

UNIVERSITY OF BUEA **REPUBLIC OF**
P.O Box 63
Buea_South West Region
Cameroon
Tel: (+237) 674354327
Fax: (+237) 3332 22 72



CAMEROON

PEAC PEACE-WORK - FATHERLAND

FACULTY OF ENGINEERING AND TECHNOLOGY
COMPUTER ENGINEERING DEPARTMENT
CEF 440: INTERNET PROGRAMMING (J2EE) AND MOBILE PROGRAMMING

TASK 2: REQUIREMENTS ANALYSIS FOR A BIOMETRIC ATTENDANCE SYSTEM

Presented by:

Group 11

Course Instructor:

Dr. Nkemeni Valery

Academic year:

2023/2024

Group members

| SN | NAMES | MATRICULE |
|----|-----------------------------|-----------|
| 1 | NGULEFAC JERRY MBUOH | FE21A265 |
| 2 | NEBA PRINCEWILL AMBE | FE21A251 |
| 3 | NKENGBEZA DERICK | FE21A277 |
| 4 | KAH JOSPEN NGUM | FE21A264 |
| 5 | NYOCHENBENG ENZO NKENGAFACK | FE21A293 |

Table of Contents

| | |
|---|----|
| 1. Introduction | 3 |
| 1.1. Overview of the project | 3 |
| 1.2. Purpose of the requirement analysis | 3 |
| 1.3. Scope of the project | 4 |
| 2. Stakeholders' analysis | 5 |
| 2.1. List of identified stakeholders | 5 |
| 3. Assumptions And Constraints | 5 |
| 3.1. Assumptions made during gathering Process | 5 |
| 3.2. Dependencies made on external factors | 5 |
| 3.3. Constraints that may impact Implementation (e.g. budget, time, technology) | 6 |
| 4. Requirements Overview | 6 |
| 4.1. Summary of all gathered requirement | 6 |
| 4.2. Categories of the requirements | 9 |
| 5. Requirement Analysis | 10 |
| 5.1. Analysis of Requirements (to ensure clarity, consistency, feasibility) | 11 |
| 5.2. Identification and Resolution of Conflicts and Ambiguities | 11 |
| 5.3. Prioritization of requirements (based on impact and importance) | 12 |
| 6. Requirements Documentation | 12 |
| 6.1. Functional Requirements | 12 |
| 6.2. Non-Functional Requirements | 14 |
| 6.3. External Interface Requirements | 16 |
| 7. Use Cases | 18 |
| 8. Verification and Validation | 18 |
| 8.1. Verification of Documented Requirements | 18 |
| 8.2. Validation Techniques and Methods | 19 |
| 9. Risk Analysis | 19 |
| 9.1. Identification of Potential Risks | 19 |
| 9.2. Assessment of likelihood and impact of risk | 20 |
| 9.3. Mitigation strategies for managing the risk | 20 |
| 10. Conclusion | 20 |
| 10.1. Summary of key findings | 20 |
| 10.2. Next steps (System Modelling and Design) | 21 |

1. Introduction

1.1. Overview of the project

The biometric student application project aims to develop a comprehensive solution for tracking student attendance using biometric authentication methods. This application will enable educational institutions to streamline attendance management processes, enhance security, and improve accountability in monitoring student presence during classes and events. By leveraging biometric technology, the application will offer a reliable and efficient means of authentication, ensuring accurate attendance tracking and reducing the likelihood of attendance fraud or discrepancies.

1.2. Purpose of the requirement analysis

The purpose of requirement analysis in this project is to analyze the gathered requirements and define the system requirements and specifications essential for the successful development and deployment of the biometric student application and to ensure alignment between stakeholders' expectations and the envisioned solution. Requirement analysis serves as the foundation for the entire development lifecycle, guiding the design, implementation, and testing phases to deliver a solution that meets the needs and preferences of end-users while adhering to technical and operational constraints.

Requirement analysis facilitates:

- Understanding Stakeholder needs, preferences, and pain points related to attendance tracking and management.
- Identifying and specifying the functional requirements that dictate the core functionalities and features of the biometric student application such as enrollment, reporting, recording and alerting.
- Establishing System Attributes and Non-functional requirements identified during requirement analysis, such as scalability, security, performance, and user-friendliness, define the quality attributes and constraints that shape the overall design and implementation of the application.
- Serves as a roadmap for development teams, guiding their efforts in prioritizing tasks, making design decisions, and allocating resources effectively to meet project objectives within the specified constraints.
- By clearly defining the scope and boundaries of the project through requirement analysis, stakeholders can establish realistic expectations regarding project deliverables, timelines, and resource requirements, thereby minimizing the risk of scope creep and project delays.

1.3. Scope of the project



The scope of the project encompasses.

- **Mobile Application Development:**

The design and implementation of a mobile application compatible with popular platforms such as Android or iOS. The application would feature intuitive user interfaces tailored for easy attendance tracking by students

- **Biometric Authentication Integration:**

The application will incorporate biometric authentication functionality to significantly enhance security of attendance record progress by verifying the identities of students using fingerprints.

- **Real-time Attendance Tracking:**

Implementation of real-time attendance tracking capabilities that will allow instructors to access attendance records instantly as students check enabling effective monitoring of student participations. The system will also ensure recording should not exceed 5 seconds to minimize disruptions during class sessions.

- **Scalability and Customization:**

Designing with scalability and customization would produce a flexible system to meet the needs of educational institutions and accommodate varying class sizes. This ensures seamless integration into diverse academic environments.

- **Automated Attendance Reports:**

Implement functionalities to generate automated attendance reports for instructor and administrators. Reports can provide students participation rates and attendance trends to streamline administrative tasks and decision-making.

- **Notifications, Reminders, and Alerts**

2. Stakeholders' analysis

2.1. List of identified stakeholders

Their Interest and concerns regarding the stakeholders' analysis for a biometric attendance system involve identifying and understanding the various individuals or groups who have an interest in or are affected by the implementation and operation of the system. Here's a breakdown of potential stakeholders and their interests:

- **Administrators:** School administrators are responsible for overall management and decision-making regarding the attendance system. Their interests may include improving attendance accuracy, monitoring student and staff attendance trends, and ensuring compliance with attendance policies.
- **Instructor:** Teachers and staff are end-users of the attendance system. They are interested in a system that is easy to use, accurately records attendance data, and helps them track student attendance for reporting and intervention purposes.
- **Students:** Students are also end-users of the attendance system. Their interests may include privacy and data protection, as biometric data is involved. They may also be concerned about the fairness and accuracy of the system in recording their attendance.
- **IT Department:** The IT department is responsible for implementing and maintaining the technical infrastructure of the attendance system. Their interests include system reliability, data security, integration with existing systems, and technical support for end-users

3. Assumptions And Constraints

3.1. Assumptions made during gathering Process

- **Biometric Hardware availability:** Assuming that the necessary hardware devices such as fingerprint scanners or facial recognition cameras can be easily acquired.
- **Internet connectivity:** Assuming that the application will have stable access to internet connection for real-time data synchronization.
- **User adoption:** Assuming that users are willing to adopt biometric authentication for attendance tracking and are comfortable with the technology.
- **Training Requirement:** The users may require how to use the biometric attendance application including IT support and infrastructure.
- **Student Consent:** Assuming that the students and their guardians are willing to provide consent for collection and use of their biometric data for attendance.
- **Accuracy and Reliability:** Assuming that the biometric authentication technology used in the application is accurate and reliable for capturing and verifying student identities.

3.2. Dependencies made on external factors

Dependencies made on external factors refer to situations where the development and implementation of a student biometric attendance system rely on factors outside the direct

control of the project team. These dependencies can greatly influence the project's timeline, resources and outcome. Some of them are;

- **Biometric Technology:** Standards: Dependency on industry standards and protocols for biometric authentication, which may evolve or change over time, requiring adjustments to the application to ensure compatibility and compliance.
- **Infrastructure availability:** Dependency on the availability of infrastructures such as electricity, internet connectivity and network infrastructure in the geographical location.
- Supplier relationship:
- **Data Privacy:**
- **User Acceptance and Adoption:**

3.3. Constraints that may impact Implementation (e.g. budget, time, technology)

- **Budget Constraints:** Limited Financial resources may restrict the scope of the project affecting the hardware, software implementation strategy selection.
- **Time Constraints:** Small timeframes for implementation such as academic calendars or project deadlines, may impose some constraints on the development and deployment of the project.
- **Training and Support:** Constraints Related to the availability of resources and expertise for training users and providing ongoing support for training users and providing ongoing support for the biometric attendance system.
- **Cultural Sensitivity:** Cultural norms, perception of privacy and attitudes towards technology may pose a constraint in the acceptance of such a system.
- **Technology Limitation:** Constraints related to Biometric hardware devices, Software algorithms may impact the functionality and performance of the application.
- **Regulatory Compliance:** Compliance with data privacy regulations such as GDPR or HIPAA may impose constraints on data collection, storage and usage requiring careful implementation.

4. Requirements Overview

4.1. Summary of all gathered requirement

A) From Google Form Surveys:

a. Biometric Modality Preferences:

- Stakeholders prefer fingerprint recognition due to its familiarity and ease of use.
- Interest exists in exploring other modalities such as facial recognition and iris scanning for enhanced security and convenience.

b. Desired Features and Functionalities:

- Enrolment capabilities, real-time attendance recording, and comprehensive reporting functionalities are desired.
- Emphasis on a user-friendly interface and seamless integration with existing systems.

c. Performance Expectations:

- Stakeholders expect high performance in terms of speed, scalability, and reliability.
- The system should efficiently handle large volumes of attendance data, especially during peak hours.

d. User Interface Design and Usability:

- Preferences for simplicity, clarity, and intuitiveness in the user interface design.
- Easy navigation and minimal training requirements for users of all skill levels.

e. Training and Support Requirements:

- Comprehensive training and ongoing support are needed for effective system utilization.
- Training sessions for administrators, teachers, and students, along with access to technical support resources.

B) From Benchmarking

a. Technology

- Include facial recognition, geolocation and timestamps

b. Simplified UI

- Minimize learning curve
- Limited steps to check in
- Intuitive UX

c. Continuous Improvements

- Feedback mechanisms
- Updates and maintenance

d. Comprehensive Report

- Figures and charts for trends
- Monitoring tools and Customizable features like time for analysis
- Notifications, reminders and alerts

C) From Brainstorming

a. Enrollment Module

- Capture biometric data (fingerprints), manage student enrollment, bulk enrollment
- Features include; Biometric Data Capture, Secure Storage, Integration with Student Database, Enrollment Analytics

a. Attendance Recording Module:

- Record student attendance using biometric authentication, provide real-time access.
- Features include; Biometric Authentication, Automated Attendance Recording, Attendance Alerts, Integration with Timetable, Data Synchronization

b. Reporting and Monitoring Module:

- Generate attendance reports, monitor attendance trends, customization options.
- Features include; Data Visualization, Customization Options, Export Functionality, Notification System

c. Student Conduct and Performance Module:

- Provide insights into students' attendance performance and conduct.
- Features include; Comprehensive Reporting, Customization Options, Real-Time Monitoring

d. Scalability and customization

- Implement cloud-based architecture
- Provide flexible configurations options

e. Biometric Technology

- Multi-biometric features to enhance security e.g. multiple fingers plus facial recognition

- Use of Geolocation and timestamps to ensure accuracy
 - f. Training and support**
 - Providing an app tour
 - Establishing robust Feedback mechanism
- D) From Paper-Based Questionnaires:**
- a. Instructors:**
 - Preferences for specific features like customizable reporting formats and attendance trend analysis tools.
 - Requirements for user-friendly interfaces with minimal learning curves.
 - Suggestions for continuous improvement mechanisms such as feedback channels and regular updates.
 - b. Administrators:**
 - Need for comprehensive reporting functionalities with figures, charts, and trend monitoring tools.
 - Preferences for simplified UI design and intuitive user experiences.
 - Requirements for notifications, reminders, and alerts for timely management of attendance data.
 - c. Students:**
 - Desire for a simplified check-in process and easy navigation within the application.
 - Need for user-friendly interfaces and intuitive user experiences to minimize learning curves.
 - d. IT Staff:**
 - Preferences for technology enhancements such as facial recognition, geolocation, and timestamps for accuracy.
 - Requirements for continuous improvements, including feedback mechanisms and regular updates and maintenance.
 - Need for comprehensive reporting functionalities with customizable features for analysis.
- E) From Interviews:**
- a. Instructors:**
 - Preferences for specific features or functionalities based on teaching styles and classroom needs.
 - Insights into the importance of certain features for classroom management and attendance tracking.
 - b. Administrators:**
 - Requirements related to administrative tasks such as data analysis, budget considerations, or compliance requirements.
 - Preferences for integration with existing administrative systems and scalability options.
 - c. Students:**
 - Feedback on usability and user experience from a student perspective, including suggestions for improvements.
 - Input on accessibility features and preferences for mobile applications.
 - d. IT Staff:**
 - Technical requirements such as system architecture preferences or compatibility with existing IT infrastructure.

- Recommendations for security measures or data management practices.

4.2. Categories of the requirements

1. Instructors:

a. Enrollment and Attendance:

- Desire for enrollment capabilities.
- Real-time attendance tracking and management.
- Real-time access to attendance records.

b. Reporting and Analysis:

- Preferences for specific features like customizable reporting formats and attendance trend analysis tools.
- Comprehensive reporting functionalities.
- Customization options for reports.

c. User Interface and Support:

- Simplified UI with minimal learning curve.
- Easy navigation and minimal training requirements.
- Access to comprehensive training and ongoing support.
- Feedback mechanisms for continuous improvements.

2. Administrators:

a. Reporting and Monitoring:

- Need for comprehensive reporting functionalities with figures, charts, and trend monitoring tools.
- Requirements related to administrative tasks such as data analysis, budget considerations, or compliance requirements.
- Requirements for notifications, reminders, and alerts for timely management of attendance data.

b. System Integration and Scalability:

- Preferences for simplified UI design and intuitive user experiences.
- Preferences for integration with existing administrative systems and scalability options.
- Scalability and customization options, including cloud-based architecture.

c. Enrollment and Support:

- Enrollment capabilities, including bulk enrollment.
- Real-time attendance recording with biometric authentication.
- Access to training sessions and technical support.
- Feedback mechanisms and updates for continuous improvements.

3. Students:

a. User Experience:

- Desire for a simplified check-in process and easy navigation within the application.
- Need for user-friendly interfaces and intuitive user experiences to minimize learning curves.
- Feedback on usability and user experience, including suggestions for improvements.
- Input on accessibility features and preferences for mobile applications.

b. Attendance Access and Training:

- Real-time access to their attendance records.

- Access to comprehensive training.
- Feedback mechanisms for continuous improvements.

4. IT Staff:

a. Performance and Security:

- High-performance expectations in terms of speed, scalability, and reliability.
- Multi-biometric features for enhanced security.
- Preferences for technology enhancements such as facial recognition, geolocation, and timestamps for accuracy.

b. Support and Maintenance:

- Access to technical support resources.
- Requirements for continuous improvements, including feedback mechanisms and regular updates and maintenance.

c. Reporting and Technical Requirements:

- Need for comprehensive reporting functionalities with customizable features for analysis.
- Technical requirements such as system architecture preferences or compatibility with existing IT infrastructure.
- Scalability and customization options, including cloud-based architecture.

5. Requirement Analysis

| ID | REQUIREMENTS GATHERED | SOURCE | STAKEHOLDER INCLUDED | PRIORITY | CATEGORY | Potential Conflict | Feasibility | DEFINITION |
|----|--|--------------------------|----------------------|-------------|----------------|--------------------|---------------------|-------------------|
| 1 | Real-time attendance tracking | Paperbased questionnaire | Lecturer | Must-Have | Functional | NIL | Feasible | Success condition |
| 2 | Biometrics for authentication | User interview | Student | Should-Have | Functional | NIL | Require much effort | User action |
| 3 | App's push notification | User interview | Lecturer | Should-Have | Functional | NIL | Feasible | System response |
| 4 | In-app notification | User interview | Lecturer | Must-Have | Functional | NIL | Feasible | System response |
| 5 | Email notification | Paperbased questionnaire | Lecturer | Could-Have | Functional | NIL | Feasible | System response |
| 6 | Multibiometric authentication | Competitive analysis | Student | Won't-Have | Functional | NIL | Not feasible | User action |
| 7 | Intuitive user interface for easy navigation | User interview | Lecturer | Must-Have | Non-Functional | NIL | Feasible | System response |
| 8 | Security of attendance data | User interview | Tech staff | Must-Have | Non-Functional | NIL | Feasible | System response |
| 9 | Security of user information | Paperbased questionnaire | Tech staff | Must-Have | Non-Functional | NIL | Feasible | System response |
| 10 | Validate attendance using biometrics | Online survey | Student | Must-Have | Functional | NIL | Feasible | User action |
| 11 | Export attendance reports | Paperbased questionnaire | Administrator | Must-Have | Functional | NIL | Feasible | User action |
| 12 | Receive notifications for late comers | User interview | Lecturer | Should-Have | Functional | NIL | Require much effort | System response |
| 13 | Track attendance duration for each student | User interview | Lecturer | Won't-Have | Functional | NIL | Not feasible | Success condition |
| 14 | Secure login and access control | Paperbased questionnaire | Lecturer | Must-Have | Non-Functional | NIL | Require much effort | System response |
| 15 | Fast and reliable response time for attendance marking | Competitive analysis | Student | Must-Have | Non-Functional | 12 | Feasible | System response |
| 16 | Offline functionality of app | User interview | Lecturer | Should-Have | Non-Functional | NIL | Feasible | System response |
| 17 | Biometrics for validation of attendance | Paperbased questionnaire | Student | Must-Have | Functional | NIL | Feasible | User action |
| 18 | Initiate attendance session | Paperbased questionnaire | Lecturer | Must-Have | Functional | NIL | Feasible | User action |
| 19 | Get reminders for initiating attendance | Paperbased questionnaire | Lecturer | Should-Have | Functional | NIL | Feasible | System response |
| 20 | Accessibility features for the disabled | User interview | Lecturer | Should-Have | Functional | NIL | Feasible | System response |
| 21 | Access and manage different user accounts | User interview | Administrator | Must-Have | Functional | NIL | Require much effort | User action |
| 22 | Access and manage attendance data | Paperbased questionnaire | Administrator | Must-Have | Functional | NIL | Feasible | User action |
| 23 | Generate comprehensive attendance reports | Paperbased questionnaire | Lecturer | Must-Have | Functional | NIL | Feasible | User action |
| 24 | Integrate app with existing student info systems | Online survey | Administrator | Should-Have | Non-Functional | 3 | Require much effort | System response |
| 25 | Configure data security settings | User interview | Administrator | Must-Have | Functional | NIL | Require much effort | User action |
| 26 | Scalability to accommodate vast number of users | Online survey | Tech staff | Must-Have | Non-Functional | NIL | Feasible | System response |
| 27 | Data encryption | User interview | Tech staff | Must-Have | Non-Functional | NIL | Feasible | System response |
| 28 | Cloud based architecture | Competitive analysis | Administrator | Should-Have | Functional | NIL | Feasible | User action |
| 29 | Compatibility with multiple platforms | Online survey | Student | Could-Have | Non-Functional | NIL | Not feasible | System response |
| 30 | Use GPS location for verification | Online survey | Tech staff | Could-Have | Non-Functional | NIL | Feasible | System response |
| 31 | Recording the timestamp during attendance marking | Competitive analysis | Lecturer | Must-Have | Functional | NIL | Feasible | System response |
| 32 | Ability to mark student attendance | User interview | Lecturer & Student | Must-Have | Functional | NIL | Feasible | Success condition |
| 33 | Use QR code to access attendance session | Paperbased questionnaire | Administrator | Should-Have | Functional | NIL | Feasible | User action |
| 34 | Use class code entry to access attendance session | Paperbased questionnaire | Lecturer | Won't-Have | Functional | NIL | Require much effort | System response |
| 35 | Use session link to access attendance session | Paperbased questionnaire | Lecturer | Must-Have | Functional | NIL | Not feasible | User action |
| 36 | Ability to filter and search attendance records | Online survey | Student | Should-Have | Non-Functional | NIL | Feasible | System response |
| 37 | Login using secure credentials | Online survey | Lecturer | Should-Have | Functional | 13 | Not feasible | User action |
| 38 | Login using biometrics | Online survey | Administrator | Won't-Have | Functional | NIL | Feasible | User action |
| 39 | View personal attendance history | Competitive analysis | Lecturer | Must-Have | Non-Functional | NIL | Feasible | System response |
| 40 | Receive notifications for upcoming attendance | Paperbased questionnaire | Administrator | Could-Have | Non-Functional | NIL | Feasible | User action |
| 41 | Manage account settings | Competitive analysis | Student | Could-Have | Functional | NIL | Not feasible | Success condition |
| 42 | Secure admin dashboard with role-based access control | User interview | Lecturer | Should-Have | Non-Functional | NIL | Feasible | Success condition |
| 43 | Robust feedback mechanism and software updates | Competitive analysis | Lecturer | Must-Have | Non-Functional | NIL | Feasible | User action |
| 44 | Monitory tools to manipulate data | Competitive analysis | Administrator | Must-Have | Non-Functional | NIL | Feasible | System response |

Fig. Complete analyzed data.

5.1. Analysis of Requirements (to ensure clarity, consistency, feasibility)

Some Issues

- A. Integration with Existing systems:** Requires clarification on specific systems and scalability needs, Examining API documentation and interoperability, increase development time and cost
- B. Scalability Needs:** Further details on institutional needs are needed to determine specific scalability requirements for integration and system architecture
- C. Compatibility with all devices:** May not be feasible to ensure compatibility with all devices but ensuring compatibility with commonly used devices such as Android, and web applications can be pursued
- D. Single Device for Attendance tracking:** Using mobile devices for attendance tracking via geolocation and timestamps is a feasible alternative for passing round a single device which may be damaged but sensor qualities of the mobile devices need to be considered.

5.2. Identification and Resolution of Conflicts and Ambiguities

Conflict 1: **User Interface Complexity vs. Customization**

- Instructors require a simple UI with minimal learning curve
- Instructors/Administrators require customizable reporting functionalities with a wider range of features and tools

Resolution 1: **Implement a layered UI**, Instructors can have a basic mode/view with core functionalities like attendance tracking while they can also have a more detailed view with customizable options in advanced mode

Conflict 2: **Security vs. User Experience**

- Students desire a simplified check-in process with minimal steps
- IT-staff preference for multibiometric features to enhance security which could slow check-in process.

Resolution 2: **Offer simultaneous check-in** process where the faces are recognized at the same time the fingerprint is being recorded

Conflict 3: **Scalability vs. Cost**

- Cloud based architecture for scalability
- Prefer cost effective solution due to low budget

Resolution 3: **Explore a hybrid Model** with a basic on-premise solution for smaller institutions and a cloud-based option with scalability features for larger institutions with budget flexibility.

Conflict 4: **Training needs and self sufficiency**

- Users require a user-friendly interface with no training requirements
- May require training on advance features (e.g., reporting tools)

Resolution 4: Develop comprehensive in-app tutorials and user guides for self-learning. Offer tiered support with easy access to FAQs and online resources for basic issues. Reserve in-person training sessions for more complex features or user groups requiring dedicated support (new instructors, for example).

Conflict 5: **Integration vs. Performance**

- Integrations with existing administrative systems could impact application performance due to data synchronizations between systems and slow response time

Resolution 5: Conducting thorough performance testing during integration to ensure smooth operation

5.3. Prioritization of requirements (based on impact and importance)

- Real-time attendance tracking and enrollment capabilities for instructors and administrators are high-priority as they form the core functionality of the system.
- User-friendly interfaces and simplified check-in processes for students are also high-priority to ensure smooth user experience.
- Comprehensive reporting functionalities and support mechanisms for administrators and IT staff are crucial for effective management and maintenance of the system.
- Customization options and feedback mechanisms for continuous improvements should be prioritized across all user groups to enhance usability and functionality over time.

6. Requirements Documentation

6.1. Functional Requirements

The application aims to provide a comprehensive solution for tracking student attendance using biometric authentication methods. The functional requirements are categorized into key modules to ensure clarity and effectiveness in the development process.

I. Biometric Data Capture:

❖ Multibiometric Authentication:

- The application must support multiple biometric authentication methods such as fingerprints, facial recognition, and iris scanning.
- Users should have the flexibility to choose their preferred biometric method for authentication.
- Multi biometric data can be captured simultaneously

❖ Validate Attendance Using Biometrics:

- Attendance for each student must be validated using biometric data captured from enrollment during a session.
- The system should accurately match the biometric data provided during authentication with stored data for validation.
- The system must ensure that only authorized students with valid biometric credentials can mark their attendance.

II. Enrollment and Authentication Module:

❖ Biometrics for Authentication:

- Biometric data particular fingerprint recognition should be utilized as the primary method for user authentication within the application.
- Students must enroll their biometric data securely into the system for authentication purposes.

❖ Secure Login and Access Control:

- The application should implement secure login mechanisms to authenticate users.
- Access control measures must be in place to restrict unauthorized access to sensitive information and functionalities for different stakeholders.

❖ Sign In Using Secure Credentials:

- Users should have the option to log in using traditional username/password credentials for enhanced security.

- Passwords must be securely stored and encrypted to prevent unauthorized access.
 - ❖ **Login Using Biometrics:**
 - Biometric authentication methods such as fingerprint scanning and or facial recognition should be integrated into the log in process for user convenience.
- III. Real-time Attendance Tracking:**
- ❖ **Initiate Attendance Session:**
 - Teachers or authorized personnel should be able to initiate attendance sessions for their respective classes or events.
 - Sessions must be time-bound and automatically closed after a specified duration to prevent unauthorized attendance marking.
 - ❖ **Real-time Attendance Marking:**
 - The application must track student attendance in real-time during classes and events.
 - Attendance data should be updated instantly to reflect the current status of students' presence.
 - ❖ **Use GPS Location for Verification:**
 - GPS location verification should be employed to ensure that students are marking their attendance from the designated location.
 - This feature adds an additional layer of security and prevents attendance fraud.
 - ❖ **Recording Timestamp During Attendance Marking:**
 - The system should record timestamps for each attendance mark to maintain a chronological record of student attendance.
 - Timestamps are essential for auditing and tracking attendance patterns over time.
 - ❖ **Ability to Mark Student Attendance:**
 - Teachers should have the ability to mark attendance for individual students manually in case of technical issues or exceptional circumstances.
 - Manual attendance marking should be recorded with proper justification and authorization.
- IV. Reporting:**
- ❖ **Export Attendance Reports:**
 - Users should be able to export attendance reports in various formats (e.g., PDF, CSV) for further analysis and documentation.
 - The exported reports should include detailed information such as attendance dates, student names, and attendance status.
 - ❖ **Generate Comprehensive Attendance Reports:**
 - The application must generate comprehensive attendance reports that provide insights into student attendance patterns and trends.
 - Reports should be customizable to accommodate specific user requirements and preferences.
 - ❖ **Access and Manage Attendance Data:**
 - Users with appropriate permissions should be able to access and manage attendance data securely.
 - Data management functionalities should include editing, deleting, and archiving attendance records as necessary.
 - ❖ **Detail Analysis, sorting, searching and filtering of Attendance Data:**

- Provide monitoring tools to enable instructors perform analysis of attendance data and trends
- Provide filtering, sorting and searching capabilities of attendance data for instructors

V. Notifications:

❖ App's Push Notification:

- The application should send push notifications to users' devices to notify them of important events and updates.
- Notifications may include reminders for upcoming classes, latecomer alerts, and attendance session initiation prompts.

❖ In-App Notification:

- Notifications should also be displayed within the application interface to ensure that users receive timely updates even when not actively using the app.

❖ Email or SMS Notification:

- Users should receive notifications via email for critical events such as late arrivals or absence from scheduled classes.
- Email notifications should be customizable and include relevant details to facilitate prompt action.

❖ Receive Alerts for Latecomers:

- Teachers and administrators should receive notifications when students arrive late for classes beyond a predefined threshold.
- Latecomer notifications serve as a proactive measure to address attendance issues promptly.

❖ Get Reminders for Initiating Attendance:

- Teachers and administrators should receive reminders to initiate attendance sessions in advance or at the beginning of each class or event.
- Timely reminders help ensure that students and staff are adequately prepared and present for scheduled activities.
- Reminders help streamline the attendance tracking process and minimize oversight or delays.

The functional requirements serve as a comprehensive guide for the development of the biometric student application. By addressing key functionalities such as biometric data capture, enrollment/authentication, real-time attendance tracking, reporting, and notifications, the application aims to provide a robust and user-friendly solution for managing student attendance effectively. Adherence to these requirements will contribute to the development of a reliable and efficient system that meets the needs of educational institutions and stakeholders.

6.2. Non-Functional Requirements

These requirements complement the functional aspects of the application by addressing critical aspects such as scalability, customization, security, performance, and user-friendliness. Adhering to these non-functional requirements ensures that the application meets the highest standards of reliability, efficiency, and user satisfaction.

I. Scalability:

❖ Scalability to Accommodate a Vast Number of Users:

- The application must be capable of handling a large volume of users concurrently without compromising performance or user experience.
- Scalability should be achieved through robust architecture design and efficient resource utilization.

❖ **Cloud-Based Architecture:**

- Utilizing a cloud-based architecture enables seamless scalability by leveraging cloud resources to accommodate varying workloads and user demands.
- Cloud infrastructure offers scalability, reliability, and accessibility across different geographical locations.

II. Security:

❖ **Security of Attendance Data:**

- Attendance data must be secured using robust encryption algorithms and access controls to prevent unauthorized access or tampering.
- Data security measures should comply with industry standards and regulations to safeguard sensitive information.

❖ **Security of User Information:**

- Personal user information, including biometric data, contact information and login credentials, must be protected against unauthorized access or disclosure.
- Secure storage mechanisms, encryption protocols, and access controls should be implemented to ensure user privacy and confidentiality.

❖ **Data Encryption:**

- All sensitive data that is biometric data transmitted and stored within the application should be encrypted using industry-standard encryption algorithms.
- Encryption ensures data integrity and confidentiality, especially during data transfer over networks or storage on remote servers.

III. Performance.

❖ **Offline Functionality of App:**

- The application should maintain core functionality even in offline mode, allowing users to access essential features and data without an internet connection.
- Offline capabilities enhance user experience and ensure uninterrupted operation in areas **with limited connectivity**.

❖ **Compatibility with Multiple Platforms:**

- The application must be compatible with multiple platforms, including web browsers, mobile devices (iOS/Android), and desktop computers.
- Cross-platform compatibility maximizes accessibility and user reach across diverse devices and operating systems.

❖ **Fast and Reliable Response Time for Attendance Marking:**

- The system should provide fast and reliable response times when marking attendance to minimize delays and ensure accuracy.

IV. User-Friendly Interface.

❖ **Intuitive User Interface for Easy Navigation:**

- The application interface should be intuitive and user-friendly, with clear navigation paths and intuitive design elements.
- User experience (UX) best practices should be followed to enhance usability and accessibility for all users.

❖ **Manage Account Settings:**

- Users should have the ability to manage their account settings easily, including profile information, notification preferences, and security settings.
- Account management features should be accessible and straightforward, empowering users to customize their experience according to their preferences.
- ❖ **View Personal Attendance History:**
 - Users should be able to view their personal attendance history conveniently within the application.
 - Access to attendance history enables users to track their own attendance patterns and monitor their progress over time.
- ❖ **Secure Admin Dashboard with Role-Based Access Control:**
 - The admin dashboard must be secure and feature role-based access control (RBAC) to manage user roles and permissions effectively.
 - RBAC ensures that only authorized personnel can access and manage sensitive administrative functionalities, enhancing system security and integrity.
- ❖ **Robust Feedback Mechanism and Software Updates:**
 - The application should include a robust feedback mechanism to gather user feedback and suggestions for continuous improvement.
 - Regular software updates should be provided to address user feedback, fix bugs, and introduce new features, ensuring that the application remains up-to-date and responsive to user needs.

6.3. External Interface Requirements

- I. **Hardware Requirements:**
 - a. **Smartphones/Tablets for students:** with fingerprint sensors for scanning fingerprint and cameras for facial recognition
 - b. **Desktop for instructors:** Used to analyze attendance data
- II. **Software requirements:**
 - a. **Authentication Interface:** The authentication interface handles user authentication and authorization, verifies user credentials (e.g., username, biometric data) and determines access rights based on roles and permissions.
 - b. **Database Interface:** The database interface interacts with the underlying database management system (DBMS) to perform operations such as storing, retrieving, updating, and deleting data related to students, faculty, classes, attendance records
 - c. **Attendance Tracking Interface:** The attendance tracking interface is responsible for capturing attendance data during class sessions. It communicates to record attendance in real-time.
 - d. **Reporting Interface:** The reporting interface generates various types of attendance reports based on user-specified criteria. It allows users to customize report parameters (e.g., date range, student/class filters) and formats reports for export or printing.
 - e. **Web Services/APIs:** Web services or APIs (Application Programming Interfaces) provide programmable interfaces for interacting with the attendance management system. They enable third-party developers to build custom applications or integrations and facilitate communication between different modules within the system.

III. Technological Requirements:

a. Front-end:

- **HTML/CSS/JavaScript**
- **Front-End Frameworks: React Native**
- **UI/UX Design Tools: Adobe XD, Figma, Sketch**

b. Back-end:

- **Programming Languages: Node.js (JavaScript), Python**
- **Database Management: PostgreSQL, MongoDB**
- **Web Frameworks: Express.js (Node.js)**
- **Mobile framework: Kivy (Python)**

IV. Software Integration:

❖ Integration with Existing Student Information Systems (SIS):

- The application must support seamless integration with existing student information systems (SIS) commonly used in educational institutions.
- Integration capabilities should enable bidirectional data exchange between the biometric student application and SIS to synchronize student records, course schedules, and attendance data.

❖ Interoperability with Third-Party Applications:

- The application should facilitate interoperability with third-party applications and services commonly utilized in educational settings, such as learning management systems (LMS) and communication platforms.
- Integration APIs and standardized protocols should be provided to enable easy data exchange and interaction between the biometric student application and external systems.

V. Hardware Compatibility:

❖ Biometric Sensor Integration:

- The application must be compatible with various biometric sensors and devices used for biometric authentication, such as fingerprint scanners, facial recognition cameras, and iris scanners.
- Compatibility with a wide range of hardware ensures flexibility and accessibility for users across different devices and platforms.

❖ Mobile Device Compatibility:

- The application should be compatible with a diverse range of mobile devices, including smartphones and tablets, running on popular operating systems such as iOS and Android.
- Cross-platform compatibility ensures broad accessibility and usability for users regardless of their device preferences.

VI. Mobile Support:

❖ Mobile Application Development:

- The application should be developed as a mobile app to provide users with the convenience of accessing attendance tracking and authentication functionalities on the go.
- Mobile app development should adhere to platform-specific guidelines and best practices to ensure optimal performance and user experience.

❖ Responsive Design for Mobile Devices:

- The mobile application interface should feature responsive design principles to adapt seamlessly to various screen sizes and resolutions.

- Responsive design enhances usability and accessibility for mobile users by optimizing layout and content presentation based on the device's screen characteristics.

VII. Data Exchange Formats:

❖ Standardized Data Exchange Formats:

- The application should utilize standardized data exchange formats and protocols for seamless integration with external systems and data exchange.
- Commonly used formats such as JSON (JavaScript Object Notation) and XML (eXtensible Markup Language) should be supported to facilitate interoperability and compatibility.

❖ API Documentation and Specifications:

- Comprehensive documentation and specifications for application programming interfaces (APIs) should be provided to enable smooth integration with external systems and development of custom integrations.
- API documentation should include details such as endpoints, request/response formats, authentication methods, and usage guidelines.

These external interface requirements are essential for ensuring the compatibility, interoperability, and accessibility of the biometric student application in diverse educational environments

7. Use Cases

- **Schools and Universities:** Manage attendance of students across various educational institutions.
- **Classroom Attendance:** Automatically record student attendance for each classroom session using biometric technology.
- **Extracurricular Activity:** Track student attendance on extracurricular activities such as clubs and special events.
- **Student Engagement:** Analyze attendance data to identify patterns allowing educators to intervene and support students who may be struggling with attendance or engagement.
- **Parental Involvement:** Provide parents or guardians with real-time access to their child's attendance records, enhancing communication and accountability.

8. Verification and Validation

8.1. Verification of Documented Requirements

Verification of documented requirements involves ensuring that the specified requirements for the student biometric attendance system are accurate, complete and feasible.

- **Reviews:** Reviewing the documented requirements with stakeholders, including educators and IT professionals in order to validate their accuracy and relevance to the project goals.
- **Traceability:** Ensuring that each documented requirements are traceable back to project's objectives, ensuring that each requirement contributes to project's goal or aim.
- **Testability:** Verifying that the requirements are testable. Meaning they can be objectively verified through testing or validation activities confirming they have been successfully implemented.

- **Feasibility Assessments:** Verifying if requirements fall within project's constraints including budget, timeline, technological capabilities and regulatory compliance.
- **Consistency and Completeness:** Ensuring that the documented requirements are consistent with each other and not conflicting or redundant. Also verifying that all necessary requirements are included to support intended functionality.
- **Feedback Incorporation:** Incorporating feedback from stakeholders and subject matter experts into requirement documentation, addressing any issue or concerns raised during the verification process.

8.2. Validation Techniques and Methods

Validation plan for the student biometric attendance system outlines the approach and activities for confirming that the system meets specified requirements and works as expected.

The Primary goal or objective of our system is successfully record student attendance data using biometric technologies such as fingerprints or facial recognition.

Some of the validation techniques include;

- **Testing:** Here acceptance testing is used to test the cases that will be executed.
- **Inspections and Reviews:** Here Inspections can be carried out on each functionality to evaluate how good it is.
- **Prototyping:** Build prototypes here to validate key features or some user interactions.
- **User Feedback:** Feedbacks will serve as a means for validation since from feedbacks, we can estimate how far we are from our goal.

9. Risk Analysis

The purpose of this is to conduct a risk analysis for the development and implementation of the biometric student attendance system. This analysis aims to identify potential risks, assess their likelihood and impact, and propose mitigation strategies to manage these risks effectively.

9.1. Identification of Potential Risks

A. Technical Risks:

- Incompatibility with existing systems.
- Technical glitches or failures during implementation.
- Security vulnerabilities leading to data breaches.

B. Operational Risks:

- Resistance from stakeholders to adopt biometric authentication.
- Insufficient training leading to low user adoption rates.
- Operational disruptions due to system downtime or maintenance.

C. Regulatory Risks:

- Non-compliance with data protection regulations (e.g., GDPR, HIPAA).
- Legal challenges regarding biometric data usage and privacy concerns.

D. Financial Risks:

- Cost overruns due to unexpected technical challenges or scope changes.
- Budget constraints impacting the quality or scope of the system.

E. Schedule Risks:

- Delays in development or implementation due to unforeseen technical issues.
- Resource constraints leading to schedule slippage.

9.2. Assessment of likelihood and impact of risk

| Risk | Likelihood | Impact |
|-------------|-----------------|------------------|
| Technical | Moderate | High |
| Operational | High | Moderate |
| Regulatory | Low to moderate | High |
| Financial | Moderate | Moderate to high |
| Schedule | Moderate | moderate |

9.3. Mitigation strategies for managing the risk

A. Technical Risks:

- Conduct thorough compatibility testing with existing systems.
- Implement robust security measures and regular vulnerability assessments.
- Engage experienced technical consultants to address potential challenges.

B. Operational Risks:

- Provide comprehensive training and support for stakeholders.
- Implement change management strategies to address resistance to adoption.
- Develop contingency plans for operational disruptions.

C. Regulatory Risks:

- Ensure compliance with relevant data protection regulations from the outset.
- Obtain legal counsel to review data usage policies and ensure compliance.
- Implement privacy-enhancing features and obtain consent for biometric data usage.

D. Financial Risks:

- Conduct thorough cost estimation and contingency planning for unexpected expenses.
- Prioritize features and functionalities to align with budget constraints.
- Regularly monitor project expenses and adjust plans as needed.

E. Schedule Risks:

- Develop a realistic project schedule with buffer time for unforeseen delays.
- Regularly monitor progress and adjust timelines as needed to mitigate schedule risks.
- Allocate sufficient resources to avoid resource constraints impacting the schedule.

Effective risk management is crucial for the successful development and implementation of the biometric student attendance system. By identifying potential risks, assessing their likelihood and impact, and implementing appropriate mitigation strategies, the project team can minimize disruptions and ensure project success.

Regular monitoring and review of risks throughout the project lifecycle are essential to adapt mitigation strategies as needed. Additionally, clear communication and collaboration among stakeholders are key to addressing risks effectively and ensuring project objectives are met.

10. Conclusion

10.1. Summary of key findings

Throughout the requirement analysis process, several key findings have emerged, highlighting the critical aspects and considerations for the development of the biometric student application. These findings include:

- I. **Complexity of Stakeholder Needs:** The diverse requirements gathered from stakeholders underscore the complexity of managing student attendance in educational settings. Stakeholders' needs range from real-time attendance tracking to robust security measures and seamless integration with existing systems.
- II. **Significance of Non-Functional Requirements:** Non-functional requirements such as scalability, security, and performance play a pivotal role in shaping the overall effectiveness and usability of the application. Ensuring compliance with these requirements is essential for achieving long-term success and user satisfaction.
- III. **Integration Challenges:** Integrating the biometric student application with existing student information systems and hardware devices presents technical challenges that require careful consideration and planning. Seamless integration is crucial for data accuracy, interoperability, and user experience.
- IV. **Risk Analysis:** The risk analysis phase has been completed, identifying potential risks and mitigation strategies to manage them effectively. This analysis will inform decision-making throughout the development process, ensuring proactive risk management and project success.
- V. **Verification and Validation:** Verification and validation activities have been conducted to ensure that the documented requirements align with stakeholders' expectations and are feasible to implement. These processes validate the accuracy, completeness, and consistency of the requirements, laying a solid foundation for subsequent development stages.

10.2. Next steps (System Modelling and Design)

- **System Modelling:** Utilizing appropriate modelling techniques such as use case diagrams, sequence diagrams, and class diagrams to visually represent the system's functionality, interactions, and structure. System modelling helps stakeholders and development teams gain a comprehensive understanding of the system's behavior and architecture.
- **Architectural Design:** Designing the system architecture to address the identified requirements and ensure scalability, reliability, and maintainability. This involves selecting suitable architectural patterns and technologies, defining component interactions, and establishing data flows and communication protocols.
- **Prototype Development:** Developing a prototype or proof-of-concept to validate the proposed system design and gather feedback from stakeholders. The prototype serves as a tangible demonstration of the application's functionality and allows for early detection of potential issues or areas for improvement.
- **Iterative Refinement:** Iteratively refining the system design based on feedback, stakeholder input, and evolving requirements. Continuous refinement ensures that the final solution aligns closely with stakeholders' expectations and addresses their needs effectively.