Development of Smart Bin Apps for Kampar Residence

BY

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iii

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iv

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Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

v

ABSTRACT

As the number of people using smart devices grows exponentially, mobile applications have become popular as effective solutions to various problems. Although there are many smart waste management software with scheduling systems, notification systems, route optimization systems, and reporting systems, the market still demands a comprehensive mobile application. Therefore, I want to offer "ProWaste", a mobile application designed to provide an efficient way to manage waste in Kampar. Collectors and managers can use this app to manage waste in different residential areas of Kampar. Moreover, the smart waste bin app allows collectors to set reminders, reminding them to collect waste at specific locations on a given day, and collectors can report waste issues in their area to the manager using this app. Most importantly, Firebase is used to securely store user credentials. I plan to use the Mobile Application Development Lifecycle (MADLC) as the framework for developing this mobile app. Essentially, the app aims to help collectors effectively plan their weekly waste collection, optimize collection routes based on specified locations, and report issues to the manager efficiently.

Bachelor of Information Technology (Honours) Communications and Networking
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TABLE OF CONTENTS

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

vii

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

viii

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

ix

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

x

LIST OF FIGURES

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

xi

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

xii

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

xiii

LIST OF TABLES

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

xiv

CHAPTER 1

Introduction

This chapter starts the process of outlining the motivation for our study, the main issue we want to solve, the goal we want to accomplish, the parameters that govern our project, and the general course we want to take. Our primary goal is to develop Smart Bin Apps that are tailored to the needs of Kampar locals.

1.1 Problem Statement and Motivation

Problem Statement

Effective waste management is one of several challenges facing Kampar. A significant issue is that waste collectors lack effective scheduling and route planning tools. Resulting inefficiencies include things like missed pickups and overlapping routes. Kampar need a trustworthy scheduling system in order for waste collectors to accurately arrange their task. It is possible to assist garbage collectors in remembering crucial collection dates or jobs by adding alerts or reminders into the system. These improvements will let Kampar guarantee prompt and effective waste pickup.

Furthermore, the waste management procedure is made more difficult by the absence of an extensive database that highlights Kampar's residential zones. Waste collectors could find it difficult to determine which residential areas need priority attention or where waste needs to be collected if there isn't a clear and current inventory of these places. In order to guarantee that all Kampar residential areas receive sufficient garbage collection services, a comprehensive database would facilitate improved planning, routing, and service distribution.

Kampar suffers difficulties with recycling and waste disposal procedures in addition to garbage collection-related difficulties. When it comes to waste dumping problems, including overflowing bins or illicit dumping, there are conspicuously few reporting channels. The ecology and public health may be at risk from environmental contamination brought on by this absence of reporting mechanisms. Kampar must set up a reporting system that enables garbage collectors to notify managers or other appropriate authorities of problems with waste disposal in a timely manner in order to address this. This proactive strategy is crucial for preserving Kampar's cleanliness, attending to environmental issues, and guaranteeing secure trash disposal procedures.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

1

Lastly, sorting and organising garbage is also essential for effective recycling and sustainable waste management. If different trash kinds are mixed together without the proper waste sorting techniques or tools, the mixture may get contaminated and recycling efforts may be hindered. Kampar ought to focus on encouraging residents and garbage collectors to appropriately separate waste in order to promote appropriate waste management practices and increase recycling rates. By implementing garbage segregation capabilities and creating explicit policies, Kampar may considerably profit from more ecologically friendly waste management techniques.

Motivation

First and foremost, I propose implementing a schedule function so that collectors can arrange their daily tasks. The day of the week, the area to be covered, and the collection time are all customizable for collectors. After scheduling, they get access to their scheduled tasks. The collector will receive a notification from the application on the approaching appointed time, reminding them to arrive on time to the assigned location for rubbish collection.

Secondly, to assist collectors and managers in visualizing collection regions, I propose integrating a map view option. With the help of this feature, users can see locations on a map and click on markers to see a route that will take them from where they are right now to the collection site. Users will also be able to easily locate particular locations using the search box, and the application will display the route in line with their search terms.

Thirdly, I suggest including a reporting option to handle problems with waste dumping. A collector can use this app to report issues such as unauthorized dumping or overflowing bins. In addition to writing a description and identifying the area, they can take a picture as proof and submit it to the manager. The manager can address the issue after seeing the report. This feature is essential for preserving Kampar's cleanliness, taking care of environmental issues, and guaranteeing secure disposal procedures for garbage.

Finally, I propose including a feature that encourages appropriate waste sorting for recycling. Efficient recycling requires proper waste sorting. Kampar can increase recycling rates and implement more environmentally friendly waste management techniques by enticing citizens and collectors to properly classify rubbish.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

2

1.2 Objectives

1. To study the relevant features of smart bin application

    The aim of the study is to understand how waste collection activities can be organized more efficiently. The smart bin application offers a comprehensive set of features including scheduling tasks, map view feature, and reporting capabilities to streamline waste collection and management processes.

2. To develop a mobile apps for smart bin applications for Kampar.

    Focus on developing a special mobile app for Kampar to assist with smart bin functionality. In order to effectively use smart bin systems and receive real-time updates on waste collection schedules and operating status, map views and reporting capabilities to improve waste collection efficiency, a user-friendly and intuitive mobile application must be designed, built and deployed.

3. To evaluate the development features of smart bin application

    Conduct a comprehensive evaluation of the functionality created for the smart box application. The main goal is to thoroughly test and validate the features added during the application development phase. This project aims to ensure the stability, reliability and user-friendliness of the Smart Bin App customized for Kampar by systematically analyzing these functions.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

3

1.3 Project Scope

The purpose of the "Smart Bin Apps for Kampar Residence" project is to develop an advanced mobile application designed specifically for Kampar's effective management of garbage collection. This user-friendly application improves operational efficiency and streamlines procedures for both managers and collectors. The app's primary features are its scheduling feature, map view capability, and reporting feature. Together, these components offer a comprehensive waste management solution.

Once the collector logged into the app, collectors use the scheduling feature to effectively manage their daily responsibilities. They can choose particular days, areas, and times to arrange collections, and they can even set alarms for use as a reminder. The collector receives a vibrating notification from the app when it's time for collection. A visual depiction of collection sites is also provided by the map view feature, which makes it easier for collectors to move between locations. They can help with route optimisation by clicking on area markers, which show them their current location, the destination of choice, and the optimal path to the collecting point. Furthermore, collectors can report instances of rubbish dumping, including descriptions, area identification, and the submission of photographic proof, through the app's reporting tool.

After login for the manager, the software provides managers with the means to monitor and efficiently handle concerns that are reported. Managers can see reported issues that collectors have submitted and take appropriate action. Managers can visualise collection regions in the same way as collectors may with the map view function. Managers are able to see the current location, the destination they have chosen, and the recommended path by clicking area markers. The software will show the appropriate path based on the search criteria entered by managers, who can also utilise the search box to find specific locations.

In conclusion, a database system will be utilised as a trustworthy backup for the system in a mobile application for smart bins, securely storing manager and collector data. In the event of a system failure or data loss, the database ensures that critical data is accessible and undamaged, protecting the application's dependability and continuity.

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4

1.4 Contribution

1. Scheduling Assistance for Waste Collection:
   - The app offers an organized scheduling method for waste collection, reducing the chances of missed pickups and minimizing route overlaps. In addition, the efficiency of the waste collection process is improved through optimized planning and organization, ensuring timely and systematic collection.

2. Map View Functionality for Route Planning:
   - Integrated map view provides a visual summary of designated collection zones. Furthermore, the application can help the managers and collectors plan and navigate routes more efficiently. Access to route details and visual collection regions on a map allows for streamlined collection routes, reducing travel time and improving spatial awareness.

3. Reporting Tool for Issue Resolution:
   - Collectors can report issues such as overflowing or illegal bins using the app's reporting tool. and proactive reporting facilitates timely action by notifying relevant management or authorities. Ensure Kampar's environmental issues, hygiene standards and safe waste disposal are addressed promptly.

4. Revamping Kampar's Waste Management System
   - Introduce technological advancements to increase efficiency, transparency and environmental awareness. Designed to provide residents with a more sustainable and cleaner environment. It is hoped that the waste collection process will be reduced through the state-of-the-art facility.

5. Enhance Kampar's environmental awareness
   - Make significant progress towards your waste management goals with this app. Additionally, by implementing technology solutions, we are creating a greener future for Kampar.

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5

1.5 Report Organization

The subsequent chapters present the specifics of this study. Chapter 1 will include the problem statement, motivation, objectives, project scope, background information, and contribution. A few relevant background information about the mobile application for the smart bin application is examined in Chapter 2. Furthermore, the system architecture diagram, use case diagram, entity relationship diagram and system methodology utilised for the project will be included in Chapter 3. In addition, the system overview flowchart diagram and the collectors' and managers' flowchart diagram are provided in Chapter 4. Moreover, Chapter 5 discusses system implementation, including the technologies and tools used, including hardware, software, software setup and system operation. The discussion of system testing and result, objectives evaluation and project challenges will follow in Chapter 6. There will be a conclusion and recommendation in Chapter 7.

1.6 Background Information

The field of waste management has evolved significantly over the past decades, shifting from traditional practices to more technology-driven solutions that align with the principles of sustainability and environmental consciousness. Waste disposal and its efficient management have become critical concerns in urban environments worldwide, with increasing populations generating escalating amounts of waste. Historically, waste management primarily revolved around physical collection and disposal, often resulting in environmental pollution, resource wastage, and inefficiencies in collection schedules [1].

Innovative solutions that make use of real-time data and user engagement to address these enduring difficulties have been introduced as a result of the introduction of smart technology in waste management methods. For the management and disposal of garbage, many programs are used. It can be done by eliminating, processing, recycling,
reusing, or managing garbage. Reduced waste and potential environmental and health problems are the primary objectives of waste management [2]. As cities work to lessen their ecological impact and improve the quality of life for their citizens, the convergence of waste management and technology is in line with the worldwide movement towards sustainable urban living.

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6

Smart bin software can assist Kampar in resolving its waste management issues. The scheduling features of these programs optimize waste collection routes, guaranteeing effective collections and reducing the number of missed collections. They also offer integrated residential zones that make effective planning for waste collection possible. Collectors are able to promptly notify supervisors of any waste dumping scenario so that prompt action can be performed because of the system's integrated reporting capabilities. These components can be used by Campbell Soup to improve waste management, improve environmental protection, and improve service delivery.

This project, focused on the development of a Smart Bin App for Kampar Residence, emerges at the juncture of waste management challenges and technological innovation. By offering readers this background insight into the evolving landscape of waste management and the integration of smart technology, we provide a foundation for understanding the project's significance and potential for reshaping waste disposal practices in a more sustainable direction.

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7

CHAPTER 2

Literature Review

1.1 Sensoneo

In this section the project would highlight the Sensoneo application. The detail explanation will be highlighted in the upcoming subsections.

2.1.1 Introduction

According to Figure 2.1.1 Sensoneo application is developed by Martin Basila and Andrea Basilova in 2014 [3]. In an increasingly developing world, where urbanization and technological advances shape our environment, the management of waste and resources becomes increasingly important. Sensoneo, a pioneering company at the intersection of technology and sustainability, has emerged as a solution to these challenges. Sensoneo is revolutionizing waste management, harnessing the power of data-driven insights and innovative sensor technology to revolutionize the way cities, businesses and communities deal with waste.

Sensoneo's main goal is to create a world where waste management is a smart process with minimal negative impact on the environment and not just a normal task. Traditional garbage collection methods often use fixed schedules, which can lead to inefficiencies and overflowing containers. Sensoneo actively questions the current situation. To accurately track fill levels, waste management teams can strategically place sophisticated ultrasonic sensors within waste containers to optimize collection routes and time frames.

Sensoneo stands out for its comprehensive and flexible solutions. The technology offers more than simple fill level monitoring and integrates the entire waste management ecosystem. An intuitive interface helps waste management professionals visualize data, obtain insightful information, and make informed decisions. The technology also brings benefits to citizens, fostering engagement by providing real-time information on alternative waste disposal methods and encouraging a more ecologically responsible life style. [4].

Sensoneo has an impact on multiple industries. Municipalities can significantly reduce operating costs and carbon footprints by reducing unnecessary collection trips. Improving waste management efficiency can help businesses save money and create a greener image.

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8

Sensoneo's advancements in waste management technology ultimately reflect the need for smarter, more sustainable practices around the world.
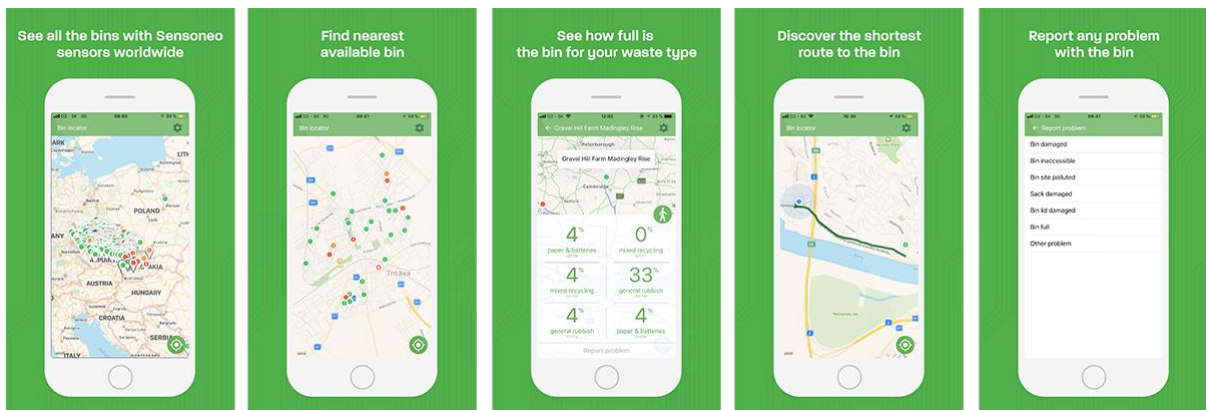
Figure 2.1.1 Sensoneo Application

2.1.2 Strength

1. **Smart Waste Management:** Sensoneo offers advanced waste management systems that utilize IoT (Internet of Things) technology to continuously monitor waste bins.

2. **Effective Collection Routes:** The solution optimizes waste collection routes based on real-time data, reducing fuel use, emissions and operating costs.

3. **Fill-level Monitoring:** Bin sensors provide waste management teams with accurate fill level data, allowing them to schedule collections only when bins are close to capacity and minimize unnecessary trips.

4. **Predictive Analytics:** Sensoneo uses predictive analytics to uncover trends in waste generation, allowing planners to allocate resources efficiently and prepare for peak periods.

2.1.3 Limitation

1. **Data Privacy and Security:** Real-time monitoring requires the collection and transmission of sensor data, which raises concerns about data security and privacy. Protecting sensitive data and ensuring compliance is critical.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

9

2. **Human Intervention:** Although the system optimizes routes and schedules, human intervention may still be required at times, such as when unplanned changes, emergencies, or irregular garbage collection needs arise.

3. **Infrastructure compatibility:** Sensoneo's performance depends on reliable internet connectivity and infrastructure, which can be challenging in some countries or remote areas.

2.1.4 Recommendation

1. **Data security and privacy:** Strong data privacy and security policies should be in place to protect sensitive data sent through applications and recorded by sensors.

2. **Emergency procedures:** Develop contingency plans and procedures for unforeseen circumstances, emergencies, or system failures that may affect waste collection operations.

3. **Sustainability awareness:** Use the app to spread awareness about waste minimization, recycling and sustainability to the public and waste management teams.

4. **Performance evaluation:** Always track the program's performance, solicit user feedback, check data for accuracy, and resolve any technical issues as soon as they arise.

2.1.5 Summary

In conclusion, Sensoneo is a leader in innovation in the waste management industry, using Internet of Things technology to make rubbish collection more intelligent and effective than it was in the past. In addition to increasing operational effectiveness, Sensoneo also promotes sustainability and lessens environmental impact by using predictive analytics, optimising collection routes, and providing real-time fill-level monitoring. But to reach its full potential, issues like infrastructure compatibility, human intervention, and data privacy need to be resolved. Sensoneo can maintain its position as a leader in the global movement towards cleaner and greener cities and communities by implementing strong data security protocols, emergency protocols, and a strong emphasis on sustainability awareness.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

10

2.2 BigBelly

In this section, the project will highlight the BigBelly app. The detailed explanation will be highlighted in the following subsections.

2.2.1 Introduction

The BigBelly App [5] is a revolutionary waste management concept developed by the company BigBelly Solar that combines cutting-edge technology with an environmentally friendly approach. BigBelly Solar is a pioneering leader in smart waste management systems, revolutionizing the way cities, universities and companies approach waste collection and environmental management. The BigBelly app created by BigBelly Solar is a breakthrough solution to the problems of traditional waste management technologies [6]. BigBelly Solar's broad platform revolutionizes the way waste is collected, managed and optimized in urban environments. The business is committed to technology and sustainable innovation. The BigBelly app also provides a comprehensive response to contemporary waste management issues through real-time monitoring, optimized collection routes and data-driven insights.

The mobile application provides useful features and benefits to citizens. Users can find more information about available smart bins nearby, ensuring easy waste disposal and encouraging ethical waste management practices. Users of the app can also submit such bin issues so waste managers can quickly address issues such as damaged bins or overflowing waste. Hence, Bigbelly mobile app has a simple user interface and easy navigation. Due to its user-friendly design, waste management enjoys wider acceptance and active participation from community members, thereby increasing accessibility and enjoyment.

Bigbelly transforms waste management by optimizing operational efficiency, promoting environmental sustainability and increasing public engagement by fusing the functionality of smart bins with an easy-to-use smartphone app. The Bigbelly system offers waste management companies the opportunity to streamline collection procedures, cut costs and develop cleaner, greener communities.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

11

2.2.2 Strength

1. **Data-Driven Insights:** A key component of how the BigBelly app works is data-driven insights to fully understand waste generation trends. By continuously tracking bin fill levels in real-time, the gadget collects data that shows when and where the most trash accumulates. Translating this information into practical insights enables waste management teams to deploy resources more efficiently. By identifying peak waste generation times and high-traffic areas, cities and organizations can better meet demand by modifying the design of waste infrastructure, collection schedules, and personnel distribution.

2. **Remote Monitoring and Management:** The BigBelly program's remote monitoring and management capabilities transform waste management operations. Waste management teams have access to a central dashboard that displays real-time data for all connected bins. Because bin fill levels can be proactively monitored, teams are able to take action before bins fill up and are in danger of overflowing. By remotely resolving issues such as overflowing bins or mechanical issues, waste management teams can deploy resources precisely where and when they are needed, minimizing the potential for disruption, unsightly trash piles and associated cleanup costs. Because of this remote capability, waste management professionals are better able to increase overall efficiency while maintaining a high level of customer service and responsiveness.

3. **Community Engagement:** BigBelly's focus on community engagement transforms waste management from a secretive responsibility to a collaborative effort. The app prevents trash cans from overflowing and keeps public areas clean, creating a more aesthetically pleasing environment. This encourages residents and guests to be responsible for their surroundings and fosters a sense of community pride. When people can immediately benefit from clean streets and parks, they are motivated to dispose of waste responsibly and work together to keep their surroundings clean.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

12

2.2.3 Limitation

1. **Data Privacy and Security:** The prospect of the program collecting location-based and other sensitive data as real-time data raises concerns about data privacy and security. Strong data privacy and security measures must be in place to prevent unauthorized access or data leakage.

2. **Technology Dependence:** The functionality of technical components such as sensors, networks and the mobile application itself is necessary for the BigBelly application to function well. Any technical glitches, network issues or system flaws can hinder the waste management process.

3. **Limited Customization for Special Needs:** Even if the application is flexible, it may not adequately meet the unique waste management needs of each site. There may be limitations to customization, which may result in trade-offs.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

13

2.2.4 Recommendation

1. **Data Privacy and Security:** Develop strong data privacy and security processes to protect sensitive information. This includes role-based access control, data encryption in transit and data encryption at rest. In addition, please be sure to comply with any applicable data protection laws and local privacy laws. While emphasizing ethical data management practices, emphasize the value of data privacy and security while educating employees and users.

2. **Technology Dependence:** To resolve any issues quickly, have a strong technical support and maintenance plan in place. Redundancy and failover strategies can also be used to reduce disruption from network or system failures. For example, sensors and connections should be regularly updated and maintained to ensure their reliability.

3. **Customization for Special Needs:** Consider and document the special restrictions and specifications for waste management at each location. Investigate any anticipated modifications or changes with the program developers to see if specific requirements can be better met. Be prepared to make smart trade-offs when necessary, taking into account factors such as budget constraints and the importance of achieving important waste management goals.

2.2.5 Summary

In summary, BigBelly Solar's BigBelly App is a prime example of how technology and sustainability can be combined with trash management, providing businesses and communities with a strong platform to enhance operations, include the community, and promote environmental sustainability. Its strengths are in community participation that promotes civic duty, remote monitoring capabilities that improve response, and data-driven insights that enable effective resource allocation. However, issues with data protection, reliance on technology, and restrictions on customisation call for close consideration. To fully utilise the BigBelly App, it will be essential to implement strong data protection measures, provide strong technical support, and provide customisation based on site-specific requirements. With these things in mind, the BigBelly App is well-positioned to keep changing waste management procedures and promoting greener, cleaner communities worldwide.

Bachelor of Information Technology (Honours) Communications and Networking
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14

2.3 iRecycle

In this part, the project would highlight the iRecycle app. The detailed explanation will be pointed out in subsequent subsections.

2.3.1 Introduction

Earth911, Inc., the largest environmental service provider in the United States, has developed the famous recycling program iRecycle [7]. To help people and businesses make decisions that benefit the environment, Earth911 has been at the forefront of providing environmental information and solutions. By providing tools and services such as iRecycle software, the organization aims to help individuals live a sustainable lifestyle. iRecycle is a mobile application that helps users find recycling and disposal facilities for a variety of commodities [8]. By providing useful information about recycling centres, drop-off locations and collection schemes, it makes it easier for people to recycle ethically and reduce their impact on the environment. In addition to being the creation of Earth911, iRecycle is also the result of collaboration with numerous area regulators, recycling facilities and environmental organizations. Through these partnerships, the app enables users to access the latest region-specific information on recycling facilities, drop-off sites and best practices. The creators of iRecycle have developed a comprehensive and user-friendly app to help recycling efforts across the United States by partnering with a wide range of stakeholders. In summary, Earth911, Inc. worked with a network of partners and organizations to develop iRecycle, a mobile application that promotes environmental awareness [9]. Its goal is to encourage recycling, waste reduction and proper disposal practices by making recycling information easily accessible to users, making it a useful tool for people and communities trying to mitigate their environmental impact.

Bachelor of Information Technology (Honours) Communications and Networking
Faculty of Information and Communication Technology (Kampar Campus), UTAR

15

2.3.2 Strength

1. **Comprehensive Recycling Information:** The extensive recycling data provided by iRecycle includes information on recycling facilities, drop-off sites, and best practices for recycling a variety of materials. This vast database is a huge asset as it provides users with a one-stop shop for all their recycling needs.

2. **Location-Based Services:** iRecycle uses location-based services to guide users to nearby recycling bins. This feature improves the user experience and ensures that the information provided is up-to-date and relevant.

3. **Environmental Education:** The app provides guidance material on sustainability and recycling that raises awareness and inspires users to adopt eco-friendly habits.

4. **Partnerships with Local Authorities:** iRecycle's collaboration with regional regulatory agencies and recycling facilities increases the accuracy and comprehensiveness of its data by receiving frequent direct updates from these sources.

2.3.3 Limitation

1. **Geographic Limitations:** The app's comprehensive database may not include recycling options in other countries as it is primarily focused on the United States. For users outside the United States, information may be sparse.

2. **Dependency on Data Accuracy:** Consistent updates from partner organizations and local authorities are critical to the app's information accuracy. Inaccurate or outdated information may provide users with false information.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

16

2.3.4 Recommendation

1. **Real-Time Updates:** Implement a system that enables users and affiliated organizations to send real-time information updates about recycling facilities. Using this crowdsourcing approach can improve the accuracy of your data.

2. **International Expansion:** iRecycle should consider expanding its scope to include information on recycling options in other countries to reach a wider audience. This will increase the value of the application to users around the world.

3. **Enhanced Educational Content:** Continue to create informative articles, videos, and descriptions for the app to better inform users about environmental sustainability and waste reduction.

2.3.5 Summary

In conclusion, Earth911's iRecycle programme is a vital tool for increasing environmental awareness and recycling in the US. Users may decrease trash and recycle with knowledge thanks to its comprehensive database, location-based services, and educational resources. Partnerships with local government entities further enhance the app's accuracy and trustworthiness. However, there are challenges due to its limited spatial scope and dependence on exact data. By adding crowdsourced real-time updates, considering global expansion to reach a larger audience, and enhancing instructional content, iRecycle can solidify its position as the best recycling app. By encouraging and guiding individuals and communities worldwide towards more sustainable practices, iRecycle can promote its mission of environmental stewardship with these enhancements.

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17

2.4 Comparison

Feature	Sensoneo (2014)	BigBelly (2003)	iRecycle
Overview	Smart waste management solution with real-time monitoring and data analytics	Solar-powered compacting bins with waste monitoring and management features	Recycling and waste management platform with educational tools and incentives
Key Features	Real-time fill level monitoring Route optimization Waste analytics	Solar Compactors Smart waste collection Waste tracking	Recycling incentives, educational resources, community engagement
Sustainability Impact	Optimizes waste collection routes.	Reduces collection frequency, decreases waste overflow.	Encourages recycling.
Launch Date	Year 2014	Year 2003	Not publicly known
User-Friendly Interface	For waste collectors and management authorities.	For waste managers and collectors	Residents with recycling tips and rewards.

Table 2.4: Table comparison of reviewed waste management in literature review

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

18

CHAPTER 3

System Methodology/Approach

In this chapter, we'll delve into the system architecture diagram, use case diagram, and the description of the smart bin application, followed by the entity relationship database and the system methodology.

3.1 System Architecture Diagram
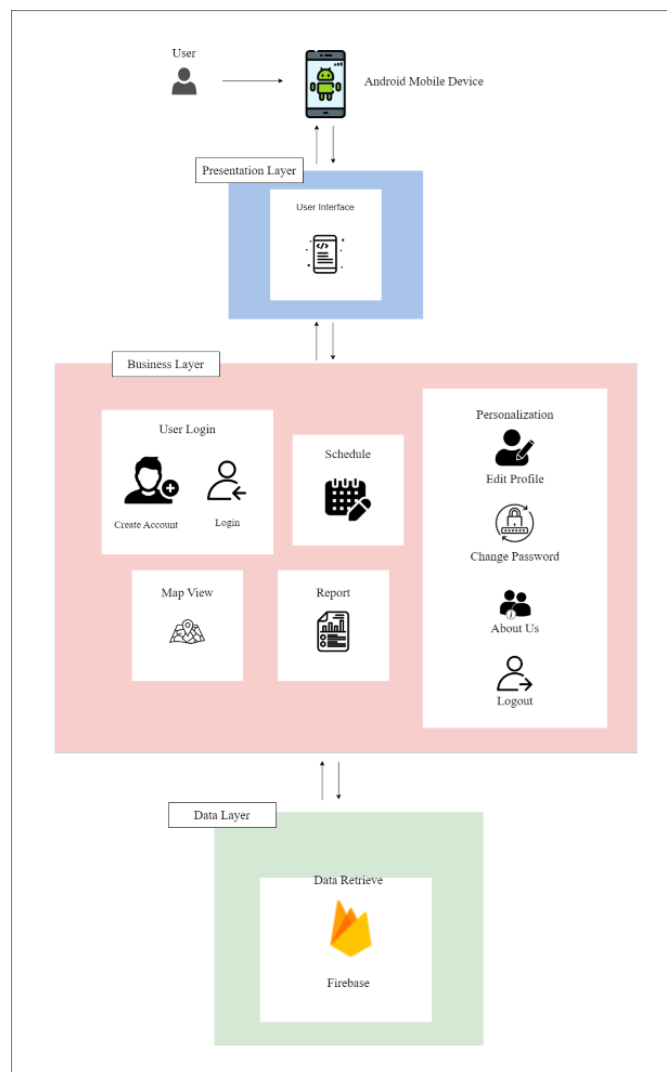
Figure 3.1: System Architecture Diagram

Based on Figure 3.1 the system architecture diagram shows the mobile application Smart Bin Apps for Kampar Residence in a layered format. The Presentation Layer interacts with users through an array of features and functionalities on their Android mobile devices. In order to

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

19

store and retrieve data, handle user input, and manage crucial application functionality, the Business Layer communicates with Firebase. Firebase serves as the Data Layer, securely storing calendars, reports, user data, and other important information. The programme can address Kampar's waste management requirements in a scalable and maintainable manner due to the clear delegation of tasks facilitated by this design.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

20

3.2 Use Case Diagram and Description

Figure 3.2: Use Case Diagram of Smart Bin Application

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21
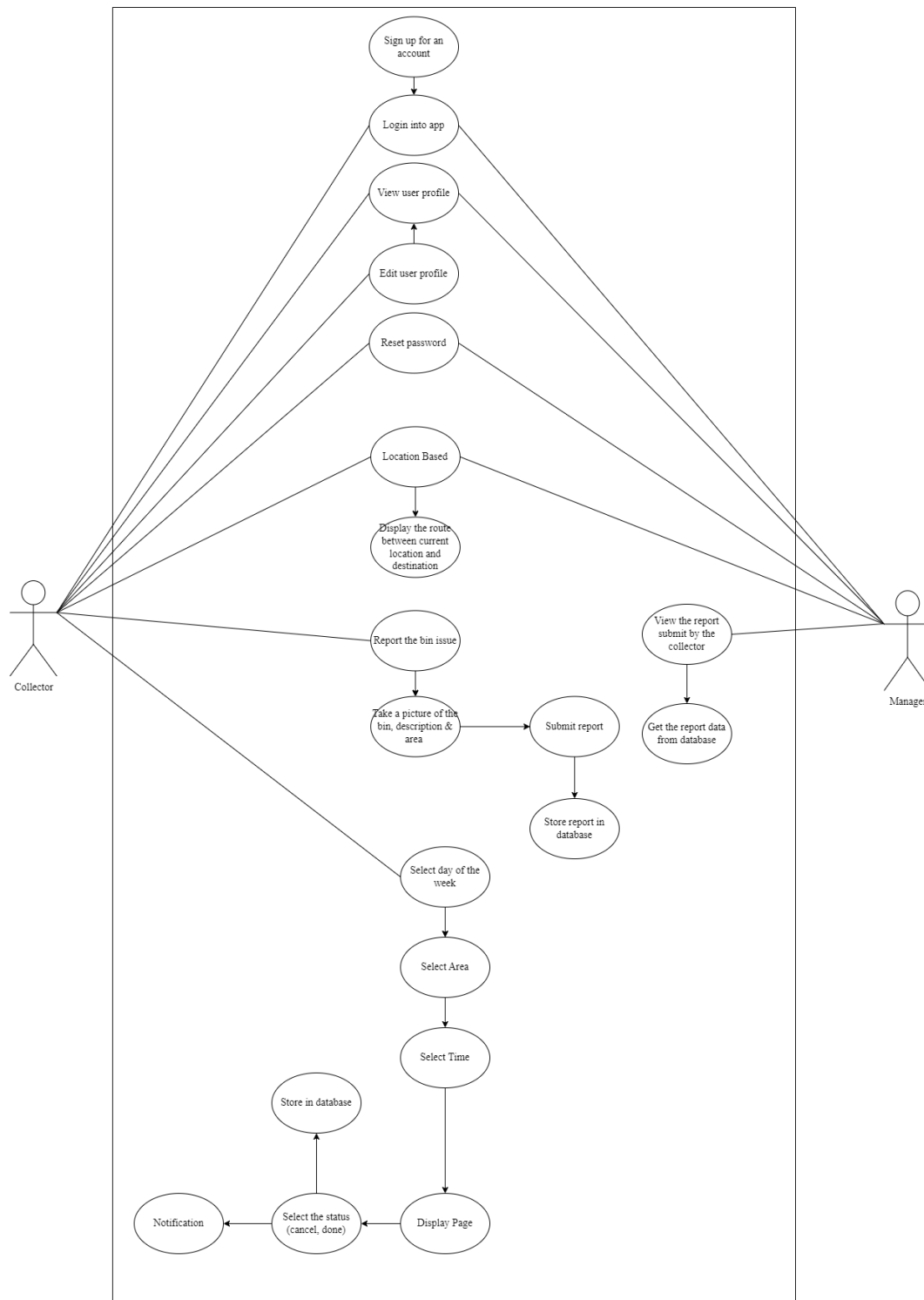
According to Figure 3.2 use case diagram of smart bin application, the system is designed to satisfy two different user roles: collector and manager. Both roles require users to register an account and verify their email before accessing the application. After verifying the email, the user needs to log in into the application. Furthermore, users can view and edit their profiles and have the option to reset their passwords if desired.

Collectors can efficiently handle their collection operations with the use of tools. By choosing the day of the week, the location, and the hour for collections, they can make schedules. After then, a list with these choices is presented, making it simple for collectors to view their assigned jobs. Collectors receive notifications to remind them when it's time for a collection and have the ability to change the status of tasks from "cancelled" to "done." Collectors may conveniently travel and visualise collecting regions by utilising the map view feature. The application shows the best route from the collector's present location to the selected destination by tapping on an area or by using the search function. Collectors can also notify supervisors about problems such as unlawful dumping by describing the area in question, locating the problem, and sending photos of the incident.

Managers are able to keep focused on issues that are reported and efficiently address them. When issues are brought up by collectors, they can review them, handle them, and take necessary action. Managers have the same ability to see collecting regions and routes by using the map view function as collectors. Managers can see their current location as well as selected destinations and suggested routes by pressing on a location marker or by using the search box. Effective route scheduling and issue resolution are aided by the application, which shows the best routes depending on the search parameters the administrator specified.

Overall, the system offers managers and collectors an easy-to-use platform to effectively and cooperatively oversee Kampar's waste collection. In order to assist develop a more structured and effective waste management system, collectors can schedule, navigate, and report concerns, while supervisors can supervise operations, address problems, and plan routes effectively.

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22

3.3 Entity Relationship Diagram
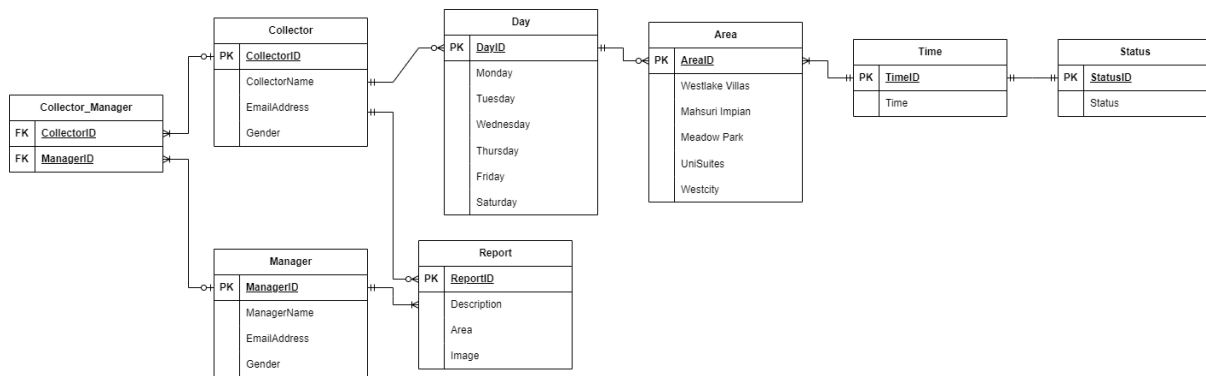
Figure 3.3: Entity Relationship Diagram of Smart Bin Application

The Entity Relationship Diagram in Figure 3.3 for the smart bin application outlines two main roles: collector and manager, each with distinct primary keys. The collector table includes the collector ID (primary key), collector name, email address, and gender. Meanwhile, the manager table features the manager ID (primary key), manager name, email address, and gender. Additionally, the day entity lists the day ID along with individual days of the week: Monday through Saturday. The area entity has an area ID (primary key) with specific locations: Westlake Villas, Mahsuri Impian, Meadow Park, UniSuites, and Westcity. The time table includes a time ID (primary key) and the specific time. The status table has a status ID (primary key) and different status descriptions. Lastly, the report table comprises a report ID (primary key), description, area, and image. All this data is stored in the database.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

23

3.4 System Methodology

An organized process based on the Figure 3.4 Mobile Application Development Life Cycle (MADLC) will be used to develop the Smart Bin application for Kampar Residence. MADLC consists of a number of phases, each of which is important to the project's success as a whole. The technique will include numerous phases, including phases for requirements collection and analysis, design, development, prototyping, testing, deployment, and maintenance [10].
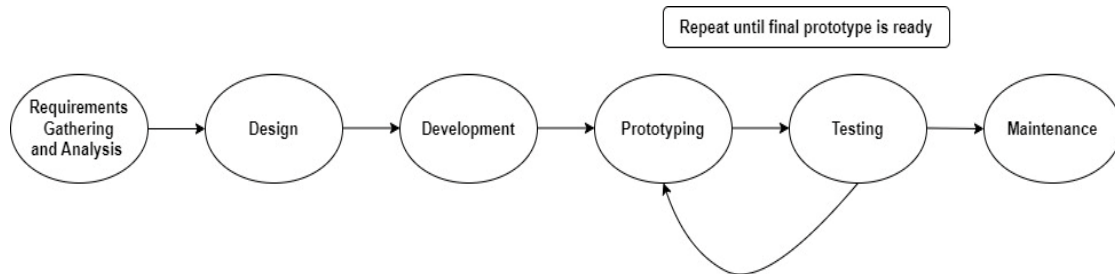
Figure 3.4: Mobile Application Development Life Cycle Model (MADLC)

Requirements Gathering and Analysis Phase

This phase will involve obtaining thorough data regarding the project's aims, targets, and user requirements. Interactions with Kampar Residence stakeholders will be required to identify the main elements and functionality of the Smart Bin application.

Design Phase

The requirements acquired will be used to develop the application's architecture, user interface, and user experience. Wireframes and mockups must be made in order to visualize how the app will appear and work.

Development Phase

At this stage, the actual coding and application development for the Smart Bin application happens. Developers that are proficient in the necessary frameworks and coding languages, such as Java for Android, will write the necessary code.

Prototyping Phase

This phase aims to validate the design ideas, gather user feedback, and identify any necessary adjustments before moving on to full-scale development.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

24

Testing Phase

Extensive testing will be done to ensure the application's operation, performance, and security. A number of testing methodologies, such as unit testing, integration testing, and user acceptability testing, will be utilized to identify and address any faults or problems.

Deployment Phase

The application will be launched onto appropriate platforms, such the Google Play Store, after extensive testing.

Maintenance Phase

The app will undergo ongoing maintenance and upgrades after it is published in order to address any issues that may develop, including new features, and make sure the app is still compatible with the various mobile operating systems and devices.

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25

CHAPTER 4

System Design

In this chapter, we'll explore the system overview flowchart and its various functions.

4.1 System Overview Flowchart
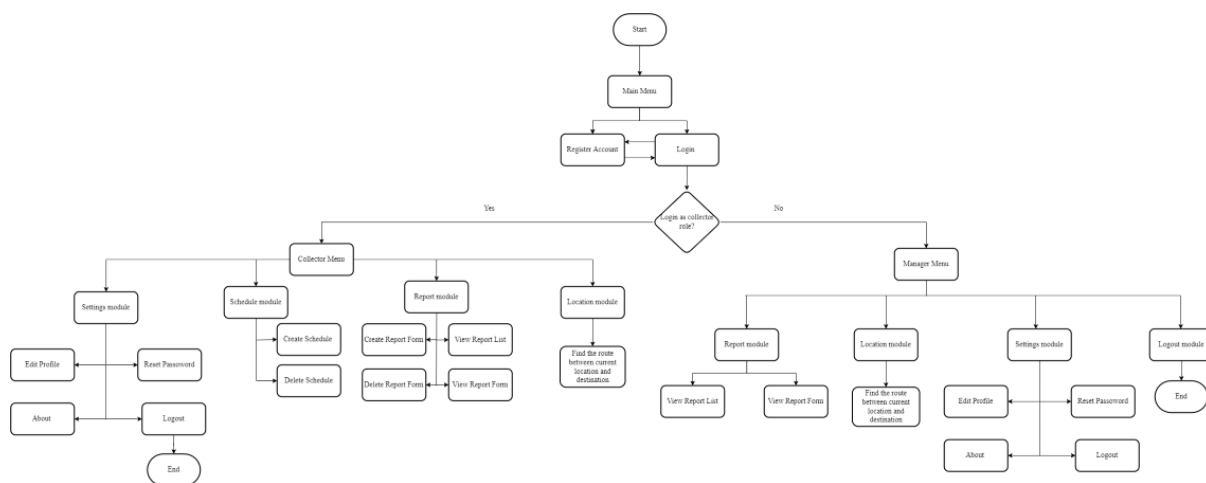
Figure 4.1: System Overview Flowchart

According to the Figure 4.1 system overview flowchart for the application used in this project. First and first, users must register and log in as their choice of role.

There are three modules for the collector and manager: Settings, Schedule, Report, and Location. The Schedule module, on the other hand, only applies to the collector. The settings module is the same for both collectors and managers; they can change their profile, reset their password, view about us, and log out if they want.

If the user logs in as a collector, they will be directed to the Collector Menu page. Collectors' report module allows them to manage reports, including creating and deleting them. In addition, the schedule module allows collector to create and delete schedules. Furthermore, for the location module, collector can determine the route between the present place and the destination.

If the user logs in as a manager, they will be directed to the Manager Manu page. Managers can access the report section and read the report submitted by the collector. Managers can also use the location module to find the route between their current location and their desired destination.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

26

4.2 Flowchart

4.2.1 Flowchart (Collector)

4.2.1.1 Flowchart of Register and Login
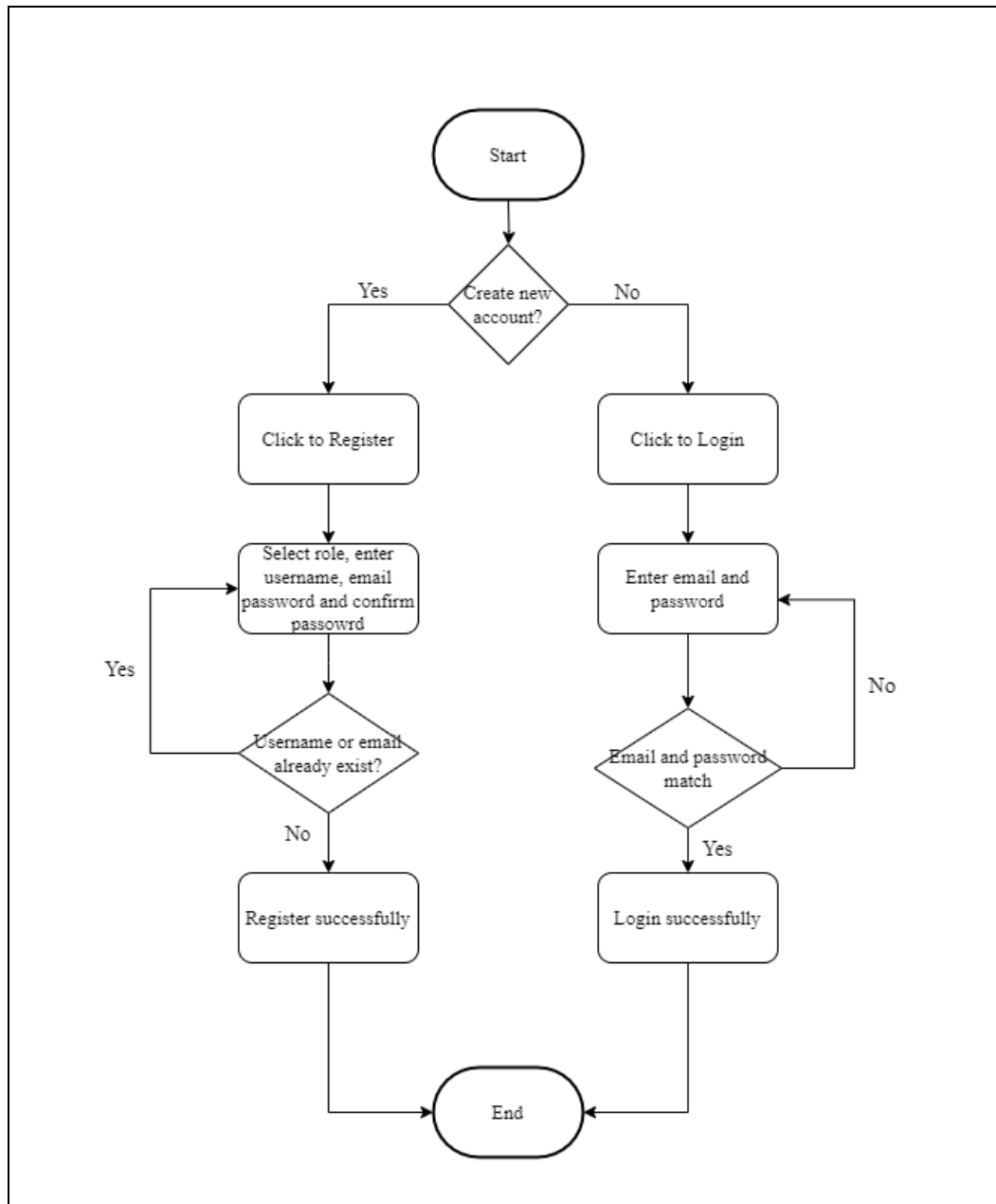
Figure 4.2.1.1 Flowchart of Register and Login

Based on the Figure 4.2.1.1 Flowchart of register and login process begins with new users being prompted to register by entering essential details like role, username, email, password, and confirming the password. The system checks if the username and email are already registered; if so, the user is prompted to register again. If not, the registration is successful. For

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27

existing users, clicking on the login option allows them to enter their email and password. The system verifies these credentials against the database; if they match, the login is successful; otherwise, the user needs to re-enter their email and password.

4.2.1.2 Flowchart of Forgot Password
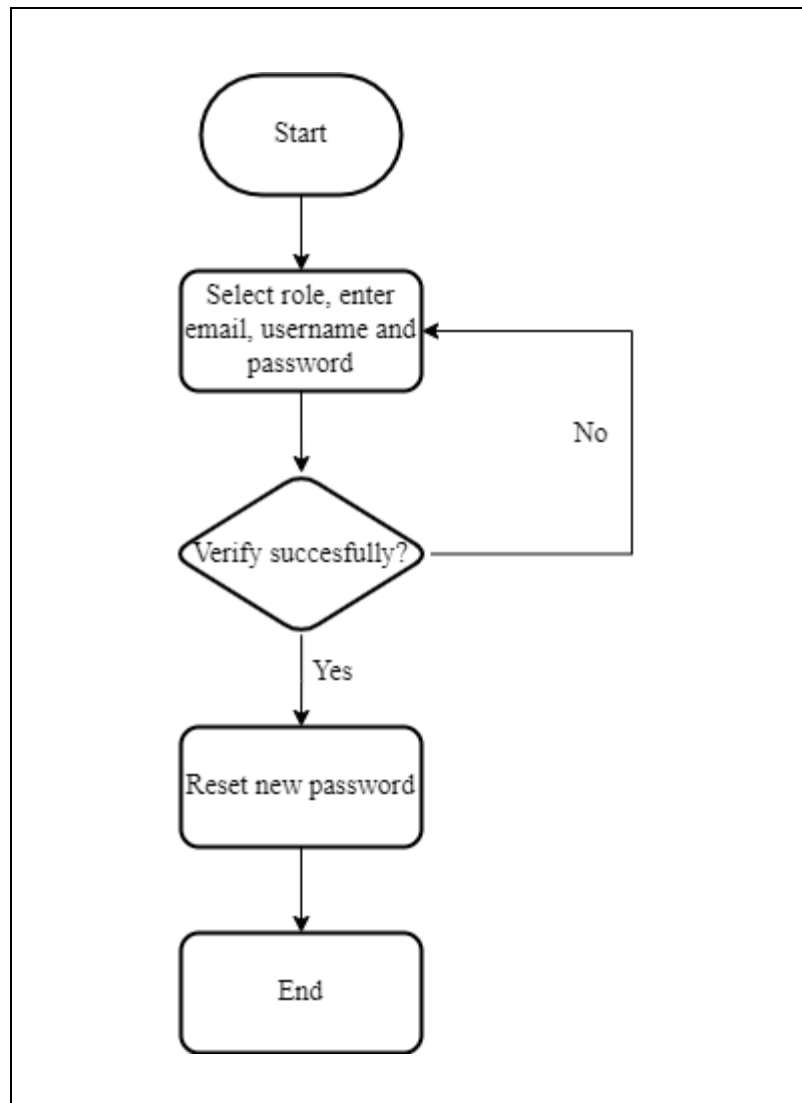
Figure 4.2.1.2 Flowchart of Forgot Password

In Figure 4.2.1.2 flowchart of forgot password process shows that users first select their role and then enter their email, username, and password. The system verifies these details; if verification is successful, the user can proceed to reset their password. If the verification fails, the user must re-enter their details to try again.

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28

4.2.1.3 Flowchart of Select Day
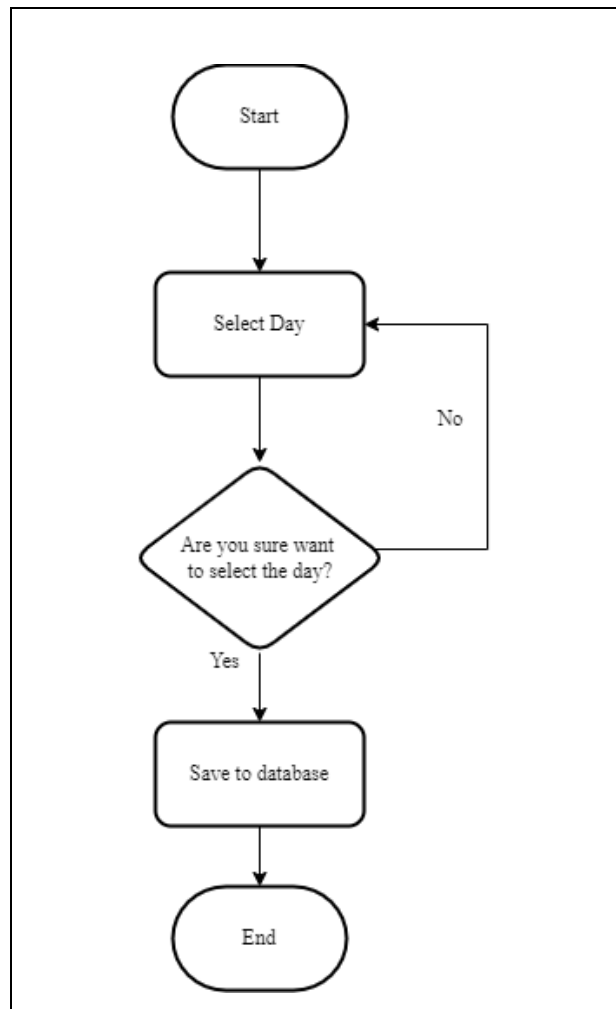
Figure 4.2.1.3 Flowchart of Select Day

Based on Figure 4.2.1.3 flowchart of select day allows users to choose their desired day. A confirmation dialog then prompts the user to confirm their selection. If the user clicks "yes," the selected day is stored in the database. Otherwise, the user must make a new selection.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

29

4.2.1.4 Flowchart of Select Area
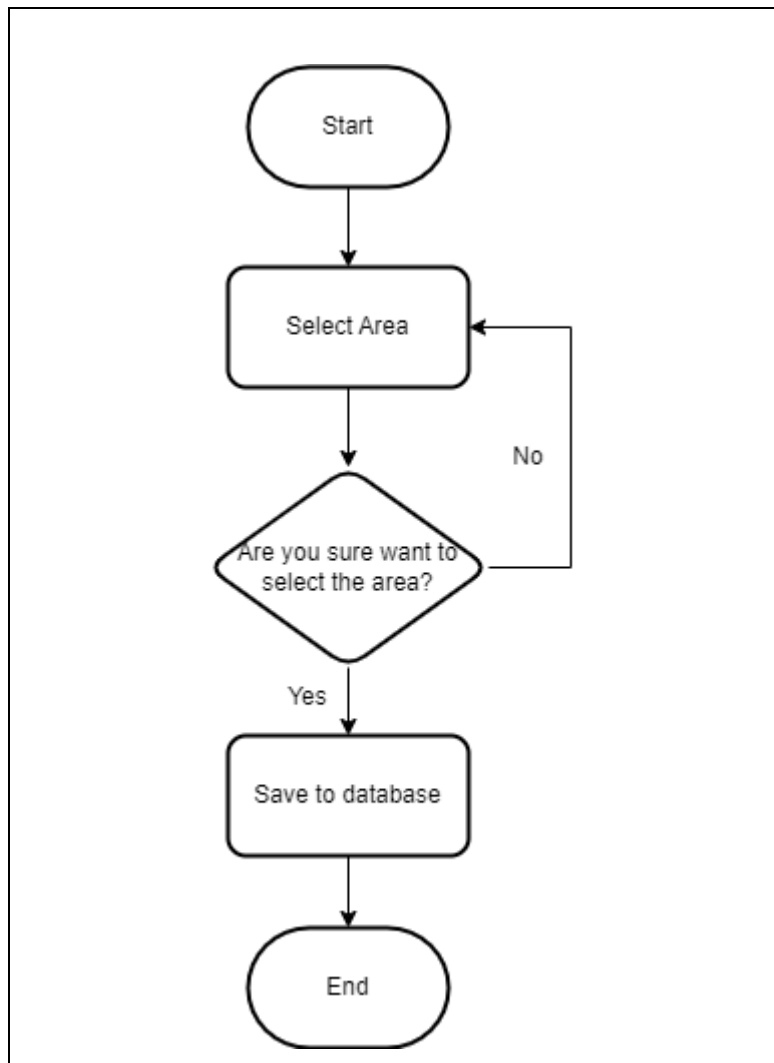
Figure 4.2.1.4 Flowchart of Select Area

In Figure 4.2.1.4, the flowchart for selecting an area lets users choose their preferred location. After selection, a confirmation dialog appears asking the user to confirm their choice. If the user clicks "yes," the chosen area is stored in the database. If not, the user needs to make a new selection.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

30

4.2.1.5 Flowchart of Select Time
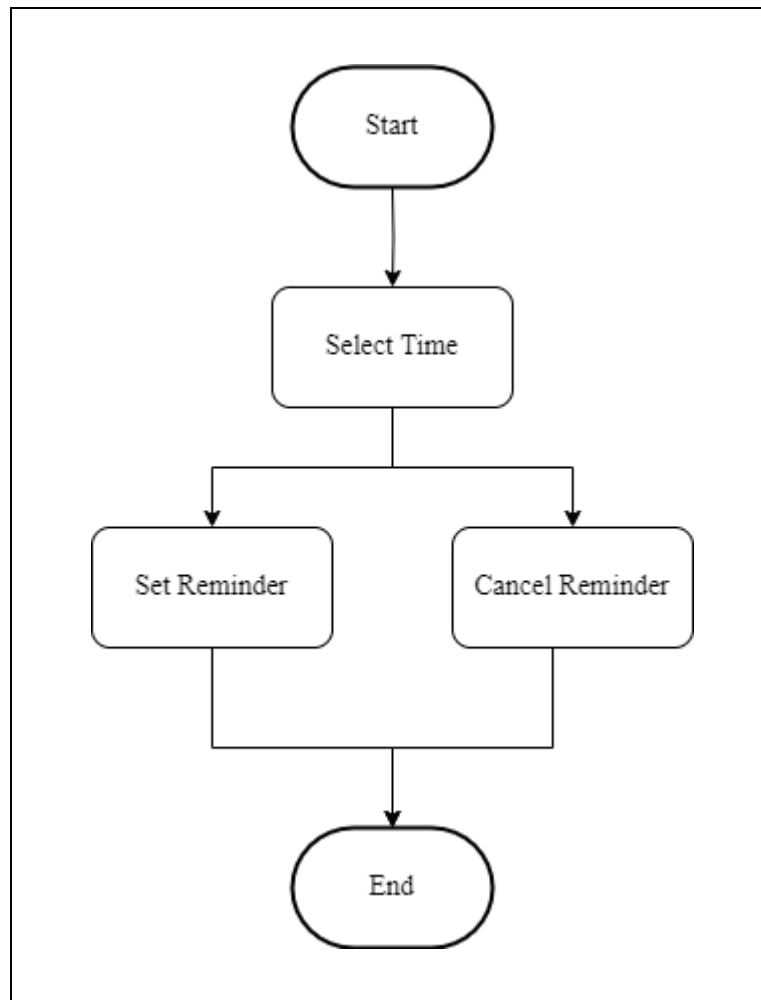
Figure 4.2.1.5 Flowchart of Select Time

In Figure 4.2.1.5, the flowchart for selecting time lets users pick their desired time. After selecting a time, users can click on "set reminder." When the set time arrives, a notification notifies the user. If the user wishes to cancel the reminder, they can simply click on the "cancel reminder" button.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

31

4.2.1.6 Flowchart of Select Status
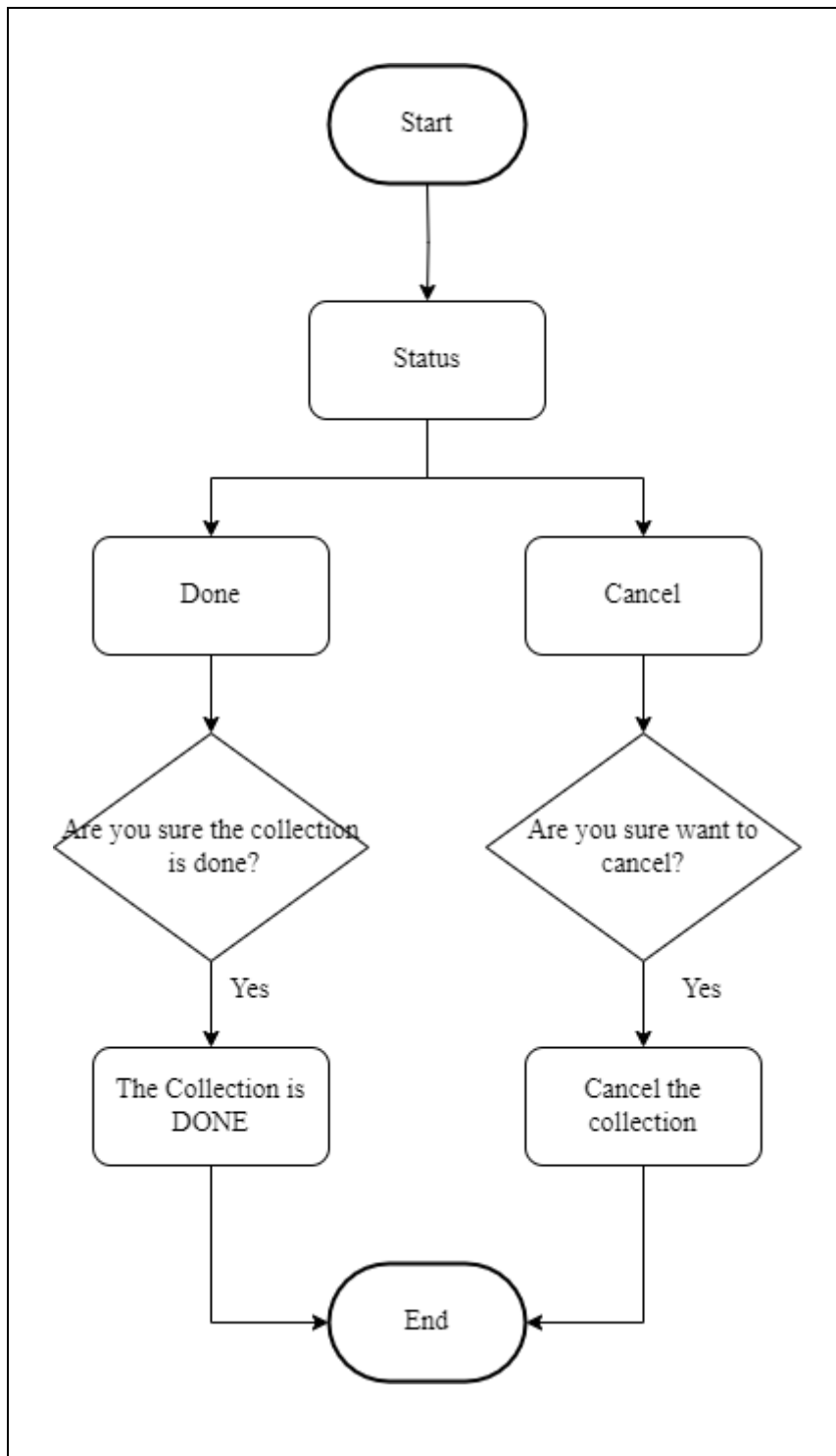
Figure 4.2.1.6 Flowchart of Select Status

In Figure 4.2.1.6, the flowchart for updating task status allows users to mark a task as "done."
After selecting the "done" option, a confirmation prompt appears. If the user selects "yes," the
task is marked as completed. However, if the user clicks "cancel," the task will be removed.

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32

4.2.1.7 Flowchart of Location
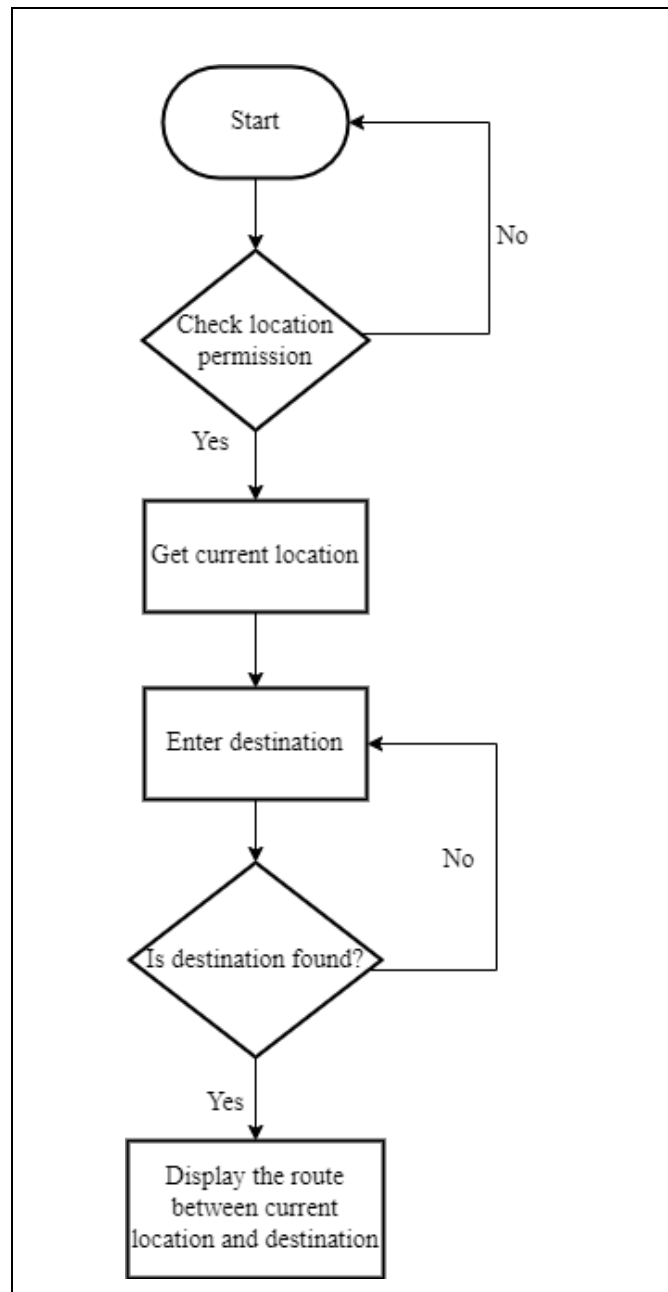
Figure 4.2.1.7 Flowchart of Location

Figure 4.2.1.7 illustrates the flowchart depicting location access in the system. Initially, the system request's location permission from the user. If the user denies permission, the flow returns to the start. However, if the user grants permission, the system retrieves the current location. The user is then prompted to enter a destination. The system checks if the destination is valid. If it is, the route between the current location and the destination is displayed. Otherwise, the user is prompted to re-enter the destination.

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

33

4.2.1.8 Flowchart of Create Report
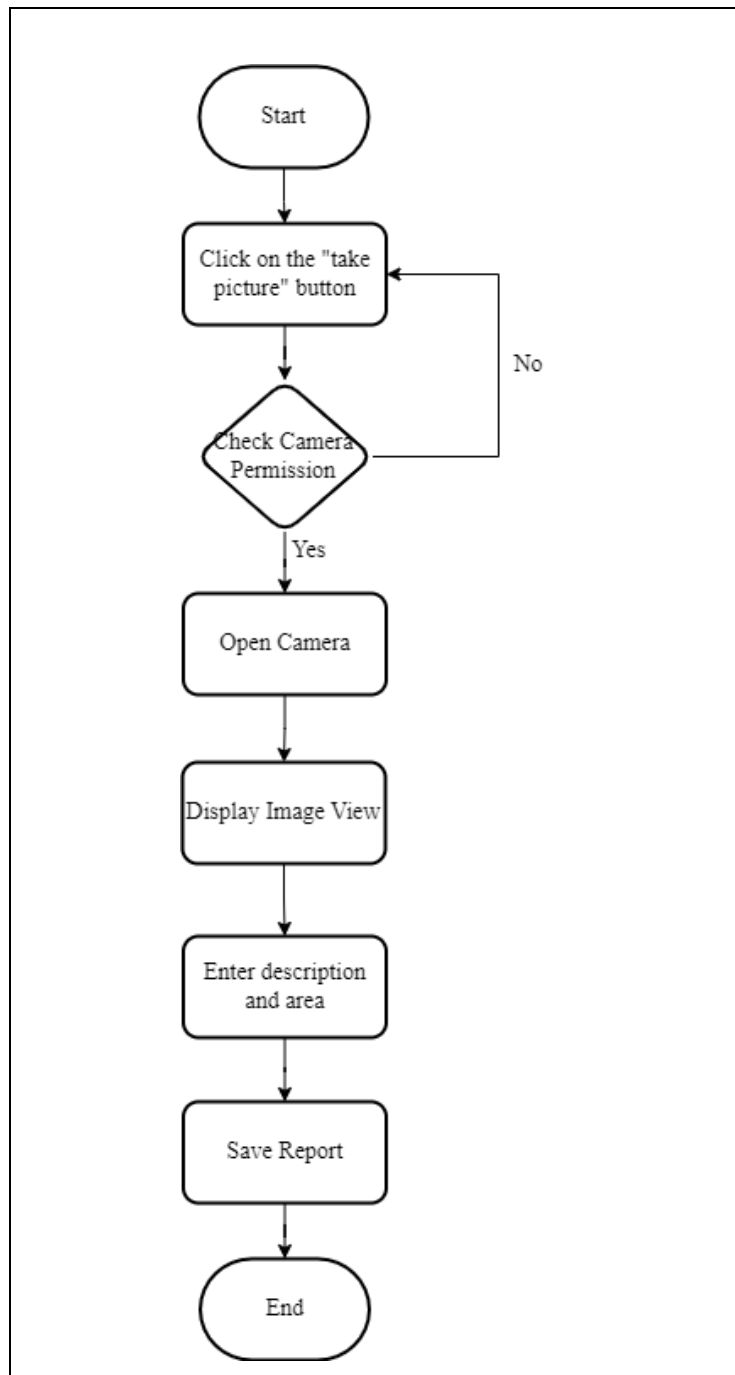
Figure 4.2.1.8 Flowchart of Create Report

Figure 4.2.1.8 presents the flowchart for the Create Report process. Initially, the user clicks the "take picture" button, prompting the system to request camera permission. If the user declines, they are returned to the form page. If the user grants permission, the camera opens. After capturing a photo, it is displayed in the layout. Subsequently, the user enters a description and area before submitting the report.

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34

4.2.1.9 Flowchart of View Report

Figure 4.2.1.9 Flowchart of View Report

Figure 4.2.1.9 illustrates the flowchart for the View Report process. Initially, the system retrieves reports from the database and then displays the report which is submitted by the collector.

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35

4.2.1.10 Flowchart of Delete Report
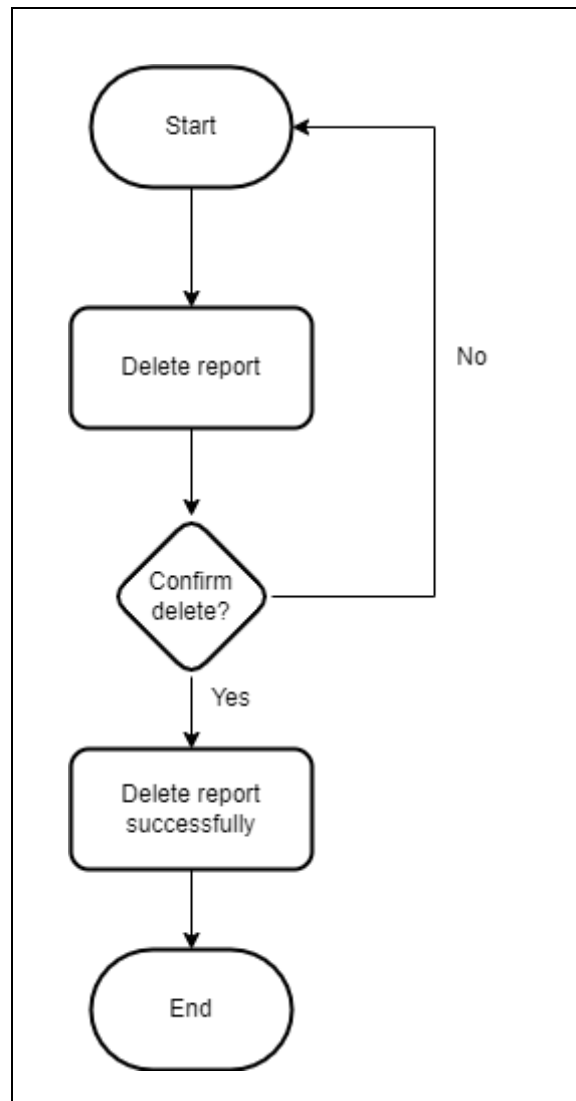
Figure 4.2.1.10 Flowchart of Delete Report

Figure 4.2.1.10 depicts the flowchart for the Delete Report process. Initially, if the user chooses to delete a specific report, a confirmation prompt is displayed. If the user selects "no," the form remains unchanged. However, if the user chooses "yes," the report is successfully deleted.

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36

4.2.2 Flowchart (Manager)

4.2.2.1 Flowchart of Register and Login
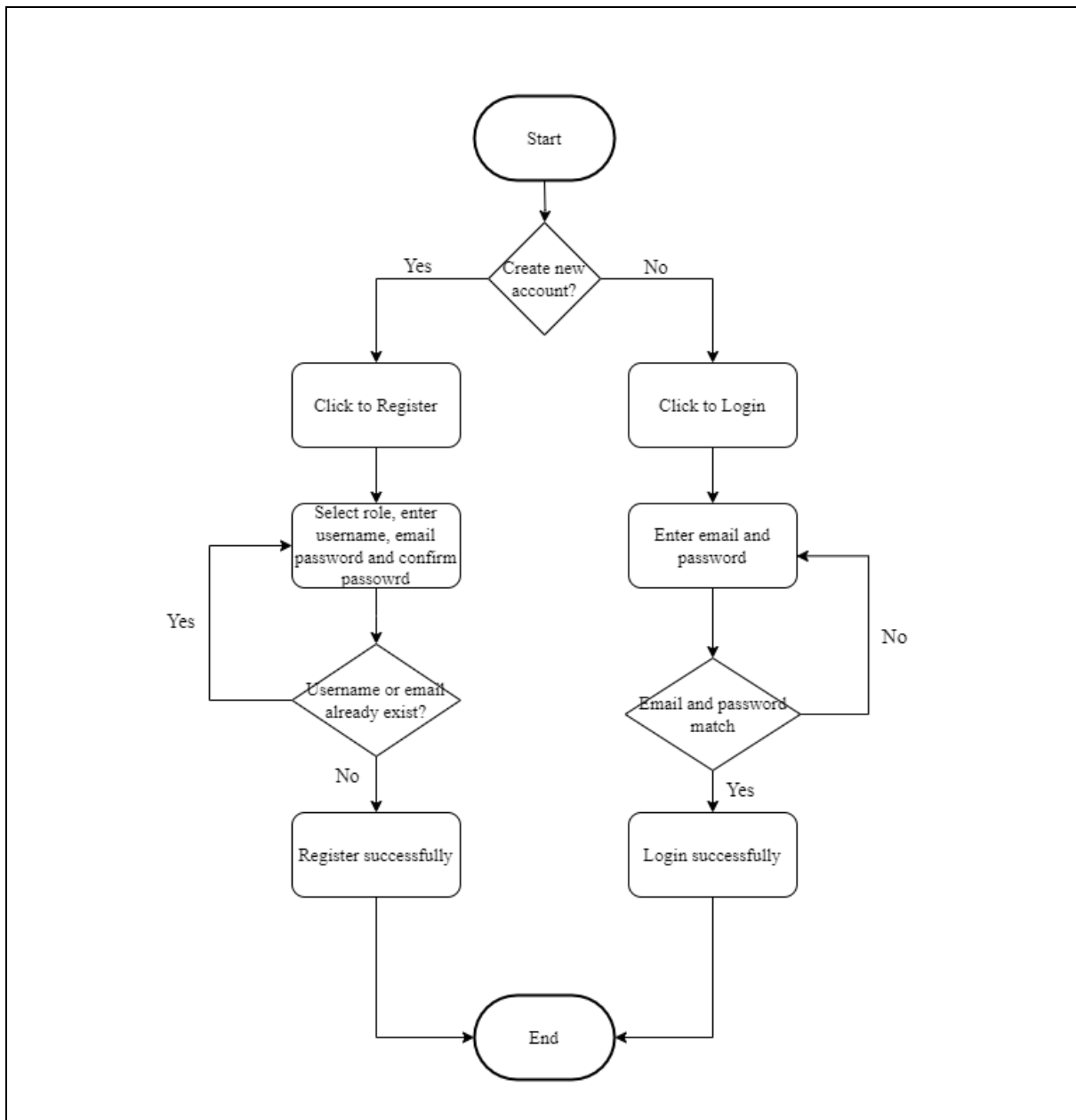
Figure 4.2.2.1 Flowchart of Register and Login

In Figure 4.2.2.1, the registration and login process begin with new users providing necessary details such as role, username, email, and password, along with password confirmation. The system checks for existing registrations based on the username and email. If either is already registered, the user is prompted to try again; otherwise, registration proceeds successfully. For returning users, selecting the login option prompts them to enter their email and password. The

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

37

system then verifies these details with the database. If they match, the login is approved; otherwise, users must retry entering their credentials.

4.2.2.2 Flowchart of Forgot Password
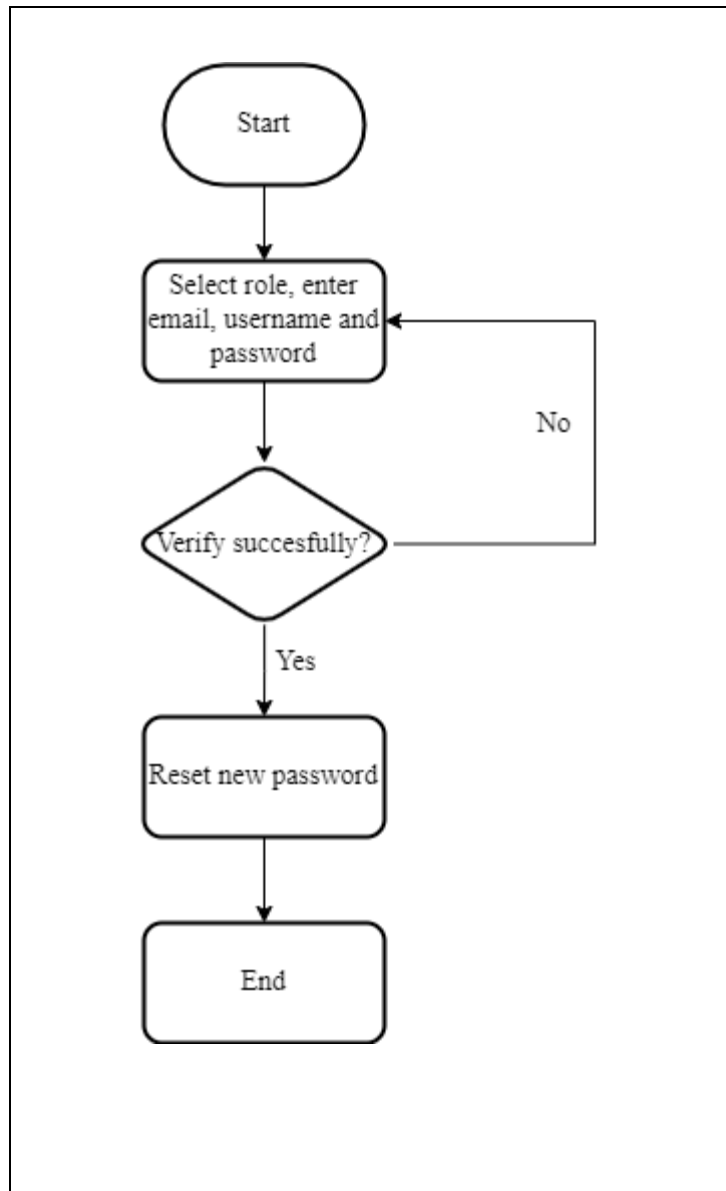
Figure 4.2.2.2 Flowchart of Forgot Password

Figure 4.2.2.2 shows the flowchart of the forgot password procedure, with users first selecting their role and then entering their email, username, and password. The system checks these details; if the verification is successful, the user can reset their password. If the verification fails, the user must reenter their information and try again.

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38

4.2.2.3 Flowchart of Location
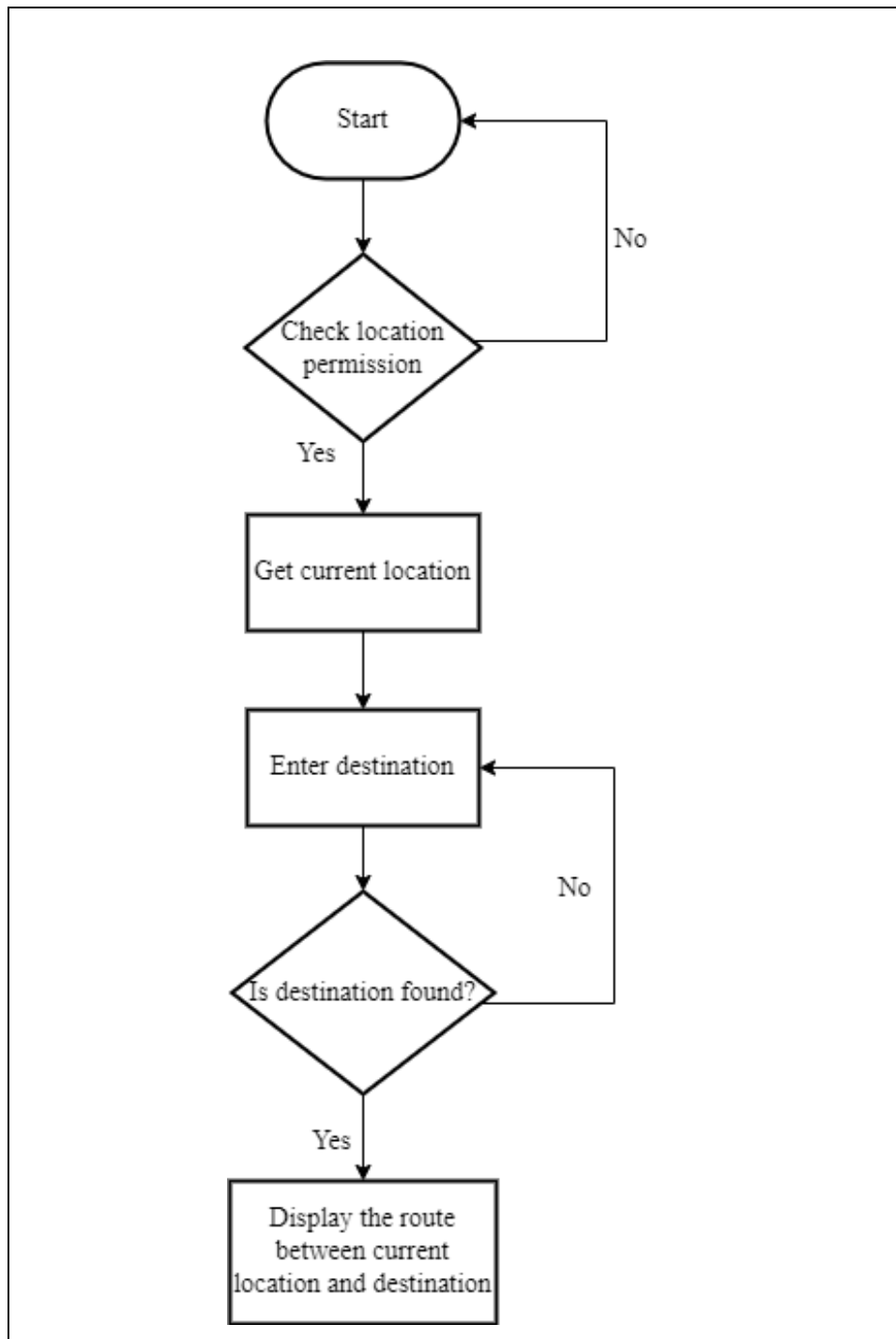
Figure 4.2.2.3 Flowchart of Location

Figure 4.2.2.3 demonstrates the flowchart for location access in the system. Initially, the system request's location permission from the user. If the user refuses permission, the flow restarts to the beginning. However, if the user authorizes permission, the system will retrieve the current location. The user is next invited to specify a destination. The system determines whether the

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

39

destination is valid. If it is, the route from the present position to the destination is displayed. Otherwise, the user is prompted to reenter the destination.
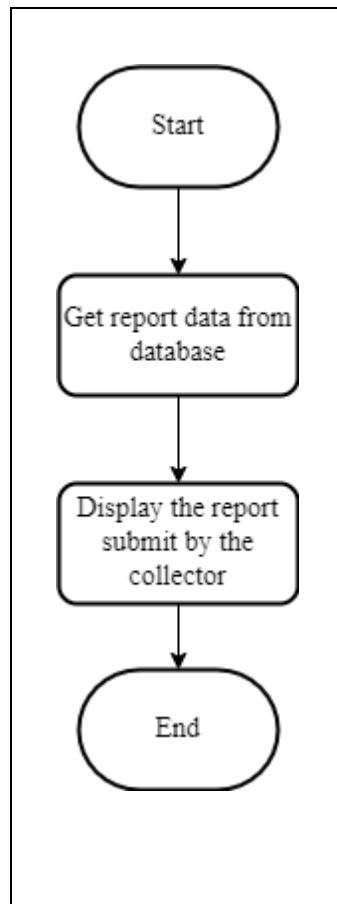
4.2.2.4 Flowchart of View Report
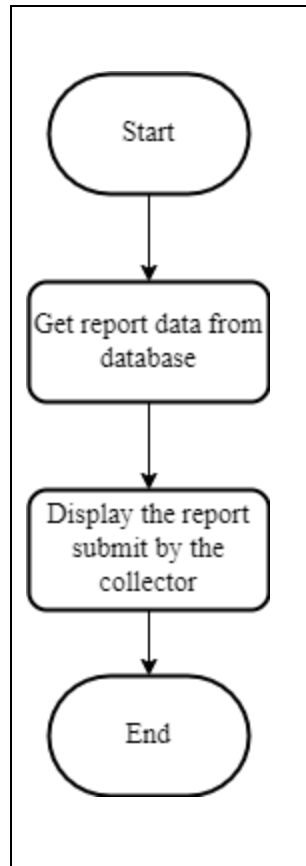
Figure 4.2.2.4 Flowchart of View Report

Figure 4.2.2.4 depicts a flowchart for the View Report process. Initially, the system retrieves reports from the database and shows the reports submitted by the collector.

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40

CHAPTER 5

System Implementation

5.1 Technologies and Tools Involved

In this chapter, we'll delve into the technologies and tools used, the software setup, and the system's operation.

5.1.1 Hardware

In this project, android mobile device and computer are required hardware. A computer is used in the process of coding. An android mobile device is used for testing and deploying this "Pro Waste" application.

Description	Specification
Model	Huawei Matebook D14
Processor	IntelI Core I i5-10210U CPU @ 1.60GHz 2.11 GHz
Operating System	Windows 10
Graphic	NVIDIA GeForce GT 930MX 2GB DDR3
Memory	8GB RAM
Storage	512GB

Table 5.1.1 Specifications of laptop

5.1.2 Software

Before starting to develop the Smart Bin application, there is one piece of software that needs to be installed and used on my laptop:

Figure 5.1.2.1 Android Studio logo

1. **Android Studio**

    Figure 5.1.2.1 Android Studio is an integrated development environment (IDE) created exclusively for developing Android applications is called Android Studio. It gives

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41

developers a wide range of features and tools to effectively plan, create, test, and debug Android applications. The official IDE for developing Android apps is called Android Studio, and both novice and seasoned developers frequently utilize it. Besides that, Android Studio's user interface allows for more interaction, which improves the user experience [11].

Figure 5.1.2.2 Firebase logo

2. **Google Firebase**

Figure 5.1.2.2 highlights the use of Firebase for data retrieval and storage. Developers can easily build, manage, and expand apps with the help of Firebase, a Google product. It aids in the faster and more secure development of apps by developers. It is simple to integrate Firebase's functionalities effectively because no programming is required on that side of the application. Along with services for IOS, Android, Unity, and the web, it provides cloud storage [12].

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42

5.2 Software Setup

5.2.1 Android Studio

1. Install Android Studio
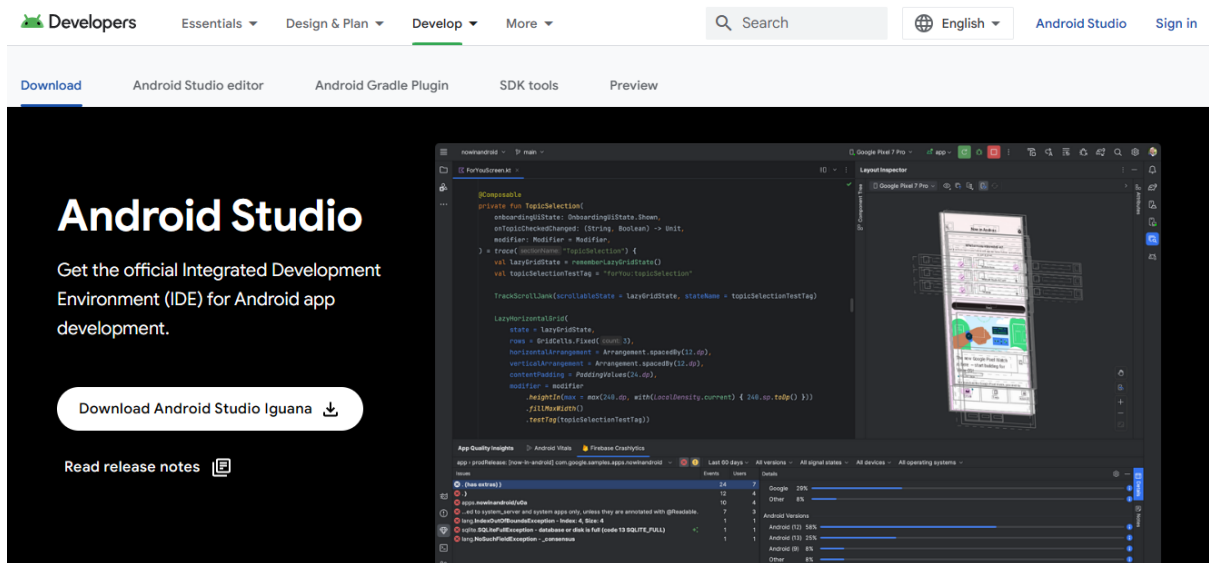
Figure 5.2.1.1 Figure of Install Android Studio

- In Figure 5.2.1.1 show that the layout of the Android studio. You can get the latest Android Studio from the following links: https://developer.android.com/studio.

2. Once you downloaded, you will see the following icon:
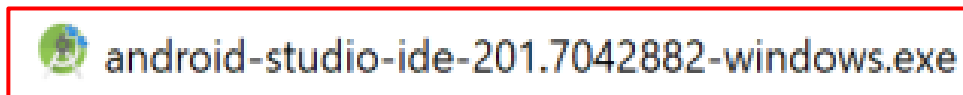
Figure 5.2.1.2 Figure of android studio icon

- In Figure 5.2.1.2 Double click on the icon and install.

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43

3. Click on the "Configure" and select the SDK Manager:
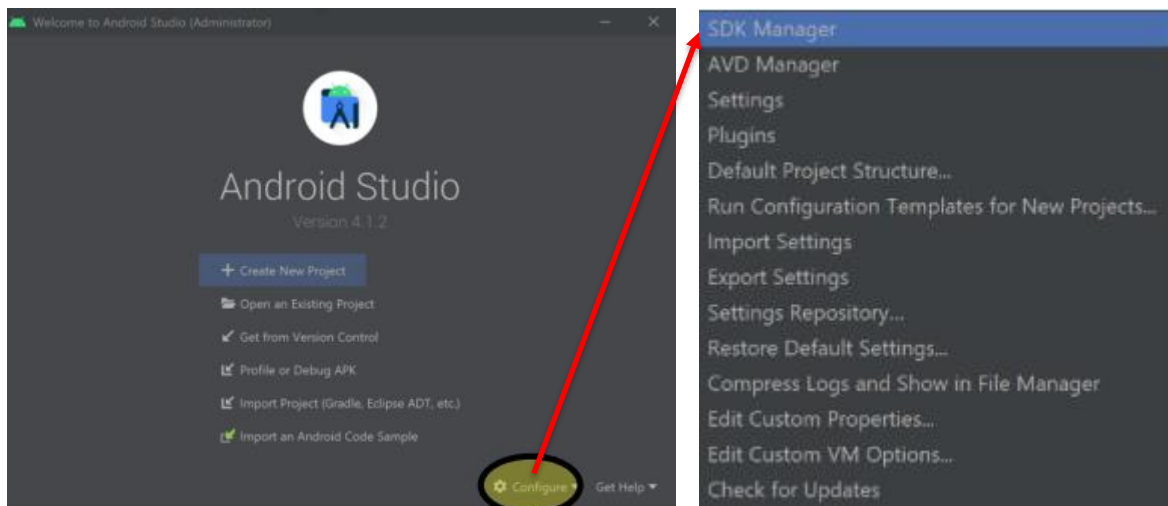
Figure 5.2.1.3 Figure of select SDK Manager

- Figure 5.2.1.3 depicts the process of selecting the SDK Manager, where users can click to download all the required SDK Platforms.

4. Downloading the Components
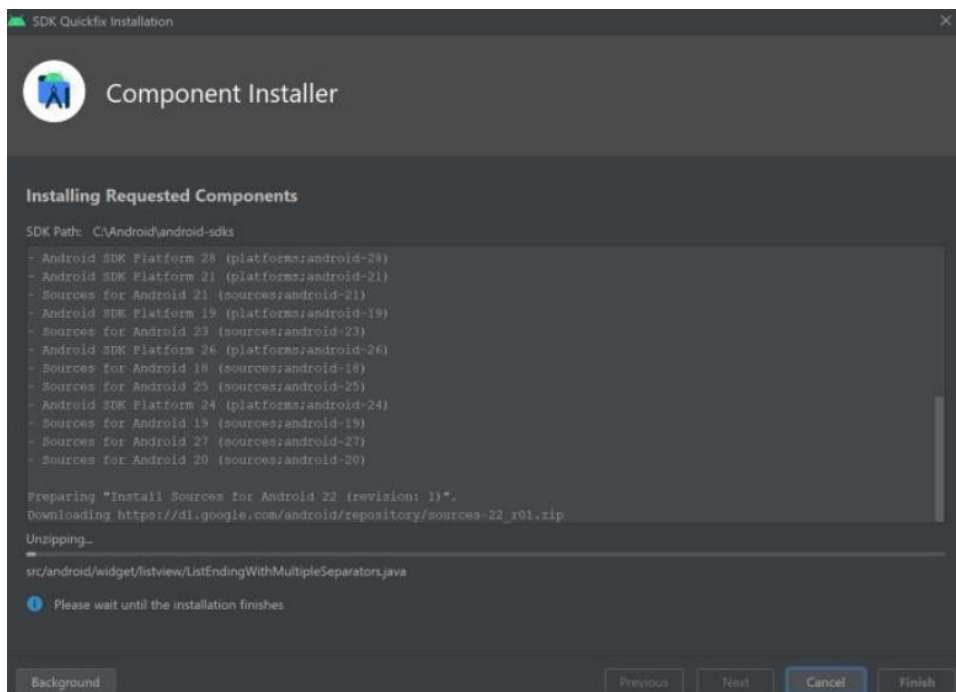
Figure 5.2.1.4 Figure of download the components

- According to Figure 5.2.1.4, after successfully downloading the component, users should click "finish."

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44

5. **Create New Project**
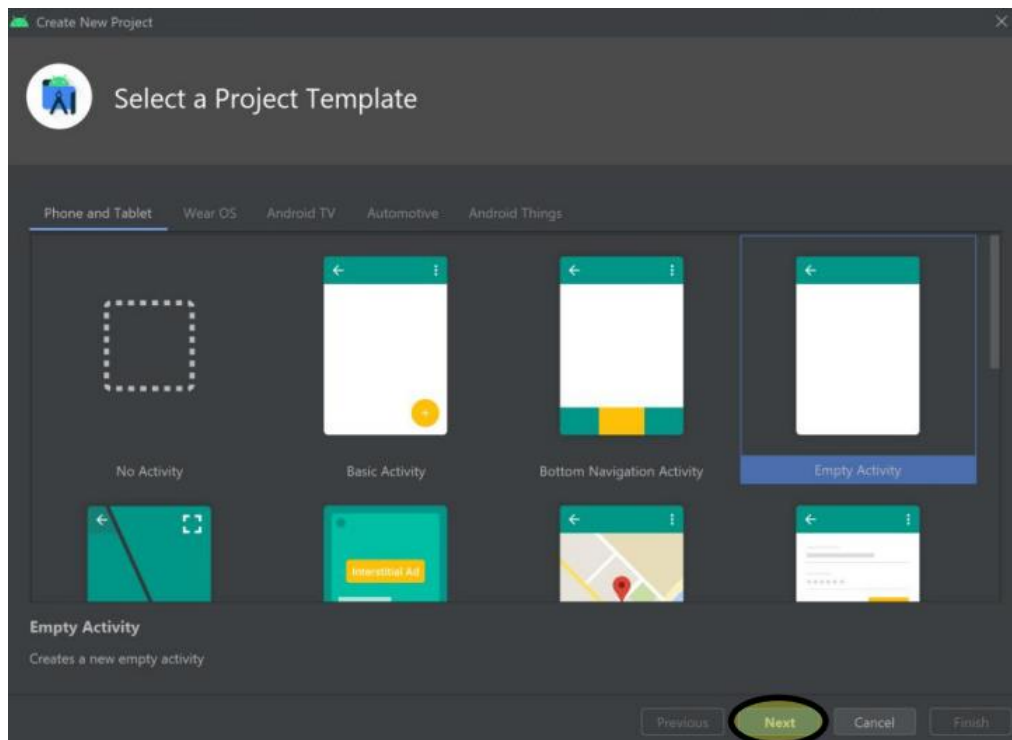
Figure 5.2.1.5 Figure of create new project

- In Figure 5.2.1.5, to create a new project, navigate to File → New → New Project → Empty Activity.

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45

6. Go to Tools → ADV Manager, then follow the steps below:
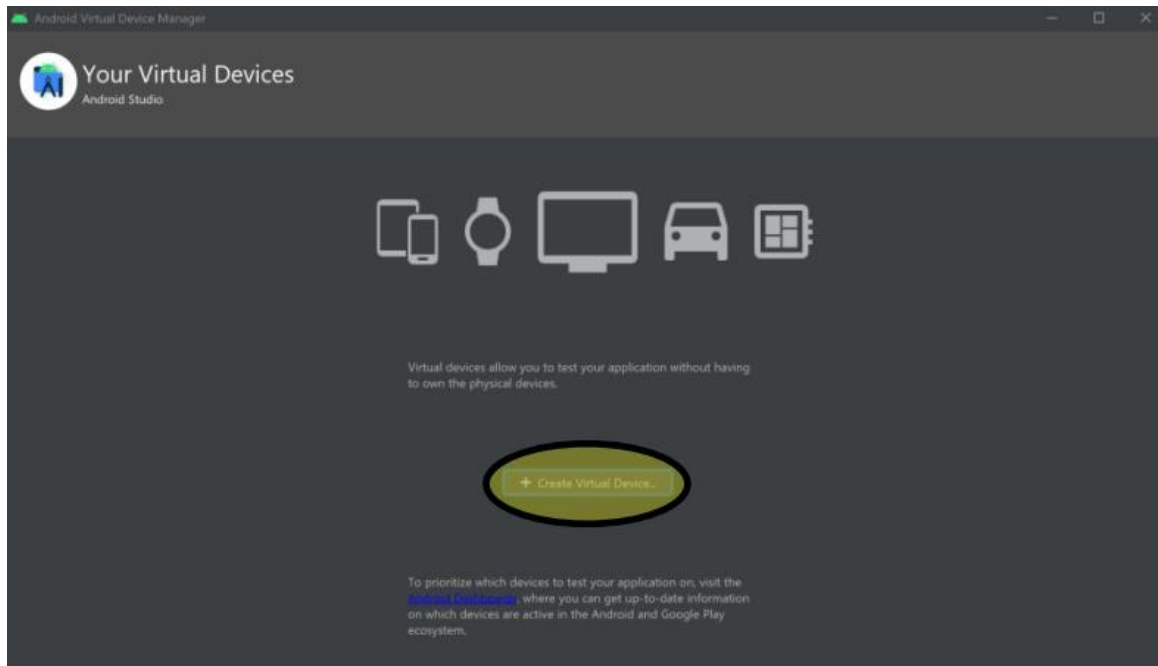
Figure 5.2.1.6 Figure of create virtual device

- Figure 5.2.1.6 demonstrates creating a virtual device by clicking on the yellow circle.
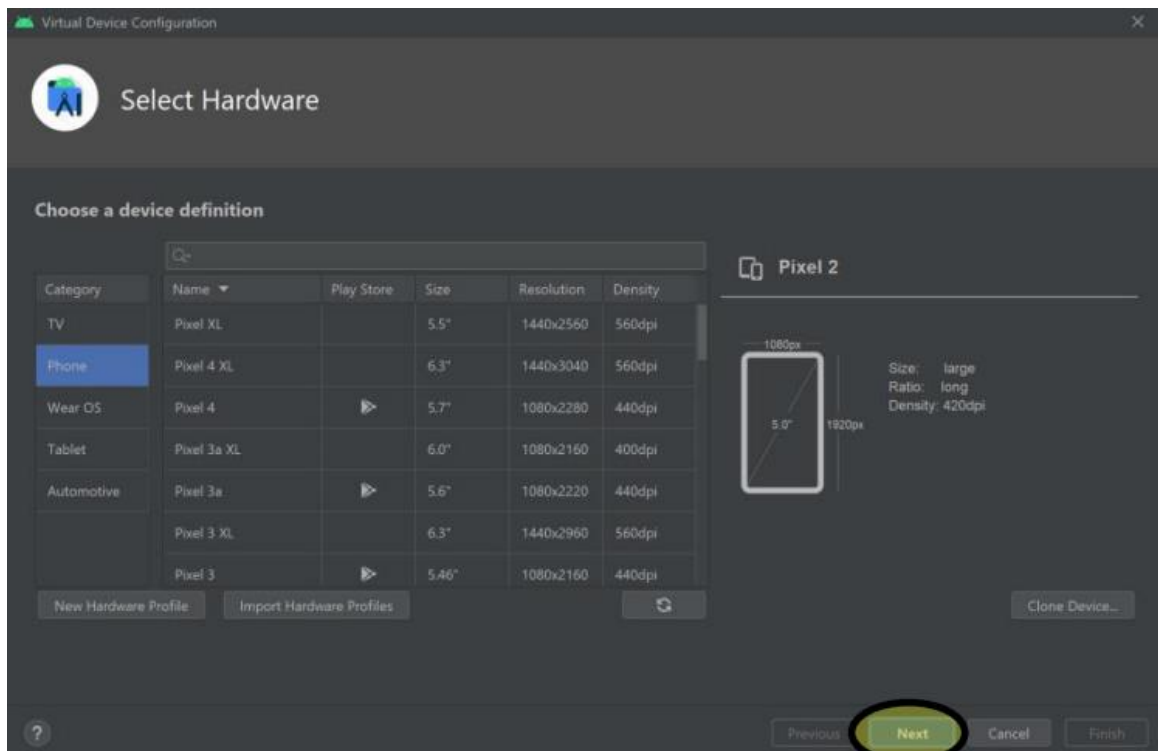
Figure 5.2.1.7 Figure of select hardware

- Figure 5.2.1.7 illustrates selecting a virtual hardware device, which can be named "myMobileVirtualDevice."

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

46
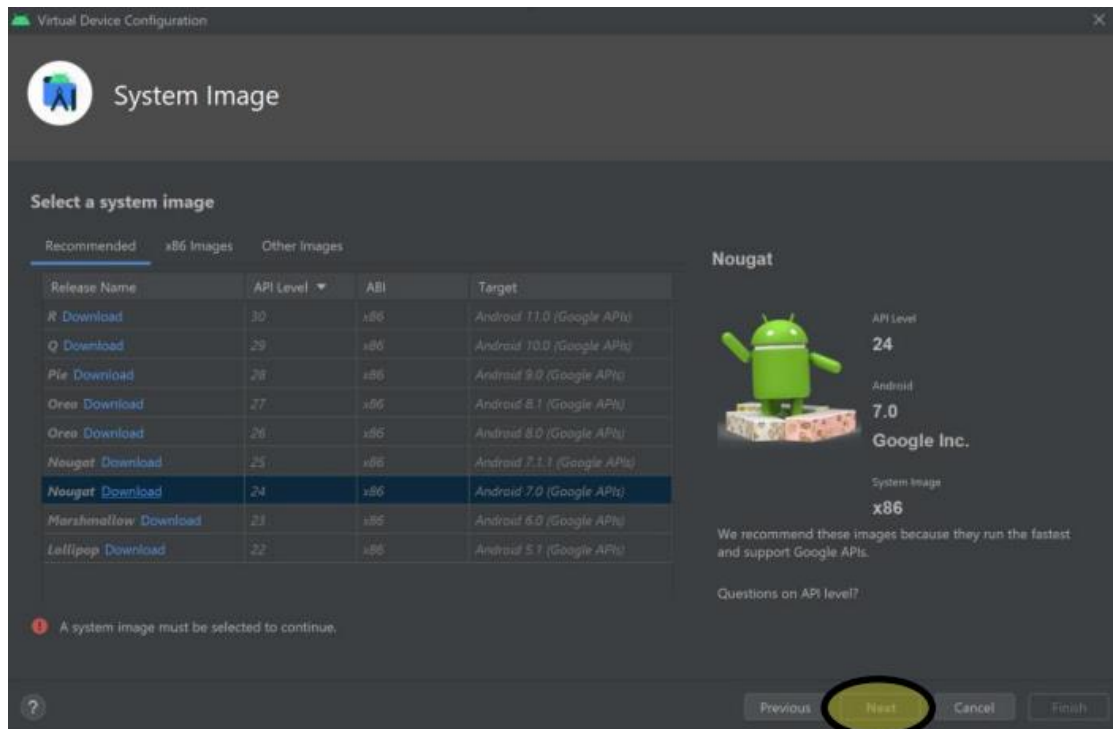
Figure 5.2.1.8 Figure of select image

- Figure 5.2.1.8 depicts selecting an image; download Nougat (API Level 24) as the system image and click "Next" once the download is complete.
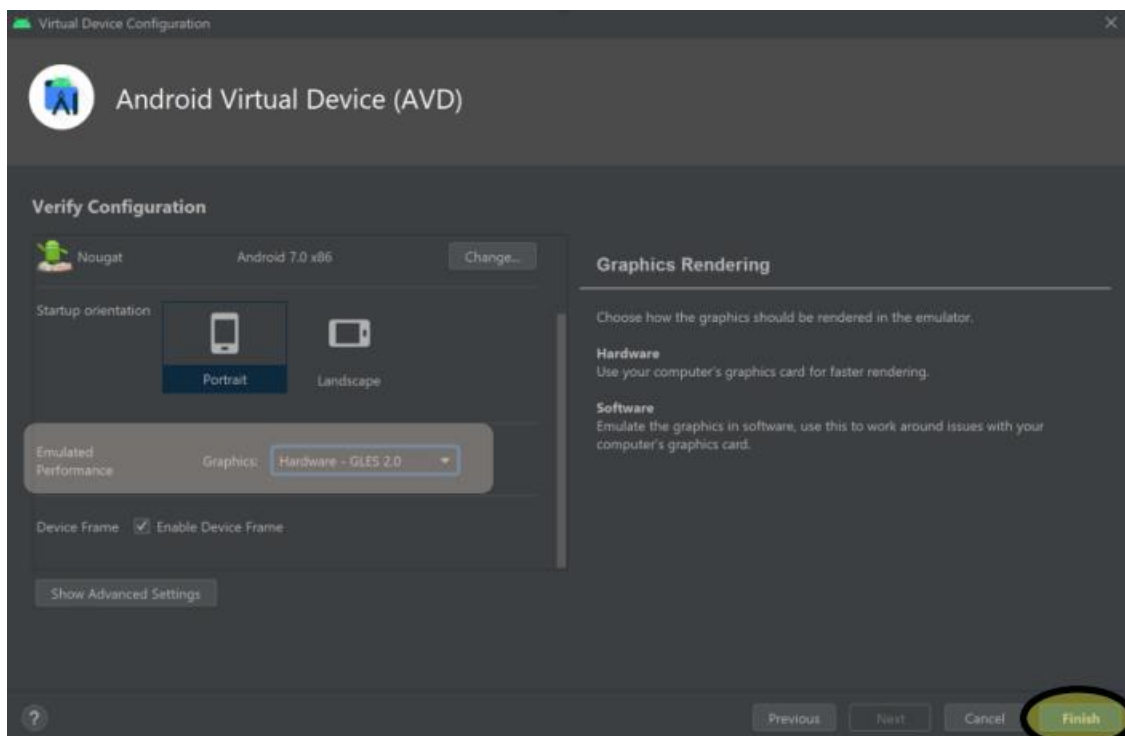
Figure 5.2.1.9 Figure of configure android virtual device

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

47

- Figure 5.2.1.9 demonstrates configuring the Android virtual device. Under Emulated Performance, select Hardware - GLES2.0.
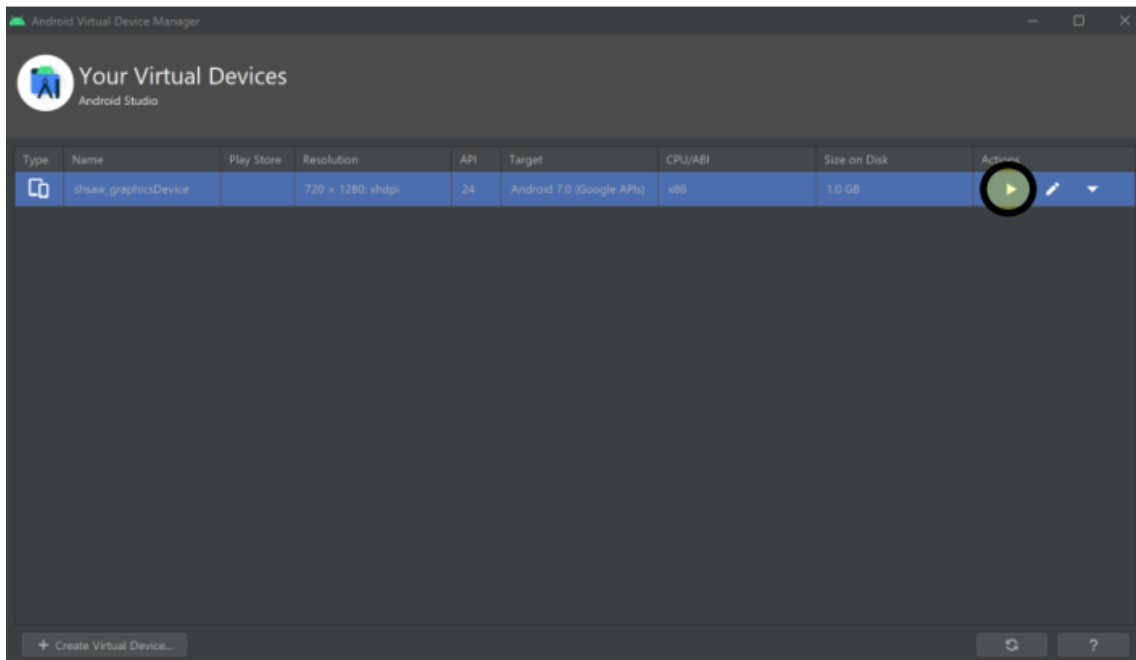
Figure 5.2.1.10 Figure of start your virtual device

- Figure 5.2.1.10 illustrates starting the virtual device by clicking on the yellow circle.

7. Now you can start to coding.
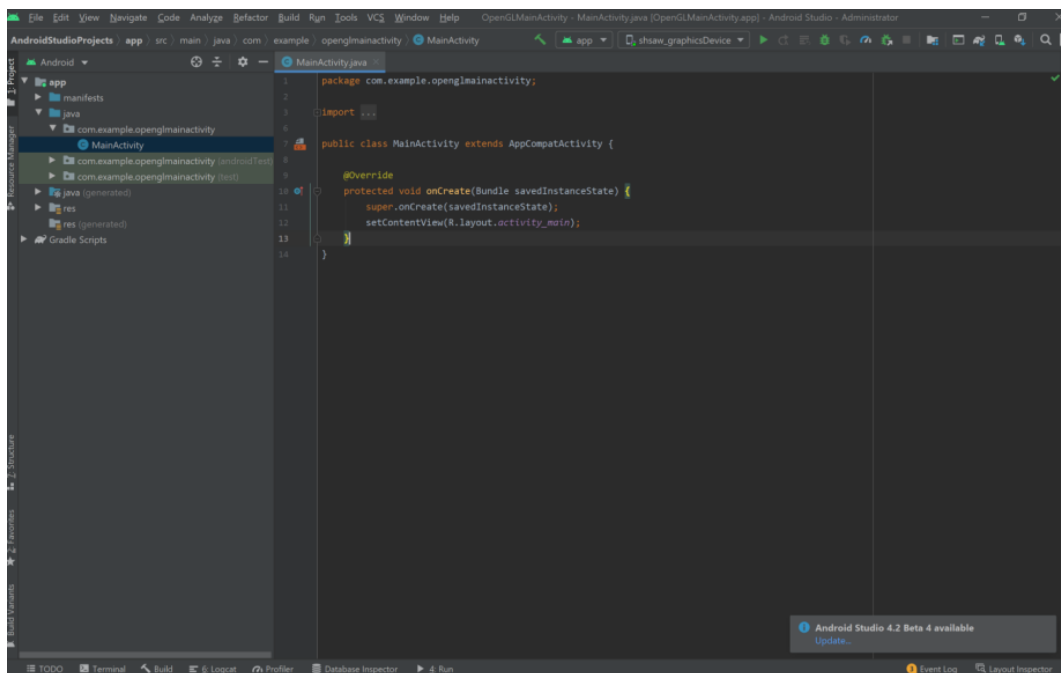
Figure 5.2.1.11 Figure of main activity page

- Figure 5.2.1.11 shows the main activity page where users can write code.

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48

8. Add dependencies

- All Firebase service need this dependency in the project.

```
implementation(platform("com.google.firebase:firebase-bom:32.8.0"))
```

Figure 5.2.1.12 Figure of Firebase BoM manages dependency

- Figure 5.2.1.12 depicts the Firebase BoM (Bill of Materials), which manages dependencies for simplified library management in projects.

```
implementation 'com.google.firebase:firebase-auth'
```

Figure 5.2.1.13 Figure of Firebase Authentication Database dependency

- Figure 5.2.1.13 shows the Firebase Authentication Database dependency, which provides secure and easy-to-use authentication services for apps.

```
implementation 'com.google.firebase:firebase-firestore'
```

Figure 5.2.1.14 Figure of Firebase Storage dependency

- Figure 5.2.1.14 illustrates the Firebase Storage dependency, facilitating secure and scalable cloud storage solutions for app data.

```
implementation 'com.google.firebase:firebase-database'
```

Figure 5.2.1.15 Figure of Firebase Realtime Database dependency

- Figure 5.2.1.15 showcases the Firebase Realtime Database dependency, enabling real-time data synchronization across devices and platforms.

```
implementation 'com.google.firebase:firebase-storage'
```

Figure 5.2.1.16 Figure of Firebase Cloud Storage dependency

- Figure 5.2.1.16 displays the Firebase Cloud Storage dependency, offering secure and scalable cloud-based storage for user-generated content.

- The location service needs this dependency in the project.

```
implementation 'com.google.android.gms:play-services-location:21.2.0'
```

Figure 5.2.1.17 Figure of Location-based dependency

- Figure 5.2.1.17 represents the Location-based dependency, which integrates location services for geospatial functionalities in the app.

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49
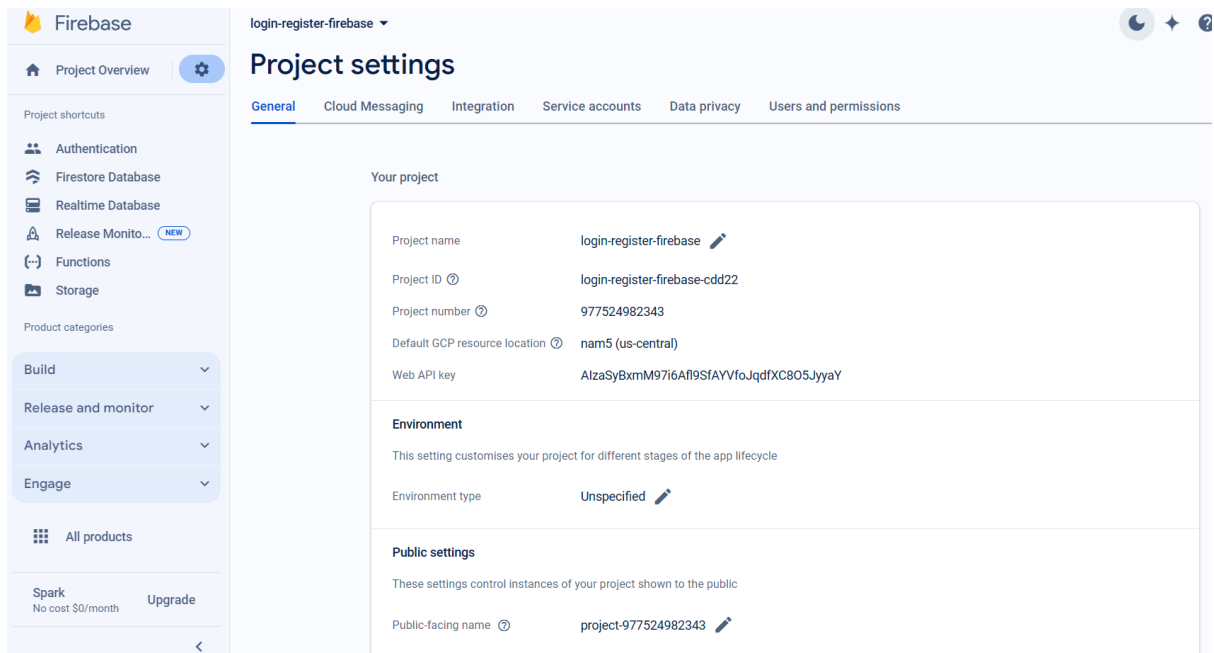
5.2.2 Firebase

Figure 5.2.2.1 Figure of Firebase project setup

- Figure 5.2.2.1 illustrates the Firebase project setup, guiding users through the initial configuration of Firebase services for app integration.
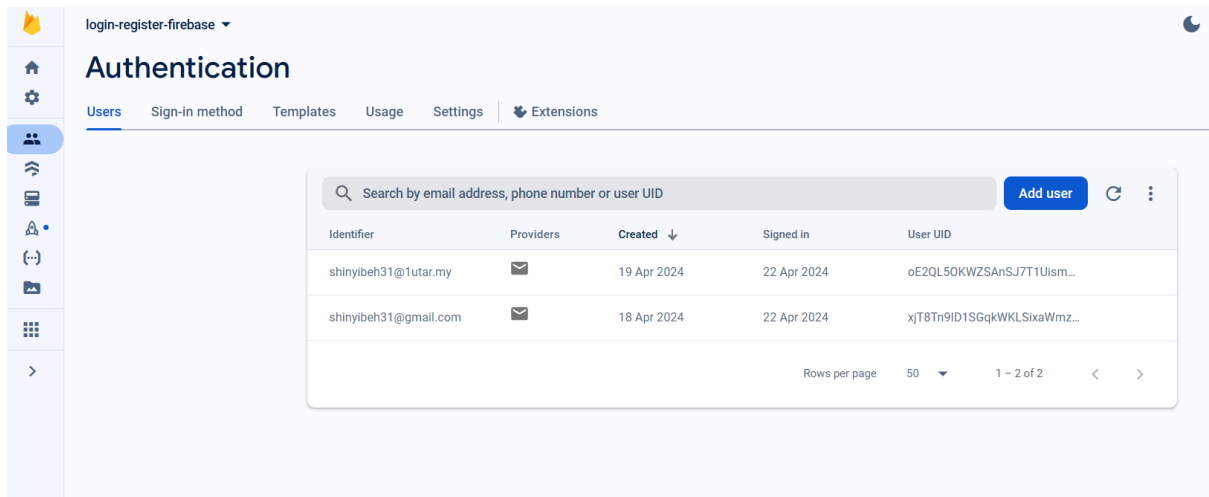
Figure 5.2.2.2 Figure of Authentication

- Figure 5.2.2.2 depicts the Authentication process, highlighting Firebase's secure handling of user information. Firebase Authentication manages user IDs and ensures secure authentication for enhanced app security.

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50
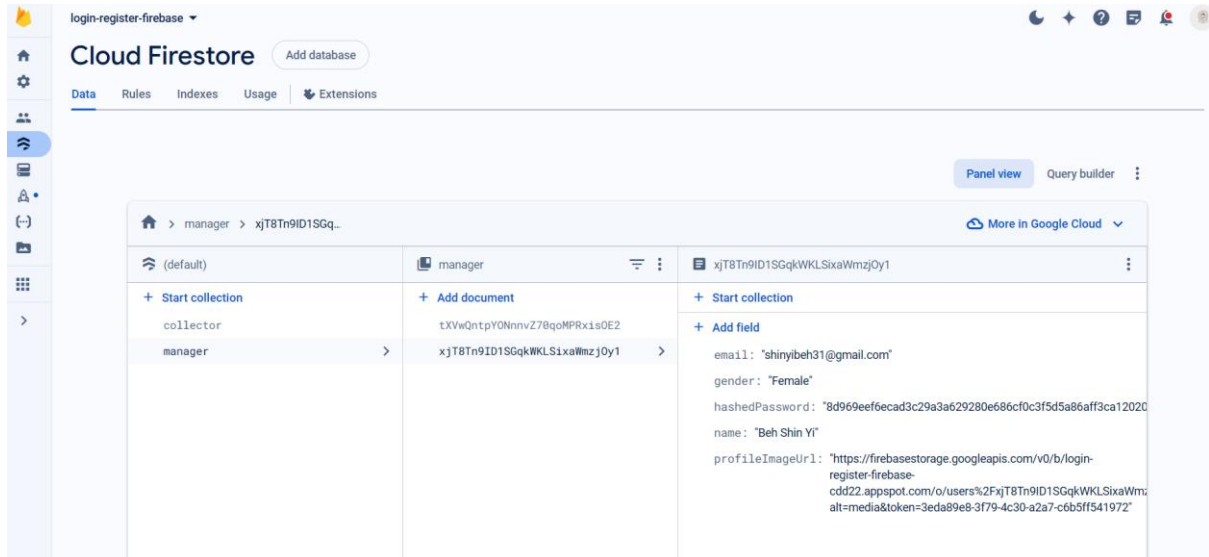
Figure 5.2.2.3 Figure of Cloud Firestore

- Figure 5.2.2.3 showcases Cloud Firestore as the database solution, storing user data categorized into two roles: Collector and Manager for efficient data management.
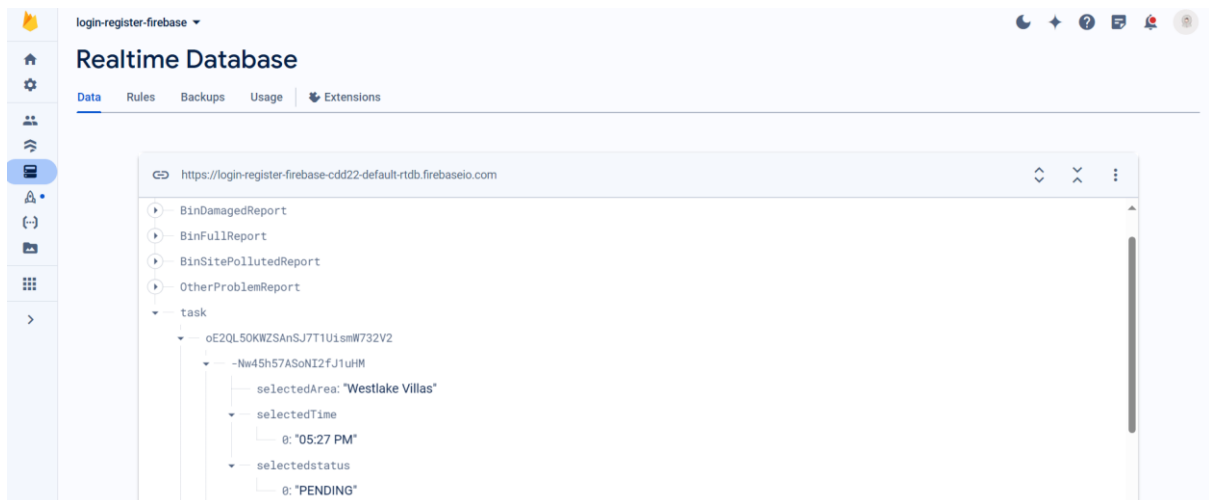
Figure 5.2.2.4 Figure of Realtime Database

- Figure 5.2.2.4 illustrates the Realtime Database setup, where report data is stored across four tables: BinDamagedReport, BinFullReport, BinSitePollutedReport, and OtherProblemReport. Additionally, task details like area, time, and status are also stored in this database for efficient task management.

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51
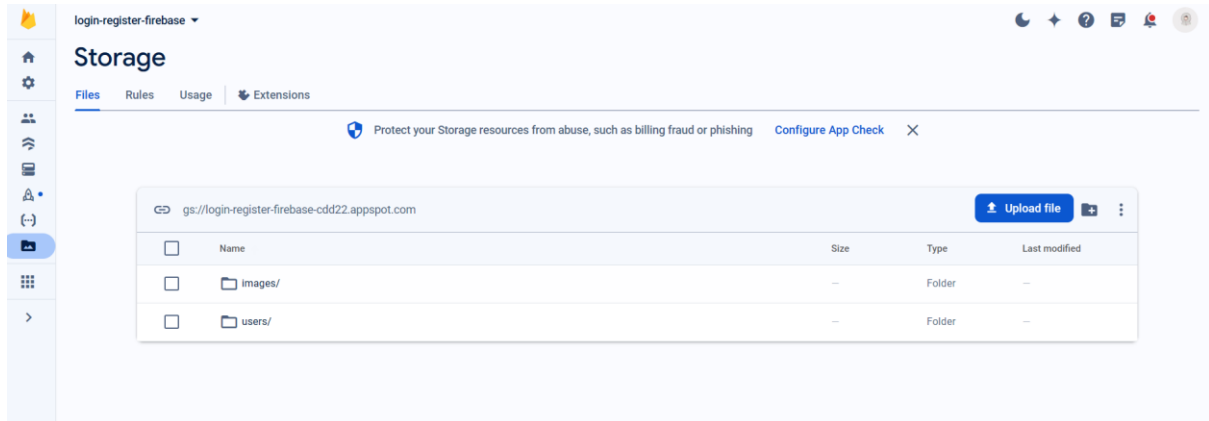
Figure 5.2.2.5 Figure of Firebase Cloud Storage

- Figure 5.2.2.5 presents Firebase Cloud Storage configuration, storing report images under the "images" file name and user profile images under the "users" file name for organized file management.

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52

5.3 System Operation

5.3.1 Main Page

Figure 5.3.1 Main Page

Figure 5.3.1 displays the main page presented to users. New users can click "CLICK TO REGISTER" to create an account, while existing users can click "CLICK TO LOGIN" to access their account.

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53
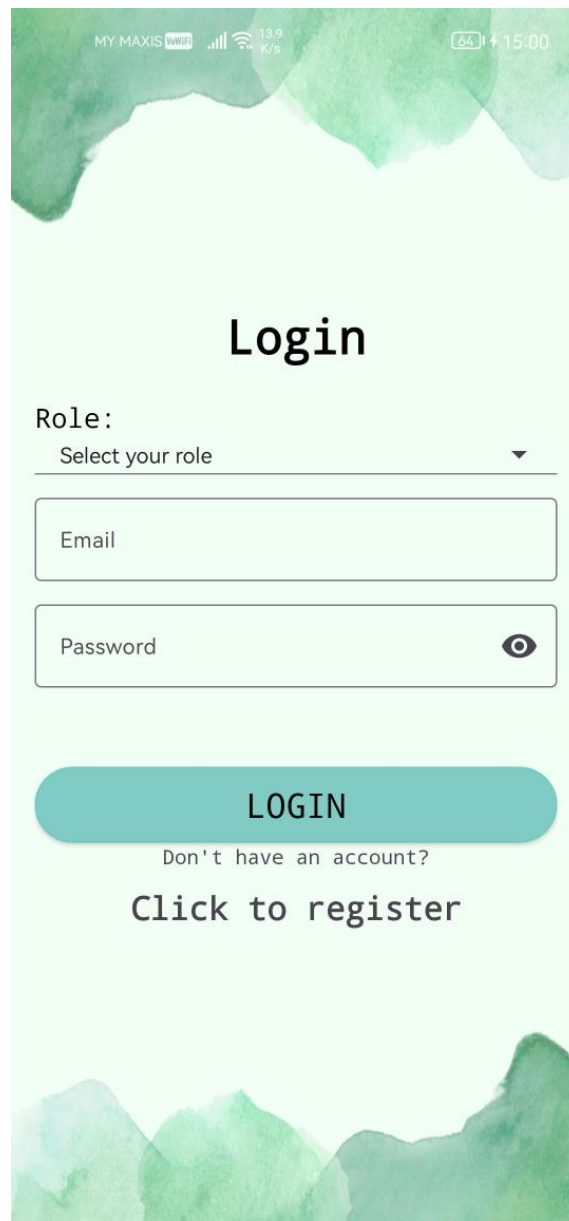
5.3.2 Login Page

Figure 5.3.2 Login Page

Figure 5.3.2 shows the Login page accessed by clicking "CLICK TO LOGIN" on the Main Page (Figure 5.3.1). Users must choose their role (Collector or Manager) and enter their correct email and password to access the app. New users can click "CLICK TO REGISTER" to create an account.

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54
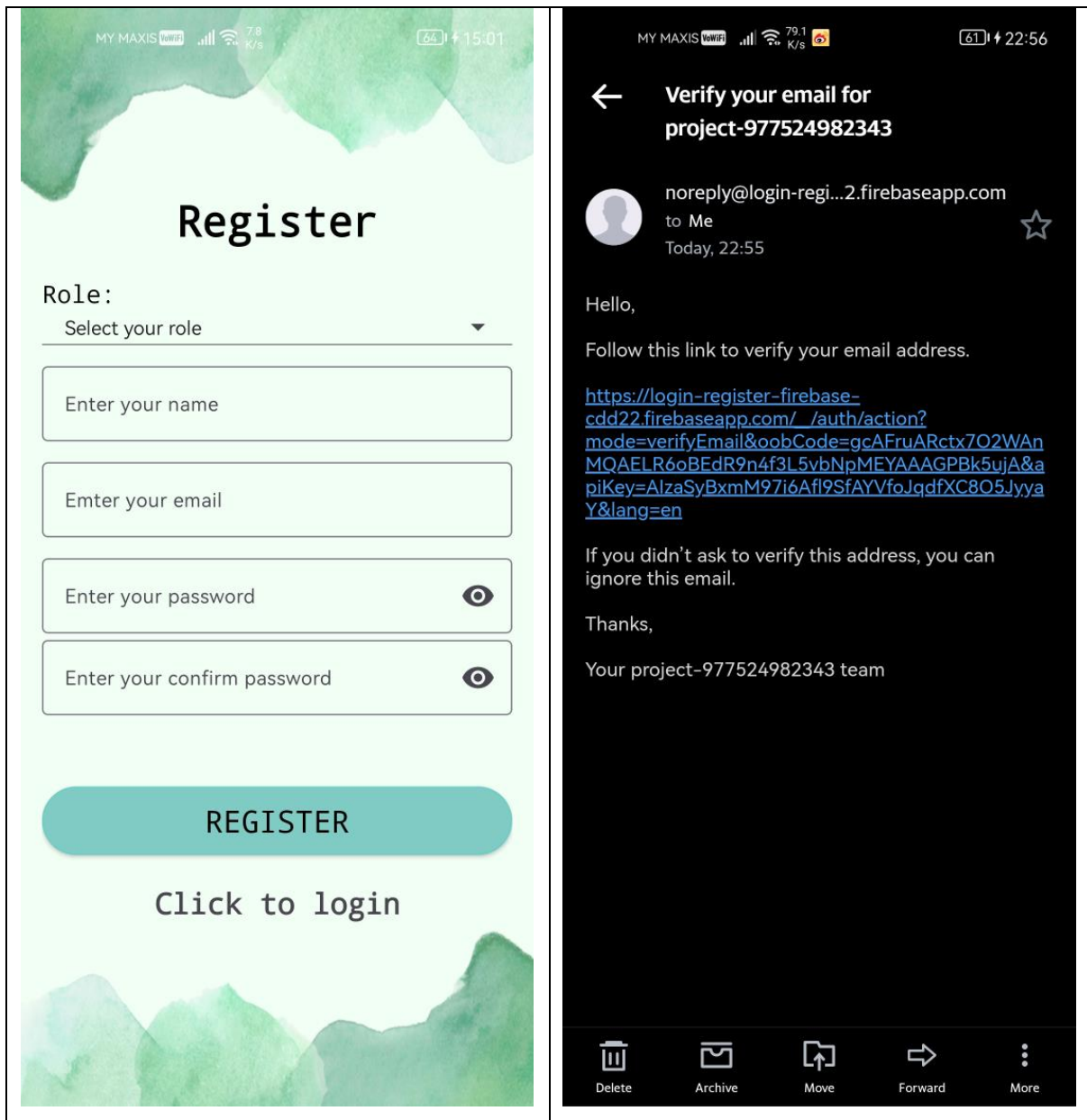
5.3.3 Register Page

Figure 5.3.3 Register Page

Figure 5.3.3 displays the Register page accessed by clicking "CLICK TO REGISTER" on the Main Page (Figure 5.3.1). Users choose a role and provide account details including name, email, password, and confirm password. Registration allows users to select either "collector" or "manager" as their role. Duplicate email addresses from pre-registered users are not accepted. Upon successful registration, an email verification link is sent for user confirmation before accessing their account.

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55

5.3.4 Collector Menu Page
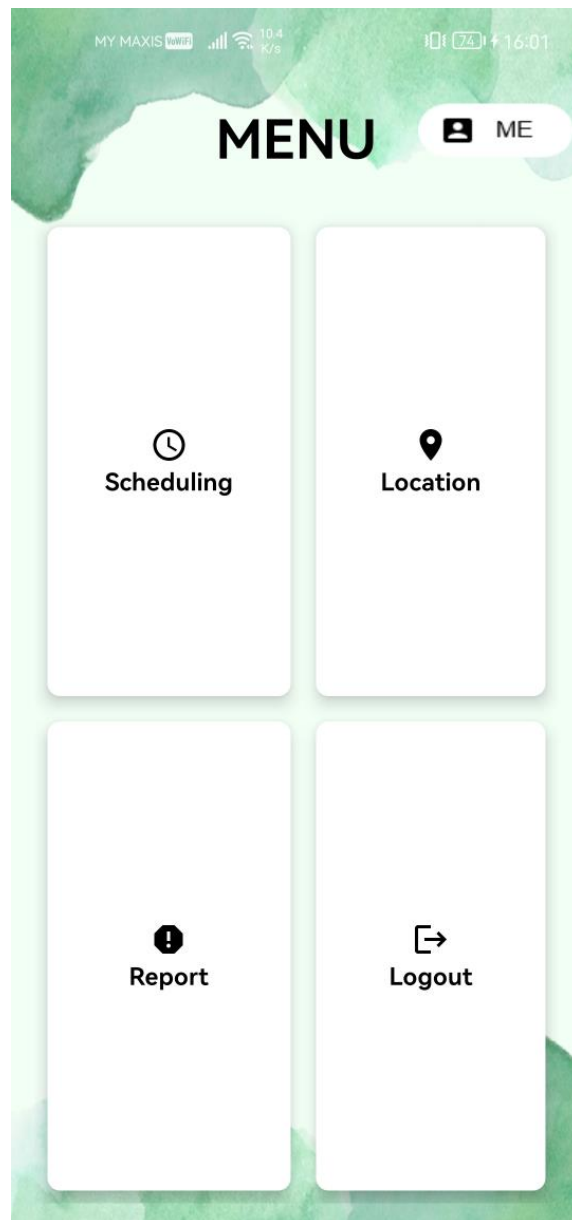
Figure 5.3.4 Collector Menu Page

Figure 5.3.4 showcases the Collector Menu Page, displayed after successful login with a collector role. The menu offers options such as Scheduling, Location, Report, and Logout for user navigation.

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56

5.3.5 Create Schedule Page
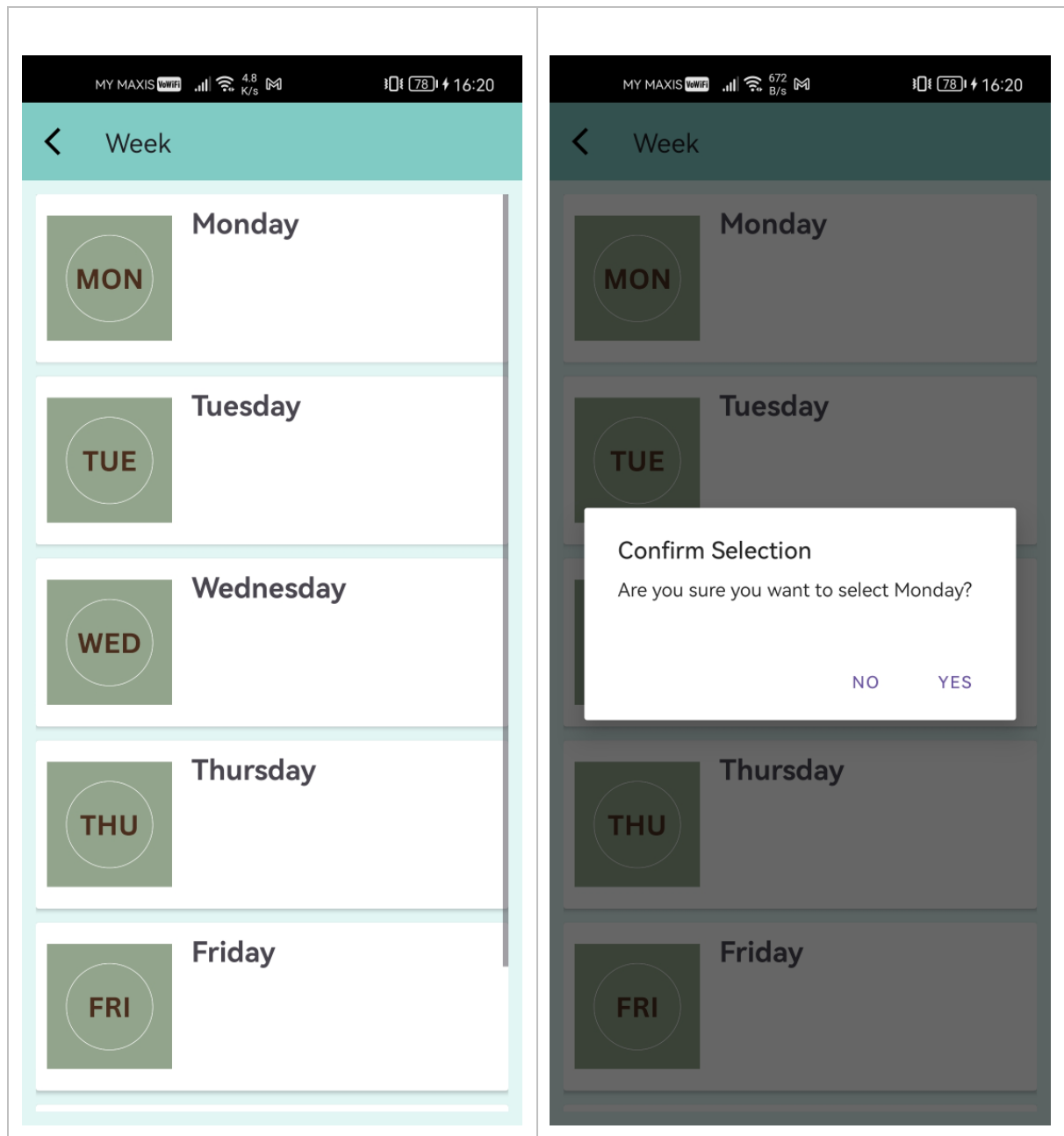
Figure 5.3.5.1 Days of Week Page

Figure 5.3.5.1 present the Days of Week Page, where the collectors can choose the days for garbage collection. Upon selection, a dialog box prompts the collector to confirm their chosen days.

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57
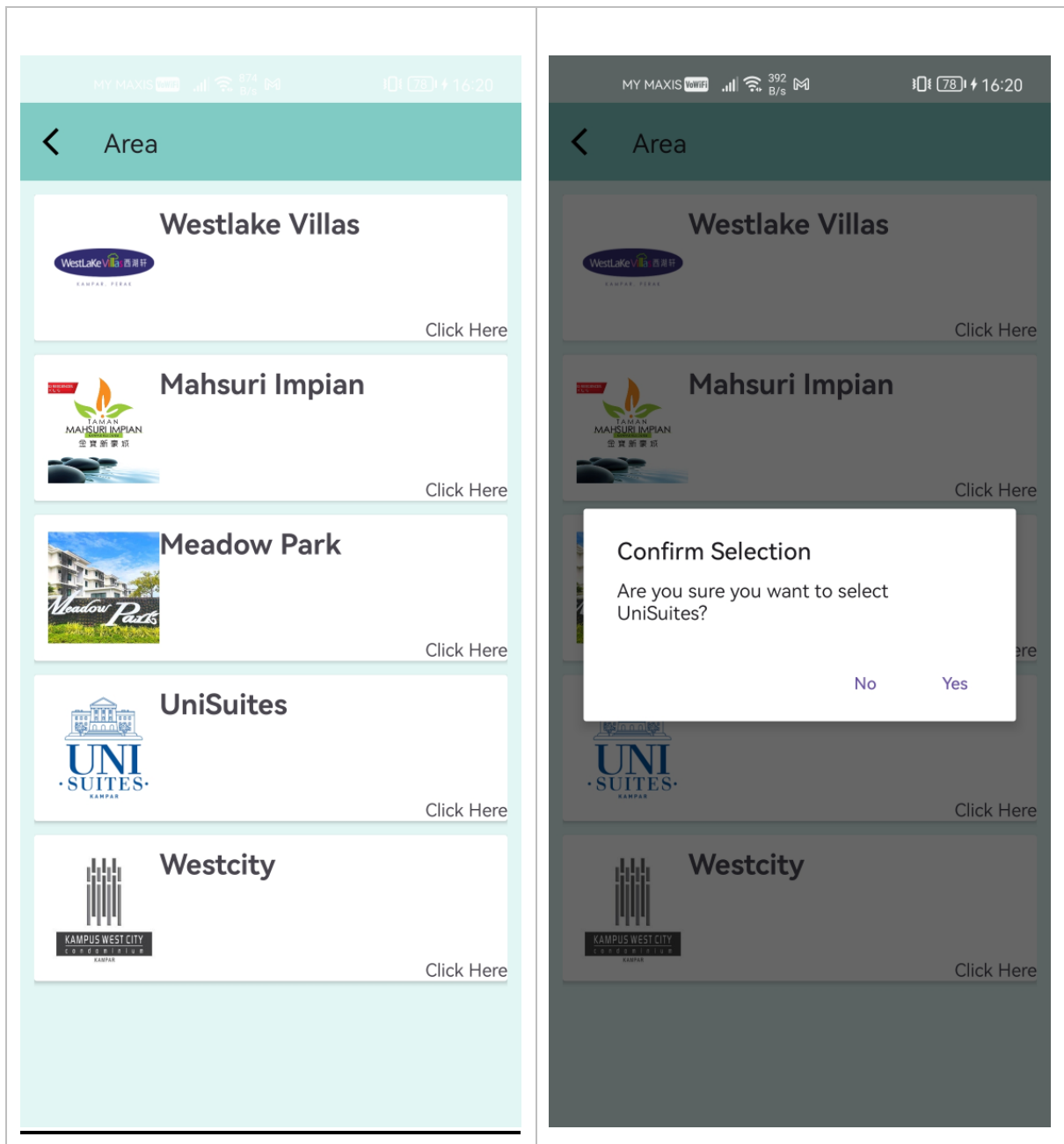
Figure 5.3.5.2 Area Page

Figure 5.3.5.2 displays the Area Page, enabling collectors to choose a specific location or area for garbage collection. After selection, a dialog box appears, prompting the collector to confirm their choice.

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58
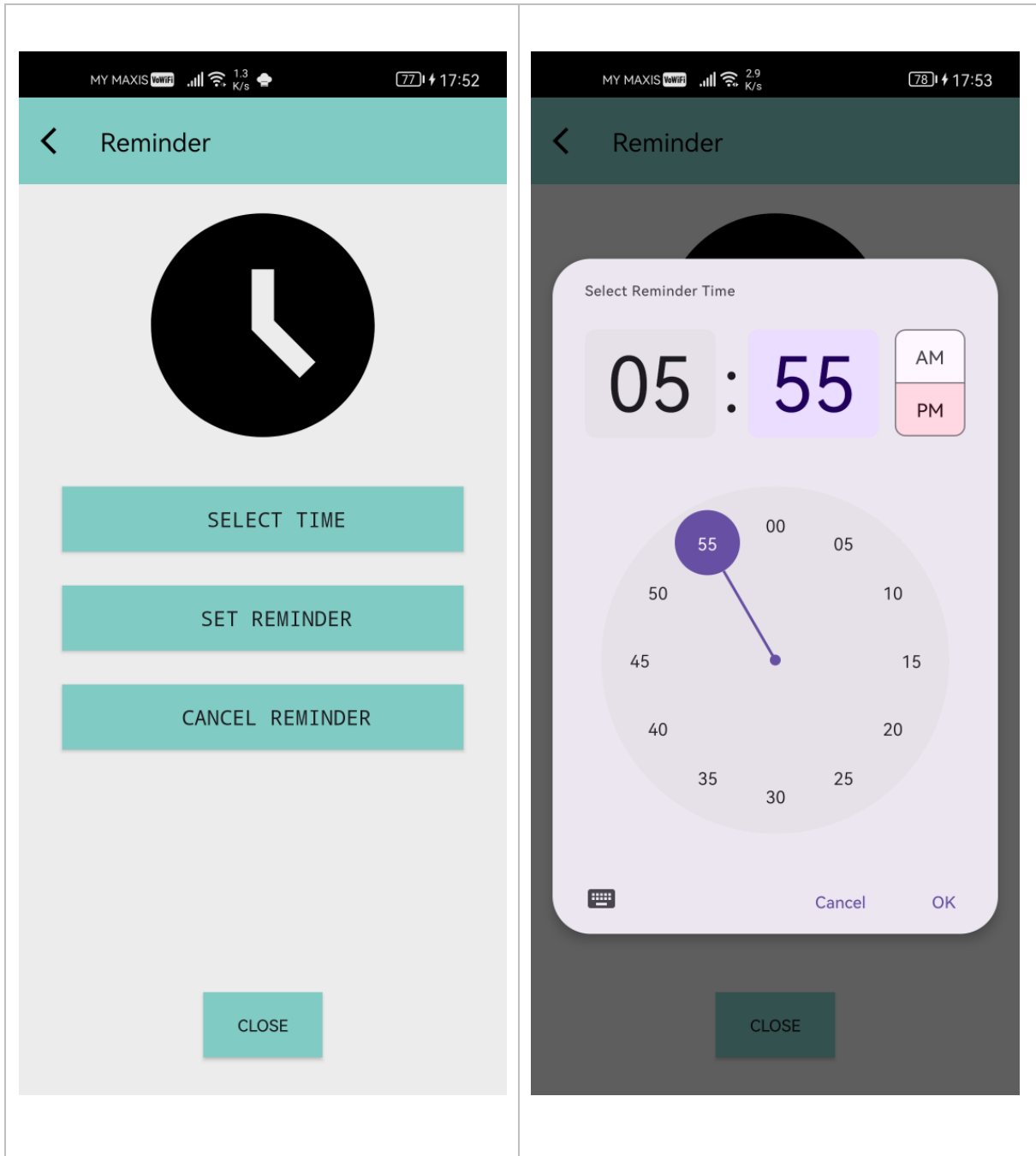
Figure 5.3.5.3 Time Page

Figure 5.3.5.3 showcases the Time Page, allowing users to select a specific time. After selecting a time, users can confirm the reminder by clicking "SET REMINDER" or cancel it with "CANCEL REMINDER". A notification will remind users at the chosen time.

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59
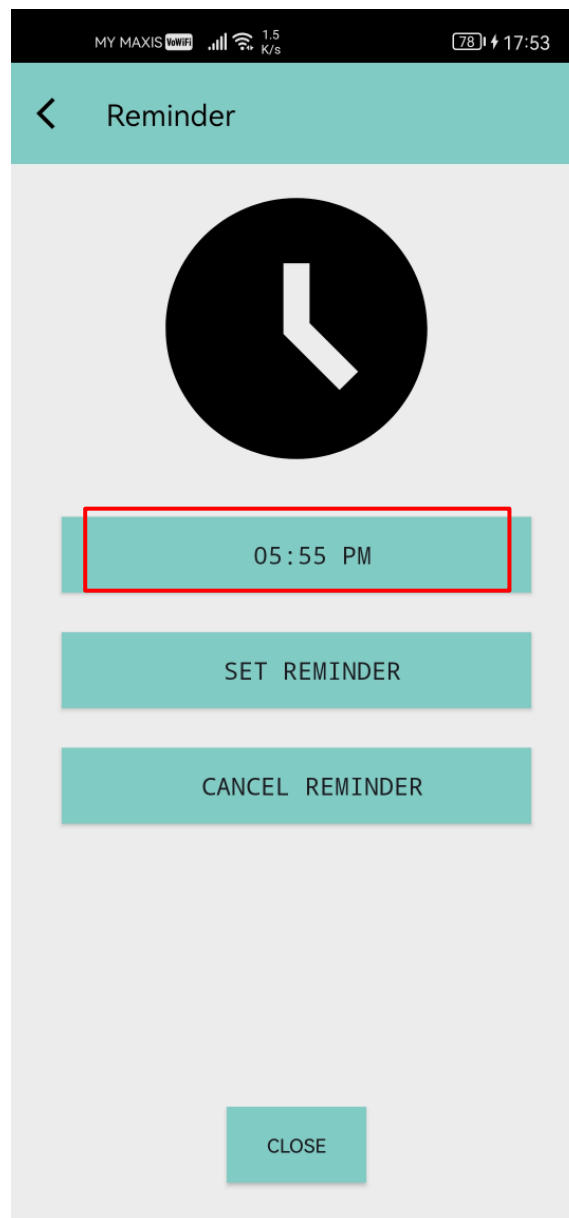
Figure 5.3.5.4 Time Display on the UI

Figure 5.3.5.4 presents the Time Display on the UI, showing the user's selected time. This feature improves user experience by clearly displaying the chosen time.

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60
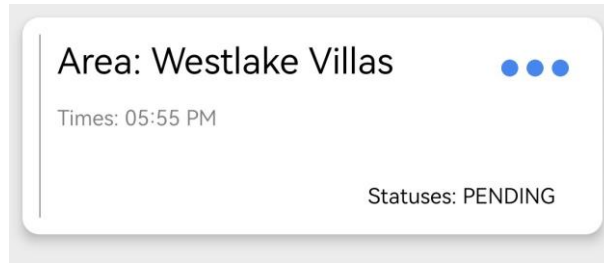
Figure 5.3.5.5 Display Information Page

Figure 5.3.5.5 features the Display Information Page, showcasing the selected time and area chosen by the collector.

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61

5.3.6 Schedule View Page
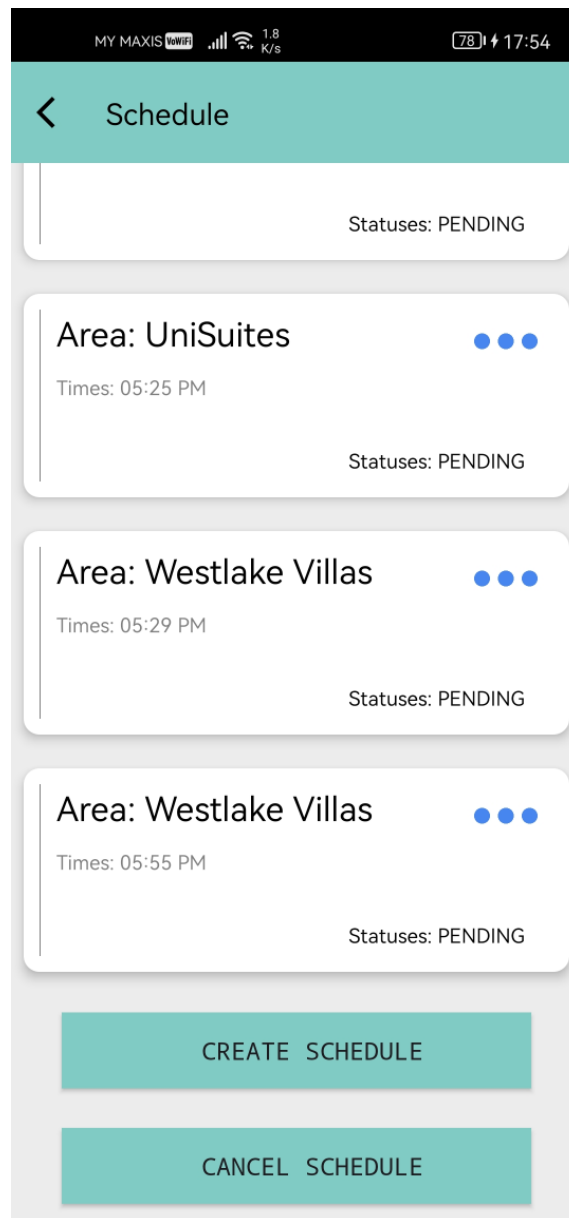
Figure 5.3.6 Schedule View Page

Figure 5.3.6 presents the Schedule View Page, which lists all user-selected information including area, time, and status for easy reference.

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62

5.3.7 Notification Page
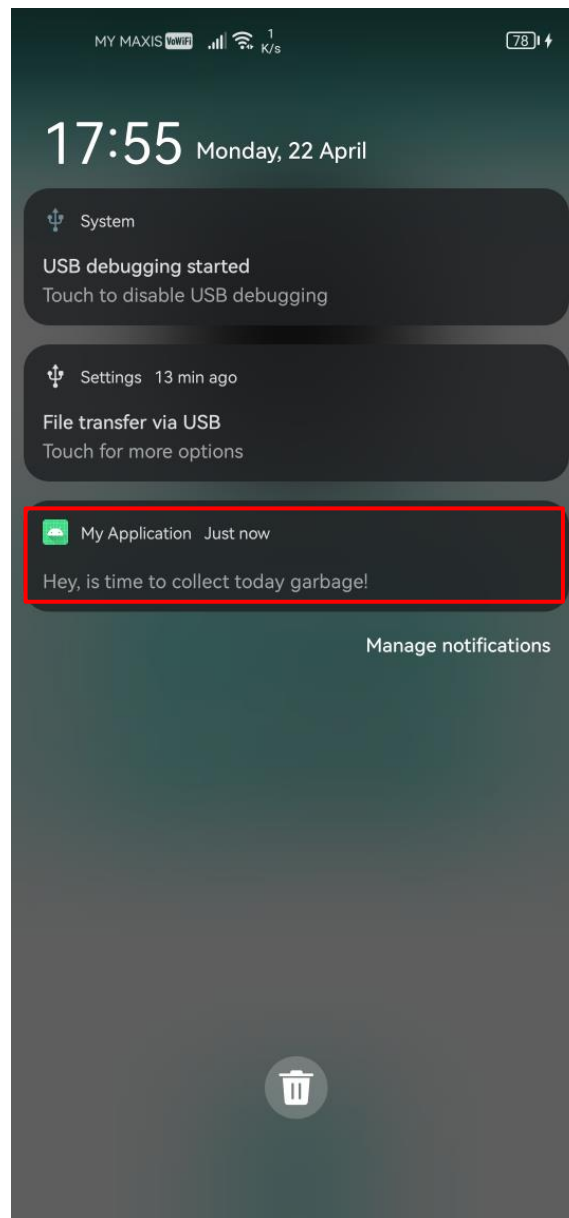
Figure 5.3.7 Notification Page

Figure 5.3.7 depicts the Notification Page, where users receive reminders when the selected time is reached. The display shows the notification received by the user.

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63
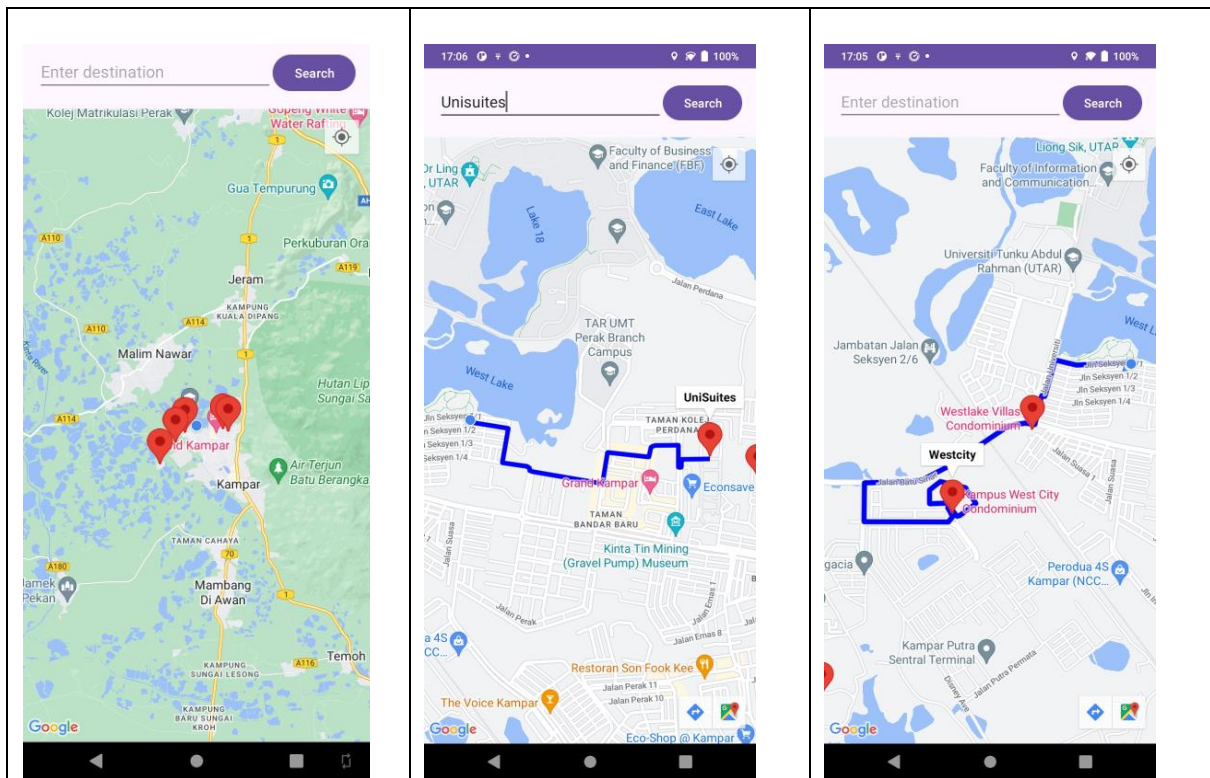
5.3.8 Location Page

Figure 5.3.8 Location Page

Figure 5.3.8 showcases the Location Page, enabling both collectors and managers to view routes from their current location to the destination. Users can either click on markers or utilize the search bar to locate specific areas.

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64

5.3.9 Collector Report View Page

Figure 5.3.9.1 Report Problem Page

Figure 5.3.9.2 Report View Page
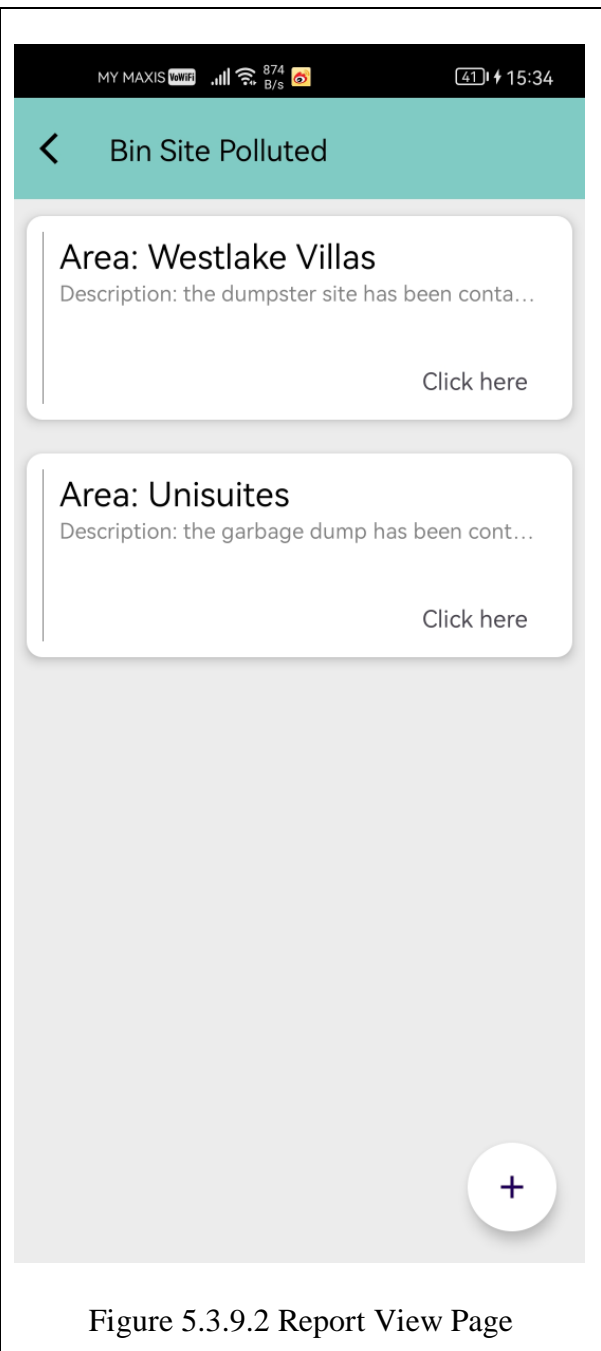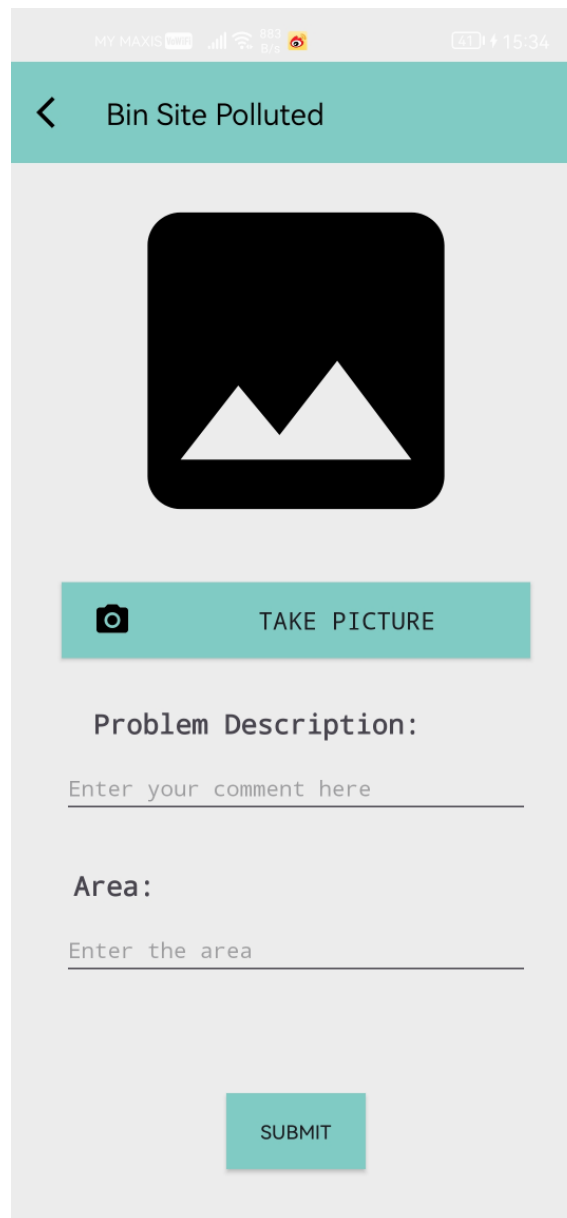
Figure 5.3.9.1 displays the Report Problem Page, where collectors can select the type of issue they wish to report. Upon selecting "Bin Site Polluted," users are directed to Figure 5.3.9.2, the Report View Page. Here, all forms related to that issue type are displayed, along with their respective areas and descriptions. Collectors can create a new form for this issue type by clicking the Add icon.

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65

5.3.10 Create Report Page

Figure 5.3.10 Create Report Page

Figure 5.3.10 features the Create Report Page, enabling collectors to capture and upload photos to the image view. Collectors can also input the problem description and area, then click submit. Once submitted, the form appears on the Report View Page (Figure 5.3.9.2).

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66

5.3.11 Collector Report View Form Page
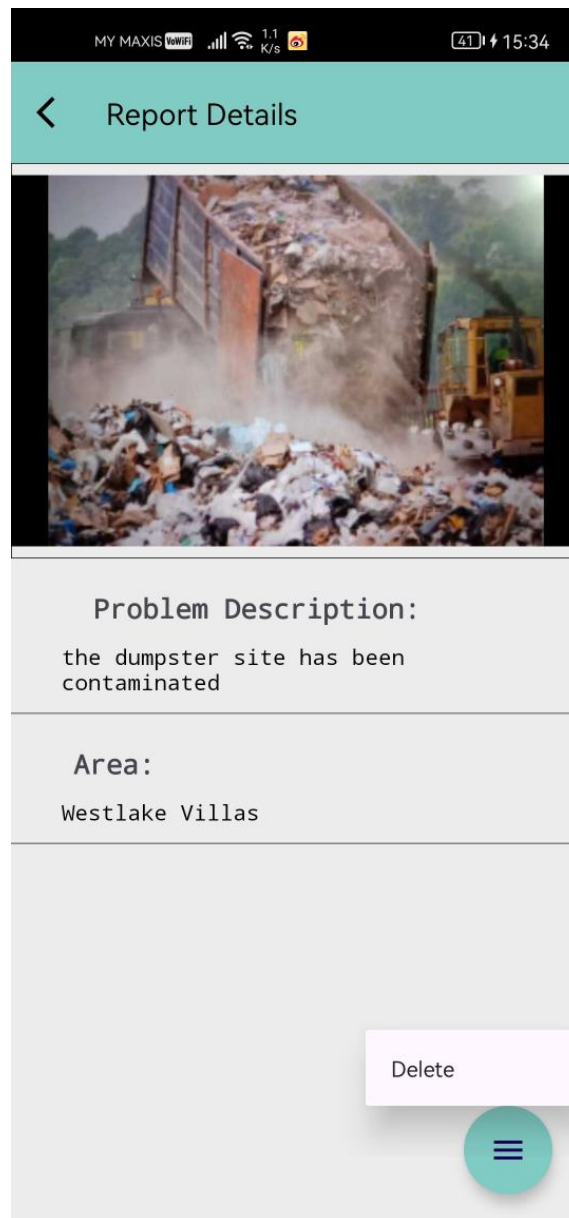
Figure 5.3.11 Collector Report View Form Page

Figure 5.3.11 showcases the Collector Report View Form Page, accessed from the Report View Page (Figure 5.3.9.2). Here, collectors can view and delete reported details.

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67

5.3.12 Manager Menu Page
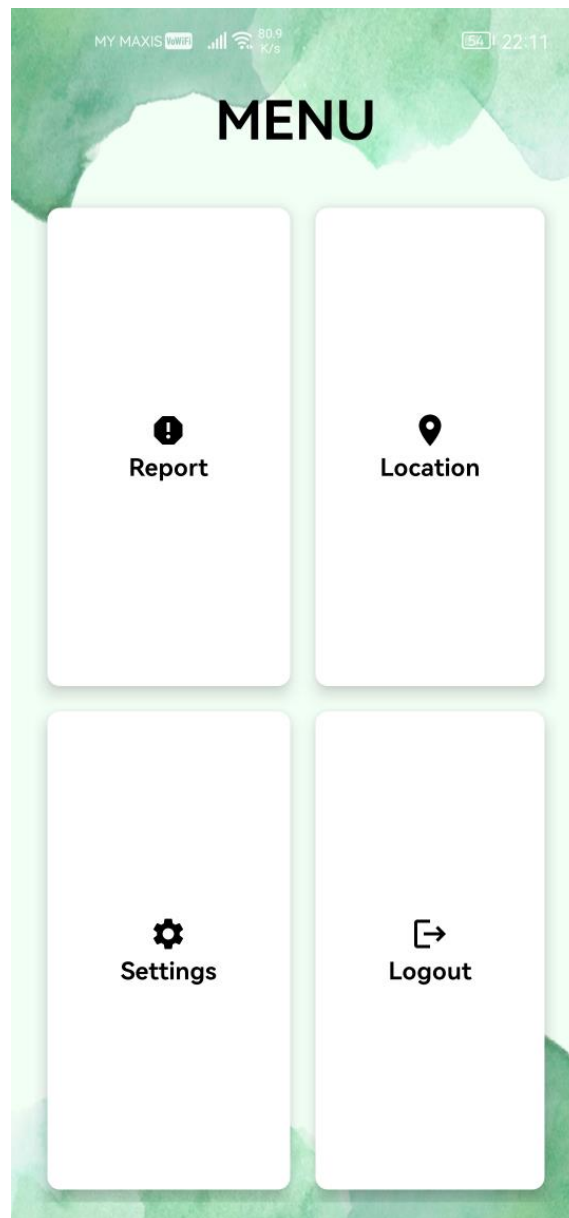
Figure 5.3.12 Manager Menu Page

Figure 5.3.12 displays the Manager Menu Page, accessible after successful login with a manager role. The menu offers options such as Report, Location, Settings, and Logout for user navigation.

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68

5.3.13 Manager Report View Page

| Figure 5.3.13.1 Manager Report Problem Page | Figure 5.3.13.2 Manager Report View Page |
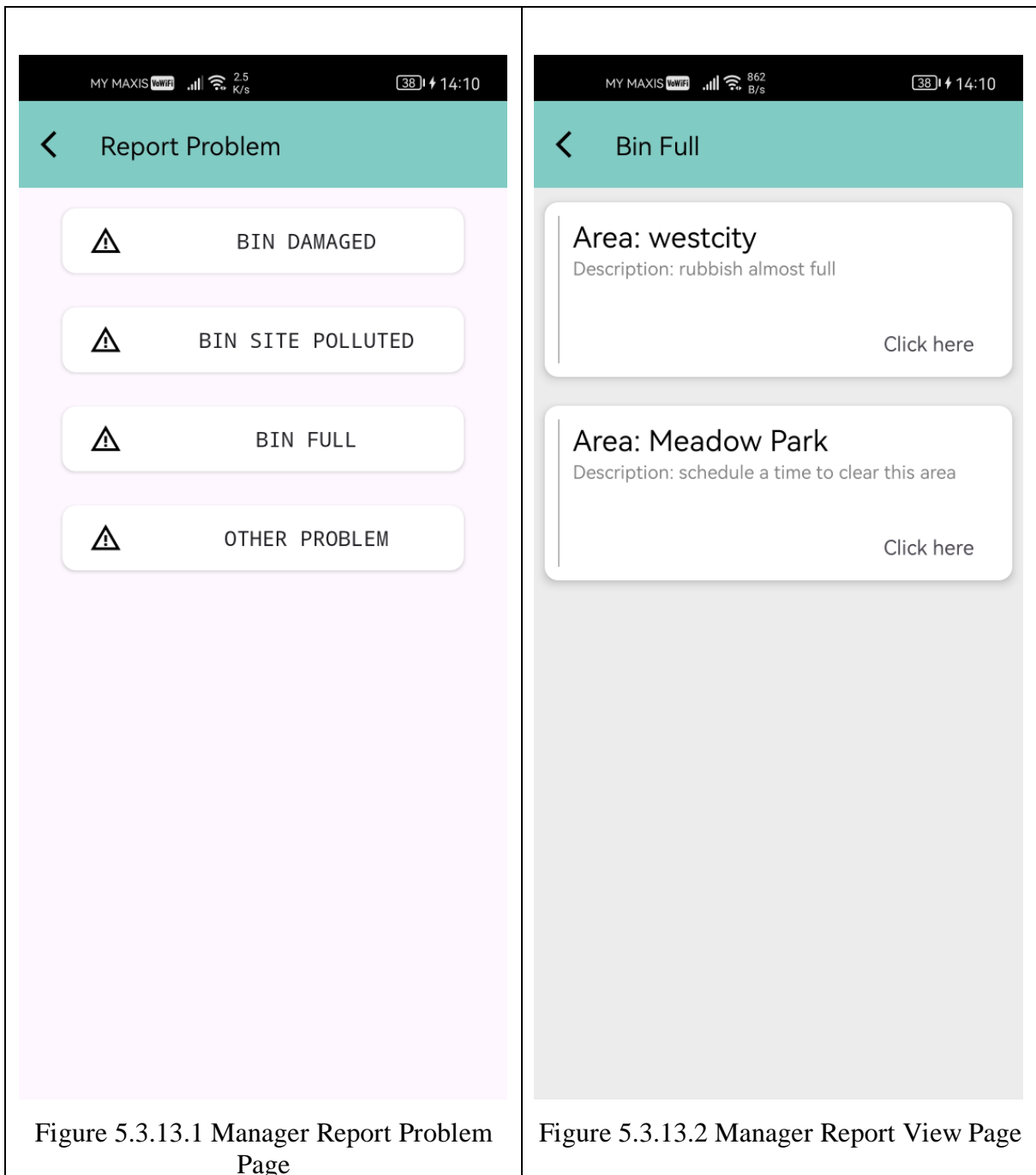
Figure 5.3.13.1 shows the Manager Report Problem Page, where managers can select the type of issue they wish to address. Upon selecting "Bin Site Polluted," they are taken to Figure 5.3.13.2, the Manager Report View Page. Here, all forms submitted by collectors related to that issue type are displayed, along with their respective regions and descriptions.

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69

5.3.14 Manager Report View Form Page
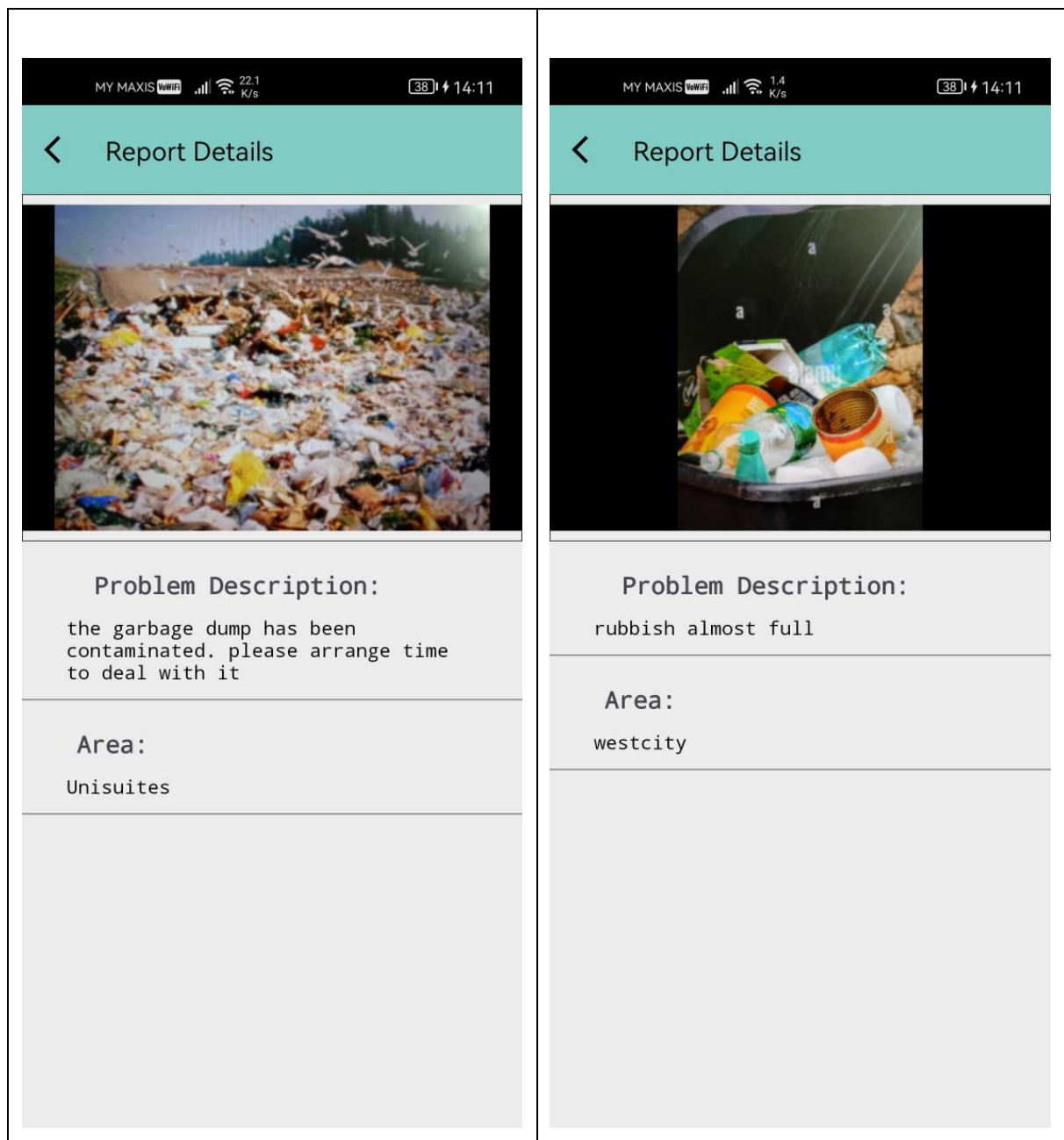
Figure 5.3.14 Manager Report View Form Page

Figure 5.3.14 displays the Manager Report View Form Page, accessible from the Report View Page (Figure 5.3.13.2). Here, managers can view photos, problem descriptions, and areas submitted by the collectors.

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70
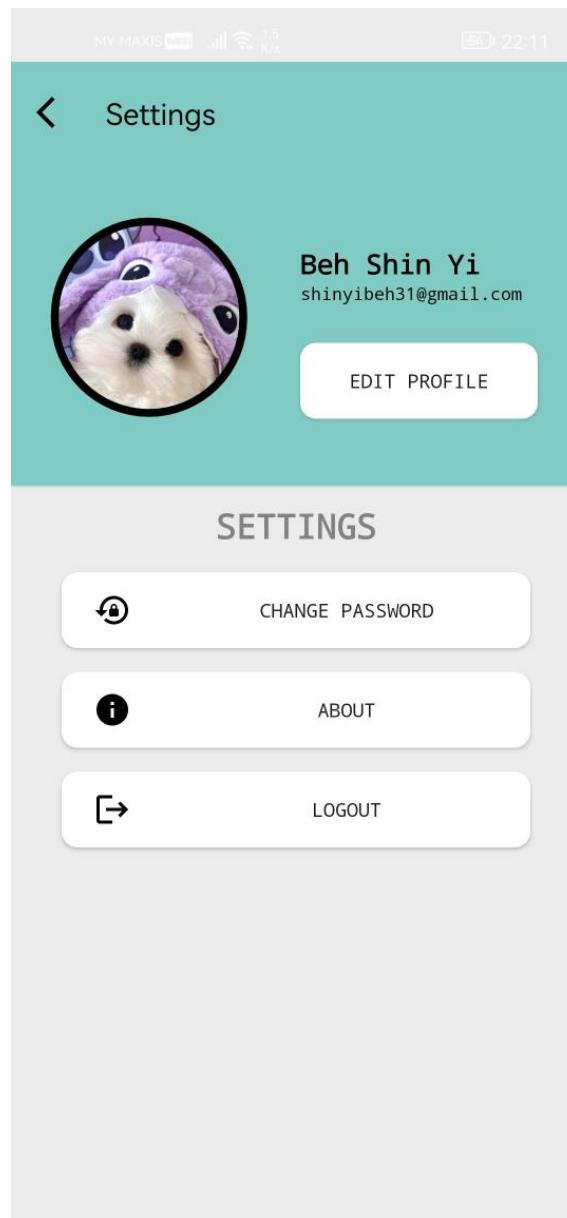
5.3.15 Settings Page

Figure 5.3.15 Settings Page

Figure 5.3.15 presents the Settings Page, which has a consistent design for both collectors and managers. The header showcases the user's profile image, name, and email address. Within this page, users can update their profile details, change passwords, access the About page, and log out of the application.

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71

5.3.16 Edit Profile Page
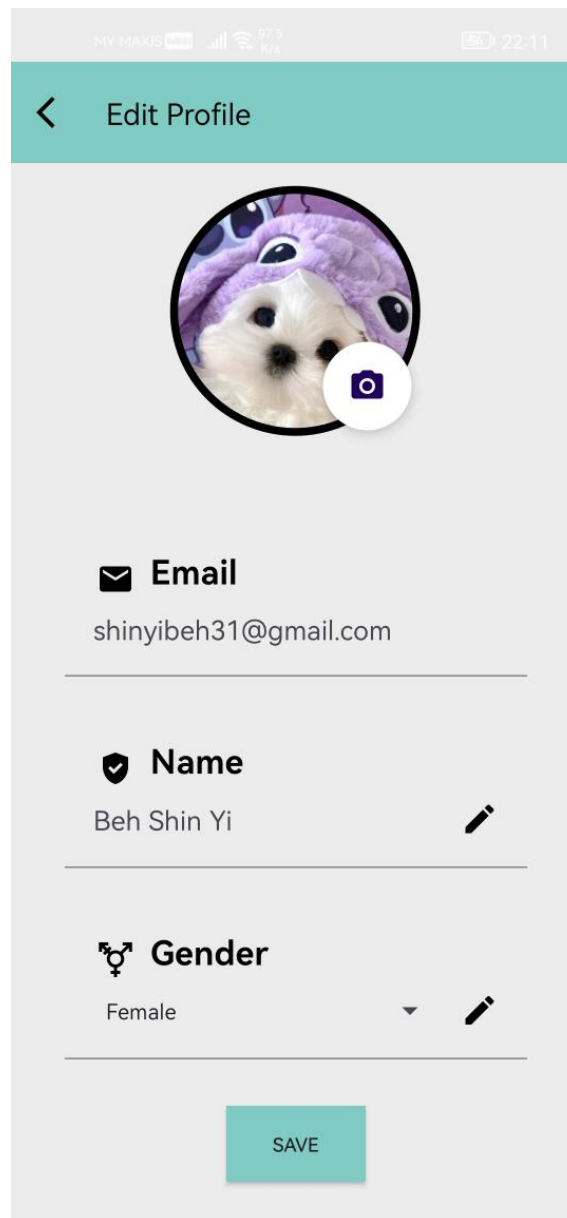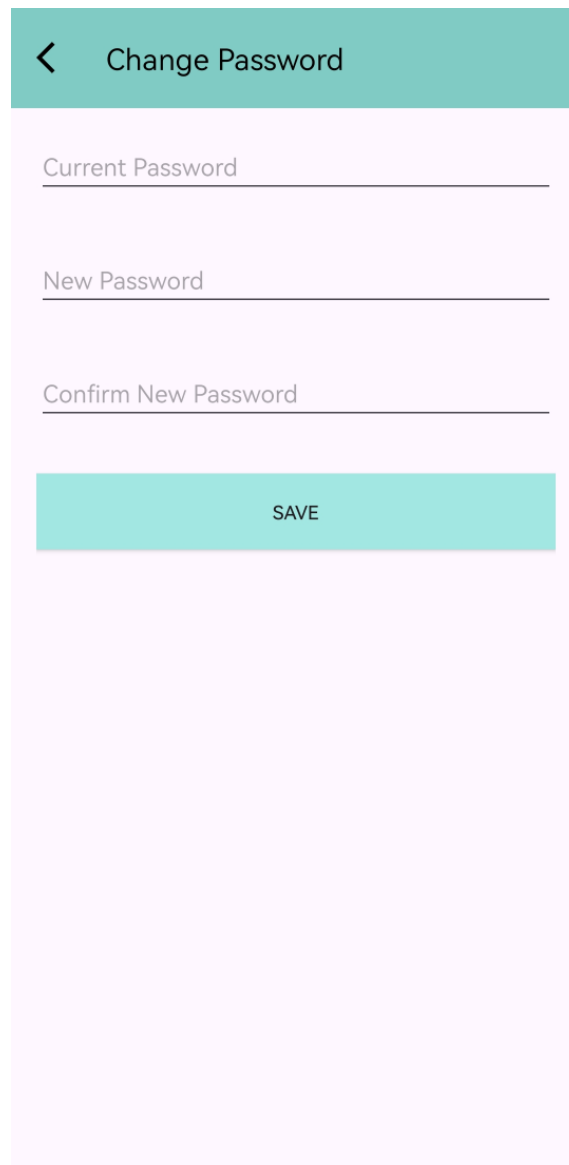
Figure 5.3.16 Edit Profile Page

Figure 5.3.16 features the Edit Profile Page, accessible from the Settings Page (Figure 5.3.15). Users can update their profile by clicking the "Edit Profile" button. Clicking on the camera icon enables users to select an image from their device to set as their profile picture. Additionally, users can modify their name and gender, but email addresses remain unchanged.

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72

5.3.17 Change Password Page

Figure 5.3.17 Change Password Page

Figure 5.3.17 displays the Change Password Page, accessible from the Settings Page (Figure 5.3.15). Users can change their password by clicking the "Change Password" button. They need to input their current password, choose a new one, and confirm it. Upon providing correct information, the password update is successfully processed.

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73

5.3.18 About Page

Figure 5.3.18 About Page

Figure 5.3.18 presents the About Page, accessible for users to view additional information about the application or company.

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74
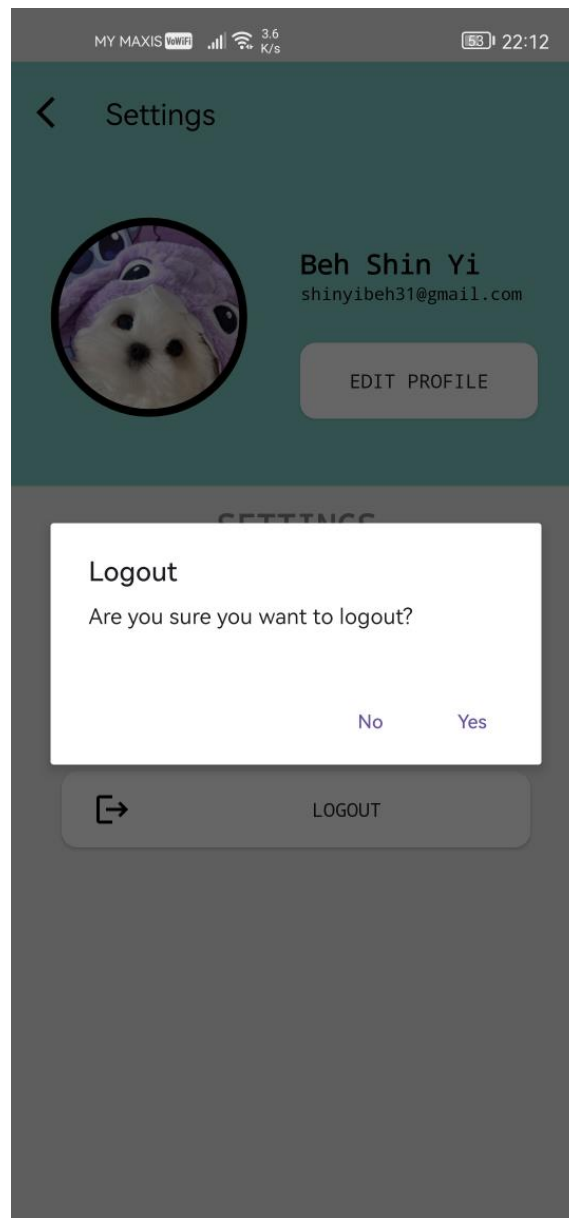
5.3.19 Logout Dialog

Figure 5.3.19 Logout Dialog

Figure 5.3.19 showcases the Logout Dialog. When users select the Logout option on the Settings Page (Figure 5.3.15), a confirmation dialog appears. Upon clicking "Yes," users are redirected to the Login Page (Figure 5.3.2).

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75

CHAPTER 6

System Evaluation and Discussion

This chapter initiates the system testing process and presents the results, evaluates project challenges, and reviews the objectives.

6.1 System Testing and Result

6.1.1 Main Page

Test Case	Expected Result	Actual Result	Status
Press "Login" button	Navigate to Login page	Navigate to Login page	Pass
Press "Register" button	Navigate to Register page	Navigate to Register page	Pass

Table 6.1.1 Main Page

The Main Page demonstrated consistent functionality across all test cases. Pressing the "Login" button correctly navigated users to the Login page, facilitating user authentication. Similarly, clicking the "Register" button directed users to the Register page, enabling new user registrations. All test cases passed without any issues.

6.1.2 Register Page

Test Case	Expected Result	Actual Result	Status
If role is not selected	Show error message	Show error message	Pass
Leave name field empty	Show error message	Show error message	Pass
Leave email field empty	Show error message	Show error message	Pass
Leave password field empty	Show error message	Show error message	Pass
Leave confirm password field empty	Show error message	Show error message	Pass
Press "show eye" icon	Show password	Show password	Pass

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

76

Press "hide eye" icon	Hide password	Hide password	Pass
Insert email that already exist	Show "Email" exist	Show "Email" exist	Pass
Insert invalid email format	Show "Invalid email format"	Show "Invalid email format"	Pass
Password not same with confirm password	Show error message	Show error message	Pass
Insert password length less than 5	Show error message	Show error message	Pass
Press "Click to login"	Navigate to Login page	Navigate to Login page	Pass
Insert name, email, password and confirm password in correct format	1. User data is stored in the database 2. Show "Register successfully"	1. User data is stored in the database 2. Show "Register successfully"	Pass

Table 6.1.2 Register Page

Based on Table 6.1.2 for the Register Page, the register page functioned effectively across all test cases, ensuring a smooth user registration process. The page appropriately validated user inputs, displaying error messages for missing or incorrect information, such as an unselected role, empty fields, or mismatched passwords. The password visibility toggle, represented by the "show eye" and "hide eye" icons, also operated correctly, allowing users to view or hide their password as needed. The system correctly identified existing email addresses and displayed appropriate error messages for invalid email formats. Upon successful registration with correct and valid information, user data was stored in the database, and a confirmation message "Register successfully" was displayed, confirming the registration process's success.

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77

6.1.3 Login Page

Test Case	Expected Result	Actual Result	Status
If role is not selected	Show error message	Show error message	Pass
Leave email field empty	Show error message	Show error message	Pass
Leave password field empty	Show error message	Show error message	Pass
Press "show eye" icon	Show password	Show password	Pass
Press "hide eye" icon	Hide password	Hide password	Pass
Insert invalid email format	Show "Invalid email format"	Show "Invalid email format"	Pass
Login with account does not exist	Show "Invalid email or password"	Show "Invalid email or password"	Pass
Press "Click to Register"	Navigate to Register page	Navigate to Register page	Pass
Insert email and password in correct format and press "Login" button	Navigate to Menu page	Navigate to Menu page	Pass

Table 6.1.3 Login Page

Table 6.1.3 Login Page demonstrated consistent and accurate behavior across all test scenarios. It effectively handled validation checks, displaying error messages for unselected roles, empty fields, or incorrect email formats. The password visibility toggle worked seamlessly, allowing users to easily toggle between showing and hiding their password with the respective "show eye" and "hide eye" icons. The system correctly identified non-existent accounts and displayed the appropriate "Invalid email or password" message. Upon successful login with correct credentials, users were navigated to the Menu page as expected.

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78

6.1.4 Collector Menu Page

Test Case	Expected Result	Actual Result	Status
Press "Schedule"	Navigate to Days of Week page	Navigate to Days of Week page	Pass
Press "Location"	Navigate to Location page	Navigate to Location page	Pass
Press "Report"	Navigate to Report page	Navigate to Report page	Pass
Press "Logout"	Navigate to Main page	Navigate to Main page	Pass
Click "person" icon	Navigate to Setting page	Navigate to Setting page	Pass

Table 6.1.4 Collector Menu Page

Table 6.1.4 Collector Menu Page functioned effectively across all test cases, ensuring smooth navigation to the respective pages when selecting options like "Schedule," "Location," "Report," "Logout," and the "person" icon. Each button correctly directed users to its corresponding page.

6.1.5 Days of the Week Page

Test Case	Expected Result	Actual Result	Status
Select a day from the list and confirm your selection by pressing "Yes" in the dialog box.	1. The selected date should be stored in database. 2. Navigate to the Area page. 3. A toast should display "Selected day saved in Realtime Database".	1. The selected date should be stored in database. 2. Navigate to the Area page. 3. A toast should display "Selected day saved in Realtime Database".	Pass
Select a day from the list and cancel the selection by pressing "No" in the dialog.	1. Nothing should change in the Firebase Realtime Database. 2. The user should remain on the Week page without navigating to Area page.	1. Nothing should change in the Firebase Realtime Database. 2. The user should remain on the Week page without navigating to Area page.	Pass
Press "back" button	Navigate to Menu page	Navigate to Menu page	Pass

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

79

Login again after selecting some days previously.	1. The previously selected days should be loaded from the Firebase Realtime Database. 2. These days should be displayed as selected in the Week page.	1. The previously selected days should be loaded from the Firebase Realtime Database. 2. These days should be displayed as selected in the Week page.	Pass
Error in Storing day in Database	Show error message	Show error message	Pass
Error Loading Selected Days	Show error message	Show error message	Pass

Table 6.1.5 Days of the Week Page

Table 6.1.5 Days of the Week Page demonstrated consistent functionality across all test cases. Selecting a day and confirming or canceling the selection worked as expected, with data accurately stored or unchanged in the Firebase Realtime Database. Navigating back to the Menu page and logging in after selecting days previously also functioned correctly, indicating successful data retrieval and display. Error handling was effective, with appropriate error messages displayed for any issues.

6.1.6 Area Page

Test Case	Expected Result	Actual Result	Status
Select an area from the list and confirm the selection by pressing "Yes" in the dialog.	1. The selected area should be stored in database. 2. Navigate to the Time page. 3. Toast message "Selected area saved in Realtime Database" should appear.	1. The selected area should be stored in database. 2. Navigate to the Time page. 3. Toast message "Selected area saved in Realtime Database" should appear.	Pass
Select an area from the list and decline the selection by	1. No action is taken 2. The user remains on the Area page to reselect an area.	1. No action is taken 2. The user remains on the Area page to reselect an area.	Pass

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Faculty of Information and Communication Technology (Kampar Campus), UTAR

80

Test Case	Expected Result	Actual Result	Status
pressing "No" in the dialog.			
Error in Storing area in Database	Show error message	Show error message	Pass
Press "back" button	Navigate to week page	Navigate to week page	Pass

Table 6.1.6 Area Page

Table 6.1.6 Area Page performed reliably across all test scenarios. Selecting an area and confirming or declining the choice functioned as intended, with data either stored in the Firebase Realtime Database or no action taken as appropriate. The navigation to the Time page after selecting an area was successful, accompanied by a toast message confirming the selection. Error handling was effective, displaying relevant error messages when necessary. Additionally, pressing the "back" button correctly navigated users back to the Week page.

6.1.7 Time Page

Test Case	Expected Result	Actual Result	Status
Click on the "Select Time"	The time picker dialog should appear.	The time picker dialog appears.	Pass
Select a time from the time picker dialog.	he selected time should be displayed on the "Select Time" button.	The selected time is displayed on the button.	Pass
Click the "Set Alarm" button after selecting a time.	1. Selected times should be added to Firebase. 2. An alarm should be set for the selected time.	1. Selected times should be added to Firebase. 2. An alarm should be set for the selected time.	Pass
Click the "Cancel Alarm" button.	The previously set alarm should be canceled.	The alarm is canceled.	Pass
Click the "Close" button with at least one time selected.	Navigate to display working list page and pass the selected time, and selected area.	Navigate to display working list page and pass the selected time, and selected area.	Pass

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81

Click the "Close" button without selecting any time.	A toast message should appear saying "Please select at least one time."	A toast message should appear saying "Please select at least one time."	Pass

Table 6.1.7 Time Page

Table 6.1.7 Time Page demonstrated consistent functionality across all test cases. Opening the time picker dialog, selecting a time, and displaying it on the button worked seamlessly. Upon setting an alarm, the selected times were successfully stored in Firebase, and the alarm was set as expected. Cancelling the alarm functioned correctly and pressing the "Close" button without selecting a time triggered an appropriate toast message. When selecting a time and area, the page navigated to the Display Working List page with the selected time and area passed correctly.

6.1.8 Display Working List Page

Test Case	Expected Result	Actual Result	Status
Click the "Close" button.	Navigate to the Menu page and close the current page.	Navigate to the Menu page and close the current page.	Pass
Retrieve the data from database.	Display the retrieved data in a list.	Display the retrieved data in a list.	Pass
Simulate an error while fetching data from Firebase.	Show error message	Show error message	Pass

Table 6.1.8 Display Working List Page

Table 6.1.8 Display Working List Page performed reliably across all test cases. Clicking the "Close" button navigated users back to the Menu page as expected. The retrieval of data from the database was successful, displaying the retrieved data in a list. In the case of an error while fetching data from Firebase, the page appropriately displayed an error message.

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82

6.1.9 Location Page

Test Case	Expected Result	Actual Result	Status
Enter a valid destination	The map displays the route, a blue polyline indicates the route, and the camera zooms to fit both locations.	The map displays the route, a blue polyline indicates the route, and the camera zooms to fit both locations.	Pass
Enter an invalid destination	Show error message	Show error message	Pass
Deny the location permission when prompted.	A toast message display "Location permission denied".	A toast message display "Location permission denied".	Pass
Click on a marker for a location	The map displays the route, a blue polyline indicates the route, and the camera zooms to fit both locations.	The map displays the route, a blue polyline indicates the route, and the camera zooms to fit both locations.	Pass

Table 6.1.9 Location Page

Table 6.1.9 Location Page demonstrated consistent and expected behavior across all test cases. Entering a valid destination successfully displayed the route on the map with a blue polyline and adjusted the camera to fit both locations. Error handling for invalid destinations and denied location permissions functioned as intended, displaying the appropriate error messages. Clicking on a marker also correctly showed the route and adjusted the camera view.

6.1.10 Report Page

Test Case	Expected Result	Actual Result	Status
Press "BIN DAMAGED"	Navigate to Bin Damaged page	Navigate to Bin Damaged page	Pass
Press "BIN SITE POLLUTED"	Navigate to Bin Site Polluted page	Navigate to Bin Site Polluted page	Pass
Press "BIN FULL"	Navigate to Bin Full page	Navigate to Bin Full Page	Pass

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83

Press "OTHER PROBLEM"	Navigate to Other Problem page	Navigate to Other Problem page	Pass
Press "back" button	Navigate to Menu page	Navigate to Menu page	Pass

Table 6.1.10 Report Page

Table 6.1.10 Report Page demonstrated consistent navigation behavior across all test cases. Each specific report option ("BIN DAMAGED," "BIN SITE POLLUTED," "BIN FULL," and "OTHER PROBLEM") correctly directed users to their respective dedicated pages. Additionally, pressing the "back" button reliably returned users to the Menu page.

6.1.11 Collector View Report List Page

Test Case	Expected Result	Actual Result	Status
Press "Back" button	Navigate to Report page	Navigate to Report page	Pass
Click "Add" icon	Navigate to Create Report page	Navigate to Create Report page	Pass
Click on the specific item	Navigate to the view report form page	Navigate to the view report form page	Pass

Table 6.1.11 Collector View Report List Page

Table 6.1.11 Collector View Report List Page performed reliably across all test cases. The "Back" button successfully navigated users back to the Report page. Clicking the "Add" icon directed users to the Create Report page, facilitating the addition of new reports. Additionally, selecting a specific item correctly navigated users to the view report form page, allowing them to view detailed report information. All test cases passed without issues, indicating the consistent and dependable functionality of the Collector View Report List Page.

6.1.12 Create Report Page

Test Case	Expected Result	Actual Result	Status
Press "Back" button	Navigate to View Report page	Navigate to View Report page	Pass

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84

Allow the camera permission when prompted.	Camera application will be displayed	Camera application will be displayed	Pass
Deny the camera permission when prompted.	A toast message "Camera permission denied" should appear.	A toast message "Camera permission denied" appears.	Pass
Leave description field empty	Show error message	Show error message	Pass
Leave area field empty	Show error message	Show error message	Pass
Leave image field empty	Show error message	Show error message	Pass
Simulate a failure during image upload	Show error message	Show error message	Pass
Fill in all the required fields, take a picture, and click the submit button.	1. A progress dialog should show up with the message "Uploading...". 2. The report should be successfully submitted, and a toast message "Report submitted successfully" should appear. 3. The user should be navigated to the view report page.	1. A progress dialog should show up with the message "Uploading...". 2. The report should be successfully submitted, and a toast message "Report submitted successfully" should appear. 3. The user should be navigated to the view report page.	Pass
Simulate a failure while saving data to Firebase	Show error message	Show error message	Pass

Table 6.1.12 Create Report Page

According to table 6.1.12 Create Report Page demonstrated consistent functionality across all test cases. The navigation using the "Back" button correctly directed users to the View Report

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85

page. The camera permission prompt worked as intended, both when allowed and denied, displaying the appropriate messages. Error messages were shown when required fields were left empty, ensuring data integrity. In scenarios involving image uploads and data saving to Firebase, the page handled failures appropriately by displaying error messages. When all required fields were filled, a picture was taken, and the submit button was clicked, the report was successfully submitted, and the user was navigated to the view report page. Overall, all test cases passed without issues, confirming the robustness and reliability of the Create Report Page's functionalities.

6.1.13 Collector View Report Form Page

Test Case	Expected Result	Actual Result	Status
Display Report Details Successfully	1. The image should be loaded from database 2. The description and area should be displayed.	1. The image is loaded from the database. 2. The description and area should be displayed.	Pass
Click the menu icon to show the popup menu.	A popup menu should be displayed with the "Delete" option.	A popup menu is displayed with the "Delete" option.	Pass
Click the "Delete" option in the popup menu.	A confirmation dialog should be displayed asking if the user is sure they want to delete the item.	A confirmation dialog is displayed asking if the user wants to delete the item.	Pass
Click "Yes" in the delete confirmation dialog.	The item should be deleted from database and a toast message should confirm the deletion.	The item is deleted from database and a toast message confirms the deletion.	Pass
Click "No" in the delete confirmation dialog.	The item should not be deleted, and the dialog should close.	The dialog closes without deleting the item.	Pass

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86

Press "Back" button	Navigate to View Report List page	Navigate to View Report List page	Pass

Table 6.1.13 Collector View Report Form Page

Table 6.1.13 View Report Form Page functioned as expected for all the tested scenarios. When displaying report details, the image was successfully loaded from the database, and both the description and area were displayed correctly. Interactions with the popup menu and delete confirmation dialog operated seamlessly, providing users with clear options for managing items. The "Back" button also navigated users back to the View Report List page as intended. All test cases passed without any issues, ensuring a smooth user experience and proper functionality of the page.

6.1.14 Manager Menu Page

Test Case	Expected Result	Actual Result	Status
Press "Report"	Navigate to Report page	Navigate to Report page	Pass
Press "Location"	Navigate to Location page	Navigate to Location page	Pass
Press "Setting"	Navigate to Setting page	Navigate to Setting page	Pass
Press "Logout"	Navigate to Main page	Navigate to Main page	Pass

Table 6.1.14 Manager Menu Page

Based on the table 6.1.14 Manager Menu Page functioned as expected across all test cases. Pressing the "Report," "Location," "Setting," and "Logout" buttons correctly navigated users to their respective pages without any issues. All interactions passed successfully, ensuring the expected navigation flow within the application and a smooth user experience.

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87

6.1.15 Manager View Report List Page

Test Case	Expected Result	Actual Result	Status
Press "Back" button	Navigate to Report page	Navigate to Report page	Pass
Click on the specific item	Navigate to the view report form page	Navigate to the view report form page	Pass

Table 6.1.15 Manager View Report List Page

Table 6.1.15 show that the Manager View Report List Page performed consistently and as expected for the tested scenarios. Clicking the "Back" button correctly navigated users to the Report page, and selecting a specific item successfully led users to the View Report Form page. Both actions passed without any issues, ensuring smooth navigation within the application.

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88

6.1.16 Manager View Report Form Page

Test Case	Expected Result	Actual Result	Status
Display Report Details Successfully	1. The image should be loaded from database 2. The description and area should be displayed.	1. The image is loaded from the database. 2. The description and area should be displayed.	Pass
Press "Back" button	Navigate to Manager View Report List page	Navigate to Manager View Report List page	Pass

Table 6.1.16 Manager View Report Form Page

Table 6.1.16 show that the Manager View Report Form Page operated as expected for the tested scenarios. When displaying report details, the image was successfully loaded from the database, and both the description and area were displayed correctly. Additionally, the "Back" button functioned as intended, directing users back to the Manager View Report List page without any issues.

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89

6.1.17 Settings Page

Test Case	Expected Result	Actual Result	Status
Press "Edit profile" button	Navigate to Edit Profile page	Navigate to Edit Profile page	Pass
Press "Change Password"	Navigate to Change Password	Navigate to Change Password	Pass
Press "About"	Navigate to About page	Navigate to About page	Pass
Press "Logout"	Show confirm logout custom dialog	Show confirm logout custom dialog	Pass
Press "Yes" of confirm logout custom dialog	Navigate to Login page	Navigate to Login page	Pass
Press "No" of confirm logout custom dialog	Exit confirm logout custom dialog	Exit confirm logout custom dialog	Pass
Press "back" button	Direct back to Menu page	Direct back to Menu page	Pass

Table 6.1.17 Settings Page

According to Table 6.1.17 the Settings Page performed consistently and as expected across all test cases. Pressing various buttons such as "Edit Profile," "Change Password," "About," and "Logout" correctly navigated users to their respective pages or displayed the appropriate dialogs. The "back" button also functioned correctly, directing users back to the Menu page. All interactions with the custom dialogs, including the confirm logout dialog, operated as intended, ensuring a smooth user experience.

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90

6.1.18 Edit Profile Page

Test Case	Expected Result	Actual Result	Status
Leave name field empty	Show error message	Show error message	Pass
Press "Camera" icon	1. Navigate to gallery of device 2. User can pick image from gallery	1. Navigate to gallery of device 2. User can pick image from gallery	Pass
Press "Save" icon	1. User data is updated in database 2. Show "Profile updated successfully"	1. User data is updated in database 2. Show "Profile updated successfully"	Pass

Table 6.1.18 Edit Profile Page

Based on the results from Table 6.1.18, the Edit Profile Page functioned as expected. All test cases passed without issues, demonstrating the system's capability to manage empty fields, navigate to the device gallery via the "Camera" icon, and update user data in the database upon pressing the "Save" icon. Users were also provided with appropriate feedback through error messages and a success confirmation message.

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91

6.1.19 Change Password Page

Test Case	Expected Result	Actual Result	Status
Leave current password field empty	Show error message	Show error message	Pass
Leave new password field empty	Show error message	Show error message	Pass
Leave confirm new password field empty	Show error message	Show error message	Pass
New password not same with confirm password	Show error message	Show error message	Pass
New password length not greater than 5	Show error message	Show error message	Pass
Enter wrong current password	Show "Invalid current password"	Show "Invalid current password"	Pass
Press "back" button	Direct back to Settings Page	Direct back to Settings Page	Pass
Press "Save" icon with valid inputs	1. Password is updated in database 2. Show "Password changed successfully"	1. Password is updated in database 2. Show "Password changed successfully"	Pass

Table 6.1.19 Change Password Page

Based on Table 6.1.19 for the Change Password Page, all test cases passed successfully, validating the functionality of the password change feature. The system correctly handled various scenarios such as empty fields, mismatched passwords, and incorrect inputs, displaying appropriate error messages. Additionally, valid password changes were saved to the database, with a confirmation message displayed to the user.

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92

6.1.20 About Page

Test Case	Expected Result	Actual Result	Status
Press "back" button	Direct back to Settings page	Direct back to Settings page	Pass

Table 6.1.20 About Page

Based on Table 6.1.20, the "back" button on the About Page functions as expected, directing users back to the Settings page without any issues.

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93

6.2 Project Challenges

First and foremost, Android Studio faces challenges and constraints in its implementation of garbage classification and recycling. This is due to the difficulty I have in implementing the garbage detection method. This means that in order to successfully implement this functionality, I must develop my own solution. It can be time-consuming and advanced, requiring ongoing upgrades and maintenance.

Another challenge is that a large number of collectors utilizing this application must be able to handle the load without failing. In this instance, I need to ensure that the programme is scalable enough to handle multiple concurrent users.

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94

6.3 Objectives Evaluation

Objective	Evaluation	Conclusion
To study the relevant features of smart bin application.	The aim of the study is to understand how waste collection activities can be organized more efficiently. The smart bin application offers a comprehensive set of features including scheduling tasks, map view feature, and reporting capabilities to streamline waste collection and management processes.	Achieved
To develop a mobile apps for smart bin applications for Kampar.	Focus on developing a special mobile app for Kampar to assist with smart bin functionality. In order to effectively use smart bin systems and receive real-time updates on waste collection schedules and operating status, map views and reporting capabilities to improve waste collection efficiency, a user-friendly and intuitive mobile application must be designed, built and deployed.	Achieved
To evaluate the development features of smart bin application	Conduct a comprehensive evaluation of the functionality created for the smart box application. The main goal is to thoroughly test and validate the features added during the application development phase. This project aims to ensure the stability, reliability and user-friendliness of the Smart Bin App customized for Kampar by systematically analyzing these functions.	Achieved

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95

CHAPTER 7

Conclusion and Recommendation

This chapter will cover the conclusion and provide recommendations.

7.1 Conclusion

This project involves developing a smart bin system for collectors and administrators using a mobile application. On the collector side, there are now 13 capabilities available, including login and logout, password reset, profile update, profile image upload from device, schedule creation, schedule deletion, schedule view, and notification when a selected schedule is met, create report, delete report, view report, and use the location feature to identify the route between the collector's present location and destination. On the manager's side, there are 7 functionalities available: login and logout, password reset, profile update, profile image upload from device, report view, and location function, which allows the manager to find the path between their present location and destination.

As a result, the project succeeded by creating a comprehensive smart bin system that fits the needs of both collectors and administrators. This system seeks to modernise waste collection management by leveraging technology to improve operational efficiency, transparency, and user pleasure.

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96

7.2 Recommendation

Given the successful creation and implementation of the smart bin system for collectors and administrators, it is critical to prioritise continual improvement and user feedback. First, we propose that both collectors and managers receive frequent user training sessions to ensure that they completely grasp and successfully use all available functions. This will help to maximise the system's benefits while also ensuring smooth everyday operations. Furthermore, getting user input on their experience with the mobile application might provide useful insights for future updates and improvements.

Furthermore, given the rapid improvements in technology, it would be prudent to investigate incorporating new functions or modules into the system. For example, implementing real-time monitoring capabilities using IoT sensors could improve operating efficiency by delivering live data on bin condition and fill levels. Furthermore, adding predictive analytics could aid in forecasting waste generation patterns, allowing for improved planning and resource allocation. By remaining proactive and adaptable to technological advances and consumer needs, the smart bin system may continue to improve and set new benchmarks in waste collection management.

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97

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98

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99

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: T3Y3	Study week no.: 6
Student Name & ID: Beh Shin Yi	
Supervisor: Dr Ahmad Hakimi Bin Ahmad Sa'ahiry	
Project Title: Development of Smart Bin Apps for Kampar Residence	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

    i.   Schedule notification

2. WORK TO BE DONE

    i.   Schedule notification vibration
    ii.   Location-based

3. PROBLEMS ENCOUNTERED

    i.   No

4. SELF EVALUATION OF THE PROGRESS

    i.   Need to work harder.

_____ _____

Supervisor's signature Student's signature

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100

FINAL YEAR PROJECT WEEKLY REPORT
(Project II)

Trimester, Year: T3Y3	Study week no.: 10
Student Name & ID: Beh Shin Yi	
Supervisor: Dr Ahmad Hakimi Bin Ahmad Sa'ahiry	
Project Title: Development of Smart Bin Apps for Kampar Residence	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

    i.   Schedule notification vibration
   ii.   Chapter 2 Literature Review

2. WORK TO BE DONE

    i.   Chapter 1 Introduction

3. PROBLEMS ENCOUNTERED

    i.   No

4. SELF EVALUATION OF THE PROGRESS

    i.   Need to work harder

_____   _____
Supervisor's signature   Student's signature

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101

FINAL YEAR PROJECT WEEKLY REPORT
(Project II)

Trimester, Year: T3Y3	Study week no.: 11
Student Name & ID: Beh Shin Yi	
Supervisor: Dr Ahmad Hakimi Bin Ahmad Sa'ahiry	
Project Title: Development of Smart Bin Apps for Kampar Residence	

1. WORK DONE
[Please write the details of the work done in the last fortnight.]

    i.   Chapter 1 Introduction

2. WORK TO BE DONE

    i.   Location-based
   ii.   Report function

3. PROBLEMS ENCOUNTERED

      5.   No

4. SELF EVALUATION OF THE PROGRESS

   ii.   Need to work harder.

_____

Supervisor's signature

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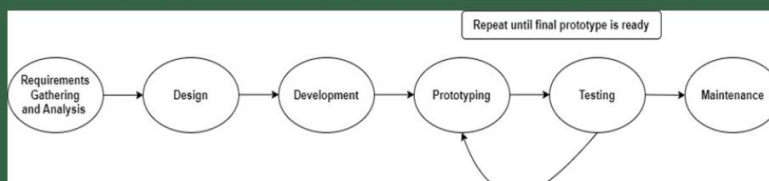
102

POSTER

INTRODUCTION

With a background in waste management and a strong interest in sustainability, I believe in using smart solutions to create cleaner, more efficient urban environments. This project, focused on developing a smart bin application for Kampar, aims to revolutionize waste management through innovative technology.

OBJECTIVE

- **Schedule Function:** Customizable daily task planning for collectors.
- **Location Module:** Visualize collection regions on a map.
- **Report Module:** Report unauthorized dumping or overflowing bins.

METHODOLOGY

Repeat until final prototype is ready

Requirements Gathering and Analysis → Design → Development → Prototyping → Testing → Maintenance

Mobile Application Development Lifecycle

CONCLUSION

Integrating advanced features and leveraging technology, we aim to modernize waste management, improve efficiency and user experience, and create cleaner, smarter cities.

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103

PLAGIARISM CHECK RESULT

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Signature of Supervisor   Signature of Co-Supervisor

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109