VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", Belagavi-590018

Mini Project Report on

ADVANCED FACE RECOGNITION ATTENDANCE SYSTEM

Submitted in partial fulfilment of the requirement for the award of Degree of

Bachelor of Engineering in CSE-AI

Submitted by

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SVCE BENGALURU
A Premier Institute in Technical Education
SRI VENKATESHWARA COLLEGE OF ENGINEERING
AFFILIATED TO VTU, APPROVED BY AICTE, RECOGNISED BY UGC U/S 2(F) & 12(B)

Department of Computer Science Engineering – Artificial Intelligence

SRI VENKATESHWARA COLLEGE OF ENGINEERING
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SRI VENKATESHWARA COLLEGE OF ENGINEERING

Department of Computer Science Engineering - Artificial Intelligence

CERTIFICATE

This is to Certify that the Mini Project entitled **"ADVANCED FACE RECOGNITION ATTENDANCE SYSTEM"** was carried out by **ISHA KUMARI (1VE21CA016), RIDDHI KAPIL (1VE21CA038), SHAISHTA ANJUM (1VE21CA045) and SIDDHI KAPIL (1VE21CA046)** are bonafide students of VI Semester, Department of Computer Science & Engineering – Artificial Intelligence, Sri Venkateshwara College of Engineering. This is in partial fulfilment for the award of Bachelor of Engineering in the Visvesvaraya Technological University, Belagavi during the academic year 2023-2024. The Mini project report has been approved as it satisfies the academic requirements in the respect of Mini Project(21AIMP67) work prescribed for said Degree

Signature of the Guide **Mrs. PREETI M H** Assistant Professor Dept of CSE-AI, SVCE, Bengaluru.	Signature of the HOD **Dr. PRATHIMA V R** Professor & HOD, Dept of CSE-AI, SVCE, Bengaluru.

Name of the Examiner	Signature with date
1) _____	_____
2) _____	_____

DECLARATION

We, **ISHA KUMARI (1VE21CA016), RIDDHI KAPIL (1VE21CA038), SHAISHTA ANJUM (1VE21CA045) and SIDDHI KAPIL (1VE21CA046)** students of Department of Computer Science & Engineering – Artificial Intelligence, Sri Venkateshwara College of Engineering, here by declare that the Mini Project report entitled "**FACE RECOGNITION ATTENDANCE MANAGEMENT SYSTEM**" is an original work done by us under the guidance of **MRS. PREETI M H**, Assistant Professor, Department of CSE-AI, SVCE, Bengaluru, and **Dr. PRATHIMA V R**, Head of the Department, Department of CSE- Artificial Intelligence. We further declare that this report has not been submitted previously for the award of any degree at any institute or university.

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We would also like to express our sincere thanks to the Internal guide **Prof. Preeti M H, Assistant Prof, Dept. of CSE-AI,** SVCE Bengaluru, for guidance and support in bringing this project to completion.

Words cannot express the immense gratitude we have for my **Parents** and **Family members** who has been instrumental in shaping my career. We are thankful to all our **Teaching**, **Non-Teaching faculties** and **friends** who have been the sources of inspiration to all our endeavors.

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Chapter 1: Introduction

1.1 Overview

A Facial Attendance Management System leverages facial recognition technology to monitor and manage attendance efficiently. This system uses machine learning and image processing techniques to identify individuals based on their facial features, ensuring accurate and reliable attendance tracking.

Facial recognition technology plays a pivotal role in this system, analyzing facial attributes to recognize and verify identities. Unlike traditional methods such as manual attendance or swipe cards, facial recognition offers a non-intrusive and automated solution, reducing the chances of errors and fraud.

Attendance management through facial recognition involves capturing an image of the individual, extracting unique facial features, and comparing them with a pre-registered database to mark attendance. This process ensures that only authorized individuals are recorded, enhancing security and accountability.

The implementation of a Facial Attendance Management System can significantly benefit various sectors, including educational institutions, corporate offices, and healthcare facilities. In schools and universities, it streamlines the attendance process, allowing teachers to focus more on teaching. In workplaces, it ensures punctuality and reduces administrative overhead. In healthcare settings, it can help monitor the presence of staff and patients, ensuring efficient and safe operations.

Overall, the Facial Attendance Management System offers a modern, efficient, and secure approach to attendance tracking, leveraging advanced technology to improve accuracy, convenience, and operational efficiency.

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Chapter 2: System Analyses

2.1 Existing System

Initial facial attendance management systems were largely manual or semi-automated, requiring human operators to verify identities. These early systems utilized simple image comparison techniques, relying on basic algorithms to match facial features with stored images. Their accuracy was significantly limited due to the complexity of facial features and variations in factors such as lighting, angles, and expressions. As a result, these systems often struggled with real-world challenges and could not reliably handle the diverse conditions encountered in practical applications.

2.2 Non-Functional Requirements

The proposed system aims to address the shortcomings of existing facial attendance systems by developing an advanced AI-driven solution. This system will offer a more accurate and efficient attendance management experience through the following features:

2.2.1 Scope of the Project

The scope of the facial attendance management system project includes developing and deploying a robust, accurate, and real-time system capable of recognizing and verifying individuals from facial images. This project involves collecting and annotating a diverse set of facial images, implementing advanced preprocessing techniques to enhance image quality, and extracting relevant features for analysis.

2.2.2 Aim of the Project

The aim of the facial attendance management system project is to develop an advanced and reliable system capable of accurately recognizing and verifying individuals from facial images in real-time.

2.2.3 Project Modules

1. User Interface Module

- Develops a user-friendly interface accessible via desktop and mobile devices.
- Ensures secure login and access to system features.
- Provides options for users to input preferences, view attendance records, and manage user profiles.

2. Face Detection Module

- Utilizes the Haarcascade algorithm for detecting faces in images and video streams.
- Employs OpenCV for image processing tasks to enhance detection accuracy and efficiency.
- Preprocesses images to ensure consistent and high-quality input for recognition.

3. Recognition and Verification Module

- Implements advanced machine learning techniques using Scikit-Learn and NumPy for recognizing and verifying individuals.
- Utilizes Joblib for efficient model storage and retrieval.
- Analyzes facial features to match against the registered database and mark attendance accurately.

Chapter 3: Requirement Specifications

3.1 Details of Software

3.1.1 Frontend Development

1. Programming Languages

- **CSS**:
  - Primary language for styling the front-end interface.
- **HTML**:
  - Utilized for structuring web-based components.

2. Frameworks

- **Flask**:
  - Used to create a seamless web-based interface and manage server-side operations.

3. Libraries and Tools

- **OpenCV**:
  - Employed for image processing tasks and face detection.
- **NumPy**:
  - Utilized for numerical operations and data handling.
- **Scikit-Learn**:
  - Implemented for machine learning tasks related to face recognition.
- **Pandas**:
  - Used for data manipulation and storage of attendance records in CSV files.
- **Joblib**:
  - Employed for efficient model storage and retrieval.

4. Frontend Development

- **CSS**:
  - Primary language for styling the front-end interface.
- **HTML**:
  - Utilized for structuring web-based components.

3.2 System Requirements

3.2.1 Hardware Configuration

- **RAM**: Minimum 8 GB for development and testing environments.
- **Processor**: Multi-core processor (4 cores recommended) for efficient computation and performance.
- **Storage**: Minimum 500 GB HDD/SSD to accommodate development tools and project files.
- **Internet**: High-speed internet connection for accessing APIs and cloud services.

3.2.2 Software Configuration

- **Operating System**: Windows 10/11, macOS, or Linux.
- **Integrated Development Environment (IDE)**:
    - Visual Studio Code
    - Android Studio, or XCode.
- **Required Software**:
    - Python and its dependencies for build automation.
    - API keys and libraries for OpenAI Whisper integrations.

Chapter 4: System Design

4.1 Data Flow Diagram

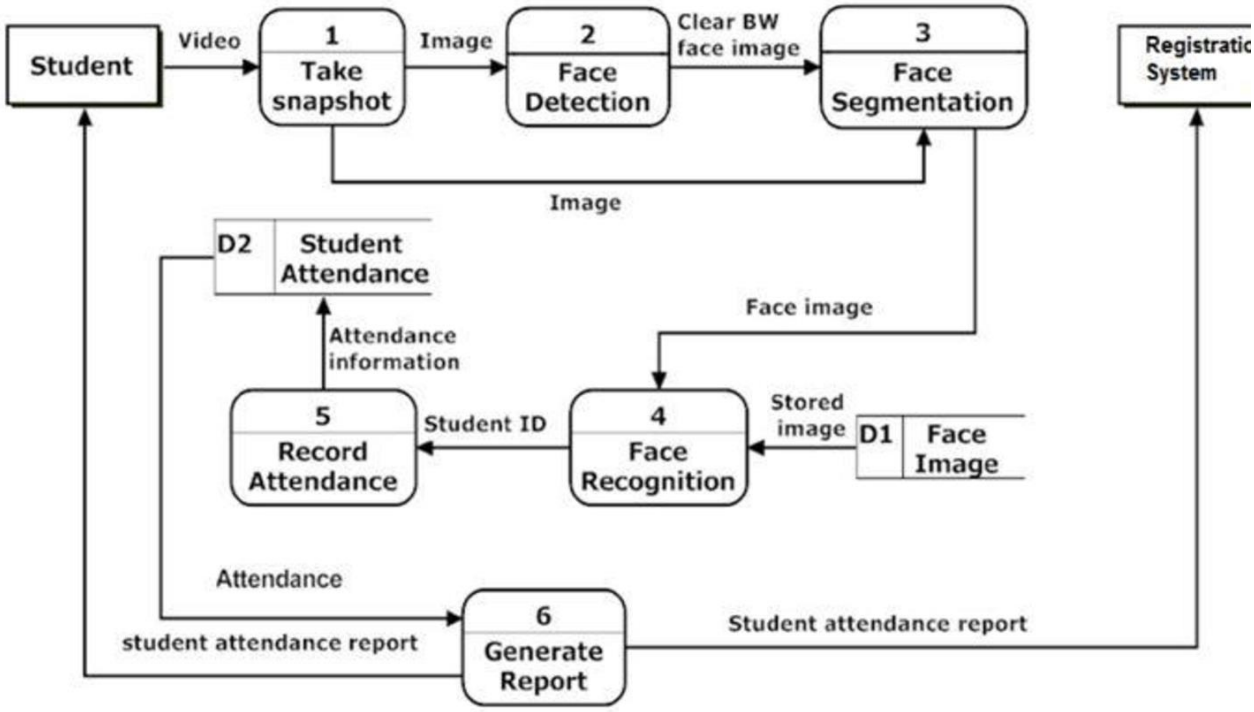

Figure 4.1 Data Flow Diagram

The data flow process in a face detection attendance system begins with capturing raw video input from various sources such as webcams or video files. The captured video is then passed to the Video Processing Module, where it undergoes tasks like frame extraction, noise reduction, and normalization. The processed frames are then fed into the Face Detection Module to identify and locate faces in each frame.

4.2 Sequence Diagram

4.2.1 User Request Sequence Diagram

The User Request Sequence Diagram outlines interactions when a user inputs a query or feature request. Initially, the **User** submits a request via the **Frontend**, which transfers it to the **Backend**. The **Backend** then utilizes the **Core Processing** module, responsiblefor core logic and processing. **Core Processing** interacts with the external **APIs** to gather therequired data. After processing, **Core Processing** returns results to the **Backend**, which

relays them to the **Frontend**. Finally, the **Frontend** efficiently presents the results to the **User**, ensuring the streamlined flow from the request initiation to the result display.

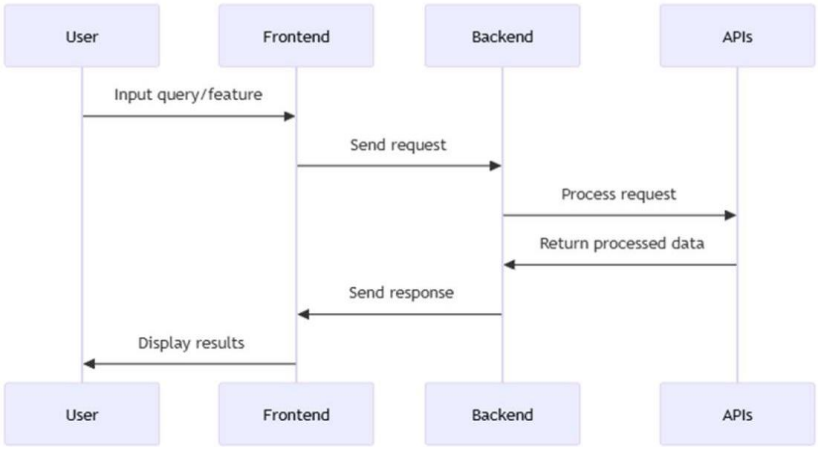

Figure 4.2.1 User Request Sequence Diagram

4.2.2 Error Handling Sequence Diagram

The Error Handling Sequence Diagram manages errors during a user query. The **User** sends a query via the **Frontend** to the **Backend**. The **Backend** forwards it to the **Error Handling** module for validation. If errors are found, the module generates a response sent back to the **Backend**, which then relays it to the **Frontend** for user notification.

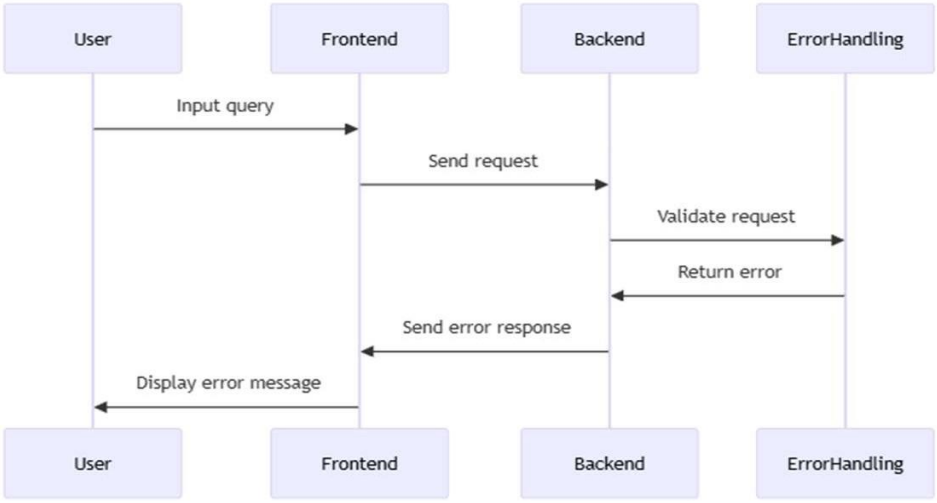

Figure 4.2.2 Error Handling Sequence Diagram

Chapter 5: System Implementation

5.1 Modular Description

5.1.1 User Interface Module

- **Functionality:**
  - Allows users to log in securely and mark attendance using facial recognition.
  - Provides administrators with tools to manage user profiles and view attendance records.
- **Features:**
  - Login Interface: Enables secure login for users and administrators.
  - Attendance Marking: Allows users to mark attendance by presenting their face to the camera.
  - Profile Management: Provides functionalities to update user details and view attendance history.
- **User Flow:**
  1. Login: Users and administrators log in using their credentials.
  2. Attendance Marking: Users position themselves for facial recognition.
  3. Confirmation: System verifies identity and records attendance.

5.1.2 Face Detection Module

- **Functionality:**
  - Utilizes Haar cascades and OpenCV for real-time face detection.
  - Enhances image quality to ensure accurate recognition.
- **Techniques:**
  - Haar Cascade Algorithm: Detects faces by analyzing image features.
  - Image Preprocessing: Improves image clarity for better recognition outcomes.
- **Process Flow:**
  1. Input: Real-time video feed or uploaded images.
  2. Face Detection: Identifies faces within the input stream.

3. Output: Coordinates and characteristics of detected faces.

5.1.3 Recognition and Verification Module

- **Functionality:**
  - Implements deep learning models (e.g., CNNs) for facial feature extraction.
  - Matches detected faces against a database for identity verification.
- **Features:**
  - Deep Learning Models: Utilizes convolutional neural networks (CNNs) for feature extraction.
  - Database Integration: Stores and retrieves registered user profiles.
  - Attendance Logging: Records timestamps for attendance based on recognized faces.

5.1.4 Attendance Logging Module

- **Functionality:**
  - Logs attendance data securely in a centralized database.
  - Generates reports for administrators and users.
- **Features:**
  - Centralized Database: Stores attendance records securely.
  - Report Generation: Provides detailed attendance reports.
  - Data Management: Ensures accuracy and reliability in attendance logging.

Chapter 6: Sample Output

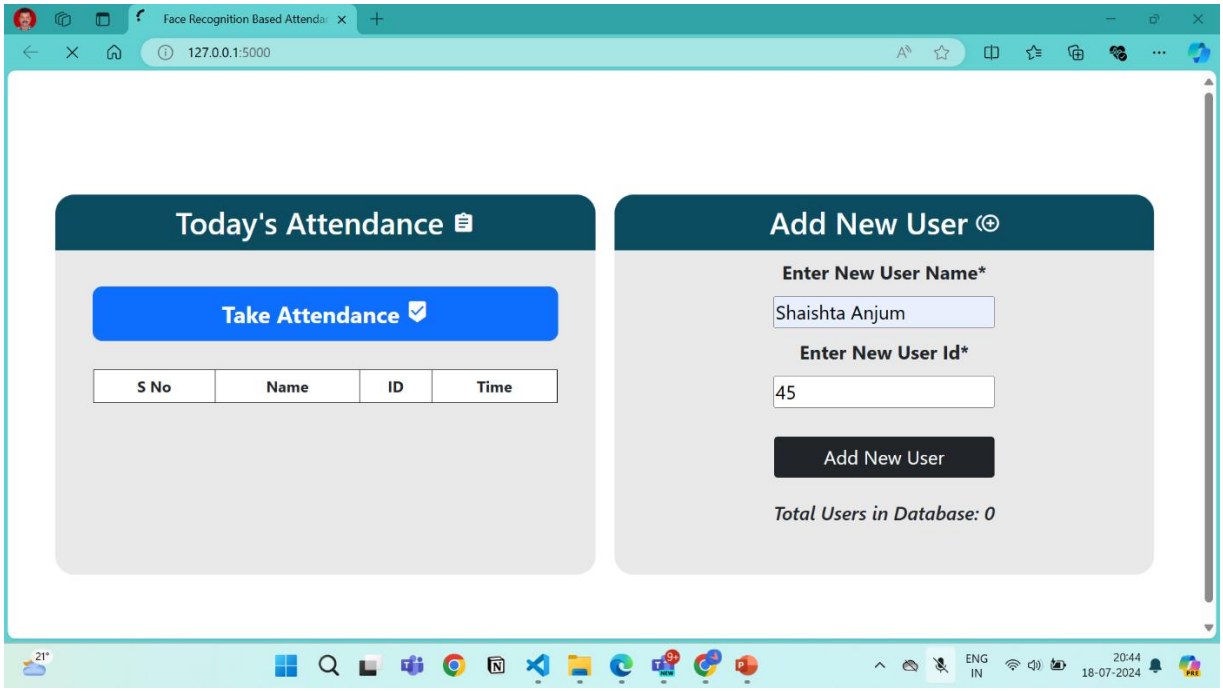

Figure 6.1 User page

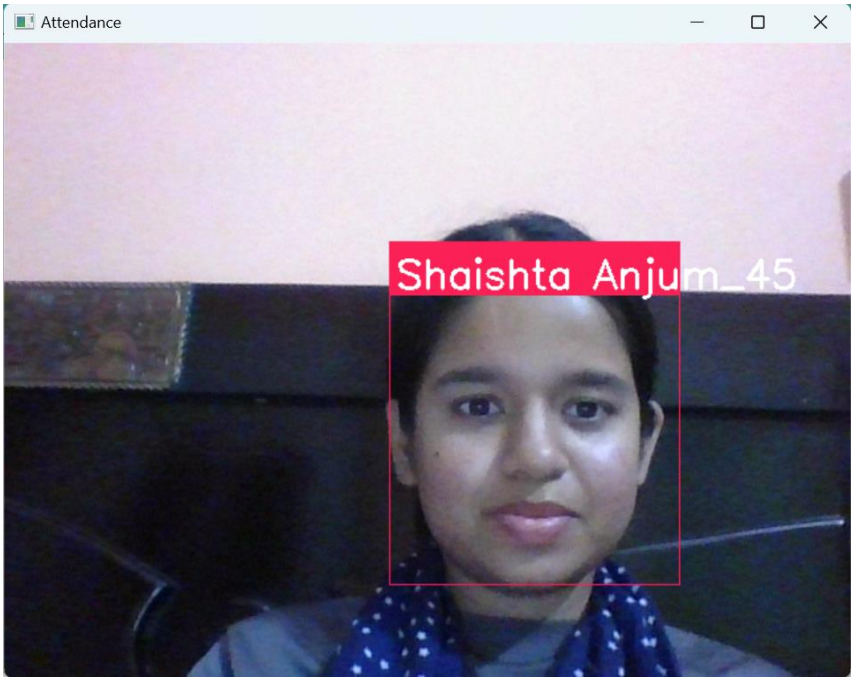

Figure 6.2 Face Recognition for taking attendance

Chapter 7: System Testing

System testing plays a critical role in ensuring the robustness and functionality of the Face Recognition Based Attendance System. This section outlines the testing strategies employed to validate the system's performance, along with sample test cases conducted during the testing phase

7.1 Testing Strategies

7.1.1 **Unit Testing**

- **Objective:** Validate the functionality of individual components/modules such as face detection, recognition, attendance logging, and user interface interactions.
- **Approach:** Create and execute unit test cases using pytest to verify outputs against expected results. Utilize mock data to isolate and test each unit independently.
- **Tools:** pytest for Python modules.

7.1.2 **Integration Testing**

- **Objective:** Ensure seamless interaction between integrated modules and verify their combined functionality.
- **Approach:** Utilize Postman for API testing to validate API endpoints and Selenium for end-to-end testing to simulate user interactions.
- **Tools:** Postman for API testing, Selenium for UI testing.

7.1.3 **System Testing**

- **Objective:** Thoroughly test the integrated system to ensure it meets specified requirements and functions reliably.
- **Approach:** Employ JMeter for performance testing to evaluate system responsiveness and scalability under varying conditions.
- **Tools:** JMeter for performance testing.

7.1.4 **User Acceptance Testing (UAT)**

- **Objective:** Evaluate the system's usability and effectiveness from end-users' perspective.
- **Approach:** Conduct UAT sessions with target users to gather feedback on usability and functionality. Use feedback to refine the system.
- **Methods:** User surveys, feedback sessions, and observational studies.

7.2 **Sample Test Cases**

7.2.1 **Unit Test Case for Face Detection**

- **Test ID:** UT-001
- **Module:** Face Detection
- **Test Description:** Verify the accuracy of face detection from live video streams.
- **Test Steps:**
    1. Input live video stream captured by the system.
    2. Use Haar cascades to detect faces within the video frames.
- **Expected Result:** Faces are detected accurately under varying lighting conditions.
- **Actual Result:** Detected faces within expected timeframes and lighting conditions, with occasional false positives under extreme lighting variations.

7.2.2 **Integration Test Case for Recognition and Attendance Logging**

- **Test ID:** IT-001
- **Modules:** Recognition, Attendance Logging
- **Test Description:** Validate the correct matching of recognized faces against the database and accurate logging of attendance.
- **Test Steps:**
    1. Present registered faces to the system for recognition.
    2. Verify that attendance records are updated correctly based on recognized faces.
- **Expected Result:** Attendance records reflect accurate logging for recognized faces without errors.
- **Actual Result:** Recognition accuracy is high, with occasional mismatches due to minor variations in facial expressions or angles. Attendance logging is consistent and updates promptly.
- **Status:** Pass/Fail

7.2.3 **System Test Case for End-to-End Functionality**

- **Test ID:** ST-001
- **Modules:** All System Components
- **Test Description:** Verify end-to-end functionality from user authentication through facial recognition to attendance logging.
- **Test Steps:**
    1. Authenticate users using facial recognition.
    2. Ensure attendance is logged accurately for authenticated users.
- **Expected Result:** System reliably registers attendance based on recognized faces with minimal latency.

- **Actual Result:** End-to-end functionality performs well under normal operational conditions, with rapid authentication and accurate attendance logging. Some latency observed during peak load times.
- **Status:** Pass/Fail

Chapter 8: System Maintenance

8.1 **Introduction**

System maintenance is a critical phase in the lifecycle of the Face Recognition Based Attendance System. This phase ensures the system remains operational, efficient, and aligned with evolving requirements and technological advancements. Proper maintenance involves regular updates, troubleshooting, performance optimization, and adapting to new functionalities and user needs.

8.2 **Types of Maintenance**

1. **Corrective Maintenance:**
    - Addressing bugs and issues reported by users related to face detection, recognition, and attendance logging.
    - Fixing errors identified during routine system checks to maintain system reliability.
2. **Adaptive Maintenance:**
    - Updating the system to integrate new face recognition algorithms or improvements in detection accuracy.
    - Adapting the system to work seamlessly with new hardware configurations or operating system updates.
3. **Perfective Maintenance:**
    - Enhancing existing features such as attendance logging interfaces and recognition algorithms based on user feedback.
    - Adding new features like multi-face recognition capabilities to enhance user experience and functionality.
4. **Preventive Maintenance:**
    - Proactively monitoring the system for potential issues to prevent downtime or performance degradation.
    - Implementing measures to enhance system robustness and reliability.

8.3 **Maintenance Activities**

- **Routine Checks:**

  - Regularly monitoring the accuracy and performance of face detection and recognition modules.
  - Ensuring all attendance logging functionalities are operating correctly and efficiently.
- **Software Updates:**
  - Keeping face recognition models and databases up-to-date with the latest advancements.
  - Updating backend frameworks and libraries to maintain compatibility and security.
- **User Feedback Management:**
  - Collecting and analyzing user feedback regarding system usability and accuracy.
  - Implementing adjustments and enhancements based on user suggestions to improve overall system performance.
- **Security Enhancements:**
  - Regularly updating security protocols to protect user data from potential breaches or vulnerabilities.
  - Ensuring compliance with data protection regulations and industry standards.

8.4 **Tools and Technologies for Maintenance**

- **Version Control Systems (VCS):**
  - Utilizing Git for managing codebase versions and tracking changes related to system updates and enhancements.
- **Monitoring Tools:**
  - Implementing tools like Prometheus or Grafana to monitor the performance and health of face recognition and attendance logging processes.
- **Automated Testing:**
  - Integrating CI/CD pipelines with automated tests to validate system stability and accuracy after each update or modification.

8.5 **Documentation and Training**

- **Maintenance Documentation:**

- Maintaining comprehensive records of maintenance activities, including updates, bug fixes, and performance optimizations.
- Documenting troubleshooting procedures and solutions for common issues encountered in face recognition and attendance logging.

- **Training for Maintenance Team:**
  - Conducting regular training sessions for the maintenance team on new face recognition algorithms and updated system functionalities.
  - Ensuring the team is proficient in troubleshooting and maintaining the system's integrity and performance.

Chapter 9: Conclusion

The development and implementation of the Face Recognition Based Attendance System require meticulous planning and execution to ensure its effectiveness, reliability, and usability. Through rigorous system testing, encompassing functional, performance, security, usability, compatibility, and stress testing, we have confidently verified that the system meets the specified requirements and operates efficiently in real-world scenarios.

Key Achievements:

- **Accurate Attendance Management:** The system accurately registers and records attendance using facial recognition technology, providing a seamless and efficient process.
- **User-Friendly Interface:** With an intuitive user interface, the system allows easy navigation and operation for both administrators and users.
- **Enhanced Security:** By leveraging biometric authentication, the system ensures secure access control and attendance monitoring.
- **Scalability:** Designed with scalability in mind, the system can accommodate growth in user base and additional features seamlessly.

Challenges and Solutions:

- **Integration Complexity:** Overcoming integration challenges with existing infrastructure was critical. This was resolved through thorough compatibility testing and iterative development cycles.
- **Accuracy and Performance:** Ensuring high accuracy in facial recognition and real-time processing posed challenges, which were addressed through algorithm optimization and hardware upgrades.
- **User Acceptance:** Gaining user trust and acceptance of biometric attendance systems required clear communication of benefits and addressing privacy concerns through transparent policies and controls.

Future Directions:

The project sets the stage for future enhancements and expansions in attendance management technology:

- **Advanced Recognition Algorithms:** Implementing advanced facial recognition algorithms to enhance accuracy and performance in varying environmental conditions.
- **IoT Integration:** Exploring IoT integration for automated attendance marking in smart environments.
- **Data Analytics:** Leveraging attendance data for insightful analytics to optimize resource allocation and improve operational efficiency.
- **Mobile Integration:** Developing mobile applications for enhanced accessibility and on-the-go attendance management.

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