

Development Web-Based Inventory and Customer Management System for Retail Bakery Online

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Abstract: Maggie Pastry, a retail bakery online founded by Maggie in 2020 during covid-19 pandemic. The inventory management process of the bakery is handled manually. Hence, there will be many uncontrollable human errors occurred. The two main problems cause by the above situation are hard prediction for the inventory level of baking ingredients and lack of customer service. Therefore, a web-based inventory and customer management system is proposed by using iterative development model. The proposed system was developed by using PHP language, AJAX technique, jQuery and SQL. MySQL was used as database management system while Visual Studio Code was used as text editor. The management process in a bakery done by system is familiar nowadays. The system can assist them by automating most of the repetitive tasks. In future, the automation in the system will be keep improved until fewer human resources are required in the process of management.

Keywords: Inventory Management System, Customer Management System, Web-based, Retail Bakery Online

1. Introduction

In March 2020, Covid-19 virus officially arrived in Malaysia, causing serious damage to Malaysian economy, especially the retail industry. Fortunately, this era is the Industrial Revolution 4.0, and the technology of this era has reduced some of the damage to the retail industry. They began to transform their business from physical stores to online stores. Maggie Pastry is one of the retail bakeries online which start their business during this pandemic period.

Maggie Pastry, a retail bakery online, which done all the process of management manually. First, salesman will promote their baked goods through social media, such as Facebook, WhatsApp, and WeChat. After received an order, the salesman will jot down the order information on a paper and pass it to the bakers. Then, the bakers will start their works. Their customers usually need to make a 3 days pre order. In this case, we know that they manually manage the inventory of baking ingredients and baked goods by writing them down on paper. In addition, all communications between sellers and

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customers regarding order information or delivery status are conducted through third-party messaging applications.

From the above situation, few problems can be identified. First, it is difficult for them to predict the inventory level of baking ingredients. Therefore, they might face inventory problems of too much or too little stock of baking ingredients on hand and this might cause business failures [1]. Second, the salesman needs to manually process all the customer messages from different types of communication applications. This order processing method takes up a lot of time as well as manpower. The process also easy to get wrong due to human error. As we know, today's customer wants a shorter, lower cost and precise delivery speeds [2]. Those human error will increase the time of delivery and mislead delivery information to customers. At the end, it causes the bakery lost a lot of potential customers.

Hence, we know that a retail bakery online without a management system is difficult to succeed. In this project, a web-based inventory and customer management system will be made for them. This system can also be used by other online bakery shops. In general, the system is divided into three parts which administrator, bakery manager and customer. For the administrator and bakery manager system, they share almost the same features. It able to keeps track the current inventory levels for recipes at the ingredient level. The system can also make order forms that can be automatically sent to vendors to purchase the ingredients. Moreover, the system able to record all the orders automatically, and administrator can view those orders at once. For the customer system, it allows users to view all the details of various baked goods at the online shop and purchase online. They can check the purchase information immediately after they make the payment. With this management system, many tasks can be completed automatically without manpower, and these tasks can be completed more accurately. This will help develop their business.

2. Related Work

In this chapter, the related work of the proposed system will be discussed. The terms and concept regarding to the proposed system will be explained in this section. They are Inventory Management System, Customer Management System, Web-based System, Hypertext Preprocessor (PHP) Programming Language, MySQL Database and Apache Web server

2.1 Inventory Management System

Inventory management is the process of monitoring, regulating, storing, and utilizing the amounts that a company uses to make the products it sells [3]. It will track products along the supply chain, from procurement to manufacture to final sales. In general, inventory management system standardizes the methods of inventory management of a company.

Inventory management system is very helpful to manage the stock in any company as it able to track and control the stock accurately. Without an inventory management system, workers must manage inventory manually and eventually the company will soon face an overstock or understock scenario. This is because human error will occur when a large amount of inventory is manually managed, resulting in inaccurate inventory counting. The inventory management systems will indicate the total of elements or ingredients which need to make or assemble the final product in a very accurate method. This will prevent the company from facing excess inventory, eroding the bottom line, or insufficient inventory to meet client needs. As a result, the inventory management system really helps retail online stores manage their inventory in an accurate way, so they can focus on sales marketing strategies.

2.2 Customer Management System

Customer management system, also called customer relationship management (CRM) is broadly recognized as a critical management discipline. It is defined as the fundamental business approach that combines internal processes and activities with external networks in order to develop and provide

profitable value to target customers [4]. It is built on high-quality customer-related data such as customer information, customer purchase information and customer review. These data is able to be collected and managed by the system.

Customer management system provide a set of software tools meant to handle the three axes of business-to-customer relationships which are sales, marketing, and service [5]. Customer management system allow the company always to have a connection with customer by centralizing and analyzing the customer-related data. As a result, customer management system improves the company's capacity to coordinate marketing and service activities. Since primary strategic aims of each company include long-term expansion and sustainability [6], therefore the key goals of customer management system are to meet customer wants and requirements while also boosting customer happiness. Hence, the adoption and utilization of customer management system in retail online store has yielded immediate results in terms of financial performance and day-to-day operations of a company.

2.3 Web-based System

Web-based system is defined as the information and interaction technology software [7]. For both its related equipment or related software and hardware, web-based system evolves at a breakneck pace. It allows the assessment of information at anywhere and during anytime.

Web-based system is such a information systems that can be applied for any purposes, such as business interactions, inventory checking, customer management, etc. The industry has previously implemented web-based system in the construction of database information systems due to the well-organized of its manufacturing procedure, database maintenance, and marketing procedure as well as low cost of development. Hence, a web-based system is very suitable to serve as an approach of inventory and customer management system for retail store online due its simple and well-organized interface and affordable development fees.

2.6 Comparison Existing Systems with the Proposed System

There is a comparison among the four system in which three of them are existing system and one of them is proposed system. The existing system are Flexibake, Globalbake and BakeSmart. The result of comparison is shown in table 1.

Table 1: Comparison Existing Systems with the Proposed System

Features/System	FlexiBake	Globalbake	BakeSmart	Proposed System
Web-based	✓	✓	✓	✓
Simple and well-organized interface	✓	✓	✓	✓
Store data for baking ingredients	✓	✓	✓	✓
Store data for products	✓	✓	✓	✓
Notify user for low inventory level	✗	✗	✓	✗

Table 1: (cont)

Provide information of delivery process to user and customer	✓	✗	✗	✗
Automate reorder levels according user's setting	✗	✓	✗	✗
Report generating	✓	✓	✓	✓
Information of customer order display at user's order screen	✓	✓	✓	✓
Email notification to customer for their order	✓	✓	✓	✗
Mobile version	✓	✓	✓	✗

3. Methodology/Framework

In this project, iterative development model will be used to develop web-based inventory and Customer Management system for retail bakery online. At the most fundamental level, this model is built up based on a continuous cycle of planning, analysis, implementation, testing, and evaluation. The iterative development model begins with the initial planning and general needs. Therefore, the priority portion of the project becomes the development cycle's beginning stage. Each portion will be improved by trial and error. It will serve as the foundation for the next phase of the development once it is completed. Each portion improves the overall development. Figure 3.1 show each phase in each portion which used to develop the proposed system. These five phases are planning and requirements, analysis and design, implementation, testing as well as evaluation and review which can be repeated as many times based on the requirement of developer.

Iterative development also can be known as circular or evolutionary development. This is because developer able to improve the first version based on the results of succeeding cycles, particularly when gathering and incorporating requirements of the proposed system development. As a result, this model increases the customer involvement in the development and make the development more flexible as it allows developer to recognize new requirements by discussing with customer.

3.1 Planning and Requirements

This phase is divided into two parts which are planning and requirements gathering. Planning is the most basic procedure of any project, whether it is a development project or another form of project. This is due to developer able to gain essential data which will be utilized to design the way of system working. During planning period, the problem statement is determined according to the current problem faced by customer. Then there are the objectives, scope, and modules of the project.

Based on the data collected, a rough system can be sketched in mind. Then, requirements gathering is made based on the rough system. In order to carry out requirements gathering, few existing systems which similar to the rough system have been reviewed. Next, these systems are analyzed from a variety of perspectives, including the hardware and software utilised, the programming language used, and its functionality. At the end, a comparison is made between the existing systems and the proposed system.

The method of collecting essential data is discussion with customer. The discussion is carried out from time to time to recognize the requirements of the proposed system. It is a very important step to ensure that the proposed system meet customer's need. In addition, the Gantt Chart in which all planned tasks are divided into numerous stages to complete the proposed system development is displayed in attachment A.

3.2 Analysis and Design

In this phase, customer needs, technical requirements as well as software and hardware requirements are finalized. Table 2 and Table 3 displayed the hardware and software requirements for the proposed system respectively.

Table 2: Hardware Requirements of the Proposed System

Hardware Type	Hardware Specification
Device Model	LAPTOP-TO3D1N2R
Central Processing Unit (CPU)	Intel(R) Core(TM) i5-8250U CPU @ 1.60GHz 1.80 GHz
Random Access Memory (RAM)	8.00 Gigabyte (GB)
Hard Disk Drive (HDD)	1.0 Terabyte (TB)
Solid State Drive (SSD)	120 Gigabyte (GB)

Table 3: Software Requirements of the Proposed System

Software Type	Software Specification
Wireframe.cc	Used to draw wireframes of user interface,
Lucid chart	Used to draw flowchart and related diagram
EdrawMax	Used to draw flowchart and related diagram
Visual Studio Code	Used to code and develop system

Table 3: (cont)

Project Libre Version 1.9.3	Used to create Gantt Chart for timetable planning
XAMPP	Used as the local host server to implement the system
MySQL	Used for database storage of the system

In the portion of analysis, customer needs and technical requirements have been classified into functional requirements and non-functional requirements. By doing the classification, the user requirements can be determined. Table 4 and Table 5 demonstrated the functional and non-functional requirements respectively.

Table 4: Functional Requirements of the Proposed System

Module	Functionalities
Login (admin, manager, baker)	<ul style="list-style-type: none"> User can login to the system by providing valid credentials respect to their role Alert message will be displayed for any invalid credentials
User management	<ul style="list-style-type: none"> Allow admin to add user as manager and baker User id is provided to keep their records, such as name and role of user.
Ingredient management	<ul style="list-style-type: none"> Allow user to record the quantity of baking ingredients that available to use Ingredient id is provided to keep their records, such as name and status.
Category management	<ul style="list-style-type: none"> Allow admin to record the details of category Category id is provided to keep their records, such as name and status.
Product management	<ul style="list-style-type: none"> Allow user to record the quantity of product Product id is provided to keep their records, such as name, quantity, and status.
Order management	<ul style="list-style-type: none"> Allow admin and manager to record order Order id is provided to keep their records, such as date of order made, customer name and quantity.

Table 5: Non-Functional Requirements of the Proposed System

Requirement	Description
Reliability	The overall operation of system is understandable and easy to use.

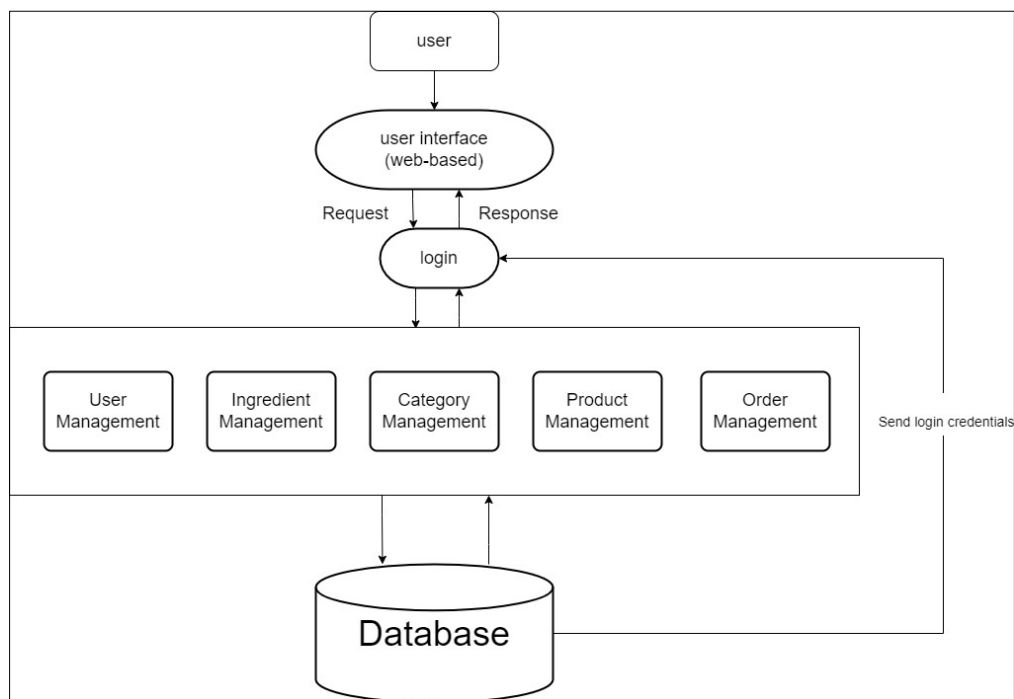
Table 5: (cont)

Scalability	The system is capable enough to handle hundred thousand users at the same time.
Availability	The system is available at all the time except scheduled maintenance service.
Security	Valid credentials must be provided by user to access through the system. Every failed attempt by a user to access data in the system will be recorded in the audit trail for further investigation.
Maintainability	Maintenance service will be carried out regularly to fix bugs and therefore the features of system can perform well.
Serviceability	The response time of each service is reasonable. No problem will be occurred when user moving from one operating system page to another.

Then, the working structure, diagram and algorithm are created to meets the analyzed requirements.

The design part is classified into backend design and frontend design to avoid troublesome during the designation of system. The backend design is primarily concerned with the input data and output data of the system. Therefore, design of database will be more concerned in backend design as compared to user interface. Flowchart, Data Flow Diagrams (DFD) and Entity Relational Diagram (ERD) are included in backend design.

The figure below is a general system architecture which describes the overall interaction of each user role with the system.

**Figure 1: System architecture diagram of proposed system**

Data flow diagram (DFD) is first explained on Structured Design written by Larry Constantine and Ed Yourdon. It shows how the system works with data based on input and output. In this project, DFD diagrams able to assist the development of web-based Inventory and Customer Management System due to DFD can usually "speak" things that are difficult to describe in words in a visual manner. The DFD diagrams consist of context diagram, DFD level 1 and DFD level 2. These three diagrams of proposed system are displayed as shown in figure 2,3 and 4 respectively.

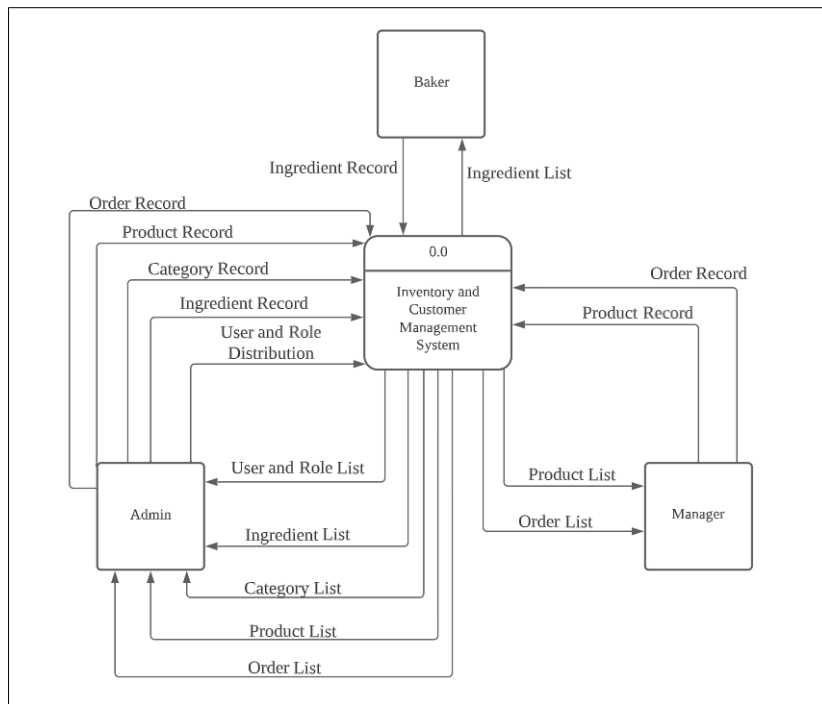


Figure 2: Context diagram of proposed system

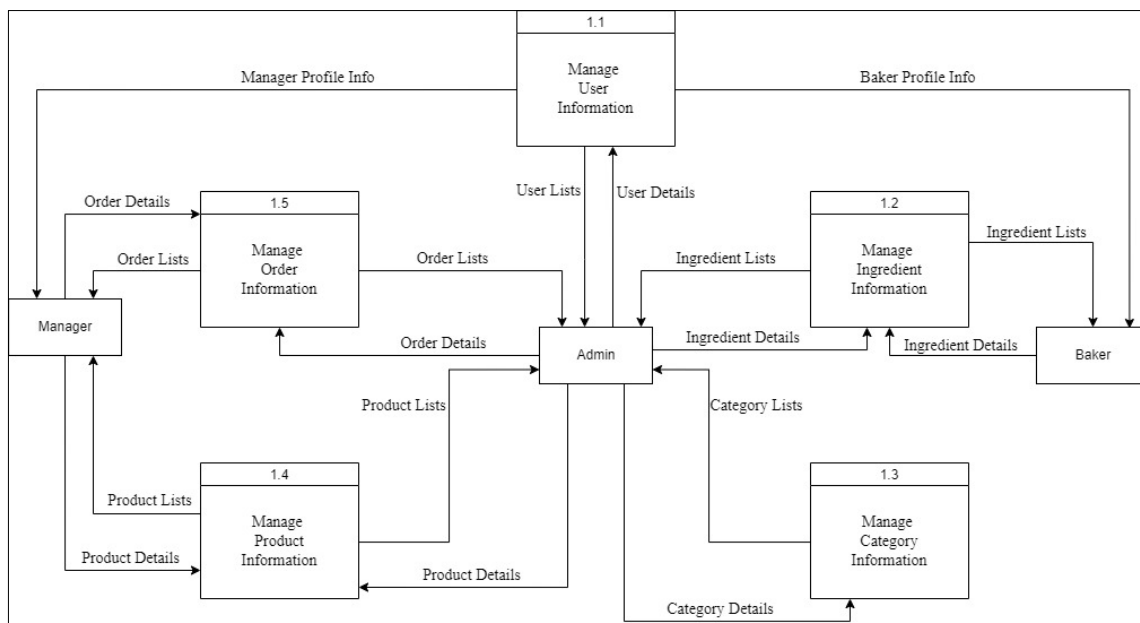


Figure 3: DFD level 0 of proposed system

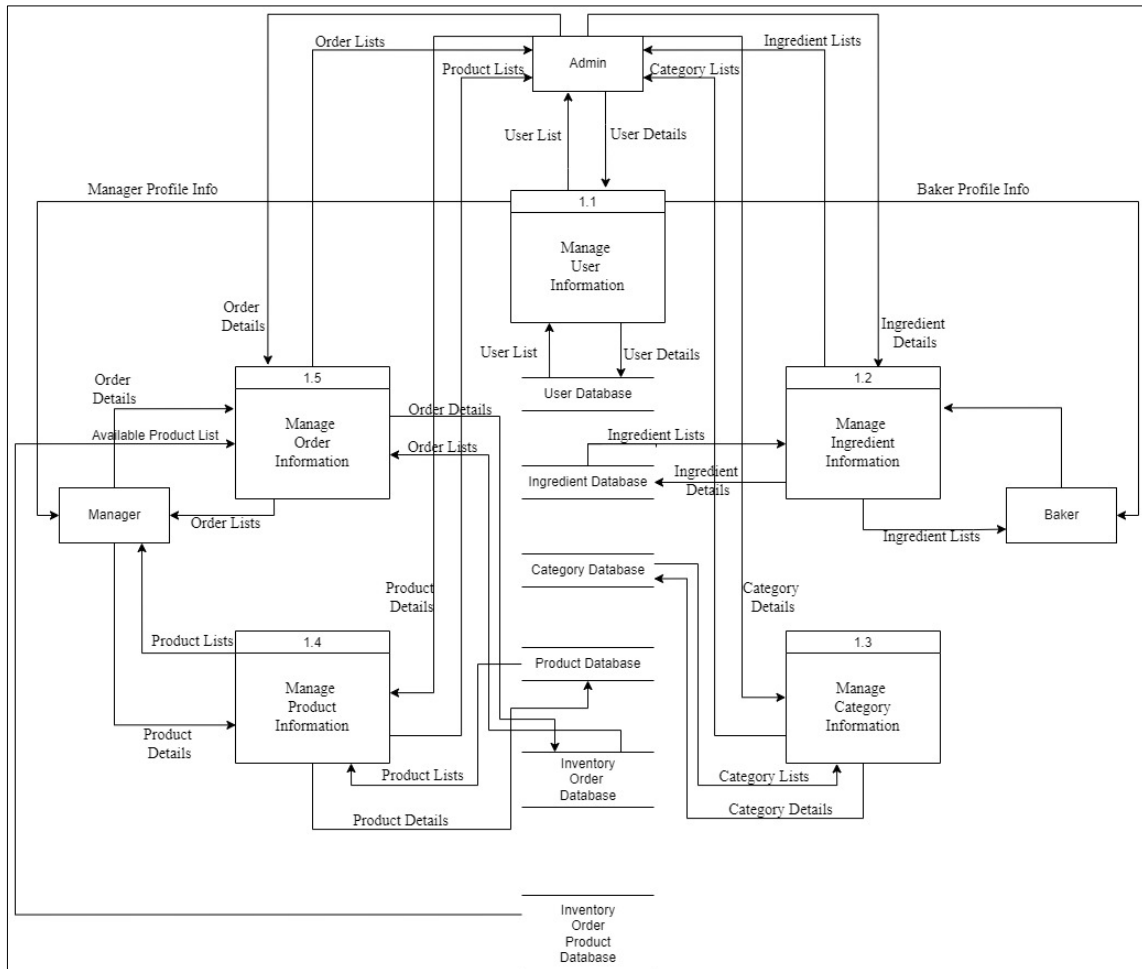


Figure 4: DFD level 1 of proposed system

Activity diagram defined as the flowchart that depicts the flow of information in a system from one action to the next. In general, the diagram able to show the working process of system and several decision routes that could influence the system behavior. The activity diagram of proposed system is displayed in Figure 5.

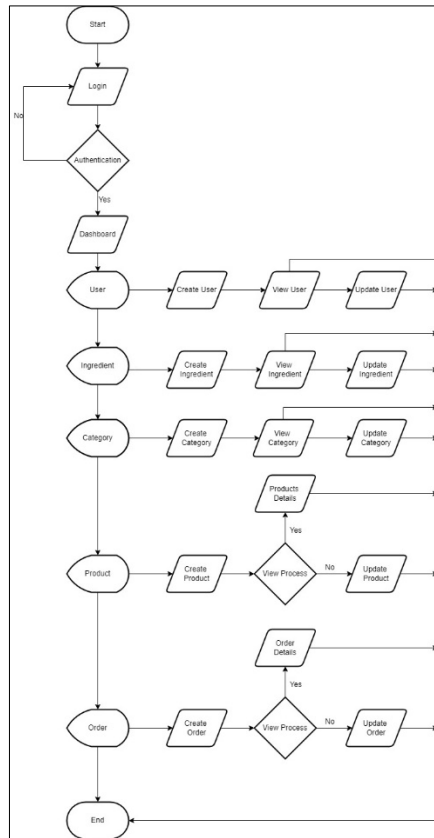


Figure 5: Activity diagram of proposed system

The relationship between a group of entities contained in a database is depicted in an entity relationship diagram (ERD). In this case, the entity is an object, or a data component. A collection of similar entities is referred to as an entity set. The property of entity can be defined via attribute. The entity relationship diagram (ERD) in Chen Form of proposed system is displayed in Figure 6.

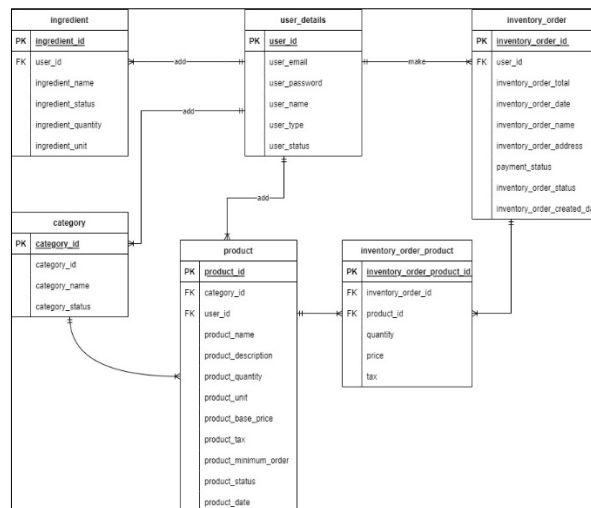


Figure 6: Entity Relationship Diagram of proposed system

For the frontend design, the way of data input as well as the presentation of output data and database to the user are mainly considered. It designed according to the User Experience (UX) and User Interface (UI) of general inventory and customer management system as well as requirements of customer. User interface (UI) design is defined as the visual layout of items that users may interact with in a website or technological product. It is used to attract potential user and displayed the features of system. UI design

is very important due to it will affect user experience of system directly. The layout of UI design should be simple and well-organized so that user can locate the elements of system in a logical order. User login interface, home interface, module interface and profile interface of proposed system are displayed in figure 7, 8, 9 and 10 respectively.

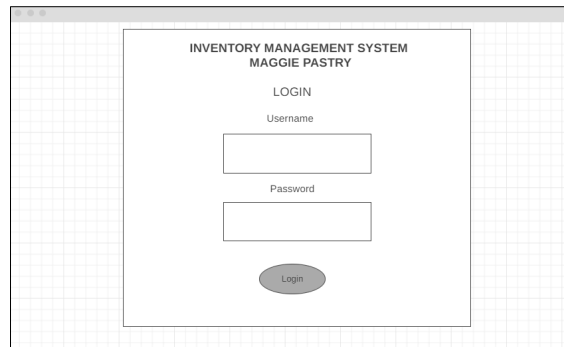


Figure 7: User login interface

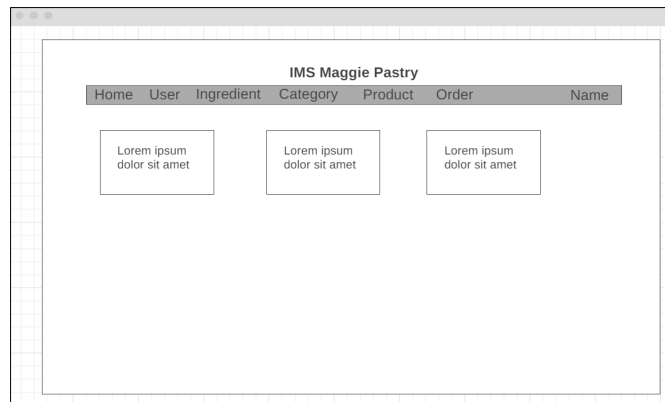


Figure 8: Home interface

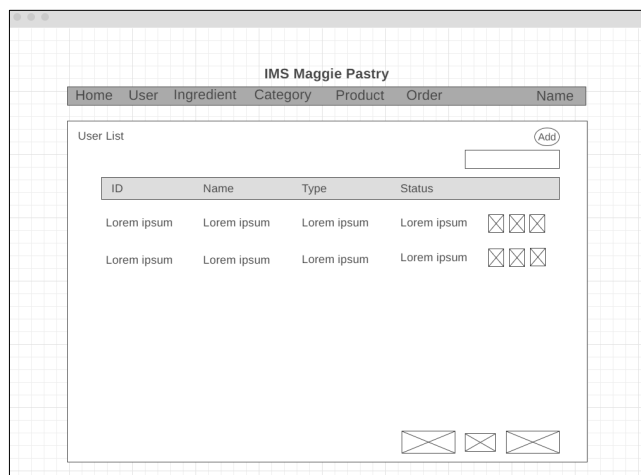


Figure 9: Module interface

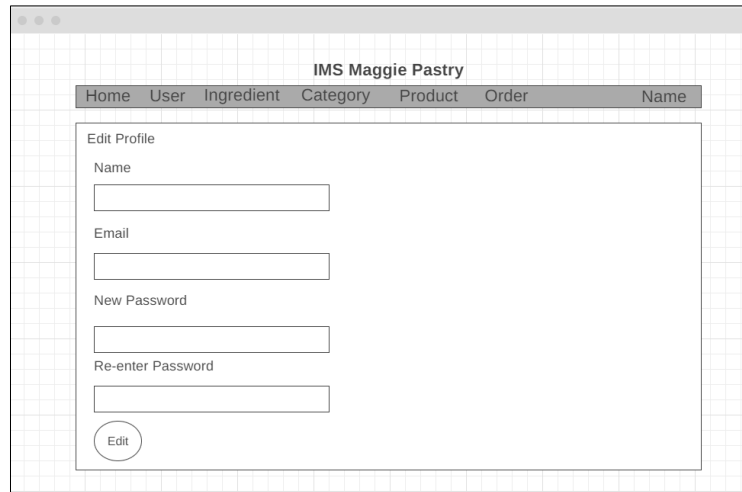


Figure 10: Profile interface

3.3 Implementation

The proposed system is divided into five modules which are user management, ingredient management, category management, product management and order management. The proposed system was developed by using PHP language, Asynchronous JavaScript and XML (AJAX) technique and jQuery. The implementation tools are XAMPP, MySQL and Visual Studio Code.

First, the system asks the user to log in with their credentials as shown in Figure 11. If valid credentials keyed by user, then the webpage will redirect to index.php which is the homepage of proposed system. In homepage, details of the proposed system will be displayed, such as total user, total ingredient, total category, and others as shown in Figure 12.

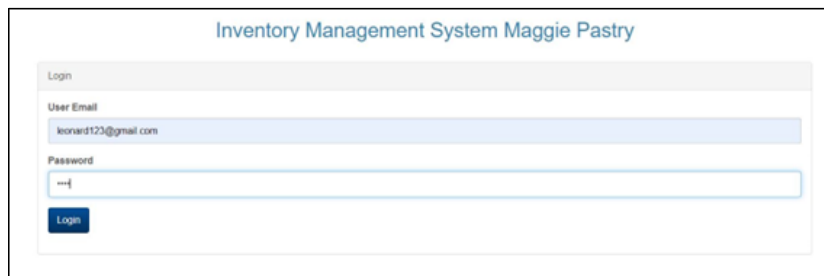


Figure 11: Login Page interface

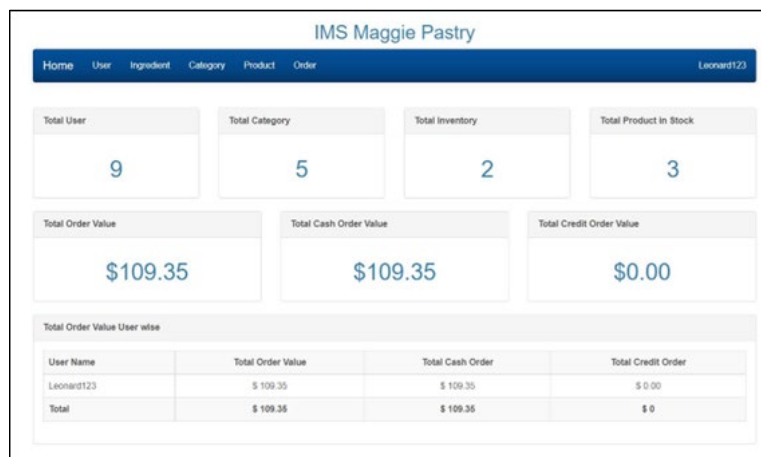


Figure 12: Homepage interface

Then, users can manage their profile details, such as name, email, and password. Users are not forced to change passwords during profile editing as shown in figure 13.

Figure 13: Profile interface

If users click on “user”, the system will redirect user to user interface as shown in Figure 14. In this interface, users able to add, update, activate and delete user as baker and manager. In add user interface, name, email, password, and role are required to add user as shown in Figure 15. By clicking update, users able to edit name, email, password, and role of user as shown in Figure 16. Users also can activate and delete user by clicking activate and delete.

ID	Email	Name	User Type	Status	Edit	Activate	Delete
8	musa@gmail.com	Aisyah binle Musi	baker	Active	Update	Activate	Delete
7	aiman@gmail.com	Aiman el-Shaer	baker	Active	Update	Activate	Delete
6	meiling@gmail.com	Liew Mei Ling	baker	Active	Update	Activate	Delete
5	sara@gmail.com	Saravanan Sunitha	baker	Active	Update	Activate	Delete
4	ramaiah@gmail.com	Ramesh Ramaiah	manager	Active	Update	Activate	Delete
3	Osman@gmail.com	Razak bin Osman	manager	Active	Update	Activate	Delete
2	LXM123@gmail.com	Lee Xiao Ming	manager	Active	Update	Activate	Delete

Figure 14: User interface

Figure 15: Add user interface

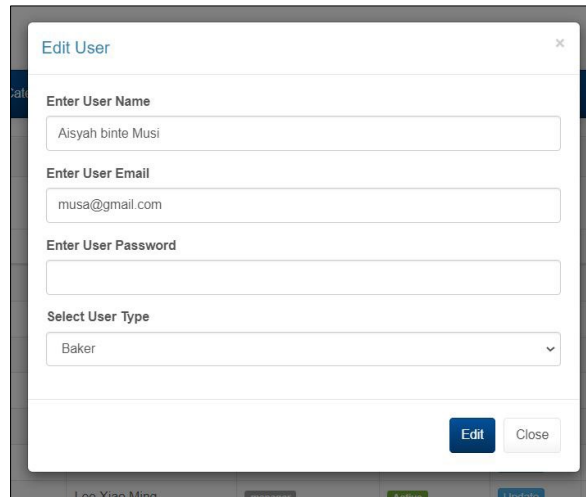


Figure 16: Edit user interface

If users click on “ingredient” or “category”, the system will redirect user to their selected page. These two interfaces are like user interface. In these pages, user also able to add, update, activate and delete data. In add ingredient interface, name and quantity are required to add ingredient. While only category name is required to add a category to the system. For both pages, users can update the data by clicking update. Users also can activate and delete data by clicking activate and delete.

When users move to product page, they can add product and view the product details as shown in figure 17 and 18 respectively. In this page, update, activate and delete button are provided to users.

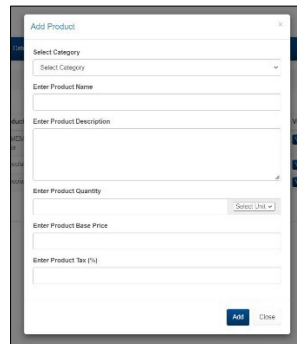


Figure 17: Add product interface

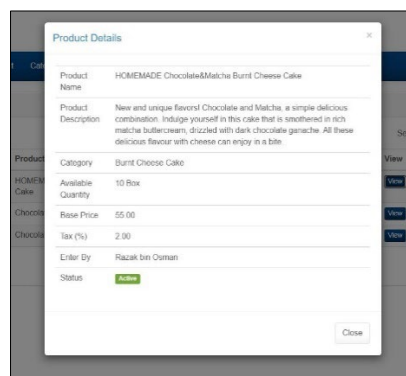


Figure 18: View product interface

After that, users can move to order page. In this page, they can add order and view the order details in PDF format as shown in figure 19. In this page, update, activate and delete button are provided to users.

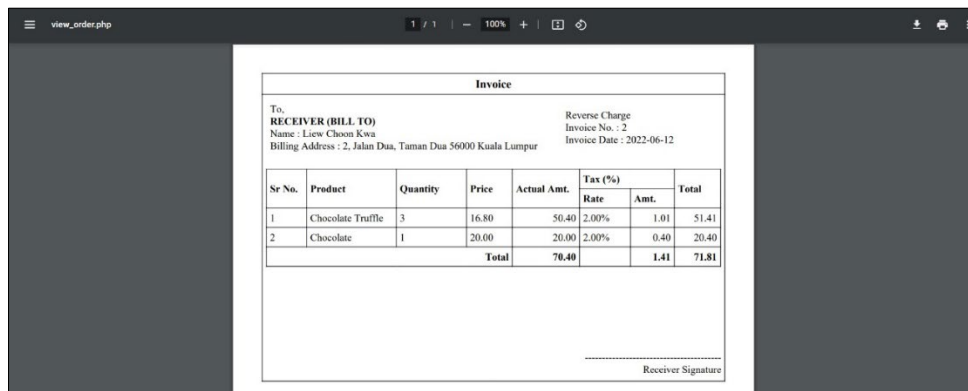


Figure 19: View order interface

4. Result and Discussion

Two types of tests will be run on the proposed system which are functional tests and user acceptance tests. These tests were run to check that the proposed system meets the functional and non-functional requirements of developed system.

4.1 Functional Testing

Functional testing was used to check every functional button and logical calculation in the proposed system. The test results are shown in table below.

Table 6: Results of Functional Testing

Test	Expected Result	Actual Result
Valid username and password input during login	User will be redirected to the home page of system.	Pass
Invalid username and password input during login	User will be shown an indication of invalid login credentials. User is required to enter the login credentials again.	Pass
Empty credentials input during login	The empty text field will be indicated to user. User is required to enter the login credentials for the empty text field.	Pass
User able to update a profile	System should display the results of user actions. The updated details for a profile should reflect to the user clearly.	Pass

User able to view the profile	System should display the profile details clearly.	Pass
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Table 6: (cont)

Users able to create and sort a user	System should display the results of user actions. A user should be added successfully. The sorting result should display on the interface.	Pass
User able to view, update, activate and delete a user	System should display the results of user actions. User details and updated user details should show on the interface clearly.	Pass
User able to create and sort an ingredient	System should display the results of user actions. An ingredient should be added successfully. The sorting result should display on the interface.	Pass
User able to view, update, activate and delete an ingredient	System should display the results of user actions. Ingredient details and updated ingredient details should show on the interface clearly.	Pass
User able to create and sort a category	System should display the results of user actions. An ingredient should be added successfully. The sorting result should display on the interface.	Pass
User able to view, update, activate and delete a category	System should display the results of user actions. Category details and updated category details should show on the interface clearly.	Pass
User able to create and sort a product	System should display the results of user actions. A product should be added successfully. The sorting result should display on the interface.	Pass

User able to view, update, activate and delete a product	System should display the results of user actions. Product details and updated product details should show on the interface clearly.	Pass
User able to create and sort an order	System should display the results of user actions. An order should be added successfully. The sorting result should display on the interface.	Pass

Table 6: (cont)

User able to view, update, activate and delete an order	System should display the results of user actions. System should generate the details of order record in a PDF format. The updated order details should show on the interface clearly.	Pass
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4.2 User Acceptance Testing

In this section, user satisfaction on the functionality of system will be tested. Total of 5 users completed the testing. Feedbacks for the system were provided by the users. Figure 20 shows the result of user acceptance testing for the developed system.

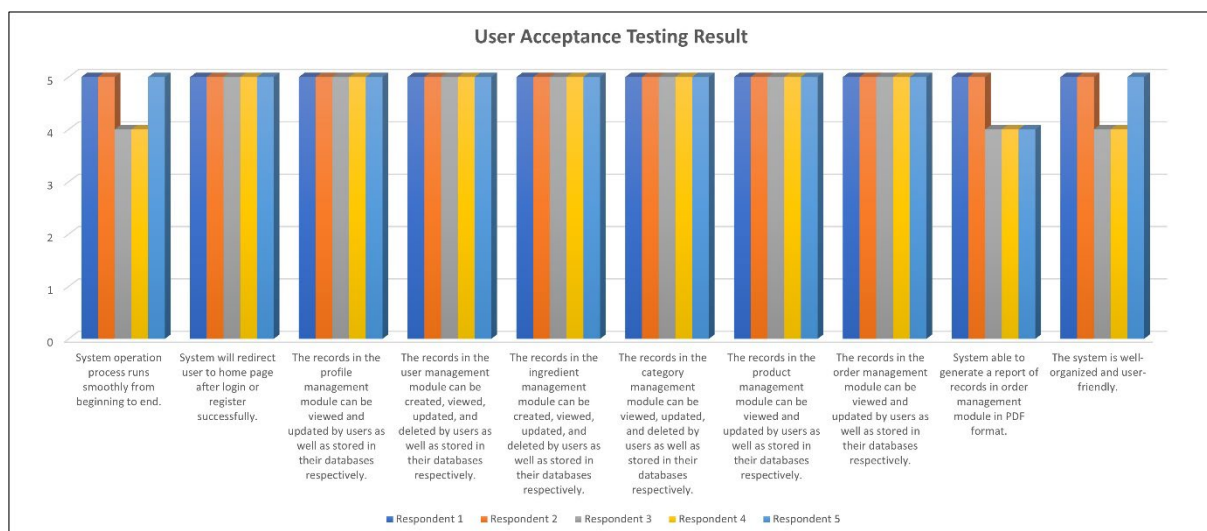


Figure 20: Bar chart for result of user acceptance test

According to the bar chart above, all users were satisfied with all aspects of the developed system. However, the running speed of the system, the generation of reports and the organization of the system are slightly unable to meet the satisfaction of users. No users were found to be dissatisfied with the acceptance requirements of the developed system.

5. Conclusion

In conclusion, all objectives for web-based inventory and customer management system for retail bakery online were achieved. By using the system, Maggie Pastry should be able to reduce the dependent of human resources on inventory and customer management. However, there are some limitations for the system, such as customer not able to involve in the system and lack of recommended sales strategies based on the sales recorded in the system. These limitations can be solved by implementing machine learning and connecting system with front end website.

Acknowledgment

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Appendix A

1	Entity and customer web-based management system for retail bakery online	166 days	10/4/21 8:00 AM	5/23/22 5:00 PM
2	Proposal	11 days	10/4/21 8:00 AM	10/18/21 5:00 PM
3	Introduction	2 days	10/4/21 8:00 AM	10/5/21 5:00 PM
4	Problem Statement	2 days	10/6/21 8:00 AM	10/7/21 5:00 PM
5	Objective	1 day	10/8/21 8:00 AM	10/8/21 5:00 PM
6	Scope	1 day	10/11/21 8:00 AM	10/11/21 5:00 PM
7	Expected Outcome	1 day	10/12/21 8:00 AM	10/12/21 5:00 PM
8	Project Significant	1 day	10/13/21 8:00 AM	10/13/21 5:00 PM
9	Project Planning	3 days	10/14/21 8:00 AM	10/18/21 5:00 PM
10	Analysis and Design	39 days	10/19/21 9:00 AM	12/13/21 9:00 AM
11	System Requirement Analysis	10 days	10/19/21 9:00 AM	11/2/21 9:00 AM
12	DFD Context Diagram (DFD CD)	4 days	11/3/21 8:00 AM	11/8/21 5:00 PM
13	DFD Level 0	4 days	11/9/21 9:00 AM	11/15/21 9:00 AM
14	Entity Relationship Diagram	2 days	11/16/21 9:00 AM	11/18/21 9:00 AM
15	Design	6 days	11/19/21 9:00 AM	11/29/21 9:00 AM
16	Interface Design	5 days	11/30/21 9:00 AM	12/7/21 9:00 AM
17	Schema Table	3 days	12/8/21 9:00 AM	12/13/21 9:00 AM
18	Modules for administrator and bakery manager	52 days	12/14/21 8:00 AM	2/23/22 5:00 PM
19	Admin	7 days	12/14/21 8:00 AM	12/22/21 5:00 PM
20	Manager	7 days	12/23/21 8:00 AM	12/31/21 5:00 PM
21	Storage	7 days	1/3/22 8:00 AM	1/11/22 5:00 PM
22	Inventory	7 days	1/12/22 8:00 AM	1/20/22 5:00 PM
23	Baked Goods	7 days	1/21/22 8:00 AM	1/31/22 5:00 PM
24	Orders	7 days	2/1/22 8:00 AM	2/9/22 5:00 PM
25	Delivery	10 days	2/10/22 8:00 AM	2/23/22 5:00 PM
26	Modules for customer	33 days	2/24/22 8:00 AM	4/11/22 5:00 PM
27	Registration	3 days	2/24/22 8:00 AM	2/28/22 5:00 PM
28	Login	3 days	3/1/22 8:00 AM	3/3/22 5:00 PM
29	Categories	5 days	3/4/22 8:00 AM	3/10/22 5:00 PM
30	Shopping cart	10 days	3/11/22 8:00 AM	3/24/22 5:00 PM
31	Customization	3 days	3/25/22 8:00 AM	3/29/22 5:00 PM
32	Payment	5 days	3/30/22 8:00 AM	4/5/22 5:00 PM

Figure 21: Gantt Chart for Project Planning (Continuous)

33	Email notification	4 days	4/6/22 8:00 AM	4/11/22 5:00 PM
34	Implementation	30 days	4/12/22 8:00 AM	5/23/22 5:00 PM
35	Combination of modules	5 days	4/12/22 8:00 AM	4/18/22 5:00 PM
36	Testing	10 days	4/19/22 8:00 AM	5/2/22 5:00 PM
37	Bug fixing	10 days	5/3/22 8:00 AM	5/16/22 5:00 PM
38	Future recommendations for system	5 days	5/17/22 8:00 AM	5/23/22 5:00 PM

Figure 22: Gantt Chart for Project Planning (Continuous)

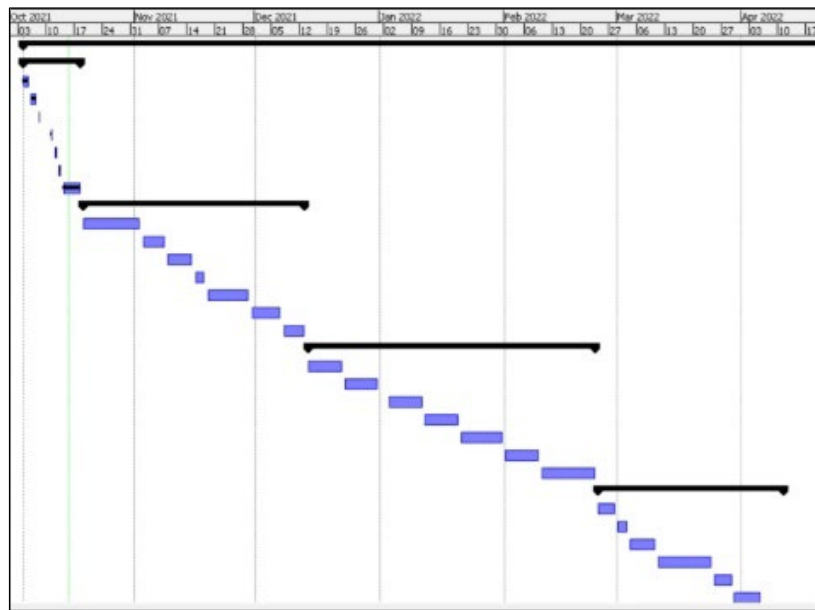


Figure 23: Gantt Chart for Project Planning

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