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A Management System for Car Maintenance Services

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Abstract: The web-based Vision Car Service Shop Management System is a system proposed to aid in business management by providing business processes systemization to Vision Car Service. Vision Car Service shop currently faces a significant problem in business operation which is heavy workloads due to massive manual business processes. The purpose of developing this system is to overcome the problems by aiming to initiate business process systemization through the conversion of manual documentation works to system-based works. The proposed web-based system is designed based on users' requirements and it consists of 4 modules which are register and login module, document management module, inventory module, and reports generating module. Through this system, employees of Vision Car Service can create, read, update and delete document information provided by system functionalities, generate sales and inventory reports as well as manage inventory stocks. The proposed system is developed using the Sashimi Waterfall model as the system development life cycle with a design approach. The system provides functionalities to users through the 4 modules defined in scope and based on user requirements while fulfilling system requirements. The constraint of the system is it only available on a personal computer to preserve data security as well as reliability. For the system testing, functional testing and user acceptance testing are conducted and the results showed that it fulfilled system and customer requirements. In conclusion, the system helps Vision Car Service shop to manage documents, inventory, and reports with ease and efficiently.

Keywords: management system, structured approach, Waterfall model, web-based

1. Introduction

Vision Car Service shop is a local car repairing and servicing centre located in Ipoh, Perak. It was established in June of 2005 and the owner has been serving his customers and servicing their cars for several decades. The shop owner and his employees have been striving to fulfil customer requirements as well as elevate their satisfaction from time to time by providing excellent car servicing experiences throughout the business operations. Car servicing records are jotted down in a notebook so that they

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can refer to it in the future on repair history. Other than that, paper works including receipts, invoices and other financial documents are documented in files and stored manually in the shop.

Consequently, the workload of employees has increased by leaps and bounds as a result of business expansions and an increasing number of customers. The documentation and stocktaking works which are handled manually by either the business owner or employees since the start of business are becoming an additional burden due to the heavy workloads on car servicing and repairing. Not only that, both the owners and his employees have to handle the financial documents before the end of each month to compile them into a business monthly financial report which is then used for taxes and audit-related tasks.

Therefore, a Vision Car Service Shop Management System is proposed and developed to overcome these issues by systemizing several business operations to provide convenience and reducing workloads. This proposed system provides features to manage the documents within the system by reviewing and extracting any data as well as information with ease. Moreover, this proposed system will be able to keep tracking of certain important records as well as stock quantity from time to time. Other than that, it also able to generate monthly reports based on users' requirement of data to aid in smoothening other financial processes.

Besides that, this proposed system should allow users to create, read, update and delete any data and information that is inserted and stored within it. Next, it should allow users to register user accounts and able to log into the system to perform their tasks through the proposed system. Furthermore, this proposed system should be able to update the inventory automatically whenever invoices and receipts are created within the system so that owners can keep track of stock quantity left. Last but not least, the proposed system should be able to generate a monthly business report regarding invoices and net incomes.

Generally, the first section of this paper describes the business problems faced by the owner and employees Vision Car Service shop and general descriptions of the system proposed to overcome the issues. In section 2, the domain study and comparison between system prototype and existing related system are described. In section 3, the methodology and system development life cycle of the system are described in detail. In section 4, the logical and physical design, interface design and test case design of the system are presented and described in detail. In section 5, the advantages, limitations and future improvements of the system are listed as the conclusion of system development.

2. Literature Review

Car service is a type of health check with routine maintenance for vehicles by examining their physical condition and it is usually performed by a mechanic or automotive technicians as it requires plenty of system and component checks, adjustments and parts replacement.

Car service shop management system is an enhanced version of the management system that is developed based on the combination of a web-based system, document management system and inventory system. Generally, a management system enables an organization to manage the interrelated parts of the business to achieve business targets and objectives such as business process systemization, automation and operational efficiency. In short, the integration between web-based technologies, document management system and inventory system pose a more complete and hybrid organization management system that produce a better quality of services and extra functionalities.

2.1 Web-based system

According to A.S. Gillis [1], a web-based system is a system that required both hardware devices and an Internet connection to access the system. Other than that, A.S. Gillis [1] also mentioned that the web-based system is an application that is accessed via the Hypertext Transfer Protocol (HTTP) and

the term web-based is usually used to describe applications that run in a web browser. According to D. Tony Liu and X. William Xu [2], adoption of web-based technologies in data management system provides advantages in terms of user-friendliness, accessibility, applicability, and constructive linking to stakeholders.

S. Angela [3] stated that Web-based architecture defines the interaction between applications, web browsers, databases and servers to ensure multiple applications can work together. Web-based architecture is vital for the web-based systems as it supports future growth in terms of interoperability, system reliability and quality requirements. According to Peng et al. [4], the architecture of a web-based system consists of 3 layers which are user interface, application logic or system and database. In the user interface layer, a browser-based platform with a graphic user interface is developed through PHP Hypertext Preprocessor (PHP), HyperText Markup Language (HTML) and Cascading Style Sheets (CSS) to present desired contents and an attractive web interface for interaction with users. In the application logic layer, queries are implemented to manage input as well as output between users and the database whereas the database layer is the data storage that is used to store images, files and data.

Banga S. [5] mentioned that the components included in web-based architecture are separated into two categories as well – user interface app components and structural components. User interface app components are a reference to the web pages that have a role that is related to the display, settings and configurations. Banga S. [5] also stated that the structural components in web application refer to the functionality of the web application that allows user interactions, application control and database storage which includes the web browser, web application server and database server.

Web-based system provides plenty of advantages to both system users and developers and one of it is lower development costs compare to other systems. According to R. Thomas [6], this is due to a web-based system or application is a responsive web application that runs in a web browser and can be used across multi-device types. Furthermore, Kulkarni M. [7] commented that accessibility is another advantage possessed by web-based systems as it is accessible by thr user whenever internet connection and web browser are available.

2.2 Document management system

A document management system (DMS) is a system that is used to store, manage and keep track of electronic documents. According to Mary and Usha S. [8], a document management system acts as the centralized storage of organizations' information by providing access control as well as organizing documents workflow. Other than that, Besides, Mary M. Bendik. [9] argued that accessing information through computer networks has become even more significant due to the continuous growth of digital documents and it has turned into a fundamental requirement for an organization to be able to survive in the competitive market.

According to Konishi K.[10], the architecture of DMS consists of two important structures which are DMS core, e-archive and graphic user interface (GUI). Generally, GUI will be presented to system users and the interaction and connection between them are developed using PHP and JavaScript while visualisation is accomplished using HTML and CSS.

Chris P. [11] stated that one of the advantages of implementing DMS is reduced storage space of organizations as document management system served as a central repository for important documents that allows users to access, view, change and share them with others. Other than that, Cory P. [12] mentioned that the implementation of DMS can aid in reducing business costs as the cost of documents storage, filing and printing can be minimalized when documents can be inserted and saved in DMS.

2.3 Inventory management system

An inventory management system (IMS) is a system that is adopted to perform monitoring and tracking of stocked products to oversee the items flow and maintain inventory utilization. Anas M. Atieh et al. [13] explained that an inventory management system aimed to lower operational costs by providing efficiency and automated inventory management process that produce dependable reports and accurate results in comparison with the manual processes.

According to Arsan et al. [14], the architecture of IMS consists of elements like a user, database, report printing and analysis. Arsan et al. stated that the interface and design of IMS allow users to manage and manipulate data and information related to items and stocks in inventory. Abby J. [15] said that one of the advantages provided by IMS is cost-savings as the automation of stock checking processes can eliminate the manual way of inventory management that requires huge costs and efforts from a human. Furthermore, Laura [16] mentioned that the IMS can enhance productivity in operations as analytics and reports generated through IMS enable users to manage item information, checking out expiry dates and perceive the quantity of items.

2.4 Study of Odoo Car Care Enterprise Resource Planning System

Odoo Car Service Management System is a vehicle service system or auto garage management system that is developed by Odoo Techno [17] to ensure service quality to customers and also ensure enhanced reporting and workflow system. This system is a service-sales focused Enterprise Resource Planning (ERP) which involves stakeholders such as clients, vendors, products, vehicles and users. The objective of this system is to create a stronger relationships with customers, deliver a high level of service and support, eventually improving organizational sales.

This management system provides features to discuss, sales, purchases, inventory, accounting, employees, fleet, apps and settings. Generally, the discuss feature allows system users to share data with other users or groups whereas the sales feature contains functionality like manage customers, products, quotations, service orders, job cards, stock product sales and sales configuration. The purchase feature allows users to manage requests for quotes, vendors, purchase orders and receipts. For inventory feature, it allows users to manage stock, stock adjustments, stock reports and stock movements. The accounting feature allows users to manage customer invoices, vendor bills, payments and history as well as generate accounts reports.

2.5 Study of Elva Vehicle Service Management System

Elva vehicle service management system is a data management system developed by Elva DMS [18] that aimed to provide vehicle repair business functions and allows users to manage the entire organization through it. Lists of features provided by this system include financial management, inventory management, service management, multi-inventory management and other automotive business management.

In the financial management module, users can acquire an overview of all fixed assets and provide correct periodic depreciation. This module also allows users to manage insurance policies and maintenance costs related to fixed assets, postfixed asset transactions and generate varying statistics as well as reports.

Inventory management modules consist of sub-modules like spare part replenishment, warehouse management and multi-location stock management. Spare part replenishment allows users to acquire a basic overview of inventory levels and expected supplies over time to aid in providing accurate delivery dates for multiple items. Besides, warehouse management offers assistance with the administration of workflow-based internal, inbound and outbound warehouse activities to users. Multi-location stock

management allows users to manage multiple inventories and physical or virtual placements of items using one database in all locations.

2.6 Study of DreamzTech Car Servicing Workshop System

DreamzTech Car Servicing Workshop System is a system that has been developed by DreamzTech Solutions [19] to enable efficient management by companies on all of the information related to car servicing, car booking, car repairing, and others. This system aimed to provide car servicing workshop system automation solutions that helps the organizations' customers to go through a smooth experience while visiting car servicing workshops. Integration of Customer Relationship Management System (CRM), Point of Sale (POS) system and inventory system are available as well to solve company's business problems and improve customer experience.

DreamzTech Car Servicing Workshop System consists of several modules and provides feature like car service management. It allows users to manage car information easily using POS web admin and users can also manage car services information of workshop. Users can also manage customer info and related car information through this system by inserting and searching their personal whereas customers can perform online booking afterward. Other than that, employees can select the products to the bill, alter the price of items, providing discounts and produce the final bill. Payment and billing modules also allow users to select payment methods like cash, credit card and vouchers or points. Then, invoices will be generated for customers. Users can view their service history and detailed information through this system. This system can also generate a service history report and car information report so that users can view car health details.

2.7 Comparison with the Existing Systems

In comparison between the functionalities provided by Vision Car Service Shop Management System and the three related existing systems, the proposed system generally provides every feature available and it also provides an extra feature which is updating the inventory levels automatically when receipts and invoices are created.

3. Methodology

The waterfall model is widely adopted in project development due to its sequential process of software development that produces stable and constant progress from one stage to the other. The phases in the Waterfall model go downwards through requirement analysis, design, coding, testing and maintenance. According to Peterson K. et al. [20], the waterfall model is usually adopted in a small or middle-sized project as it provides outstanding quality control as it prioritizes detailed project planning and massive project documentations. Hence, P. Matkovic [21] stated that the ideas of slicing sashimi have been implemented into the waterfall model to allow overlapping of phases and continuous communication between phases throughout the system development life cycle which indicates the phases only end when the system had been successfully developed while fulfilling system requirements.

System development lifecycle adopted in developing Vision Car Service management system which is Sashimi model start with software concept phase. In this phase, preliminary analysis on company background and requirements gathering is carried out to identify detailed information related to the target company and define primary business problems through observations. Other than that, business rules and business requirements are acquired through interview sessions with business owners. User stories and scenarios are recorded to produce a high-level definition of requirements based on comments and communication with business owners to collect data for generation software requirement specification documents that consist of problem definition, problem statement, objectives and project scopes in next phase. Project scheduling is then carried out so that the workflow of the project is determined as well as smoothly. Hence, deliverables are accomplished before the expected timeline and

more accurately, on time. In this phase, system conceptual design and Gantt chart are the final deliverable.

For the requirement analysis phase, the system conceptual design is revised again and corrections are performed so that the user stories and scenarios collected previously are further analysed to produce a requirement list which consists of functional and non-functional requirements that highlight the system requirements.

In the architectural design phase, problem definition and business models include AS-IS and TO-BE models are defined and constructed to demonstrate the overall business problems encountered and improvements that can be made in business operations. Not only that, software and hardware requirements for project development and documentation are determined as well. After that, a suitable approach and system constraints were determined to highlight issues and tasks that should be considered well. Next, a flow chart regarding business processes and workflows is constructed, refined and normalized to show the general architectural design of a functioning system. In this phase, the requirements traceability matrix and system logical designs are the final deliverables.

For the detailed design phase, the user interface of each module is designed by constructing the wireframe diagrams to present a general idea of the system interface. The main functions and features provided by the system as well as data management flow are demonstrated through these diagrams as deliverables for this phase. All the system designs and diagrams will be constructed using hardware and software mentioned previously so that they are suitable for future implementation.

For the coding and debugging phase, the system physical design created previously was implemented as coding using programming knowledge to produce a fully functioning system that fulfils the list of requirements. Specific software and database server were applied to integrate the code and store data collected in the system as well. Unit testing on specific modules was carried out so that the syntax errors of the system are reduced and the modules work smoothly during system integration. In this phase, a fully functioning system prototype is the final deliverable.

The last phase is the system testing phase which test cases are listed and produced based on system functions to carry out unit testing again so that the system has minimum defects. Every part of codes based on system architecture was tested to assure minimum bugs and errors. Next, an user acceptance test which involves client testing on the system prototype is carried out to ensure all system requirements are met and feedbacks were collected to improve the system.

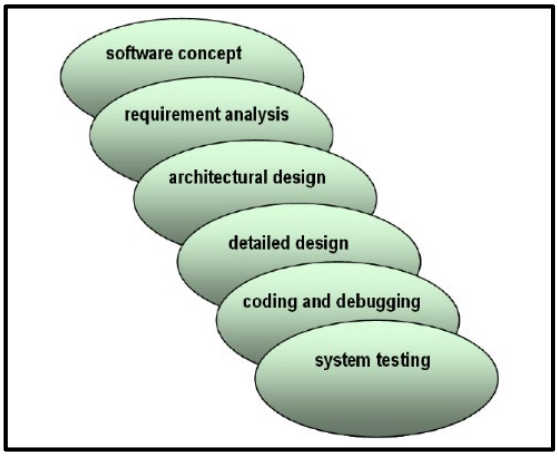

Figure 1: Sashimi Waterfall model with overlapping phases proposed by Matkovic, Predrag & Tumbas, Pere. [21]

3.1 Software Requirements Specification

Software and its functionality required to develop the system are as below:

- Atom, as code editor to develop the system
- Microsoft Project, as tools to prepare the Gantt Chart
- Microsoft Visio, as tools to prepare the logical design of system architecture
- XAMPP, as a cross-platform web server for system
- MySQL, to design and develop database server

3.2 Hardware Requirements Specification

Hardware and its functionality required to develop the system are as below:

- Central Processing Unit (CPU) with Intel Core i5-8250
- Random Access Memory (RAM) with 4 Gigabyte
- Hard drive storage with 1000 Gigabyte

4. Analysis and Design

The functionalities of the Vision Car Service shop management system are determined based on system requirements as well as user stories elicited through interviews and it is documented as a list of user requirements which is a high-level abstract statement. Functional requirements which describe what must be done by the system and non-functional requirements that describe the quality of services provided by the system are defined to demonstrate system behaviours. Casey et al. [22] stated that the structured approach that is applied in system development aid in breaking down the large complex into smaller but manageable modules through structured techniques includes process modelling, data modelling and business modelling to determine system architecture. Casey et al. [22] also mentioned that structured diagrams like context diagram are used to establish system context and system boundaries of system, data flow diagram is used to provide a graphical representation of information and data flows between processes and entity relationship diagram is used to illustrates the relationship between multiple data stores or entities in the system.

4.1 System Requirement

System requirement consists of functional requirements which describe the features or functions that will be provided by the system and non-functional requirements that illustrate the system attributes as well as the quality of services of the system. According to Alan. F. et al. [23], System requirements are all of the requirements at the system level that describe the functions which the system as a whole should fulfil to satisfy the stakeholder requirements and expectations. Table 1 shows the functional requirements provided by Vision Car Service Management System.

Table 1: Functional requirements of Vision car service management system

No	Modules	Functionalities
1	Register and Log in	• The system should only allow admin to register a new user account. • The system should allow admin to log into the account using Username and password. • The system should allow employees to log into their account using Username and password. • The system should display an alert message when there is invalid input. • The system should redirect users to the main page of the system after logging into the account successfully.

Table 1: continue

No	Modules	Functionalities
1	Register and Log in	• The system should only allow admin to register a new user account. • The system should allow admin to log into the account using Username and password. • The system should allow employees to log into their account using Username and password. • The system should display an alert message when there is invalid input. • The system should redirect users to the main page of the system after logging into the account successfully.
2	Document management	• The system should display options that include vehicle servicing records, purchase orders, invoices and receipts on the main interface. • The system should allow employees to create, view, update and delete any documents. • The system should display documents detail. • The system should allow employees to print the documents.
3	Report generating	• The system should display a report generating module on the main interface. • The system should display various reports that are available in this module. • The system should allow users to choose which kind of report to be generated. • The system should display report details. • The system should allow employees to print the sales reports.
4	Inventory	• The system should display the inventory module on the main page. • The system should display items information and current stock quantity in the warehouse. • The system should allow employees to create, view, update and delete inventory stocks or items. • The system should update stock quantity automatically when receipts of customers and invoices from suppliers are created.

Non-functional requirements specify how the system should do, perform a certain function and behave to external environments [23]. Non-functional requirements define system behaviour, quality of services, features and general characteristics that affect the user experience. In other words, non-functional requirements cover all the remaining requirements which are not covered by the functional requirements and it specify criteria that judge the system operation instead of specific behaviours which is mentioned in functional requirements. Table 2 describes the non-functional requirements of Vision Car Service Management System.

Table 2: Non-functional requirements of Vision car service management system

No.	Modules	Functionalities
1	Performance	• The response time of the system should be less than 1 second. • The system should be able to be accessed by users anytime.
2	Security	• Passwords shall never be viewable at the point of entry or during log-in. • Users can only access the system through registered account using ID and verified password.
3	Usability	• The system shall be easy to use, easy to navigate and no training session is required. • The system shall use easy and understandable vocabulary in English.
4	Scalability	• The system shall be scalable to support the unlimited growth of businesses and the number of documents. • The system shall be scalable to support the unlimited number of reports generation.

4.2 User Requirement

User requirements generally describe what the user expects from the proposed system and how the system will behave to meet business needs by providing certain functionalities and features [24]. User requirement is determined based on agreement and understanding between stakeholders and developers through interview sessions and observations to produce desired prototype system that can overcome business problems. Table 3 shows the list of user requirements elicited for system development.

Table 3: User requirements for Vision car service shop management system

No.	User requirements
1	All users should be able to log into the system using an ID and password.
2	Employees should be able to insert purchase orders, receipts and invoices details.
3	Employees should be able to update purchase orders, receipts and invoices details.
4	Employees should be able to view purchase orders, receipts and invoices details.
5	Employees should be able to delete purchase orders, receipts and invoices details.
6	Employees should be able to print purchase orders, receipts and invoices.
7	Employees should be able to view vehicle servicing records.
8	Employees should be able to update vehicle servicing records.
9	Employees should be able to search vehicles using car plate numbers.
10	Employees should be able to print sales reports
11	Employees should be able to view inventory stock and current stock quantity.
12	Employees should be able to view and update inventory stock details and information.
13	Employees should be able to print inventory reports.

4.3 Context Diagram

A context diagram aids in understanding the entire system by presenting the overview of the system and it contains elements like entities or stakeholders that interact with the system, data flows and the proposed system which is located right in the middle of the diagram [25]. Context diagram starts with mentioning major processes with little details then goes on to give more details of the processes using the top-down approach. Figure 2 shows the Context Diagram of Vision Car Service Management System.

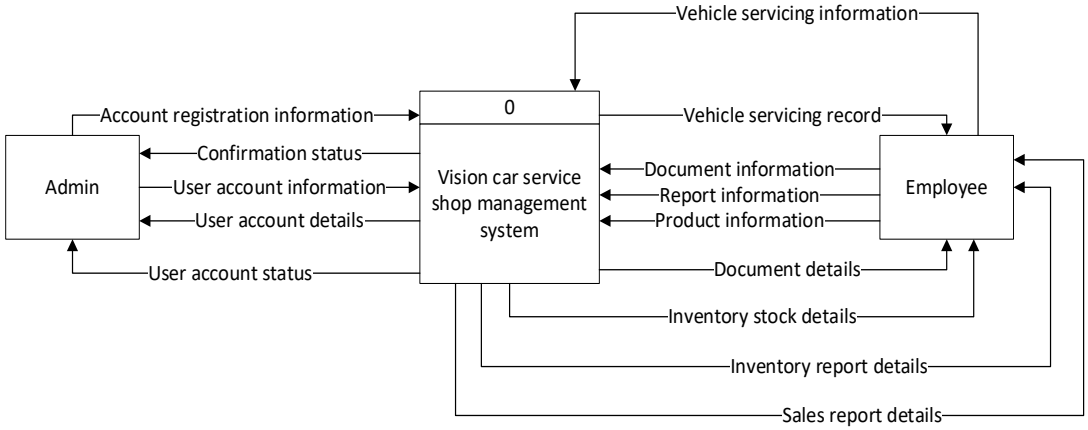

Figure 2: Context diagram of Vision car service shop management system

4.4 Data Flow Diagram

A data flow diagram describes the requirements or features of the system in a graphical form by showing the data flow between entities, various functions and data store to specify how the current system is implemented [26]. The process model of Vision car service shop management system consists of 6 main functionalities which include register account, manage account, manage documents, manage report, manage inventory stock and manage vehicle servicing record, 2 entities that are admin and employee as well as 8 data stores. The data flow diagram of Vision Car Service Management System is presented in Appendix A.

4.5 Entity Relationship Diagram

An entity relationship diagram is known as a graphical representation of data requirements for the system database and it is the highest level of abstraction for the data model [27]. It presents the data store within the system using diagrams and symbols to show the relationship and communication between the datastore. Appendix B shows the entity relationship diagram of Vision Car Service Shop Management System.

4.6 Swim Lane Diagram

A swim lane diagram is constructed in order to show how a process flows from beginning to end as each step is broken down in detail to determine what needs to be done, who is involved, how the process will be accomplished and what is the output of the process [28]. In short, it aids in highlighting waste, redundancy and inefficiency in a process. The swim lane diagram of document management process is demonstrated in Appendix C.

4.7 Data Dictionary

Data dictionary consists metadata that is available in database or data store of the system and it contains the information such as what is in the database, the data type of attribute, where the database

physically stored is and the description of each data. The data dictionary of Vision Car Service Shop Management System is shown in Table 4.

Table 4: Data dictionary of Vision car service shop management system

Attribute Name	Data Type	Description
User_ID	Int	User ID for employee
User_Name	Varchar	User name is based on account registration name insert by admin
User_Password	Varchar	Account password with combine numerical and alphabet
User_Role	Varchar	User role in system.
Vehicle_ID	Int	Vehicle ID for vehicle
Vehicle_Name	Varchar	Vehicle name of customers
Vehicle_Plate	Varchar	Plate number of vehicles
Vehicle_Comment	Varchar	Comment on service provided.
Purchase_ID	Varchar	Purchase order ID for purchase order
Purchase_Date	Date	Date of issuing purchase order
Purchase_Comment	Varchar	Employee's comment on purchase order
Noti_ID	Int	Notification ID for notifications
Noti_Date	Date	Date of notifications
Noti_Message	Varchar	Comments in notifications
Noti_Status	Text	Reading status of notifications
Rec_ID	Int	Receipt ID for receipt
Rec_Date	Date	Date of issuing receipt to customer
Rec_Total	Float	Total payment to be made by customer
Inv_ID	Int	Invoice ID for invoices
Inv_Date	Date	Date of receiving invoices from supplier
Inv_Supplier	Varchar	Name of supplier
Inv_Total	Float	Total payment to be made by Vision car service
Stock_ID	Int	Stock ID for stocks
Stock_Name	Varchar	Name of stocks
Stock_Price	Float	Price of stocks
Stock_Description	Varchar	Stock details and information
Stock_Qty	Int	Current quantity of stocks

4.8 Interface Design

The user interface is the front-end application view to which the user interacts to use the system. The user interface design of each module in Vision Car Service shop is constructed to present an overview of how the system will interact with users to provide a rich user experience. The user interface design of this system is constructed using the wireframe diagram to demonstrate simple yet clear insight of the system. The interface designs of Vision Car Service Shop Management System are presented in Appendix D.

5. Testing

5.1 Functional Testing

Test cases with test data, descriptions and expected results are developed to perform the functional test on the prototype system to ensure it fulfils system requirements. A list of test cases for the register and login account module is shown in Table 5.

Table 5: List of test cases for functional testing on Register and Login account module

No.	Test Cases	Description	Expected Result
1.	TEST_100_001	Check system behavior when valid username, password and confirm password is entered.	User should be able to register new account successfully.
2.	TEST_100_002	Check system behavior when valid username and invalid password is entered.	User should not be able to register new account.
3.	TEST_100_003	Check system behavior when invalid username and valid password is entered.	User should not be able to register new account.
4.	TEST_100_004	Check system behavior when valid username, valid password and invalid confirm password is entered.	User should not be able to register new account.
5.	TEST_100_005	Check system behavior when valid username, invalid password and invalid confirm password is entered.	User should not be able to register new account.
6.	TEST_100_006	Check system behavior when username is entered, password and confirm password is left blank, then Register button is entered.	User should not be able to register new account.
7.	TEST_100_007	Check system behavior when username, password and confirm password is left blank, then Register button is entered.	User should not be able to register new account.
8.	TEST_100_008	Check system behavior when valid username and valid password is entered in login page.	User should be able to login to system.
9.	TEST_100_009	Check system behavior when invalid username and valid password is entered in login page.	User should not be able to login to system.
10.	TEST_100_010	Check system behavior when valid username and invalid password is entered in login page.	User should not be able to login to system.
11.	TEST_100_011	Check system behavior when invalid username and invalid password is entered in login page.	User should not be able to login to system.
12.	TEST_100_012	Check system behavior when username and password is left blank and login button is entered in login page.	User should not be able to login to system.

A total of 75 test cases have been established in the test plan and executed to verify and validate the system functionalities and behaviors. All of the expected results are similar to the actual results produced during functional testing. The testing result of 75 test cases is passed and none of the test cases failed. The functional testing result on Register Account and Login module is shown in Appendix E1 and the overall result of functional testing is presented in Appendix E2.

5.2 User Acceptance Test

User acceptance test (UAT) is conducted by inviting employees of Vision Car Service to rate the prototype system based on performance and behaviors through a questionnaire. Comments and feedbacks are gathered to further improve the functionalities of the system. The questions proposed and the result of UAT regarding system performance rating are shown in Figure 6.

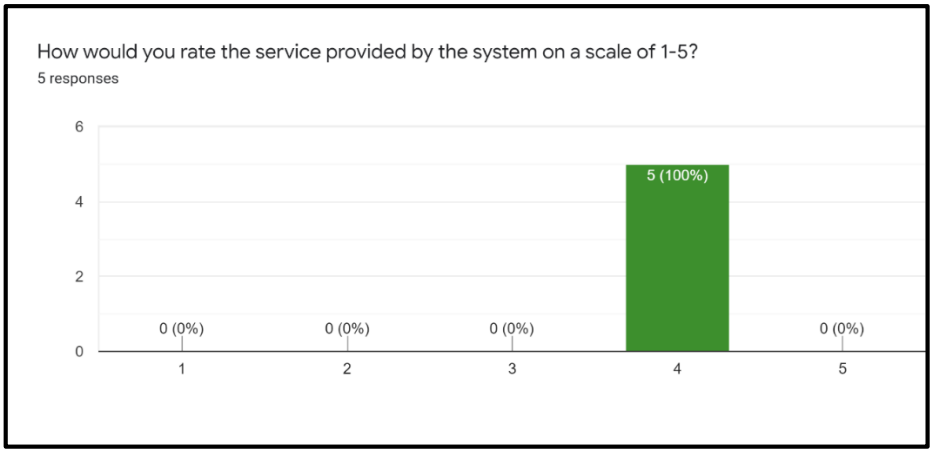

Figure 6: Responses of end-users on system rating

Generally, majority of the employees have rated 4 out of 5 for the prototype system performance and its features.

Responses of employees on business process efficiency when using system during UAT is presented in Figure 7.

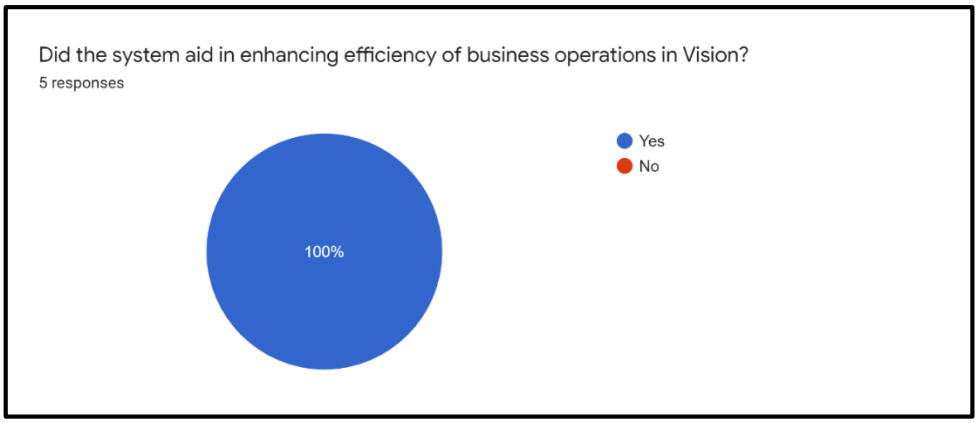

Figure 7: Responses of end-users on business process efficiency when using system

Generally, majority of the respondents agreed that the prototype system aid in enhancing the efficiency of business operations after adopting the system in business environment.

6. Conclusion

Vision car service shop management is a web-based system designed and developed to help users to manage documents, generate reports, manage inventory and provide business process systemization so that users can manage the business efficiently. The system is developed using a structured approach and Sashimi Waterfall model as the system development life cycle. For future system development, Vision Car Service Shop Management System can be improved by including more stakeholders or entities in the system. Functionalities like sharing of documents through the system with the entities and stocks ordering can also be included in the system. Other than that, the system can be developed into a mobile application to enhance the quality of services of the system.

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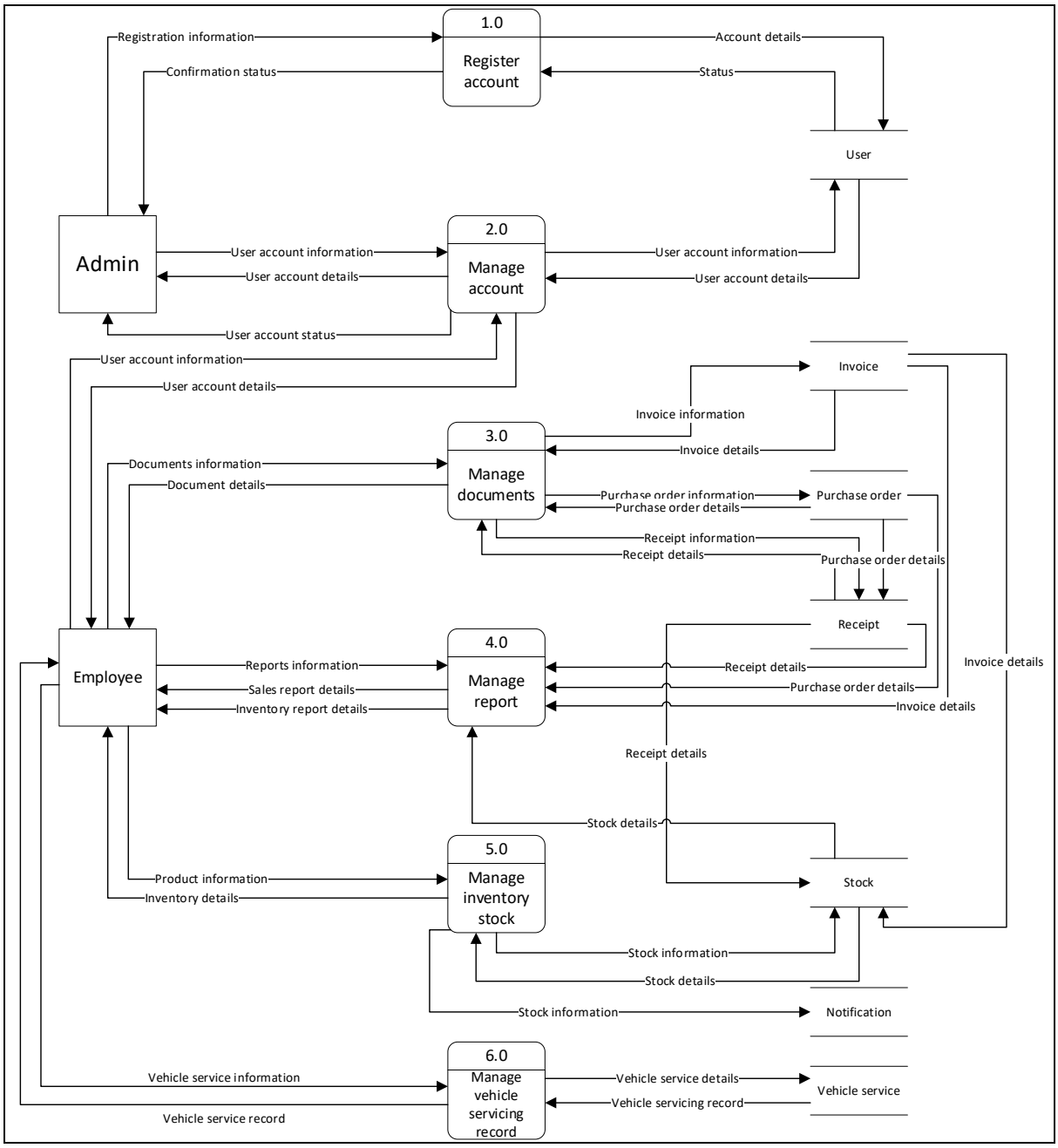
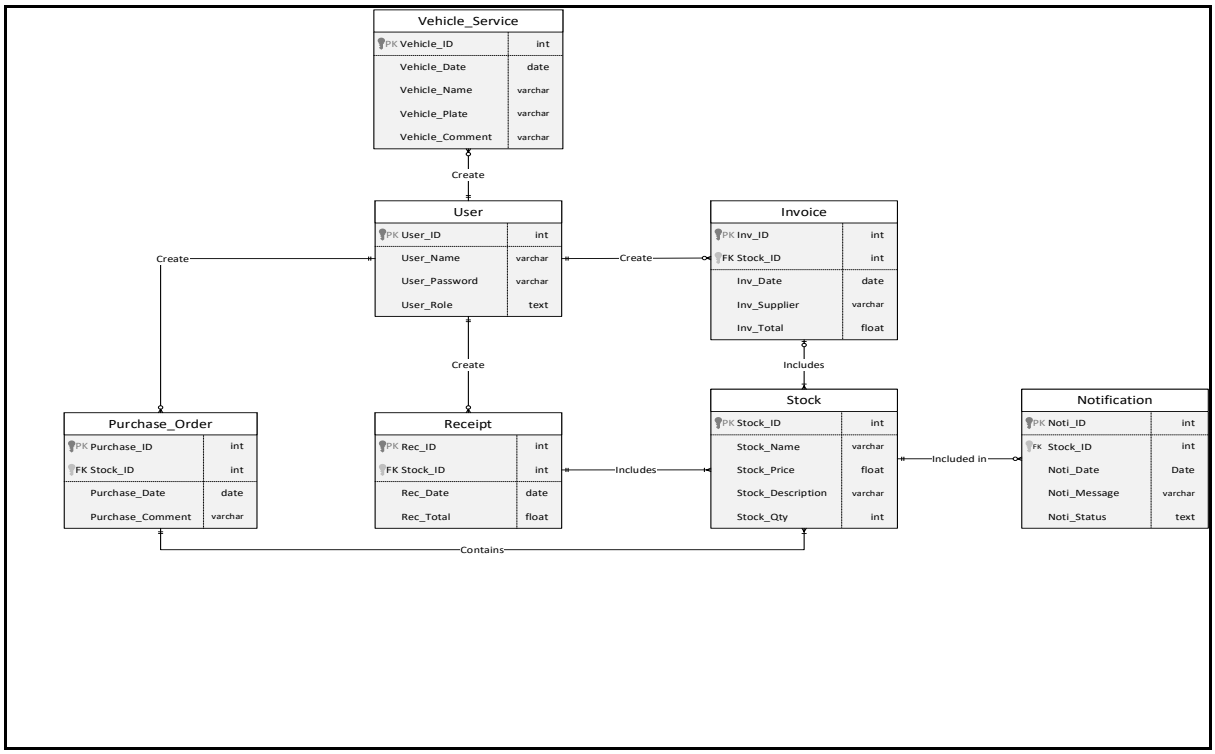
Appendix A



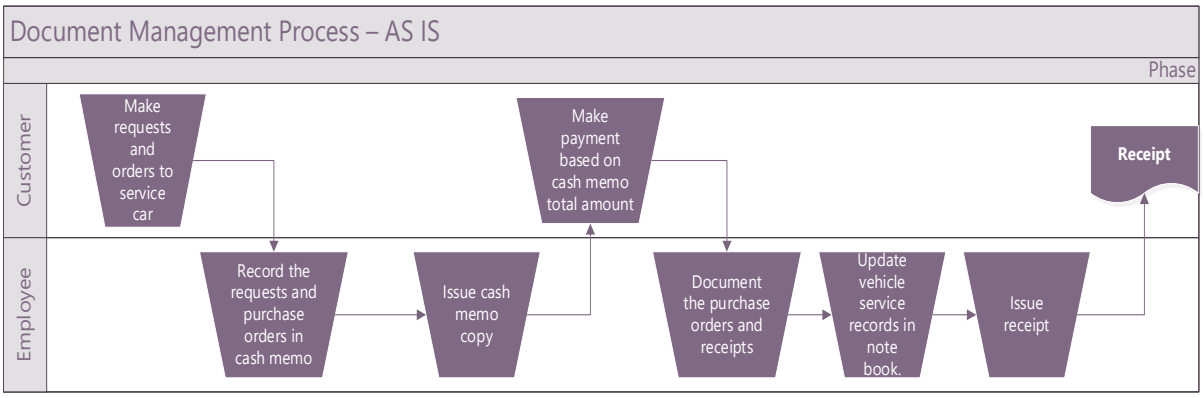
Appendix A1: Data Flow Diagram of Vision Car Service Shop Management System

Appendix B

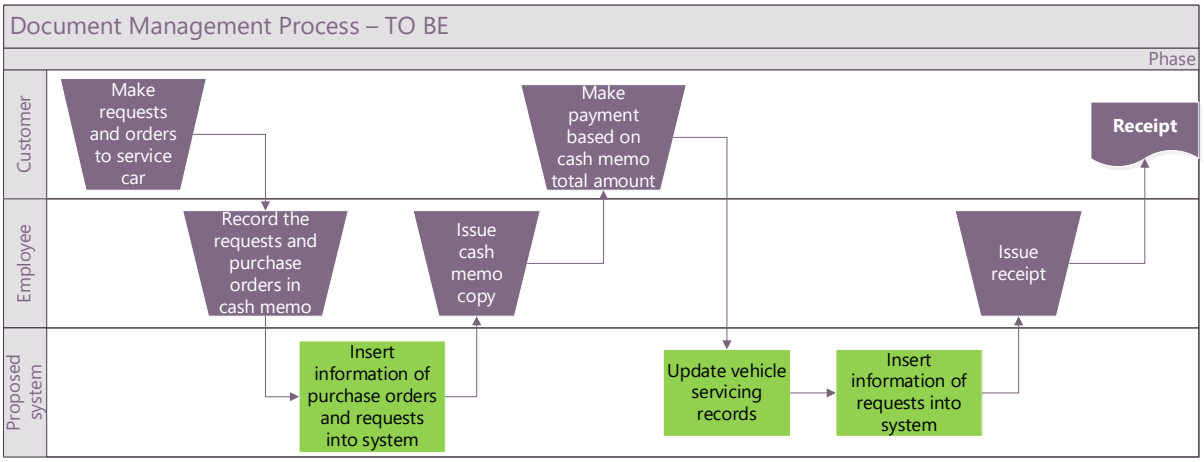


Appendix B1: Entity Relationship Diagram of Vision car service shop management system

Appendix C

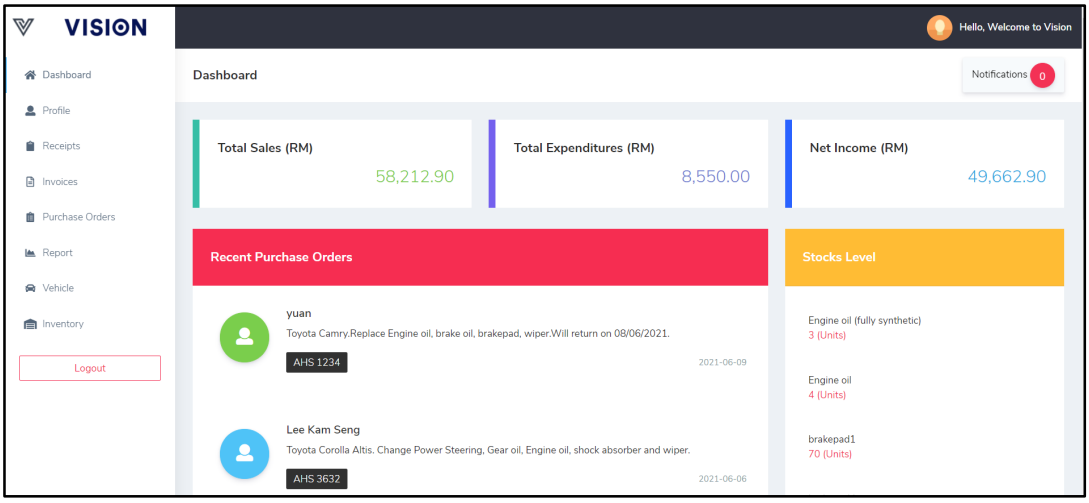


Appendix C1: Swim Lane diagram of document management process (AS-IS)

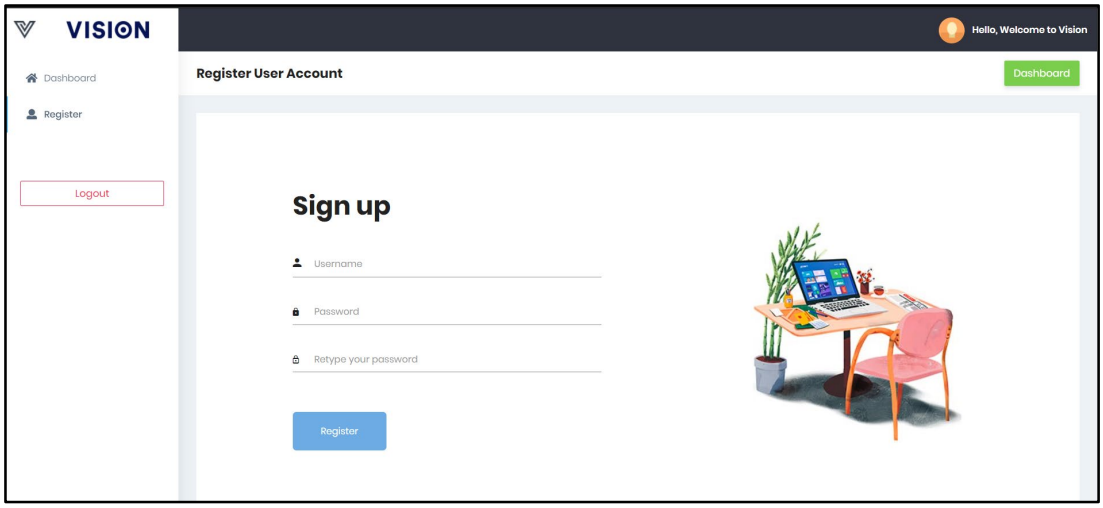


Appendix C2: Swim Lane diagram of document management process (TO-BE)

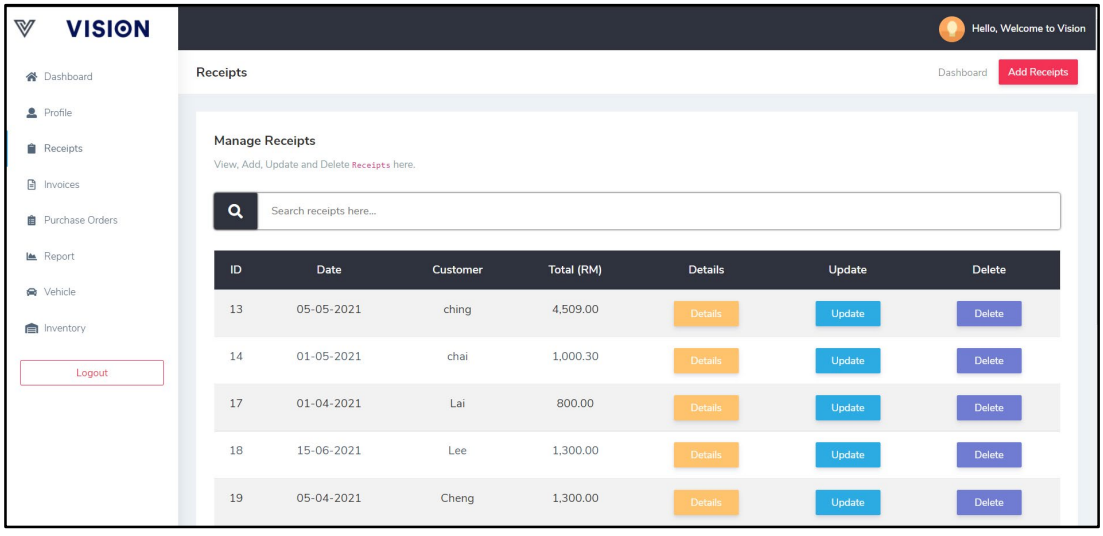
Appendix D



Appendix D1: Interface design for homepage of Vision car service shop management system

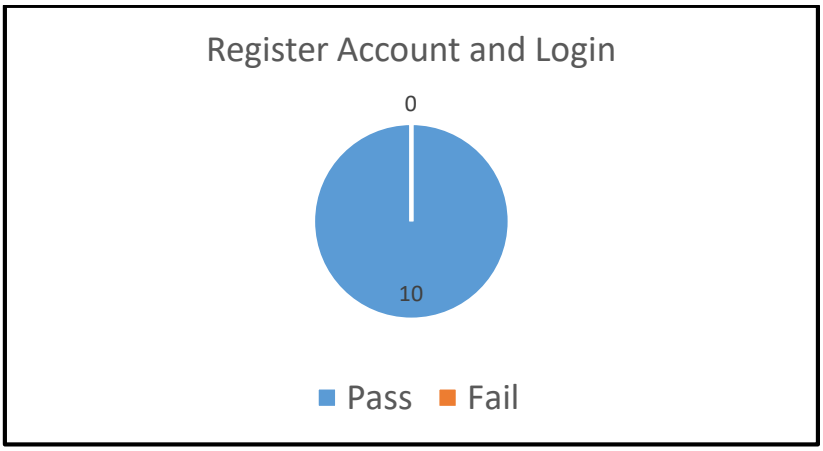


Appendix D2: Interface design for Register page of Vision car service shop management system

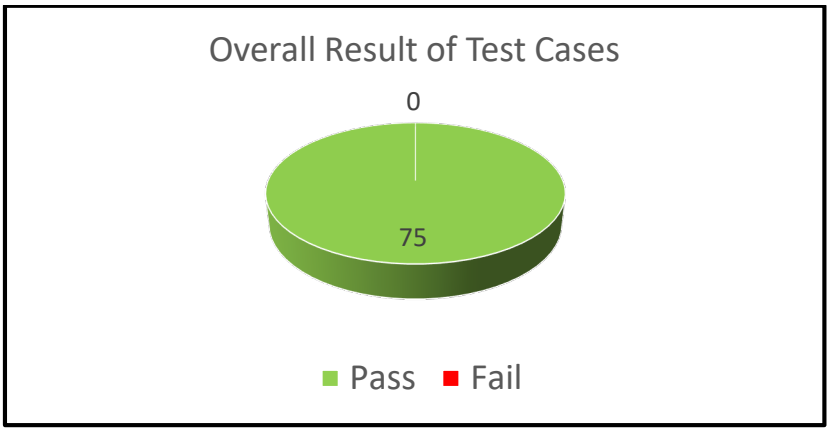


Appendix D3: Interface design for Document management

Appendix E



Appendix E1: Percentage of pass and fail of test case on Register Account and Login module



Appendix E2: Percentage of pass and fail in overall result of functional testing

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