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COLLEGE OF INFORMATICS AND COMPUTING SCIENCES

RESOURCEHUB: A MOBILE APPLICATION FOR SUSTAINABLE RESOURCE EXCHANGE IN THE CIRCULAR ECONOMY

A Capstone Project Presented to the Faculty of the
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The National Engineering University
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In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Information Technology
Major in Business Analytics

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APPROVAL SHEET

This Capstone Project entitled **"RESOURCEHUB: A MOBILE APPLICATION FOR SUSTAINABLE RESOURCE EXCHANGE IN THE CIRCULAR ECONOMY"** prepared and submitted by **ALZONA, ROVIC ANDREA T., AMPLOYO, JANINE C., RAMOS, JOSEPH WILLIAM C.** in partial fulfillment of the requirements for the Degree**, Bachelor of Science in Information Technology Major in Business Analytics,** has been examined and is recommended for Oral Examination.

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The Developers

DEDICATION

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R.A.T.A

J.C.A

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EXECUTIVE SUMMARY

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The Executive Summary is typically several paragraphs long. It summarizes everything about the project. It includes the idea behind the conceptualization of the project, its significance, the project's major functionalities, the implementation techniques, results, conclusions and recommendations.

It should briefly highlight the following:

i. A clear articulation of systems requirements,

ii. The importance of developing a software application or technology to solve specific systems need,

iii. The proposed application developed to address specific systems need, the recommended infrastructure and manpower training to operationalize the use of the developed software application or technology (if applicable)

iv. The implications on other systems

Executive Summary normally should not include any reference to the literature.

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CHAPTER 1

INTRODUCTION

The rapid increase in solid waste generation presents a significant challenge, demanding immediate solutions. According to the World Bank, approximately 2.01 billion tonnes of municipal solid waste are produced globally each year, with over one-third of this waste not being disposed of through environmentally sustainable methods [1]. The linear approach to resource consumption follows a “take, make, dispose” framework, where resources are extracted, processed into products, and eventually discarded as waste. This model drives resource depletion by relying heavily on finite natural materials, exhausting reserves and undermining environmental stability. Furthermore, the disposal of waste in this manner contributes to ecosystem degradation, harming biodiversity and polluting air, water, and soil [2]. One such solution is the implementation of an effective solid waste management system, which transforms waste into secondary materials and energy, all while safeguarding ecosystem health. The concept of circular economy breaks away from the traditional linear model, which focuses on one-way resource consumption. Instead, the circular economy emphasizes the continuous and cylical use of materials, energy, and resources within a system, ensuring that they remain in use for as long as possible [3]. The circular economy is centered on establishing

a closed-loop system that prioritizes reducing waste generation and optimizing resource use through sustainable practices. By incorporating circular economy principles into waste management, it becomes feasible to address the environmental challenges posed by traditional linear models, which are often characterized by excessive resource extraction and significant waste disposal [4]. The closed-loop approach emphasizes sustainability by promoting the continuous use of materials within the production and consumption cycle [5]. International cities such as Copenhagen and Amsterdam have implemented circular economy principles into their waste management strategies to promote sustainability and reduce environmental impact. By adopting these principles, both cities have significantly minimized their reliance on landfills and achieved higher recycling rates [6]. Traditional waste management methods, such as incineration and landfilling, are no longer sustainable in the face of mounting environmental and economic pressures. In response, the circular economy model offers a sustainable alternative by promoting the continuous use of materials through practices like reuse, recycling, and resource recovery.

Despite increasing public awareness, many individuals and businesses continue to struggle with practical solutions for managing surplus products and excess materials. According to the study of Radu et al. [7], the linear economy is as

system where companies focus solely on producing goods from resources to meet community needs, without takibg accountability for the environmental consequences of disposing unused or surplus goods into landfills. That is why linear approach is identified as a major contributor to climate change and ecosystem degradation, as it encourages excessive resource consumption and waste generation, resulting to harmful impacts on the environment, such as pollution and biodiversity loss. In industries like horticulture, systematic overproduction leads to surplus products becoming waste due to institutional, cultural, and material factors, termed "surplus-to-waste lock-ins." Addressing this issue requires proactive, system-wide approaches that focus on waste creation processes throughout the supply chain [8]. The lack of accessible tools for redistributing usable goods leads to unnecessary waste and underutilization of valuable resources. To bridge this gap, this study presents ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy. ReSourceHub is a digital application designed to enable companies, communities, and consumers to list, browse, and exchange surplus resources in a streamlined, efficient manner. By leveraging smart technologies and real-time data, the app empowers users to reduce waste, lower costs, and actively participate in a more sustainable resource management ecosystem.

ReSourceHub is aligned with the core principles of the circular economy, which Geisendorf and Pietrulla [9] describe as a sustainability-driven model that redefines conventional production and consumption. Their study emphasizes that circularity must be grounded in practical frameworks that encourage economic regeneration, restorative systems, and a shift away from linear models of disposal. This mobile solution also directly supports several United Nations Sustainable Development Goals (SDGs), particularly SDG 12 on responsible consumption and production, SDG 13 on climate action, SDG 9 on industry, innovation, and infrastructure, and SDG 11 on sustainable cities and communities. Through its design and purpose, ReSourceHub encourages users to participate in reducing waste, maximizing the use of resources, and contributing to environmentally sound practices that support global sustainability targets.

The significance of this project lies not only in its technological innovation but also in its potential to foster long-term behavioral change. Through ReSourceHub, users are encouraged to rethink waste as a resource, thereby contributing to a greener future, smarter consumption, and more resilient communities.

Project Context

In an era where resource depletion and environmental pollution are growing concerns, sustainable practices are no longer optional but imperative. One of the most significant challenges facing both individuals and businesses today is the efficient management and exchange of resources to reduce waste and ensure responsible consumption. Despite the growing awareness of environmental issues, many businesses and consumers still face barriers when it comes to recycling or repurposing surplus materials. Traditional waste management methods such as incineration, landfilling, and even conventional recycling have proven to be ineffective and insufficient in addressing the scale of global waste generation. Waste incineration processes toxic pollutants, substances that are released into the air through incinerator emmissions, posing severe risks to human health. Heavy metals, once released, can contaminate air, water, and soil, making them difficult to control and eliminate. Incineration often undermines recycling efforts by diverting potentially recyclable materials to incinetors instead [10]. Landfilling remains a widely accepted method for the final disposal of municipal solid waste due to its economic advantages. It involves disposing, compressing, and covering waste at designated sites. Lanfilling, specifically open dumping remains popular due to its affordability and lower technical requirements, particularly in countries with limited waste management infrastructures. However, the environmental risks of landfilling,

including methane emissions, groundwater contamination, and biodiversity loss. Emphasizing the long-term ecological damage caused by landfill sites [11]. Furthermore, conventional recycling has long been regarded as a solution for reducing waste and promoting environmental sustainability. While this approach proved to contribute to minimizing waste, it faces numerous limitations in addressing the scale and complexity of global waste generation. In the context of material degradation, recycling processes often lead to the deterioration of material quality, making it difficult to reuse materials, technological limitations hinder handling complex waste, and insufficient infrastructure leads to reliance on less sustainable methods such as landfilling and incineration [12]. These methods often fail to maximize the value of materials, leading to their premature disposal and continued environmental degradation.

The need for a more effective, innovative solution has never been more urgent. This is where ReSourceHub comes into play. The project introduces a mobile application designed to facilitate sustainable resource exchange, bridging the gap between those with surplus materials and those in need of resources. Through this application software, businesses, communities, and individuals can list, browse, and trade surplus goods, creating a marketplace for materials that would otherwise contribute to environmental harm. By promoting the principles of the

circular economy, ReSourceHub not only reduces waste but also creates a system where materials are reused and recycled, thereby conserving resources and reducing the environmental footprint.

Traditional methods of resource disposal and management are increasingly insufficient in a world where consumption patterns are evolving at a rapid pace. Landfills and incinerators are reaching their capacity, and while recycling programs exist, they often require significant infrastructure and do not always encourage widespread participation. Furthermore, businesses often struggle to dispose of surplus materials responsibly, leading to wasted resources and unnecessary costs. ReSourceHub addresses these issues by offering a simple, accessible application program that connects users, streamlining the process of resource exchange.

The decision to develop ReSourceHub stemmed from a clear recognition that the traditional approach to waste management simply is not enough. It fails to offer a seamless way for businesses and individuals to exchange surplus goods, contributing to inefficiency and environmental harm. By integrating smart technology, real-time data, and user-friendly features, ReSourceHub provides an innovative solution to these challenges. This mobile app not only empowers users to engage in sustainable practices but also fosters a culture of resource sharing and environmental responsibility.

ReSourceHub aims to revolutionize the way we think about waste by transforming it into a valuable resource. By utilizing technology to facilitate the exchange of surplus goods, the app makes it easier for users to contribute to the circular economy, reduce waste, and conserve resource, ultimately helping to create a more sustainable future for all.

Purpose and Description

The purpose of this project is to evaluate the effectiveness of community recycling program in reducing solid waste and to develop a mobile application for the City of Sto. Tomas that facilitates sustainable resource exchange for residents and local businesses. While the application will feature tools for sustainable resource exchange within the context of the circular economy by trading surplus resources, thus promoting sustainability and reducing waste ensuring that resources are continually reused rather than discarded.

The management of solid waste is recognized as a significant global challenge that necessitates immediate solutions from governments and their citizens. In the Philippines, as one of the nations experiencing a continuous increase in solid waste generation, the issue is projected to intensify in the years to come. The challenges in solid waste management are attributed to the growing volume of waste due to weak law enforcement, limited availability of sanitary landfills, and

improper disposal practices. Without effective waste disposal measures, these problems can lead to rapid environmental degradation. Common consequences include land pollution, water contamination, air pollution, climate change, and the spread of diseases. To address this pressing issue, the government has implemented laws such as Republic Act No. 9003, also known as the Ecological Solid Waste Management Act of 2000 [13]. This legislation emphasizes practices such as segregation, proper waste disposal, and waste diversion, empowering communities and individuals to adopt environmentally friendly habits and promoting sustainable waste management strategies.

Furthermore, another potential solution to solid waste management problems, apart from legislative implementation, is valorization. Valorization is a waste-to-resource technique that emphasizes processes such as recycling, reusing, and converting materials into valuable resources. This method helps mitigate environmental challenges, including the depletion of natural resources. However, despite the existence of comprehensive approaches to waste management, their application within communities remains limited due to various challenges, such as the lack of access to advanced technologies. Additionally, inadequate local support and the absence of robust government policies may hinder the execution of such solutions. Alternative strategies include smart waste management systems and

community-driven initiatives, which, if properly supported and implemented, can significantly enhance waste management while addressing the needs of individual communities.

The proponents designed a system to benefit a diverse group of users, particularly focus on residents, communities, local businesses, and local government of City of Sto. Tomas. This system aims to create a user-friendly application that empowers individuals, businesses, and communities to actively participate in the circular economy by promoting sustainable practices and resource exchange. The system will feature a login and registration page where users will be required to create an account using their personal information for registration. Once registered, users can log in using their credentials to access the system. During registration, users will have two account type options: Individual Account and Business Account. The Individual Account is designed for regular users who do not operate a business. These users may focus on personal participation in resource exchange or sustainability efforts. In contrast, the Business Account is tailored for users who own or manage business and wish to participate in trade or collaborative activities through the app. This distinction allows the system to cater to the specific needs and roles of both individuals and businesses effectively.

The system will include a comprehensive user module, enabling users to create personalized profiles, post and manage resource listings, and efficiently search for available materials. To enhance user experience, the system will incorporate a smart matching feature that suggests relevant resource exchanges based on the user preferences. Both individual and business account users will have the ability to view and contact the owners of listed materials to initiate transactions. A messaging system will be integrated to facilitate smooth communication between users, ensuring efficient negotiation and coordination. To further support seamless transactions, offering multiple exchange modes, such as direct barter and auction-based trading, to ensure fair distribution among participants. Moreover, users will have the option to utilize a third-party payment gateway for financial transactions, providing flexibility and security. The application software will include resource verification and image-based features, ensuring the authenticity and quality of listed materials, with detailed transaction tracking and history logs.

On the other hand, the system will also define an administrative role to oversee and manage activities. The admin will be able to manage user accounts, monitors activities and transactions for security, moderate content by approving or rejecting listings, resolves disputes, handles user feedback for system improvement, and generates detailed performance reports. In addition, to support these

administrative functions, the system provides a dashboard with graphical representations, such as charts and graphs. This allows the administrator to monitor the overall performance and user engagement within the application effectively.

The beneficiaries of this project are diverse, encompassing the entire community of Sto. Tomas City, with the goal of promoting a circular economy. Firstly, the residents and local businesses in Sto. Tomas City will benefit directly from this project, which serves as a digital marketplace for trading or exchanging resources. Local businesses, in particular, can use the software application to responsibly manage resources and contribute to eco-conscious practices. Second, the administrators will benefit from tools that allow them to manage user accounts, monitor activities in real time, and ensure smooth operations. They can also track user activities, moderate content, and resolve disputes to improve system performance. Third, the communities within Sto. Tomas City will benefit by actively participating in resource exchange. The participation fosters a culture of sustainability and collective responsibility, encouraging collaboration among residents and local enterprises. Fourth, as a key partner in this project, the City Department of Environment and Natural Resources Office (City ENRO) of Sto. Tomas stands to gain significant advantages. The application provides tools to help the city department, enabling the optimization of waste management practices by

recycling and reusing potential surplus materials. Fifth, the City of Sto. Tomas itself is a major beneficiary, as the implementation of the application will improve local waste management processes. By transforming waste into valuable resources through the circular economy approach, the system helps the city to move closer to achieving its sustainability goals. Sixth, this project will provide an opportunity for further exploration and innovation for future researchers who can expand the study to meet the evolving needs of the economy. Lastly, the project will also benefit its proponents, as they gain practical experience contributes to their professional growth and expertise in creating technological solutions.

Objectives of the Study

The main objective of this study is to develop ReSourceHub, a mobile application aimed at facilitating sustainable resource exchange within the framework of the circular economy. This digital application will serve as a marketplace for individuals, businesses, and communities to trade surplus materials, promoting sustainability and reducing waste. The development of ReSourceHub will address the need for an accessible and efficient software application that encourages the reuse and exchange of resources, reducing the reliance on traditional waste disposal methods and supporting a more sustainable, circular approach to resource management.

The specific objectives of the study are as follows:

1. Develop a sustainable resource exchange application software that will:

    1.1. Serve as a marketplace where users can list and browse surplus materials for exchange.

    1.2. Implement a smart matching system to suggest relevant resource exchanges based on user preferences and needs.

    1.3. Provide real-time inventory updates to ensure accurate resource availability tracking.

    1.4. Introduce an Auction-Based Exchange Option

        1.4.1 Enable users to bid for high-demand resources, ensuring fair distribution.

2. Develop a user module that will:

    2.1. Allow users to create and manage profiles for individuals and businesses.

    2.2. Enable users to post, edit, and remove resource listings.

    2.3. Include a search and filter function to help users find resources efficiently.

    2.4. Implement a secure messaging system to facilitate negotiations and transactions.

2.5. Provide user ratings and reviews to ensure trust and reliability in transactions.

2.6. Provide real-time alerts for relevant resource listings, messages, and trade opportunities.

2.7. Enable Resource Verification

2.7.1 Allow users to assess the authenticity and quality of listed resources and auctions through image-based inspection.

2.8. Implement a Secure Transaction System for Seamless Exchanges

2.8.1 Multiple Transaction Modes

2.8.1.1 Direct Exchange (One-to-One Barter)

2.8.1.2 Auction-Based Trading

2.8.1.3 Monetary-Based Transaction

2.8.2. Transaction Tracking with Status Updates & History Logs

2.8.2.1 Transaction Status Updates: Users receive automated updates for key transaction stages:

2.8.2.1.1 Pending**:** The offer is submitted and awaiting acceptance.

2.8.2.1.2 In Progress: The trade is being processed.

2.8.2.1.3 Completed: The exchange is finalized, and both parties confirm receipt.

2.8.2.1.4 Disputed: A user has raised an issue, requiring admin intervention.

2.8.2.1.5 Cancelled: The transaction is voided due to user or system action.

2.8.2.2 Transaction History & Logs:

2.8.2.2.1 Users can review past transactions, including timestamps, exchanged resources, and counterparties.

2.8.2.3 Proof of Exchange & Digital Receipts:

2.8.2.3.1 Users receive digital trade confirmations for tracking and verification.

2.8.3. Secure Payment Integration for Monetary Payment and Aucttion-Based Transactions

2.8.3.1 Secure Payment Gateway for Money and Auction-Based Purchases

2.8.3.1.1 Multi-Factor Authentication (MFA) ensures secure transactions.

2.8.3.1.2 Using third-party payment gateway (GCash).

3. Develop an administrator module that will:

3.1. Manage user accounts, including authentication and verification of resource listings.

3.2. Provide insights and reports on platform activity, user engagement, and impact metrics.

3.3. Implement fraud detection mechanisms to prevent misuse and unauthorized activities.

3.4. Send notifications and alerts about relevant listings, updates, and policy changes.

3.5. Provide a dashboard with features such as:

3.5.1 User Management Panel

3.5.1.1 View and suspend user accounts.

3.5.1.2 User activity tracking and login history.

3.5.1.3 Manage auction listings and view bidding activities.

3.5.1.4 Monitor and manage user transactions.

3.5.2. Resource and Auction Listing Verification

3.5.2.1 Approve or reject resource and auction listings.

3.5.2.2 Track listings status and resource shortages.

3.6. Dispute Resolution

3.6.1. User Dispute Handling

3.6.1.1 Allow users to report fraudulent transactions or conflicts.

3.6.1.2 Admins can investigate, mediate, and take corrective action.

4. Implement an analytics module that will:

4.1. Provide descriptive analytics to summarize platform usage trends, including:

4.1.1 Number of active users and listings.

4.1.2 Most exchanged resource categories.

4.1.3 Geographical distribution of exchanges.

4.2. Offer prescriptive analytics to provide recommendations for:

4.2.1 Optimizing resource allocation.

4.2.1.1 Identify peak trading periods.

4.2.1.2 Provide location-based insights for optimal resource redistribution.

4.2.2 Enhancing user engagement strategies.

4.2.2.1 Provide personalized content and notifications based on user preferences.

4.3. Utilize predictive analytics to analyze trends in resource demand and supply, helping businesses and communities plan sustainable practices.

5. To test and evaluate the developed system using:

    5.1 Test case; and

    5.2 ISO/IEC 25010 2011 software evaluation criteria in terms of;

        5.2.1 Functionality Suitability;

        5.2.2 Performance Efficiency;

        5.2.3 Reliability; and

        5.2.4 Usability;

6. Develop an implementation plan for the application;

Scope and Limitations of the Study

The ReSourceHub application is designed to provide a digital space where users can list available resources for exchange, search for materials they need, and conduct transactions that support sustainability and reduce waste. It specifically caters to residents and local businesses in Sto. Tomas City who may have surplus products or unused items that can be repurposed. The proposed project encourages responsible resource use while promoting the principles of the circular economy within the community.

The applicationn includes several features to enhance functionality and ease of use. It offers a smart matching system that suggests resource exchanges based on user preferences and needs. This feature improves the accuracy of resource

recommendations, making transactions more efficient for users. In addition, the platform incorporates real-time inventory updates that automatically reflect changes in the availability of resources. This prevents issues such as overselling or purchasing items that are no longer available, while reducing the need for manual updates and ensuring reliability. The system also provides a user module that allows individuals and businesses to create and manage profiles. Users can post, edit, and remove resource listings as needed and use advanced search and filter functions to locate specific items efficiently. To support communication between users, the platform integrates a secure messaging system, enabling smooth negotiations for transactions. Notifications and alerts are also included to keep users informed about new listings, messages, or trade opportunities, ensuring active engagement.

For transactions, the system supports multiple exchange modes, such as direct barter, auction-based trading, and fixed-price listings. For monetary transactions, users can rely on secure payment gateways and Multi-Factor Authentication which helps safeguard user transations. The administrative module equips platform administrators with tools to manage user accounts, verify resource listings, monitor platform activities, and enforce compliance with policies. Administrators can also generate detailed reports on system activities, resource exchanges, and sustainability outcomes. Additional features for content moderation

and dispute resolution are included to maintain the quality of interactions and ensure user satisfaction. The platform also provides administrators with a real-time dashboard featuring graphs and charts to monitor performance metrics and user engagement effectively. Finally, the system includes an analytics module that offers descriptive, prescriptive, and predictive analytics. These features summarize platform usage trends, provide actionable strategies to optimize operations and encourage user participation, and analyze resource demand to support proactive planning for sustainability.

On the other hand, the application will require an active internet connection to function effectively, as the reliability of data synchronization between users and administrators depends entirely on real-time connectivity. Additionally, the platform is initially intended for implementation within Sto. Tomas City only. This is because the system is specifically designed to address the unique needs and circumstances of the community in Sto. Tomas City. Moreover, the analytics module relies heavily on real-time user activity data to generate reports and predictions. To ensure the reliability and relevance of the analytics output, the system requires high-quality and frequent data inputs from its users. This dependency underscores the importance of user engagement for accurate analytics. The application is also designed to operate on Android operating systems during its

initial phases. However, it can be enhanced due to its iOS compatibility for future versions to improve the platform's features, performance, and overall user experience. As a result, users on operating systems other than Android will not have access to the application during its early stages. Furthermore, the application will specifically focus on surplus resources related to sustainability and the circular economy. These include material and equipment that can be repurposed or reused. However, the system will not handle all types of resources outside these categories, limiting its applicability to broader resource management. While the platform includes a secure transaction system to strengthens the payment security, the overall security of transactions depends on users adhering to platform rules and maintaining accurate transaction records. Integrating ReSourceHub with external platforms or third-party systems, such as payment gateways, may also pose challenges and could require custom development. This dependency on external systems is essential for ensuring secure and efficient payment transactions.

In addition, the effectiveness of the inventory management system is reliant on users providing timely and accurate updates regarding the availability of resources. Inaccurate or outdated resource listings may compromise the system's reliability and decreasse its utility for users. ReSourceHub will also not include features for verifying user attendance or tracking the physical delivery of resources

during exchanges. Instead, the platform is primarily focused on facilitating the scheduling and management of the exchange process. As such, users will not be required to confirm their physical presence for exchanges through the app, and the system will not monitor or provide updates on the transportation or delivery status of resources. Finally, the performance of the system may vary based on factors such as the user's device, network conditions, and individual settings. These factors could affect the functionality of real-time updates, notifications, and the overall usability of the platform.

Definition of Terms

This section provides definitions for key terms and concepts used throughout the study of ReSourceHub, offering clarity and consistency in understanding. Many of these terms are integral to the system's design and functionality, while others may be more technical in nature. The definitions provided will help readers understand how these terms are used within the context of the project and ensure a common understanding of the terminology critical to the development and operation of the platform. By defining terms operationally, we aim to foster clearer communication and better comprehension of the system's objectives, structure, and expected outcomes.

API (Application Programming Interface): Application Programming Interface or API acts as a contract between different software applications, ensuring they can work together seamlessly [14]. This system is a set of tools and protocols that allow different software applications to communicate with each other. In ReSourceHub, APIs will be used to integrate the mobile app with other platforms, allowing for efficient data transfer and system interaction.

Circular Economy: A circular economy is a model of production and consumption aimed at reducing waste and the continual use of resources [15]. In the context of ReSourceHub, the circular economy involves the exchange, reuse, and recycling of resources to promote sustainability.

Closed-loop Approach: A system designed to reduce waste and environemtal harm by creating processes that optimize the use of resources and ensuring materials are recycled [16]. This framework functions by keeping resources in use for as long as possible rather than discarded. In this system, it directly supports the optimization of resource use by connecting indiviuals and organizations with surplus materials who can make practical use of them.

Descriptive Analytics: Fundamental branch of data analysis focused on interpreting historical data to understand past events within a business or

organization [17]. It helps to uncover trends, patterns, as well as relationships by collecting, summarizing, and presenting data. In the context of ReSourceHub app, descriptive analytics could be applied to analyze platform usage trends, resource exchange, and user engagement, helping to optimize its features and improve overall functionality.

Linear Model: Traditional linear economy, often described as "take-make-dispose", hinders efforts to achieve environmental sustainability, sustainable economic growth, social welfare, and environmental protection [18]. It is a process of extracting raw materials, manufacturing products to meet demand, and discarding them as waste once they are no longer useful. ReSourceHub system transforms surplus materials into valueable resources, integrating them into a closed-loop system where materials are continuously reused, redistributed, or repurposed.

ML (Machine Learning): Significant branch within the broader filed of Artificial Intelligence (AI) and a multidisciplinary domain that blends statistical methods with computer science algorithms to create systems capable of learning patterns from data [19]. In ReSourceHub application, it is designed to analyze amounts of product data to uncover patterns and trends.

Predictive Analytics: This analytic proved to empower organizations to anticipate future events with remarkable accuracy and involves examining historical data to identify patterns and trends that can help forecast outcomes [20]. In the context of ReSourceHub, the predictive analytics can play a transformative role by analyzing trends in resource demand and supply to provide actionable insights.

Prescriptive Analytics: It is an advanced approach that goes beyond simply predicting future outcomes, it focuses on providing actionable recommendations to help decision-makers choose the best course of action [21]. In this system, the use of prescriptive analytics could enhance the ability of the application to provide actionable recommendations for resource management.

Smart Matching System: This can be system that uses artificial intelligence (AI) to improve the process of matching precision [22]. A feature in the application that suggests relevant resource exchanges based on user preferences and needs. In this system, it uses algorithms to recommend potential matches for users, facilitating more efficient and relevant exchanges.

Sustainability Metrics: Tools or indicators designed to assess and measure the sustainability of a system, process, or activity [23]. Quantitative measures used to assess the environmental impact of transactions and resource exchanges. These

metrics help users track their sustainability contributions and make informed decisions about their resource exchanges.

Third-Party Payment Gateway: Platform that connects consumers, banks, and businesses, simplifying the process of transferring money by reducing the time funds circulate between parties [24]. This enables advanced technology and streamlines transactions while improving efficiency and overall convenience for all parties involved. In this system, the integration of third-party payment gateway (GCash) could enhance the reliability of the payment process, simplifies transaction while ensuring the safety of funds being transferred.

CHAPTER 2

REVIEW OF RELATED SYSTEMS

This section explores and examines existing technology-driven sustainability solutions and their significance in academic and technology development, providing related systems and it involves the software processes followed during the entire development of the system.

Technical Background

In contemporary times, the increasing complexity of waste management, driven by urbanization and heightened consumption, necessitates innovative solutions to address the challenges of utilizing potential waste and minimizing excessive resource usage which are among the key factors contributing to this complexity. Consequently, various studies have been evaluated to explore effective strategies for waste management that align with sustainability objectives, including waste reduction, responsible consumption, and community empowerment. Recognizing the role of mobile technologies as dynamic tools that streamline processes, connect users, and foster collaboration, the proposed system, ReSourceHub, aims to facilitate resource exchange and promote environmentally responsible practices. This initiative seeks to reshape the management and sharing of resources. The development of ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy serves as a specialized

mobile platform designed to enable resource exchange within the framework of the circular economy in Sto. Tomas City, Batangas.

The proposed system aims to reduce and convert waste into resource by connecting users who need items with those who can offer them, this supports the circular economy principles. To support the requirements to the development and features of the ReSourceHub platform, several programming tools and technologies were selected. These tools were chosen for the applicability and alignment with development processes. With the help of backend development, which deals with data processing, tasks and events are stored in a database which acts as the backend of the system ensuring that all the data created by the user is stored securely and can be accessed when needed. The functionality of the frontend development emphasizes the graphical user interface and user experience within the application, ensuring a smooth and intuitive experience for its users. Regular users can conveniently access the system through their mobile phones, while administrators can monitor and oversee the system effectively via web browsers.

The developers aim to develop the ReSourceHub initially available on the Android Operating System (OS) for target users, who are the residents or members of Sto. Tomas City, Batangas. The proponents' intent to utilize the said operating system to be widely accessible to the target users, as Android is known to be the most widely used mobile operating system in the world and enables the user to reach

larger and more diverse group of users. The mobile application was specifically designed to cater the specific needs for seamless resource exchange and communication of the regular users. While there are various mobile operating systems, each offering their own distinct features and advantages, Android continues to play a vital role as preferred platform, particularly for applications targeting broader audience, making it suitable for the development of the ReSourceHub.

To meet the functional and non-functional requirements of the ReSourceHub platform, a carefully selected set of software tools, frameworks, and technologies will be adopted. These technologies will be chosen based on their reliability, scalability, development efficiency, and alignment with the platform's mission to facilitate responsible resource-sharing and sustainability-driven collaboration. The system will consist of two main platforms: a mobile application intended for end users and a web-based dashboard tailored for administrative functions. These platforms will be seamlessly integrated via cloud services to ensure synchronized data exchange and a consistent user experienceThe mobile application will be developed using Flutter, an open-source UI toolkit from Google that supports cross-platform development. Flutter will allow the team to create a high-performance mobile app from a single codebase that runs on both Android and iOS devices. Dart, the programming language behind Flutter, will be used to deliver fast rendering,

native-like performance, and a rich user interface. To support financial transactions within the app, Dragonpay will be integrated as the payment gateway, ensuring secure and localized transaction processing.

The administrative dashboard and web-based services will be built using the MERN stack, composed of MongoDB, Express.js, React.js, and Node.js. This full-stack JavaScript architecture will provide robust backend services and a responsive, interactive frontend. The use of modern styling utilities like Tailwind CSS and accessible UI libraries such as shadcn/ui will ensure a clean, user-friendly, and WCAG-compliant interface across the platform. React's component-based design will enable scalable UI development and efficient state management for administrative tasks and user monitoring. Firebase will serve as the system's primary backend service for real-time data synchronization, cloud storage, and authentication. With support for Cloud Firestore, Realtime Database, Firebase Authentication, and Cloud Functions, Firebase will offer a scalable, secure, and efficient infrastructure. It will also provide real-time notifications, user engagement analytics, and offline capabilities that are critical for mobile-first platforms like ReSourceHub. The system's database layer will use MongoDB, a flexible NoSQL database well-suited for storing semi-structured data such as user profiles, resource listings, and transaction logs. MongoDB's document-based model will allow for dynamic and efficient data modeling, while its scalability features will support the

platform's expected growth. Firebase and MongoDB will be used in tandem to manage both mobile and web application needs, offering a robust and responsive data pipeline.

Development activities will be carried out using Visual Studio Code, a lightweight and powerful code editor known for its extensive extension support, intelligent code completion, and Git integration. Git and GitHub will be used for version control, ensuring collaborative development, issue tracking, and release management. Automated testing will be implemented using testing tools such as Jest for JavaScript codebases and Flutter's built-in testing tools for unit and widget tests. These tools will help ensure the platform's reliability and performance during both development and post-deployment stages. Deployment of the web application will be carried out through cloud-based hosting platforms, with domain integration and CDN support to ensure high availability and low latency across different geographic regions. Firebase Hosting may also be used for deploying backend services and hosting static resources. These technologies, working in harmony, will establish a secure, scalable, and maintainable foundation for ReSourceHub, allowing it to fulfill its vision of enabling a responsible and tech-driven resource exchange system.

System Architecture

This section should provide a clear and concise overview of the system architecture, explaining how different components interact to ensure the system functions effectively. Figure 1 illustrates the System Architecture of the platform, showcasing the various components and their interactions. Users and Administrators will interact with the system through their respective devices, all connected via the Internet. Users will primarily engage through a cross-platform Mobile App developed using Flutter and Dart. This app will integrate Dragonpay for secure and reliable payment transactions and will use Firebase services such as Firestore for real-time data handling, Firebase Authentication for secure user sessions, and Cloud Functions for server-side operations.

Administrators will interact through a dedicated Website developed using the MERN Stack—MongoDB for the database, Express.js for the server, React.js for the frontend, and Node.js for backend logic. This website will also be integrated with Firebase for real-time synchronization and user management. Hosting will be managed through a web hosting provider with a registered domain, ensuring availability and accessibility.

Both the Mobile App and the Admin Website will interface with Firebase, facilitating seamless data flow between the frontend and the backend. Dragonpay will serve as the platform's payment gateway, handling payment requests and

confirmations securely. The Internet will act as the communication bridge, transmitting data between the client devices, Firebase servers, and Dragonpay's API endpoints. This architecture supports cross-platform compatibility, real-time operations, and secure financial transactions, all within a scalable and maintainable system structure.

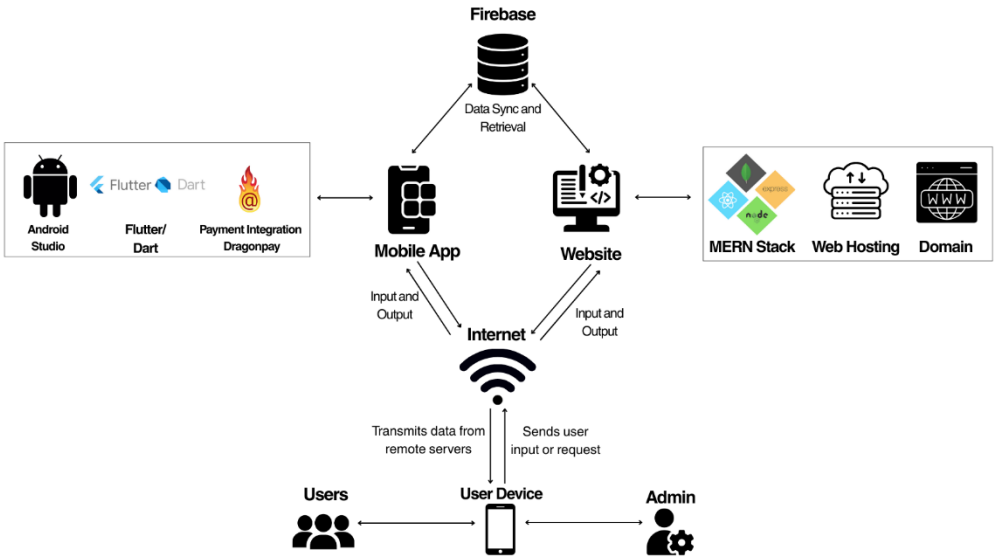

Figure 1. System Architecture Diagram of RESOURCEHUB

Related Systems

This section provides an examination of existing technologically advanced solutions, emphasizing their significance in both academic research and technological advancement. It outlines various related systems and methodologies, establishing a foundational understanding of their core features and the impact of

these systems have on sustainable practices. Waste management has become increasingly complex in modern times, necessitating innovative approaches that effectively address the utilization of waste and excessive resources. Several studies have analyzed the implementation of resource management solutions, highlighting their contributionns to sustainability goals, such as waste reduction, resource conservation, and community empowerment. Mobile technologies have emerged as dynamic tool capable of streamlining processes, connecting users, and fostering collaborative exchanges. By leveraging the capabilities of mobile technology, this system facilitates the exchange of resources and promotes environmentally responsible practices, reshaping how resources are managed and shared. A closer examination of the existing systems reveals their significant roles in driving systematic change toward a circular economy, enhancing sustainability and user engagement. These insights provide a valuable foundation for the development of ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy as a specialized mobile application crafted to facilitate sustainable resource exchange within the framework of circular economy in Sto. Tomas City Batangas.

According to Islam et al. [25] the circular economy (CE) reduces waste through methods such as reuse, recycling, and repurposing resources. This

technique offers a sustainable alternative to the traditional linear economy, which is follows the pattern of "take-make-consume-dispose" model. In contrast, the circular economy emphasizes reuse, recycling, and repurposing to eliminate waste and promote long-term resource efficiency. The circular economy reflects the natural cycles of the Earth, promoting a system where waste is minimized and resources are continually resued, repurposed, or regenerated. The researchers emphasize the potential of biomass as renewable and sustainable energy source within the circular economy, highlighting its role in stimulating economic growth, protecting natural ecosystems, and encouraging innovation. However, they also address that the success of the circular economy extends beyond biomass, it requires efficient and innovative waste management systems. Practices such as recycling, compostinf, and responsible disposal are fundamental to this approach, turning environmental challenges into opportunities for sustainable development.

This perspective directly supports the foundation of ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy, which seeks to promote waste reduction and resource optimization through a digital platform. By enabling users to exchange surplus or unused items instead of disposing of them, the system supports key CE strategies such as reuse and

redistribution, the platform helps reduce waste generation and contributes to building a more sustainable, circular system at the local level.

According to researchers Stylianos Zavos and Olli Pyyhtinen [26], the waste-to-resource paradigm within the circular economy (CE) is built upon specific conceptual foundations, guiding principles, and inherent constraints. While the CE strives to convert trash into valuable resources, numerous experts have expressed concerns about the simplicity and inherent difficulties of this strategy. This study aims to address key challenges in understanding waste and resources within the circular economy (CE), highlighting conceptual uncertainties that arise when trying to define what is waste and what is resource, recognizing that these definitions can be fluid and context dependent. Second, the study critiques the scalar constraints of existing CE models. Also, the study advocates for a dynamic and relational understanding of waste and resources should be understood dynamically, as interconnected elements influenced by social, economic, and environemental factors, rather than categories. The circular economy has gained popularity as an alternative to the linear economy (take-make-dispose), stressing the conversion of waste into resources through processes such as recycling, reuse, and recovery. However, despite widespread adoption of the CE framework, there is no commonly agreed definition for the idea. Most of these definitions converge on the 4Rs

paradigm (reduce, reuse, recycle, and recover), which is important to the waste-to-resource transition. The researchers were able to discuss the expansion of the 4Rs into an 11Rs framework from the study of Keijer et al. [27], which includes: Reject, reduce, reuse, redistribute, repair, refurbish, repurpose, remanufacture, recycle, recover, and return. The CE places a high value on non-toxic products that are safe for human health and the environment. The biological cycle includes consumable things like food, detergents, and personal care items that disintegrate and return to the biosphere. These concepts highlight material safety, cycle categorization, material leakage removal, and reliance on renewable energy sources as all contributing to a regenerative and sustainable economic framework.

This article offers useful information that is closely related to the proposed project, ReSourceHub: A Mobile Appkication for Sustainable Resource Exchange in the Circular Economy. It emphasizes the importance of expanding traditional circular economy models, such as the 4Rs (reduce, reuse, recycle, recover), into more comprehensive frameworks like the 11Rs, which include practices such as redistributing, repairing, refurbishing, and remanufacturing. These expanded principles can help to shape the design and functionality of your mobile application to support a wider range of sustainable resource exchange choices. Furthermore, the article's emphasis on a relational knowledge of waste and resource dynamics

highlights the mobile application's ability to connect individuals, communities, and organizations, boosting joint efforts for sustainability. This is consistent with the basic principles of material safety, classification, and regenerative economic systems, which the project seeks to promote through technical innovation.

As explained by Koval et al. [28], sustainable resource management policies as an important tool for national economic development. Their research found that responsible resource usage and production are critical for achieving ecological balance and economic stability. They criticized standard linear economic models, which rely on resource extraction and depletion, causing environmental damage and economic danger. Sustainable resource management, on the other hand, encourages resource efficiency, reuse, and conservation, as well as waste reduction and support for circular economy ideas. The study also emphasized the significance of creative policy tools for balancing economic growth with environmental sustainability. These policies aim to diversify energy sources, advance green technology, and ensure resource security. Koval et al. stated that good resource management strategies can reduce the risks associated with climate change and resource scarcity, encouraging long-term economic stability.

This study is strongly related to the proposed project, since it emphasizes the need of effective resource management in attaining sustainable growth, which is a

key goal of the initiative. It also promotes the integration of policies that conserve natural resources while fostering community engagement and technology innovation all of which are important features of the mobile application for promoting environmental awareness and sustainable behaviors.

Based on the system developed by Chandra A et al. [29], it successfully facilitates connections between producers, consumers, and materials, fostering a novel approach to drive the transition toward sustainable material reuse. The researchers project, "Scraptastic: Give Junk a Second Chance!", seeks to create an online storefront where people can display and sell goods made from recycled or upcycled materials. The system aims to enable users to contribute to sustainable consumption pattern by offering a platform for financial opportunities and creative expression. "Scraptastic: Give Junk a Second Chance!" promotes ethical creativity and resourcefulness. By implementing a digital platform, it encourages the users to transform and repurpose discarded materials (scrap) into valuable items. Scraptastic operates as an online platform dedicated to upcycled products. It serves as a marketplace where sellers or also known as merchandisers can showcase and trade their creatively repurposed items. Scraptastic prioritizes environmental care, encouraging individuals and businesses to consume resources thoughtfully and reduce waste by advocating the practices such as reusing, repairing, and repurposing

materials. These methods help to preserve resources and minimizes need for new production as possible. Scraptastic is a marketplace for upcycled products which provides a dedicated space for trading upcycled goods, encouraging environmentally friendly practices by giving discarded materials a new lease of life.

"Scraptastic: Give Junk a Second Chance!" closely aligns and supports the development of "ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy". Both platforms function as online storefronts aimed at promoting sustainable practices through the reuse and redistribution of materials. While Scraptastic primarily focuses on facilitating the sale of upcycled and creatively repurposed products, thereby fostering environmental consciousness. Similarly, ReSourceHub is designed to serve as a digital marketplace where individuals and organizations can trade surplus items, with the objective of minimizing waste and maximizing resource efficiently. Specifically, while both systems align with principles of circular economy, Scraptastic centers around upcycled creativity, whereas ReSourceHub focuses on the sustainable redistribution of unused and surplus materials. Both initiatives support a move away from the traditional linear consumption model by encouraging users to see excess or discarded materials as useful resources instead of waste. By using digital platforms, the proposed project helps to promote more sustainable consumption habits and play

a role in reducing the need for new materials, ultimately contributing to a more circular and environmentally conscious economy.

E-Bartering System built by Schuhaiber et al. [30], was locally created in the United Arab Emirates. The aforementioned system enables people within the society to exchange surplus goods and services without the use of money. The system promotes sustainability by encouraging the reuse and recycling of items, reducing waste, and addressing environmental risks associated with waste generation in a smart and resourceful way. E-barter exchanging system as a platform that facilitates the exchange of various products and services without monetary transaction. Instead, the transaction is governed by social agreement or mutual arrangement determined by the individuals participating in the barter ensuring the flexibility and fairness tailored to the participants. It allows users to trade diverse goods and services, catering to different needs and preferences. The concept of the system is to exchange surplus items or less useful items for more beneficial ones, enabling individuals to maximize the usefulness of their items. Moreover, the system core functionality is to maintain sustainability by reducing waste and promoting eco-friendly practices. The E-Barter is recognized for its environmentally conscious and sustainable approach, offering a smart platform for

community members to exchange goods and acquire items that are otherwise unavailable in their local marketplace.

The designed system conducted to present an E-Bartering System which closely aligns with the core concept of the proposed project, ReSourceHub. This system particularly relevant ReSourceHub, which aims to provide a flexible system facilitating the exchange of good through barter-to-barter model, allowing users to trade surplus or underused items for those that are more beneficial, without involving monetary transactions. The study supports the system by promoting mutual agreements in trading by providing a smart platform. The system maximizes the value of items that would otherwise remain unused or be discarded. The study highlights how e-bartering reduces waste generation by encouraging reuse and recycle. Similarly, ReSourceHub aims to minimize environmental impact by promoting responsible consumption and extending the lifecycle of goods within communities.

Malhotra et al. [31] achieved to develop an online auction management system specifically for buyers and sellers for reducing negotiation period. The researchers first defined auction as a system that used for buying and selling goods, where the final price is determined through a competitive bidding process. The auction works as the sellers usually set initial or fixed amount for the product, while

the buyers place bids, offering progressively higher amounts at a reasonable price. The bidding concludes when the highest bidder agrees to pay the set amount, surpassing the offers of other participants. The auction system is a set of agreements and understanding of the partnerships. Auction mechanism can be classified into two types namely English auction and Dutch auction. The development of the online auction system intended to enhance e-business applications and help the buyers and sellers in a convenient way. Specifically, the online auction system facilitates the buying and selling of products through an auction mechanism. The online auction system involves registration and access which both buyers and sellers must register on the platform to participate in the auction process. The system also featured different user roles, including as bidder login, seller login, and admin login. Each role is designed with specific capabilities tailored to the specific needs of users at different stages of interaction. The system also includes the key parameter for buying and selling include product certificates, item description, usage details, and market value to ensure transparency and informed decision-making. The online auction system combines advanced digital tools with transparency and efficiency, providing a seamless platform for buyers and sellers to interact, evaluate, and trade goods while obtaining the cost at an appropriate price level.

The developed system relates to the proposed project, ReSourceHub in terms of having a flexible way of online auction management system. The objective of the online auction management system by Malhotra et al. is to streamline the buying and selling process through digital auction mechanism. This concept aligns with one of the core features of the proposed project, ReSourceHub, which integrates an auction-based exchange system for products. Both systems aim to enhance the user experience in trading goods online by offering structured and competitive methods for value determination. While the proposed project only adopts a reserve auction model that allows seller list an item with minimum acceptable value, and buyers place bids until the reserve price is met or exceeded, the system developed by Malhotra et al. primarily utilizes a double-auction model, where both buyers and sellers submit bids and offers to find a matching price. Malhotra's system encourages simultaneous negotiations from both sides, while ReSourceHub ensures that trades only proceed when a seller's minimum valuation is respected. Despite the difference in auction type, the system creates a support about the use of auction mechanism as a valuable tool for facilitating digital trade and enhancing user interaction. Both systems agree to increase efficiency, fairness, and engagement in item exchanges, even if the underlying auction logic differs. Similarly, ReSourceHub incorporates a well-structrured user role system. It includes an administrator module responsible for overseeing resource exchanges, moderating

transactions, managing user accounts, and ensuring compliance with platform policies. The user module functions as the customer interface, allowing users to browse, bid on, or acquire surplus materials, while the seller acts as another user role, providing surplus items for exchange or sale. Both systems highlight the importance of tailored functionalities and oversight in ensuring smooth and secure digital trade.

Adejumo and Chinonso [32] emphasized the importance of cybersecurity in the financial sector, particularly in safeguarding digital transactions against fraud and security threats. Their research highlights the rapid adoption of online banking, mobile payments, cryptocurrency transactions, and electronic fund transfers, which have significantly improved accessibility and efficiency in financial systems. However, alongside these advancements comes an increased risk of cyber threats, including identity theft, unauthorized transactions, and fraudulent activities, necessitating stronger security measures. To address these risks, the study discusses various advanced security technologies, including AI-driven fraud detection, blockchain-based verification, quantum encryption, biometric authentication, and Multi-Factor Authentication (MFA). MFA, in particular, requires users to verify their identity using multiple authentication factors, such as a password combined with a physical device (e.g., a mobile phone or authentication app). This added layer

of security significantly reduces the likelihood of unauthorized access, ensuring that financial systems remain protected, reliable, and compliant with security standards.

The insights from this study align with the security framework of ReSourceHub, particularly in its integration of MFA to safeguard user transactions. Unlike financial platforms that employ AI-driven fraud detection mechanisms to monitor irregular transaction patterns, ReSourceHub does not incorporate AI-powered fraud detection but instead relies on MFA as its primary security measure. By requiring multiple verification steps, MFA ensures that only authenticated users can engage in secure exchanges of goods and payments within the platform. While blockchain technology is recognized in the study for its ability to enhance transparency and security in financial transactions, ReSourceHub primarily focuses on resource exchange within the circular economy rather than solely securing monetary transactions. Unlike traditional financial systems that prioritize fraud prevention in digital payments, ReSourceHub serves as a collaborative marketplace that facilitates the exchange of surplus materials, promoting sustainability and responsible resource management. Its security model ensures user trust through MFA-based authentication rather than complex fraud detection algorithms, aligning with its goal of fostering a safe and ethical exchange network for users.

Ngong and Njeck [33] developed an online payment system designed to enhance security and trust between buyers and sellers, addressing critical concerns related to fraudulent activities in online transactions. Their study highlights the increasing reliance on digital commerce, emphasizing both its convenience and the accompanying risks, particularly payment fraud. Common fraudulent practices include scams where sellers fail to deliver goods after receiving payment, unauthorized transactions, and identity theft, all of which undermine trust in e-commerce platforms. To mitigate these risks, their proposed system, SmPay (Secure Mobile Payment), integrates Two-Factor Authentication (2FA) as a key security feature. 2FA strengthens payment security by requiring users to verify their identity through two independent authentication factors, such as a password or PIN combined with a physical device (e.g., a phone or authentication app). By implementing 2FA, unauthorized access is significantly reduced, ensuring that transactions are more secure and resistant to fraud. The developed system relates to the proposed project in terms of security and trust in online payment systems, addressing key challenges faced by buyers and sellers in e-commerce, particularly fraud and the lack of mutual trust during transaction. Their proposed system, SmPay, utilizes two main features to ensure safe transactions: Escrow and Two-Factor Authentication (2FA).

The relevance of this study extends to the development of ReSourceHub, particularly in the implementation of secure payment mechanisms. While ReSourceHub does not utilize an escrow system, it adopts 2FA to safeguard transactions and prevent unauthorized activities. The integration of 2FA reinforces account security, ensuring that only verified users can access and complete financial transactions within the platform. This authentication method addresses concerns related to fraudulent access and protects users engaging in resource exchanges, making the system more reliable and secure. Unlike SmPay, which primarily focuses on securing financial transactions within e-commerce, ReSourceHub operates as a sustainability-driven marketplace aimed at reducing waste and promoting responsible material exchange. Although escrow functionalities are not incorporated, the adoption of 2FA serves as a robust security measure, aligning with the platform's goal of fostering a trusted environment for users. By implementing strong authentication protocols, ReSourceHub ensures that transactions are protected while maintaining its commitment to sustainability and ethical resource sharing.

Lapuz et al. [34] developed a web-based management system for Bazaar City in Metro Manila that provides dashboard with data visualization. The study of Angela et al. discussed the benefits of data visualization capabilities to predict

customer trends, increase sales, and support efficient data retrieval and summarization. The aforementioned system includes four primary modules: paintball module handles reservations, payments, and real-time updates, while the stall management module tracks stall reservations and utility expenses. The event management module allows efficient event reservation handling by authorized staff, and the reports module visualizes operational data for strategic decision-making. The system features two uuser interaces for registered custromers and staff, with dashboards displaying tables and graphs to monitor performance. Simarly, the developers incorporated dynamic charts and dashboards into the system, enabled administrators to identify peak hours and seasonal booking trends.

These finding aligns closely with the proposed system, particularly in the integration of data visualization within a web-based management system. Although, the dashboard system is applicable to the admin, it is specifically designed for administrative use only to monitor performance and support informed decision-making. ReSourceHub could adopt the similar dashboard, enabling user to monitor goal progress and spot areas that require improvement.

CHAPTER 3

DESIGN AND METHODOLOGY

This chapter outlines the design methodology applied to ensure the systematic and efficient development of the ReSourceHub. It provides a comprehensive framework for the design and implementation process, along with the tools and techniques that guided each of the designs.

Data Gathering

The objective of the data gathering process was to systematically collect information and facts relevant to addressing specific research questions, solving problems, and achieving objectives. It was utilized to obtain accurate, reliable, and relevant data that served as the foundation for making informed decisions and accomplishing the study's goals. By employing data gathering methods, the research strengthened its objectives by providing essential evidence to address the study's aims effectively.

This study integrated both qualitative and quantitative methods to comprehensively understand current practices, challenges, and opportunities related to waste management and surplus product exchange. These methods were particularly significant in the development of the ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy system for

Sto. Tomas City. Quantitative data referred to measurable information expressed numerically, such as statistical scores or metrics, whereas qualitative data captured descriptive and non-numerical insights such as opinions, perceptions, and experiences. For this study, quantitative data collection was conducted through surveys, which consisted of a uniform set of questions systematically presented to all participants. This ensured consistency and reliability in the data gathered. The proponents utilized surveys that were specifically designed to assess the knowledge, behaviors, and perceptions of the residents of Sto. Tomas City regarding environmental sustainability, resource management, and the concept of the circular economy. Quantitative metrics such as user satisfaction scores, levels of awareness and familiarity, and perceptions of resource exchange initiatives were measured using a Likert scale, enabling respondents to express their degree of agreement or importance for specific statements. These metrics provided valuable insights into the community's perspectives on sustainability practices.

Complementing the quantitative methods, qualitative data collection was employed to capture deeper insights into participants' experiences and motivations. Howerver, interviews, conducted either directly or virtually, enabled in-depth exploration of the participants' perspectives. By engaging directly with the client, the proponents identified critical areas of concern, proposed alternative solutions, and validated the feasibility of certain system features. Another qualitative method

employed was the structured questionnaire technique, which served as an alternative to direct interviews. This approach facilitated the collection of detailed and open-ended responses, further enriching the qualitative data. In this study, the qualitative questionnaire targeted both business owners and non-business individuals as potential users of the application, providing meaningful data regarding their practices, challenges, and preferences. Specifically, business owners offered insights into how surplus goods were generated and managed in industries prone to surplus production, such as retail, manufacturing, and construction. On the other hand, non-business participants, including residents and community groups, shared their awareness and willingness to participate in a surplus exchange system. The qualitative questionnaire was distributed online using google form, allowing participants, including both business owners and non-business individuals based on their relevance to the objectives of the study, to conveniently provide their responses. This online approach ensured accessibility and consistency, as participants could answer the structured questions remotely at their convenience.

Additionally, direct interviews were conducted with key personnel from city and municipal environmental offices to gather policy-driven insights on waste management practices and surplus handling. These interviews allowed the researchers to understand the regulatory and governance aspects of waste management and further refine the application's features to align with government

initiatives. The study employed purposive sampling to select participants based on their relevance to the research, including business owners, non-business households, and government officials involved in waste management and surplus handling. Additionally, voluntary response sampling was used to collect data through the survey distributed to residents of Sto. Tomas, allowing individuals to participate independently. This approach ensured diverse representation, capturing varying levels of awareness and engagement with waste management practices. Finally, the data gathering process enabled the proponents to make informed decisions, refine the proposed system, and ensure that the ReSourceHub application effectively met its objectives in fostering sustainable resource exchange within Sto. Tomas City.

Project Concept

This project focuses on the development of ReSourceHub, a sustainable resource exchange application designed to address surplus material waste and promote efficient redistribution within the circular economy framework. Businesses, organizations, and households generate significant amounts of surplus materials, many of which are discarded rather than repurposed. This practice diminishes the opportunity for potentially reusable resources and contributes to environmental concerns, especially when these materials are simply discarded.

According to Roberts et al. [35], the destruction of unsold and surplus products is a major issue in production-consumption systems. Instead of being repurposed or redistributed, these products are disposed of merely because they are deemed unwanted. Companies often dispose of functional goods due to overproduction, defects, or market inefficiencies, following the unsustainable "take-make-dispose" model. The deliberate disposal of functional and usable products worsens waste generation and undermines efforts to optimize resource efficiency. This practice increases waste generation and complicates waste management. Proper solid waste management plays a crucial role in mitigating these issues. Instead of discarding or destroying consumer goods, recycling and reuse strategies can provide an alternative approach that aligns with sustainability goals. By facilitating the redistribution of surplus materials, that can support individuals who struggle to access essential goods while simultaneously minimizing waste within the system.

The practice of proper solid waste management is not only essential for safeguarding human well-being but also for protecting the environment, which serves as a primary source of resources for society. Despite the critical importance of effective waste management and the existence of regulatory measures, it remains widely neglected. Many individuals fail to recognize that improper waste

management can lead to the contamination of soil, water, and air quality, ultimately impacting overall living conditions according to Kihila et al. [36]. Although waste segregation receives minimal attention from affluent communities and is often informally practiced in local communities, various programs have been still implemented to encourage waste segregation and promote reuse and recycling initiatives. These measures aim to reduce the volume of waste requiring disposal and enhance the efficiency of waste collection processes. It also contributes to public health preservation and increases recycling rates, which aligns with the principles of the circular economy by enabling the reuse and repurposing of surplus products.

The Philippines generates 61,000 million metric tons of waste daily, with 24% consisting of plastic based on Philstar Global News [37]. According to Maria Antonia Yulo-Loyzaga (2023), 70% of plastic's economic value is lost annually, as much of it is discarded rather than recycled or repurposed. Global resource consumption has exceeded 1.75 times the Earth's regenerative capacity. Additionally, the Circular Gap Report states that 70% of greenhouse gas emissions stem from the handling, usage, and disposal of materials, contributing to global warming and pollution. The Philippines produces significant plastic waste daily, including 163 million sachet packets, 48 million shopping bags, and 45 million thin-

film bags. Of this, 33% end up in landfills, while 35% pollutes open environments and oceans. Global circularity has declined from 9.1% (2018) to 7.2% (2023), underscoring the circularity gap, or the nation's limited ability to recycle and reintegrate materials. Currently, over 90% of materials become waste, demonstrating that most resources originate from newly extracted raw materials instead of being recirculated. Strengthening waste recovery and circular economy strategies is crucial to sustainability and environmental conservation.

According to Olawade [38], insufficient infrastructure and funding hinder effective waste disposal and decomposition, leading many communities to resort to illegal dumping, which worsens environmental problems. According to Bera and Wilts [39], digital platforms are crucial for the circular economy, enabling material loops and recycling through industry-wide connectivity. Additionally, they optimize resource use and reduce dependence on primary materials, generating economic benefits while promoting sustainable practices.

Improper waste disposal negatively impacts businesses, local communities, and the environment, causing financial losses, pollution, resource depletion, and health risks. Addressing these issues requires immediate solutions to reduce waste's ecological and public health effects, reinforcing the principles of the circular economy. In response to these challenges, the proponents of this study developed a

mobile application benefiting the community of Sto. Tomas City. ReSourceHub is designed to integrate technology into waste management by connecting businesses, communities, and consumers in a circular economy, enabling the trade of excess resources to reduce waste and promote sustainability.

Moreover, many usable surplus materials are discarded instead of being reintegrated into the system due to limited recycling and reuse capacity, which results from a weak redistribution framework. This inefficiency leads to increased waste generation and environmental degradation. The system aims to encourage resource reuse through recycling while reducing reliance on traditional waste disposal methods that follow the unsustainable "take-make-consume-dispose" model. Instead, it advocates a more sustainable approach, following the "reuse, recycle, and repurpose" model, by allowing users to trade or sell surplus items, thereby minimizing waste and reinforcing local sustainability efforts. ReSourceHub: A Mobile Application for Sustainable Resource Exchange in the Circular Economy is a mobile and web-based platform designed to streamline the management and exchange of shared resources across communities. The project extends the lifecycle of goods, minimizes the disposal of excess products, and fosters community cooperation, contributing to environmental conservation and responsible consumption.

Development Method

This sub-section discusses the development methodology employed in system creation, providing a structured framework that guides the entire project lifecycle, from planning and design to implementation, testing, and deployment. Selecting an appropriate methodology is crucial for ensuring efficiency, consistency, and adaptability, allowing for systematic progress throughout the development process.

For this study, the Agile development lifecycle was adopted, as illustrated in Figure 2, for the development of the mobile application. Agile methodology was selected as the most suitable framework for the ReSourceHub application due to its iterative nature, adaptability, and flexibility. These characteristics enable continuous updates, feature enhancements, and adjustments based on user needs, making Agile an ideal approach for dynamic system development. Additionally, the Agile methodology follows an iterative and incremental model, allowing developers to deliver functional components while ensuring higher client satisfaction through refinements. The Agile development lifecycle consists of distinct phases that facilitate flexibility and continuous improvement. In this study, the Agile development methodology comprises six key phases that facilitate a structured and adaptable approach to system development.

The first phase focuses on Requirements Gathering that primarily serves as the foundation of the development process, ensuring that project goals, technical specifications, and client needs are clearly defined. In this phase, developers actively collaborate with the client to refine the system's objectives, functional requirements, and constraints to ensure alignment with client's expectations. To accomplish this, the proponents conducted stakeholder interviews and surveys to gather comprehensive insights into the necessary system features, user needs, and operational considerations. The collected data is systematically documented, serving as a reference throughout the development cycle to maintain consistency and adherence to the project scope.

The second phase is Planning. The Planning Phase is an essential stage in Agile development that focuses on organizing work in a flexible, adaptive, and iterative manner to ensure efficiency and alignment with project goals. Following the Requirements Gathering Phase, where stakeholder interviews and surveys were conducted, the collected data is analyzed and refined to define the system's objectives and expected outcomes. During this phase, proponents systematically filter and categorize technical, functional, and project requirements to establish a clear development framework. Additionally, this involves identifying the necessary tools and technologies essential for implementation. A structured workflow is also

developed to enable effective tracking of progress, ensuring that tasks are managed efficiently and aligned with the project scope.

The third phase focuses on Design and Layout, ensuring the development of an intuitive, efficient, and visually appealing interface that enhances user interaction and experience. During this stage, the proponents translate the gathered data, system objectives, and design concepts into functional code, ensuring alignment with project requirements. The system's design and layout were initially developed and deployed using Vercel, a cloud-based platform optimized for front-end frameworks and static sites. This platform was selected for its ability to facilitate efficient development workflows, allowing the proponents to seamlessly transform their conceptual ideas into a semi-functional system while maintaining a strong focus on design objectives. Additionally, this phase involves the planning of user experience (UX) design, ensuring smooth and intuitive interactions before full-scale development.

The fourth phase is Development. The Development Phase is the stage where actual coding, implementation, and system integration occur based on the defined requirements and designs. This phase is crucial for transforming conceptual ideas into a fully functional application, ensuring that both front-end and back-end elements are properly connected. Additionally, it involves setting up the database

and server infrastructure, enabling seamless data management and system operations.

Once the development phase is completed and all requirements have been successfully implemented, the system proceeds to the Deployment and Testing Phase. These final stages are crucial in ensuring that the system functions properly, meets user expectations, and is ready for release. During the testing phase, pilot testing is conducted to identify and resolve any issues before final deployment. Various testing methods, including unit testing, integration testing, system testing, and User Acceptance Testing (UAT), are carried out to verify functionality, stability, and usability, ensuring a seamless user experience.

In the Deployment Phase, after testing confirms the system's reliability, the client assesses its functionality to determine whether it meets project objectives. Once validated, the system is officially deployed and made accessible for end users.

Lastly, the Maintenance and Updates. Once the application system is deployed and confirmed to meet the expected outcomes, it requires continuous maintenance, updates, and testing to ensure long-term functionality and an optimal user experience. Based on client feedback and system evaluations, adjustments and refinements may be necessary to align the system with user needs and expectations. If modifications are required, the development process reassesses and revises the requirements, undergoing iteration and refinement until the necessary updates are

finalized and successfully integrated into the system. This ensures that the application remains efficient, adaptable, and capable of meeting evolving demands, reinforcing its reliability and usability over time.

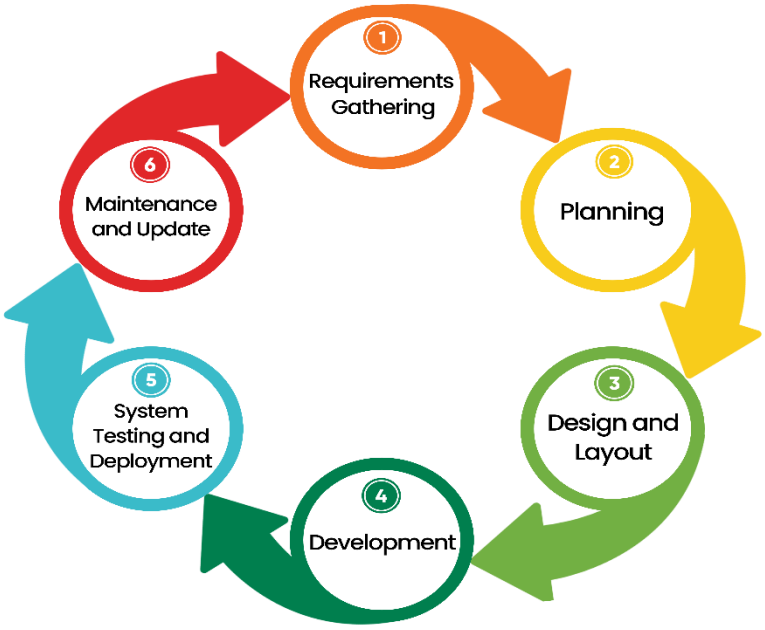

Figure 2. Development Methodology

Development Approach

This section describes the the development approach employed by the proponents in developing a system. The proponents utilized the Top-Down Approach, a structured method used by breaking down broad concepts into smaller, manageable components in system development. The process begins with high-level design and planning, and then progresses to refining the details of each stage

until all individual elements are fully developed. The Planning Phase serves as the foundation for a well-structured development process, ensuring that the project aligns with the client's needs and system objectives. To achieve a comprehensive understanding of the organization's needs, the proponents conducted data-gathering activities, including interviews with key stakeholders. Specifically, discussions were held with the designated head of the Solid Waste Management Program and personnel from the City Environment and Natural Resources Office (City ENRO) of Sto Tomas. Through these engagements, existing challenges were identified, allowing the proponents to refine the project's objectives, scope, and functional requirements in a manner that directly addresses the client's concerns.

Following the Planning Phase, the Analysis Phase focuses on examining and refining the gathered information to develop detailed system requirements. This phase ensures that the application is designed based on precise and complete data, mitigating risks that could impact its core functionality. A significant aspect of this phase is the assessment of organizational workflows and potential challenges. This phase also distinguishes functional and non-functional requirements, which are essential for optimizing user experience and system efficiency. Moreoverr, the detailed evaluation of requirements ensures that the application is practical, usable, and aligned with the client's needs.

The Design Phase transforms the requirements outlined in the Analysis Phase into a detailed blueprint that defines the system's structure and operations. The primary goal of this phase is to establish a clear development roadmap, ensuring that each component is designed to meet the identified requirements. During this stage, the proponents developed system architecture to outline the application's structure, database design to manage data storage and retrieval efficiently, data flow and process diagrams to visualize the movement of information within the system, integration and interface design to ensure compatibility with external components. The user interface (UI) was designed with simplicity, ensuring that users can navigate and interact with the system intuitively and efficiently.

The Implementation Phase marks the transition from conceptual design to practical execution, wherein all system components are developed, integrated, and tested. The proponents began by translating the conceptual design into functional software components, following structured coding methodologies to ensure reliability. nce the initial development was completed; the application underwent extensive testing processes to verify its functionality and compliance with system requirements. The testing phase such as unit testing, integration testing, system testing, and User Acceptance Testing (UAT). Each testing process was importamt to ensuring that the system operated as intended while adhering to established standards.

Laslty, The Maintenance Phase is the final yet continuous stage of application development, ensuring that the system remains functional, secure, and adaptable over time. This phase focuses on preserving the application's longevity by addressing potential defects, implementing software updates, and optimizing system performance. By continuously monitoring system performance and adapting to user needs, the Maintenance Phase ensures that the application remains relevant, efficient, and aligned with evolving requirements.

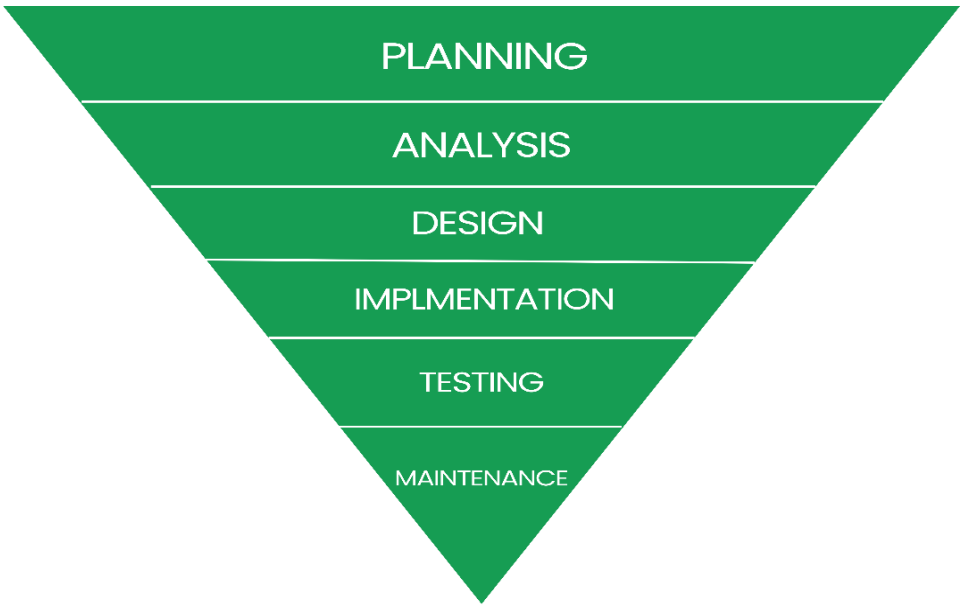

Figure 3. Top-Down Approach

Context Flow Diagram

Figure 4 presents the Context Flow Diagram for ReSourceHub, illustrating the interactions between the system and its external entities. The primary external

stakeholders include User and Admin, each playing a distinct role in system operations and data flow. This diagram serves as a high-level representation of how information moves within the system, demonstrating the relationships between key components. Users access the ReSourceHub mobile application through their mobile devices by signing in or registering using their credentials. Upon successful login, the system prompts the user to select initial preferences, such as categories of interest that align with their needs. This serves as the first interaction between the user and the system, enabling ReSourceHub to personalize their content and recommendations based on these preferences. For business users, the system provides functionality to list available resources, such as surplus materials, by specifying relevant details, including quantity, condition, and location. On the other hand, individual users can browse listings and initiate transactions through messaging or direct purchasing, based on their preferences. The transaction process within ReSourceHub consists of multiple modes, including: Direct exchange where users engage in item swaps without monetary involvement. Monetary transactions that enable purchases conducted using financial transactions. Lastly, the Auction-based transactions which allows users bid on available resources. Upon completion of a transaction, users are given the option to rate the transaction, providing feedback that contributes to transparency and credibility within the platform. The Admin side of the platform operates through a dedicated web interface, structured

separately yet fully integrated into the system. The Admin webpage enables centralized management of system functionalities, serving as the control panel for monitoring and overseeing operations within the system.

Data Flow Diagram

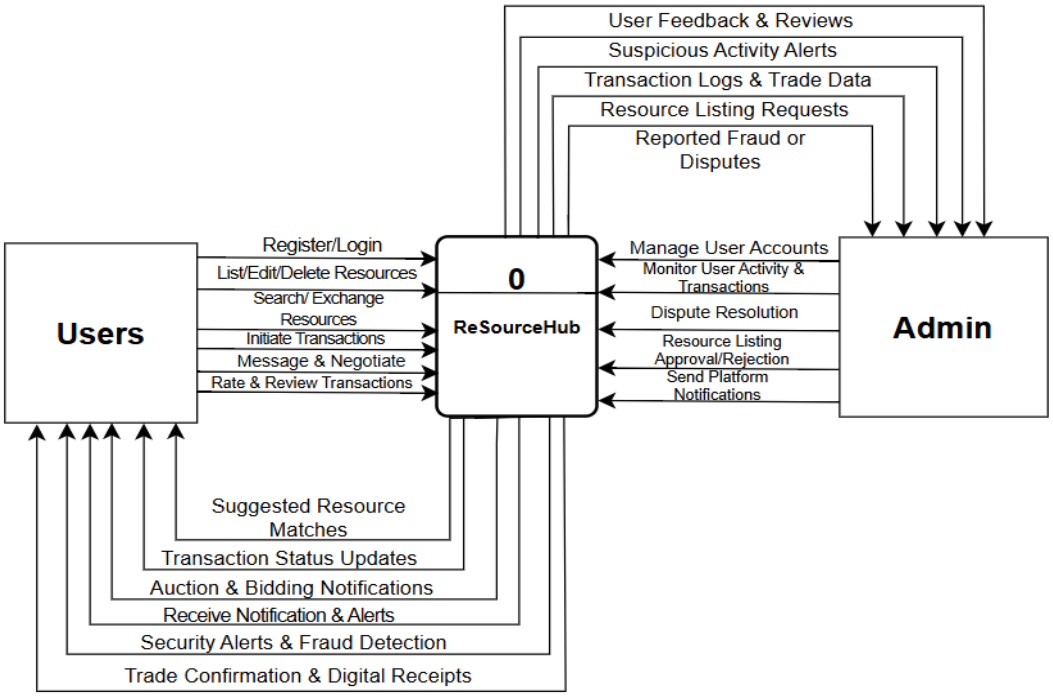

Figure 4. Context Flow Diagram

Figure 5 presents the User Data Flow Diagram for the ReSourceHub mobile application, which facilitates the exchange and trade of surplus resources among users. The diagram outlines key processes related to user authentication, resource management, transaction execution, and feedback submission within the system. Users begin by registering or logging into the application using their credentials,

which are stored and retrieved from the tbl_users database. Upon successful login, users select preferred categories that align with their interests, enabling a personalized browsing experience within the home page.

Authenticated users, both individuals and business entities can add, edit, or delete resource listings. These modifications trigger system updates, with resource data being stored in tbl_resources, ensuring accessibility for browsing and searching. The Resource Management module processes these actions, maintaining real-time synchronization between users and the system. Users can search for resources using specified filters such as location, type, and availability. The system employs a smart matching engine that generates recommendations based on user preferences. Once suggested matches are presented, users can review details and initiate an exchange proposal through the Confirm Exchange Details process. The exchange request is sent to the recipient, facilitating negotiation and agreement on transaction terms. Upon finalizing the transaction, details are processed and stored in tbl_transactions, ensuring accurate record-keeping of exchanges. Users engage in different modes of transaction, including direct exchange, monetary purchase, and auction-based bidding. These processes are structured to maintain efficiency, security, and transparency. After completing an exchange, users can provide ratings and reviews based on their transaction experience. These evaluations contribute to

the credibility of the system and are stored in tbl_reviews, assisting future users in assessing resource reliability and user trustworthiness.

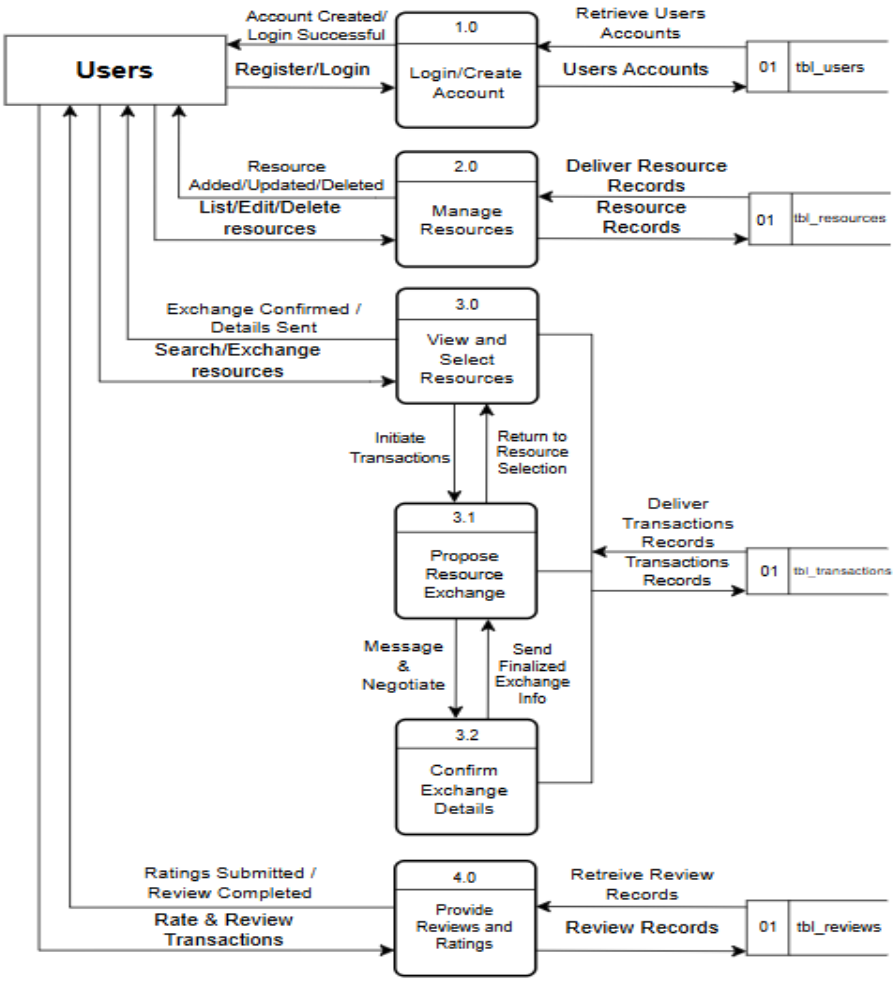

Figure 5. Data Flow Diagram for Users

Figure 6 expands on the Data Flow Diagram**,** further illustrating user interactions within the ReSourceHub system**,** particularly in resource matching, transaction tracking, auction notifications, security monitoring, and transaction

confirmation. When a user searches for a resource, the system generates suggestions based on predefined search criteria such as location, type, and availability. These recommendations are derived from records stored in tbl_resources, ensuring relevant and accurate results. To keep users informed of their transaction progress, the system continuously monitors and updates transaction statuses (e.g., pending, completed). This ensures transparency, allowing users to track their exchanges in real time. For auction-based transactions, the system dispatches automated notifications, informing users of: bidding updates, new offers, and auction closures. These notifications are managed within tbl_notifications, ensuring timely communication and active user participation in time-sensitive auction events. The system continuously detects and responds to unauthorized activity that may compromise platform security. If a user reports fraudulent behavior, the system logs the incident in tbl_security_alerts, initiating predefined security measures to mitigate risks and protect users. Following a successful transaction, users must confirm the exchange, upon which the system generates and delivers a digital receipt as proof of completion. These transaction records are securely stored in tbl_receipts, serving as formal documentation.

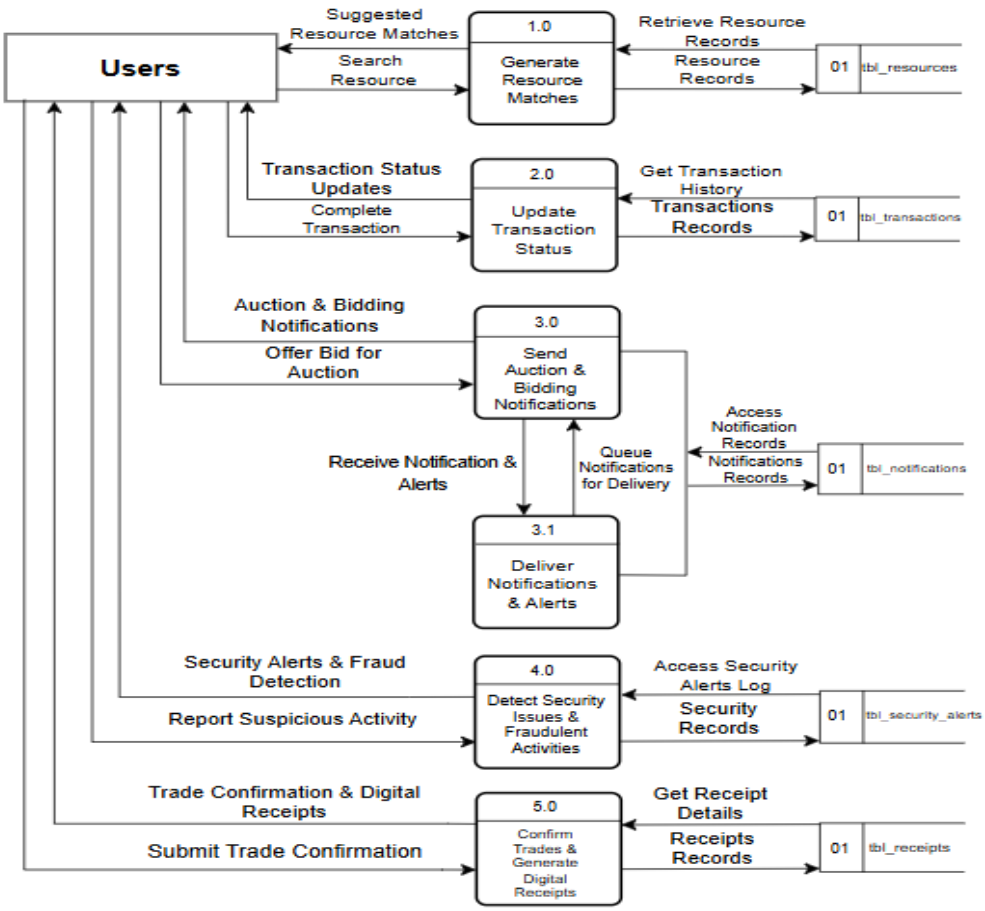

Figure 6. Data Flow Diagram for Users (Cont.)

Figure 7 presents the Data Flow Diagram illustrating administrative functions within the ReSourceHub system. It outlines how the administrator interacts with the platform, managing user accounts, overseeing transactions, moderate content, and handling system notifications. To begin with, the administrator interacts with the system by overseeing user account status and access control, retrieving account information stored in tbl_users. Requests for user details

are processed between the admin and the system, ensuring proper access control and management of account permissions. The system tracks user engagement and financial transactions, allowing administrators to review activity logs and transaction histories. Data related to tranasctions is stored in tbl_transactions, providing insights into user interactions and financial exchanges within the platform. Furthermore, the admin moderate platform content and manages dispute resolution, ensuring compliance with system policies. When disputes are reported, the system retrieves case records from tbl_disputes, allowing administrator to review and address user concerns effectively. Following content moderation, the admin allows users to review resources submitted by the users and decides whether to approve or reject submitted resources. The submitted resources are reviewed through the system. Moreover, resource approval records are accessed or managed in tbl_resource_approvals. This ensures that user-submitted resources meet quality standards and remain relevant to maintain platform integrity. One of the functionalities available to admin is the ability to send notifications across the platform, informing users of system updates, accounts actions, and platform announcements. These notificatons are created, dispatched and logged in tbl_notifications, ensuring users remain informed of important updates.

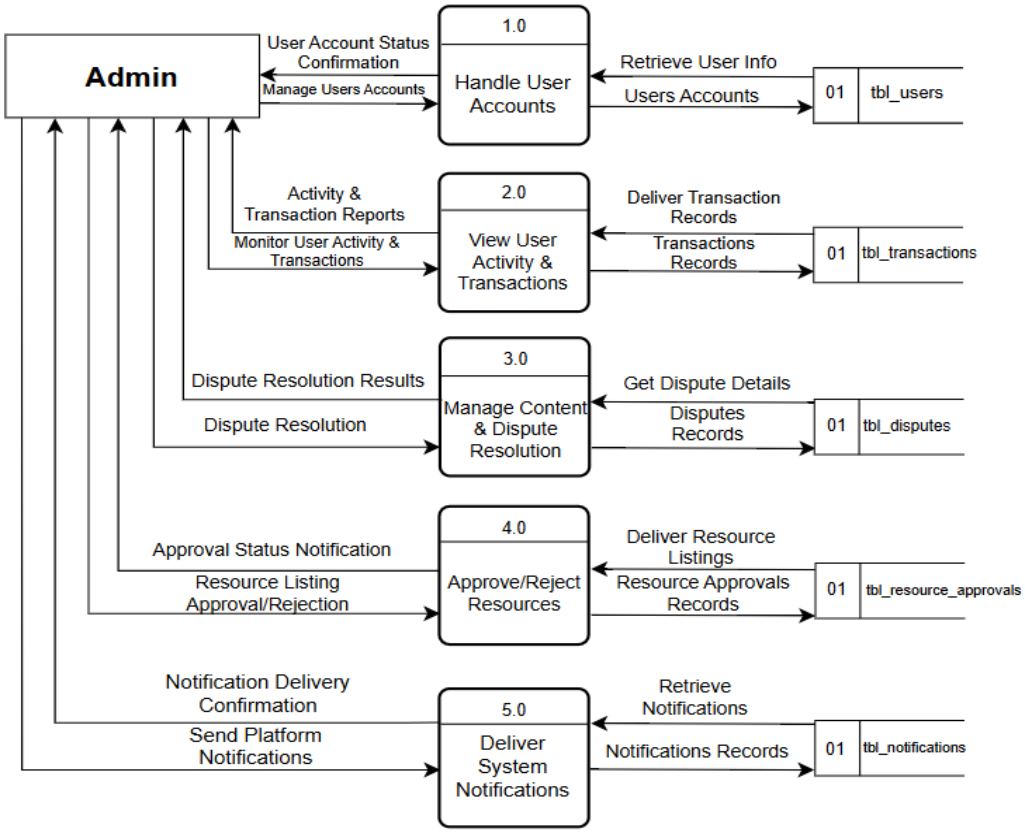

Figure 7. Data Flow Diagram for Admin

Figure 8 represents a continuation of the Data Flow Diagram, detailing key administrative functions within the ReSourceHub system. It illustrates how the administrator manages user issues, transaction monitoring, security alerts, resource approvals, and feedback assessment, ensuring platform integrity and compliance. Here, the admin resolves reported user issues such disputes or fraudulent activities, which initially forwarded to the admin for evaluation. The system retrieves dispute records from the Dispute table, allowing the admin to review cases and take appropriate action to resolve conflicts efficiently. Following dispute resolution,

admin evaluate submitted resource listings, determining whether to approve or reject them. As part of this process, listing requests from the user are analyzed based on quality standards and relevance. Afterwardd, approval decisions are recorded in tbl_resource_approvals by the system. In addditon, admin also oversee user transactions, ensuring secure and transparent exchanges. Once a transaction occurs, the system delivers transaction data and logs for administrative review. These records, stored in tbl_transactions, enable effective monitoring of financial activities and trade interactions. Alongside transaction monitoring, the system actively detects and responds to potential security threats. Whenever suspicious activity is identified, the mobile system generates security alerts, which are forwarded to the administrator for further analysis. Then, alerts are stored in tbl_security_alerts, allowing timely intervention to protect user accounts and maintin security. Finally, admin assesses user-submitted feedback and reviews, examining concerns related to system functionality and service quality. To facilitate this, feedback submissions are retrieved from tbl_reviews.

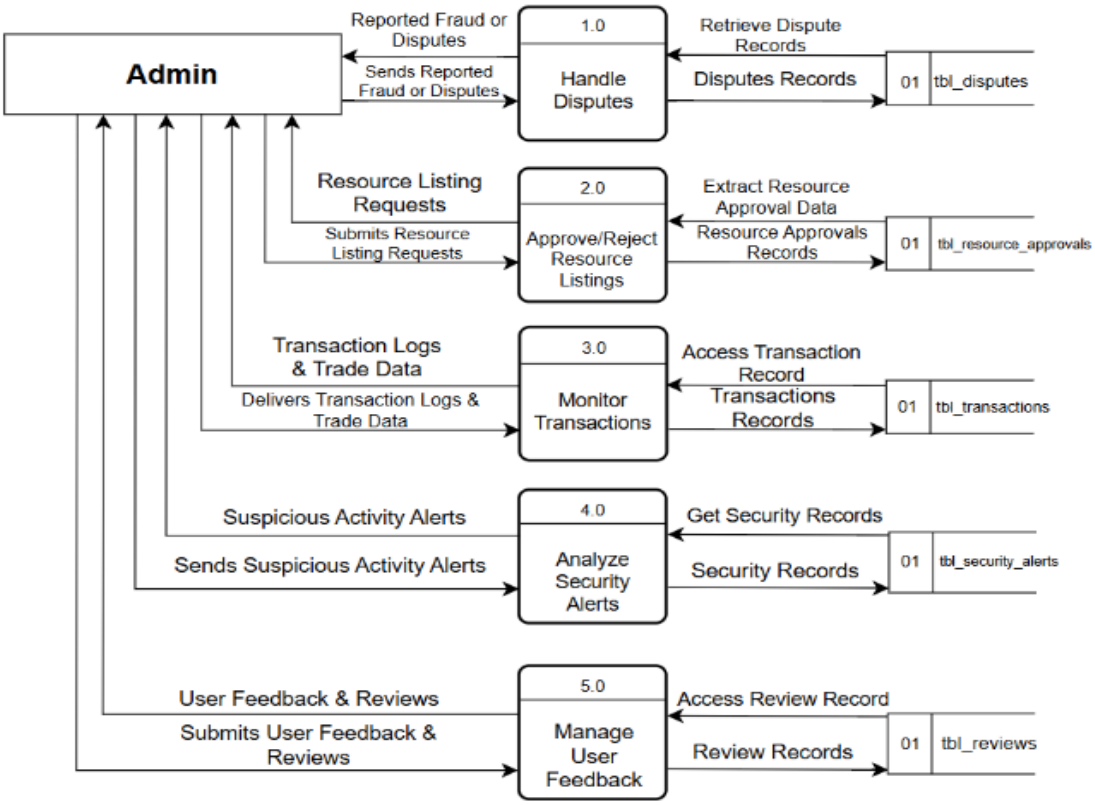

Figure 8. Data Flow Diagram for Admin (Cont.)

Functional Requirements

This section outlines the functionality of the ReSourceHub mobile application and website, detailing the features available to both users and admin. It defines how the system operates, ensuring efficient interactions and proper management of its functions.

Table 1

Functional Requirements of the Mobile Application

Features	Description
Login	To enable admin and user to access the mobile app for user and website for admin, it must ask the admin and user to login by inputting the correct username and password.
Register	To enable users to create an individual or business account for accessing platform features.
Forgot Password	To enable admin and user to change their password.
Home Page	This section shall display real-time updates of resources, alerts, featured listings, and personalized suggestions.
Explore Page	This section shall allow users to browse available surplus materials for direct exchange, purchase, or auction.
Activity Page	This section shall display a user's transaction status (Pending, In Progress, Completed, Disputed, Cancelled) and transaction history with timestamps and exchange details or receipt.
Profile Page	This section shall allow users to manage their personal or business profile, view listings, saved resources, and ratings or reviews received.
List Resource	To enable the user to create a resource listing by entering details such as title, category, condition, quantity, location, and images for others to view and potentially exchange and purchase.

Post Auction	To enable the user to initiate an auction by setting a starting price, bidding duration, and resource details, allowing others to place competitive bids on high-demand items.
View Resource	To enable the user to view the full details of a listed resource, including images, description, owner information, availability, and exchange or purchase options.
Edit Resource	To enable the user to update the content of an existing resource listing, such as changing the description, images, price, category, or availability status.
Delete Resource	To enable the user to remove a previously listed resource from the platform when it is no longer available or relevant.
Save Resource	To enable the user to save a resource listing to their profile for easy access and consideration at a later time.
Search	To enable users search resources, messages and admins to search for specific resources, users, transactions, and auctions using relevant keywords.
Select Category	To enable user to select category based on their preferences.
Filter	To enable users and admin to refine search results by category, location, condition, availability, or exchange method.
Notifications	To enable users to receive real-time alerts for new listings, messages, offers, status updates, and system-wide announcements.

Messages	To enable users to securely send and receive messages for negotiating exchanges, asking questions, and coordinating transactions in real-time.
Propose Exchange	To enable users to offer a direct exchange for a listed resource.
Accept	To enable the user to accept a proposed direct exchange offer, confirming their agreement to proceed with the transaction.
Buy Now	To enable users to directly purchase a listed resource with a fixed price through a secure transaction.
Place Bid	To enable users to submit bids on auctioned items, participating in the competitive resource exchange.
Verify	To enable users to verify their phone number for secure transactions.
Cancel	To enable the user to cancel an ongoing transaction due to valid reasons such as unresponsiveness, change of terms, or other issues, with the status updated accordingly.
Receipt	To enable users to receive a digital receipt or trade confirmation after completing a transaction, serving as proof of exchange.
Review	To enable users to rate and review other users after transactions, promoting transparency and reliability.
Report Issue	To enable users to report fraudulent listings, disputes, or suspicious activities to the admin.
Logout	The user shall be able to logout to the mobile app for user, and website for admin.

Table 2

Functional Requirements of the Website

Features	Description
Dashboard	This section shall allow the admin to monitor key platform activities including transactions, user growth, and listings.
Users Page	This section shall enable the admin to view, manage, verify, or suspend user accounts and track login history.
Resources Page	This section shall enable the admin to review all posted resources, including approval or rejection status.
Auctions Page	This section shall enable the admin to monitor ongoing and completed auctions and manage listings.
Transactions Page	This section shall enable the admin to view transaction logs, statuses, and receipts.
Disputes Page	This section shall enable the admin to review reported issues, mediate conflicts, and resolve disputes.
Analytics Page	This section shall allow the admin to view Descriptive, Prescriptive and Predictive analytics.
Fraud Detection Page	This section shall allow the admin to review and manage system-detected fraud alerts, suspicious behaviors, and initiate actions to prevent misuse.
Approve/Reject Resource and Auction	The admin shall be able to approve or reject resource and auction listings.

Suspend User	The admin shall be able to suspend a user account involved in disputes or fraud.
Resolve Dispute	The admin shall be able to mediate and resolve disputes reported by users.
Send Notifications	The admin shall be able to send notifications such as announcements and updates to the users of the mobile app.
Logout	The admin shall be able to logout to the mobile app for user, and website for admin.

Non-Functional Requirements

Table 3 defines the non-functional requirements of the ReSourceHub mobile application and website, outlining the essential attributes that contribute to its overall performance and capable of delivering a seamless user experience.

Table 3

Non-Functional Requirements of the Mobile Application

Features	Description
Functional Suitability	The developed mobile application and website shall be able to operate reliably without unexpected failures or interruptions. All features and buttons must function as intended, ensuring a smooth user experience.
Performance Efficiency	The developed mobile application and website shall be able to maintain optimal speed, responsiveness, and scalability, ensuring a seamless user experience.

Usability	The developed mobile application and website shall be able to provide an intuitive and user-friendly experience, ensuring ease of navigation and accessibility.
Reliability	The developed mobile application and website shall consistently perform its intended functions without unexpected failures and disruptions.
Maintainability	The developed mobile application and website shall be designed for easy updates, modifications, and troubleshooting.
Portability	The developed mobile application and website shall be adaptable across various environments, ensuring smooth operation on different devices and browsers.

User Design Interface

This section outlines the hardware requirements necessary for both the development and usage of the system. The key considerations include Operating System, CPU, Storage, and RAM, all of which must meet the specified standards to ensure optimal performance and prevent compatibility issues.

Figure 9 shows the first interface that the user will see once the mobile application is introduced. (1) The first page showcases the logo, which includes the name of the application, ReSourceHub. The interface presents a "Login" button,

which allows existing users to access the ReSourceHub platform by entering their credentials, and a "Register" button (2), which allows new users to create an account on the ReSourceHub platform by providing the necessary information.

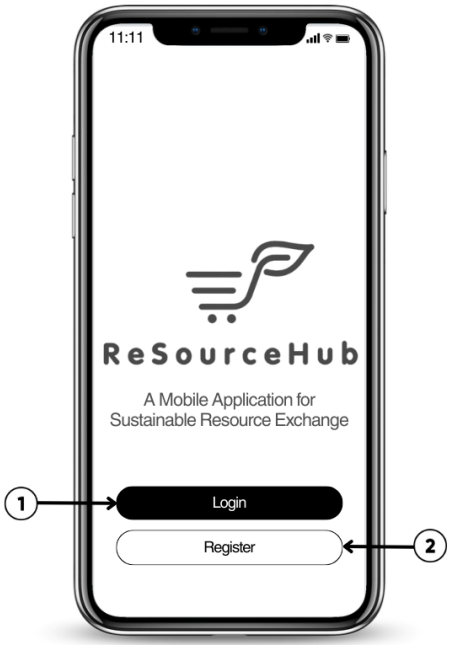

Figure 9. Login and Register Page

Figure 10 shows the login and registration interfaces for the ReSourceHub mobile application. The left image displays the Login Page (1) indicating the section where users enter their credentials. (2) Users input their registered email or username, and (3) their password. (4) A toggle option allows password visibility. (5) A "Forgot password?" link is provided, and (6) the "Login" button submits credentials for account access. The right image displays the Registration Page. (1) the account creation section. New users provide their (2) first name, and (3) last

name, (4) email address, (5) mobile number, and (6) username. (7) Users set their password and (8) confirm it. (9) A toggle option allows password visibility. (10)

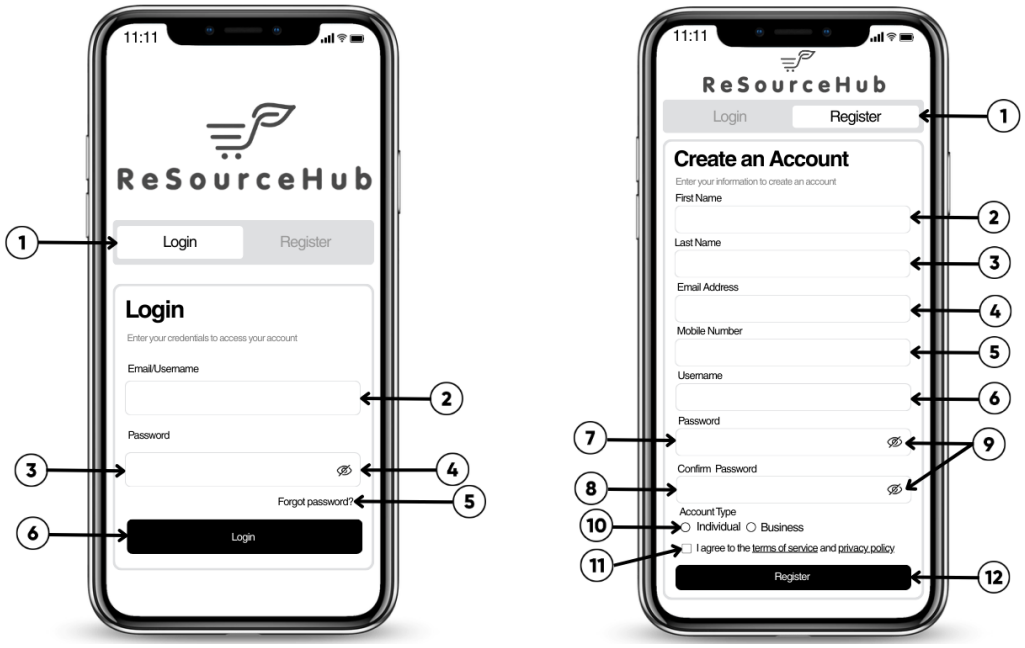

Figure 10. Login and Registration Page

Users select account type (individual or business). (11) Agreement to terms is required, and (12) the "Register" button submits information.

Figure 11 shows the interface that the user will see upon opening the application. (1) The user is currently on the home screen, which provides an overview of resources and platform activity. (2) The "Explore" button navigates the user to the explore section, where they can browse available resources, and (3) the "+" button allows the user to add a new resource. (4) The "Activity" button takes

the user to the activity feed, where they can view notifications and updates, and (5) the "Profile" button takes the user to their profile page. (6) The notification icon allows users to view alerts and updates, and (7) the chat icon takes the user to their inbox. (8) The search bar enables users to search for resources, and (9) the filter icon opens a menu to apply filters. (10) Different categories of resources are displayed, and (11) the "View" button allows users to see detailed information about a resource listing.

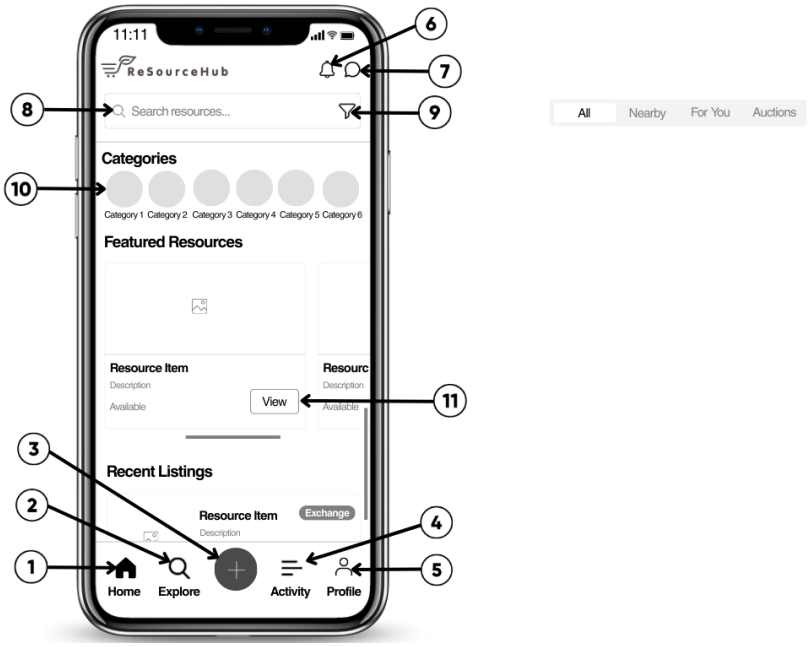

Figure 11. Home Page

Figure 12 shows different filtered views of the ReSourceHub home screen. The left image shows the "Resources Near You" section. (1) The "View Details" button allows users to access a detailed view of a specific resource listing within

this section, providing more information. The middle image displays the "Recommended For You" section. (1) The "View" button allows users to see more information about a recommended resource, and (2) the "Save" button enables users to save a resource listing for later viewing. The right image shows the "Active Auctions" section. (1) The "View Details" button allows users to access a detailed view of a specific auction listing, providing auction-specific details.

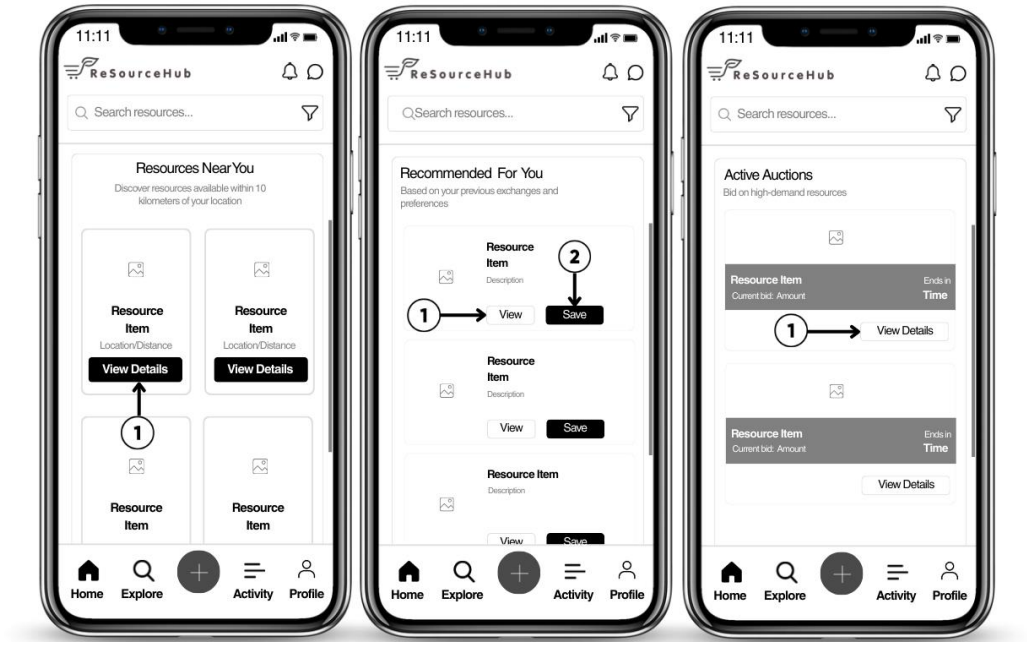

Figure 12. Home Filtered Pages

Figure 13 shows the ReSourceHub Explore page. (1) The filter button allows users to filter the displayed resources based on the selected category or type of exchange.

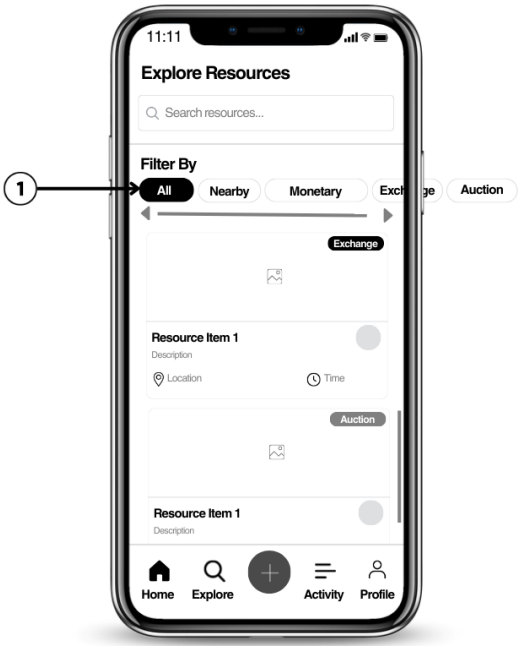

Figure 13. Explore Page

Figure 14 shows the add resource page. (1) The "List a Resource" button allows users to post a new resource listing, and (2) the "Start an Auction" button enables users to create an auction listing. (3) The "Edit" button allows users to modify the details of a listed resource, and (4) the "Delete" button allows users to remove a resource listing.

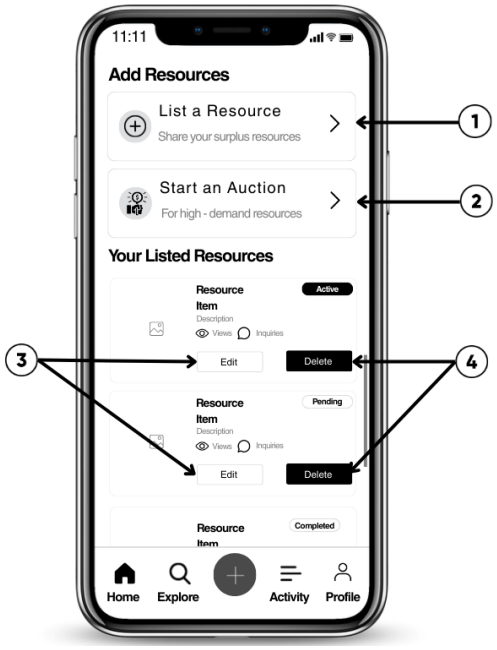

Figure 14. Add Resource Page

Figure 15 shows the List Resource Page. On the left, (1) the "Add Photo" button allows users to upload photos of the resource they want to list. (2) The "Enter resource name" field is where users type in the name or title of the resource. (3) The "Select a category" dropdown allows users to choose a category for their listing. (4) The description field is where users provide a detailed description of the resource. (5) Users can specify the condition of the resource. On the right, (6) the quantity field allows users to specify the quantity of the resource they are listing. (7) Users can select whether the resource is for monetary or direct exchange. (8) The location field is where users specify the location of the resource. (9) The "List Resource" button submits the listing.

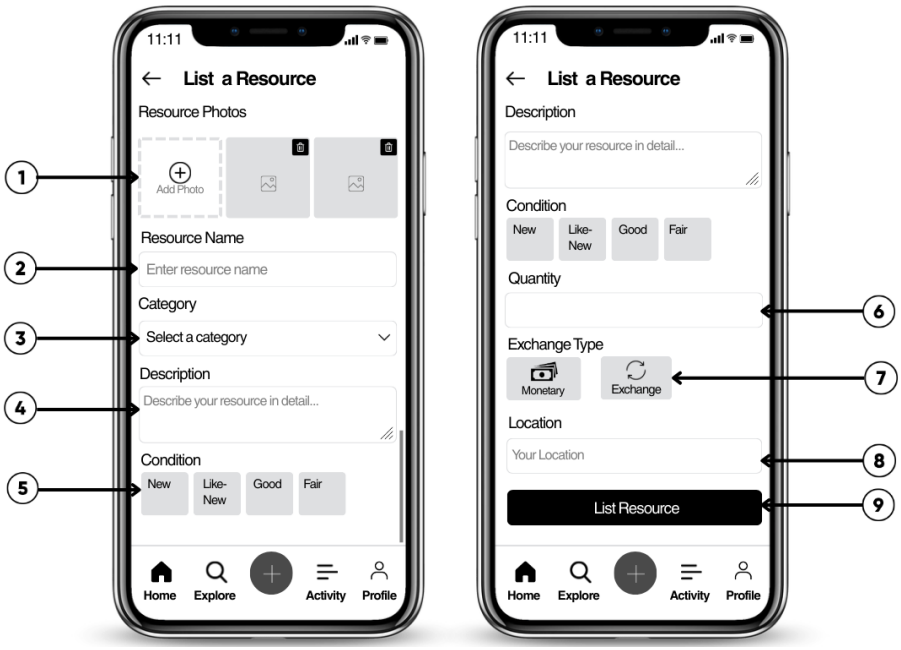

Figure 15. List Resource Page

Figure 16 shows the Start an Auction Page. On the left, (1) the "Add Photo" button allows users to upload photos. (2) The "Enter resource name" field is for the resource title, and (3) the "Select a category" dropdown lets users categorize their auction. (4) The description field is for detailed descriptions, and (5) users can specify the resource's condition. On the right, (6) "Auction" is confirmed as the exchange type. (7) The location field allows users to specify the resource location. (8) The "Enter amount" field is for the starting bid, and (9) the "Maximum Bid" field is for the highest acceptable bid. (10) Users set the auction's duration, and (11) the "Post Auction" button submits the listing.

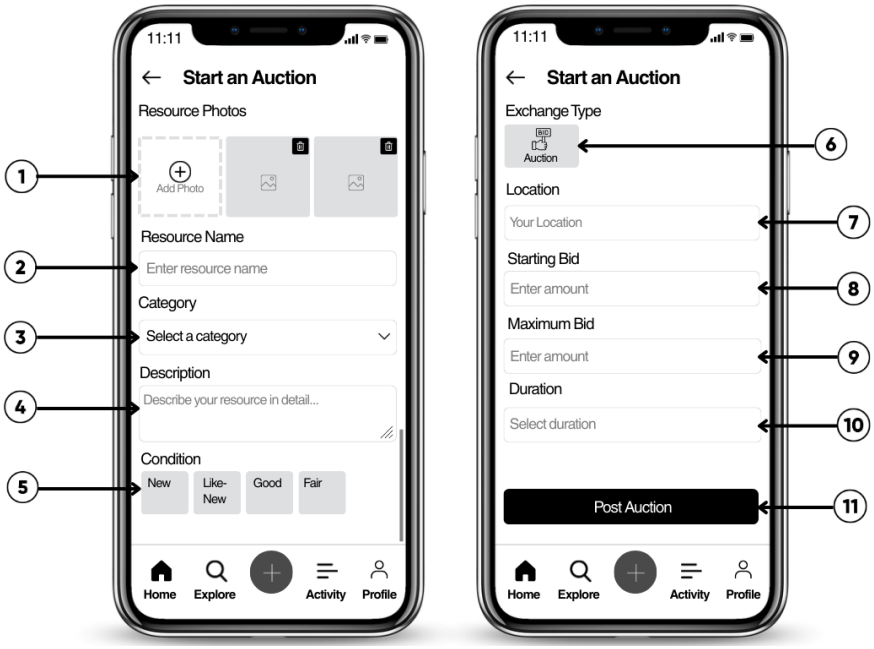

Figure 16. Start an Auction Page

Figure 17 shows the Direct Exchange Resource Listing Page. (1) The back arrow navigates the user to the previous screen. (2) The save icon allows users to save the listing. (3) The image carousel indicator shows multiple images, and (4) the "Propose Exchange" button allows users to initiate a direct exchange.

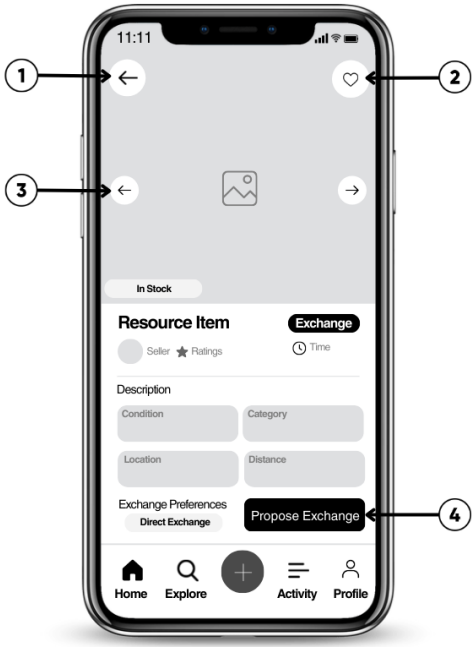

Figure 17. Direct Exchange Resource Listing

Figure 18 shows the Propose Exchange Transaction Page. The left image shows the "Propose Exchange" screen, where (1) users can input the item, they want to exchange, and (2) write a message to the owner of the resource. (3) Users can also select a suggested message. (4) Users can cancel or (5) continue to the next step. The middle image shows the "Arrange Meeting" screen, where (6) users can specify the meeting location, (7) proposed date and (8) time, and their (9) mobile number. Users can go back to the previous step, or (10) continue to the next step. The right image shows the "Verify Your Exchange Proposal" screen, where (11) users enter a verification code for security verification. (12) The exchange proposal

summary displays the details of the proposed exchange, and users can verify their proposal.

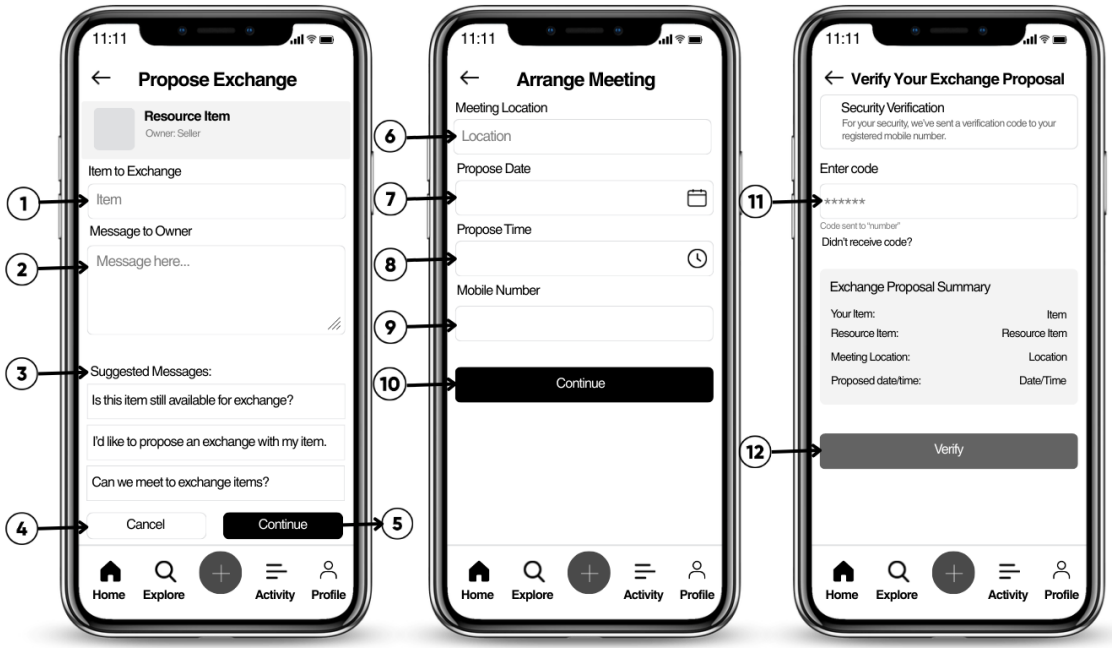

Figure 18. Propose Exchange Transaction Page

Figure 19 shows the Monetary Exchange Resource Listing Page. (1) The back arrow navigates the user to the previous screen. (2) The save icon allows users to save the listing. (3) The image carousel indicator shows multiple images, and (4) the "Buy Now" button allows users to purchase the listed resource at a fixed price.

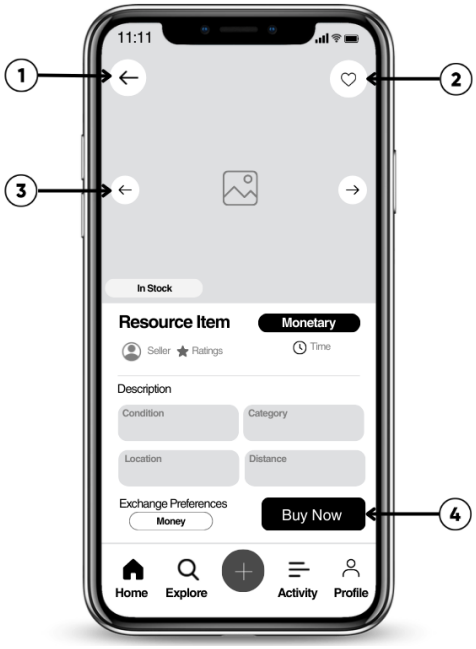

Figure 19. Monetary Exchange Resource Listing

Figure 20 shows the Monetary Transaction Page. The left image shows the "Complete Purchase" screen, where (1) GCash is selected as the payment method, and (2) the user enters their mobile number. (3) Users can cancel or (4) proceed with the payment. The middle image shows the "Complete Purchase" screen with (5) Cash selected as the payment method, and users can confirm the transaction. The right image shows the "Verify Your Purchase" screen, where (6) users enter a verification code, and (7) confirm the purchase.

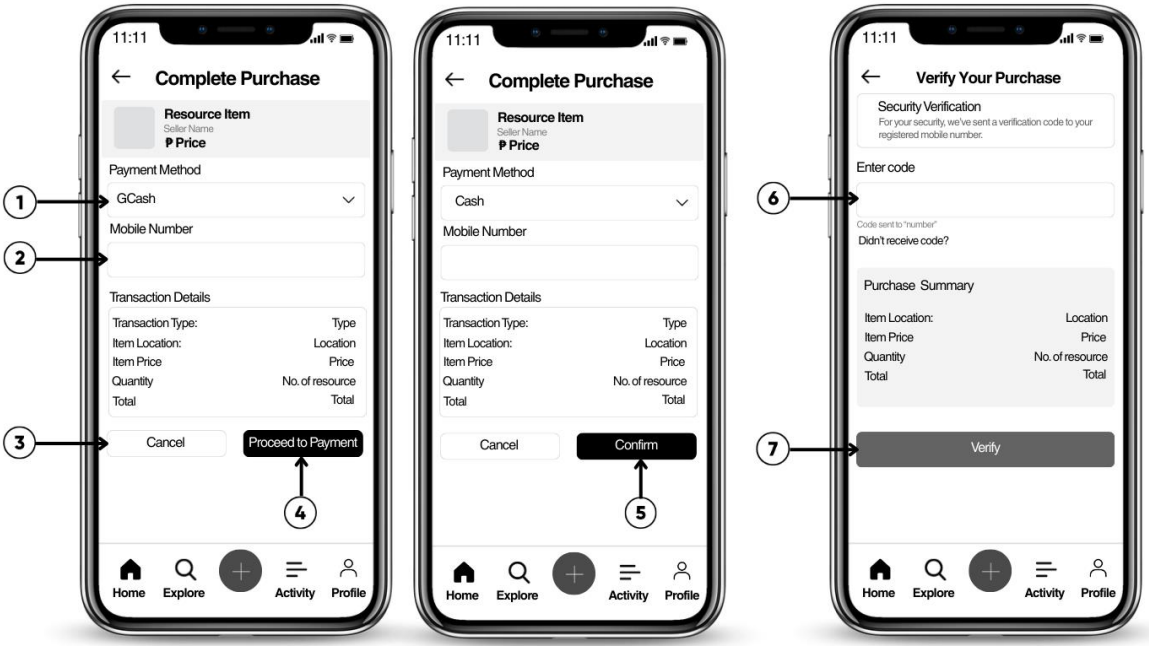

Figure 20. Monetary Transaction Page

Figure 21 shows the Auction Exchange Resource Listing Page. (1) The back arrow navigates the user to the previous screen. (2) The save icon allows users to save the listing. (3) The image carousel indicator shows multiple images, and (4) the "Place Bid" button allows users to submit a bid for the resource being auctioned.

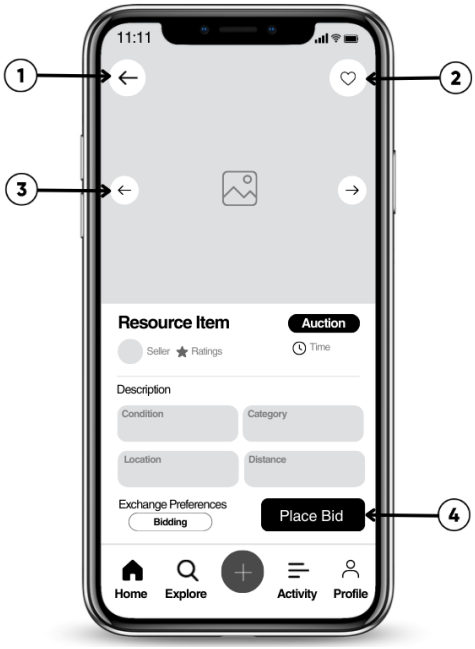

Figure 21. Auction Exchange Resource Listing

Figure 22 shows the Place Bid Page. (1) The "Enter bid amount" field is where users input their bid for an auction. (2) The "Place Bid" button submits the user's bid.

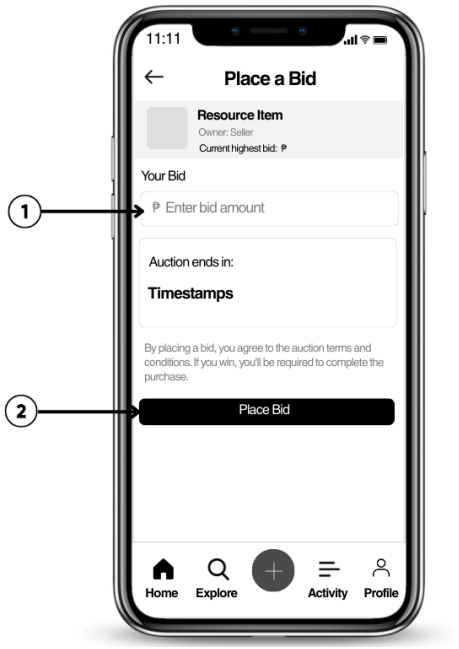

Figure 22. Place Bid Page

Figure 23 shows the Auction Transaction Page. The left image shows the "Complete Bid" screen, where (1) users can select a payment method such as GCash, and (2) add the user's mobile number. (3) Users can cancel or (4) proceed to payment. The middle image also shows the "Complete Bid" screen, but with (5) Cash selected as the payment method. (6) Users can confirm the transaction. The right image shows the "Verify Your Bid" screen, where (7) users enter a verification code, and (8) confirm their bid.

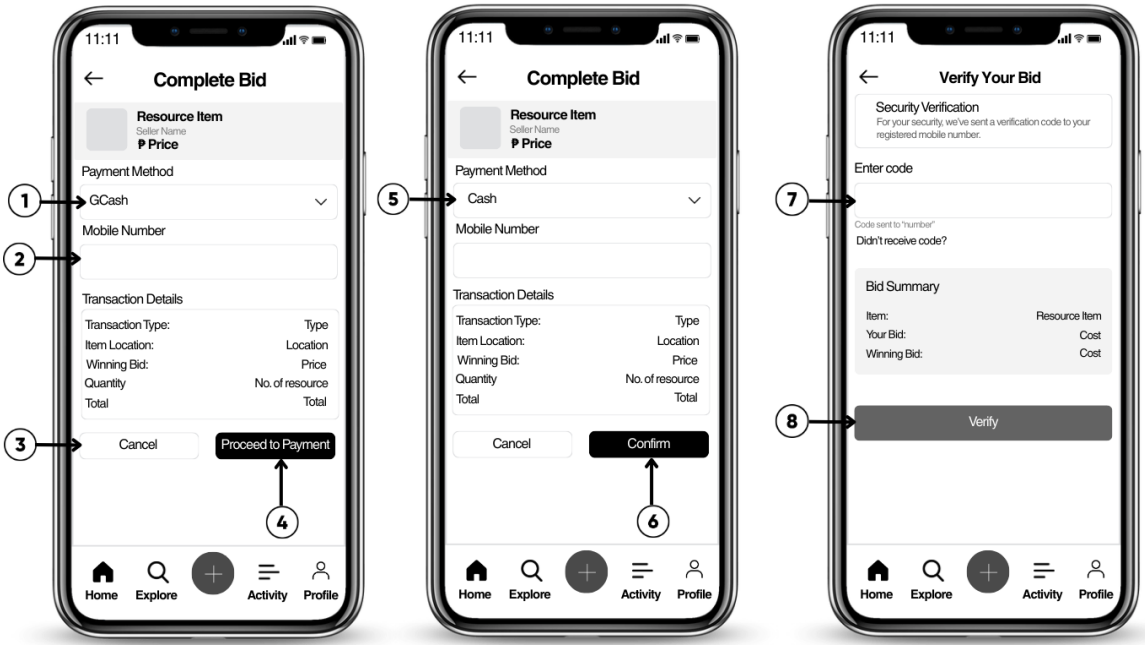

Figure 23. Auction Transaction Page

Figure 24 shows the Activity Transaction Page. (1) The "Transaction" tab indicates that the user is viewing the transaction section. (2) The status bar allows users to filter transactions by their status. (3) The "Accept" button allows users to accept a pending transaction. (4) The "Cancel" button allows users to cancel a transaction. (5) The "View Details" button allows users to see all transaction details. (6) The "Report Issue" button allows users to report a problem with a transaction. (7) The "Review" button allows users to leave a review of a completed transaction.

Figure 24. Activity Transaction Page

Figure 25 shows the Activity Transaction History Page. (1) The "Transaction History" tab indicates that the user is viewing their past transactions. (2) The "Receipt" button allows users to view the digital receipt for a specific transaction.

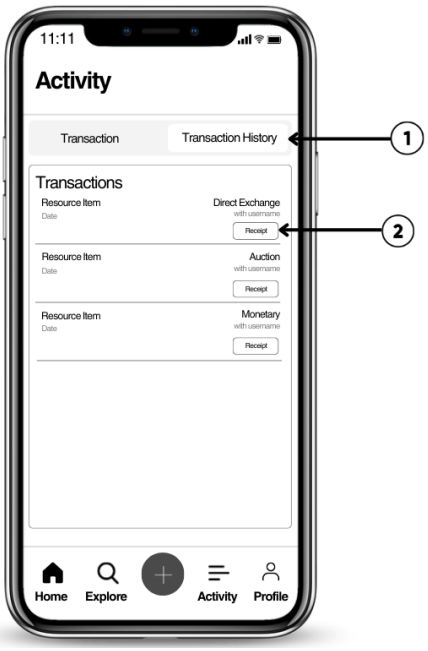

Figure 25. Activity Transaction History Page

Figure 26 shows the Notifications Page. (1) The "Mark as Read" button allows users to mark all notifications as read.

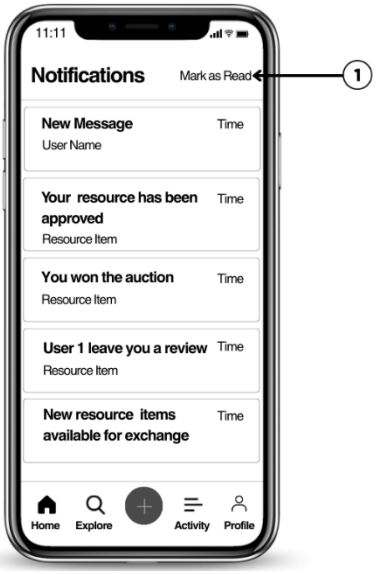

Figure 26. Notifications Page

Figure 27 shows the Messages Page. (1) The "Search messages" bar allows users to search for specific messages. (2) The message status filter allows users to filter messages. (3) The message previews display the sender, message snippet, and resource item.

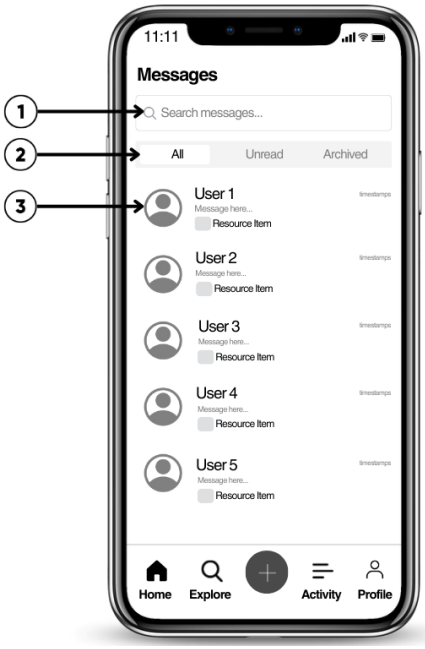

Figure 27. Messages Page

Figure 28 shows the Report an Issue modal. (1) The "Issue Type" dropdown allows users to select the category of issue they want to report. (2) The "Describe the issue" field allows users to provide a detailed description of the problem. (3) The "Upload Evidence" button allows users to upload supporting documents. (4) The "Cancel" button allows users to discard their report. (5) The "Submit Report" button submits the issue report.

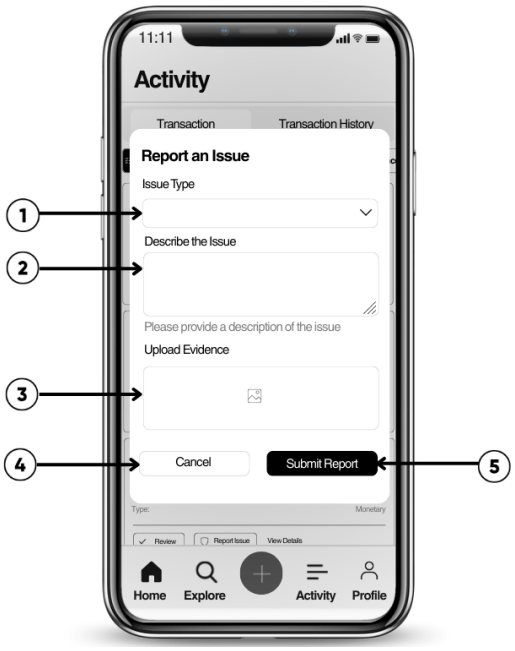

Figure 28. Report an Issue Modal

Figure 29 shows the Transaction Review modal. (1) The star rating allows users to rate their transaction experience. (2) The review text area allows users to write a detailed review. (3) The "Skip" button allows users to bypass leaving a review. (4) The "Submit Review" button submits the user's rating and review.

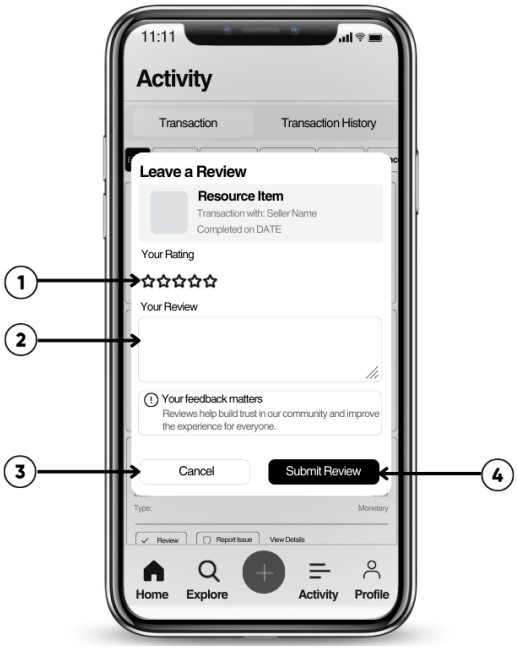

Figure 29. Transaction Review Modal

Figure 30 shows the User Profile Page. (1) The gear icon allows users to access their account settings. (2) The sign-out icon allows users to sign out. (3) The tabbed navigation allows users to switch between "Listings," "Saved," and "Reviews."

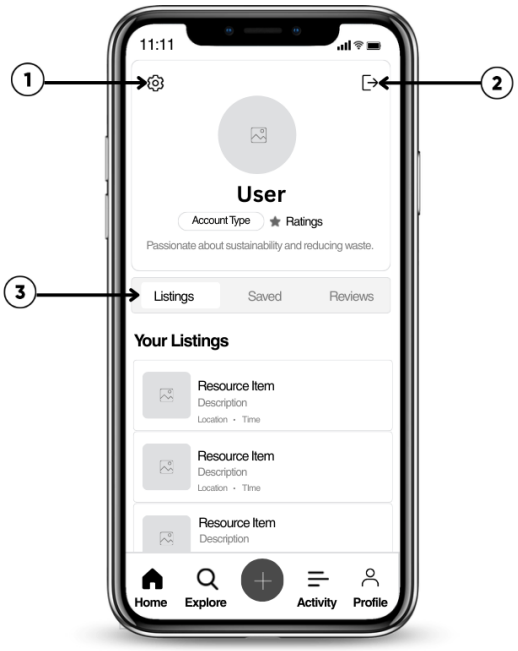

Figure 30. User Profile Page

Figure 31 is the Admin side. It shows the Admin Login Page. (1) The "Email" field is where administrators enter their email. (2) The "Password" field is where administrators enter their password. (3) The eye icon allows administrators to toggle password visibility. (4) The "Forgot password?" link allows administrators to navigate to the password recovery page. (5) The "Sign In" button submits the login credentials.

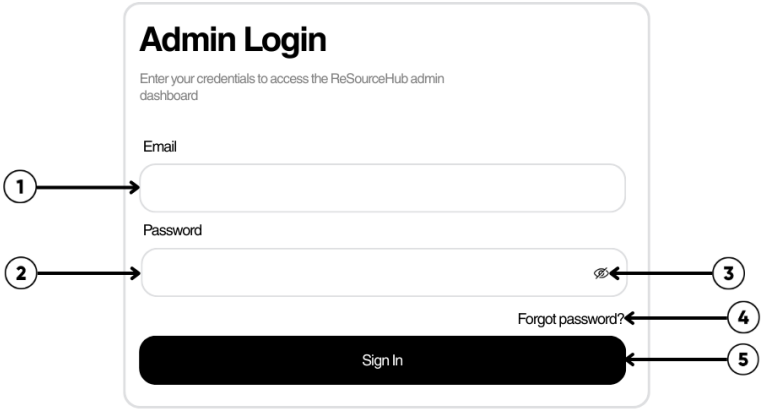

Figure 31. Admin Login Page

Figure 32 shows the Admin Dashboard Page. (1) The "Dashboard" option in the navigation bar indicates the currently selected section. (2) The "Users" option navigates to the user management section. (3) The "Resources" option navigates to the resource management section. (4) The "Auctions" option navigates to the auction management section. (5) The "Transactions" option navigates to the transactions section. (6) The "Disputes" option navigates to the dispute resolution section. (7) The "Analytics" option navigates to the analytics section. (8) The "Fraud Detection" option navigates to the fraud detection section. (9) The bell icon allows administrators to view alerts and notifications. (10) The profile icon provides access

to admin settings and logout. (11) The "View All" buttons allow the administrator to see the complete lists of recent users and recent transactions.

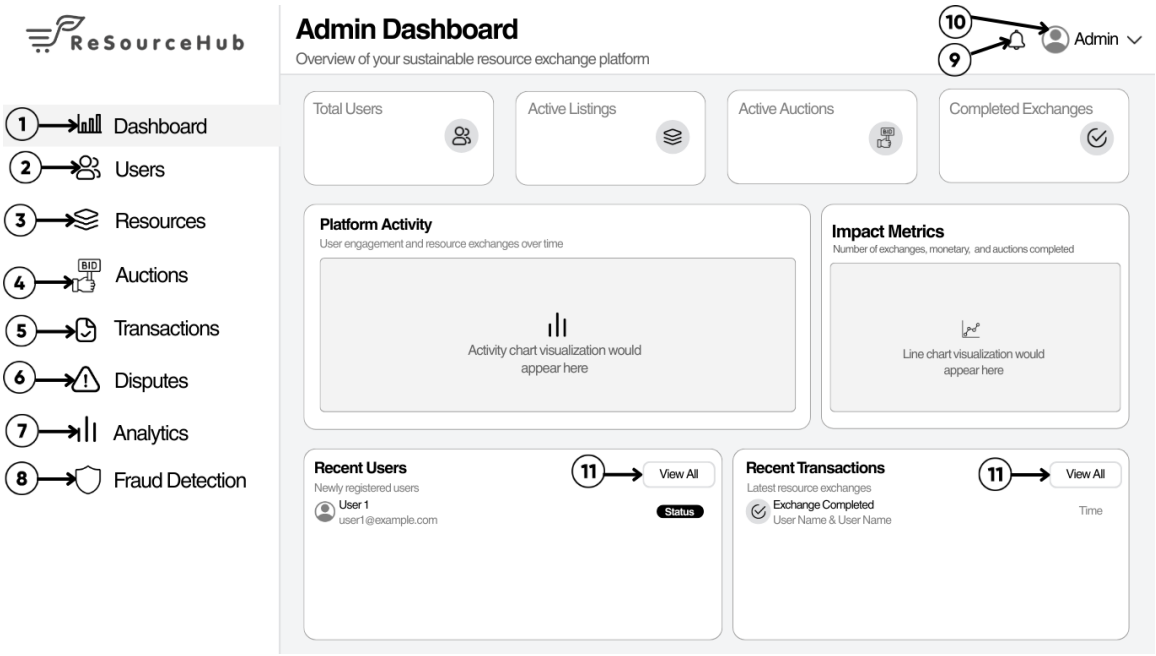

Figure 32. Admin Dashboard Page

Figure 33 shows the Users Page. (1) The "Search users" bar allows administrators to search for specific users. (2) The "Filter" button allows administrators to filter the user list. (3) The "View Details" button allows the admin to view all the details of a selected user.

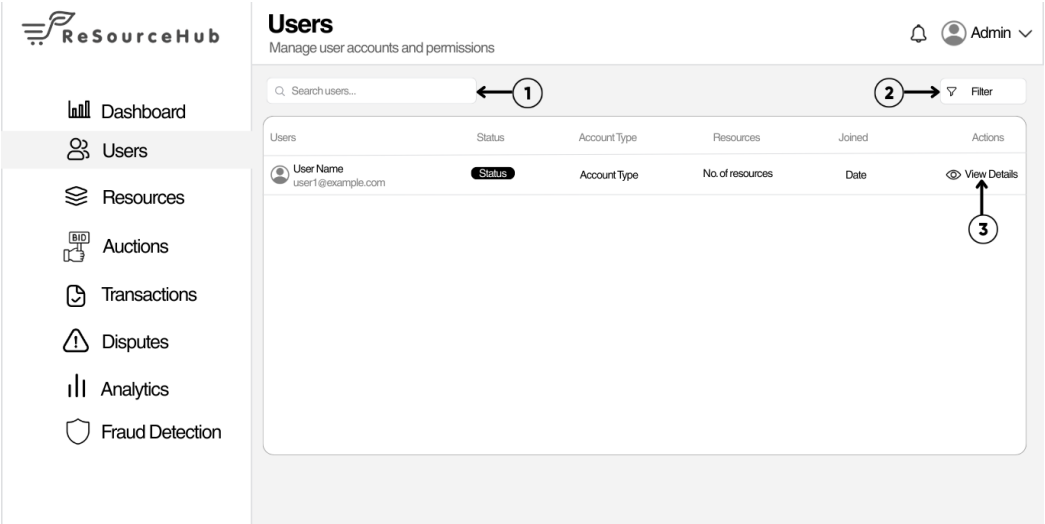

Figure 34. Users Page

Figure 34 shows the User Details Modal. (1) The "Overview" tab allows administrators to view a summary of the user's key information. (2) The "Suspend User" button allows administrators to suspend or disable a user's account.

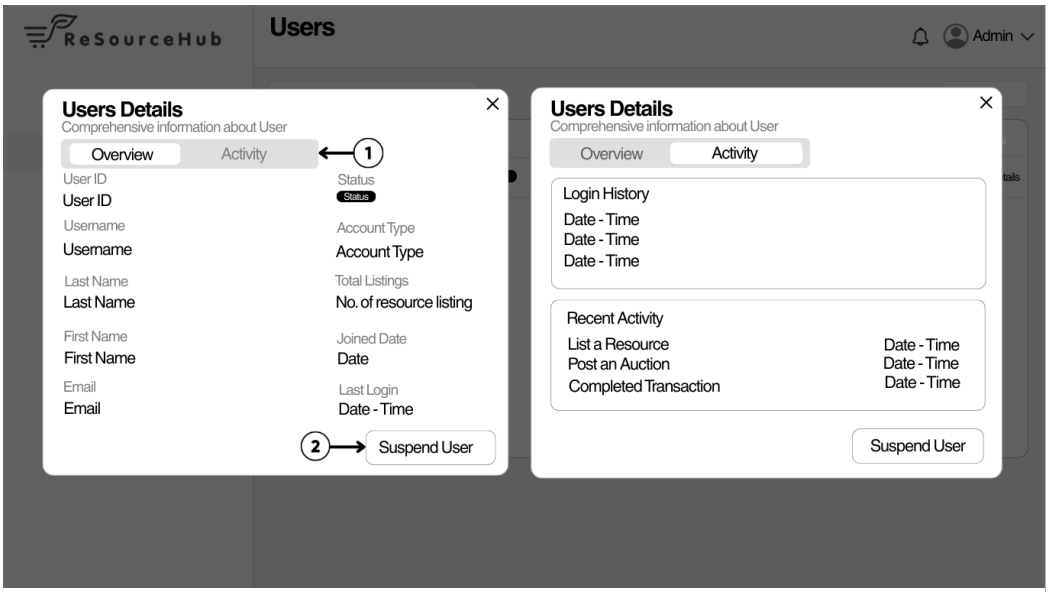

Figure 33. User Details Modal

Figure 35 shows the Resources Page. (1) The "Search resources" bar allows administrators to search for specific resources. (2) The "Filter" button allows administrators to filter the resource list. (3) The "View Details" button allows the admin to view all the details of a selected resource.

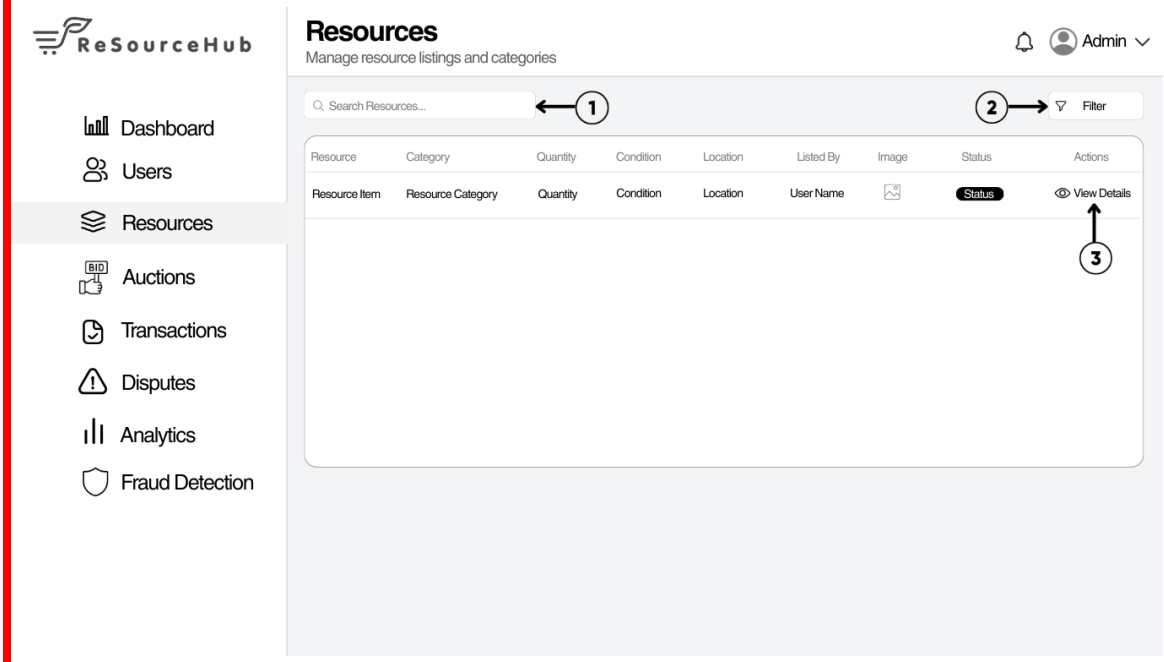

Figure 35. Figure 35. Resources Page

Figure 36 shows the Resource Details Modal. (1) The "Reject" button allows administrators to reject a resource listing. (2) The "Approve" button allows administrators to approve a resource listing.

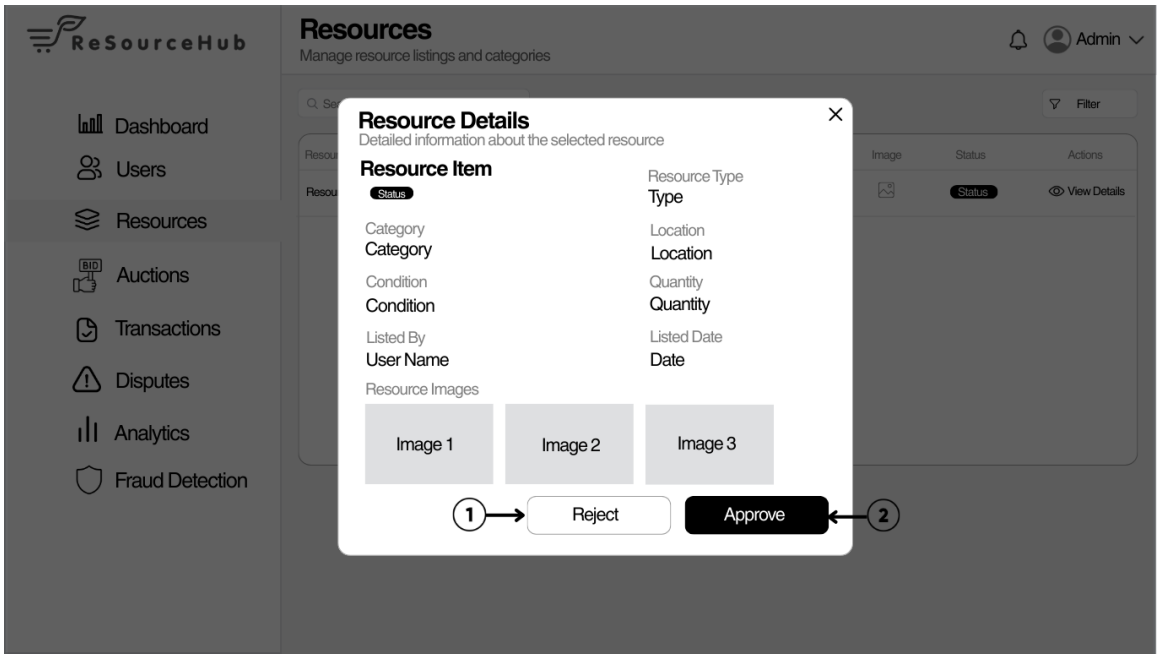

Figure 36. Figure 36. Resource Details Modal

Figure 37 shows the Auctions Page. (1) The "Search auctions" bar allows administrators to search for specific auctions. (2) The "Filter" button allows administrators to filter the auction list. (3) The "Auctions/Bidding" toggle allows administrators to switch between viewing auction listings and managing bidding activities. (4) The "View Details" button allows the admin to view all the details of a selected auction.

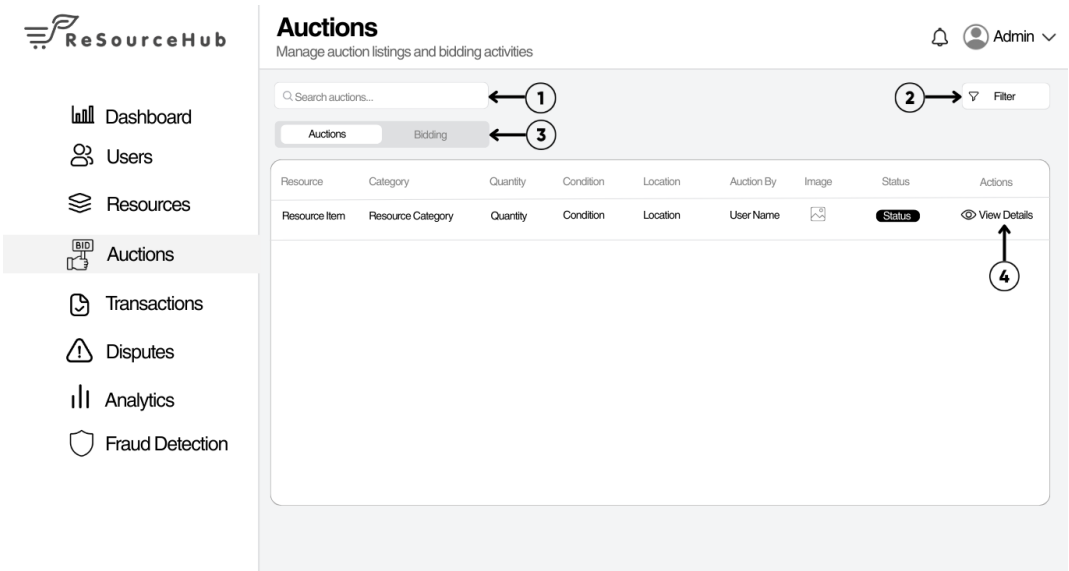

Figure 37. Auctions Page

Figure 38 shows the Auction Details Modal. (1) The "Reject" button allows administrators to reject an auction listing. (2) The "Approve" button allows administrators to approve an auction listing.

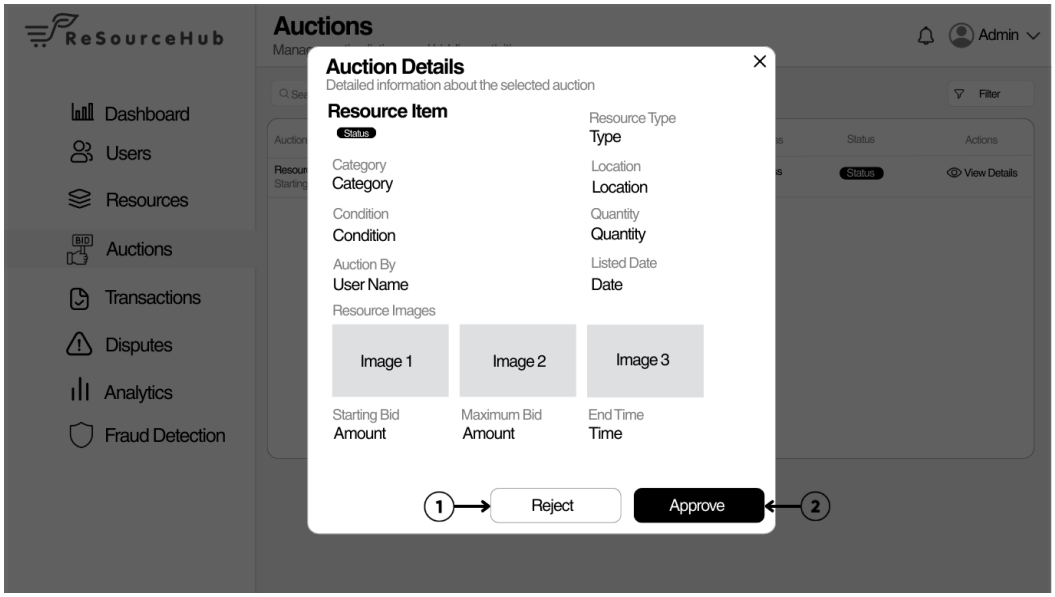

Figure 38. Auction Details Modal

Figure 39 shows the Auctions Page (Bidding Section). (1) The "Search auctions" bar allows administrators to search for specific auctions. (2) The "Filter" button allows administrators to filter the auction list. (3) The "Auctions/Bidding" toggle allows administrators to switch between viewing auction listings and managing bidding activities. (4) The "View Details" button allows the admin to view all the details of a selected bidding.

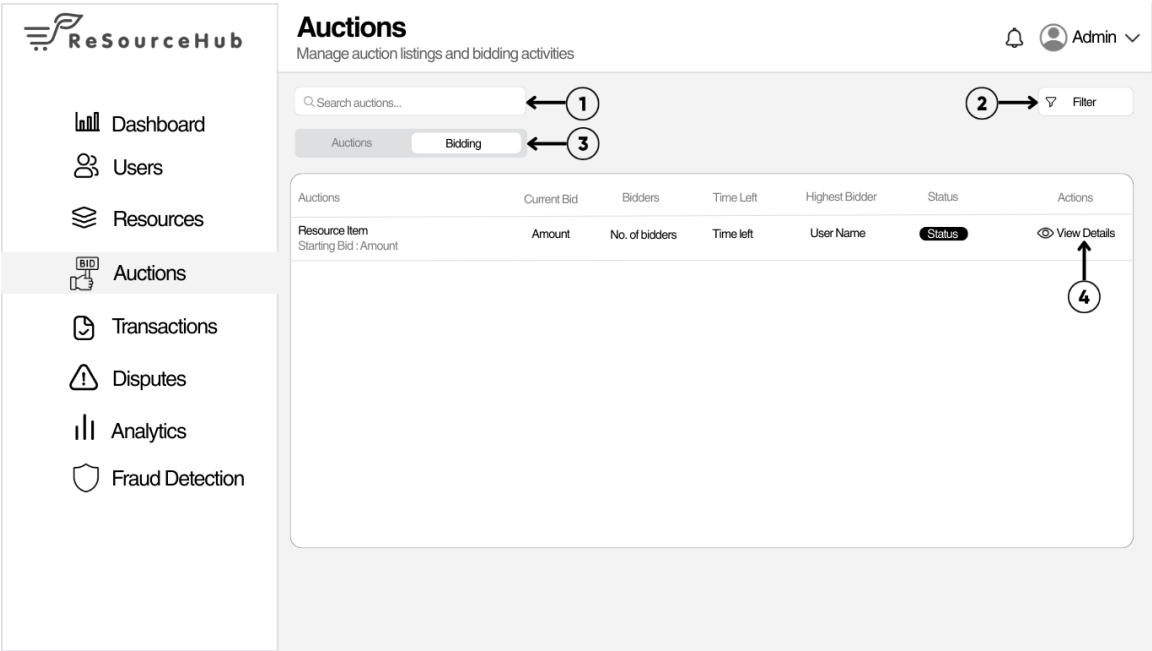

Figure 39. Auctions Page (Bidding Section)

Figure 40 shows the Transactions Page. (1) The "Search transactions" bar allows administrators to search for specific transactions. (2) The "Filter" button allows administrators to filter the transaction list. (3) The "View Details" button allows the admin to view all the details of a selected transaction.

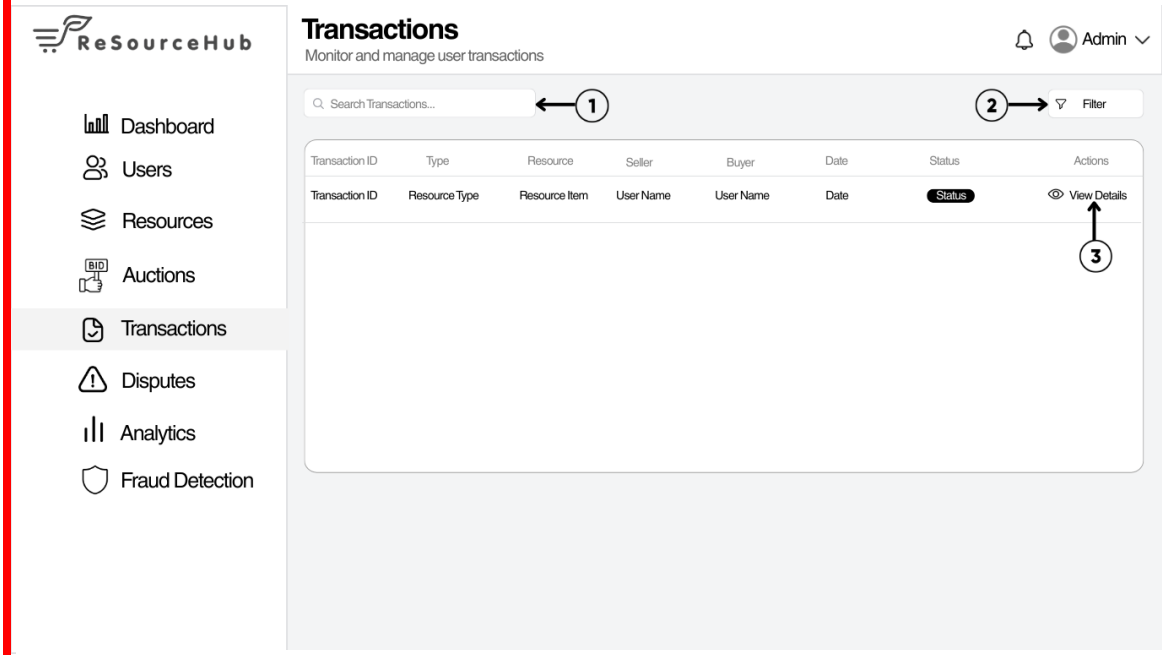

Figure 40. Transactions Page

Figure 41 shows the Transaction Details Modal. (1) The "Receipt" button allows administrators to view the receipt for a selected transaction.

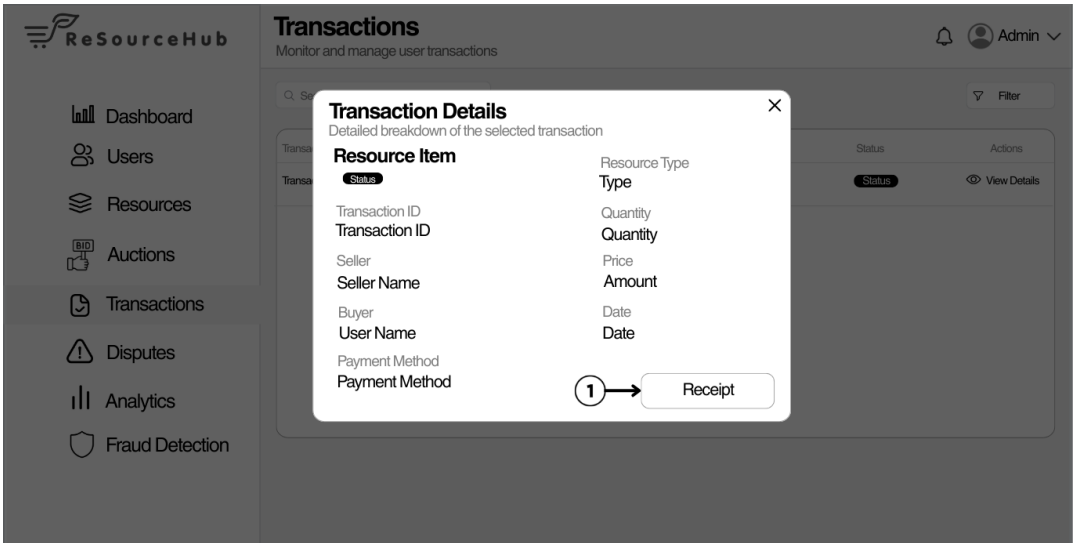

Figure 42. Transaction Details Modal

Figure 42 shows the Disputes Page. (1) The "Filter" button allows administrators to filter the dispute list. (2) The "View Details" button allows the admin to view all the details of a selected dispute.

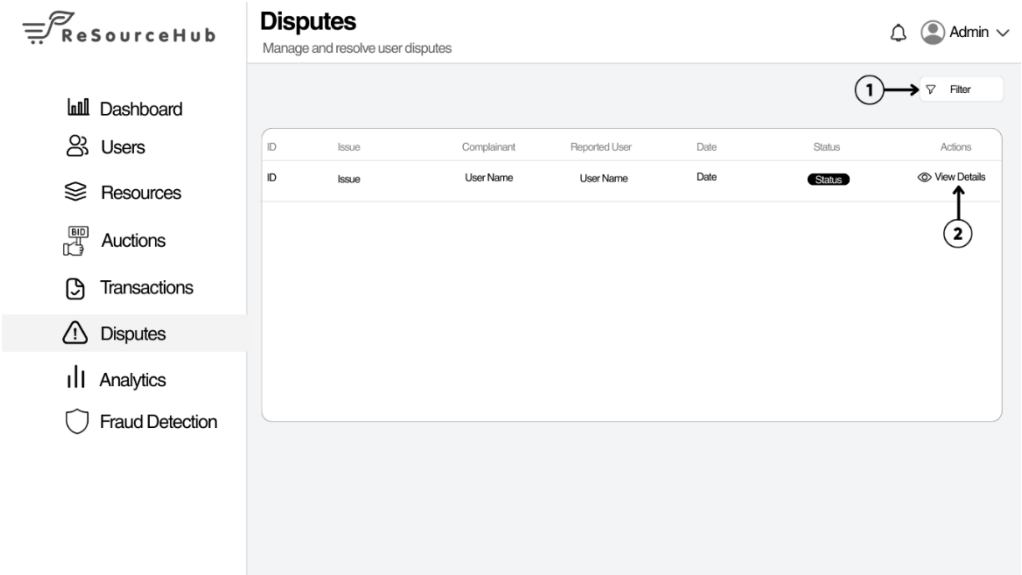

Figure 41. Disputes Page

Figure 43 shows the Dispute Details Modal. (1) The "Resolve Dispute" button allows administrators to submit their resolution for a selected dispute.

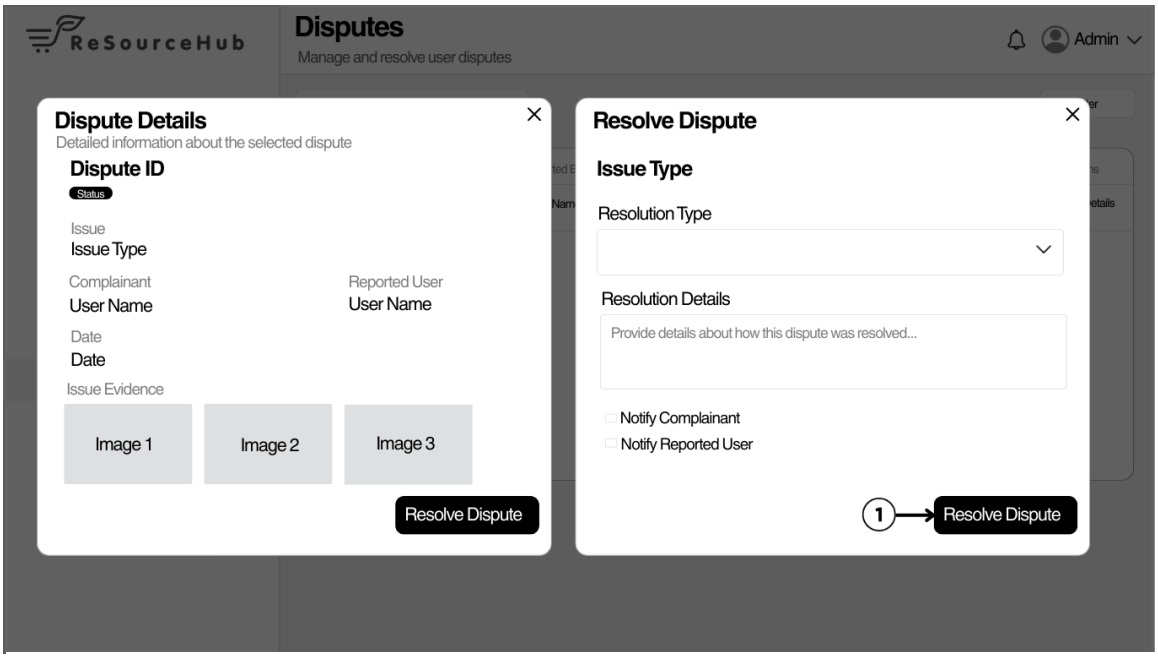

Figure 43. Dispute Details Modal

Figure 44 shows the Analytics Page. (1) The "Dashboard" option in the navigation bar indicates the currently selected section, providing an overview of past platform data, such as user activity. (2) The "Filter" button enables administrators to filter the displayed analytics data based on specific criteria.

F

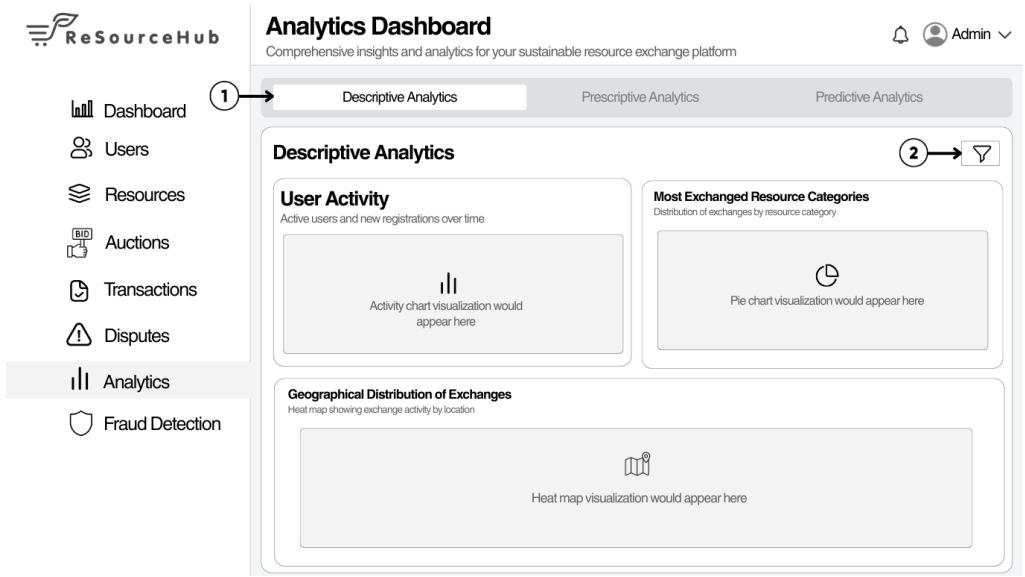

Figure 44. Analytics Page

Figure 45 shows the Fraud Detection Page. (1) The "Filter" button enables administrators to filter the fraud alert list based on specific criteria. (2) The "View Details" button allows the admin to view all the details of a selected fraud alert.

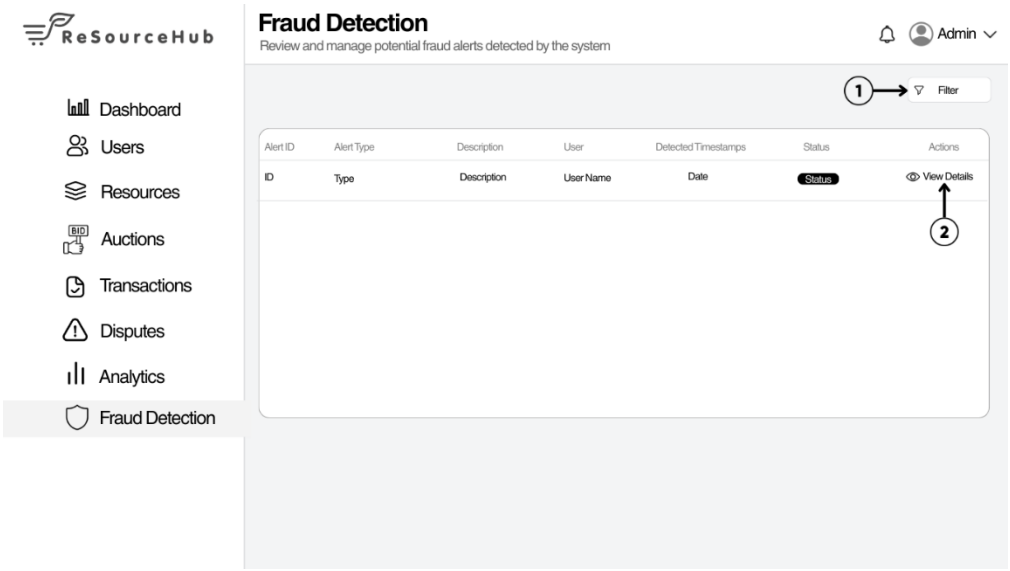

Figure 45. Fraud Detection Page

Figure 46 shows the Notifications Page. (1) The "Send Notifications" button allows administrators to compose and send notifications to users. (2) The "Mark as Read" button allows administrators to mark all notifications as read.

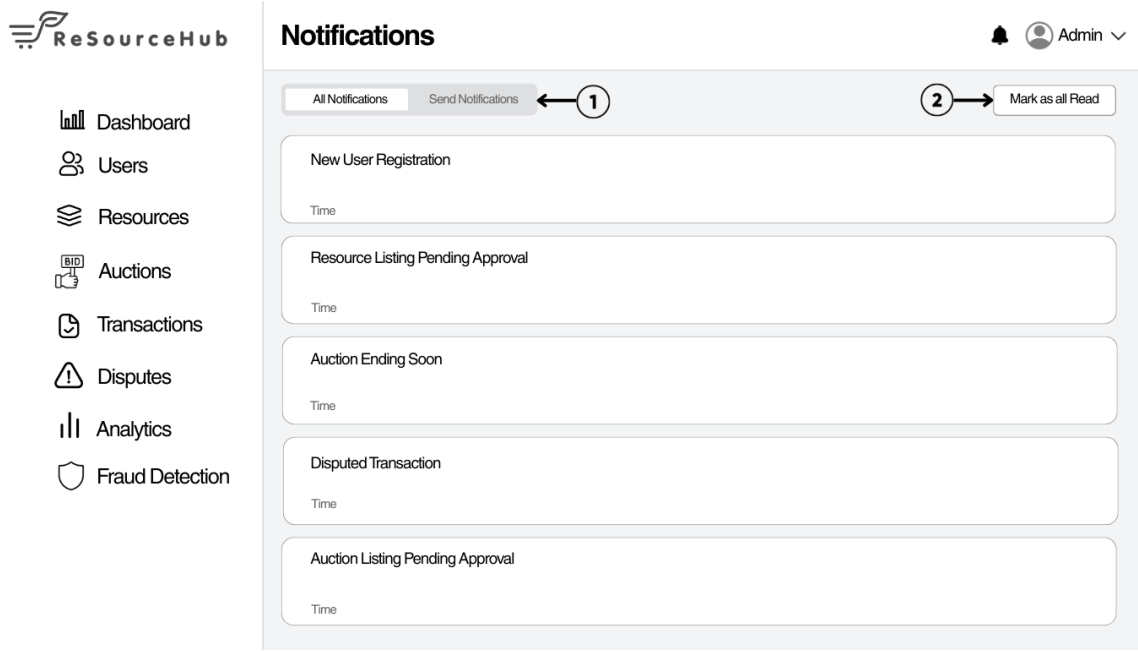

Figure 46. Notifications Page

Figure 47 shows the Send Notifications Page. (1) The "Send Notification" tab indicates that the user is on the send notification page. (2) The "Recipient" dropdown allows administrators to select the recipients of the notification (e.g., all users, a specific user group, or individual users). (3) The "Notification Type" dropdown allows administrators to select the type of notification (e.g., information, update, alert). (4) The "Notification Title" field designates the area where administrators should enter the title for the notification. (5) The "Message" field

designates the area where administrators should type the main content or message of the notification. (6) The "Send Notification" button submits the composed notification to the selected recipients.

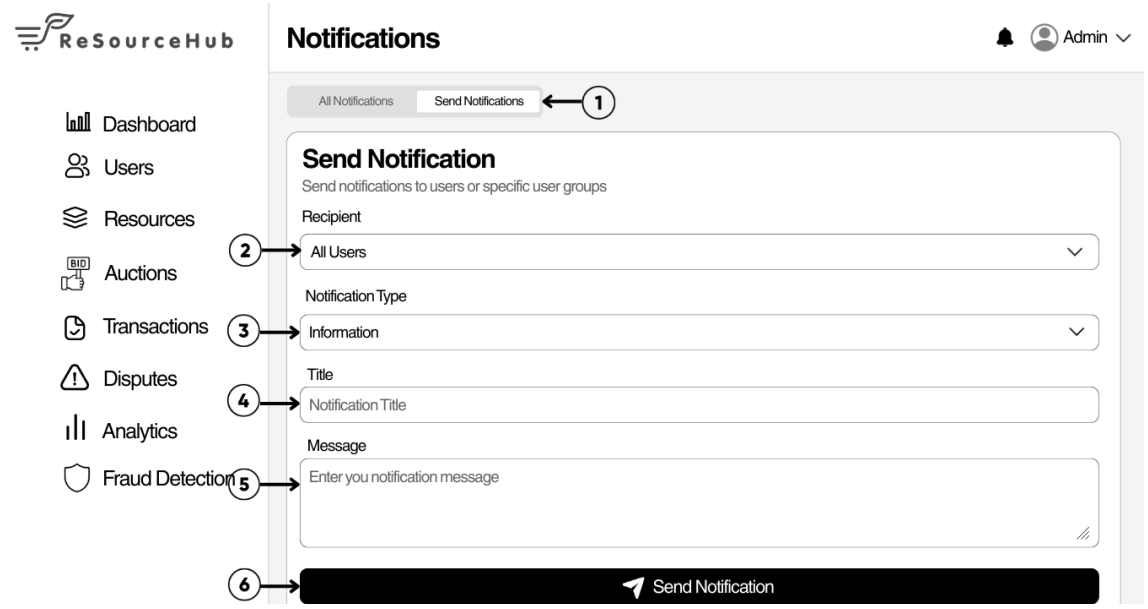

Figure 47. Send Notifications Page

Hardware Requirements in Developing the System

This section specifies the hardware components necessary to build and develop the system. It includes details such as device specifications, processors, memory requirements, and other critical hardware tools.

Table 4 shows the Hardware Requirements for developing the system. The Operating System that the developers will use is Windows 10 with 64-bit. To develop the system, at least an Intel Core i5 processor is required. For RAM, at least

8GB is recommended to support running emulators, Flutter SDK, Firebase CLI, and other related tools. The storage should have at least 512GB capacity to handle the mobile and web development environments, SDKs, and project files. These hardware specifications are essential to maintaining a responsive and stable development workflow

Table 4

Hardware Requirements for Developing ReSourceHub

Equipment	Specification
Operating System	At least Windows 10 and up (64 bit)
Processor	At least Intel Core i5
RAM	At least 8GB
Storage	At least 512GB

Hardware Requirements in Using the System

This section defines the hardware requirements essential for the effective utilization of the system. It outlines the minimum specifications necessary to ensure optimal performance, including operating system compatability, processor capabaliyies, memory allocation, and storage capacity. Compiling to these requirements prevents performance issues, ensures system stability, and maintain seamless functionality across different user environments.

Table 5 outlines the requirements for running the developed system smoothly on user devices. Users will need at least Android 7 as the operating system. The processor should be a Qualcomm Snapdragon 600 series, MediaTek Helio G series, Samsung Exynos 7 series or higher for Android. A minimum of 4GB RAM and 64GB storage is necessary to ensure the mobile app runs efficiently. A minimum internet connection speed of 5 Mbps is required for stable app performance, particularly when loading real-time data from Firebase.

Table 5

Hardware Requirements for the Users

Equipment	Specification
Operating System	Android 7 or higher
Processor	Qualcomm Snapdragon / MediaTek Helio / Samsung Exynos
RAM	At least 4GB
Storage	At least 64GB
Internet Speed	At least 5 Mbps

Table 6 shows the requirements needed for the admin to access and manage the system's web interface. The administrative side of ReSourceHub will be accessible via a browser, so a Windows 10 or newer OS is required for

compatibility. The processor should be at least an Intel Core i3, paired with a minimum of 4GB RAM and 50GB of storage. An internet connection of at least 5 Mbps is recommended for consistent access to Firebase services and to avoid lag during updates or data synchronization. These specifications ensure optimal admin-side performance.

Table 6

Hardware Requirements for the Admin

Equipment	Specification
Operating System	At least Windows 10 and up (32/64 bit)
Processor	At least Intel Core i3
RAM	At least 4GB
Storage	At least 50GB
Internet Speed	At least 5 Mbps

Software Requirements in Developing the System

This section provides the software requirements for developing the applications as well as for accessing and using them. In Table 7, the tools used to build the system are detailed. For the development environment, developers will use at least Windows 10 as the operating system. Visual Studio Code and Android Studio will be utilized for web and mobile app development. DART and Flutter will

be used for developing the cross-platform mobile app, while HTML, CSS, and JavaScript may be used for parts of the admin web. Firebase will serve as the backend platform, handling authentication, real-time databases, and cloud functions. Chrome or Microsoft Edge will be used for previewing and debugging the web dashboard.

Table 7

Software Requirements for Developing ReSourceHub

Equipment	Specification
Operating System	At least Windows 10
Browser	Chrome, Microsoft Edge
Programming Language	Dart, Flutter, HTML, CSS, JavaScript
Development Tools	Visual Studio Code, Android Studio
Database	Firebase

Software Requirements in Using the System

This section outlines the software requirements necessary for the proper operation of the system, ensuring compatibility, stability, and optimal functionality. It specifies the required operating system, frameworks, libraries, and other dependencies essential for seamless execution.

Table 8 presents the software requirements for the users of the mobile application. They must use at least Android version 7 to ensure compatibility with Flutter's system requirements. Users should also have the latest version of the ReSourceHub app installed to benefit from performance updates, new features, and bug fixes.

Table 8

Software Requirements for the Users

Equipment	Specification
Operating System	Android 7 or higher
App Version	Latest Version

Table 9 outlines the software needed by the admin to operate the system's web dashboard. A Windows 10 operating system and a modern web browser such as Chrome or Edge are necessary for full functionality. These browsers ensure compatibility with Firebase integrations and responsive admin dashboard features.

Table 9

Software Requirements for the Admin

Equipment	Specification
Operating System	Windows 10 and up
Browser	Chrome, Microsoft Edge

Testing and Evaluation

The testing and evaluation phase is conducted to verify that the system functions as intended and complies with standards outlined in ISO/IEC 25010:2011, focusing on Functional Suitability, Performance Efficiency, Usability, Reliability, Maintainability, and Portability. Function Suitability ensures that the system consistently delivers the required functionalities without errors or disruptions, maintaining operational stability. Performance Efficiency evaluates the system's responsiveness, ensuring minimal delays and stable operation even under high workload conditions. Usability assesses the interface design to confirm accessibility for users of varying skill levels, ensuring intuitive navigation while preserving functionality. Reliability verifies that the system perfroms as expected without failures or unexpected interruptions, reinforcing dependability. Portability determines the ssytem's adaptability across different environments with minimal modifications, ensuring flexibility in deployment. To assess the feasibility of the system, the proponents will conduct a survey-based evaluation involving one hundred (100) residents as respondents. This sample size is selected to provide statistically reliable insights while ensuring efficient data analysis.

The evaluation will utilize a structured rating scale, as shown in Table 10, to measure user perceptions of system performance and effectivvness. Surveys will be distributed to both clients and end-users, ensuring diverse feedback that reflects

usability, functionality, and overall user satisfaction. This approach ensures a comprehensive assessment, validating whether the system meets user expectations and successfully addresses the identified needs.

Table 10

Likert Scale

Scale	Interpretation
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Table 11 presents the verbal interpretation of the weighted mean, providing a qualitative assessment of each criterion after numerical analysis. This interpretation translates statistical data into meaningful insights, enhancing readability and understanding of user feedback and satisfaction levels. By converting raw numerical values into easily interpretable descriptions, it ensures clarity without requiring statistical expertise, making the evaluation process more accessible and informative.

Table 11

Range of Verbal Interpretation

Weighted Mean Range	Verbal Interpretation
4.21 – 5.00	Strongly Agree
3.41 – 4.20	Agree
2.61 – 3.40	Neutral
1.81 – 2.60	Disagree
1.00 – 1.80	Strongly Disagree

Test Case

Test case provides a structured and systematic approach to verifying that specific elements functionalities of an application meet predefined requirements and specifications. It plays a crucial role in identifying defects, validating system behavior, and ensuring that implemented features align with user expectations and project objectives. Each test case is designed to assess a particular aspect of the system under controlled conditions, guaranteeing accuracy, consistency, and reliability in performance. Functional testing is conducted to confirm that the application behaves as expected, verifying that core features and functionalities work properly while identifying any issues before full deployment. Performance testing evaluates how well the application functions under various loads, ensuring

stability and responsiveness. Usability testing examines the ease of use and overall user experience, determining whether the interface is intuitive and allows users to accomplish tasks efficiently and without confusion. User feedback is instrumental in ensuring the system meets the actual needs and expectations of its users. If the system encounters errors or behaves unexpectedly, it indicates that the intended objectives have not been met, deeming the system unsuccessful. Conversely, if the system delivers the expected functionality, meets user requirements, and allows them to perform their tasks effectively, it is considered successful. By incorporating user feedback, developers can refine test cases to address edge cases that may have been overlooked during initial testing. This approach enhances the system's overall quality and ensures a seamless user experience.

Table 12 presents the test cases for the users of the ReSourceHub application, ensuring developers clearly understand each feature's expected behavior through validation and verification of user functional requirements. These test cases help confirm that all functionalities are thoroughly tested. When modifications or new features are introduced, developers can reference these test cases to prevent unintended disruptions to existing functionality. Additionally, if an issue occurs during maintenance or updates, the test case table serves as a valuable tool for

identifying what changed, pinpointing the failed step, and determining the appropriate solution.

Table 12
Test Cases for ReSourceHub Mobile Application User

Task No.	Task Description	Expected Results
1	Login and Register an account	The user should be able to successfully create an account.
2	List surplus materials	The user should be able to post items for exchange or donation.
3	Browse resource listings	The user should be able to view all available surplus materials.
4	Place a bid in an auction	The user should be able to bid on a resource in an ongoing auction.
5	Search and filter resources	The user should be able to search and apply filters to find resources quickly.
6	Send and receive messages	The user should be able to use messaging for negotiations and discussions.
7	Rate and review other users	The user should be able to submit ratings and feedback for completed transactions.

8	Receive real-time alerts	The user should be notified about messages, listings, and trade opportunities.
9	Initiate a direct (barter) exchange	The user should be able to complete a one-to-one item exchange.
10	Participate in auction-based trades	The user should be able to engage in auctions and track bids.
11	Make monetary transactions	The user should be able to pay securely using GCash.or Cash.
12	View transaction status and transaction history.	The user should be able to track current transaction status and view previous exchanges with details.
13	Receive digital receipt after exchange	The user should get a receipt confirming trade completion.

Table 13 presents the test cases for the administrative functionalities of ReSourceHub, ensuring that system management features work as expected. These test cases validate administrative actions, the system can maintain security, efficiency, and reliability, ensuring that both users and administrators can interact with the platform without disruptions. These test cases also help in identifying potential issues early, preventing system failures, and improving overall application

usability. If errors occur during maintenance, the test case table assists in diagnosing issues, tracking modifications, and implementing necessary fixes.

Table 13
Test Cases for ReSourceHub Website Administrator

Task No.	Task Description	Expected Results
1	Verify/Approve or reject resource and auction listings	Admin should be able to approve or reject posted items based on validity.
2	Suspend user accounts	Admin should have the capability to disable access to the application for selected users.
3	Track user activity and login logs	Admin should be able to view detailed logs of user sessions and actions.
4	Manage and oversee auction activities	Admin should be able to track bidding and control auction-related issues.
5	Monitor and manage user transactions	Admin should view all ongoing and past user transactions.
6	Detect and flag potential fraud	Admin should be able to detect suspicious activity and flag accounts.

7	Push notifications and announcements	Admin should send system-wide or targeted updates and alerts.
8	Handle user dispute cases	Admin should review reports and mediate disputes fairly.

System Evaluation

The evaluation of system quality is crucial for it provodes comprehensive assessement of a system's performance, quality, and alignment with user requirements. It helps determine whether the system fulfills its intended purpose and objectives, ensuring that it meets both technical standards and user expectations. System evaluation ensures system's effectiveness, reliability, and usability. The proposed system, ReSourceHub, based on the internationally recognized ISO/IEC 25010:2011 standard, which defines essential software quality characteristics. The evaluation aims to determine ReSourceHub's compliance to key quality attributes, incluing Functional Suitability, Performance Efficiency, Usability, Reliability, Maintainability, and Portability. In terms of functional suitability, ReSourceHub should be able to demonstrate comprehensive and reliable capabilities that align with the diverse requirements of its users, including individuals, businesses, and community organizations engaged in resource exchange. The application must ensure seamless performance in core areas such as posting and browsing surplus materials, initiating trade or auction-based exchanges, and managing real-time

inventory updates. Its functionalities should be intuitive, allowing users to efficiently list, search, match, and transact items with minimal complexity.

In the context of efficiency, ReSourceHub should demonstrate high-performance responsiveness to ensure that users experience minimal delays during interactions such as loading listings, executing transactions, or navigating between modules. The application must be capable of handling multiple concurrent users without compromising speed or reliability.

In relation to usability, the application should prioritize an intuitive and accessible interface that caters to a wide range of users, from individuals and businesses to community groups. The application should allow the users to quickly navigate through its features, post items, browse available resources, and complete trasanctions without encountering unnecessary complexity.

For ReSourceHub, reliability is essential, as users depend on the application to facilitate important resource exchanges in a timely and seamless manner. The system should maintain a stable and dependable environment that allows users to exchange surplus materials without interruption. The application aims to operate smoothly under varying loads and recovering quickly fromm unexpected technical issues. Addtionally, ReSourceHub can support a reliable user experience for individuals, businesses, and cmoounity organizations participating in circular economy pratices.

Maintainability is a key consideration for any scalable application, and ReSourceHub should reflect a high level of maintainability to support long-term growth and adaptability. The platform aims to be adaptable and easy to modify, allowing it to evolve alongside emerging user needs, technological advancements, and sustainability trends. The system should be deisgned with clean and modular code that enables developers to efficiently implement updates, fix bugs, or enhance existing features without disrupting the overall functionality.

Portability is essential for any modern application that seeks to reach a broad and diverse user base, and ReSourceHub should demonstrate a strong level of portability. The application aims to be flexible and easily transferable, allowing it to be deployed across different environments with minimal configuration or compatability issues. This includes responsive design to adapt to different screen sizes and device capabilities.

In conclusion, the evaluation of ReSourceHub is essential to ensuring its compliance with internationally recognized ISO/IEC 25010:2011 quality standards. The system must demonstrate functional suitability, providing reliable and comprehensive features that support seamless resource exchange. It should exhibit performance efficiency, maintaining responsiveness and stability even under high user loads. Additionally, usability must be prioritized through an intuitive and accessible interface that accommodates a diverse range of users. The system's

reliability ensures continuous operation without disruptions, while maintainability allows for efficient updates and adaptability to evolving user needs. Finally, portability guarantees compatibility across different devices and environments, reinforcing accessibility and scalability. Through rigorous assessment, the evaluation process validates the system's effectiveness, ensuring that ReSourceHub meets technical requirements and user expectations while contributing to sustainable resource management practices.

Schedule and Timeline (Gantt Chart)

This section presents the Gantt Chart, which details the activities required in partially achieving the project objectives. It serves as a roadmap that organizes key tasks into distinct phases, including brainstorming, title approval, writing chapters, prototyping, revisions, and final documentation. The timeline specifies start and end dates for each task, ensuring progress is systematically monitored.

NO.	TASKS	START	END	STARTING	January	February	March	April	May
1	Brainstroming	01/04/25	02/03/25						
2	Title Creation and TAF Approval	02/06/25	03/27/25						
3	Title Approved	03/27/25	03/27/25						
4	Chapter 1 - Introduction	04/01/25	04/12/25						
5	Chapter 2 - Related Review Literature	04/07/25	04/13/25						
6	Sketch/Prototype	04/07/25	05/04/25						
7	Chapter 3 - Methodology	04/14/25	04/17/25						
8	Revision of Chapter 1	04/17/25	04/19/25						
9	Revision of Chapter 2	04/17/25	05/01/25						
10	Revision of Chapter 3	04/17/25	05/06/25						
11	Final Document	04/01/25	05/06/25						

Project Teams and their Responsibilities

In this section, the team structure and role distribution are outlined to ensure efficient collaboration and accountability throughout the project lifecycle. Responsibilities include designing system components, coding functionalities, conducting testing procedures, and managing documentation. By clearly defining roles and tasks, the project team maintains workflow efficiency, minimizes redundancies, and ensures timely completion of deliverables.

For the development of RESOURCEHUB: A Mobile Application for Sustainable Resource Exchange in The Circular Economy, **Rovic Andrea T. Alzona** serves as the Documenter that handles the preparation, organization, and management of all written records related to the project. This role ensures accuracy, clarity, and completeness of documentation throughout the development lifecycle, supporting seamless project execution and project record-keeping. **Janine C. Amployo** takes on the role of UI/UX Designer and Secondary Developer, focusing on designing user-friendly and visually consistent interfaces. This role ensures that the application is intuitive and accessible to users while supporting development tasks to maintain alignment between design and functionality. Finally, **Joseph William C. Ramos** functions as the Project Manager and Primary Developer, overseeing overall project coordination, task delegation, and progress monitoring.

As he leads the system development process by implementing core features, ensuring technical performance, and managing team collaboration to achieve project goals effectively.

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