Development of Spare Part Management System for Automotive Repairing Shop

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Abstract: Spare part management system allows an organization to manage the interrelated parts of its business to achieve its objectives. The target organization of this project is Kedai Motor Auto Power, which located at Melaka. The problem with the traditional management system are data redundancy, limited data sharing and difficulty in accessing data. The objective of this project is to design, develop and evaluate the automotive repairing shop information system. The spare part management system provides stock management, sales management, supplier information, search, login and registration features to solve the problems. The system should allow the owner to manage the stock and sales of the shop through online. Moreover, the system should also allow the customers to make order of the spare part through online. This system is expected to manage the information and inventory of spare part with more systematic way. The contributions of Spare Part Management System is providing a paperless, efficiency and systematic working environment to the owner, which promote a better working environment in the future.

Keywords: Management System, Spare Part, Stock Management

1.   Introduction

Manual filing system is one of the traditional management system that help the owner or staff of the organization to keep and store their company's information in the file. Manual filing system is a way in which a person keep the papers inside the file and arrange it at the bookshelf. Next, the person in charge will need to search proper files all the way long from the bookshelf when the files are needed.

The management system that is going to be discussed is the spare part management system of the automotive repairing shop. The name of the automotive repairing shop is Kedai Motor Auto Power. Some issues found in the manual filing system of Kedai Motor Auto Power which are data redundancy, limited data sharing and difficulty in accessing data. These issues will cause lots of inconvenience to the owner and staff of the automotive repairing shop.

In order to solve this issue, a modern management system is developed. The web based management system can be accessed by using laptop and desktop that connected to the internet. The modern management system will provide a systematic and organized management service to the user. The issues stated above can be solved by developing the Spare Part Management System that provide multiple functions such as product management feature, supplier information feature and searching feature. For example, when the user faced the difficulty in accessing data, he or she can look for the item by using the searching feature that available in the system.

The objective of the project is to analyze, develop and evaluate the automotive repairing shop information system. There are six modules in the spare part management system of automotive repairing shop. The system's modules are designed in the spare part management system to carry out the required function that stated by the client. The modules are login, sales management, stock management, manage user information, manage customers' order and supplier information.

2. Literature Review

2.1 Background of Case Study

The organization that is chosen for this project is Kedai Motor Auto Power [1]. Kedai Motor Auto Power was established at 23-03-1988 and it is located in Sungai Udang, Melaka. The owner of Kedai Motor Auto Power is Mr. Lau Chee Cheng. Mr Lau has started his business when he was 21 years old. Two main services provided by Kedai Motor Auto Power which is repairing service and spare part selling service.

The current management system is performed manually by keeping the paper and files in a folder [2]. The receipt and order list of the item from the suppliers has been kept in the files and then arrange in a bookshelf. The receipt and order list of the item are separated into different files according to the suppliers. The owner can search the order list they want by looking at the dates of the order lists inside the files. Moreover, the spare part of Kedai Motor Auto Power is arranged inside several drawers or closets. The spare part is categorized into many types such as accessories, brakes & suspension and body & frame.

2.2 Study of existing system

In studying the existing systems and the proposed system, the Spare Part Management System of Kedai Motor Auto Power is compared to three existing systems in order to give a complete view for this project. The three existing systems stated in the Table 1 is Hardware and Furniture Inventory Management System, Most Stationery Inventory Management System and Information Technology Club Management System [3][4][5].

2.3 Comparison between the existing system and proposed system

Table 1: Comparison between the existing system and proposed system

Systems Features	Hardware and Furniture Inventory Management System [3]	Most Stationery Inventory Management System [4]	Information Technology Club Management System [5]	Spare Part Management System
Registration	-	-	New member registration.	Owner can register the staff as the system user.

Table 1: Comparison between the existing system and proposed system (cont)

Features \ Systems	Hardware and Furniture Inventory Management System [3]	Most Stationery Inventory Management System [4]	Information Technology Club Management System [5]	Spare Part Management System
Log In	Able to login for the use of administrator and staff.	Able to login for the use of operators and workers.	Able to login for the use of staff and members.	Able to login for the use of owner and staff.
User Information	-	Able to add, update and delete the worker's information by the admin.	Able to manage the user information by the admin.	Admin are able to manage user information (admin and staff) such as username and password.
Suppliers	Display the information of supplier.	Display additional form or list of suppliers.	-	Manage the information of suppliers.
Report	Analyse that item by using Periodic Review System Model.	Include report displayed such as daily report and sales report.	Include activity reports of club.	Include report displayed such as sales report.
Search	-	Provide a search function.	-	Provide a search function.
Stock	Manipulate data or information stock by store, input and output data.	Manipulate the data or information stock such as add, update and delete.	-	Manage product information such as product photo, product name, price, quantity, supplier, category and status.
Sales	-	Display the total sales of the year.	-	Display the total sales.

3. Methodology/Framework

3.1 Planning Phase

In the project-planning phase, the data gathering activities such as interview session is conducted between the owner and the developer in order to analyze the requirements for this system. Next, the timeline of the project will be arranged neatly in Gantt Chart in order to give a clearer view for the developer about the process flow of the project.

Several methods are used to conduct data gathering, which are interviewing, questionnaire, observation, survey form, focus group and so on. The method of data gathering that is used for the proposed system is interviewing.

An interview is a structured conversation between the interviewee and interviewer where the interviewer asks questions and the interviewee provide the answer [6]. Interview is one of the most

commonly used requirement elicitation technique which includes selecting interviewees, designing interview questions, preparing for the interview, conducting the interview and post-interview follow-up. An interview form with a list of questions is attached in Appendix A.

From the response of the owner, he agreed that the proposed management system could increase the efficiency of the spare part management process. Moreover, the owner also said this system would help him to monitor the daily and monthly sales of the shop. This will allow him to have better understanding on the stock of the shop.

3.2 Analysis Phase

Functional requirement analysis is a process that show the developer the functionalities of the modules for the proposed system.

Table 2: Functionalities requirement for the system

No	Modules	Functionalities
1	Login	1) User login to the system and conducting the management process in the system.
2	Sales Management	1) User view the total sales of the shop.
		2) User generates the report of the sales.
3	Stock Management	1) User manages the item or spare part by using the function of add, delete and edit.
4	Manage user information	1) User manages user's information such as username, password and phone number.
5	Manage customers' order	1) User manages customers' order by adding, editing and removing the order list.
6	Supplier Information	1) User manages the information of suppliers such as the contact number and address.

Non-functional requirement analysis is a process that show the developer the capabilities and constraints of the proposed system.

Table 3: Non-functionalities requirement for the system

No	Requirement	Description
1	Security	1) The password must be in eight characters with the combination of alphabet and number.
		2) The system can only been accessed with the insertion of the correct username and password.
2	Operational	1) The system should be able to function well at all web browser.
3	Performance	1) The interactions between users and webpages should not be longer than two seconds.

3.3 Design Phase

Use case diagram is a UML diagram that show the relationship between the actors, use cases and system.
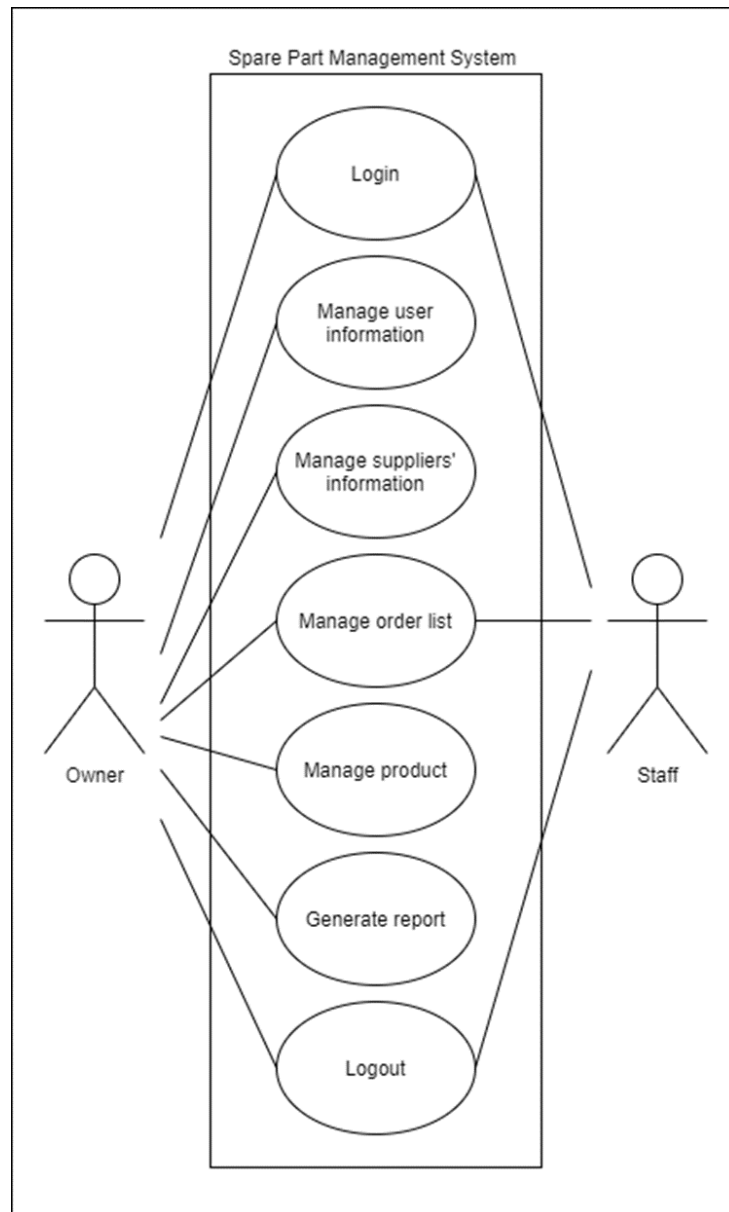
Figure 1: Use case diagram

Requirement Traceability Matrix is a document that used to track the user requirement with test cases. It also used to validate all the requirements through software testing. In Spare Part Management System, there are seven requirements, which is login, manage user information, manage suppliers' information, manage order list, manage product, generate report and logout.

Table 4: Requirement Traceability Matrix for Spare Part Management System

Allocation	Description
REQ_100	Login
FR01-01	The system can allowed the user to login.
CR01-01	The system cannot allowed login process if there are invalid username and password.
REQ_200	Manage user information
FR02-01	The system can allowed the user to add new user of the system.
FR02-02	The system can allowed the user to edit the user information.
FR02-03	The system can allowed the user to remove the user.
CR02-01	The system will not allowed the user to add new user if there are empty space on the text field.
CR02-02	The system will not allowed the user to edit user information if there are empty space on the text field.
REQ_300	Manage suppliers' information
FR03-01	The system can allowed the user to add supplier's information.
FR03-02	The system can allowed the user to edit the suppliers' information.
FR03-03	The system can allowed the user to remove the suppliers' information.
CR03-01	The system will not allowed the user to add suppliers' information if there are empty space on the text field.
CR03-02	The system will not allowed the user to edit suppliers' information if there are empty space on the text field.
REQ_400	Manage order list
FR04-01	The system can allowed the user to add new order.
FR04-02	The system can allowed the user to edit the order information.
FR04-03	The system can allowed the user to remove the order from the order list.
FR04-04	The system can allowed the user to print the order receipt.
CR04-01	The system will not allowed the user to add new order if there are empty space on the text field.
CR04-02	The system will not allowed the user to edit order information if there are empty space on the text field.
REQ_500	Manage product
FR05-01	The system can allowed the user to add new product.
FR05-02	The system can allowed the user to edit the product information.
FR05-03	The system can allowed the user to remove the product.
CR05-01	The system will not allowed the user to add new product if there are empty space on the text field.
CR05-02	The system will not allowed the user to edit product information if there are empty space on the text field.
REQ_600	Generate report
FR06-01	The system can allowed the user to choose start date and end date.
FR06-02	The system can generate the order report.
CR06-01	The system will not generate the order report if there is not date selection.
REQ_700	Logout
FR07-01	The system can allowed the user to logout.

Class diagram is a UML diagram that show relationship between systems' classes, attributes, and methods in an object-oriented system.
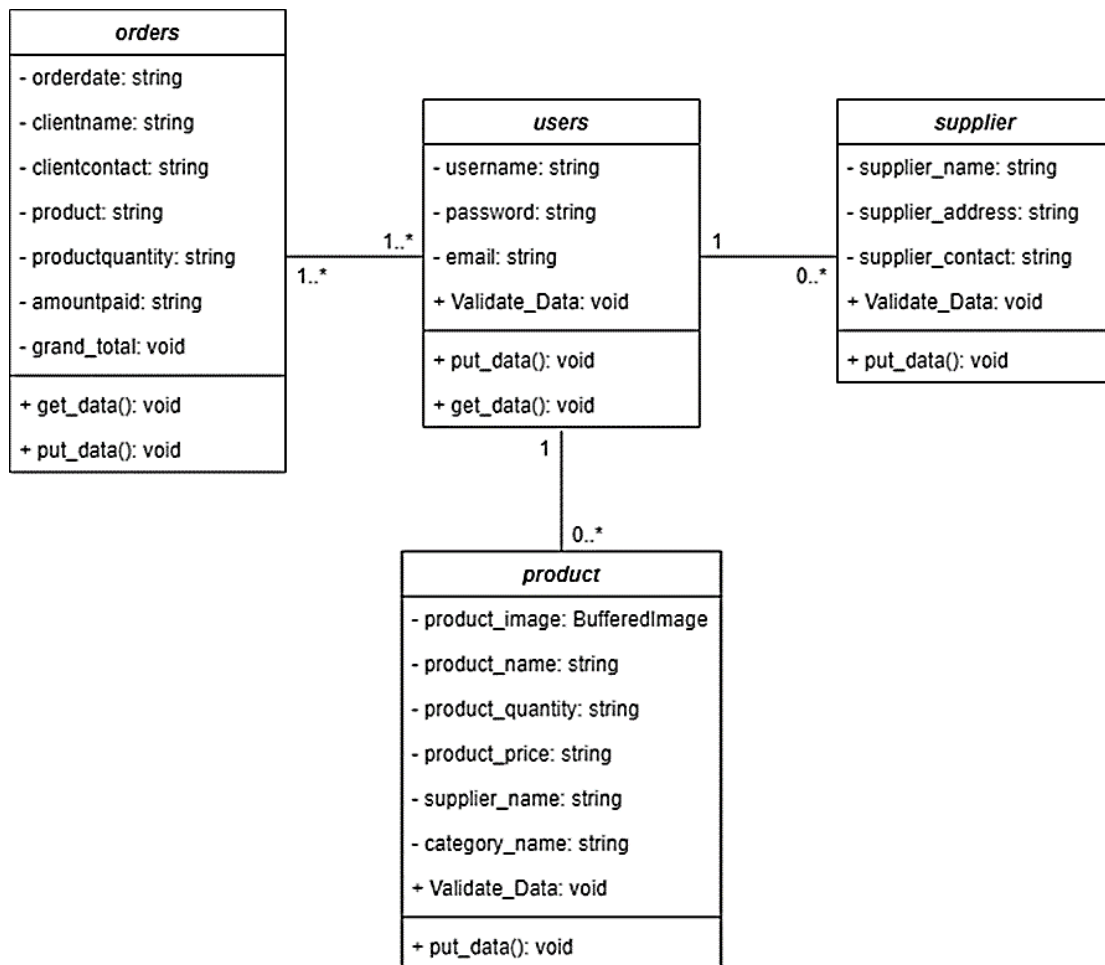
orders

- orderdate: string
- clientname: string
- clientcontact: string
- product: string
- productquantity: string
- amountpaid: string
- grand_total: void

+ get_data(): void
+ put_data(): void

users

- username: string
- password: string
- email: string
+ Validate_Data: void

+ put_data(): void
+ get_data(): void

supplier

- supplier_name: string
- supplier_address: string
- supplier_contact: string
+ Validate_Data: void

+ put_data(): void

product

- product_image: BufferedImage
- product_name: string
- product_quantity: string
- product_price: string
- supplier_name: string
- category_name: string
+ Validate_Data: void

+ put_data(): void

Figure 2: Class diagram

3.4 Implementation Phase

The first module to be discussed is login module. The login module allowed the user to login to Spare Part Management System by using username and password. The user required to enter the correct combination of username and password in order to access the management system. There will be an alert message display on the screen if the user insert the wrong username and password.

The next module to be discussed is sales management module. The sales management module can allowed the user to generate the sales report in Spare Part Management System. The user required to choose the start date and end date in order to generate the sales report. The sales information such as total sales is included inside the sales report.

The third module is stock management module. The stock management module allowed the user to manage the product of Kedai Motor Auto Power inside the system. The user is able to add, edit and remove the product in Spare Part Management System.

The next module is manage user information module. The manage user information module allowed the user to manage the system user information by adding, editing and removing the system user in the management system. There are two types of user in this system, which is owner and staff of Kedai Motor Auto Power.

The manage customers' order module allowed the user to add, edit and remove customer's order in Spare Part Management System. Owner and staff can use this module to manage customers' order.

The last module to be discussed is supplier module. The supplier module allowed user to manage the suppliers' information inside the management system. User is able to manage the suppliers' information by adding, editing and removing the supplier's information in the Spare Part Management System.

3.5   Testing Phase

In testing phase, test cases are being developed based on the Requirement Traceability Matrix. The test results is also shown in this section. There are 17 test cases constructed for the testing of Spare Part Management System based on the function that provided by Spare Part Management System.

4.   Results and Discussion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

4.1   Test Case

The following test case is constructed to test the login process. The summary of the test case is shown in Table 5(a) and the detailed result is shown in Table 5(b).

Table 5(a): Test Case Login

Test Case ID	Requirement	Description	Result
STD_TEST_100_001	REQ_101	The system can allowed the user to login.	PASS

Table 5(b): Test Case Login

Test Case ID	Event	Expected Result	Result
STD_TEST_100_001	User clicks on the button that is label "Sign in".	The system will display system home page in order to show that the user had login to the system successfully.	PASS

The following test case is constructed to test the management process for user information. The summary of the test case is shown in Table 6(a) and the detailed result is shown in Table 6(b).

Table 6(a): Test Case Manage User Information

Test Case ID	Requirement	Description	Result
STD_TEST_200_001	REQ_201	The system can allowed the user to add new user of the system.	PASS
STD_TEST_200_002	REQ_202	The system can allowed the user to edit the user information.	PASS
STD_TEST_200_003	REQ_203	The system can allowed the user to remove the user.	PASS

Table 6(b): Test Case Manage User Information

Test Case ID	Event	Expected Result	Result
STD_TEST_100_001	User clicks on the button that is label "Save Changes".	The new user will be added into the user list on the Manage User page.	PASS
STD_TEST_200_002	User clicks on the button that is label "Save Changes".	The user information will be changed in the user list on the Manage User page.	PASS
STD_TEST_200_003	User clicks on the button that is label "Save Changes".	The user will be removed from the user list on the Manage User page.	PASS

The following test case is constructed to test the management process for suppliers' information. The summary of the test case is shown in Table 7(a) and the detailed result is shown in Table 7(b).

Table 7(a): Test Case Manage Suppliers' Information

Test Case ID	Requirement	Description	Result
STD_TEST_300_001	REQ_301	The system can allowed the user to add supplier's information.	PASS
STD_TEST_300_002	REQ_302	The system can allowed the user to edit the suppliers' information.	PASS
STD_TEST_300_003	REQ_303	The system can allowed the user to remove the suppliers' information.	PASS

Table 7(b): Test Case Manage Suppliers' Information

Test Case ID	Event	Expected Result	Result
STD_TEST_300_001	User clicks on the button that is label "Save Changes".	The new supplier's information will be added into the supplier list on the Manage Supplier page.	PASS
STD_TEST_300_002	User clicks on the button that is label "Save Changes".	The supplier's information will be changed in the supplier list on the Manage Supplier page.	PASS
STD_TEST_300_003	User clicks on the button that is label "Save Changes".	The suppliers' information will be removed from the supplier list on the Manage Supplier page.	PASS

The following test case is constructed to test the order management process. The summary of the test case is shown in Table 8(a) and the detailed result is shown in Table 8(b).

Table 8(a): Test Case Manage Order List

Test Case ID	Requirement	Description	Result
STD_TEST_400_001	REQ_401	The system can allowed the user to add new order.	PASS
STD_TEST_400_002	REQ_402	The system can allowed the user to edit the order information.	PASS
STD_TEST_400_003	REQ_403	The system can allowed the user to remove the order from the order list.	PASS
STD_TEST_400_004	REQ_404	The system can allowed the user to print the order receipt.	PASS

Table 8(b): Test Case Manage Order List

Test Case ID	Event	Expected Result	Result
STD_TEST_400_001	User clicks on the button that is label "Save Changes".	The new order will be added into the order list on the Manage Order page.	PASS
STD_TEST_400_002	User clicks on the button that is label "Save Changes".	The order information will be changed in the order list on the Manage Order page.	PASS
STD_TEST_400_003	User clicks on the button that is label "Save Changes".	The order will be removed from the order list on the Manage Order page.	PASS
STD_TEST_400_004	User clicks on the button that is label "Print".	The order receipt will show in the system and the user are able to download it.	PASS

The following test case is constructed to test the product management. The summary of the test case is shown in Table 9(a) and the detailed result is shown in Table 9(b).

Table 9(a): Test Case Manage Product

Test Case ID	Requirement	Description	Result
STD_TEST_500_001	REQ_501	The system can allowed the user to add new product.	PASS
STD_TEST_500_002	REQ_502	The system can allowed the user to edit the product information.	PASS
STD_TEST_500_003	REQ_503	The system can allowed the user to remove the product.	PASS

Table 9(b): Test Case Manage Product

Test Case ID	Event	Expected Result	Result
STD_TEST_500_001	User clicks on the button that is label "Save Changes".	The new product will be added into the product list on the Manage Product page.	PASS
STD_TEST_500_002	User clicks on the button that is label "Save Changes".	The product's information will be changed in the product list on the Manage Product page.	PASS
STD_TEST_500_003	User clicks on the button that is label "Save Changes".	The product will be removed from the product list on the Manage Product page.	PASS

The following test case is constructed to test the process for report generation. The summary of the test case is shown in Table 10(a) and the detailed result is shown in Table 10(b).

Table 10(a): Test Case Generate Report

Test Case ID	Requirement	Description	Result
STD_TEST_600_001	REQ_601	The system can allowed the user to choose start date and end date.	PASS
STD_TEST_600_002	REQ_602	The system can generate the order report.	PASS

Table 10(b): Test Case Generate Report

Test Case ID	Event	Expected Result	Result
STD_TEST_600_001	User click on the start date and end date text field to choose a date through calendar.	The start date and end date can be choose from the calendar provided.	PASS
STD_TEST_600_002	User clicks on the button that is label "Generate Report".	The order report will show in the system and the user are able to download it.	PASS

The following test case is constructed to test the logout process. The summary of the test case is shown in Table 11(a) and the detailed result is shown in Table 11(b).

Table 11(a): Test Case Logout

Test Case ID	Requirement	Description	Result
STD_TEST_700_001	REQ_701	The system can allowed the user to logout.	PASS

Table 11(b): Test Case Logout

Test Case ID	Event	Expected Result	Result

STD_TEST_700_001	User clicks on the button that is label "Logout".	The system will display Login page in order to show that the user had logout from the system successfully.	PASS

4.2   Overall Test Results

A total 17 test cases were performed to test the functionality of the system. The system had passed 14 out of 14 of the test cases or 100% of all the test cases. The overall result is shown in Table 12.

Table 12: Overall test result for Spare Part Management System

ID	Total Test Cases	Total Passes	Total Fails
STD_TEST_100	1	1	-
STD_TEST_200	3	3	-
STD_TEST_300	3	3	-
STD_TEST_400	4	4	-
STD_TEST_500	3	3	-
STD_TEST_600	2	2	-
STD_TEST_700	1	1	-
Total	17	17	-

The test result is summarized in Figure 3, which shows 100 percent pass rate in the system requirements. The test result shows all the functionality provide by the Spare Part Management System is well functioning and can give a well user experiences to the end user.
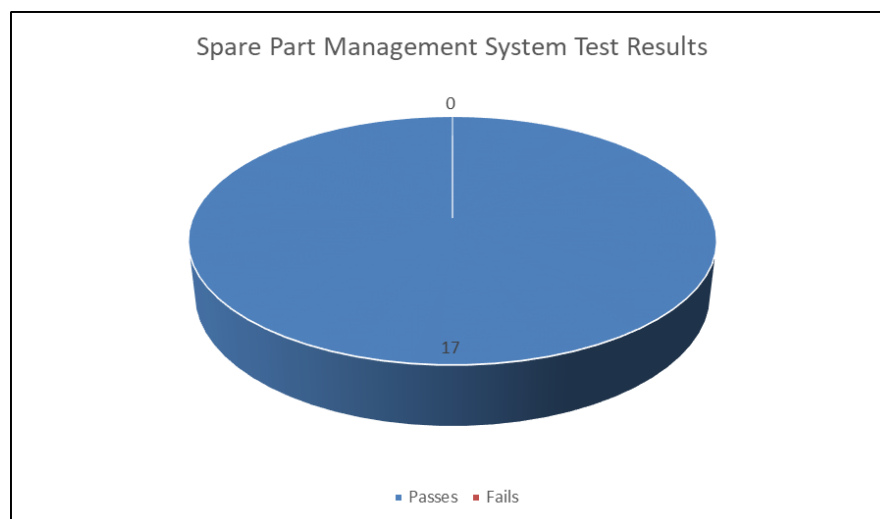

Figure 3: Test result for Spare Part Management System

4.3   User Acceptance Testing

User Acceptance Testing is a type of testing that carried out by the client or end user in order to ensure the software system met the user requirements [7]. User Acceptance Testing is conducting after the system testing. The User Acceptance Testing of Spare Part Management System is attached in Appendix B. From the result of User Acceptance Testing of Spare Part Management System, the owner and staff of Kedai Motor Auto Power were satisfied with the function of the system. The system has passed seven out of seven acceptance criteria. However, the owner has left some comments on the order management criteria. The owner wish the system can generate the order receipt after the order has been

made. Based on the comment from the owner, the developer has added the generate receipt function into the system.

5. Conclusion

Spare Part Management System is a fully functioning management system that can help the owner and staff of Kedai Motor Auto Power to manage their product and order. The objectives of this project are fully achieved where this system can ease the management process of the owner of the automotive repairing shop. Although the system has fulfil all the requirements, it also has some flaws due to some limitation. The limitation that existed are the system can only allowed the owner and staff to manage the customer's order but not allowed the customer to manage their own order. Moreover, the system can only allowed the owner to manage the information of supplier but not manage the order from the supplier. However, some improvements can be made in the future in order to solve the limitations. The improvements that can be made are create a customer interface in order to allow the customers manage their own order and information in the system. Next, the system can allowed the owner to order the product from the supplier directly through the system.

Acknowledgement

Appendix A

Interview Form for Owner of Kedai Motor Auto Power

1. Did your shop consists of Spare Part Management System?
    a. If yes, how did the system run?
    b. If no, did you plan to run a Spare Part Management System?
2. Do you think that a Spare Part Management System is needed to manage the business activities in your shop? Yes or No.
3. Why do you think that this system is required to manage the spare part or accessories?
4. Do you think that having this system helps in solving problem such as difficulty in accessing data?
5. Do you think that the following function is suitable to run the system? Why or why not?
    a. Sales Management   d. Display Report
    b. Stock Management   e. Manage User Information
    c. Get Supplier Information
6. Is there anything else to add on?

Appendix B

User Acceptance Testing (UAT) :
Spare Part Management System of Kedai Motor Auto Power

Name : LAU CHEE CHENG

Date of Birth : 03-09-1967

Phone number : 019-3610059

Employer : Kedai Motor Auto Power

Position : Owner

No	Acceptance Criteria	Test Results		Comments
		Pass	Fail	
1	As an owner, I want to login to the system.			
	a) Show Login page for login purpose.	✓		
	b) Provide option to enter the username and password of user.	✓		
2	As an owner, I want to register the user of the system.			
	a) Show Manage User page for user registration purpose.	✓		
	b) Provide option to add user of the system.	✓		
	c) Provide option to edit and remove user's information.	✓		
	d) Provide the search function.	✓		
3	As an owner, I want to manage supplies' information.			
	a) Show Manage Supplier page for supplier management process.	✓		

	b) Provide option to add suppliers' information.	✓		
	c) Provide option to edit and remove suppliers' information.	✓		
	d) Provide the search function.	✓		
4	**As an owner, I want to manage customers' order.**			
	i) **Add Order Page**			
	a) Show Add Order page for order management process.	✓		
	b) Provide option for user to insert the information.	✓		generate Receipt Function
	ii) **Manage Order Page**			
	a) Show Manage Order page for order management process.	✓		
	b) Provide option to edit and remove customers' order.	✓		generate Receipt Function
	c) Provide the search function.	✓		
5	**As an owner, I want to manage product.**			
	a) Show Manage Product page for product management process.	✓		
	b) Provide option to add product.	✓		
	c) Provide option to edit and remove product.	✓		
	d) Provide the search function.	✓		
6	**As an owner, I want to generate sales report.**			
	a) Show Sales Report page for	✓		

	reporting process.			
	b) Provide option for user to insert the start date and end date.	✓		
7	**As an owner, I want to logout from the system.**			
	a) Show Logout button on the navigation bar for logout purpose.	✓		

I. _LAU CHEE CHENG_ hereby declare that the information provided is true and correct.

Agreed by,   Witnessed by,

自力摩哆
KEDAI MOTOR AUTO POWER
NO. 5032-C, BATU 13,
76300 SUNGAI UDANG MELAKA
019-3610059

Name   : LAU CHEE CHENG   Name   : LAU ZI JIAN
Position   : OWNER   Position   : Developer
Date   : 21-05-2021   Date   : 21-05-2021

User Acceptance Testing (UAT) :

Spare Part Management System of Kedai Motor Auto Power

Name   : Ng Poh Lan
Date of Birth : 30 – 8 – 1972
Phone number : 019 – 4461138
Employer   : Kedai Motor Auto Power
Position   : Staff

No	Acceptance Criteria	Test Results		Comments
		Pass	Fail	
1	As a staff, I want to login to the system.			
	a) Show Login page for login purpose.	✓		
	b) Provide option to enter the username and password of user.	✓		
2	As a staff, I want to manage customers' order.			
	i) **Add Order Page**			
	a) Show Add Order page for order management process.	✓		
	b) Provide option for user to insert the information.	✓		
	ii) **Manage Order Page**			
	a) Show Manage Order page for order management process.	✓		
	b) Provide option to edit and remove customers' order.	✓		
	c) Provide the search function.	✓		
3	As a staff, I want to logout from			

the system.		✓		
	a) Show Logout button on the navigation bar for logout purpose.	✓		

I, _Ng Poh Lan_ hereby declare that the information provided is true and correct.

Agreed by,

自 力 摩 哆
KEDAI MOTOR AUTO POWER
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76300 SUNGAI UDANG MELAKA
019-3510059

Name : Ng Poh Lan
Position : Staff
Date : 21-05-2021

Witnessed by,

Name : Lau Zi Jian
Position : Developer
Date : 21-05-2021

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