

GECTFMA:Facility Management App

A Mini Project Report

*submitted to the APJ Abdul Kalam Technological University
in partial fulfillment of the requirements for the award of degree*

Bachelor of Technology

in

Computer Science and Engineering

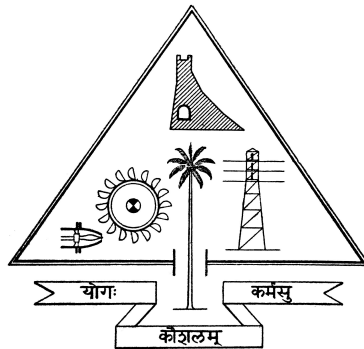
by

Basila S Nazer(TCR21CS016)

Anagha Jayan(TCR21CS009)

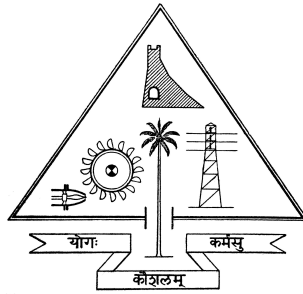
Aparna Krishnan(TCR21CS015)

Jithin P Kumar(TCR21CS027)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
GOVERNMENT ENGINEERING COLLEGE, THRISSUR
KERALA
MAY 2024**

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
GOVERNMENT ENGINEERING COLLEGE
THRISSUR - 680009



CERTIFICATE

This is to certify that the report entitled **GECTFMA:Facility Management App** submitted by **Basila S Nazer**(TCR21CS016),**Anagha Jayan**(TCR21CS009),**Aparna Krishnan**(TCR21CS015) & **Jithin P Kumar**(TCR21CS027) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the mini project work carried out by him/her under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Dr. Shibily Joseph
(Project Guide)
Associate Professor
Department of CSE
GEC Thrissur

Dr. Ezudheen P
(Project Coordinator)
Assistant Professor
Department of CSE
GEC Thrissur

Dr. Ajay James
Head of the Department
Department of CSE
GEC Thrissur
Thrissur

DECLARATION

We hereby declare that the project report **GECTFMA:Facility Management App** , submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of **Dr. Shibily Joseph**.

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Thrissur
01-05-2024

Basila S Nazer
Anagha Jayan
Aparna Krishnan
Jithin P Kumar

Abstract

In response to prevalent inefficiencies in handling plumbing and electrical complaints within college campuses, the proposal outlines the development of GECTFMA: Facility Management App, an innovative mobile application. This solution aims to revolutionize existing manual processes, addressing issues such as delays, miscommunication, and a lack of transparency.

The proposed system comprises key technical components including robust user authentication and authorization mechanisms, advanced mobile app development techniques, efficient database management, real-time communication capabilities.

Rigorous user authentication and authorization protocols are instituted to ensure the security of the system, while mobile app development endeavors to create an intuitive interface for seamless complaint submission and user interaction. The database management system is meticulously designed to efficiently store and retrieve maintenance data, and real-time communication features provide instantaneous updates for all stakeholders.

GECTFMA: Facility Management App aims to redefine the management of maintenance complaints in colleges, offering an integrated, transparent, and responsive solution. By mitigating delays and improving communication, the objective is to provide a safer and more convenient experience for the college community.

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Basila S Nazer

Anagha Jayan

Aparna Krishnan

Jithin P Kumar

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ABBREVIATIONS

GECTFMA	Government Engineering College Thrissur Facility Management App
UI	User Interface
UX	User Experience
IDE	Integrated Development Environment
GDPR	General Data Protection Regulation
HIPPA	Health Insurance Portability and Accountability Act
HTTPS	Hypertext Transfer Protocol (Secure)
WCAG	Web Content Accessibility Guidelines
API	Application Programming Interface
CCPA	California Consumer Privacy Act
SRS	Software Requirements Specification
PTA	Parent-Teacher Association

Chapter 1

Introduction

1.1 Topic Introduction

Educational institutions play a pivotal role in fostering growth and development, with their facilities serving as essential components of the learning environment. However, despite technological advancements, colleges grapple with inefficiencies in managing maintenance complaints, particularly regarding plumbing and electrical issues. These challenges disrupt daily operations and compromise the safety of the college community.

The genesis of the project lies in recognizing these prevalent inefficiencies and the need for comprehensive solutions. Conventional approaches to managing maintenance complaints rely on manual processes and fragmented communication channels, leading to delays, miscommunication, and a lack of transparency. In response, the development of GECTFMA: Facility Management App aims to revolutionize maintenance complaint handling by leveraging innovative mobile technology and robust technical infrastructure.

Central to the project's motivation are the key problems within current facility management practices. Delays in issue resolution, compounded by fragmented communication and inefficient task assignment, highlight the urgency for improvement. GECTFMA seeks to address these challenges by offering an integrated, trans-

parent, and responsive solution, ultimately contributing to a safer and more efficient educational environment.

1.2 Problem Statement

Managing plumbing and electrical complaints within college campuses presents persistent challenges that hinder facility operations. Manual processes and ineffective communication channels contribute to significant delays in addressing maintenance issues, leading to inconvenience and potential safety hazards for students, faculty, and staff. Additionally, miscommunication among stakeholders results in misunderstandings and a lack of transparency regarding complaint status, causing frustration and impeding timely resolution.

Moreover, the absence of an optimized task assignment mechanism exacerbates these challenges, leading to disparities in workload distribution and further delaying issue resolution. Furthermore, the increasing reliance on digital platforms raises concerns about the security of user data and sensitive information. These issues underscore the urgent need for a comprehensive solution to revolutionize maintenance complaint management within college campuses.

In response to these challenges, the GECTFMA: Facility Management App aims to streamline processes, enhance communication, and improve overall user experience. By leveraging innovative mobile technology, the project seeks to create a safer, more efficient, and transparent facility management system, ultimately contributing to a conducive learning and working environment within colleges.

1.3 Objectives

Our project aims to address the following objectives through the implementation of GECTFMA: Facility Management App:

- Streamline Complaint Management:

Develop a system to efficiently report, track, and resolve plumbing and electrical complaints within college campuses.

- **Ensure Security and Privacy:** Implement robust authentication mechanisms to safeguard user data and ensure the security of information shared within the application.
- **Improve User Experience:** Design an intuitive mobile application interface to streamline complaint submission, tracking, and interaction for all users, enhancing overall user experience and satisfaction.
- **Enhance Accountability:** Establish mechanisms to track the progress of complaints and assign responsibilities to relevant personnel, promoting accountability and transparency in the resolution process.
- **Optimize Resource Allocation:** Develop tools to analyze maintenance data and ensuring timely resolution of complaints while minimizing costs.
- **Facilitate Feedback Mechanisms:** Integrate feedback mechanisms to allow users to provide input on the resolution process and suggest improvements, fostering continuous improvement and user satisfaction.
- **Promote Sustainability:** Incorporate features to encourage environmentally friendly maintenance practices, such as energy-efficient solutions and waste reduction initiatives.

1.4 Novelty of Idea and Implementation Steps

The novelty of the idea lies in the comprehensive approach taken to revolutionize the management of maintenance complaints within college campuses through the development of GECTFMA: Facility Management App. Unlike traditional methods that rely on manual processes and fragmented communication channels, this project introduces an innovative mobile application that integrates cutting-edge technology to streamline complaint management, enhance communication, and improve overall user experience. GECTFMA distinguishes itself in various key aspects:

- **Comprehensive Solution:** GECTFMA offers a holistic approach to addressing prevalent inefficiencies in handling maintenance complaints within college campuses, integrating cutting-edge technology with user-centric design principles.
- **Efficient Complaint Management:** Unlike traditional manual processes, GECTFMA streamlines complaint management, enhancing communication, and improving overall user experience by providing a transparent and efficient platform for reporting, tracking, and resolving plumbing and electrical issues.
- **Robust Security and Privacy:** GECTFMA incorporates robust authentication mechanisms and real-time communication features to ensure the security and privacy of user data while facilitating instant updates for all stakeholders.
- **Promotion of Accountability and Transparency:** GECTFMA promotes accountability and transparency by tracking the progress of complaints and facilitating feedback mechanisms for continuous improvement.
- **Commitment to Sustainability:** GECTFMA stands out for its commitment to sustainability, promoting environmentally friendly maintenance practices and supporting colleges in reducing their environmental footprint.
- **Enhanced Decision Making:** GECTFMA facilitates informed decision-making by providing insights into maintenance trends and patterns, allowing colleges to optimize resource utilization and enhance overall efficiency.

1.5 Societal and Industrial Relevance

The GECTFMA: Facility Management App holds significant societal and industrial relevance by addressing critical challenges in maintenance complaint management within college campuses. Industrially, the project offers a streamlined solution that can be adopted by educational institutions to enhance their infrastructure management processes. By reducing maintenance downtime, and improving overall efficiency, colleges can minimize operational costs and allocate resources more effectively. Moreover, the application's commitment to sustainability aligns with growing industry

trends towards environmental responsibility and resource conservation.

Societally, GECTFMA empowers college communities by providing a transparent and efficient platform for reporting and resolving maintenance issues. By facilitating timely response and resolution, the application enhances safety, convenience, and overall quality of life for students, faculty, and staff. Furthermore, the project fosters a culture of accountability and transparency, promoting trust and collaboration within the college community. Socially, GECTFMA contributes to fostering a sense of belonging and community among college members, as it facilitates communication and collaboration in addressing shared challenges.

In summary, GECTFMA serves as a valuable tool for both industry stakeholders and societal members, offering tangible benefits in terms of operational efficiency, environmental sustainability, and community well-being. Its ability to streamline maintenance processes, promote sustainability practices, and enhance communication and collaboration underscores its relevance in addressing industry challenges while contributing positively to societal welfare.

Chapter 2

Literature Review

Facility management in educational institutions encompasses the coordination of physical assets, infrastructure, and services to support teaching, learning, and research activities. It plays a crucial role in creating conducive learning environments by ensuring that facilities are well-maintained, safe, and efficient. Common challenges in facility management include budget constraints, aging infrastructure, and evolving educational needs. Maintenance issues, such as plumbing and electrical problems, are particularly pertinent due to their immediate impact on daily operations and safety. We referred to a paper on facility management in academic institutions [1] to address challenges in reservation and monitoring activities. By analyzing customer requirements and technical specifications, we selected the best design for our Facility Management System.

2.1 Current Practices and Challenges in Maintenance Complaint Handling

Manual processes for handling maintenance complaints often involve paper-based forms, phone calls, or emails, leading to inefficiencies and delays. These methods are prone to miscommunication, resulting in unresolved issues and frustration among stakeholders. The consequences of inefficient maintenance management extend beyond inconvenience, affecting the overall functioning and safety of college campuses. Urgent issues may go unnoticed or unaddressed, posing risks to students, faculty, and

staff.

2.1.1 Technological Solutions in Facility Management

Technology-driven solutions have emerged to streamline facility management processes, offering digital platforms for complaint handling, asset tracking, and resource optimization. Mobile applications have become instrumental in addressing maintenance challenges by providing convenient ways for users to submit and track complaints in real-time. Existing facility management apps offer features such as photo attachments, location tagging, and status updates to enhance communication and transparency.

2.1.2 Key Features and Requirements for an Effective Maintenance App

User authentication and authorization mechanisms ensure the security and privacy of user data, protecting against unauthorized access and data breaches. Intuitive user interface design [2] simplifies complaint submission and tracking, reducing user friction and increasing adoption rates. Real-time communication capabilities enable instant updates and notifications for stakeholders, facilitating timely resolution of maintenance issues. Efficient database management ensures reliable storage and retrieval of maintenance data, supporting data-driven decision-making.

2.1.3 Case Studies

In our client's workflow, when a maintenance complaint is raised by the Head of the Department (HOD), it undergoes initial assessment by the HOD to determine the nature of the work required—whether plumbing or electrical. Subsequently, the complaint is directed to the respective Plumbing or Electrical Incharge based on the type of maintenance needed. The Plumbing or Electrical Incharge then reviews the complaint and assesses its urgency and complexity. After this initial evaluation, the complaint is forwarded to the Sergeant, who acts as the central coordinator for task assignment within the maintenance team. From there, the Sergeant proceeds

to allocate the complaint to the appropriate staff members based on various factors such as expertise, workload, and resource availability. This sequential process ensures that maintenance issues are efficiently routed to the relevant department and promptly addressed by the designated personnel under the supervision of the Sergeant.

2.2 Security and Data Privacy Considerations

Securing user data and sensitive information is paramount in maintenance apps to maintain trust and comply with regulations. Best practices include encryption, role-based access control, and regular security audits to identify and mitigate vulnerabilities. Compliance with data protection laws such as GDPR [3] and HIPAA [4] ensures that user privacy rights are respected and protected.

2.2.1 User Experience and Satisfaction

User-centric design principles prioritize the needs and preferences of users, resulting in intuitive and enjoyable experiences. Factors influencing user satisfaction include ease of use, speed of issue resolution, and transparency throughout the complaint handling process. Improved user experience leads to higher satisfaction levels, increased user engagement, and greater likelihood of app adoption and continued usage.

2.3 Gap Analysis

2.3.1 Identification of Gaps in Existing Research and Literature

- Lack of depth and specificity in research on maintenance complaint handling within educational institutions [1], particularly concerning user perspectives and satisfaction levels.
- Scarcity of research on the effectiveness of digital solutions, such as mobile apps, in tackling maintenance challenges specific to college campuses.
- Existing literature tends to offer broad overviews of facility management practices but fails to comprehensively examine specific issues like delays in issue

resolution and inefficiencies in task assignment.

- The intersection between facility management technology and educational outcomes, such as its impact on student performance, remains largely unexplored.
- Emphasizes the need for more focused research to provide actionable insights for practitioners and policymakers aiming to improve maintenance management systems in educational settings.

2.3.2 Areas Where Current Solutions or Approaches Fall Short

- Lack of integration and interoperability in current maintenance management systems results in fragmented communication channels between stakeholders.
- Persistence of manual processes leads to delays and a lack of transparency in issue resolution.
- Existing maintenance apps may suffer from suboptimal user experiences and security concerns, thereby hindering widespread adoption.
- Disparities in access to technology and digital literacy skills exacerbate inequalities in maintenance management effectiveness.
- Addressing these shortcomings requires innovative solutions that prioritize integration, user-centric design, security, and equitable access to technology.

2.4 Summary

The literature review highlights the critical role of facility management in educational institutions, emphasizing challenges such as delays and miscommunication in maintenance complaint handling. While technological solutions, especially mobile apps, show promise in addressing these challenges, gaps in empirical research and user perspectives persist.

Addressing maintenance challenges is crucial for creating safe, healthy learning environments and supporting student success. Neglecting maintenance issues can

lead to safety risks, operational disruptions, and reputational damage for educational institutions.

To fill existing gaps and improve facility management in educational institutions, the development of GECTFMA (Facility Management App) is justified. GECTFMA aims to streamline maintenance processes and enhance user satisfaction through features like user authentication and real-time communication. By bridging the gap between current practices and best practices, GECTFMA seeks to contribute to safer, more efficient facility management in educational institutions.

Chapter 3

Feasibility Study and Requirements Analysis

3.1 Feasibility

The feasibility of implementing the GECTFMA: Facility Management App is assessed across various dimensions, including technical, financial, operational, time, legal, environmental, social, and economic factors. This comprehensive analysis guides decision-making, identifies challenges and opportunities, and lays the foundation for successful project execution.

3.1.1 Technical Feasibility

From a technical perspective, the project's feasibility is determined by assessing the availability of necessary technology and expertise required for development. The team possesses the requisite skills in software development, database management, and mobile app development. Furthermore, the technologies required to implement key features such as real-time communication and task assignment algorithms are readily available and accessible.

3.1.2 Economic Feasibility

Economic feasibility assesses the project's ability to generate economic value and provide a positive return on investment. By streamlining maintenance processes and

reducing operational costs, GECTFMA offers tangible economic benefits to colleges. Moreover, the potential for additional revenue streams, coupled with cost savings, enhances the project's economic viability and sustainability over the long term.

3.1.3 Time Feasibility

Estimated breakdown:

Developing and implementing the GECTFMA: Facility Management App will necessitate both time and resources.

Phase	Estimated Time
Software Development & Algorithm Design	3-6 Months
Testing & Deployment	1-2 Months
Total Estimated Time	4-8 Months

Table 3.1: Estimation breakdown of Time Feasibility

1. Algorithm Development: Refining and optimizing key algorithms, such as those for data processing or user interaction, can be a time-consuming process. These algorithms may require significant experimentation, optimization, and validation to ensure their accuracy and efficiency.
2. App Development and Testing: Building a user-friendly and reliable mobile app requires thorough testing and user feedback iterations. Integration of advanced features such as database management and secure authentication mechanisms can contribute to the complexity of app development.
3. Field Testing and Deployment: Extensive field testing in various conditions is crucial before widespread deployment. Ensuring compatibility with different devices, network environments, and user scenarios requires thorough testing and validation. Moreover, addressing any issues or bugs identified during field testing can impact the deployment timeline.

3.1.4 Legal Feasibility

Legal feasibility examines the project's compliance with relevant laws, regulations, and standards. GECTFMA undergoes a thorough legal review to ensure adherence to

data protection laws, privacy regulations, and intellectual property rights. Measures are implemented to safeguard user data privacy and confidentiality, including robust security protocols and user consent mechanisms. Furthermore, the application is designed to comply with industry standards and best practices to mitigate legal risks and ensure ethical conduct throughout the project lifecycle.

3.1.5 Operational Feasibility

Operational feasibility examines the project's compatibility with existing organizational processes and infrastructure. GECTFMA is designed to seamlessly integrate with college management systems and workflows, ensuring minimal disruption to existing operations. Additionally, the application's user-friendly interface and intuitive features enhance user adoption and acceptance among college stakeholders.

3.2 Project Requirements

This document serves as the Software Requirements Specification (SRS) [5] for the GECTFMA: Facility Management App. It provides a clear and detailed description of the system's functionalities, performance characteristics, and technical specifications. The SRS [5] aims to guide the development team towards a robust and successful implementation of the system.

3.2.1 Functional Requirements

Functional Requirements for the GECTFMA: Facility Management App:

1. User Registration and Authentication:
 - Users should be able to create accounts securely and log in using authentication mechanisms such as email/password or social media integration.
 - Authentication should be robust to ensure the security of user data and prevent unauthorized access.
2. Maintenance Issue Reporting:

- Users should be able to report plumbing and electrical issues seamlessly through the app.
- The reporting process should include options for users to describe the issue, attach relevant images or documents.

4. Secure Data Transmission and Storage:

- All maintenance data, including user reports and sensor data, should be transmitted securely using HTTPS [6] protocols.
- Data should be stored securely in a centralized database, ensuring data integrity and user privacy.

6. User Profile Management:

- Profile management functionalities should include options for password reset, email verification, and account deletion if needed.

7. Notification System:

- The app should incorporate a notification system to alert users of new maintenance issues, status updates on reported problems, and important announcements from administrators.
- Notifications should be customizable, allowing users to opt-in or opt-out of specific types of notifications.

8. Administrator Dashboard:

- Administrators should have access to a dashboard for managing reported maintenance issues, and tracking issue resolution progress.
- The dashboard should provide analytics and reporting features to monitor maintenance trends, identify areas for improvement, and generate reports for stakeholders.

10. Integration with External Systems:

- The app should integrate with external systems such as building management systems or maintenance ticketing systems to streamline workflow processes.
- Integration should facilitate seamless data exchange between the app and existing infrastructure, enhancing operational efficiency.

3.2.2 Non-Functional Requirements

1. Performance:

- The app should exhibit fast response times and minimal latency, even under high user loads.
- It should be capable of handling a large volume of concurrent users without significant performance degradation.

2. Scalability:

- The app architecture should be scalable to accommodate future growth in user base and data volume.
- It should support horizontal scaling to add additional servers or instances as needed to meet increased demand.

3. Reliability:

- The app should be highly reliable, with minimal downtime and robust error handling mechanisms.
- It should be resilient to failures, with built-in redundancy and failover mechanisms to ensure continuous availability.

4. Security:

- The app should adhere to industry-standard security practices to protect user data and ensure privacy.
- It should implement encryption protocols for data transmission and storage to prevent unauthorized access or data breaches.

5. Adaptability:

- The app should be adaptable to varying network conditions and device capabilities, providing consistent performance and functionality across different environments.
- It should dynamically adjust to changes in network bandwidth and device specifications to ensure optimal user experience, even in challenging conditions such as low connectivity or limited processing power.
- Additionally, the app should gracefully degrade its features and interface elements on devices with limited capabilities, allowing users to access essential functionalities without sacrificing usability.

6. Usability:

- The app should have a user-friendly interface, with intuitive navigation and clear instructions.
- It should be designed with usability principles in mind to minimize user errors and facilitate efficient task completion.

7. Compatibility:

- The app should be compatible with a wide range of devices and operating systems, including smartphones, tablets, and desktop computers.
- It should support popular web browsers and mobile platforms to ensure accessibility across different devices.

8. Maintainability:

- The app codebase should be well-structured and modular, facilitating ease of maintenance and future enhancements.
- It should adhere to coding standards and documentation guidelines to enable collaboration among developers and support knowledge transfer.

9. Performance Monitoring and Logging:

- The app should include monitoring and logging capabilities to track performance metrics, detect anomalies, and troubleshoot issues.
- It should generate logs for critical events and errors, enabling administrators to identify and address issues promptly.

10. Regulatory Compliance:

- The app should comply with relevant regulations and standards related to data privacy, security, and accessibility.
- It should undergo regular audits and assessments to ensure compliance with legal and regulatory requirements.

3.2.3 Implementation Requirements

1. Hardware:

- Adequate server infrastructure with sufficient processing power, memory, and storage capacity is required, along with considerations for scalability and redundancy.
- Reliable network infrastructure with reliable internet connectivity, load balancing, and failover mechanisms is necessary for high availability.

2. Software:

- Programming languages such as Dart [7] and Kotlin for mobile app development, along with integrated development environments (IDEs) like Android Studio or VSCode, are essential.
- Version control systems like Git are needed for managing code changes, and collaboration tools are required for team communication and coordination.

3. Development Team:

- A skilled team comprising developers, designers, testers, and project managers with expertise in mobile app development, database management, software engineering, and user interface design is necessary.

- Effective communication and collaboration tools are essential for ensuring seamless teamwork.

4. User Interface Design:

- Design tools like Figma, Canva and draw.io are used to create wireframes, mockups, and prototypes, followed by an iterative design process incorporating user feedback.
- Accessibility considerations, including compliance with accessibility standards (e.g., WCAG [8]), are crucial for ensuring usability for users with disabilities.

5. Data Security Measures:

- Implementation of encryption for data at rest and in transit, along with robust authentication mechanisms and secure transmission protocols like HTTPS [6], is necessary to safeguard user data.
- Regular security audits and updates are essential for monitoring vulnerabilities and addressing security threats.

6. Testing Environment:

- Staging servers or emulators are utilized for simulating real-world usage scenarios, and various testing methodologies such as unit testing, integration testing, and user acceptance testing are employed.
- Test automation tools and bug tracking systems facilitate efficient testing and bug resolution processes.

7. Integration Capabilities:

- APIs [9] and data exchange protocols are used to facilitate communication with external systems, and compatibility testing ensures seamless integration with existing systems.
- Comprehensive API [9] documentation is provided for developers and stakeholders to facilitate integration.

8. User Training and Support:

- Training materials such as user manuals, tutorials, and online help resources are developed to guide users through the app's features and functionalities.
- A dedicated support team is available to address user inquiries and provide assistance as needed.

9. Scalability Plan:

- Vertical scaling involves adding more resources to existing servers, while horizontal scaling entails adding more servers to distribute the workload.
- Capacity planning and performance monitoring are crucial for predicting growth, monitoring system performance, and scaling as needed.

10. Regulatory Compliance:

- Compliance with data privacy regulations such as GDPR [3] and CCPA [10], accessibility standards like WCAG [8], and relevant industry-specific regulations is necessary.
- Regular audits and updates ensure ongoing compliance with evolving regulatory requirements.

3.2.4 Deployment Requirements

- App Store Distribution: The app will be available for download on major app stores.
- System Integration: Integration with college authorities for efficient data utilization.
- User Awareness: Campaigns to promote app adoption and usage.
- Ongoing Maintenance: Regular updates and support for long-term functionality.

Chapter 4

Project Design

Project design refers to the comprehensive planning and organization of the project's activities, resources, timelines and deliverables. It encompasses the strategic approach taken to achieve the project's objectives, ensuring effective communication and successful implementation.

4.1 UI/UX Design

a. User Interface (UI):

- The UI is clean and intuitive, minimizing cognitive load and ensuring easy navigation. Accessibility features cater to all users, including those with disabilities, maintaining consistency with the college's branding.

b. User Experience (UX):

- The UX design prioritizes a frictionless experience, guiding users through logical flows and providing immediate system responses. User testing helps identify and address pain points iteratively.

c. Prototyping and Validation:

- High-fidelity prototypes created using Figma undergo multiple rounds of user testing to refine usability and functionality.

d. UI of GECTFMA

- After successful authentication with their email and password, users, particularly HODs, are directed to the Complaint Management Dashboard. This dashboard provides a comprehensive overview of all registered complaints, displaying essential details such as complaint status, type of issue, and submission date. Additionally, users have the option to file a new complaint by clicking on the "New Complaint" button.
- When filing a new complaint, users are prompted to provide detailed information about the issue they are encountering. This includes selecting the type of problem from predefined categories, such as plumbing or electrical issues, and providing a description of the problem. Users can elaborate on the nature of the issue, its location, and any other relevant details that would aid in its resolution.
- The user-friendly interface of the complaint filing system ensures that users can quickly and efficiently report maintenance concerns, facilitating timely resolution and effective facility management. By streamlining the complaint submission process and providing a platform for clear communication, the system enhances user satisfaction and contributes to the overall efficiency of maintenance operations within the institution.
- When the sergeant logs in, they gain access to a centralized dashboard where they can view all registered complaints. This feature allows the sergeant to have a comprehensive overview of all reported issues, enabling them to efficiently assign tasks and monitor the resolution process.

The meticulously designed project architecture, as illustrated in Figure 4.1, lays the foundation for the GECTFMA Mobile App to be an efficient, user-centered solution. Overall, this comprehensive project design not only ensures the technical robustness of the GECTFMA Mobile App but also underscores its potential to significantly enhance maintenance management processes in college campuses. With a focus on efficiency, usability, and scalability, the app is poised to streamline facility maintenance operations and improve overall user satisfaction.

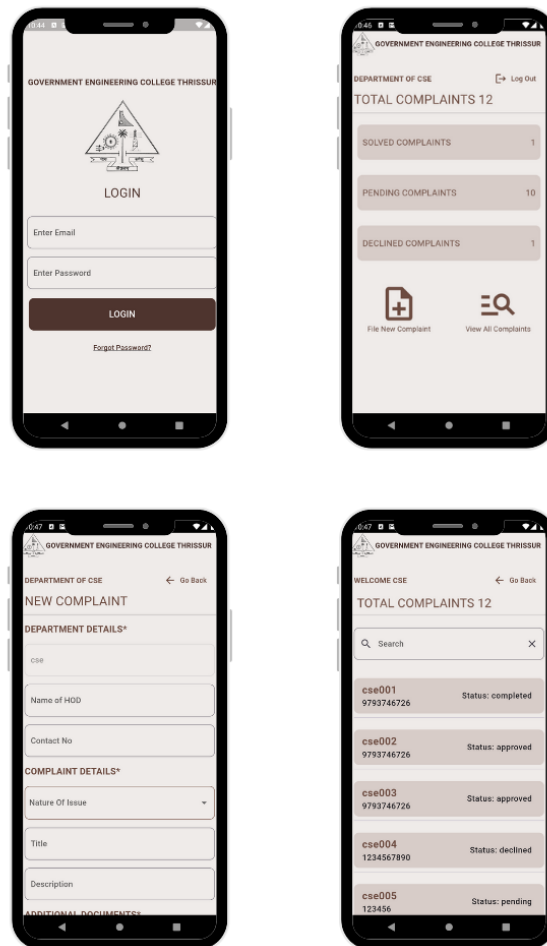


Figure 4.1: User Interface of Mobile Application

4.2 Architectural Overview

The architecture diagram for the GECTFMA project, depicted in Figure 4.2, provides a visual representation of the intricate data flow and component interactions within the system. At the outset, the Flutter development kit acts as the foundational framework for constructing the mobile application, ensuring compatibility across multiple platforms and devices.

Once the analysis is complete, the data is stored in the database system, ensuring seamless access and retrieval of information. The database system serves as the central repository for all maintenance-related data, enabling efficient management and organization.

Finally, the user interface (UI) serves as the bridge between users and the underlying system, providing an intuitive platform for reporting and tracking maintenance complaints. With its user-friendly design and seamless functionality, the UI empowers users to interact with the system effortlessly, enhancing overall user experience and engagement.

In essence, the architecture diagram underscores the interconnected nature of the components within the GECTFMA system, emphasizing the seamless flow of data from initial processing to user interaction. This holistic approach to system design ensures the efficiency, reliability, and effectiveness of the GECTFMA solution in addressing maintenance challenges within educational institutions.

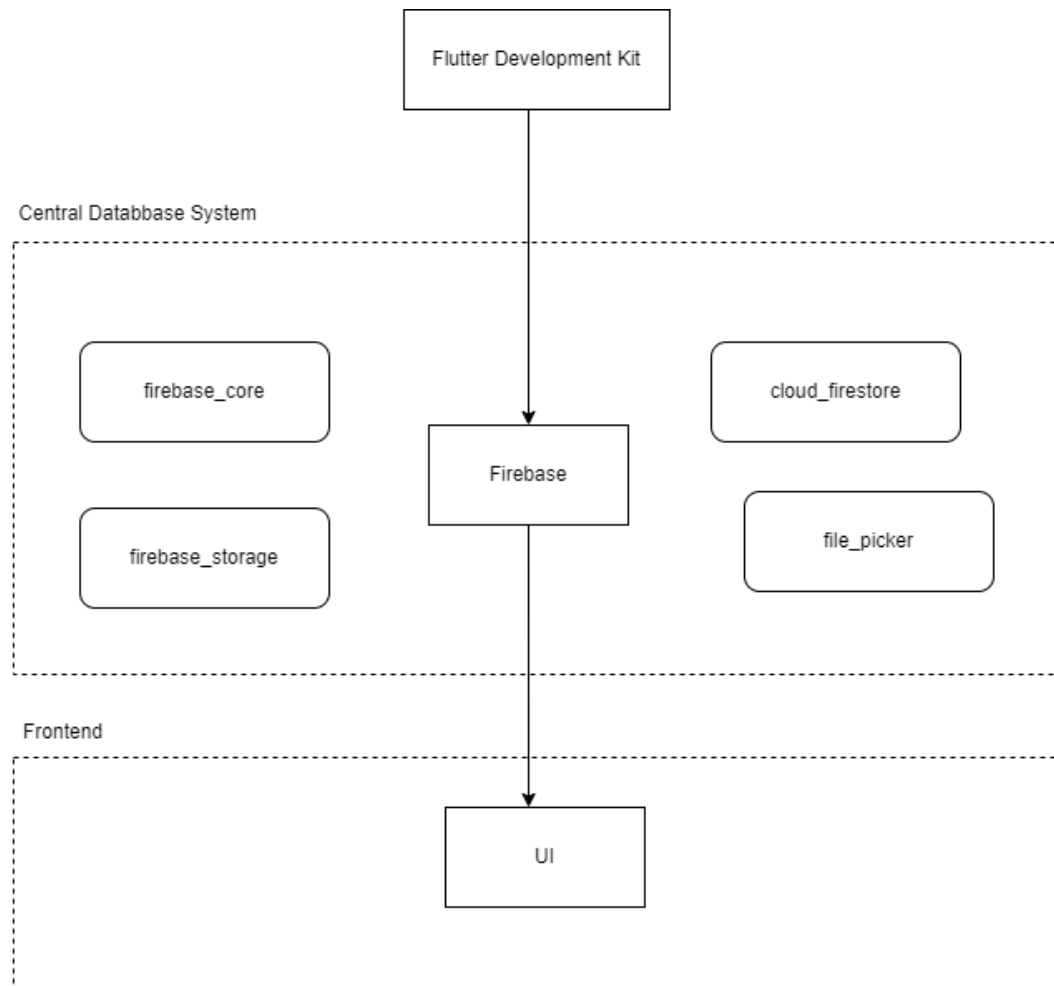


Figure 4.2: Architecture Diagram of overall system

4.3 Use Case Diagram

The use case diagram for the GECTFMA depicted in Figure 4.3 illustrates the collaborative interactions between various actors and the system functionalities. Actors involved in the process include HODs, Plumbing Incharge, Electrical Incharge (Electrical HOD), and Principal, each with specific roles and responsibilities within the system.

In the operational framework, actors engage in several key use cases. Firstly, the "File Complaint" feature enables HODs, Plumbing Incharge, and Electrical Incharge (Electrical HOD) to initiate a complaint by providing pertinent details regarding maintenance issues such as type, location, and description. Following this, the "View Complaint" function allows actors to access and review registered complaints, ensuring they stay informed about their status and associated details.

Subsequently, the "Verify Complaint" use case empowers Plumbing and Electrical Incharges to validate complaints within their respective domains, thereby ensuring accuracy and authenticity. Meanwhile, the "Approve Complaints" functionality grants the Electrical Incharge, who serves as the Electrical HOD, the authority to sanction electrical-related complaints after a thorough review for further action. Similarly, the Plumbing Incharge has the authority to approve plumbing-related complaints.

The "Decline Complaint" functionality allows Plumbing Incharge and Electrical Incharge, who is also the Electrical HOD, to reject complaints that do not meet the criteria or require further clarification. This feature empowers them to ensure that only valid complaints proceed for resolution, maintaining the integrity and efficiency of the maintenance management system.

The "Manage Complaints" feature empowers both the Principal and the Sergeant to oversee and handle the registered complaints effectively. They have the authority to monitor the status of complaints, track progress, and take necessary actions to ensure timely resolution.

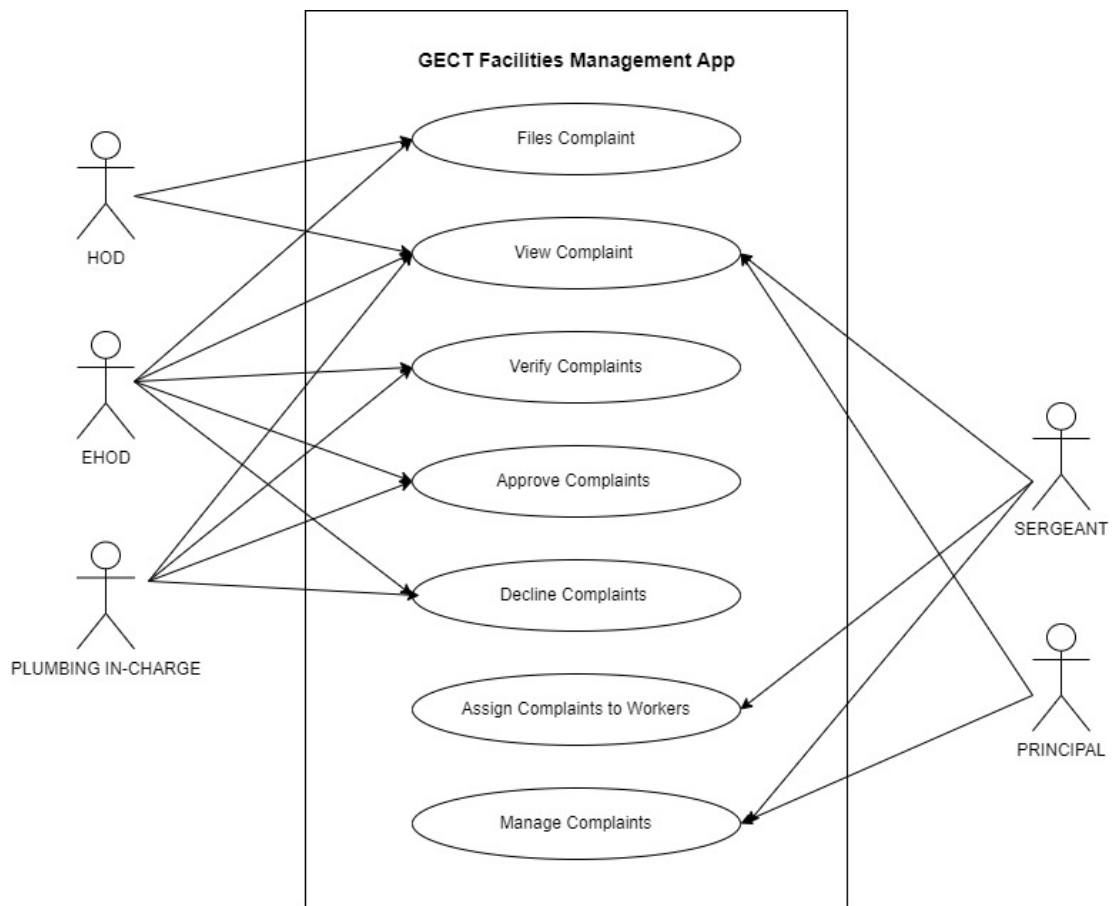


Figure 4.3: Use Case Diagram

4.4 Work Flow

The work flow diagram for GECTFMA is depicted in Figure 4.4. Upon logging in, the principal gains access to the dashboard, where they can view all registered complaints. The principal has the ability to fetch detailed information about each complaint, allowing them to stay informed about maintenance issues within the institution.

The sergeant can effectively monitor all complaints by gaining access to the dashboard after logging in. They can track the progress of each complaint to ensure timely resolution.

Upon successful authentication, HODs are directed to the dashboard, offering an overview of all registered complaints, including status, issue type, and submission date. Users can file new complaints by selecting the issue type and providing a description, facilitating efficient reporting. The user-friendly interface streamlines the process, enhancing user satisfaction and maintenance efficiency.

Additionally, the plumbing in charge and electrical in charge have specific roles within the system. The plumbing in charge can view and verify complaints related to plumbing issues, while the electrical in charge can perform the same function for complaints related to electrical problems. This segregation ensures that each type of complaint is handled by the relevant authority.

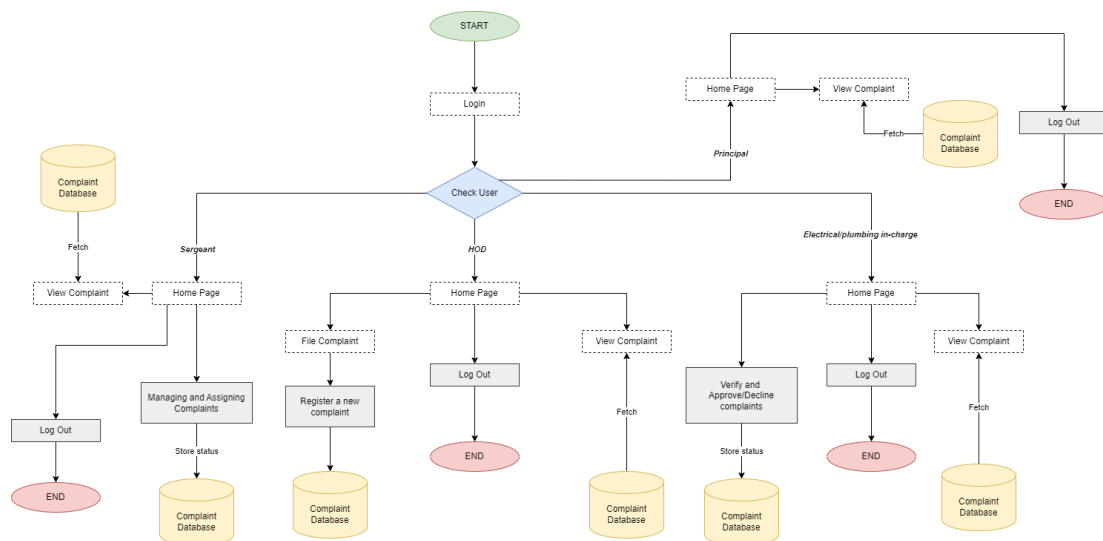


Figure 4.4: Work Flow Diagram

Chapter 5

Implementation and Testing

5.1 App Development

- Developed the GECTFMA mobile application using Flutter, emphasizing clean code, modularity, and thorough documentation to ensure maintainability and scalability.
- Ensured secure transmission of maintenance data to Firebase Firestore [11] using HTTPS protocols [6] to maintain data integrity and user privacy.
- Design intuitive user interfaces [2] for seamless submission of maintenance complaints and viewing all registered complaints.

5.2 Server-Side Implementation

- Developed a secure API [9] on the server-side, utilizing Firebase to facilitate data exchange between the app and authorized entities.
- Implemented authentication and authorization mechanisms to ensure only authorized personnel can access data.

5.3 Unit Testing

Unit tests are implemented using testing frameworks compatible with each technology stack. These tests focus on verifying the functionality of individual functions, modules and API [9] endpoints.

5.4 Integration Testing

Integration tests are performed to evaluate the interaction between different components of the system. These tests validate the integration of NoSQL database with Dart [7] for frontend UI components and backend APIs [9], ensuring seamless communication between different layers of the application.

5.5 User Acceptance Testing

User acceptance testing involves real users interacting with the application and providing feedback. Test scenarios are created to simulate common user interactions, such as survey creation, feedback submission, data visualization, and report generation. User feedback is collected and incorporated into iterative improvements to enhance the user experience.

5.6 Performance Testing

Performance testing is conducted to evaluate the system's response time, scalability, and resource usage under various load conditions. These tests help identify potential bottlenecks and optimize the system's performance for real-world usage scenarios.

5.7 Source code

Github:<https://github.com/basilanazer/mini-project>

Chapter 6

Results and Discussion

- System Development Progress

The development of the GECTFMA: Facility Management App is underway, focusing on addressing maintenance issues within college campuses, particularly plumbing and electrical complaints. Leveraging smartphone sensors and a user-friendly mobile application and the system aims to achieve real-time complaint submission.

- Preliminary Testing and Validation

While the system is still in development, preliminary testing has been conducted to assess its functionality and usability. Initial results indicate progress in implementing key features such as complaint submission and task assignment algorithms. However, comprehensive testing and validation are pending to ensure the system's accuracy and reliability.

- Anticipated Challenges and Future Improvements

As development progresses, anticipated challenges include refining algorithms for accurate issue detection and optimizing user interfaces for seamless interaction. Additionally, future improvements will focus on addressing user feedback and enhancing system performance under various network conditions.

- Conclusion and Next Steps

Although the project is ongoing, early progress demonstrates the potential of the GECTFMA: Facility Management App in streamlining maintenance complaint

handling on college campuses. Continued development and testing efforts are essential to ensure the system meets user requirements and effectively addresses maintenance challenges.

Chapter 7

Conclusions and Future Scope

7.1 Conclusion

In summation, the GECTFMA: Facility Management App emerges as a pivotal solution to the persistent challenges encountered in managing maintenance issues within college campuses. By providing a streamlined platform for reporting and addressing plumbing and electrical concerns, the app offers an efficient and user-friendly avenue for enhancing campus infrastructure.

Looking ahead, the potential of the GECTFMA: Facility Management App transcends its current capabilities. Through continuous innovation and the integration of advanced technologies such as predictive analytics and augmented reality, it can evolve into a comprehensive facility management tool, empowering institutions to proactively address maintenance needs and optimize resource allocation.

Moreover, the scalability of the GECTFMA: Facility Management App opens avenues for broader implementation across various institutional settings, promising widespread benefits beyond college campuses. By fostering collaboration and adaptability, the app stands poised to revolutionize facility management practices, ultimately contributing to safer, more sustainable, and well-maintained environments for all stakeholders.

In essence, the GECTFMA: Facility Management App epitomizes a vision for modernizing facility management processes and ensuring the longevity and efficiency of campus infrastructure. With continued dedication to improvement and responsiveness to user needs, it holds the potential to drive positive change in facility management practices for years to come.

7.2 Future Scope

- **Integration of Additional Maintenance Services:**Expand the app's functionality to include a wider range of maintenance services beyond plumbing and electrical issues. This could involve incorporating modules for HVAC maintenance, structural repairs, landscaping, and more, catering to comprehensive facility management needs.
- **Advanced Analytics and Reporting:** Implement advanced analytics capabilities to analyze maintenance data trends and patterns. Introduce reporting tools and dashboards for administrators to gain insights into maintenance performance, identify areas for improvement, and make data-driven decisions.
- **Predictive Maintenance Solutions:** Explore the implementation of predictive maintenance algorithms to forecast potential issues before they occur. By leveraging historical data and machine learning techniques, the app can predict maintenance requirements, optimize resource allocation, and minimize downtime.
- **Enhanced User Engagement Features:** Enhance user engagement by introducing features such as gamification, rewards programs, and community forums. Encourage active participation from users in reporting maintenance issues, providing feedback, and collaborating on solutions, fostering a sense of community ownership and involvement.
- **Expansion to New Markets:**Consider expanding the app's reach beyond college campuses to cater to other institutional settings such as schools, hospitals,

corporate offices, and residential complexes. Customize the app's features and interface to meet the specific needs of different market segments.

- Continuous Improvement and Iteration: Embrace a culture of continuous improvement and iteration by soliciting feedback from users, stakeholders, and industry experts. Regularly update the app with new features, optimizations, and bug fixes to ensure it remains relevant and competitive in a dynamic environment.

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