

## EMS: E-Merchant System

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**Abstract:** EMS: E-Merchant System is a web-based system that allows merchants who do not have their own digital service system yet to use this developed system to own their ecommerce website by publishing their business online. The target users of this developed system are merchants and merchant customers. Some merchants have been slow to adopt digital services due to the cost of development and maintenance, lack of knowledge about digital management, and fear of negative impact on their original business. Therefore, this project is proposed to be developed. The Bootstrap framework, HTML, CSS, JavaScript, PHP and MySQL are used to develop the system. The waterfall model is chosen as the methodology. In the developed system, there are two types of users, namely merchants and customers. Through this developed system, merchants can own their own digital service system without spending too much time and money.

**Keywords:** Merchant Management System, Ecommerce, Merchant, Web-based

### 1. Introduction

In this digital age, many enterprises and even stores are beginning to use digital services to help their productivity and increase their exposure [1][2][3]. The COVID-19 pandemic also encouraged various industries to start using digital services. Examples of digital trends include cashless payment services, electronic ordering services, data analysis services, online shopping services and take-out services. However, due to the cost of development and maintenance, lack of knowledge about digital management, and fear of negative impact on their original business, some businesses have been slow to adopt digital services [3]. This is a loss for consumers and businesses because businesses may miss potential customers, and consumers may not have so many choices in the market [2]. For every industry, it is very important to keep up with the trend of digitalization in order to maintain its competitiveness.

To address the issues of cost, lack of knowledge, and fear of negative impact, the author conducted research and developed a digital service system called EMS: E-Merchant System for merchants who do not have their own digital service system. This system allows merchants to publish their business online and manage it digitally. The author asks merchants to test the system and provide feedback on their user experience, and whether the system encourages them to adopt digital services in their businesses.

To solve the above problems, several objectives need to be achieved:

1. To design a digital service system based on the research result.
2. To develop a web-based digital service system that can be used by various merchants.
3. To do alpha & beta tests for the digital service system.

There are two types of users involved in the system, including merchants and merchant's customers. This system includes several modules such as user management module, ordering module, payment module, products management module, and generate sales module.

The purpose of this project aims to develop a digital service system for businesses that do not have their own system at present. Our goal is to create a system that is easy for businesses to use and maintain, without requiring them to have rich IT knowledge or bear high costs. This system is a central sharing system, which means that businesses can use this system without developing and maintaining their own management system. The project aims to solve the concerns of merchants who are unwilling to use digital services because of the cost and risk. It is especially suitable for businesses in the catering, clothing and electrical appliance industries, because the cost and risk of trying this system are very low. This project aims to solve the concerns of businesses who are hesitant to adopt digital services by providing an accessible and cost-effective solution.

In conclusion, this paper can be divided into five main sections: Section 2 conducts a literature review of previous work and relevant systems. Section 3 outlines the methodology and system analysis and design used to create the system. Then, Section 4 describes the results and discussion about the system output. Finally, Section 5 summarizes the discussion in this paper and puts forward some suggestions for the future.

## **2. Related Works**

### **2.1 Digital Transformation**

Digital transformation is a trend, which involves increasing the use of digital technology in various tasks and operational fields to improve efficiency and collect valuable data [2]. This trend has become more common in recent years, especially due to the COVID-19 epidemic, which has led governments and enterprises to adopt more digital tools and systems to avoid contact between people. Digital transformation is very important for companies and countries because it can help them to increase profits, plan their future and maintain their market competitiveness. However, failing to keep up with this trend may have a negative impact on the economy of a company or country [2].

### **2.2 E-Business**

E-business refers to businesses that are conducted online through the use of the web, internet, extranet, or a combination of these platforms [4]. Ecommerce is a kind of ecommerce, including buying and selling products or services on the Internet. The E-business market is growing rapidly, with a larger volume and customer base than traditional businesses. Ecommerce can be realized by registering and selling products on online platforms, establishing an ecommerce platform to independently sell products, creating a payment-based service billing platform, or providing content-based online services, such as learning applications or entertainment software. E-businesses can also generate revenue through advertising. Ecommerce is a viable and growing industry, and well-known companies such as Google, Facebook, Twitter and Shopee are all considering ecommerce.

### **2.3 The Current Status of the Merchant**

In recent years, many companies have adopted digital transformation, which is either voluntary or influenced by the COVID-19 epidemic [1][2][3]. Governments have also played a role in promoting digital transformation, especially through some measures, such as providing funds for people to use

online payment platforms during the epidemic. As a result, many merchants, particularly in the restaurant industry, are now offering cashless payment services and using takeaway platforms and ordering systems to increase revenue and efficiency. However, there is still room for improvement, including using web pages and online shopping platforms to manage the company's operations.

## 2.4 Comparison with the Existing Application

To inform the development of the E-Merchant System (EMS), three similar software applications were selected for comparison. These are Google Sites, Carousell, and Watsons. The comparison aims to identify features from these applications that could be useful for the developed system. The results of the comparison are presented in Table 1.

**Table 1: Comparison between Existing Systems and Developed System**

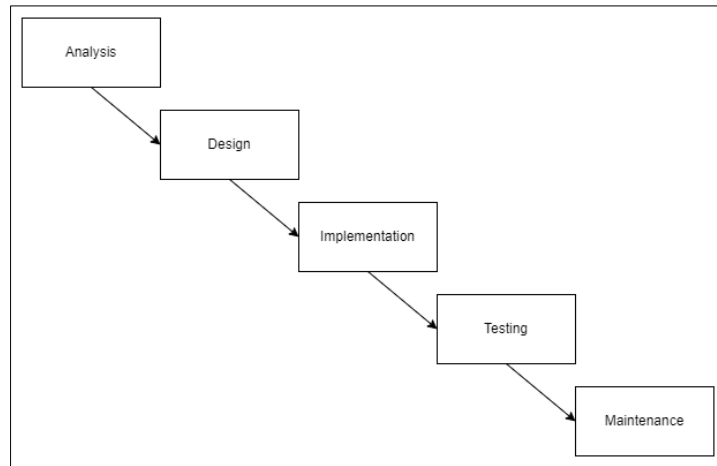
Features / System	Google Sites [5]	Carousell [6]	Watsons [7]	Developed System
User Management Module	×	√	√	√
Ordering Module	×	√	√	√
Payment Module	×	√	√	√
Manage Product Module	×	√	√	√
Sales Generation Module	×	√	√	√
Check Sales Module	×	√	√	√
Do not need to do their own system development	×	√	×	√
No need to undertake repairs and maintenance	√	√	×	√
Publish user's own website	√	√	×	√
Not display information that is irrelevant to the user	√	×	√	√
iOS based	√	√	√	×
Android based	√	√	√	×
Generate Report	×	√	√	√
Searching Items	×	√	√	√
Items Recommendation	×	√	√	√
Mobile-friendly	√	√	√	√
Web-based	√	√	√	√

√– Available, ×– Not Available

## 3. Methodology

### 3.1 Waterfall Model

The EMS: E-Merchant System is being developed using the waterfall model, a linear approach to the software development process that is popular for software and web application development. The waterfall model consists of five phases: analysis, design, implementation, testing, and maintenance. The analysis phase involves gathering and analysing requirements and defining the project scope. The design phase involves creating a detailed plan for the system. The implementation phase involves building the system according to the design plan. The testing phase involves verifying that the system meets the requirements and fixing any issues. The maintenance phase involves ongoing support and updates to the system. Figure 1 shows the waterfall model and Table 2 shows the workflow of the development of EMS: E-Merchant System based on the methodology.



**Figure 1: Waterfall Model**

**Table 2: Workflow of the Development of EMS: E-Merchant System**

Phases	Activity	Deliverables
Analysis	I. Identify problem statements, objectives, scope, expected result, and project significance.	I. Project Proposal.
	II. Set up a work plan.	II. Gantt Chart.
	III. Study-related articles and theses	III. Literature Review.
	IV. Create a questionnaire.	IV. Collect user requirements.
	V. Collect the data from the questionnaire.	
	VI. Analysis of hardware and software requirements.	
Design	I. Identify functional and non-functional requirements.	I. Functional and non-functional requirements.
	II. Identify the relationship among all classes.	II. Data Flow Diagram.
	III. Design the wireframe. Design the database design.	III. Context Diagram.
		IV. Activity Diagram.
		V. Entity Relationship Diagram
		VI. DFD level of 0,1,2.
		VII. Wireframes.
	Database.	
Implementation	I. Develop the front-end side.	I. Proposal System.
	II. Develop the server-side.	
	III. Connect with the database. Integrate the system.	
Testing	I. Testing the system.	I. Find the error or problem. Debug the error or problem.
Maintenance	I. Keep in touch with the target user.	I. Fix the error or problem as soon as possible.
	II. Identify the area for improvement.	II. In the documentation, note the improvements and flaws.
	II. Identify the area for weakness.	

### 3.2 System Analysis and Design

In this chapter, the author explained about the analysis and design for the developed system which is the EMS: E-Merchant System. The system requirement analysis includes functional and non-functional. The important diagrams, such as data flow diagram (DFD), entity relationship diagram (ERD) and the developed interface system of wireframe are described in this section. The function requirements of the developed system which is EMS: E-Merchant System are listed in Table 3.

**Table 3: Functional Requirements of EMS: E-Merchant System**

Function	Description
Register	I. This function allows the merchant to register their own ecommerce website.
	II. This function allows the customer to register their account for a specific merchant's ecommerce website.
Login	I. This function allows merchants and customers to login into the merchant management website.
	II. This function allows the customer to login into a specific merchant's ecommerce website.
Manage Product	I. This function allows merchants to view all the existing products, add new products, edit a product, and delete a product.
Manage User	I. This function allows merchants to view all their existing customers and merchants, add new customers or merchants, edit a customer or merchant, and delete a customer or merchant.
Manage Order	I. This function allows merchants to update the status of the order.
View Sales	I. This function allows merchants to check their sales and generate their sales report.
Edit Profile	I. This function allows merchants and merchants' customers to edit their profile information.
Make an Order	I. This function allows the customer to confirm their order based on their shopping cart.
	II. This function allows the customer to make payment for their order.

The non-functional requirements of the developed system which is EMS: E-Merchant System are listed in Table 4.

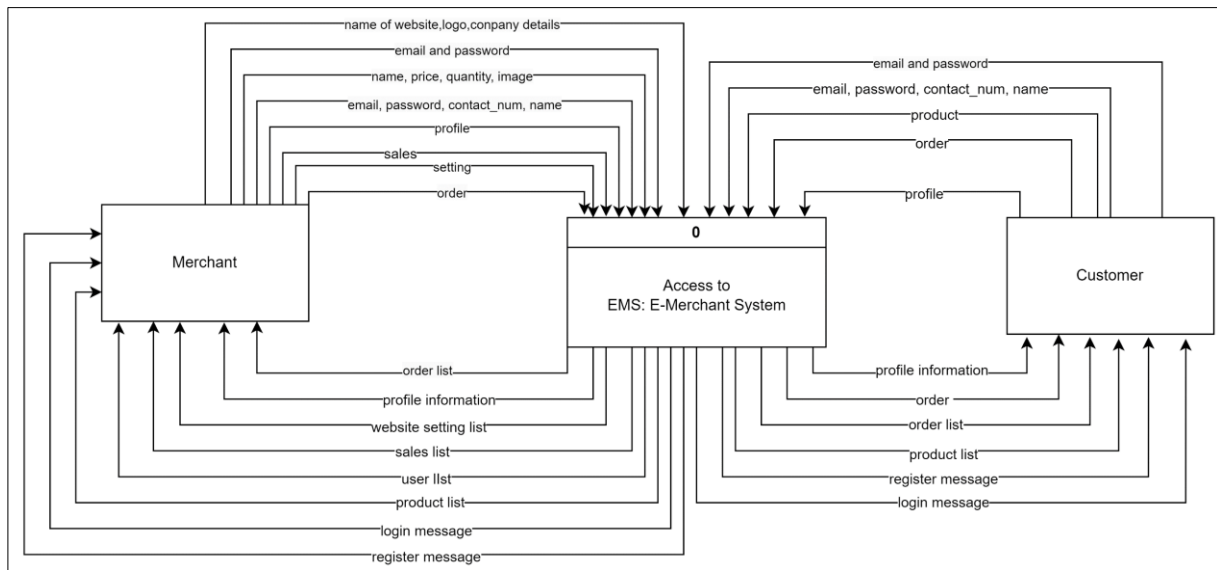
**Table 4: Non-functional Requirements of EMS: E-Merchant System**

Function	Description
Performance	I. This system should run smoothly without any trouble. The system can respond to user interaction within 4 seconds.
Security	I. All passwords in the database are encrypted.
	II. Only users who have passed user account and password verification can log in to the system.
Operational	I. The system can be used for 24 hours per day and 365 days a year.

**Table 4: (cont.)**

Function	Description
Usability	I. The system supports the English language, the user can easily understand and use the system.
	II. The interface of the system is user-friendly.
	III. The system is responsive which can be used for any different size of devices.

Data flow diagram (DFD) is a graphical representation that provides brief data moves through a system, illustrating how information is transferred between processes, data stores, and external entities. Figure 2 shows the Data Flow Diagram Context Diagram (DFD CD). Figure 3 shows the Data Flow Diagram Level 0 (DFD Level 0).



**Figure 2: Context Diagram of EMS: E-Merchant System**

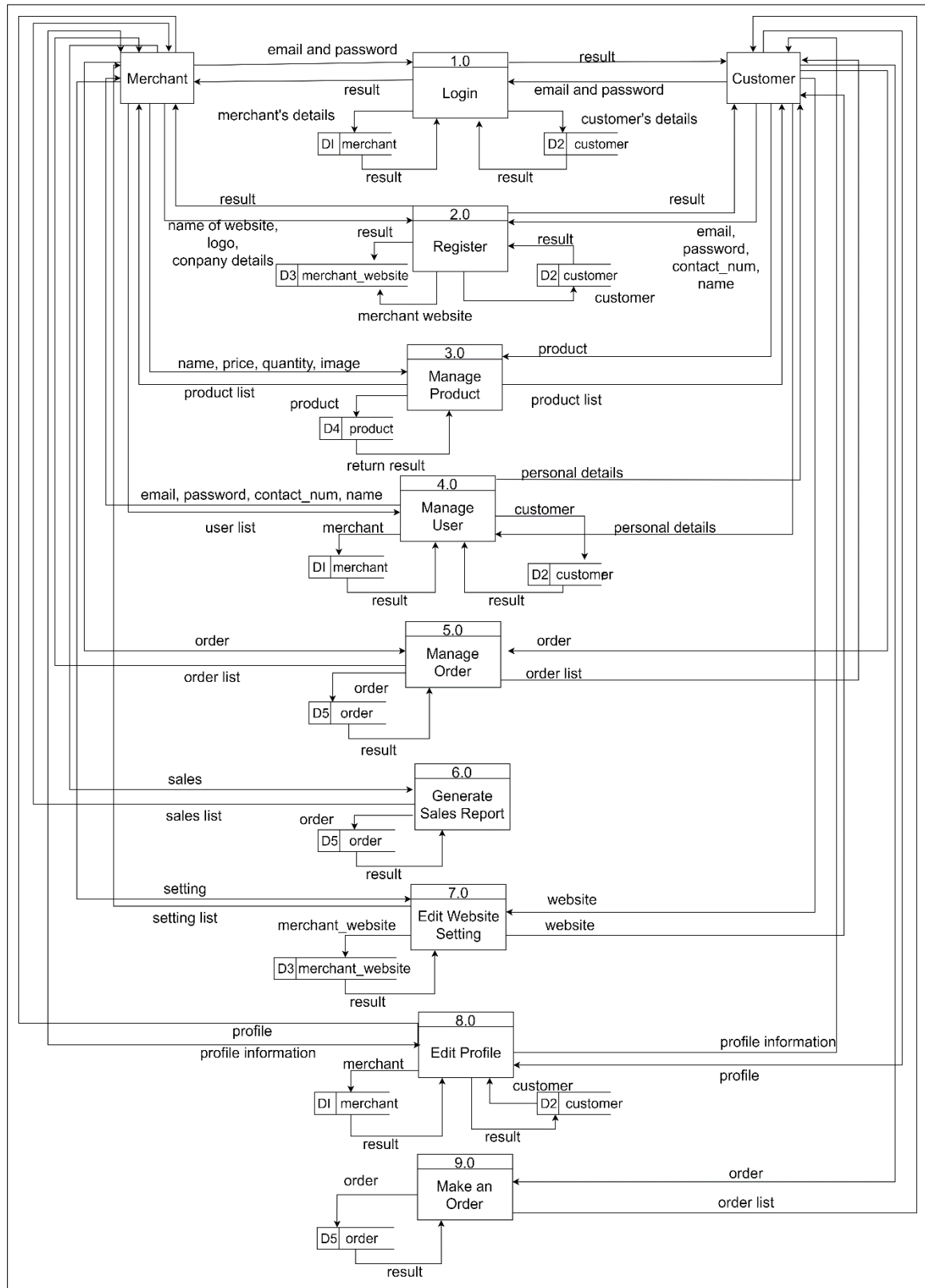
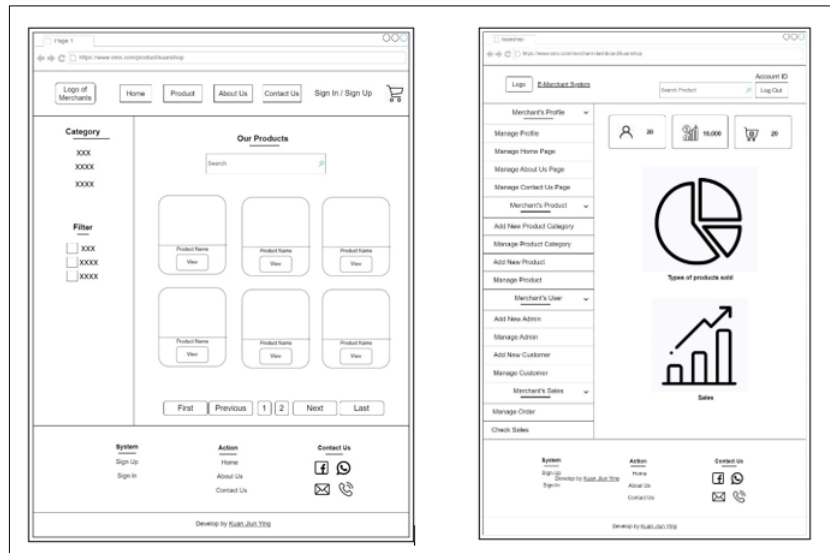


Figure 3: DFD Level 0 of EMS: E-Merchant System





**Figure 5: Interface of EMS: E-Merchant System**

## 4 Results and Discussion

The EMS: Merchant System is implemented in this section. The system interface is developed based on the wireframe design. Client-side scripting is done using HTML, CSS, JavaScript with Bootstrap, jQuery, and AJAX. Server-side scripts are developed with PHP and MySQL. The author uses the Azure Web App service to host web server and filess.io for database hosting. These platforms enable EMS to be successfully hosted on the cloud, and anyone can access it through the network and browser. Besides, system testing is described in this section.

### 4.1 System Implementation

User input validation, data sanitization and query parameterization techniques are used to prevent SQL injection and further to increase the security of the developed system.

Every input value must be verified before being sent to the server. It can ensure that all the input values filled in by the user are not invalid or harmful. This is very effective to prevent the front-end systems from facing security problems, especially SQL injection. Figure 6 shows the JavaScript input validation code segment.

```

if (password !== confirmPassword || password.trim() === "" || confirmPassword.trim() === "") {
    // Display error message for password fields
    $("#password_error").show();
    return;
} else {
    $("#password_error").hide();
}

if (!isValidEmail(email) || email.trim() === "") {
    // Display error message for email field
    $("#email_error").show();
    return;
} else {
    $("#email_error").hide();
}

if (!isValidMobileNumber(mobile) || mobile.trim() === "") {
    // Display error message for mobile number field
    $("#mobile_error").show();
    return;
} else {
    $("#mobile_error").hide();
}
    
```

**Figure 6: JavaScript Input Validation Code Segment**

Data sanitization involves utilizing the `mysqli_real_escape_string()` function to escape or eliminate special characters such as apostrophes and backslashes from a string. This procedure ensures that a valid SQL string is generated, which can be used safely in SQL statement. Figure 7, Figure 8, and Figure 9 display code segments that implement the data sanitization approach for GET requests and POST requests.

```
function get_safe_value($con,$str){
    if($str!=''){
        $str=trim($str);
        return mysqli_real_escape_string($con,$str);
    }
}
```

**Figure 7: Implement a Data Sanitization Function**

```
$order_id      =get_safe_value($con,$_GET['order_id']);
$status_id     =get_safe_value($con,$_GET['status_id']);
$billcode     =get_safe_value($con,$_GET['billcode']);
$transaction_id =get_safe_value($con,$_GET['transaction_id']);
```

**Figure 8: Develop Data Sanitization Function for GET Requests**

```
$address=get_safe_value($con,$_POST['address']);
$city=get_safe_value($con,$_POST['city']);
$pincode=get_safe_value($con,$_POST['pincode']);
$payment_type=get_safe_value($con,$_POST['payment_type']);
```

**Figure 9: Develop Data Sanitization Function for POST Requests**

Query parameterization technology is used to separate the SQL query from user input value, and the user input values are passed as parameter to prevent SQL injection attacks. Before using parameterized queries, you need to define the SQL code. This method allows the database to distinguish data from code, regardless of the user input. By specifying the expected data type to MySQL, the potential risk of SQL injections can be minimized using the `bind_param()` function. Figure 10, Figure 11, Figure 12, and Figure 13 show code segments that use the query parameterization technique for SQL statements such as SELECT, INSERT, UPDATE and DELETE.

```
$order_get_id = mysqli_insert_id($con);

$query = "SELECT * FROM `order` WHERE id = ?";
$stmt = $con->prepare($query);
$stmt->bind_param("i", $order_get_id);
$stmt->execute();
$result = $stmt->get_result();

if ($result->num_rows > 0) {
    $order = $result->fetch_assoc();
    $order_id = $order['order_id'];
    // Process the order data as needed
}
```

**Figure 10: Employ Query Parameterized SQL SELECT Statement**

```
$query = "INSERT INTO `order` (order_id, user_id, address, city, pincode, payment_type, payment_status, order_status,
added_on, total_price, txnid, coupon_id, coupon_code, coupon_value, merchant_id)
VALUES (?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?, ?)";
$stmt = $con->prepare($query);
$stmt->bind_param("sssssssdss", $create_order_id, $user_id, $address, $city, $pincode, $payment_type, $payment_status,
$order_status, $added_on, $total_price, $txnid, $coupon_id, $coupon_code, $coupon_value, $merchant_id);
$stmt->execute();
```

**Figure 11: Employ Query Parameterized SQL INSERT Statement**

```
$stmt = $con->prepare("UPDATE `order` SET txnid=?, payment_status=?, billcode=? WHERE order_id=?");
$stmt->bind_param("sssi", $transaction_id, $status, $billcode, $order_id);
```

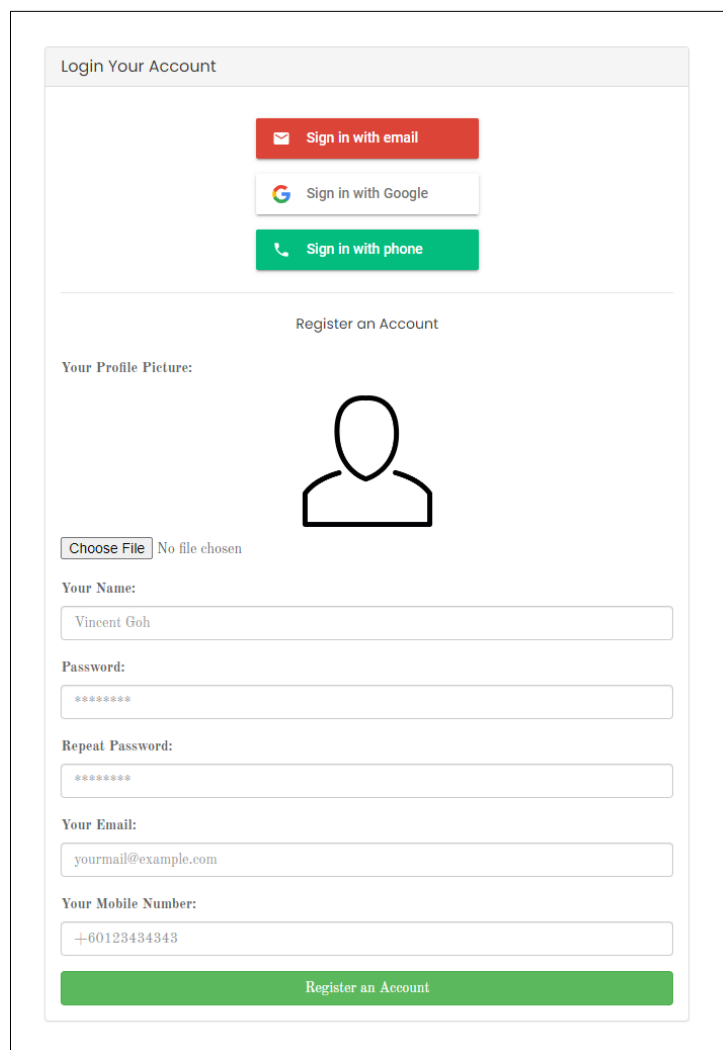
**Figure 12: Employ Query Parameterized SQL UPDATE Statement**

```
if(isset($_GET['wishlist_id'])){
    $wid=get_safe_value($con,$_GET['wishlist_id']);
    $query = "DELETE FROM wishlist WHERE id = ? AND user_id = ? AND merchant_id = ?";
    $stmt = $con->prepare($query);
    $stmt->bind_param("iii", $wid, $uid, $merchant_id);
    $stmt->execute();

    $stmt->close();
}
```

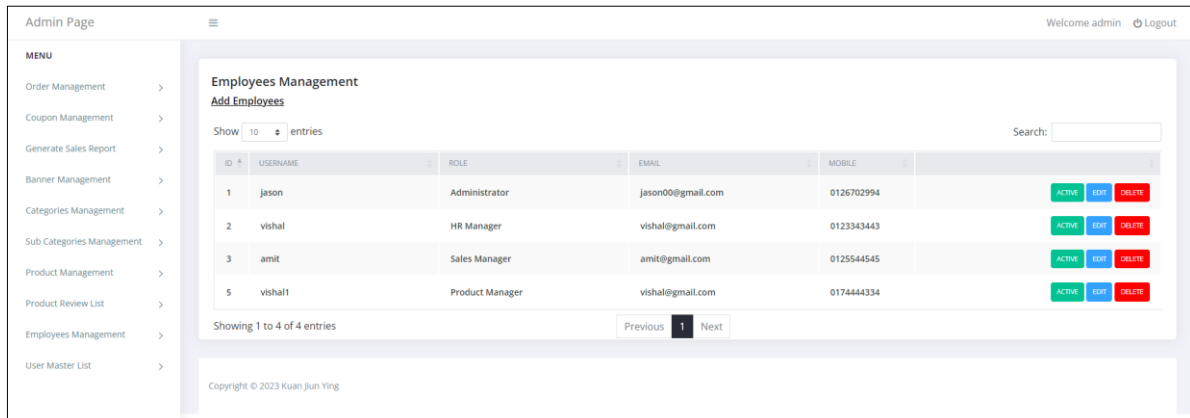
**Figure 13: Employ Query Parameterized SQL DELETE Statement**

In this login and registration page, the customers of the merchant can register their account, or log in to their account through their email, mobile phone number or Google account. The author uses Firebase Authentication and Firebase UI to achieve this function. It can guarantee the security of user data and increase the security of the system, because this third-party authentication technology is a very mature, safe, and famous service at present. Figure 14 shows the login and registration page.



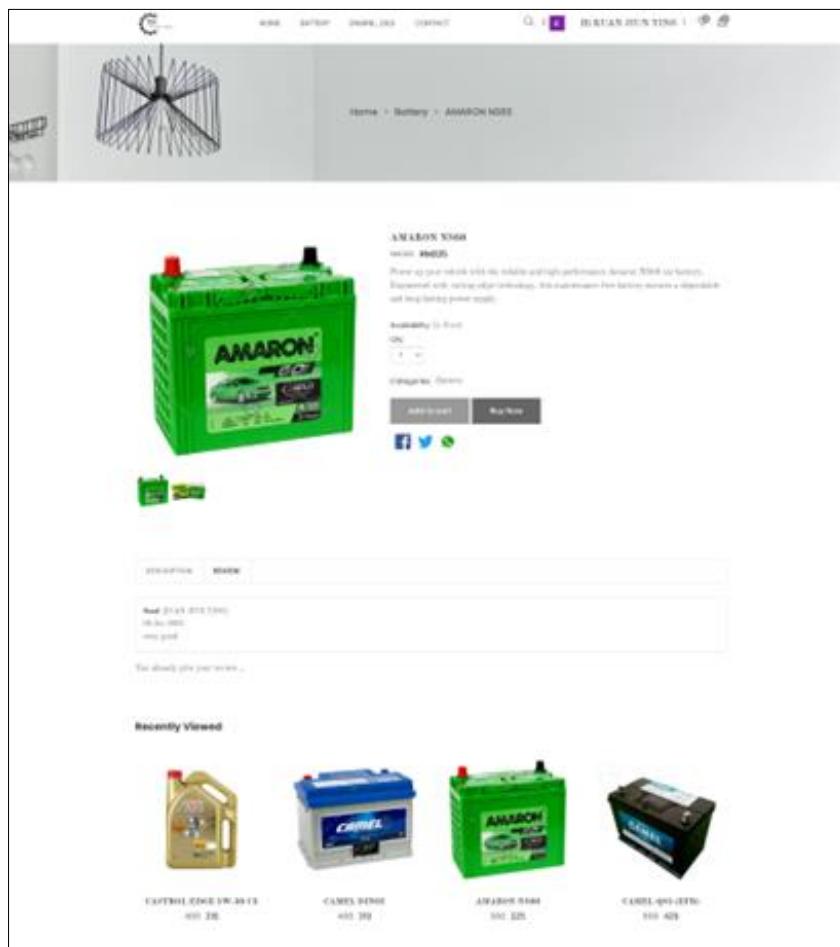
**Figure 14: Interface of Login and Registration Page**

In the employee management page, the list of employees is shown in a table. The administrator or human resources manager can update the employees' status, modify the employees' information, and delete the selected employee. Figure 15 shows the employee management page.



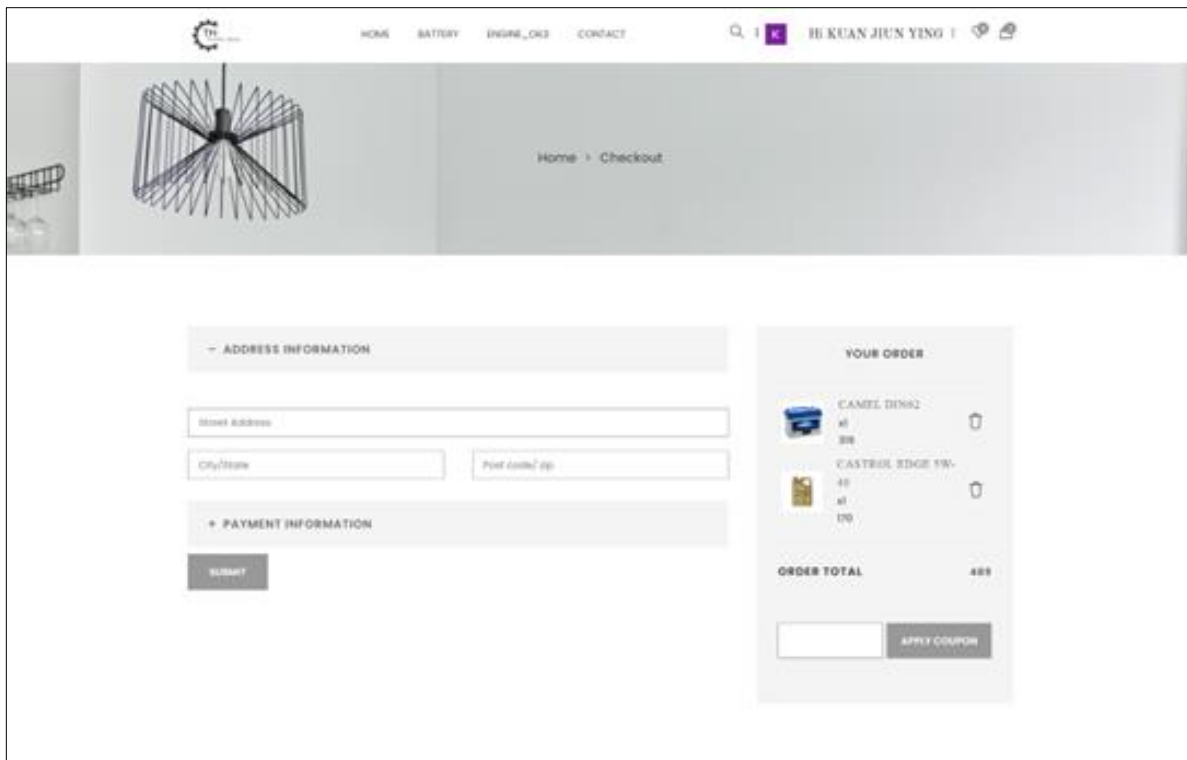
**Figure 15: Interface of Employee Management Page**

In the product page, the detailed information of the product, such as product name, product picture, and product description, is displayed. Customers of a merchant can access this page via search page, home page, and category page. Customers of a merchant can add products to the shopping cart or buy the product according to the quantities they want. Figure 16 shows the product page. Appendix A.1 shows the home page of the ecommerce system in EMS.



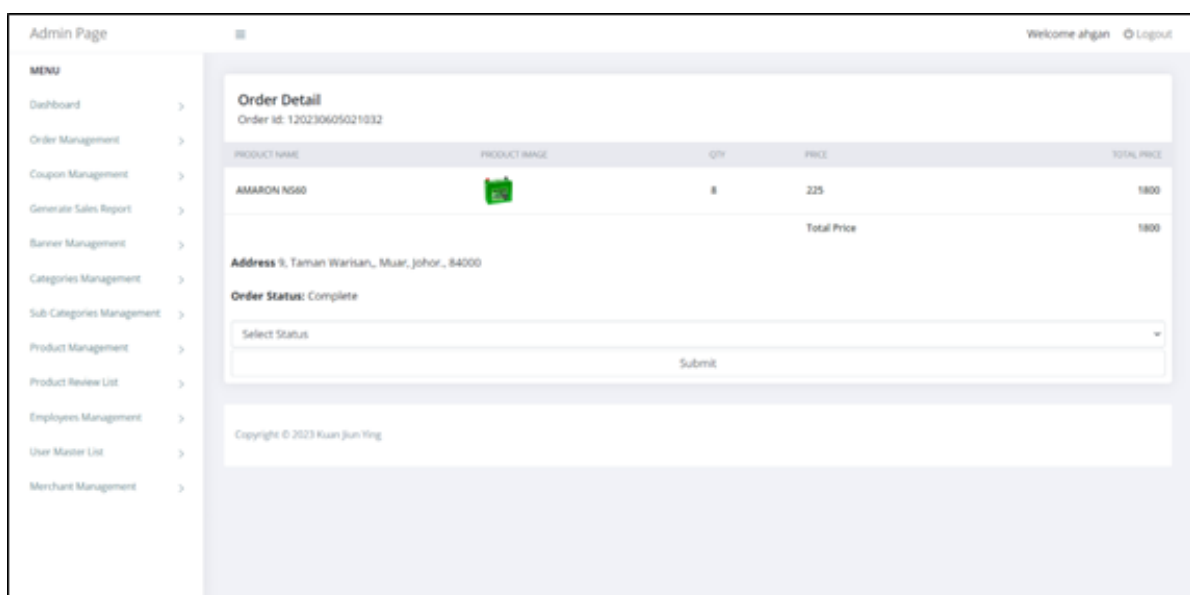
**Figure 16: Interface of Product Page**

On the checkout page, the merchant’s customers can fill in their address information and choose the payment method they want to check out. The payment method includes COD and Online Banking. The customers of the merchants can also view the products they ordered on this page. In addition, they can apply for a coupon provided by the merchant to obtain purchase discounts. After completing the order, an email invoice is sent to the customer’s email. Appendix A.2 shows the invoice of order in an email. Figure 17 shows the checkout page.



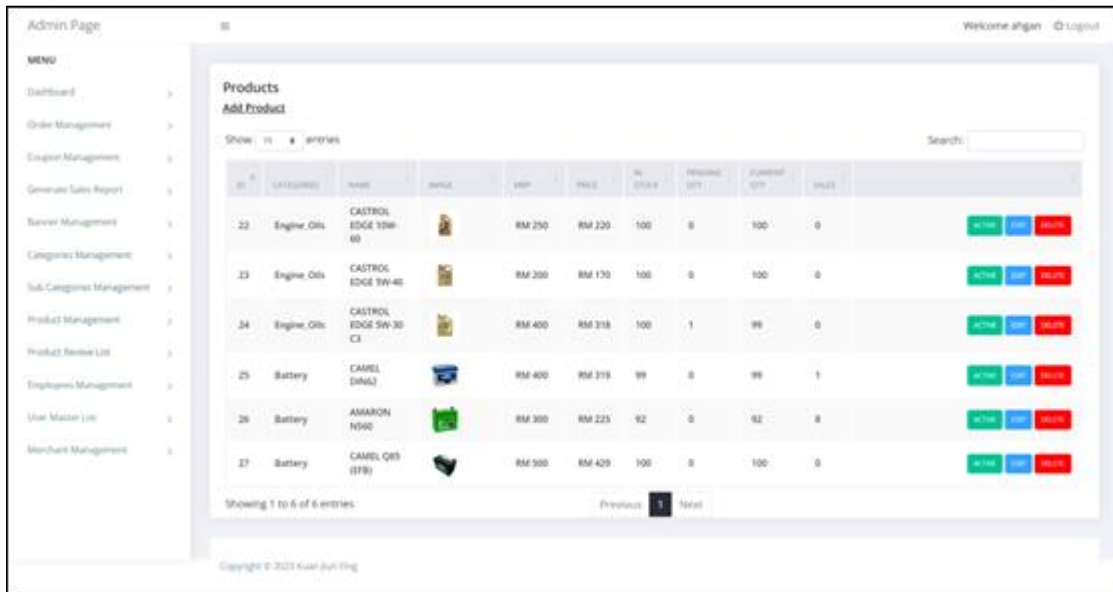
**Figure 17: Interface of Checkout Page**

The administrator or sales manager can update the status of the order details. Figure 18 shows the order detail page for the merchant management system.



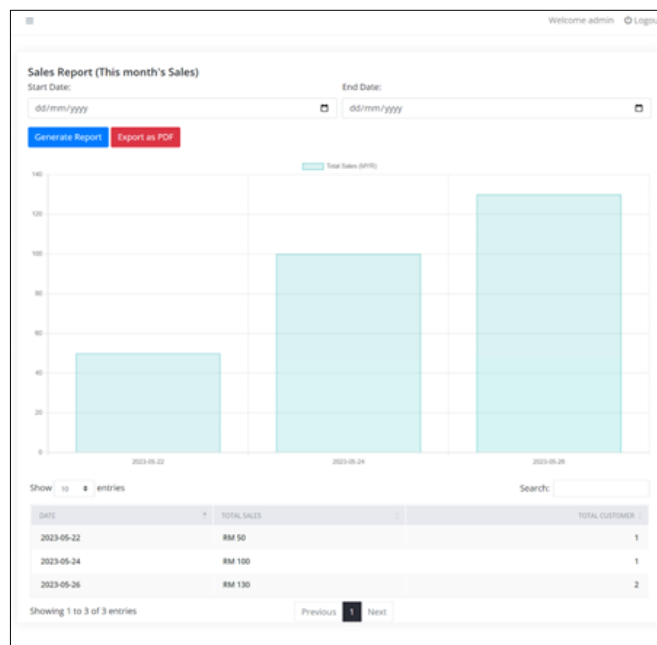
**Figure 18: Interface of Order Detail Page**

In the product management page, the list of products is displayed in the table. The administrator or product manager can view the product list, update product status, and delete the selected product. Figure 19 shows the product management page.



**Figure 19: Interface of Product Management Page**

The sales report generation page allows merchants to view and generate sales reports based on specific dates conveniently. The report includes a comprehensive sales chart and a table, which visually shows the total sales over a period of time. In addition, merchants can choose to export the sales reports to PDF format for further analysis and record keeping. Figure 20 shows the sales page for the merchant management system.



**Figure 20: Interface of Sales Page**

ToyyiPay Online Banking Payment Method is implemented into this developed system. Customers of the merchant can pay for their purchases through FPX. The payment status of the order is updated after the FPX payment process. Figure 21 shows the ToyyiPay Online Banking Payment Page.



In the merchant management page, merchants are allowed to modify or edit on their information of ecommerce website such as the merchant's logo, merchant's name, merchant's email, and phone number. Figure 23 shows the merchant management page.

The screenshot displays the 'Edit Merchant Details' form. At the top right, it says 'Welcome Jason123' and 'Logout'. The form fields are as follows:

- Merchant Name:** FashionGangassa
- About Us:** Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.
- Address:** FashionGang, muar123sadsasdaw
- Google Map:** <https://www.google.com/maps?l=2.044586,102.566274&z=17&t=m&hl=zh-CN&g=MY&mapclient=embed&cid=7343421323413450790>
- Email:** fasiongang@gmail.com
- Phone Number:** 6012-23334334
- Payment API Key:** as22
- Payment Category Code:** sa
- Google Map IFrame:** <https://www.google.com/maps/embed?pb=!1m14!1m3!1d1993.6391343731696!2d102.5638924!3d2.044586!3m2!1!1024!2!768!4!13.1!3m3!1m2!1s0x31d1b9059292be51%3A0x65e912c95a167026!2z6bqm5b2T5Yqz5et>
- Facebook Link:** <https://www.facebook.com/jiunying0335>
- WhatsApp Link:** <https://wa.me/60126702008>
- Instagram Link:** [https://www.instagram.com/silentk\\_95/](https://www.instagram.com/silentk_95/)
- Website Link:** <https://www.facebook.com/jiunying0335>
- Merchant's logo:** Choose File | No file chosen. Preview shows an orange shopping bag icon with 'EMS' below it.
- Merchant's favicon logo:** Choose File | No file chosen. Preview shows the same orange shopping bag icon with 'EMS' below it.

At the bottom of the form is a blue 'Update' button.

**Figure 23: Merchant Management Page**

## 4.2 System Testing

This section describes the system testing, including function testing and User Acceptance Testing (UAT). The functional testing follows the system test plans for merchants and their customers and verifies whether the system operates as expected. UAT evaluates the final satisfaction and expectations of the target users for the system. These tests have ensured the integrity, standardization, and security of the system.

### 4.2.1 Functional Testing

The various modules and functions of E-Merchant System (EMS) are validated through functional testing from the perspectives of both the merchant and the merchant's client. The merchant management

system within the EMS is functionally tested by the merchants using the merchant test plan. All ten of the merchants who took part in this test gave it a passing grade for the EMS's merchant management system's various features. Table 5 shows the results of Merchant Test Plan

**Table 5: Result of Merchant Test Plan**

Functions		Expected Result	Actual Results (Pass)	Actual Result (Fail)
Login & Registration	I.	Login to the merchant management system	10	
	II.	Register their own ecommerce website		
Product Management	I.	A list of products shown	10	
	II.	New product is added		
	III.	Product's information is edited		
	IV.	Product is deleted		
User Management	I.	A list of users shown	10	
	II.	New user is added		
	III.	User's information is edited		
	IV.	User is deleted		
Order Management	I.	A list of orders shown	10	
	II.	Order is updated		
Sales Generation	I.	A list of sales shown	10	
	II.	Sales report is generated		
Edit Website Setting	I.	A list of setting shown	10	
	II.	Website setting is edited		

Secondly, the merchant's customer uses the customer test plan to test the functions of the e-commerce system within the EMS. The customers from ten different merchants who insisted on the specified test plan participated in the test stage. The goal is to comprehensively evaluate the performance and function of the e-commerce system within the EMS from the users' perspective. Result of Customer Test Plan shown in Table 6.

**Table 6: Result of Customer Test Plan**

Functions		Expected Result	Actual Results (Pass)	Actual Results (Fail)
Login & Registration	I.	Login to the system	10	
	II.	Register an account for a specific ecommerce		
Display Product	I.	A list of products shown	10	
	II.	Product detail shown		
Add to Cart	I.	A list of products in cart shown	10	
	II.	Products' detail in cart such as quantity are updated		
	III.	Selected products in cart are removed		
	IV.	Order is confirmed		
Payment	I.	Payment method is selected to complete their payment	10	
Check Order	I.	A list of order shown	10	
	II.	Order detail is shown		
Edit Profile	I.	Profile information shown	10	
	II.	Profile information is updated		

#### 4.2.1 User Acceptance Testing (UAT)

Within the EMS: E-Merchant System, User Acceptance Testing (UAT) is carried out by two separate users based on the functionality of the merchant management system (merchant) and the ecommerce system (merchant's customer). Google Forms is used to carry out the UAT.

After testing the function of the EMS merchant management system, the merchants completed the UAT form for merchants. Ten merchants' UAT findings are shown in Table 7. Most merchants spoke highly of the EMS acceptance standard.

**Table 7: Result of Customer Test Plan**

No.	Acceptance Requirement	Score				
		1	2	3	4	5
I	Able to login to the system				2	8
II	Able to register their own ecommerce website				2	8
III	Able to manage product			2	2	6
IV	Able to manage user				1	9
V	Able to manage order				1	9
VI	Able to view and generate sales				1	9
VII	Able to edit website's setting				2	8

Customers of the merchant use the UAT to evaluate the e-commerce features. Table 8 shows the UAT results of ten customers of the merchant. It has been noted that most of the clients of the merchants have given the EMS's acceptance criteria a high rating.

**Table 8: Result of User Acceptance Testing Form for Merchants' Customers**

No.	Acceptance Requirement	Score				
		1	2	3	4	5
I	Able to login to the system				2	8
II	Able to register account to the system				2	8
III	Able to view all the products			2	2	6
IV	Able to add the product into the cart					10
V	Able to update the cart				1	9
VI	Able to confirm an order				1	9
VII	Able to do the payment				2	8
VIII	Able to check their order				1	9
IX	Able to edit their profile's information.				1	9

## 5. Conclusion

The EMS: E-Merchant System is a comprehensive platform that enables merchants to create their own ecommerce websites without requiring much IT knowledge. This platform provides various functions, such as user management, ordering, payment, product management and sales generation modules. It also ensures security by validating user input and sanitizing data and offers convenient authentication methods through Firebase Authentication. The platform is user-friendly and mobile-friendly, with a responsive layout, timely feedback through message boxes, and easy accessibility from any device via cloud deployment.

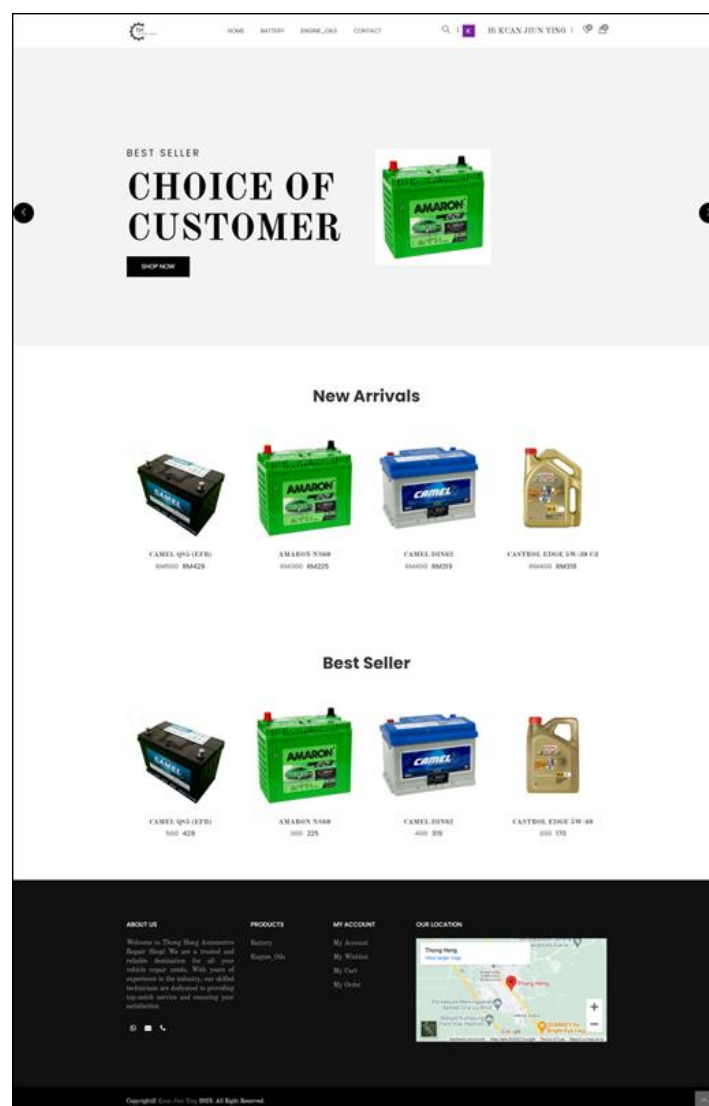
However, the platform also has some limitations, such as the lack of a responsive interface for the merchant management system, the inability to select products according to specific attributes, and the interface design that may look dull and lack creativity.

Future improvements should be aimed at creating a responsive management interface, improving the ordering module to support attribute-based product selection, and enhancing the interface design to make it more attractive, and combining with colours, animations and interactive elements. These improvements will increase the user experience, improve user satisfaction, and ultimately enhance the system performance and reputation.

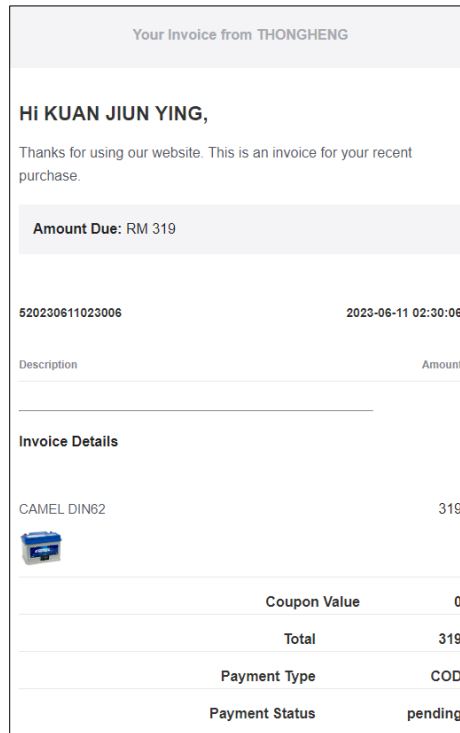
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### Appendix A



Appendix A.1: Interface of Home Page of Ecommerce System in EMS



#### Appendix A.2: Email Invoice after Purchasing

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