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Digitising Hardware Shop Management to Enhance Business Operation

Ong Jian Yao¹, Dr. Yana Mazwin Mohmad Hassim^{1*}

¹Faculty of Computer Science and Information Technology,
University Tun Hussein Onn Malaysia, 86400, Batu Pahat, Johor, Malaysia

*Corresponding Author Designation

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Abstract: Rong Fatt hardware shop is a local hardware shop located in Batu Pahat, Johor that sells various type of hardware such as polyvinyl chloride (PVC) pipe, screwdriver, wrench, hinge and plywood to the customers. The purpose of this project is to develop a web based inventory management system for Rong Fatt hardware shop. The hardware shop is currently facing some problem as the shop is still using log books to manually record all the stocks and transactions. This method is quite inefficient as it takes up a lot of time to complete all the manual recording. Several modules such as product information, stock managing, report generating, register and login and notification are introduced for the system. Waterfall model is used as the software development method for this project. The system is built using Visual Studio Code text editor and MySQL as the database. To design a complete system, the functional requirement, non-functional requirement and user requirement are well elicited and defined from the stakeholders. Through this system, Rong Fatt hardware shop can manage their stocks systematically and also place orders on registered supplier easier. Testing is also conducted to ensure there is no critical bugs or error that can cripple the system. The development of this system is able to assist Rong Fatt hardware shop in daily business operation and help them getting familiar with computerised inventory system.

Keywords: Hardware Shop, Inventory System, Manual Recording, Manage Stocks

1. Introduction

Rong Fatt hardware shop is a local hardware shop located in Batu Pahat, Johor. The business was started back in 2018 in a rather new shop loft. This hardware shop provides various type of hardware to the customers. The owner sells products such as PVC pipe, screwdriver, wrench, hinge, plywood and many more. The owner strives to sell his merchandise at a more reasonable price so that he can attract more regular customers. To date, the owner does not implement any inventory software on his daily business operation as he is not very fond of new technologies. The owner is satisfied with the traditional manual recording method he is using currently. As time goes on, the owner is selling more and more

*Corresponding author: yana@uthm.edu.my

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product. This has made the owner hard to record the stock quantity and thus cause him to suffer some profit loss.

Currently, the shop owner is facing some problems on organizing the stock list and recording the daily, monthly and year stock flow. The owner and his employee recorded the stocks status manually using a log book. There are several log books prepared by the owner to record each type of hardware according to their category and this method is quite inefficient as it takes up quite a lot of time to complete the recording. As for sales, the owner is currently using a small piece of paper to record any transaction made with the customer. He does not provide any receipt for the customers and he sums up all the earnings after the shop closing hour. The owner then records the daily profit in a book which only can be viewed by himself. The owner handles all the transactions and the employee cannot interfere in this matter. The owner also encounters some problems on ordering the stocks with the suppliers. Sometimes the owner cannot get in touch with the supplier and it causes the restock to be delayed. The supplier does not receive any form of notification such as short message service (SMS) or email whenever the owner places an order. Therefore, the supplier might not notice there is an order being placed and thus causing the delivery to be delayed. The objective of this project is to design a web based inventory system for Rong Fatt hardware shop and to test the developed system. To create an inventory system that will solve the client's existing problems, this project covers the inventory management system of the shop that aims to replace the existing manual recording system that still rely on file-based system to this date. The system will focus on product information module, stock managing module, report generating module, register and login module and notification module.

By gathering information from the stakeholders, charts and diagrams can be plotted in this project to aid the description of the current situations in the business visually. It can be used by the stakeholders to improve the current manual filing system or facilitate the process of shifting from manual to a computerized, web-based system. The web-based system designed in this project can be applied in an actual business environment to allow the management and storage of records at a centralized place. The web-based system will deliver the solutions or functionalities that meet the requirements stated in the analysis phase.

This inventory management system can provide convenience for the owner of Rong Fatt hardware shop to check, insert and edit data as well as information related to business operations such as the stock availability, stock prices and daily income. This management system can simplify the processes of storing information related to business and it provides even greater quality of services in terms of security, scalability and reliability than manual recording. This system can record stock flow and invoices received throughout business operations then generate business monthly reports with specified information as per the owner's request.

2. Related Work

2.1 Zoho Inventory: Online Inventory Software

Zoho Inventory was founded in 1996 with the name called AdventNet Inc. which provided network management services. The founders are Sridhar Vembu and Tony Thomas in Pleasanton, California, and has a presence in seven locations with its global headquarters in Chennai and corporate headquarters in Pleasanton. Right now, the organisation focuses on web-based business tools and information technology, such as an online office suite, Internet of things management platform, and a suite of IT management software [1].

This system provides centralized inventory feature where the user can update their inventory quantities across all of the selling channels automatically whenever a sale has been made. Product listing is also included in this system which helps to keep the inventory organised with important details such as the price, cost and availability. Variants of an item can be created based on the custom attributes and it will keep them organised. Besides, Zoho inventory also has automatic re-ordering system. This

feature will help the client to never lose out on another sale due to stock-outs in any of the channels. Re-order points, reminders and preferred vendors for the products can be set prevent untimely stock-outs. It also provides barcode inventory management which the client can scan barcodes of items and the fields will be auto-populated every time an invoice, sales or purchase order is created. This system also has serial number tacking and batch and expiry date tracking which is important as it helps to track the items.

2.2 Brahmin Solution: Inventory Management System

Founded in 1 June 2017 by Brahm Meka, Brahmin Solution is a cloud-based inventory platform that is designed for retailers, wholesalers, and manufacturers. It is a rather new and small company located at New Jersey, United States of America. They strive to provide a comprehensive view and complete control of business operations so that it can grow efficiently and intelligently. Brahmin Solutions integrates with top sales channels such as Shopify, Magento, and Amazon as well as add-ons including Quickbooks, ShipStation, Shipttheory, Authorize.net, Stripe and more [2].

The Brahmin Solution inventory management system support purchase function in which the system will automatically place order on sold out inventory from suppliers, track the purchase costs incurred from ordering stock, receive purchase orders and track delivery items from supplier. It also has a feature called inventory control and optimise which serve as inventory control of raw and finished goods. The feature also helps in setting minimum and maximum point or have the system set automatically as per the demand forecasting. Another feature introduced in this system is sales order fulfilment. Through this feature, the client will be able to get real-time order management overview, make to order, backorder or fulfil from available stock, pick and pack inventory using barcode scanners.

2.3 Odoo: Modern Online Warehouse Management Software

In 2005, Fabien Pinckaers, the founder and the CEO of Odoo, started to work on his first software product, TinyERP. Then, the name was changed to OpenERP after three years. The company started to evolve quickly and OpenERP houses a 100+ employee company in 2010. Odoo is a suite of business management software tools including CRM, e-commerce, billing, accounting, manufacturing, warehouse, project management, and inventory management. Odoo is a suite of open source business apps that cover all your company needs: CRM, eCommerce, accounting, inventory, point of sale, project management and many more. [3] This system offers a tracking feature which track every stock move from purchase to warehouse bin to sales order. Trace lots or serials upstream or downstream from anywhere in your supply chain. It also provides a report generating module which helps the client to make smarter decisions with real-time dynamic reports that can be saved and shared with anybody.

Table 1: Comparison of features between existing system and developed system

Features/System	Zoho Inventory	Brahmin Solution	Odoo	Rong Fatt Hardware Inventory management system
Register and login page	Yes	Yes	Yes	Yes
Inventory management	Yes	Yes	Yes	Yes
Auto reorder	Yes	Yes	No	No
Product listing	Yes	Yes	Yes	Yes
Receive purchase order	Yes	Yes	Yes	Yes
Stock sales reporting	Yes	Yes	Yes (with charts)	Yes
Database required	Yes	Yes	Yes	Yes

Bar code/QR code item tracking	No	Yes	Yes	No
Editable product information	Yes	Yes	Yes	Yes

Table 1: (cont)

Features/System	Zoho Inventory	Brahmin Solution	Odoo	Rong Fatt Hardware Inventory management system
Responsive web Supported platform	Yes Web, Android, IOS	Yes Web, Android, IOS	Yes Web, Android, IOS	Yes Web only
Subscription	Yes (free to register)	Yes (based on subscription plan)	Yes (based on subscription plan)	No

Table 1 is the comparison between the existing system and the system that is going to be developed in this project. Most of the features such as register, login, inventory, product listing, stock sales reporting and editable product information are available for all the system. However, auto reorder and bar code item tracking will not be included in this project and the developed system is only available for web platform.

2.4 Web Based System

A web-based system is an application that can be accessed through Hypertext Transfer Protocol (HTTP). Web-based is generally a term that used to describe applications that is capable of running in a web browser. It can also be used to describe applications that have a very small component of the solution loaded on the client PC. The host server for a web-based system can be a local server or it could be accessed via the Internet. In the past, web-based system has limited amount of function [4]. However, the potential of web-based system has increased due to advancement in technology, security and internet speeds. Today, web-based system has been used in various kind of industry and business as it offers some significant advantages over native, client-based software. Moreover, it is also popular because of its low development costs nature. Although the developed system needs to be tested in different web browser but there is no need to test it on different operating systems.

2.5 Inventory Management System

An inventory management system is the combination of technology (hardware and software) and processes and procedures that oversee the monitoring and maintenance of stocked products, whether those products are company assets, raw materials and supplies, or finished products ready to be sent to vendors or end consumers [5]. Most of the inventory system provide a central database and point of reference for all inventory, coupled with the ability to analyse data, generate reports, forecast future demand, and more. The inventory system is important as it helps to keep track of the stock flow throughout the supply chain of the business. Therefore, inventory management system is generally encouraged among small medium enterprise to be integrated with their business process as it will help to improve the overall daily operation and it brings many benefits to the user. This system is capable of providing computerized services to keep track of stocks in precise way so that human error that lead to costly profit loss can be avoided

3. Methodology

The software development method selected for this project is traditional waterfall model. It was introduced in 1970 by Winston W. Royce [6]. In this approach, the whole process of software development is divided into several different phases. In this model, the outcome or the output of the previous phase acts as the input for the next phase sequentially [7]. This model is chosen because the user requirement is well defined and there will not be any drastic changes in the future. Another reason is that it is hard to conduct any face-to-face interviews nowadays due to the pandemic outbreak and the client can only be reached through phone calls. Therefore, every requirement is determined and confirmed first before proceeding to the next phase.

3.1 Requirement Definition Phase

During the requirement definition phase, the requirement elicitation and analysis are carried out. The purpose of the activity is to find out what are the requirements of the stakeholders. The information regarding the requirements are gathered through a series of interview with the stakeholders. Questionnaire that aims to gather enough valid data for requirement of the system are also handed out to the stakeholders. Interviews with stakeholders such as the owner and employees are also conducted for better elicit the requirements. There is also another sub activity which is requirements specification that helps to define the requirements in detail. The last one is requirements specification in which the activity of checking the validity of the requirements will be conducted. The documented requirements are presented to the stakeholders to gather their thoughts and opinions whether they accept the requirements or there is a need to add new requirements. The outputs of this phase are Gantt chart, flowchart, DFD and ERD.

3.2 Design Phase

There are several sub activities will be done in this phase. One of them is architectural design. The purpose for this activity is to identify the overall structure of the system, the principal components, their relationship and how they are distributed [3]. There is also database design where the design of the system data structures is carried out and how it is represented in a database. There is also interface design where the interfaces between system components are defined. The outputs of this phase are interface design and data dictionary.

3.3 Implementation and Unit Testing Phase

In this phase, the system is implemented by developing a program. The implementation process can only start after the design phase is completed because design and implementation are interleaved activities for most types of system [3]. Programming is an individual activity with no standard process. The system is divided and developed in small part of programs called units, which are integrated in the next phase. After that, unit testing is carried out in which each unit is developed and tested for its functionality. The output of this phase is a functional system.

3.4 Integration and System Testing Phase

During integration and system testing phase, the tested units are integrated in order to carry out system testing. This testing involves executing the system with test cases that are derived from the specification of the real data to be processed by the system [3]. Besides that, acceptance testing will also be implemented to check whether the system fulfills the customers' requirements and expectation. The outputs of this phase are result of conducted test cases and user acceptance testing.

3.5 Operation and Maintenance Phase

Once the test cases are done, the product is deployed to the client environment. Lastly, in maintenance phase, if issues are to arise in the client environment, updates will be released to fix those issues.

Maintenance is done to deliver these changes in the client's environment. This is conducted to ensure that the deployed system always perform at optimum level.

4. Analysis and Design

The data flow diagrams and context diagram will be illustrated according to the requirement elicited. The AS-IS diagram and TO-BE diagram of the business process will also be included in this topic. The design of the entity relationship diagram (ERD) will be shown in this topic along with the schema table. The conceptual design of the system interface is also illustrated.

4.1 System Requirement Analysis

The functional requirement, non-functional requirement and the user requirement are tabulated after elicited from the stakeholders during the requirement definition phase.

4.2 Functional Requirement

Table 3 shows the functional requirement of the system. The requirements are elicited from the users.

Table 3: Functional requirement of the developed system

No.	Modules	Functionalities
1	Register Module	<ul style="list-style-type: none"> The system should allow user to register new account.
2	Login Module	<ul style="list-style-type: none"> The system should allow the users to login into the system using registered id and password. The system should provide a field for user to enter their login credential.
3	Information Module	<ul style="list-style-type: none"> The system should allow user to register new item. The system should allow user to update the information of the selected product. The system should allow the user to view the description of the product.
4	Stock Managing Module	<ul style="list-style-type: none"> The system should allow user to view, edit and delete selected stock information. The system should allow user to sort the items according to their category.
5	Report Generating Module	<ul style="list-style-type: none"> The system should generate a report on daily, monthly and yearly sales of the product. The system should allow the user to view any selected report.
6	Notification Module	<ul style="list-style-type: none"> The system should notify the user whenever the stock quantity is low. The system should notify the supplier whenever an order is placed.

4.3 Non-Functional Requirement

Table 4 shows the non-functional requirement of the system

Table 4: Non-functional requirement of the developed system

No.	Requirements	Description
1	Performance	<ul style="list-style-type: none"> The system should can be access anytime.
2	Operational	<ul style="list-style-type: none"> The system should be able to operate on any web browser available.
3	Security	<ul style="list-style-type: none"> Only owner can view and print report. Users can only access their account registered login credential.
4	Usability	<ul style="list-style-type: none"> The system should be user friendly. The system should be easy to navigate. The way of using the system should be easy to learn.

4.3 User Requirement

Table 5 shows the user requirement of the system. There are total of 14 requirements.

Table 5: User requirement of the developed system

No.	User Requirement
1	The user should be able to login to system with registered id and password.
2	The owner should be able to view the employee details.
3	The owner should be able to insert new stock in the system.
4	The owner should be able to view the quantity and information of selected stock.
5	The owner should be able to receive a notification whenever the stock quantity hit a certain pre-set level.
6	The owner should be able to place order on the items he wants to restock.
7	The owner can view the daily, monthly and yearly report.
8	The employee can edit the stock description.
9	The employee can add new stock to the system.
10	The employee can view stock quantity.
11	The supplier can view the order list.
12	The supplier should be able update the status of the order placed by owner.
13	The supplier should have the option to accept or reject the order.
14	The supplier should be able to receive a notification whenever an order is placed.

4.4 System Analysis

4.4.1 Data Flow Diagram (DFD)

There are total of eight activities in this diagram. The register process which allows the owner to register new users. The login process allows the user to access the system with the correct ID and password. Then, there is manage stock process that allows the user to edit the quantity of the selected items. In order to allow the user to enter new information about a certain product, the insert new stock information process is introduced. The owner will be able to view the report of the stock transaction through the generate report process. Besides, the order stock process will help the restock the items he needed by placing order to the supplier. Lastly, there is also notify order process that helps to notify the supplier whenever an order is received and the owner about the status of the order he placed. The DFD level 0 is shown as Figure 7 in Appendix A.

Figure 2 shows the ERD design for the system. There are total of eight entities that define the database of the system. The owner, employee and supplier entity are responsible for storing the personal information of the registered users. The account entity is used for storing registered account information. The stock entity is responsible for storing the products' data. Then, the order entity will store all the order placed, category entity will store category created, flow entity will store the transaction of the stocks.

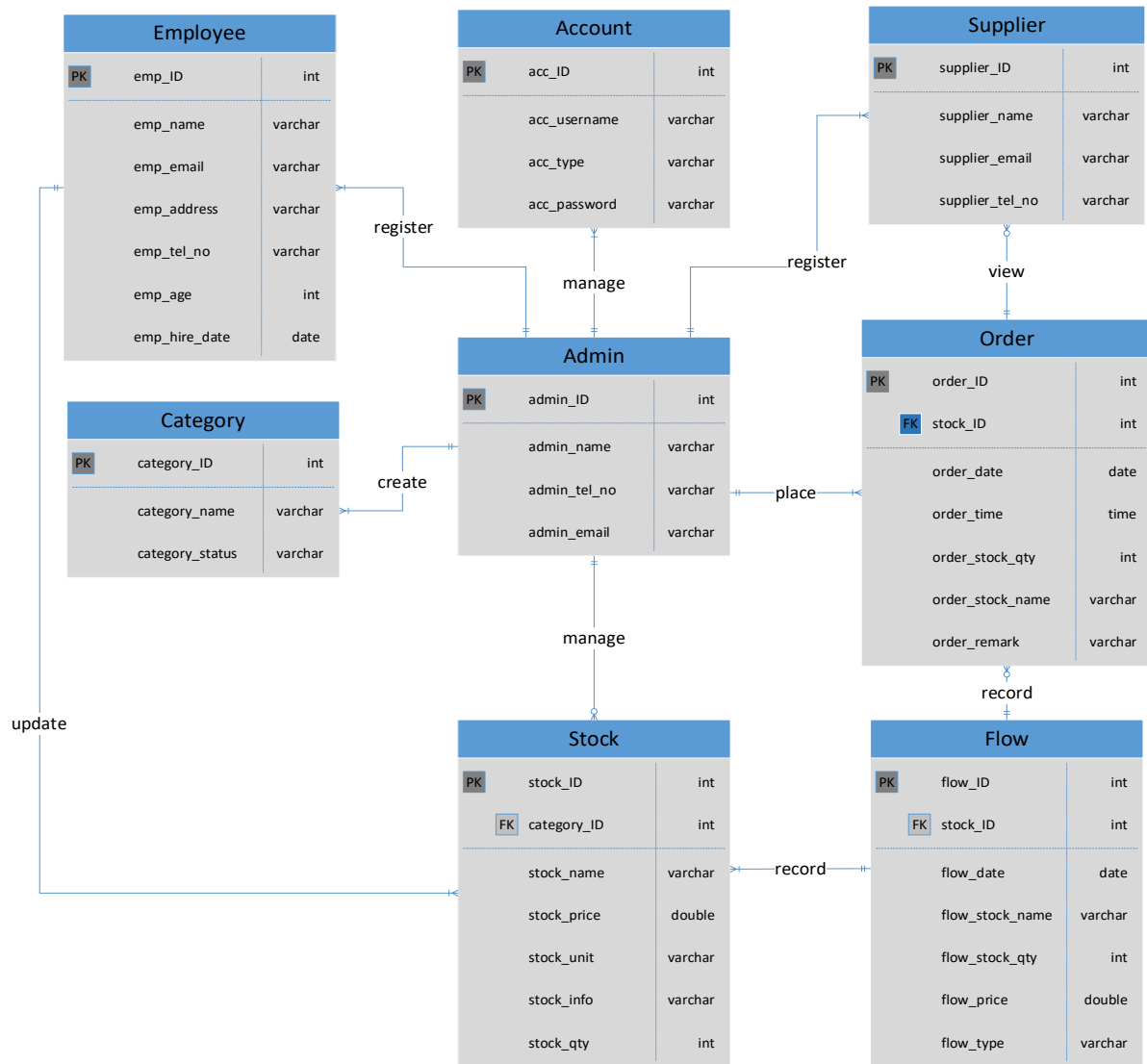


Figure 1: ERD

4.5 System Design

In this segment, the swim lane diagrams are included to show the AS-IS process and the TO-BE process after implementing the system. The interface of the system is also shown.

4.5.1 Manage Stock Process

Figure 3 shows the current stock managing process of Rong Fatt Hardware while Figure 4 shows the TO-BE swim lane diagram for stock managing process.

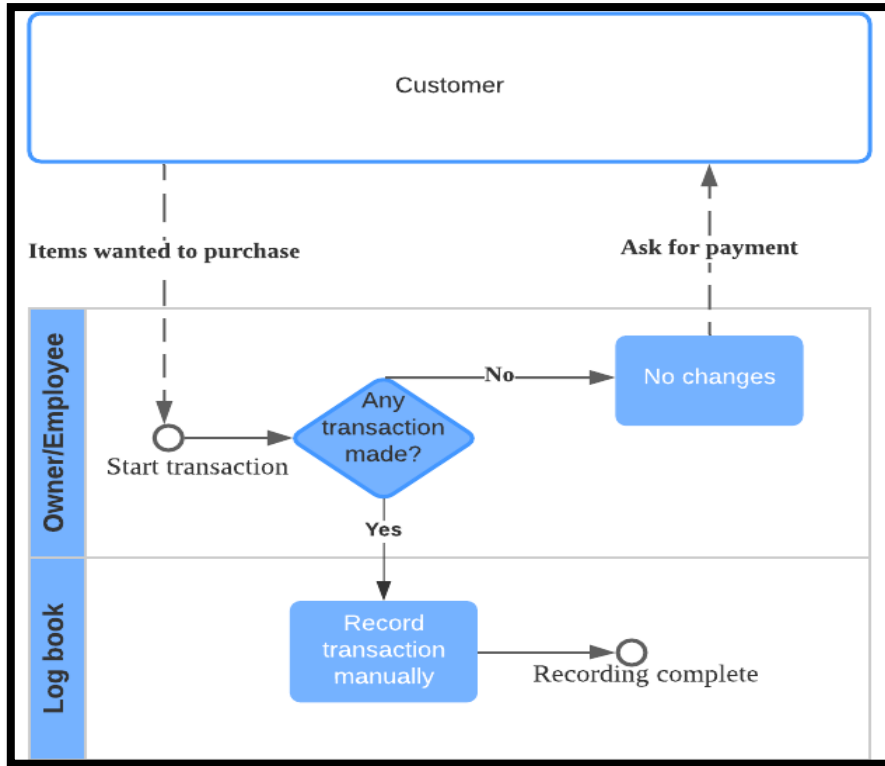


Figure 2: AS-IS Swim Lane diagram for manage stock process

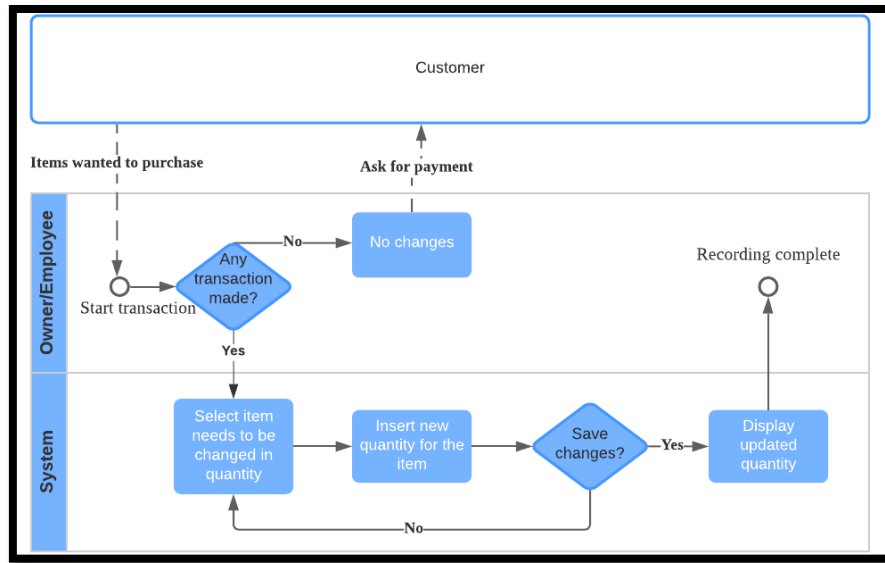


Figure 3: TO-BE Swim Lane diagram for manage stock process

4.5.2 Insert New Stock Information Process

Figure 5 shows the current insert new stock information process of Rong Fatt Hardware while Figure 6 shows the TO-BE swim lane diagram for insert new stock information process.

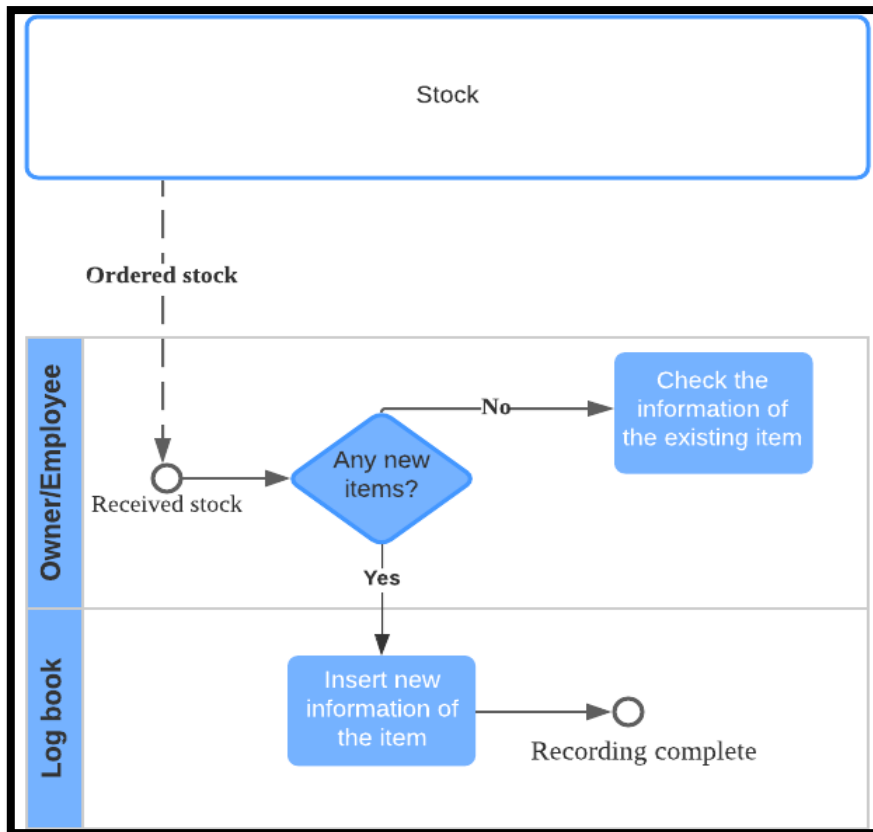


Figure 4: AS-IS swim lane diagram for insert new stock information process

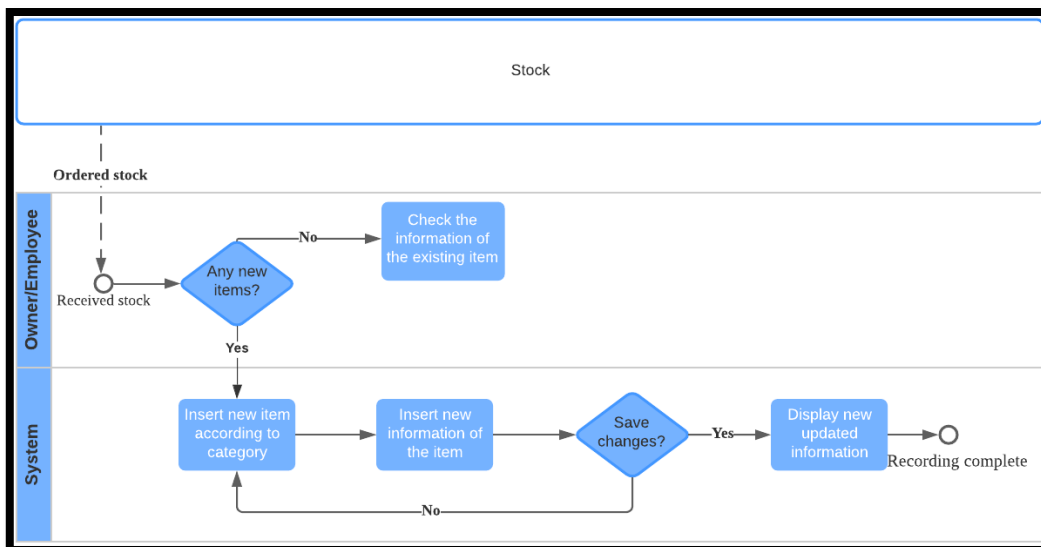


Figure 5: TO-BE swim lane diagram for insert new stock information process

4.5.3 Stock Order Process

Figure 7 illustrates the current stock order process of Rong Fatt Hardware while Figure 6 shows the TO-BE swim lane diagram for stock order process.

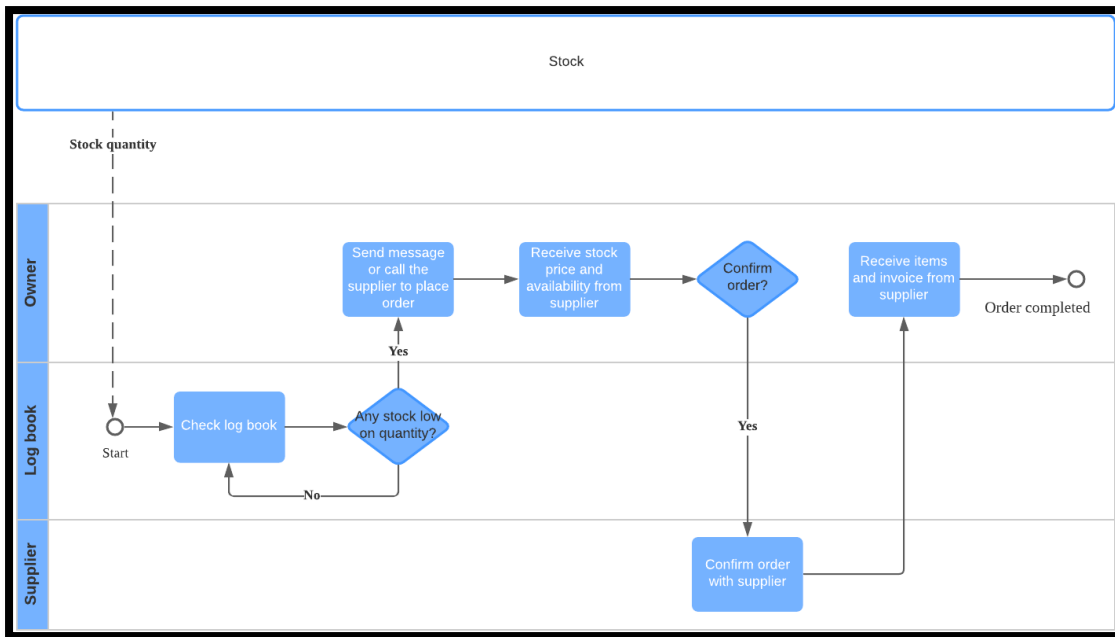


Figure 6: AS-IS swim lane diagram of stock order process

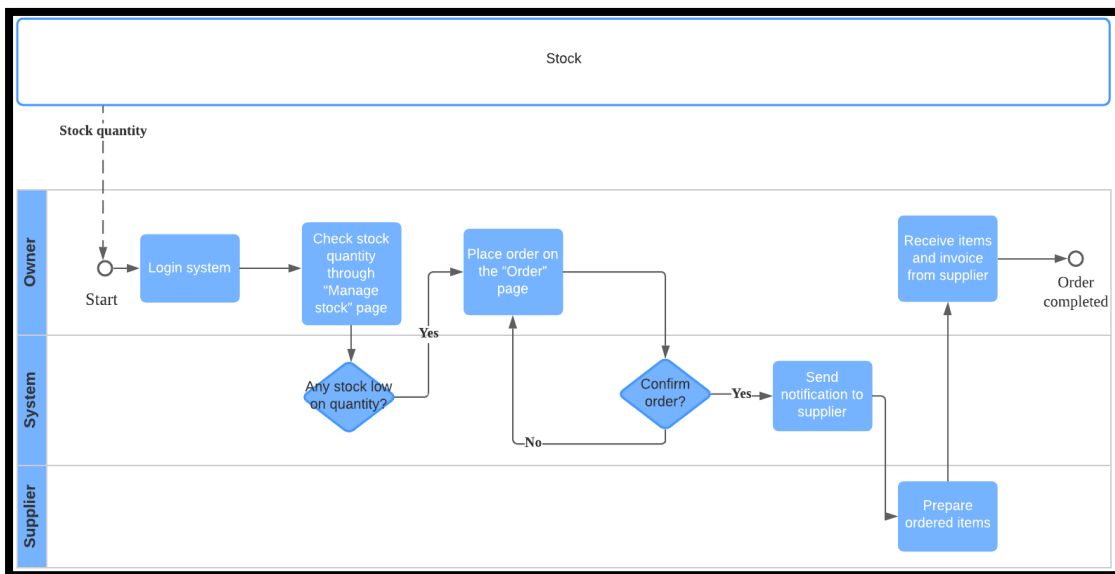


Figure 7: TO-BE swim lane diagram of stock order process

4.6 Interface Design

Interface design provides the user interfaces that will be implemented into the proposed system later. It provides a shape of how a proposed system will be looked like. Figures for the developed interfaces will be shown as in Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, and Figure 18 in Appendix A.

4.7 Testing

A total of 55 test cases have been designed in this test plan and they were executed to verify and validate the system functionalities and behaviours under certain conditions. The testing were carried out along

with the development of the system [8]. The overall result of test cases available is illustrated as shown in Figure 9. All the test cases were successfully carried out. The table below shows one of the test cases carried out in this project.

No.	Test Case	Description	Expected Result	Actual Result
TEST_100 [Register New Users (supplier, employee)]				
1.	TEST_100_001	Test system response when valid username, email, password and confirm password is entered during registering new employee or supplier.	User should be able to register new account successfully.	As expected output
2.	TEST_100_002	Check system response when invalid username and invalid password are entered.	User should not be able to register new account.	As expected output
3.	TEST_100_003	Check system response when invalid username, email and password are entered.	User should not be able to register new account.	As expected output
4.	TEST_100_004	Check system response when confirm password is filled with the same as password.	A “matching” message should show up on the confirm password field.	As expected output
5.	TEST_100_005	Check system response when confirm password is filled with the same as password and “Add” button is clicked.	User should be able to register new account.	As expected output
6.	TEST_100_006	Check system response when password and confirm password are different.	A “not matching” message should show up on the confirm password field.	As expected output
7.	TEST_100_007	Check system response when password and confirm password are different.	User should not be able to register new account.	As expected output
8.	TEST_100_008	Check system response when username is entered, password and confirm password is left blank, then “Add” button is clicked.	User should not be able to register new account and system will prompt please fill in this field.	As expected output
9.	TEST_100_009	Check system behavior when username, email, password and confirm password are left blank, then “Add” button is clicked.	User should not be able to register new account and system will prompt please fill in this field.	As expected output
10.	TEST_100_010	Check system behavior when username, email, password and confirm password is left blank, then “Add” button is clicked.	User should not be able to register new account.	As expected output

Table 6: Test cases for register module

4.7.1 User Acceptance Testing

The user acceptance testing was conducted at Rong Fatt Hardware, Batu Pahat, Johor. Then, the survey form was later filled in online by using Google Form as the client and end user were reluctant to meet up for extended period of time as they are worried about the pandemic situation. The end users were able to experience the developed system. The end users consists of the owner, employees and suppliers. There are total of ten users who took the user acceptance test. The implementation of the application testing was successfully conducted. The actual outputs are similar to the expected results. Comment and suggestions from the user acceptance testing are gathered and adopted to improve the application in the future. The results of the user acceptance testing shown in Appendix A.

5. Conclusion

In conclusion, this inventory management system is developed for Rong Fatt hardware shop. Through this system, Rong Fatt hardware shop can manage stocks in a more organised way and place orders on supplier easier. The development of this system is able to assist Rong Fatt hardware shop in daily business operation and helping them getting familiar with computerise inventory system. One of the disadvantages of the system is the system cannot record the transaction of stock through barcode scanning. The system also cannot receive invoice from supplier. Besides, the user will not be able to track the delivery progress of the stock they have ordered.

As for the future system improvement, it is recommended that a barcode scanning system can be integrated to the system to further improve the daily business operation. Furthermore, feature such as receiving invoice from supplier can also be added to the system. The system should also have better security feature as to prevent any unauthorized access to the system which will leads to breach of data. Other than that, the system can be developed for smartphone, as it is a norm to handle all the things on the fingertip these days.

Acknowledgement

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Appendix A

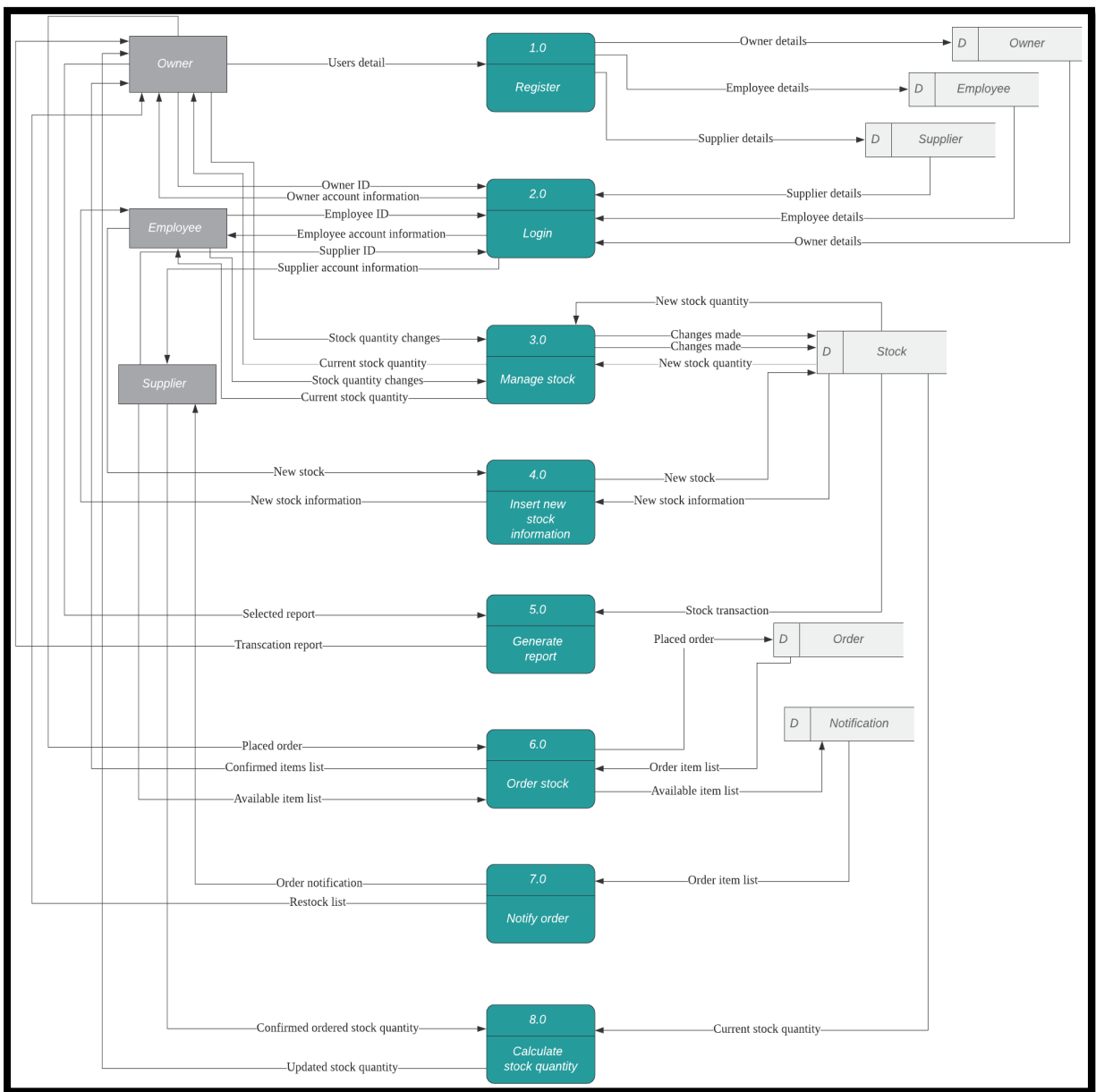


Figure 8: DFD Level 0

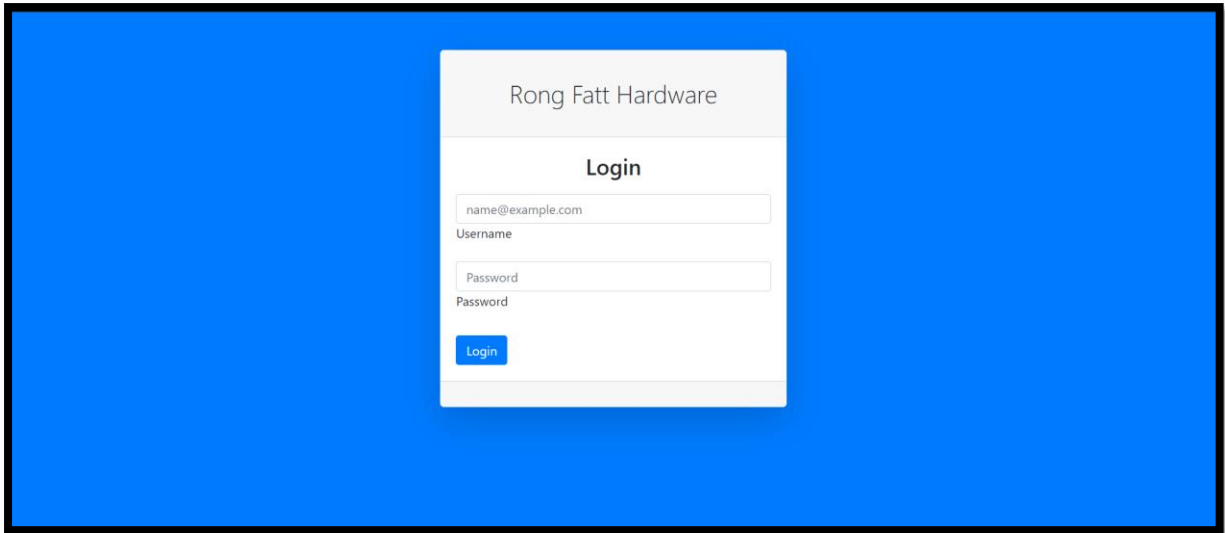


Figure 9: Login Interface

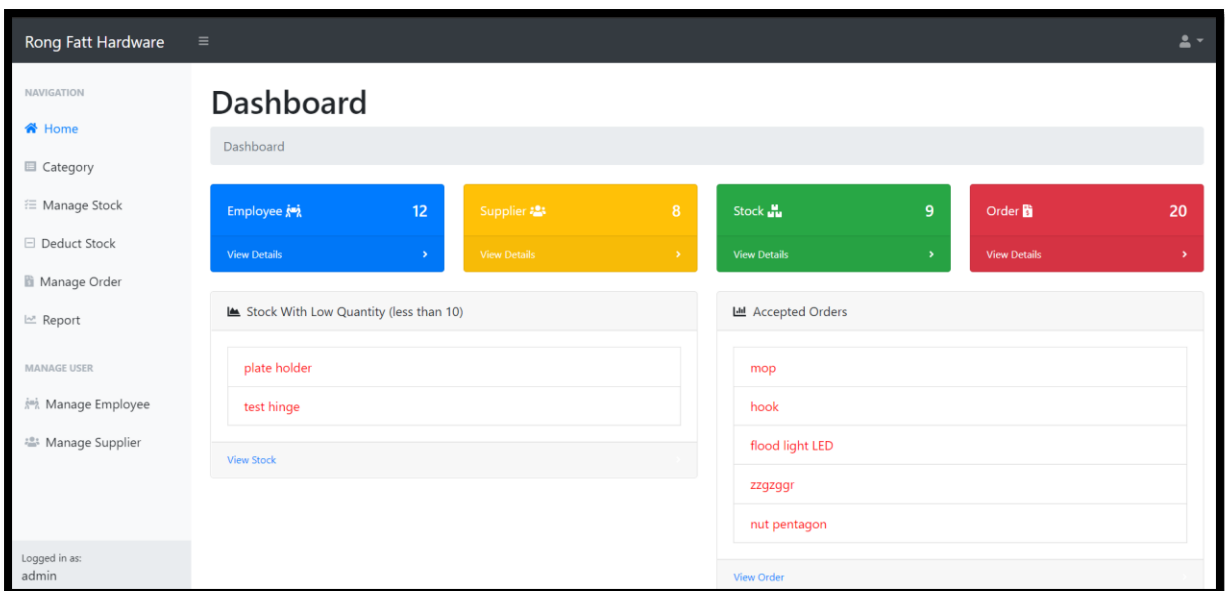


Figure 10: Home Page Interface

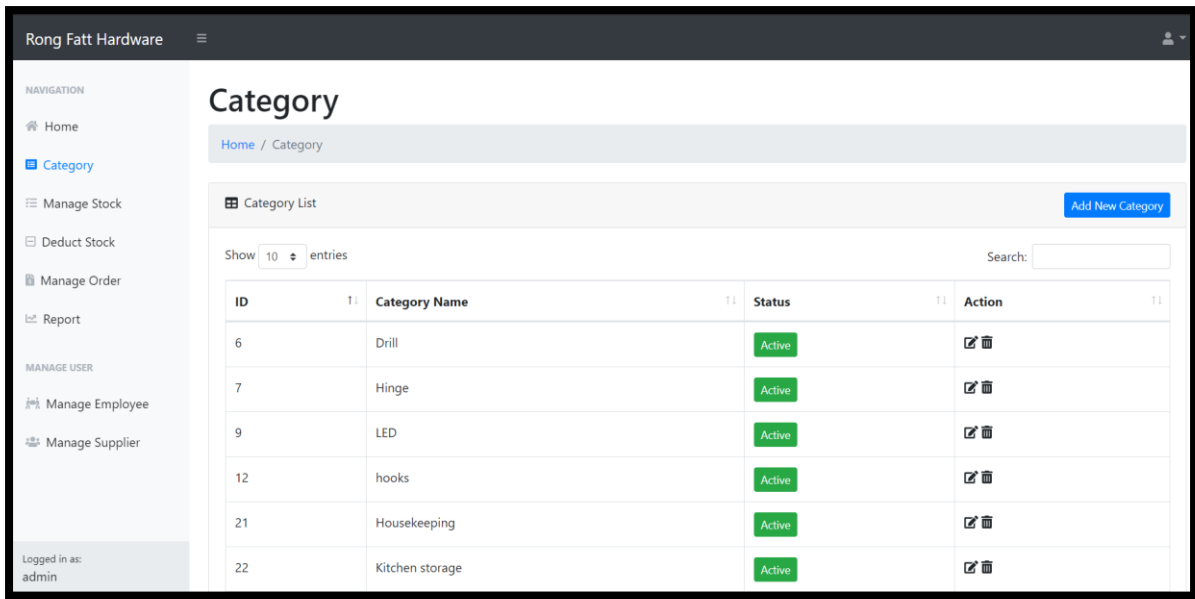


Figure 11: Category Interface

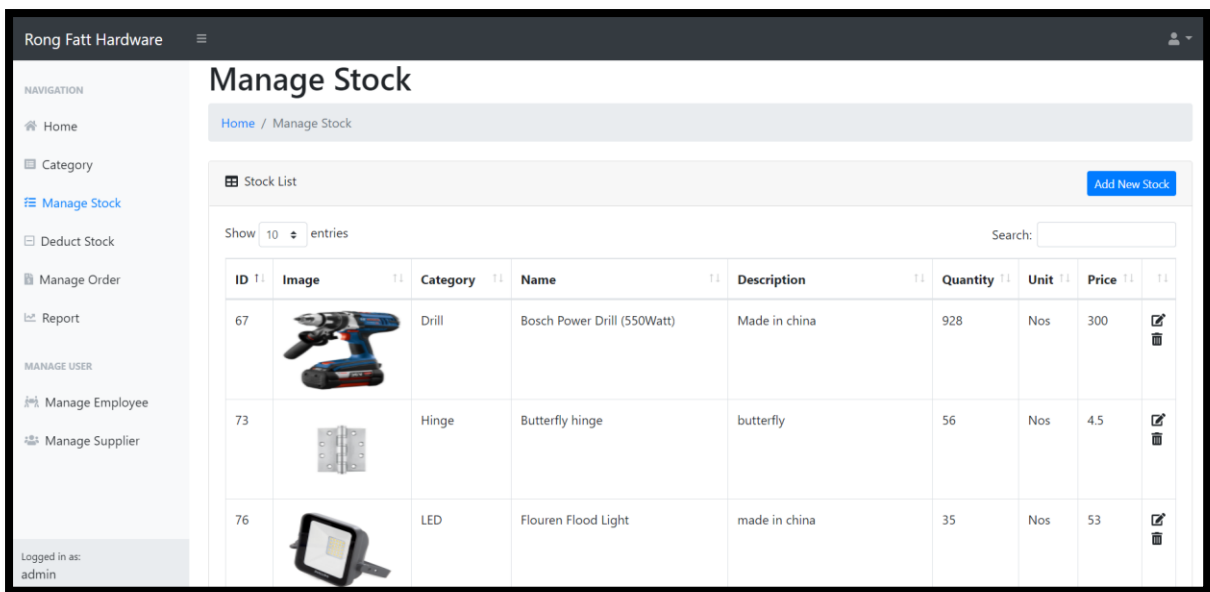


Figure 12: Manage Stock Interface

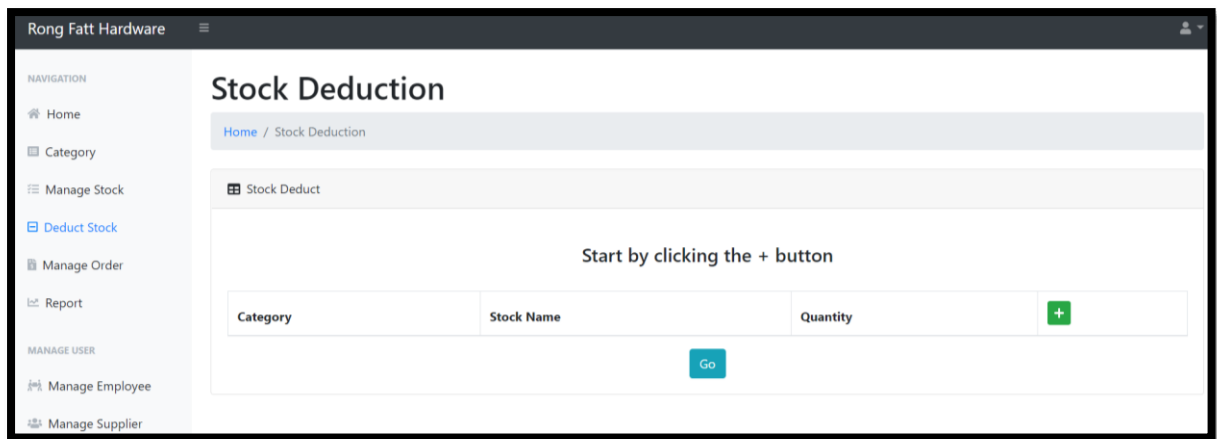


Figure 13: Stock Deduction Interface

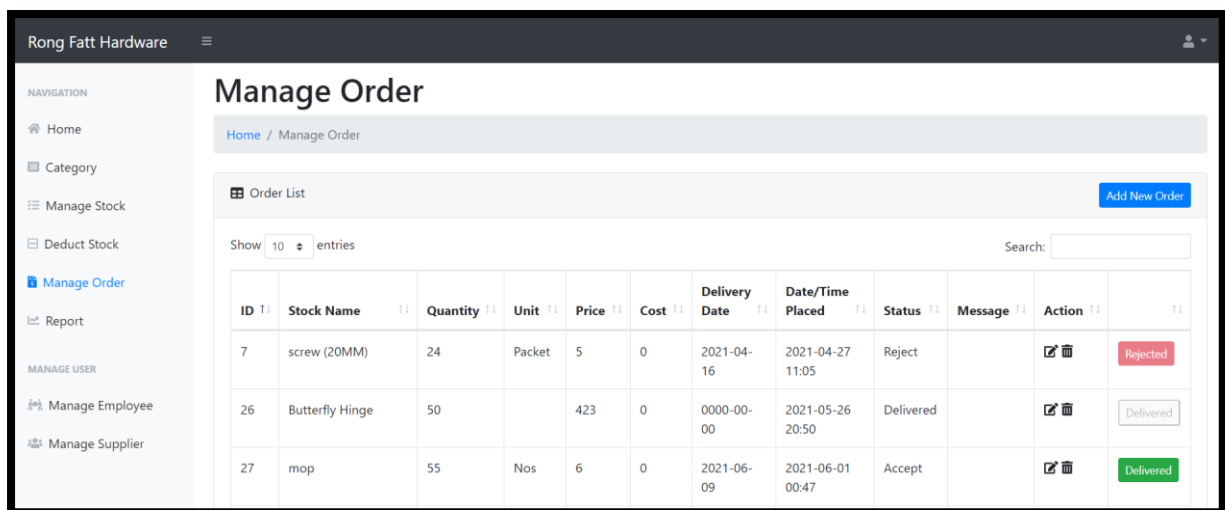


Figure 14: Manage Order Interface

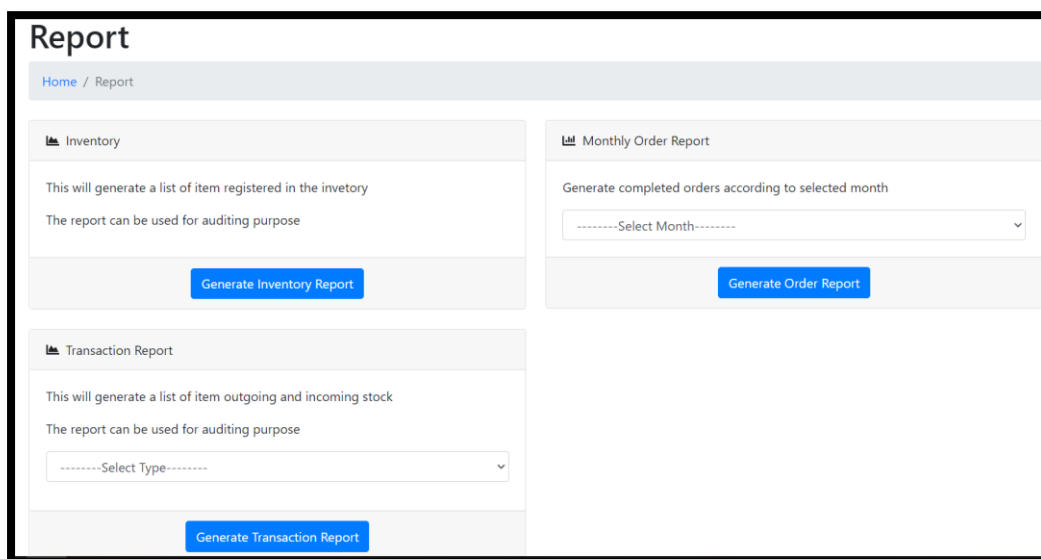


Figure 15: Report Interface

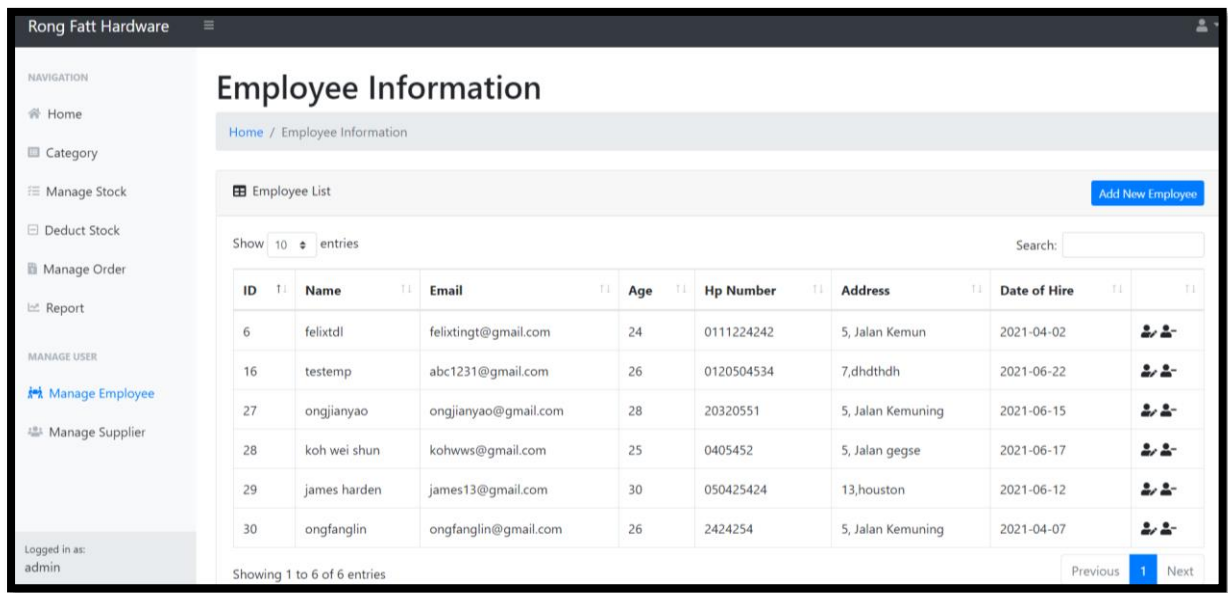


Figure 16: Manage Employee Interface

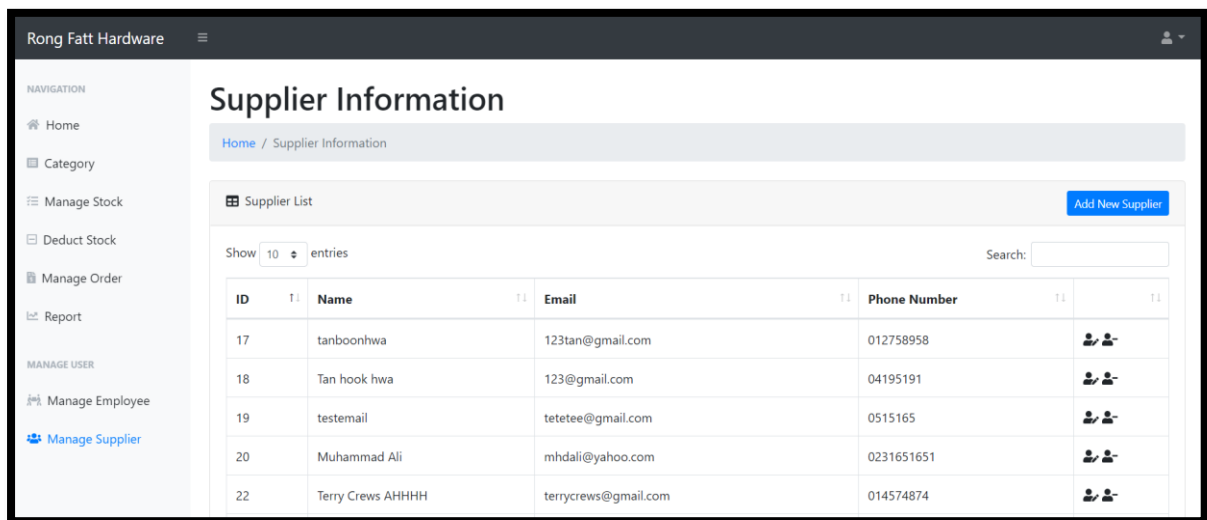


Figure 17: Manage Supplier Interface

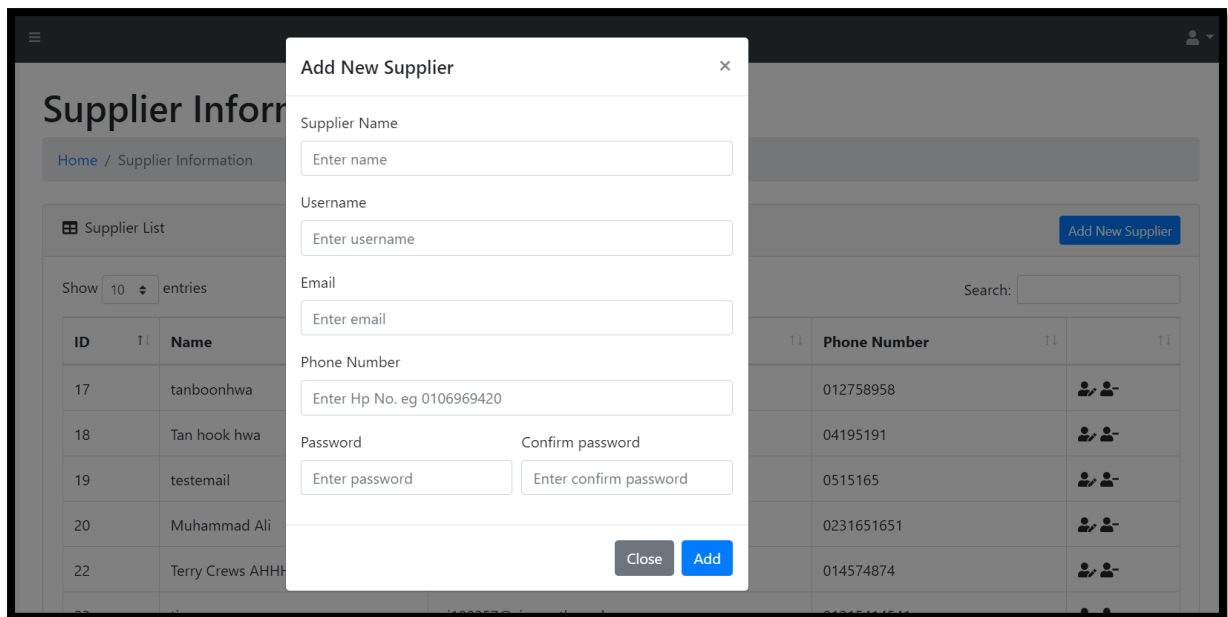


Figure 18: Add New Supplier Modal

B	C	D	E	F	G	H	I
Login Function	Register Function (admin)	Add Category Function (ac	Manage Stock Function (Manage Stock Function (Manage Order Function (View Order Function (sup	Manage Employee Function (admin)
4	3	3	4	3	3		4
4				3			
3				3			
5							
3							
3							
4						4	
3						3	
3						4	
5						3	

Figure 19: User Acceptance Testing Result

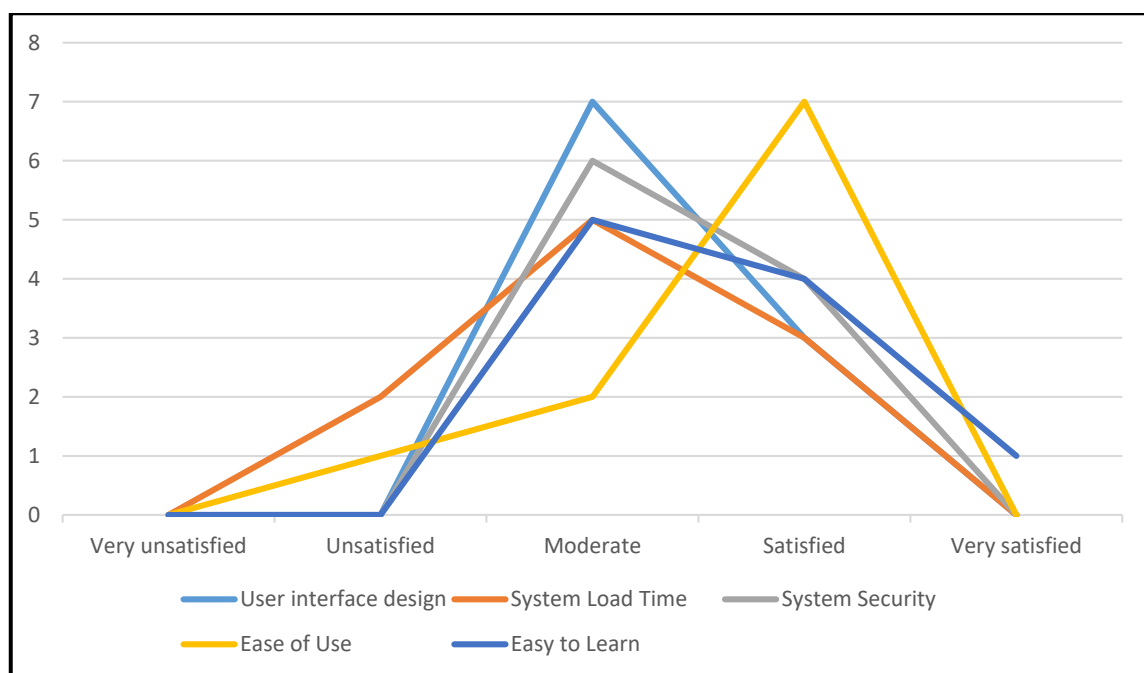


Figure 20: Level of Satisfactory on System Non-Functional Requirement