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Improving Data Management at Recycle Center by using Waste Management System

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Abstract: Recycle center is a company that responsible for collecting recyclable material and sells recyclable material after classified the waste to other manufacturers. For instance, Beyn Newman Waste Solution recycle center is managing varieties of recyclable materials such as paper, plastic, aluminum, bottle, iron and so on. Currently, the Beyn NewMan Waste Solution recycle center uses the waste management system for storing the waste information and sales order. However, the current system consists of several issues that need to be optimized in terms of waste material management, lack of sales report function and low efficiency. Thus, the proposed system is developed to help overcome these limitations. The proposed system has seven modules which are the login module, manage user module, waste attribute module, waste category module, waste material module, sales order module and sales report module. This system is developed by using the waterfall model methodology. The proposed system is written by using PHP programming language and the developed platform is Microsoft Expression Web 4. XAMPP is being used as a database server. Beyn NewMan Waste Solution recycle center as the target to take part in the user acceptance test(UAT) after the developed system is released. The expected outcome of the proposed system is waste material information become well-organized, enhance the system's efficiency by adding the manage user function and having the sales report function.

Keywords: Recycle Center, Waste Material, Sales Report, Manage User

1. Introduction

Humans start to concern about recycling action since humans facing a lot of environmental issues such the resource shortage, global warming and so on. Recycling action is important for reducing the garbage landfill and resource wasted on our mother earth. Recycle center played an important role to collect the recyclable garbage from citizen and sells to the supplier after recycling [1]. There have a variety of recyclable materials such as paper, plastic, aluminum can, iron and so on.

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The target recycle center is Beyn NewMan Waste Solution. The existing system that currently used by the target company is the waste management system. Waste management system is used to manage the waste available, transaction and history information on waste audit [2]. However, the current system consists of three main issues that need to be resolved. The first problem of the existing system is the waste material cannot be deleted from the list. The second problem is lack of the manage user function causes the system to become low efficiency. The third problem is lack of the sales report function in the system. Obviously, a computerized system is needed for recycle center to manage the sales and the waste material to reach accuracy and efficiency.

For the rest of paper, second section shows the literature review related with the existing system. Third section describe the project methodology. Forth section shows the system analysis and design. Fifth section shows the implementation and testing part. Sixth section is the conclusion of the project.

2. Related Works

This section shows the result of the literature review for the waste management system. The research of analyzing three existing systems to compare with the developed system are required for defining the weaknesses and strengths of the existing systems. The collection of useful information helps to gain good ideas for developing a valuable and comprehensive waste management system.

2.1 Domain Background

Based on the case study, Beyn Newman Waste Solution recycle center is managing varieties of recyclable materials such as paper, plastic, aluminum, bottle, iron and so on. This recycle center is located at Kulai, Johor. The existing system that currently used by the target company is waste management system. When recycle center buying recyclable materials from the manufacturer, they need to classify each of the materials by counting the quantity and weighing the materials. They will key in the waste material information into the system. Then, the recycle center mainly sells the waste material to other manufacturers or companies. The sales activities will be recorded into the sales order of the system.

There have some ill-defined functions in their waste management system. It could bring some effect to database management and reduce efficiency. The first problem in the current system is the waste material cannot be deleted from the list. Besides that, the manage user function is needed to enhance the system's efficiency. Besides that, admin need to generate the sales report manually. It may cause time-consuming and procrastinate the time to evaluate the profit and loss. The weaknesses in the existing system will cause the management of waste material to get worse and reduce efficiency.

2.2 PHP Programming Languages

PHP programming language is stands for Hypertext Preprocessor. PHP is a server-side scripting language that is used for managing databases, session tracking and dynamic site. PHP can connect and access to the MySQL database localhost server for storing the system's data [3]. PHP able to add, delete and edit the data in the database. PHP also support to a variety of platforms such as Window, Linux, Mac OS and so on. PHP have five characteristics such as easily to use, efficiency, safety, adaptability and familiarity. The ability to interact with a variety of databases such as PostgreSQL, MYSQL, mSQL and dbase is one of the PHP's strongest features [4].

2.3 Structured-Based Approach

PHP is considered as a structured-based approach programming language. Structure programming is a program style which that aim to improve the quality, clarity, development time programs for making use of block structures [5]. It is a better way to program as it involves the systematic organization of programs. Structured programming includes 3 phases which are top-down analysis, modular programming, and structured code. There have several benefits for structured programming such as improve the problem-solving process, better organization of the program, clear description of data and structure and modifiable and documentable.

2.4 Microsoft Expression Web 4

Microsoft Expression Web is a web design software package that includes an HTML editor invented by Microsoft in 2010. Expression Web supports various of programming languages such as HTML5, CSS3, PHP, JavaScript, ASP. NET, XML+XSLT, and XHTML for designing and developing web pages [6]. Microsoft Expression Web act as a professional tool for creating, managing and publishing a functionality website that adheres to web standards. User can check their website layout design precisely when they are developing the program code in the platform without going to the browser.

2.5 XAMPP

XAMPP is a free open source local web-servers invented by Apache Friends. It is a popular cross-platform web server that allows programmers to test and built their code. It is a platform that is easily used for developing web applications. Users able to store database tables, connected databases and execute the codes by using PHP language [7]. Apache and MYSQL must be in running condition while developing the web application.

2.6 Study of Related Existing Systems

This section shows the comparison between three existing systems and proposed system.

2.6.1 Existing System 1: Zoho Inventory Management Software

Zoho Inventory Management software is a powerful system that developed for the small or medium business company to help them organize and handle their inventory management activities. It provides several advantages for the company inventory management which are inventory tracking, item organization, order management, order fulfillment and warehouse control [8].

2.6.2 Existing System 2: Finale Inventory

Finale Inventory is a simple and useful inventory system that develop for the small and medium-sized business companies. This is a cloud-based application inventory management system by using the cloud computing service as the hosting. Company no need worries about the software installing, upgrading the system and managing the data[9].

2.6.3 Existing System 3: Xero Accounting Software

Xero is a beautiful and comprehensive accounting software built for small and medium-sized companies. There over 2 million companies have subscribed to the Xero accounting software. It provided amazing reliable data, secure data protection and smart online accounting [10].

2.7 Proposed System: Waste Management System for Recycle Center

The proposed waste management system is developed for the Beyn NewMan Waste Solution recycle center. The waste management system is used to manage the waste material available, transaction and history information on waste material audits. The proposed system contains seven modules which are the login module, manage user module, waste attribute module, waste category module, waste material module, sales order module and sales report module.

Table 1: Comparison between three existing systems with proposed system

Features	Zoho Inventory	Finale Inventory	Xero Accounting Software	Waste Management Proposed System
Login	Yes	Yes	Yes	Yes
Manage user	No	No	No	Yes

Manage waste attribute	No	No	No	Yes
Manage waste category	Yes	Yes	Yes	Yes

Table 1: (cont.)

Features	Zoho Inventory	Finale Inventory	Xero Accounting Software	Waste Management Proposed System
Manage waste material	Yes	Yes	Yes	Yes
Sales order	Yes	Yes	Yes	Yes
Sales report	Yes	No	Yes	Yes

3. System Methodology

This section shows the waterfall model that used to develop the proposed system. Waterfall model includes a series of the activities that need to be implemented in each of the phases.

3.1 Waterfall Model

The waterfall model is the oldest Software Development Life Cycle(SDLC) model. SDLC includes a series of flows that need to be implemented in sequence to produces a comprehensive or quality system. The waterfall model is one of the types of SDLC that consists of six phases which are planning, analysis, system design, system implementation, testing and deployment. The benefits of the waterfall model are simply to use, performs well, easy to maintain, systematic and documentation. The waterfall model can detect the error early because each of the phases is clearly defined. 'Since the following phases are dependent on previous phase, this approach ensure project deadline control.'[11]. Figure 1 shows the waterfall model.

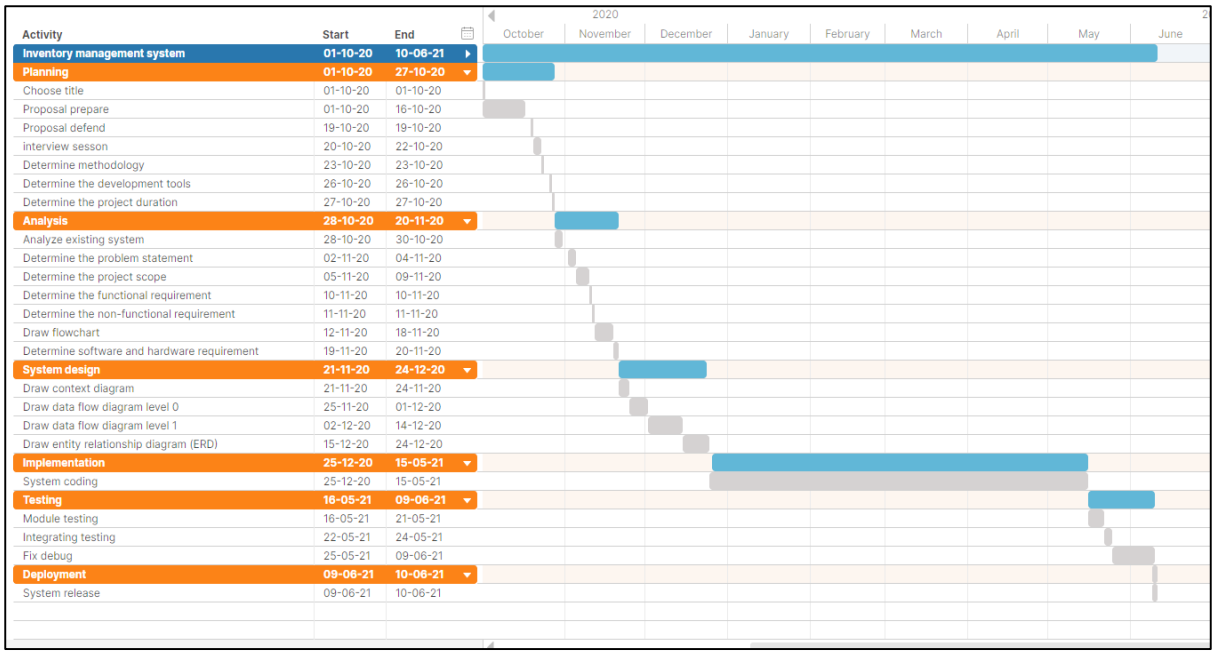


Figure 1: Waterfall model

3.2 System Development Workflow

There are six phases to be followed for developing the system such as planning, analysis, system design, implementation, testing and deployment. Each of the phases has its activities that need to be done before the next phase begins. Table 2 shows the system design workflow.

Table 2: System design workflow

Phase	Activity	Process	Development Tool
Planning	• Information gathering • determine the proposed system • Determine the methodology and project schedule	• conduct interview section with the target company • draw Gantt chart	• TOM'S PLANNER • online tool
Analysis	• Determine the current system and analyse the limitation • Analyse the system flow • Analyse the system module • Analyse the functional requirement and non-functional requirement.	• List the details of functional requirement and non-functional requirement. • Flowchart	• Draw.io
System design	• Design the system process in the diagrams. • Design database management system • Design user interface	• Context diagram • DFD level 0 • DFD level 1 • ERD • User interface design	• Draw.io
Implementation	• Write the system coding • Build the database and connect to the system	Apply the source code and develop the database of the system	• Microsoft Expression Web 4 • XAMPP
Testing	• Module testing • Integrate testing • Fix debug	Integrate and refine the coding	• Microsoft Expression Web 4
Deployment	• Release the system		

3.3 System Design

In this section shows the illustration of the system flow design by using context diagram and data flow diagram (DFD).

3.3.1 Requirement Analysis

Requirement analysis is a crucial part to list out the system functions that cater to the user's expectation. The requirement analysis needs to compatible with the system flow design and logical. There include two types of requirement analysis such as functional requirement analysis and non-functional requirement analysis.

3.3.2 Context diagram

Figure 2 has shown the context diagram that illustrates for the waste management system. A context diagram is a type of data flow diagram which is under level 0. There have three components structuring the context diagram such as process system, external entity and data flow line. The process system is waste management system. The external entities are administrator and staff.

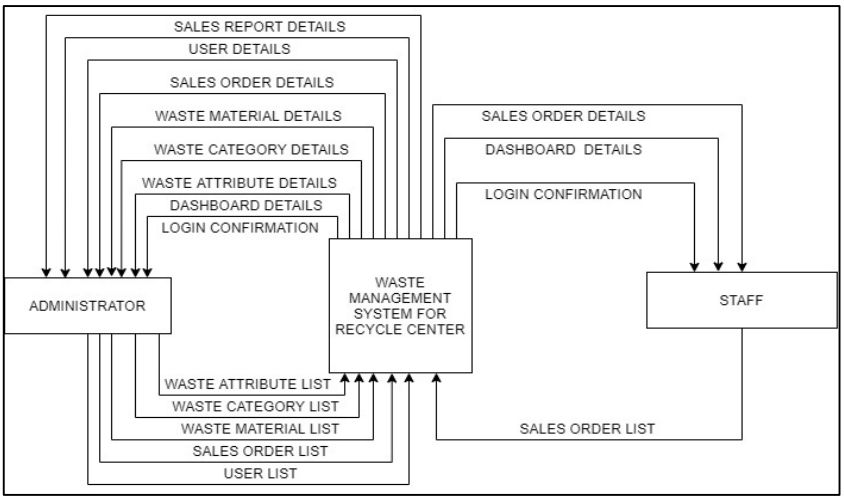


Figure 2: Context diagram (waste management system)

3.3.3 Flowchart

Figure 3 shows the flowchart that illustrate for the admin side in the waste management system. Admin able to access all the functional modules but staff just only can access dashboard page and sales order module only.

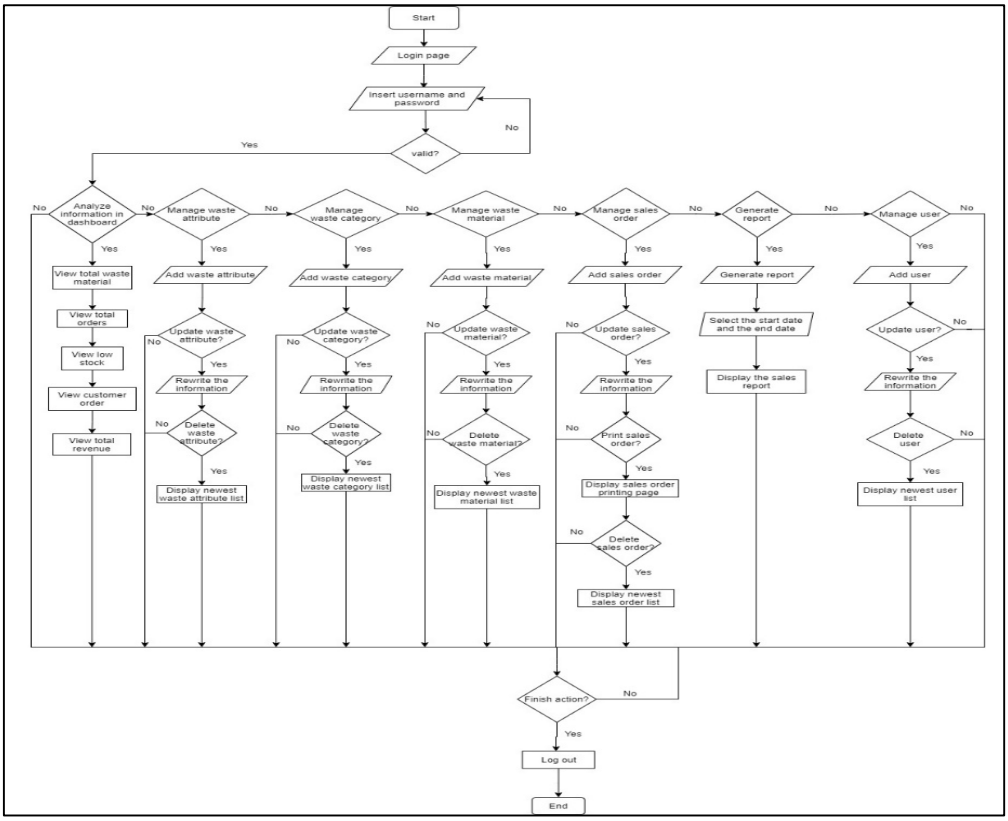


Figure 3: Flowchart for waste management system (admin side)

3.3.4 Data flow diagram level 0

Figure 4 shows the data flow diagram level 0 for the waste management system. Data flow diagram is used to illustrate the system flow of waste management system logically. The system process will be clearly defined by using this diagram is to reduce any logical error happened during developed this proposed system. This data flow diagram composed of two external entities. Seven processes and six data stores. Each of the process and data store has labelled by the numbering ID which follows the sequential.

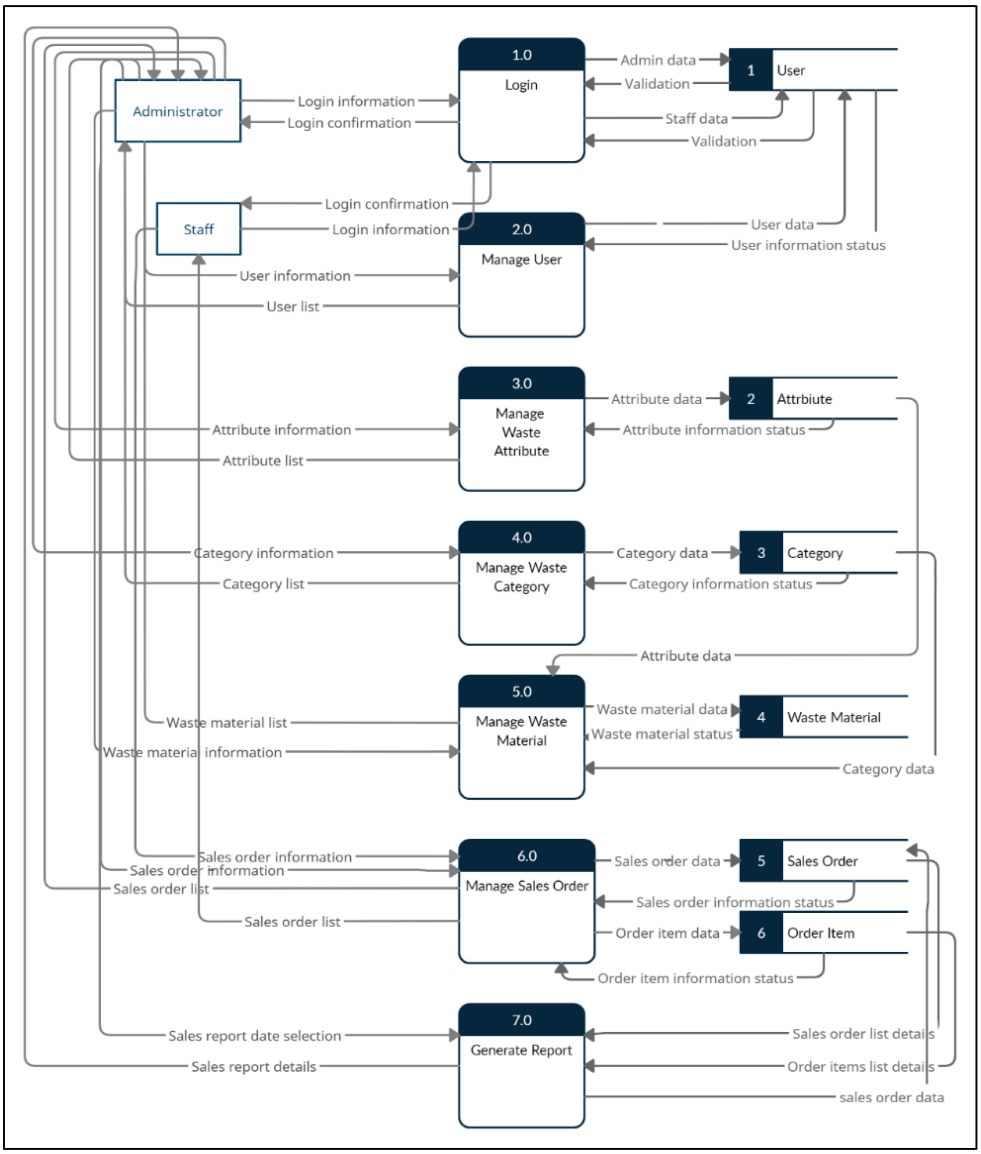


Figure 4: Data flow diagram 0 (waste management system)

3.3.5 Entity Relationship Diagram (ERD)

Figure 5 shows the entity relationship diagram for waste management system. Entity relationship diagram (ERD) is a type of structural diagram that used for illustrating the database design. There has the relationship among the entities that labeling by different crowfoot notations.

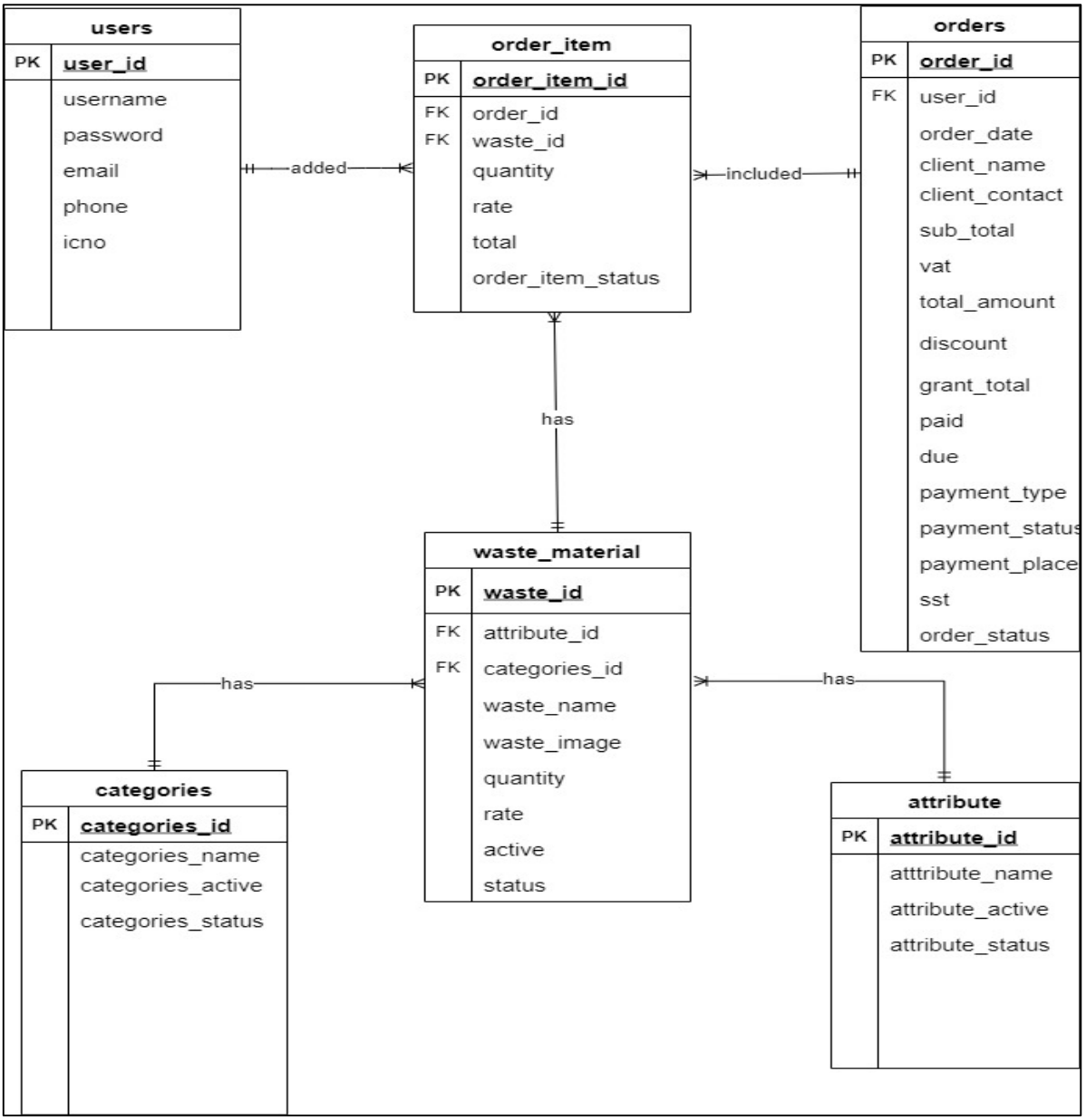


Figure 5: ERD diagram (waste management system)

3.4 Implementation

This section will show the project outcome by showing each of the complete modules in details, segment code and the functionality.

3.4.1 Implementation

There include seven modules such as login module, waste attribute module, waste category module, waste material module, sales order module, sales report module and manage user module.

3.4.1.1 Login Module

Figure 6 shows the user interface of login module. For the login module, admin and staff need to insert the correct username and password for accessing the system.

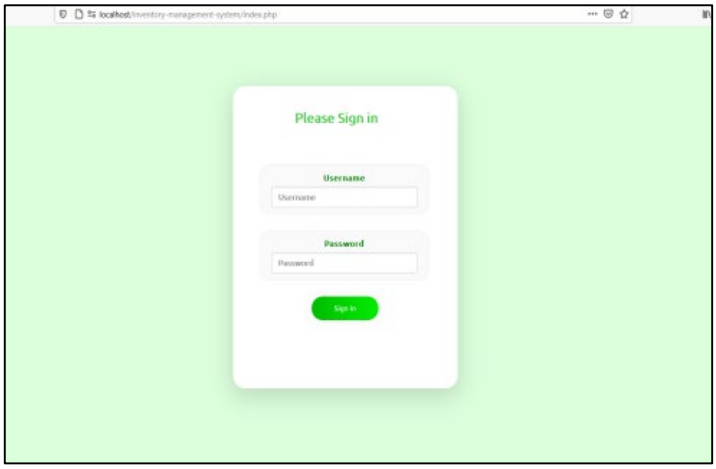
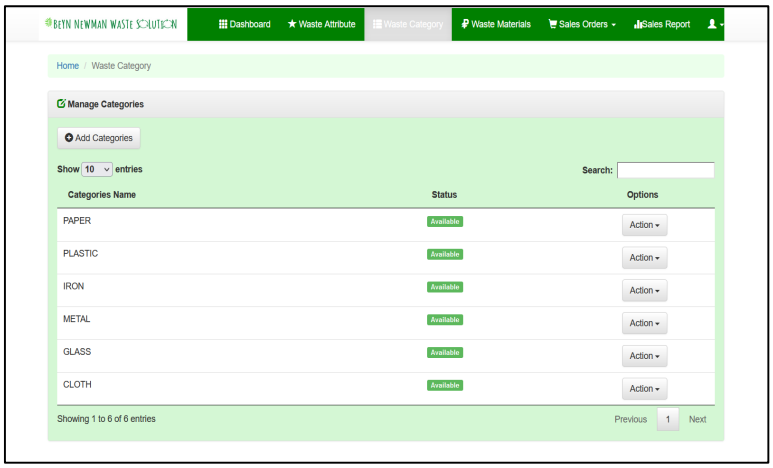


Figure 6: User interface of login module

3.4.1.2 Waste Attribute, Waste Category and Waste Material Module

Figure 7 shows the user interface for waste attribute, waste category and waste material module. For the waste attribute module, admin able to add, update and delete the waste attribute name. Then, admin able to update the status for each of the waste attribute. For the waste category module, admin able to add, update and delete the waste category name. Admin able to update status for each of the waste category. For the waste material module, admin able to add, update and delete the waste material information such as waste material photo, waste material name, quantity, price, waste attribute and waste category. Then. Admin able to update the status for each of the waste material.



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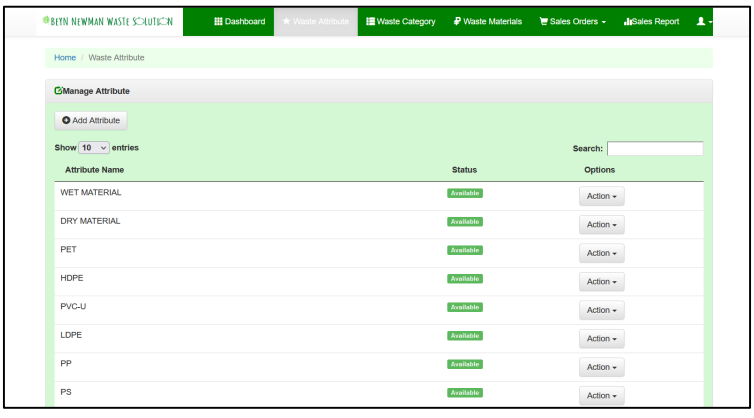
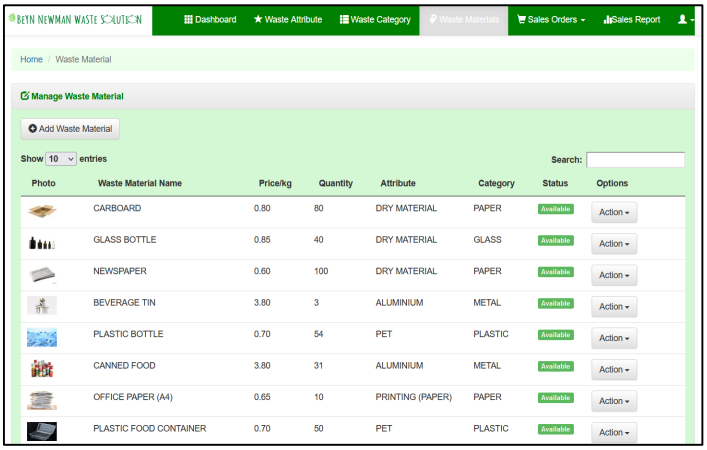


(b)

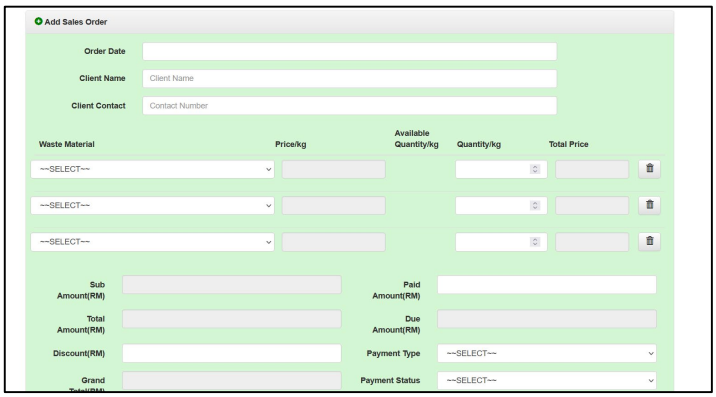


(c)

Figure 7: (a) User interface for waste attribute, (b) waste category and (c) waste material module

3.4.1.3 Sales Order Module

Figure 8 shows the user interface of sales order module and print sales order page. For the sales order module, admin and staff able to add, edit and delete the sales order information such as order date, client name, client contact, waste material, quantity, discount, paid amount, payment type, payment status and payment price. For the print sales order page, user able to print out the sales order with full of the sales information.



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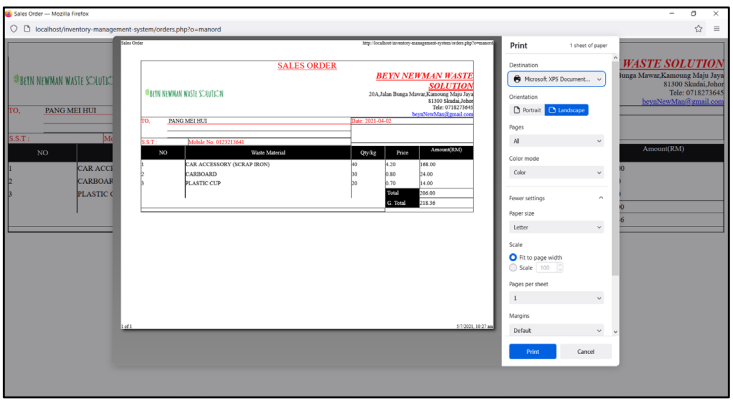
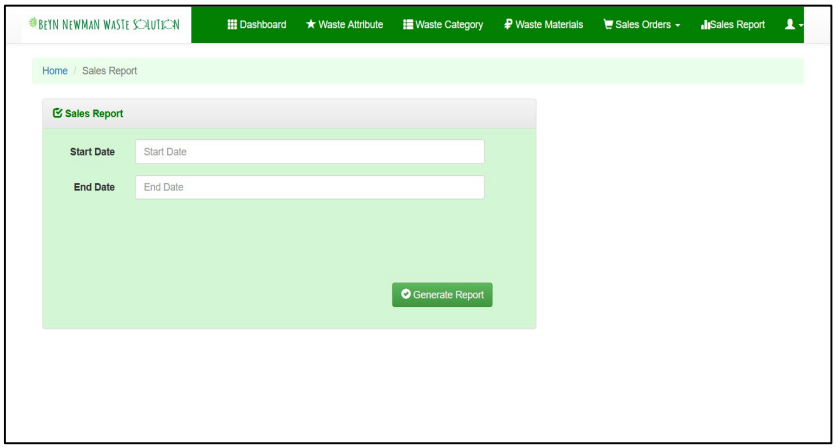


(b)

Figure 8: (a) User interface of sales order and (b) print sales order

3.4.1.4 Sales Report Module

Figure 9 shows the user interface of sales report and print sales report page. For the sales report module, admin able to select the start date and end date for the sales report. The sales report will be generated and displayed for the admin to print out.



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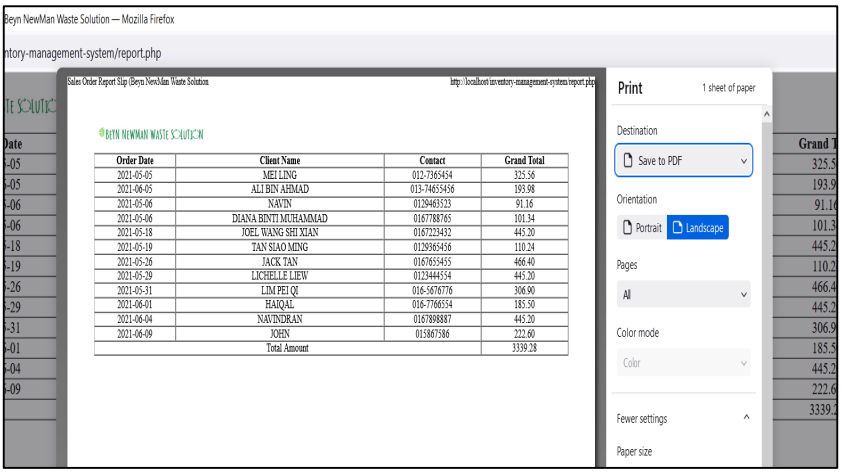


(b)

Figure 9: (a) User interface of sales report and (b) print sales report

3.4.1.5 Manage User Module

Figure 10 shows the user interface of manage user module. For the manage user module, admin able to add, edit and delete the user information such as username, password, email, phone number and IC number.

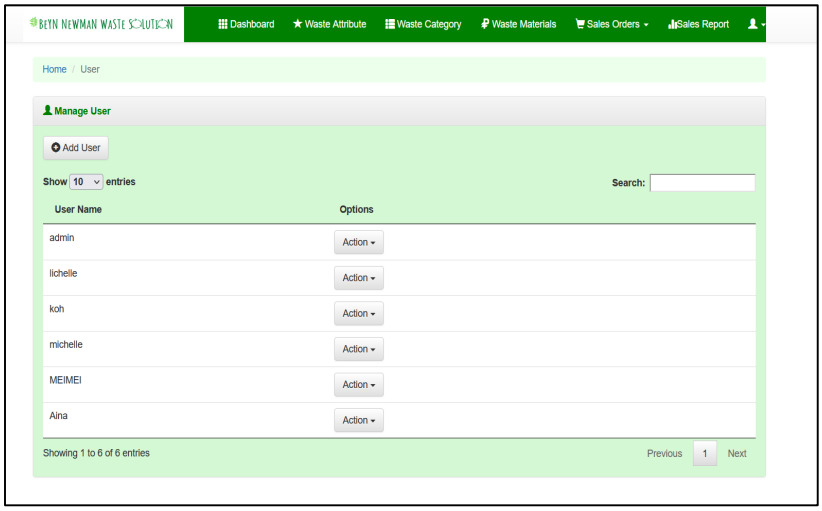
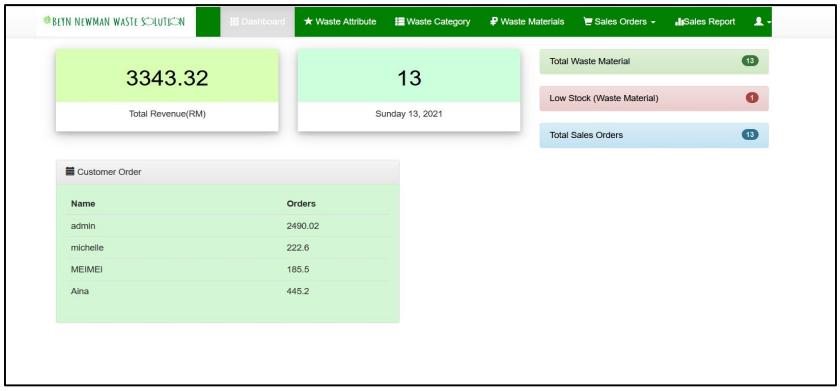


Figure 10: User interface of managing user

3.4.1.6 Dashboard Page

Figure 11 shows the user interface of admin side and staff side dashboard pages. For the dashboard page, admin able to view the calendar, total revenue, total waste material, low stock(waste material), total sales order and the customer order. Staff can view the information same as the admin except for the total waste material, total revenue, low stock(waste material) and customer order.



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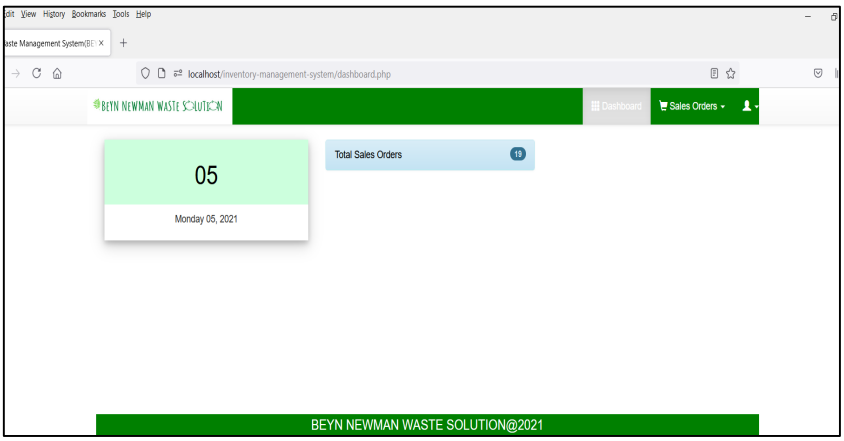

(b)

Figure 11: (a) User interface of admin side dashboard page and (b) staff side dashboard page

4. Result and Discussion

This section discussed the results of user acceptance testing(UAT) which refers to the Google Form responses to determine whether the developed system is suitable to use and met the user demands. The results have listed in the table.

4.1 User Acceptance Testing (UAT)

The user acceptance testing(UAT) is done by the owner of Beyn NewMan Waste Solution recycle center. Only one respondent took part in this user acceptance testing(UAT) since this system is developed for the target company to use. The feedback and satisfaction of the company owner is most important to approve change to verify this developed system is suitable to use for the company especially from a business perspective. User acceptance testing is conducted by using Google form. Google form includes one system's demonstration video for respondent to view and eighteen questions need to answer properly. According to the result, the result indicates all the functionality modules meet the user's demands by showing the actual results states as "pass" for each of the testing questions. Respondent is satisfied with the system's functionality and the user interface is simply to use. Table 3 shows the user acceptance testing (UAT) table which includes eighteen testing questions and the actual results done by the company owner.

Table 3: User Acceptance Testing (UAT)

Testing Module	Testing	Expected Results	Actual Results
User Login	• Existing users insert the valid username and password.	• User able to access into the system. User directly get into the dashboard page.	• Pass
Manage User	• Admin can add new user by filling the user information in the form.	• Displayed the new user information.	• Pass
	• Admin can update the user information.	• Displayed the updated user information.	• Pass
	• Admin can delete the user account.	• Displayed the newest user list.	• Pass
Manage Waste Attribute	• Admin can add new waste attribute by filling the waste attribute information in the form.	• Displayed the new waste attribute information.	• Pass
	• Admin can update the waste attribute information.	• Displayed the updated waste attribute information.	• Pass
	• Admin can delete the waste attribute.	• Displayed the newest waste attribute list.	• Pass

Table 3: (cont.)

Testing Module	Testing	Expected Results	Actual Results
Manage Waste Category	• Admin can add new waste category by filling the waste category information in the form. • Admin can update the waste category information. • Admin can delete the waste category.	• Displayed the new waste category information. • Displayed the updated waste category information. • Displayed the newest waste category list.	• Pass • Pass • Pass
Manage waste material	• Admin can add new waste material by filling the waste material information in the form. • User can update the waste material information. • User can delete the waste material.	• Displayed the new waste material information. • Displayed the updated waste material information. • Displayed the newest waste material list.	• Pass • Pass • Pass
Sales Order	• User can add new sales order. • User can update the sales order information. • User can delete the sales order.	• Displayed the new sales order information. • Displayed the updated sales order information. • Displayed the newest sales order information.	• Pass • Pass • Pass
Sales report module	• Admin can view the sales report by selecting the start date and the end date for the report.	• Displayed the sales report information.	• Pass

5. Conclusion

This developed waste management system has achieved the project's objectives and meet the user demands. This system has seven modules that were successfully developed such as login module, waste attribute module, waste category module, waste material module, sales order module, sales report module and manage user module. This system has resolved the problems of the current system such as

the waste material cannot be deleted from the list, lack of manage user function and sales report function. This system is able to help the user manage their waste material and sales efficiently without wasting their time to record or calculate the total sales profit on a piece of paper. The system result indicates a lot of benefits that could bring good values to the client from a business perspective. According to the user acceptance testing, client is satisfied with the system's functionalities. The author hopes the client's company can get a good value by using this developed system even though it still has room for improvement. This system may have an opportunity to be modified and make it become more advanced in the future.

Acknowledgement

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