Hamdard University

Department of Computing

Final Year Project

AttendEase: Facial Recognition Attendance System

FYP-003/FL24

Software Design Specifications

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Fall 2021

Document Sign off Sheet

Document Information

Project Title	AttendEase: Facial Recognition Attendance System
Project Code	FYP-003/FL24
Document Name	Software Requirements Specifications
Document Version	1.0
Document Identifier	FYP-003/FL24-SRS
Document Status	Draft
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Approver(s)	Afzal Hussain
Issue Date	16-01-25

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Revision History

Date	Version	Description	Author
16-01-025	1.0	First Draft	Imran Ali,

Definition of Terms, Acronyms, and Abbreviations

Term	Description
OpenCV	Open Source Computer Vision Library, a popular library for computer vision and image processing tasks.
TensorFlow	An open-source platform for machine learning, particularly useful for deep learning applications.
IDE	A software application that provides comprehensive tools for software development
Feature Extraction	The process of identifying and isolating significant patterns or features from images or videos for use in machine learning models
OpenCV	Open Source Computer Vision Library, a popular library for computer vision and image processing tasks.
Dlib	A modern machine learning algorithms and tools for creating complex software, including facial recognition.

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

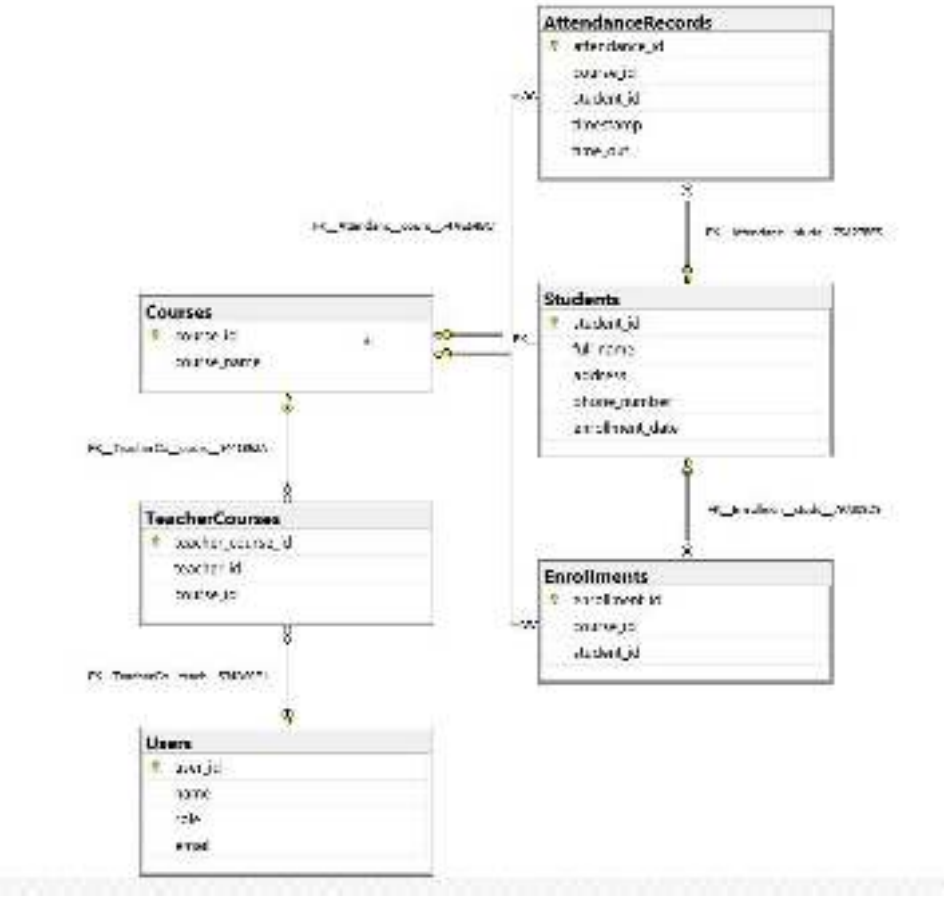
- Future System Extension: The system will be modular, allowing future additions such as multi-factor authentication.
- System Reuse: The algorithms and interface design can be adapted for other use cases like access control.
- User Interface Paradigms: Intuitive design for easy navigation and minimal 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

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



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	

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	

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	

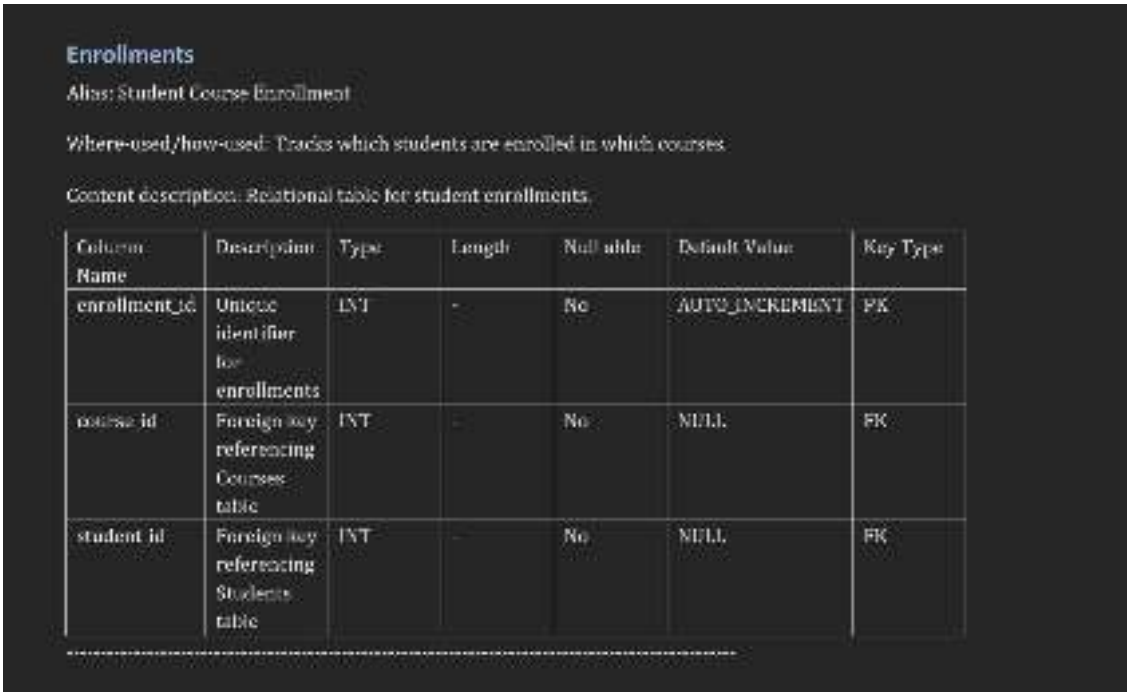
TeacherCourses

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



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 allo	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

AttendanceRecords

Alias: Attendance Logs

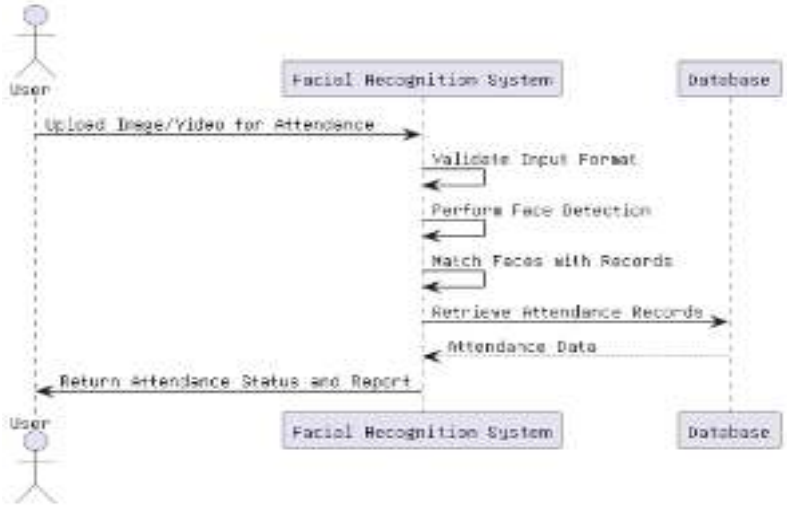
Where used/how used: Tracks attendance details for students in courses.

Content description: Logs attendance records.

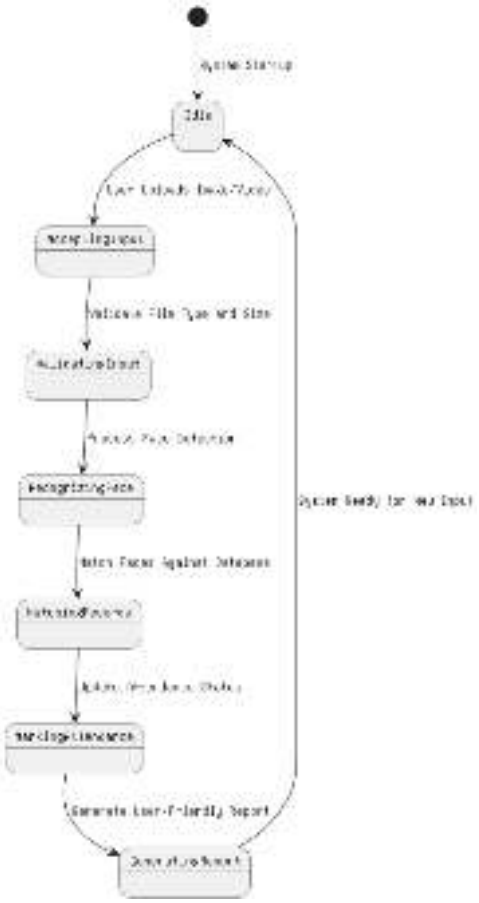
Column Name	Description	Type	Length	Nullable	Default Value	Key Type
attendance_id	Unique identifier for attendance records	INT	-	No	AUTO_INCREMENT	PK
course_id	Foreign key referencing Courses table	INT	-	No	NULL	FK
student_id	Foreign key referencing Students table	INT	-	No	NULL	FK
timestamp	Time and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

Application Design

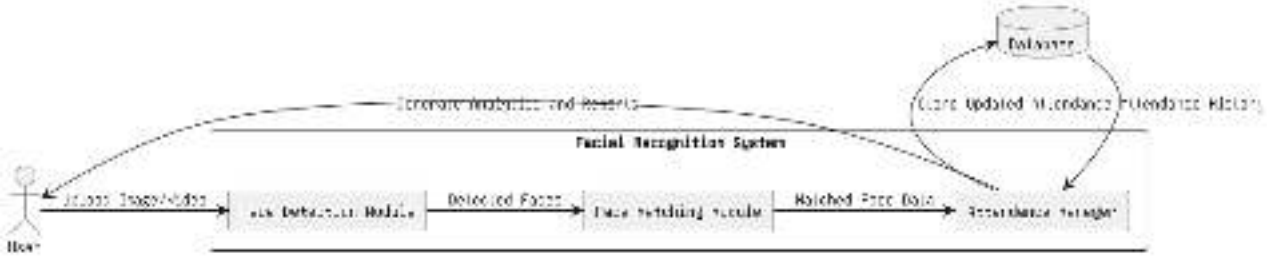
6.1.2 Sequence Diagram



6.1.3 State Diagram



5.2.5 DFD Level 1 Diagram:



6.2 GUI Design

6.2.1 <Login - Mock Screen 1>

6.2.2 <Home Page - Mock Screen 2>

6.2.3 <Class Selection - Mock Screen 3>

6.2.4 <Mark Attendance- Mock Screen 4>

6.2.5 <Notifications - Mock Screen 5>

6.2.6 <Calender - Mock Screen 6>

7 References

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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