

**REPUBLIC OF  
CAMEROON**

**MINISTRY OF HIGHER  
EDUCATION**

**Peace-Work-Fatherland**



**REPUBLIC DU CAMEROUN**

**MINISTERE DE  
L'ENSEIGNEMENT  
SUPERIEUR**

**Paix-Travail-Patrie**

# **UNIVERSITY OF BUEA**

**FACULTY OF ENGINEERING AND TECHNOLOGY,**

**CEF440:**

**INTERNET PROGRAMMING AND MOBILE PROGAMING**

**GROUP 23: TASK 2**

Names	Matriculation Number
NDIFON LEMUEL ASHU-MBI	FE21A247
NGWASIRI RYAN TANIFIORM ONGA	FE21A266
NJIDDA SALIFU	FE21A272
ASONGNKWELLE COURAGE AYIM	FE21A142
NKWO BRAINIE NGONDA	FE21A282

Course Instructor:

May, 2024

Dr. Nkemeni Valery

## Catalog

<b>1. Introduction .....</b>	<b>1</b>
<b>2. Stakeholders .....</b>	<b>1</b>
i. Students .....	1
ii. System Administrators .....	1
iii. Faculty Members .....	2
iv. Developers .....	2
<b>3. Analysis Technique .....</b>	<b>2</b>
i. Identification of Services .....	2
ii. Service Composition .....	3
iii. Service Contrasts .....	3
iv. Service Communication .....	3
v. Service Governance .....	3
vi. Service Security .....	3
vii. Service Reusability and Interoperability .....	4
<b>4. Functional Requirements .....</b>	<b>4</b>
<b>6. Technical Requirements .....</b>	<b>7</b>
i. Biometric Integration .....	7
ii. Platform Compatibility .....	7
iii. Database Management: .....	7
iv. Security Protocols .....	7
v. Scalability .....	7
<b>7. Hardware Requirements .....</b>	<b>8</b>
i. Smartphones or Tablets: .....	8
ii. Fingerprint Scanners: .....	8
iii. Network Connectivity: .....	8
iv. Backend Server Infrastructure: .....	8
v. Battery Power: .....	8

<b>8. Priority Requirements .....</b>	<b>9</b>
I. Priority: HP .....	9
II. Priority: MP .....	10
III. Priority LP .....	11
<b>9. Constraints .....</b>	<b>12</b>
a) Hardware Limitations: .....	12
b) Regulatory Compliance: .....	12
c) Network Connectivity: .....	12
d) Budget Constraints: .....	12
e) Time Constraints: .....	12
<b>10. Dependencies .....</b>	<b>13</b>
<b>11. Final Approval .....</b>	<b>15</b>
a) Stakeholder Interviews and Workshops .....	15
b) Requirement Reviews .....	15
c) Prototyping and Mockups .....	15
d) Feasibility Assessment .....	15
e) Requirement Prioritization .....	16
<b>12. Conclusion .....</b>	<b>16</b>
<b>13. References .....</b>	<b>17</b>

# 1. Introduction

In the contemporary educational landscape, efficient attendance management stands as a pivotal aspect of ensuring academic success and administrative efficacy. Traditional paper-based methods of attendance tracking have proven to be cumbersome and prone to errors, necessitating the integration of technological solutions. Among these, mobile applications offer unparalleled convenience and accessibility, empowering educational institutions to streamline their attendance management processes.

The development of a fingerprint student attendance mobile app represents a sophisticated response to this imperative, leveraging biometric technology to enhance accuracy, security, and efficiency. This app aims to revolutionize the conventional approach to attendance monitoring by providing a seamless and user-friendly interface for both students and educators. However, before delving into the intricacies of app design and implementation, a comprehensive requirement analysis is indispensable.

## Requirement Analysis:

The requirement analysis serves as the cornerstone of the app development process, laying the foundation for its functionality, usability, and performance. It involves a systematic examination of the needs, objectives, and constraints inherent in the development of the fingerprint student attendance mobile app. This analysis encompasses multiple dimensions, including technical, functional, and non-functional requirements, each crucial for ensuring the app's effectiveness and relevance.

# 2. Stakeholders

## i. Students

- ✓ Primary users of the app who will utilize it to mark their attendance using fingerprint recognition.
- ✓ Have a vested interest in the app's usability, intuitiveness, reliability, and ease of use.

## ii. System Administrators

- ✓ Responsible for overseeing the implementation and administration of the app within the educational institution.
- ✓ Concerned with overall system performance, data security, compliance with regulations, and integration with existing systems.
- ✓ Responsible for managing the system, carrying out maintenance and reporting to the administrative staff of the faculty

### iii. Faculty Members

- ✓ Will have access to student attendance database for all levels where they can query the attendance per course or for a particular student.
- ✓ Interested in features such as real-time attendance updates, reporting capabilities, and ease of integration with existing work flows.

### iv. Developers

- ✓ Responsible for designing, developing, and maintaining the app.
- ✓ Tasked with implementing the required features, ensuring compatibility with different devices, and addressing technical challenges.
- ✓ Tasked with providing updates with regards to feedback gotten from present users and the growing needs of the faculty.
- ✓ Tasked with scaling the system when a need arises.

## 3. Analysis Technique

Service-Oriented Architecture (SOA) analysis was used in the context of a fingerprint student attendance mobile app involves designing the system as a collection of loosely coupled, reusable services that communicate with each other to fulfill specific functions.

Service-Oriented Architecture (SOA) is an architectural approach that organizes software applications as a collection of loosely coupled, interoperable services. In SOA, services are self-contained, modular units of functionality that can be accessed and used independently, both within the application and across different applications or systems.

Here's a breakdown of SOA analysis for this app:

### i. Identification of Services

- ✓ **Authentication Service:** This service handles user authentication using fingerprint recognition.
- ✓ **Attendance Tracking Service:** Responsible for recording student attendance based on fingerprint scans.
- ✓ **Notification Service:** Sends real-time updates to instructors regarding attendance status.
- ✓ **Reporting Service:** Generates attendance reports for administrators, instructors, and students.

## ii. Service Composition

- ✓ **Composite Service:** The app itself serves as a composite service that orchestrates interactions between various underlying services. For example, upon a student's fingerprint scan, the app triggers the Authentication Service, which then interacts with the Attendance Tracking Service to record the attendance.

## iii. Service Contrasts

- ✓ **Input Contracts:** Define the parameters required by each service. For instance, the Authentication Service expects a fingerprint scan as input.
- ✓ **Output Contracts:** Specify the data returned by each service. The Attendance Tracking Service might return a confirmation message upon successful attendance recording.

## iv. Service Communication

- ✓ **Synchronous Communication:** Used for immediate interactions where the client waits for a response. For example, when a student scans their fingerprint, the app synchronously communicates with the Authentication Service to verify their identity.
- ✓ **Asynchronous Communication:** Employed for non-blocking interactions. For instance, the Notification Service asynchronously sends updates to instructors as attendance records are updated.

## v. Service Governance

- ✓ **Service Registry:** Maintains a registry of available services, allowing clients to discover and invoke them dynamically. In our case, the app's backend would maintain a registry of services.
- ✓ **Service Monitoring:** Monitors service performance and availability to ensure SLA compliance. This ensures that services like the Authentication Service are responsive and available when needed.

## vi. Service Security

- ✓ **Authentication and Authorization:** Ensures that only authorized users can access the services and data. The Authentication Service would require secure authentication mechanisms to verify users' identities.
- ✓ **Data Encryption:** Protects sensitive data, such as fingerprint scans and personal information, during transmission and storage.

#### **vii. Service Reusability and Interoperability**

- ✓ **Reusability:** Services should be designed to be reusable across different applications and scenarios. For example, the Authentication Service could be reused in other security-sensitive applications.
- ✓ **Interoperability:** Services should be interoperable with diverse platforms and technologies. The app should be able to communicate with the services regardless of the underlying technology stack.

By adopting SOA principles in the design and implementation of the fingerprint student attendance mobile app, organizations can achieve greater flexibility, scalability, and maintainability, while promoting service reusability and interoperability across their systems.

## **4. Functional Requirements**

Functional requirements specify the essential behaviors, functions, and capabilities that a system, software application, or product must perform to satisfy the users' needs and achieve its intended purpose. These requirements outline what the system should do in terms of its features, operations, and interactions with users and other systems. Here are some key aspects of functional requirements:

### **i. User Registration**

- ✓ A faculty member a.k.a system manager is registered to the system, he is in-charge of the attendance management like scheduling halls and also generating attendance report from the system.
- ✓ He is also responsible for registering students into the system.
- ✓ Students are registered into the system at their first encounter.

### **ii. Fingerprint Enrollment**

- ✓ The finger print information of each student is captured during their registration to help identify them during attendance marking.
- ✓ Possibility to enroll more than one finger in case of accident on the other.

### **iii. Attendance Marking**

Students mark their selves present just by scanning their fingers while entering the class.

#### **iv. Attendance Monitoring**

- ✓ Lecturers can see their course attendance by requesting the report from the sysadmin who prints or share a soft copy of the report to him.
- ✓ He can also ask for the attendance of a particular student.

#### **v. Reporting**

- ✓ Reports are generated for each course
- ✓ Report can also be generated for a particular student with the associated course.
- ✓ The results are either printed or share soft copy(excel) for easy management and grading

#### **vi. Attendance Tracking**

It should enable students to register their attendance by scanning their fingerprints upon entering the classroom.

#### **vii. Real-time Updates**

The app must provide real-time updates to instructors, allowing them to monitor attendance status and discrepancies promptly.

#### **viii. Data Management**

It should facilitate the storage and management of attendance data in a centralized database, ensuring accessibility and integrity.



## **5. Non-Functional Requirements**

### **i. Performance**

This non-functional requirement refers to the app's ability to respond to user interactions and process attendance data efficiently. It involves factors such as response time, throughput, and resource utilization. For example, the app should have minimal latency in recognizing fingerprints and recording attendance to ensure a seamless user experience, especially during peak usage times like class start times.

### **ii. Usability:**

Usability relates to how easy and intuitive the app is to use for both students and instructors. It encompasses factors such as navigation, layout, and accessibility features. For instance, the app should have a clear and intuitive interface that allows users to quickly scan their fingerprints and view attendance information without confusion or frustration.

### **iii. Security**

Security is crucial for protecting sensitive data, such as fingerprint scans and attendance records, from unauthorized access or breaches. This requirement involves implementing encryption, authentication mechanisms, and access controls to ensure the confidentiality, integrity, and availability of data. For example, the app should encrypt fingerprint data during transmission and storage and authenticate users before granting access to attendance records.

### **iv. Reliability**

Reliability refers to the app's ability to perform consistently and predictably under normal and adverse conditions. It involves factors such as uptime, error handling, and fault tolerance. For instance, the app should be resilient to network failures or server downtime and provide informative error messages to users in case of errors or interruptions.

### **v. Scalability**

Scalability relates to the app's ability to handle increasing workload or user demand without compromising performance or functionality. It involves factors such as load balancing, horizontal scaling, and resource provisioning. For example, the app should be able to accommodate a growing number of users and attendance records over time without degradation in performance or responsiveness.

## **vi. Compatibility**

Compatibility refers to the app's ability to function correctly and interact seamlessly with different devices, operating systems, and browsers. It involves testing and ensuring compatibility with a wide range of devices and platforms. For example, the app should be compatible with popular mobile devices running iOS and Android operating systems, as well as different screen sizes and resolutions.

## **vii. Data Privacy Compliance**

This requirement involves ensuring that the app complies with relevant privacy regulations and standards, such as GDPR or CCPA, to protect users' personal information and privacy rights. It involves implementing privacy policies, data anonymization, and consent mechanisms to safeguard user data. For instance, the app should obtain explicit consent from users before collecting and processing their fingerprint data for attendance tracking purposes, and provide transparency regarding how their data is used and stored.

# **6. Technical Requirements**

## **i. Biometric Integration**

The app must integrate with biometric fingerprint scanning technology to accurately identify and authenticate users.

## **ii. Platform Compatibility**

It should be compatible with both iOS and Android platforms, ensuring broad accessibility across diverse devices.

## **iii. Database Management:**

The app requires robust database management capabilities to store, retrieve, and manipulate attendance data efficiently.

## **iv. Security Protocols**

It must implement stringent security protocols to safeguard sensitive biometric and personal information from unauthorized access or breaches.

## **v. Scalability**

The app should be designed to accommodate potential scalability requirements, ensuring seamless performance as user base and data volume increase.

## **7. Hardware Requirements**

### **i. Smartphones or Tablets:**

Smartphones or tablets serve as the primary hardware platform for running the mobile app. These devices should have sufficient processing power, memory, and storage capacity to support the app's features and functionalities. Additionally, they should be equipped with a reliable fingerprint sensor for biometric authentication.

### **ii. Fingerprint Scanners:**

Fingerprint scanners are essential hardware components required for biometric authentication in the app. These scanners capture and authenticate users' fingerprints, enabling them to register their attendance securely and conveniently. The scanners should be compatible with the mobile devices used by students and instructors and should offer high accuracy and reliability in fingerprint recognition.

### **iii. Network Connectivity:**

Network connectivity is crucial for enabling real-time communication between the mobile app and the backend server or cloud-based services. Mobile devices should have built-in support for Wi-Fi or cellular data connectivity to transmit attendance data, receive updates, and synchronize information with the central database.

### **iv. Backend Server Infrastructure:**

The backend server infrastructure includes servers, databases, and other networking components required to support the app's backend services and data storage. These servers handle tasks such as user authentication, attendance tracking, data storage, and communication with the mobile app. The server infrastructure should be robust, scalable, and secure to accommodate the app's requirements, handle concurrent user requests, and ensure high availability and data integrity.

### **v. Battery Power:**

Battery power is essential for ensuring uninterrupted operation of the mobile devices used to run the app. Since students and instructors may need to use the app throughout the day, mobile devices should have sufficient battery capacity to support continuous usage without frequent recharging. Additionally, efficient power management features can help optimize battery life and extend the runtime of the devices, ensuring that users can rely on the app without being hindered by battery limitations.

## 8. Priority Requirements

Priority requirements are the features, functionalities, or characteristics of a system or software application that are deemed essential or critical for its successful implementation and operation. These requirements are prioritized based on their importance to the overall goals and objectives of the project, as well as their impact on the system's functionality, usability, performance, and other key aspects.

Priority requirements are typically categorized into different levels of priority, such as:

- a) **High Priority (HP):** Requirements critical for the core functionality and success of the system.
- b) **Medium Priority (MP):** Requirements important for the system's functionality but may have some flexibility in implementation timing.
- c) **Low Priority (LP):** Requirements that are desirable but can be deferred to future releases if necessary.

### I. Priority: HP

#### a) Fingerprint Authentication

Justification: This is the fundamental feature of the system, ensuring secure and accurate user authentication.

#### b) Mark Attendance

Justification: Essential for the primary purpose of the app, tracking student attendance accurately and efficiently.

#### c) Attendance Reports

Justification: Provides valuable insights into attendance patterns and trends, supporting administrative decision-making and regulatory compliance.

#### d) Real-time Updates

Justification: Ensures timely and accurate reflection of attendance data, enhancing the reliability and usability of the system.

#### e) Data Encryption

Justification: Critical for ensuring the security and privacy of sensitive biometric and attendance data, maintaining regulatory compliance.

**f) Intuitive User Interface**

Justification: Enhances user experience and adoption rates by providing a user-friendly interface for both students and teachers.

**g) System Availability**

Justification: Ensures uninterrupted access to the system, minimizing disruptions to attendance tracking and management processes.

**h) Regulatory Compliance**

Justification: Critical for adhering to legal requirements and protecting user privacy, mitigating potential risks and liabilities.

**II. Priority: MP**

**a) Hardware Compatibility**

**Justification:** Necessary for the successful integration of the app with existing biometric hardware, but can be addressed during the implementation phase.

**b) Absentee Alerts**

**Justification:** Helps teachers and administrators proactively address attendance issues, improving overall attendance management.

**c) Scalability**

**Justification:** Important for accommodating future growth and increasing user demands without compromising system performance.

### **III. Priority LP**

#### **a) Exportable Attendance Reports**

Provide additional options for exporting attendance reports, such as integration with third-party analytics tools or cloud storage platforms.

**Justification:** While beneficial for data analysis and sharing, this feature can be deferred to a later release without compromising the primary functionality of the app.

#### **b) Integration with External Systems**

Enable integration with external systems, such as learning management systems (LMS) or student information systems (SIS), for data synchronization and seamless workflow management.

**Justification:** While integration with external systems can improve efficiency, it may require additional development effort and can be prioritized for future enhancements.

#### **c) Offline Mode**

Provide limited offline functionality for marking attendance and accessing basic features when internet connectivity is unavailable.

**Justification:** While helpful in certain scenarios, implementing offline mode may add complexity to the app and can be considered as a future improvement.

#### **d) Multi-language Support**

Add support for multiple languages to accommodate users from diverse linguistic backgrounds.

**Justification:** While important for accessibility and inclusivity, multi-language support can be deferred to future releases to focus on core functionality.

These low priority requirements can be considered for implementation in subsequent phases or updates of the app, once the higher priority features have been successfully developed and deployed.

## 9. Constraints

Constraints in a project represent limitations or restrictions that may impact its development, implementation, or operation. Here are five potential constraints for the fingerprint student attendance mobile app project:

### a) **Hardware Limitations:**

Explanation: The availability and compatibility of fingerprint scanning hardware may pose a constraint. Not all mobile devices may support fingerprint scanning, and those that do may vary in terms of sensor quality and compatibility with the app. This constraint may require the project team to identify compatible devices or develop alternative authentication methods for devices without fingerprint scanners.

### b) **Regulatory Compliance:**

Explanation: Compliance with privacy regulations and data protection laws, such as GDPR, HIPAA, or local privacy laws, may pose constraints on the collection, storage, and use of biometric data (e.g., fingerprint scans) for attendance tracking purposes. Failure to comply with these regulations could result in legal consequences or fines, necessitating careful consideration and implementation of appropriate security and privacy measures.

### c) **Network Connectivity:**

Explanation: Reliance on network connectivity for real-time communication between the mobile app and backend servers may pose constraints, particularly in areas with limited or unreliable network coverage. This constraint may require the app to support offline functionality or synchronize data asynchronously when network connectivity is restored to ensure uninterrupted attendance tracking.

### d) **Budget Constraints:**

Explanation: Budget constraints may limit the resources available for the development, deployment, and maintenance of the app. This constraint may require the project team to prioritize features and functionalities based on their cost-effectiveness and alignment with project goals.

### e) **Time Constraints:**

Explanation: Time constraints, such as project deadlines or academic schedules, may impose limitations on the project timeline and development cycle. This constraint may require the project team to adopt agile methodologies, iterative development approaches, or phased implementation strategies to deliver key features and functionalities within the allotted time frame.

Addressing these constraints effectively requires careful planning, risk management, and stakeholder collaboration throughout the project lifecycle. By identifying and mitigating potential constraints early on, the project team can minimize disruptions and ensure the successful development and deployment of the fingerprint student attendance mobile app.

## 10. Dependencies

- ✓ **Integration with existing student information systems (SIS) for seamless data exchange.**

### **Explanation:**

Integrating the attendance system with the institution's SIS ensures seamless data exchange. When students mark their attendance using fingerprint scans, this information should automatically update the SIS.

### **Importance:**

- Accurate attendance records are essential for administrative purposes, including grading, eligibility, and student performance analysis.
- Integration streamlines processes, reduces manual data entry, and minimizes errors.

### **Implementation Considerations:**

- Establish secure APIs or connectors between the attendance system and the SIS.
- Ensure compatibility with existing SIS databases and data formats.
- ✓ Collaboration with hardware vendors for procurement and installation of fingerprint scanning devices.

### **Explanation:**

Procuring and installing reliable fingerprint scanning devices is critical. These devices capture unique biometric data for each student.

### **Importance:**

- Accurate fingerprint scans prevent proxy attendance (where one student marks attendance for another).
- Quality hardware ensures consistent performance and reliability.

### **Implementation Considerations:**

- Research reputable vendors.



- Choose devices with high accuracy, durability, and scalability.
- Plan installation logistics (placement, connectivity, maintenance).
- ✓ **Two way system design (focused mainly on the administrator and students)**

The system should be designed to cater to both administrators and students. Administrators need robust backend functionalities to manage data, while students require a simple and intuitive interface for marking attendance

- ✓ **Terminal mobile devices are being provided by the institute**

The institute providing terminal mobile devices ensures that there is a standardized platform for the attendance app. This uniformity helps in maintaining system integrity and ease of use

- ✓ **Lecturers teaching classes work hand in hand with the administration to let them know of scheduled classes or updates**

Lecturers are integral to the system's success. Their cooperation with the administration in communicating class schedules and updates ensures that the attendance data is accurate and reflects the actual class occurrences.

- ✓ **Each hall has at least two mobile devices with app already installed**

Ensuring that each hall has at least two mobile devices with the attendance app pre-installed guarantees that students can mark their attendance conveniently, even in large classes or during peak times.

- ✓ **Cloud deployment funds are being provided by the faculty for cloud development when necessary**

Faculty-provided funds for cloud deployment signify a commitment to a scalable and flexible attendance system. Cloud hosting allows for secure data storage, backup, and accessibility from anywhere.

## **11. Final Approval**

During the requirement analysis phase of the project, validation is critical to ensure that the identified requirements accurately capture the needs and expectations of stakeholders and form a solid foundation for the development of the fingerprint student attendance mobile app.

Here's how validation of the requirements was be done at this phase:

### **a) Stakeholder Interviews and Workshops**

Stakeholder engagement was conducted through interviews and workshops with administrators, instructors, students, and IT personnel. Insights were gathered on existing attendance tracking processes, pain points, and desired functionalities for the mobile app. Stakeholders emphasized the need for a user-friendly interface, real-time attendance tracking, and robust security features.

### **b) Requirement Reviews**

Documented requirements were reviewed with key stakeholders to ensure accuracy, completeness, and relevance. Stakeholders provided valuable feedback, identifying discrepancies and suggesting enhancements. Amendments were made to the requirements documentation to address stakeholder input and ensure alignment with their needs and expectations.

### **c) Prototyping and Mockups**

Prototypes and mockups of the app's user interface and functionality were developed based on the identified requirements. Stakeholders were presented with these prototypes to gather feedback on usability, intuitiveness, and effectiveness. Stakeholder interactions with the prototypes helped refine and finalize the requirements, ensuring they met stakeholders' expectations.

### **d) Feasibility Assessment**

Technical experts, including developers and system architects, conducted a feasibility assessment to evaluate the technical feasibility of implementing the identified requirements. Factors such as technology constraints, resource availability, and integration requirements were considered. Requirements were validated to ensure they were feasible within the project's technical and resource constraints.

### **e) Requirement Prioritization**

Requirements were prioritized based on their importance to the project's objectives and stakeholders' needs. MoSCoW (Must have, Should have, Could have, Won't have) technique was used to assign priorities to each requirement. Prioritization was validated to ensure alignment with stakeholders' priorities and project constraints, focusing on addressing high-priority requirements first.

## **12. Conclusion**

The requirement analysis phase concluded with validated, prioritized requirements that accurately captured stakeholders' needs and expectations. Stakeholder engagement, requirement reviews, prototyping, feasibility assessment, and prioritization were integral to ensuring the success of the project. The validated requirements will serve as the foundation for the subsequent phases of design, development, and testing of the Fingerprint Student Attendance Mobile App.

### 13. References

- ✓ [https://link.springer.com/chapter/10.1007/978-981-10-8201-6\\_58](https://link.springer.com/chapter/10.1007/978-981-10-8201-6_58)(Biometric Fingerprint Attendance System: An Internet of Things Application)
- ✓ <https://ijrpr.com/uploads/V5ISSUE3/IJRPR23363.pdf> (Fingerprint Based Attendance System)
- ✓ [https://www.academia.edu/107033775/Staff\\_Attendance\\_Monitoring\\_System\\_using\\_Fingerprint\\_Biometrics](https://www.academia.edu/107033775/Staff_Attendance_Monitoring_System_using_Fingerprint_Biometrics) (Staff Attendance Monitoring System using Fingerprint Biometrics)
- ✓ <https://www.ijsr.net/archive/v12i9/SR23923144933.pdf> ( Implementation of Attendance Management System Utilizing Fingerprint, QR Code, and GPS Technology in Educational Institutions)

