**CHAPTER 3**

**REQUIREMENT SPECIFICATION**

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### ****III. REQUIREMENTS****

The development and implementation of EDUCARE, an automated student attendance management system, require specific hardware and software components to ensure efficient functionality. This section outlines the necessary hardware, software, libraries, and tools essential for the successful development, testing, and deployment of the project.

### ****A. Hardware Requirements****

The hardware requirements for EDUCARE vary across different stages of development, testing, and deployment. During the development phase, a computer system with a stable internet connection is essential for coding, testing, and running the application. For testing, a webcam or an external camera device is required to capture student images for facial recognition. Smartphones, tablets, or laptops are also needed to ensure cross-platform compatibility of the web application.

In the deployment stage, a high-performance server is required to host the web application, ensuring seamless real-time processing. Additionally, a secure database server is needed to store student attendance data securely. High-quality web cameras or surveillance cameras in classrooms are necessary to capture clear and accurate images of students, enhancing the efficiency of facial recognition.

Hardware Requirements:

* Processor: Intel i5 or higher / AMD equivalent.
* RAM: Minimum 8GB or higher for smooth processing.
* Storage: Minimum 500GB HDD / SSD for database storage and log files.
* Webcam: High-quality HD webcam (720p or higher) for accurate face detection.
* Server: Cloud server or local host server for deployment.
* Network: Reliable internet connection for data synchronization and real-time attendance processing.

### ****B. Software Requirements****

The software requirements for EDUCARE include a range of operating systems, database management systems, programming languages, frameworks, and tools to ensure smooth functionality and development. These software components play a major role in backend processing, data management, and user interface design.

1. Operating System:
   * Windows 10/11 or Linux for development.
   * Linux servers (for deployment) or any compatible server operating system.
2. Database Management System (DBMS):
   * MySQL or SQLite is used for storing and managing attendance data.
   * It helps maintain structured records of student details, attendance logs, and authentication data.
3. Programming Languages:
   * Python: Primary programming language used for backend logic, facial recognition, and database operations.
   * JavaScript: Used for enhancing frontend interactivity and dynamic content rendering.
4. Frameworks:
   * Flask (Python): Used for developing the web application backend and connecting with the database.
   * HTML, CSS, JavaScript: Used for creating the frontend user interface of EDUCARE.
5. Development Tools:
   * Visual Studio Code (VS Code): Preferred IDE (Integrated Development Environment) for writing and testing the code.
   * PyCharm: An alternative Python IDE for developing the application.
   * Postman: Tool used for API testing and ensuring data transfer between frontend and backend.
   * npm (Node Package Manager): Used for installing and managing JavaScript dependencies.
6. Web Browser:
   * Google Chrome, Mozilla Firefox, or Edge for testing and running the web application.

### ****C. Python Libraries Used****

Several Python libraries were essential for the development and implementation of the EDUCARE project. These libraries provide support for image processing, facial recognition, data management, and real-time attendance marking.

1. **Flask**  
   Flask is a micro web framework written in Python, primarily used for developing web applications. In EDUCARE, Flask serves as the backend framework, handling HTTP requests, connecting the application with the database, and executing real-time operations.  
   **Features:**
   * Lightweight and easy to use.
   * Supports RESTful APIs for real-time attendance processing.
   * Seamless integration with Python libraries like OpenCV and TensorFlow.  
     Use in EDUCARE:
   * Manages web requests and user interactions.
   * Facilitates database connectivity for storing attendance records.
   * Handles real-time data processing for facial recognition.
2. **OpenCV (Open Source Computer Vision)**  
   OpenCV is a powerful computer vision library used for image processing, face detection, and recognition. In EDUCARE, OpenCV plays a crucial role in detecting student faces from group images and matching them with stored records to mark attendance automatically.  
   **Features:**
   * Supports face detection and recognition.
   * Facilitates real-time video capture and image processing.
   * Enhances image quality and provides accurate facial recognition.  
     Use in EDUCARE:
   * Captures and detects student faces from group images.
   * Matches the captured faces with stored records for attendance marking.
   * Enhances image clarity for better recognition accuracy.
3. **TensorFlow**

TensorFlow is an open-source deep learning framework developed by Google. It is used for building and training machine learning models for various tasks, including image recognition and facial detection. In EDUCARE, TensorFlow helps train the facial recognition model to identify student faces with high accuracy.  
**Features:**

* + Provides deep learning capabilities.
  + Facilitates training of facial recognition models.
  + Enhances accuracy in face detection and recognition.  
    Use in EDUCARE:
  + Trains and deploys the facial recognition model.
  + Improves the accuracy of student face identification.
  + Handles real-time face matching and attendance marking.

1. **SQLite**  
   SQLite is a lightweight and serverless relational database management system. In EDUCARE, SQLite is used for storing student information, attendance records, and login credentials. It enables quick and easy data retrieval without complex server management.  
   **Features:**
   * No server setup is required.
   * Fast and lightweight database.
   * Easy integration with Flask for data management.  
     Use in EDUCARE:
   * Stores student details, attendance logs, and timestamps.
   * Provides quick data access for real-time attendance tracking.
   * Ensures data consistency and prevents data loss.
2. **NumPy and Pandas**

NumPy (Numerical Python) and Pandas are essential Python libraries used for data processing, data manipulation, and managing structured data. In EDUCARE, these libraries facilitate organizing attendance logs and performing statistical operations.  
**Features:**

* + Handles large data sets easily.
  + Provides data manipulation and cleaning tools.  
    Use in EDUCARE:
  + Organizes attendance logs based on date, time, and student details.
  + Analyzes and processes student records for report generation.

### ****D. Database Management System (DBMS)****

EDUCARE requires a database to store, manage, and retrieve student attendance records, login credentials, and course details. The system uses SQLite as its primary database for simplicity and quick data access.

**Features of SQLite:**

* Serverless and easy to configure.
* Provides high-speed data processing.
* Cross-platform compatibility.
* Ensures data security and prevents data loss.  
  Use in EDUCARE:
* Stores student data, attendance logs, and timestamps.
* Manages login credentials and course details.
* Provides quick data access for real-time attendance tracking.

### ****E. Network Requirements****

EDUCARE requires a stable and high-speed internet connection for smooth data synchronization between the frontend, backend, and database. During deployment, the server requires continuous internet connectivity to process and store real-time attendance data.

Network Requirements:

* Internet Connection: Minimum 50 Mbps speed.
* Server Hosting: Cloud-based or local server.
* Firewall Protection: For secure data transfer.

### ****F. Deployment Requirements****

For deploying the EDUCARE project, a high-performance web server is required to host the web application and database. The following deployment setup is recommended:

* Server: Apache or Nginx.
* Database: MySQL or SQLite.
* Hosting Platform: Heroku, AWS, or DigitalOcean.
* Storage: Cloud storage for storing captured images and attendance records.