Software Requirements Specification (SRS) and System Design

For

VisiMark - Intelligent Facial Attendance Tracker

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Table of Contents:

1. Introduction

1.1. Purpose

An online attendance system is a software that helps schools and other educational institutions to track and record the attendance of students and staff. It has many advantages over the traditional methods of attendance marking, such as paper registers, biometric devices, or identity cards. Therefore, the purpose of making an online attendance system is to improve the quality and efficiency of education, by ensuring the regularity and punctuality of students and staff, and by providing them with useful feedback and insights. It can reduce the use of paper and other resources, and save time and effort for teachers and administrators.

1.2. Scope

The scope of the online attendance system is to provide a software solution that can help educational institutions to manage and monitor the attendance of their students and staff in an efficient and effective way. The online attendance system can have a positive impact on the quality and efficiency of education, by ensuring the regularity and punctuality of students and staff, and by providing them with useful feedback and insights. It can produce various reports and analytics, such as class-wise, subject-wise, or month-wise attendance, which can help in identifying the attendance patterns and trends.

1.3. Motivation

The motivation for making an online attendance management system is to improve the quality and efficiency of education, by ensuring the regularity and punctuality of students and staff, and by providing them with useful feedback and insights. It is more convenient and flexible, as it allows students and staff to mark their attendance using various devices and modes, such as face recognition, QR code scanning, or online login. It is more informative and communicative, as it provides real-time updates and notifications to students, parents, and teachers about the attendance status and performance.

1.4. Objectives

The objectives of the online attendance management system are the goals or aims that the system intends to achieve. One of the objectives is to reduce the administrative work by integrating the details of the students of all the departments into a single database and to eliminate human errors and frauds in attendance marking by using various devices and modes, such as face recognition, QR code scanning, or online login.

2. Literature Review

2.1. Survey of Existing System

1. Traditional Manual Systems:

   Educational institutions often rely on error-prone manual methods, including paper-based registers and manual spreadsheet entries, leading to time-consuming processes and inaccurate attendance records.

2. Barcode & RFID Systems:

   Some institutions use barcode or RFID systems, involving scanning for attendance. While more efficient than manual methods, these systems require physical contact and are prone to errors if codes or cards are lost or damaged.

3. Biometric & Facial Recognition Systems:

   Biometric-based systems, using fingerprint or iris recognition, offer reliability but may face challenges in poor lighting and hygiene concerns. Automated facial recognition systems, utilizing OpenCV-based algorithms, provide a non-intrusive and contactless approach, eliminating the need for physical cards or biometric scans.

4. Commercial Attendance Software:

   Various commercial software solutions offer attendance management features, including data analytics, reporting, and integration with student information systems. The accuracy and performance of facial recognition capabilities in these systems may vary.

2.2. Research Gap

1. Enhanced Accuracy in Challenging Conditions:

   Research ways to improve accuracy in challenging conditions like low lighting, occlusions, facial expressions, and poses. Explore techniques such as adaptive illumination normalization, multi-modal fusion, and pose-invariant algorithms.

2. Real-Time Scalability and Performance:

   Develop systems for efficient real-time attendance tracking in large-scale scenarios. Address challenges in data processing, storage, and network communication for seamless performance. Explore distributed computing, cloud solutions, and optimization algorithms for enhanced scalability and response time.

3. Ethical & Privacy Considerations:

   Research ethical and privacy implications in educational settings. Establish best practices for consent, data security, bias mitigation, and legal compliance. Explore privacy-preserving techniques like differential privacy to address concerns and build trust.

4. User Friendly Interfaces & Accessibility:

   Design user-friendly interfaces for teachers, administrators, and students. Consider ease of use, intuitive navigation, and accessibility for individuals with disabilities. Incorporate user-centered design studies, stakeholder feedback, and universal design principles.

5. User Friendly Interfaces & Accessibility:

   Research seamless integration with existing systems like student information or learning management systems. Develop standardized data formats, APIs, or interoperability protocols for data exchange.

3. Requirements

 3.1. Functional Requirements

  1. User Authentication: Teachers and administrators should have a secure login process within the system, and access to the attendance management features should only be granted with legitimate credentials.

  2. Student Registration: Teachers and administrators should be able to register students using the system by obtaining their personal data, including name, ID, and photo.

  3. Face Recognition: The detected faces should be recognized by the system and matched with the faces of the pre-registered students.

  4. Attendance Recording: Students who have been identified should have their attendance recorded in real time by the system by being marked as "present".

  5. Attendance Management: Using the functionalities of the system, teachers and administrators should be able to see, modify, and manage attendance records.

  6. Database Integration: In order to safely store and manage student profiles, attendance records, and related data, the system should interface with a MySQL database.

  7. User Interface: For teachers or administrators to access and handle attendance management responsibilities with ease, the system should feature an easy-to-use and simple interface.

3.2. Non-Functional Requirements

1. Accuracy and Reliability: High accuracy face identification and recognition should be a feature of the system, with minimum false positives and false negatives in the attendance tracking process. Face recognition should be reliable and consistent across different lighting conditions, facial expressions, and camera angles.

2. Real-Time Performance: The system should operate in real-time, providing quick and efficient face detection and recognition. It should be capable of handling a continuous stream of video or images and process them in a timely manner to ensure seamless attendance tracking during classes.

3. Security and Privacy: The system should implement stringent security measures to protect student data and ensure privacy. Access controls, user authentication, and encryption techniques should be in place to prevent unauthorized access, data breaches, and ensure secure transmission and storage of data.

4. Scalability: The system should be scalable to accommodate many students and handle multiple classrooms or educational institutions. It should efficiently manage and process attendance data, ensuring optimal performance even with increasing data volume.

5. Usability: The system should be user-friendly, intuitive, and easy to use. It should require minimal training for teachers and administrators to navigate and perform attendance management tasks. Clear instructions, error messages, and tooltips should be provided to facilitate smooth user interaction.

6. Robustness and Error Handling: The system should handle errors gracefully and provide informative error messages to users. It should have robust error handling mechanisms to recover from unexpected situations, such as network failures or system errors, without data loss or corruption.

7. Maintainability and Extensibility: The system should be designed in a modular and maintainable manner, allowing for easy updates, bug fixes, and enhancements. It should follow best practices in coding standards, documentation, and version control to ensure maintainability and ease of future development. The system should be extensible to accommodate future requirements or additional features, ensuring its longevity and adaptability to evolving technological advancements.

4. Overall Description

4.1. System Overview

An Online Attendance Management System is a digital solution designed to streamline and automate the process of tracking and managing attendance for organizations, educational institutions, or businesses. Utilizing web-based platforms or applications, this system allows users to efficiently record and monitor attendance in real-time. It typically includes features such as user authentication, automated data capture through biometrics, RFID, or QR codes, and comprehensive reporting tools. The system enhances accuracy, reduces the likelihood of errors associated with manual attendance tracking, and provides administrators with valuable insights into attendance patterns and trends. Additionally, it often incorporates notification features, ensuring timely alerts for absenteeism or late arrivals. Overall, the Online Attendance Management System contributes to increased efficiency, transparency, and data accuracy in attendance tracking processes.

## 4.2. System Interface

4.2.1. Hardware Interface

1. Computer : You will need a computer or server to run the Python code.

2. Webcam : A high-resolution webcam is required for capturing facial images. Most built-in laptop webcams or external webcams will work.

3. GPU : If you plan to use deep learning models for facial recognition, having a GPU (Graphics Processing Unit) can significantly accelerate model training and inference. NVIDIA GPUs are commonly used for deep learning tasks.

4.2.2. Software Interface

1. Operating System: The project is compatible with Windows 10, macOS, and Linux.

2. Python: The project is developed in Python 3.7. It is recommended to create a virtual environment for managing Python packages.

3. Development Environment: The code is written and tested in Visual Studio Code, a popular and user-friendly Python IDE or PyCharm will also work.

4. Libraries & Frameworks: OpenCV (version 4.5.2) for image processing and webcam access, Dlib (version 19.22.0) for facial detection and landmarks.
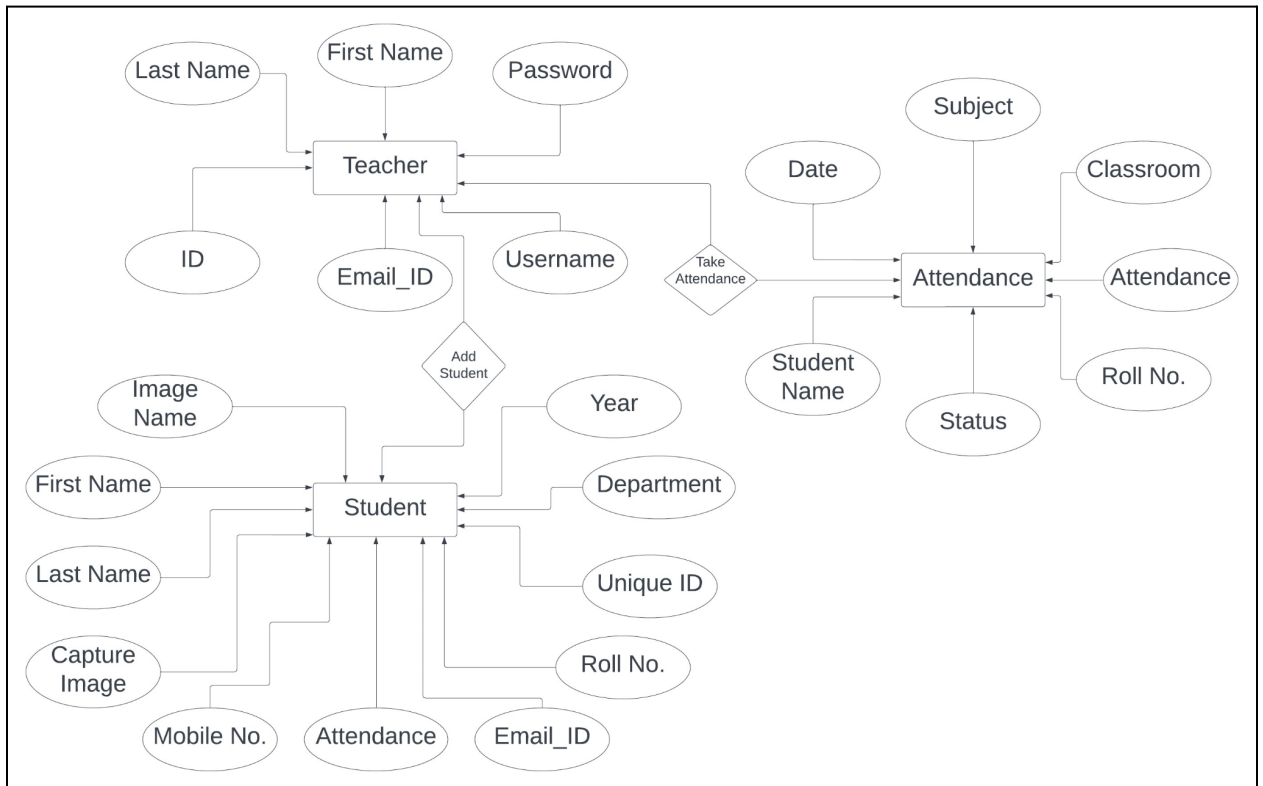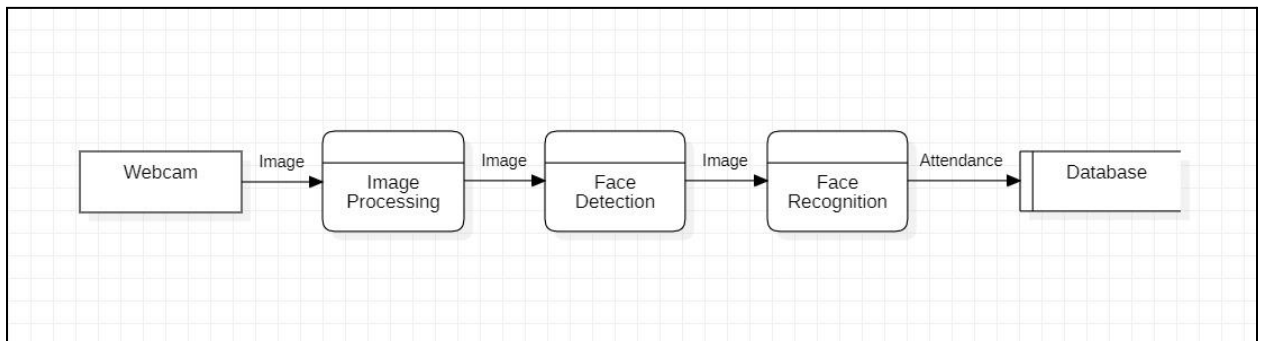
5. System Design

5.1. System Architecture
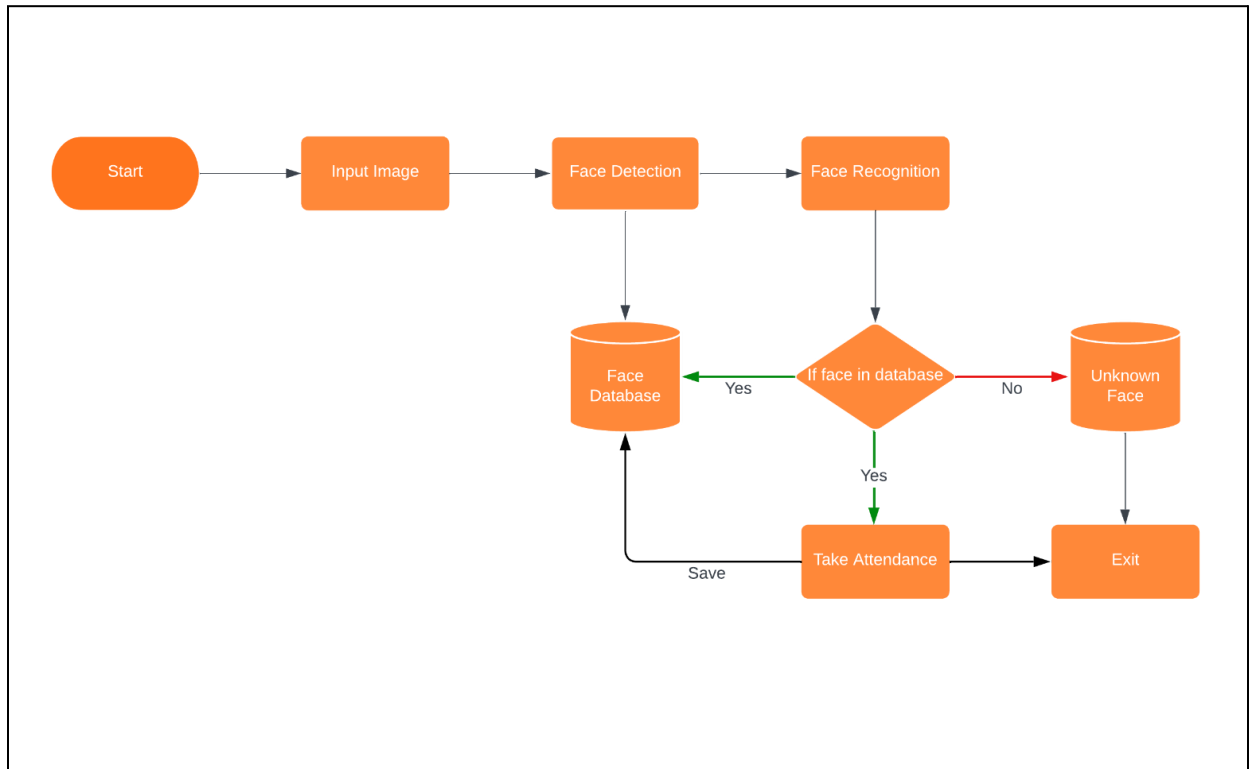
5.2. Use Case Diagram
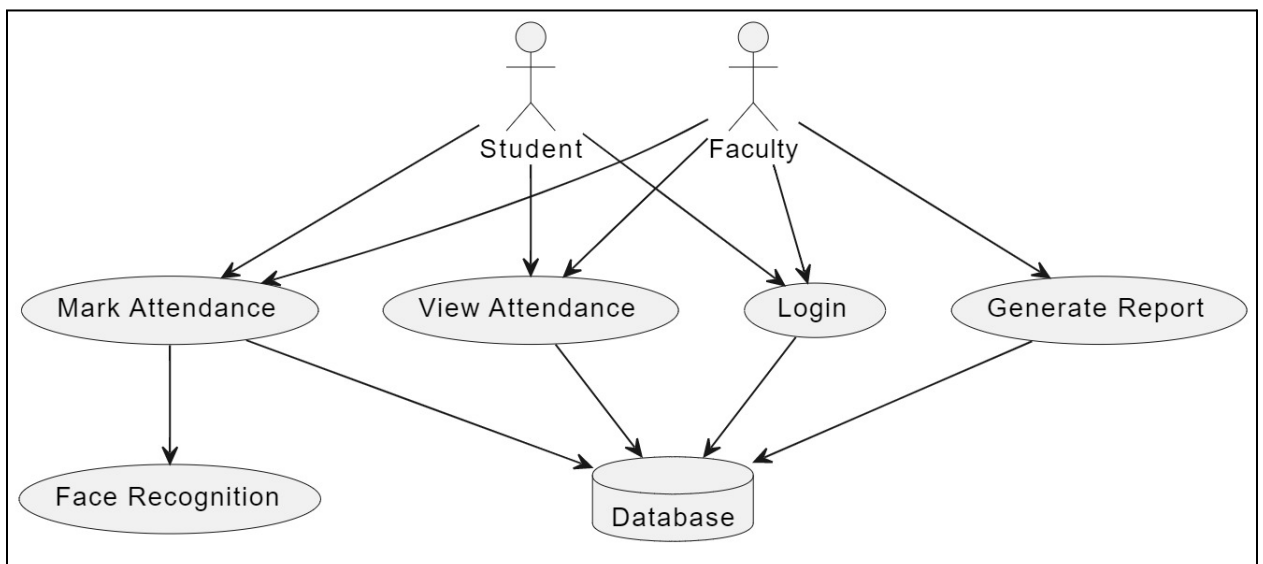
5.3. ER Diagram

5.4. Data Flow Diagram (Level 0)

5.5. Sequence Diagram