

AI BASE ATTENDANCE MANAGEMENT SYSTEM



Submitted By

INSHAL FAHEEM

BSCS-021R17-36

Supervisor

DR. HAMEEDUR RAHMAN

DEPARTMENT OF COMPUTER SCIENCE
INSTITUTE OF SOUTHERN PUNJAB, MULTAN

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By
INSHAL FAHEEM
BSCS-021R17-36

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AUTHOR'S DECLARATION

It is declared that I have developed an AI Base Attendance Management System for face recognition base attendance of Pakistani Community. I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my supervisor. It is further declared, that I have fulfilled all the requirements in line with the Quality Assurance guidelines of the Higher Education Commission.

I understand that my thesis may be made electronically available to the public.

Student Name	Inshal Faheem
Registration No.	BSCS-021R17-36
Email Address	inshalfaheem36@gmail.com
Discipline	Computer Science
Year of Study	2017-2021
Area of Study	Artificial Intelligence
Proposed Project Title	AI Base Attendance Management System

Signature of Student

(Inshal Faheem)

Signature of Supervisor

(Dr. Hameedur Rahman)

ABSTRACT

This research-based project aimed to detect and recognize Muslim Community with different constraints like women with Niqab and men with different facial hair growth styles and it is a difficult task to recognize faces with these constraints and in the crowded class scenario for purpose of their attendance. Attendance of the student is very important for every college, university and school. Conventional methodology for taking attendance which is calling the name or roll number of the student that takes a lot of time. To reduce this wastage of time, an automatic process is used in this project which is based on image processing. In this project face detection and face recognition is used. Face detection is used to locate the position of the face region and face recognition is used to recognize and for marking attendance. Compared with traditional card recognition, fingerprint recognition and iris recognition, face recognition has many advantages, including but limit to non-contact, high concurrency, and user friendly.

In this project, I use Dlib and face recognition library to detect and recognize different faces in a crowded class scenario. Face recognition is the easiest library to implement with considerable high accuracy. The database of all the students in the class is stored and when the face of the individual student matches with one of the faces stored in the database then the attendance is recorded.

Keywords

Face Detection, Face Recognition, Crowded Class, Occluded Faces, Attendance.

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List of Acronyms

SDLC	Software Development Life Cycle
RAD	Rapid Application Development
SRS	Software Requirement Specification
UML	Unified Modeling Language
UC	Use Case Diagram
DFD	Data Flow Diagram
ERD	Entity Relationship Diagram
APK	Android Package
API	Application Programming Interface
UI	User Interface
AI	Artificial Intelligence
DNN	Deep Neural Network

Chapter # 1 INTRODUCTION

1.1. Introduction

Face Detection in a crowded environment is a challenging task especially for fully-automated computer-vision systems, though not for the same reasons as humans. In the face recognition process first of all the input image is scanned and extract all the faces with their location (face detection). Then, the system compares the extracted face with another face and identify it whether it is the same face or not. If the result of the comparison is positive above a certain threshold, then that particular image is classified as the target image. Both face detection and face identification unavoidably produce false-positive results and cause accuracy reduction. Regardless of these difficulties, research has proved that the limitations of the human visual system have almost no effect on deep neural networks. In principle, this means that computer-vision systems could become more accurate than the average human, especially in tasks where visual information is presented for a certain amount of time. The performance of computer-vision systems does not reduce over time, while the performance of human is reduced with the passage of time for different reasons like fatigue. However, in realistic environments, it usually degrades way below that of humans (Valeriani & Poli, 2019).

Computer vision is one of the major areas of Artificial Intelligence. It deals with complex problems like image classification, image captioning, object detection, image segmentation, feature extraction etc. These problems have been tackled using Artificial Neural Networks which mimic the functioning of the brain (Chaudhari & Ghotkar, 2018).

Deep Neural Networks (DNN) are very successful in the area of Computer Vision as they present capabilities for processing multi-dimensional data and learn features similar to that of the brain. Face Detection in a crowded class is a challenging task due to its low resolution, small apparent size, non-uniform density and critical occlusions of the objects. In this project, Dlib and openface library is used for face detection in which the most key step is a DNN feature extractor that generates 128-d facial embeddings.

Crowd detection and counting methods are mainly divided into three categories: Detection, Regression and Density-based methods. Detection methods are useful to detect a person from the images and videos to produce the counting results by collecting every detected human. These methods required high computing resource and restricted by human obstructions and essential background in crowd scenarios, leads to low accuracy.

When the scene became more crowded and therefore the size of the thing decreases it would reduce the performance of counting and detection. The limitation of detection-based methods is that constrictions during a very dense crowd which reduce the performance of the system. Regression methods were observed suitable in crowded situations. Most regression methods are used for counting purpose and cannot be used to locate an individual object in the scene. Density methods were very effective with object counting. As compared to other regression methods, density-methods work well when objects are critically occluded (Chaudhari & Ghotkar, 2018).

Facial recognition is a way to identify or confirm an individual's identity by using his or her face. Facial recognition systems can be used to identify people in photographs, videos, or in real-time. Facial recognition is a category of biomedical safety. Other forms of biometric software include voice recognition, fingerprint recognition, eye retina or iris recognition. Recent advances in automated face analysis, pattern recognition and machine learning have enabled the development of automatic face recognition systems to address these applications. On the other hand, the use of this method in the field of computer vision remains a challenging problem. As part of the biometric systems, automatic face detection has a variety of interesting characteristics. They are focused on a significant non-invasive benefit.

Many people are familiar with the Face ID recognition technologies used to open iPhones (however, this is only one application of face recognition). However, facial recognition does not rely on a vast dataset of images to establish an individual's identity, it only identifies and acknowledges one user as the right owner of the unit and restricting access to others. Beyond unlocking phones, facial recognition technology is used in different applications that can make human life better. For example, it helps in tracking of school attendance, reducing crime, smart advertising, finding missing persons, protect law enforcement, forensic investigations, identify people on social media platforms, detect a rare disease called DiGeorge syndrome, protect schools from threats, facilitate secure transactions and validate identity at ATM etc. Almost certainly all approaches follow predominantly same steps as below:

1. Image acquisition.
2. Image normalization
3. Extract features from the face
4. Feed the features to a machine learning algorithm.

5. Matching between training set and test set.
6. Evaluate the result of matching.

These steps are also presented in Figure 1

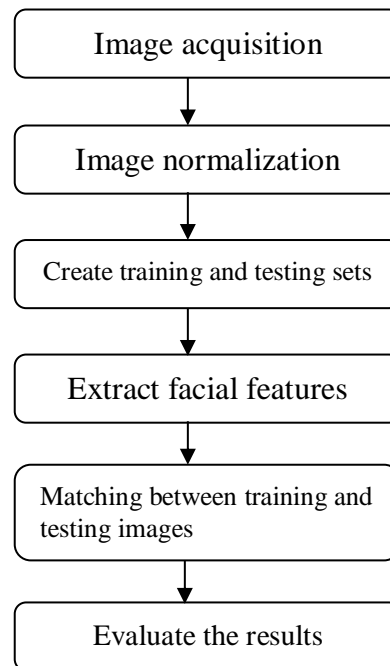


Figure 1: Steps of Face recognition process

Firstly, Image acquisition can be achieved by digitally scanning an existing photograph or using the digital camera to capture the picture of a subject. Secondly, the purpose of the normalization process is to enhance the quality of the image by adjusting the contrast of the image, diminished the noise, resizing and etc. Thirdly, in this stage, all relevant information will be extracted from the captured image. Where these characteristics are used to differentiate between people, for example, the form and position of facial components (including a mouth, eyes, brows, and nose). There are two very well-known approaches, Principle Components Analysis (PCA) and Linear Discriminant Analysis (LDA), respectively. Fourthly, it is needed to feed the features to a machine learning algorithm. At fifth, matching between training set and testing set has been done. Finally, evaluating the results.

1.2 Problem Statement and Proposed Solution

In Muslim community where mostly women prefer Niqab (is a garment of clothing that covers the face, worn by some Muslim women as a part of a particular interpretation of hijab) and men can change their facial hair growth styles, it's difficult to detect faces where same face change with different situations or time period and mostly women who wear Niqab don't want to disclose their face in public for face detection or any other

thing like this. This project specifically created for to solve such problems and proposed a method to detect these faces with maximum possible accuracy.

I have use Dlib and face recognition library to detect and recognize different faces in crowded class scenario. It can detect multiple faces in class and it can also be able to detect Muslim community with their specific religious constraints.

1.3 Objective:

A lot of automatic attendance systems based on face recognition are already developed but this system has some specific aims and unique features which are defined below:

- The purposed system is specifically developed for Pakistani community (ISP University).
- To detect students in crowded class with possible accurate results.
- To take class attendance with mobile camera and take real time pictures of class and the system will detect which students are present at that time.
- To recognize the females with Hijab and Niqab.
- Males whose facial features are changed to some extent with period of time due to factors like facial hair growth etc. as compare to their pictures used for training dataset would be recognizable by the system.
- The system is able to recognize the person even after some changes like weight gain or changing in skin tones etc. in that person.

1.4 Scope:

Face recognition is important in our daily life in order to recognize family, friends or someone we are familiar with. We might not perceive that several steps have actually taken in order to identify human faces. Human intelligence allows us to receive information and interpret the information in the recognition process. We receive information through the image projected into our eyes, by specifically retina in the form of light. Actually, human eye classify shape, size, contour and the texture of the object in order to analyze the information. The analyzed information will be compared to other representations of objects or face that exist in our memory to recognize.

The human face is a unique representation of individual identity. Thus, face recognition is defined as a biometric method in which identification of an individual is performed by comparing real-time capture image with stored images in the database of that person.

Automatic Attendance can save much time that is comparatively wasted in the traditional attendance management system. The most important feature of the software is that it can recognize a simple human face even in different situations like the same person with a face mask, weight gained, different situations of facial hair growth in men or women with different styles of hijab, etc.

1.5 Intended Audience:

The audience and user of this software are management, students, and teachers. The admin and coordinators related to management mostly interact with software for managing data of students, and teachers. While students will be able to view a report of their attendance via notifications, they received in web view of portal. Teachers can take attendance through web view of teacher's portal.

Admin:

Admin can use this software and have the authority to add, delete, update, and view the record of different department coordinators and can also manage students, teachers and class records.

Coordinators:

Coordinators can add and view data of class, students and teachers of his/her department, and also view attendance report of a particular registered class, students. Moreover, coordinators can view class and a specific student attendance and send notifications of reports to particular students related to their department.

Teachers:

According to schedule teachers can take attendance in class using a mobile camera, and take real-time pictures of the class, and through these pictures, the software identifies and saves a record of students present in that class.

Students:

Students will also get notifications of their attendance that informs them in how many classes they were present or absent.

1.6 Motivation:

Now a day's face recognition systems are utilized for security purpose. Since its 2021 but there are very few or almost no systems that are specifically designed to recognize Muslim community for example female who wear different styles of Niqab and male with different facial growth looks different in different time period and it's difficult to recognize their faces whether they are same human or not. This situation motivates me to create a system that is specifically designed for Muslim and especially for Pakistani Community who follow their religious dress codes and follow their social norms.

Face recognition has lately received more consideration and interest from the scientific community and also from a public and private sector. This interest comes from increasing needs to facial recognition applications. In addition, increasing demand for robust security systems to that prevent unauthorized physical and virtual access to important sources of information in order to make the world safer. Military researches, security accesses systems, medical imaging, and forensics are examples of the fields where face recognition discipline.

1.7 Software Development Life Cycle:

Software Development Life Cycle (SDLC) SDLC is a process followed for a software project, within a software organization. It consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process.

SDLC methodologies are similar to a checklist. You need to follow these stages for developing successful applications. Every SDLC methodology follows common phases. These phases will help you in determining the outline of your project. There are many SDLC models, some popular models are Waterfall Model, Iterative Model, Spiral Model, V-Model, Big Bang Model, Agile Model, RAD Model, Rapid Application

Development and Prototyping Models.

SDLC Stages

These stages are the same in most of the SDLC methodologies. Also, their order is also the same. Thus, you don't need to worry about checking every SDLC methodology. Figure 2 shows the common stages of software life cycle model and these stages are briefly explained below:

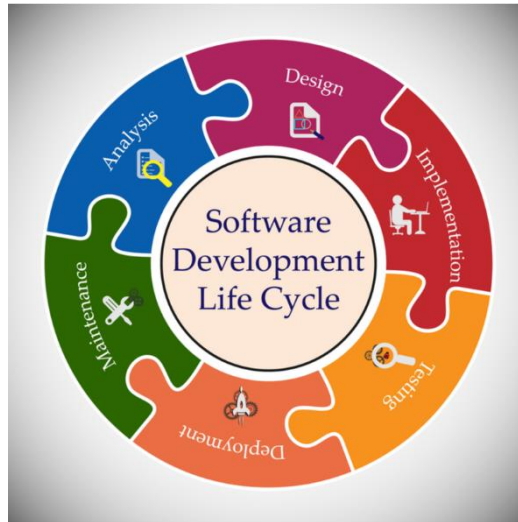


Figure 2: Stages of Software Development Life Cycle process (SDLC)

1. Planning

This is the initial phase of any development process. You need to come up with an idea to improve or develop a solution. This stage will help you in determining the magnitude of your project.

You will have a project plan after this stage. Also, you will estimate the cost of your project at this stage. This stage is mostly done by project managers. They are responsible for creating the outline of any project.

2. Requirements

In this, the business leaders will tell their requirements to the IT departments. In this phase, you need to gather data from business stakeholders and leaders. IT Department needs to work together with business leaders in this phase. It will help them in understanding the business process that they need to automate.

3. Design

In this phase, software developers will design the application. They can use already known patterns of application development. Software architects can use tools like The Open Group Architectural Framework for creating a design from old components. This will help you in promoting reusability.

4. Software Development

This is the most important phase in the SDLC cycle. In this phase, developers need to create actual software. They can use Agile or Waterfall methodology for developing their application. Also, they should try to create applications as quickly as possible. Business leaders should work together with developers. This will ensure that developers are meeting their expectations. It is important to do proper testing of the application. The IT team will work on transforming an idea into a working application.

5. Testing

This is another very important phase of SDLC. You can never deliver good software without doing proper testing. Some of the testing that you need to do are:

- Code quality testing.
- Functional testing.
- Integration Testing.
- Vulnerability Testing.
- Performance Testing.

There are various tools available in the market that you can use to automate this phase. This will help you in saving the time of your IT team. You can use tools like Codeship for automating your testing phase. After this phase, you will have a complete application.

6. Deployment

This is mostly an automated phase. If you are working in a large enterprise, then you won't even notice this phase. Your application will be deployed instantly. If you are working in a heavily regulated industry, then you need to take manual approval first. This can increase the timespan of this stage. You can use ARA or Application Release Automation tools for automating this process. It will automatically deploy all the applications. These applications usually work with the Integration tools.

7. Maintenance

Most developers forget about this phase. However, this is a very important phase. The cycle will continue until your application is operational. You need to constantly monitor your application for bugs. It is important to find all the potential bugs in your application. This will help you in fixing them in time. You need to update your application regularly for meeting quality standards. This will help you in attracting more users.

The SDLC process will define the goals for developers. Thus, they can directly start working on their project. This cycle will help you in reducing the bugs in your software. Also, it will help you in reducing the length of your development cycle.

1.7.1 RAD model

I use RAD model because it uses of powerful development tools results in high quality products in comparatively shorter time spans, it is useful when you have to reduce the overall project risk, with code generators and code reuse, there is a reduction of manual coding, prototyping in nature, there is a possibility of lesser defects, adaptable and flexible to changes. Figure 3 shows different phases of RAD model.

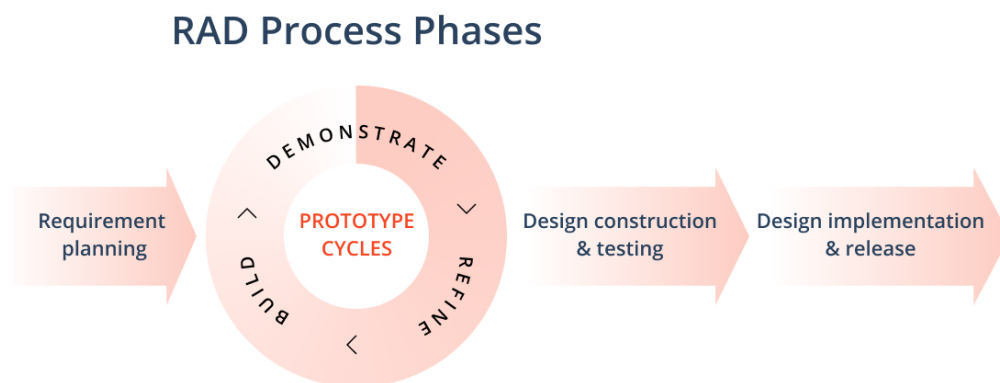


Figure 3: Phases of RAD model

First of all, GUI of system will be created, where admin and coordinator interact with system and add records like pictures of teachers, students. Records save in MYSQL database. These pictures are used as training and testing dataset for face recognition system. Then by using PyCharm IDE different libraries like face recognition and Dlib are included for image preprocessing, feature extraction, feature identification. If features are identified successfully then finally mark the attendance of that particular person.

1.8 Tools:

For development of AI Attendance system, I use different tools. Name of these tools are:

Hardware tools:

- Mobile Camera
- Computer

Software tools:

PyCharm IDE:

PyCharm is an integrated development environment (IDE) used in computer programming, specifically for the Python language. It is developed by the Czech company Jet Brains. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes), and supports web development with Django as well as data science with Anaconda.

PyCharm is cross-platform, with Windows, macOS and Linux versions. The

Community Edition is released under the Apache License, and there is also Professional Edition with extra features – released under a proprietary license.

Dlib:

Dlib is an advanced machine learning library that was created to solve complex real-world problems. This library has been created using the C++ programming language and it works with C/C++, Python, and Java. Contains a wide range of machine learning algorithms. All designed to be highly modular, quick to execute, and simple to use. It is used in a wide range of applications including robotics, embedded devices, mobile phones, and large high-performance computing.

MYSQL:

The database used in this project to store students, teachers and staff data is MySQL. It is an open-source relational database management system (RDBMS). An RDBMS organizes related data into data tables in which data types are related to each other; these relations help structure the data. With SQL programmers can create, modify and retrieve data from the relational database, as well as control user access to the database. Moreover, relational databases and SQL, an RDBMS like MySQL works with an operating system to implement a relational database in a computer's storage system, manages users, allows for network access and facilitates testing database integrity and creation of backups.

OPENCV:

OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source Apache 2 License. While we used OpenCV to facilitate face recognition, OpenCV itself was not responsible for identifying faces.

Face Recognition:

Recognize and manipulate faces from Python or from the command line with the world's simplest face recognition library. Built using dlib's state-of-the-art face recognition built with deep learning. The model has an accuracy of 99.38% on the Labeled Faces in the Wild benchmark. This also provides a simple face recognition command line tool that lets you do face recognition on a folder of images from the command line.

React

React is an open-source, front end, JavaScript library for building user interfaces or UI components. It is maintained by Facebook and a community of individual developers and

companies. It is only concerned with rendering data to the DOM, and so creating React applications usually requires the use of additional libraries for state management and routing. React code is made of entities called components. Components can be rendered to a particular element in the DOM using the React DOM library.

Node.js

Node.js is a free, open source server environment that can runs on various platforms (Windows, Linux, UNIX, Mac OS X, etc.) and use JavaScript on the server. Node.js can generate dynamic page content and also create, open, read, write, delete, and close files on the server. It can collect form data and add, delete, and modify data in your database.

Chapter # 2 BACKGROUND STUDY

2.1. Background Study

The studies of face recognition have increased rapidly in recent years to meet growing demand of adoption robust and powerful systems in modern organizations and institutions. But these studies still face a great challenge due to various conditions for images acquired under uncontrolled environment. These conditions lead to that face recognition methods that have not achieved absolute success yet. Nevertheless, there are some algorithms which produce satisfactory results (Wojcik et al, 2016).

The 2013 Boston Marathon bombing represents a case where automatic facial biometrics tools could have proven invaluable to law enforcement officials, yet the lack of robustness of current tools in unstructured environments limited their utility. In this work, we focus on complications that confound face detection algorithms. (Barr, Bowyer and Flynn, 2014). We first present a simple multi-pose generalization of the Viola-Jones algorithm. Their results on the Face Detection Data set and Benchmark (FDDB) show that it makes a significant improvement over the state of the art for published algorithms. Conversely, their experiments demonstrate that the improvements attained by accommodating multiple poses can be negligible compared to the gains yielded by normalizing scores and using the most appropriate classifier for uncontrolled data. They conclude with a qualitative evaluation of the proposed algorithm on publicly available images of the Boston Marathon crowds. Although the results of our evaluations are encouraging, they confirm that there is still room for improvement in terms of robustness to out-of-plane rotation, blur and occlusion (Barr, Bowyer and Flynn, 2014).

2.2. Comparison of Existing and Purposed System

There is a lot of educational institutes in Multan but none of them is using biometric attendance management systems and relay on manual attendance system. So, I have decided to make system in which class attendance is just one click away. I choose five existing systems to compare it with my software.

2.2.1. Existing System I: Smart Attendance by Alndra Labs

The system works on face recognition where each student in the class is photographed and their details are stored in a server. The teacher can then record the attendance by just clicking some pictures of the classroom. The system will recognize the faces and verify the presence or absence of each student.

2.2.2. Existing System II: Spectrum Campus Management System by EduServ

Key modules of the Campus Management System is its Artificial Intelligence feature. Student attendance can be taken via bio-metrics, RF-ID, manually or using Bulk Facial recognition through Artificial Intelligence.

The system automatically marks holidays, creates Detailed Employee Leave Balance Record and provides Analytical Reporting along with much more. Another key point is that the embedded AI technology that helps the platform to maintain a safe working/living environment additionally, you can merge smart devices with the AI algorithm in order to help track the daily activities of the people working inside the office.

2.2.3. Existing System III: Smart Attendance and Tracking System (Smats)

SMATS is a user-friendly, effective and powerful system that provides smoothly integrated automated access control, attendance, real-time people tracking, personnel (students) management, reporting and more.

SMATS eliminates manual process of attendance records and automates the whole process of attendance records from collecting data until reporting as well as visualizing the output. The system is also capable of tracking people movement and restrict the personnel for entering and exiting any restricted area or facility by creating virtual geo-fences.

2.2.4. Existing System IV: Student Attendance System in Crowded Classrooms using a Smartphone Camera

We release a realistic full-annotated dataset of images of a classroom with around 70 students in 25 sessions, taken during 15 weeks. Ten face recognition algorithms based on learned and handcrafted features are evaluated using a protocol that takes into account the number of face images per subject used in the gallery. In our experiments, the best one has been FaceNet, a method based on deep learning features, achieving around 95% of accuracy with only one enrollment image per subject. We believe that our automated student attendance system based on face recognition can be used to save time for both teacher and students and to prevent fake attendance.

2.2.5. Existing System V: Automated-Attendance-System-By-Real-Time-Face-Recognition By sakshamhere

An Automated Attendance system using Real-time face recognition, The GUI automates

the manual process of attendance marking and maintaining statistics. It can detect, recognize and mark attendance by face recognition.

2.2.6. Proposed System: AI Base Attendance Management System

AI Base Attendance Management System is one of most advance unique, interactive and feasible attendance management system that is specified for Pakistani Community. It can easily take attendance in crowded classes which can consists of female students Niqab or head scarf and male students with different facial growth. It allows teacher to take attendance of class using single image taken with mobile camera and save a lot of time in class.

2.3 Comparison table for existing systems

Table 1. Comparison of Existing and Proposed System

	Standards	Existing System 1: Smart Attendance by Aindra Labs	Existing System 2: Spectrum Campus Management System by EduServ	Existing System 3: Smart Attendance And Tracking System (Smats)	Existing System 4: Student Attendance System in Crowded Classrooms using a Smartphone Camera	Existing System 5: Automated-Attendance-System-By-Real-Time-Face-Recognition By sakshamhere	Proposed System: AI Base Attendance Management System
1	Attendance through Artificial Intelligence	YES	YES	YES	YES	YES	YES
2	Face detection in crowd	YES	YES	YES	YES	NO	YES
3	Manually Attendance Correction	NO	NO	NO	NO	NO	YES
4	Attendance Notification	NO	YES	YES	NO	NO	YES
5	Attendance Reports Generation	YES	YES	YES	YES	YES	YES
6	Students Record Management	YES	YES	YES	YES	YES	YES

3	Faculty Record Management	NO	YES	YES	NO	NO	YES
4	Class Records Management	NO	YES	NO	YES	NO	YES
5	Count No. of students whose attendance has been taken	NO	NO	NO	YES	NO	YES
6	RFID Detection	YES	YES	YES	NO	NO	NO
7	Detect Women Faces with Vale	NO	NO	NO	NO	NO	YES
8	Detect Men with different facial growth	NO	NO	NO	NO	NO	YES

2.4 Operating environment

- The software requires a system with at least 8GB Ram.
- The software needs a system with CUDA (Compute Unified Device Architecture) capable GPU for fast and accurate implementation of face detection models.
- A mobile camera for capturing images.
- A secondary memory to store all the images and database.
- Input can be given through mobile camera that can take pictures.
- Output is Marked Attendance as result of face recognition.

2.5 Design and Implementation Constraints:

2.5.1. Device Performance:

A system with dedicated GPU and at least 3.5 computation power is required for achieving accuracy in face detection.

2.5.2. Data requirements:

In order to train a custom model, labelled data is required. Labelled data in the context of object detection are images with corresponding bounding box coordinates and labels. That is, the bottom left and top right (x, y) coordinates and the class.

2.6 Assumptions and dependencies:

It is assumed that sufficient training and test data will be collected from university to successful for training of deep learning models. Moreover, all university cameras and devices (where you want to execute software) should work properly.

2.7 External Interface Requirements:

2.7.1. User Interfaces:

All the interactions of users are through the graphical user interface of software. User opens this software and start interacting with GUI icons and screens. Relative functions are performed according to interaction with interface. Cameras are used for face recognition from images and real-time scenario. Scanning of image is done through camera.

2.7.2. Hardware Interfaces:

The hardware environment in this system will use mobile camera for face recognition of persons. Cameras will play a significant role in the system. Class teacher must have a

mobile every classroom. All of these data are stored in the database and displayed on devices where the software is installed and teachers and students related data will displayed on their portal respectively.

2.7.3. Software Interfaces:

The system will use:

- Web pages for the forms React, JSX, Node js.
- Server
- PyCharm
- Database uses with MYSQL.

2.7.4. Communication Interfaces:

Data shall be transferred from MYSQL database to the mobile device in web view that uses the system.

Chapter # 3 DESIGN

3.1. Introduction

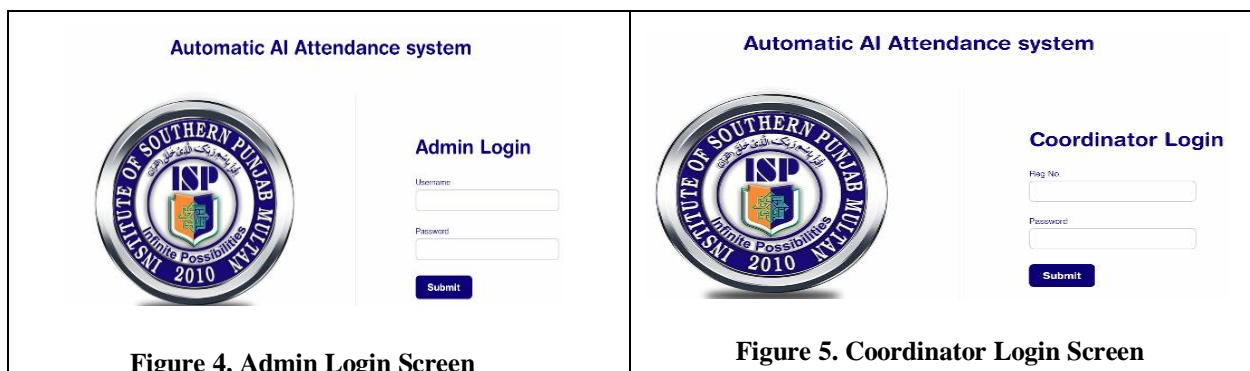
I have to develop an Attendance Management System which works on the basis of face recognition. In this system records of students, teachers and coordinators are maintained. Moreover, teachers are allowed to take attendance of class with just one picture, the picture used as input in face recognition library that recognize faces present in class and the attendance of student marked accordingly.

3.2. Complete Scenario of Software

In this section, the scenario of complete project is defined in following modules:

- | | |
|-----------------------------|----------------------------|
| 1. Login and Authentication | 2. Admin module |
| 3. Coordinator module | 4. Teacher module |
| 5. Student module | 6. Class module |
| 7. Notification module | 9. Face recognition module |

First module is for Registration and it is for authentication of user. User of this module include admin and coordinators, admin can register coordinators and assign them particular registration number and password and by giving this specific information coordinators can access their coordinator panel from where they can manage records of students, teachers and classes, similarly coordinator assign particular registration id and password to students and teachers from this they can access their particular admin or coordinator login. In Figure 4 and 5 Coordinator and Admin login Screens are shown from where they can enter username and password and access their respective portal.



Second module is about Admin, which helps admin to perform different tasks using this software. Admin have authority to add new coordinator, delete any coordinator if they institute or any other reason, update any records related to coordinators, view their saved records and also check and manage Students, Teachers and Classes. Admin have all authorities to check and maintain the system. Figure 6 shows different screens of Admin Panel:

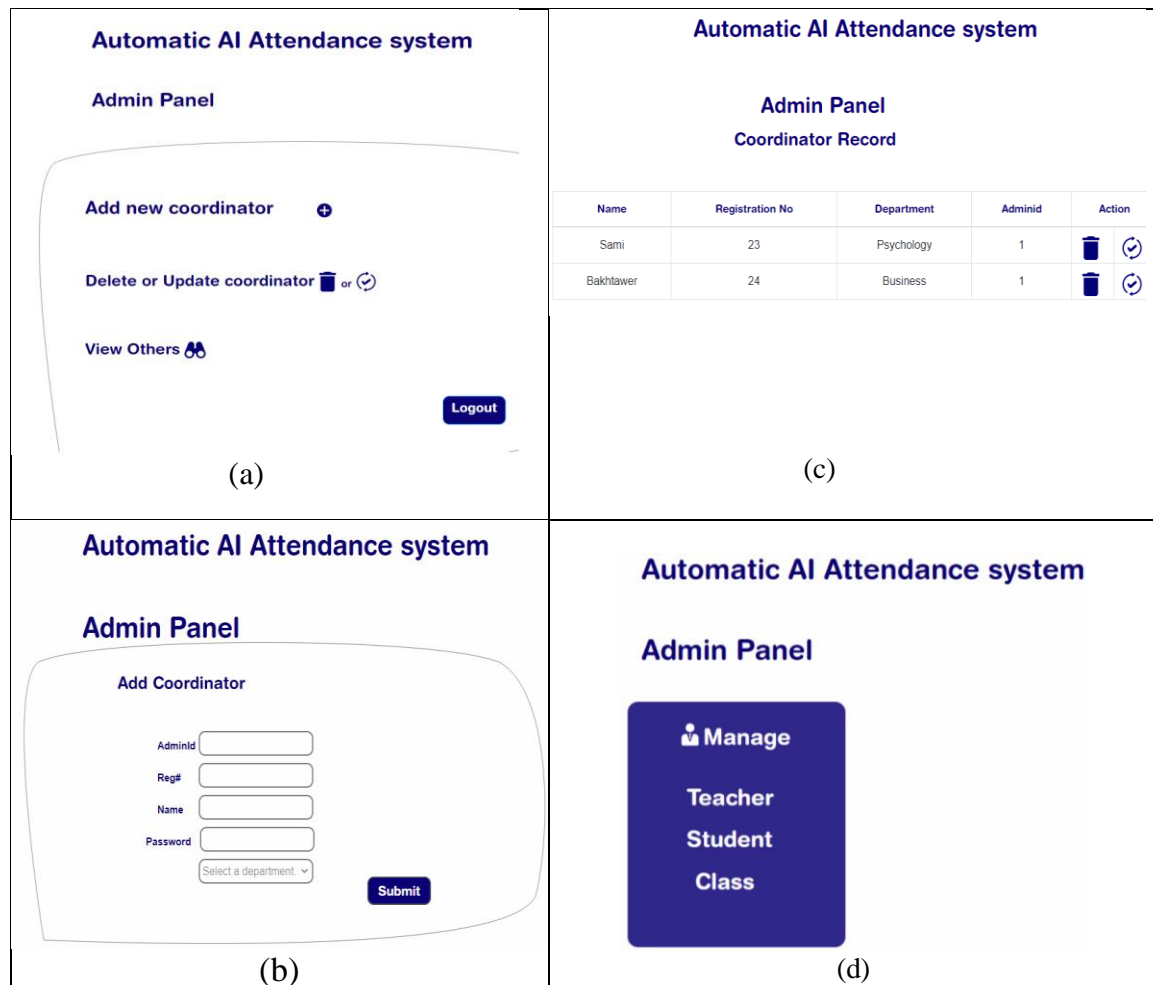


Figure 6. Admin Panel Screens (a): Basic Admin Panel, (b): Add coordinator, (c): View and delete coordinator, (d): View others option

Third module is about coordinators, what authorities they have and what they can do using this software. Firstly, in reality every university have specific coordinators of different departments, each of them manages their own department's task, and same is in the software. Each department coordinator can manage classes, students and teachers of their own department. In class category, they can add a new class, view previously registered classes, and also they can add regular class schedule.

Coordinators can manage teacher's category. They can add new teachers and view record of previously registered teachers. Coordinators can also manage student category and they can add new students, view record of previously add students. Moreover, coordinators of each department can view attendance records of particular class, students. Figure 7 shows different panels related to coordinator, where they can go to that particular panel and manage their records.

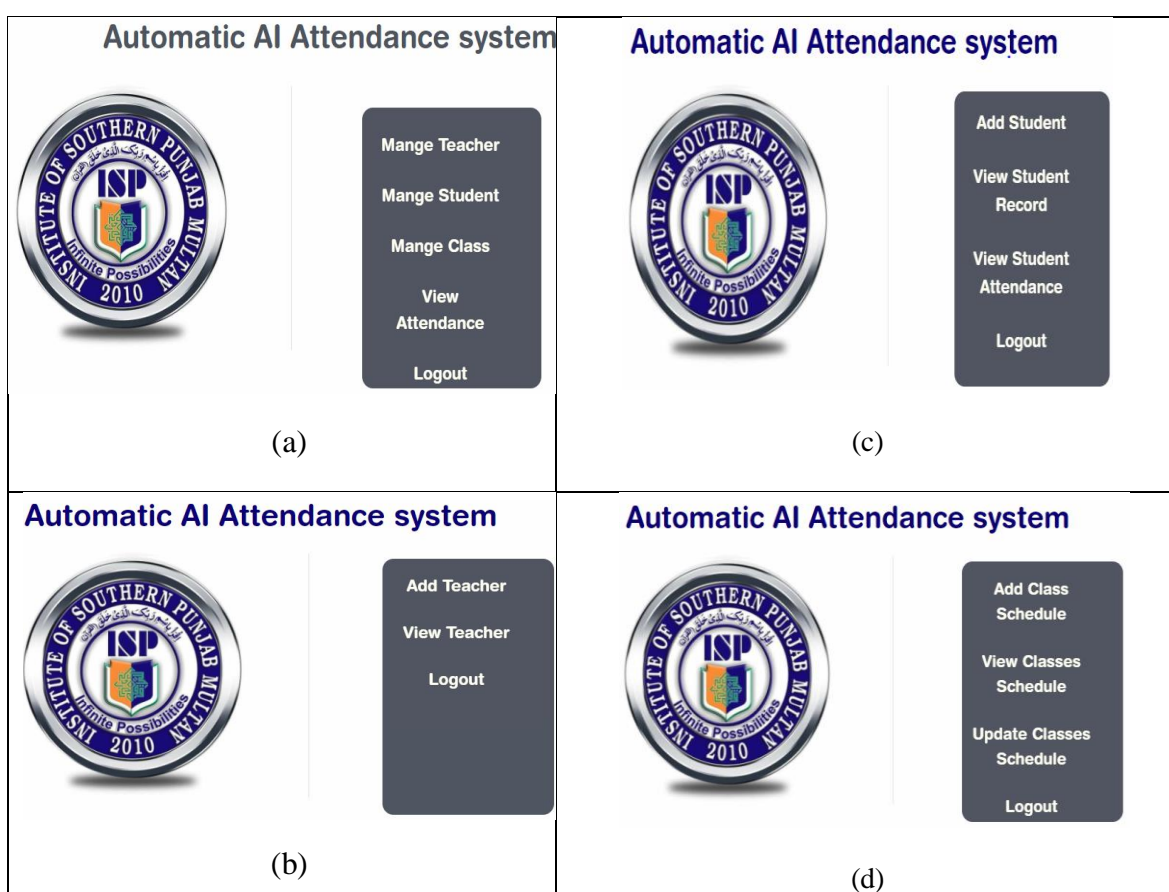


Figure 7. Coordinator Panel Screens (a): Coordinator Panel, (b): Manage Teacher, (c): Manage Student, (d): Manage Class

Fourth Module is about students, in which students can simply login to their portal via username and password provided to them. Once they login in their portal they can get their weekly attendance reports through notifications. Figure 8 shows different

screens of student module.

Student Login

Username

Password

Login

(a)

Student Attendance

Subject 1 Check

Subject 2 Check

Subject 3 Check

Subject 4 Check

(b)

Student Attendance

Date	Reg no.	Name	Attendance	Class

(c)

Figure 8. Student Panel Screens (a): Login Screen (b): Student Panel (c): View Attendance

Fifth Module is about teachers, in which they can login in their portal through their specific registration number and password and take attendance of particular class according to their scheduled class. They can open camera by clicking on camera icon and take 2 to 3 pictures of class and uploaded on portal. Once the picture is uploaded then face recognition model detect students faces and mark their attendance. When attendance is marked then teacher has an option to edit the marked attendance if there is mistake in attendance of any student because face recognition model may not work 100 percent accurate, the accuracy of model may fluctuate due to different reasons like lighting conditions or quality of picture. Figure 9 shows different screens of teacher's module.

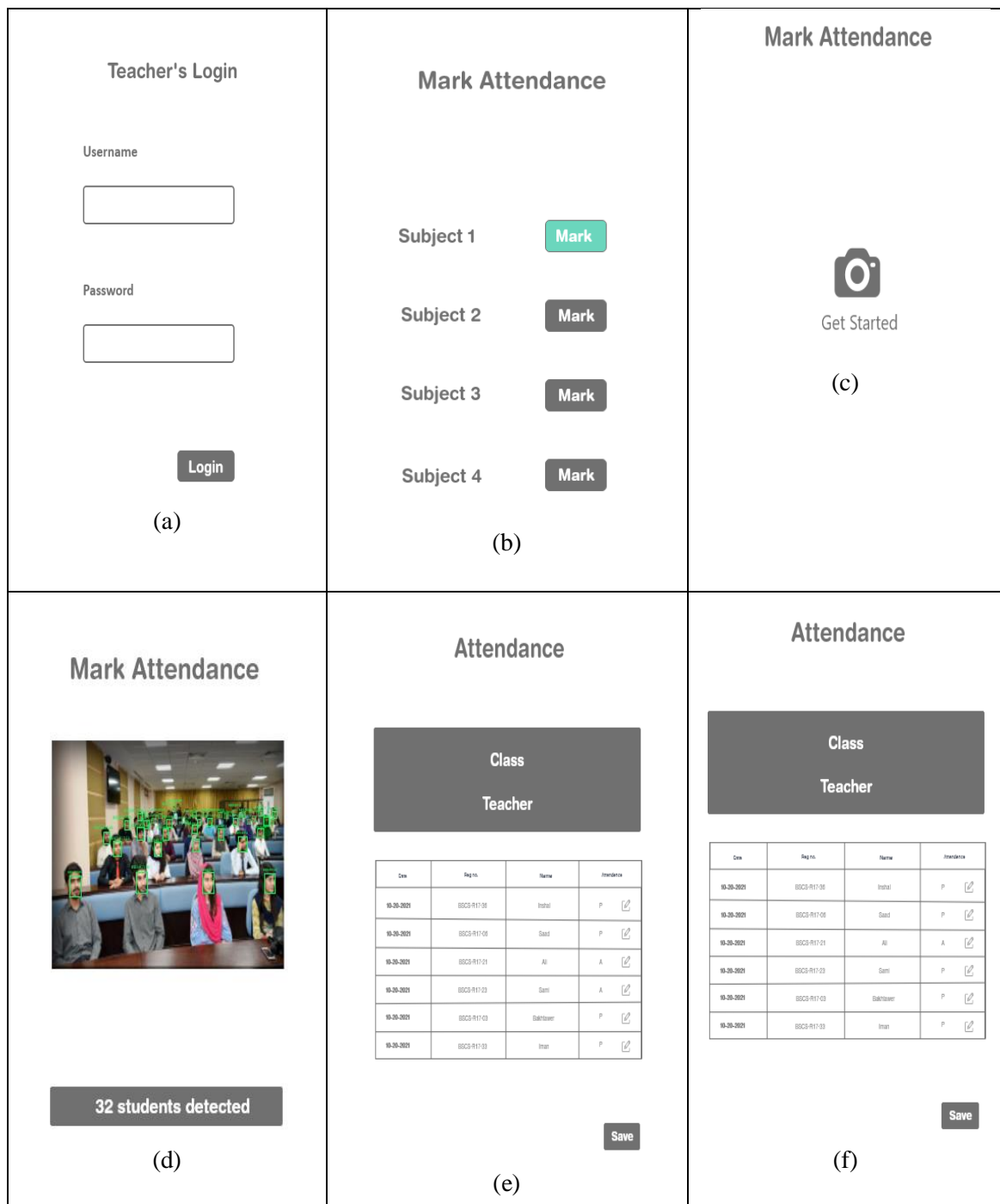


Figure 9. Teacher Module Screens (a): teachers login (b): teacher's subject (c): acquire class picture

Sixth Module is face detection and recognition module, in this module first we prepare custom dataset of some male and female students of a class and then train the model with their pictures. Then we add a picture of crowded class and detect their face and mark their attendance. Some pictures from dataset is shown in Figure 10 shows some pictures taken from dataset that is used to train face recognition model.



Figure 10. Training pictures taken from dataset

3.3 Product Functions and Features:

3.3.1. Functions of software:

Functions that user can perform using this software are:

- Registration
- Login
- Store Attendance Records
- Face Recognition and Classification in crowded class
- Students Class Attendance
- Send Attendance Notifications to related student in web view
- Add records of related persons
- View records
- Exit Software

3.3.2. Features of software:

Some features of this software are:

- There are three main categories (Admin, Coordinators, and Teacher) who deal with software.
- Each category has their own different task that they can perform using this software.
- The basic feature of software is to identify different students in crowded classes with maximum possible accuracy.
- After identification software store all classes records in database.
- Reports of each student attendance were prepared and send it to relative person through notification.
- It will identify which students are present during the class from images that teacher has taken in class timings.

3.4 User Classes and characteristics:

This software has basically three types of users Admin, Coordinators and Teachers. Each user has their various roles and performs different functionalities using the software. Admins use this and manage coordinators and can also manage students, teachers, classes' data; coordinators can manage students, teachers, and classes' data and also send them the notifications of attendance report using this software. Teachers can take real-time photos of class and software marked students' attendance using this software. Users required some basic knowledge of management, technology and something like how to use management software.

Table 2. User classes and Characteristics:

Functions	Admin	Coordinators	Teachers	Students
Login	Yes	Yes	Yes	Yes
Manage Coordinators (Add, View Records)	Yes	No	No	No
Manage Students, Teachers (Add, View Records)	Yes	Yes	No	No
View Attendance Reports	Yes	Yes	No	Yes
Take Class Attendance	No	No	Yes	No
Edit Class Attendance	No	No	Yes	No
Sending Attendance Notification	Yes	Yes	No	No

3.5 Functional Requirements:

These are the requirements specified by the users which one can see directly in the final product, unlike the non-functional requirements. All these functionalities need to be added in the system. These functions are like input to be given to the system, the operation performed and the output expected. Functional requirements capture the intended activities of the system. These activities may be expressed as services, tasks or functions the system is required to perform.

Table 3. Functional Requirements

Identifier	Requirements
Req-1	Admin and Coordinators need to create accounts.
Req-2	There are four types of user admin, coordinators, students and teachers
Req-3	Admin and Coordinators can login with username and password in software.
Req-4	Allow admins to add new coordinators.
Req-5	Each coordinator related to their respective department will only manage task related to it.
Req-6	Coordinators can add new teachers, students and classes.
Req-7	Coordinators can view attendance records student and class.
Req-8	Coordinators can view record of registered teachers, student and class.
Req-9	Coordinators can arrange class schedules.
Req-10	Admins can access and manage students, class and teachers' portion like coordinators.
Req-11	Teachers can take class attendance using mobile camera based on their class schedules.
Req-12	Teachers can Edit any attendance records.
Req-13	Admins can view records of registered coordinator.
Req-14	Admins can update coordinator records.
Req-15	Coordinators can send their attendance report to student via notification.

Req-16	The software should be interactive.
Req-17	The software should give accurate results.
Req-18	Students can view their attendance report through their portals.

3.6 Functional requirements Specifications:

3.6.1. Stakeholders:

➤ University Owner:

Owner of university buy this software to make his university attendance system more precise, easy and modern.

➤ Admin:

Admins use this software to manage coordinators.

➤ Coordinators:

Coordinators use this software to manage, students, class and teachers.

➤ Teachers:

Teachers use this software to mark and update class attendance.

➤ Students:

Students can view their attendance using software.

➤ Developers:

Developers develop this software or make changes in it like fixing errors or adding some updates.

Actors and goals:

○ Admin:

- Admin is the primary actor of software.
- Admins data is already registered in database.
- Admins have the authority to add, delete, update, and view the record of different department coordinators.

○ Coordinator:

- Initial primary actor of software.
- Can add new teachers, student and class.
- Can send their attendance notifications to student.
- Can view attendance records of class and any particular student.
- Can view record of registered teachers, student and class.

- Database:
 - Offstage actor.
 - Store data of admins, coordinators, teachers, student and class.
 - Store images data which is important for face-recognition.
 - Store attendance records.
- Face Recognition Model:
 - Offstage actor.
 - Use for face-recognition.
- System
 - Offstage actor.
 - Take real-time photos with help of mobile cameras and match images from previously registered sample images.

Table 4. Actors and their goals

Actors	Secondary Actors	Actor's Goal	Use Case Name
Admin, Coordinators, Student, Teacher	Database	Login	UC-1
Admin, Coordinators	Database	Add Record	UC-2
Admin, Coordinators, Student	Database	View Attendance Record	UC-3
Camera, Coordinators, Teacher, System	Database, Face Recognition Library	Take Class Attendance	UC-4
Coordinators, Teacher, System	Database	Send Notification	UC-5
Admin, System	Database	Delete Coordinator Record	UC-6
Admin, System	Database	Update Coordinator Record	UC-7
Admin, System	Database	View Records	UC-8

A use case diagram is a way to summarize details of a system and the users within that system. It is generally shown as a graphic depiction of interactions among different elements in a system. Use case diagrams will specify the events in a system and how those events flow, however, use case diagram does not describe how those events, and use case diagram does not describe how those events are implemented.

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. A use case diagram should describe the desired functionality of the system and relates it to use cases and actors. That way it can represent existing viewpoints of the system and how they are interpreted differently – only through this can requirements be completely understood.

An actor can be both an active user of the system and trigger use cases that way, or passively used by the system to enable the realization of use cases. When an actor is defined, it always has to be related to at least one use case. Use cases are normally presented as ovals. A use case represents a functionality of the system from the viewpoint of the user and describes the goals of their use.

3.7 Use-case diagrams of AI Base Attendance Management System

There are seven use case diagrams. These are Login in, insert, delete, update, View attendance report, class attendance. In the last complete use case diagram is provided in Figure 18 which is explaining all functionalities of software.

3.7.1. Use Case for Login: UC-1

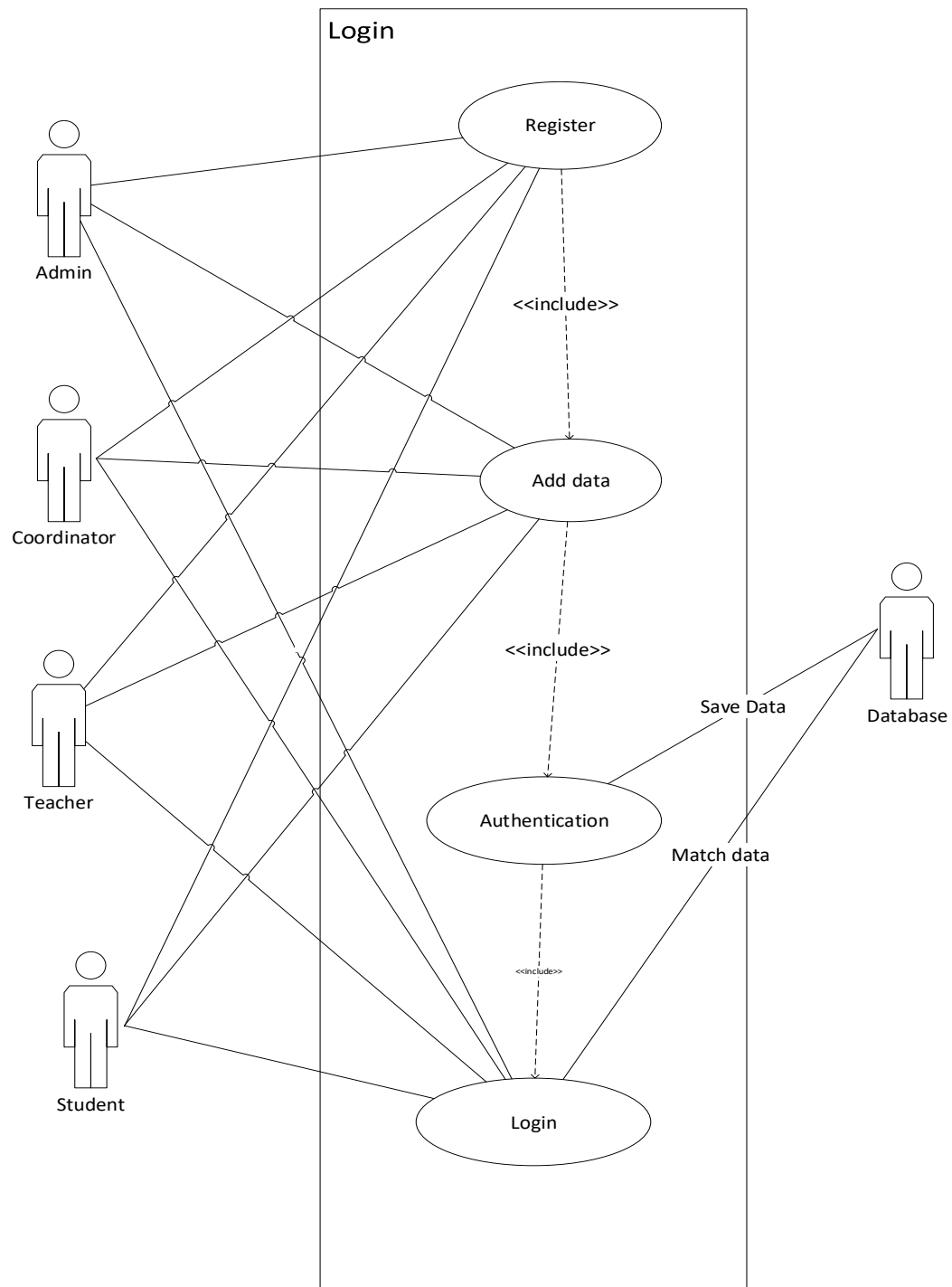


Figure 11. Use Case for Login UC-1

3.7.2. Use case to insert records: UC-2

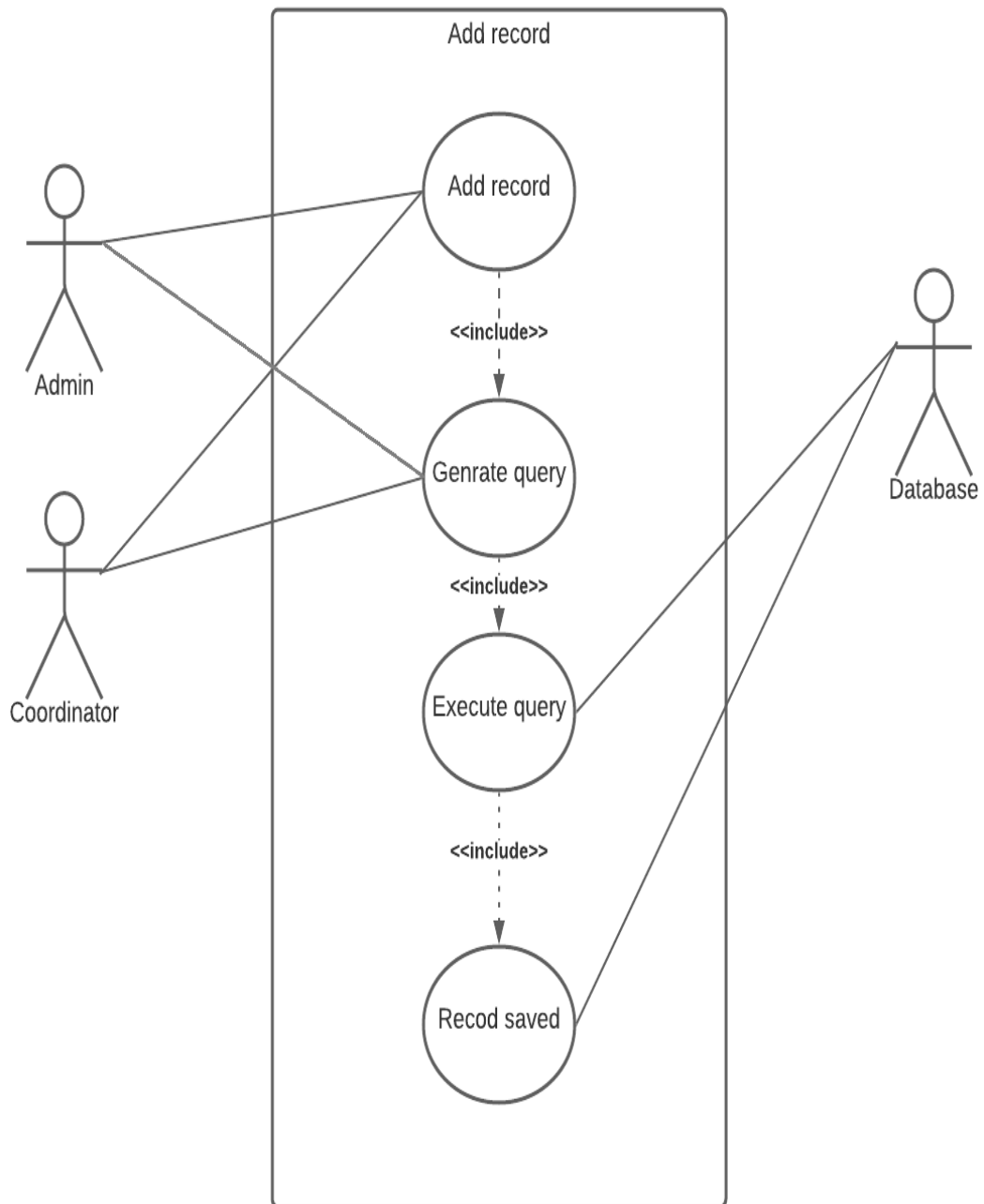


Figure 12. Use case to insert records UC-2

3.7.3. Use case for view attendance records: UC-3

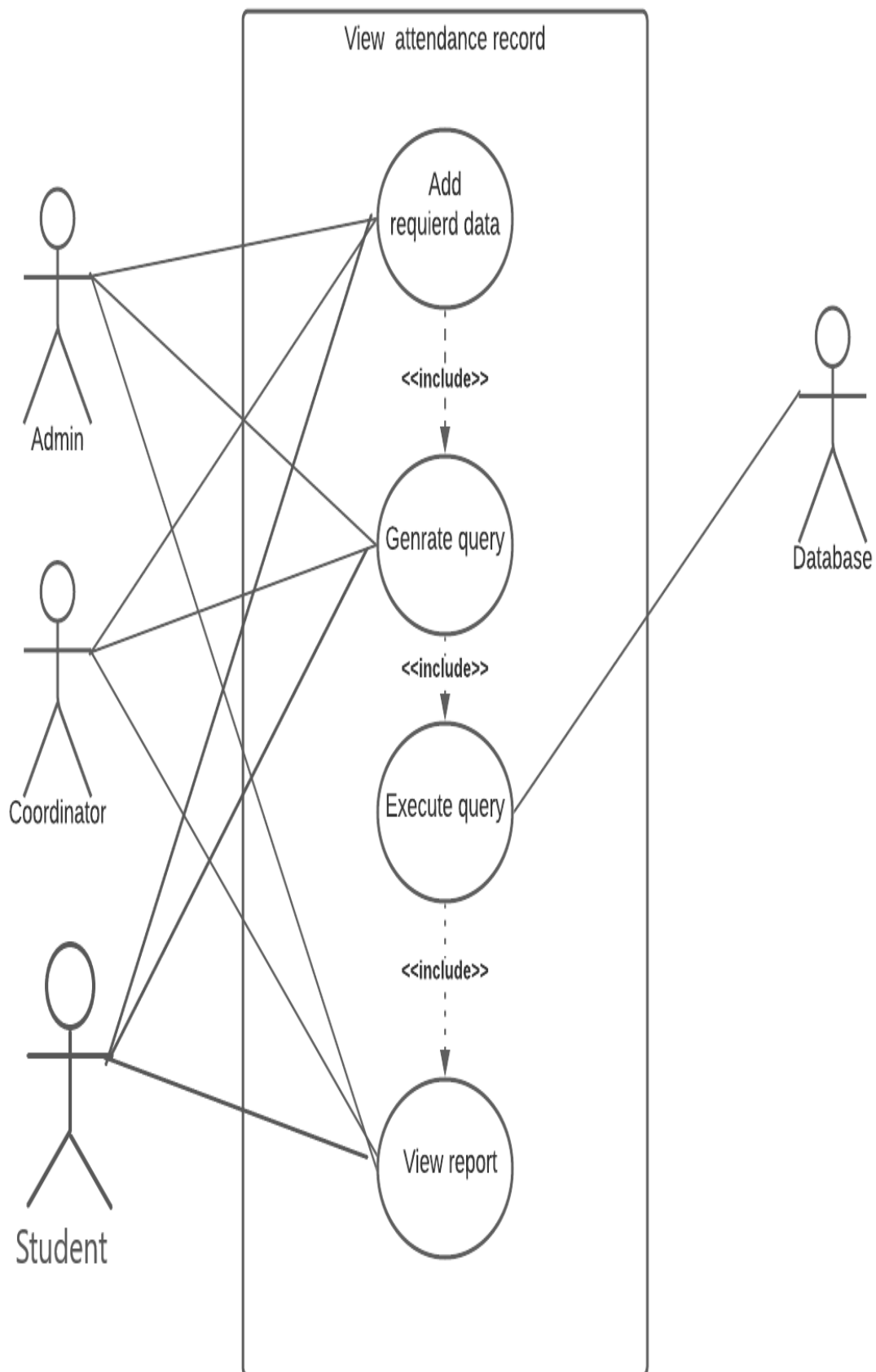


Figure 13. Use case for view attendance records UC-3

3.7.4. Use case to delete records: UC-4

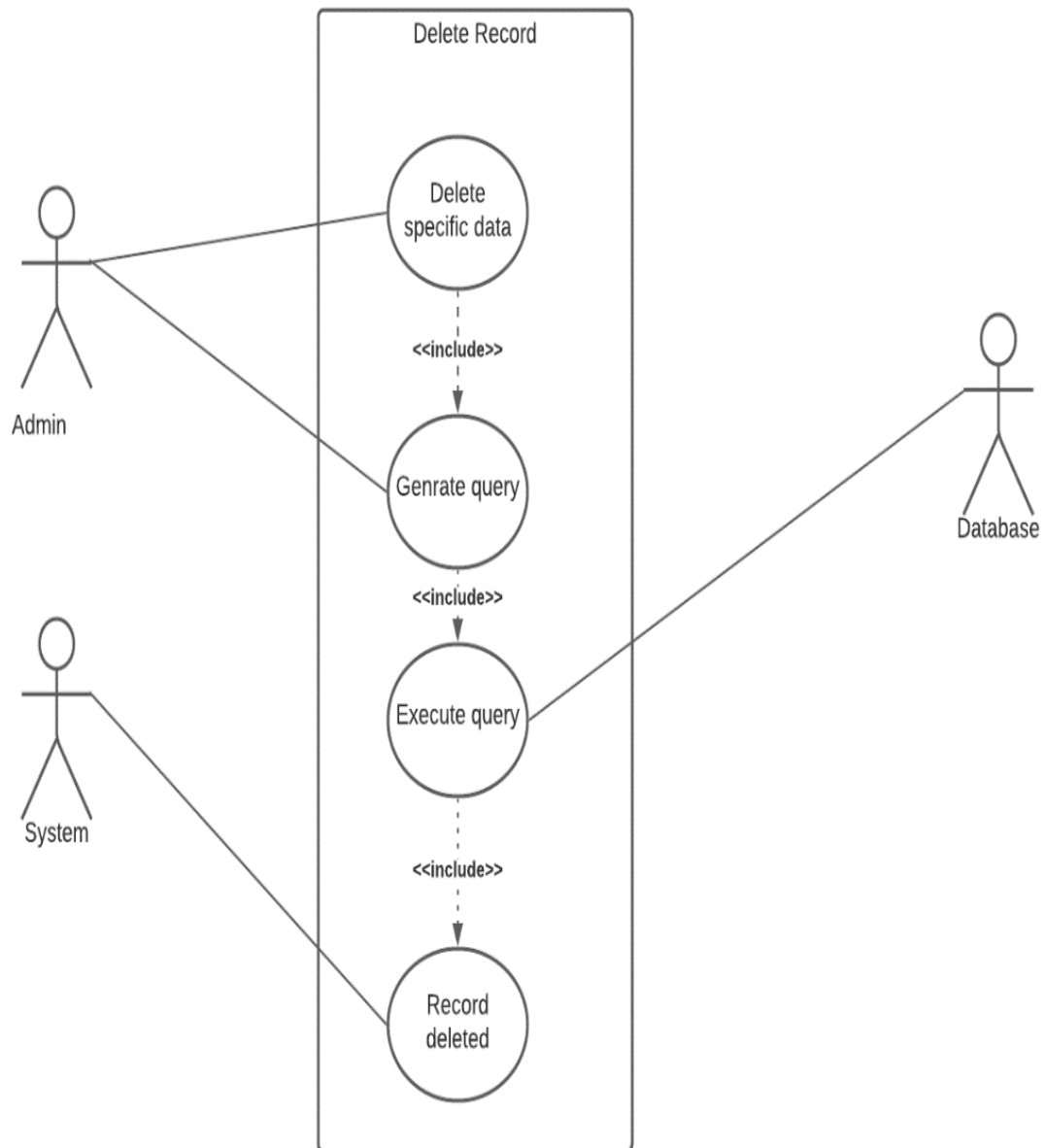


Figure 14. Use case to delete records UC-4

3.7.5. Use case to update records: UC-5

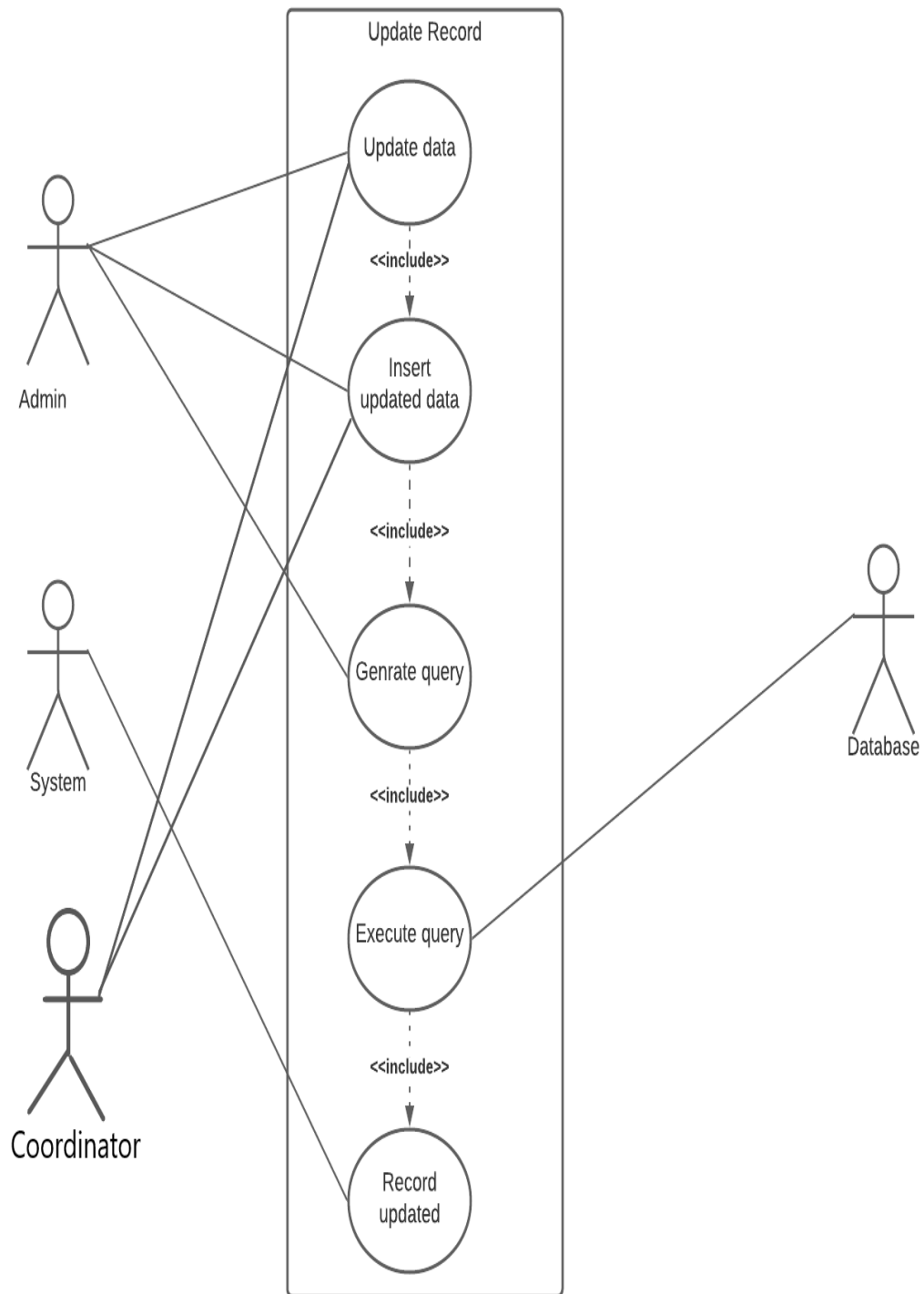


Figure 15. Use case to update record: UC-5

3.7.6. Use case to view records: UC-6

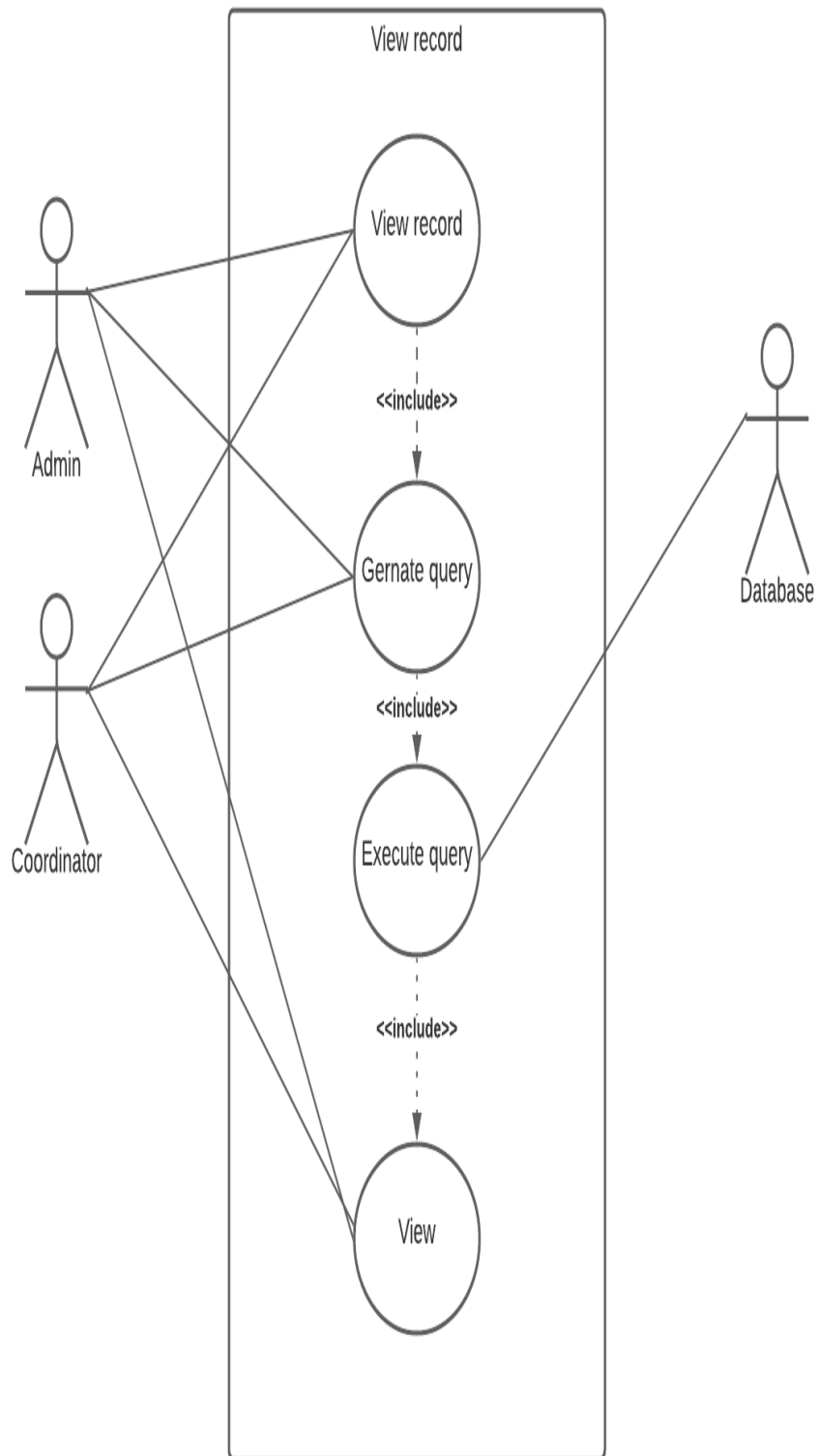


Figure 16. Use case to view records UC-6

3.7.7. Use Case for class attendance: UC-7

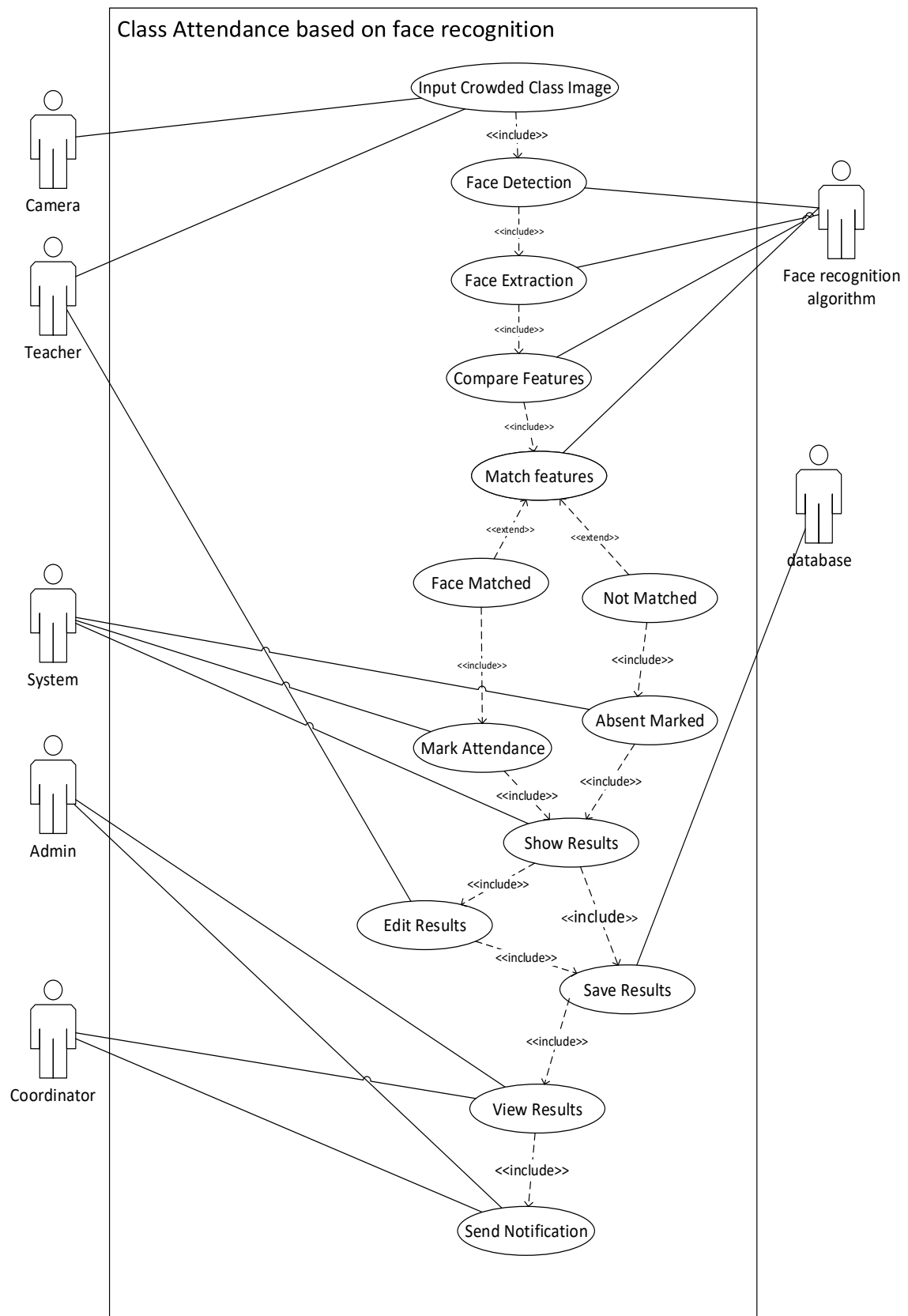


Figure 17. Use Case for class attendance UC-7

3.7.8. Complete Use-Case of AI Base Attendance Management System

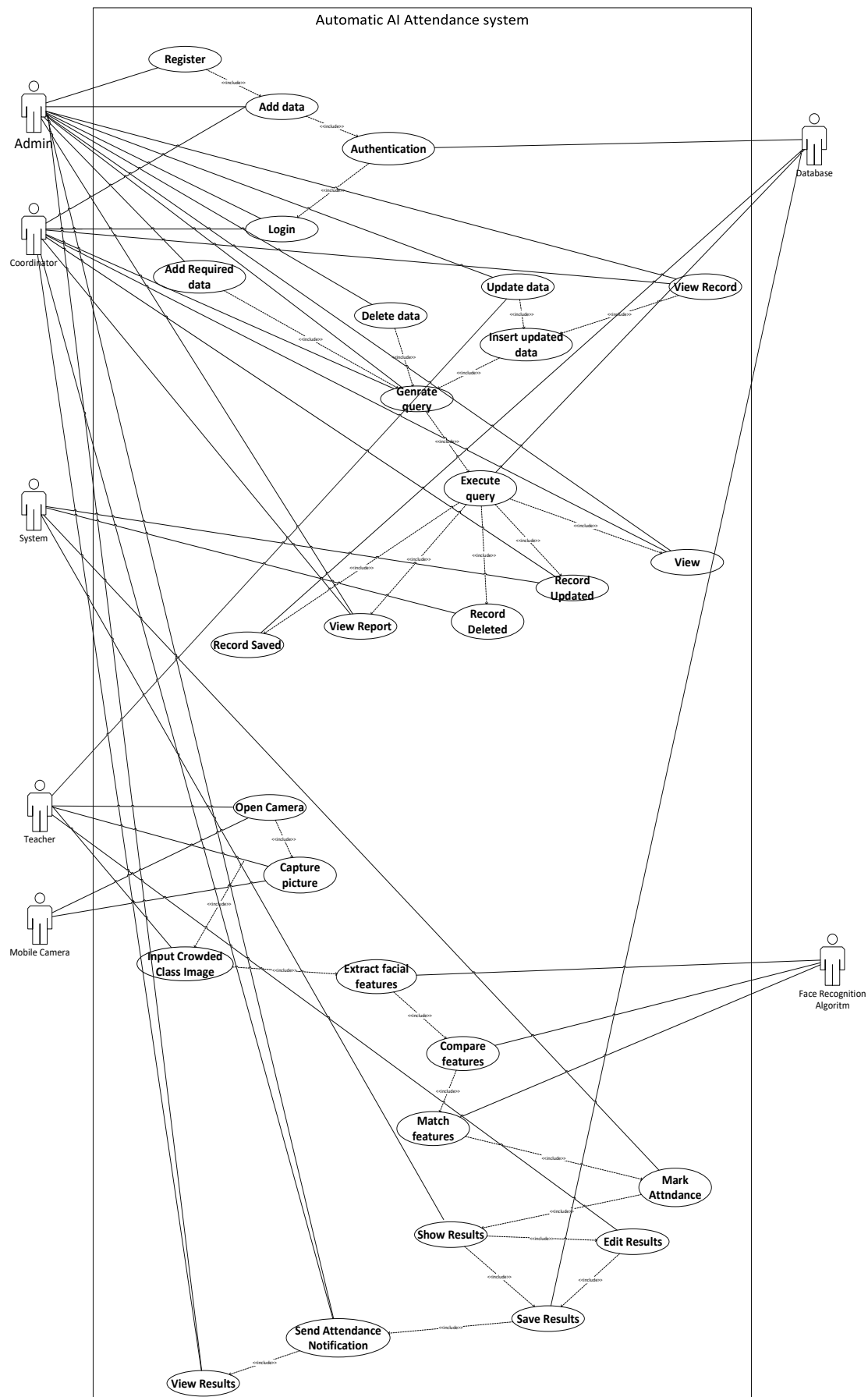


Figure 18. Complete Use-Case of AI Base Attendance Management System

3.8 Sequence Diagram of AI Base Attendance Management System

Sequence diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help to predict how a system will behave and to discover responsibilities a class may need to have in the process of modeling a new system.

Sequence diagrams, commonly used by developers, model the interactions between objects in a single use case. They illustrate how the different parts of a system interact with each other to carry out a function, and the order in which the interactions occur when a particular use case is executed.

They capture the interaction between objects in the context of a collaboration. Sequence Diagrams are time focus and they show the order of the interaction visually by using the vertical axis of the diagram to represent time what messages are sent and when. In simpler words, a sequence diagram shows different parts of a system work in a 'sequence' to get something done. Sequence diagram of AI Base Attendance Management System is given below which shows the sequence of all activities that are happening in the system.

3.9 Activity Diagram of AI Base Attendance Management System

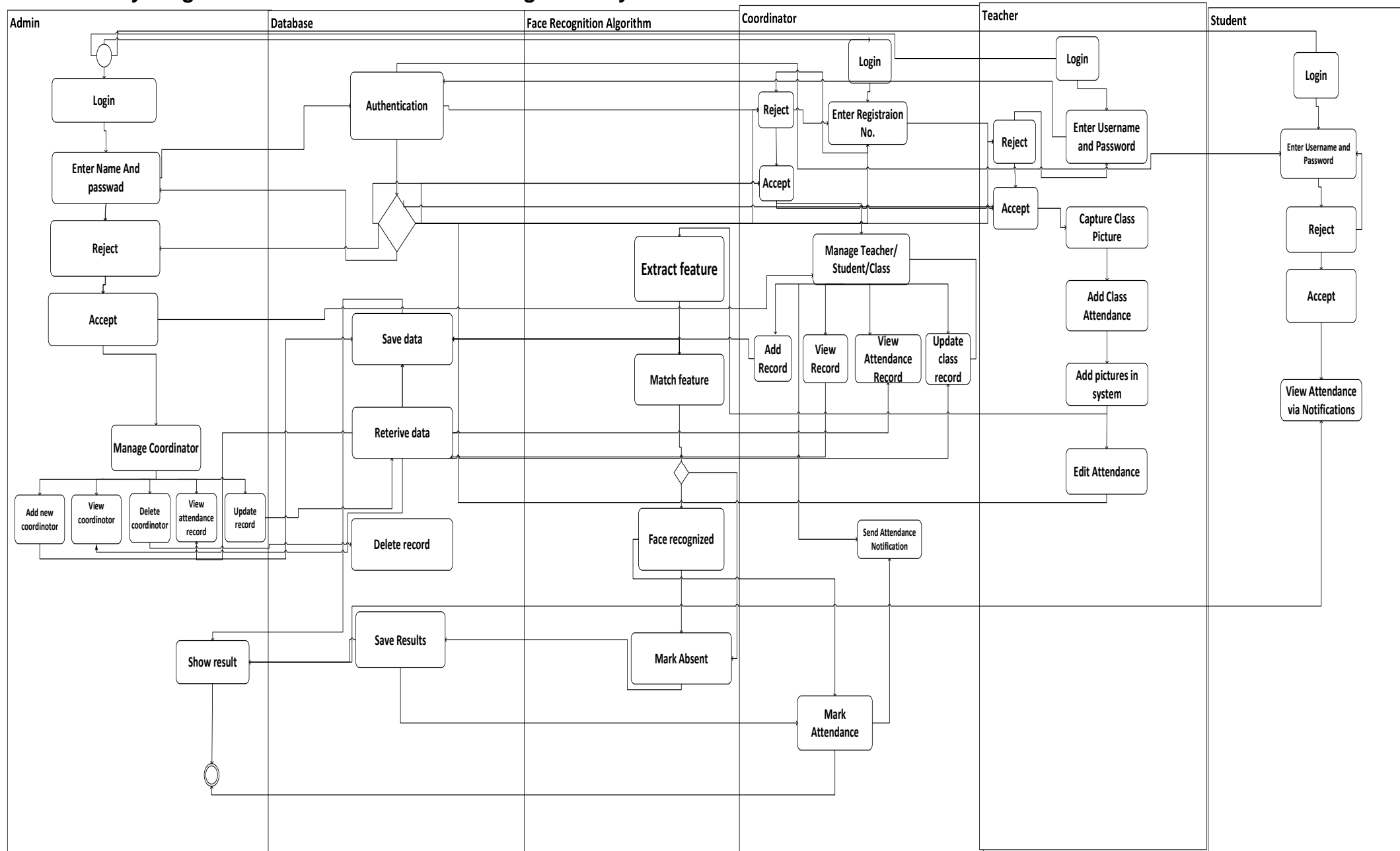


Figure 20. Activity Diagram of AI Base Attendance Management System

3.10 Data Flow Diagram of AI Base Attendance Management System

A Data Flow Diagram (DFD) is a traditional way to visualize the information flows within a system. A neat and clear DFD can depict a good amount of the system requirements graphically. It can be manual, automated, or a combination of both. It shows how information enters and leaves the system, what changes the information and where information is stored. The purpose of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communications tool between a systems analyst and any person who plays a part in the system that acts as the starting point for redesigning a system.

3.10.1. Contextual Diagram (0-level DFD):

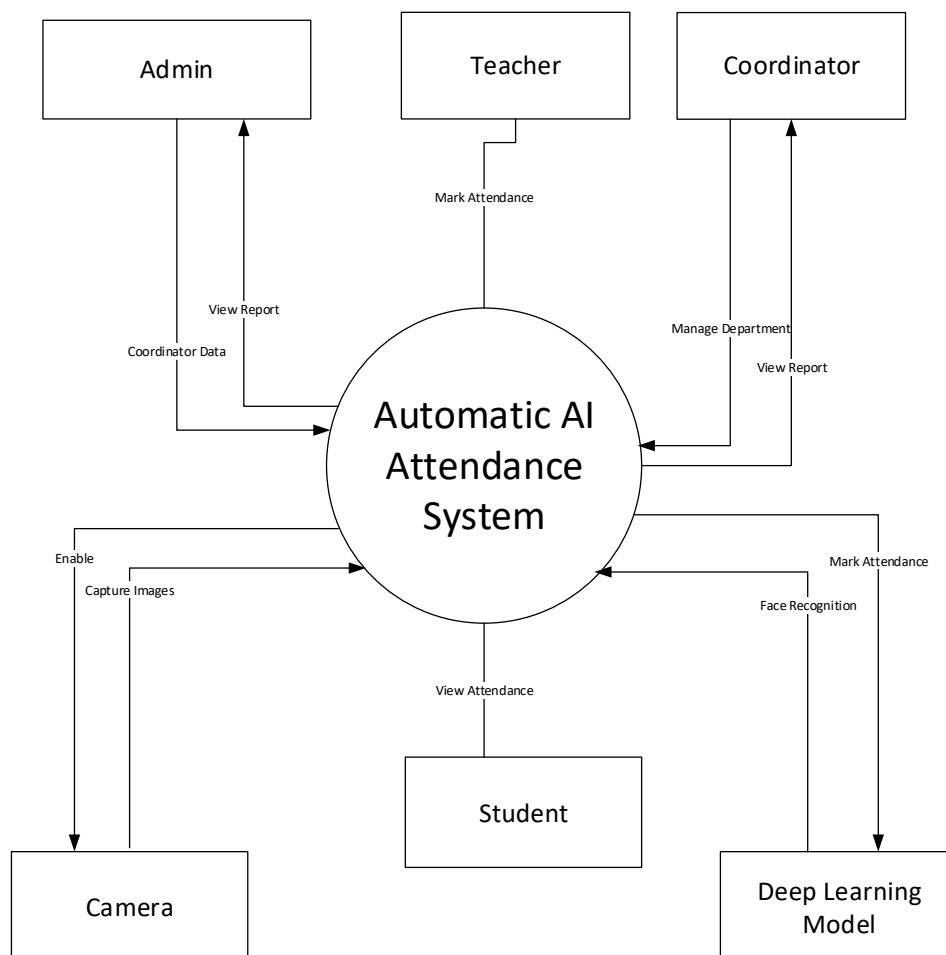


Figure 21. Contextual Diagram (0-level DFD)

3.10.2 DFD level 1:

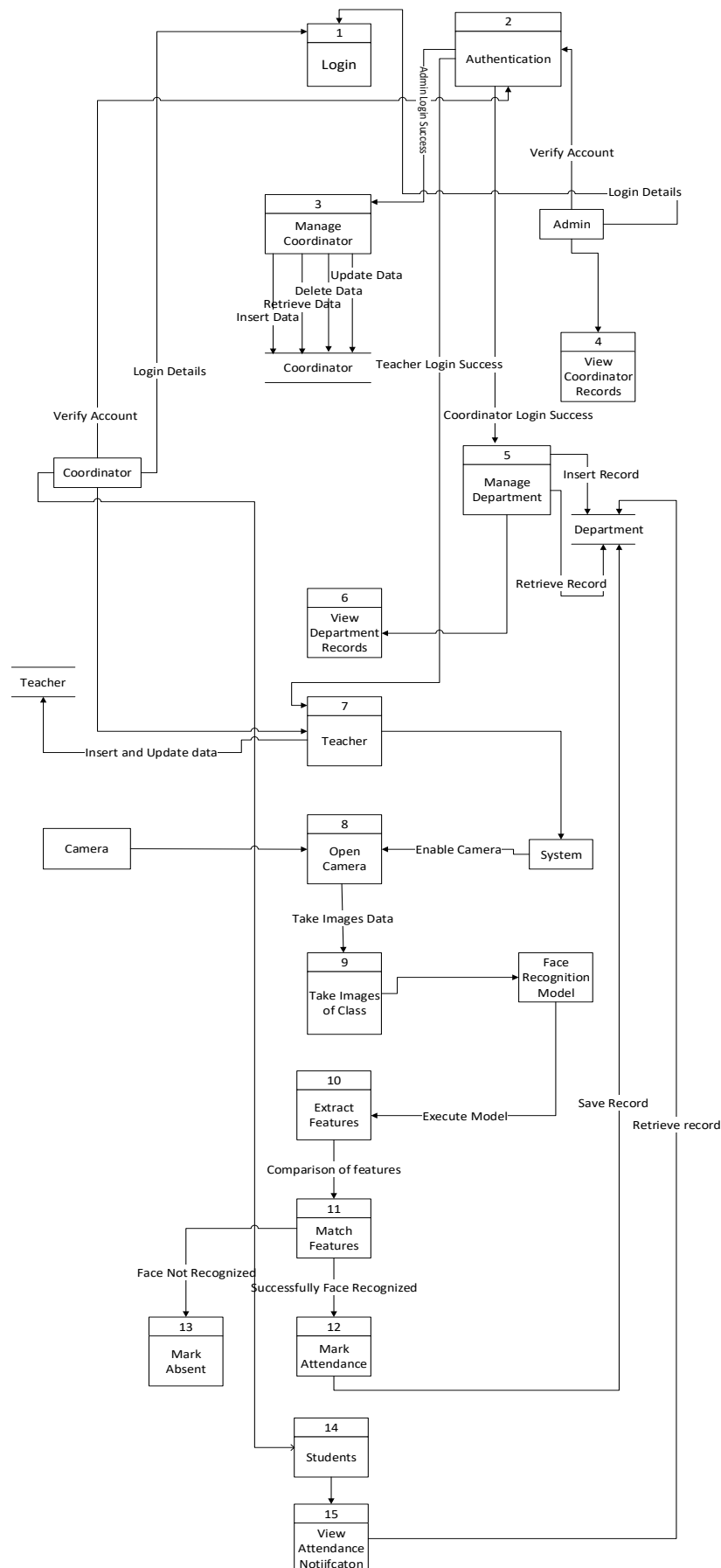


Figure 22. DFD level 1

3.11 Entity Relationship Diagram of AI Base Attendance Management System

An Entity Relationship (ER) Diagram is a type of flowchart that illustrates how “entities” such as people, objects or concepts relate to each other within a system. ER Diagrams are most often used to design or debug relational databases in the fields of software engineering, business information systems, education and research. Also known as ERDs or ER Models, they use a defined set of symbols such as rectangles, diamonds, ovals and connecting lines to depict the interconnectedness of entities, relationships and their attributes. They mirror grammatical structure, with entities as nouns and relationships as verbs.

Entity Relationship Diagram of system is shown below:

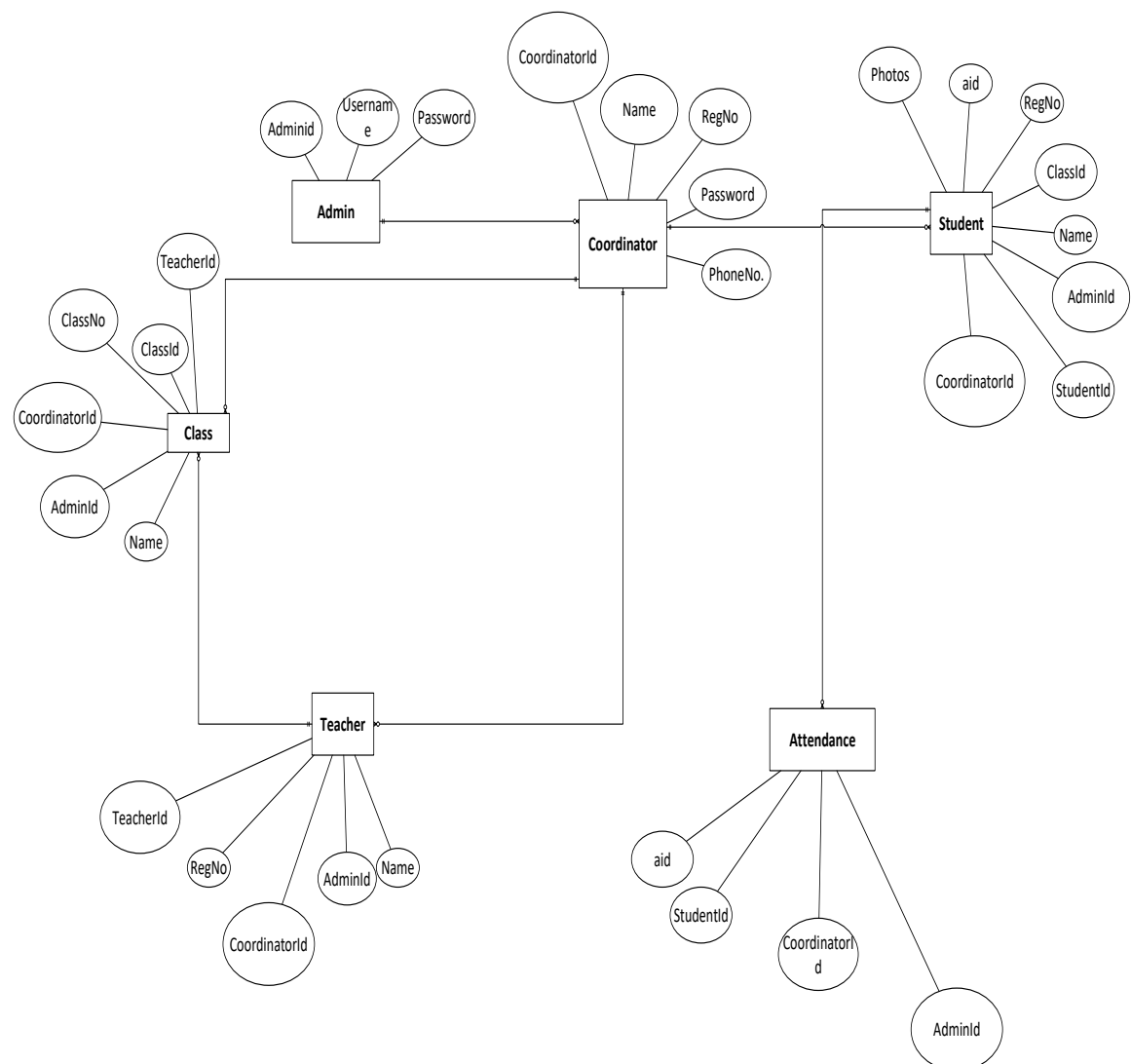


Figure 23. ERD of AI Base Attendance Management System

3.12 Database Schema diagram of AI Base Attendance Management System

Figure 24 represents the view of the entire database structure behind the software. In AI Base Attendance Management System 6 tables of admin, coordinator, class, teacher, student and attendance are created with different attributes. Each table has primary attribute which uniquely identify its record. Foreign key is also established to attain referential integrity. This helps to maintain data consistency and prevent errors in data.

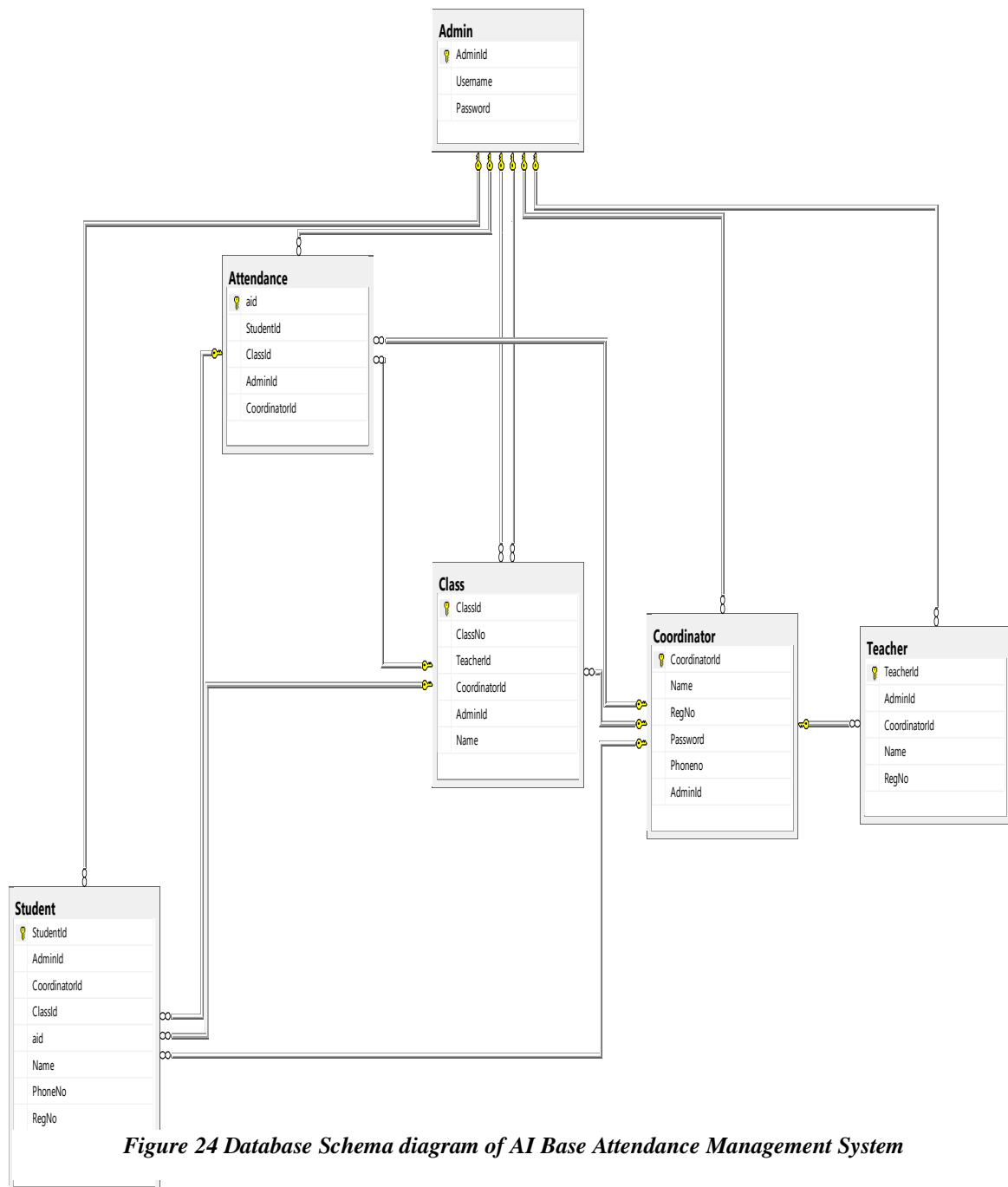


Figure 24 Database Schema diagram of AI Base Attendance Management System

3.13 Architecture for development of AI Attendance system

The architecture for development of AI Attendance system use PyCharm for implementing Face Recognition library and MYSQL database and HTML, CSS, Node js, for frontend and backend development.

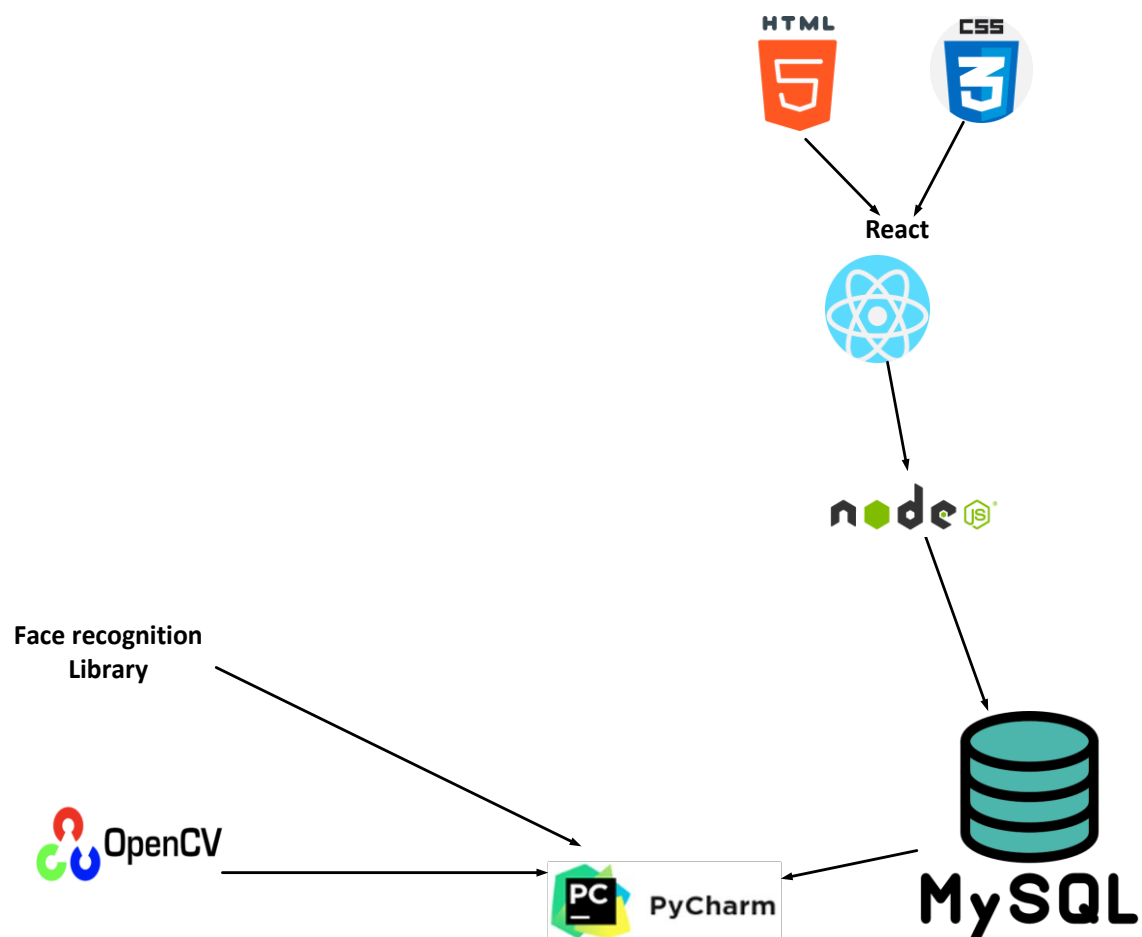


Figure 25. Architecture for development of AI Attendance system

3.14 Face Recognition System Architecture:

This attendance system based on face recognition system and its architecture is shown below:

1. Image Capturing Module
2. Face Detection and Feature extraction.
3. Feature Classification and Identification
4. Mark Attendance

3.14.1. Image Capturing Module

The facial recognition process starts from the image acquisition module. Via a mobile camera, teacher captures the class images which will be used as input to the facial recognition system. And the facial recognition system try to recognize faces in class

image.

3.14.2. Face Detection and Feature extraction.

The first step is face detection. We have to locate the faces in a photograph before we can try to tell them apart. Face detection went mainstream in the early 2000's when Paul Viola and Michael Jones invented a way to detect faces that was fast enough to run on cheap cameras. However, much more reliable solutions exist now. We're going to use a face-recognition library by Adam Geitgey. It recognizes and manipulate faces from Python or from the command line with the world's simplest face recognition library. Built using dlib's state-of-the-art face recognition built with deep learning. It uses Dlib to automatically find their faces in the image and then to automatically determine how many people there are as well as which faces belong to each person. Dlib's ResNet network with 29 convolution layers to recognize faces. The network supports both Predictor 5 and Predictor 68 model to estimate facial landmarks. This model is trained on a data set of three million faces from well-known data sets like face scrub and VGG using deep metric learning. It uses HOG feature descriptor for multiple face detection. The end result is we turn the original image into a very simple representation that captures the basic structure of a face in a simple way:

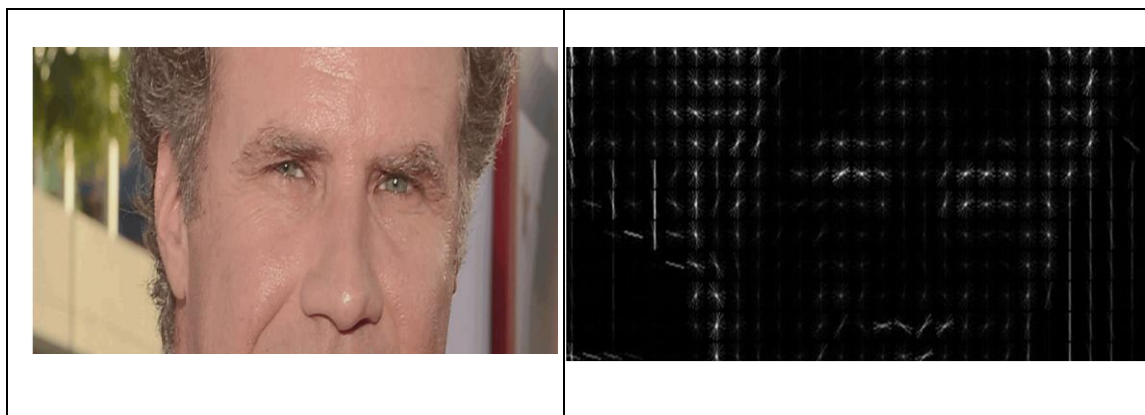


Figure 26. Dlib extract points from an image using HOG

Figure 26 shows points extracted as a result of HOG. Then figure out the pose of the face by finding the 68 landmarks in the face. Once we find those landmarks, use them to warp the image so that the eyes and mouth are centered. Dlib's use methods HOG (Histogram of Oriented Gradients) and SVM (Support Vector Machine).

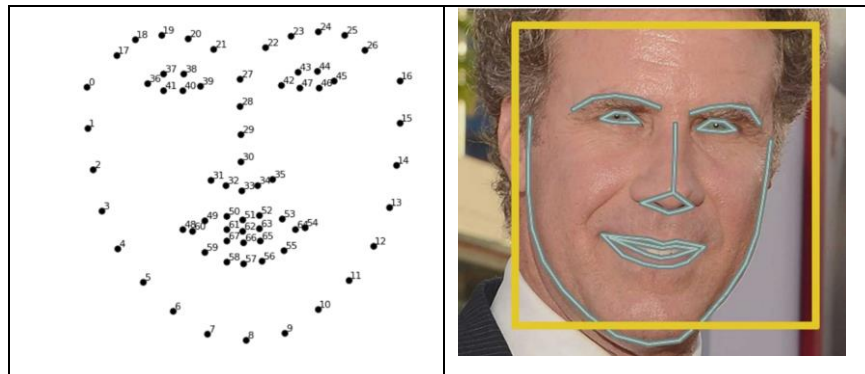


Figure 27. Facial landmark detection

Now that we know where the eyes and mouth are, we'll simply rotate, scale and shear the image so that the eyes and mouth are centered as best as possible. Facial feature extraction is the extracting of main features of human faces like eyes, nose, mouth, etc. we need is a way to extract a few basic measurements from each face. Then we could measure our unknown face the same way and find the known face with the closest measurements. For example, we might measure the size of each ear, the spacing between the eyes, and the length of the nose. Figure 27 and 28 shows different parts of face extracted by Dlib and in figure 28 after extracting features image is crop with region of interest.

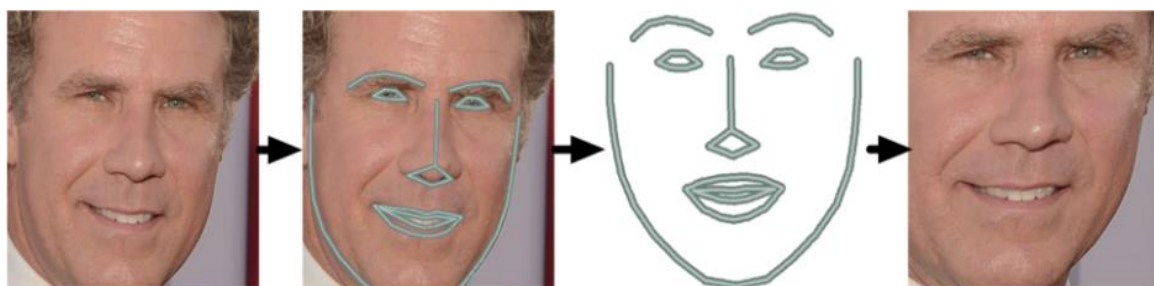


Figure 28. Facial features extracted using Dlib

3.14.3. Feature Classification and Identification

There are various algorithms for classification. Principal component analysis (PCA), k-nearest neighbor (KNN) and support vector machine (SVM) are the most popular in research area. The result from the extraction is the input of classification. When working with normalized face embedding inputs. In this proposed system, after extracting the feature, Dlib use deep metric model to identify how many different people there are and which faces belong to each person. Then result is input in face recognition library and if features were matched and faces are identified then next module of marking attendance will be executed

3.14.4. Marking Attendance

In this module the system marks the attendance of faces whose features are successfully recognize while unrecognized faces are labeled as unknown

3.15 Non-functional requirements:

Non-functional requirement (NFR) is a specification that describes the system's operation capabilities and constraints that enhance its functionality. These may be speed, security, reliability, etc. non-functional requirement specifies the quality attribute of a software system. Example of nonfunctional requirement, "how fast does the website load?" Failing to meet non-functional requirements can result in systems that fail to satisfy user needs. Non-functional requirements affect the user experience as they define a system's behavior, features, and general characteristics.

Table 5. Non-Functional Requirements

Identifier	Requirements
Req-1	The GUI of the system should be interactive and user-friendly.
Req-2	The data that will be shown to the users will be made sure that it is correct.
Req-3	The system will ensure good performance.
Req-4	The data will be available to user when he/she requires it.
Req-5	The system should be accurate in results especially in face recognition.
Req-6	The system should maintain its efficiency and efficacy.
Req-7	The system will be extended for changes and to the latest technologies.
Req-8	The system will be flexible.

3.15.1. Usability:

The system is management software users have to know how to use management software. The system is easy to use and understandable so that no time is required for

users to understand it.

3.15.2. Accuracy and Precision:

The system should perform its process whether it is inserting, retrieving data or performing face recognition process for attendance marking with accuracy and precision to avoid problems.

3.15.3. Speed and Responsiveness:

Execution of operations should be fast. The system should work with absolutely no delay or a very little delay.

3.15.4. Security:

The system should be secure as it stores a lot of data related to teachers, students, and management so privacy of data should be maintained by limiting the access of users to particular data. As mentioned earlier the system has two main users, admin and coordinators who have access to particular data.

3.15.5. Flexibility:

The system should be easy to modify, and any error should be easy to correct.

3.15.6. Reliability:

The system should be easily work 24 hours a day, 7 days of a week on system where it is installed. Attendance reports can be easily generated in the system and send it to students in form of notifications which they receive on their mobile. Admin and Coordinators can send these notifications to students.

3.16 Wireframe of system:

A wireframe is a schematic, a blueprint, useful to help you and your programmers and designers think and communicate about the structure of the software or website you're building. A screen can be built in a lot of different ways, but only a few of them* will get your message across correctly and result in an easy-to-use software or website. Nailing down a good interface structure is possibly the most important part of designing software. Wireframes are guides to where the major navigation and content elements of your site are going to appear on the page.

Wireframe for AI Base Attendance Management System is shown in Figure 30 and its link is also available at bottom of image:



Figure 29. Wireframe of AI Base Attendance Management System

Google drive link of Wireframe is given below;

(https://drive.google.com/file/d/18EE7qgqlznxkZCAJJb4sZOthk_AIX0BU/view?usp=sharing)

Chapter # 4 DEVELOPMENT

4.1. Development

Development of project is the core stage where all design scenarios have to be physically implemented which are present in detail in previous chapter. The project contains two parts: the first one is management part and how the data is managed by different users of project and second part is face recognition and attendance marking. Development of my project has 4 main components.

- Web Application development
- Mobile app development
- Database development
- Face Recognition Library Implementation

4.1.1. Web Application development

For Web Application development basically the Admin Panel and Coordinator Panels are included in web application part and to insert, view, delete operations I use React JS, that is an open-source, front end, JavaScript library for building user interfaces or UI components. With help of react js I made front end part from where user interact with application and for communication with database, I use node js and MYSQL that complete CRUD operation control flow of data from database to user interface.

In react js I mostly use functional components and manage the states with help of hooks and use axios that make API and communicate with backend.

4.1.2. Mobile app development

Student and Teacher module of the project made in react native which an open-source mobile application framework is created by Facebook. For communication with back end node js and SQL database is used.

4.1.3. Database development

For database development, I use Xampp SQL Server which is a localhost server. My database has 6 tables. Each contain primary key and foreign key.

4.1.3.1. Database Tables

Figure 30 shows the database tables of this project. Admin table that maintain admin record like Username, Password and adminid is use as primary key in admin table. Then in Coordinator table cid is use as primary key and connect this table with admin table with foreign key admin id. Coordinator records such as registration number, name,

password and department to which coordinator relates are stored in this table. In class table class record such as class number, subject, day and time are save. Primary key of class table is classid and the table is connected with teacher, coordinator and admin table via teacherid, cid and adminid respectively. In student table student registration number, name, password, phone number and path of folder where training photos are present, store in database. Primary key of student table is sid and it is connected with admin and coordinator table with adminid and cid as foreign key. Teacher table save teacher information like registration number and password that are assign by coordinator, teacher id is primary key and table is connected with admin and coordinator table adminid and cid as foreign key. Attendance table contain attendance of students which is the result of face recognition, if a face is recognized successfully then attendance attribute of particular student id store value present otherwise marked as absent. Primary key of attendance table is aid and it is connected with student, teacher, admin and coordinator with sid, teacherid, adminid and cid as foreign key.

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    
```

#	Name	Type
1	adminid	int(11)
2	Username	text
3	Password	varchar(255)

(a)

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    New --> class
    class --> coordinator
    coordinator --> student
    student --> teacher
    db_first
    
```

#	Name	Type
1	sid	int(11)
2	RegNo	varchar(50)
3	Name	varchar(50)
4	Phoneno	int(50)
5	Photos	varchar(255)
6	adminid	int(11)
7	cid	int(11)

(b)

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    New --> class
    class --> coordinator
    coordinator --> student
    student --> teacher
    db_first
    information_schema
    
```

#	Name	Type
1	classid	int(11)
2	classno	varchar(11)
3	subject	text
4	day	varchar(50)
5	time	varchar(50)
6	adminid	int(11)
7	cid	int(11)
8	Teacherid	int(11)

(c)

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    New --> class
    class --> coordinator
    coordinator --> student
    student --> teacher
    db_first
    
```

#	Name	Type
1	Teacherid	int(11)
2	Name	varchar(50)
3	RegNo	varchar(255)
4	Password	int(50)
5	adminid	int(11)
6	cid	int(11)

(d)

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    New --> class
    class --> coordinator
    coordinator --> student
    student --> teacher
    db_first
    
```

#	Name	Type
1	cid	int(11)
2	adminid	int(11)
3	regNo	varchar(255)
4	name	text
5	password	varchar(50)
6	department	varchar(10)

(e)

```

graph LR
    New --> attendance_project
    attendance_project --> New
    New --> admin
    admin --> attendance
    New --> class
    class --> coordinator
    coordinator --> student
    student --> teacher
    db_first
    
```

#	Name	Type
1	aid	int(11)
2	attendance	varchar(255)
3	sid	int(11)
4	adminid	int(11)
5	cid	int(11)
6	classid	int(11)

(f)

Figure 30.Database tables of AI Base Attendance Management System (a) Admin table (b) Student table (c) Class Table (d) Teacher Table (e) Coordinator Table (f) Attendance Table

4.2. Face Recognition Library Implementation

The Modules required to perform the facial recognition are OpenCV, OS, image module and numpy, Dlib and face-recognition library. To detect and extract facial landmarks from an image using Dlib, OpenCV, and Python. Detecting facial landmarks is a subset of the shape prediction problem. Given an input image (and normally a Region of Interest that specifies the object of interest), a shape predictor attempts to localize key points of interest along the shape. Dlib's use methods HOG (Histogram of Oriented Gradients) and SVM (Support Vector Machine).

In the context of facial landmarks, our goal is to detect important facial structures on the face using shape prediction methods. Detection of facial landmarks have two steps: first one is to localize the face in the image, and then detect the key facial structures on the face region of interest. Dlib use to detect the face in the image. With this method we obtain the face bounding box (i.e., the (x, y)-coordinates of the face in the image), then detect the key facial structures in the face region. There are a variety of facial landmark detectors, but all methods essentially try to localize and label the following facial regions such as mouth, right eyebrow, left eyebrow, right eye, left eye, nose and jaw. When we use Dlib algorithms to detect these features we actually get a map of points that surround each feature. This map composed of 67 points (called landmark points) can identify the following features:

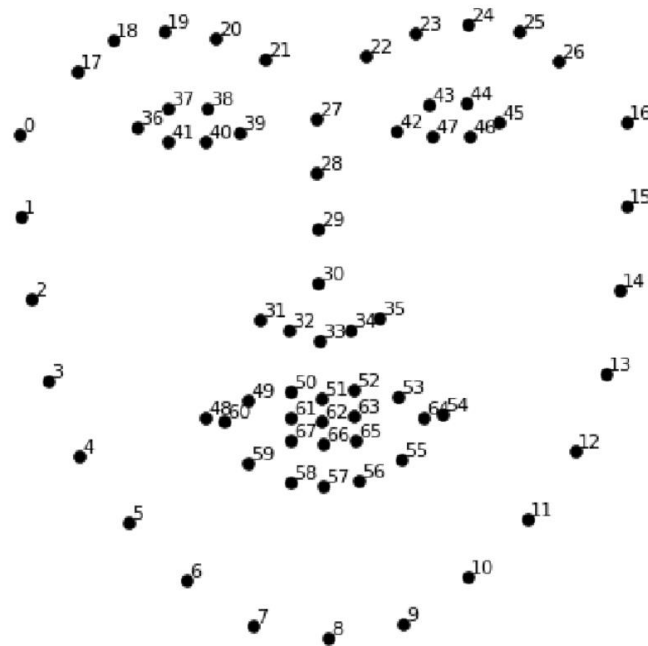


Figure 31. Face landmark points detected by Dlib

In Figure 31 Facial landmark points that are detected by Dlib are shown and their details are as following:

- Jaw Points = 0–16
- Right Brow Points = 17–21
- Left Brow Points = 22–26
- Nose Points = 27–35
- Right Eye Points = 36–41
- Left Eye Points = 42–47
- Mouth Points = 48–60
- Lips Points = 61–67

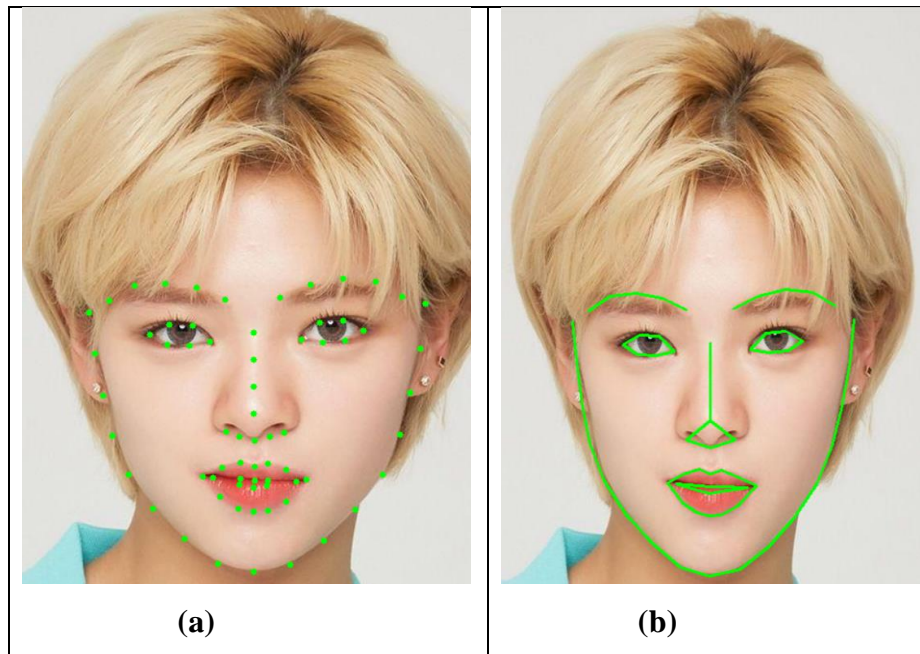


Figure 32. (a): Face landmark points are detected by Dlib on custom image (b): Outlines of facial features are extracted by Dlib on custom image

In Figure 32 face landmarks extracted and get the locations and outlines of each person's eyes, nose, mouth and chin by using Dlib, OpenCV and python are shown. Then identification and classification step are completed using face recognition library. Both Dlib and face recognition library are used to recognize faces in picture as shown in Figure 33:



Figure 33. Face Recognition library recognize faces in picture

After face recognition successfully recognize faces the attendance of students is marked and save record in database as well as it shown in teacher panel where teacher can edit attendance in case if a wrong attendance is marked due to false positive results of face recognition model or if a student is not recognized by system because the accuracy of system is not 100 % so it may provide a little bit inaccurate result. Then coordinators can also view and send the attendance record to students. Figure 34 shows teacher and student panel screen where they edit or view attendance.

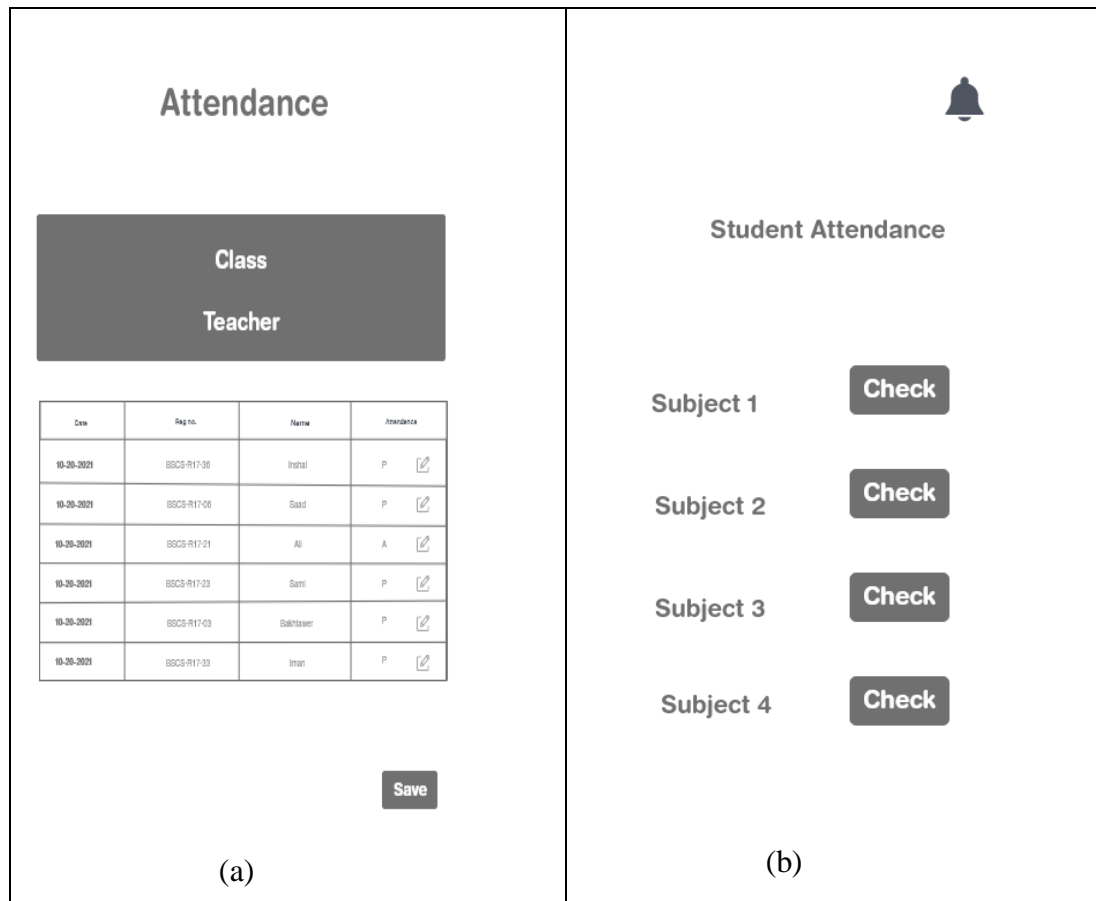


Figure 34. (a): Teacher Panel Screen where teacher can edit student attendance (b): Student Panel Screen where student can check their attendance according to subject

Chapter # 5 EVALUATION AND TESTING

Evaluation and Testing is the most important phase in project life-cycle. Here one can visualize, whether the project worth able, whether it fulfill the needs of users, whether it meeting all constraints etc. All errors and bugs are also tested in this phase according to all possible input scenarios. If any error is detected than it should be recovered.

5.1 Complete Testing of Software

Considering the scope of the project and the time limitations, we will be able to perform following tests. Different phases of test and different testing techniques is shown in Figure 35.

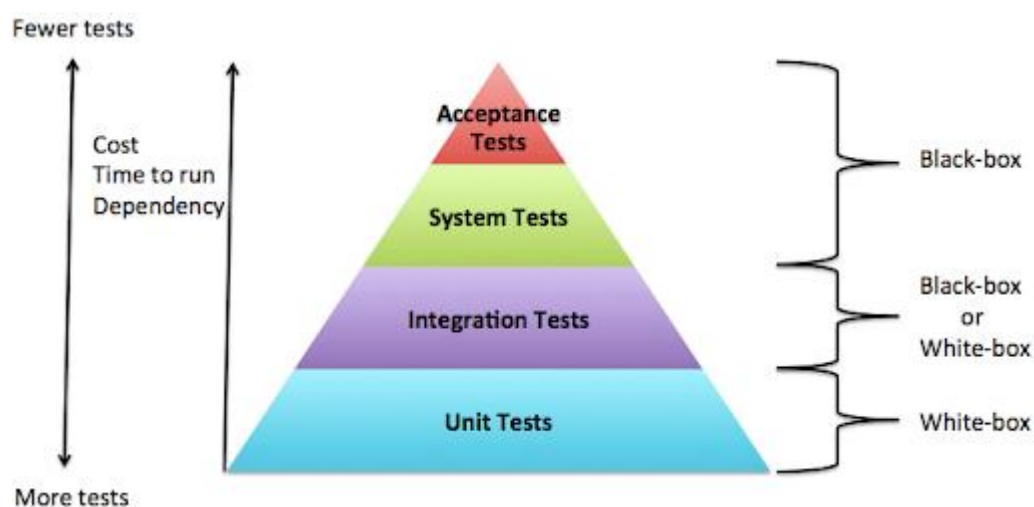


Figure 35: Different testing Phases and techniques.

5.1.1. White-box testing

White Box Testing is software testing technique in which internal structure, design and coding of software are tested to verify flow of input-output. In white box testing, code is visible to testers or can be done by developers. The testing can be done at different levels like unit, integration and system levels of software development. Verification of working flow is the main goal of White-box testing. I performed White box testing at unit level, check code flow and output of each unit

5.1.2 Unit Test

This test verifies the program logic and is based on the knowledge of the program structure. Each module/ section was tested and the purpose of the unit testing was to verify the correctness of each module making sure individual parts of the system were functioning as expected.

5.1.3. Integration Test

This test verifies the entire system's functionality according to the design specification. Integration testing is done after the individual modules are integrated as a group. So, integration testing is focused on checking whether modules are communicating with each other or not after implementation. It is tested against its intended functionality of deleting, adding and updating the records from the database using react that control the flow of data from frontend by interacting with user and get input from user and connect to backend and database with help of node js.

5.1.4. System Testing

This test verifies whether specific requirements of the customer are met. This involves evaluating the system as a whole to find errors and verify if it met specifications. This included first time end to end testing of the application as a complete software product before it is deployed into the target environment.

5.1.5. Test cases

A Test Case is a set of actions executed to verify a particular feature or functionality of software or application.

5.1.5.1. Test Case for Login Module

a. For Admin

Test Case ID	Test-01
Use Case no	UC-1
Test Description	Check Login functionality for admin
Test Steps	<p>Open web application</p> <p>Select admin option from dropdown</p> <p>Enter username and password</p> <p>Press Submit Button</p>
Test Data	<p>Username: admin</p> <p>Password: admin123</p>
Test Environment	PC or Laptop

Test Pre-condition	Software should be installed in the system.
Excepted Result	Login successfully and open admin panel.
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

b. For Coordinator

Test Case ID	Test-02
Use Case no	UC-1
Test Description	Check Login functionality for coordinator
Test Steps	<p>Open web application</p> <p>Select coordinator option</p> <p>from dropdown</p> <p>Enter registration number and</p> <p>password</p> <p>Press Submit Button</p>
Test Data	<p>Registration number: 23</p> <p>Password: pass</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Login successfully and open coordinator panel.
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.1.5.2. Test Case for Insertion Module

a. For admin

Test Case ID	Test-03
Use Case no	UC-2
Test Description	Check software is correctly inserting records of new coordinator
Test Steps	<p>Open web application</p> <p>Login as admin</p> <p>Select Add new coordinator option</p> <p>Enter Name</p> <p>Enter Password</p> <p>Enter Department</p> <p>Enter Registration Number</p> <p>Enter admin id</p> <p>Click Submit button</p>
Test Data	<p>Enter Name: Sami</p> <p>Enter Password: pass</p> <p>Enter Department: Psychology</p> <p>Enter Registration 23</p> <p>Enter admin id: 1</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record inserted successfully
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

b. For coordinator

Test Case ID	Test-04
Use Case no	UC-2
Test Description	Check software is correctly inserting records of new student

Test Steps	<p>Open web application</p> <p>Login as coordinator</p> <p>Select Manage Student</p> <p>Add student</p> <p>Enter Name</p> <p>Enter Password</p> <p>Enter Phone</p> <p>Enter Registration Number</p> <p>Enter Photos</p> <p>Enter admin id</p> <p>Enter coordinator id</p> <p>Click Submit button</p>
Test Data	<p>Enter Name: Bakhtawar</p> <p>Enter Password: 1234</p> <p>Enter Phone: 2147483647</p> <p>Enter Registration BSAI0211198</p> <p>Enter Photos: ./images/bakht.jpg</p> <p>Enter admin id: 1</p> <p>Enter cid: 23</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record inserted successfully
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

Test Case ID	Test-05
Use Case no	UC-2
Test Description	Check software is correctly inserting records of new teacher

Test Steps	Open web application Login as coordinator Select Manage Teacher Add teacher Enter Name Enter Password Enter Registration Number Enter admin id Enter coordinator id Click Submit button
Test Data	Enter Name: Manal Enter Password: 124 Enter Registration: T11 Enter admin id: 1 Enter cid: 23
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record inserted successfully
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

c. For class

Test Case ID	Test-06
Use Case no	UC-2
Test Description	Check software is correctly inserting records of new class schedule

Test Steps	Open web application Login as coordinator Select Manage class Add class Enter Class no. Enter Subject Enter day Enter time Enter admin id Enter coordinator id Enter teacher id Click Submit button
Test Data	Enter Name: Manal Enter Password: 124 Enter Registration: T11 Enter admin id: 1 Enter cid: 23
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record inserted successfully
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.1.5.3. Test Case for Deletion Module

a. For admin

Test Case ID	Test-07
Use Case no	UC-4
Test Description	Check software is correctly delete record of coordinator

Test Steps	<p>Open web application</p> <p>Login as admin</p> <p>Select Delete coordinator option</p> <p>Click on delete icon to delete that particular record</p>
Test Data	<p>Username: admin</p> <p>Password: admin123</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record deleted
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

b. For coordinator

Test Case ID	Test-08
Use Case no	UC-4
Test Description	Check software is correctly delete record of class
Test Steps	<p>Open web application</p> <p>Login as coordinator</p> <p>Select Manage class</p> <p>Select View class</p> <p>Click on delete icon to delete that particular record</p>
Test Data	<p>Registration number: 23</p> <p>Password: pass</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.

Excepted Result	Record deleted
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.1.5.4. Test Case for Update Module

a. For admin

Test Case ID	Test-09
Use Case no	UC-5
Test Description	Check software is correctly update record of coordinator
Test Steps	<p>Open web application</p> <p>Login as admin</p> <p>Select View/Update coordinator option</p> <p>Click on Edit icon in front of that record to update that particular record</p> <p>Enter the new record to update</p>
Test Data	<p>Username: admin</p> <p>Password: admin123</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record updated
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

b. For coordinator

Test Case ID	Test-10
Use Case no	UC-5
Test Description	Check software is correctly update class schedule

Test Steps	<p>Open web application</p> <p>Login as coordinator</p> <p>Select Manage Class</p> <p>Select Update class option</p> <p>Click on Edit icon in front of that record to update that particular record</p> <p>Enter the new record to update</p>
Test Data	<p>Registration no: 23</p> <p>Password: pass</p>
Test Environment	PC or Laptop
Test Pre-condition	Software should be installed in the system.
Excepted Result	Record updated
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

c. For Teachers

Test Case ID	Test-11
Test Description	Check software is correctly update mark attendance
Test Steps	<p>Open teacher application</p> <p>Login with registration number and password</p> <p>Select mark option</p> <p>Click picture of class from camera</p> <p>Click on Edit icon in front of that record to update that particular record</p> <p>Enter the new record to update</p>
Test Data	<p>Registration no: T11</p> <p>Password: 124</p>
Test Environment	Android Mobile

Test Pre-condition	App should be properly installed on mobile.
Excepted Result	Record updated
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.1.5.5. Test Case for Mark Attendance

For Teacher

Test Case ID	Test-12
Use Case no	UC-7
Test Description	Mark Class Attendance
Test Steps	Open teacher application Login as Teacher Select Mark option Take picture View marked attendance
Test Data	Registration no: T11 Password: 124
Test Environment	Android Mobile
Test Pre-condition	App should be properly installed on mobile.
Excepted Result	Record updated
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.1.5.6. Test Case for Notification Module

a. For Coordinator

Test Case ID	Test-13
Test Description	Send Attendance Notification to Student

Test Steps	Open web application Login as coordinator Select View Attendance Select send button and send attendance report as notification to students
Test Data	Registration no: 23 Password: pass
Test Environment	Android Mobile
Test Pre-condition	PC or Laptop
Excepted Result	Software should be installed in the system.
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

b. For Students

Test Case ID	Test-14
Test Description	View Attendance
Test Steps	Received Notification Open student application Login as Student Select View option View marked attendance
Test Data	Registration no: CS27536 Password: 123
Test Environment	Android Mobile
Test Pre-condition	App should be properly installed on mobile.
Excepted Result	Record updated
Actual Result	As expected
Pass/Fail	Pass
Problems/Issues	Null

5.2.1. Black Box Testing

Black Box Testing is a software testing method in which the functionalities of software applications are tested without having knowledge of internal code structure, implementation details and internal paths. Black Box Testing mainly focuses on input and output of software applications and it is entirely based on software requirements and specifications. It is also known as Behavioral Testing.

5.2.2. User testing (Functional testing or functional requirement testing)

User testing refers to the process of intentionally studying potential end-users as they interact with a product. The purpose of usability testing is to ensure the plan for a product's functions, features and overall process are in line with what users want by observing how real-life people use the product. User testing allows you to learn things about user behavior, needs, and expectations upfront. The insights and benefits gleaned from usability testing are essential to informing product development. Observing the way someone interacts with your product interface provides you with an opportunity to course correct your design and set development priorities from the get-go.

There are four users of my software i.e. admin, coordinator, teacher, student. I performed user testing with teachers and parents to evaluate different functions of the game that are listed in Table 3 (Functional Requirements) and also visualized with the help of use cases. I developed different questionnaires for teacher, coordinator and student. I asked teacher, coordinator and student to answer these questions according to their point of view what they feel after using this software.

5.2.2. User testing by Coordinator

Questionnaires for coordinators are:

1. Do application allow to login?
2. Do application allow to add records of student, teachers and class?
3. Do application allow to view records of student, teachers and class?
4. Do application allow to delete records of class?
5. Do application allow to update records of class?
6. Do application allow you to view attendance of students?
7. Do application allow you to send attendance reports of students to students?

5.2.3. User testing by teacher

Questionnaires for teacher are:

1. Do application allow to login?

2. Do application allow to view particular classes related to you?
3. Do application allow to open camera and take picture of a particular class?
4. Do application allow to view attendance of that class?
5. Do application allow to update attendance of that class?

5.2.4. User testing by students

Questionnaires for teacher are:

1. Do application allow to login?
2. Do application allow to view particular classes related to you?
3. Do application allow to view attendance of particular class?

5.2.5. User testing by Admin

Questionnaires for coordinators are:

1. Do application allow to login?
2. Do application allow to add record of coordinator?
3. Do application allow to view coordinator?
4. Do application allow to delete records of coordinator?
5. Do application allow to update records of coordinator?
6. Do application allow you to access panel of student, teacher and class?

5.3. Acceptance Testing

This test verifies whether the system needs to meet the initial objectives and customer's expectations. It is performed with the users i.e. coordinator, admin, student and teacher to help verify if the system will meet the user requirements. User acceptance is be performed by the end users to certify the system performs with intended requirements agreed upon for this purpose a group of 10 coordinators, 10 teachers and 10 students are enlisted and ask them to use the software, the coordinators add, delete, update the record of class, teacher and students. Teachers are allow to take picture of class and mark their attendance on basis of face recognition and students to check their attendance notification answer following questions

5.3.1. Testing via coordinator

Coordinators were allowed to use the application and perform all the task related to coordinators and then a survey was conducted and explain them to rate 5 simple question related to software, and the questions are:

1. Save time for maintenance records then traditional attendance
2. Easily maintain records by using this software

3. Notify students about their attendance
4. Reduce cumbersome process of manual file handling
5. Can reduce efforts of searching records

5.3.2. Testing via teacher

After coordinators survey teachers were a survey was conducted with teachers and to their opinion about the AI Based Attendance Management System. The survey consists of following questions:

1. Make attendance taking process easy
2. Like software
3. Easy to use
4. You recommend this software to other teachers
5. Prefer over traditional attendance
6. Face recognition and attendance marking work properly for Pakistani community.
7. Helps to reduce time that is taken in attendance taking process during class
8. Chance of proxy attendance is reduced
9. Save time in class to focus on studies
10. Facilitate teachers in taking attendance

5.3.2. Testing via students

A group of students were also included in survey and ask them to let us know their views about AI Based Attendance Management System and the survey included following questions:

1. Track your attendance properly
2. Prefer on traditional attendance system
3. Can reduce effort to check your attendance
4. Save time in class to focus on studies
5. Easy to use

Chapter # 6 FINDINGS AND RESULTS

The outcome shows that marking attendance using face recognition works well. Students and Management are satisfied to upgrade from their traditional attendance systems.

6.1. Results of User Testing (Functional Testing)

6.1.1. User testing by coordinators

Results of user testing shows that all functions are working properly. Table 6 shows coordinator perspective on Functional requirements. This study is conducted with the help of 10 coordinator and table shows number of coordinator who give the specific answer.

Table 6: User testing by coordinators

	Questions	Yes	No	Any difficulty
1.	Do application allow to login?	10		
2.	Do application allow to add records of student, teachers and class?	8		
3.	Do application allow to delete records of class?	10		
4.	Do application allow to update records of class?	7		1
5.	Do application allow you to view attendance of students?	10		
6.	Do application allow you to send attendance reports of students to students?	9		1
7.	Do application allow to view records of student, teachers and class?	10		

6.1.2. User testing by Teachers

Results of user testing by teachers are shown in table 7.

Table 7: User testing via teacher

	Questions	Yes	No	Any difficulty
--	-----------	-----	----	----------------

1.	Do application allow to login?	10		
2.	Do application allow to view particular classes related to you?	8		
3.	Do application allow to open camera and take picture of a particular class?	10		
4.	Do application allow to view attendance of that class?	7		1
5.	Do application allow to update attendance of that class?	8		1

6.1.3. User testing by Students

Results of user testing by students are shown below in table 8:

Table 8: User testing by students

	Questions	Yes	No	Any difficulty
1.	Do application allow to login?	10		1
2.	Do application allow to view particular classes related to you?	10		
3.	Do application allow to view attendance of particular class?	7		

6.1.4. User testing by Admin

Results of user testing by students are shown below in table 9:

Table 9: User testing by Admin

	Questions	Yes	No	Any difficulty
1.	Do application allow to login?	10		
2.	Do application allow to add record of coordinator?	10		
3.	Do application allow to view coordinator?	7		1

4.	Do application allow to delete records of coordinator?	10		
5.	Do application allow to update records of coordinator?	8		1
6.	Do application allow you to access panel of student, teacher and class?	8		

6.2 Testing Results

6.2.1 Testing Results via coordinator

Each question has 5 options. A stand for Strongly Agree, b for Agree, c for Neutral, d for Disagree and e for Strongly Disagree. Table shows the frequency of coordinator (out of 10) that goes with specific option for a question.

Table 10: Testing Results via coordinator

	Questions	a	b	c	d	e
1.	Save time for maintenance records then traditional attendance	9	1	0	0	0
2.	Easily maintain records by using this software	6	2	2	0	0
3.	Notify students about their attendance	9	1	0	0	0
4.	Reduce cumbersome process of manual file handling	10	0	0	0	0
5.	Can reduce efforts of searching records	9	1	0	0	0

Testing results from Table 10 reveal that the software enables coordinators to easily maintain record of and keep in touch with students to notify about their attendance process.

6.2.2 Testing Results via teachers

Each question has 5 options. A stand for Strongly Agree, b for Agree, c for Neutral, d for Disagree and e for Strongly Disagree. Table shows the frequency of teacher (out of 10) that goes with specific option for a question

Table 11: Testing Results via teachers

	Questions	a	b	c	d	e
1.	Make attendance taking process easy	10	0	0	0	0
2.	Like application	10	0	0	0	0
3.	Easy to use	8	2	0	0	0
4.	You recommend this software to other teachers	10	0	0	0	0
5.	Prefer over traditional attendance	10	0	0	0	0
6.	Face recognition and attendance marking work properly for Pakistani community.	6	1	0	2	1
7.	Helps to reduce time that is taken in attendance taking process during class	8	0	2	0	0
8.	Chance of proxy attendance is reduced	10	0	0	0	0
9.	Save time in class to focus on studies	9	0	1	0	0
10.	Facilitate teachers in taking attendance	7	3	0	0	0

The results shown that teachers find this convenient, modern and time saving application.

6.2.1 Testing Results via students

Each question has 5 options. A stand for Strongly Agree, b for Agree, c for Neutral, d for Disagree and e for Strongly Disagree. Table shows the frequency of students (out of 10) that goes with specific option for a question

Table 12: Testing Results via students

	Questions	a	b	c	d	e
1.	Track your attendance properly	8	2	0	0	0
2.	Prefer on traditional attendance system	6	1	1	1	1
3.	Can reduce effort to check your attendance	10	0	0	0	0
4.	Save time in class to focus on studies	10	0	0	0	0
5.	Easy to use	8	0	2	0	0

The result shows that students can easily view their attendance through this application.

1. Conclusion

In this project, we are able to detect and recognize faces of the students from a single picture of class taken by teacher and obtain the results in form of recognized faces that results in marked attendance of these students in database. I have used Dlib with OpenCV for face detection and face recognition library for face recognition. Face recognition is much easier and simpler method as there is no need to train model with a large dataset that can take several hours to train model according to custom images. In other face recognition algorithm, the optimum results are achieved only when you have provided several images of a specific object, while this method have ability to recognize faces by using single image, it can easily train with of single image of a specific person and can provide its optimum results. By using this algorithm one can be able to detect multiple faces in crowd and it can also recognize occluded faces like females in Niqab but the accuracy to detect occluded faces is not 100% so there is future research carrying out to meet best possible accuracy.

2. FUTURE WORK:

In future I will try to improve the accuracy of the application by implementation different face recognition technique or try to make a make a different hybrid model that can successfully recognize all the females with Niqab and other occluded faces in crowd and give best possible results.

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Appendix A

Gantt chart

Gantt chart represents complete schedule of project development. Without this, it's really difficult to complete project in given time constraints.

I also developed a Gantt chart for my project, this helped me a lot in completion of my project within time limit. Gantt chart is displayed in Chart 1.

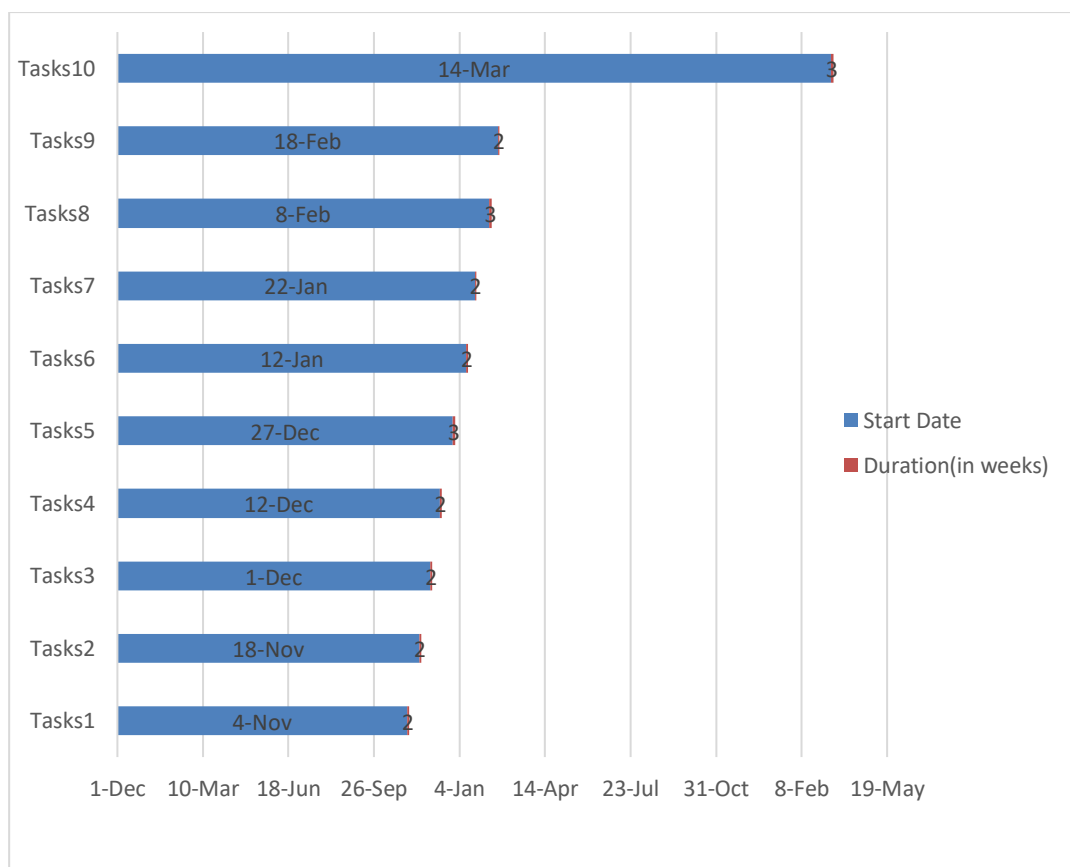



Chart 1. Gantt chart

Google drive Link of Gantt chart is also provided here;
(<https://drive.google.com/file/d/19KMP8hvmVAOSClwORoWPP-46PaXWRjNB/view?usp=sharing>)

Appendix B

Performa conducted during testing of user perception regarding the use of AI Base Attendance Management System

Name: Eman

Signature: 

Usability test by Coordinator

Does application allow you to perform different functions? (Choose options)

	Questions	Yes	No	Any Difficulty
1.	Do application allow to login?	✓		
2.	Do application allow to view particular classes related to you?	✓		
3.	Do application allow to view attendance of particular class?	✓		

Name: Fahim

Signature: 

Usability test by Teachers

Does application allow you to perform different functions? (Choose options)

	Questions	Yes	No	Any Difficulty
1.	Do application allow to login?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2.	Do application allow to view particular classes related to you?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3.	Do application allow to open camera and take picture of a particular class?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
4.	Do application allow to view attendance of that class?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.	Do application allow to update attendance of that class?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Name: Bakhtwar

Signature: Bakhtwar

Usability test by Students

Does application allow you to perform different functions? (Choose options)

	Questions	Yes	No	Any Difficulty
1.	Do application allow to login?	✓		
2.	Do application allow to add records of student, teachers and class?	✓		
3.	Do application allow to delete records of class?	✓		
4.	Do application allow to update records of class?	✓		
5.	Do application allow you to view attendance of students?	✓		
6.	Do application allow you to send attendance reports of students to students?	✓		
7.	Do application allow to view records of student, teachers and class?	✓		

Name: Sami

Signature: A. Say

Coordinators Perception for AI Base Attendance Management System.

How much satisfied with AI Base Attendance Management System. (Choose options)

*** Strongly Agree = a, Agree = b, Neutral = c, Disagree = d, strongly disagree = e**

	Questions	a	b	c	d	e
1.	Save time for maintenance records then traditional attendance	✓				
2.	Easily maintain records by using this software	✓				
3.	Notify students about their attendance	✓				
4.	Reduce cumbersome process of manual file handling	✓				
5.	Can reduce efforts of searching records		✓			

Name: Saad

Signature: S/S

Perception for AI Base Attendance Management System.

Does application allow you to perform different functions?

How much satisfied with AI Base Attendance Management System (Choose options)

* Strongly Agree = a, Agree = b, Neutral = c, Disagree = d, strongly disagree = e

	Questions	a	b	c	d	e
1.	Make attendance taking process easy	✓				
2.	Like application	✓				
3.	Easy to use	✓				
4.	You recommend this software to other teachers	✓				
5.	Prefer over traditional attendance		✓			
6.	Face recognition and attendance marking work properly for Pakistani community.			✓		
7.	Helps to reduce time that is taken in attendance taking process during class		✓			
8.	Chance of proxy attendance is reduced		✓			
9.	Save time in class to focus on studies		✓			
10.	Facilitate teachers in taking attendance	✓				

Name: Amna Saba

Signature: Amna Saba

Students Perception for AI Base Attendance Management System.

How much satisfied with AI Base Attendance Management System. (Choose options)

*** Strongly Agree = a, Agree = b, Neutral = c, Disagree = d, strongly disagree = e**

	Questions	a	b	c	d	e
1.	Track your attendance properly	✓				
2.	Prefer on traditional attendance system	✓				
3.	Can reduce effort to check your attendance		✓			
4.	Save time in class to focus on studies	✓				
5.	Easy to use	✓				