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CS: COMPUTER STORE POINT OF SALE AND INVENTORY MANAGEMENT SYSTEM WITH RFID TECHNOLOGY USING FLUTTER FRAMEWORK

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20 May 2023

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This paper prepared by **WILLORD JAY O. VILLANUEVA** with the title: **"CS: COMPUTER STORE POINT OF SALE AND INVENTORY MANAGEMENT SYSTEM WITH RFID TECHNOLOGY USING FLUTTER FRAMEWORK"** is hereby accepted by the Faculty of Information and Communication Studies, U.P. Open University, in partial fulfillment of the requirements for the degree Course.

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Biographical Sketch

Willord Jay O. Villanueva, born on October 02, 2023, in Tagum City, Davao del Norte, pursued a Bachelor's degree in Information Technology at the University of Southeastern Philippines. During his academic journey, his capstone project received recognition, earning 3rd place in both the course-wide colloquium and faculty-wide colloquium.

His capstone project, titled "CS: Computer Store Point Of Sale And Inventory Management System With Rfid Technology Using Flutter Framework," was designed to address specific company needs related to point of sales and inventory management. It was developed to reduce the workload and streamline operations for warehouse staff. This project offered a solution to the existing inventory challenges.

His background includes professional experience as a software quality assurance analyst at Tagum Cooperative for three years, where he became well-versed in the system development life cycle within a corporate setting. Currently, he works as a software developer at the same firm.

Outside of his academic and professional life, he has a keen interest in solving logical problems and developing algorithms to address unsolved challenges. These interests have naturally led him to the development of systems aimed at enhancing workflows within corporate and business environments.

Looking ahead, Willord's aspiration is to pursue a Master of Information Systems degree and ultimately earn a doctorate degree. He aims to transition to a larger corporate role after gaining experience at a nationwide cooperative financial institution. His goal is to continue contributing to the field of information technology and system development in the corporate world.

Acknowledgements

I would like to express my sincere gratitude to God for his unwavering guidance and constant presence throughout the completion of this capstone project. Without His guidance, I would not have been able to persevere through the challenges that I faced along the way.

I would also like to extend my heartfelt thanks to my family and loved ones for their support and understanding during this time. With my work commitments and the completion of my degree, my schedule was packed and demanding, but they were always there for me, providing encouragement and motivation to keep going. I am truly blessed to have such a wonderful family who has supported me every step of the way.

I would also like to thank my friend Veejay Daganato for his support and assistance during the development and testing of the system. His expertise in Flutter proved invaluable in identifying and resolving any bugs and errors that I encountered. I am grateful for his willingness to help and his contributions to the success of this project.

Finally, I would like to thank all the people who have helped me in completing this project. Your invaluable support, insights, and feedback have been instrumental in shaping this work.

Dedication

I dedicate this capstone project to my beloved family and cherished loved ones. Your unwavering support, understanding, and patience during my busy schedules have been the cornerstone of my journey. Your love and encouragement have provided the strength to persevere, and your belief in my aspirations has fueled my determination. This project stands as a testament to the importance of your presence in my life. Thank you for being my rock and my inspiration.

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ABSTRACT

The CS: Computer Store Point of Sale and Inventory Management System is a web application project integrating RFID technology, providing a comprehensive solution for Yannie Computer Store.

It includes a POS and inventory management facility that aims to streamline operations, facilitate transactions, and efficiently manage inventory. The system addresses various issues encountered in the original system, such as tracking client returns, stock transfers between branches, monitoring branch sales and stock levels, listing eligible clients for discounts, and handling bundled items.

The developer utilized the Multi-motive Information Systems Continuance Model and the Unified Theory of Acceptance and Use of Technology to ensure user acceptance and enhance user experience. Testing results confirmed the system's operational effectiveness and technical efficiency, with ratings and scores from interviews and surveys highlighting its practicality and user-friendliness compared to the previous system.

The development followed a personal SCRUM approach within the agile methodology, progressing through stages: database layer, application layer, and client layer. Future plans involve creating a storefront web application, incorporating product photos, implementing a printing report feature, and considering integration of an AI system. These enhancements aim to maintain competitiveness in the market and cater to evolving user needs.

CHAPTER I

THE PROBLEM DOMAIN

Statement of the Problem

Management issues primarily concern inventory and monitoring. In terms of inventory, the system cannot log and track client returns for repairs and defects, as well as move stocks from one branch to another. In monitoring, they had difficulty keeping track of branch sales and stock levels given the number of branches they manage and the fact that their present system does not contain inventory management and is not centralized. Minor issues with POS systems include bundled items that cannot be entered as a single purchase which affect sales operations. Lastly, they do not have a concise list of the clients who qualify for discounts.

Background and Objectives of the Project

The project is initiated to enhance the current manual system of the company and close the gaps left by their alternative existing tool through developing an application with elements and features that address the problems stated while also benefiting the concerned stakeholders.

Significance and Scope of the Project

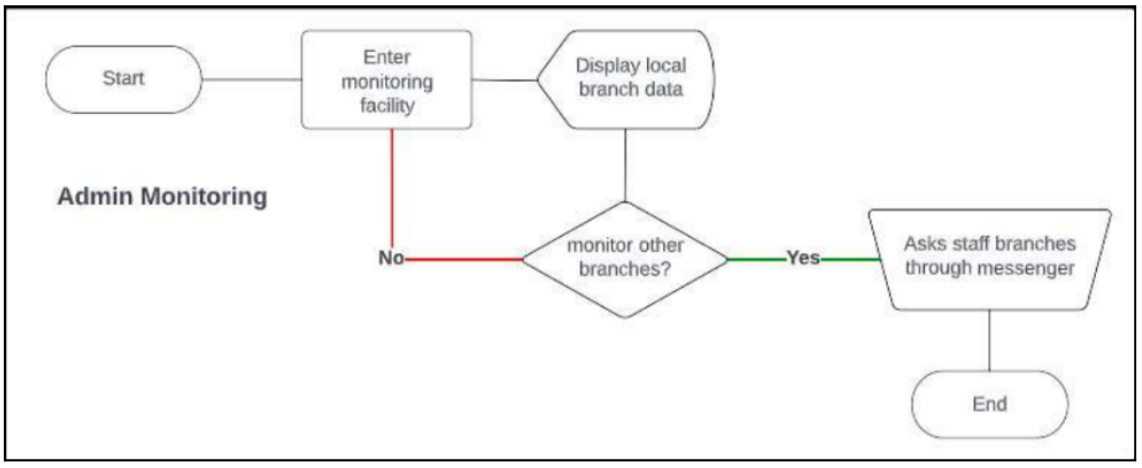
The system included a facility that kept track of all returned items and their states, so customers' returned items were considerably easier to manage. It also had

a feature for choosing stocks from storage and moving those stocks to the selected branch. Moreover, the project addressed the problems of admins in monitoring their sales and stock levels for all branches. Another feature that was added to the system was the ability to draft items into packages so they could be purchased as one item. The system also lessened the staff's workload when it came to tracking down customers and their purchases. When a customer qualified for a discount, the POS automatically discounted items. With these new features in the system, the company could expand and grow more in their business.

Documentation of Existence and Seriousness of the Problem

The key problems with their current systems and operations that the developer plan to improve through this project proposal are as follows:

Figure 1. Existing process flow of the company’s admin monitoring.

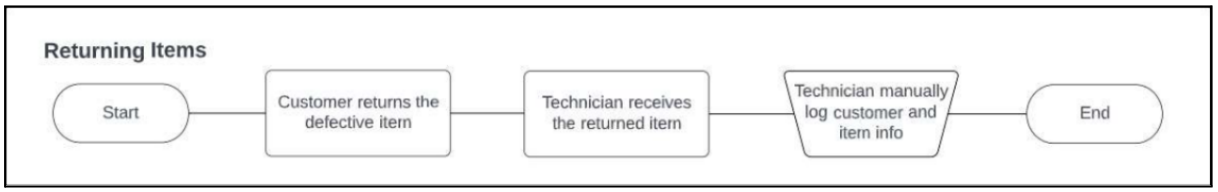


Sales and Inventory Monitoring. It refers to monitoring branch sales and stock levels across all branches. The administrator can monitor sales and stock at

the main branch store but not at the other stores. The process model above (see Figure 1) illustrates that when the administrator monitors the sales and inventory updates through the system, he has access only to the local branch monitoring. If the administrator wants to check the other branches' updates as well, he must ask the staff of those branches for updates or travel a distance to do so.

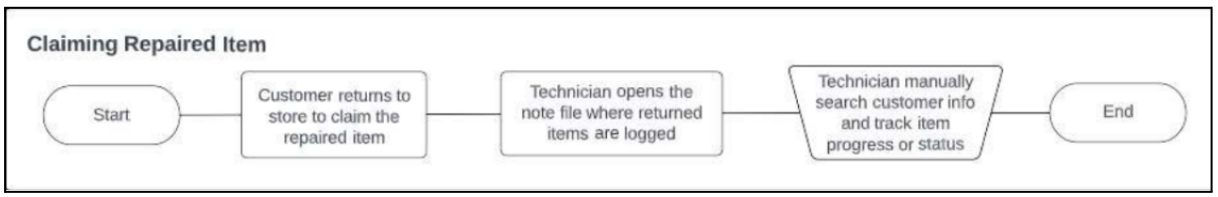
Returned Item Concerns. This concern entails recording and monitoring returned items. Since computer stores offer electronic devices, they may inevitably encounter incidents of returns for factory-related issues. However, Yannie Computer Shop lacks a structured procedure for accepting consumer returns.

Figure 2. Existing process flow of customers returning defective items.



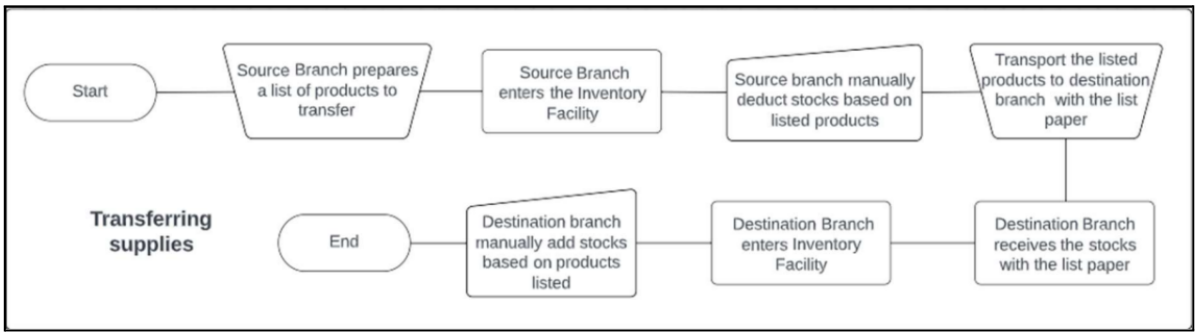
According to the process flow depicted in Figure 2, when a customer returns an item, the technician will log it in a document or file to save the customer and item details.

Figure 3. Existing process flow of customers claiming repaired items.



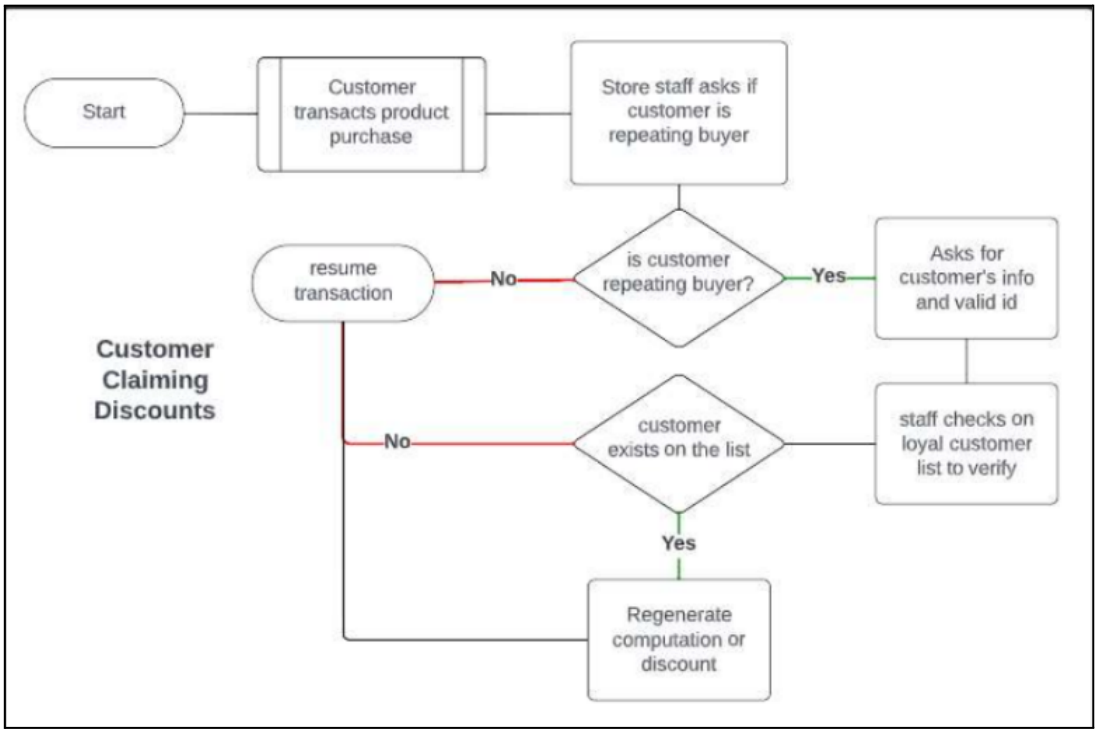
In the diagram shown above, it will be a challenge for the technician if the client comes back to pick up the repaired item since some of the notes, where the information is, were not kept. Additionally, sometimes he has trouble remembering where the file was saved or figuring out whether any of the material is still reliable or obsolete.

Figure 4. Existing process flow of transferring supplies.



Inventory. This issue arises when stocks are moved from one branch to another. Despite having a POS and inventory management system in place, the issue stems from the current system's lack of digitalization. Figure 4 shows that the workers manually list the items to transfer on paper. This paper acts as a waybill for the other branch receiving the items. The stock and this paper will then be delivered and transported by the driver to the recipient branch. The document will then serve as the foundation for any adjustments or changes the recipient branch makes to the system's stock levels.

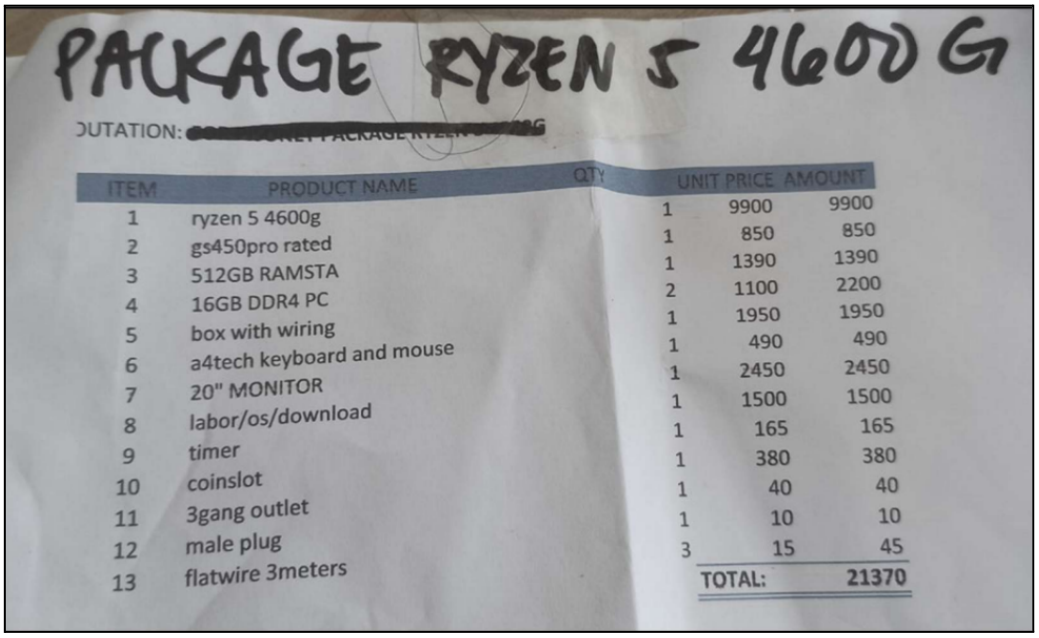
Figure 5. Existing process flow of customers claiming discounts.



Organizing Customer Information. This refers to a list of customers who are eligible for discounts. Customer information is important if the consumer wants to use their discounts when making purchases. In the company's current system flow, which is shown on Figure 5, they are still required to ask for the customer's name at all times to manually check in their document logs if the consumer is eligible for discounts. If the client is a verified loyal customer, they must manually alter the price of the goods he purchased in the POS system.

Point of Sale Optimization. They already have a POS system, but it is lacking in some key elements that greatly affect sales operations. It pertains to customer transactions, particularly when a product bundle is purchased.

Image 1. An example of a product bundle's "Package Ryzen 5 4600G" product list



PACKAGE RYZEN 5 4600 G

QUTATION: [redacted]

ITEM	PRODUCT NAME	QTY	UNIT PRICE	AMOUNT
1	ryzen 5 4600g	1	9900	9900
2	gs450pro rated	1	850	850
3	512GB RAMSTA	1	1390	1390
4	16GB DDR4 PC	2	1100	2200
5	box with wiring	1	1950	1950
6	a4tech keyboard and mouse	1	490	490
7	20" MONITOR	1	2450	2450
8	labor/os/download	1	1500	1500
9	timer	1	165	165
10	coinslot	1	380	380
11	3gang outlet	1	40	40
12	male plug	1	10	10
13	flatwire 3meters	3	15	45
			TOTAL:	21370

The computer shop employs product bundling in their business. An example of their project bundle is the image shown on Image 1.

Figure 6. Existing process flow of purchasing a product bundle

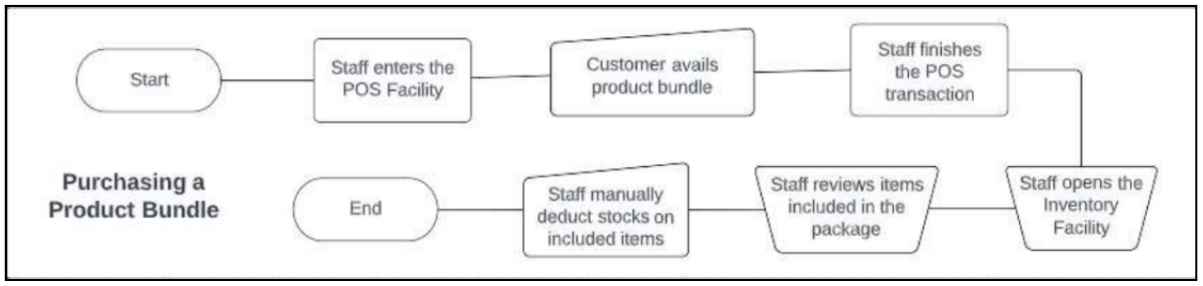


Figure 6 demonstrates that when a product bundle is purchased, the staff must navigate to the system's inventory facility and manually update the stocks of the products that are part of the bundle. They will base their deductions on the items listed on the paper. An example of a bundle paper list is the paper captured in Image 1.

Significance of the Study

The development and implementation of a Point of Sale (POS) and inventory management system for a computer store holds paramount importance in the context of modern retail operations. The significance of this study can be delineated as follows:

Enhancing Operational Efficiency. The system is poised to streamline daily operations within the computer store, reducing the time and effort required for inventory management, sales processing, and order fulfillment. This translates into improved operational efficiency and a reduction in human errors, ultimately leading to higher productivity.

Accurate Inventory Control. The system is designed to provide real-time tracking of inventory levels, enabling the computer store to maintain optimal stock levels, prevent stockouts, and reduce excess inventory. This, in turn, minimizes financial losses and ensures that products are readily available for customers, thus enhancing customer satisfaction.

Improved Customer Experience. The implementation of a modern POS system results in quicker and more accurate sales transactions, allowing customers to experience smoother and more convenient purchasing processes. This, combined with real-time access to product availability, pricing, and promotions, contributes to an improved overall customer experience.

Data-Driven Decision Making. The system captures and analyzes sales and inventory data, providing valuable insights into customer preferences, product performance, and market trends. This data-driven approach empowers the computer store management to make informed decisions regarding pricing, stock procurement, and marketing strategies.

Reduced Operational Costs. The automation of various processes, such as invoicing, stock updates, and order management, results in cost reductions related to labor and resource allocation. These savings are essential for maintaining the profitability of the computer store in today's competitive business environment.

Sustainability and Environmental Impact. The system can help minimize paper usage by automating receipts and invoices. This reduction in paper usage contributes to environmental sustainability by decreasing the store's carbon footprint and aligning with eco-friendly business practices.

In conclusion, the development and implementation of a POS and inventory management system for the computer store are pivotal for optimizing operations, enhancing customer experiences, and ensuring long-term sustainability in a competitive market. The study's significance lies in its potential to revolutionize the computer store's business processes and create a more efficient and customer-centric retail environment.

Scope and Limitation of the Study

The "Computer Store Point of Sale and Inventory Management System" was designed to fulfill specific user objectives. It enabled the recording of stock transfers between branches, facilitated the creation and purchase of product bundles with synchronized stock deductions, maintained a concise list of eligible customers, and provided a platform for recording and tracking returned products. The system offered an administrative dashboard but didn't include a storefront application, and it was built for Windows OS. The system utilized centralized data primarily for admin monitoring and stock transfers.

However, printing capabilities, particularly those related to Point of Sale (POS), did not receive extensive focus. These constraints ensured the system's boundaries were well-defined, allowing it to effectively meet the specified user objectives while acknowledging its limitations.

Operational Definition of Terminologies

In this section, we provide clear and simple definitions for key terms and concepts used throughout this capstone project. These operational definitions are designed to ensure everyone shares the same understanding of these terms, which is essential for effective communication and consistent interpretation of our research.

Inventory Management. In the context of this study, inventory management refers to the process of overseeing and controlling the computer store's stock levels, including the management of product quantities, tracking changes, and ensuring product availability.

Point of Sale (POS) System. The Point of Sale (POS) system is defined as the software application or hardware device utilized by the computer store for conducting sales transactions, recording sales data, and managing customer interactions at the point of purchase.

Stock Transfer. Stock transfer pertains to the process of moving products from one branch of the computer store to another, involving the initiation of transfers, tracking of stock movement, and updating inventory records.

Customer Returns. Customer returns, as addressed in this study, refer to the process of accepting and managing items returned by customers due to defects or other issues. This process includes recording and tracking the status of returned items.

Customer Discounts. Customer discounts involve the application of reduced pricing for eligible customers. It is the process by which customers who qualify for discounts receive reduced prices on their purchases, and this process is facilitated by the Point of Sale (POS) system.

Product Bundle. A product bundle is a collection of products that are offered for sale as a single item at a fixed price [1]. It represents a collection of individual products offered as a single item at a fixed price. This includes the packaging of various products for sale as a single unit.

Operational Efficiency. Operational efficiency is defined as the degree to which the system streamlines and optimizes the daily processes of the computer store, minimizing manual efforts and reducing the potential for human errors.

Data-Driven Decision Making. Data-driven decision making involves using information obtained from the system to make informed choices related to inventory management, pricing strategies, and marketing decisions, based on the analysis of sales and inventory data.

CHAPTER II

REVIEW OF EXISTING ALTERNATIVES

The administrators run the company using their acquired system. They receive customer orders and produce receipts through the system they purchased. Since the encoder must adjust the stock of each item in a bundle product every after transaction, the current system is ineffective during peak usage. Another problem with the current system is that it cannot record returned items, which leads to untracked and missing instances of the said items.

They also track their inventories using their current tool. However, they retrieve the backup data from each branch and compile it using Microsoft Excel as they try to employ centralization in their company. The same thing happens when monitoring the sales of every store branch. Sometimes administrators and owners call their store branches or branch managers to monitor sales.

In stock management, they manually track when an item is about to sell out by checking the bodega to see if there are any nearly empty items. If they find an item, the main branch is informed through a phone call so that the main branch can deliver the necessary supplies. Additionally, their existing method of distributing stocks gives inaccurate quantities in their inventory tracking. Due to manual stock adjustments, items from the source branch store and destination branch store are sometimes wrongly logged.

The system should have a feature to draft bundle products items. In this method, the user only needs to select the already-drafted package during a POS transaction rather than entering all those items, which will speed up the operation.

It is also best that the owners or administrators have a centralized monitoring that allows them to view inventory and sales across all branches. Tracking sales and inventory is essential for analytics, marketing, and staying up-to-date on the status of their branch store.

For stock management, there should be a feature that allows the business to log the transfer of supplies to the branch outlet from its other store branches. By using this system, the administrator saves time and receives accurate branch stock updates. It also eliminates ambiguity regarding the origin of the supplies and their destination.

When receiving returned or defective items, the system advises that the transaction should be done in the system rather than logging it manually. It will help the branch or the user keep track of and be aware of the progress of the returned item.

The system helped users draft items of a package. Every package created was treated as a single purchase by the POS. The user had the option to edit or delete this draft.

This application also had an inventory facility with features that could select the branches to which supplies should be delivered. Stock was added to the branch destination and subtracted from the branch source (main branch). Furthermore, this application streamed sales and inventory data to the main branch for centralized monitoring.

The application also had a capability where an encoder could log defective or returned items. Additionally, this facility could alter the item's status so that other users who needed the information for customer inquiries or tracking could access it.

CHAPTER III

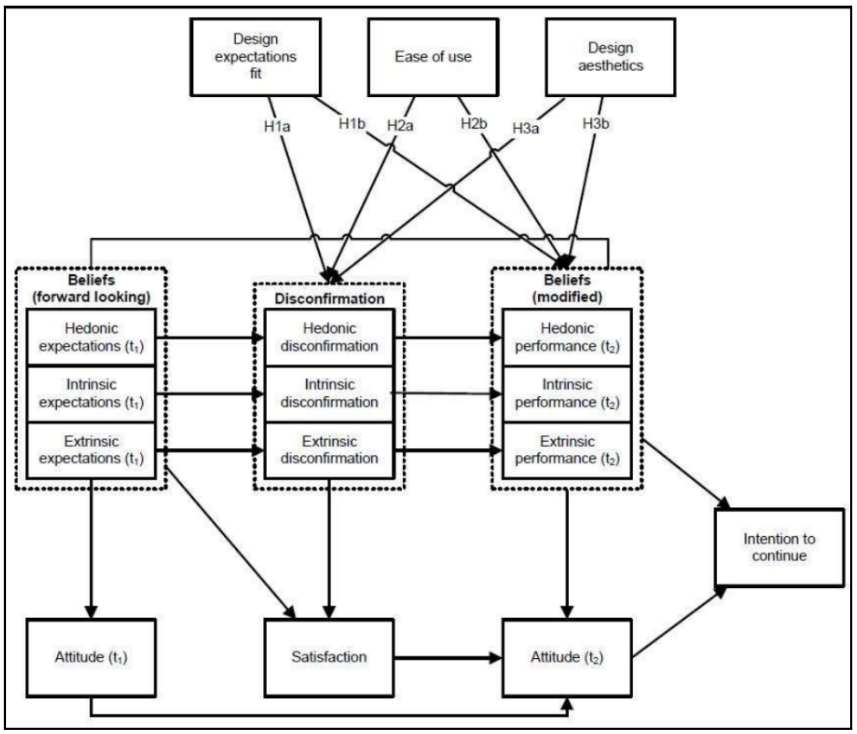
APPROACH TO BE TAKEN IN THIS SUBJECT

Theoretical Framework

The developer drew on two information system theories for the project. These include the Multi-motive information systems continuance model and the Unified Theory of Acceptance and the Use of Technology.

The Multi-motive Information Systems Continuance Model (MISC) theory is utilized to act as a guide for how the system should operate or what it should avoid to keep the system usable in accordance with their goals.

Figure 7: Overview of the Multimotive Information Systems Continuance Model

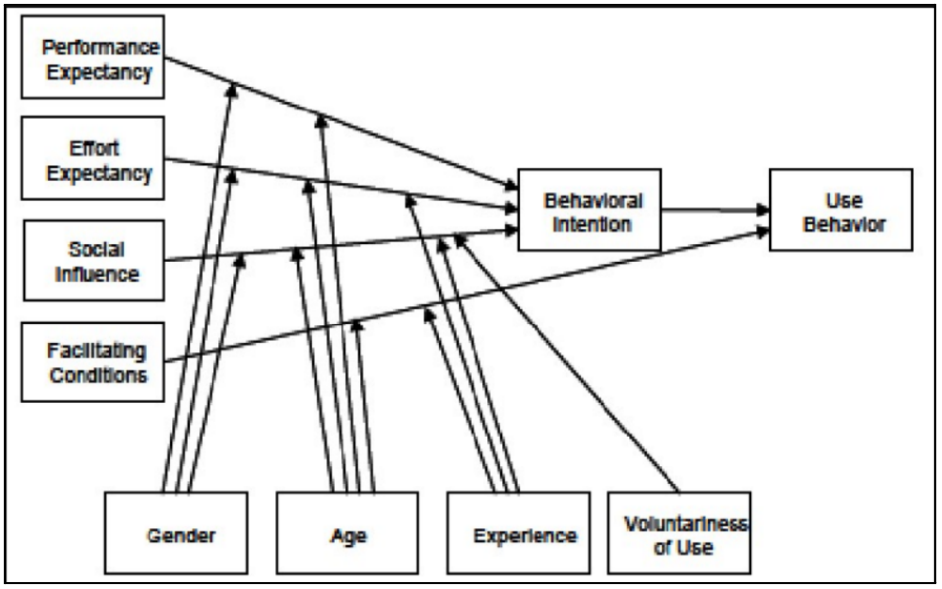


SOURCE: Lowry et al. 2015, p. 525. [3]

Figure 7 shows that multiple motives are variables of users' intention to continue. Additionally, initial empirical research by Lowry et al. (2015) reveals that design related constructs have varying effects on performance beliefs depending on system intent and user motives and expectations [4]. This theory illustrates that user motives may not always align with system design intent, which emphasizes the need for systems to be built to support diverse motives.

Before the developer can apply the theory that would help the system sustain users, the actual first concern is how the developer can get the customer to use and accept the product. Thus, the Unified Theory of Acceptance and Use of Technology (UTAUT) is another theory that was used in this project, an improved version of the Technology Acceptance Model (TAM) developed by Venkatesh and others. It is an information systems theory that models how users come to accept and use an information system and subsequent usage behavior.

Figure 8. Overview of the Unified Theory of Acceptance and Use of Technology



SOURCE: Venkatesh, V et al. 2003 [6]

Figure 8 shows that there are four main constructs: enabling factors, effort expectations, social influence, and performance expectations. The first three are direct determinants of usage intention and behavior, and the fourth is a direct determinant of user behavior. Gender, age, experience, and voluntariness of use are posited to moderate the impact of the four key constructs on usage intention and behavior [5].

The developer applied the following design concepts for the system:

1. Scalability. The ability to maintain the necessary level of service when the system load grows without altering the system. It should be built in a way that it can withstand an increase in load and continue to perform well [2].

2. Reliability. This guarantees the consistency and integrity of the system and all of its transactions [2]. It should also guard against abuse or be resistant to user mistakes.

3. Availability. It can carry out its functionality. It ensures that a service or resource is always accessible, even if its components fail [2].

4. Efficiency. It can quickly carry out its functionalities. It does a good job of making the most of the available computer resources to accomplish its goal. Measures of bandwidth, latency and response time are all important for assessing the effectiveness of the system.

5. Maintainability. It is simple to grasp for novice developers, easy to use smoothly, and simple to alter for unforeseen use cases. It is a crucial necessity to increase maintenance effectiveness and efficiency.

Rationale for the framework

Yannie Shop uses a general system as its existing tool for transactions and inventory. It presents a challenge because it is not compatible with the needs of the company. If this problem continues to be the mode of operation, the tool will lose its purpose. Over the upcoming several months, the users of the current system won't use it and will instead return to their manual or conventional methods.

This claim is backed up by the Unified Theory of Acceptance and Use of Technology. It reveals that key constructs including enabling factors, effort expectations, social influence, and performance expectations can affect the use behavior of the user or their intention to use. And if these are not met, there is no motivation to use the technology in the first place [5].

Another theory utilized is the multi-motive information continuance model. It reveals that ease of use, design expectations fit, and design aesthetics indirectly affects users' intention to continue [4]. This proves the importance of its physical appeal and impacts the satisfaction and attitude towards the application. The fact that the existing tool has no design expectations fit nor ease of use, this will lead to current users to lessen their motivation to continue using the service.

Since physical aspects of the application affects psychological aspects of users, it is also important that the design of the application adheres to some but crucial theories or principles such as reliability, scalability, availability, efficiency and maintainability that enhances not only the application’s aesthetics but its usability.

Furthermore, these theories help this application to be as user friendly as it could be, without any overwhelming additional features on it --intently straightforward to its purpose.

Technologies Used

For the application layer of the Capstone Project, the creator opted to use Laravel, a popular PHP framework for web application development. A RESTful API architecture was implemented for the Capstone Project. This allowed for seamless communication between different components of the system, making it easier to exchange data and perform various functions.

The central server for the RESTful API was hosted on the cloud. Meanwhile, the local server was hosted on the client's unit, allowing for better control and management of the system.

In this project, MySQL was used both in the cloud database and local database. The cloud database was used for storing data that needed to be accessible from multiple locations, such as the central server. The local database was used for storing data that was specific to each client unit.

Flutter (Dart) was chosen for the client layer of the application due to its flexibility and scalability, allowing for the creation of a user-friendly and visually appealing interface. It also enabled the integration of RFID technology for a faster and more efficient experience.

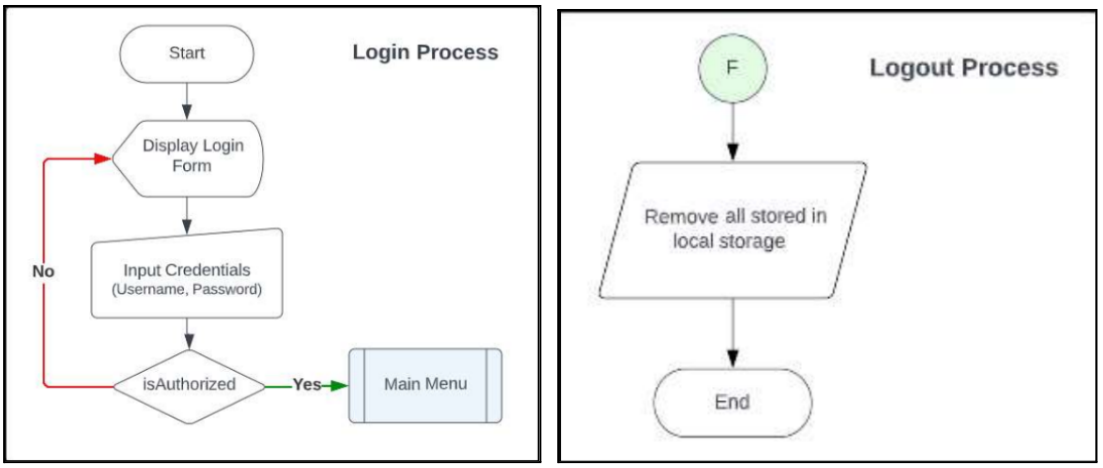
Chapter IV

PROJECT PLAN

Concept

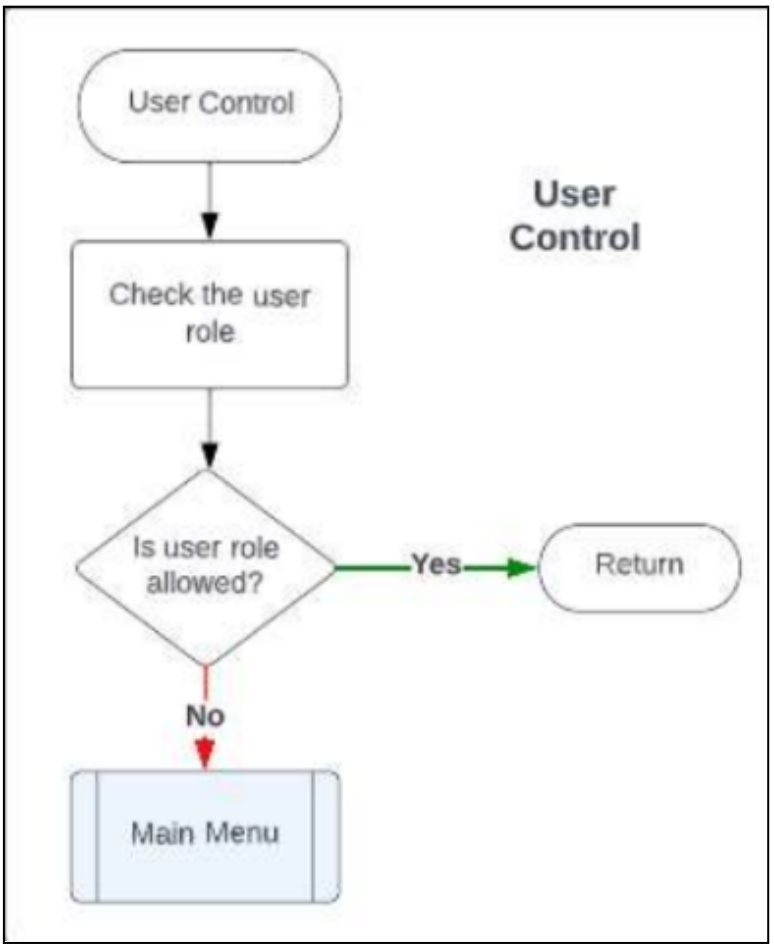
The system aims to help the user conduct a convenient system for the company. It also aids the problem of the company mainly in terms of centralization.

Figure 9. The process flow for the login module (left) and logout module (right).



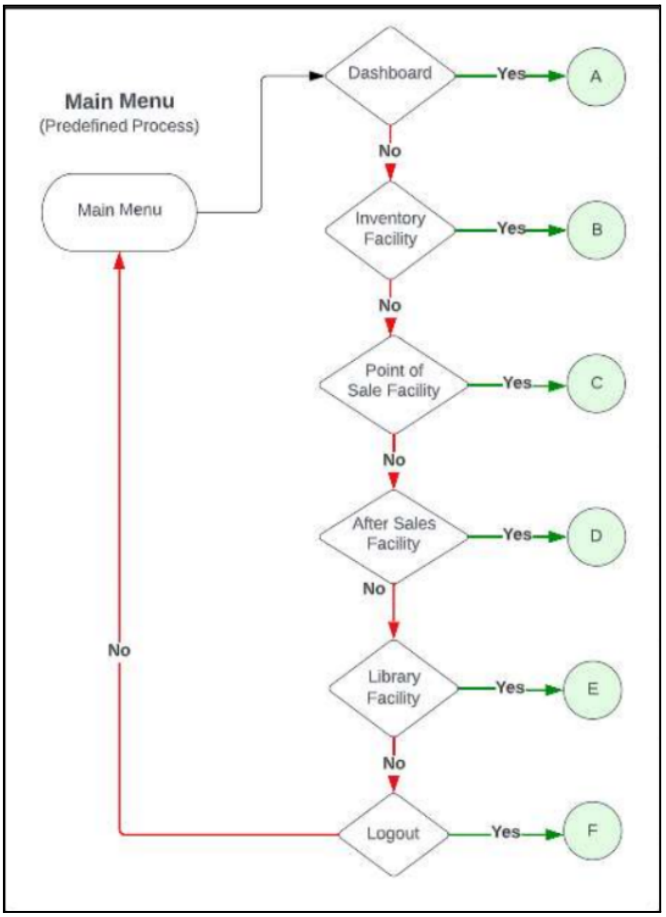
The system will ask for the branch information as well as the username and password upon login (see figure 9). If allowed, the system will be redirected to the main page; where the main menu is displayed and the dashboard as well.

Figure 10. The process flow diagram for the user control function.



The user control function is used every time a user opens a facility. It is to ensure that even if the user is authorized to log in, his role is allowed to enter a system's facility, considering that every facility has different authorized users.

Figure 11. The process flow diagram for the main menu navigation.



There are six main navigation options, including log-out, on the main menu (see figure 11). The rest are the dashboard monitoring, inventory, point-of-sale, after-sales, and library facility.

Figure 12. The process flow diagram for the dashboard facility.

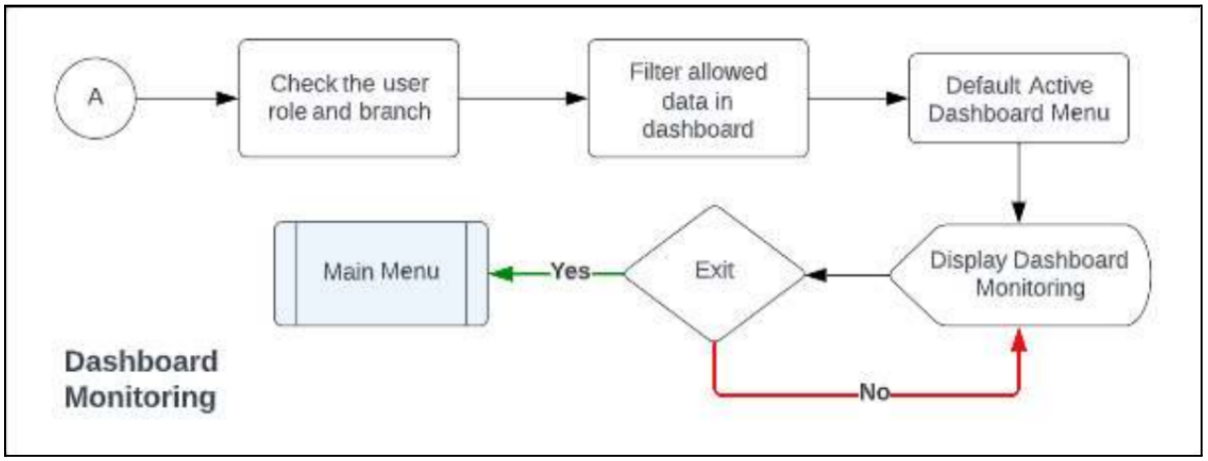
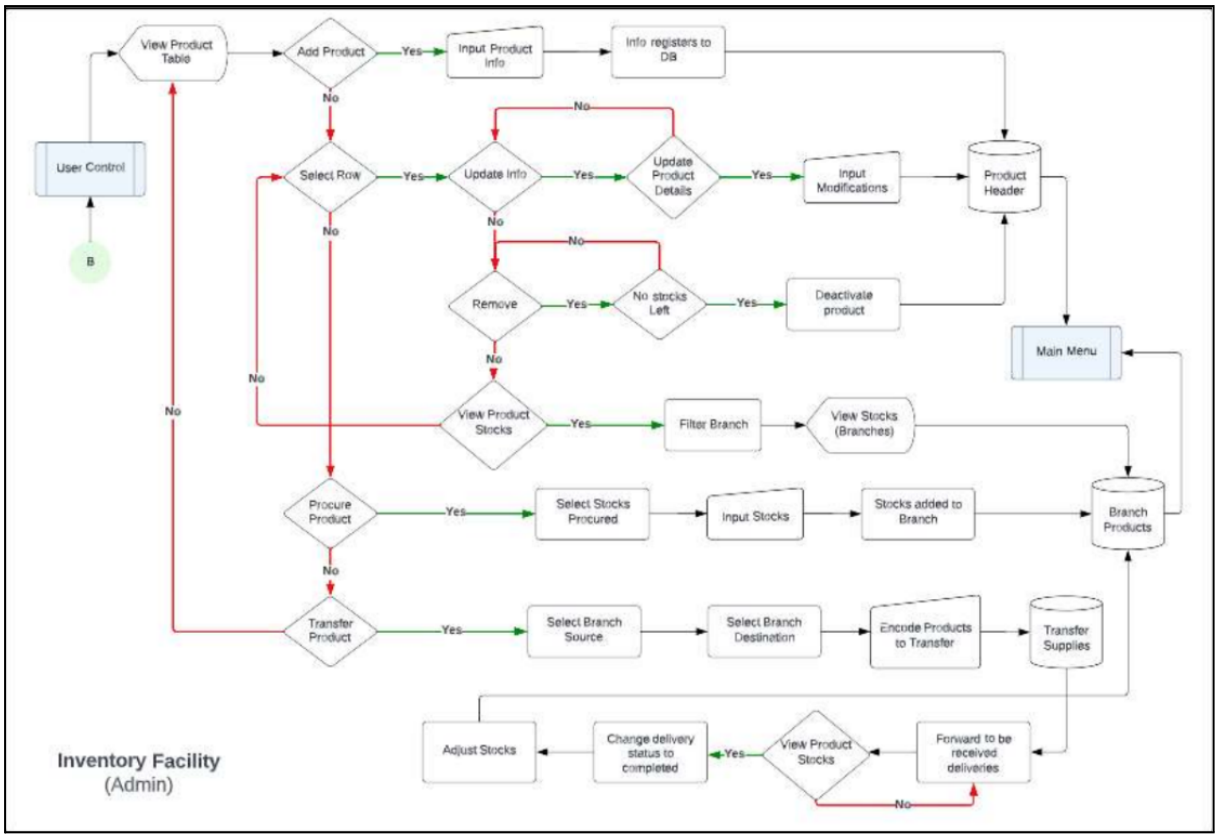


Figure 12 shows the dashboard monitoring facility. It displays informative data from branches, centralized for the admin role. While for staff, only the allowed data of their branch.

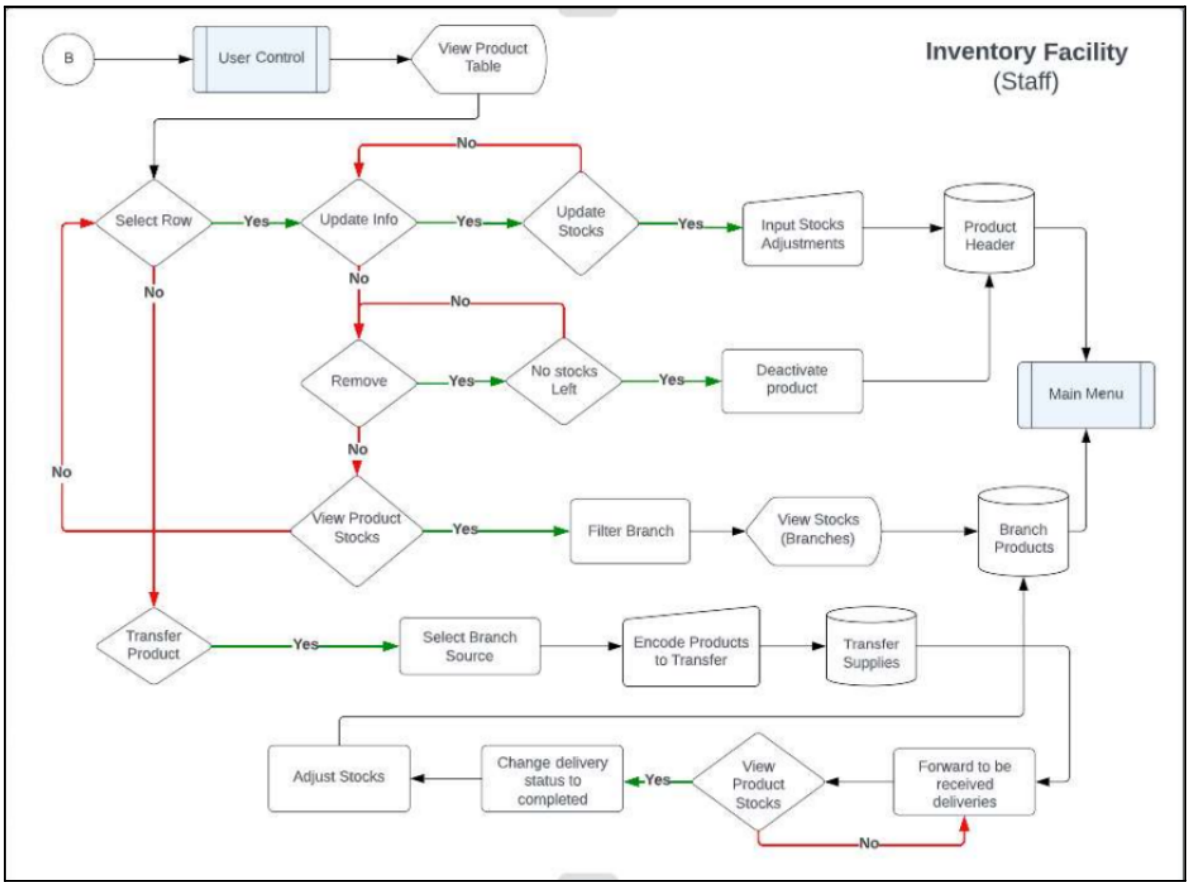
Figure 13. The process flow for the inventory facility particularly for admin roles.



This facility features procurement transactions with suppliers. It includes adding, updating, viewing, searching, and removing product information. It can also adjust inventory and transfer stocks from one branch to another (see figure 13).

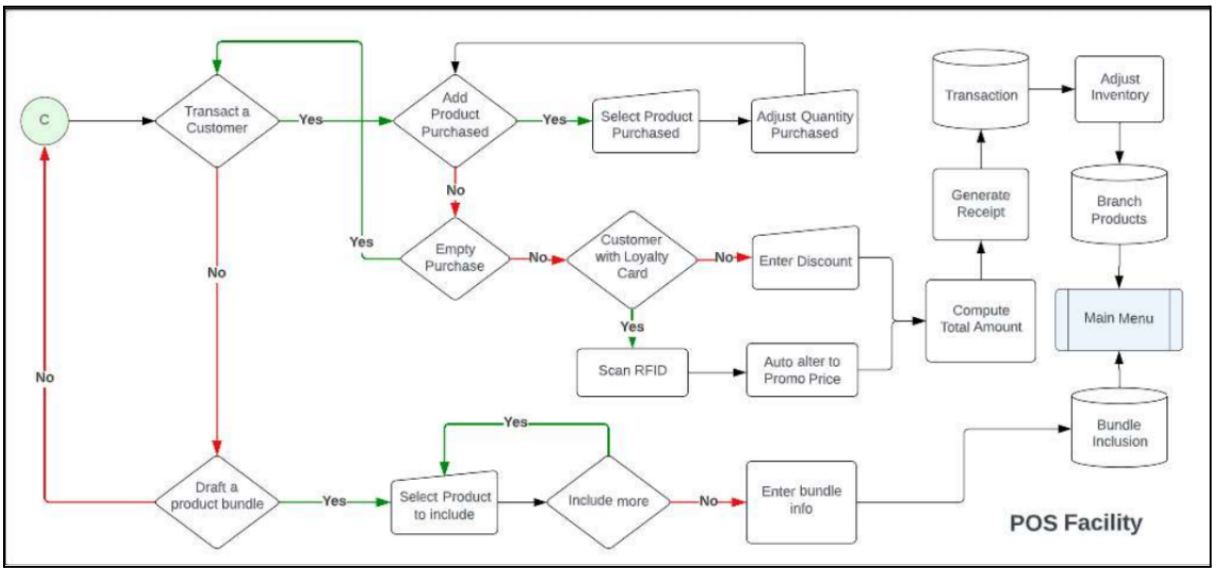
Since the two different jobs have different process flows to adhere to, a separate diagram is developed for the staff role. For further details on the inventory facility for staff, see figure 14.

Figure 14. The process flow diagram for the inventory facility (staff role).



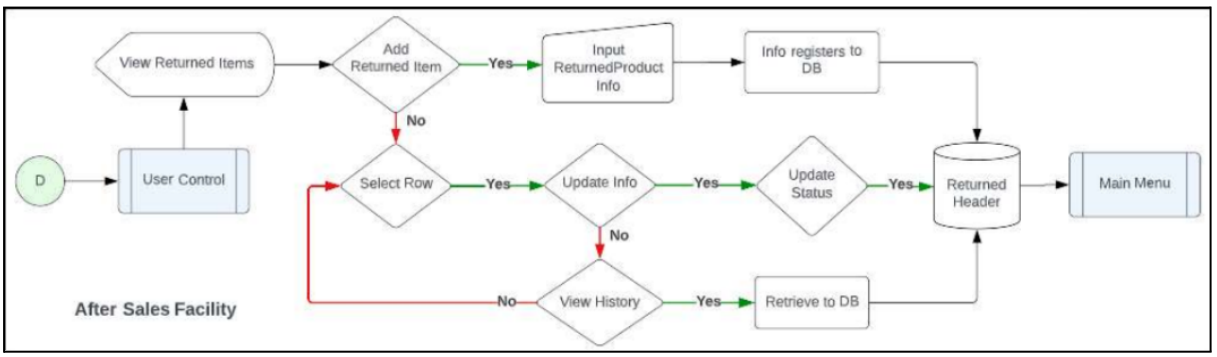
In the figure shown above, the staff role cannot access the product procurement and adding of product. The mentioned features are only accessible for administrator roles.

Figure 15. The process flow diagram for the POS facility.



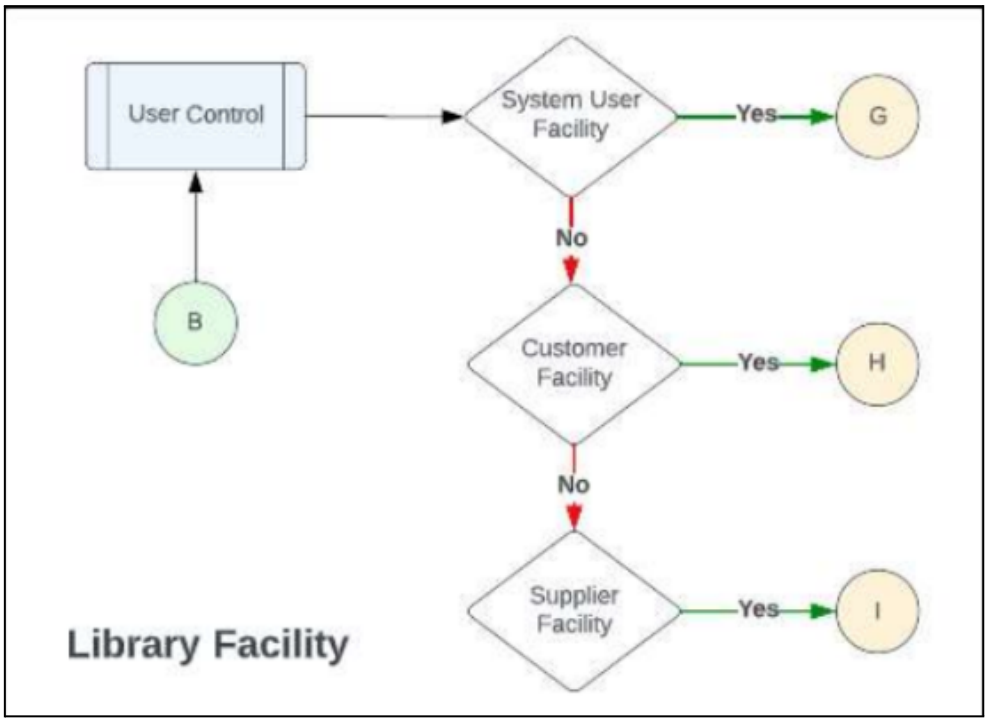
Numerous specially designed elements are in this point-of-sale setup. In addition to the features of their existing system, this system also provides tools creating drafts for product bundles and RFID for customer promotions. The purpose of RFID is to make it simple for customers to redeem promotions. Furthermore, drafting a product bundle involves putting together a collection of things that collectively function as a single product, yet stocks are reduced based on the products they contain (see figure 15).

Figure 16. The process flow diagram for the after-sales facility.



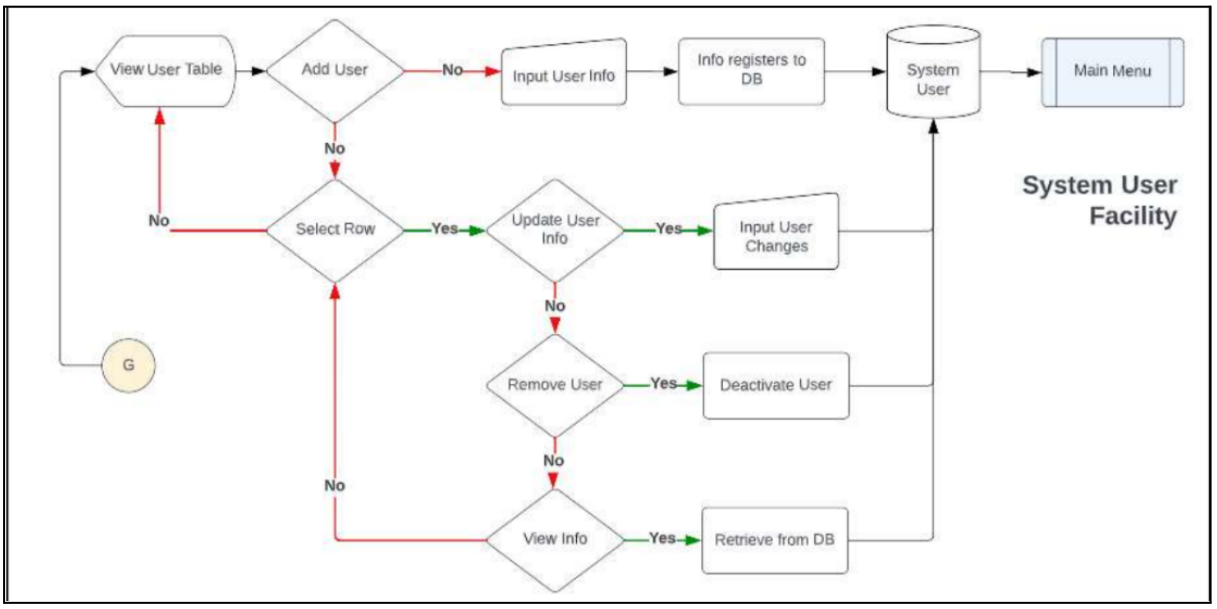
Technicians use the after-sales facility primarily. It is where the technician receives defective or returned items, where he can log the journey of the product by updating its status (see figure 16).

Figure 17. The process flow diagram for the library facility.



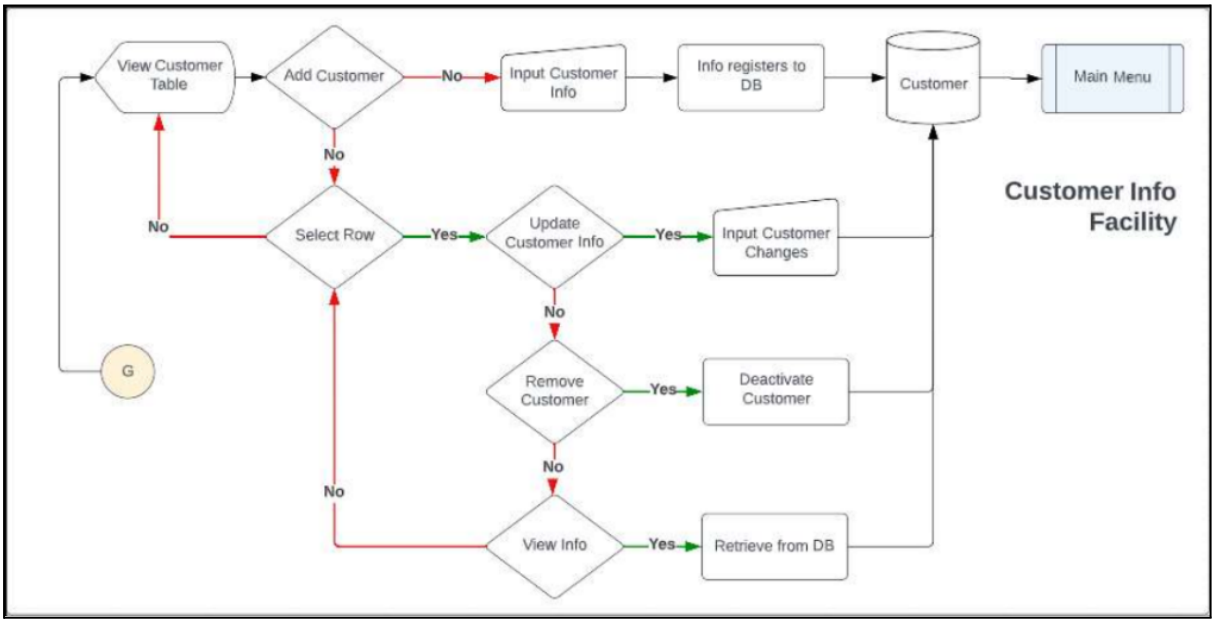
The library facility is where manipulating the data of the supplier, customer, and system user happens. It includes viewing, searching, creating, removing and updating data. This library facility is only accessible to the administrator by default (see figure 17).

Figure 18. The process flow diagram for the system user facility



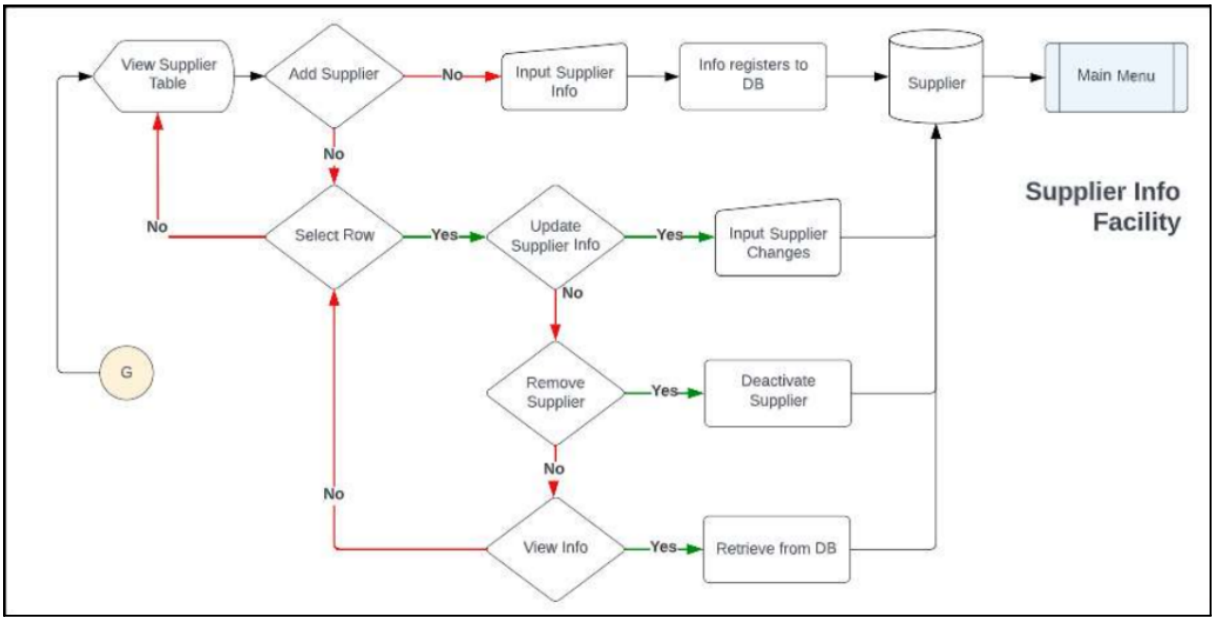
System user includes viewing/searching, creating, removing, and updating data of the system user information (see figure 18).

Figure 19. The process flow diagram for the customer information facility.



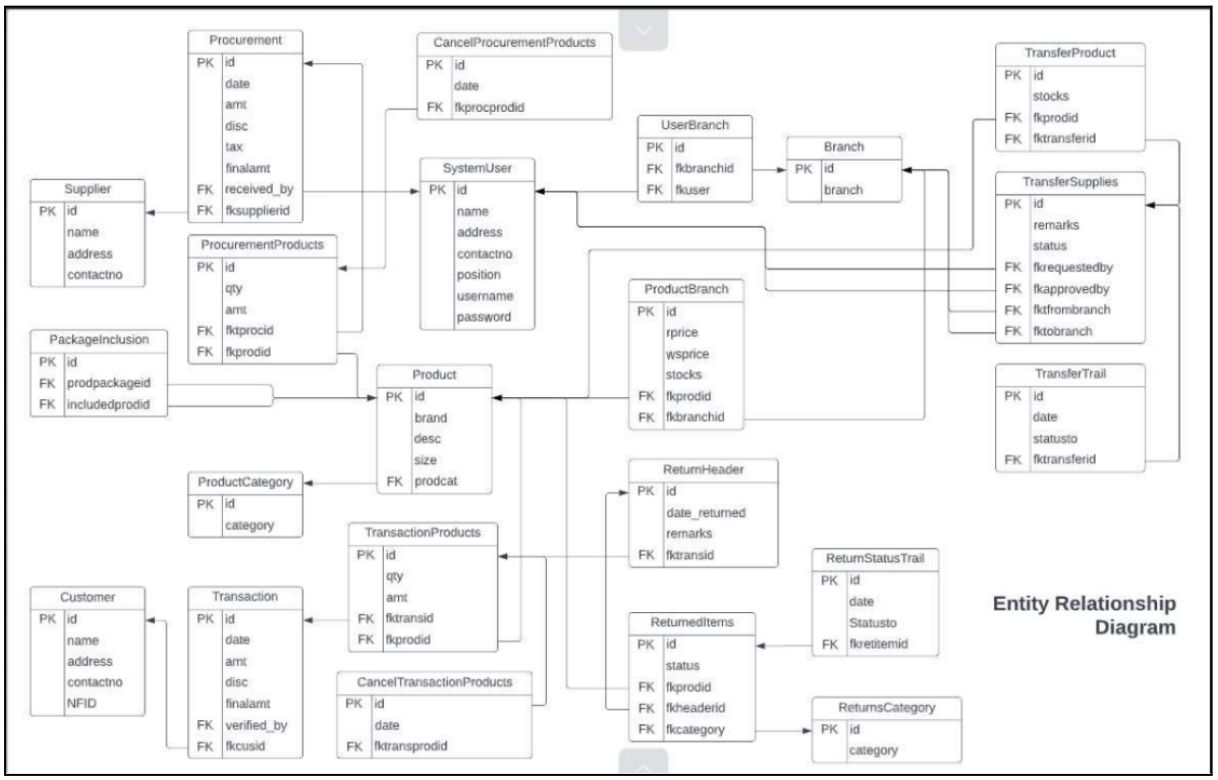
This facility is covered under the library facility. It includes viewing, searching, creating, removing, and updating data about customers (see figure 19).

Figure 20. The process flow diagram for the supplier information.



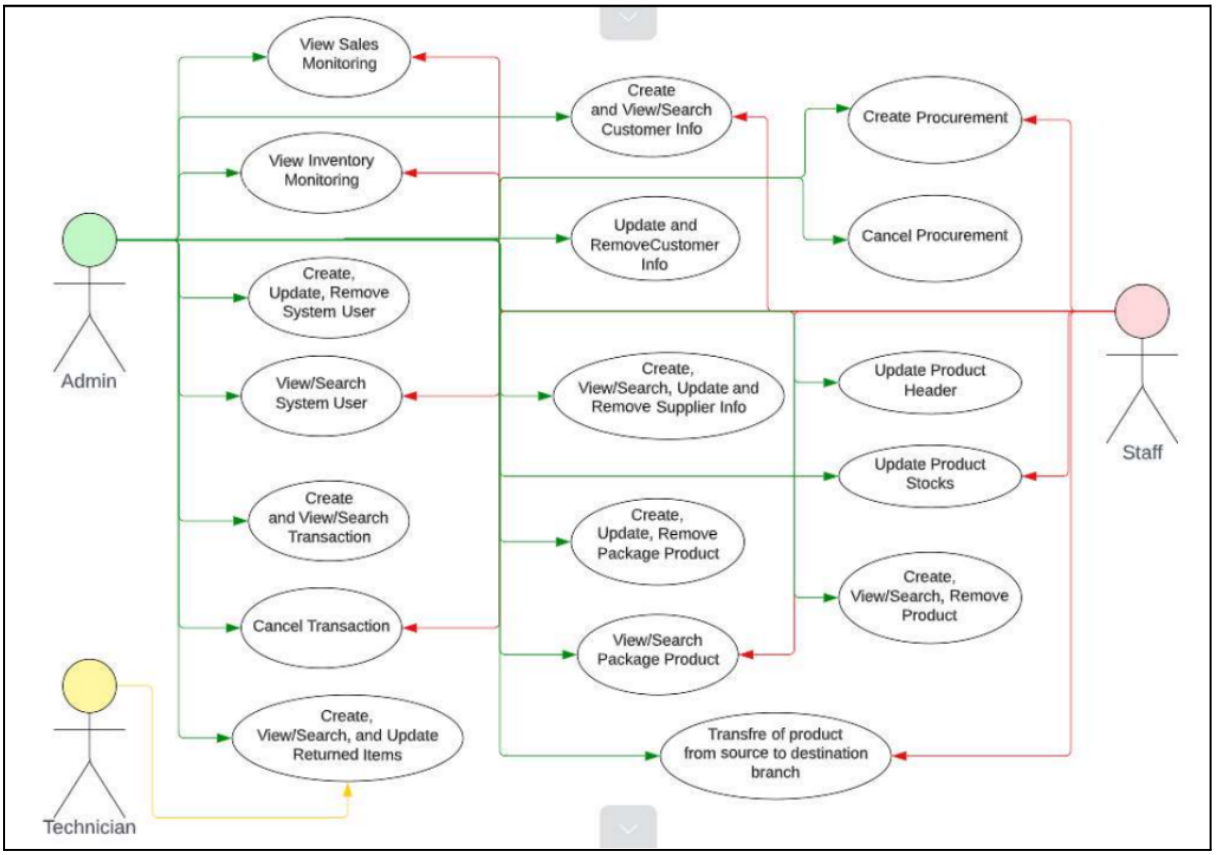
This facility includes viewing, searching, creating, removing, and updating information on suppliers (see figure 20).

Figure 21. The entity relationship diagram of the system.



The system's basic database structure is displayed in this entity relationship diagram (ERD). The data is stored in the schema illustrated above. It covers key components including products, customers, transactions, suppliers, and more.

Figure 22. The use case diagram of the system.



Three actors can use the system. It is composed of administrators, staff, and technicians. All system functionalities are accessible to the administrator. However, the staff and technicians can only use a limited number of features (see figure 22). The essential features of the suggested system are shown below, along with a brief explanation for each feature: Dashboard Monitoring. The staff can use this feature to keep track of sales and inventory at their particular branch, and the administrator can see sales across all branches.

Inventory Facility. Users can add products to their inventories and create and cancel procurement purchases using this tool. The user can also change the

branch's stock levels and record the sending and receiving of supplies to or from other branches.

System User Facility. It is the facility where the user can register a user to access the system, view their own or another's profile, make any changes to the system user's information, and disable a user from accessing the system.

Point of Sales Facility. The facility where a retail transaction is completed. Additionally, it shows the most recent transactions made by the POS and offers a mechanism to undo a transaction if necessary. The system allows users to create packages by combining products into a single item in the POS and then view, edit, or remove them if needed.

After Sales Facility. The user can register any purchased item that is returned due to a warranty problem. The produced log can be reviewed, and updated by the user.

Library Facility. Information about the customer, the supplier, and the product is included in this facility. The user can also create, update, read, or remove data from the mentioned information.

Methods

The developer used the agile technique to create the project, specifically personal scrum, as he was the only one working on the system. The developer had

previously conducted interviews with the owner and staff as part of the planning process to get the company's objectives and issues, the features that the current system was missing, and other concerns related to information management in the organization. The business had realized it required a new information system to address its primary issue of centralization.

Following the analysis, a prototype was created to allow the user to visualize the system's overall interface. The design of each primary facility's page, form layout, notifications, and dialog was prioritized over the flow. After the prototype evaluation, there was no request for a revision of the prototypes. This documentation would be sent to them so they could agree on the scope of the system before it was developed into a working system.

Plan for user testing and project assessment

To identify that the problems had been successfully handled, all of the operational objectives and technical structures set forth and documented during the analysis of the system were met. The findings were separated into two categories for analysis and interpretation: operational effectiveness and technical effectiveness.

Operational Effectiveness. To evaluate the system's operational effectiveness, the developer conducted an interview. When doing an assessment, our main concern is determining (1) whether the constructed system is practical. (2) Is the system still usable for the upcoming months? (3) Have the issues brought up during scoping and planning been resolved? (4) Have the goals been attained?

The methods of inquiry the developer used to collect this evidence is through conducting a structured in-person interview or a written survey as a review assessment of the project deployed. All the users of the created system were the proponents of the assessment. The developer assessed if there are positive effects that the information system has given them in terms of operational efficiency.

The evidence that the developer collected is the ratings or scores that the conducted interview has resulted as evidence. The results of the interview or survey must show that the new system is more practical and user-friendly than the previous one, and the results of the reports must be consistent with the reports from their current system to be considered successful.

Technical effectiveness. The developer intends to separate the technical effectiveness assessment into three categories—software, hardware, and network—for a more efficient and targeted evaluation:

Software effectiveness. The developer conducted manual performance testing to evaluate the system's responsiveness and stability under a specific workload.

Hardware effectiveness. To ensure that the recommendation is implemented or the system functions properly with the hardware used for deployment, the developer employs hardware monitors or more prominent metrics like system reaction time or downtime. The developer also used RFID during testing to assess if it works.

Network effectiveness. Testing was done in the cloud using the same architecture as the final deployment to see if the system is functional. The hosting used for the final was used to test both the system and network workarounds. Further, the entire system went through parallel testing.

The system's reports that the developer gathers served as proof. It was examined whether the report outcomes of the existing system and the newly developed system are the same, as it is operated in parallel with their previous information system.

Chapter V

RESULTS AND DISCUSSIONS

The project allowed the developer to gain new insights into the use of the Flutter and Laravel combination for a project. While the developer was previously accustomed to using Node.js with Flutter, the experience with Laravel was a valuable addition to their skill set.

One of the main things the developer learned was how to optimize API endpoints for faster and more efficient responses. This involved considering factors such as data structure, caching, and network latency. By improving the performance of the API endpoints, the overall user experience of the system can be improved, leading to greater user satisfaction and adoption.

Another key learning from the project was the importance of choosing the right hosting solution for the system. The developer was able to gain hands-on experience with a commercial hosting platform, which was not typically part of their job role as a developer. By selecting a reliable and scalable hosting solution, the system can be made more resilient to spikes in traffic and better able to handle user demand.

It is also significant to conduct continuous testing and quality assurance throughout the development process. This not only helped to identify and resolve bugs and errors, but also ensured that the final product met the functional and usability requirements of the users.

Despite the challenges of juggling unexpected personal events and a busy workload, the project also provided an opportunity for the developer to reflect on the importance of ensuring frontend responsiveness across different platforms. While the initial focus had been on delivering the project within a limited timeframe, the realization that more attention should have been paid to ensuring the frontend was optimized for different device sizes has provided a valuable lesson for future projects.

Overall, the experience of working on the capstone project has helped the developer to broaden their technical skills, gain new insights, and develop a deeper appreciation for the importance of delivering a high-quality system that meets the needs of its users.

Maintenance Plan

It is important to keep the project up-to-date and ensure its smooth operation even after its deployment. With this in mind, the developer has put in place a comprehensive maintenance plan that will help keep the project running at peak performance.

Regular Backup. In terms of data, the developer has included a feature where the user can backup their data. The user has the discretion how frequently they do their data backup. While for the code, the developer already has the repository where he can make branches for new updates and store our coding. It

also stores data of the previous versions of the app, which helps us for better version control.

Bug Fixes and Security Updates. Firstly, for the central hosted app, the developer has set up a process for maintaining and enhancing the frontend app, including hosting the application in a cloud environment that can easily pull updates from the git repository. For any change requests or enhancements, they can be easily integrated into the cloud-hosted app. However, for the backend side, maintaining the application may not be as straightforward. Every update will require careful deployment instructions, which will include uploading new files and updating components and packages to ensure that everything is up-to-date and secured

Secondly, for the local app, the developer has set up a process for maintaining and enhancing both the frontend and backend apps. Once any updates are pushed to the remote repository, the local repository can pull them to integrate them seamlessly into the local app.

Performance monitoring. In addition to these processes, regular maintenance checks are scheduled to ensure the system's performance. These checks include monitoring the database health and collecting user feedback to gauge system performance to ensure that the system remains efficient and effective.

Training. The developer will conduct training sessions for new users to ensure their comfort and confidence in using the app.

Documentation. The documentation will also be regularly updated by the developer to reflect any changes or updates made to the system. A detailed document outlining the app's technical specifications and architecture.

Overall, the developer’s maintenance plan ensures that the project is always updated, functional, and secure, and that any issues are identified and resolved promptly to minimize any downtime or potential risks to the project's success.

CHAPTER VI

CONCLUSIONS

The project provided the developer with a valuable learning experience, improving their problem-solving and critical thinking skills through the challenges and bugs encountered during implementation. They also gained a better understanding of the importance of meticulous planning, time management, and continuous learning.

The developer was able to successfully meet the project's requirements within the allotted three-month timeframe, including testing and implementation. The Gantt chart served as an essential tool for the developer to maintain control over the project's progress and ensure that all tasks were completed on time. This experience has demonstrated the importance of effective project planning and management to achieve successful software development outcomes.

In this project, the developer made sure to follow the principles and methodologies to ensure the application had a better user experience. The principles of usability, accessibility, and user-centered design were emphasized throughout the development process. This information was then used to inform the design and development of the application, resulting in a product that is both visually appealing and easy to use.

Based on the testing results, it can be concluded that the system is both operationally and technically effective, meeting the client's requirements and

specifications. The reports displayed from the system were consistent with the reports from the previous system, which demonstrates the successful implementation of the new system. These results are a testament to the hard work and dedication of the developer, and showcase the effectiveness of the development process utilized in this project.

Overall, This project has been a success in delivering a functional, operable, and effective system to the users. It has also been a valuable learning experience for the developer, highlighting the importance of proper planning, time management, and continuous learning in achieving success in the field of software development.

CHAPTER VI

RECOMMENDATIONS

For future work, there are several ideas that can be implemented to further enhance the app's functionality and user experience.

Integrated Store Front. One possible idea is for the client company to start a storefront web application since there is now a cloud storage for their product information, price, and stocks. This can help boost their sales and expand their market reach.

SMS Facility. SMS facility could be implemented to inform loyal buyers when new products are procured and restocked by the company. This could help improve customer satisfaction and retention, as buyers can quickly be notified of the availability of products they are interested in. Additionally, this feature could help the company stay competitive in the market by providing a convenient and efficient way to inform customers of new stock.

Additional Product Information. Another potential improvement is to add product photos to the app's product information. This can provide a more comprehensive view of the products and help users make informed purchasing decisions.

Enhanced Report Generation. To enhance the usability of the system, it is recommended to add a printing report feature for every monitoring table or data that

is displayed in the system. This feature should allow the user to export the data into various document formats, such as PDF, DOC, or spreadsheet, so that they can be used outside the system.

This will provide greater flexibility for the user and allow them to easily share the data with others. Additionally, it will increase the overall efficiency of the system by reducing the need for manual data entry and allowing for quicker access to important information.

Integrating AI Technology. This is to help users create compatible product bundles more easily, as the AI can intelligently suggest compatible parts and configurations for their specific needs.

These potential improvements can help the application stay competitive in the market and meet the evolving needs of users.

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APPENDICES

APPENDIX A

Deliverables and Milestones

Identified Risk. The system's connectivity poses the most risk. When branch systems are centralized, the ability to store and retrieve data from databases depends on an Internet connection. It might not work if there is no internet connection or an unstable network connection.

Risk Assessment Plan. As part of the risk management strategy, the database should first be stored locally, just like it is not centralized. All updates and transactions in the system will be stored and retrieved in the local server of every branch. Every branch will have middleware that will retrieve data from their local server and copy it to cloud storage to achieve centralized monitoring. When there is no connection available, the middleware should be able to manage problems by halting the data fetching and resume once there is a connection. Since the data from the branches is now stored in the cloud database, the centralized data will be the admin's source for monitoring the sales and inventory.

Prototype. This is the system's first user interface, or prototype version one. If scenarios change or a new feature is requested for the system, this is susceptible to modification and still editable.

Figure 23. The prototype interface of the monitoring facility.

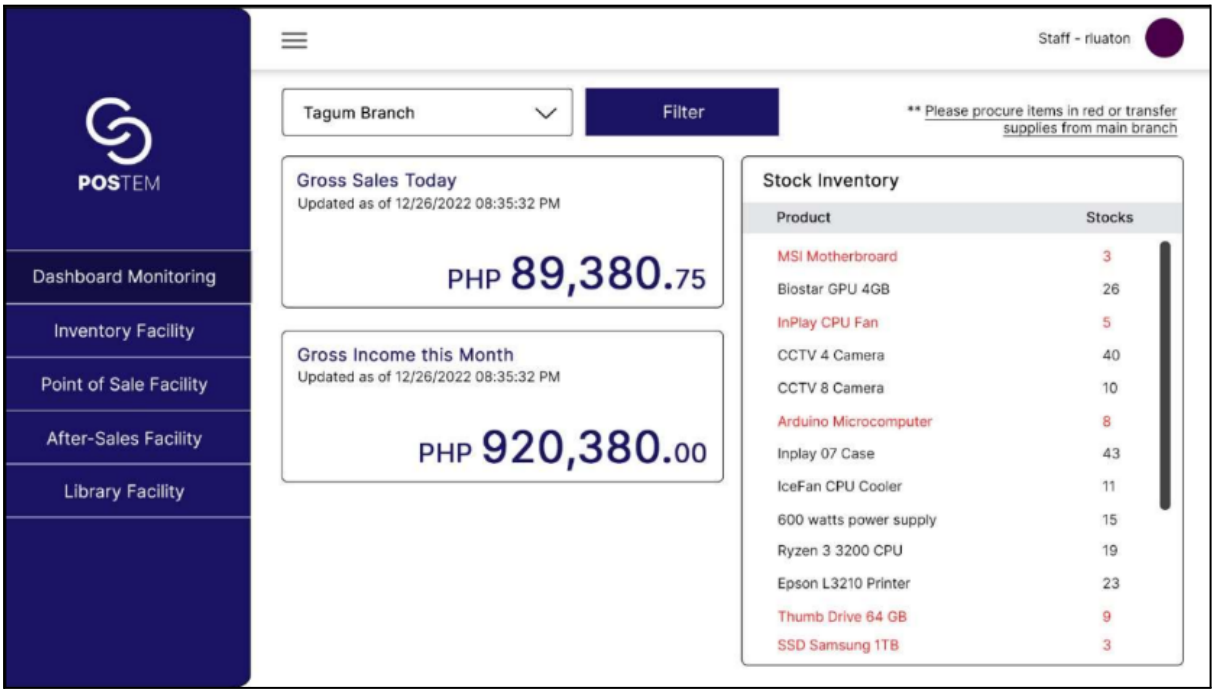


Figure 24. The prototype interface of stock transferring

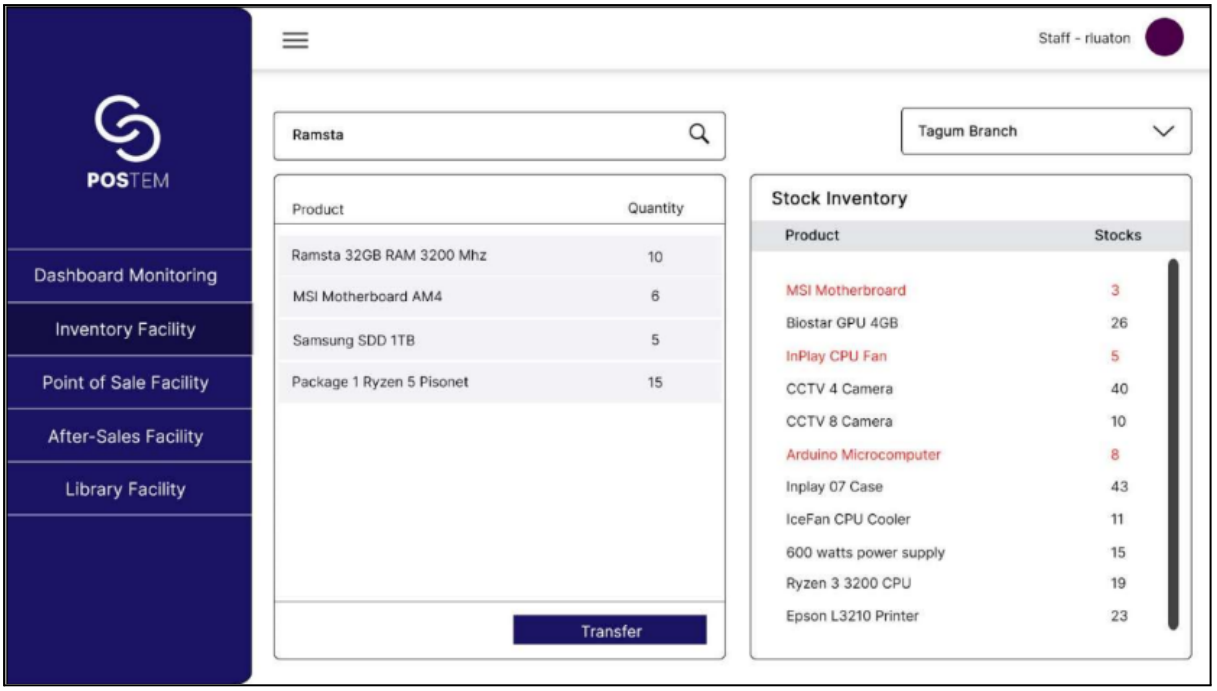


Figure 25. The prototype interface of receiving stock transferred

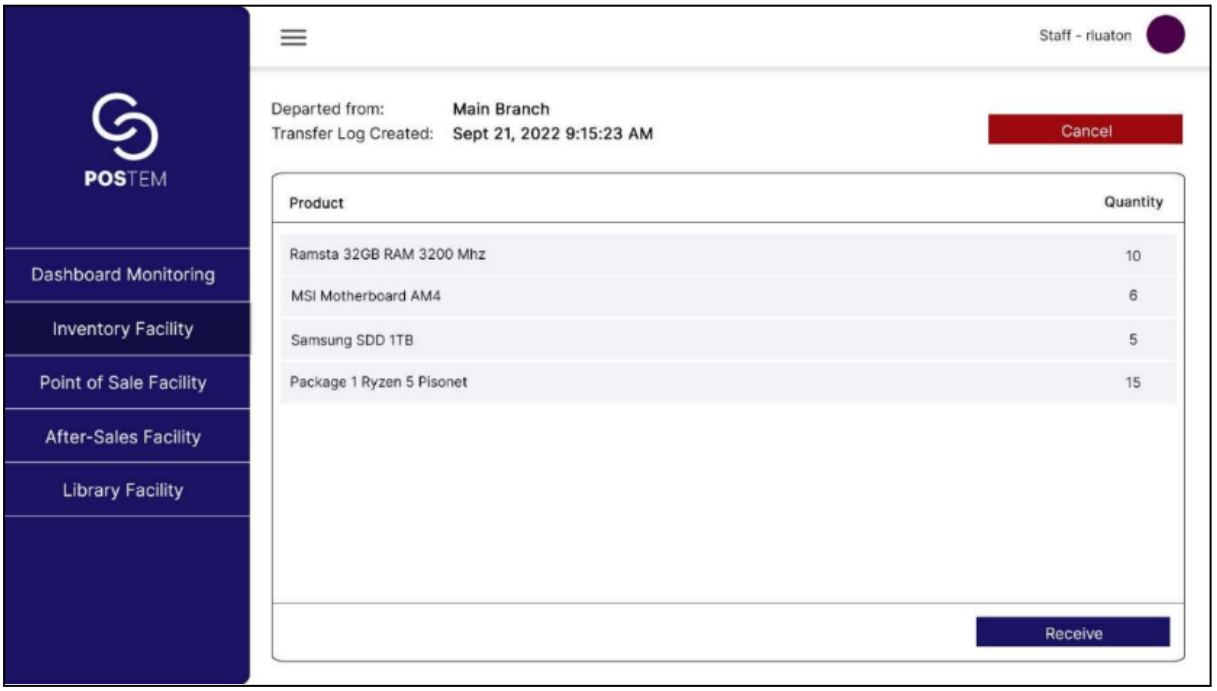


Figure 26. The prototype interface of point of sale transaction

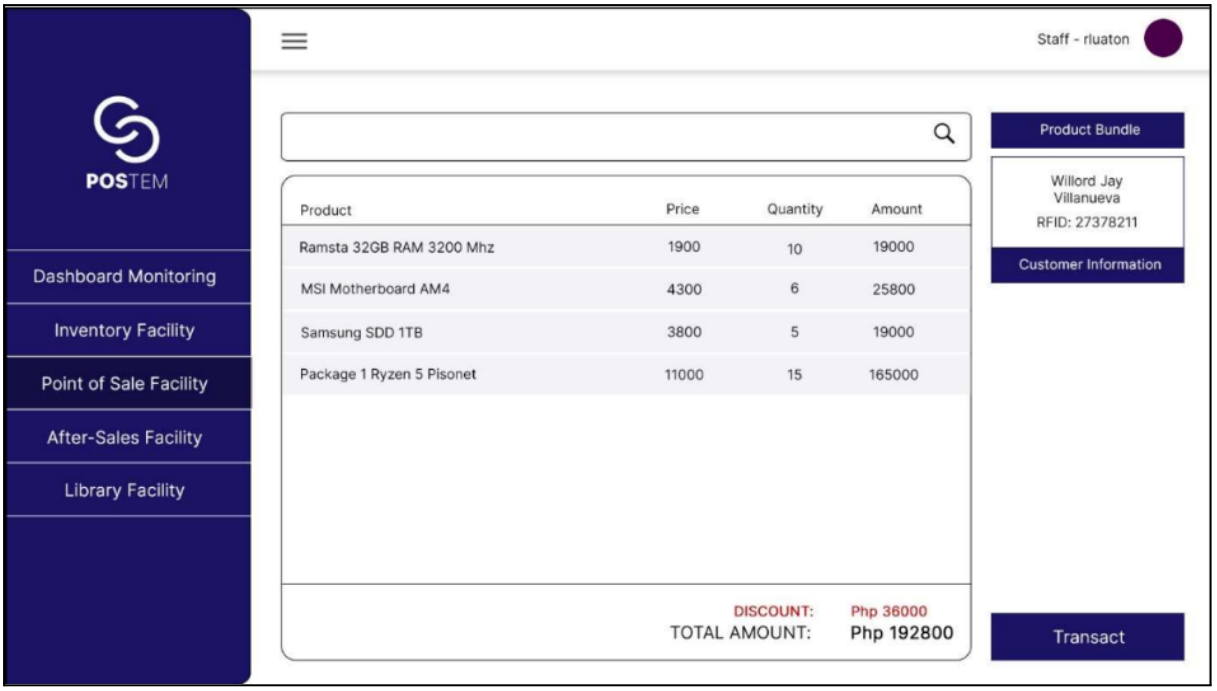


Figure 27. The prototype interface for the searching item in the POS facility

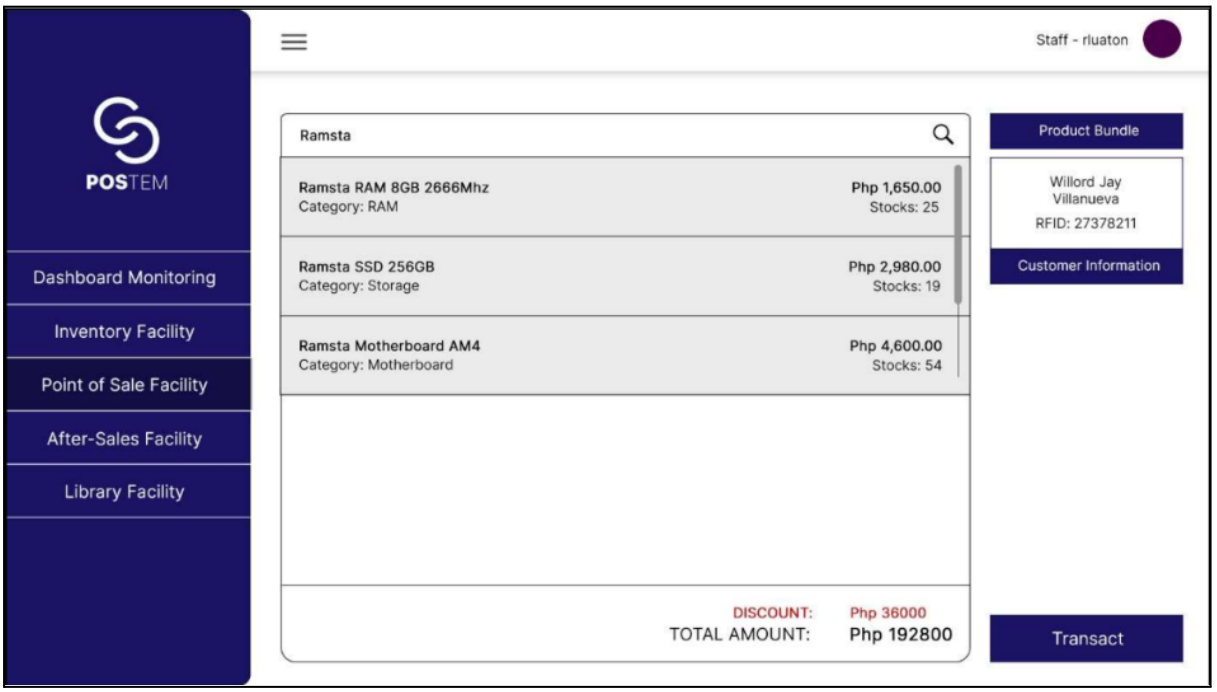


Figure 28. The prototype interface of the customer information view

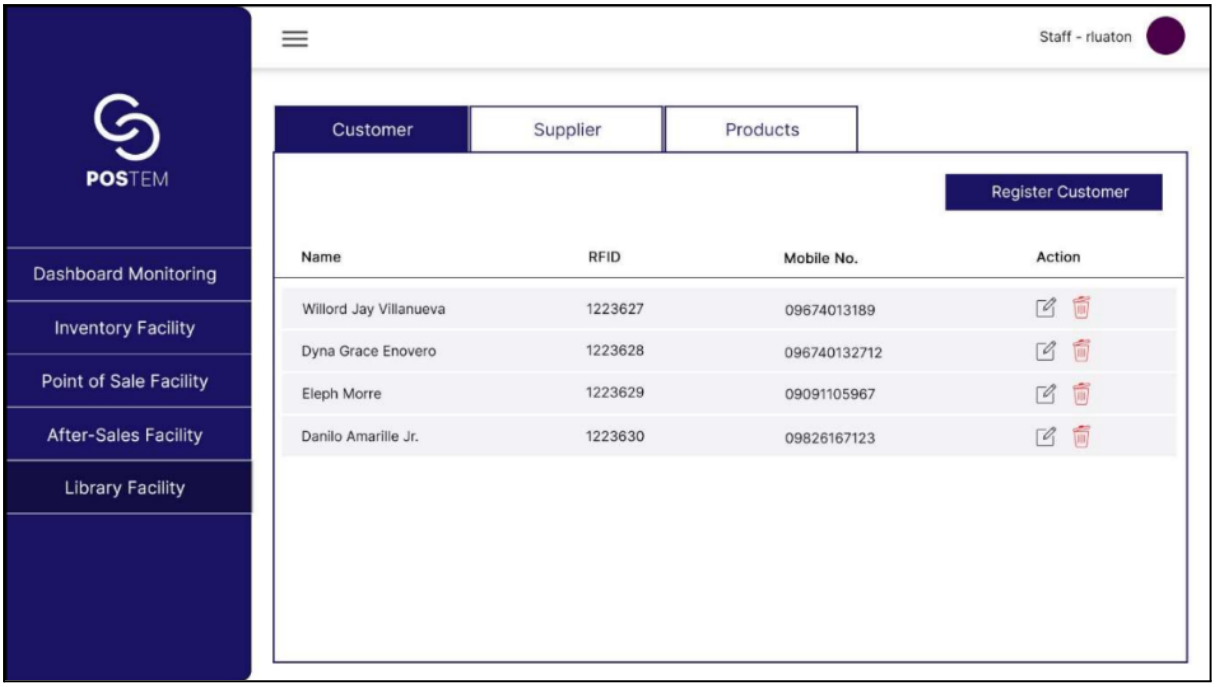
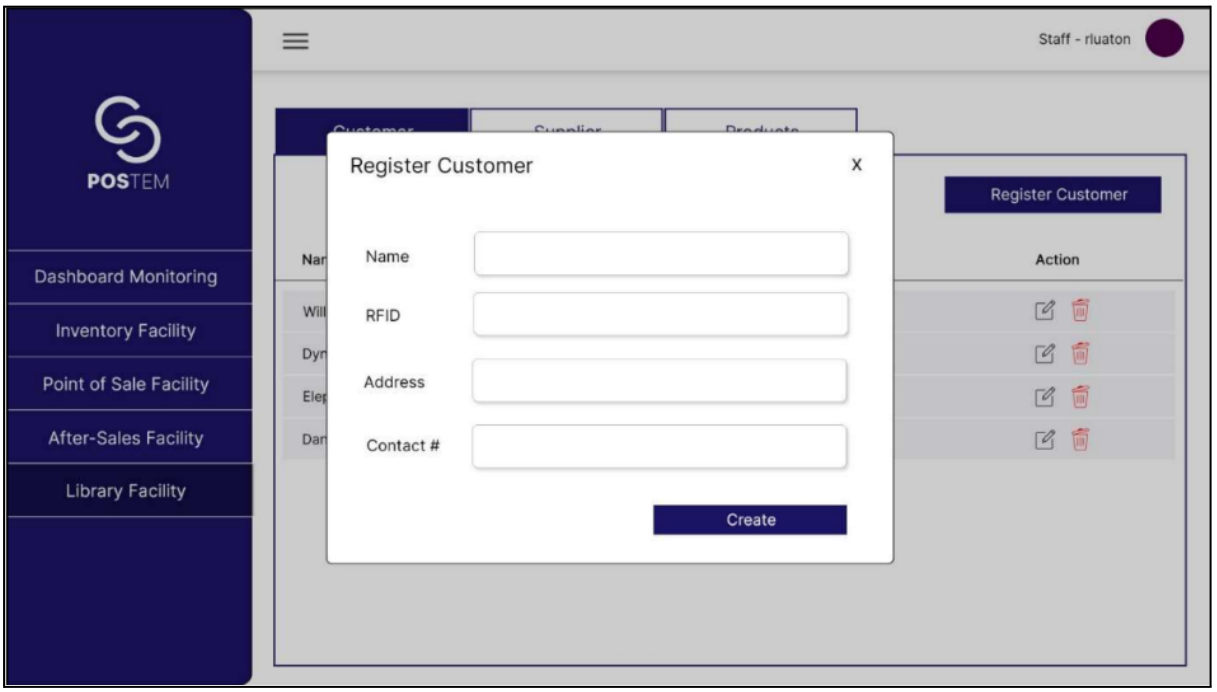


Figure 29. The prototype interface for the customer registration



APPENDIX B

Budget

The breakdown of the budgeted items for this project is listed in Table 1. The information for testing and final deployment is included.

Product	Purpose	Annual Cost	One-time Payment	Cost
(1) Hostinger	Cloud Hosting	₱ 2,028	No	₱ 2,028
(2) Domain	For name serving	₱ 599	No	₱ 0
(3) RFID Scanner	For RFID Scanning Feature		Yes	₱ 1,058
(4) RFID Cards	For 100 customers		Yes	₱ 1,580
(5) Workstation	For testing and deployment		Yes	₱ 0
		TOTAL:		₱ 4,666

Table 1. Costing of the materials to be used in this project.

JUSTIFICATION:

(1) The annual fee for the web hosting package is PHP 2,028. The company must pay Php 2028 yearly for renewal [7].

(2) A free domain is included in the web hosting service. The first year of business is free for this domain; after that, a renewal of PHP 599 is required.

(3) A 13.55 MHz RFID NFC Reader/Writer that costs Php 1058 is also included in the budget. Every time a new branch or cashiering area opens, this must be deployed.

(4) The 100 RFID IC cards were priced at PHP 1580. This is for loyal customers who will utilize this RFID to get discounts.

(5) Because they currently have workstations set up in each of their branches, we undertook the pilot testing, and workstations are essential but won't add to the costs.

Assuming that there are no more than 100 committed clients per branch, they must prepare their funds in a workstation and Php 2,638 to buy 100 RFID IC cards and an RFID reader. The company must also spend Php 2,028 for web hosting and a domain upon beginning this project, and Php 2627 for the renewal of the domain and web hosting. In cases of business expansion, the corporation must also set aside money in its budget for hosting the expansion. Currently, the starting price for this project is PHP 3,244.

APPENDIX C

Qualifications

Educational background. The analyst/developer is a graduate of the Bachelor of Science in Information Technology program at the University of Southeastern Philippines, Batch 2019. He co-developed a capstone project for their bachelor's degree entitled "R-DROID: Resistor's Value and Tolerance Meter Mobile Application using Image Processing."

Professional background. The analyst/developer formerly worked as a software quality assurance analyst for Tagum Cooperative for three years and is currently employed by the same firm as a software developer.

Experience Contribution. For this project, the developer used the Flutter framework for the front end and the Laravel back end. He is capable of creating the Flutter Web application that is employed for this project given his experience in Flutter mobile development.

Gained Skills from This Project. The developer learned about formal and structured client interviews when it came to planning information systems. The developer also gained ideas in data collection and scoping the problem area for the company.

Planning to Gain. Since I already have expertise with flutter mobile, I intend to improve my ability to design web development utilizing flutter for project development. Additionally, I want to discover how to link input/output devices with Flutter Web applications. I also want to learn more about creating middleware to connect local storage with cloud storage and host an API in the cloud.

APPENDIX D

Contributors/Collaborators

I would like to acknowledge the following people for their contributions to this thesis:

- **Assoc. Prof. Ria Mae Borromeo**, my thesis advisor: Thank you for your guidance and support throughout this process. I could not have done it without you.
- **Veejay Daganato**, co-developer: Thank you for your collaboration on the development of this thesis. I appreciate your expertise and insights.
- My QA workmates for testing the data, **Chylde Cifra** and **Linbert Tapangan**: Thank you for your diligence and attention to detail in testing the data. Your work was essential to ensuring the quality of my thesis.

I am truly grateful to all of these people for their contributions to my thesis. I could not have done it without them.

APPENDIX E

Resources

For the auto-discount feature to function, the RFID reader is a required resource for this project. Additionally, connection to the Hosting as a Service provider for testing and final deployment is required. Additionally, it requires at least one testing workstation for pilot testing.

In software resources, we require the Laravel Framework for the application's backend structure and the Flutter Framework for the project's front end or interface.

APPENDIX F

Complete Program Listing

The source code for the developed system can be found at the following links:

Frontend - https://gitlab.com/wj.villanueva/cspos

Backend - https://gitlab.com/wj.villanueva/csposbackend1

The code is hosted on GitHub and is publicly accessible. The repository contains all the necessary files for the system, including the code for the frontend and backend, the database scripts, and any other dependencies.

APPENDIX G

Technical Reference

Product: COMPUTER STORE POINT OF SALE AND INVENTORY MANAGEMENT SYSTEM WITH RFID TECHNOLOGY USING FLUTTER FRAMEWORK
Version: 1.0.0
Date: May 20, 2023

System Requirements

- Operating system: Windows, Linux, or etc.
- Processor: i5-8th Gen or Higher
- Memory: At least 8GB
- Storage: At least 500GB

Usage Instructions

1. Open the browser window
2. Access the url:

To use the product, simply launch the application and follow the on-screen instructions.

Troubleshooting

If you encounter any problems with the product, please consult the following troubleshooting tips:

- Make sure that your system meets the minimum system requirements.
- Try refreshing your browser.
- Try restarting your computer.

APPENDIX H

User Manual

Instead of a written user manual, we have created a comprehensive video. To watch the video, please click here: https://youtu.be/WCBVFthgMhs. This will direct your readers to the video instruction, where they can get a visual and step-by-step guide on how to use your product.

APPENDIX I

Software Requirements Specifications

INTRODUCTION

1.1 Introduction

The purpose of this document is to outline the project's needs, the system's capability, and its limitations.

1.2 Scope of this Document

This document includes the project's goal, scope, functional and non-functional requirements, and specifics on the software and hardware needs. It also contains information on the necessary environmental factors, security needs, and software quality criteria. The owner and employees of Yannie Computer Store are the intended users of this suggested project. Willord Jay Villanueva will work alone to build this to comply with the requirements of the University of the Philippines - Open University's Master of Information Systems program. The deadline for submitting this paper is

December 31, 2022.

1.3 Overview

The name of this project is CS: Computer Store Point of Sale and Inventory Management System. This project will incorporate RFID technology and be created using the Flutter Framework. This system, which largely consists of POS and an inventory management facility, will aid the business during its operations.

1.4 Business Context

Yannie Computer Store, a privately held business that sells computer and laptop parts and accessories, is owned by Mr. and Mrs. Jhern Luaton. Offshore brands like Nvision, InPlay, MSI, Ramsta, Etopso, and others are distributed directly by them. They offer more than just spare parts; they also offer solar panels, CCTVs, and other technological products.

GENERAL DESCRIPTION

2.1 Product Functions

The product should facilitate transactions and inventory management so users may run effective businesses and manage inventory using systematic procedures.

2.2 Similar System Information

In the mainstream market, several POS and inventory management systems can also handle tasks like buy transactions, inventory adjusting, and monitoring. But they lack the particular characteristics the company requires. It is proven by the fact that the company chose to look for a solution that is more suited to their needs despite having an inventory and point-of-sale system in place. The system's strength is its ability to draft a product package, transfer supplies, and monitor multiple branches.

2.3 User Characteristics

The Yannie Computer Store's staff and owners will be among the system's users as they keep track of sales and inventories, conduct transactions, or make changes to procurement or stock levels. The user must have a fundamental understanding of how to use a Windows computer and Microsoft Office to use this system. The user will become familiar with system functions through training sessions the developer will conduct.

2.4 User Problem Statement

Four important issues raised by the interviewee during the analysis could aid the developer or business analyst in determining what system feature to create or what solution to offer.

2.4.1. Point of Sale Concerns.

The current system has a flaw that prevents them from adding products when a product contains more than 13 items. When someone buys a package, they have problems as well. They manually modify the system's stocks after the transaction, which doubles their workload.

2.4.2. Inventory Management Issues.

The source branch will manually subtract from or adjust the stocks of the goods they are transferring when they transfer stocks. They deliver the items at the destination branch along with a note listing the items that need to be added to or altered in the system's inventory.

2.4.3. Returned Items Dilemma.

When they receive a returned item, they will enter it into an Excel spreadsheet. Sometimes they forget to list them out or lose track of the return item's progress, depending on whether it is being repaired, sent back to the manufacturer for repair, or has already arrived as a replacement from the manufacturer.

2.4.4. Customer Information Problems.

Even though they have a manual list in Excel, they still struggle to recognize repeat customers or loyal customers by name. This is especially problematic for newly hired workers.

2.5 User Objectives

This section will outline the features that the user would like to have, incorporate into their new system proposal, or address to resolve any issues with their current system.

2.5.1. The user wishes to record any things that are moved from one branch to another.

2.5.2. The user requests a particular feature for the product bundle. He desires that this new function will allow them to create packages and combine them into a single product, but when this single product is purchased, the stocks of every product included in the package will be deducted.

2.5.3. The user requests a concise list of customers.

2.5.4. The user wants to record and track the status of returned products.

2.6 General Constraints

These are the fundamental constraints of the system or its features. It will be disclosed to all stakeholders, including the client, to confirm that the system is limited to these items:

2.6.1. There is no storefront application for the client to use with this project.

2.6.2. The system may not be able to run on other platforms or operating systems because it will be designed as a desktop application in Windows OS.

2.6.3. The only functionality that will use the centralized data is the admin monitoring dashboard and stock transfers.

2.6.4. POS printing will not receive as much attention.

FUNCTIONAL REQUIREMENTS

3.1 General Functional Requirements

3.1.1. The system shall store any input you provide in the database. Data must be kept in a local database and have all of its fields filled up. Certain information from the local database must also be transferred to the cloud database.

3.1.2. The database's data should be accessible in the system. Reports on the data entered into the database should be accessible to users. Users of the system should be able to view data via tables and dashboards.

3.1.3. The system shall allow users to manipulate data and be interactive. Through the use of forms, items and other data shall be able to be added, modified, and removed.

3.2 Specific Functional Requirements

The system's specified functional requirements are listed below, along with a brief description of each feature:

3.2.1. Dashboard Monitoring. The administrator shall be able to examine sales and inventories for all branches, while the staff shall be able to monitor sales and inventory at their store branch.

3.2.2. Inventory Facility. Users shall be able to create and cancel procurement purchases and add products to their inventories. Additionally, the user shall be able to alter the branch's stock levels and keep track of the supplies that are sent to or received from other store branches.

3.2.3. Point of Sales Facility. Users shall be able to do retail transactions in this facility. Users shall also be able to combine products into packages in the

POS and view, update, or remove those packages as needed using the system.

3.2.4. After Sales Facility. Any product that has been returned because of a warranty issue must also be registered by the user. The generated log must be available for user examination and updating.

INTERFACE REQUIREMENTS

4.1 User Interfaces.

The Flutter Framework will be used to create the user interface. In this framework, elements like buttons for page and feature routing, tables for viewing, and forms for data manipulation should be created. Different data types must be accepted by forms.

4.2 Hardware Interfaces.

The program was created for 64-bit Windows. Additionally, a 13.5 MHz NFC RFID card reader/writer is needed. To read the data from the RFID card, the system will be integrated with this hardware.

4.3 Communications Interfaces

API will be used for the system's backend and frontend program connections. To ensure that only the intended sender and receiver may read or listen to messages during API calls, data or the message body must be encrypted before the flight and

decrypted after arrival. Additionally, network server communications must use the HTTPS protocol.

4.4 Software Interfaces

The system was created, at least, for Windows 8 versions. The SDK for the NFC RFID Reader/Writer must also be available for this device to work.

PERFORMANCE REQUIREMENTS

5.1 Workstation

Every branch's workstation will function as the storage server, which is also where the system is hosted. The following specification is advised to be required in order to suit the system:

- 1600 MHz processor or higher
- 8GB RAM or higher
- 100GB Available Hard Drive Space
- Windows 8 or later operating system.

5.2 Cloud Host

Data has to be kept in cloud storage as well. In order to achieve the system's required performance, cloud hosting servers need also meet the requirements listed below [2]:

- 1GB allotted RAM
- At least 50GB bandwidth
- 100GB Allotted SSD Storage
- SSL Certificate
- Cloudflare Protected Nameserver

OTHER NON-FUNCTIONAL ATTRIBUTES

6.1 Security

The capacity to guarantee that the system is impenetrable. A mechanism that protects sensitive data should be developed [1].

6.2 Scalability

The ability to maintain the necessary level of service when the system load grows without altering the system. It should be built in such a way that it can withstand an increase in load and continue to perform well [1].

6.3 Reliability

This guarantees the consistency and integrity of the system and all of its transactions [1]. It should also guard against abuse or be resistant to user mistakes.

6.4 Availability

It can carry out its functionality (uptime/total time). It ensures that a service or a resource is always accessible, even if its components fail [1].

6.5 Efficiency

It can quickly carry out its functionalities. It does a good job of making the most of the available computer resources to accomplish its goal. Measures of bandwidth, latency and response time are all important for assessing the effectiveness of the system.

6.6 Maintainability

It is simple to grasp for novice developers, easy to use smoothly, and simple to alter for unforeseen use cases. It is a crucial necessity to increase maintenance effectiveness and efficiency.

OPERATIONAL SCENARIOS

Scenario A: Login

To access the system, the user must input their account credentials. A form will be used to fill out the fields and manipulate the data.

Scenario B: Drafting Package

The system will provide a list of products after the user clicks the "draft a package" button. The user will then select multiple items and provide the name of the package. A product will be made from this package.

Scenario C: Transfer of Supplies

The user must choose a destination branch and the items they wish to move. Then, he must enter the stocks they will supply to the destination branch.

Scenario D: Receiving Returned Item

Upon receiving the returned item, the user must enter the required data into the system. The customer's identity, the item returned, and its status are all details that must be provided.

Scenario E: Registering Loyal Customers

The user must enter the necessary client information. For the RFID chip to be registered and associated with the customer profile, the user must also tap the RFID card on the reader.

Scenario F: Monitoring of Sales for Admin

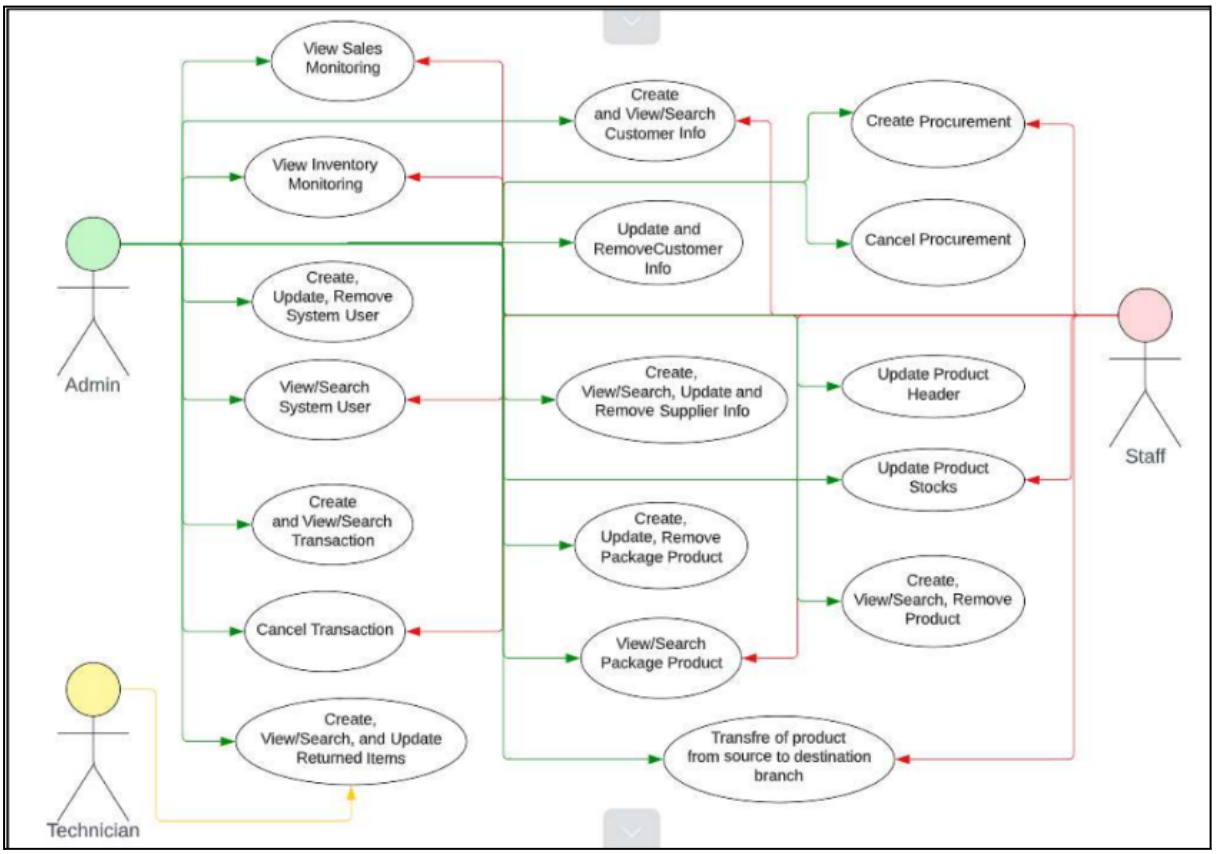
The user shall select or filter the branch he wants to monitor. This selection will determine the displayed data in the admin view.

PRELIMINARY USE CASE MODEL

The basic use cases that satisfy the system's requirements are listed in this section. The goal is to present a structural perspective of the above-mentioned requirements and how they might be met in the system.

8.1 Use Case Model

Figure 1. Use Case Diagram



Three actors will make use of the system. It is composed of administrators, staff, and technicians. All system functionalities will be accessible to the

administrator. However, the staff and technicians can only use a limited number of features.

8.2 Sequence Diagrams

Figure 2. Sequence diagram for dashboard monitoring

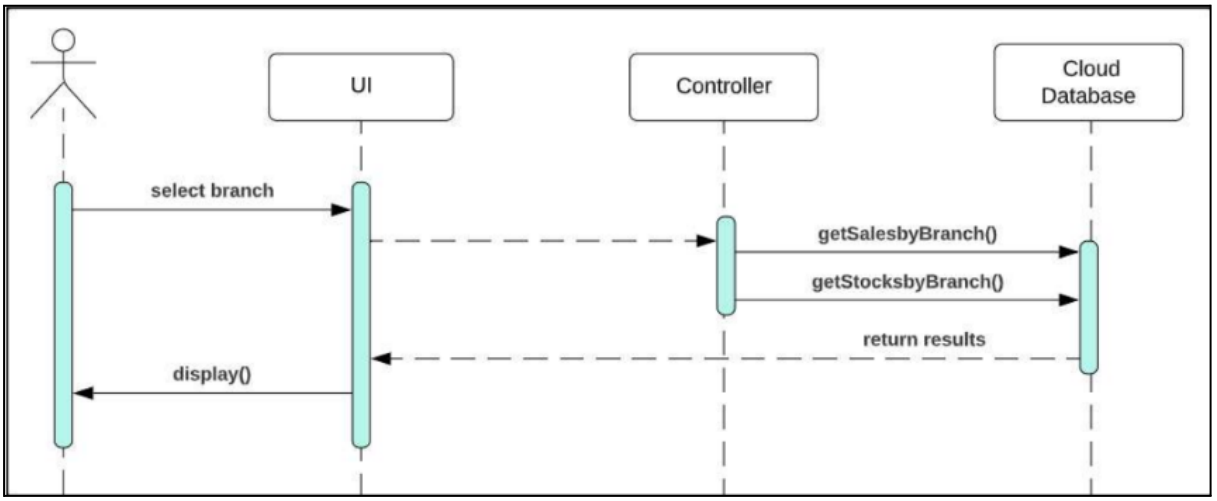


Figure 2 depicts the sequence of activities that take place on the system's backend and frontend, as well as during a user's access to the dashboard monitoring feature. For the user or admin to be able to check the inventories and sales, the admin must first choose a branch to monitor.

Figure 3. Sequence diagram for middleware

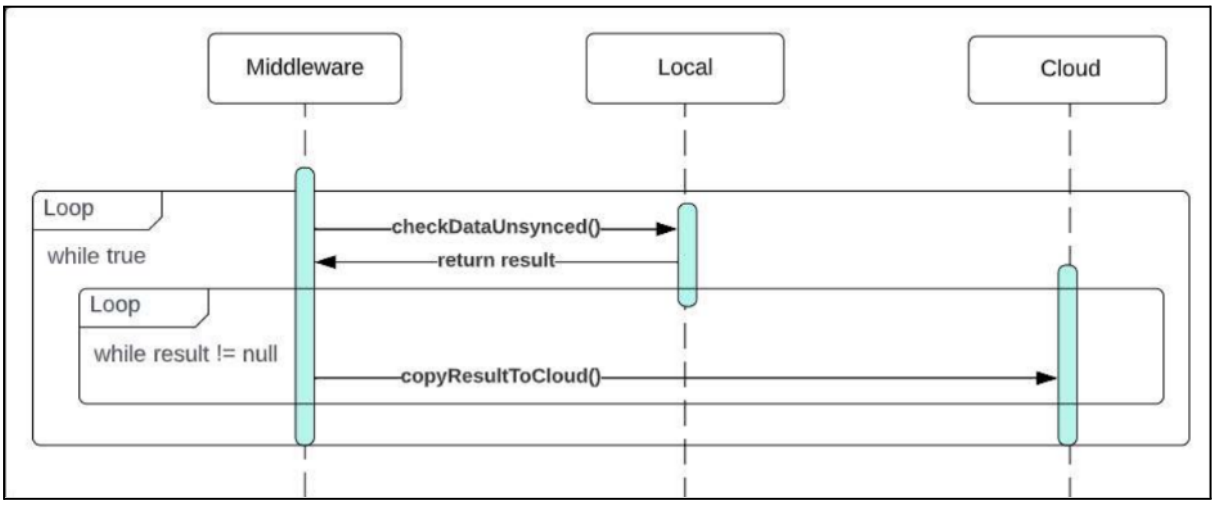


Figure 3 illustrates how middleware collects data from a local database and uploads it to a cloud database. The cloud database used in this figure is the same as the one used in figure 2.

Figure 4. Sequence diagram for transferring stocks

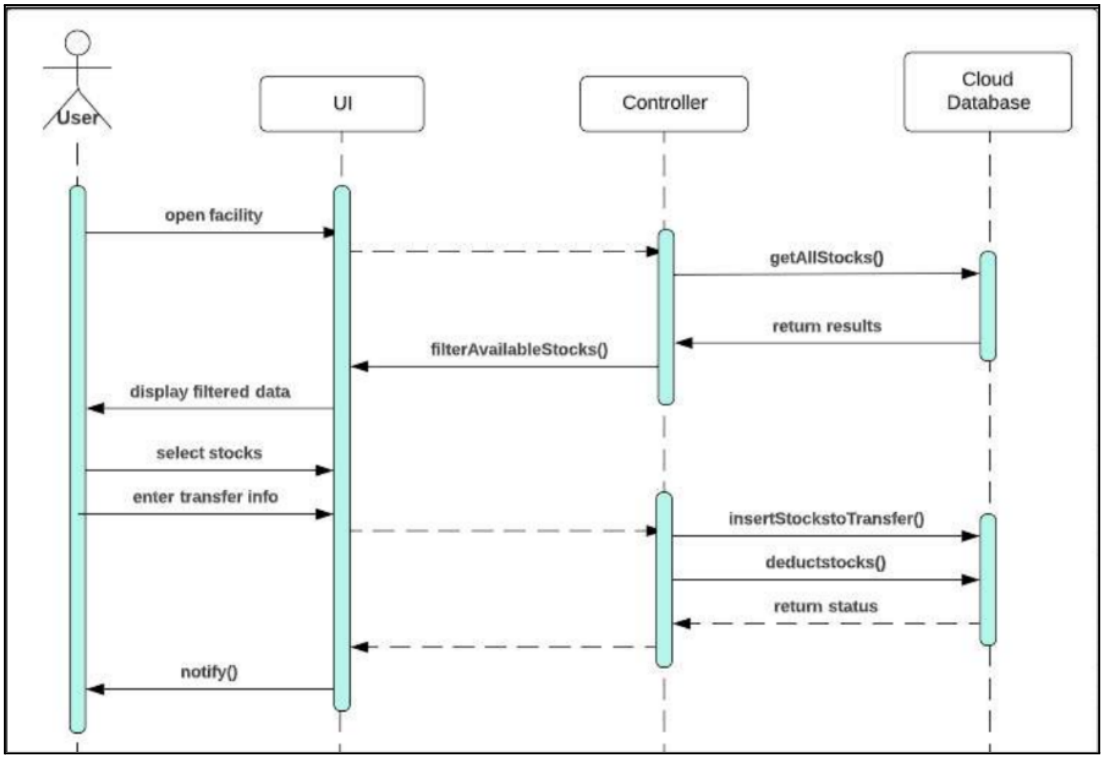
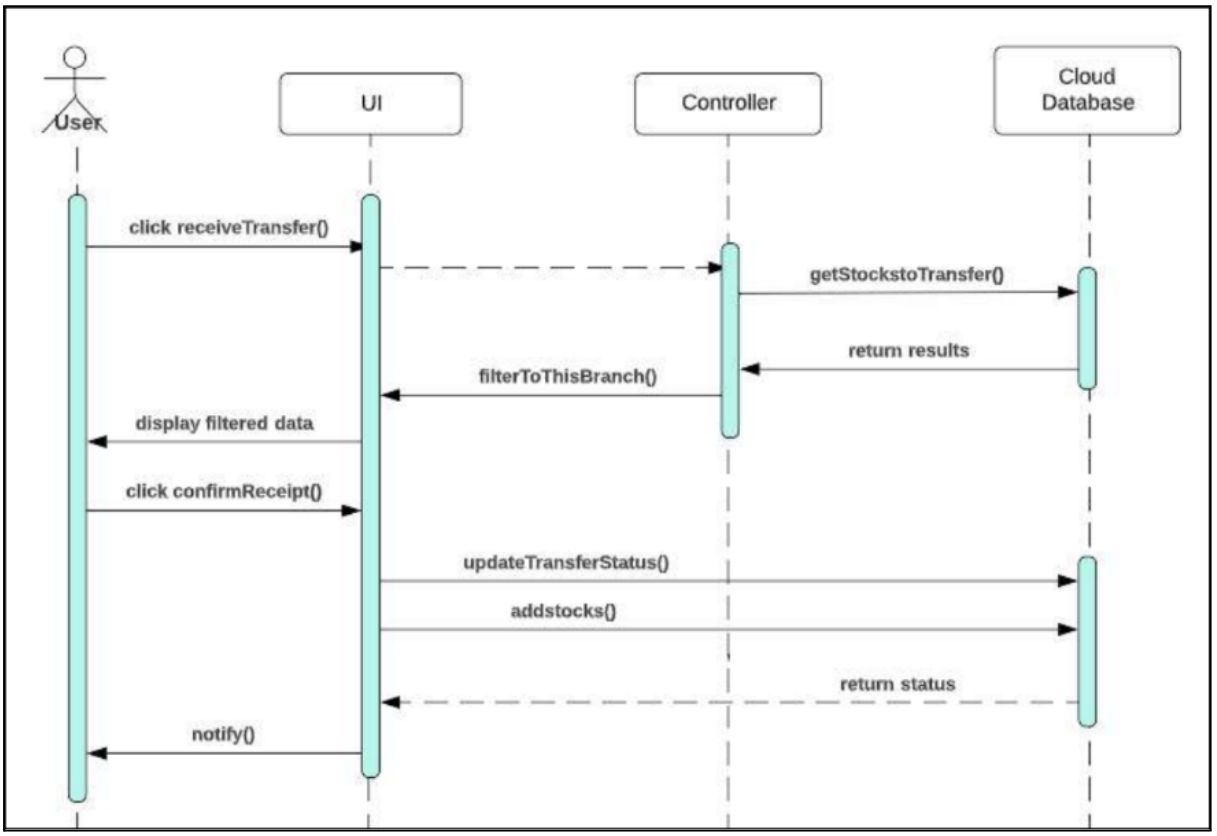


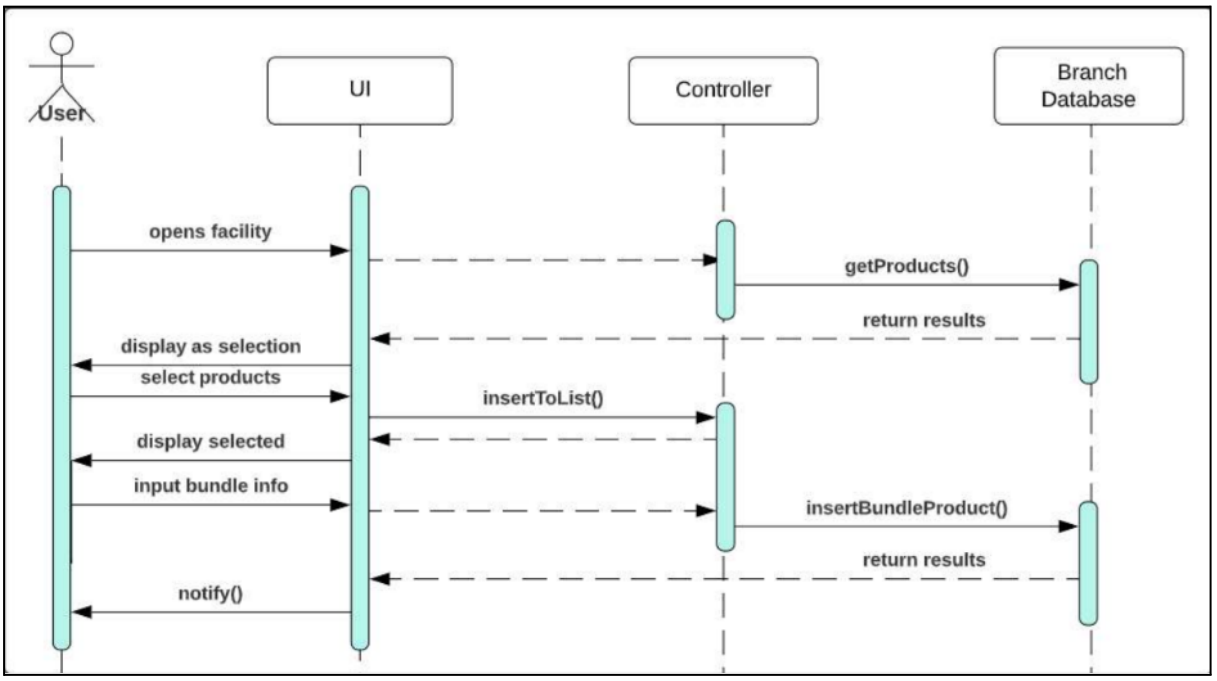
Figure 5. Sequence diagram for receiving transferred stocks



One of the ways this system differs from standard inventory systems is its ability to move supplies. It makes it possible for the main branch to digitize the waybill for the supply delivery from their branch store to the final branch store.

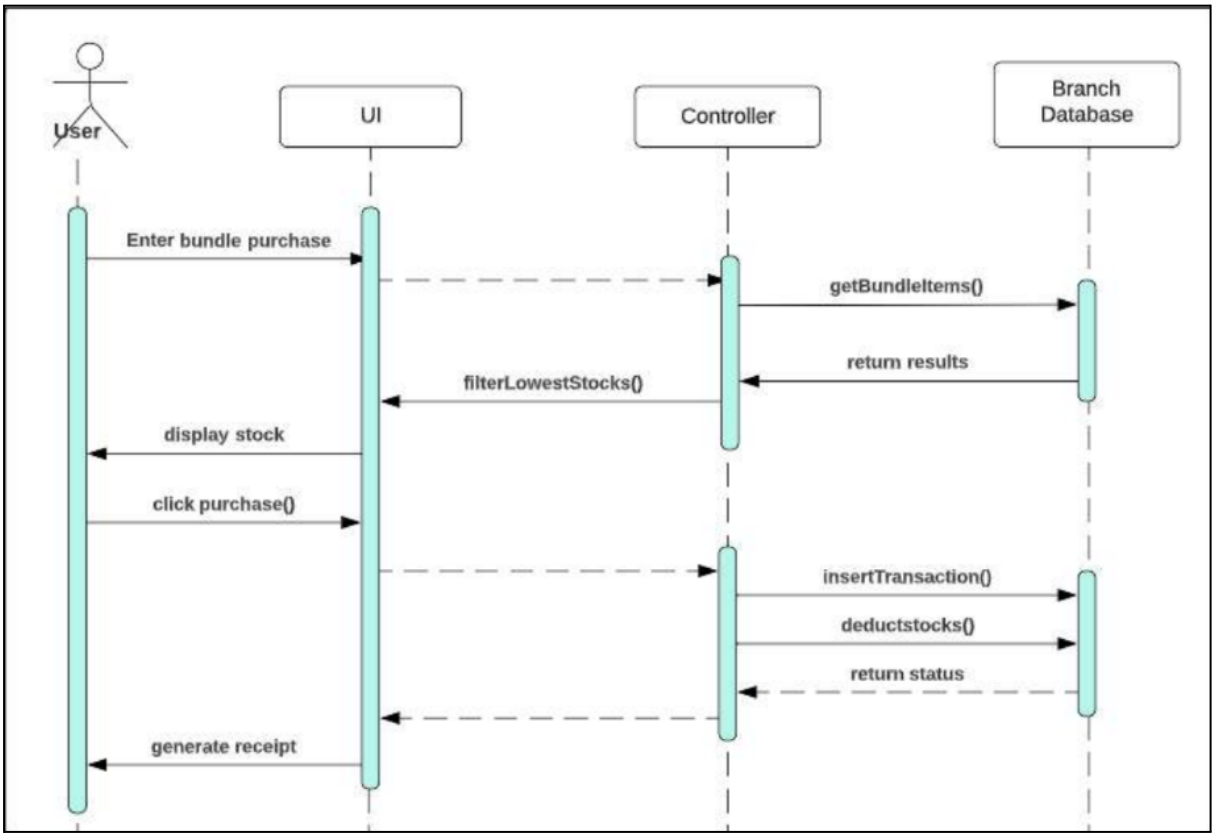
Figure 4 depicts the transfer of stocks or the creation of a digital waybill for their delivery to the destination branch. Upon getting the supply, the receiving party must also have a means of navigation. Refer to Figure 5 to trace the progression from user to database.

Figure 6. Sequence diagram for creating bundle



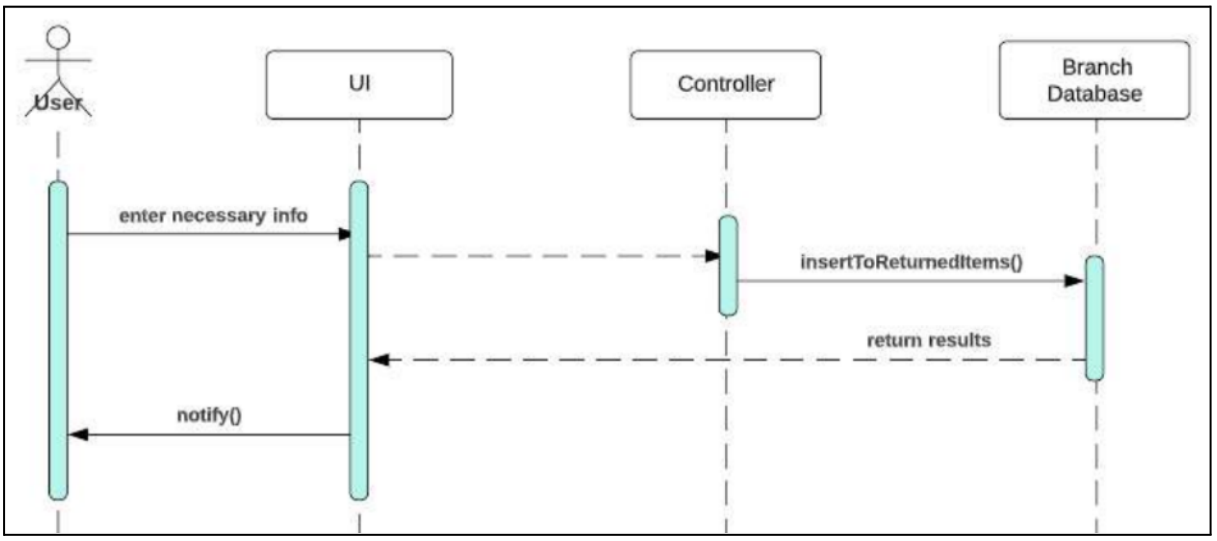
This feature occurs following the creation of a new product bundle by the company, and as a result, the user must use this feature and go through this sequence of actions to build the new product bundle in the system. The sequence flow for creating a bundle is shown in Figure 6.

Figure 7. Sequence diagram for purchasing bundle



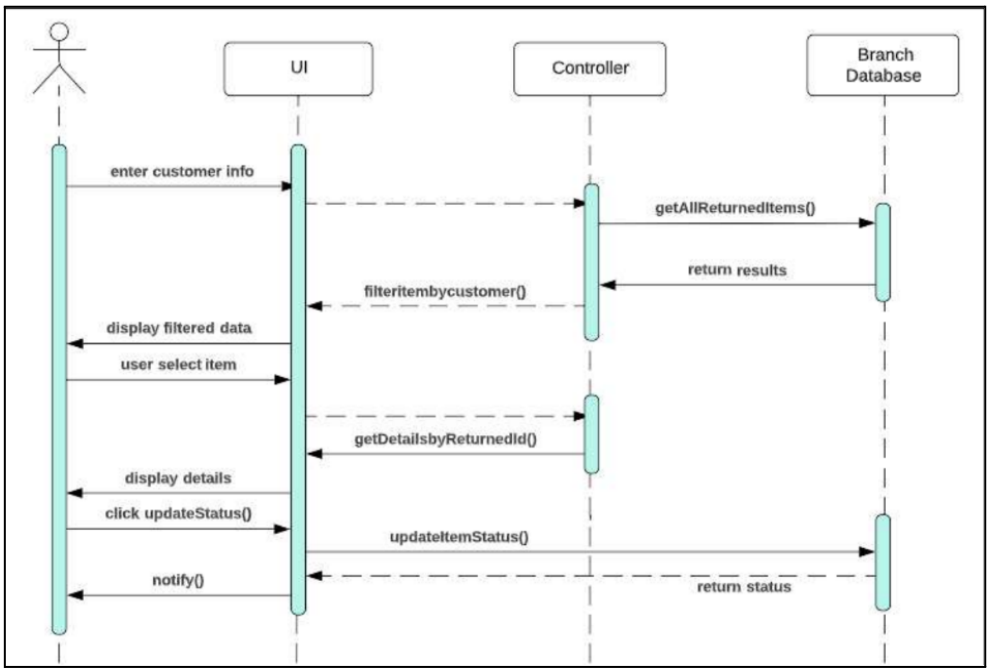
A product bundle can now be purchased once it has been established. Figure 7 will take place at the point of sale, but for the sake of this diagram, it will only cover what will happen if the buyer buys a bundle. The filterlowerStocks() function, which identifies the bundle's items with the lowest stocks, will reveal that bundle's stocks. If one of the products in a bundle is out of stock, the bundle cannot be purchased, so the system should be able to identify the lowest stock so that it will be passed down as the bundle's stock.

Figure 8. Sequence diagram for receiving returned item



For more structured tracking of return logs, the system also has a feature that requires returned products to be registered into the system. The sequence of actions when receiving a returned item, from user navigation to database storage (see figure 8).

Figure 9. Sequence diagram for updating returned item



The sequence in which the status of a logged return-item status is updated is shown in Figure 9. This status updating occurs once the returned item has reached a necessary step or checkpoint and is now fixed, available for a claim, etc.

Figure 10. Sequence diagram for registering customers

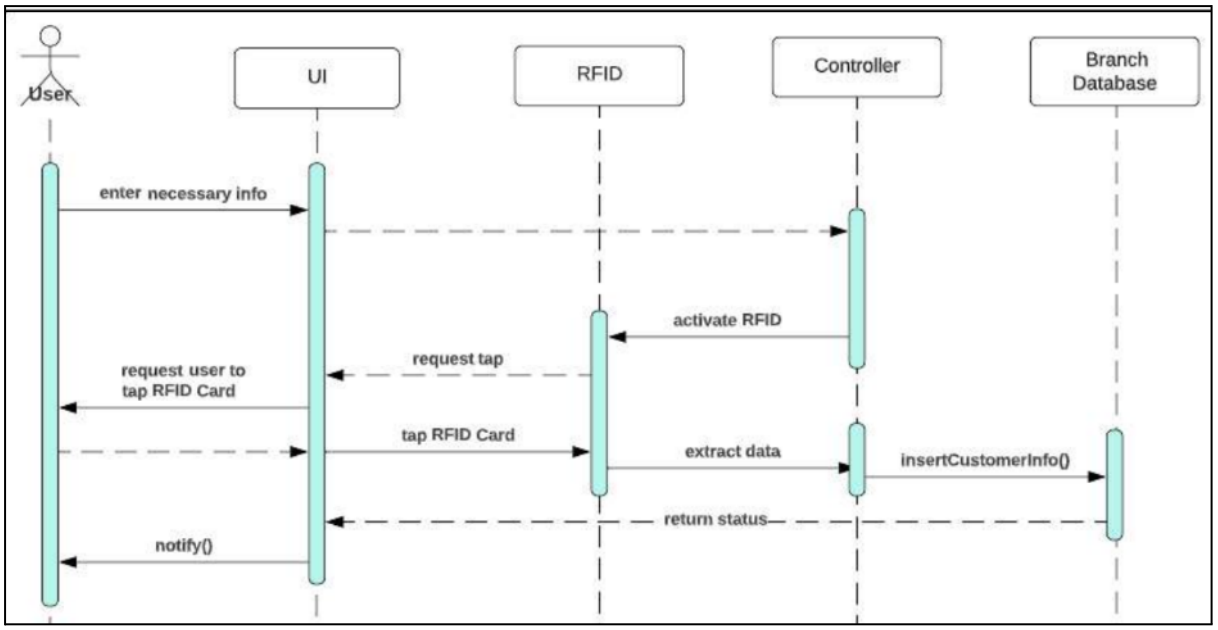
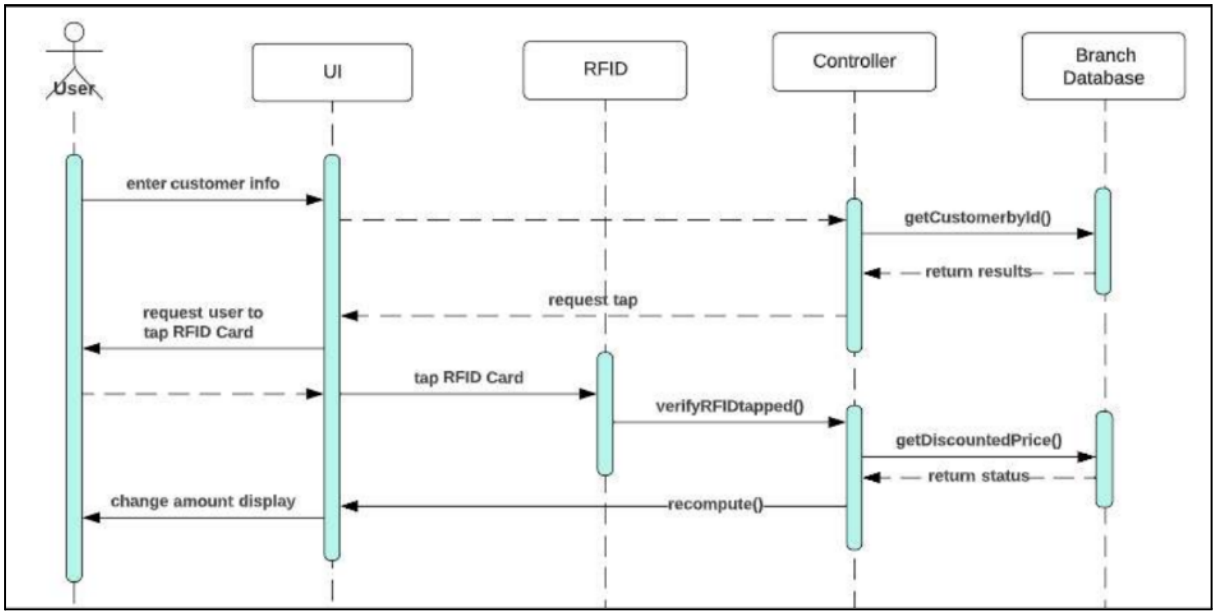
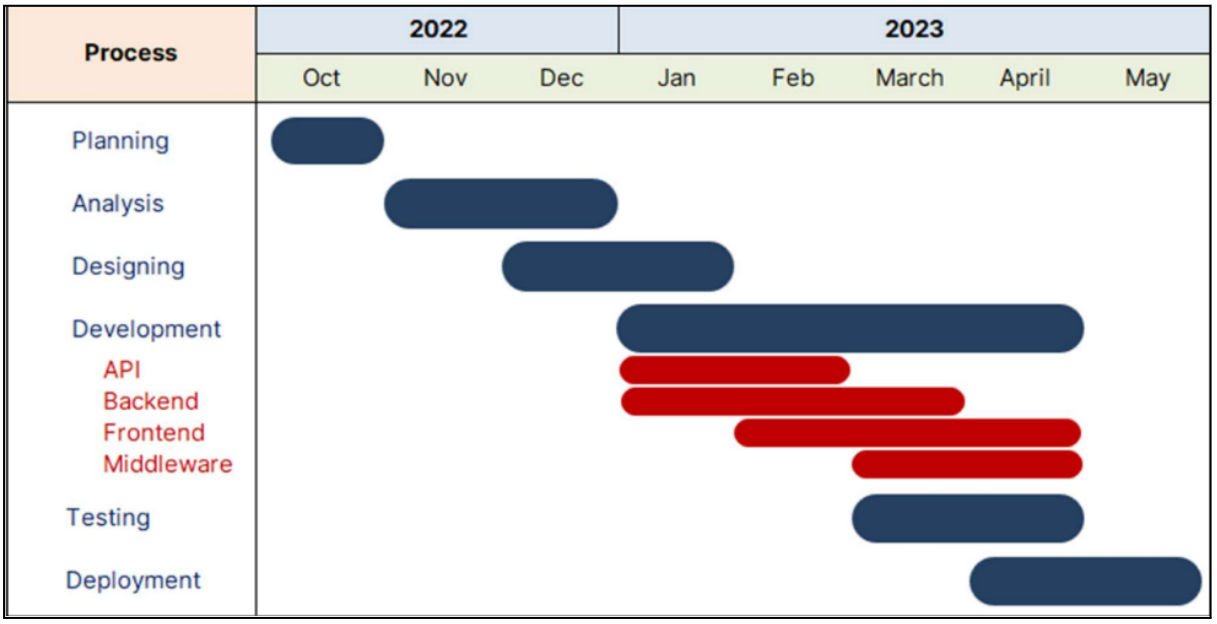


Figure 11. Sequence diagram for claiming discounts



When a consumer registers with the system (see figure 10) and when that customer wants to use discounts during his transaction (see figure 11), the system will use RFID technology.

UPDATED SCHEDULE



This timetable covers the planning, development, and implementation of this system. In October 2022, the developer had already begun the analysis. The analysis will be completed by the end of December 2022, the development will begin in January 2023, and the deployment or implementation is scheduled for June 2023.

UPDATED BUDGET

The budgeted items for this project consist of a 12-month web hosting package with a free domain, which costs PHP 2,028 [2]. The budget also includes a 13.55 MHz RFID NFC Reader/Writer that costs Php 1058 and 10 RFID IC cards that cost PHP 158.

We will conduct pilot testing on branches, which will incur no additional costs because they already have workstations set up in each of their branches. As of right now, this project will cost a total of PHP 3,244.