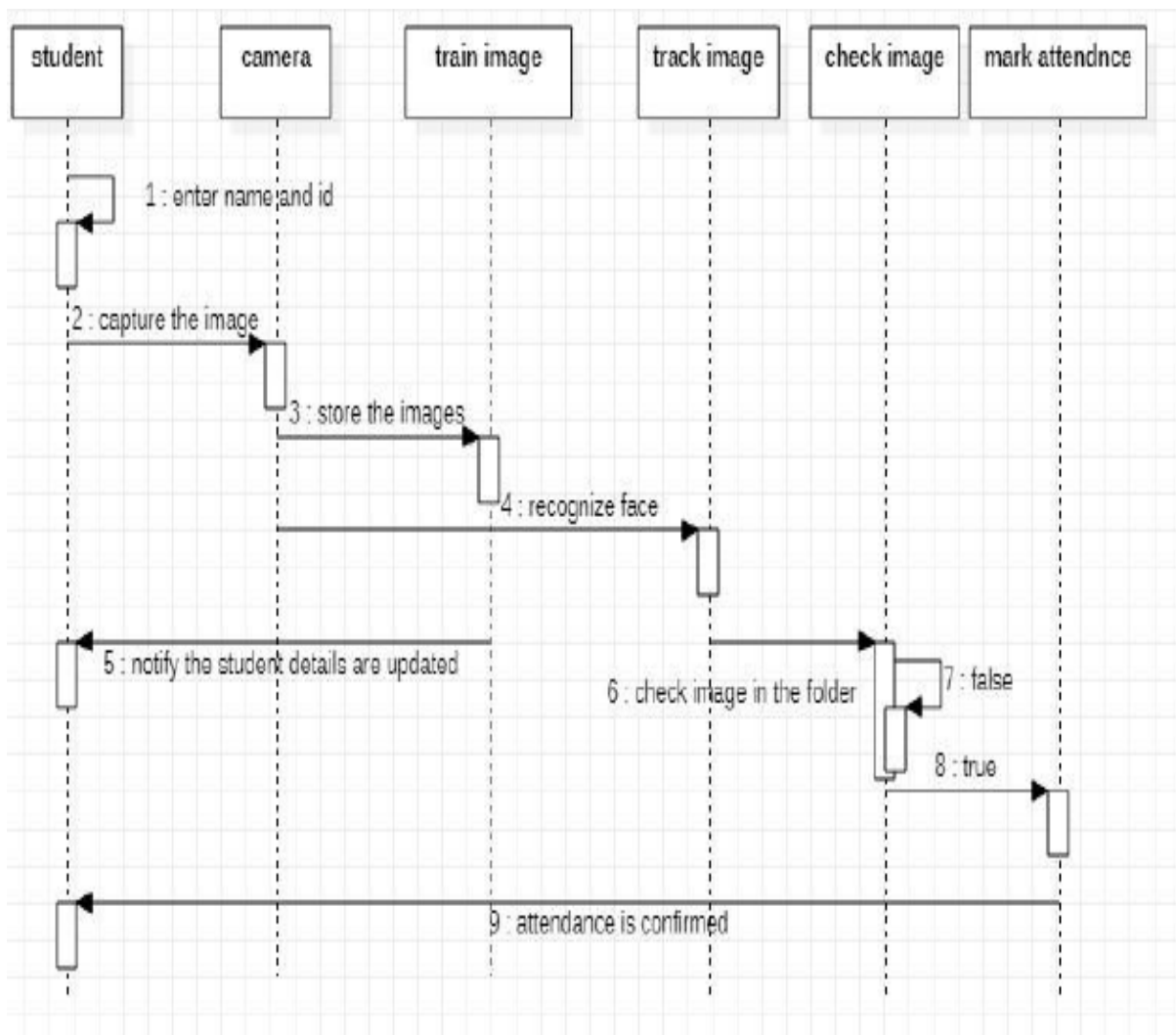


Figure 13. Sequence Diagram

## 5.2 USE CASE DIAGRAM

Another type of UML diagrams, the use case diagram, is based on communication between the user and the system. There are 4 factors that make up the use case diagram, these are: actor, system, use case and the relationships between them. The created script is triggered by the actor, and the use cases can be used again. In the example

I gave, there is a student-based system that works. In addition, use cases can be classified as generalization and grouping.

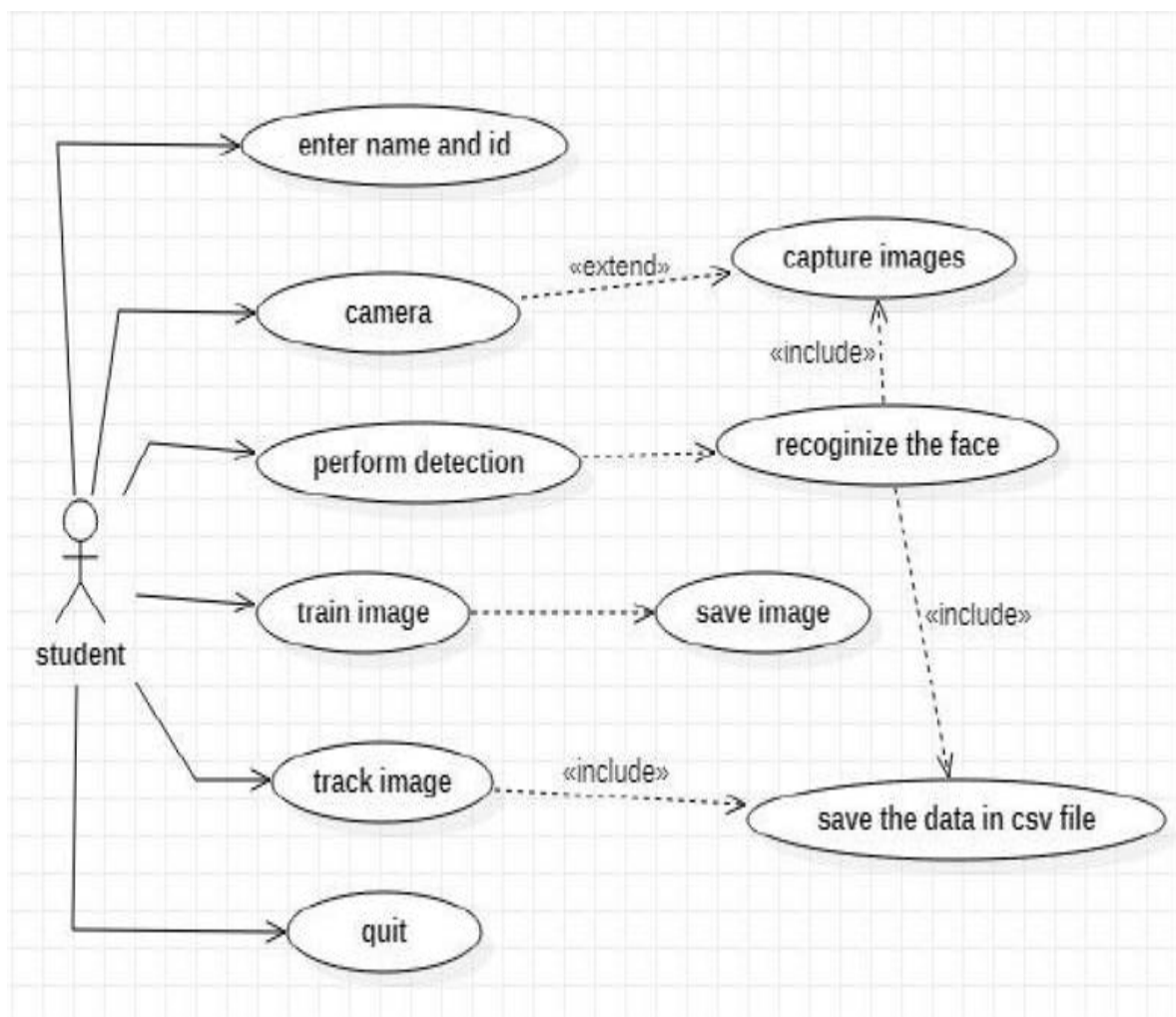


Figure 14. Use Case Diagram

### 5.3 ACTIVITY DIAGRAM

We can say that the activity diagram is similar to flowchart in structure.

Starting with a node, it is a diagram containing the flow that is passed to the final node by entering commands into the action parts and evaluating the decision node.

Activity is also the structure on which the diagram is drawn. In this example, after entering the necessary user information in the project, I wanted to describe the stages of processing images in artificial intelligence in the diagram.

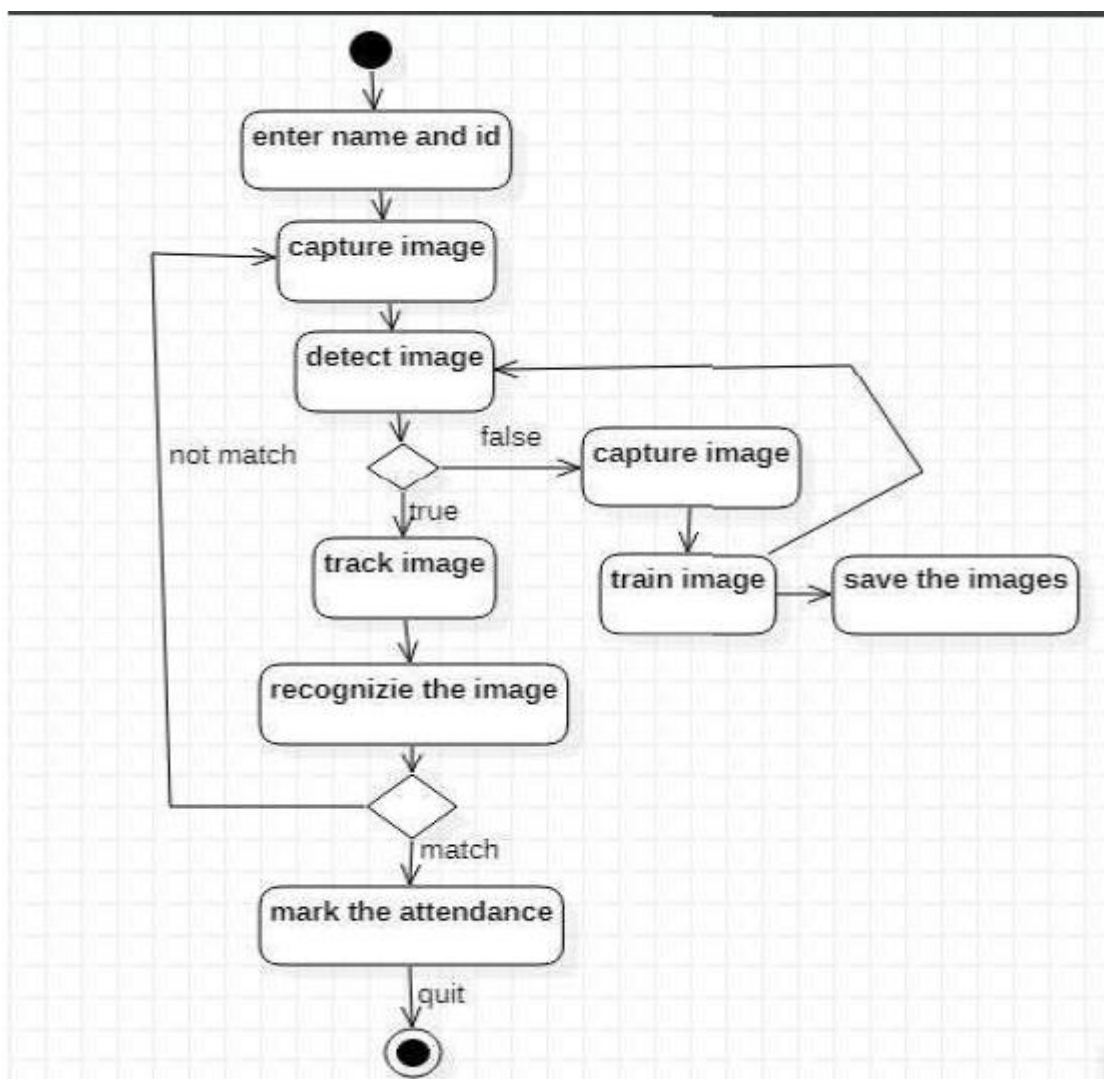


Figure 15. Activity Diagram

## 6 SYSTEM CONTEXT

In this part of our project, we will tell you what the contents of the interfaces in our system are, the purpose of using the buttons and tables in these interfaces, how the features to be used in the system work, how they are transferred to the user, and how the algorithm that makes this system work is run.

### A-LOGIN PAGE SCREEN

The first screen for us to use our face recognition based attendance system is the user login page. Users who want to use this system are directed to this screen after they register themselves to the system from the user registration page. On the user login screen, the system is accessed by entering the username and password registered in the database. If users do not remember his password, users can create a new password by clicking the forgot password button.

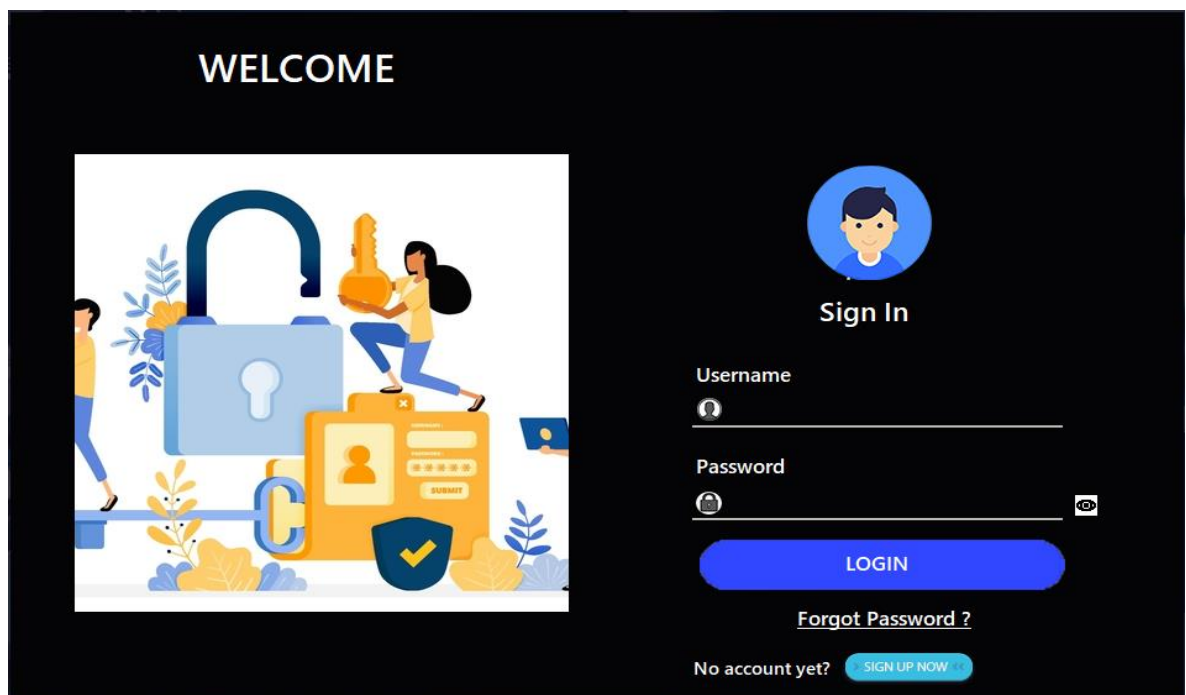
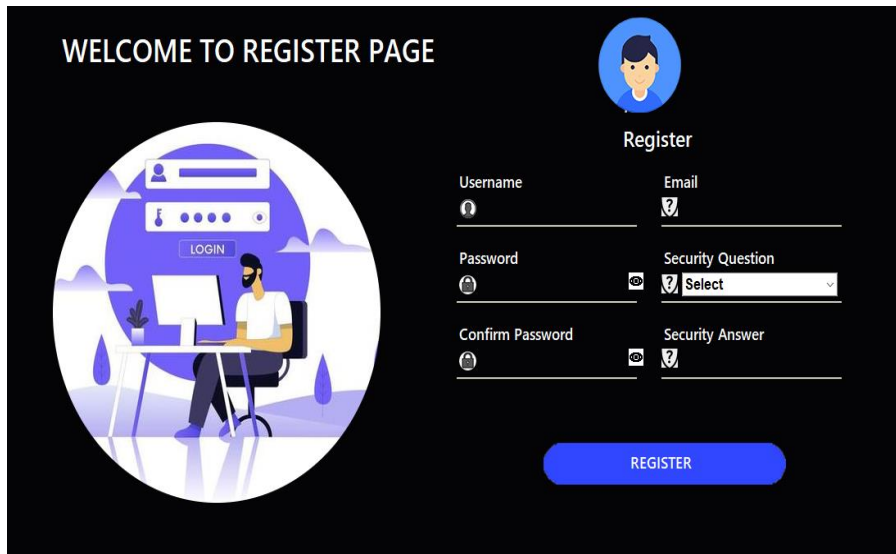


Figure 16 .Login Screen

## B-REGISTER PAGE SCREEN

The screenshot shows a registration page with a dark blue background. On the left, there is a circular illustration of a person sitting at a desk with a computer. The text 'WELCOME TO REGISTER PAGE' is at the top left. In the center, there is a profile icon of a person and the word 'Register' below it. To the right of the icon, there are four input fields: 'Username', 'Email', 'Password', and 'Security Question'. Below these, there are 'Confirm Password' and 'Security Answer' fields. A large blue 'REGISTER' button is at the bottom center.

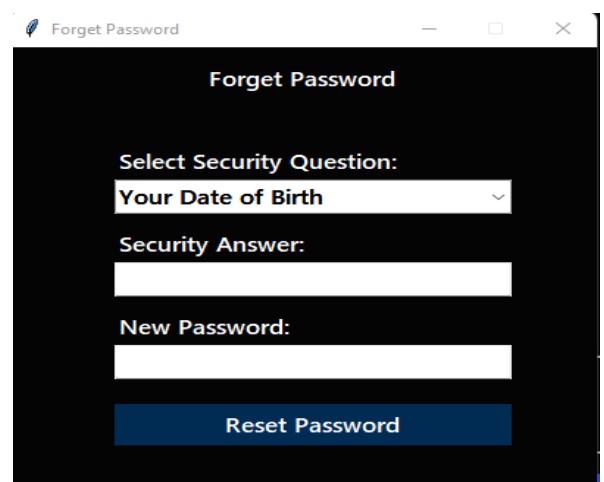
**Figure 17 .Register Page**

The first screen that will be shown to the user when they start using the system is the recording screen. An interface has been designed here that allows users to easily register in the

system. The user is expected to enter his/her username, email address, password and the second password confirming the password he/she has entered. In order to ensure that the user can be included in the system again if these created passwords are forgotten, the user is asked a secret question of his own and an answer to this secret question. This information is stored in the database for later evaluation in the forgot password section. After entering all the information, the user's registration in the system is completed by pressing the register button.

## C-FORGET PASSWORD SCREEN

This screen opens when users who have already registered in the system press the forgot password button when they forget the password they need to enter on the login screen. On this screen, the user must remember the answer to the security question that he created when registering. After entering the answer to this question in the secret answer tab, the user can refresh their password by pressing the Refresh my password button after entering the new password that they will want to use in the new password tab.

The screenshot shows a 'Forget Password' window with a dark blue background. It contains three input fields: 'Select Security Question:' with a dropdown menu showing 'Your Date of Birth', 'Security Answer:', and 'New Password:'. A blue 'Reset Password' button is at the bottom.

**Figure 18. Forget Password**

## D-MAIN PAGE SCREEN



Figure 19.Main Page

- **New Student Enrolment:** It is the screen that the user must first enter. In this screen, faculty and personal information is obtained from the student and if the student has information that needs to be changed, this is the place where the necessary arrangements are made.
- **Face Detector:** The second screen is the screen where students who register themselves in the system must enter. After the registered students have selected themselves from the registered students on this screen, it is the screen where they will wait in front of the camera for Dec pictures to be taken.
- **Train Dataset:** It is the screen that students who register themselves in the system must enter second. After the registered students select themselves among the registered students on this screen, it is the screen where they will wait in front of the camera to take face pictures.
- **Face Recognition:** It is the screen that allows the detection of the faces of the users after registering to the system and introducing the face pictures to the system.
- **Attendance Detail:** The screen where the system recognizes the face and includes the absenteeism list of the students.
- **Import/Export CSV:** The screen that allows exporting the csv files consisting of students added to the absentee list by the system.

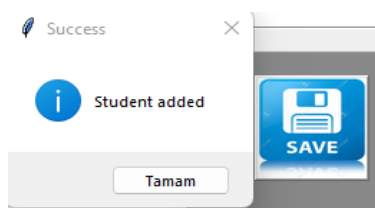


## NEW STUDENT ENROLLMENT SCREEN

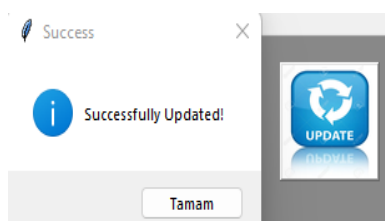
Faculty	Department	Year	Semester	CI	ID	Name	Birthday	Phone	Gender
Engineeri	Computer	2022	Spring	2	1	Fettah	28/06/11	0541328	Male
Education	Mechanic	2021	Fall	1	2	Merve	17/11/11	0533845	Female
Commun	IT	2020	Spring	2	3	Fatih	11/04/11	0535555	Male
Law	IT	2019	Fall	1	4	Fatime	22/07/11	0537691	Female
Commun	Mechanic	2020	Spring	2	5	Abdulla	07/01/11	0533332	Male
Engineeri	Computer	2022	Spring	2	6	Meryem	13/05/11	0555555	Female
Engineeri	Computer	2022	Spring	1	7	Gorkem	20/01/11	555555	Male
Engineeri	Computer	2022	Spring	1	8	Mirac	25/11/11	555555	Male
Engineeri	Computer	2022	Spring	1	9	Furkan	05/05/11	0555555	Male

Figure 20 .Student Enrolment

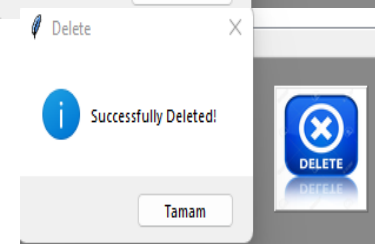
In universities, various information is requested from the students during the registration of the students. faculty information and personal information. At this stage of our system, as in universities, students are asked for information such as their faculties, departments, the year they are registered, the term they are in, and the type of formal education, as well as their name, school number, date of birth, and mobile phone. This is the screen that we will store in the database where the student is recorded.



**Save Button:** After the student enters their information in the system, they are successfully added to the system by pressing this button. A table has been added to show that they have been added to the system.



**Update Button:** A button that allows the information to be changed and a new one added if the student wants to update any of the information entered in the system.



**Delete Button :** A button that allows students to be deleted from the system that we no longer want to be present in the system.

## FACE DETECTOR SCREEN

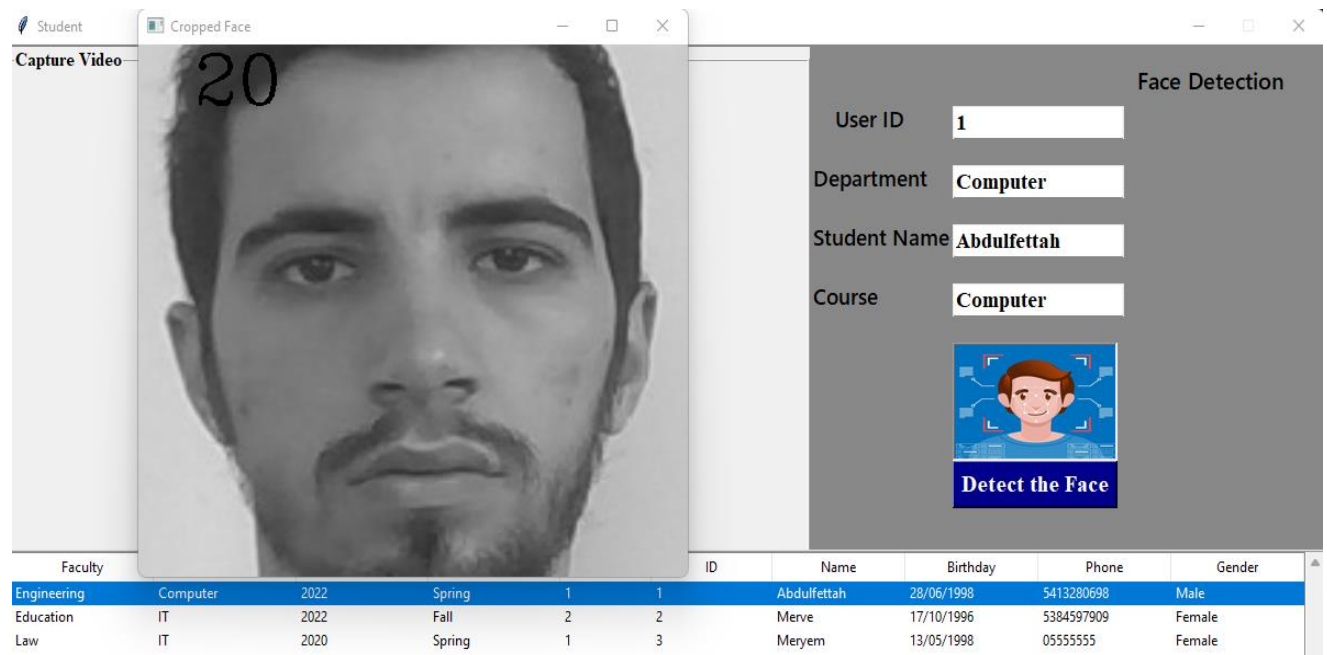


Figure 21.Face Detector

### WHAT IS FACE DETECTION ?

Face detection is an artificial intelligence technology that allows you to detect facial contours on camera images of people who show their faces to enter the system, as well as identify the marking of the face area on the image. There will be places that we will examine in our mouth, nose, lips, eyes, etc. system, which are unique features on every human face. Among these features, we will decipher the map surrounding the facial region with the help of algorithms.

After the student registers to the system from the New Student Enrollment tab, each registered student appears in the table on this screen. After the students click on their name from this list of registered people, the information of the students is transferred to the tabs and presented to the user. After the student chooses himself from the list, he waits for the button to be clicked for the system to take the student's face photos. After the student clicks the button, the camera opens and takes 100 pictures of the student from different angles. Each of these pictures are stored under the data folder in the system, paired with the student's ID.



## TRAIN DATASET SCREEN

In our train class; We collected face pictures from different angles from each student registered in the system under the data folder in the system. First of all, we access the locations of the photos we collected with the os module in python and access all our pictures here with our listdir method. We define the photos in the system one by one and convert all the photos to grayscale format in order to achieve a higher recognition rate. We transform these converted images into a numpy array format for the system to read and understand.



**Figure 22. Train the Images**

We define these two parameters as values to the arrays we defined earlier. Then we get the face and id values we get by calling the FaceRecognizer\_create module of the opencv algorithm. We send it as a parameter to the train function of this module. This method creates a classifier.xml file with these parameters.

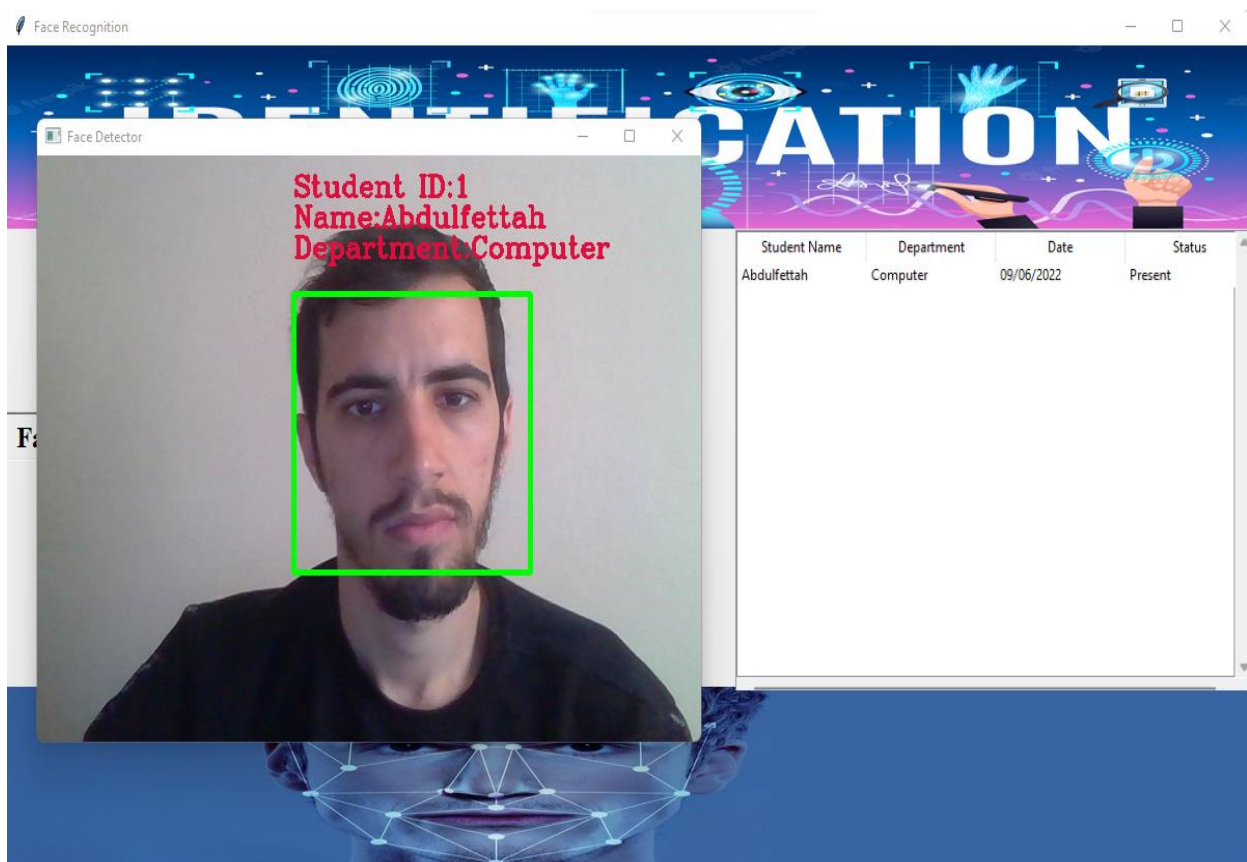


**Figure 23. Dataset Images**

## FACE RECOGNITION SCREEN

In our system, we have added students to the system so far. We have received face pictures from the students and trained them to the computer with the lbph algorithm, which is one of the machine learning algorithms. In this section, our system will now go to the recognition processes of the students who are in front of the camera. The LBPH algorithm creates histograms of each student by creating histograms from the pixels of each picture in the system. In our system, when the face pictures of the students who are in front of the camera are taken, the system creates the histogram of the student whose picture is taken and compares it with the previously registered histograms. We determined this distance value as 77. We have the absenteeism information added to the system, by pulling the information of the students who match on it from the database and showing it to the user on the rectangle.

We have created a table so that the student can see that a record of absenteeism is created while he is showing his face to the camera. As soon as the system recognizes the student, it will display information such as name, department and day in the table.



**Figure 24.Face Recognition**

## ATTENDANCE SCREEN

In the previous parts of our project, students were registered in our system, individual face photos of each student were transferred to the system, and these face photos were trained with the help of some algorithms used by deep learning. Now, this screen will be a screen where we can see the details of the students who are on the absentee list. Particularly, in the midterm and final weeks of the universities, the teachers must determine which students have participated and which students have not participated in the exam. There is a table showing which student participated. In addition to these dates, a search bar has been designed for teachers who want to search the system for a particular student's absence from the system. When the student's name is typed into the search bar, the feature of seeing that student's records either between certain dates or from the table has been added. The see all attendance button is also designed for our teachers who want to. The details of all students who attend classes through this button are shown in the table.

As seen in the example above, the records between 08/06/2022 and 09/06/2022 were queried and the results are shown in the table.

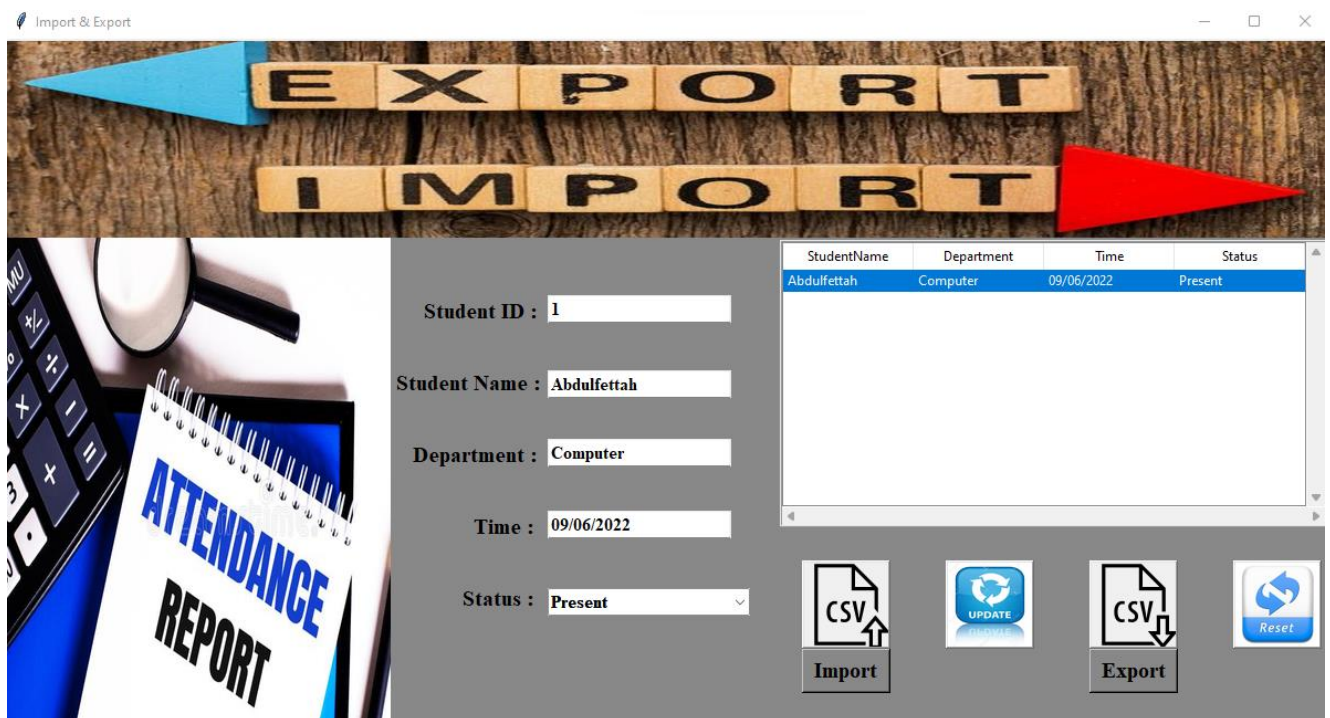
StudentName	Department	Time	Status
Abdulfettah	Computer	09/06/2022	Present

Figure 25.Attendance Details



## IMPORT EXPORT SCREEN

At the import export stage, which is the last screen of our system, we can import and export the excel files in the system. Here, firstly, we show the excels that contain the absence records from any day in the system in our table by means of the import button. In this table, there are students whose attendance records are taken by recognizing their faces. The student's information is filled into the blank texts on the screen. After the information of the students is transferred to the texts, the wrong name, wrong number or courses that may occur during the absence process are triggered by clicking the update button here and the query that connects to the database is triggered and the correct record is updated in the system instead of the wrong record obtained by running the update function. After our .Excel file is updated, this file can be saved to the desired path in our system with export csv. Since the data will be kept in the archive, it is important for both teachers and the system. The reset button, which is the last button on our screen, clears the information in the texts and ensures that the system is ready for other operations we want to do.



The screenshot displays the 'Import & Export' interface. At the top, there's a decorative header with wooden blocks spelling 'EXPORT' and 'IMPORT' flanked by blue and red arrows. Below this, a form on the left contains input fields for 'Student ID' (value: 1), 'Student Name' (value: Abdulfettah), 'Department' (value: Computer), 'Time' (value: 09/06/2022), and 'Status' (value: Present). To the right of the form is a table with the following data:

StudentName	Department	Time	Status
Abdulfettah	Computer	09/06/2022	Present

At the bottom of the interface, there are four buttons: 'Import' (with a CSV icon and an upward arrow), 'UPDATE' (with a circular refresh icon), 'Export' (with a CSV icon and a downward arrow), and 'Reset' (with a circular arrow icon). The background of the interface features a collage of a calculator, a magnifying glass over a document labeled 'ATTENDANCE REPORT', and a wooden surface.

Figure 26.Import Export CSV

## 7 IMPLEMENTATION & TESTING

### a) Haar Cascade Classifier (**Face Detection** )

### b) Local Binary Pattern Histogram (**LBPH-Face Recognition**)

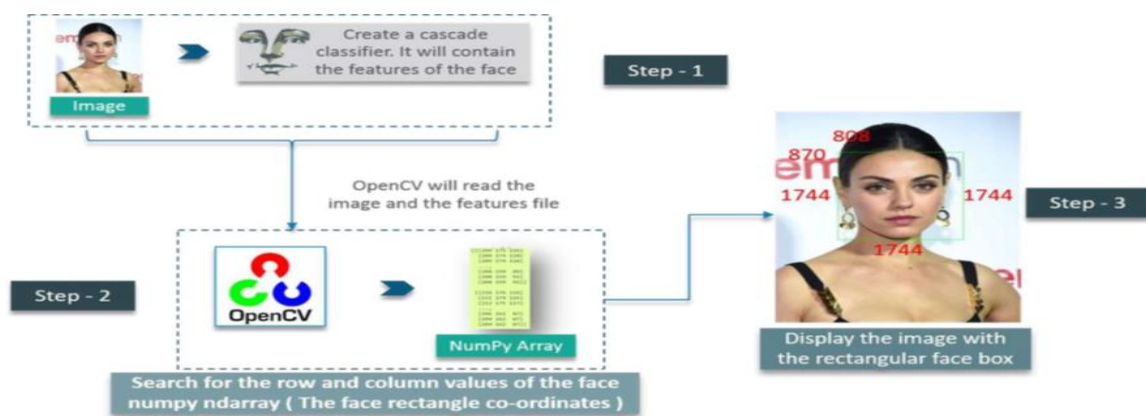
In our project, positive and negative images on faces were found and classified with Haar Cascade. For face recognition processes, recognition processes were carried out using the LBPH algorithm. First of all, after defining what face detection and face recognition are, we will explain the algorithms used in these areas.

## WHAT IS FACE DETECTION

Face detection is an artificial intelligence technology that allows you to detect facial contours on camera images of people who show their faces to enter the system, as well as identify the marking of the face area on the image. There will be places that we will examine in our mouth, nose, lips, eyes, etc. system, which are unique features on every human face. Among these features, we will decipher the map surrounding the facial region with the help of algorithms.

## HOW TO WORKS FACE DETECTION IN OPENCV

First of all, we need to transfer the face picture of the person we want to detect the face area of the system to the system via cameras. Then it is necessary to create a classifier that will allow us to identify the facial features of the person whose face picture was taken. In this step, the image taken from the user with OpenCV is the step that allows you to read the facial features obtained thanks to the classifier. The data obtained after reading the image here is stored in NumPy arrays. In order to be able to detect the face region later, it is necessary to find the values of the face region in this NumPy array. After finding the values of the face region in the NumPy array, the face region is detected by marking the face region with a rectangular box.



**Figure 27. Work Face Detection**

## A-) HAAR CASCADE CLASSIFIER

The Haar Cascade algorithm works on detecting the edges or lines on the picture in the article published by Viola and Jones in 2001. In this study, the algorithm is trained by giving more than one positive and negative pictures.

The purpose of using the Haar Cascade classifier is to find the total number of all pixels in the dark regions of the image and to find the sum of the values of both regions by finding all the pixels in the light-colored regions of the image. This is how we can learn the difference between the two. Here we can distinguish between open and closed pixels. The element is the edge regions. If an edge is detected in the picture, the haar value here will be closer to 1. Where the haar value is 1, an edge is detected in the picture. In cases where the haar value is less than 1, it is observed that there is no edge in the picture.



We can see in the image below how our Haar cascade classifiers detect a vertical edge on the image. If it is desired to detect a feature other than edge properties on the image, other haar classifiers should be selected. In order to detect and detect the edges on this image, the haar must pass through the entire image.

Haar cascade classifiers are divided into 3 groups according to the types of features they look for.

- The feature of two rectangular haarcascades is to find edges in the horizontal and vertical directions.
- The feature of the three rectangular haarcascades is to detect the presence of open areas surrounded by dark areas on the picture.
- The feature of the four rectangles haarcascade is responsible for detecting the intensity changes of the pixels in the direction of the diagonals.

## STEPS OF ALGORITHM

- As the first step of the algorithm, it is necessary to include the HaarCascade.xml classifier in the project and set the images to be given to the system as grayscale.
- As the second step of the algorithm, after converting the input images to the system into grayscale format, image manipulations such as resizing, cropping and blurring the image are performed on the image according to the uses required by the system. It quickly detects objects and face images on it.
- With the help of the Haar like classifier algorithm, the location of human faces on the frame or pictures is determined.
- In the last step of our algorithm, we determine the features on the images with the help of edge detection, line detection and center detection classifiers, which are the types of cascade we mentioned before. After our detection processes, we determine the coordinates with a square box on the picture to show the location we found. The face region is detected inside the square box.

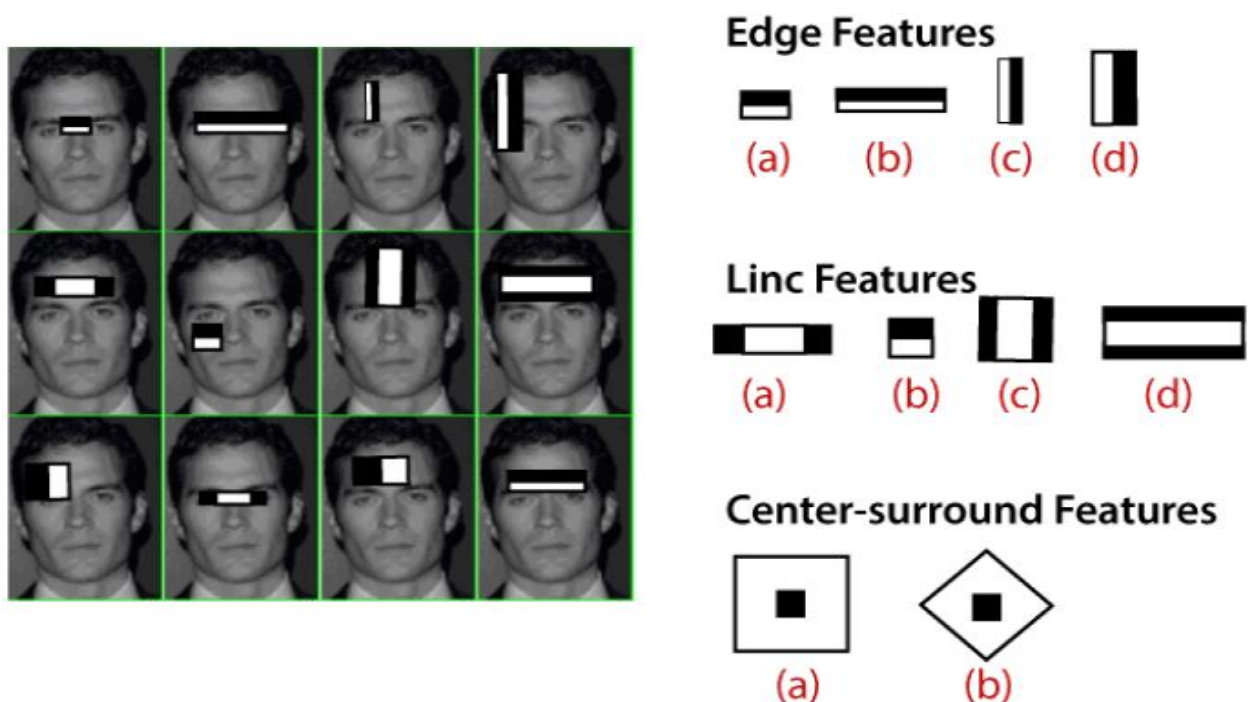


Figure 28.Haarcascades

## B-) WHAT IS FACE RECOGNITION

The facial recognition system is a biometric data that detects a person after comparing the patterns that appear as a result of the application of image processing methods on images with each other. The main principle of the face recognition system is that it works by processing numeric codes created as a result of examining 80 specific points located on the face of each person. The original numeric codes that are revealed from the face of each person are compared with previously recorded data in the database and facial recognition is performed.

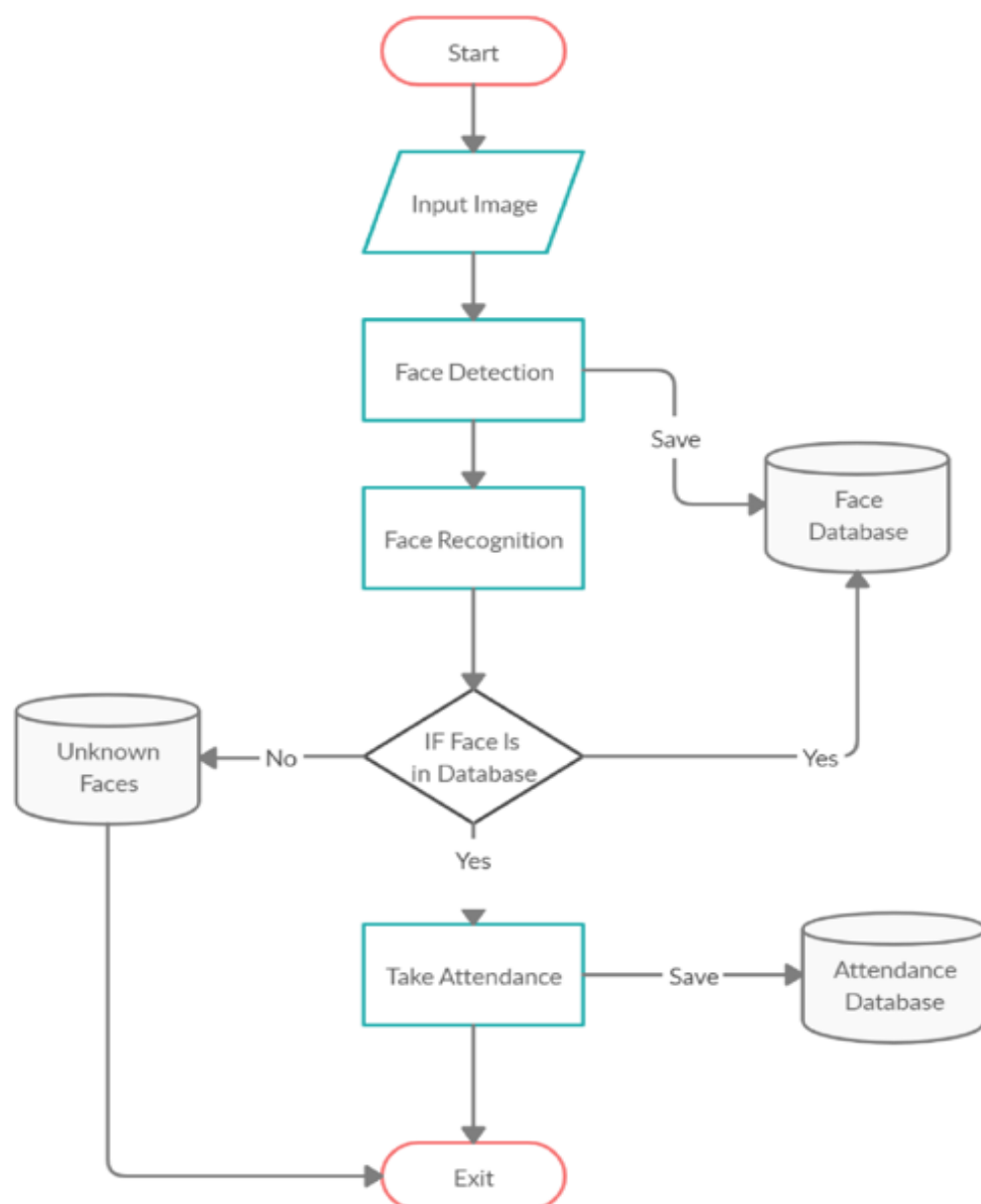


Figure 29.Face Recognition Flow Chart



## **B-) Local Binary Patterns Histograms (LBPH)**

A Local Binary Pattern is an operator that performs operations on image pixels by thresholding the values around each pixel and returning these operations as binary numbers.

LBP was determined to be a crucial component in tissue categorization efforts as a consequence of a 1994 study. When the LBP and HOG descriptors are paired with histograms, the recognition performance of data sets improves. A simple data vector is created as a result of this concatenation.

There are different types of face recognition algorithms

### **Explanation Algorithm Step By Step**

#### **1- PARAMETERS**

**Radius :** The radius, which is one of the properties that make up the circular local binary pattern, represents the distance around the pixels, that is, the radius. The value it receives is usually 1.

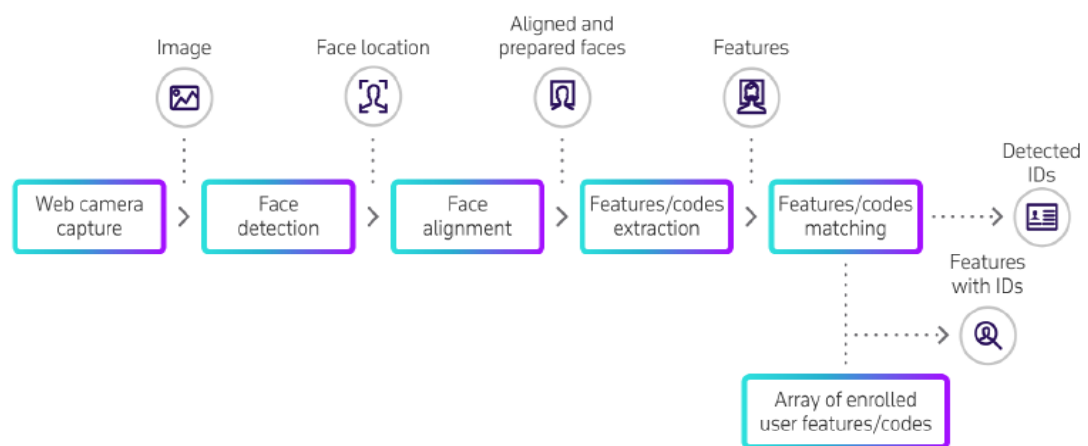
**Neighbors :** A circular local binary pattern should be created for the facial images to be analyzed. Neighbors also refers to the number of these points. If we increase the number of sample points for analysis, the higher the calculation operations will be. In general cases, it takes the value 8.

**Grid X :** Represents the number of cells located in horizontal alignment. As the number of cells in this horizontal alignment increases, the size of the feature vector that will be formed will increase at the same rate. In general cases, it takes the value 8.

**Grid Y :** Represents the number of cells located in the vertical alignment. As the number of cells in this vertical alignment increases, the size of the feature vector that will be formed will increase at the same rate. In general cases, it takes the value 8.

## 2- TRAINING THE ALGORITHM

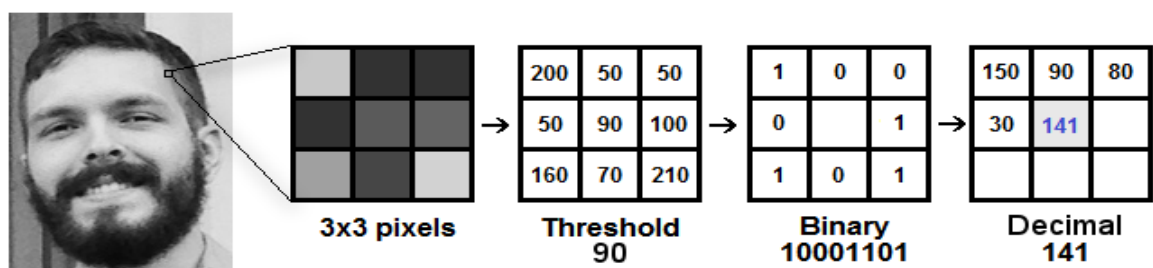
In the previous stages, we detected facial regions from the images we received from users and determined our parameter values to be able to perform operations on the images. Now we need to start the training process of the algorithm included in our system. For this algorithm, we need to have a dataset of the faces we want to learn. We need to set a unique ID for each face image here. After the system recognizes the person, it will be determined that it has found the right person with this ID number.



**Figure 30. Training Algorithm Flow**

## 3- APPLYING THE LBP OPERATION:

The first step when applying the LBPH algorithm is to identify the necessary facial features from the original face image and to decipher an intermediate image that is better to identify. In order to create this intermediate image, the radius and neighbors variables of our algorithm are swiped on the pixels of the original image dec performed.

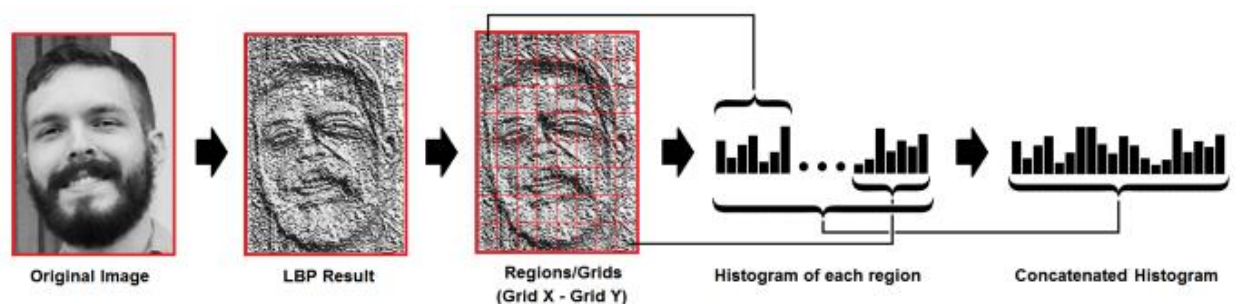


- In order to analyze the original face images we receive from users more efficiently, we turn them into a grayscale image.

- We get a 3x3 pixel window from the image that we translate into a grayscale image. Each value in the matrix represents the density of the pixel (0-255).
- We will use the central value of the matrix obtained as the threshold.
- The threshold value that we get is used to determine the values that the 8 neighbors that we will create new will get new. If the calculation of the values that the neighbors will receive new, we divide the value of 1 for values higher than the threshold value for each neighbor of the threshold value and 0 for values lower than the threshold value for each neighbor.
- Each of the neighboring pixels that we recalculated according to the threshold values contains binary values. Now we need to combine each binary value found in our matrix with a new binary value.
- We translate the values we find for each neighboring pixel into decimal values this time and fill the matrix with the threshold value in the center. Since the image we create with these values is produced from obtaining the necessary properties from the original image, we get an image that can be obtained better than the original image.

#### 4- EXTRACTING THE HISTOGRAMS:

After all the operations we have performed on the original image, we can divide the image into multiple grids using the grid X and grid Y parameters that we have already specified.



We create a histogram representing each of the grids we have created with the Grid X and Grid Y parameters. The density of these pixels will represent 256 locations.

Finally, it is necessary to combine the histograms that we have created with the grid Y and grid X grids. Since the histograms we have created with grids have an  $8 \times 8$  grid, the new histogram we will create will have  $8 \times 8 \times 256 = 16384$  pixels. This resulting histogram represents the characteristics of the image after the original image has undergone the necessary facial recognition algorithms operations.

## 5- PERFORMING THE FACE RECOGNITION



As a result of the operations we have done in this section, our algorithm training process has been completed. Our histograms obtained by dividing the image in a certain way are used as an expression of each image in our training data set.

**Figure 31. Performing Face Recognition**

The histograms of the facial images found in the system are compared with the facial image taken from the user who wants to log in to the system, and the person recognition process is performed by returning the histogram that gives the closest result to the facial image of the user who wants to log in to the system.

Some mathematical calculations are used to compare the histogram of the person who wants to log in to the system and the histograms in his data. As an example of these mathematical calculations, Euclidean distance, absolute value, chi-square methods can be given.

## TESTING

In software projects, after all the coding processes on the projects are completed, software tests should be applied to reveal the errors in the project and correct these errors before delivering the project to the customers. The purpose of these tests is; is to design scenarios of the possibility of error that may arise from the functions on the project.

There are two different ways to implement software tests.

1-Tests in which internal programs are tested using scenarios - White Box | Test Case

2-Tests that control software requirements-Block box | Test Case

Our aim in both software tests we have explained above is to reveal the biggest mistakes in the project with the least effort. The test here should be applied at every stage of the project so that we can understand where our mistakes are.

Let's examine in detail what these tests are.

### **White Box Testing**

It is a test design technique performed by knowing what the content of the code structures of the software used in the projects developed in white box tests are. White box tests deal with the internal structure and workflows of the developed software. Data flows, control flows, expression coverage, and branch coverage are all part of the white box test design approach. The main principle in the application of white box tests is the knowledge of the code. The time of this test during the construction process of the project is very important. If it is done in the early stages, it turns out that the correction cost will decrease at the same rate since the errors in the project are noticed in a shorter time.

### **Block Box Testing**

The most distinctive feature of black box tests is a software testing technique that only measures the functionality of the system without knowing the internal lines of the written software, the codes. A person performing black box tests is not concerned with how the software is built. That persons only concerned with what the software is supposed to do.

Black box testing methods include; all-pairs testing, state transition tables, decision table testing..

S.NO	TEST CASE DESCRIPTION	EXPECTED VALUE	ACTUAL VALUE	RESULT
1	Username and password match the database	Username and password must match	Username and password match	PASS
2	Redirect to home page with login button	Redirect to Home Page	Redirect to Home Page	PASS
3	Redirect to register page with signup button	Redirect to Register Page	Redirect to Register Page	PASS
4	Saving the student to the database with the Save button	Students are saved in database	Students are saved in database	PASS
5	Updating the students with the update button	Students are uptaded	Students are uptaded	PASS
6	Deleting the students with the delete button	Selected student is deleted	Selected student is deleted	PASS
7	Camera opens after clicking the detect face button	Camera is opened	Camera is opened	PASS

8	Capturing of image	Image is captured	Image is captured	PASS
9	Message display where pictures are saved	Message is showed	Message is showed	PASS
10	Image samples are checked and saved in the Training image folder.	Images are stored	Images are stored	PASS
11	Check whether the camera identifies the faces it has recognized.	Name,department and id of the recognized student is showed	Name,department and id of the recognized student is showed	PASS
12	Detecting multiple faces at once	Multiple faces are detected	Multiple faces are detected	PASS
13	Check Import/Export status in attendance	Files are aviable to import and export	Files are available to import and export	PASS
14	After exiting, check to see if attendance was saved in the attendance folder.	Attendance is stored	Attendance is stored	PASS

**Table 4. Testing the System**

## **8 - CONCLUSION**

In this study, facial recognition systems have been studied in detail. In terms of the scope of the study, the purpose of the project, advantages and disadvantages, security risks are indicated. It is indicated what is the development of facial recognition throughout history. In addition to this historical development of the system, the results of the research on how the problems arising in the system are solved by examining the published articles are explained. In the light of these data, the designs of the planned project have been determined. Then, the stages of operation of facial recognition and face algorithms that will be included in the content of the project are explained. Finally, some analysis methods have been explained in order to evaluate the performance of the facial recognition system in the project later. As a result of the project, an excel file showing the participation of students familiar with the system in the course was obtained.

### **8.1 LIFE LONG LEARNING**

In order to complete the project in its entirety, it was necessary to benefit from the applications of developing technology. In order to complete this project, I tried to get information about the work done in the field of artificial intelligence, which renews itself every day in today's software world. I realized that it is important. I have experienced how to use this information, by reading the articles written by previous researchers.

### **8.2 PROFESSIONAL AND ETHICAL RESPONSIBILITIES OF ENGINEERING**

Since our project content includes face data and personal information, which is one of the sensitive data within the face recognition-based attendance system, sharing and storing this information required us to be in ethical concern. The project was completed by obtaining the permissions for storage and use in the system.

### **8.3 CONTEMPORARY ISSUES**

With the developing technology, people want the comfort of doing their daily work automatically by machines. It has been revealed that this workload should be reduced in taking attendance by hand in universities. Our aim in the project is to introduce this system to teachers and students and to facilitate the attendance process for both parties.

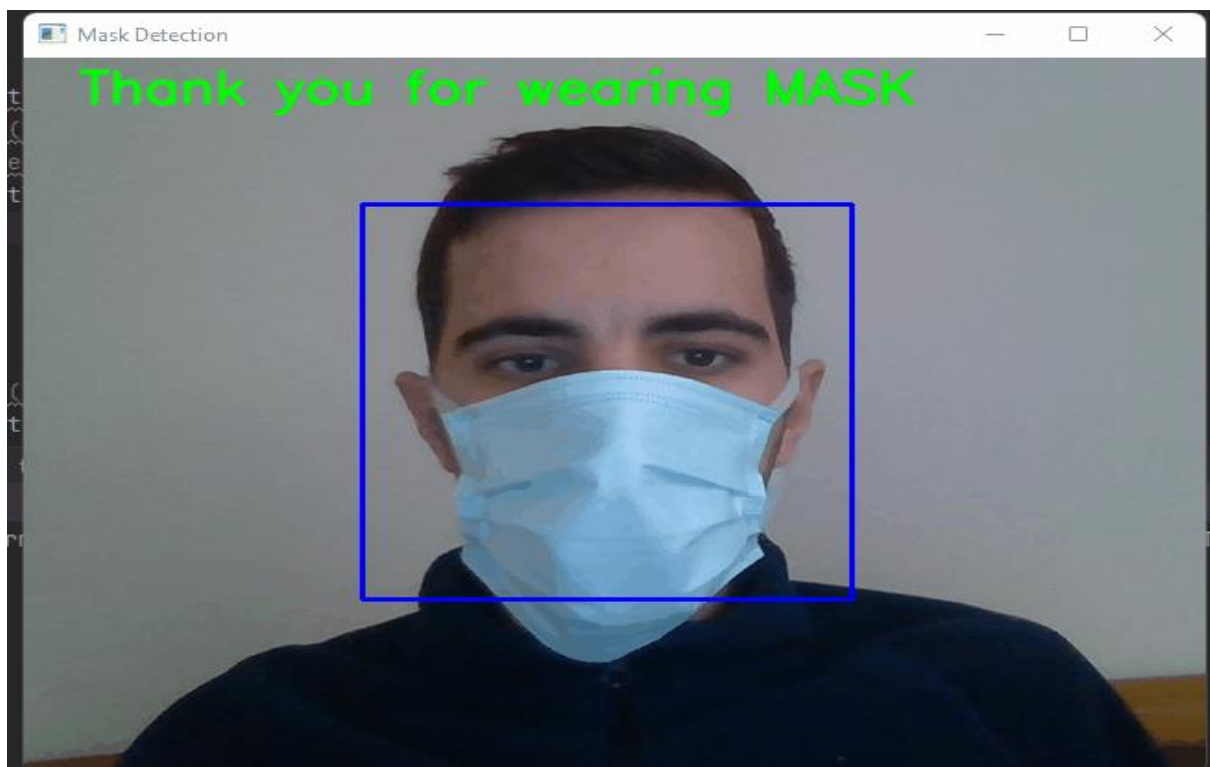


## 8.4 FUTURE WORK

. We completed our project with the help of artificial intelligence algorithms, haar cascade classifier and local binary pattern histogram algorithms. However, it has been observed that the recognition rate of these algorithms is lower than the recognition rate of deep learning algorithms due to the effects of background color, ambient light and camera resolution in the recognition rate of these algorithms. We aim to reduce absenteeism by getting to know students at a higher rate by integrating them.

On the other hand, during the development of the project, a pandemic was seen in the world. One of the difficulties that this pandemic brought to participation in classes at universities was the mask. The program written together has not been integrated into the system. In case of a different pandemic in the following years, our mask system is kept ready in reserve so that the system will be kept ready.

In the photo below, a gif showing whether the student is wearing a mask is shown.



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