

A Scan and Pay Mobile Application for Grocery Store: Development and Implementation

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Abstract: This project aims to enhance the customer experience in grocery shopping by developing a mobile application called Scan and Pay for Bistari Mini Market. The current manual pricing and payment processes in the mini market bring to challenges such as missing price tags, long queues, and customer dissatisfaction. The Scan and Pay mobile application allow customers to scan item barcodes using their smartphones, providing accurate and real-time information on prices, names, and discounts. Customers can add items to their shopping carts, view comprehensive details, and choose their preferred payment method. The expected outcome includes a user-friendly application for customers and administrators, offering convenience and reduced waiting times. This project revolutionizes grocery shopping by leveraging technology to streamline processes, improve satisfaction, and promote efficiency in the mini market industry.

Keywords: Grocery Shopping, Mobile Application, Scan and Pay

1. Introduction

Grocery stores are essential establishments that provide basic necessities, food, and household supplies to the local community. These stores play a crucial role in ensuring the smooth functioning of society by supplying residents with essential resources. In 2020, grocery stores contributed to the economy and made up 1.2% of the \$20.93 trillion gross domestic product in the United States with a combined output of more than \$255 billion [1]. This system is implemented based on the case study of the bistari mini market company that sells basic essential items and food in Bistari, Parit Raja. The current labeling of price tags on rack items in the mini market relies on manual methods, involving handwritten labels. This manual approach often leads to errors, such as incorrect or missing price tags, causing inconvenience for both customers and workers. Additionally, the existing payment flow requires customers to pick up items and place them on the cashier's table for scanning, followed by a notification of the total payment amount, and finally, the customer making the payment either in cash or through e-wallets. This multi-step payment process often results in long queues, leading to customer dissatisfaction and extended waiting times.

2. Related Work

2.1 Management Information System

Management Information System (MIS) is a person-oriented system that collects, records, store, analyze, moves, add, operations, updates, and retrieve information using computer hardware, software, and network equipment. In small and medium businesses, top management was limited in decision-making, the management decisions can be improved more effectively with the reports on operations for every level of management in a company [2]. Management information systems are centrally coordinated to ensure that their data processing is developed, and operated in a planned and organized manner to ensure that information is transmitted as needed among the sub-systems. An organization can achieve a competition advantage when an organization can do things and decision effectively than other competitors [3]. Therefore, provides precise information promptly that can be used by various levels of management to make the right decisions.

2.2 Internet of Things

The concept of the Internet of Things may be summed up as the interconnection of numerous physical and digital items with the Internet. It also can define IoT systems serving various types of functions such include services for data dissemination, device detection, device control, and modelling [4]. The physical devices and sensors include Wi-Fi connections, Bluetooth connections, and Radio-Frequency Identification (RFID). The device only emits data to establish an internet connection and transfers the data intended for the cloud. Each device in the system has a unique identification that serves as its identity (UID) which ensures the data information reached the devices [5]. IoT platforms are created to determine which data is important and which may be deleted in order to find trends, offer suggestions, and foresee issues.

2.3 Study of existing system

For the proposed system, three systems were chosen for comparison to the proposed system. The existing system studied including Scan & Shop Malaysia, Mydin Online and Jaya Grocer. The three systems are studied and compared to the features of the proposed system. Table 1 shows what are the similarities and the differences of existing system with the proposed system.

Table 1: Comparison between existing application and proposed system

No	Feature	Scan & Pay Malaysia	Mydin Online	Jaya Grocer	Proposed System
1	Login and Logout	Available	Available	Available	Available
2	Add to shopping cart	Available	Available	Available	Available
3	Item discount	Available	Available	Available	Available
4	Update profile information	Available	Unavailable	Unavailable	Available

No	Feature	Scan & Pay Malaysia	Mydin Online	Jaya Grocer	Proposed System
5	Scan barcode of item	Available	Available	Available	Available
6	Language	English	English, Malay	English	English
7	Membership	Available	Available	Available	Available
8	Free delivery	Unavailable	Unavailable	Unavailable	Unavailable
9	Payment method	Unsupported	Online payment, Credit/Debit Card	Credit/Debit Card	Cash, Credit/Debit Card
10	Payment record	Unavailable	Available	Available	Available

3. Methodology/Framework

The waterfall model is used in developing the system. Waterfall methodology is one of the application development models that emphasize a sequential, linear process of project management which emphasizes that a logical progression of steps be taken throughout the software development life cycle (SDLC). Waterfall testing is a specific type of software testing where each testing phase follows a sequential order with its own set of steps and actions. Testing is categorized and conducted in a systematic manner, progressing to the next level only after the previous level has been completed and tested [6]. Additionally, the waterfall model outlines all phases and activities, providing a structured approach to project execution [7]. Waterfall methodology helps in determining the end goal early. When projects have clear goals, it allows everyone to know what the planned outcome is from the start of the project. Next, help the manage the project which each phase has well-defined goals and deliverables. By analyzing the output of each stage, it helps to provide high visibility. The waterfall methodology is suitable for the project because it is easy to understand and manage. Figure 1 shows the phase of Waterfall Methodology implemented in proposed application.

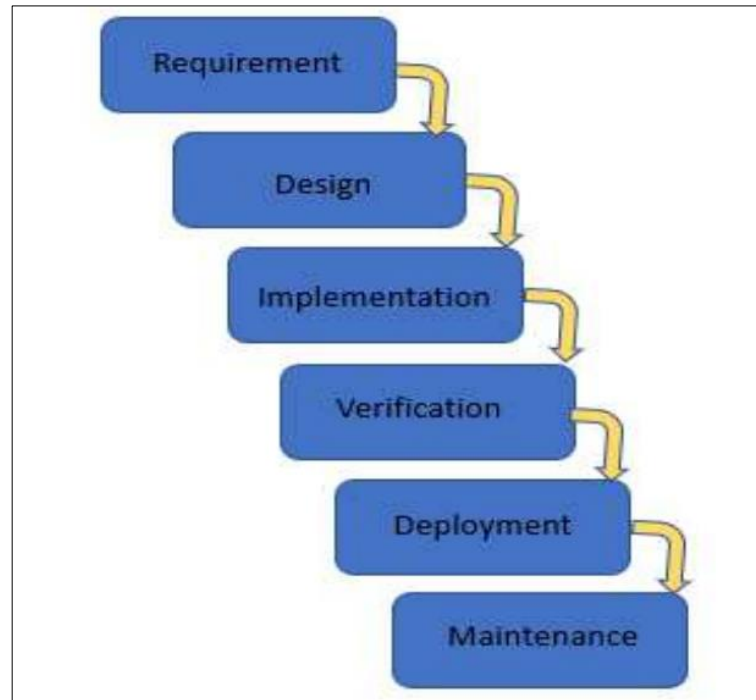


Figure 1: Phase of Waterfall Methodology implemented in proposed application

3.1 Requirement Analysis Phase

The process of identifying the functionalities and features to our proposed application can enable effectively design and implement an efficient structure by conducting a thorough analysis of these requirements. The complete proposed system functional and non-functional requirement are identified and presented in Table 2 and Table 3 respectively.

Table 2: Functional Requirement

No	Requirement	Users	Functionalities
1	Login	Customers	Application should allow user to register as a new user to the application and alert users for any invalid input
2	Register	Customers and Staff	Application should allow users to login system by email address that have registered
3	Reset Password	Customers	Application should allow user to reset their password by email
4	Profile Management	Customers	Application should allow user to Create, Read, Update and Delete their profile information
5	Scan Item Barcode	Customers	Application should allow user to scan the barcode of items to check the item’s information
6	Add Item to Shopping Cart	Customers	Application should allow user to add item into shopping cart after scan the barcode of items

No	Requirement	Users	Functionalities
7	Payment Method	Customers	Applications should allow user to make payment by using online payment
8	Logout	Customers and Staff	Applications should allow user to logout from the system

Table 3: Non-Functional Requirement

No	Non-Functional Requirement	Functionalities
1	Operational Requirements	Application should perform fluently at what specification of hardware, software, and network requirements
2	Performance Requirements	Application should be run regardless the total and peak number of users and the volume of
3	Security Requirements	Application should have limitation function that only allow who can access what type of data
4	Usability Requirements	Application should be user friendly and easy to use

3.2 Design Phase

The system's required features and module were determined during the design phase. The design has covered the of system architecture with numerous associated diagrams such as UML diagrams (UML), Use Case Diagram, Sequence Diagram, Class Diagram and Entity Relationship Diagram (ERD), which contains all of the proposed system's function modules, during this phase.

3.2.1 UML Diagram

Unified Modelling Language (UML) is a is a standard that is mostly used for developing object-oriented systems. It is used for specifying, visualizing, building, and documenting the software system. Use-case diagrams offer a graphical depiction of the system's actors, their interactions with the system's functions, and how they engage with one another. On the other hand, class diagrams showcase the relationships, attributes, and methods among classes within the system [8]. By offering visual models, UML diagrams make it easier to determine the requirements and scopes of systems and applications. The goal of UML is to establish a standard way to visualize how a system was built.

3.2.2 Use Case Diagram

A use case diagram is a visual representation of the interactions between the user and module in this system. The customer and admin are the users of the proposed system. The use case diagram is used to show the use case model of Scan and Pay mobile application and define the interaction between user and the proposed application.

3.2.3 Sequence Diagram

The sequence diagram is a type of interactions between the objects in a system in sequential order. In sequence diagram, it uses the vertical axis of the diagram to represent time, describe the order of the

interaction. It shows a clear sequence of messages exchanged, as well as the occurrence specifications on the lifelines. Figure 2 shows the register sequence diagram module. After user go to login page, new user can register new account by clicking the signup button. User is redirected to register page, then user need to provide required information to register new account. The information of new user is stored inside database. The page is redirect to login page and user can login the system by email and password that used in register.

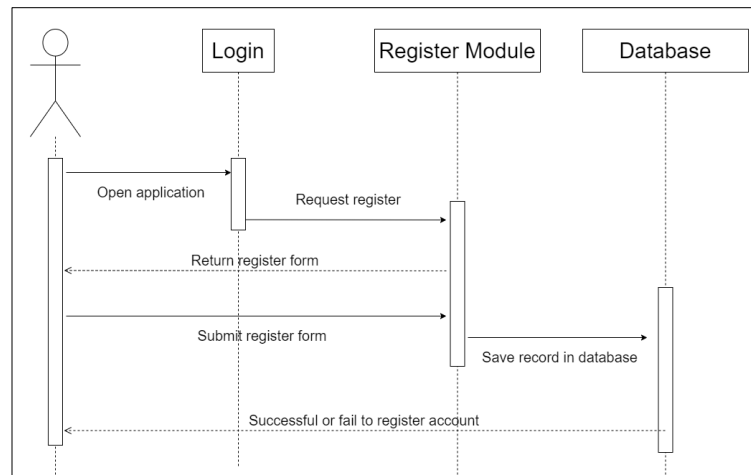


Figure 2: Login sequence diagram

3.2.4 Class Diagram

A class diagram is a static structural diagram that shows the classes, their properties, operations (or methods), and object relationships to represent the organization of a system. The class diagram can provide a better understand the general overview of the schematics of applications.

3.2.5 Database Design

A database's conceptual design is used to construct a database schema, and it is utilized in an entity relational model to develop entities and attributes. Database design is the process of defining a specific practical application environment, building an appropriate database model, and establishing a database system. Moreover, a database is an integrated collection of data that is stored, managed and centrally controlled.

3.3 Implementation Phase

In this phase, the proposed system is built using all data that gathered at previous phase. Visual Studio Code, use flutter dart as the programming language, Firebase database, storage and real-time is used to act as database for the system.

4.4 Testing Phase

The test plan includes a thorough understanding of the workflow and operations of the system and details how each is evaluates to see whether they perform as intended, to detect problems, and to establish the system's true limitations.

4. Results and Discussion

In this section also discuss the user interface in the proposed system. The programing language used to develop the system are flutter dart while Firebase database, storage and real-time is used as a database.

4.1 System Implementation

Figure 3 shows the interface of login page. Users need to fill in their email and password that have registered in the registration form to login their account. After user press, login button, the user's information is checked by using Firebase database where the users account information is stored. User go to their respective page based on their role. Figure 4 shows the interface of the register page. User must fill in the information in the form before can register the account.

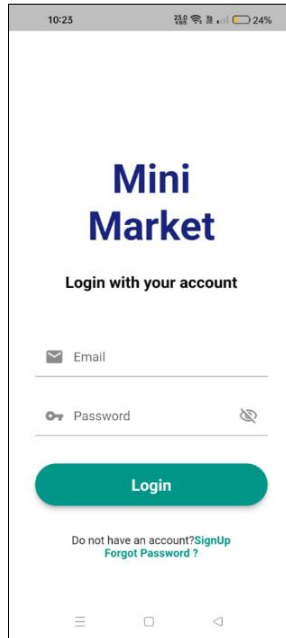


Figure 3: Login page

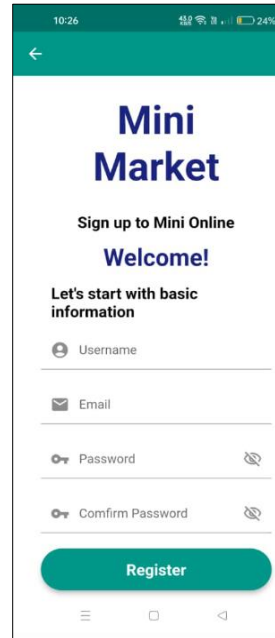


Figure 4: Registration page for customer

Figure 5 shows the interface of the home page. For customers, they can view the feature brand product that selling and the picture of items and the items' name. Figure 6 shows interface of scan item barcode page. It allows customers scan the barcode of item. If the barcode is not inside the database, an alert dialog is pop out in the middle of page to inform the customer that the scanned barcode was not found in the database.

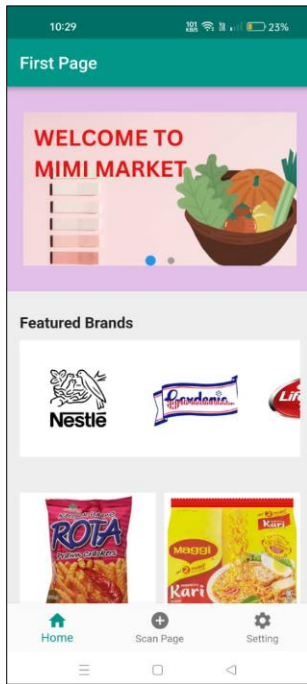


Figure 5: Home page for customer

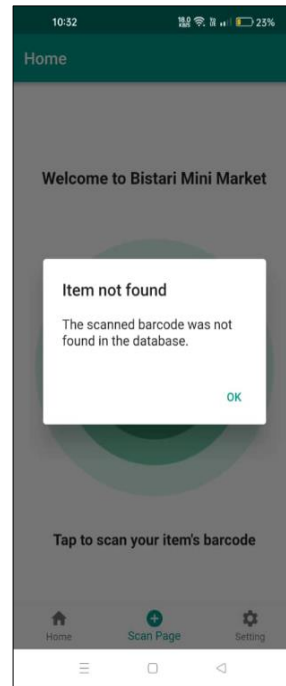


Figure 6: Scanner page for customer

Figure 7 shows the interface of item information page for customer. The information of item displays is item name, quantity of item, price of item, discount price and total price. Figure 8 shows the interface of Shopping Cart page for customer. It displays the quantity, name and total price of each item in the list of items.

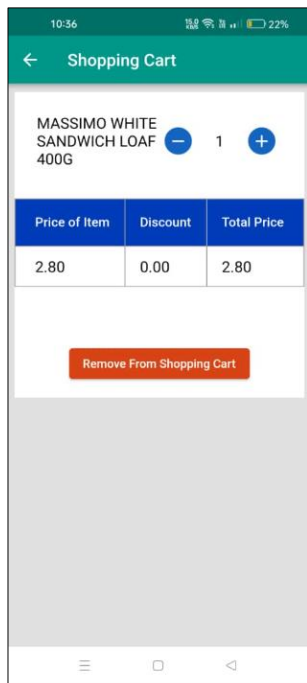


Figure 7: Item Information page for customer

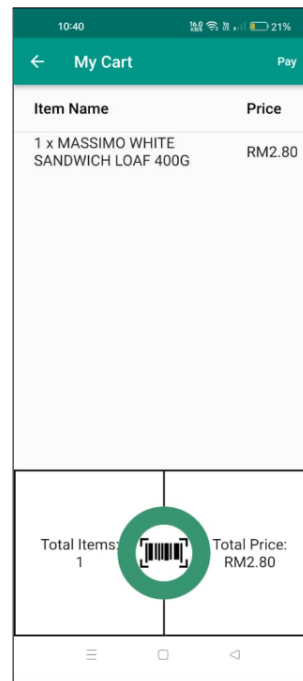


Figure 8: Shopping Cart page for customer

Figure 9 shows the interface of admin manage item page. It is used to update and manage the item's information. It includes a search bar that allows the admin to search for items based on item's barcode.

Figure 10 shows the interface of admin update item page. It used to update the item's information. The displayed information includes the item's, barcode, name, original price, discount price, final price and quantity.



Figure 9: Admin Manage Item page for admin

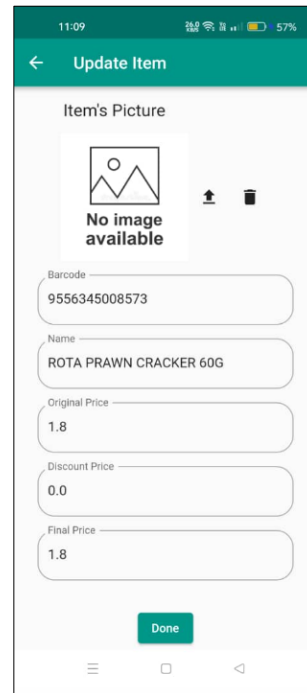


Figure 10: Admin Update Item page for admin

Figure 11 shows the interface of admin check customer shopping page. It can scan the QR code from customer to identify customer's shopping cart. Figure 12 shows the interface of admin check payment status page is used to check the payment status of orders by scanning a QR code. Users can simply click the "Scan QR Code" button to initiate the scanning process. Upon scanning the QR code, the app retrieves the corresponding payment status from the database. If a record with the scanned data exists, the app displays an alert dialog in the center of the screen.

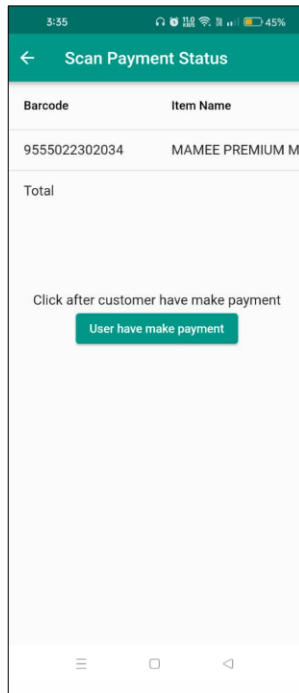


Figure 11: Admin Check Customer Shopping Cart page for admin

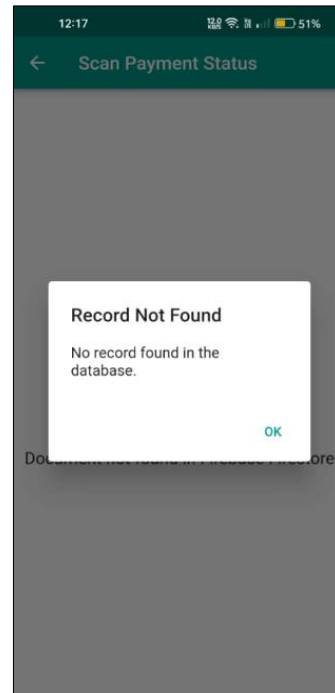


Figure 12: Admin Check Payment Status page for admin

4.2 System Testing

Testing cases are designed to systematically assess the system's behavior, detect potential defects or issues, and verify its proper functionality. We can improve the system's quality, fix any issues found, and make sure it functions as intended by conducting thorough testing.

4.2.1 Test Case

It used to test to determine whether the system requirement is met or not. This helps to monitor the requirements and ensure that all of them have been tested. Table 3 shows test plan for Login Page and Table 4 shows test plan for Registration Page.

Table 3: Test plan for Login Page

No	Test Case	Expected Result	Actual Result
1	Correct and valid email and password	Successful login and direct to homepage	Pass
2	Incorrect and valid email and password	Unsuccessful login and direct to login page	Pass
3	Able to reset password if forgot password	User able to reset the password	Pass

Table 4: Test plan for Registration Page

No	Test Case	Expected Result	Actual Result
1	Correct and valid registration data	Successful registration and direct to login page	Pass
2	Incorrect and valid registration data	Error message is shown up and request user reregistration again	Pass
3	Register using password less than 6 number	Error message is shown up and request user insert password again	Pass
4	Input password and confirm password is different	Error message is shown up and request user insert password again	Pass

4.2.2 User Acceptance Testing

The user acceptance test was conducted afterward as a short survey using Google Form. In this survey, 15 users were chosen to take part in the test. The user acceptance test was conducted afterward as a short survey using Google Form. The test is rate on scale of 1 to 5. While 1 is Poor, 5 is excellent. Figure shows customer’s feature of application evaluation’s result. Figure 13 shows customer’s feature of application evaluation’s result. Figure 14 shows the administrator’s feature of application evaluation’s result.

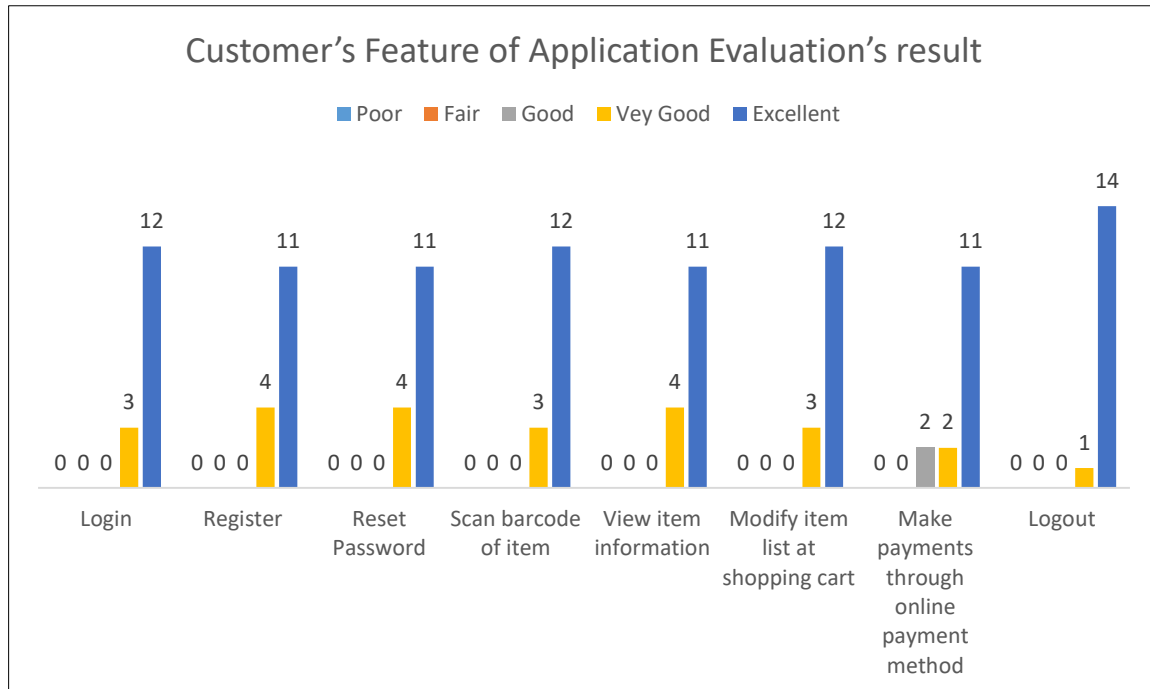


Figure 13: Customer’s Feature of Application Evaluation’s result in bar chart

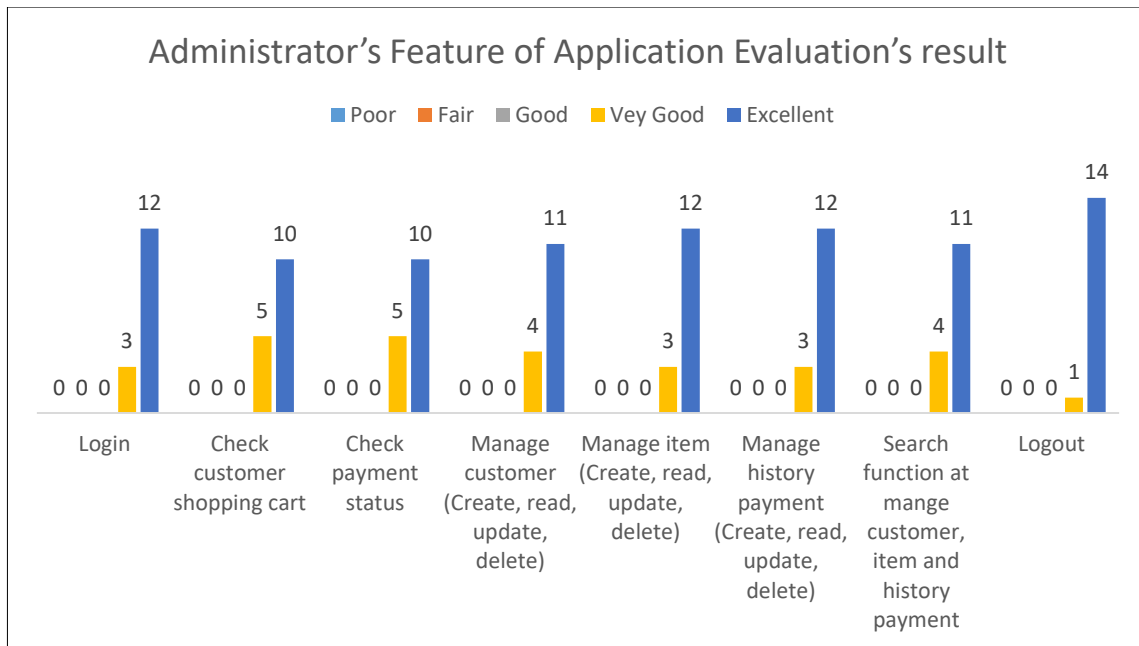


Figure 14: Administrator's Feature of Application Evaluation's result in bar chart

5. Conclusion

In conclusion, the system that was developed effectively dealt with the problems the mini market came across and greatly improved the shopping experience. The system has improved customer satisfaction by enabling customers to scan items for accurate pricing, offering convenience with mobile payments. Despite the system's many benefits, but still has limitation of the system, such as its reliance on smartphone ownership and internet connectivity. However, the system can continue to develop and meet changing demands from consumers by considering into consideration future works such as alternative login options, support for online banking and visitor mode.

Acknowledgment

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Appendix A

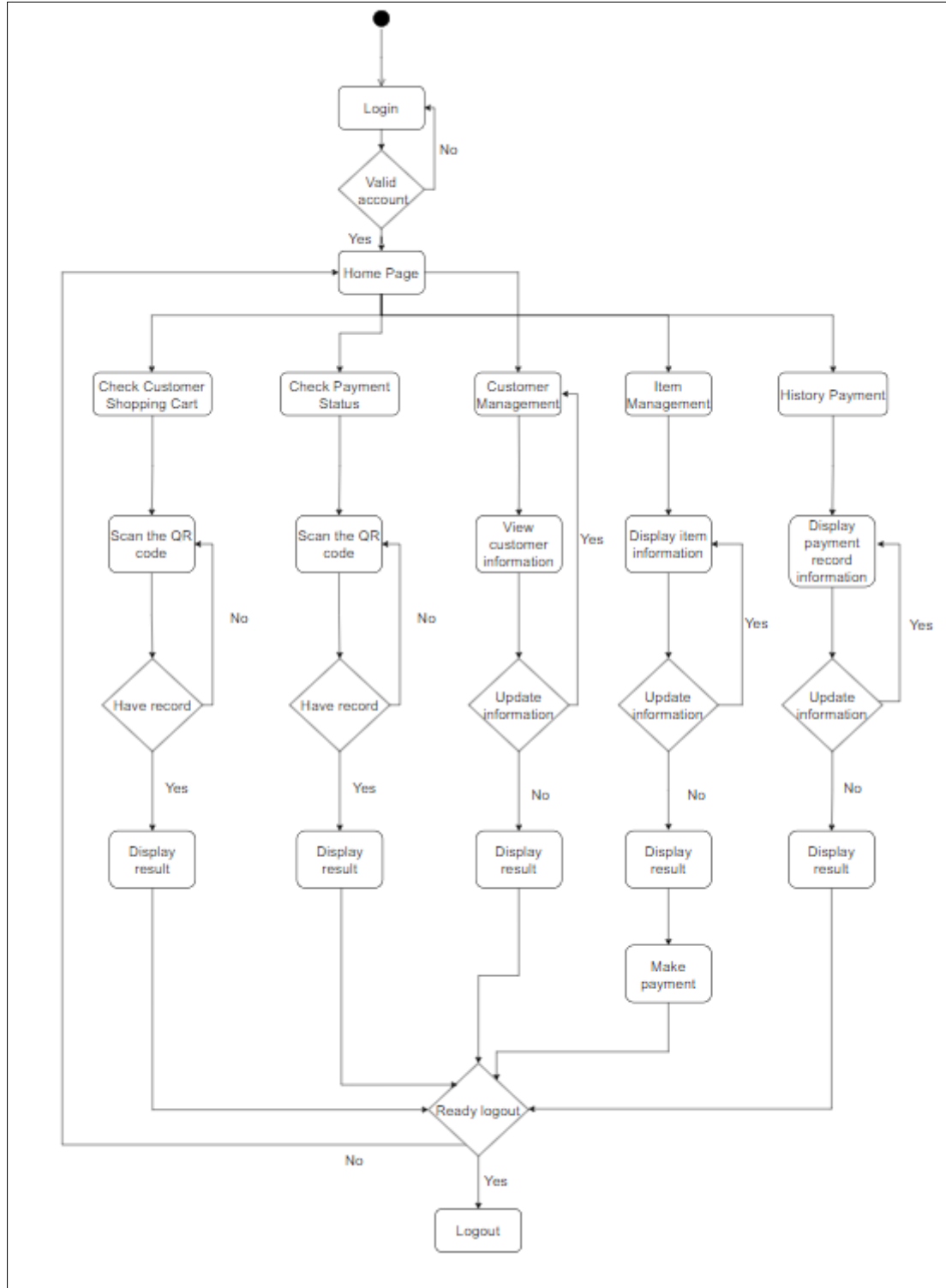


Figure 15: Activity diagram for admin

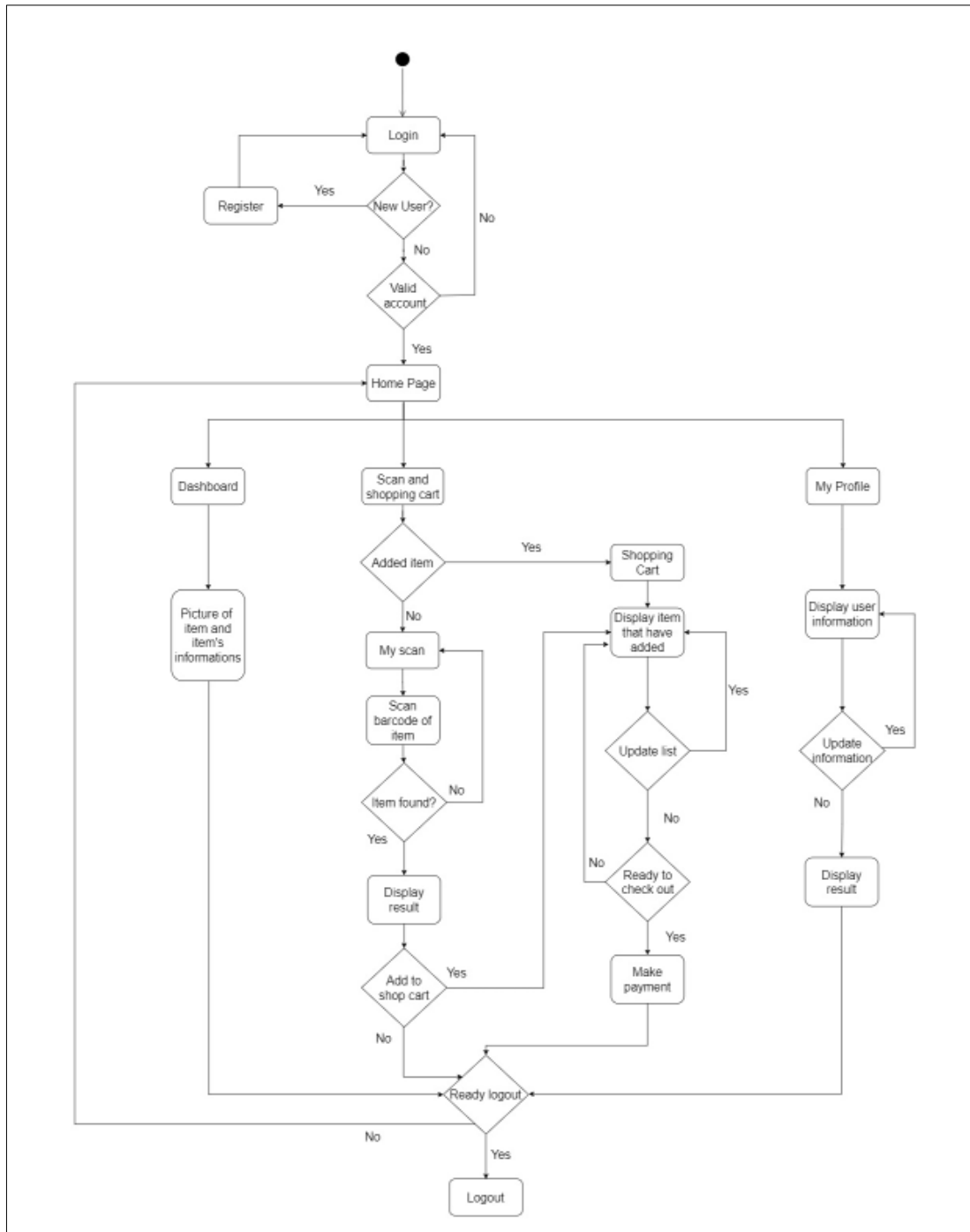


Figure 16: Activity diagram of customer

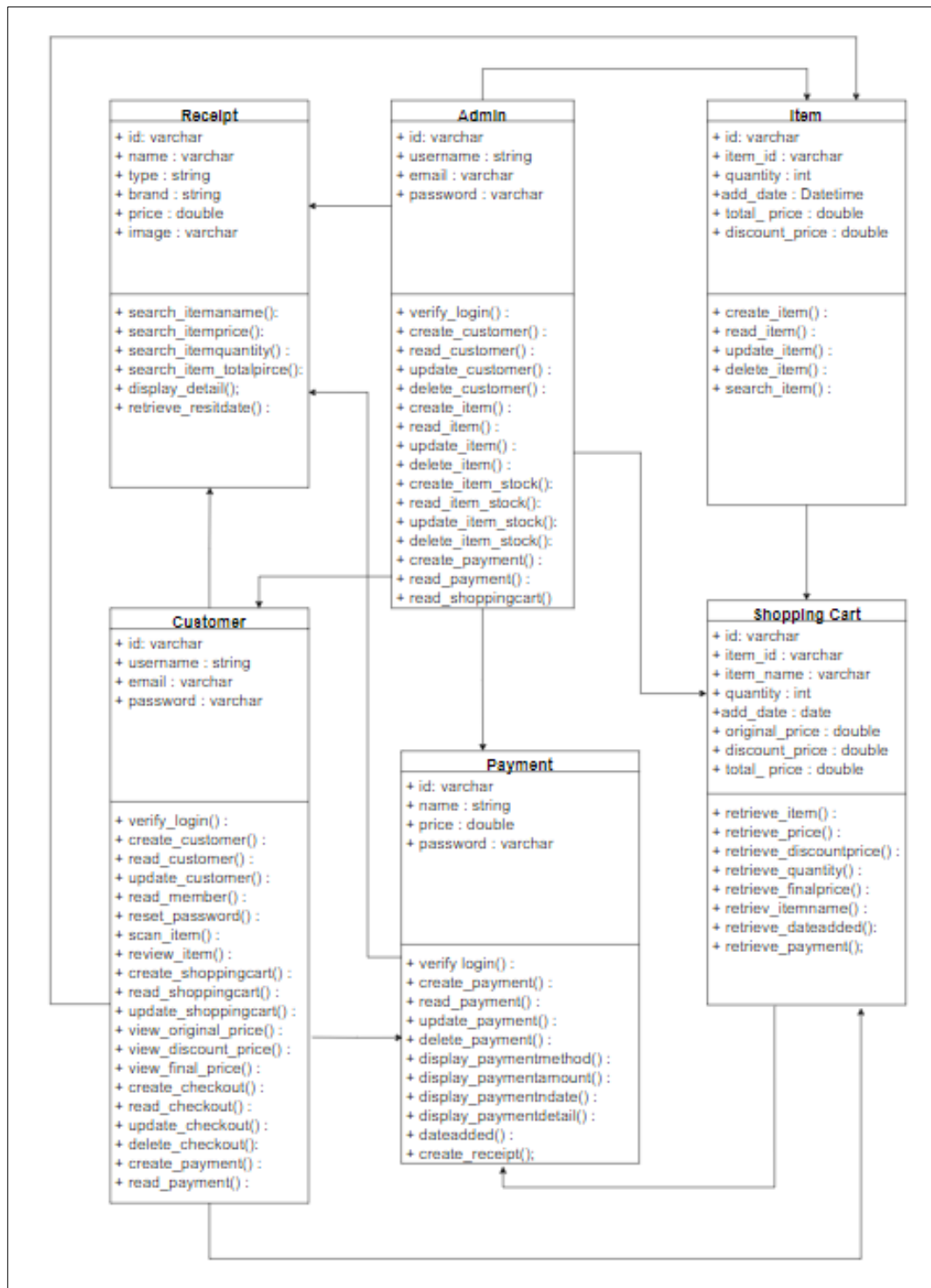


Figure 17: Entity Relationship Diagram of the proposed system

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