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

TASK 2: REQUIREMENTS GATHERING FOR A BIOMETRIC ATTENDNCE SYSTEM

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1. INTRODUCTION

The purpose of this work is to document the requirement gathering process for the development of a Biometric Student's Attendance Mobile Application. The project aims to address the challenges associated with traditional attendance tracking methods in higher educational institutions by leveraging biometric technology, specifically fingerprint recognition, to create a secure and efficient system for recording student attendance.

In other to create an innovative solution, deep understanding of the existing system to ensure the sustainability of proposed solution is needed. This involves comprehensively examining current practices, including their methodologies, frequency attendance recordings, challenges encountered, and the volume of data processed. Moreover, it is imperative to identify the target users and their specific requirements to tailor the solution effectively.

To achieve this understanding, a variety of techniques were employed throughout the requirement gathering process. These techniques include interviews, surveys, shadowing, studying the current system, prototyping, and workshops. By implementing these techniques, we sought to gain insights into stakeholder needs, preferences, and pain points, laying the groundwork for a sustainable and user-centric solution.

1.1 What is Requirement Gathering?

Requirement gathering is the process of identifying your project's exact requirements from start to finish. This process occurs during the project initiation phase but you'll continue to manage your project requirements throughout the entire project timeline.

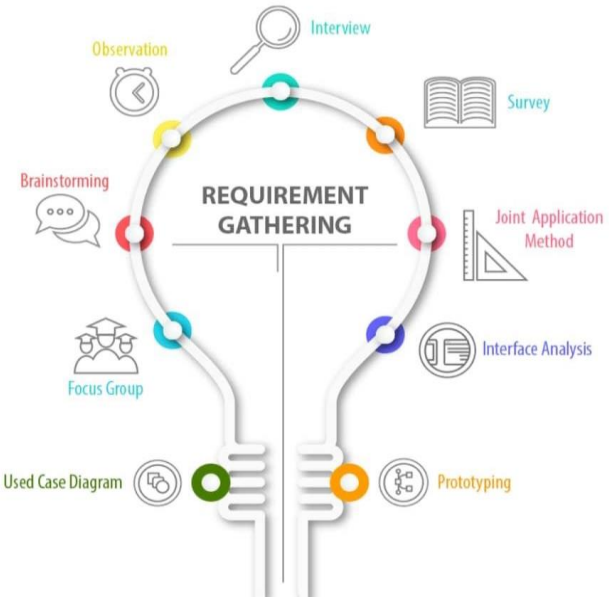


Fig: Requirement gathering

Requirement gathering typically happens during the project briefing or initial kick-off meeting.

Some questions during this briefing include?

- How long will our project schedule be?
- Who will be involved in the project?
- What risks may we face in this project?

The project initiation phase is an important time to establish the foundation of a successful project. Laying out all the key information early ensures that your entire team is in the same page before your work even begins. The best way to do this? Create a project initiation document template.

1.2 What is a project initiation document (PID)?

A project initiation document (PID) is a type of document that project managers create before they begin a project. This document complies key project information such as the project scope, goals, success criteria, business value, and potential project risks. This is also commonly referred to as project charter or a project brief.

1.3 What is a project initiation document (PID) template?

A project initiation document (PID) template is a reusable outline of a project initiation document. It's best used when you're creating new projects so you can quickly duplicate the template, and then fill in the relevant project information. This saves project managers time so they don't have to create a brand new PID every time they start a new project.

1.4 Why we used a PID template?

Using a project initiation document template provides your team with a few different benefits. Here's how it can help you:

- **Establishes consistency across all projects**:
  Using a PID template helps streamline the project creation process, so the project manager can easily follow the same steps every time a new project begins.
- **Allows for customization for specific teams**:
  PIDs help standardize the project creation process, but one of the major benefits is that you can still customize it to fit the needs of other projects. The template provides the main structure for your

project initiation document, but from there you can add and remove different sections based on specific project needs.

- **Quickly provide context for stakeholders**:
  When stakeholders are managing several different projects at once, it's important for them to get information quickly with as much context as possible. Using a project initiation document template makes it easy for them to find the information they need without having to hunt for it or have unnecessary status meetings.

1.5 What's included in a project initiation document template?

A good project initiation document template will have all of the important project information a stakeholder needs to know in a glance. This template should include:

- **Project goals or objective:**
  This clearly states what the project intends to achieve and the larger business objectives it connects to.
- **Success metrics:**
  These are the specific metrics that your team is tracking to monitor whether or not this project is successful.
- **Project scope:**
  In this instance, a project scope includes the scope of work, the allotted budget, and estimated timeline.
- **Communication plan**:
  This details information on how your team will communicate throughout the project duration.
- **Resourcing strategy:**
  Key resource information such as a resource allocation plan or a resource management strategy plan.
- **Key stakeholders:**
  Important individuals involved in the project from individual contributors to higher management.
- **Project risks:**
  Information about project risks, such as a RAID log or a risk analysis.

2. REQUIREMENT GATHERING PROCESS

The requirement gathering process comes to play when we actually intend to start the data collection phase.

Fig: Requirement gathering process

2.1 Project Scope Definition:

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 produces 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.

2.2 Identifying Stakeholders and Defining their Roles:

In the initial phase of requirement gathering for the development of the Biometric Student's Attendance Mobile Application, it is crucial to identify the key stakeholders who will be involved or impacted by the project. Stakeholders are individuals or groups with an interest in the project's success and have the potential to influence or be influenced by its outcomes. Below outline the identified stakeholders and their respective roles and interests in the project.

a. Administrators:

- This group comprises administrators, deans, department heads, registrars, attendance officers
- Their interests involve streamlining attendance management processes, policy enforcement and institutional governance.

b. Instructors:

- This group comprises lecturers, and teaching assistants responsible for managing attendance records and monitoring student participation.
- Their interests involve streamlining attendance management processes, reducing administrative burden, and gaining insights into student engagement.

c. Students:

- Students are end-users of the mobile application and have a vested interest in its usability, reliability, and convenience.
- They seek a seamless and user-friendly experience for recording their attendance, minimizing manual effort, and ensuring the security of their biometric data.

d. IT Department:

- The developers, IT department of educational institutions or external IT service providers will play a crucial role in the implementation, integration, maintenance of the mobile application and provide technical support.
- Their interests revolve around system compatibility, data security measures, and technical support requirements.

Stakeholder Roles, Interests and Requirements

1) Administrator:

- These stakeholders seek a user-friendly and efficient attendance tracking solution that reduces administrative workload, enables real-time monitoring, and provides actionable insights into student engagement.
- **Role**: Administrators oversee the overall implementation and management of the attendance tracking system.

- **Requirement:** Their requirements include scalability, customization options, integration with existing systems, and compliance with institutional policies.

2) **Instructors:**
   - Their main interest is monitoring student participation within their courses.
   - **Role**: Instructors are responsible for managing attendance and monitoring student participation.
   - **Requirements**:
   - **An intuitive and user-friendly interface** that facilitates easy attendance tracking, enables real-time monitoring, and provides quick access to relevant attendance data and analytics

3) **Students:**
- **Role:** End-users prioritize usability, accessibility, user experience and data security.
- **Requirement**: They expect a mobile application that simplifies attendance recording, minimizes disruptions to their learning experience, and protects their personal information including biometric data, and the ability to access attendance records.

4) **IT Department:**
- **Role:** Technical stakeholders are focused on ensuring the compatibility, reliability, and security of the mobile application, including data encryption, system integration, and ongoing maintenance and support.
- **Requirement:** Their requirements include system reliability, compatibility, security measures, data backup procedures, maintenance and technical support for end-users.

2.3 Gathering Techniques

Various techniques were employed to gather requirements, including; interviews and questionnaires, surveys, shadowing, studying current systems, workshops. These techniques allowed for a comprehensive understanding of stakeholder needs, preferences, and pain points related to attendance tracking. This ensures the final application meets the requirements and objectives of the project. The key techniques implemented were;

1. Paper-Based Questionnaires

Questionnaires are an effective tool for gathering quantitative data from a large sample of stakeholders in a structured manner. They consist of a set of pre-defined questions designed to collect specific information about the use of biometrics for marking the students' attendance. Here's how questionnaires were used and conclusions were drawn from the results obtained.

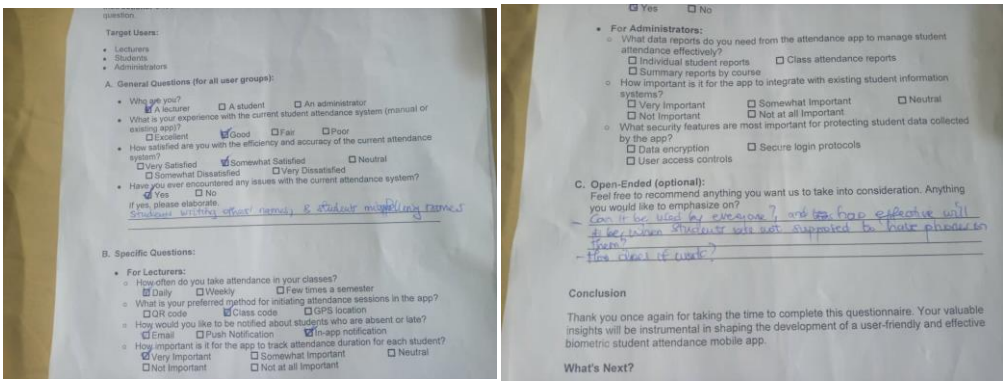
(i) **Designing the Questionnaire:**

- Identifying the objectives of the questionnaire and defining the research questions to be addressed.
- Developing a clear and concise set of questions that are relevant to the research objectives.
- Using a mix of closed-ended (e.g., multiple-choice, Likert scale) and open-ended questions to gather both quantitative and qualitative data.

- Ensuring that the questionnaire is easy to understand and navigate, with clear instructions for respondents.

(ii) **Distributing the Questionnaire:**

- Choosing the appropriate distribution channels based on the target audience which is the paper-based questionnaire.
- Providing incentives or assurances of confidentiality to encourage participation.
- Monitoring response rates and follow up with reminders to increase participation if needed**.**



Target Users:
- Lecturers
- Students
- Administrators

A. General Questions (for all user groups):
- Who are you? ☑ A lecturer ☐ A student ☐ An administrator
- What is your experience with the current student attendance system (manual or existing app)? ☐ Excellent ☑ Good ☐ Fair ☐ Poor
- How satisfied are you with the efficiency and accuracy of the current attendance system? ☐ Very Satisfied ☑ Somewhat Satisfied ☐ Neutral ☐ Somewhat Dissatisfied ☐ Very Dissatisfied
- Have you ever encountered any issues with the current attendance system? ☑ Yes ☐ No

If yes, please elaborate.
Students writting others' names, & student misspelling names

B. Specific Questions:
- For Lecturers:
  - How often do you take attendance in your classes? ☑ Daily ☐ Weekly ☐ Few times a semester
  - What is your preferred method for initiating attendance sessions in the app? ☐ QR code ☑ Class code ☐ GPS location
  - How would you like to be notified about students who are absent or late? ☑ Email ☐ Push Notification ☑ In-app notification
  - How important is it for the app to track attendance duration for each student? ☑ Very Important ☐ Somewhat Important ☐ Neutral ☐ Not Important ☐ Not at all Important

☑ Yes ☐ No
- For Administrators:
  - What data reports do you need from the attendance app to manage student attendance effectively? ☐ Individual student reports ☐ Class attendance reports ☐ Summary reports by course
  - How important is it for the app to integrate with existing student information systems? ☐ Very Important ☐ Somewhat Important ☐ Neutral ☐ Not Important ☐ Not at all Important
  - What security features are most important for protecting student data collected by the app? ☐ Data encryption ☐ Secure login protocols ☐ User access controls

C. Open-Ended (optional):
Feel free to recommend anything you want us to take into consideration. Anything you would like to emphasize on?
- Can it be used by everyone?, and how how effective will it be when students are not supposed to have phones in there?
- How cheat it work?

Conclusion

Thank you once again for taking the time to complete this questionnaire. Your valuable insights will be instrumental in shaping the development of a user-friendly and effective biometric student attendance mobile app.

What's Next?

Fig: Sample Questionnaire answered by a lecturer.

Conclusions were drawn regarding the overall satisfaction level with the app's user interface, specific features that are most valued by the stakeholders, and areas for improvement to enhance user experience. These conclusions can then inform iterative improvements to the app and guide future development effort

2. Conducting User Interviews:

Conducting one-on-one interviews with stakeholders allows for in-depth exploration of their needs, preferences, and challenges. Interviews provide a platform for stakeholders to express their thoughts and ideas freely, leading to rich qualitative data. Interview questions can be tailored to probe specific areas of interest, such as user interface design, authentication methods, and scalability requirements.

Stakeholders interviewed may include students, instructors, administrators, and IT support staff but the primary users remain the instructors(lecturers). Questions about their current attendance process, the pain points they face, and their expectations for the mobile app were asked. Here are some sample questions:

- What challenges do you face with the current attendance system (manual or existing app)?
- What features would make the attendance process easier and more efficient for you?

- How would you like to be notified about attendance (lecturers) or view attendance records (students)?

Based on the user interviews conducted with stakeholders, several key conclusions can be drawn regarding their needs, preferences, and challenges with the current attendance tracking systems:

- ✓ **Challenges with Current Systems:**

  Stakeholders(instructors), highlighted various challenges with the current attendance systems. These challenges ranged from manual processes, such as roll calls and paper-based attendance sheets, to limitations in existing attendance tracking apps. Common issues included time-consuming processes, inaccuracies in data recording, and difficulties in accessing and managing attendance records.

- ✓ **Desired Features for Improved Efficiency:**
  There was a consensus among instructors regarding the need for features that would enhance the efficiency and effectiveness of the attendance tracking process. Key features identified included seamless integration with biometric authentication for enhanced security and accuracy, real-time attendance tracking capabilities to monitor student participation instantly, and intuitive user interfaces that simplify attendance recording for both students and instructors.

- ✓ **Preferences for Notification and Access:**

  Preferences regarding notification and access to attendance records varied among stakeholders. Instructors expressed a desire for streamlined notification mechanisms to alert them of attendance discrepancies or trends.

Overall, the user interviews provided valuable insights into the pain points, expectations, and desired features of stakeholders regarding attendance tracking systems. These insights will inform the development of the Biometric Student's Attendance Mobile Application, ensuring that it addresses real-world needs and delivers a user-friendly and efficient solution.

3. Google Form Surveys:

Surveys are a method of collecting data to have information, opinions, and feedback from a targeted group of individuals.

Here are the types of requirements that can be gathered through surveys for a biometric student attendance system:

- ✓ Identify specific requirements for biometric modalities such as iris scanning, facial recognition, fingerprint based on usability and user preferences.
- ✓ Come out with the desired features and functionalities of the system such as enrolment, attendance recording.
- ✓ Gather feedback on acceptable response times for attendance recording and verification, especially during peak hours.
- ✓ Solicit feedback on user interface design, ease of use, and intuitiveness of the biometric attendance system for different user groups (example, administrators, instructors).
- ✓ Identify requirements for training and support to ensure users can effectively utilize the system.

Based on the surveys conducted among stakeholders for the biometric student attendance system, several conclusions can be drawn regarding requirements, preferences, and concerns related to the system's development and implementation:

i. **Biometric Modality Preferences:**

Stakeholders expressed varying preferences for biometric modalities, with fingerprint recognition being the most widely accepted due to its familiarity and ease of use. However, there was interest in exploring other modalities such as facial recognition and iris scanning, particularly for their potential to enhance security and convenience.

ii. **Desired Features and Functionalities:**

The most desired features of the system included enrolment capabilities, real-time attendance recording, and comprehensive reporting functionalities. Stakeholders emphasized the importance of a user-friendly interface and seamless integration with existing systems.

iii. **Performance Expectations:**

Stakeholders had high expectations for the performance of the biometric attendance system, particularly in terms of speed, scalability, and reliability. There was a consensus that the system should be capable of handling large volumes of attendance data efficiently, especially during peak hours.

iv. **User Interface Design and Usability:**

Feedback on the user interface design indicated a preference for simplicity, clarity, and intuitiveness. Stakeholders highlighted the importance of easy navigation and minimal training requirements for users of all skill levels.

v. **Training and Support Requirements:**

Stakeholders identified the need for comprehensive training and ongoing support to ensure effective utilization of the system. This included training sessions for administrators, teachers, and students, as well as access to technical support resources.

In addition to these conclusions, a photo showing the analysis based on some answered questions can provide visual insights into the survey findings.

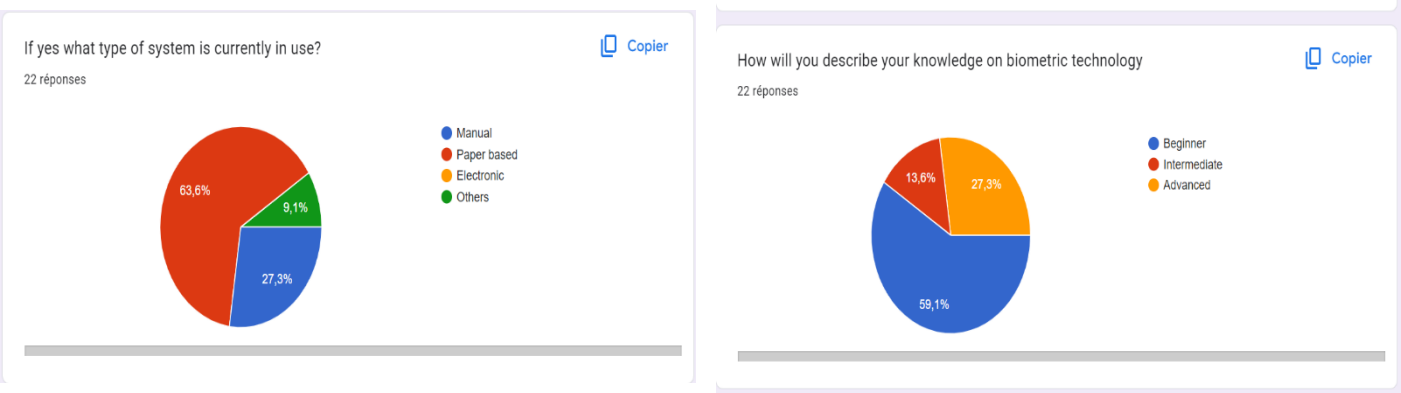


Fig: Sample online survey question and answers.

Furthermore, providing a link to the Google Form used for the survey allows stakeholders to access the survey results and further engage with the data.

Link to Google Form: [Google form survey.]

4. Workshop and brainstorming Session

- **Objective:**

The workshop and brainstorming session were conducted to gather insights, identify requirements, and generate innovative ideas for the design and implementation of the Biometric Student's Attendance Mobile Application. The primary goal was to leverage the collective expertise and perspectives of the participants to ensure the development of a comprehensive and user-centric solution.

- ✓ Organizing workshops brings together a diverse group of stakeholders in a collaborative setting to brainstorm ideas and discuss requirements.

- ✓ Workshops foster creativity and innovation by encouraging participants to generate and refine ideas collectively.

Fig: Vector image of stakeholders and developers at workshop.

- ✓ Structured activities and exercises, such as brainstorming sessions, group discussions, and prioritization exercises, help elicit requirements and identify common themes.
- ✓ Workshops provide an opportunity for stakeholders to share insights, build consensus, and align expectations.

Here's a breakdown of the user requirements identified for each module:

i. Enrollment Module:

- Stakeholders discussed the functionality related to enrolling students into the system by capturing their biometric data, specifically fingerprints.
- Key points included specifying the biometric traits to be captured and ensuring secure storage of biometric templates.
- **Instructor/Administrator Perspective:**
  - **Management Tools:** Instructors and administrators should have the ability to manage student enrollment, including adding new students to the system and updating their information as needed.
  - **Bulk Enrollment:** The module should provide tools for bulk enrollment to streamline the process for large classes.
- **Module features:**
  - **Biometric Data Capture**: Enable the capture of various biometric traits, such as fingerprints, iris scans, or facial recognition, for student identification and authentication.
  - **Secure Storage:** Implement secure storage mechanisms to safeguard biometric templates and ensure compliance with privacy regulations.

- **Integration with Student Database:** Integrate seamlessly with the institution's student database to streamline enrollment processes and maintain accurate student records.
- **Enrollment Analytics:** Provide analytics tools to track enrollment trends, demographics, and other relevant metrics for informed decision-making by administrators.

ii. Attendance Recording Module:

- Discussions centered around the functionality for recording student attendance using biometric authentication.
- Stakeholders outlined how attendance records would be automatically generated and stored in the system.

- **Instructor Perspective:**
  - **Real-time Access:** Instructors should have real-time access to attendance records, allowing them to monitor student participation and identify any discrepancies promptly.
  - **Manual Entry Options:** The module should provide options for manual attendance entry in case of technical issues or exceptions.
- **Module Features:**
  - **Biometric Authentication:** Implement biometric authentication methods (e.g., fingerprint scanning, facial recognition) for accurate and secure attendance tracking.
  - **Automated Attendance Recording:** Enable automatic generation and recording of attendance data based on student check-ins using biometric credentials.
  - **Attendance Alerts:** Set up alerts or notifications for instructors/administrators to receive real-time notifications of student check-ins or absences.
  - **Integration with Timetable:** Integrate with the institution's timetable system to automatically populate class schedules and facilitate seamless attendance tracking.
  - **Data Synchronization:** Ensure synchronization of attendance data across multiple platforms and devices for accessibility and consistency.

iii. Reporting and Monitoring Module:

- Stakeholders specified features related to generating attendance reports and monitoring attendance trends.
- Discussions included defining the scope of reports, accessibility of reports, and customization options for filtering data.

- **Instructor/Administrator Perspective:**
  - **Comprehensive Reports:** Instructors and administrators should have access to comprehensive attendance reports, including attendance rates, trends, and exceptions.

- **Customization Options:** The module should support customization options for generating reports based on specific criteria (example., date range, class).

- **Module Features:**
  - **Data Visualization:** Incorporate data visualization tools to present attendance trends and patterns in a visually accessible format for better analysis.
  - **Customization Options:** Support customization options for generating reports based on specific criteria (e.g., date range, class) to meet diverse institutional needs
  - **Export Functionality:** Allow for the export of attendance reports in various formats (e.g., PDF, Excel) for further analysis or sharing with stakeholders.
  - **Notification System**: Implement a notification system to alert instructors/administrators of significant changes or irregularities in attendance data for timely intervention.

iv. Student Conduct and Performance module:

- Discussions centered around providing insights into students' attendance performance and conduct within the educational system.
- Stakeholders outlined features to track attendance rates, trends, and patterns of absenteeism to facilitate student improvement and instructor intervention.
- **Instructor Perspective:**
  - **Engagement Assessment:** Instructors can use the performance module to assess student engagement and participation levels over time.
  - **Intervention Support:** By analyzing attendance data, instructors can identify students who may need additional support or intervention to succeed academically.
  - **Customizable Reports:** The module should support customization options for generating reports based on specific criteria (e.g., date range, class, student).
- **Module Features:**
  - **Comprehensive Reporting:** Provide comprehensive reports on student attendance conduct and performance, including attendance rates, trends, and exceptions.
  - **Customization Options:** Support customization options for generating reports based on specific criteria (e.g., date range, class) to meet diverse institutional needs.
  - **Real-Time Monitoring:** Enable real-time monitoring of student conduct and performance to promptly identify any discrepancies or areas for improvement.

❖ **Biometric Technology:**

During the workshop, the group explored the technical aspects of implementing fingerprint recognition for biometric authentication. Discussions centered around the advantages, challenges, and security considerations associated with this technology.

- ✓ Explore different biometric authentication methods, focusing on the advantages and limitations of fingerprint recognition.
- ✓ Discuss the technical aspects of implementing biometric authentication in a mobile application, including security considerations and compatibility with different devices.

Advantages of Fingerprint Recognition:

Unique and Unchangeable: Fingerprint patterns are unique to each individual and remain relatively stable throughout a person's life, making them an ideal biometric identifier.

High Accuracy: Fingerprint recognition systems offer high accuracy rates, minimizing the risk of false positives or negatives.

Convenience: Fingerprint authentication is convenient for users, as it eliminates the need to remember passwords or carry physical tokens for identification.

Speed: The authentication process using fingerprints is fast and seamless, requiring only a brief scan of the finger to verify identity.

Mobile Platform compatibility: Compatibility with both Android and iOS platforms ensures broader accessibility and adoption of biometric student's Attendance Mobil Application among users using different devices.

Challenges of Fingerprint Recognition:

Sensor Quality: The accuracy and reliability of fingerprint recognition systems depend on the quality of the sensors used. Low-quality sensors may result in inaccurate readings or failure to recognize fingerprints.

Environmental Factors: External factors such as dirt, moisture, or damage to the fingers can affect the quality of fingerprint scans and compromise the accuracy of the authentication process.

Biometric Variability: While fingerprints are generally stable, certain factors such as age, injury, or certain medical conditions can lead to changes in fingerprint patterns over time, potentially affecting recognition accuracy.

Mobile Platform Compatibility: Developing for multiple platforms can increase development complexity and require additional resources in terms of time and effort.

Security Considerations:

Data Encryption: Fingerprint data should be encrypted both during transmission and storage to prevent unauthorized access or interception.

Secure Storage: Fingerprint templates should be securely stored on the device using cryptographic techniques to prevent tampering or theft.

Anti-Spoofing Measures: To mitigate the risk of spoofing attacks, the system should incorporate anti-spoofing algorithms and mechanisms to detect and prevent the use of fake or replicated fingerprints.

User Privacy: Protecting user privacy is paramount, and the system should adhere to strict privacy regulations and guidelines governing the collection, storage, and use of biometric data.

Mobile Platform Compatibility: Ensuring seamless integration of fingerprint recognition functionality with the native biometric authentication frameworks provided by Android and iOS is essential for a consistent and secure user experience.

- **Real-Time Data Management:** Strategies for efficiently managing and processing attendance data in real-time were discussed. Participants shared insights on data storage, security measures, and the importance of timely reporting for instructors.

(iii) Data Storage

- **Cloud-Based Storage:** Participants discussed the feasibility of utilizing cloud-based storage solutions for storing attendance data. Cloud storage offers scalability, flexibility, and accessibility, allowing for seamless data management across multiple devices and locations.
- **Local Storage:** While cloud storage provides many benefits, participants also highlighted the importance of incorporating options for local storage on the device. Local storage can ensure data availability and functionality even in offline or low-connectivity environments.

(iv) Security Measures:

- **Encryption**: Ensuring the security of attendance data is crucial to protect sensitive information from unauthorized access or breaches. Participants emphasized the importance of encrypting attendance data both during transmission and storage using robust encryption algorithms.
- **Access Control**: Implementing access control mechanisms is essential to restrict access to attendance data to authorized users only. Role-based access control (RBAC) can be used to assign specific permissions and privileges to different user roles (e.g., students, instructors, administrators).
- **Audit Trails**: Maintaining audit trails of all attendance-related activities can enhance accountability and transparency. Participants discussed the importance of logging access attempts, modifications, and other relevant actions to facilitate forensic analysis and compliance with regulatory requirements

ii) Timely Reporting for Instructors:

- **Real-Time Updates**: Instructors rely on real-time attendance data to monitor student participation and identify any discrepancies promptly. Participants emphasized the importance of providing instructors with real-time updates and notifications whenever students check in or out of classes.
- **Customizable Reports:** The mobile application should offer customizable reporting options that allow instructors to generate attendance reports based on specific criteria (e.g., date range, class). Customizable reports enable instructors to tailor the information to their needs and preferences**.**

❖ **Scalability and customization:** During the workshop, the group explored various ideas for designing the Biometric Student's Attendance Mobile Application to be scalable and customizable, enabling educational institutions to adapt it to their specific needs and varying class sizes. Several key considerations and strategies were discussed:

(i) Scalability:

- **Cloud-Based Architecture:** Implementing a cloud-based architecture allows the application to scale dynamically based on demand.
- **Modular Design:** Designing the application with a modular architecture by braking system in to small modules enables components to be scaled independently since functionalities can be added or removed based on institutions needs without affecting system performance.
- **Load Balancing:** Implementing load balancing mechanisms ensures that incoming requests are distributed evenly across multiple servers or instances.

(ii) Customization:

- **Flexible Configuration Options:** Providing institutions with flexible configuration options allows them to tailor the application to their specific requirements. This may include settings and templates for attendance policies, notification preferences, and reporting formats.
- **User Roles and Permissions:** Allow administrators to control access to features based on user roles, ensuring security and customization.

Considerations:

- **Scalability vs Performance:** Balancing these would be crucial for optimal performance.

- **Security and Privacy:** Discussions focused on ensuring the security of biometric data and protecting user privacy. Participants exchanged ideas on implementing robust authentication protocols and encryption mechanisms.
  - ✓ Discussions centered on implementing strong authentication protocols to ensure the integrity and confidentiality of user data.
  - ✓ Implementing robust security measures such as encryption of biometric templates during transmission and storage to prevent unauthorized access or interception.
  - ✓ Adhering to strict privacy regulations.
- **Integration with Existing system:** Strategies for integrating the attendance application with existing educational management systems were explored. Participants identified potential challenges and discussed ways to ensure seamless integration and interoperability.

- ✓ Participants explored strategies for integrating the attendance application with existing educational management systems to ensure seamless data exchange and workflow integration.
- ✓ Potential challenges such as data synchronization, data mapping, and system compatibility were identified. To mitigate these, careful planning and thorough testing or simply creating an independent without need for integrating into other systems

- **User Training and Support:** The importance of providing comprehensive training and support for users was emphasized. Participants discussed strategies for developing training materials and providing ongoing technical assistance to ensure successful adoption of the new system.
    - Providing a tour within the application
    - Making the platform so simple that it does not require training
    - Establishing feedback mechanisms

5. Observational Research and User Shadowing

Observational research is a way of obtaining results just based on observations while shadowing is acting or putting yourself in another one position to mimic his/her views or reactions

❖ **Observational Research Findings:**

(i) Classroom Observations:

During classroom observations, a variety of attendance tracking methods were observed. These methods ranged from verbal call-outs of student names to manual counting and passing around attendance sheets for students to mark their attendance. While some instructors used pre-printed class list on attendance sheets for quick identification and marking, others relied on visual counts, which were susceptible to inaccuracies.

(ii) Instructor and Student Interactions:

Interactions between instructors and students during attendance taking revealed both strengths and weaknesses in the current process. Instructors faced challenges in accurately calling out student names and manually recording attendance, leading to potential errors and incomplete data. However, students occasionally took initiative in marking attendance for absent classmates, demonstrating a collaborative approach to attendance tracking.

(iii) Technological Infrastructure:

The assessment of technological infrastructure highlighted a lack of standardized systems for attendance tracking across educational institutions. While some institutions had implemented digital solutions like excel sheets and cloud based for attendance recording, others relied on manual methods due to limited technological

resources. Additionally, compatibility with mobile platforms for attendance tracking appeared to be inconsistent across institutions.

❖ **User Shadowing Findings:**

1. **Accompanying Instructors:**

   Assisting instructors provided valuable insights into their workflows and challenges during attendance recording. Instructors faced difficulties in accurately identifying and marking attendance for large classes, leading to potential inaccuracies in attendance records. Manual processes, such as passing around attendance sheets, often resulted in time constraints and incomplete data.

2. **Following Students:**

   Shadowing students allowed for a deeper understanding of their experiences and preferences related to attendance tracking. Students expressed frustration with manual attendance methods, citing delays in the recording process and concerns about accuracy. Additionally, the lack of transparency in attendance tracking raised questions about accountability and fairness.

3. **Documenting Workflows:**

   Documenting the step-by-step workflows followed by both instructors and students revealed some inefficiencies in the current attendance tracking process. Manual methods were prone to errors and time-consuming, leading to delays in recording attendance and potential discrepancies in records.

6. Benchmarking and Competitive Analysis

In our pursuit to develop a Biometric Student's Attendance Mobile Application, we conducted benchmarking and competitive analysis to gather insights from existing solutions in the market. Below outlines our findings and recommendations based on the features, functionalities, user experience, and adoption rates observed in similar applications.

1. **Existing Applications Reviewed:**
   We evaluated several existing biometric attendance tracking applications, including:
   - **On the Clock** that allows multiple fingerprints, faces and phones recognitions
   - **Deputy** that offers biometric clock-in scheduling and communication features
     - **Jibble** that uses facial recognition and geolocation
     - **N-Check** which is flexible and works on many platforms

- **Master Soft** which uses figures and charts for reporting

2. **Key Features Identified:**

After thorough analysis, we identified the following key features common among the reviewed applications:

- **Multi-Biometric Authentication:** All applications incorporate biometric authentication, predominantly fingerprint recognition, complimented with facial recognitions, to verify student identities securely.
- **Real-time Attendance Tracking:** Similar to our proposed solution, existing applications offer real-time attendance tracking, enabling instructors to monitor student participation instantly. Some have alert systems through SMS and emails for absenteeism.
- **Flexibility:** Some of these applications are compatible with popular mobile platforms such as Desktop, Android and iOS, ensuring widespread accessibility and adaptability to different working environments.
- **Scalability and Cloud Based:** Most applications provide customization options to adapt to the specific requirements of educational institutions and scale according to class sizes. Some are Cloud based platforms, hosted as a PAAS (Platform as a Service).
- **User-Friendly Interface:** Intuitive user interfaces facilitate ease of use for both students and instructors, contributing to a seamless attendance tracking experience. Making it easy to navigate platform with a user-friendly interface to quickly access specific staff attendance data and student daily activity records.
- **Reporting:** Customizable reports that summarize attendance data for administration and instructor analysis. Use of figures and charts to display trends and attendance percentages.

3. **Strengths and Weaknesses:**

i. **Strengths:**

- Existing applications demonstrate strong security measures with reliable biometric authentication systems.
- The ability to track attendance in real-time enhances accountability and facilitates efficient monitoring of student participation.
- Compatibility with Android and iOS platforms ensures accessibility for a broader range of users.

ii. **Weaknesses:**

- Some applications exhibit complexities in their user interfaces, potentially leading to usability issues for end-users.
- While most applications offer customization options, the extent of customization may be limited, posing challenges for institutions with unique requirements.
- In certain cases, attendance recording processes may take longer than optimal, impacting the overall efficiency of the system.

4. **Recommendations for Our Platform:**

- **Multi-fingered or Multi Biometric authentication:** Implementing a multi biometric authentication for improve security or atleast multiple fingered recognition to mitigate risk of environmental factors.
- **Simplified User Interface:** Prioritize the development of an intuitive and user-friendly interface to enhance the overall user experience and minimize the learning curve for both students and instructors.
- **Optimized Performance:** Focus on optimizing the attendance recording process to ensure that checking in takes no more than 5 seconds per student, aligning with industry standards for efficiency.
- **Enhanced Configurations:** Offer extensive customization options to cater to the diverse needs of educational institutions, empowering them to tailor the application according to their specific requirements.
- **Continuous Improvement:** Implement a feedback mechanism to gather insights from users and incorporate regular updates and improvements to address any identified issues and enhance the functionality of the application over time.
- **Real-Time Attendance Tracking:** Ensuring fast and reliable real-time attendance tracking to streamline the attendance management processes.
- **Comprehensive Reporting:** Developing robust reporting and monitoring tools with customizable features to enable detailed analysis of attendance data

4. REQUIREMENT DOCUMENTATION

Documenting requirements is a crucial step in the software development process, ensuring that all stakeholders have a clear understanding of what needs to be built and how it will function. This documentation serves as a blueprint for the development team, guiding the design, implementation, and testing phases of the project.

1. Use Cases

a. **Enrollment:** As a student, I want to enroll in the system by providing my biometric data (fingerprints) to access attendance tracking. ix. **Attendance Recording:** As an instructor, I want to record student attendance using biometric authentication to ensure accuracy and security.

b. **Reporting**: As an administrator, I want to generate attendance reports based on specific criteria (e.g., individual student, class, time period) for monitoring and analysis.

2. User stories

a. As a student, I want to be able to enrol in the system easily by providing my fingerprints for biometric authentication.

b. As an instructor, I want to record student attendance quickly and accurately using biometric technology to streamline the process.

c. As an administrator, I want to access customizable attendance reports to monitor attendance trends and identify patterns.

CONCLUSION

By following these steps, you'll have a solid foundation of user needs and functionalities to guide the development of your biometric student attendance mobile app. Remember, this is an iterative process. As you develop the app, you might need to revisit these requirements and refine them based on user feedback during testing.