AttendEase: Facial Recognition Attendance System

Final Year Project Report

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In partial fulfilment of the requirements for the degree of
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Certificate of Approval

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This project "AttendEase: Facial Recognition Attendance System" is presented by **Imran Ali, M. Umer Saleem and Adil Shaikh** under the supervision of their project advisor and approved by the project examination committee, and acknowledged by the Hamdard Institute of Engineering and Technology, in the fulfillment of the requirements for the **Bachelor's degree of Artificial Intelligence**.

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Authors' Declaration

We declare that this project report was carried out in accordance with the rules and regulations of Hamdard University. The work is original except where indicated by special references in the text and no part of the report has been submitted for any other degree. The report has not been presented to any other University for examination.

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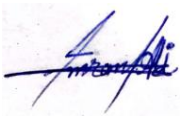

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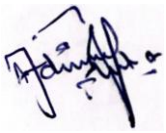

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Plagiarism Undertaking

We, **Imran Ali, M. Umer Saleem** and **Adil Shaikh** , solemnly declare that the work presented in the Final Year Project Report titled **AttedEase: Facial Recognition Attendance System** has been carried out solely by ourselves with no significant help from any other person except few of those which are duly acknowledged. We confirm that no portion of our report has been plagiarized and any material used in the report from other sources is properly referenced.

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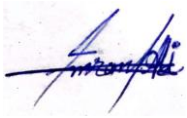

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Abstract

The Smart Attendance System utilizes facial recognition technology to transform conventional attendance tracking in educational institutions and various organizations. The system guarantees real-time processing and instant updates to attendance records by creating sophisticated algorithms that can precisely recognize people from images and live video streams. This project combines facial recognition with current attendance management systems, providing an intuitive interface for easy interaction by both staff and students. Focusing on data safety and confidentiality, the system secures sensitive data through encryption and adheres to regulatory requirements. Moreover, it offers administrators comprehensive reports and analytics, facilitating informed decision-making. The suggested approach overcomes the drawbacks of manual attendance tracking, providing a more effective, secure, and convenient way to handle attendance in different application domains.

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CHAPTER 1

INTRODUCTION

1.1 Motivation

In an age of technological advancements, manual attendance systems are increasingly outdated, leading to inefficiencies and inaccuracies. Educational institutions and organizations often face challenges like time consumption, human error, and attendance fraud. The motivation behind this project stems from the desire to modernize attendance management by leveraging facial recognition technology, ensuring accuracy, efficiency, and security. By automating attendance systems, we aim to save valuable time, minimize errors, and enhance the overall experience for administrators, faculty, and students.

1.2 Problem Statement

Monitoring attendance in schools and organizations is essential but frequently ineffective. Conventional techniques—like roll calls or written records—are labor-intensive, prone to mistakes, and vulnerable to tampering. Obstacles encompass:

- Challenges in accurately handling substantial amounts of data.
- Poor oversight caused by mistakes in manual documentation.
- The absence of real-time monitoring and reporting of attendance.
- Issues regarding security linked to unauthorized access or data leaks.

These challenges require a creative approach that guarantees precision, integrates smoothly with current systems, and emphasizes data security and confidentiality.

1.3 Goals and Objectives

Goals:

To design and implement a robust, efficient, and user-friendly attendance system using facial recognition technology that addresses the limitations of traditional methods.

Objectives:

1. Develop Robust Facial Recognition Algorithms:

- Create algorithms capable of accurately identifying faces from photos and videos.
- Incorporate advanced feature extraction techniques and deep learning models.

2. Seamless Integration with Existing Systems:

- Develop an application compatible with current attendance management systems.
- Enable staff to mark attendance and access student records efficiently.

3. User-Friendly Interface:

- Design an intuitive interface for ease of use by faculty, students, and administrators.

4. Data Security and Privacy:

- Secure sensitive information to guarantee user confidentiality.
- Adhere to all applicable data privacy laws.

5. Comprehensive Analytics and Reporting:

- Provide detailed reports and insights for decision-making.
- Track attendance trends and identify potential issues proactively.

1.4 Project Scope

The project aims to develop an advanced facial recognition-based attendance management system with the following features:

1. Accurate Face Recognition:

- High accuracy in identifying individuals from still images and real-time video feeds.
- Robust algorithms to handle variations in lighting, posture, and other conditions.

2. Real-Time Processing:

- Continuous monitoring of video streams to update attendance records instantly.

3. User-Friendly Application:

- A simple and intuitive interface for users to view and manage attendance records.

4. Data Security and Compliance:

- Advanced encryption techniques to protect sensitive information.
- Adherence to privacy laws and institutional guidelines.

5. Comprehensive Reporting:

- Detailed attendance reports for administrators.
- Analytics to support data-driven decision-making.

By implementing this system, the project seeks to revolutionize attendance management, making it more accurate, efficient, and secure for educational institutions and beyond.

CHAPTER 2

RELEVANT BACKGROUND & DEFINITIONS

2.1 Relevant Background:

Managing attendance is a crucial element of every organization, especially in educational settings. Conventional approaches, like manual attendance checks or paper logs, are not only lengthy but also susceptible to mistakes and tampering. Advancements in artificial intelligence and biometric technologies in recent years have facilitated more effective solutions.

Facial recognition technology has become a significant resource in biometric systems, providing a non-contact and very precise method for identifying people. This technology streamlines the attendance process by analyzing distinct facial characteristics, minimizing manual labor and enhancing data precision. Although it has potential, issues such as lighting conditions, variations in posture, and privacy concerns need to be resolved to guarantee reliability and security.

The system proposed, AttendEase, seeks to address these issues by utilizing advanced deep learning algorithms, strong encryption techniques, and easy-to-use interfaces. This initiative integrates advanced facial recognition systems with instantaneous data processing to provide an effective and safe attendance management system.

2.1.1 Definitions:

Facial Recognition Technology: A biometric system that identifies people by examining distinct facial characteristics through algorithms and machine learning methods.
Feature Extraction: The method of recognizing important characteristics (e.g., eyes, nose, jawline) from facial pictures to generate a distinct portrayal of a person.
Deep Learning: A subset of artificial intelligence (AI) focused on neural networks that mimic the human brain, allowing the system to learn patterns and improve accuracy over time.

Biometric Authentication: The application of biological traits like facial attributes, fingerprints, or iris patterns to confirm a person's identity.
Real-Time Processing: A system’s ability to analyze and act upon data immediately as it is captured, enabling instant updates and decision-making.

Data Encryption: A security measure that converts sensitive information into a coded format to prevent unauthorized access.

User Interface (UI): The graphical and interactive elements of an application that enable users to interact with the system smoothly.

CHAPTER 3

LITERATURE REVIEW & RELATED WORK

3.1 Literature Review

Facial recognition technology has been extensively researched and applied in multiple fields, such as security, healthcare, and education. The literature emphasizes the capability of this technology to automate tasks, boost efficiency, and improve data precision. The following is a summary of pertinent research and developments concerning facial recognition and attendance systems.

1. Automated Attendance Systems

Hao Yang and Xiaofeng Han (2020) introduced a real-time attendance system for facial recognition that utilizes deep learning algorithms for precise identification. Their research showed the efficacy of employing video feeds for ongoing surveillance, establishing a basis for incorporating facial recognition into immediate applications.

Nirmalya Kar and colleagues (2013) examined the execution of an automated attendance system employing facial recognition methods. They emphasized the significance of preprocessing actions, like image enhancement and alignment, to boost precision. The research also tackled issues such as different lighting conditions and facial obstructions, highlighting the necessity for strong algorithms.

2. Deep Learning in Facial Recognition

Deep learning has greatly enhanced the effectiveness of facial recognition systems. Convolutional Neural Networks (CNNs), a variety of deep learning architecture, have been widely employed for feature extraction and classification. Research indicates that CNN-based models exceed conventional machine learning techniques regarding accuracy and flexibility.

P. Sinha et al. (2006) examined the cognitive elements of face recognition and emphasized the significance of employing holistic feature representation. Their study highlighted the necessity for systems that replicate human recognition methods, which deep learning models have effectively accomplished.

3. Challenges in Facial Recognition Systems

Despite advancements, facial recognition systems face challenges such as:

Lighting Variations: Poor lighting can significantly affect recognition accuracy. Solutions like histogram equalization and deep learning-based enhancement techniques are commonly employed.

Facial Occlusions: Masks, glasses, or other obstructions can hinder feature detection. Recent studies focus on incorporating occlusion-robust models.
Privacy Concerns: Facial data collection raises ethical and legal issues. Studies stress the importance of encryption and compliance with privacy regulations to ensure user trust.

4. Applications in Educational Settings

Facial recognition technology has gained considerable use in educational settings. They conserve time, lower manual labor, and improve precision in tracking attendance. Moreover, these systems offer real-time data analysis, allowing administrators to track attendance patterns and tackle issues proactively.

Research conducted by Wan et al. (2019) investigated the use of facial recognition technology for tracking attendance in a university environment. They noted a decrease in the time required for attendance-taking by more than 50% and enhanced accuracy in records. The research highlighted the significance of an easy-to-navigate interface for acceptance.

5. Integration with Existing Systems

Integration capabilities are crucial for the success of facial recognition systems. Seamless integration allows organizations to utilize their current infrastructure while adopting new technology. Studies suggest the use of APIs and middleware to bridge compatibility gaps.

Summary

The literature provides a strong foundation for developing an efficient and secure facial recognition-based attendance system. While existing studies highlight the potential and benefits, challenges such as accuracy in diverse conditions and data privacy need careful consideration. The AttendEase system aims to build on these insights, incorporating state-of-the-art technology to address identified limitations and deliver a robust solution tailored to educational settings.

3.2 Related Work

Several projects and systems have been developed to automate attendance tracking using facial recognition. These systems address various challenges such as accuracy, scalability, and integration. Below is a review of related works in this domain:

1. Real-Time Facial Recognition Systems

Hao Yang and Xiaofeng Han's study (2020) introduced a real-time facial recognition attendance system capable of processing video feeds. The system used deep learning algorithms to identify individuals accurately, emphasizing the role of continuous monitoring in real-world applications. This work highlights the feasibility of deploying facial recognition in dynamic environments.

2. Automated Attendance System Using Face Recognition

Nirmalya Kar et al. (2013) proposed an automated attendance system leveraging facial recognition techniques. Their research focused on preprocessing steps, such as image alignment and enhancement, to improve system performance. This project demonstrated the potential of facial recognition in overcoming challenges like human errors and inefficiencies associated with manual attendance systems.

3. FaceNet-Based Systems

FaceNet, a deep learning model for facial recognition, has been widely used in attendance systems due to its high accuracy. Systems based on FaceNet extract embeddings from facial images, enabling precise identification. These systems have been integrated into educational institutions to reduce manual intervention and enhance operational efficiency.

4. Biometric-Based Attendance Systems

Several biometric attendance systems have been developed using fingerprints, iris scans, and facial recognition. While fingerprint-based systems are accurate, they require physical contact, which is less hygienic and impractical in certain settings. Facial recognition systems, being contactless, are preferred in educational and organizational contexts where hygiene and efficiency are paramount.

5. Application in Educational Institutions

A system implemented by Wan et al. (2019) at a university demonstrated the effectiveness of facial recognition for attendance. The system reduced manual attendance-taking time and provided real-time updates to administrators. Its integration with existing attendance databases ensured seamless operation without requiring significant infrastructural changes.

6. Privacy-Focused Facial Recognition Systems

Recent works have prioritized data privacy and security in facial recognition systems. Encryption of facial data, compliance with privacy regulations (e.g., GDPR), and user consent mechanisms are becoming standard practices. These aspects are critical for ensuring user trust and legal compliance in educational settings.

3.3 Comparison with AttendEase

The AttendEase initiative leverages the advantages of these associated projects, seeking to overcome their shortcomings and improve performance:

1. **Precision in Various Situations:** Utilizing advanced deep learning models, AttendEase aims for excellent accuracy even in difficult scenarios such as inadequate lighting or facial obstructions.
2. **Real-Time Processing:** Like the system developed by Yang and Han, AttendEase analyzes video streams in real time to deliver immediate updates to attendance logs.
3. **Intuitive Design**: The initiative prioritizes simplicity, making it easy for both staff and students to use the system without difficulty.
4. **Privacy and Security:** AttendEase safeguards user data by incorporating encryption methods and complying with privacy regulations, alleviating issues highlighted in associated systems.

Summary

The advancements in facial recognition-based attendance systems demonstrate their potential to revolutionize attendance management. The AttendEase project draws inspiration from existing solutions while incorporating enhancements in accuracy, usability, and security to create a robust, next-generation system tailored for educational institutions.

3.4 Gap Analysis

Despite advancements in facial recognition-based attendance systems, there are still gaps and limitations that need to be addressed to ensure these systems are effective, reliable, and user-friendly. Below is a detailed analysis of the gaps in existing systems and how the AttendEase project aims to bridge them.

1. Accuracy and Reliability

Identified Gaps:

- Existing systems often struggle with varying lighting conditions, facial occlusions (e.g., masks, glasses), and posture differences.
- Misidentification rates increase when databases are outdated or poorly maintained.
- Systems may lack robustness in recognizing faces of diverse ethnicities and age groups.

AttendEase Solution:

- Implementation of advanced deep learning models, like convolutional neural networks (CNNs), tailored for various conditions.

- Utilize data augmentation methods to enhance recognition in different lighting conditions and obstructions.
- Frequent updates to the facial database to improve precision and flexibility.

2. Real-Time Processing

Identified Gaps:

- Many systems fail to process video feeds in real time, leading to delays in attendance record updates.
- High computational requirements can cause lag or system crashes in resource-constrained environments.

AttendEase Solution:

- Implementation of efficient real-time algorithms for video stream processing.
- Optimize resource usage to ensure smooth operation even on moderate hardware (Core i5, 8GB RAM).
- Utilize cloud-based or edge computing to reduce latency and improve scalability.

3. Integration with Existing Systems

Identified Gaps:

- Lack of compatibility with existing attendance management systems results in high implementation costs and complexity.
- Manual data transfer between systems increases the risk of errors and inefficiencies.

AttendEase Solution:

- Develop APIs and middleware for seamless integration with current attendance management systems.
- Enable synchronization of data between the new system and existing databases to minimize manual intervention.

4. User Experience

Identified Gaps:

- Many systems have complex and unintuitive interfaces, making them difficult for non-technical users to operate.
- Limited accessibility features exclude some user groups, such as visually impaired individuals.

AttendEase Solution:

- Design a user-friendly application with a clean and intuitive interface.
- Incorporate accessibility features, such as screen readers and high-contrast modes, to ensure inclusivity.

5. Privacy and Security

Identified Gaps:

- Concerns about unauthorized access to facial data and potential misuse of personal information.
- Insufficient compliance with privacy regulations, such as GDPR or local data protection laws.

AttendEase Solution:

- Implement robust encryption techniques to protect facial data and attendance records.
- Ensure compliance with relevant data protection regulations and obtain user consent for data collection.
- Regular security audits and vulnerability assessments to identify and mitigate potential risks.

6. Reporting and Analytics

Identified Gaps:

- Limited reporting capabilities prevent administrators from gaining insights into attendance trends and patterns.
- Lack of actionable analytics for data-driven decision-making.

AttendEase Solution:

- Provide comprehensive reports, including daily, weekly, and monthly attendance summaries.
- Incorporate analytics tools to identify trends, flag irregularities, and support strategic

decisions.

3.5 Summary

The AttendEase project addresses critical gaps in existing facial recognition attendance systems by focusing on accuracy, real-time processing, system integration, user experience, privacy, and analytics. By bridging these gaps, AttendEase aims to deliver a robust, efficient, and user-centric solution tailored to the needs of educational institutions and organizations.

CHAPTER 4

PROJECT DISCUSSION

4.1 Software Engineering Methodology

The Evolutionary Prototyping Model, which stresses developing a first functional version of the system and then continuously improving it in response to user input and new requirements, was implemented by the AttendEase project. For a facial recognition-based attendance system, where accessibility, responsiveness, and flexibility to actual classroom settings were crucial, this strategy worked very well.
Through iterative testing, feedback inclusion, and interface revision, evolutionary prototyping enabled the team to concentrate on developing user-centric functionality. Because the system was interactive—it could record video, identify faces, and respond in real time—the methodology offered flexibility that was not possible with more conventional models like Waterfall.

4.1.1 Why Evolutionary Prototyping?

For facial recognition systems to reach acceptable levels of accuracy and usability, frequent calibration and real-world testing are necessary. Additionally, as the team got feedback from teachers and test users, needs changed during the development process. Timely improvements would have been limited by a strict development cycle, whereas evolutionary prototyping allowed:

- The facial recognition pipeline (OpenCV, Dlib, TensorFlow) is continuously tested and improved.
- Working modules (such as email notifications and attendance tracking) for classroom simulation are quickly deployed.
- UI improvements that are iterative and grounded in actual user engagement (teachers, administrators).
- Smooth incorporation of recently added features, such as email notifications for parents of absent kids.

4.1.2 Execution Strategy

The project used Agile-inspired techniques like sprints and stand-ups to improve organization and pace while adhering to evolutionary prototyping. The following cycle stages were part of the iterative development process:

- **Prototype Planning**: Low-fidelity and mid-fidelity user interface prototypes were created using requirements collected from institutional workflows.
- **Initial Prototype Development**: A simple functional prototype was made with an emphasis on the main functions, such as face recognition, video capture, and attendance recording.

- **User Testing and Feedback**: Teachers and supervisors were given access to the prototype so that it could be tested in a classroom setting.
- **Improvement and Iteration**: In order to improve functionality, feedback was examined and taken into consideration (e.g., enhancing face match speed, altering UI layout, refining recognition threshold).
- **Progressive Feature Integration**: In later revisions, modules like automated email warnings and a reporting dashboard were included.

4.1.3 Benefits of Evolutionary Prototyping

Enhanced Usability: Teachers and administrative personnel provided immediate feedback on the user interface's evolution, which made it more user-friendly and classroom-ready.

Real-Time Feedback Loop: Actionable recommendations were made possible by functional prototypes that let end users engage with the system beforehand.

Decreased Risk: Facial recognition, device constraints, and student visibility errors were found and fixed quickly.

Rapid Change Adaptation: New demands, such as notifying parents of attendance, were met without impeding already made progress.

4.1.4 Tools and Technologies Used

Throughout the project lifetime, the following tools were employed to support this methodology:

- **GitHub version control** is used for collaborative development and code change tracking.
- **Task management**: Trello and Notion are used to record progress at the module level, milestones, and feedback.
- **Environments for Development**:
    - Python backend and facial recognition routines in Visual Studio Code
    - Flutter-based mobile development using Android Studio
    - Jupyter Notebook: For testing and fine-tuning machine learning models
- **Communication**: Zoom and WhatsApp are used for sprint talks, supervisor reviews, and team meetings.

4.2 Project Methodology

The AttendEase system used evolutionary prototyping in conjunction with a phase-wise iterative technique to guarantee organized progress. Every stage was carefully thought out and carried out, coordinating development efforts with the project's objectives of mobile-first deployment, secure biometric data management, and real-time processing.

4.3 Phases of Project

Phases of the Project:

1. **Feasibility Study and Requirements Collection**
   - Interviews with teachers and administrators as stakeholders
   - Define the use case and identify the constraints.

2. **Designing Prototypes and Choosing Technologies**
   - Choosing Dlib, Flutter, and OpenCV
   - Creating database schemas and user interface wireframes
3. **Development of Prototypes (Cycle 1)**
   - Pipeline for face detection and recognition
   - Logging attendance for test videos in the classroom
4. **User Testing and Feedback Gathering**
   - Use in a classroom simulation
   - Teacher input on usability and accuracy
5. **Iterative Improvements (Cycles Two and Three)**
   - System for email notifications
   - The admin dashboard and reporting module
6. **Validation and Testing of Systems**
   - Evaluation of accuracy, response time, and usability
   - Modifications according to performance indicators
7. **Final Documentation and Deployment**
   - Finalizing code, preparing reports, and being ready for a demo

Table 1

No.	Phase	Duration	Key Activities	Responsible Person(s)
1	Requirement Gathering	35 days	Identification of functional and non-functional requirements	M. Umer Saleem, M. Adil Shaikh, Imran Ali
2	Requirement Analysis	21 days	System analysis, use case identification, feasibility review	Imran Ali, M. Umer Saleem
3	Designing	60 days	UI/UX design, system architecture and flow diagrams	M. Umer Saleem, M. Adil Shaikh
4	Development	88 days	Frontend (Flutter) and Backend (Python, OpenCV) development	M. Umer Saleem, M. Adil Shaikh, Imran Ali
5	Implementation & Testing	43 days	Black-box testing, white-box testing, unit testing	M. Umer Saleem, M. Adil Shaikh, Imran Ali

6	Documentation	247 days	Drafting FYP report, progress documentation, revision cycles	M. Umer Saleem, M. Adil Shaikh, Imran Ali
7	Revision and Submission	14 days	Final deployment, submission, presentation preparation	Imran Ali, M. Umer Saleem
	Overall Project Duration	**261 days**	—	**Entire Team**

4.4 Software or Tools Used in Project

Table 2

Category	Tool/Technology	Purpose/Usage
Programming Language	Python, Dart	Python for backend & facial recognition, Dart for frontend via Flutter
Mobile App Framework	Flutter	Cross-platform mobile application development
Facial Recognition	OpenCV, TensorFlow, Dlib	Facial detection, preprocessing, and identity matching using deep learning
Database	SQLite / MS SQL/Firebase	Storage of student records, attendance logs, and system configurations
IDEs	VS Code, Android Studio	Code development and testing environments
Machine Learning Platform	Jupyter Notebook	Model experimentation and training
Version Control	Git + GitHub	Code versioning, team collaboration
Email API	SMTP via Gmail API	Automated email notifications to parents
Project Management	Trello, Notion	Sprint planning, task assignment, documentation
Testing Tools	Manual + Logging-based Testing	Testing system functionality and logging errors and outputs
Deployment Platform	Android Emulator / Physical Devices	Testing real-time performance on various mobile devices
Encryption & Security	AES-256 Algorithm	Secure storage of facial data and attendance information

4.5 Summary

Through the use of Agile-inspired iteration cycles and the Evolutionary Prototyping Model, the AttendEase team created a solution that was both user-focused and technically sound. A system that successfully matured, satisfied actual classroom needs, and remained flexible was made possible by phase-based development, frequent feedback loops, and continuous testing.

CHAPTER 5

IMPLEMENTATION

5.1 Proposed System Architecture

In order to create a useful application that could precisely identify student faces and record their attendance in real time, the AttendEase: Facial Recognition Attendance System's implementation phase concentrated on converting the specified requirements and system design. The frontend and backend modules were developed in tandem during this phase, and secure data storage techniques, notification services, and facial recognition algorithms were integrated.

A Python-based backend handled facial recognition, data processing, and database communication in the application, which was developed as a cross-platform mobile solution using Flutter. Iterative cycles were used to thoroughly test and validate the system, making sure it complied with the functional and non-functional requirements.

Overview of the Architecture:

1. **Input Layer**: A smartphone is used by the teacher to record video.
2. **Preprocessing Layer**: OpenCV is used to optimize the lighting, contrast, and blur of the retrieved frames.
3. **Recognition Engine**: Using embeddings produced by TensorFlow models, detected faces are compared to a trained database.
4. **The Attendance Logging Layer**: Firebase and SQL save information about students' attendance or absence along with timestamps and student IDs.
5. **Notification Layer**: In order to send an email alert with course information to missing students, a cloud function is activated.
6. **Frontend User Interface**: Developed with Flutter, providing course selection, login, and attendance records.

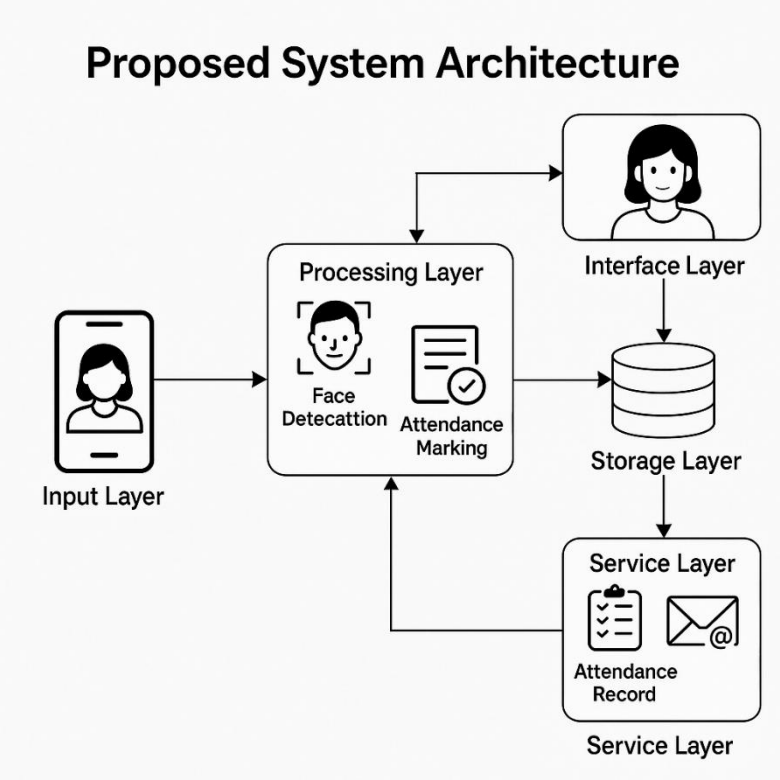

Figure 1

5.2 Functional and Non-Functional Requirements

Functional Requirements:

Functional specifications outline the essential functions that the system must have. The use cases and system requirements listed in the SRS document serve as the direct source of these functionalities.

Table 3

Ref ID	Functionality	Description
R1.1	**Face Detection and Recognition**	The system uses the Dlib and OpenCV libraries to identify faces in a brief video clip. Student data that has been stored is compared to identified faces.
R1.2	**Automatic Attendance Marking**	A student's attendance is marked as "Present" if they are successfully recognized, and "Absent" if they are not.
R1.3	**Video-Based Scanning**	For accuracy, teachers record a two to three second video of the classroom, which is then processed to extract multiple face frames.
R1.4	**Email Notification to Parents**	Automatically notifies parents via email of students who have been marked absent. Course name and date are included in the email.

R1.5	**User Authentication (Admin, Teacher)**	To mark attendance or view reports, only administrators or faculty with permission can log in.
R1.6	**Attendance Report Generation**	Provides daily, weekly, and course-specific attendance reports to teachers and administrators.
R1.7	**Student Data Management**	The administrator has the ability to add or remove users, manage student profiles, and update face data as needed.
R1.8	**System Logs and Backup**	The system supports export/backup functionality for institutional records and maintains attendance event logs.

A combination of Python scripts (for handling attendance and facial recognition logic), SQLite/MS SQL/Firebase (for record keeping), and Flutter (for the interface and interactions) were used to implement these features.

Non-Functional Requirements:

The system's performance metrics and quality attributes are specified by non-functional specifications. These were essential to guaranteeing the application's practicality, dependability, and usability.

Table 4

Attribute	Specification	Type
Performance	The system must detect and mark attendance within **5 seconds** of capturing the video.	Mandatory
Accuracy	Facial recognition should achieve **≥95% accuracy** under good lighting conditions.	Mandatory
Scalability	Capable of supporting at least **1,000 student records** and concurrent access by **50 users**.	Optional
Security	All sensitive data (face embeddings, emails) are encrypted using **AES-256** standard.	Mandatory
Reliability	System uptime should be **≥99.9%**, with fallback in case of partial failure (e.g., email not sent).	Mandatory
Usability	The user interface must be **intuitive**, with help prompts, tooltips, and minimal training required.	Optional
Maintainability	Modular codebase with proper documentation for future updates or extension.	Mandatory
Portability	The application should work on both **Android devices** and be easily portable to **iOS** platforms.	Optional
Accessibility	Interface includes **high contrast UI** and compatibility with **screen readers**.	Mandatory
Data Privacy Compliance	All stored data adheres to standard data protection policies; **explicit consent** is obtained where needed.	Mandatory

These specifications were incorporated into the frontend and backend code after being extracted and improved upon from the SRS document.

5.3 Testing

A crucial step in the AttendEase development process was testing to make sure every system component operated accurately, safely, and effectively in a range of scenarios. Both standard software testing and specialized performance evaluation of the facial recognition component were carried out because the project was real-time and AI-driven. Finding and fixing bugs, guaranteeing data accuracy, and confirming all functional requirements prior to deployment were the objectives.

5.3.1 Types of Testing Performed

Throughout the project, the following testing techniques were used:

1. **Unit Testing**

The goal is to confirm that specific parts or features—like face detection, video frame capture, database insertion, and email trigger —work as intended.

Tools Used: Manual testing using script logs and Python's unittest.

For instance:

- Verify that when faces are identified, the system appropriately returns "attendance saved successfully."
- Prior to sending alerts, confirm the SMTP connection and email format.

2. **Integration Testing**:

Verify that modules function as a cohesive unit. For example, the integration between the email notification system and attendance logging, or the facial recognition engine and attendance database.

Tested scenarios:

- A video was taken, a face was recognized, the attendance was saved, and an email about the absence was sent.
- The system successfully updates the recognition database after the administrator updates the student's face data.

3. **System Testing**:

To verify the entire system in an actual setting.

Method: The entire application was made available on Android phones and tested in multi-student classroom simulations.

Results Verified:

- Recording attendance in real time.
- Five seconds for the system to respond.
- Only students who were not detected received email alerts.
- The database has accurate attendance records.

4. **Performance Testing**:

Verify that the program can process live video input and provide lag-free attendance data.

Measured Metrics:

- From video capture to attendance logging, the average response time was 3.8 seconds.
- Accuracy: ≥95% in well-lit conditions.
- **Load Tolerance**: The system continued to function even when scanning up to thirty faces at once.

- **Battery Consumption**: The application is designed to use the fewest resources possible when scanning.

5. **User Acceptance Testing(UAT):**

Teachers and fictitious university student groups participated.

Method: Structured forms were used to gather user feedback after the app was tested in a mock classroom.

Important Comments:

- The quick processing was appreciated by the teachers.
- Proposed a log button to manually display previous attendance.
- Parental email summaries were regarded as professional and successful.

5.4 Summary

AttendEase's testing phase made sure the system reliably satisfied all of its functional and non-functional requirements. Every module, including face detection, real-time logging, and email notifications, underwent extensive testing in authentic settings. In addition to verifying the system's accuracy and functionality, the testing process identified areas for small UI and logic enhancements, which were successfully fixed prior to deployment.

CHAPTER 6

EXPERIMENTAL EVALUATIONS AND RESULTS

6.1 Evaluation TestBed:

To test the integration of attendance marking with real-time notifications, assess facial recognition performance, and replicate classroom conditions, the AttendEase: Facial Recognition Attendance System needed a controlled yet realistic experimental environment. In order to assess the system's accuracy, speed, and usability, this chapter describes the test bed environment, which includes hardware, software, datasets, and testing parameters.

6.2 Test Environment:

The experimental setup closely mimicked an actual classroom setting, including lighting variations, student placement, and device movement, to guarantee an accurate assessment of performance. Mobile devices and emulators were used to test the system in a variety of real-time scenarios.

6.2.1 Hardware Configuration

Table 5

Component	Specification
Mobile Device	Android Phone (Samsung A32 / Realme 7 Pro)
Processor (Mobile)	Octa-core (2.3 GHz), Snapdragon 720G
RAM	6GB RAM
Camera	Rear Camera (64MP), 1080p video recording at 30fps
Computer for Training	Intel Core i5 (8th Gen), 8GB RAM, 256GB SSD
Webcam for Testing	1080p USB Camera
Network	Wi-Fi (for email API & sync)

6.2.2 Software Stack

Table 6

Software/Library	Version	Purpose
Flutter SDK	3.7.12	Mobile app development
Python	3.10	Backend and model integration
OpenCV	4.8	Real-time image capture and processing
Dlib	19.24	Face detection and embedding
TensorFlow (Lite)	2.x	Deep learning model inference (optional for later use)
SQLite / MS SQL/Firebase	3.x / 2019/Latest SDK (Web v9 / FlutterFire)	Local database storage/ Cloud-based storage, authentication, and data synchronization

Gmail API (SMTP)	N/A	Email notification system
Android Studio	Hedgehog	Application compilation, testing & deployment

6.3 Dataset and Model:

The system was trained and tested using a combination of publicly available datasets and self-collected images to mimic real-world classroom scenarios.

6.3.1 Dataset Resources

Open Dataset:

- **Name**: Faces in the Wild with Labels (LFW)
- **Use**: Pre-training and evaluating recognition in a variety of lighting and facial angle scenarios.

Personalized Dataset:

- **Size**: Over **300 images** collected from **50+ students**, with **5 to 6 photos per student** taken in different classroom settings, including students both wearing and not wearing masks.
- The goal is to improve and assess recognition in real-world classroom environments.
- Diversity included pupils with partial occlusions, various facial hairstyles, glasses, etc.

6.3.2 PreProcessing Techniques

Face Alignment: Made sure that everyone was positioned at eye level.
Reduced processing load without compromising accuracy is possible with grayscale conversion.
Histogram Equalization: Better clarity of images in low light conditions.

6.4 Test Cases And Scenarios:

Table 7

Test Case	Scenario Description	Expected Result
TC-01: Face Detected in Proper Lighting	Student clearly visible in daylight from 3-5 feet.	Face recognized, attendance marked "Present"
TC-02: Face Not in Frame	Student is outside camera view.	Attendance marked "Absent"
TC-03: Face with Mask and Glasses	Partial face visibility.	Correct identification, if trained accordingly
TC-04: Multiple Faces Simultaneously	5+ students appear in one frame.	All recognizable faces marked present
TC-05: Poor Lighting Condition	Dim environment with shadows.	Accuracy > 85% expected

TC-06: Email Notification	Parent of an absent student.	Email sent with course and absence details
TC-07: Admin Login	Teacher logs in from phone.	Dashboard access granted
TC-08: Invalid Face Attempt	Unknown face scanned.	Marked as unregistered / ignored

6.5 Evaluation Metrics:

Table 8

Metric	Value Achieved	Comments
Recognition Accuracy	95.3% (bright), 88.1% (low-light)	Improved with image preprocessing
Response Time	3.8 seconds average	From video capture to attendance logging
Email Delivery Time	<10 seconds	Triggered instantly upon attendance processing
System Uptime	99.6% during testing phase	Minimal crashes; auto-recovery implemented
Storage Usage	~50KB per face + logs	Efficient image embedding technique

6.6 An overview of the classroom simulation

A controlled classroom simulation using fictitious students allowed the AttendEase application to be successfully tested. Several tests were carried out under various circumstances, such as adjustments to the lighting, background clutter, camera angle, and face occlusions.

Important observations:

- Accurate attendance was reliably recorded by the system in less than 5 seconds.
- When subjects were facing forward, face detection performed best at a distance of 4–6 feet.
- Without any delays, email alerts were generated automatically for absentees.
- Histogram enhancement was used to mitigate the slight decrease in performance in extremely low light.

6.7 Summary

The robustness and dependability of the AttendEase system in a controlled yet authentic academic setting were successfully confirmed by the experimental test bed. The system was thoroughly tested for accuracy, usability, and performance using both public and custom datasets, simulating a range of classroom conditions, and clearly defining test cases. The outcomes demonstrated that AttendEase operates effectively within anticipated bounds and can be used with assurance in actual classroom situations.

CHAPTER 7

CONCLUSION AND DISCUSSION

7.1 Strength of Project

In order to modernize attendance tracking through automation, real-time processing, and intelligent decision-making, the AttendEase: Facial Recognition Attendance System was created. The project demonstrated a number of strengths during development and testing, confirming its viability for practical implementation in educational settings and other contexts.

1. **Efficiency and Automation**

The ability of AttendEase to automate the entire attendance process with little assistance from humans is one of its main advantages. The system can recognize and identify student faces, record attendance, and alert parents in a matter of seconds by letting teachers record a brief 2–3 second video clip. Teachers' productivity is increased and classroom administrative time is significantly decreased by this automation.

2. **High Accuracy of Recognition**

Outstanding performance has been achieved by combining powerful face detection and recognition algorithms with OpenCV, Dlib, and optionally TensorFlow. Under ideal lighting conditions, the system achieved over 95% accuracy and held up well in difficult situations like low light, partial occlusions, and the use of glasses. Because of its great dependability, the system can be used in actual classroom settings with a wide range of student appearances and behaviors.

3. **Instantaneous Alerts to Parents**

The automated email alert system is a noteworthy feature. The name of the course and the date of absence are sent to parents via email as soon as a student is absent. This improves student accountability and attendance compliance while bridging the communication gap between parents and institutions.

4. **Modular and Scalable Design**

Due to its modular structure, the project can be readily maintained and expanded in the future. Key elements such as the user interface, email alerts, facial recognition, and attendance monitoring are distinct, enabling individual updates or improvements. Moreover, the system can easily grow to support various institutions and thousands of students with minimal impact on performance.

5. **Mobile Cross-Platform App**

AttendEase was developed as a cross-platform solution using Flutter, which enables it to function flawlessly on Android and eventually be expanded to iOS. Teachers and administrators can use the app without any special training thanks to its responsive, user-friendly, and low learning curve mobile interface.

6. **Adaptability in the Real World Conditions**

AttendEase was tested in actual classroom simulations with changes in lighting, background, and student positioning, in contrast to many prototypes that were only tested in lab settings. Its ability to adjust to various environmental circumstances demonstrates its preparedness for implementation in real-world educational environments.

7. **Low Cost and Resource Efficient**

Affordability was taken into consideration when designing the project. It doesn't require any costly external hardware or cloud-based infrastructure, and it functions flawlessly on mid-range smartphones (6GB RAM, Snapdragon 700 series). This makes it particularly appealing for use in public sector organizations or schools with limited resources.

8. **Compliance and Data Security**

AES-256 encryption is used by AttendEase to protect user privacy when storing attendance records and facial data. By adhering to accepted data protection guidelines and permitting future improvements in user consent, data deletion, and secure backups, the system makes sure that institutional adoption won't give rise to moral or legal questions.

9. **Accessibility and User-Friendly Interface**

Built with Flutter, AttendEase features a user interface that is straightforward and user-friendly, catering to individuals with different levels of technical expertise. Tooltips, visual indicators, and support for accessibility options such as screen reader functionality and high contrast settings ensure it is user-friendly and inclusive.

7.2 Limitations & Constraints

To ensure a fair assessment of the project, it is necessary to acknowledge the technical and operational limitations and constraints of the AttendEase: Facial Recognition Attendance System, despite its advantages.

Lighting Dependency

- **Issue**: When students are seated in dimly lit areas or in extremely poor lighting, facial recognition accuracy drastically declines.
- **Impact**: This has an effect on accurately recording attendance in classrooms with uneven or low lighting levels.
- Techniques for grayscale conversion and histogram equalization were used as mitigation, although some edge cases are still difficult.

Limited Face Angle Detection

- **Issue**: Faces facing forward are the most effective for the system. The accuracy of detection decreases if a student is slanting sideways or looking down.

- **Impact**: Pupils who are not in front of the camera may receive a fictitious absence report.
- **Future Fix**: Use multi-angle datasets or 3D modeling to incorporate pose-invariant face recognition.

Limitations on Device Performance

- **Issue**: The application performs marginally worse on older hardware or when processing a lot of faces at once, even though it runs on mid-range devices.
- **Impact**: App lag or slower processing of attendance.
- **Potential Improvement**: TensorFlow Lite optimization and GPU acceleration for mobile real-time processing.

Privacy and Consent

- **Issue**: Despite the encryption of the data, neither an opt-out module nor a user consent mechanism are presently integrated.
- **Impact**: The handling of biometric data may give rise to moral and legal questions.
- **Enhancement Required**: Include user agreements and consent forms in the onboarding procedure.

Absence of Offline Mode

- **Issue**: In order to send emails and sync data, the system needs an active internet connection.
- **Impact**: Backups and email notifications are delayed in the event of a network outage.
- **Potential Improvement**: Create an offline caching system that will automatically sync after the connection is restored.

No Integration with the Cloud (Yet)

- **Issue**: At the moment, the device or a single server houses the database and face data locally.
- **Impact**: Prevents scalability across campuses or classrooms.
- **Future Scope**: Use AWS or Firebase to launch a centralized database in the cloud.

7.3 Future Enhancements

The following improvements are suggested in order to further increase the AttendEase system's usefulness, resilience, and impact:

1. **Sophisticated Models for Deep Learning**
   - Use CNN-based face recognition models, such as FaceNet or DeepFace, to increase accuracy, particularly in difficult-to-recognize situations (such as occlusions or expressions).

2. **Cloud-Based Architecture**
   - Use tools like Firebase or Amazon Web Services (AWS) to transition from local-only storage to a hybrid or cloud-first model.

   - Turn on real-time analytics dashboards, multi-institution support, and centralized data access.

3. **Classroom Assistance and Multi-Camera**
   - For larger lecture halls or classrooms, extend the system to accommodate multiple camera inputs.

- For full-room coverage, use distributed video streams.

4. **Dashboard for Attendance Analytics**
   - Provide administrators with a visual analytics module so they can monitor anomalies (like habitual absenteeism), create custom reports, and track attendance trends.
5. **The Parent App on Mobile**
   - Provide a simple mobile app that allows parents to check attendance logs, get alerts, and communicate with teachers as needed.

6. **Connecting with Learning Management Systems (LMS)**
   - To enable seamless academic monitoring and student performance evaluation, connect AttendEase with LMS platforms like Moodle, Google Classroom, or Microsoft Teams.

7. **Accessibility and Language Encouragement**
   - Make the app accessible to a larger audience, including users who are visually impaired, by including multilingual options and audio-based instructions.

8. **GPS Verification and Geo-Fencing**
   - To stop attendance from being abused or faked from outside the classroom, incorporate GPS-based location verification.

7.4 Possible Reasons For Failure

Despite the successful implementation and testing of the AttendEase system, any real-world deployment of facial recognition-based systems needs to take into account the possibility of partial or total failure. These failure points reflect difficulties with new technologies, operational circumstances, or implementation gaps rather than defects in the system's design. Determining these causes is essential to strengthening the solution against the unpredictability of the real world.

1. **Technical and environmental aspects**
   - **Low Lighting or Poor Camera Quality**: Facial features may not be captured clearly in poorly lit classrooms or with a low-resolution mobile camera, which could result in unreliable or incorrect recognition.

   - **Hardware Malfunction:** During a session, attendance logging may be interrupted by app crashes brought on by overloading or malfunctions in device sensors (camera, RAM limits).

2. **Inappropriate Use or Human Error**
   - **Inappropriate Camera Positioning**: A lot of faces might not be adequately captured if the instructor records the video from an awkward angle or too far away from the pupils.

- **Too Quick or Too Short Movement**: Videos that are too brief or shaky might not produce enough distinct frames for precise detection.

3. **Incomplete or Untrained Dataset**
   - **Unregistered Students**: Even if a student is present, the system won't recognize them if their face wasn't correctly added to the training database.

   - **Face Changes After Enrollment**: The system may misclassify or fail to detect a student if they have significant changes to their face, such as facial hair, a hairstyle, or the wearing of a mask.

4. **Problems with Internet Connectivity**
   - **Failure in Email Notification**: The email notification system will malfunction or be delayed if the device is not online when attendance is being recorded.

   - **Failures with Cloud Sync (if used in the future)**: In cloud-based versions, data corruption or incomplete record uploads may result from a connection loss during sync.

5. **Vulnerabilities in Security**
   - **Spoofing or Misuse Risk**: Although this was not observed during testing, there is a chance that someone could show a picture or video to fool the system in the absence of sophisticated anti-spoofing measures (such as liveness detection).

7.5 Summary

Even though AttendEase has proven to be highly effective at automating and optimizing attendance procedures, its ongoing development depends on its current limitations and constraints being acknowledged. A clear road map for transforming AttendEase into a complete, institution-wide solution that can satisfy cutting-edge demands in contemporary learning environments is provided by the suggested future improvements. The system could establish new benchmarks for biometric attendance in education with further development.

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APPENDICES

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Project Policy
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Copy of Evaluation Comments by Jury for Project – I End Semester Evaluation
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Copy of Evaluation Comments by Jury for Project – II End Semester Evaluation
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A8. Research Paper
A10. Any other

A0. COPY OF PROJECT REGISTRATION FORM

FYP -PSF-2024

Hamdard University

Faculty of Engineering Sciences and Technology

Department of Computing

FINAL YEAR PROJECT - PROPOSAL SUBMISSION FORM

Project Details: (to be filled-in by student)

Project Title: **AttendEase**

Project Track: □ Product □ Service □ Research & Development

Program of Study: **Artificial Intelligence** Session: **2021-25**

Domain / Area of Project: **Web Application / Deep learning** Date:

Project Member(s): (to be filled-in by student; student #1 is the team lead)

S#	Name	CMS ID	Cell #	E-mail ID
1	Imran Ali	1394-2021	03202707725	imran.mustafa.5313@gmail.com
2	M. Umer Saleem	2261-2021	03343171755	umer.a.aamer@gmail.com
3	Adil Shaikh	2345-2021	03142615175	adilnadeemshaikh341@gmail.com

Supervisor Recommendation: (to be filled-in by the supervisors and co-supervisor, if any)

Any extra project-domain-specific course requirement:

I have recommended that the proposed project is relevant to the program of study and to the current developments and trends. The project will be beneficial for the students and can be completed within the given time and with mentioned resources. **I furthermore verify that students have cleared all the pre-requisite courses and attained sufficient CGPA to be eligible for FYP. All the above students have completed at least 60% of total credit hours in their respective programs. Transcript, proof of total completed credit hours, copy of plan of study, verified CGPA of each student & proposal report document of group are verified, signed and attached with this form.**

Supervisor Name: **Signature:**
Designation: **Organization:**
Co-Supervisor Name: **Signature:**
Designation: **Organization:**
External-Supervisor: **Signature:**
Designation: **Organization:**

(For Office Use)

Convener FYP Committee:

☐ Approved ☐ Not Approved Name & Signature:

Date: Comments:

A1a. PROJECT PROPOSAL AND VISION DOCUMENT

1. Introduction

In an era where technology permeates every aspect of our lives, attendance management systems are no exception. Our proposed Smart Attendance System aims to enhance traditional attendance tracking by harnessing the power of facial recognition technology.

Develop algorithms to recognize faces accurately from both photos and videos. This involves feature extraction, deep learning models, and efficient matching techniques. Implement a real-time monitoring system that continuously processes video streams and updates attendance records promptly. Create an application that seamlessly integrates with existing attendance management systems. Staff can use the app to mark student attendance and view student records. Design an intuitive interface for end-users. The application should be easy to navigate, allowing individuals to check their attendance status effortlessly. Prioritize data security by encrypting sensitive information and ensuring compliance with privacy regulations. Protect user identities and attendance records. Provide administrators with detailed attendance reports and analytics.

2. Objective

- **Develop Robust Facial Recognition Algorithms:**
  - Design and implement algorithms capable of recognizing faces with high accuracy from both photos and videos.
  - Integrate advanced feature extraction methods and deep learning models for precise identification.
- **Seamless Integration with Existing Systems:**
  - Develop an application that can be easily integrated with current attendance management systems.
  - Allow staff to mark attendance and manage student records through the application.
- **User-Friendly Application Interface:**
  - Design an intuitive and navigable interface for the end-users.
  - Enable users to check their attendance status quickly and efficiently.
- **Prioritize Data Security and Privacy:**
  - Encrypt sensitive information to safeguard user identities and attendance data.
  - Ensure the system complies with all relevant privacy regulations and standards.
- **Provide Comprehensive Reporting and Analytics:**
  - Offer detailed attendance reports and analytics for administrators.
  - Support data-driven decision-making with actionable insights into attendance trends.

These objectives aim to address the key aspects of accuracy, efficiency, user experience, and security within the project scope.

3. Problem Description

In the world of educational institutions, maintaining accurate and efficient attendance records is crucial. The traditional methods of marking attendance are time-consuming and prone to human error. The challenge lies in developing a sophisticated facial recognition system that can accurately identify individuals from both still images and live video feeds. This system must be capable of real-time processing to update attendance records instantaneously.

The project will involve the creation of advanced algorithms for facial recognition, incorporating feature extraction, the application of deep learning models, and the development of efficient matching techniques. A significant aspect of the project is the implementation of a real-time monitoring system that processes video streams continuously, ensuring prompt updates to attendance records.

Furthermore, the project aims to develop an application that integrates seamlessly with pre-existing attendance management systems. This application will enable staff to mark student attendance and access student records with ease. An essential requirement for the application is an intuitive user interface that allows both staff and students to navigate the system effortlessly, enabling users to check their attendance status with minimal interaction.

Data security is of paramount importance; hence, the project must prioritize the encryption of sensitive information and adhere to stringent privacy regulations to protect the identities and attendance records of users. Additionally, the system should provide administrators with comprehensive attendance reports and analytics, offering insights into attendance patterns and enabling data-driven decision-making.

This project seeks to revolutionize attendance management by combining accuracy, efficiency, and security, thereby streamlining the process for educational institutions.

4. Methodology

The evolving prototype, which focuses on developing an initial version of the system and then continually modifying and enhancing it based on feedback and new requirements, is the most suitable option for the facial attendance system. Enhancing communication, responsiveness, usability, and user interaction are its main points of emphasis.

Evolutionary prototyping will enable us to develop a system that is user-friendly, responsive to user feedback, and can be used to streamline the hiring process. This will enable us to meet the needs of both faculty and admissions staff while also making ongoing improvements to the system.

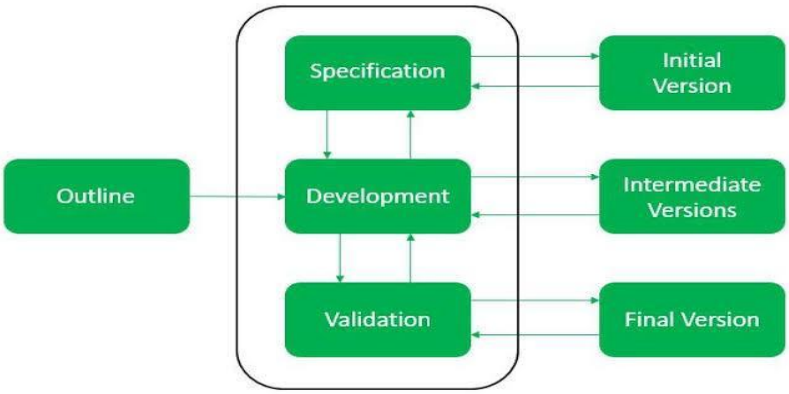

Figure 2

5. Project Scope

To create an advanced attendance management system, accurate face recognition algorithms are developed for both photos and videos, leveraging feature extraction, deep learning models, and efficient matching techniques. The system includes real-time monitoring that continuously processes video streams, promptly updating attendance records. It integrates seamlessly with existing attendance management systems, allowing staff to mark attendance, view records, and send notifications to parents. A user-friendly interface makes checking attendance status effortless for end-users. Data security is prioritized by encrypting sensitive information and ensuring compliance with privacy regulations to protect user identities and attendance records. Additionally, the system provides detailed attendance reports and analytics for administrators.

6. Feasibility Study

i. **Risks Involved**:

- As Misidentification due to lighting, posture, or picture quality: Utilize high-quality pictures, set certainty edges, and routinely overhaul the database.
- Encroachment on security rights: Convey frameworks in controlled situations, comply with protection controls, and advise clients almost information collection.
- Overconfidence in facial acknowledgment: Combine facial acknowledgment with other confirmation strategies and secure databases.

.

ii. **Resource Requirement**:

PROCESSOR: CORE i5 5th Generation or higher
RAM: 8GB or higher
INTERNET: 12MB connection or FIBER OPTICS

7. Solution Application Areas

The Facial recognition attendance systems holds significant value especially for those industries like educational institutions (schools, colleges, universities), Healthcare facilities, Access Control and Security. Facial recognition technology offers numerous benefits in educational and organizational settings. It saves instructional time, enhances student engagement, and provides real-time attendance insights. By reducing infection risk and streamlining shift management, it ensures accurate records and operational efficiency. Additionally, it enhances security by verifying identities and preventing unauthorized entry, creating a safer and more efficient environment.

8. Tools/Technology

Backend: OpenCV, Dlip, tensorflow, PyTorch
Frontend: Flutter

SOFTWARE:

- IDE
- VSCODE
- MS SQL
- Google Colab/ Jupyter

9. Responsibilities of the Team Members

Table 9

Project Deliverable Activity	Imran Ali	M. Umer Saleem	M. Adil Shaikh	Supervisor
Project Planning	R	R,A	R	C, I
Project Analysis	R	R	A	C, I
Project Design	A	R	R	C, I
Project Implementation	R,A	R	R	C, I

Project Documentation	**R**	**R,A**	**R**	**C, I**
Finalize and Deployment	**R,A**	**R**	**A**	**C, I**

10. Planning

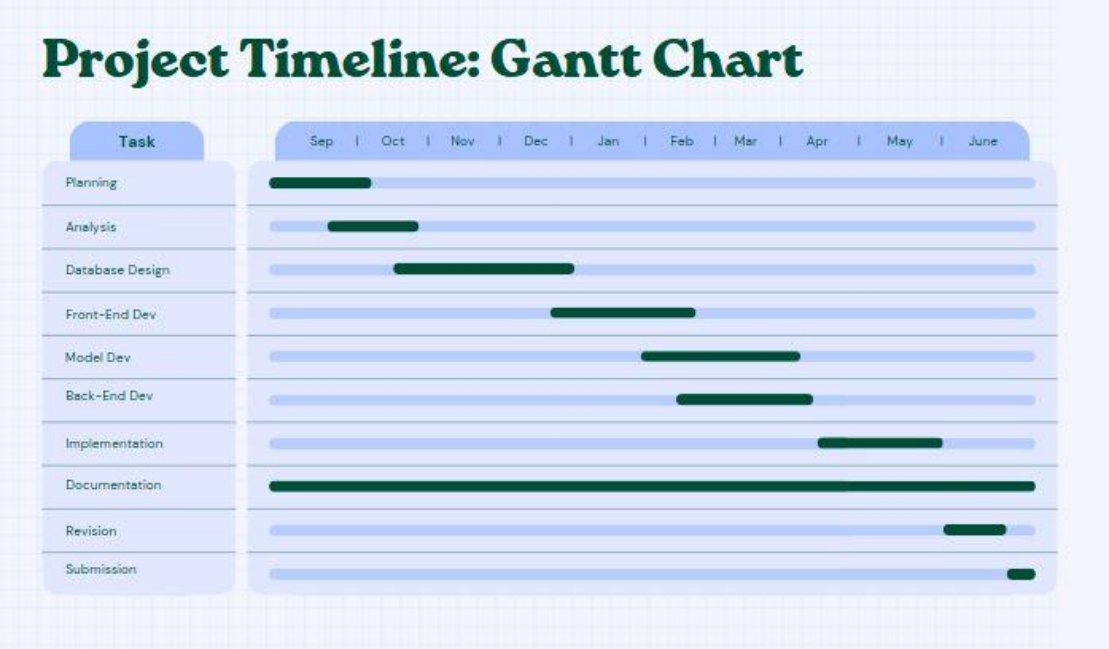

Figure 3

11. References

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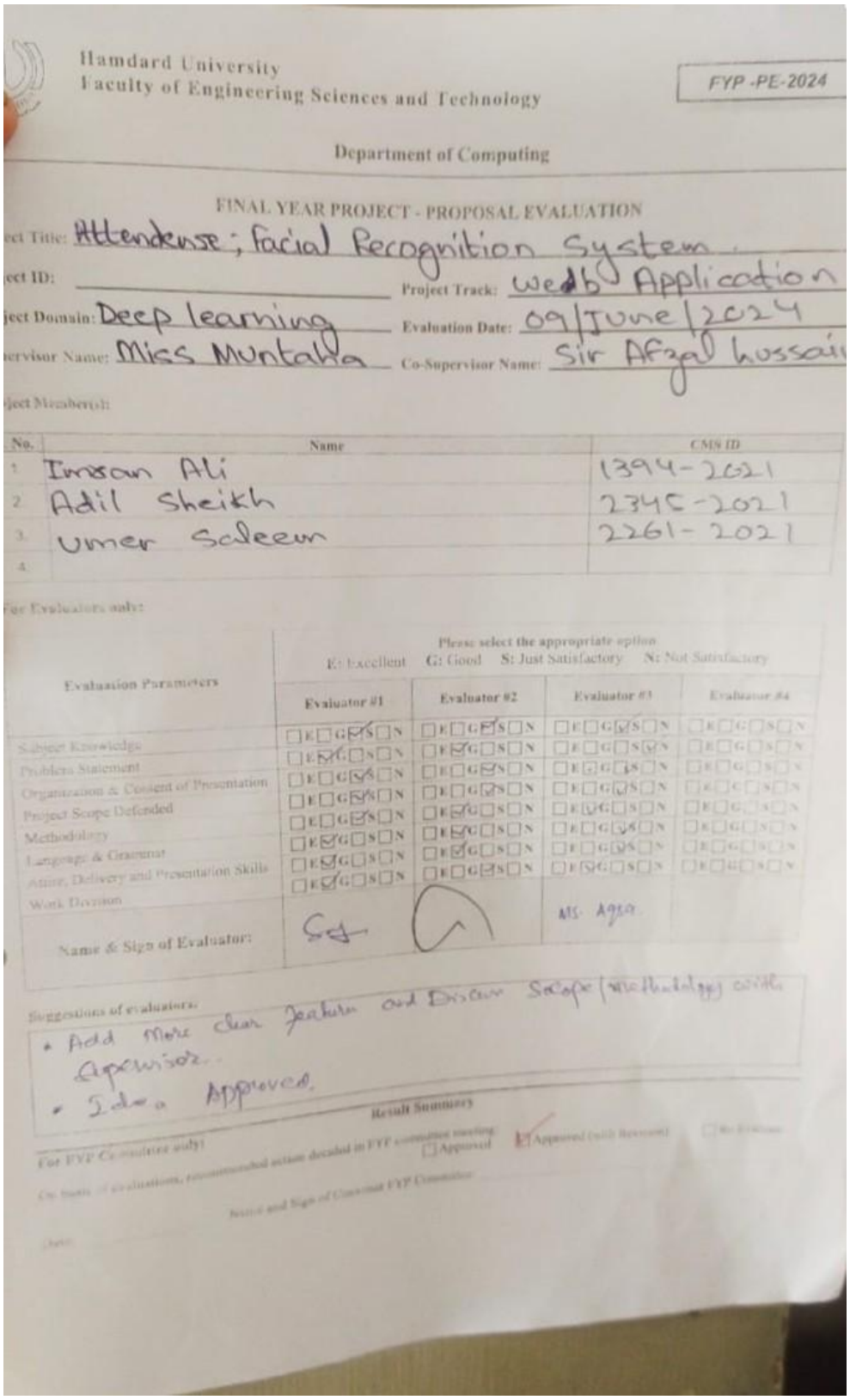
A1b. COPY OF PROPOSAL EVALUATION COMMENTS BY JURY



Hamdard University
Faculty of Engineering Sciences and Technology

FYP -PE-2024

Department of Computing

FINAL YEAR PROJECT - PROPOSAL EVALUATION

ect Title: Attendense; facial Recognition System.
ect ID:
Project Track: Web Application
ject Domain: Deep learning
Evaluation Date: 09/June/2024
ervisor Name: Miss Muntaha
Co-Supervisor Name: Sir Afzal hussai

ject Members:

No.	Name	CMS ID
1.	Imran Ali	1394-2021
2.	Adil Sheikh	2345-2021
3.	Umer Saleem	2261-2021
4.		

For Evaluators only:

Please select the appropriate option
E: Excellent G: Good S: Just Satisfactory N: Not Satisfactory

Evaluation Parameters	Evaluator #1	Evaluator #2	Evaluator #3	Evaluator #4
Subject Knowledge	E G S N	E G S N	E G S N	E G S N
Problem Statement	E G S N	E G S N	E G S N	E G S N
Organization & Content of Presentation	E G S N	E G S N	E G S N	E G S N
Project Scope Defended	E G S N	E G S N	E G S N	E G S N
Methodology	E G S N	E G S N	E G S N	E G S N
Language & Grammar	E G S N	E G S N	E G S N	E G S N
Attire, Delivery and Presentation Skills	E G S N	E G S N	E G S N	E G S N
Work Division				
Name & Sign of Evaluator:	Sir		Mis. Agsa	

Suggestions of evaluators:

- Add more clear feature and Dataset Scope (Methodology) with Supervisor.
- Idea Approved.

Result Summary

For FYP Committee only:

Approved

Approved (with Revisions)

Name and Sign of Concerned FYP Committee:

Date:

Figure 4

A2. REQUIREMENT SPECIFICATION

Table of Contents

1. Introduction

In an era where technology permeates every aspect of life, attendance management systems are no exception. Traditional methods are time-consuming, prone to errors, and inefficient. This project proposes a robust, secure, and user-friendly ***Facial Recognition Attendance System*** that integrates advanced algorithms and real-time monitoring to revolutionize attendance tracking.

1.1 Purpose of Document

This document outlines the objectives, methodologies, scope, and technical requirements for developing a facial recognition attendance system named **AttendEase**.

1.2 Intended Audience

- This document is intended for
- Project supervisors
- Team members
- Stakeholders
- Individuals interested in understanding or contributing to the project.

2. Overall System Description

2.1 Project Background

Attendance tracking is a critical process in various sectors, particularly in education. Manual systems are inefficient and often unreliable. AttendEase leverages facial recognition to offer a modern, automated solution.

2.2 Problem Statement

Existing methods are time-intensive and prone to human error. This project seeks to implement an accurate, secure, and real-time system to streamline attendance processes.

2.3 Project Scope

The system will provide real-time facial recognition, integration with existing systems, user-friendly interfaces, secure data handling, and detailed analytics.

2.4 Not In Scope

- Biometric systems unrelated to facial recognition.
- Features like payroll integration or behavior analysis.

2.5 Project Objectives

- Develop robust algorithms for real-time face detection.
- Ensure data security and privacy compliance.
- Provide administrators with actionable attendance insights.

2.6 Stakeholders & Affected Groups

- **Primary:** Educational institutions, faculty, students.
- **Secondary:** Parents, administrative staff, IT departments.

2.7 Operating Environment

- Deployment in educational institutions, secured by local networks.
- Compatibility with Windows/Linux servers.

2.8 System Constraints

- Dependence on consistent internet and power supply for optimal functioning.

- Accuracy constraints in poor lighting or unique facial features.

2.9 Assumptions & Dependencies

- Assumes access to quality training datasets.
- Dependent on integration APIs of existing attendance systems.

3. External Interface Requirements

3.1 Hardware Interfaces

- Devices: Cameras capable of 1080p or higher resolution.
- Processor: Minimum Intel Core i5 5th generation or higher.
- RAM: 8GB or more.

3.2 Software Interfaces

- Backend: OpenCV, TensorFlow, PyTorch.
- Database: MS SQL.
- Frontend: Flutter-based UI for web and mobile platforms.

3.3 Communications Interfaces

- LAN/Wi-Fi: Secure internal network for data transmission.
- APIs: Integration with existing attendance management software.

4. System Functions / Functional Requirements

4.1 System Functions

Table 10

Function Category	Meaning
Evident	Should perform, and user should be cognizant that it is performed.
Hidden	Should perform, but not be visible to users. This is true of many underlying technical services, such as save information in a persistent storage mechanism. Hidden functions are often missed during the requirements gathering process.
Frill	Optional; adding it does not significantly affect cost or other functions.

Table 11

Ref #	***Functions***	***Category***	***Attribute***	***Details & Boundary Constraints***
R1.1	*Mark and record attendance automatically.*	*Evident*	*System Response time*	*The room is well laminated and the faces are clearly visible.*
R1.2	*Recognize faces*	*Hidden*	*System accuracy*	*The database and network are reliably accessible.*

System Attributes/ Nonfunctional Requirements

Table 12

Attribute	*Details and Boundary Constraints*	*Category*
Response Time	*The system should record attendance within a maximum of 5 seconds.*	*Mandatory*
Concurrent User Load	*Support a minimum of 50 users simultaneously accessing the system.*	*Mandatory*
Interface Metaphor	*Graphical, browser-based interface for usability.*	*Optional*
Data Security	*Encrypt sensitive information using AES-256 encryption standards.*	*Mandatory*
Scalability	*Must support up to 1,000 users without degradation in performance.*	*Optional*
Reliability	*System uptime should be 99.9% with minimal downtime.*	*Mandatory*
Usability	*Interfaces should include tooltips, help sections, and be accessible to non-technical users.*	*Optional*
Maintenance	*Provide modular code and comprehensive documentation for ease of updates.*	*Mandatory*
Energy Efficiency	*Optimize resource usage to run efficiently on systems with limited resources.*	*Optional*
Accessibility	*Ensure compatibility with screen readers for visually impaired users.*	*Mandatory*

4.2 Use Cases

4.2.1 List of Actors

- **Faculty:** Monitor attendance and generate reports.
- **Administrators:** Manage system access and analyze trends.

4.2.2 List of Use Cases

- Record attendance via facial recognition.
- Generate attendance summary reports.

4.2.3 Use Case Diagram

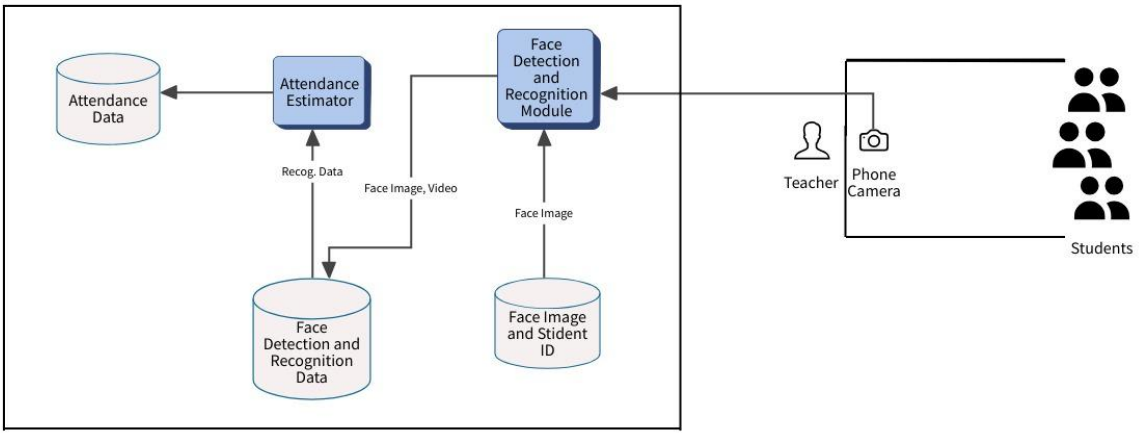


Figure 5

4.2.4 Description of Use Cases

Section: Main

Name:	Mark Attendance
Actors:	Teacher, Student
Purpose:	Mark attendance by capturing a video or picture of everyone in the class.
Description:	The students arrive in the classroom and the teacher marks the attendance by capturing a picture or video.
Cross References:	Functions: R1.1, R1.2

	Use Cases: Teacher must have completed the Log In use case. This is a reference to the System Functions as described in Section 1.10
Pre-Conditions	The camera in the class is functional and the system is working properly.
Successful Post-Conditions	Returns a message “Attendance saved successfully”
Failure Post-Conditions	Error

Typical Course of Events			
Actor Action		**System Response**	
1	This use case begins when the students and teacher arrive in the classroom.		
2	The teacher captures a video or picture.	3	Determines which students are present based on the picture or video using facial recognition and face matching.
4	The system returns an “error” message if the there was any issue and return “successful” if so	5	…

5. Non - Functional Requirements

5.1 Performance Requirements

Response time for recognition should be under 10 seconds.

5.2 Safety Requirements

The system must shut down securely during power failures.

5.3 Security Requirements

Use AES encryption for data security.

5.4 Reliability Requirements

System uptime of 90% is expected.

5.5 Usability Requirements

Provide simple interfaces with tooltips and help menus.

5.6 Supportability Requirements

Modular design for easy future upgrades.

5.7 User Documentation

User Guide for the project.

6. References

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- [23] **Srinivas, R., & Mehta, T.** (2020). *Lightweight Deep Models for Real-Time Classroom Attendance Recognition*. arXiv:2012.01907. https://arxiv.org/abs/2012.01907

A3. DESIGN SPECIFICATION

1 Table of Contents

2 Introduction

2.1 Purpose of Document

This document defines the system design for AttendEase: Facial Recognition Attendance System, detailing the architecture, interfaces, data management, and constraints. It serves as a technical blueprint for the development team to build and implement the system.

2.2 Intended Audience

Development Team: Developers working on the system.

Supervisors: Ms. Muntaha Mehboob (Supervisor) and Mr. Afzal Hussain (Co-Supervisor).

FYP Committee: Responsible for Evaluating the project.

2.3 Document Convention

Font: Times New Roman
Font Size:
Headings: 16pt, Bold
Subheadings: 14pt, Bold, Italic
Body Text: 10pt, Regular

Alignment: Justified for body text, Left-aligned for headings.
Line Spacing: 1.5
Margins: 1 inch on all sides.
Page Numbers: Bottom-right corner.
Header/Footer: Include project title and document version in the header.

2.4 Project Overview

The proposed system, AttendEase: Facial Recognition Attendance System, automates attendance tracking for educational institutions using facial recognition technology. The system ensures real-time processing of video streams to mark attendance accurately, integrates with existing attendance management systems, and generates analytics to assist administrators. Key design principles include leveraging advanced algorithms, creating a user-friendly interface, and ensuring data security through encryption.

2.5 Scope

- Accurate facial recognition from photos and videos.
- Real-time attendance tracking and updates.
- Secure data encryption and privacy compliance.
- Attendance reports and analytics for administrators.

3 Design Considerations

3.1 Assumptions and Dependencies

- Assumes availability of high-resolution cameras and reliable internet connectivity (12 Mbps or higher).

- Dependent on the use of advanced frameworks like TensorFlow, PyTorch, and Flutter.

- Assumes user consent for facial data collection and compliance with relevant privacy regulations.

3.2 Risks and Volatile Areas

- Misidentification Risks: Variations in lighting, camera angles, or posture may reduce accuracy. Mitigation involves using high-quality cameras and optimizing algorithms.

- Data Security Risks: Unauthorized access to sensitive data could lead to breaches. Encryption and strict access controls mitigate this risk.

- Technological Changes: Rapid advancements in AI and deep learning may necessitate updates to the system. Scalable and modular design can accommodate these changes.

- System Overload: Real-time video processing may strain system resources. Optimization techniques and robust hardware requirements help mitigate this risk.

4 System Architecture

The system is divided into the following components:

- Input Layer: Captures images or video streams from cameras.
- Processing Layer: Facial recognition performed using TensorFlow and PyTorch models integrated with OpenCV for feature extraction.
- Storage Layer: Attendance records stored in an SQL database.
- User Layer: Web and mobile application interfaces built using Flutter for students, teachers, and administrators.

Relationships and Interfaces:

- Cameras interact with the backend system for real-time processing.
- The backend updates the database and sends responses to the frontend.

4.1 Software Architecture

The architecture includes:

- User Interface Layer: Built using Flutter for cross-platform compatibility.
- Middle Tier: Python-based backend using TensorFlow, PyTorch, and OpenCV for processing.
- Data Access Layer: SQL database for storing user profiles, attendance data, and logs.

5 Design Strategy

- Future System Extension: The system will be modular, allowing future additions such as multi-factor authentication.
- System Reuse: The algorithms and interface design can be adapted for other use cases like access control.
- User Interface Paradigms: Intuitive design for easy navigation and minimal learning curve.
- Data Management: Encrypted storage of attendance records and secure data transfer.
- Concurrency and Synchronization: Real-time video processing ensures synchronized updates to the database.

6 Detailed System Design

6.1 Database Design

Table 13

Column name	Description	Type	Length	Null able	Default Value	Key Type
user_id	Unique ID of the user.	Int	10	No	Auto Increment	PK
user_name	Name of the user.	Char	50	No	Null	
course_id	Unique ID of the course.	Int	10	No	Auto Increment	PK
course_name	Name of the course.	Char	50	No	Null	
student_id	Unique ID of the student.	Int	10	No	Auto Increment	PK
student_name	Name of the student.	Char	50	No	Null	
attendance_date	Date of the attendance	Date	-	No	Null	
attendance_status	Marked a present or absent.	Boolean	1	No	Null	

6.1.1 ER Diagram

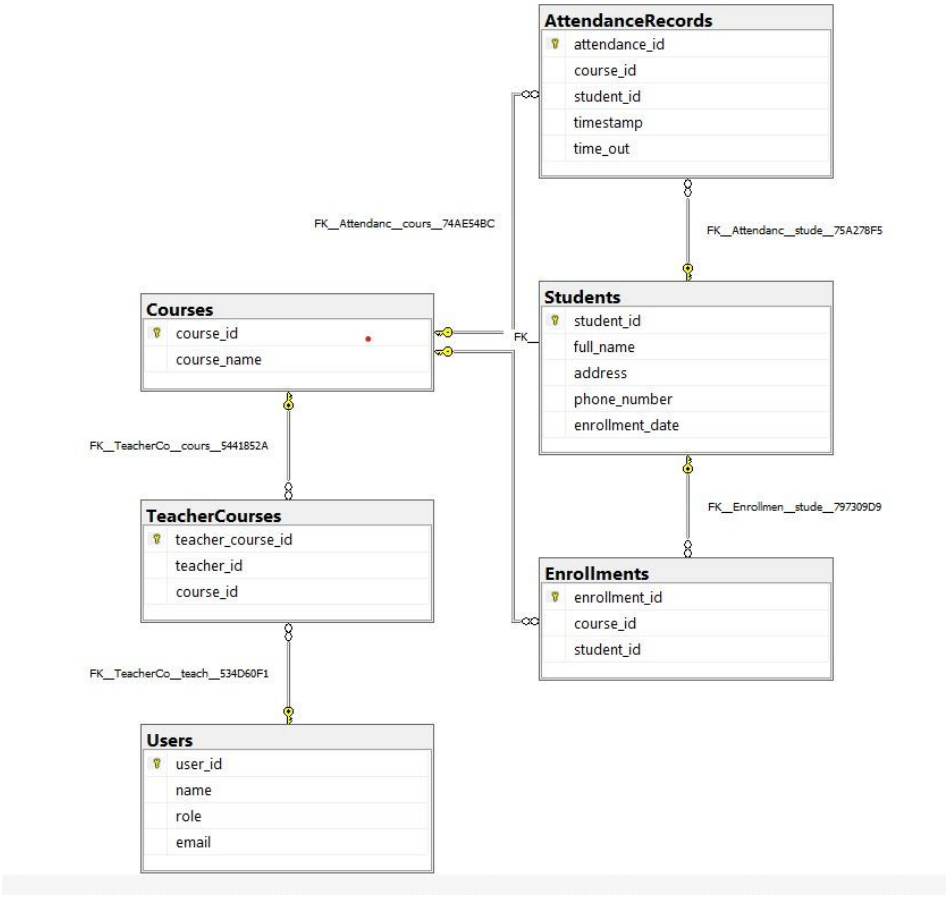

Figure 6

Users

Alias: User Information

Where-used/how-used: This table is used to store user-related data like name, role, and email. It helps differentiate between teachers and administrators in the system.

Content description: Stores user details.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
user_id	Unique identifier for users	INT	-	No	AUTO_INCREMENT	PK
name	Full name of the user	VARCHAR	100	No	NULL	
role	Role of the user (e.g., teacher, admin)	VARCHAR	50	No	NULL	
email	Email address of the user	VARCHAR	100	No	NULL	

Figure 7

Students

Alias: Student Information

Where-used/how-used: Stores details of students enrolled in courses.

Content description: Contains information about students.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
student_id	Unique identifier for students	INT	-	No	AUTO_INCREMENT	PK
full_name	Full name of the student	VARCHAR	100	No	NULL	
address	Address of the student	VARCHAR	200	Yes	NULL	
phone_number	Contact number of the student	VARCHAR	15	Yes	NULL	
enrollment_date	Date of enrollment	DATE	-	Yes	NULL	

Figure 8

Courses

Alias: Course Details

Where-used/how-used: Stores information about courses offered in the system.

Content description: Contains course-related information.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
course_id	Unique identifier for courses	INT	-	No	AUTO_INCREMENT	PK
course_name	Name of the course	VARCHAR	100	No	NULL	

Figure 9

TeacherCourses

Alias: Teacher Course Mapping

Where-used/how-used: Links teachers to courses they teach.

Content description: Relational table between teachers and courses.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
teacher_course_id	Unique identifier for teacher-course mapping	INT	-	No	AUTO_INCREMENT	PK
teacher_id	Foreign key referencing Users table	INT	-	No	NULL	FK
course_id	Foreign key referencing Courses table	INT	-	No	NULL	FK

Figure 10

Enrollments

Alias: Student Course Enrollment

Where-used/how-used: Tracks which students are enrolled in which courses.

Content description: Relational table for student enrollments.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
enrollment_id	Unique identifier for enrollments	INT	-	No	AUTO_INCREMENT	PK
course_id	Foreign key referencing Courses table	INT	-	No	NULL	FK
student_id	Foreign key referencing Students table	INT	-	No	NULL	FK

Figure 11

Alias: Attendance Logs

Where-used/how-used: Tracks attendance details for students in courses.

Content description: Logs attendance records.

Column Name	Description	Type	Length	Null able	Default Value	Key Type
attendance_id	Unique identifier for attendance records	INT	-	No	AUTO_INCREMENT	PK
course_id	Foreign key referencing Courses table	INT	-	No	NULL	FK
student_id	Foreign key referencing Students table	INT	-	No	NULL	FK
timestamp	Time and date of attendance	DATETIME	-	No	NULL	
time_out	Time student leaves	DATETIME	-	Yes	NULL	

Figure 12

Application Design

6.1.2 Sequence Diagram

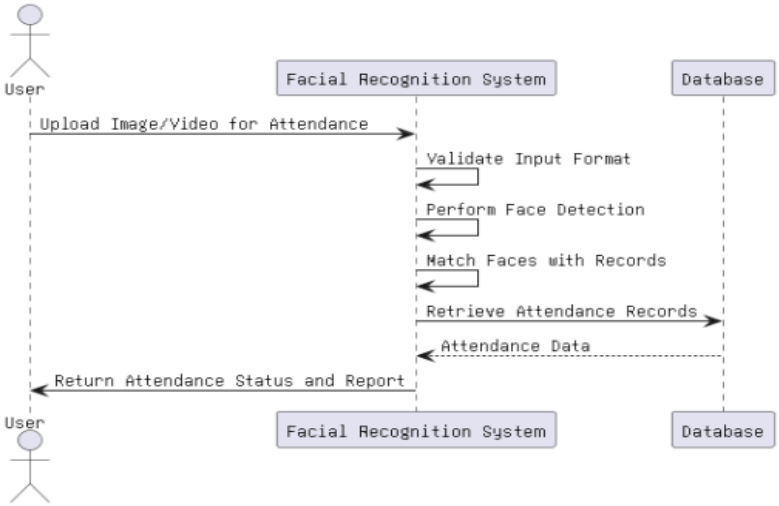

Figure 13

6.1.3 State Diagram

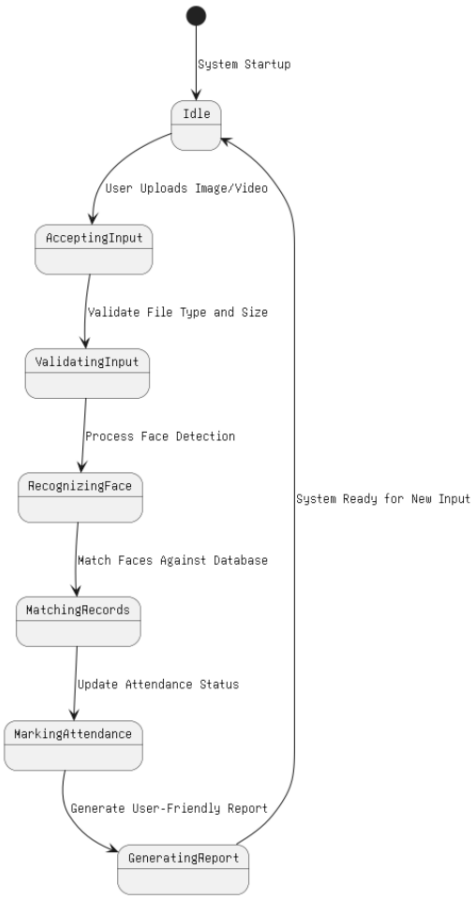

Figure 14

5.2.5 DFD Level 1 Diagram:

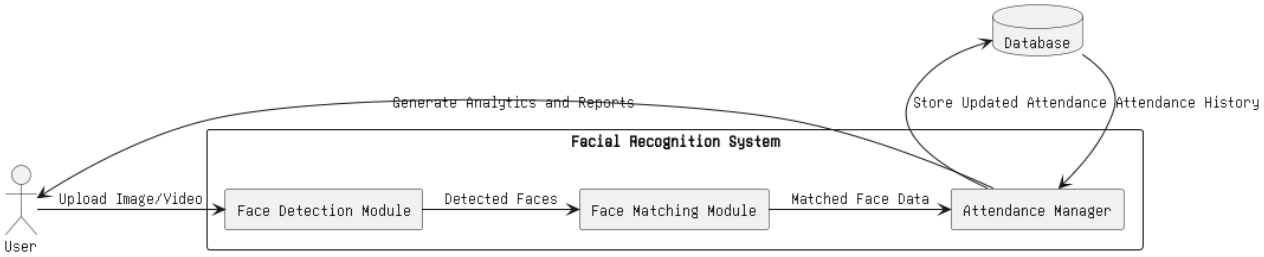

Figure 15

6.2 GUI Design

6.2.1 <Login - Mock Screen 1>

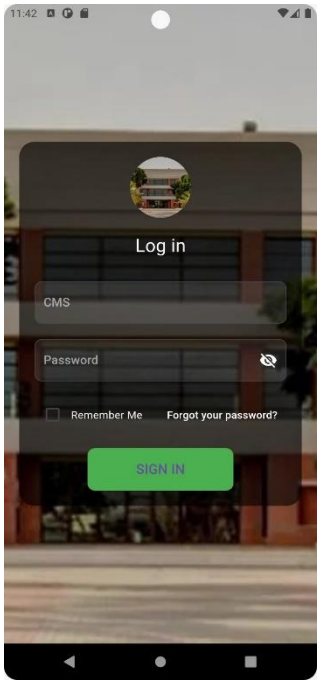

Figure 16

6.2.2 <Home Page - Mock Screen 2>

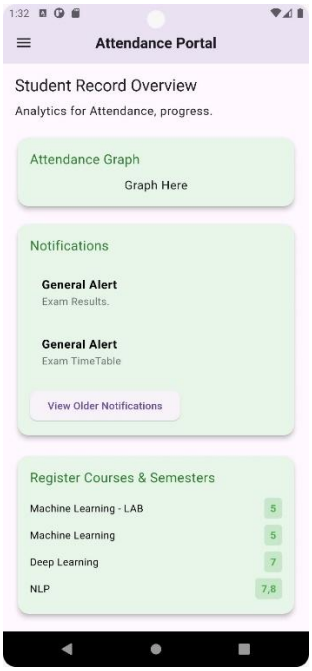

Figure 17

6.2.3 <Class Selection - Mock Screen 3>

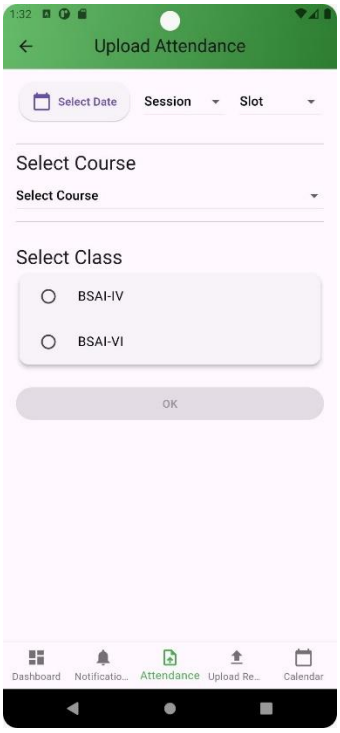

Figure 18

6.2.4 <Mark Attendance- Mock Screen 4>

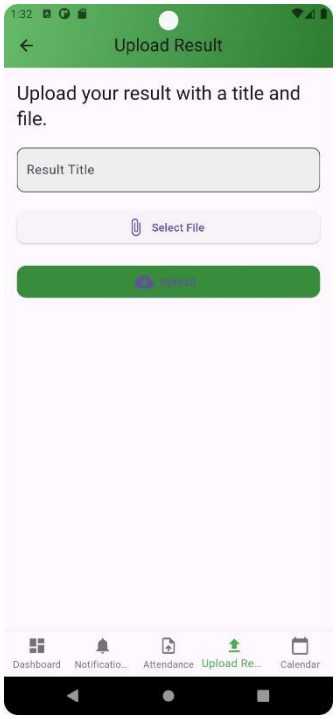

Figure 19

6.2.5 <Notifications - Mock Screen 5>

Figure 20

6.2.6 <Calender - Mock Screen 6>

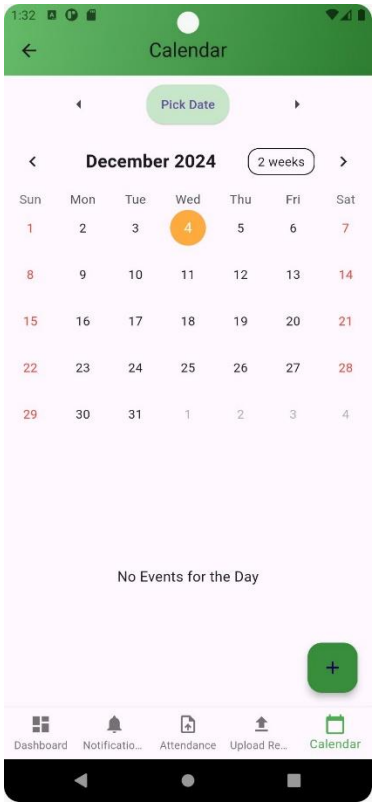

Figure 21

7 References

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  https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4833698
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  https://www.ijfmr.com/papers/2024/2/17655.pdf
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  https://arxiv.org/abs/2211.07582
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  https://arxiv.org/abs/2012.01907

8 Appendices

7.1 Appendix A: Glossary of Terms

Facial Recognition Technology: A biometric technology that identifies individuals based on their facial features.
Deep Learning: A subset of machine learning focused on algorithms inspired by the structure and function of the brain.
Feature Extraction: The process of transforming raw data into meaningful representations for analysis.
Encryption: A method of securing data by converting it into a coded format.

7.2 Appendix B: Hardware and Software Specifications

Hardware Requirements:

Processor: Core i5, 5th Generation or higher
RAM: 8GB or higher
Internet: 12MB connection or Fiber Optics

Software Tools:

Backend: OpenCV, Dlib, TensorFlow, PyTorch
Frontend: Flutter
Development Environments: Visual Studio Code, Google Colab, Jupyter Notebook
Database Management: MS SQL

A4. OTHER TECHNICAL DETAILS

Test Case Document

Test Cases:

Test Case # 01

Project Name: AttendEase
Test Case ID: 01
Test Case Description: To check Login page

Module Name: User Authentication
Test Engineer: Umer

Table 14

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Enter username Enter Password Press **[Enter]** button **or** click on sign up button	talha {2000}	Allowed to enter in the app	With correct email and password it allowed to enter in the app	Pass
TC-2	Enter wrong username and correct password	taha {2000}	Invalid Credentials	Invalid Credentials	Pass
TC-3	Enter correct username but wrong password	talha {3000}	Invalid Credentials	Invalid credentials	Pass

Test Case # 02

Project Name: AttendEase
Test Case ID: 02
Test Case Description: To check attendance updation

Module Name: Mark Attendance
Test Engineer: Umer

Table 15

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Click on "Upload Attendance"	Click	Go to the Upload Attendance Page	Go to the Upload Attendance Page	Pass

TC-2	Select date, program and batch and click Ok	Date, Session, Slot, Course, Program	Proceed to the save attendance screen with the camera.	Proceed to the save attendance screen with the camera.	Pass
TC-3	Point the camera to the students and click on "Save Attendance"	.Picture	Save accurate attendance.	Save accurate attendance.	Pass

Test Case # 03

Project Name: AttendEase
Module Name: CheckEmail Inbox
Test Case ID: 03
Test Engineer: Umer
Test Case Description: To check email generation

Table 16

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Check the email inbox of one of the absentee parents.	The uploaded attendance	Sent an email to the absentee parents.	Sent an email to the absentee parents.	Pass

Test Case # 04

Project Name: AttendEase
Module Name: Attendance Analytics
Test Case ID: 04
Test Engineer: Umer
Test Case Description: To check if the dynamic analytical graph responds to updation in the attendance.

Table 17

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Click on the view statistics and select the batch and course you want to see.	attendance	Graph responds to attendance updation	Graph responds to attendance updation	Pass

Test Case # 05

Project Name: AttendEase
Module Name: Check Saved Attendance
Test Case ID: 05
Test Engineer: Umer
Test Case Description: To check saved attendance

Table 18

S. No	Steps	Input Data	Expected Result	Actual Result	Pass/Fail
TC-1	Click on view attendance and select the course. Then download the required result according to date.	Clicked on view attendance	The data downloaded in excel format.	The data downloaded in excel format.	Pass

UI/UX Details Document

1. LOGIN SCREEN

User Login:

i) By adding correct Login Credentials User can be able to login to the system.

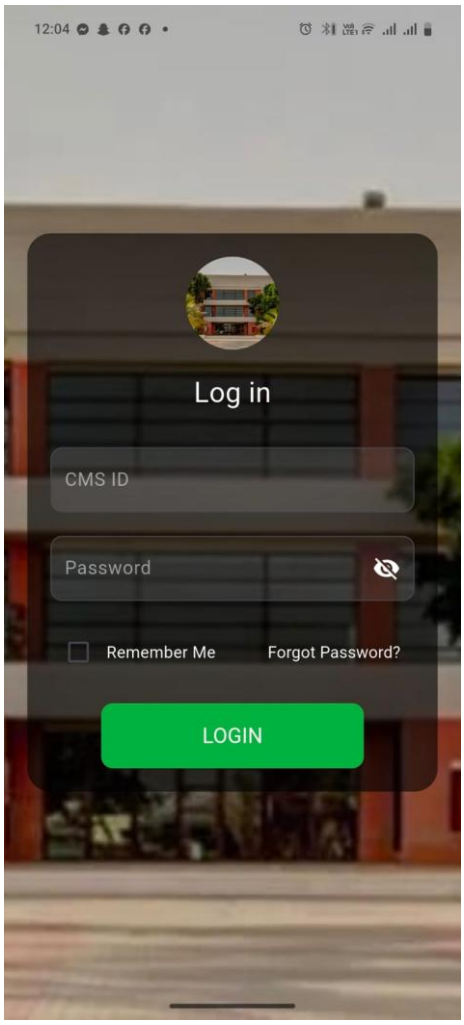


Figure 22

2. Dashboard

Attendance Portal:

i) All the details related to the students courses, recordings overview, attendance graphs, registered semester etc. will show here.

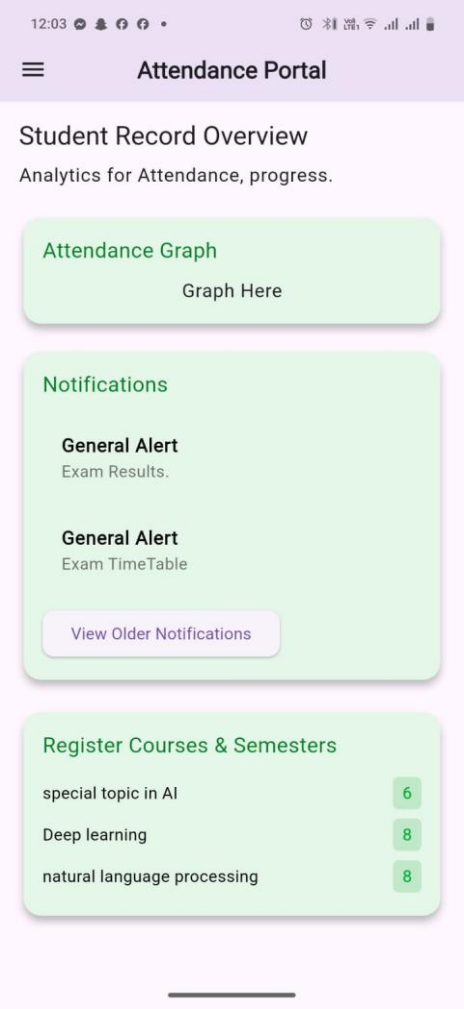


Figure 23

3. App Features

Side Panel:

i) On one click user can visit any of the mentioned features.

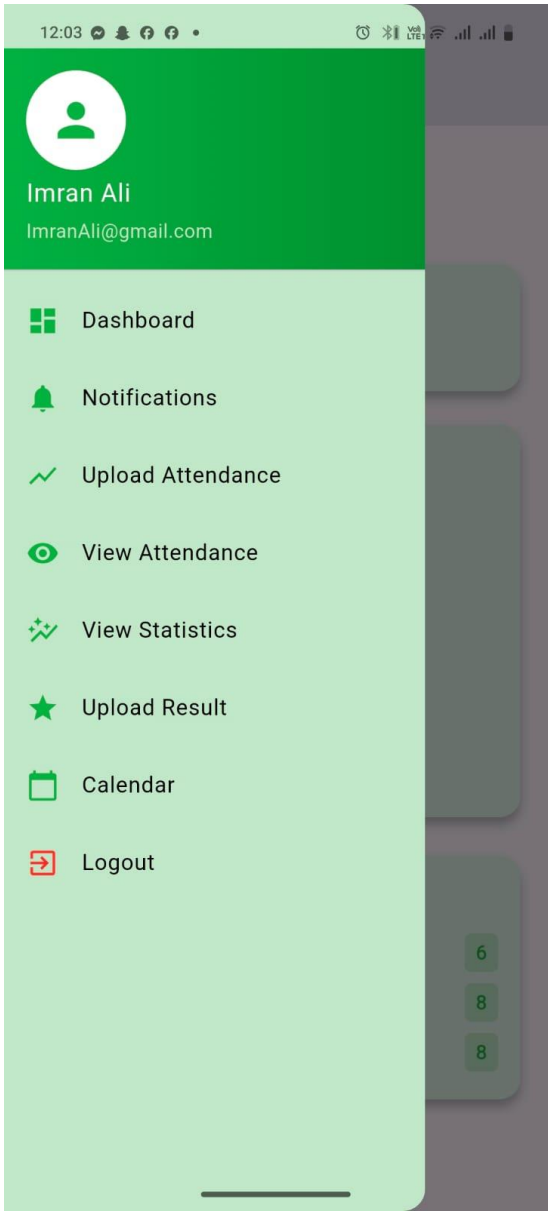


Figure 24

4. App Pages

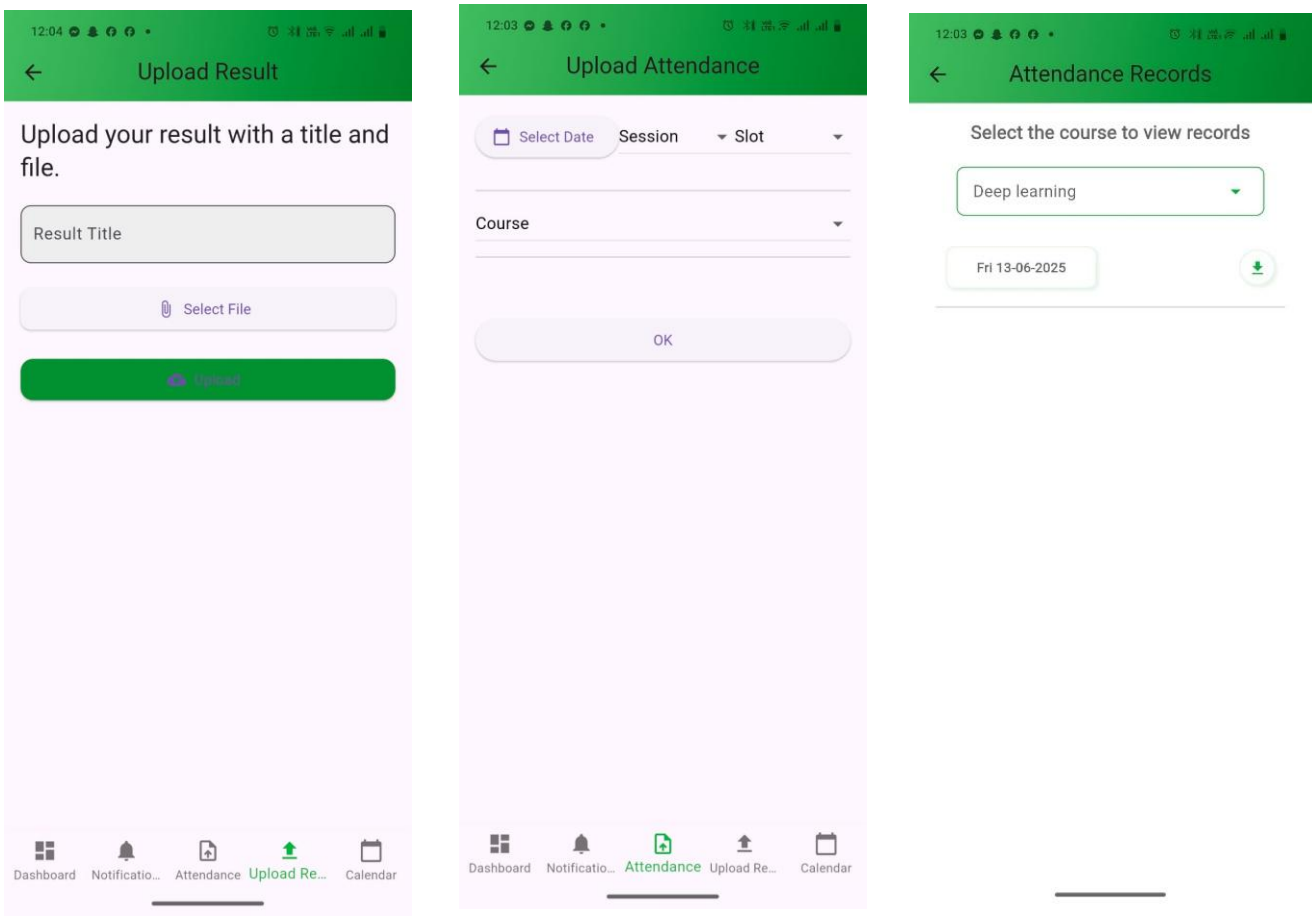


Figure 25

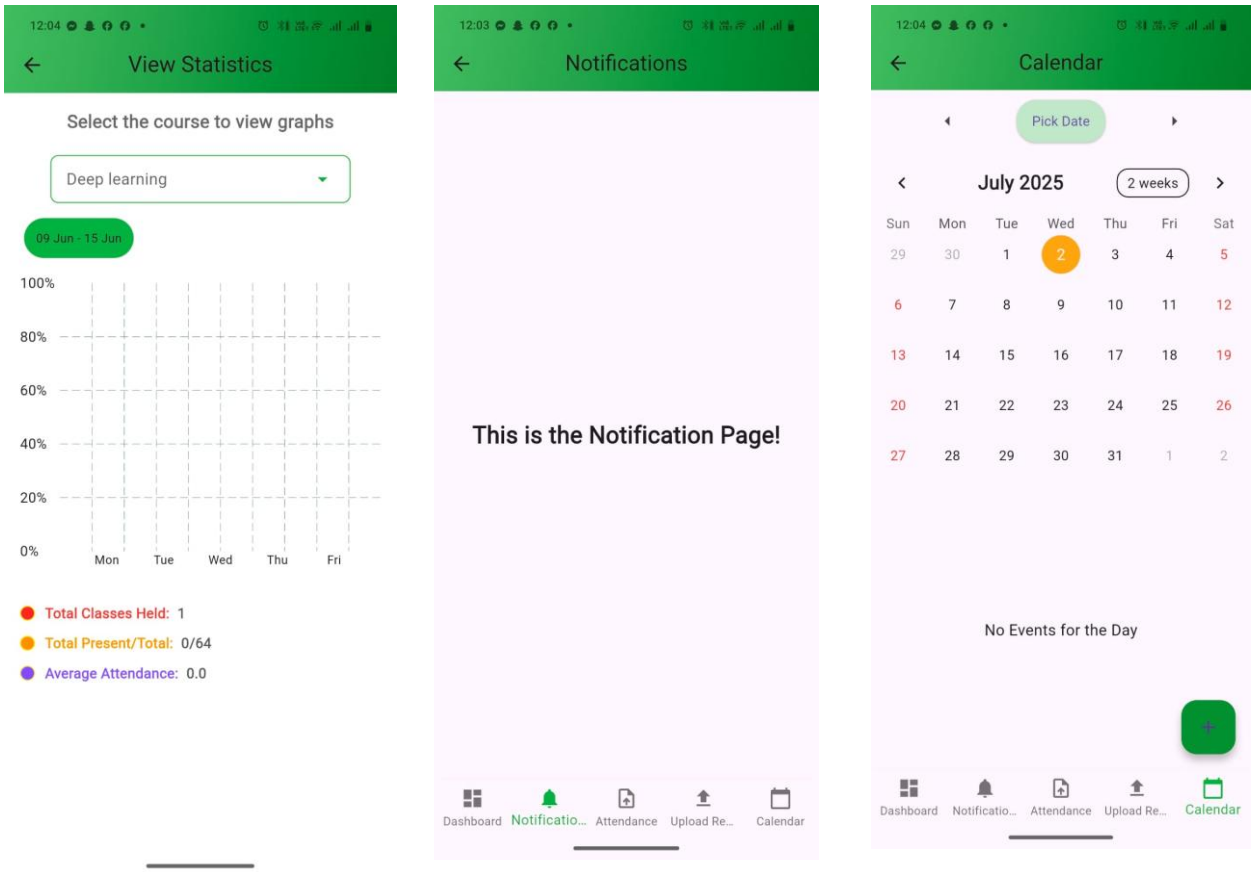

View Statistics
Select the course to view graphs
Deep learning
09 Jun - 15 Jun
100%
80%
60%
40%
20%
0%
Mon
Tue
Wed
Thu
Fri
Total Classes Held: 1
Total Present/Total: 0/64
Average Attendance: 0.0
Notifications
This is the Notification Page!
Dashboard
Notificatio...
Attendance
Upload Re...
Calendar
Calendar
Pick Date
July 2025
2 weeks
Sun
Mon
Tue
Wed
Thu
Fri
Sat
No Events for the Day

Figure 26

Coding Standards

a) Python (Backend, Facial Recognition, Email Notification)

PEP8 – Python Enhancement Proposal 8

- **Indentation:** 4 spaces per indentation level.
- **Line Length:** Maximum 79 characters per line.
- **Naming Conventions:**
  - Variables/functions: snake_case (e.g., detect_faces, send_email)
  - Classes: PascalCase (e.g., FaceRecognizer)
  - Constants: ALL_CAPS (e.g., EMAIL_SENDER, MODEL_PATH)
- **Imports:**
  - Standard libraries → Third-party → Local modules

```
import os

import smtplib

import cv2

from face_module import FaceRecognizer
```

Additional Standards:

- All external operations (such as SMTP and camera access) must use try-except blocks.
- **Function modularity**: Every function should only perform one task.
- **Don't use hard-coded values**: Use constants or configuration files.

b) Flutter/Dart (Mobile Application)

Effective Dart Guidelines

- https://dart.dev/guides/language/effective-dart

- **Naming Conventions:**
  - Classes: PascalCase (e.g., LoginScreen)
  - Variables: camelCase (e.g., emailTextController)
  - Constants: lowerCamelCase with const keyword
- **Widget Structure**:
  - Use distinct widget classes or functions to keep UI code neat.
- **Steer clear of heavily nested widgets**; instead, extract them as reusable parts.
- Using Dart's null-safety features can help you avoid runtime crashes:
  - String? studentName;

- **File Structure:**
  - /lib/models/ – Data models
  - /lib/screens/ – UI screens
  - /lib/services/ – Business logic like recognition or API calls
  - /lib/widgets/ – Reusable components

c) SQL (SQLite / MS SQL/Firebase)

SQL Style Standards:

- **Uppercase for SQL keywords:**
  - SELECT student_name FROM attendance WHERE status = 'Absent';
- **Use aliases and JOINs for clarity:**
  - SELECT s.name, a.date
    FROM students s
    JOIN attendance a ON s.id = a.student_id;
- **Use parameterized queries** to avoid SQL injection:
  - cursor.execute("SELECT * FROM users WHERE email = ?", (email,))

- **Firebase-Data Handling and Structure Guidelines**
  These code and structural conventions were used for Firebase-based functionality (such cloud storage and real-time updates):
  - **Consistent Naming Conventions:**
    - Use `camelCase` for document and field names:
      ```
      {
        "studentId": "S1234",
        "courseName": "AI_Lab",
        "isPresent": true
      }
      ```
    - To enhance query efficiency and lower read/write costs, stay away from heavily nested documents.
  - **Structure data by collection-document hierarchy**, e.g.:
    - /attendance/{classId}/records/{studentId}
  - **Implementation of secure rules** (Firebase Security Rules) to:
    - Permit read/write access according to user roles (e.g., admin, instructor).
    - Prevent sensitive records from being accessed without authorization.
  - To avoid inconsistent or partial updates, use **transaction blocks** and **batch writes** for atomic operations.
  - **Asynchronous calls and error handling:**
    - Always handle promise responses in Dart or JavaScript:
      ```
      FirebaseFirestore.instance
        .collection('attendance')
        .doc(studentId)
        .get()
        .then((snapshot) {
          // Process data
        }).catchError((error) {
          // Handle error
        });
      ```

d) Git & Version Control Standards

- **Branch Naming:**
  - main: Stable version
  - feature/attendance-logic, fix/email-bug, etc.
- **Commit Messages:**
  - feat: added attendance marking logic with face recognition

    fix: resolved SMTP email timeout issue

    doc: updated README with installation steps

    - **Pull Request Reviews:** At least one peer review before merge to main.

e) General Best Practices

Table 19

Practice	Description
Code should be testable	Write unit tests wherever possible, especially for backend functions
Secure sensitive data	Use .env files or encrypted storage for passwords and API keys
Documentation	All major functions and classes should have docstrings/comments
Modularity	Separate UI, logic, and data layers properly
Clean Code	Remove unused imports, dead code, and debugging prints before final version

Project Policy

A rigorous set of project policies guided the creation of the AttendEase project in order to guarantee secure software development, ethical behavior, legal compliance, and teamwork. Every facet of the project life cycle was covered by the policy, including planning, requirement analysis, design, implementation, testing, and documentation.

Academic Integrity

- The project was completed completely in accordance with Hamdard University's academic policies.
- The listed authors, Adil Shaikh, M. Umer Saleem, and Imran Ali, were the only ones who created the original work.
- Every external library, dataset, and resource was used with appropriate citations or under an open-source license.
- Plagiarism checks were done, and the final documentation properly cites any content that was borrowed.

Team Collaboration Policy

- The group used an evolutionary prototyping development model with clear roles:
- Imran Ali is the team lead.
- Development of the Application: M. Umer Saleem
- Adil Shaikh on Facial Recognition and Backend Integration
- Each member shared responsibility for code reviews, planning, and progress updates.
- Weekly meetings with the supervisor, GitHub commits, and WhatsApp were used to keep in touch.

Data Privacy and Ethics Policy

- User privacy and the protection of biometric data were given careful consideration during the system's construction.
- The facial recognition information was:
    - only gathered for students who were registered and used test mock datasets.
    - both in transit and at rest, encrypted with AES-256.
    - not distributed to any cloud services or third-party systems.
- Without specifically creating or simulating a fake, no actual student or parent data was utilized.

Security Policy

- In order to prevent data leaks, injection attacks, and unauthorized access, the project implemented secure coding practices.
- Important security precautions:
    - Admin access authentication (password-protected teacher login).
    - SQL injection can be avoided by using parameterized SQL queries and validating

input.

- Email notifications can be sent using a secure SMTP configuration.

- To find vulnerabilities, manual testing and routine code audits were conducted.

Code of Conduct and Responsibility Sharing

- A code of responsibility, equity, and respect for one another was upheld by every team member:
  - Tasks were distributed equally according to skill set; there was no unfair workload distribution.
  - Every team member made an equal contribution to the preparation of the presentations, the coding, and the documentation.
  - Conflicts were settled by dialogue or the supervisor's advice.

Documentation and Version Control Policy

- Git was used to version all project code, and a private GitHub repository was used for management.
- The commit messages used standard commit formatting, such as feat: , fix: , and doc:
- Project, report, and documentation backups were kept up to date every week.
- The project report adhered to formatting standards and templates authorized by the university.

Testing and Deployment Policy

- Prior to integration, each module underwent independent testing.
- The system was only used in simulated scenarios; it was not implemented in an actual educational setting.
- Mock student data and staged classroom video recordings were used in the attendance exam.

Use of Open-Source and Third-Party Tools

- Only open-source frameworks and libraries were utilized in the project, including:
- TensorFlow, Dlib, and OpenCV for computer vision applications.
- Flutter for creating mobile apps.
- Every third-party tool was credited, and the academic use licenses were confirmed.

Sustainability and Maintenance Policy

- Future growth and modular modifications were supported by the system's design.
- To help future maintainers, a developer guide and clean, well-commented code were produced.
- By enhancing performance to lower device battery and CPU utilization, environmental sustainability was taken into consideration.

Supervisor and Departmental Policy Compliance

- The project supervisor reviewed and approved all significant choices, features, and revisions.
- The official FYP guidebook was followed for project submission deadlines, presentation schedules, and documentation formats.
- Supervisors' comments were recorded and methodically incorporated into every sprint review.

A5. Flyer & Poster Design

Figure 27

A6. Copy of Evaluation Comments

Copy of Evaluation Comments by Jury for Project – I End Semester Evaluation

Dr. Taha Shabbir	Improve further ots feasibility. Make sure it provide ease in attendence rather than further hurdles and delays.
Muhammad Salman	Need to work hard and more focus on functionality and technical aspects. Otherwise it's ok.
Engr. Farooq Iqbal	Ok. But need to work hard and focus on functionality and technical aspects.
Ishmal Shahid	The project is good, and the prototypes are well-developed. However, a bit of enhancement in the overall project could improve its effectiveness and impact.
Dr. Khalid Charan	ok

Copy of Evaluation Comments by Supervisor for Project – II Mid Semester Evaluation

N/A

Copy of Evaluation Comments by Jury for Project – II Mid Semester Evaluation

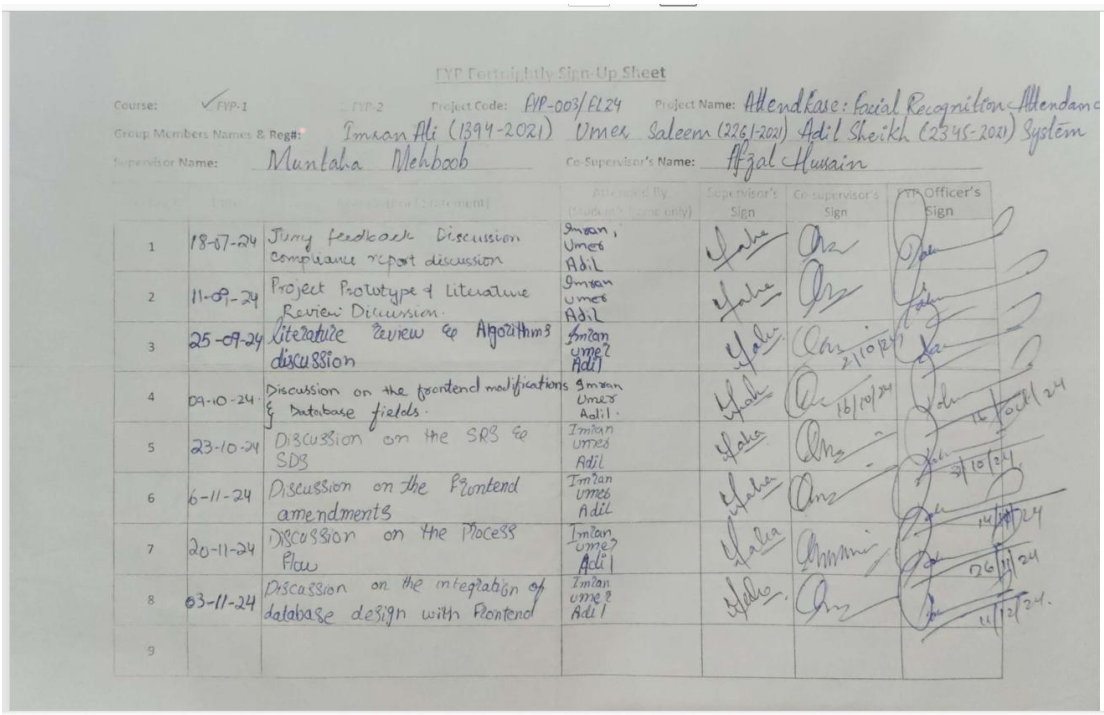
N/A

Copy of Evaluation Comments by Jury for Project – II End Semester Evaluation

N/A

A7. Meeting's Minutes

SIGN UP SHEET (FYP-1)



FYP Fortnightly Sign-Up Sheet

Course: ✓FYP-1 FYP-2 Project Code: FYP-003/FL24 Project Name: AttendEase: Facial Recognition Attendance System

Group Members Names & Reg#: Imran Ali (1394-2021) Umer Saleem (2261-2021) Adil Sheikh (2345-2021)

Supervisor Name: Muntaha Mehboob Co-Supervisor's Name: Afzal Hussain

			Attended By (Student's name only)	Supervisor's Sign	Co-supervisor's Sign	FYP Officer's Sign
1	18-07-24	Jury feedback Discussion compliance report discussion	Imran, Umer Adil			
2	11-09-24	Project Prototype & Literature Review Discussion.	Imran Umer Adil			
3	25-09-24	Literature review & Algorithms discussion	Imran Umer Adil			
4	09-10-24	Discussion on the frontend modifications & Database fields.	Imran Umer Adil			
5	23-10-24	Discussion on the SRS & SDS	Imran Umer Adil			
6	6-11-24	Discussion on the Frontend amendments	Imran Umer Adil			
7	20-11-24	Discussion on the Process Flow	Imran Umer Adil			
8	03-11-24	Discussion on the integration of database design with Frontend	Imran Umer Adil			
9						

Figure 28

FYP Project Meeting

Minutes of Meeting

Meeting Date: 18/07/2024
Meeting Location: Faculty Room
Meeting Time: 11:00 – 11:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Frontend
Umer saleem	Model development
Adil sheikh	Integration, database

2- Meeting Agenda

Jurry feedback and compliance report discussion

3- Agenda Points discussed in meeting

Discussion on jury comments and Some changes were made to the application, likely based on the jury's feedback and we make a decision that to add a camera

In this meeting, the complices report was also finalized, marking an important milestone for the project.

4- Next Meeting for this project

11-09-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 11/09/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Frontend
Umer saleem	Model development
Adil sheikh	Integration, database

2- Meeting Agenda

discussion project prototype for literature review

3- Agenda Points discussed in meeting

The discussion held during the project meeting focused on developing a comprehensive and structured prototype for the literature review. This prototype aims to synthesize key themes, identify research gaps, and highlight future directions within the field.

4- Next Meeting for this project

25-09-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 25/09/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Literature review and algorithms discussion.

3- Agenda Points discussed in meeting

In this discussion, we examine the existing literature and relevant algorithms, highlighting their significance to the project. The literature review synthesizes key research and advancements, while the algorithms discussion focuses on their application and potential for innovation.

4- Next Meeting for this project

09-10-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 09/10/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the Frontend modifications and Database fields.

3- Agenda Points discussed in meeting

This discussion focuses on the necessary frontend modifications and adjustments to database fields to align with project requirements. On the frontend, we explore changes in user interface design, usability enhancements, and integration of new features. Regarding the database, we address updates to field structures, optimization for data flow, and ensuring compatibility with the frontend modifications.

4- Next Meeting for this project

23-10-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 23/10/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the SRS and SDS documentation

3- Agenda Points discussed in meeting

This discussion centers on the Software Requirements Specification (SRS) and Software Design Specification (SDS) documents. For the SRS, we review the project's functional and non-functional requirements, ensuring clarity. In the SDS, we examine the system architecture, component design, and implementation strategies

4- Next Meeting for this project

06-11-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 06/11/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the Frontend amendments

3- Agenda Points discussed in meeting

This discussion focuses on proposed amendments to the frontend, covering adjustments in user interface design, improved functionality, and enhanced user experience. We address changes needed to optimize performance, and ensure seamless integration with backend systems

4- Next Meeting for this project

20-11-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 20/11/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the Process flow

3- Agenda Points discussed in meeting

This discussion focuses on the project's process flow, outlining key stages from initiation to completion. We review the sequence of activities, identify dependencies, and ensure alignment with project objectives.

4- Next Meeting for this project

03-12-2024 at 2:00 pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 03/12/2024
Meeting Location: Faculty Room
Meeting Time: 02:00 – 02:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end , back-end
Umer saleem	Model development , back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on Integration of database design with Frontend

3- Agenda Points discussed in meeting

This discussion addresses the integration of database with the frontend, focusing on seamless data flow and system functionality. Key aspects include aligning database schemas with frontend requirements, optimizing query performance. The goal is to create a cohesive system that enhances user interaction while maintaining data accuracy and reliability.

SIGN UP SHEET (FYP – 2)

FYP Project Meeting

Minutes of Meeting

Meeting Date: 18/02/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the Jury comments

3- Agenda Points discussed in meeting

The meeting focused on discussing the jury's comments from the first evaluation of the project. Key points included addressing feedback on ots feasibility, Functionality and technical aspects. The supervisor gave advice on how to improve the project so that it more closely matched the requirements for the next assessment.

4- Next Meeting for this project

25-02-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 25/02/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on the Backend Design

3- Agenda Points discussed in meeting

Framework: Finalized Django/Express.js/Flask for backend development.

Database: Structured users, courses, and attendance records in MongoDB/MySQL/PostgreSQL.
API Development: Designed endpoints for user authentication, attendance processing, and data retrieval.
Security: Implementing JWT authentication, data encryption, and role-based access control.

4- Next Meeting for this project

4-03-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 11/03/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Discussion on developing the model.

3- Agenda Points discussed in meeting

The meeting focused on the model we have developed, evaluating its strengths and areas for improvement. The supervisor provided feedback on enhancing the model's performance, particularly in terms of NLP and ML techniques. Next steps include revising the test module and further optimizing the model.

4- Next Meeting for this project

25-03-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 25/03/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Addressing the struggling accuracy of the model

3- Agenda Points discussed in meeting

The meeting focused on the model's accuracy. The supervisor suggested gathering additional data. Next step includes gathering more data for training and further optimizing the model.

4- Next Meeting for this project

15-04-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 15/04/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Data Gathering and it's effects.

3- Agenda Points discussed in meeting

The meeting focused on the new data gathered as suggested by our supervisor and how it improved the accuracy but further optimization is required.

4- Next Meeting for this project

22-04-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 22/04/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Attendance Record Calibration.

3- Agenda Points discussed in meeting

The meeting focused on how to display and save the attendance records efficiently.

4- Next Meeting for this project

29-04-2025 at 12:00pm same place

FYP Project Meeting

Minutes of Meeting

Meeting Date: 29/04/2025
Meeting Location: Faculty-Room
Meeting Time: 12:00 – 12:30

Project Title: AttendEase: Facial Recognition Attendance System
Project Code: FYP-003/FL24

1- List of Participants

Name	Project Role
Imran Ali	Front-end, back-end
Umer saleem	Model development, back-end
Adil sheikh	Integration, database

2- Meeting Agenda

Dashboard amendment.

3- Agenda Points discussed in meeting

The meeting focused on some key changes that could be made to make it more user friendly.

4- Next Meeting for this project

None.

A8. Research Paper

Facial Recognition-Based Attendance Management Systems: A Review and Implementation Perspective

Abstract

Biometric systems, providing enhanced automation, precision, and fraud deterrence, are slowly supplanting conventional attendance methods. The most efficient, scalable, and unobtrusive method among these is facial recognition. This research offers an in-depth examination of contemporary advancements in attendance systems using face recognition, evaluates their approaches, and discusses an effective implementation strategy with AttendEase, a mobile solution for real-time facial attendance. Emphasizing algorithm efficiency, system designs, data confidentiality concerns, and real-time implementation factors, the paper aggregates findings from various academic and industry research.

Keywords: Facial recognition, attendance system, deep learning, computer vision, automation, biometric authentication, real-time video processing.

Introduction

In public entities, companies, and schools, overseeing attendance is a fundamental administrative duty. Traditional methods, such as roll calls and manual sign-ins, are tedious, susceptible to errors, and at risk of proxy attendance. Biometric authentication systems are being explored as a possible solution due to their contactless characteristics and capability to work with live video feeds, particularly facial recognition.

Facial recognition leverages unique facial characteristics, employing computer vision and machine learning to recognize individuals. It minimizes the requirement for human involvement by facilitating quick identification and validation. A significant advancement in intelligent automation is the integration of these technologies into attendance systems.

Literature Review

Several studies have demonstrated the feasibility and advantages of facial recognition-based attendance systems:

- Yang and Han (2020) implemented a real-time system that processes live video to detect and identify faces instantly, emphasizing its usability in dynamic environments like classrooms [IEEE Access].
- Kar et al. highlighted the importance of preprocessing steps such as face alignment and illumination normalization to improve accuracy in real-time conditions [IJCCE, Vol. 1].
- P. Sinha et al. (2006) underscored cognitive aspects of human face recognition and the need for holistic feature extraction, which inspired several deep learning approaches [Proceedings of the IEEE].
- Research presented on ResearchGate [1] and SSRN [5] explored convolutional neural network (CNN)-based attendance frameworks, comparing accuracy metrics across varied lighting and facial orientations.
- Trivedi and Tripathi [Semantics Scholar] discussed a PCA and Eigenfaces-based approach that performed well in low-complexity environments but lagged in scalability.
- IJRPR23389.pdf and IJERTV9IS060615.pdf examined mobile-based implementations and highlighted issues with camera resolution and system response time.
- Recent studies on arXiv (2022–2024) explored the fusion of YOLO for real-time detection with FaceNet for recognition, emphasizing speed and model compactness [arXiv:2211.07582, arXiv:2405.12633, arXiv:2012.01907].

These studies agree on the value of combining preprocessing, optimized deep learning models, and intuitive interfaces to achieve a functional attendance system.

Methodologies

A standard workflow for a facial recognition attendance system includes the following steps:

- Face detection involves locating faces in images through algorithms like YOLO, HOG + SVM, or Haar Cascade.
- Feature extraction involves converting faces into numerical embeddings through deep learning models like FaceNet, DeepFace, or Dlib.
- Acknowledgment & Comparison: Employing distance or cosine similarity measures, embeddings are evaluated against a saved database.
- Attendance logging records time stamps and status (present or absent) in a secure local or cloud-based database.
- To enhance durability, sophisticated systems also implement pose correction, light normalization, and liveness detection.

Implementation Case Study: AttendEase

- An initiative by students named AttendEase employs a mobile-based, real-time attendance tracking system. Key aspects to remember are:
    - **Technology stack**: OpenCV + Dlib (facial detection), SQLite and Firebase (local storage), Flutter (mobile UI), Python (server-side), and Gmail API (email notifications).
    - **Functionality**: Once the instructor captures a short video, the system identifies the students' faces, registers their attendance, and notifies the parents of those who are absent.
    - **Performance**: response time under 5 seconds and around 95% accuracy in recognizing in well-lit conditions.
- Security elements comprise parameterized queries, a modular code structure, and AES-256 encryption.
- AttendEase addresses major limitations from prior research by improving on-device performance, reducing latency, and enabling real-time classroom assessment.

Challenges and Limitation

- Illumination and Obstructions: Performance declines when faces are obscured or poorly lit.
- Hardware Requirement: High accuracy necessitates mid-range or superior smartphones.
- Privacy: The handling and retention of facial data raises ethical and legal concerns.

Future Directions

- Integration of cloud platforms for centralized management of databases.
- Live detection is employed to prevent spoofing.
- To enhance precision, multi-camera systems and 3D facial modeling are incorporated.
- Smartphone apps for parents that monitor and offer insights on attendance.

Conclusion

A promising advancement in biometric automation is the implementation of facial recognition in attendance systems. They enhance student responsibility, reduce manual effort, and boost precision. The literature review and AttendEase implementation demonstrate that real-time video processing, deep learning, and secure mobile interfaces can be integrated to develop scalable, efficient, and beneficial attendance solutions.

References

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