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MINOR-2 PROJECT
SRS Document

For

Attendance System Using Face Recognition

Submitted By

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SRS Document

1. **Title: -** Attendance System Using Face Recognition

2. **Introduction: -**

In the present day, the demand for effective and dependable attendance tracking systems has increased tremendously across a variety of industries. The project "Attendance System Using Face Recognition" takes a revolutionary way to meeting this demand. This system uses facial recognition technology to provide a comprehensive and user-friendly solution for attendance control in a variety of locations, including educational institutions, corporate settings, and events.

Traditional methods of attendance tracking frequently require manual processes or cumbersome biometric sensors that are prone to errors and manipulation. In contrast, the suggested approach uses advanced algorithms to reliably identify people based on their distinct face characteristics. By capturing and analyzing facial data in real time, it eliminates the need for physical touch or manual intervention, increasing productivity and convenience.

Furthermore, using facial recognition technology improves security by preventing instances of proxy attendance or unauthorized access. Each person's identity is validated using a digital image of their face, ensuring that only authorized workers are listed in the attendance records. This not only encourages accountability, but also protects sensitive data and resources.

The deployment of this project demonstrates the transformational power of facial recognition technology in attendance management systems. By demonstrating its speed, precision, and adaptability, it emphasizes the potential of such solutions in modern environments. Through this research, we hope to demonstrate the practical application of facial recognition technology in streamlining attendance processes, resulting in increased efficiency, transparency, and security in organizational operations.

Purpose:

The purpose of this project is to automate attendance tracking using facial recognition technologies. This technology is intended to replace old methods, such as manual entry or barcode scanning, with a more efficient and precise approach. Facial recognition is used to streamline attendance management processes in a variety of contexts, improving both convenience and security. The project aims to demonstrate the potential of this technology to revolutionize routine administrative tasks, ensuring accurate attendance records while saving time for both administrators and attendees.

Scope:

It involves the design, implementation, and testing of a facial recognition-based attendance monitoring system. This entails designing and programming the software to correctly recognize faces, connecting it with current attendance management systems or developing a new one, and thoroughly testing it to assure its dependability and efficacy. The scope also includes taking into account the various contexts and conditions in which the system will be deployed, such as lighting conditions and angles, in order to ensure its versatility and resilience. Furthermore, the research may investigate scalability alternatives for deployment at various organizational scales and industries.

Definitions, Acronyms, and Abbreviations:

- **Face Recognition Library:** A software tool or package containing pre-built algorithms and functions for implementing facial recognition technology.
- **CNN:** Convolutional Neural Network, a type of deep learning algorithm commonly used in image recognition tasks, including facial recognition.

- **Facial Recognition:** A biometric technology that analyzes facial features to verify or identify individuals.
- **Attendance System:** A software application used to monitor and record the presence of individuals in a particular environment.
- **API:** Application Programming Interface, a set of protocols, tools, and definitions that allows different software applications to communicate with each other.
- **GUI:** Graphical User Interface, a visual way of interacting with a computer program through graphical elements such as windows, buttons, and icons.

References:

[1] Siswanto, Adrian Rhesa Septian, Anto Satriyo Nugroho, and Maulahikmah Galinium. "Implementation of face recognition algorithm for biometrics based time attendance system." 2014 Interna

[2] Evaluation of Haar Cascade Classifiers Designed for Face Detection R. Padilla, C. F. F. Costa Filho and M. G. F. Costa

[3] Research on Face Recognition Based on CNN Jie Wang and Zihao Li School of Electrical Engineering, Zhengzhou University, Zhengzhou, China

[4] https://www.analyticsvidhya.com/blog/2022/04/face-recognition-system-using-python/

3. Overall Description: -

SWOT ANALYSIS

Strengths:

- **Accuracy:** It's good at recognizing faces accurately, so attendance records are less likely to have mistakes.
- **Convenience:** People can mark their attendance quickly without needing cards or fingerprint scanners.
- **Time-saving:** It saves time for both users and administrators because it's automated.
- **Security:** Only authorized people can mark their attendance, reducing cheating.
- **Scalability:** It can handle a lot of users without needing big changes.

Weaknesses:

- **Cost:** It can be expensive to set up initially.
- **Reliability:** Sometimes it might not work well in certain lighting or with low-quality cameras.
- **Privacy concerns:** Some people worry about their face data being collected.
- **Training needed:** Users might need training to use it properly.
- **Integration issues:** It could be hard to connect with existing systems.

Opportunities:

- **Growing demand:** Many places want better attendance systems.
- **Technology improvements:** Face recognition tech keeps getting better.
- **Customization:** You can adjust it to fit different needs.
- **Compliance:** It can be made to follow data protection rules.
- **Expanding use:** It could be used for more than just attendance, like security.

Threats:

- **Competition:** Other systems might be cheaper or easier to use.

- **Data risks:** If it's not secure, data could be stolen.
- **Rules and regulations:** Laws might restrict how it can be used.
- **People might not like change:** Some users might not want to switch to this new system.
- **Ethical concerns:** Some people might not like the idea of their faces being tracked.

Project Features:

This project boasts several key features aimed at revolutionizing attendance tracking. Firstly, it utilizes cutting-edge facial recognition technology to accurately identify individuals, eliminating the need for manual entry or barcode scanning. The system seamlessly integrates with existing attendance management software, ensuring compatibility and ease of implementation. It offers real-time attendance logging, providing administrators with up-to-date information for efficient monitoring. Additionally, the system prioritizes data security, with robust measures in place to safeguard attendance records stored in the database. A user-friendly interface enhances user experience, allowing administrators to effortlessly manage the system and generate attendance reports. Scalability is also a prominent feature, enabling the system to accommodate varying organizational sizes and attendance needs. Overall, these features collectively contribute to a streamlined, reliable, and technologically advanced solution for attendance management.

Design and Implementation Constraints:

- Ensuring compliance with privacy requirements for biometric data.
- Hardware compatibility with cameras and infrastructure.
- It should be scalable i.e. Supports a high number of users and attendance records.

Assumptions and Dependencies:

- Assumption: Users' faces will be clearly captured for proper identification.
- Requires stable internet connection for system functioning and updates.
- Requires integration with existing attendance management systems to synchronize data.

Methodology:

a) Data Collection:
- Utilize a face recognition library to capture images of individuals during attendance sessions.
- Crop the faces from the collected images for better accuracy using the face recognition library's capabilities.

b) Data Preprocessing:
- Split the collected data into training, testing, and validation sets.
- Ensure each set represents a diverse range of individuals to improve model generalization.

c) Model Training:
- Design a convolutional neural network (CNN) architecture for face recognition tasks.
- Train the model using the training dataset, adjusting hyperparameters as needed to optimize performance.
- Utilize techniques such as data augmentation to prevent overfitting and improve model robustness.

d) Model Testing:
- Evaluate the trained model's performance using the testing dataset.
- Capture new images during testing sessions to simulate real-world scenarios.
- Calculate metrics such as accuracy, precision, recall, and F1-score to assess model effectiveness.

e) Attendance Marking:
- Create a CSV file to store attendance records, including fields for SAP ID, name, Roll No, Course, Specialization, Batch, and attendance status.

- Use the trained model to recognize faces during attendance sessions.
- Upon successful recognition, mark the attendance of the identified individual in the CSV file.
- Implement error handling mechanisms for cases where faces are not recognized or identified accurately.

f) Feedback Mechanism:

- Utilize the Pygame library to provide sound feedback during the attendance process.
- Assign unique sounds to each individual's SAP ID to announce their presence.
- Play the corresponding sound when an individual's attendance is successfully marked.

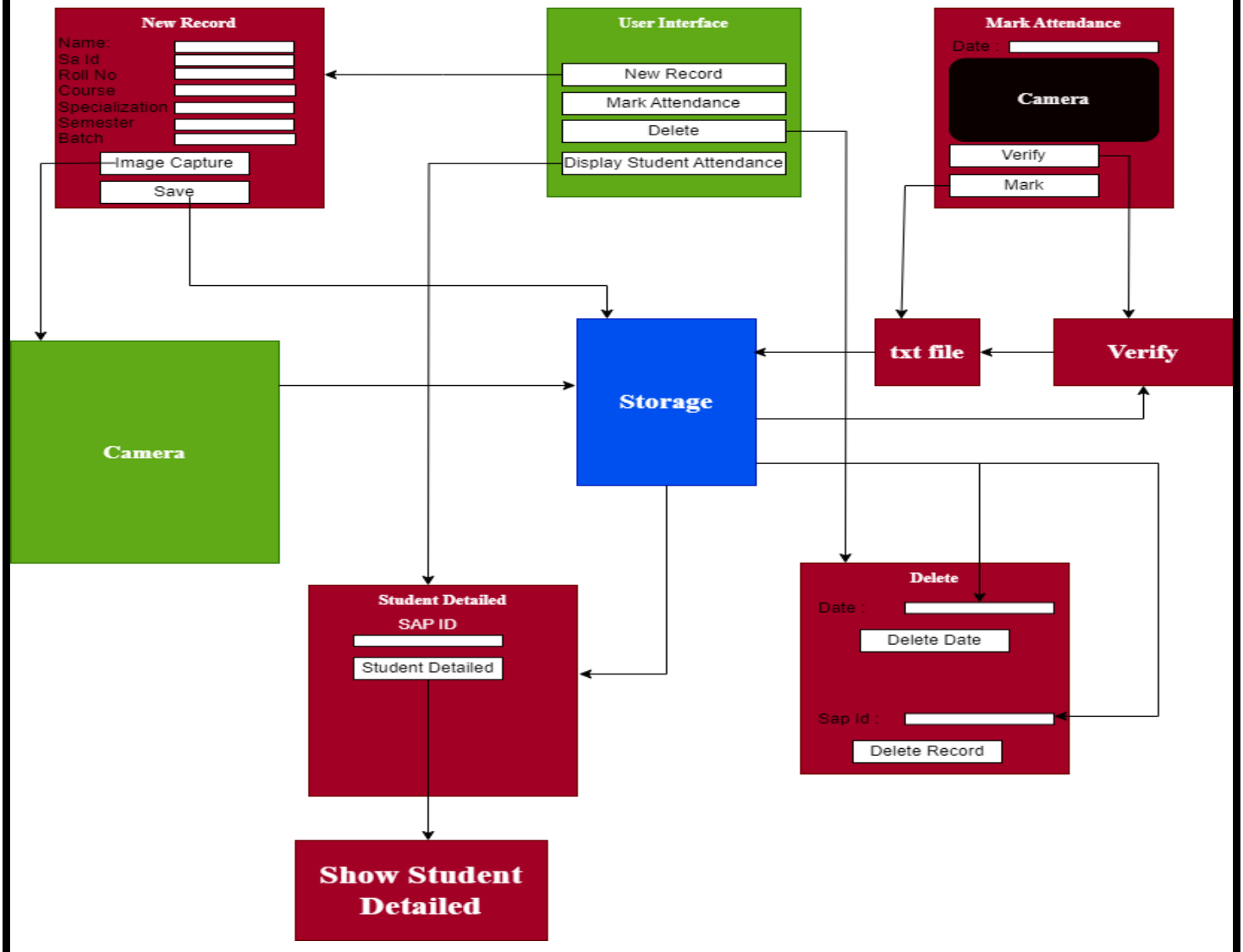
g) Deployment:

- Integrate the developed system into a user-friendly interface for ease of use.
- Ensure compatibility with different operating systems and hardware configurations.
- Conduct thorough testing to identify and address any bugs or issues.
- Provide user documentation and support to facilitate system adoption and usage.

h) Maintenance and Updates:

- Regularly update the face recognition model with new data to adapt to changing conditions and improve accuracy.
- Address any issues or feedback from users to enhance system performance and reliability.
- Stay informed about advancements in face recognition technology and implement relevant updates to the system.
- Maintain data privacy and security measures to protect the integrity of attendance records.

Design Diagram:



4. Specific Requirements: -

External Interface Requirements:

- User-Facing Interface: Provides access for administrators to manage the system and view attendance reports.
- Integration Interface: Facilitates integration with existing attendance management software for data synchronization.
- Hardware Interface: Interfaces with cameras or imaging devices for capturing facial images.

User Interfaces:

The system features a Graphical User Interface (GUI) accessible to administrators for system management. It includes options for configuring settings, viewing attendance reports, and performing administrative tasks.

Hardware Interfaces: The system requires cameras or imaging devices capable of capturing facial images with sufficient resolution and clarity for accurate recognition. These hardware components interface with the software to provide input for the facial recognition algorithm.

Software Interfaces: Integration with existing attendance management software is facilitated through software interfaces, allowing seamless data exchange between systems. Additionally, the system may utilize APIs (Application Programming Interfaces) for accessing external libraries or services related to facial recognition.

Communication Interfaces: The system relies on communication interfaces to interact with external components such as csv file for storing attendance records. It may utilize network protocols for data transmission between different modules of the system or for remote access by administrators. Additionally, communication interfaces may be employed for system updates or notifications.

Functional requirements

Detailed Description of Each Function:

a) Face Detection and Recognition:

Description: This function detects faces within images captured by the camera and recognizes individuals based on their facial features.

Detailed Process: Utilizes a face recognition to detect facial landmarks and features. Compares these features with stored templates to identify individuals.

b) Attendance Logging:

Description: Records attendance data in real-time, associating each attendance entry with the respective individual.

Detailed Process: Upon successful face recognition, timestamps the attendance entry and stores it in the csv file along with the individual's identification information.

c) Integration:

Description: Ensures seamless integration with existing attendance management systems, enabling data synchronization and interoperability.

Detailed Process: GUI tkinter to allow communication between the facial recognition system and external attendance management software. Implements protocols for secure data transfer and synchronization.

d) Data Storage:

Description: Safely stores attendance records and associated information in a csv file. It also stores the sound and and face of each student.

Detailed Process: Utilizes a scv file to create and maintain a structured database. Stores attendance entries with relevant metadata such as timestamps, individual IDs, and any additional information.

e) User Interface:

Description: Provides a user-friendly interface for administrators to interact with the system and manage attendance-related tasks.

Detailed Process: Designs a graphical user interface (GUI) with intuitive controls and features for configuring settings, viewing attendance reports, and performing administrative actions.

Input and Output Formats:

- **Input:** Facial images captured by the camera in formats compatible with image processing algorithms (e.g., JPEG, PNG).
- **Output:** Attendance records stored in a structured format within the database, typically consisting of fields such as timestamp, individual ID, and additional metadata.

Processing Logic:

- **Face Detection and Recognition:** Utilizes image processing techniques and neural network algorithms to analyze facial features and match them against stored templates.
- **Attendance Logging:** Implements logic to associate recognized faces with timestamps and store them securely in the database.
- **Integration:** Establishes communication channels and protocols for seamless data exchange between the facial recognition system and external software.

5. System Features

Feature 1:

Feature: Delete Record

Description: This feature enables the deletion of a specific attendance record associated with a given SAP ID and date from a CSV file. Upon activation, it removes the attendance entry corresponding to the provided SAP ID and date from the CSV file. Additionally, it deletes any associated sound and facial recognition data linked to the specified SAP ID within the CSV file.

Inputs:

- SAP ID: The unique identifier associated with the individual whose attendance record is to be deleted.
- Date: The date for which the attendance record is to be deleted.

Processing:

- Read CSV File: Load the attendance data from the CSV file into memory.

- Locate Record: Search for the attendance entry associated with the provided SAP ID and date within the CSV data.
- Delete Record: Remove the attendance record, including the specified date column, from the CSV data.
- Purge Sound and Face Data: Delete any sound and facial recognition data associated with the specified SAP ID within the CSV file.
- Write Changes: Save the modified CSV data back to the file.

Outputs:

- Confirmation Message: Display a notification confirming successful deletion of the attendance record and associated data for the specified SAP ID and date from the CSV file.

Feature 2:

Feature: Show Student Details and Attendance Percentage

Description: This feature provides detailed information about a student, including their personal details and attendance percentage, retrieved from a CSV file. It allows administrators to access comprehensive data about a particular student's attendance performance.

Inputs:

- SAP ID: The unique identifier associated with the student whose details are to be displayed.

Processing:

- Read CSV File: Load the student and attendance data from the CSV file into memory.
- Locate Student Details: Search for the student's personal information corresponding to the provided SAP ID within the CSV data.
- Retrieve Attendance Data: Extract the attendance records associated with the provided SAP ID from the CSV data.
- Calculate Attendance Percentage: Determine the attendance percentage based on the total number of attended sessions compared to the total sessions available.

Outputs:

- Student Details: Display the personal information of the student, including their name, ID, department, etc., retrieved from the CSV file.
- Attendance Percentage: Show the calculated attendance percentage for the student, indicating their attendance performance, based on data extracted from the CSV file.

Feature 3:

Feature: New Data Record

Description: This feature allows administrators to add a new student record to the CSV file, including personal details such as name, SAP ID, roll number, course, specialization, semester, and batch. Additionally, it enables the storage of the new student's face image for facial recognition purposes.

Inputs:

- Name: The full name of the new student.

- SAP ID: The unique identifier associated with the new student.
- Roll Number: The roll number assigned to the new student.
- Course: The academic course in which the new student is enrolled.
- Specialization: The specialized field of study chosen by the new student (if applicable).
- Semester: The current semester of enrollment for the new student.
- Batch: The batch or academic year to which the new student belongs.
- Face Image: The facial image of the new student captured for facial recognition.

Processing:

- Read CSV File: Load the existing student data from the CSV file into memory.
- Add New Record: Create a new record for the new student with the provided personal details.
- Store Face Image: Save the facial image of the new student to a designated folder or directory for facial recognition.
- Append Data: Add the new student record to the CSV file.

Outputs:

- Confirmation Message: Display a notification confirming the successful addition of the new student record to the CSV file.

6. External Interface Requirements:

User Interfaces:

- **User-Facing Interface:** A graphical user interface (GUI) for administrators to interact with the system, perform various tasks such as managing records, and accessing attendance reports.

Hardware Interfaces:

- **Camera or Imaging Device:** Interfaces with cameras or imaging devices to capture facial images for recognition purposes.
- **Storage Device:** Interfaces with storage devices to store facial images and attendance data, such as hard drives, SSDs, or cloud storage.

Software Interfaces:

- **Facial Recognition Library:** Interfaces with facial recognition libraries or APIs to perform facial recognition tasks.
- **CSV File:** Interfaces with CSV files for storing and managing student records and attendance data.

Communication Interfaces:

- **Network Protocol:** Interfaces with network protocols (e.g., TCP/IP, HTTP) for communication between system components and external systems.
- **Application Programming Interface (API):** Provides interfaces for integrating with external systems, such as attendance management software or student information systems.

7. Non-functional Requirements:

Usability:

- **Intuitive Interface:** The system should have a user-friendly interface that is easy to navigate and understand, facilitating efficient interaction for administrators.

- **Accessibility:** The system should be accessible to users with diverse technical backgrounds and abilities, ensuring inclusivity and ease of use.

Reliability:

- **Accuracy:** The facial recognition system should have a high level of accuracy in identifying individuals, minimizing false positives and negatives.
- **Availability:** The system should be available and operational whenever required, with minimal downtime for maintenance or updates.

Performance:

- **Speed:** The facial recognition process should be fast and responsive, providing real-time attendance tracking without significant delays.
- **Scalability:** The system should be scalable to accommodate a growing number of users and attendance records, maintaining performance levels as the user base expands.

Supportability:

- **Maintenance:** The system should be designed for easy maintenance and updates, with clear documentation and support resources available for administrators.
- **Compatibility:** The system should be compatible with a variety of hardware and software environments, ensuring interoperability and ease of integration.

Security:

- **Data Protection:** The system should implement robust security measures to protect sensitive data, such as facial images and personal information, from unauthorized access or misuse.
- **Authentication:** Access to the system should be restricted to authorized users through secure authentication mechanisms, such as passwords or biometric verification.
- **Audit Trail:** The system should maintain an audit trail of user activities and access attempts, enabling administrators to track and monitor system usage for security purposes.