FACE RECOGNITION ATTENDANCE SYSTEM

A
Research Project Report (Stage 1)

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology
in
Computer Science and Engineering

Submitted by

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Certificate

This is to certify that the Research Project report work entitled "**FACE RECOGNITION ATTENDANCE SYSTEM**" is a bonafide work carried out by a team consisting of **M.Hemalatha Yadav** bearing Roll no. **22SS1A0528**, **T. Nalini** bearing Roll no. **22SS1A0551**, **K. Srilatha** bearing Roll no. **22SS1A0519**, **T.Madhu Kiran** bearing Roll no. **22SS5A0552**, in partial fulfillment of the requirements for the degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE AND ENGINEERING discipline to Jawaharlal Nehru Technological University Hyderabad Unviersity College of Engineering Sultanpur during the academic year 2023 - 2024.

The results embodied in this report have not been submitted to any other University or Institution for the award of any degree or diploma.

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Declaration

We hereby declare that the Research Project entitled " **FACE RECOGNITION ATTENDANCE SYSTEM**" is a bonafide work carried out by a team consisting of **M.Hemalatha Yadav** bearing Roll no. **22SS1A528**, **T.Nalini** bearing Roll no.**22SS1A0551**, **K.Srilatha** bearing Roll no. **22SS1A0519**, **T.Madhu Kiran** bearing Roll no. **22SS5A0552**, in partial fulfillment of the requirements for the degree of Bachelor of Technology in Computer Science and Engineering discipline to Jawaharlal Nehru Technological University Hyderabad University College of Engineering Sultanpur during the academic year 2023- 2024. The results embodied in this report have not been submitted to any other University or Institution for the award of any degree or diploma.

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Abstract

In colleges, universities, organizations, schools, and offices, taking attendance is one of the most important tasks that must be done on a daily basis. The majority of the time, it is done manually, such as by calling by name or by roll number. The main goal of this project is to create a Face Recognition-based attendance system that will turn this manual process into an automated one. This project meets the requirements for bringing modernization to the way attendance is handled, as well as the criteria for time management. This device is installed in the classroom, where and student's information, such as name, roll number, class, sec, and photographs, is trained. The images are extracted using Open CV. Before the start of the corresponding class, the student can approach the machine, which will begin taking pictures and comparing them to the qualified dataset. Logitech C270 web camera and NVIDIA Jetson Nano Developer kit were used in this project as the camera and processing board. The image is processed as follows: first, faces are identified using a Haarcascade classifier, then faces are recognized using the LBPH (Local Binary Pattern Histogram) Algorithm, histogram data is checked against an established dataset, and the device automatically labels attendance. An Excel sheet is developed, and it is updated every hour with the information from the respective class instructor.

Keywords: Face Detection, Face Recognition, HaarCascade classifier, NVIDIA Jetson Nan

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Chapter 1

INTRODUCTION

A face recognition attendance system utilizes advanced biometric technology to accurately identify individuals based on their unique facial features. By capturing and comparing facial images through cameras, this system provides a seamless and secure method for tracking attendance in various settings such as schools, offices, and public institutions. It enhances efficiency by eliminating the need for traditional methods like swipe cards or manual registers, offering real-time data and improving overall operational management.

1.1 Project Overview

The face recognition attendance system project introduces a modern approach to attendance management by employing facial recognition technology. The project involves implementing robust facial recognition algorithms, integrating hardware components like cameras, and developing a user-friendly interface for seamless operation in educational and organizational environments. Evaluation will focus on assessing system performance, reliability, and user satisfaction to demonstrate its practical benefits.

1.2 Problem Statement

The face recognition attendance system project seeks to resolve the limitations of conventional attendance tracking methods prevalent in educational institutions and corporate environments. Existing systems often suffer from inaccuracies due to manual entry errors or the ease of proxy attendance. Moreover, traditional methods such as swipe cards or PIN codes are susceptible to misuse or loss, compromising security and reliability. By adopting facial recognition technology, this project aims to establish a robust and automated system capable of accurately identifying individuals based on their unique facial features. The system's implementation intends to streamline attendance recording processes, eliminate fraudulent practices, and enhance overall operational efficiency. Additionally, it aims to address privacy concerns and ensure compliance with data protection regulations, providing a secure and user-friendly solution for managing attendance in diverse organizational contexts.

1.3 Aims and Objectives

The objective of this project is to develop face recognition attendance system. Expected achievements in order to fulfill the objectives are:

To detect the face segment from the video frame.

To extract the useful features from the face detected.

To classify the features in order to recognize the face detected.

To record the attendance of the identified student

1.4 Scope of the project

We are setting up to design a system comprising of two modules. The first module (face detector) is a mobile component, which is basically a camera application that captures

student faces and stores them in a file using computer vision face detection algorithms and face extraction techniques. The second module is a desktop application that does face recognition of the captured images (faces) in the file, marks the students register and then stores the results in a database for future analysis .

1.5 Conclusion

In conclusion, the implementation of a facial recognition-based automatic attendance system represents a significant advancement over traditional manual methods. By prioritizing user-friendliness and leveraging modern technologies, the system enhances operational efficiency, ensures reliability in attendance recording, and strengthens overall security. The detailed exploration of software components, face detection algorithms, and database management underscores its potential to deliver improved accuracy and mitigate attendance-related challenges. Looking ahead, addressing identified challenges and pursuing further enhancements will be crucial for optimizing the system's performance and expanding its practical applications across various organizational contexts.

Chapter 2

System Analysis

2.1 Requirement Analysis

2.1.1 Functional Requirements

- **Facial Recognition Accuracy**: Specify the system's capability to accurately detect and recognize faces under varying conditions such as lighting and facial expressions.
- **Real-time Processing**: Ensure the system can process facial data in real-time to capture attendance promptly.
- **Attendance Recording**: Define how attendance data will be recorded and stored securely in a central database.
- **User Interface**: Describe requirements for an intuitive user interface that allows administrators to manage attendance records and generate reports easily.
-

2.1.2 Non-functional Requirements

- **Performance**: Define performance metrics such as recognition speed and system response time under peak loads.

- **Security**: Outline requirements for data security, including encryption of facial images and attendance records, and measures to prevent unauthorized access.
- **Reliability**: Specify the system's availability and reliability, ensuring minimal downtime and accurate attendance tracking.
- **Scalability**: Define how the system should scale as the number of users and data volume increases over time.
- **Usability**: Describe usability requirements to ensure the system is easy to use for administrators and end-users, minimizing training needs.

2.1.3 Operational Constraints

Environmental Conditions: Consider constraints such as lighting conditions for facial image capture and potential noise interference.

Regulatory Compliance: Ensure the system complies with data protection regulations (e.g., GDPR, HIPAA) regarding the collection, storage, and processing of biometric data.

2.2 System Design

2.2.1 Architecture Overview

The system will consist of several key components:

- **Camera Setup**: High-resolution cameras strategically placed to capture facial images of individuals entering designated areas.
- **Facial Recognition Software**: Utilizes advanced algorithms to detect and verify identities based on stored facial templates.
- **Database Management**: Centralized database to store attendance records securely and integrate with existing organizational databases if applicable.

- **User Interface**: Intuitive interface for administrators to manage system settings, view attendance reports, and handle exceptions.

2.2.2 Component Details

- **Camera Configuration**: Discuss the specifications of cameras used, such as resolution, frame rate, and positioning to ensure optimal facial image capture.
- **Facial Recognition Algorithm**: Describe the specific algorithm employed for facial feature extraction and comparison against stored templates.
- **Database Schema**: Outline the structure of the database schema, including tables for storing facial templates, attendance logs, and metadata.
- **User Interface Design**: Provide mockups or describe the design principles of the user interface, emphasizing ease of use and functionality for administrators.

2.2.3 Integration and Connectivity

- **Integration with Existing Systems**: Detail how the system will integrate with current attendance management systems or student information systems.
- **Network Requirements**: Specify network requirements for real-time data transmission between cameras, facial recognition software, and the database.
- **Security Protocols**: Outline security measures such as data encryption, access controls, and audit logs to protect sensitive biometric and attendance data.

2.3 Data Flow Diagram

- **Face Recognition Attendance System**: The main component where overall control and coordination occur.
- **Camera Capture Module**: Captures facial images of individuals entering designated areas.

- **Facial Recognition Algorithm**: Processes the captured images to identify and verify individuals based on stored facial templates.
- **Attendance Database Management**: Stores attendance records securely and manages data related to attendance logs, facial templates, and other relevant information.

This simplified DFD illustrates the basic flow of data and activities within the face recognition attendance system, focusing on capturing facial images, processing them through recognition algorithms, and storing attendance records in a centralized database.

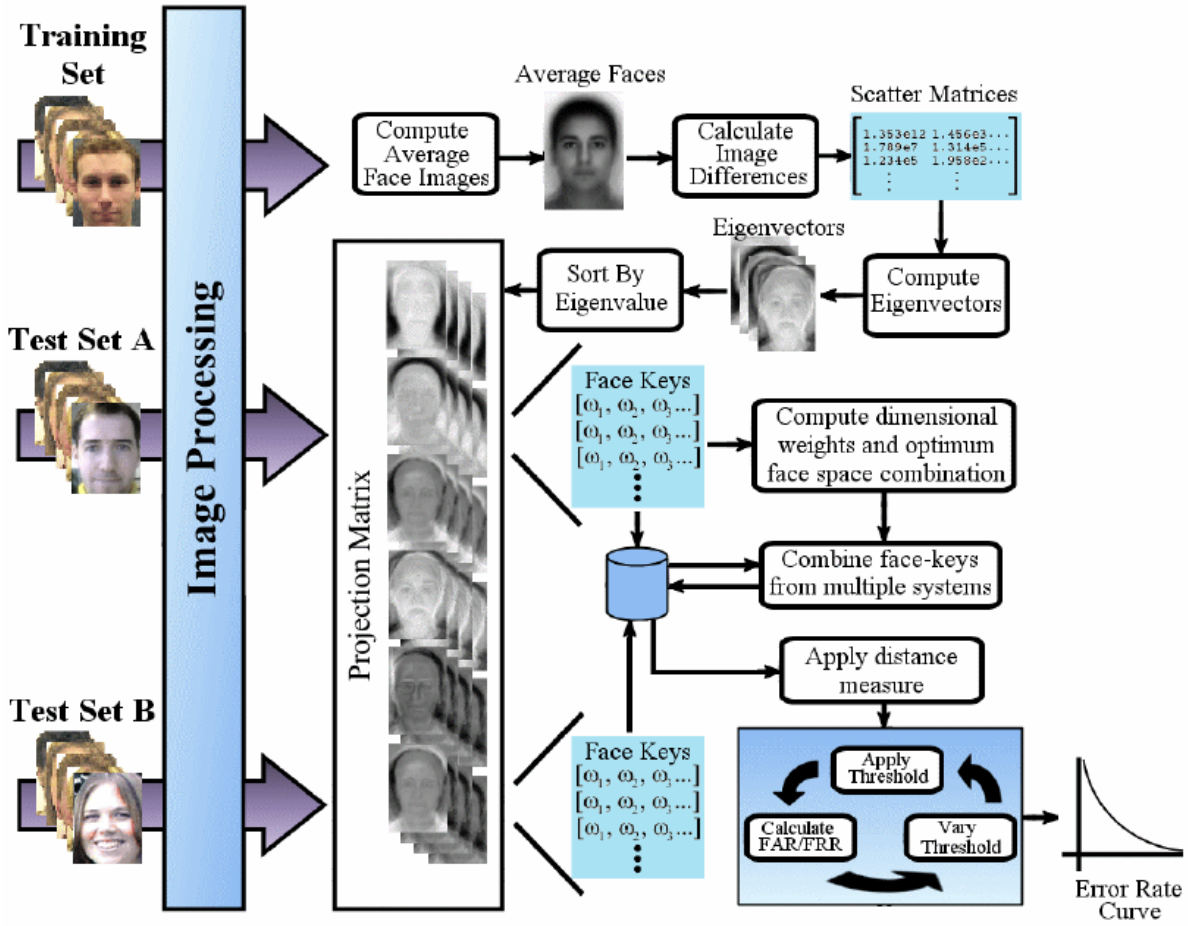


Figure 2.1: *System Architecture*

2.4 Integration and Compatibility

In the face recognition attendance system project report, integration and compatibility considerations are critical to ensure seamless operation within existing infrastructure.

The system must integrate smoothly with current attendance management systems or student information databases, facilitating data synchronization and minimizing operational disruptions. Compatibility with diverse hardware setups and network configurations is essential for robust performance across different environments, ensuring reliable facial image capture, processing, and attendance recording.

2.5 Cost-Benefit Analysis

The cost-benefit analysis for the face recognition attendance system project indicates a substantial initial investment in hardware and software development. However, the long-term benefits include improved accuracy in attendance tracking, reduced administrative workload, and enhanced security measures, ultimately leading to operational efficiency and cost savings over time.

Chapter 3

LITERATURE SURVEY

3.1 Introduction

It provides an overview of the foundational research and advancements in face recognition technology, setting the stage for understanding its application in attendance management.

3.2 Student Attendance System

The student attendance system leveraging face recognition technology aims to streamline attendance management by offering seamless and accurate tracking. It enhances efficiency by automating the attendance process, reducing manual errors, and providing real-time data insights for educators and administrators. Additionally, it promotes a secure and transparent environment while ensuring student privacy and compliance with data protection regulations.

3.3 Digital Image Processing

Digital image processing plays a pivotal role in the face recognition attendance system by first capturing high-quality images of individuals. It then employs algorithms to preprocess and enhance these images, extracting key facial features for accurate recognition. Through techniques like pattern recognition and machine learning, it enables the system to match captured faces with stored templates, ensuring reliable attendance tracking and authentication in various environments and conditions.

3.4 Image Representation in a Digital Computer

Image representation in a digital computer for the face recognition attendance system involves converting visual data into a numerical format that can be processed and analyzed. Advanced techniques such as grayscale or RGB encoding further refine these representations, enabling algorithms to extract and compare facial features accurately for identification and attendance purposes.

3.5 Face Detection

Face detection is a critical component of the face recognition attendance system, involving algorithms that identify and locate human faces within digital images or video frames. Techniques such as Haar cascades or deep learning-based convolutional neural networks (CNNs) analyze patterns and features to distinguish faces from backgrounds or other objects. This initial step is essential for subsequent processes like face alignment and feature extraction, enabling accurate recognition and attendance tracking based on detected faces in various environmental conditions.

3.6 Local Binary Pattern Histogram

The Local Binary Pattern (LBP) histogram is a robust feature extraction method utilized in face recognition attendance systems. It operates by dividing the face into small regions and computing a binary pattern for each pixel based on its neighboring pixels' intensity values. These patterns are then represented as histograms, capturing unique texture information from facial regions. By comparing these histograms across stored templates, the system can accurately identify individuals, making LBP an efficient and effective technique for enhancing recognition accuracy in diverse lighting and pose conditions within attendance systems.

3.7 Conclusion

In conclusion, the literature survey highlights the evolution of face recognition technology, emphasizing its critical role in enhancing attendance systems through improved accuracy, efficiency, and security measures.

Chapter 4

Requirement specification

Language Used: OpenCV python Operating systems : Windows 10/11 Platform : Windows, Linux, MacOs Front-End :Tkinter, PyQt, or Kivy Back-End : SQLite, MySQL, or MongoDB

4.1 Hardware Requirement:

The hardware requirements for a face recognition attendance system typically include:

- **Camera:** High-resolution cameras capable of capturing clear images for accurate face detection and recognition.
- **Processor:** Powerful CPUs or GPUs to handle real-time image processing and deep learning computations.
- **Memory:** Sufficient RAM to store and manipulate large datasets of images and attendance records.
- **Storage:** Adequate storage space for storing image datasets, attendance records, and system logs.
- **Network:** Stable network connectivity for real-time communication with databases and other networked devices.

- **Display:** Monitors or display screens for viewing attendance information and system status.

4.2 Conclusion

In conclusion, Hardware and Software are required to make a computer system to operate effectively. Hardware is the physical components while the software forms the interface between the hardware and software.

Chapter 5

WORKING OF SYSTEM

A facial recognition-based attendance system can streamline attendance tracking and reduce the administrative burden on organizations. However, it is important to ensure that such systems are designed and implemented with due consideration for privacy and security concerns. To implement our model we need a PC/Laptop with 4 GB+ RAM, i3 5th Generation 2.2 Ghz or equivalent/higher and atleast 128 GB SSD.

Tools we used: Python 3.9+ Python Libraries (Numpy, OpenCV, face_recognition, os, datetime) Visual Studio Code. In our proposed model we have taken following steps to implement our model.

Database Creation: At first database is created manually. A clear picture of every student is added to a folder and each image file is named as their Roll number or enrolment number which should be unique.

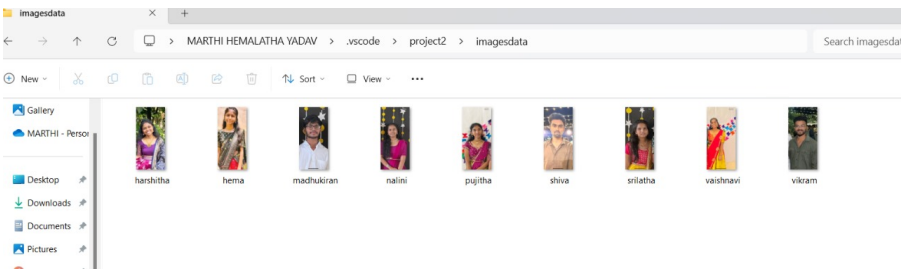


Figure 5.1: *Student's Database*

Image Amelioration:

In a classroom every student may not be in idle position. Due to movements, image captured by the camera may get blurred. So generative adversarial networks can be used to get the texture information from images.

Face Detection:

One of the most important steps in this system. Input is taken from a video sequence which is generally in RGB format which is converted to grayscale. Using Haar Cascade algorithm face detection process is done. We have certain features to detect a face like eyebrows, bridge between two eyes or lips. In Haar Cascade algorithm almost 6000 features are used to detect a face. At first, a combination of features is applied to images pixel by pixels. These features will match only if a face exists. Those pixels with which features got matched is saved and by this the face is detected. Then a face boundary box is drawn.

Face Recognition:

Feature extraction and matching is done with LBPH (Local Binary Patterns Histogram). In LBPH 9 pixels (3x3 matrix) is taken. Central pixel is compared with its surrounding 8 pixels. The range of intensity of a pixel is 0 to 255. The central pixel value is considered as the threshold. Among surrounding pixels, if intensity of a pixel is equal to or higher than the threshold value then it is marked as 1 or else 0. Now we get a binary number for a combination of 8 pixels. This binary value is converted into decimal and set into the central pixel. By doing this to the whole image we get similar values for each 3x3 matrix. Now we plot a histogram based on those decimal value for each region and later all these are concatenated to get a bigger histogram which represents the characteristics of an image. This histogram is unique for any faces. After extracting the features it is compared to the images in the database.

Report Generation:

Faces from video sequence input from the camera are compared to the images in the database. If any face matches its roll no. is shown and the attendance is marked in the CSV file .

5.1 Conclusion

The system architecture designed for the face recognition attendance system demonstrates a cohesive integration of hardware and software components. By leveraging advanced image processing, face detection, and recognition algorithms, the system achieves robust attendance tracking capabilities. The modular design allows for scalability and adaptability to different environments, while the inclusion of a user-friendly interface enhances usability for administrators and users alike. Overall, this architecture ensures efficient and accurate attendance management through innovative application of face recognition technology.

Chapter 6

Code Implementation

6.1

Chapter 7

DESIGN

The design introduction for the face recognition attendance system project report outlines the framework integrating hardware like cameras with software modules for real-time face detection, recognition, and attendance recording, ensuring accurate and efficient attendance management.

7.1 Use Case Diagram

The use case diagram for the face recognition attendance system project illustrates actors such as administrators and users interacting with system functions like face detection, recognition, attendance marking, and database management. It visualizes how different stakeholders interact with the system to achieve efficient attendance tracking through facial recognition technology.

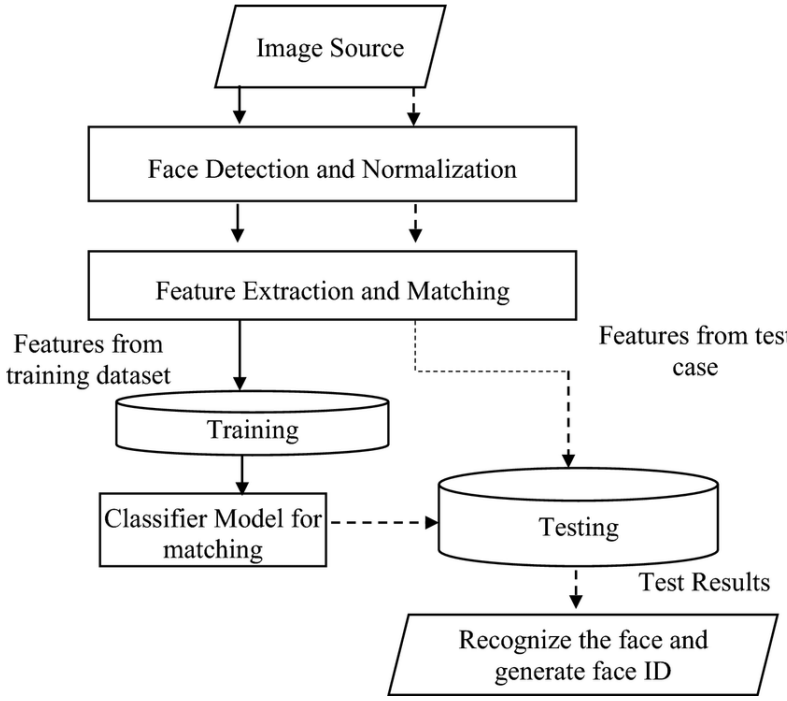
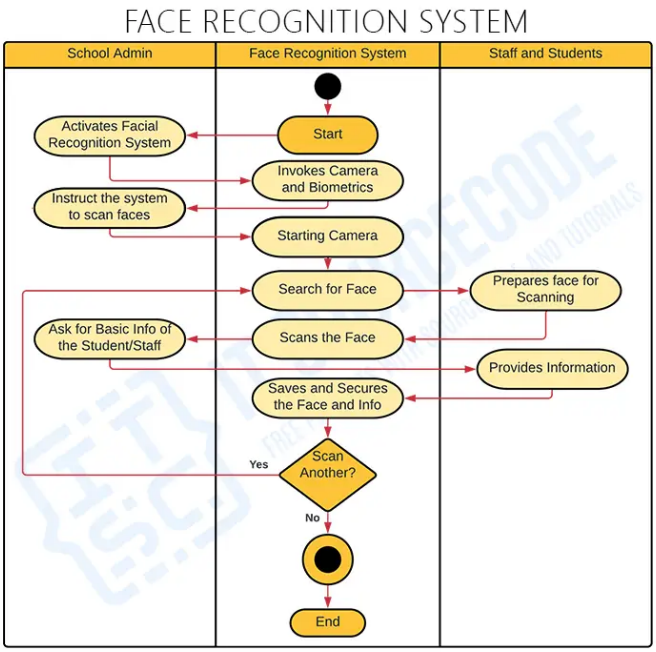


Figure 7.1: *Use Case diagram*

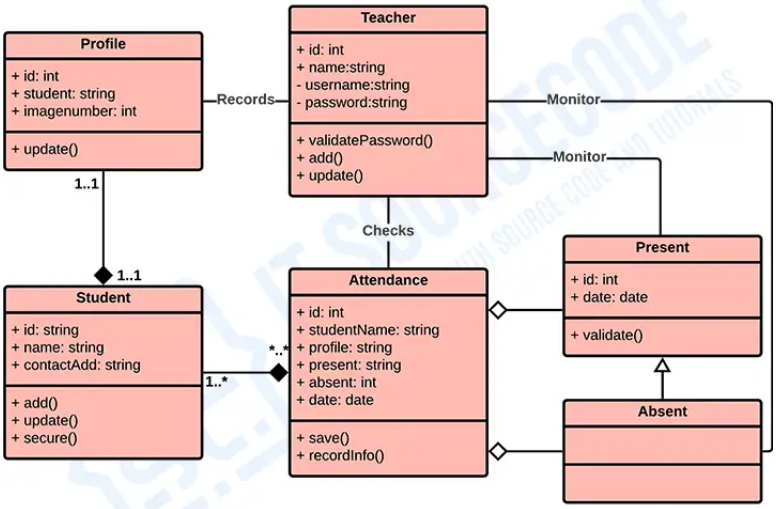
7.2 Activity Diagram

The activity diagram for the face recognition attendance system project depicts sequential steps involved in attendance tracking: starting from image acquisition, preprocessing for quality enhancement, face detection to identify faces, feature extraction for unique characteristics, face recognition to match against stored templates, and finally, updating attendance records in the database. It visually represents the systematic flow of operations within the system to ensure accurate and reliable attendance management through face recognition technology.



7.3 Class Diagram

The class diagram for the face recognition attendance system project illustrates the structure of the system's objects and their relationships. It includes classes such as Camera, ImageProcessor, FaceDetector, FaceRecognizer, AttendanceRecord, and DatabaseManager, showing how these components interact to facilitate image capture, processing, face detection, recognition, attendance logging, and database management for efficient attendance tracking using face recognition technology.



CLASS DIAGRAM

Figure 7.2: *Class diagram*

7.4 Flow Chart Diagram

The flow chart diagram for the face recognition attendance system project visually maps the sequential steps involved in the system's operation. It begins with image acquisition from cameras, followed by preprocessing for image enhancement, face detection to locate faces, feature extraction to capture facial features, face recognition to match against stored templates, and concludes with updating attendance records in the database. This diagram serves as a roadmap illustrating the systematic flow of operations in achieving accurate attendance tracking through face recognition technology.

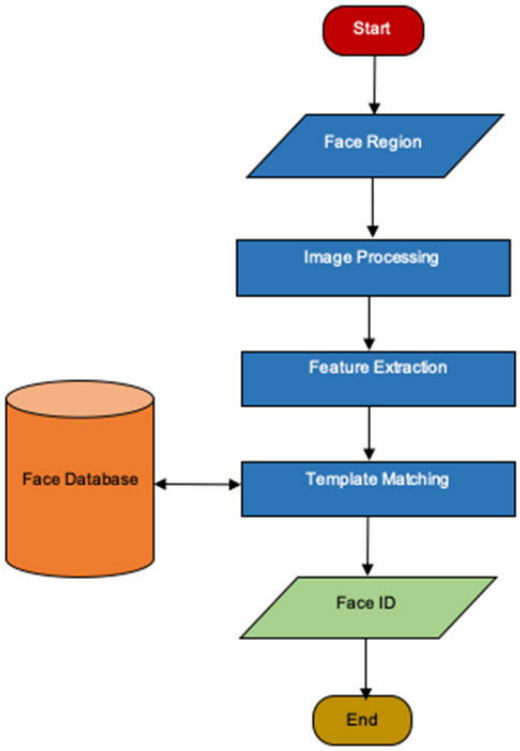


Figure 7.3: *Flow Chart diagram*

7.5 Conclusion

In conclusion, the design of the face recognition attendance system project effectively integrates hardware and software components to achieve reliable attendance tracking through advanced facial recognition technology. The structured approach ensures efficiency in data acquisition, processing, and management, offering a robust solution for accurate attendance monitoring in diverse environments.

Chapter 8

Testing

Testing for the face recognition attendance system involves several critical phases to ensure its reliability and accuracy:

1. **Unit Testing**: Each module (e.g., face detection, feature extraction, recognition) is tested individually to verify functionality and identify any bugs or errors.
2. **Integration Testing**: Modules are integrated and tested together to ensure they work seamlessly as a unified system. This includes testing communication between modules and handling of data flows.
3. **Performance Testing**: The system's performance is evaluated under various conditions, such as different lighting conditions, varying camera angles, and different facial expressions. This ensures that the system can reliably recognize faces in real-world scenarios.
4. **Accuracy Testing**: The accuracy of face recognition is measured by comparing recognized faces against a ground truth dataset. Metrics such as True Positive Rate (TPR), False Positive Rate (FPR), and Recognition Rate are calculated to assess the system's performance.
5. **User Acceptance Testing (UAT)**: End-users, such as administrators and users, participate in UAT to validate the system meets their requirements. Feedback is gathered to improve usability and address any user-related issues.
6. **Security Testing**: The system undergoes security testing to identify and mitigate

vulnerabilities, ensuring that sensitive data, such as facial images and attendance records, are protected from unauthorized access or manipulation.

7. **Stress Testing**: The system is tested under high loads to evaluate its stability and performance under extreme usage conditions, ensuring it can handle peak attendance recording times without issues.

By conducting thorough testing across these phases, the face recognition attendance system can be validated for robustness, accuracy, and reliability, ensuring it meets the intended objectives of efficient and secure attendance management.

Chapter 9

Result

In summary, the face recognition attendance system represents a transformative solution in modern attendance management, driven by advancements in computer vision and artificial intelligence. By effectively combining hardware components like cameras with sophisticated software algorithms for face detection, recognition, and database management, the system achieves remarkable accuracy and efficiency in tracking attendance. Its implementation ensures seamless integration into various environments, offering real-time monitoring capabilities that reduce administrative burdens and enhance organizational productivity. Moreover, the system's ability to operate reliably under diverse conditions underscores its potential to significantly improve operational workflows and data integrity in educational institutions and corporate settings alike.

Chapter 10

CONCLUSION

In conclusion, the face recognition attendance system represents a significant advancement in attendance management, leveraging cutting-edge technology to enhance accuracy, efficiency, and security. By seamlessly integrating hardware components such as cameras with sophisticated software modules including image processing algorithms and deep learning-based face recognition techniques, the system offers a reliable solution for real-time attendance tracking. The implementation ensures seamless operation through systematic image acquisition, preprocessing, face detection, feature extraction, and matching against stored templates, culminating in precise attendance records stored securely in a database. This comprehensive approach not only streamlines administrative tasks but also improves overall organizational efficiency and transparency in attendance monitoring.

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