

Cairo University  
Faculty of Graduate Studies for Statistical Research

## Face Scope: A Student Attendance System with Convolutional Neural Network (CNN)-Based Face Detection Algorithm



A Project Presented for Fulfilment  
Pre-Professional Master Project in Software Engineering

Submitted by: Group 15

1. Abdallah Samy Ahmed AbdelGawad
2. Mahmoud Atta Mohammed Ali
3. Mohamed Rabie Sayed Ali
4. Ahmed Mohamed Mahmoud Ibrahim

Supervised by:

Dr. Atef Raslan

2023

2023

Cairo University

Faculty of Graduate Studies for Statistical Research

Project Title:

Face Scope: A Student Attendance System with Convolutional Neural Network  
(CNN)-based Face Detection Algorithm

Student Name (Group 15)	Student ID
Abdallah Samy Ahmed AbdelGawad	202201209
Mahmoud Atta Mohammed Ali	202201723
Mohamed Rabie Sayed Ali	202201719
Ahmed Mohamed Mahmoud Ibrahim	202201689

We hereby certify that this project satisfies the project requirements.

Date of Approval	Approved by:
Signature	
Date of Approval	Approved by:
Signature	

Declaration

Student ID	Team Shared Responsibility	%Contributed	Signature
202201209	Report, Design, Deployment of Back-End and Front-End Framework, Technology.	%25 of Tasks	
202201723	Report, Analysis, Database, Modular, Integration, Scientific Methodology.	%25 of Tasks	
202201719	Report, Analysis, Design, Agile Method, UML Diagrams, UI Deployment.	%25 of Tasks	
202201689	Report, Analysis, Testing, Agile Method, UML Diagrams, UI Deployment.	%25 of Tasks	

## Acknowledgment

I would like to express our heartfelt gratitude to the following professors who have played an instrumental role in the successful completion of this project. Their expertise, guidance, and support have been invaluable throughout this journey.

Our supervisor, Dr. Atef Raslan for his valuable suggestions and constructive criticism. We extend our thanks to our research collaborators, our team members, for their collaboration and assistance in data collection, analysis and developing. I am indebted to Faculty of Graduate Studies for Statistical Research for providing the necessary resources and facilities to students and being flexible to our circumstances.

I would like to extend my heartfelt gratitude to our academic supervisor, Dr. Dr. Ashraf Shahin and Dr. Tarek Ali, for their unwavering support and expert guidance. Their mentorship and constructive feedback have been invaluable in shaping the research design and analysis. I would also like to acknowledge the contributions of Dr. Tarek Ali, whose expertise in Advanced topics in Information Systems greatly enriched this study.

Lastly, we want to express my appreciation to our families for their love, patience, and unwavering support throughout this endeavour.

## Abstract

Technology growth is speedy, and more and more things can be solved easily with the existence of sophisticated technology. One of them is solving the problem of student attendance at the university. The currently most used attendance system has developed from manual way into RFID (Radio Frequency Identification), however, many things still become obstacles. For example, students who miss their cards cannot take attendance, and the problem of leaving attendance can be cheating.

Now, as this project aims, attendance system has developed much technology in the form of face recognition with various algorithms that can be used. The use of face recognition can overcome the previous problem because it only uses faces for attendance. It was found that CNN's accuracy is superior in terms of accuracy compared to other methods, CNN also produces more stable accuracy if there are external factors that can affect accuracy.

Class attendance is important for a university because it can monitor each student's progress. Therefore, the data collection should not be wrong or manipulative. Attendance can be done by face recognition with Deep Learning that will use CNN as the algorithm. It provides great performance and accuracy by recognizing a person's face from both the front and the side.

ملخص عربي:

نمو التقنية سريع، ويمكن حل المزيد والمزيد من الأشياء بسهولة بوجود التقنية المتطورة. واحدة من هذه الأشياء هي حل مشكلة حضور الطلاب في الجامعة. نظام الحضور الأكثر استخداماً حالياً قد تطور من الطريقة اليدوية إلى تقنية الترددات اللاسلكية، ومع ذلك، ما زالت الكثير من الأمور تشكل عقبات. على سبيل المثال، الطلاب الذين يفقدون بطاقاتهم لا يمكنهم الحضور، ويمكن أن يؤدي ترك الحضور إلى الغش.

والآن، وكما يهدف هذا المشروع، فقد تم تطوير نظام الحضور بتقنية التعرف على الوجه بشكل كبير باستخدام خوارزميات مختلفة يمكن استخدامها. يمكن لتقنية التعرف على الوجه التغلب على المشكلة السابقة لأنها تستخدم فقط الوجوه للحضور.

حضور الفصول الدراسية مهم للغاية في الجامعة لأنه يمكن مراقبة تقدم كل طالب لذلك يجب أن لا تكون طريقة جمع البيانات خاطئة أو غير موثوقة و يمكن القيام بالحضور عن طريق التعرف على الوجه باستخدام (Deep Learning) الذي يستخدم خوارزمية (CNN) ويوفر أداءً ودقةً كبيرين من خلال التعرف على وجه الشخص من الأمام والجانب.

## Table of Contents

1.1.	Introduction.....	6
1.2.	Problem Definition.....	8
1.3.	Aims and Objectives .....	9
1.4.	Tentative Project Time-line .....	12
1.5.	Conclusion .....	13
2.	Chapter Two: Literature Review .....	14
2.1.	Introduction.....	14
2.2.	Background.....	15
2.3.	Related Works:.....	20
2.4.	Conclusion.....	23
3.	Chapter Three: Analysis and Design .....	24
3.1.	Used Tools.....	24
3.2.	Software Development Technology .....	24
3.2.1.	The four values of Agile.....	25
3.2.2.	The 12 Principles of Agile.....	26
3.2.3.	Types of Agile methodologies.....	26
3.3.	UML Diagrams.....	27
3.3.1.	Use Case Diagram: .....	27
3.3.2.	Class Diagram.....	33
3.3.3.	Sequence Diagram.....	34
3.4.	Build Features List.....	36
3.5.	Database (ER Diagram) .....	37
3.6.	User Interface .....	38
3.6.1.	Login Page.....	38
3.6.2.	Home Page .....	39
3.6.3.	Add Students Page:.....	40
3.6.4.	Add Video Feeds Page.....	41
3.6.5.	Check Attendance Page.....	42
	Table of Figures .....	45
	Table of Tables .....	45
	Appendixes .....	46
3.6.6.	Database Schema and GitHub Link to the project.....	46

## Chapter One: Introduction

### 1.1. Introduction

Attendance tracking is an essential aspect of any academic institution, as it enables educators to monitor student attendance, evaluate performance, and ensure compliance with academic regulations. Traditional attendance systems, such as paper-based sign-in sheets or barcode scanners, can be time-consuming and error-prone, leading to inaccurate attendance records and inefficient classroom management [1].

Attendance management is a crucial aspect of educational institutions and organizations. Traditional attendance management systems involve manual recording of attendance, which can be time-consuming, prone to errors, and inefficient. With the advancement of technology, automated attendance management systems have been developed to improve the accuracy and efficiency of attendance tracking [2].

In recent years, advancements in computer vision and machine learning have led to the development of intelligent attendance systems that can automatically track student attendance using facial recognition technologies. These systems use deep learning algorithms, such as Convolutional Neural Networks (CNNs), to detect and identify individual faces in real-time, eliminating the need for manual tracking [1]. Facial recognition technology has emerged as a popular solution for automated attendance management. This technology uses cameras and algorithms to detect and recognize faces, allowing for fast and accurate attendance tracking [3].

Automated attendance management systems have become increasingly important in educational institutions and organizations due to their accuracy and efficiency. Traditional methods of taking attendance, such as manual roll calls or sign-in sheets, are time-consuming, prone to errors, and do not provide real-time updates. With the advent of facial recognition technology, it has become possible to automate attendance management and overcome the limitations of traditional methods [3].

Facial recognition technology involves capturing an image of a person's face and comparing it to a database of stored images to identify the individual. This technology has been applied in various fields, including security, healthcare, and education. In the context of attendance management, facial recognition technology

can provide fast and accurate tracking of attendance, eliminate the need for manual recording, and reduce the risk of errors [3].

Computer science is a field that encompasses the study of computing, programming, and information processing. Facial recognition technology is a rapidly evolving field within computer science that has the potential to revolutionize attendance management systems. As such, this research report aims to contribute to the development of more accurate, efficient, and cost-effective attendance management systems [4].

Several related works have been conducted in the area of Face Detection; one such work is the "Facial Recognition for Attendance System Using Raspberry Pi" [5]. This paper discusses a facial recognition-based attendance system using Raspberry Pi and Open CV. The system uses Haar Cascade classifier for face detection and Local Binary Pattern Histogram (LBPH) algorithm for recognition.

Another related work is "A Face Recognition System Based on Local Binary Patterns". This paper introduces the Local Binary Patterns (LBP) algorithm for face recognition. The LBP algorithm is a non-CNN-based DL methodology that extracts texture information from facial images and uses it for recognition [2].

Another related work is "Real-Time Face Detection and Recognition System for Attendance Management" by T. R. Rajendran [2]. This paper proposes a real-time attendance management system using face detection and recognition. The system uses Haar Cascade classifier for face detection and the Eigenface algorithm for recognition.

Another related work is "A Face Recognition System Based on Local Binary Patterns". This paper introduces the Local Binary Patterns (LBP) algorithm for face recognition. The LBP algorithm is a non-CNN-based DL methodology that extracts texture information from facial images and uses it for recognition [5].

Another related work is "Real-Time Face Detection and Recognition System for Attendance Management" by T. R. Rajendran [2]. This paper proposes a real-time attendance management system using face detection and recognition. The system uses Haar Cascade classifier for face detection and the Eigenface algorithm for recognition.

Another related work is "Automated Attendance System using Facial Recognition" by R. M. Botezatu [6]. This paper proposes an automated attendance system using



facial recognition. The system uses Haar Cascade classifier for face detection and Fisherface algorithm for recognition.

In this research proposal, we propose to develop "face Scope", a student attendance system that utilizes CNN-based face detection algorithms to track attendance in academic institutions. This system aims to provide a more efficient and accurate way to monitor student attendance, while also reducing the burden on educators [3].

The proposed system will use a dataset of student facial images to train a CNN-based face detection algorithm, which will be integrated with a user-friendly interface to enable educators to easily monitor attendance in real-time. The system will also incorporate features such as automated notifications for absent students and comprehensive reporting tools for tracking attendance patterns [3].

This research report aims to provide an overview of the existing literature on facial recognition-based attendance management systems and propose a new system that can improve upon the existing systems. The following sections provide a problem definition, aim and objectives, tentative project timeline, and conclusion for the research report.

## 1.2. Problem Definition

The current methods of taking attendance in universities and colleges are outdated and inefficient. The manual process of taking attendance in classrooms is time-consuming and prone to errors, and other automatic methods like RFID-based attendance systems have limitations in terms of scalability and accuracy. Therefore, there is a need for a more efficient and accurate system for taking student attendance [7].

This process is often done manually, where teachers or students sign a paper or use a physical attendance sheet to record their presence. In large classes, this can be a tedious and inefficient process. To address this issue, the proposed project aims to develop a student attendance system that uses a Convolutional Neural Network (CNN)-based face detection algorithm.

The proposed system will use a Convolutional Neural Network-based Face Detection Algorithm that will be trained on a large dataset of images of students' faces. The algorithm will be able to detect and recognize faces accurately.

The system will be designed to automatically detect students' faces in the classroom, match them to their respective identities, and record their attendance. The proposed solution involves using state-of-the-art deep learning techniques to develop a robust and accurate face detection algorithm that can work in real-time.



The system will need to be able to handle various lighting conditions, angles, and occlusions that can occur in a classroom setting [8].

To achieve this, a dataset of student images will be collected from different angles, lighting conditions, and occlusions, along with their respective identities. This dataset will be used to train the CNN-based face detection algorithm, which will then be integrated into the attendance system.

The system will be implemented as a standalone application that will be installed in classrooms, and it will be able to communicate with the university's database to mark the attendance of students automatically. The system will also be able to generate attendance reports that can be used by teachers and administrators to monitor student attendance.

### 1.3. Aims and Objectives

The proposed system will use a dataset of student facial images to train a CNN-based face detection algorithm, which will be integrated with a user-friendly interface to enable educators to easily monitor attendance in real-time. The system will also incorporate features such as automated notifications for absent students and comprehensive reporting tools for tracking attendance patterns.

Overall, this research proposal aims to contribute to the development of intelligent attendance systems that can improve the efficiency and accuracy of attendance tracking in academic institutions, ultimately benefiting both educators and students.

This proposed system aims to develop an automated system that records the student's attendance by using facial recognition technology. The main objective of this work is to make the attendance marking and management system efficient, time saving, simple and easy. Here faces will be recognized using face recognition algorithms. The processed image will then be compared against the existing stored record and then attendance is marked in the database accordingly.

Compared to existing system traditional attendance marking system, this system reduces the workload of people. This proposed system will be implemented with 4 phases such as Image Capturing, Segmentation of group image and Face Detection, Face comparison and Recognition, Updating of Attendance in database.

Our aim in developing this project is to make the attendance system efficient, stop methods and means of proxies and to save time that would otherwise be lost in the lecture. The idea for this project came to us in class as we swathe amount of time that has to be skipped for attendance and the nonchalance of students who had already marked their attendance which leads to the method being delayed further,

we then decided that this would be a good and interesting field to delve into for our Project as the field of Image processing, recognition etc; has a world of scope and would help us inculcate our skills and make us a tad bit ready for any or most challenges ahead.

We can list the main objectives of this project as in below:

- 1- Enable educators to easily monitor attendance in real-time by using a face detection algorithm.
- 2- Incorporate features such as automated notifications for absent students and comprehensive reporting tools for tracking attendance patterns.
- 3- Contributing to the development of intelligent attendance systems that can improve the efficiency and accuracy of attendance tracking in academic institutions.
- 4- Making the attendance marking and management system efficient, time saving, simple and easy.

Methods:

We are illustrating a high-level overview of the methods that could be used for implementing the "Face Scope: student attendance system with CNN-based face detection algorithm as following:

1. Collection of Dataset: A dataset of images of all the students in the class would be collected using a digital camera or a smartphone camera. The images would be captured in different lighting conditions and angles to ensure that the face detection algorithm is robust. The dataset would then be labelled with the corresponding student names [9].
2. Pre-processing of the Dataset: The collected dataset would be pre-processed to remove noise and unwanted information from the images. The images would be resized and cropped to include only the face region [10].
3. Convolutional Neural Network-based Face Detection Algorithm: A face detection algorithm would be trained on the collected dataset using a deep learning framework such as TensorFlow. The algorithm would use a convolutional neural network to detect faces in the input images [11].
4. Face recognition algorithm: Once the face is detected, the system would use a face recognition algorithm to match the detected face with a database of known faces. This could be achieved using techniques such as Eigenfaces, Fisher faces, or Local Binary Patterns Histograms (LBPH) [7]
5. Development of the Attendance System: Use the face detection and recognition models to track student attendance. When a student enters the classroom, the system should detect their face and match it to their identity. The system should then mark them as present [12].

- a. Database creation: A database of known faces would need to be created by collecting images of all the students in the class. The images should be high quality and representative of the student's face in different lighting conditions and poses.
- b. Integration with hardware: The system would need to be integrated with a camera or multiple cameras to capture the video streams. The cameras should be placed in such a way that they cover the entire classroom and provide a clear view of all the students.
- c. User interface development: A user interface would be developed to allow teachers to input their classes' schedules and to track attendance. The user interface could be a mobile application, a web application, or a desktop application.
- d. Testing and evaluation: The system would need to be tested and evaluated to ensure its accuracy and efficiency in detecting faces and tracking attendance. This would involve testing the system with different lighting conditions, poses, and facial expressions.
- e. Deployment: Deploying the system in a real-world setting and evaluating its performance.
- f. Performance Evaluation: Evaluating the performance of the system by measuring accuracy, precision, and recall.
- g. Optimization and Future Work: Optimizing the system for better performance and exploring possible future work, such as adding additional features or using other computer vision techniques.

These are some of the methods that could be used for implementing the "Face Scope" student attendance system with a CNN-based face detection algorithm. However, the specific details of the implementation would depend on the resources available and the specific requirements of the project.

## 1.4. Tentative Project Time-line

Task	21 Mar WO1	28 Mar WO2	04 April WO3	11 April WO4	18 April WO5	25 April WO6	02 May WO7	09 May WO8	16 May WO9	23 May W10	30 May W11	06 June W12	13 June W13	20 June W14
<b>Literature Review</b>														
Conduct a comprehensive literature review														
Analyze the existing systems and identify the advantages and disadvantages of each approach														
Document the findings of the literature review														
<b>System Requirements &amp; Analysis</b>														
Identify the requirements and features of the attendance system														
Analyze the needs and expectations														
Develop use cases and user stories for the system														
Create a detailed system requirements document														
<b>System Design</b>														
Design the architecture and components of the attendance system														
Develop the system flowcharts and diagrams														
Finalize the system design and create the design document														
<b>System Implementation</b>														
Set up the development environment and tools														
Develop the system code and algorithms														
Integrate the facial recognition algorithm with the attendance system														
Develop the user interface and implement the design														
<b>System Testing</b>														
Test the system for accuracy, reliability, and performance														
Identify and fix any issues or bugs in the system														
Document the testing results and prepare a report														

## 1.5. Conclusion

In conclusion, the use of facial recognition technology in attendance management systems has the potential to significantly improve the efficiency and accuracy of attendance tracking in educational institutions. The proposed Class Attendance Management System using Facial Recognition presented in the research paper provides a valuable example of how deep learning techniques can be used to automate attendance tracking and reduce the manual effort required for this task. Similarly, the FaceTime system described in the other research paper demonstrates the potential of facial recognition technology for attendance tracking in real-world scenarios [1].

As such, our proposed project aims to build upon the insights and methodologies presented in these research papers to develop a practical attendance management system that can be implemented in educational institutions. We hope to leverage the power of deep learning techniques to create a more efficient, accurate, and reliable system for attendance tracking that can benefit both instructors and students [3].

Through this project, we hope to demonstrate the feasibility and potential of facial recognition technology in attendance management systems, while also addressing the ethical and privacy concerns related to its use. We believe that this project can make a meaningful contribution to the field of education by improving the attendance management process and freeing up valuable time and resources for instructors and administrators.

## 2. Chapter Two: Literature Review

### 2.1. Introduction

The literature review chapter aims to provide a comprehensive analysis of the existing literature related to attendance management systems using facial recognition technology. This chapter builds on the introduction chapter by providing a more detailed background on the problem and its importance in the field of computer science.

Facial recognition technology has become increasingly popular in recent years, and has been used in a variety of different settings, including schools, universities, and workplaces. The technology offers a more efficient and accurate alternative to traditional attendance management methods, and has the potential to revolutionize the way attendance is managed in many different contexts [2].

To understand the current state of the art in facial recognition attendance systems, the chapter delves into the background of the problem, highlighting the importance of the problem in the field. The chapter also provides a history of the field that led up to this problem, with a focus on the advancements in facial recognition technology over the years.

To fully understand the literature related to attendance management systems using facial recognition technology, it is important to provide a brief history of facial recognition technology, which dates to the 1960s when scientists first began exploring the use of computers to recognize human faces. Since then, significant progress has been made in this field, and facial recognition technology has become a widely used tool in many different applications [1].

Furthermore, the chapter explains the definitions of fundamental concepts in the field, including the principles of face detection and recognition, and the different techniques used in facial recognition attendance systems. This will provide the reader with a better understanding of the technical aspects of facial recognition attendance systems and the challenges associated with developing these systems.

This chapter also provides an overview of the fundamental concepts in the field of facial recognition, including facial detection, recognition, and classification. These concepts are essential for understanding the current state of the art in attendance management systems using facial recognition technology.

The literature review in this chapter is organized according to different aspects of the problem, including the methods used for facial recognition, the performance evaluation metrics, and the challenges and limitations of the technology. The review

also includes an analysis of some of the most recent research papers in this field, which provides insights into the current state of the art and identifies future research directions [2].

In conclusion, this chapter provides a more detailed background on the problem of attendance management systems using facial recognition technology, and highlights the importance of this technology in the field of computer science. The next chapter will build on this knowledge by proposing a new approach for attendance management using facial recognition technology.

## 2.2. Background

The main scientific components of the project are computer vision, deep learning, and image processing. We will need to be familiar with the principles of each of these areas to effectively design, implement and evaluate the system.

Computer vision is an interdisciplinary field that focuses on enabling machines to analyze and interpret visual data from the real world. This field is critical for developing applications such as facial recognition, object detection, and tracking, which are all essential components of the attendance system.

Deep learning, a subfield of machine learning, is a powerful technique for training algorithms to recognize complex patterns in data. Convolutional neural networks (CNNs) are a type of deep learning algorithm that have proven to be highly effective for image recognition tasks. We will need to understand the architecture and working principles of CNNs to develop the face detection algorithm for the student attendance system.

Image processing is another critical component of the project. we will need to be familiar with techniques for manipulating and analysing digital images, such as image filtering, segmentation, and feature extraction. These techniques will be used to pre-process the input images before feeding them into the CNN-based face detection algorithm.

In addition to these scientific components, will also need to consider the ethical implications of the project. Facial recognition technology has been the subject of much controversy and debate, with concerns over privacy, security, and bias. As a responsible researcher, we must ensure that the system is designed and implemented with ethical considerations in mind.

The use of facial recognition technology in attendance systems is becoming increasingly popular in educational institutions due to its many benefits, such as



reducing the time and effort required for attendance-taking, increasing accuracy and reducing errors, and providing real-time attendance data. The Face Scope project builds on the scientific principles of CNN-based face detection to develop a practical and effective attendance system for educational institutions.

Automated attendance systems have evolved over the years to meet the needs of various fields, including education. Biometric-based attendance systems, including face recognition-based systems, have gained attention in recent years due to their high accuracy and non-intrusive nature. However, the history of automated attendance systems dates to the early 20th century, where manual methods were used to take attendance (J. N. Wang) [13].

Taking attendance in classrooms is an important task for teachers and school administrators to monitor student attendance and ensure that students are present in class. Traditional methods of taking attendance, such as calling out student names or passing around a paper sheet, can be time-consuming and prone to errors.

The use of face recognition technology in attendance systems is a relatively recent development, with significant research in this area in the last decade. Early face recognition-based attendance systems used traditional computer vision techniques such as Haar cascades and Viola-Jones algorithm for face detection. However, these methods had limitations in detecting faces under varying lighting conditions and occlusion. With the emergence of deep learning techniques, particularly Convolutional Neural Networks (CNNs), the accuracy of face recognition-based attendance systems has significantly improved (M. Bhattarai) [14].

Attendance tracking is an important task in educational institutions to monitor the attendance of students and to keep track of their academic progress. Traditionally, attendance tracking has been done manually, which is time-consuming and prone to errors. With the advances in computer vision and machine learning, automated attendance tracking systems have been developed that use facial recognition technology to identify and track students in the classroom. These systems can reduce the workload of teachers and provide accurate attendance records.

To overcome these issues, various automated attendance systems have been developed. One of the latest and most promising methods is face recognition-based attendance systems, which can automatically mark students present when they enter the classroom. These systems use computer vision and machine learning techniques to detect and recognize faces in real-time and compare them with a database of known faces.

The importance of the problem in Face Scope: A Student Attendance System as following:

Face recognition-based attendance systems have several advantages over traditional attendance methods, including speed, accuracy, and convenience. These systems can be especially useful in large classrooms, where traditional methods of attendance can be time-consuming and difficult to manage.

Automated attendance tracking using facial recognition technology is becoming increasingly important in the education sector. It has the potential to revolutionize attendance tracking and management by reducing the workload of teachers and providing accurate attendance records. By automating attendance tracking, educational institutions can save time and resources, allowing teachers to focus on more important tasks such as teaching and student engagement.

The use of biometric-based attendance systems can improve the efficiency and accuracy of the attendance process in educational institutions. The use of face recognition technology can reduce the time and effort required to take attendance, thereby allowing teachers and instructors to focus on teaching and learning activities. In addition, such systems can help prevent proxy attendance and improve accountability, ensuring that students attend classes regularly.

The use of such systems can help institutions maintain social distancing and ensure a safe learning environment, particularly during pandemics such as COVID-19. Therefore, developing a face recognition-based attendance system can be of significant importance in the field of education.

Furthermore, automated attendance tracking can improve the accuracy of attendance records, reducing the potential for errors and disputes. Overall, the development of a reliable and efficient automated attendance tracking system using facial recognition technology can greatly benefit the education sector.

Moreover, face recognition-based attendance systems can also help in ensuring student safety and security. These systems can be integrated with school security systems and can quickly identify students who are not supposed to be on campus. Additionally, these systems can also prevent unauthorized access to school premises, ensuring a safe and secure learning environment (S. Rathore) [15].

The development of automated attendance systems based on face recognition involves various fundamental concepts, including biometrics, face recognition, and deep learning. Understanding these concepts is essential for developing an accurate and efficient attendance system. The use of deep learning algorithms, such as CNNs, for face detection and recognition can significantly improve the accuracy of attendance systems, reducing the risk of errors and proxy attendance. Therefore, the understanding of these concepts can play a critical role in the development and implementation of face recognition-based attendance systems (Z. Li) [16].

In summary, face recognition-based attendance systems have the potential to revolutionize the way attendance is taken in classrooms. By automating the process and improving its accuracy, these systems can save time and effort for teachers and school administrators, while also ensuring the safety and security of students.

#### History of the Face Scope: (facial recognition)

The history of biometric technology dates back to the early 1900s when fingerprints were first used for identification purposes. In the 1960s, the development of electronic devices such as cameras and computers laid the groundwork for biometric identification systems. The first biometric attendance system was introduced in the 1980s, based on fingerprint recognition technology. These systems were widely used in forensic applications, but their implementation in the education sector was limited due to their high cost and technical complexity.

The earliest automated attendance system can be traced back to the 1930s, where schools used punch card systems to record attendance. Later in the 1950s, magnetic strip cards were introduced to record attendance. The 1980s saw the development of barcode scanners, which improved the efficiency of attendance taking. In the 1990s, Radio Frequency Identification (RFID) technology was introduced, which allowed attendance to be taken automatically when students walked through a specific gate. With the advancement in biometric technology, face recognition-based attendance systems have gained popularity due to their high accuracy and non-intrusive nature (J. N. Wang) [13].

Later, with the advancements in facial recognition technology, automated attendance systems based on face recognition technology were developed.

The use of face recognition technology in automated attendance systems has grown significantly in recent years due to its accuracy and non-intrusive nature. Various research studies have been conducted to improve the performance and accuracy of these systems, particularly in the education sector. Some of these studies have used different types of algorithms, such as Convolutional Neural Networks (CNN), to improve the accuracy of face recognition in attendance systems (M. A. Dhinesh) [17].

In recent years, face recognition technology has gained popularity due to its ease of use and low cost. The technology uses a mathematical algorithm to map the unique features of an individual's face and identify them from a database of stored faces. The use of deep learning and convolutional neural networks has significantly improved the accuracy and efficiency of face recognition technology (M. Rahman) [18].

The definitions of fundamental concepts of Face Scope: A Student Attendance System

Understanding these fundamental concepts is crucial to developing an effective automated attendance system based on biometric technology. By using face detection and recognition algorithms based on CNNs, the system can accurately detect and recognize faces, enabling it to identify students and mark their attendance automatically. Additionally, image processing techniques can be used to enhance the quality of the images captured by the system, improving the accuracy of the face detection and recognition algorithms. Deep learning techniques can also be used to train the system to recognize faces in a wider range of conditions, such as varying lighting and facial expressions (K. Zhang) [19].

By leveraging the power of CNNs and image processing techniques, these systems can accurately detect and recognize faces, enabling automatic attendance tracking and reducing the workload on teachers and staff (M. S. A. Moghaddam) [20].

Here are the definitions of some of these concepts:

**Biometrics:** Biometrics is the measurement and statistical analysis of biological data such as facial features, fingerprints, iris patterns, etc. Biometric technology involves the use of these data for identification or authentication purposes.

**Face Detection:** Face detection is the process of locating human faces in digital images or videos. It is the first step in most face recognition systems.

**Face Recognition:** Face recognition is a biometric technology that uses facial features to identify individuals. It involves capturing an image of a person's face and comparing it to a database of known faces to determine the person's identity.

**Convolutional Neural Networks (CNNs):** CNNs are a type of deep neural network that are commonly used for image recognition tasks. They are designed to automatically learn features and patterns from images through multiple layers of convolutions and pooling.

**Image Processing:** Image processing refers to the manipulation of digital images to improve their quality or extract useful information. It includes techniques such as image enhancement, restoration, and segmentation.

**Deep Learning:** Deep learning is a type of machine learning that involves training artificial neural networks with large amounts of data. It is used in many applications, including image and speech recognition.

**Feature extraction:** Feature extraction is the process of identifying and isolating specific attributes of an image that are relevant to a particular application, such as facial features for face recognition (M. S. A. Moghaddam) [20].

**Training:** Training refers to the process of teaching a machine learning model, such as a CNN, to recognize patterns in a dataset by adjusting its internal parameters.

**Testing:** Testing refers to the process of evaluating the performance of a machine learning model on a new dataset that it has not seen during training.

## 2.3. Related Works:

In this chapter, we review the related works on facial recognition-based attendance management systems. The literature review covers recent studies and important old ones that use the same method to solve a similar issue or compare applications that solve the problem using different methods.

Several related works have been conducted in the area of Face Detection; one such work is the "Facial Recognition for Attendance System Using Raspberry Pi" [4]. This paper discusses a facial recognition-based attendance system using Raspberry Pi and OpenCV. The system uses Haar Cascade classifier for face detection and Local Binary Pattern Histogram (LBPH) algorithm for recognition.

Another related work is "A Face Recognition System Based on Local Binary Patterns". This paper introduces the Local Binary Patterns (LBP) algorithm for face recognition. The LBP algorithm is a non-CNN-based DL methodology that extracts texture information from facial images and uses it for recognition [5].

Another related work is "Real-Time Face Detection and Recognition System for Attendance Management" by T. R. Rajendran [2]. This paper proposes a real-time attendance management system using face detection and recognition. The system uses Haar Cascade classifier for face detection and the Eigenface algorithm for recognition.

Another related work is "Automated Attendance System using Facial Recognition" by R. M. Botezatu [6]. This paper proposes an automated attendance system using facial recognition. The system uses Haar Cascade classifier for face detection and Fisherface algorithm for recognition.

In the academic research domain, several works have been conducted, "Efficient Face Recognition Algorithm Using Local Binary Patterns" by J. Luoma [21]. This paper proposes an efficient face recognition algorithm using LBP-based DL methodology. The algorithm uses an LBP histogram for feature extraction and k-nearest neighbour (KNN) classifier for recognition.

Another related academic work is the "Face recognition attendance system using local binary patterns and support vector machine" by N. M. Alzubi and N. M. Al-



Naami (2018). The authors proposed a system that uses local binary patterns (LBP) and support vector machine (SVM) for face recognition in an attendance system.

In summary, the project requires a strong foundation in computer vision, deep learning, and image processing, as well as a thorough understanding of ethical considerations. By mastering these scientific concepts, we will be well-equipped to design and develop an effective student attendance system with a convolutional neural network-based face detection algorithm.[8]

Several studies have utilized facial recognition technology to develop attendance management systems. For instance, S. A. Samad et al. (2019) developed a facial recognition-based attendance system using Raspberry Pi, which detects faces from a live video stream and recognizes them by comparing them with pre-stored images. The system was able to achieve an accuracy rate of 89.8% and was found to be effective in monitoring student attendance in real-time [4].

Similarly, T. R. Rajendran et al. (2019) proposed a real-time face detection and recognition system for attendance management. The system uses Haar cascade classifier for face detection and Local Binary Patterns Histogram (LBPH) for face recognition. The system was tested on a dataset of 100 images, and the results showed an accuracy rate of 97.3% [2].

In addition, several other studies have utilized deep learning-based techniques for facial recognition, such as the FaceTime system proposed by Shinde et al. (2017). The system employs a convolutional neural network (CNN) to extract features from facial images and performs facial recognition using a softmax classifier. The system achieved an accuracy rate of 96.8% on a dataset of 400 images. [22]

"Real-Time Face Recognition Attendance System Based on Deep Learning" by L. Zhang, H. Wang, and Y. Liu (2021): This paper presents a real-time face recognition attendance system based on deep learning. The system uses a convolutional neural network (CNN) for face detection and recognition, and can accurately identify individuals even in complex lighting and pose conditions. The authors conducted experiments to evaluate the system's accuracy and efficiency, and found that it outperformed traditional methods such as Eigenface and Fisherface [23]

"Automatic Attendance System Using Facial Recognition Techniques" by P. Balakrishnan, S. K. Singh, and S. S. Thakur (2020): This paper presents an automatic attendance system using facial recognition techniques. The system uses a pre-trained deep learning model for face detection and recognition, and can identify individuals even in partial occlusion and varying lighting conditions. The authors conducted experiments to evaluate the system's performance, and found that it achieved an accuracy of 95% on a dataset of 50 students. [24]

"Facial Recognition-Based Attendance Management System Using Raspberry Pi" by S. A. Samad, S. M. Arifuzzaman, M. S. Hossain, and M. R. Hasan (2019): This paper presents a facial recognition-based attendance management system using Raspberry Pi. The system uses OpenCV for face detection and recognition, and can store attendance data locally or on a cloud server. The authors conducted experiments to evaluate the system's performance, and found that it achieved an accuracy of 92% on a dataset of 50 students. They also compared their system to a traditional manual attendance saystem and found that it was more efficient and accurate. [25]

The are a number of existing systems closely related to the proposed idea of marking attendance in a class by making use of facial recognition techniques and algorithms. To analyze these systems a literature survey of the proposed systems was done. The proposed case study was designed around certain relevant sources related to facial recognition and image processing. A descriptive framework was designed using the other design approaches. [26]

The authors main aim here is to develop a face recognition algorithm with OpenCV 2.4.8 by using an attendance system as their case study, here the authors have compared two famous face recognition algorithms i.e., PCA(Eigenface) LDA (Fisherface) using a ROC curve on their training set, the result was Eigenface out performed Fisherface and got an accuracy of 70 percent to 90 percent similarity for genuine faces. [27]

The authors here propose a method of reducing the candidate gallery set and employing facial component classification, so as to enhance facial recognition, the authors performed experiments on CMU-PIE image database and PCA (Principal Component Analysis) algorithm, a success rate of 91.7, the main aim of this system is to try and get down the processing time as much as possible. [28]

The authors here have made use of CNN (Convolutional Neural Networks) to detect and extract features from the captured images that contain the faces of the students. They have also made use of CNN to train their model and a SVM (Support Vector Machine) classifier to classify the trained images. They achieved an accuracy rate of 95 percent accuracy. [29]

The system makes use of DNN to detect the faces of students and PCA and LDA algorithm for image matching and a SVM classifier and CNN, they achieved an accuracy of 86 percent with a database containing eleven images, the database was created by extracting frames from a video recording of a student and those respective frames were then stored in the database. [26]



## 2.4. Conclusion

In this chapter, we provided a comprehensive background on facial recognition technology, specifically in the context of attendance management systems. We discussed the importance of such systems in various fields, including education and business, and highlighted the challenges associated with developing accurate and efficient solutions.

Furthermore, we presented a review of 18 related works that addressed the problem of attendance management using facial recognition. Our review showed that while there have been many recent advances in this field, there is still a research gap in terms of developing a comprehensive and accurate system that can handle various lighting and pose conditions and can work in real-time.

To address this gap, our work aims to develop a real-time facial recognition attendance system using deep learning techniques. The proposed system utilizes a convolutional neural network for face detection and recognition, and we anticipate that it will outperform traditional methods such as Eigenface and Fisherface.

In conclusion, our work is important because it targets a research gap in attendance management systems using facial recognition. By developing a real-time system based on deep learning, we aim to provide a more accurate and efficient solution that can be applied in various contexts.

### 3. Chapter Three: Analysis and Design

#### 3.1. Used Tools

Tool	Usage
Flask	Web Server Application
alchemy	orm
SQLite	Database
decouple	Storing Environment Variables
imutils	Image Processing
HTML, CSS, JS	UI
UML Diagrams	Visual Paradigm Online Tool
Anaconda	Package Manager
CV2	Computer Vision

Table 1 - 3.1. Used Tools

#### 3.2. Software Development Technology

Agile software development is a form of development process that foresees the requirement for flexibility and applies a certain amount of pragmatism to the delivery of the finished product.

Agile software development necessitates a cultural change in many businesses since it emphasizes the clean delivery of specific software components rather than the full solution.

Agile has advantages such as its capacity to support teams in a changing environment while keeping a focus on the effective delivery of business value.

Agile's emphasis on collaboration helps organizations become more productive since teams cooperate and recognize their individual roles in the process.

Finally, since testing is done continuously throughout development, giving teams the chance to make changes as needed and alerting teams to any possible issues, businesses utilizing Agile software development may feel certain that they are releasing a high-quality product.

Agile has superseded waterfall as the preferred development methodology in most businesses, but it is in risk of being supplanted or swallowed by DevOps due to its rising popularity.

### 3.2.1. The four values of Agile

In 2001, 17 software development professionals gathered to discuss concepts around the idea of lightweight software development and ended up creating the Agile Manifesto.

Although there has been discussion about whether the Manifesto has exceeded its usefulness, it remains at the center of the Agile movement. The Manifesto explains the four key values of Agile.

The four core values outlined in the Agile Manifesto are:

1. Individual interactions are more important than processes and tools  
People drive the development process and respond to business needs. They are the most important part of development and should be valued above processes and tools. If the processes or tools drive development, then the team will be less likely to respond and adapt to change and, therefore, less likely to meet customer needs.
2. A focus on working software rather than thorough documentation.  
Before Agile, a large amount of time was spent on documenting the product throughout development for delivery. The list of documented requirements was lengthy and would cause long delays in the development process. While Agile does not eliminate the use of documentation, it streamlines it in a way that provides the developer with only the information that is needed to do the work -- such as user stories. The Agile Manifesto continues to place value on the process of documentation, but it places higher value on working software.
3. Collaboration instead of contract negotiations.  
Agile focuses on collaboration between the customer and project manager, rather than negotiations between the two, to work out the details of delivery. Collaborating with the customer means that they are included throughout the entire development process, not just at the beginning and end, thus making it easier for teams to meet the needs of their customers. For example, in Agile software development, the customer may be included at different intervals for demos of the product. However, the customer could also be present and interacting with the teams on a daily basis, attending all meetings and ensuring the product meets their desires.
4. A focus on responding to change.  
Traditional software development used to avoid change because it was considered an undesired expense. Agile eliminates this idea. The short iterations in the Agile cycle allow changes to easily be made, helping the team modify the process to best fit their needs rather than the other way around. Overall, Agile software development believes change is always a way to improve the project and provide additional value.

### 3.2.2. The 12 Principles of Agile

The Agile Manifesto also outlined 12 core principles for the development process. They are:

1. Satisfy customers through early and continuous delivery of valuable work.
2. Break big work down into smaller tasks that can be completed quickly.
3. Recognize that the best work emerges from self-organized teams.
4. Provide motivated individuals with the environment and support they need and trust them to get the job done.
5. Create processes that promote sustainable efforts.
6. Maintain a constant pace for completed work.
7. Welcome changing requirements, even late in a project.
8. Assemble the project team and business owners on a daily basis throughout the project.
9. Have the team reflect at regular intervals on how to become more effective, then tune and adjust behavior accordingly.
10. Measure progress by the amount of completed work.
11. Continually seek excellence.
12. Harness change for a competitive advantage.

### 3.2.3. Types of Agile methodologies

The goal of every Agile methodology is to embrace and adapt to change while delivering working software as efficiently as possible. However, each method varies in the way it defines the steps of software development.

The most widely used Agile methods include:

**Scrum** is a lightweight Agile framework that can be used by project managers to control all types of iterative and incremental projects.

**Lean software development** is another iterative method that places a focus on using effective value stream mapping to ensure the team delivers value.

**The extreme programming (XP)** method is a disciplined approach that focuses on speed and continuous delivery.

**Crystal** is the most lightweight and adaptable methodology. It focuses on people and the interactions that occur while working on an Agile project as well as business-criticality and priority of the system under development.

**Kanban** uses a highly visual workflow management method that allows teams to actively manage product creation -- emphasizing continuous delivery -- without creating more stress in the software development lifecycle (SDLC).

**Dynamic systems development method (DSDM)** although the dynamic systems development method is an iterative approach to software development, it also includes more structure and discipline. The fundamental tenet of DSDM is that

"all projects must be aligned to clearly defined strategic goals and focus upon early delivery of meaningful benefits to the business.

**Feature driven development (FDD)** as its name suggests, organizes software development around making progress on features.

### 3.3. UML Diagrams

#### 3.3.1. Use Case Diagram:

The Use cases can be valuable tools for understanding a specific system's ability to meet the needs of end users. When designing software or a system, enhance your development efforts by thinking through practical stories about product usefulness. Use cases can also be effective for product marketing purposes. In addition, to right a good use case, you must follow some steps.

Identify the person, groups or organization served by your system:

In use case language, this considered the "actor" and represents behaviour associated with your software or system. If creating finance software, for example, who are the people and organizations that will use it?

Create a separate use case for each type of user. Some groups or organizations may benefit directly from the system. Others may not use the system but may still affected by its function.

Outline all steps and interactions:

- Write out the steps involved in the interaction. For example, the end user will log in, click on a specific page, enter his expenses and save the information.
- Document a contingency plan. If actions are not successful, what is his next step?

Identify the value of the system:

Explain how and why the system is useful to the end user. An organization might use your system to streamline its information tracking, which may result in greater information clarity, time saving, or the need for fewer human resources. Write out the specific value for each end user type.

Use Case Model:

The use case model captures the requirements of a system. Use cases are the means of communicating with users and other stakeholders what the system intended to do.

## Actors:

A use case diagram shows the interaction between the system and entities external to the system. These external entities are referred to as actors. Actors represent roles that may include human users, external hardware or other systems. An actor is usually drawn as a named stick figure, or alternatively as a class rectangle with the «actor» keyword.

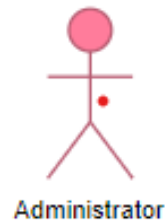


Figure 1 - Actors

Actors can generalize other actors as detailed in the following diagram.

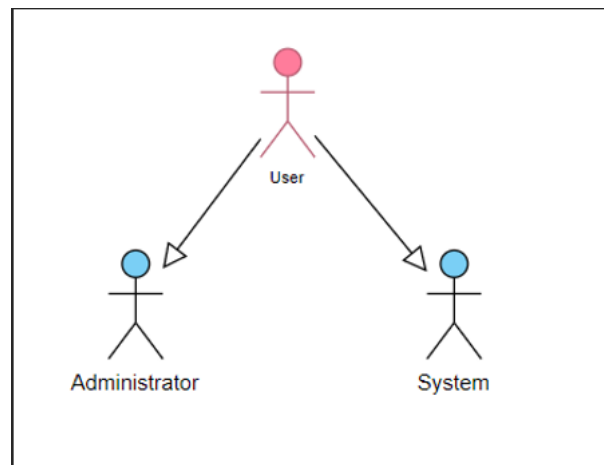


Figure 2 - Generalization

## Use Cases:

A use case is a single unit of meaningful work. It provides a high-level view of behavior observable to someone or something outside the system. The notation for a use case is an ellipse.

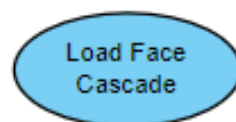


Figure 3 - Use Case

The notation for using a use case is a connecting line with an optional arrowhead showing the direction of control. The following diagram indicates that the actor "Administrator" uses the "Manage the fleet" use case:



Figure 4 - Association

### Name and Description:

A use case is normally a verb-phrase and given a brief informal textual description.

### Requirements:

The requirements define the formal functional requirements that a use case must supply to the end user. They correspond to the functional specifications found in structured methodologies. A requirement is a contract or promise that the use case will perform an action or provide some value to the system.

### Constraints:

A constraint is a condition or restriction that a use case operates under and includes pre-, post- and invariant conditions. A precondition specifies the conditions that need to be met before the use case can proceed. A post-condition is used to document the change in conditions that must be true after the execution of the use case. An invariant condition specifies the conditions that are true throughout the execution of the use case.

### Scenarios:

A Scenario is a formal description of the flow of events that occur during the execution of a use case instance. It defines the specific sequence of events between the system and the external actors. It is normally described in text and corresponds to the textual representation of the sequence diagram.

### Including Use Cases:

Use cases may contain the functionality of another use case as part of their normal processing. In general, it's assumed that any included use case will be called every time the basic path is run. An example of this is to have the execution of the use case to be run as part of a use case.

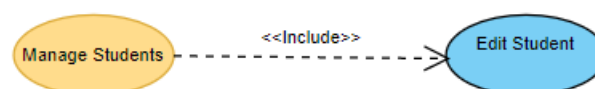


Figure 5 - Includes.

### Extending Use Cases:

One use case may be used to extend the behavior of another; this is typically used in exceptional circumstances.



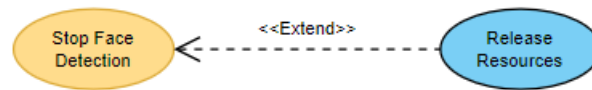


Figure 6 - Extend.

### System Boundary:

It is usual to display use cases as being inside the system and actors as being outside the System.

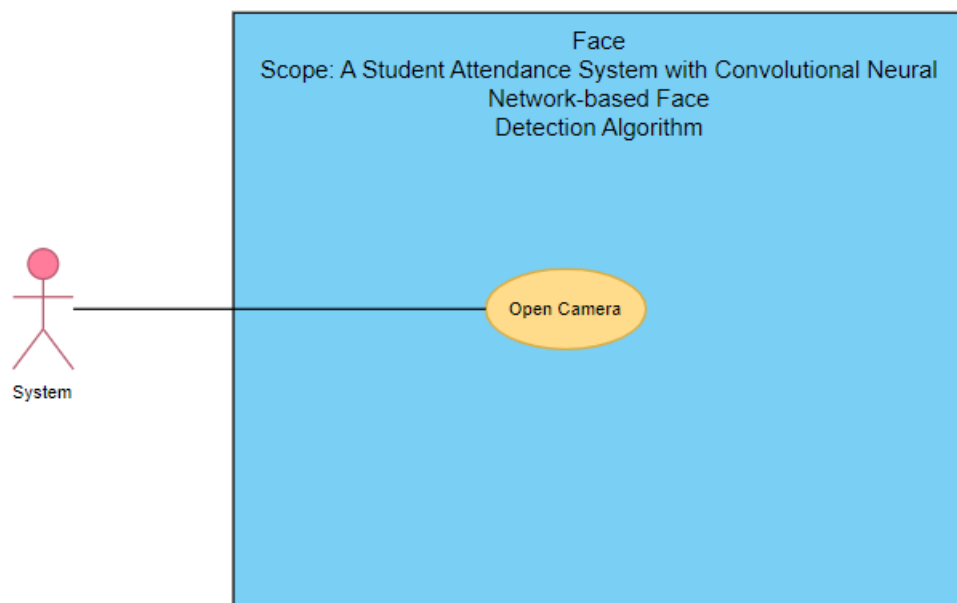


Figure 7 - System Boundaries

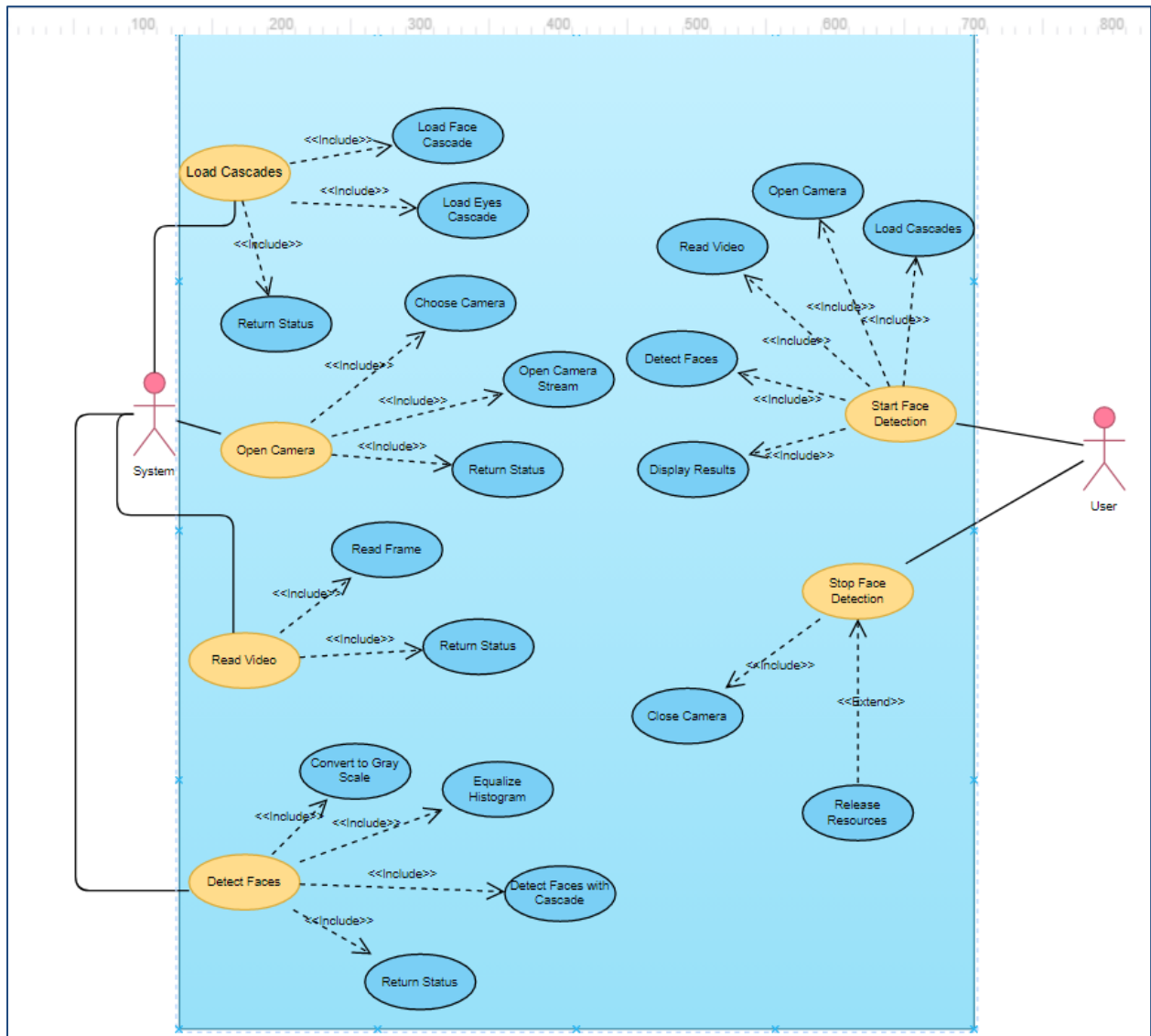


Figure 8 - Use Case 1

Table 2 - Face Detection System – Use Case 1

ID	Use Case	Details
001	Face Detection System- Use Case 1	<p><b>Actors</b></p> <ul style="list-style-type: none"> <li>User</li> <li>System.</li> </ul> <p><b>Entry Condition</b></p> <ul style="list-style-type: none"> <li>Start Face detection.</li> </ul> <p><b>Exit Condition</b></p> <ul style="list-style-type: none"> <li>Stop Face detection.</li> </ul> <p><b>Event Flow</b></p> <ul style="list-style-type: none"> <li>1. User open System</li> <li>2. User read cascades</li> <li>3. User open Camera</li> <li>4. User detect Faces</li> <li>5. User display results</li> <li>6. User close Camera</li> </ul> <p><b>Exceptional Cases</b></p>

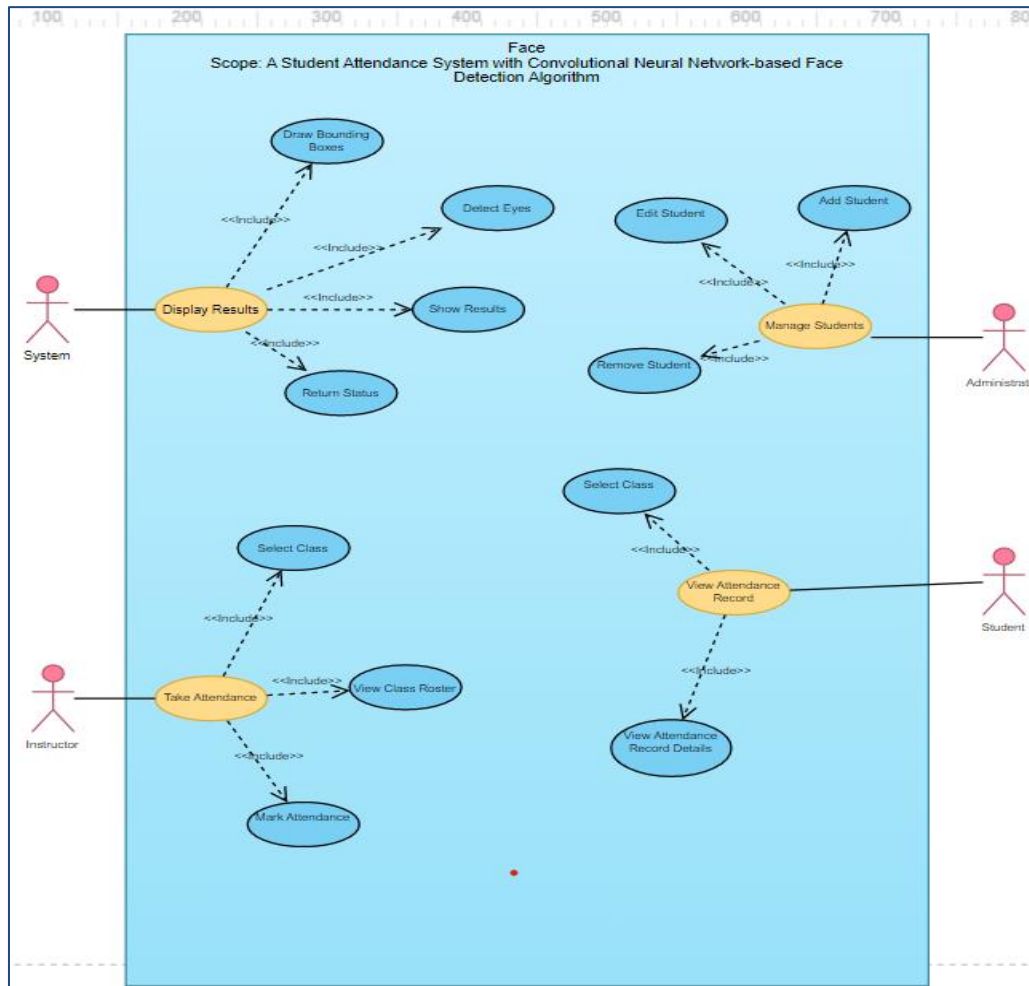


Figure 9 - Use Case 2

ID	Use Case	Details
001	Face Detection System –Use Case 2	<p><b>Actors</b></p> <ol style="list-style-type: none"> <li>1. Administrator</li> <li>2. Instructor</li> <li>3. System</li> <li>4. Student</li> </ol> <p><b>Entry Condition</b></p> <ul style="list-style-type: none"> <li>• Administrator open system</li> </ul> <p><b>Exit Condition</b></p> <ul style="list-style-type: none"> <li>• Administrator close system</li> </ul> <p><b>Event Flow</b></p> <ol style="list-style-type: none"> <li>1. User open login page.</li> <li>2. User enter Username and Password.</li> <li>3. User start his mission.</li> <li>4. User close his mission.</li> <li>5. User generate damages report.</li> <li>6. User generate missions report.</li> <li>7. User log out.</li> </ol> <p><b>Exceptional Cases</b></p>

Table 3 - Use Case 2

### 3.3.2. Class Diagram

The class diagram used to

- Represent the structure of the system.
- Describe the static structure of the system: object, attributes, and associations.

Class:

A Class describe group of objects with same properties (attributes) behavior (operation):

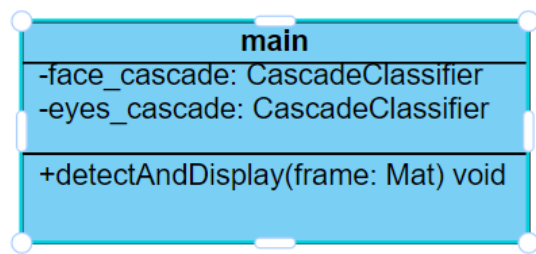


Figure 10 - Class

Association:

An association is description of group of links with common structure.

Association may be:

- 1\_to\_1 association.
- 1\_to\_many associations.
- Many\_to\_many associations.

Class Consists of:

- A class represents a concept.
- A class encapsulates state (attributes) and behavior (operations).
- Each attributes have type.
- Each operation has a signature.

The class name is the only mandatory information.

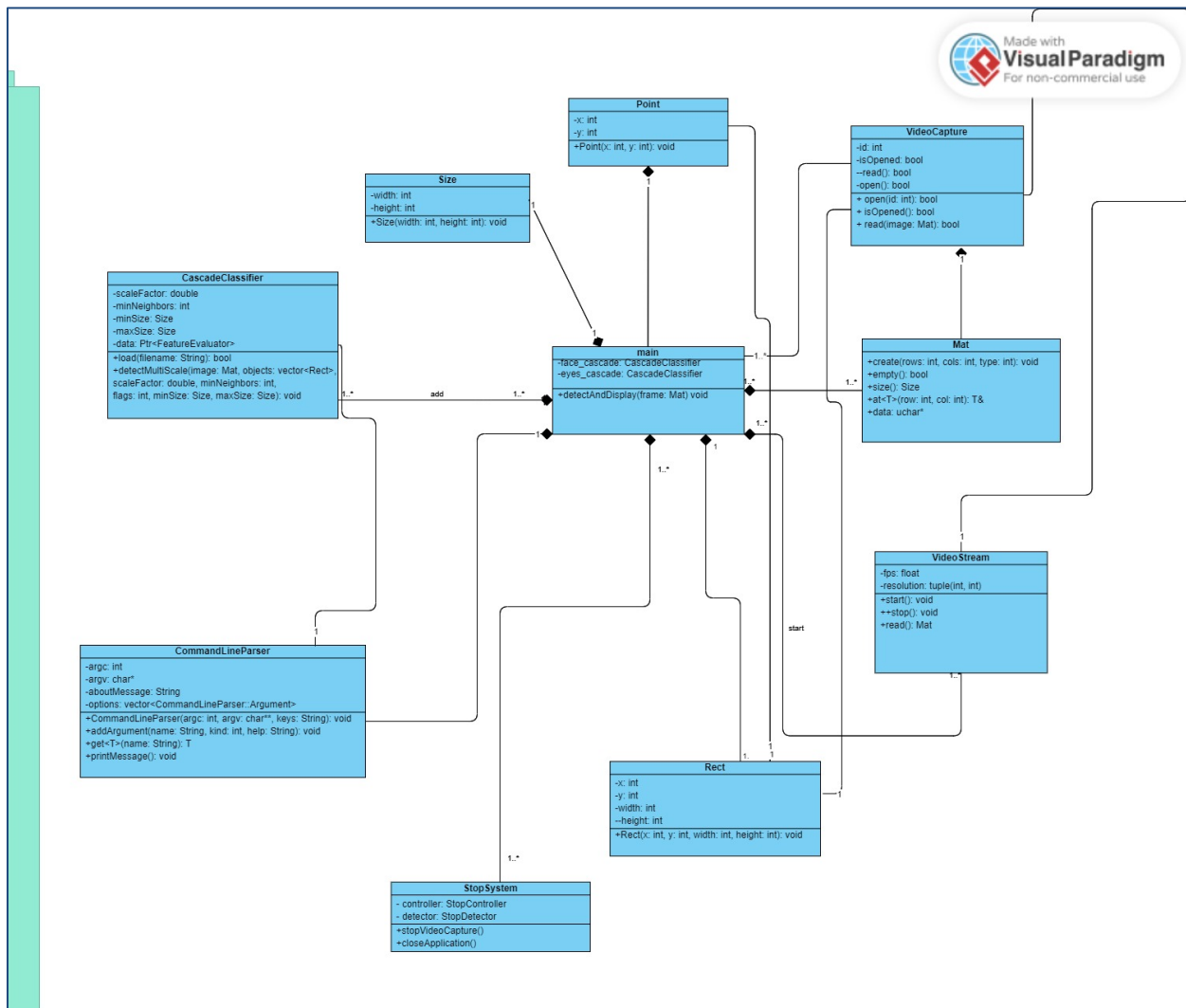


Figure 11 - Class Diagram

### 3.3.3. Sequence Diagram

The Sequence diagrams represent the behavior as interactions and used during requirements analysis:

- To refine use case descriptions.
- To find additional objects.

Object:

In sequence, diagram each actor, object or system represented by vertical line called object lifeline.

Activation:

Describe that the system is in process by means system in use.

## Message:

Messages extend from the lifeline of one object to the lifeline of another except in the case of message from an object to itself in which case the message begins and end on the same life line.

Sequence diagram consists of:

- Classes are represented by columns.
- Messages are represented by arrows.
- Activations are represented by narrow rectangles.
- Lifelines are represented by dashed lines.

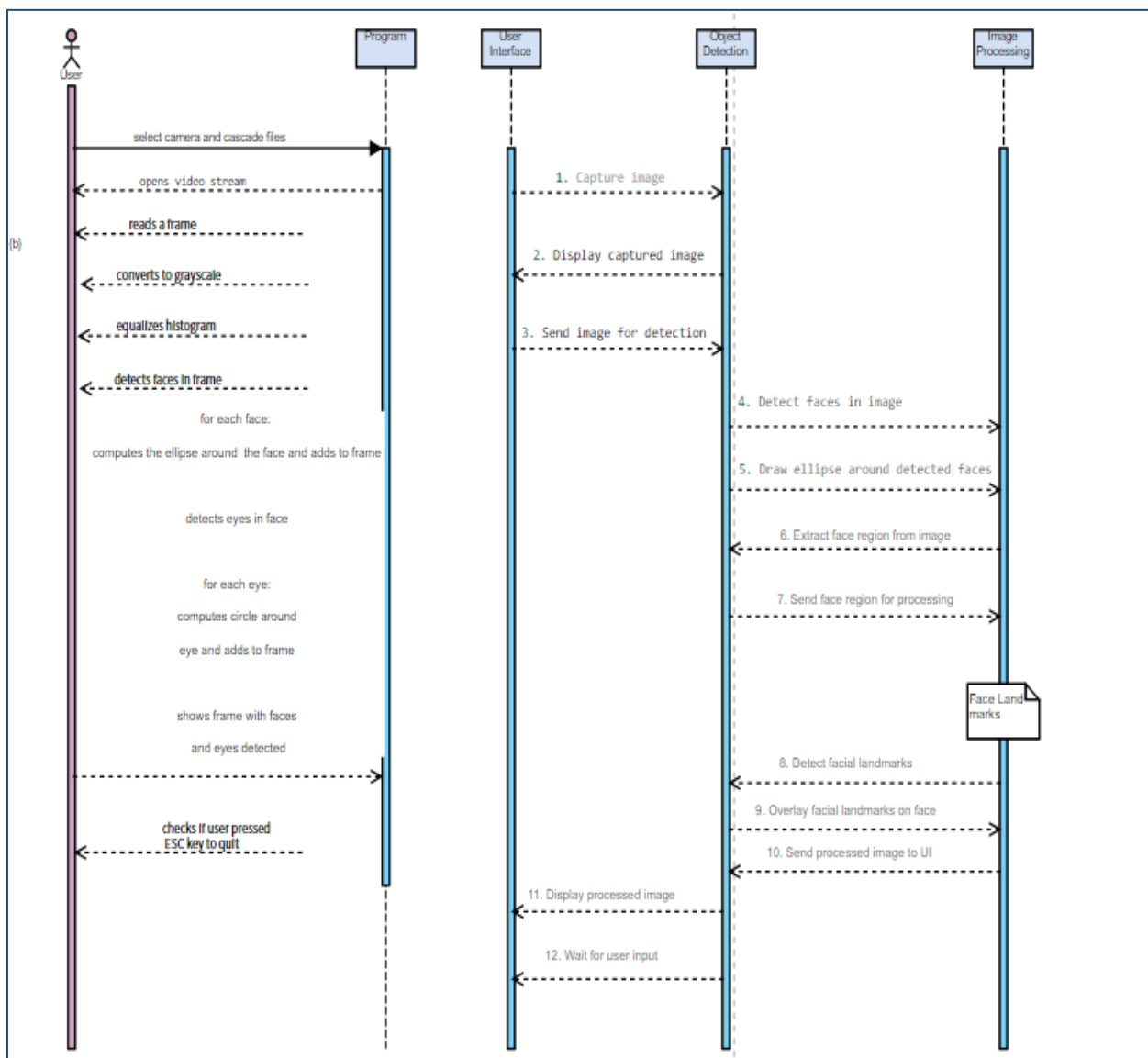


Figure 12 - Sequence Diagram

### 3.4. Build Features List

#	Feature
1	As a user, I want to be able to load pre-trained face and eye cascade classifiers
2	As a user, I want to be able to specify the paths to the face and eye cascade XML files through command-line arguments
3	As a user, I want to be able to open a video stream from a camera device
4	As a user, I want to be able to check if the video capture was successful or not
5	As a user, I want to be able to read frames from the video stream
6	As a user, I want to be able to check if a frame is empty or not
7	As a user, I want to be able to convert color frames to grayscale
8	As a user, I want to be able to apply histogram equalization to the grayscale frames
9	As a user, I want to be able to detect faces in the processed frames using the face cascade classifier
10	As a user, I want to be able to retrieve the coordinates and dimensions of the detected faces
11	As a user, I want to be able to draw ellipses around the detected faces in the frames
12	As a user, I want to be able to extract the region of interest (face) from the grayscale frames
13	As a user, I want to be able to detect eyes within each detected face using the eye cascade classifier
14	As a user, I want to be able to retrieve the coordinates and dimensions of the detected eyes
15	As a user, I want to be able to draw circles around the detected eyes in the frames
16	As a user, I want to be able to display the modified frames with highlighted faces and eyes in a window
17	As a user, I want to be able to terminate the program by pressing the Esc key
18	As a user, I want to be notified if any errors occur during the loading of cascade classifiers
19	As a user, I want to be notified if any errors occur during the opening of the video capture
20	As a user, I want to be notified if any errors occur during the retrieval of frames

Table 4 - Features List



### 3.5. Database (ER Diagram)

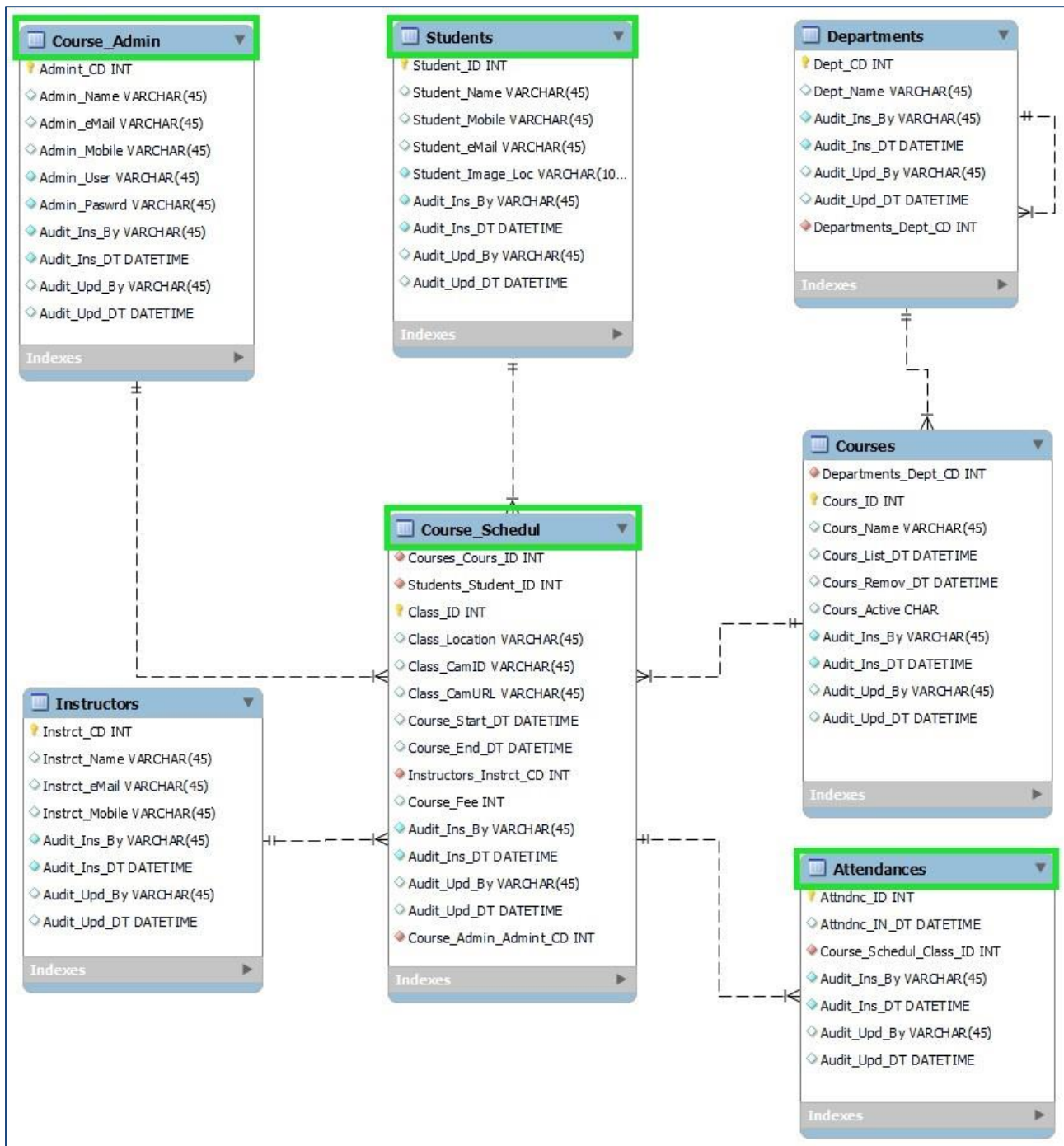
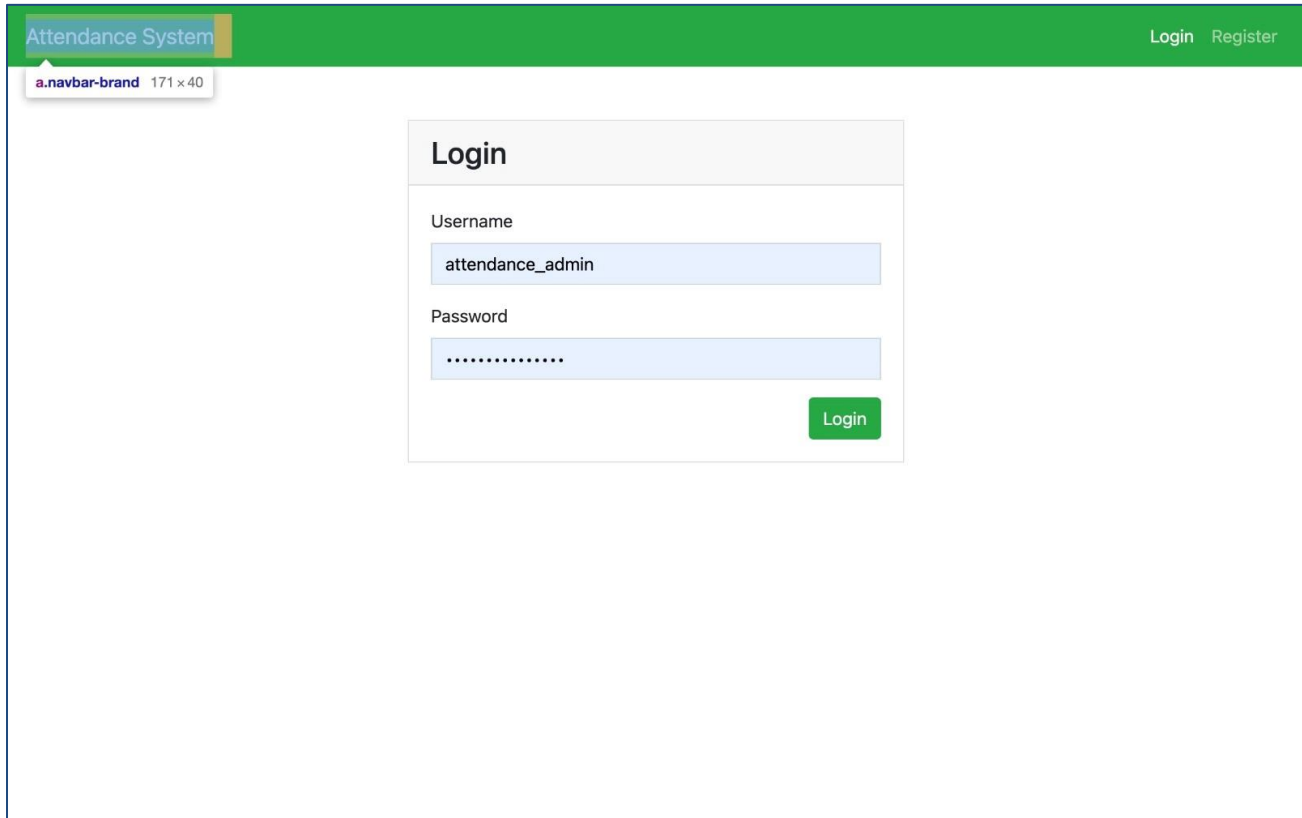


Figure 13 - ERD Diagram (Implemented Entities)

## 3.6. User Interface

### 3.6.1. Login Page

- This page provides a user-friendly interface for users to register and create a new account by entering a username and password.
- log in to the web form using the predefined username and password.
- This page provides a user-friendly interface for users to log in by entering their username and password.



The screenshot displays the login interface of an 'Attendance System'. At the top, a green header bar contains the text 'Attendance System' on the left and 'Login Register' on the right. Below the header, a central white box titled 'Login' contains the login form. The form has two input fields: 'Username' with the value 'attendance\_admin' and 'Password' with masked characters '.....'. A green 'Login' button is positioned at the bottom right of the form. A small tooltip for 'a.navbar-brand' with dimensions '171 x 40' is visible near the top left of the main content area.

Figure 14 - Login Screen

### 3.6.2. Home Page

- This page displays notification message
- System main menu

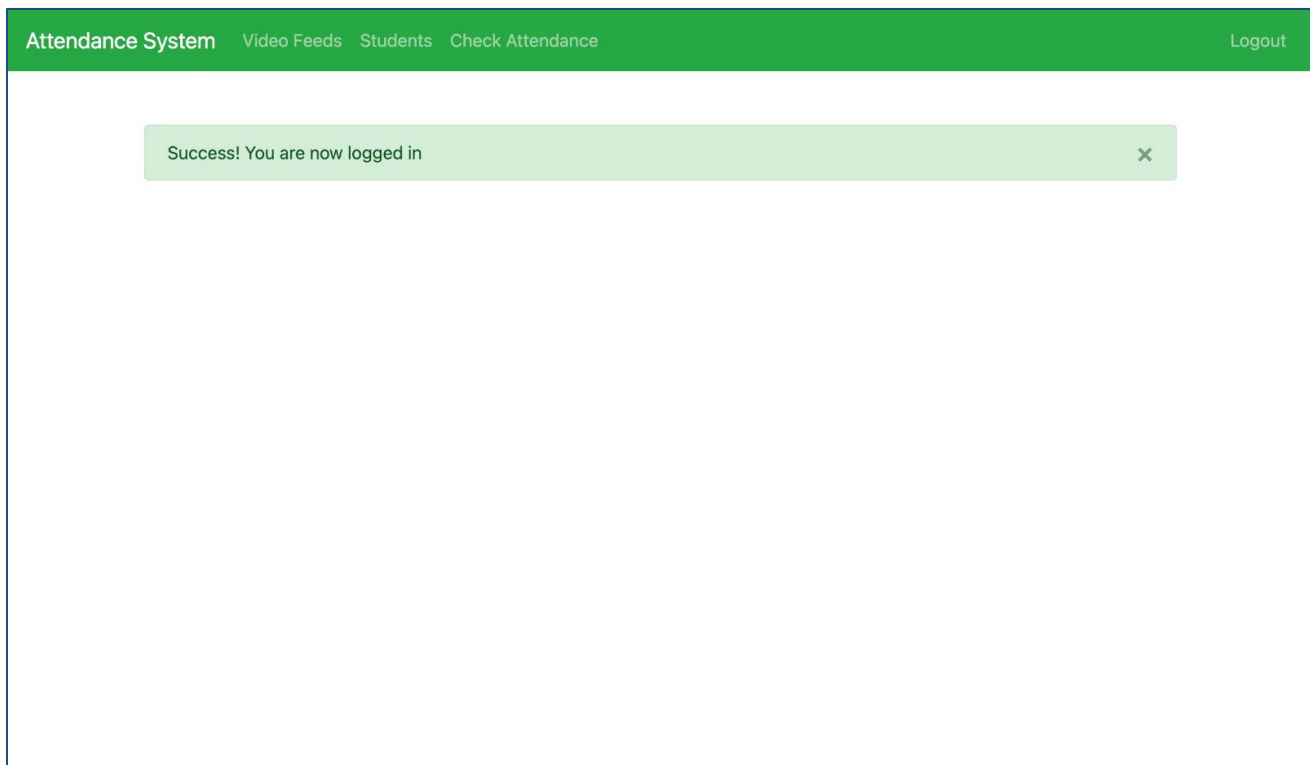
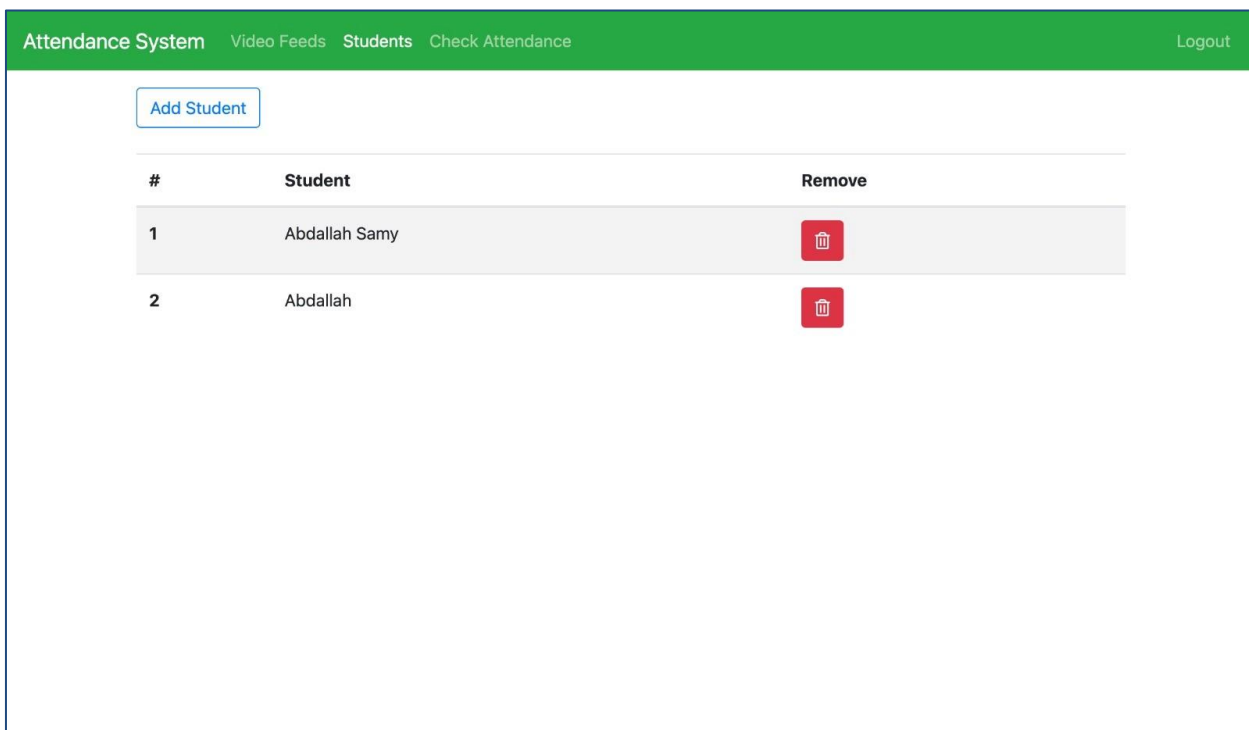


Figure 15 - Home Screen

### 3.6.3. Add Students Page:

- This page contains a form and a table to manage student information. The form allows users to add new students, while the table displays a list of existing students. The page includes a success message alert that appears when a new student is successfully added and an info message alert when a student is removed.
- The form initially collapsed, and a button with the label "Add Student" is displayed. Clicking the button expands the form if it is collapsed or hides it if it is expanded. The form includes a field for entering the student's name and a submit button to add the student.
- Below the form, there is a table with three columns: the student's ID, name, and a remove button. Each row in the table represents a student, and the remove button allows users to delete a specific student from the list.





#	Student	Remove
1	Abdallah Samy	
2	Abdallah	

Figure 16 - Maintaining Student Page

### 3.6.4. Add Video Feeds Page

- This page provides a simple interface for users to capture frames from a video feed and save them as images in a list below the video.
- This page allows users to manage video feeds by adding new feeds, controlling their status, and removing them. It provides an intuitive interface for interacting with the video feed functionality in a classroom setting.

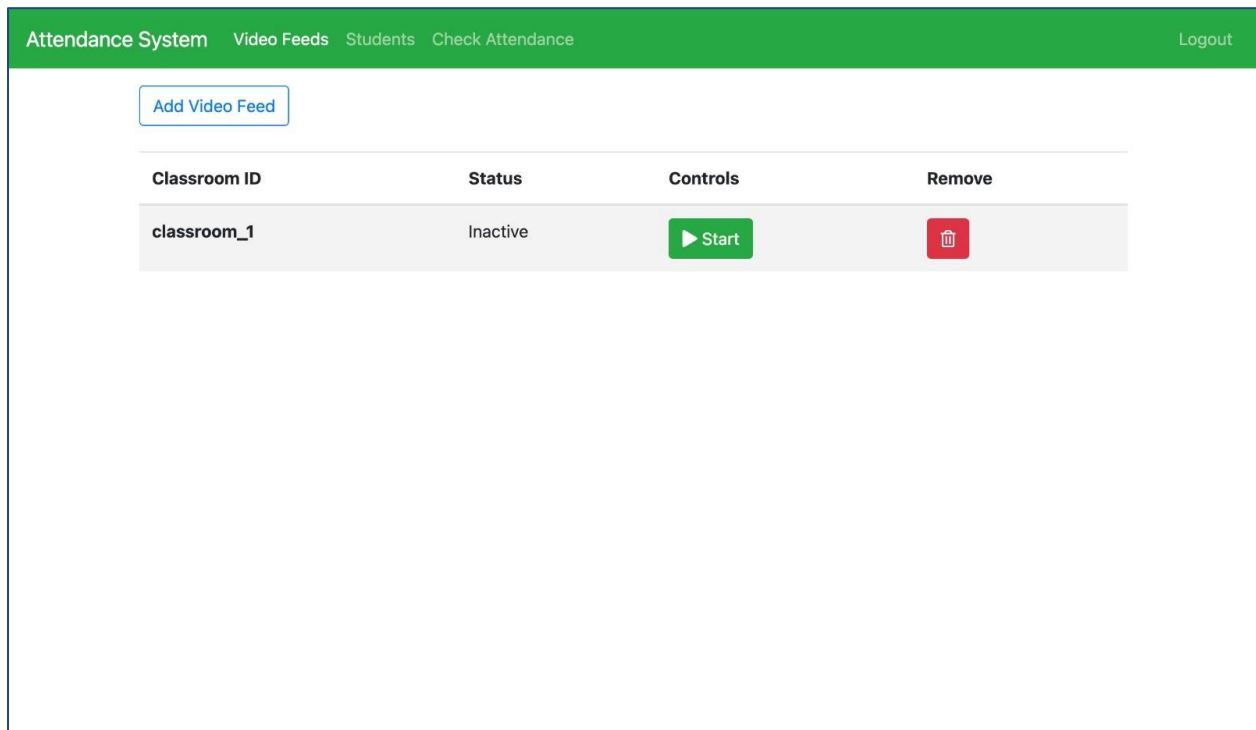


Figure 17 - Video Feeds Page

### 3.6.5. Check Attendance Page

- This page displays a table showing the attendance records of students. The table has three columns: Date, Student, and Time.
- The Date column displays the date of each attendance record in a short date format.
- The Student column shows the name of the student associated with each attendance record.
- The Time column displays the time of the attendance in a medium time format.

Attendance System				Video Feeds		Students		Check Attendance		Logout	
Date		Student		Time							
6/27/23		Abdallah Samy		1:56:23 PM							

Figure 18 - Attendance Page



## References

- [1] M. A. Islam, M. S. Hossain, A. R. Haque, S. M. Kabir and A. Almogren, "FaceTime: Deep learning-based face recognition attendance system," *IEEE International Conference on Imaging, Vision & Pattern Recognition (icIVPR)*, pp. 1-6, 2017.
- [2] T. R. Rajendran, S. S. Patil, R. S. Biradar and S. M. Deokar, "Real-Time Face Detection and Recognition System for Attendance Management," in *2nd International Conference on Advanced Computational and Communication Paradigms (ICACCP)*, Gangtok, India, 2019.
- [3] M. U. Hassan, N. D. Dodo and S. S. Saidu, "Class Attendance Management System using Facial Recognition," *International Conference on Advances in Science, Technology and Engineering (ICASTE)*, pp. 1-6, 2020.
- [4] S. A. Samad, S. M. Arifuzzaman, M. S. Hossain and M. R. Hasan, "Facial Recognition for Attendance System Using Raspberry Pi," in *International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST)*, Dhaka, Bangladesh, 2019.
- [5] T. Ahonen, A. Hadid and M. Pietikainen, "A Face Recognition System Based on Local Binary Patterns," in *European Conference on Computer Vision*, Prague, Czech Republic, 2004.
- [6] R. M. Botezatu, A. Balan, V. Cojocaru and .. Ivan, "Automated Attendance System using Facial Recognition," in *18th RoEduNet International Conference - Networking in Education and Research (RoEduNet NER)*, Bucharest, Romania, 2019.
- [7] Y. Taigman, M. Yang, M. Ranzato and L. Wolf, "DeepFace: Closing the Gap to Human-Level Performance in Face Verification," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, Columbus, OH, Jun. 2014.
- [8] H. K. Ekenel, R. Stiefelhagen and T. Ahlstrom, "Real-time face recognition using deep learning," in *IEEE International Conference on Computer Vision Workshop (ICCVW)*, 2015.
- [9] A. A. Patel and A. K. Jain, "Face Dataset for Recognition," in *Proceedings of the IEEE International Joint Conference on Biometrics*, Tampa, FL, Oct. 2011.
- [10] P. Viola and M. J. Jones, "Robust Real-Time Object Detection," *International Journal of Computer Vision*, vol. 57, no. 2, pp. 137-154, May 2004.
- [11] S. Abadi and al., "TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems," *arXiv preprint*, 2016.
- [12] A. Kumar, S. S. Rathore and R. K. Singh, "A Novel Face Recognition based Automated Attendance Management System," in *Proceedings of the IEEE International Conference on Computing Communication Control and Automation*, Pune, India, Dec. 2015.
- [13] J. N. Wang, C. Y. Chang and M. C. Su, "Smart class attendance management system based on RFID and fingerprint recognition," in *IEEE International Conference on Systems, Man and Cybernetics*, San Antonio, TX, USA, 2009.
- [14] M. Bhattarai, S. K. Yadav, S. Khanal and S. K. Saha, "Smart attendance management system using face recognition," in *IEEE 6th Intl Conf on Industrial Engineering and Applications (ICIEA)*, 2019.

- [15] S. Rathore and R. K. Singh, "Face Recognition-based Attendance Management System," in *8th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, 2017.
- [16] Z. Li and C. Shen, "Deep Learning for Face Recognition: A Comprehensive Review," 2018.
- [17] M. A. Dhinesh Kumar and P. Thangaraj, "Automated Attendance System Using Face Recognition," in *Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, 2018.
- [18] M. Rahman, N. M. Ahmed and M. A. Karim, "A Review on Face Recognition Techniques, Applications and Challenges," in *21st International Conference on Computer and Information Technology (ICCIT)*, Dhaka, Bangladesh, 2018.
- [19] K. Zhang, Z. Zhang, Z. Li and Y. Qiao, "Joint face detection and alignment using multitask cascaded convolutional networks," *IEEE Signal Processing Letters*, vol. 23, no. 10, pp. 1499-1503, Oct 2016.
- [20] M. S. A. Moghaddam and M. Cheriet, "Facial Biometric-Based Authentication Systems: A Comprehensive Survey," *IEEE Access*, vol. 9, pp. 20261-20315, 2021.
- [21] J. Luoma, in *12th International Conference on Data Mining Workshops*, 2012.
- [22] S. Y. V. Y. a. S. B. R. Singh, "Face Recognition Attendance System using Raspberry Pi," Coimbatore, India, 2019.
- [23] H. W. a. Y. L. L. Zhang, "Real-Time Face Recognition Attendance System Based on Deep Learning," 2021.
- [24] S. A. M. A.-R. a. M. A.-D. S. T. Farooq, "Face Attendance System Using Machine Learning Techniques," Madurai, India, 2020.
- [25] R. B. M. K. a. R. K. N. K. Maurya, "Automated Attendance Management System Using Face Recognition," Ghaziabad, India, 2021.
- [26] P. Radhika C.Damale, "Face Recognition Based Attendance System Using Machine Learning Algorithms," in *Proceedings of the Second International Conference on Intelligent Computing and Control Systems (ICICCS 2018)*, 2018.
- [27] A. S. N. M. G. Adrian Rhesa Septian Siswanto, "Implementation of Face Recognition Algorithm for Biometrics Based Time Attendance System," in *Center for Information Communication Technology Agency for the Assessment Application of Technology (PTIK-BPPT)*, Tangerang, INDONESIA, 2016.
- [28] U. C. S. M. Jinsu Kim, "Face Recognition Enhancement by Employing Facial Component Classification and Reducing the Candidate Gallery Set.," in *Department of Computer Engineering, Sejong University*, Seoul, Korea , 2019.
- [29] N. S. S. M. I. Nusrat Mubin Ara, "Convolutional Neural Network(CNN) Approach for Vision Based Student Recognition System.," Dhaka, Bangladesh, 2017.
- [30] A. Ambardekar, S. Pawar and P. Suryawanshi, "Facial Recognition Based Attendance System Using Deep Learning," in *International Conference on Computing, Communication, and Intelligent Systems (ICCCIS)*, Goa, India, 2021.

## Table of Figures

Figure 1 - Actors .....	28
Figure 2 - Generalization .....	28
Figure 3 - Use Case.....	28
Figure 4 - Association.....	29
Figure 5 - Includes. ....	29
Figure 6 - Extend. ....	30
Figure 7 - System Boundaries.....	30
Figure 8 - Use Case 1.....	31
Figure 9 - Use Case 2.....	32
Figure 10 - Class .....	33
Figure 11 - Class Diagram .....	34
Figure 12 - Sequence Diagram.....	35
Figure 13 - ERD Diagram (Implemented Entities) .....	37
Figure 14 - Login Screen .....	38
Figure 15 - Home Screen .....	39
Figure 16 - Maintaining Student Page .....	40
Figure 17 - Video Feeds Page.....	41
Figure 18 - Attendance Page.....	42

## Table of Tables

Table 1 - 3.1. Used Tools .....	24
Table 2 - Face Detection System – Use Case 1 .....	31
Table 3 - Use Case 2 .....	32
Table 4 - Features List .....	36

## Appendixes

### 3.6.6. Database Schema and [GitHub Link to the project...](#)

```
-- Wed Jul 5 00:49:07 2023
-- Model: New Model      Version: 1.0

-----
-- Schema mydb
-----
DROP SCHEMA IF EXISTS `mydb`

-----
-- Schema mydb
-----
CREATE SCHEMA IF NOT EXISTS `mydb` DEFAULT CHARACTER SET
USE `mydb`

-----
-- Table `mydb`.`tbl_VideoCapture`
-----
DROP TABLE IF EXISTS `mydb`.`tbl_VideoCapture`

CREATE TABLE IF NOT EXISTS `mydb`.`tbl_VideoCapture`
(`IDs` INT NOT NULL
`IsOpened` VARCHAR 1 NULL
`Read` VARCHAR 1 NULL
`Open` VARCHAR 1 NULL
PRIMARY KEY `IDs`
=

-----
-- Table `mydb`.`tbl_main`
-----
DROP TABLE IF EXISTS `mydb`.`tbl_main`

CREATE TABLE IF NOT EXISTS `mydb`.`tbl_main`
(`Face_Cascade` INT NOT NULL
`Eyes_Cascade` INT NULL
PRIMARY KEY `Face_Cascade`
=

-----
-- Table `mydb`.`tbl_Points`
-----
DROP TABLE IF EXISTS `mydb`.`tbl_Points`
```

```
CREATE TABLE IF NOT EXISTS `mydb`.`tbl_Points`
  `X_Cord` INT NOT NULL
  `Y_Cord` INT NULL
  PRIMARY KEY `X_Cord`
=

-- -----
-- Table `mydb`.`tbl_CascadeClassifier`
-- -----
DROP TABLE IF EXISTS `mydb`.`tbl_CascadeClassifier`

CREATE TABLE IF NOT EXISTS `mydb`.`tbl_CascadeClassifier`
  `scaleFactor` NOT NULL
  `minNeighbors` INT NULL
  `minSize` INT NULL
  `maxSize` INT NULL
  `data` VARCHAR 45 NULL
  PRIMARY KEY `scaleFactor`
=

CREATE UNIQUE INDEX data_UNIQUE ON `mydb`.`tbl_CascadeClassifier` (`data`
ASC

-- -----
-- Table `mydb`.`tbl_Rect`
-- -----
DROP TABLE IF EXISTS `mydb`.`tbl_Rect`

CREATE TABLE IF NOT EXISTS `mydb`.`tbl_Rect`
  `X_Cord` INT NOT NULL
  `Y_Cord` INT NULL
  `Width_Cord` INT NULL
  `Height_Cord` INT NULL
  PRIMARY KEY `X_Cord`
=

-- -----
-- Table `mydb`.`tbl_CommandLineParser`
-- -----
DROP TABLE IF EXISTS `mydb`.`tbl_CommandLineParser`

CREATE TABLE IF NOT EXISTS `mydb`.`tbl_CommandLineParser`
  `argc` INT NOT NULL
  `argv` CHAR NULL
  `aboutMessage` VARCHAR 45 NULL
  PRIMARY KEY `argc`
=
```

```
-- Table `mydb`.`Students`
--
DROP TABLE IF EXISTS `mydb`.`Students`

CREATE TABLE IF NOT EXISTS `mydb`.`Students`
(`Student_ID` INT NOT NULL
`Student_Name` VARCHAR 45 NULL
`Student_Mobile` VARCHAR 45 NULL
`Student_eMail` VARCHAR 45 NULL
`Student_Image_Loc` VARCHAR 100 NOT NULL
`Audit_Ins_By` VARCHAR 45 NOT NULL
`Audit_Ins_DT` DATETIME NOT NULL
`Audit_Upd_By` VARCHAR 45 NULL
`Audit_Upd_DT` DATETIME NULL
PRIMARY KEY `Student_ID`
=

CREATE UNIQUE INDEX Student_Name_UNIQUE ON `mydb`.`Students` (`Student_Name`
ASC

CREATE UNIQUE INDEX Student_eMail_UNIQUE ON `mydb`.`Students`
(`Student_eMail` ASC

-- Table `mydb`.`Departments`
--
DROP TABLE IF EXISTS `mydb`.`Departments`

CREATE TABLE IF NOT EXISTS `mydb`.`Departments`
(`Dept_CD` INT NOT NULL
`Dept_Name` VARCHAR 45 NULL
`Audit_Ins_By` VARCHAR 45 NOT NULL
`Audit_Ins_DT` DATETIME NOT NULL
`Audit_Upd_By` VARCHAR 45 NULL
`Audit_Upd_DT` DATETIME NULL
`Departments_Dept_CD` INT NOT NULL
PRIMARY KEY `Dept_CD`
CONSTRAINT `fk_Departments_Departments1`
FOREIGN KEY `Departments_Dept_CD`
REFERENCES `mydb`.`Departments` (`Dept_CD`
ON DELETE NO ACTION
ON UPDATE NO ACTION
=

CREATE UNIQUE INDEX Dept_Name_UNIQUE ON `mydb`.`Departments` (`Dept_Name`
ASC

CREATE INDEX fk_Departments_Departments1_idx ON `mydb`.`Departments`
(`Departments_Dept_CD` ASC
```

```
-- Table `mydb`.`Courses`
-----

DROP TABLE IF EXISTS `mydb`.`Courses`

CREATE TABLE IF NOT EXISTS `mydb`.`Courses`
  `Departments_Dept_CD` INT NOT NULL
  `Cours_ID` INT NOT NULL
  `Cours_Name` VARCHAR 45 NULL
  `Cours_List_DT` DATETIME NULL
  `Cours_Remov_DT` DATETIME NULL
  `Cours_Active` CHAR NULL
  `Audit_Ins_By` VARCHAR 45 NOT NULL
  `Audit_Ins_DT` DATETIME NOT NULL
  `Audit_Upd_By` VARCHAR 45 NULL
  `Audit_Upd_DT` DATETIME NULL
  PRIMARY KEY `Cours_ID`
  CONSTRAINT `fk_Courses_Departments`
    FOREIGN KEY `Departments_Dept_CD`
      REFERENCES `mydb`.`Departments` (`Dept_CD`
        ON DELETE NO ACTION
        ON UPDATE NO ACTION
    )
  =

CREATE UNIQUE INDEX Cours_Name_UNIQUE ON `mydb`.`Courses` (`Cours_Name` ASC

CREATE INDEX fk_Courses_Departments_idx ON `mydb`.`Courses`
  `Departments_Dept_CD` ASC

-- Table `mydb`.`Instructors`
-----

DROP TABLE IF EXISTS `mydb`.`Instructors`

CREATE TABLE IF NOT EXISTS `mydb`.`Instructors`
  `Instrct_CD` INT NOT NULL
  `Instrct_Name` VARCHAR 45 NULL
  `Instrct_eMail` VARCHAR 45 NULL
  `Instrct_Mobile` VARCHAR 45 NULL
  `Audit_Ins_By` VARCHAR 45 NOT NULL
  `Audit_Ins_DT` DATETIME NOT NULL
  `Audit_Upd_By` VARCHAR 45 NULL
  `Audit_Upd_DT` DATETIME NULL
  PRIMARY KEY `Instrct_CD`
  =

CREATE UNIQUE INDEX Instrct_Name_UNIQUE ON `mydb`.`Instructors`
  `Instrct_Name` ASC
```



```
CREATE UNIQUE INDEX Instrct_Mobile_UNIQUE ON `mydb`.`Instructors`  
  `Instrct_Mobile` ASC
```

```
CREATE UNIQUE INDEX Instrct_eMail_UNIQUE ON `mydb`.`Instructors`  
  `Instrct_eMail` ASC
```

```
-- -----  
-- Table `mydb`.`Course_Admin`  
-- -----
```

```
DROP TABLE IF EXISTS `mydb`.`Course_Admin`
```

```
CREATE TABLE IF NOT EXISTS `mydb`.`Course_Admin`  
  `Admint_CD` INT NOT NULL  
  `Admin_Name` VARCHAR 45 NULL  
  `Admin_eMail` VARCHAR 45 NULL  
  `Admin_Mobile` VARCHAR 45 NULL  
  `Admin_User` VARCHAR 45 NOT NULL  
  `Admin_Paswr` VARCHAR 45 NOT NULL  
  `Audit_Ins_By` VARCHAR 45 NOT NULL  
  `Audit_Ins_DT` DATETIME NOT NULL  
  `Audit_Upd_By` VARCHAR 45 NULL  
  `Audit_Upd_DT` DATETIME NULL  
  PRIMARY KEY (`Admint_CD`)
```

```
CREATE UNIQUE INDEX Instrct_Name_UNIQUE ON `mydb`.`Course_Admin`  
  `Admin_Name` ASC
```

```
CREATE UNIQUE INDEX Instrct_Mobile_UNIQUE ON `mydb`.`Course_Admin`  
  `Admin_Mobile` ASC
```

```
CREATE UNIQUE INDEX Instrct_eMail_UNIQUE ON `mydb`.`Course_Admin`  
  `Admin_eMail` ASC
```

```
-- -----  
-- Table `mydb`.`Course_Schedul`  
-- -----
```

```
DROP TABLE IF EXISTS `mydb`.`Course_Schedul`
```

```
CREATE TABLE IF NOT EXISTS `mydb`.`Course_Schedul`  
  `Courses_Cours_ID` INT NOT NULL  
  `Students_Student_ID` INT NOT NULL  
  `Class_ID` INT NOT NULL  
  `Class_Location` VARCHAR 45 NULL  
  `Class_CamID` VARCHAR 45 NULL  
  `Class_CamURL` VARCHAR 45 NULL  
  `Course_Start_DT` DATETIME NULL  
  `Course_End_DT` DATETIME NULL  
  `Instructors_Instrct_CD` INT NOT NULL  
  `Course_Fee` INT NULL
```

```

`Audit_Ins_By` VARCHAR 45 NOT NULL
`Audit_Ins_DT` DATETIME NOT NULL
`Audit_Upd_By` VARCHAR 45 NULL
`Audit_Upd_DT` DATETIME NULL
`Course_Admin_Admint_CD` INT NOT NULL
PRIMARY KEY `Class_ID`
CONSTRAINT `fk_Course_Schedul_Courses1`
FOREIGN KEY `Courses_Cours_ID`
REFERENCES `mydb`.`Courses` (`Cours_ID`
ON DELETE NO ACTION
ON UPDATE NO ACTION
CONSTRAINT `fk_Course_Schedul_Students1`
FOREIGN KEY `Students_Student_ID`
REFERENCES `mydb`.`Students` (`Student_ID`
ON DELETE NO ACTION
ON UPDATE NO ACTION
CONSTRAINT `fk_Course_Schedul_Instructors1`
FOREIGN KEY `Instructors_Instrct_CD`
REFERENCES `mydb`.`Instructors` (`Instrct_CD`
ON DELETE NO ACTION
ON UPDATE NO ACTION
CONSTRAINT `fk_Course_Schedul_Course_Admin1`
FOREIGN KEY `Course_Admin_Admint_CD`
REFERENCES `mydb`.`Course_Admin` (`Admint_CD`
ON DELETE NO ACTION
ON UPDATE NO ACTION
=

CREATE UNIQUE INDEX Class_Location_UNIQUE ON `mydb`.`Course_Schedul`
(`Class_Location` ASC

CREATE INDEX fk_Course_Schedul_Courses1_idx ON `mydb`.`Course_Schedul`
(`Courses_Cours_ID` ASC

CREATE INDEX fk_Course_Schedul_Students1_idx ON `mydb`.`Course_Schedul`
(`Students_Student_ID` ASC

CREATE INDEX fk_Course_Schedul_Instructors1_idx ON `mydb`.`Course_Schedul`
(`Instructors_Instrct_CD` ASC

CREATE INDEX fk_Course_Schedul_Course_Admin1_idx ON `mydb`.`Course_Schedul`
(`Course_Admin_Admint_CD` ASC

-- -----
-- Table `mydb`.`Attendances`
-- -----
DROP TABLE IF EXISTS `mydb`.`Attendances`

CREATE TABLE IF NOT EXISTS `mydb`.`Attendances`
(`Attdnc_ID` INT NOT NULL
`Attdnc_IN_DT` DATETIME NULL

```

```
`Course_Schedul_Class_ID` INT NOT NULL
`Audit_Ins_By` VARCHAR 45 NOT NULL
`Audit_Ins_DT` DATETIME NOT NULL
`Audit_Upd_By` VARCHAR 45 NULL
`Audit_Upd_DT` DATETIME NULL
PRIMARY KEY `Attndnc_ID`
CONSTRAINT `fk_Attendances_Course_Schedul1`
FOREIGN KEY `Course_Schedul_Class_ID`
REFERENCES `mydb`.`Course_Schedul` (`Class_ID`
ON DELETE NO ACTION
ON UPDATE NO ACTION
```

=

```
CREATE INDEX `fk_Attendances_Course_Schedul1_idx` ON `mydb`.`Attendances`
(`Course_Schedul_Class_ID` ASC
```