HARDWARE BUSINESS MANAGEMENT SYSTEM

By

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A REPORT

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ABSTRACT

This project focuses on developing a comprehensive web-based business management system specifically tailored for hardware store owners, aiming to streamline the operations and address the inefficiencies of traditional manual methods and fragmented software solutions. The system integrates essential functions such as inventory management, sales tracking, customer and supplier management and data-driven reporting into a unified platform, significantly enhancing operational efficiency and reducing the management burden. The inventory management feature allows for real-time stock tracking, automatic updates and notifications for low or out-of-stock items, preventing supply disruptions. Work order management optimizes customer service by efficiently managing repair requests and order fulfilment, ensuring smooth operations. The sales tracking and reporting features enable business owners to monitor all transactions and analyze sales data, helping identify trends, optimize revenue and improve product offerings. Additionally, the customer management functionality helps maintain detailed profiles of customers, tracking purchase history and preferences to personalize services and strengthen customer relationships. Supplier management enables better communication and organization of supplier data, streamlining the order and allowing for more effective negotiations. The system also includes reporting and analytics tools that generate daily, monthly and annual reports on sales performance and other key metrics, with visual representations such as charts and graphs for easier data interpretation. The dashboard serves as the central hub for quick access to all key functionalities and provides real-time sales analysis. Furthermore, the live chat feature integrated into supplier management allows users to report damaged products and negotiate directly with suppliers, ensuring seamless communication and enhancing overall operational flow. By offering an integrated, user-friendly interface, this system not only improves business efficiency but also empowers hardware store owners with actionable insights, leading to better decision-making, enhanced customer satisfaction and increased growth. In the long term, the system is envisioned to expand beyond the hardware industry, evolving into a versatile, intelligent and automated business management platform applicable to various industries, contributing to the modernization of business operations.

Area of Study: Business Management System

Keywords: Web-based Application, Hardware Store, Real-time Sales Analysis, User-friendly Interface, Decision-making

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LIST OF ABBREVIATIONS

POS	Point of Sale
ERP	Enterprise Resource Planning
CRM	Customer Relationship Management
CRUD	Create, Read, Update and Delete
UI	User Interface
UX	User Experience
SDLC	Software Development Life Cycle
XAMPP	Cross-Platform, Apache, MySQL, PHP and Perl
SQL	Structured Query Language
ERD	Entity Relationship Diagram
AI	Artificial Intelligent

CHAPTER 1

INTRODUCTION

This chapter will briefly introduce this project in term of project background, problem statement and motivations, contributions to the study field and the outline of the thesis.

1.1 Problem Statement and Motivation

Traditionally, many businesses have relied on manual methods, such as physical ledgers or fragmented software solutions, which have led to operational inefficiencies and frequent human errors. [1] These disjointed systems failed to integrate key business processes, resulting in inaccurate inventory tracking, delayed and unreliable sales reporting and incomplete or inconsistent customer and supplier records. These inefficiencies not only disrupt daily operations, but also hinder overall productivity, preventing businesses from achieving seamless workflows and operational harmony. [1]

In addition, the lack of real-time data analysis tools and actionable reporting mechanisms severely limits businesses' ability to make informed data-driven decisions. Without comprehensive analytics, it is difficult for businesses to effectively adjust their strategies in response to emerging trends or market demands. This results in a growing gap between raw operational data and actionable insights, leading to missed opportunities for optimization and growth in an increasingly competitive market.

Furthermore, many existing business management solutions have overly complex and unintuitive user interfaces, making it difficult for employees to learn and use them effectively. These cumbersome systems hinder user adoption, increase the likelihood of errors and add unnecessary barriers to streamlining daily operations. In today's fast-paced environment, businesses are in urgent need of user-friendly, responsive and integrated solutions to streamline processes, minimize errors and enhance the overall user experience.

The goal of this project is to develop a comprehensive web application that meets the needs of hardware store owners, allowing them to manage their businesses more efficiently. Traditional methods of business management, such as manual record keeping or fragmented software solutions, have proven to be inefficient, error-prone and cumbersome to use. [1] By addressing these challenges, the proposed web application will provide an integrated system that

streamlines business operations, automates critical tasks and enhances decision-making capabilities through real-time analytics and reporting tools.

Additionally, the application will improve existing solutions by providing a user-friendly and intuitive interface that simplifies complex operations and encourages user adoption. By integrating advanced features such as inventory tracking, sales management, customer and supplier record keeping and actionable data insights, the system is designed to eliminate inefficiencies, reduce manual errors and increase productivity. [1] Ultimately, the proposed solution is expected to allow hardware store owners to seamlessly manage their businesses and achieve greater operational efficiency.

1.2 Research Objectives

This project aims to develop a comprehensive web-based business management system tailored for hardware stores to improve on existing solution in the market. These are the 3 main objectives of the project as stated below:

1. To streamline and automate business operations by developing an integrated business management system that addresses inefficiencies, reduces manual errors and eliminates reliance on fragmented software solutions.
2. To enable data-driven decision-making by providing real-time data analytics and generating actionable reports that support informed business strategies.
3. To enhance user experience through the creation of a user-friendly, responsive and intuitive interface that simplifies complex business operations and ensures ease of use.

1.3 Project Scope and Direction

This project involves the design, development and implementation of a comprehensive web-based business management system that meets the specific needs of hardware store owners. The system is designed to address the inefficiencies of traditional methods such as manual record keeping and fragmented software solutions by providing an integrated platform to streamline operations, automate key tasks and increase productivity. Key features include inventory management for accurate inventory tracking, work order management for streamlined order processing, sales tracking with real-time performance analysis, supplier management for effective communication and coordination and reporting and analytics for data-driven decision making. A core feature of the system is its intuitive dashboard, which

consolidates essential tools into a user-friendly interface, allowing hardware store owners to effectively manage work orders, sales and other key operations.

The direction of this project is to focus on creating a robust, scalable and future-proof solution that will evolve with the growing needs of modern businesses. By integrating advanced features such as real-time analytics, automated workflows and a simplified user interface, the system will not only address current challenges but also enable hardware store owners to adapt to market changes and remain competitive. Future enhancements may include mobile app integration for anytime, anywhere access and advanced predictive analytics for better decision making.

Ultimately, the project aims to become an indispensable tool for hardware store owners, improving operational efficiency, reducing errors and enhancing user experience. The long-term vision is to establish the system as a benchmark for business management solutions in the hardware retail sector, ensuring sustainability, scalability and continuous innovation.

1.4 Contributions

The main goal of the project is to develop an innovative business management system tailored specifically for the hardware industry, addressing the inefficiencies of traditional approaches and fragmented software solutions. Unlike existing web applications on the market, the system integrates and enhances key functions such as inventory management, work order processing, sales tracking, supplier management and real-time reporting into a unified platform. By streamlining and automating key business processes, the proposed solution reduces the management burden on hardware store owners, minimizes human errors and significantly improves operational efficiency. The core contribution of the project is the development of an intuitive and user-friendly interface designed to simplify complex operations and enhance user experience. In addition, the system provides real-time analysis and decision-making tools to provide hardware store owners with actionable insights to drive business growth. Through its dashboard functionality, users can efficiently manage critical tasks and monitor business performance in real-time, setting it apart from existing solutions. Looking ahead, the project envisions expanding the web application beyond the hardware industry to become a versatile and universal business management platform for various industries. The system was designed with scalability and innovation in mind, with plans to incorporate advanced technologies such as predictive analytics, automation and mobile accessibility. By promoting the adoption of

smart and automated business management practices, the solution aims to transform the way businesses operate, improving overall quality, productivity and profitability.

1.5 Report Organization

The structure of this report is organized to provide a clear and logical progression of the project's development. Chapter 2 offers a comprehensive literature review, examining existing business management systems and their functionalities while identifying gaps and challenges in current solutions. Chapter 3 focuses on the proposed method for the system's development, including detailed representations such as use case diagrams and wireframes to illustrate the system's design and workflow. Chapter 4 discusses the preliminary work completed for the project, outlining the initial implementation steps, challenges encountered and progress made toward achieving the project objectives. Chapter 5 concludes the report by summarizing the key findings, contributions and potential future developments of the system. Finally, a project poster is included, providing a visual summary of the system's features, objectives and overall impact.

CHAPTER 2

LITERATURE REVIEWS

2.1 Previous Work on Business Management System

2.1.1 Unleashed Software

General Introduction to Application

Unleashed Software is a cloud-based inventory management system that helps users to keep track of all products and services. It gives user instant visibility into all inventory and sales, allowing user to complete more tasks in less time at a lower cost. Unleashed software was established by former co-founder, Greg Murphy on Year 2009. [2] Greg Murphy recognized the critical need for wholesale, distribution and manufacturing to have more streamlined process management in supply, production, inventory and sales. [2] Due to Unleashed Software is a perpetual inventory system, it updates the inventory levels in real time. [2] This gives user an instant and better understanding of the purchasing needs without having to manually count each item. Additionally, Unleashed Software automates repetitive and manual processes involved in merchandise management. [2] This functions have improved the work efficiency, saved time and reduced labour and operating costs. When the user logs in to Unleashed Software, the business analysis summary dashboard (Figure 2.1.1) will serve as the user's homepage. In the dashboard, the user can observe the sales analysis in graphical form.

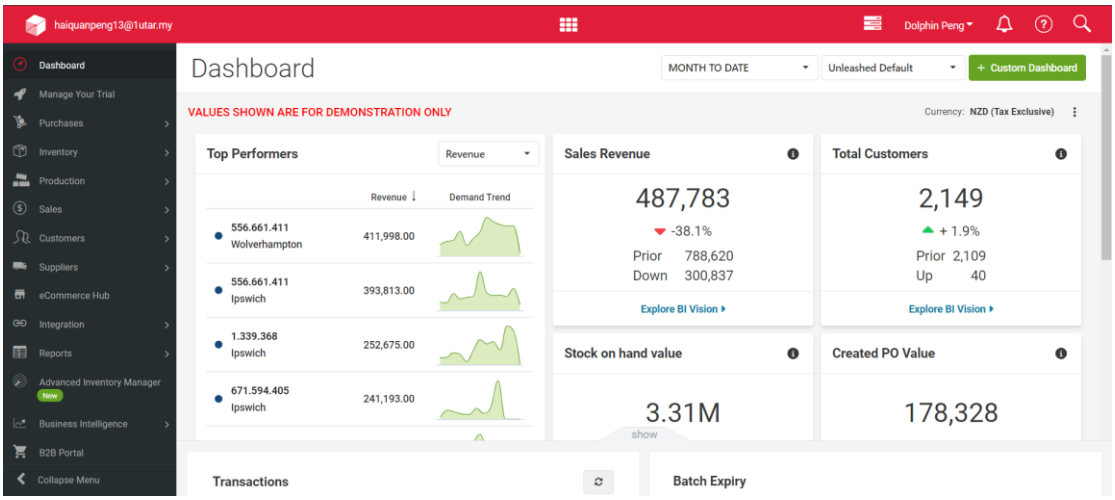


Figure 2.1.1 Dashboard of Unleashed Software

Features of the Application

By selecting the View Purchases in the menu, a detail page of list of purchase orders (Figure 2.1.2) will be displayed to users. In this page, users can view the purchase order by clicking on the purchase order number, add new purchase order by clicking on Add Purchase button and update or delete details for each purchase order. Additionally, there are some filter provided for user to filter the purchase order.

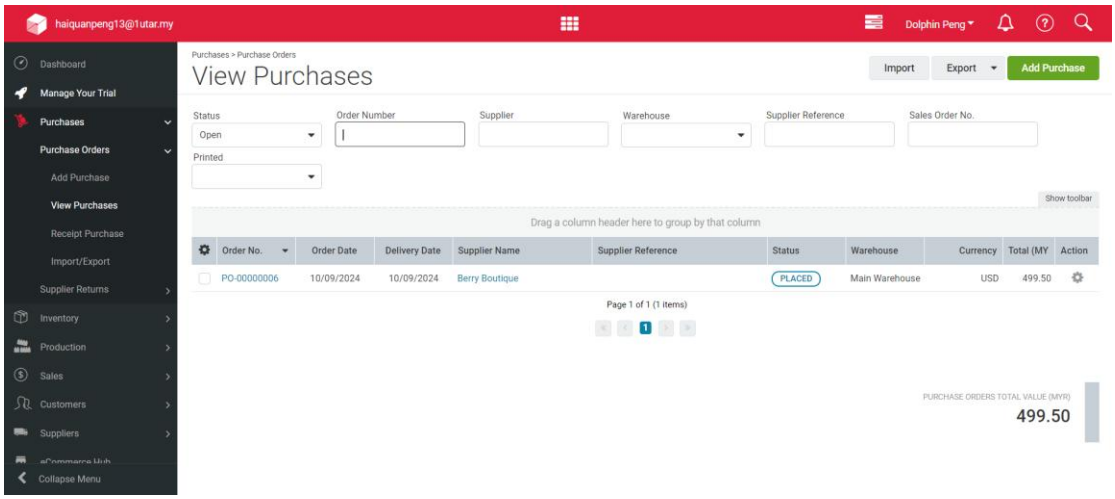


Figure 2.1.2 Unleashed Software of Purchase Order Management Page

By selecting the View Products in the menu, the detail of list of products (Figure 2.1.3) will be displayed to users. In this page, users can view the product details by clicking on the product code, add new product by clicking on Add Product button and update or delete the product details by clicking on the Action for each product. Additionally, there are provided some filters for user to filter the product.

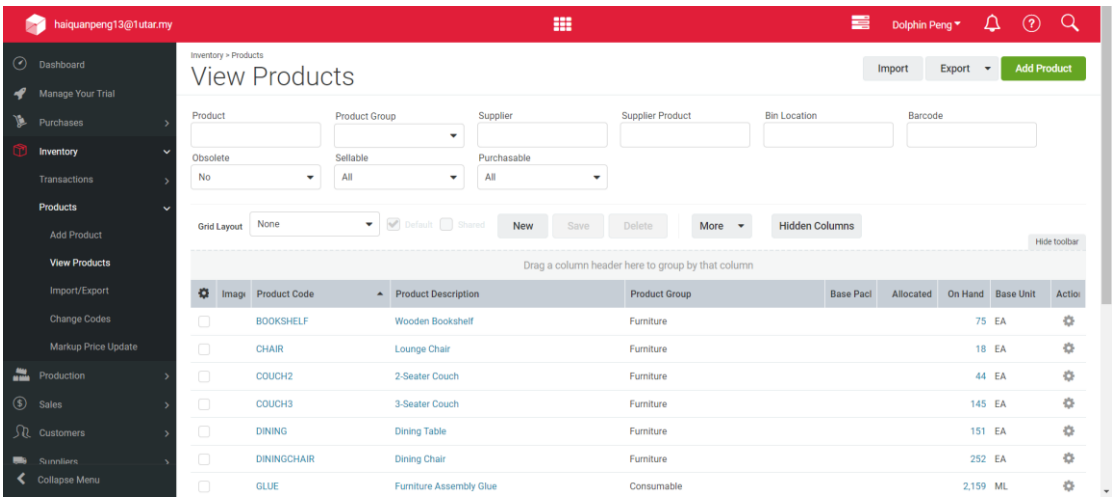


Figure 2.1.3 Unleashed Software of Product Management Page

By selecting the View Customers in the menu, the details of customer (Figure 2.1.4) will be displayed in table form to users. In this page, users can view the customer details, add new customer by clicking on Add Customer button and update or delete the existing customer details by clicking on Action for each customer. Additionally, there are some filters provided for users to filter the customers.

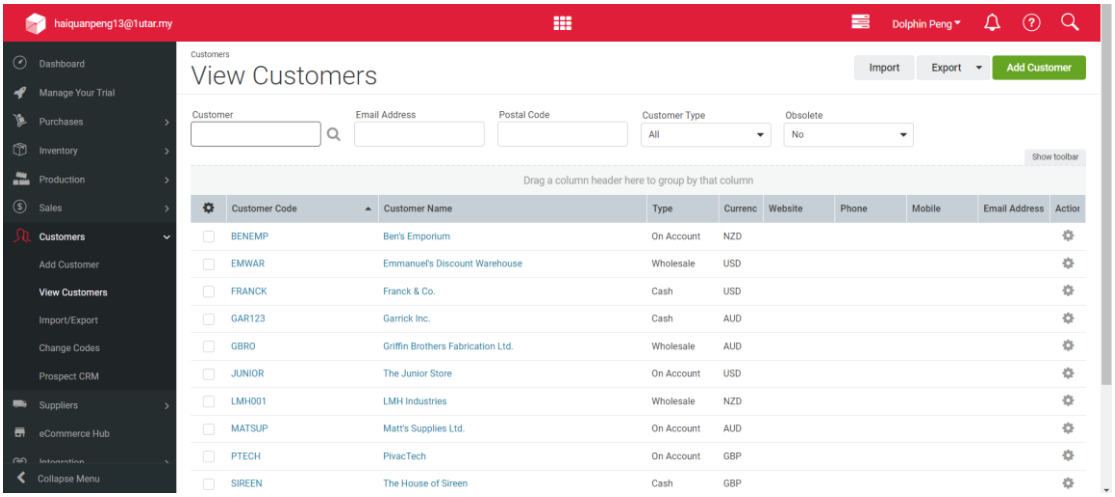


Figure 2.1.4 Unleashed Software of Customer Management Page

By selecting the View Suppliers in the menu, the details of suppliers (Figure 2.1.5) will be displayed to users in table form. In this page, users can view suppliers details by clicking on the Supplier Code, add new supplier by clicking on Add Supplier button and update or delete existing supplier details by clicking on Action button for each supplier. Additionally, there are some filter provided for users to filter the supplier details.

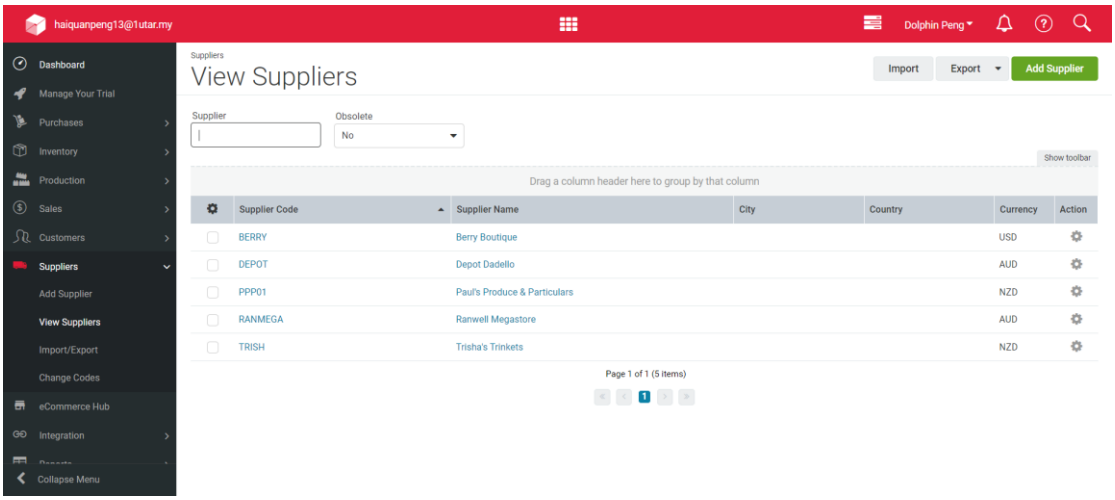


Figure 2.1.5 Unleashed Software of Supplier Management Page

By selecting Report in the menu, there are some different types of report provided. Figure 2.1.6 is one of the type of report, Purchase Enquiry Report. In this page, there are some fields that can be selected for modification of the result in this report. This page provides export function to let users can export the generated report to PDF, CSV and XLSX format.

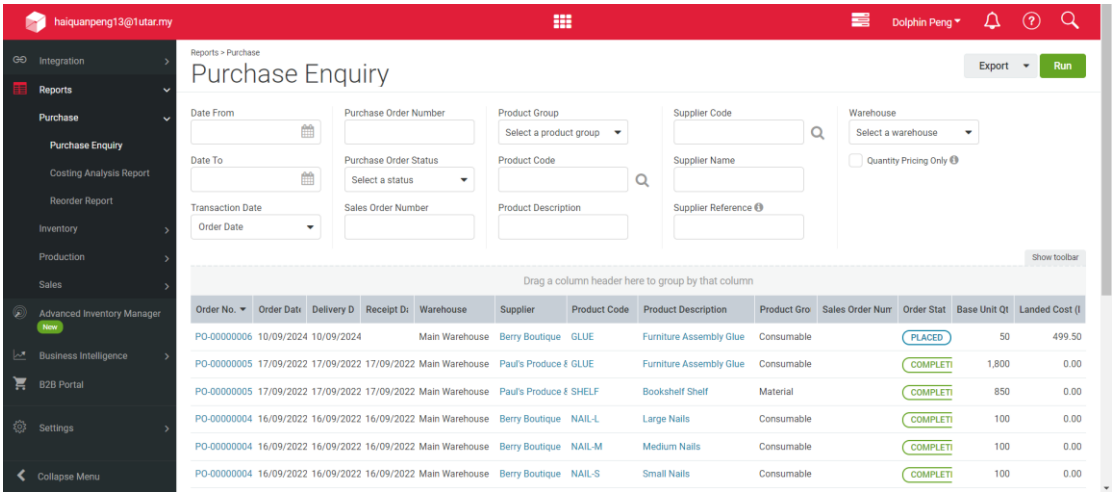


Figure 2.1.6 Unleashed Software of Report Management Page (Purchase Enquiry Report)

Strengths of the Application:

Besides the obvious strength that is the perpetual stock control, Unleashed Software offers some benefits for users. A major benefit is the reduction of management time by applying simple automation techniques. Unleashed Software works by transforming manual processes into automated processes. As a result, these fast and accurate workflows will help users minimize management time, allowing users to focus more on revenue-generating activities. [2] Furthermore, the benefit is reduced inventory storage and production costs. [2] Unleashed Software enables users maximize the storage space without running out of inventory. When inventory levels are optimized and updated in real-time in the cloud, user can implement just-in-time strategies. [2] This will help users in minimizing the amount of inventory for each product, thereby reducing inventory carrying costs. Inventory visibility and product traceability are strengths of Unleashed Software. The app provides users with accurate, real-time insights into all inventory moments, allowing users to make more informed decisions. Through serial number tracking, users can track the entire process of a product from raw materials and parts to finished product sales.

2.1.2 Lightspeed

General Introduction to Application

Lightspeed is a cloud-based point of sale (POS) and eCommerce solution designed to help retailers, restaurants and hospitality business manage their operations more efficiently. Lightspeed was established by Dax Dasilva on Year 2005. [3] Lightspeed provides a comprehensive set of tools for inventory management, sales tracking, customer management and analytics. Lightspeed aims to provide an all-in-one platform that can handle everything form in-store and online sales to customer engagement and reporting. [3] When users logged into Lightspeed, a simple dashboard (Figure 2.1.7) will be provided and served as Homepage for users.

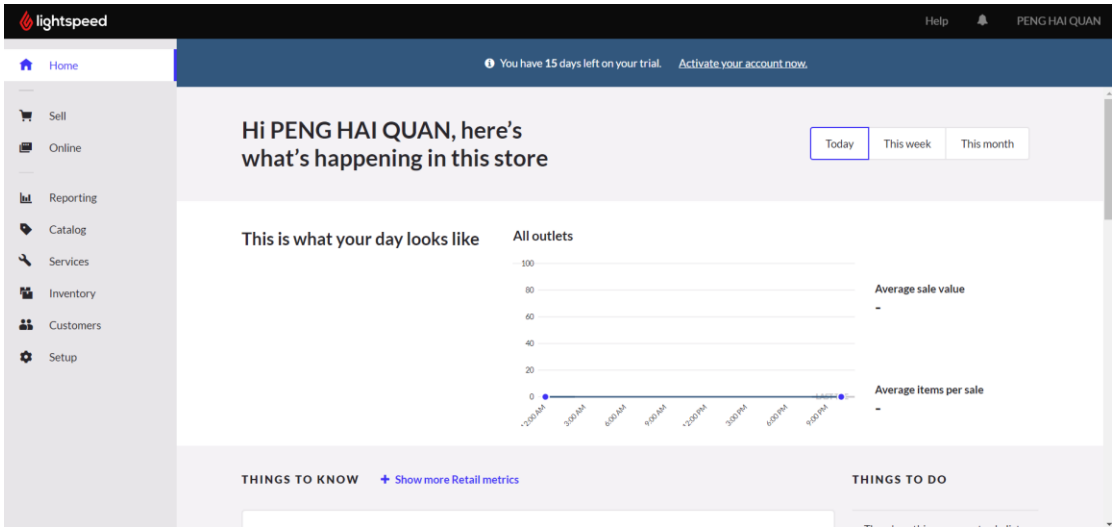


Figure 2.1.7 Lightspeed of Homepage

Features of the Application

By selecting Products in the menu, the detail of product page (Figure 2.1.8) will be displayed to users. In this page, users can view the product details by clicking on the product name, add new product by clicking on Add Product button and update or delete the existing product details by clicking on the pencil icon for each product. Additionally, there are some filters provided for users to filter the product details.

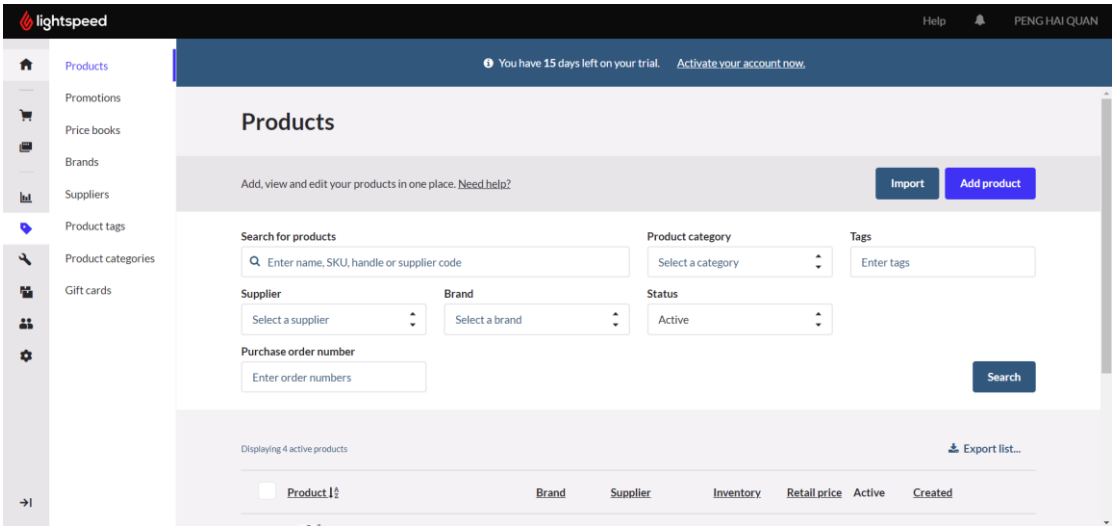


Figure 2.1.8 Lightspeed of Products Page

By selecting Suppliers in the menu, the detail of supplier page (Figure 2.1.9) will be displayed to users. In this page, users can view the supplier details by clicking on supplier name, add new supplier by clicking on Add Supplier button update existing supplier details by clicking pencil icon and delete the supplier details by clicking dustbin icon. Additionally, there are some filter provided for user to filter the suppliers.

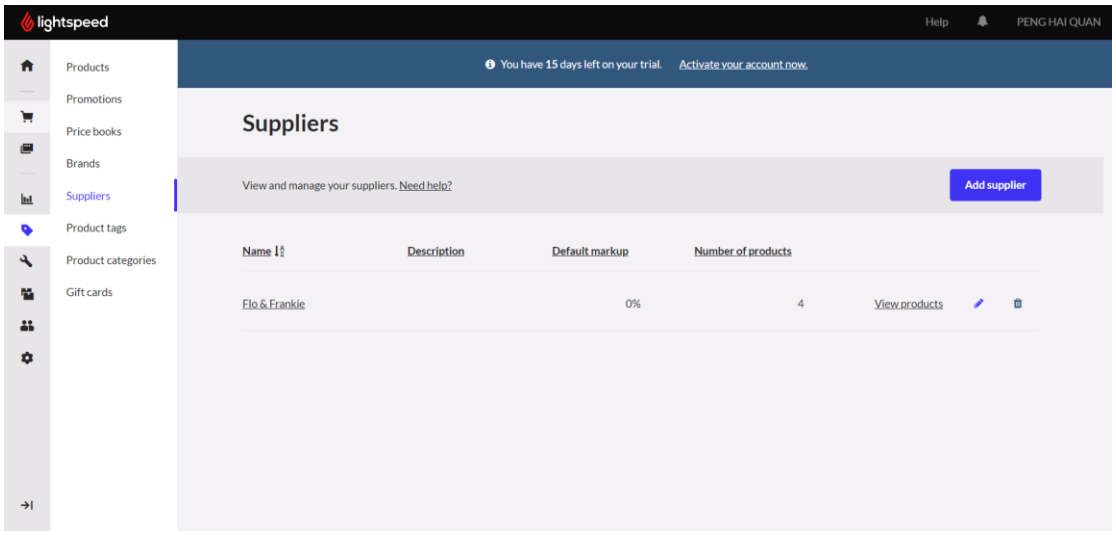


Figure 2.1.9 Lightspeed of Suppliers Page

By selecting Customers in the menu, a detail of customer page (Figure 2.1.10) will be displayed to users. In this page, users can view the customer details by clicking customer name, add new customer by clicking on Add Customer button, update or delete the existing customer details by clicking on the pencil icon for each customer. Additionally, there are some filter provided for users to filter the customer details.

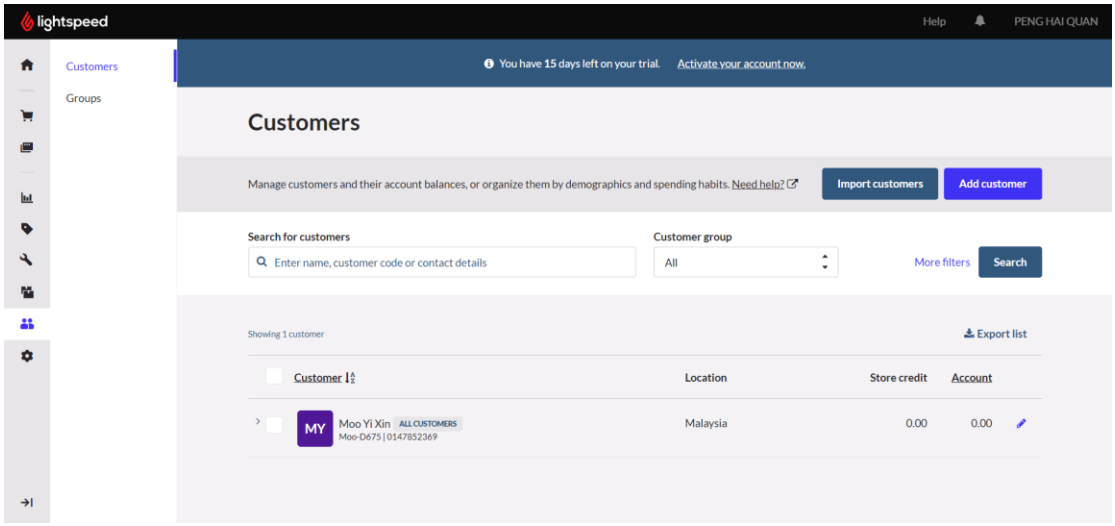


Figure 2.1.10 Lightspeed of Customers Page

By selecting Reporting in the menu, there are a retail dashboard (Figure 2.1.11) provided for users. Besides that, there are some different type of the report have been provided for users. Users can select the report type and enter the filter value to generate the report. Additionally, there are export report function provided in the report page (Figure 2.1.12). Users can use it to export the report to XLSX and CSV format.

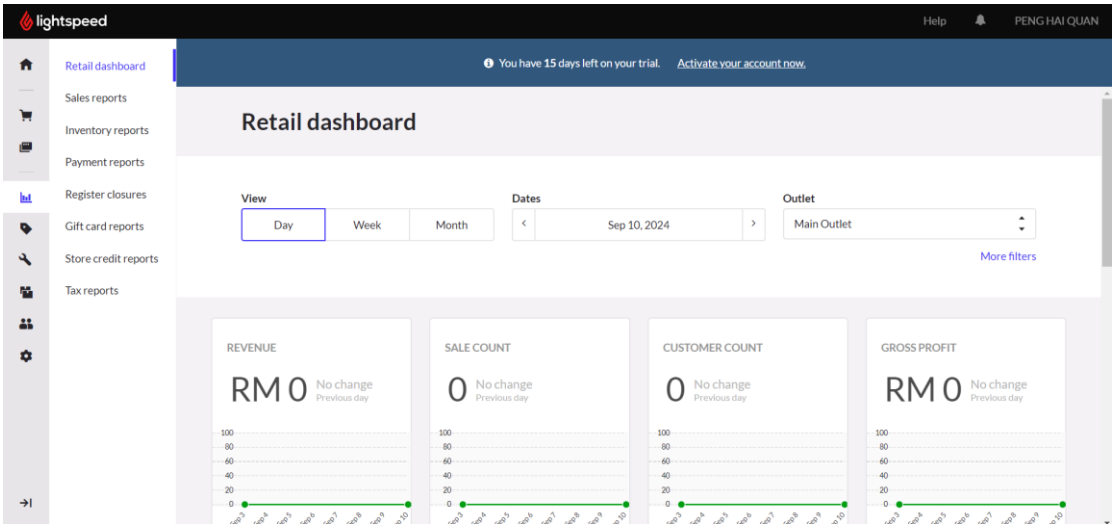


Figure 2.1.11 Lightspeed of Reporting Page (Retail Dashboard)

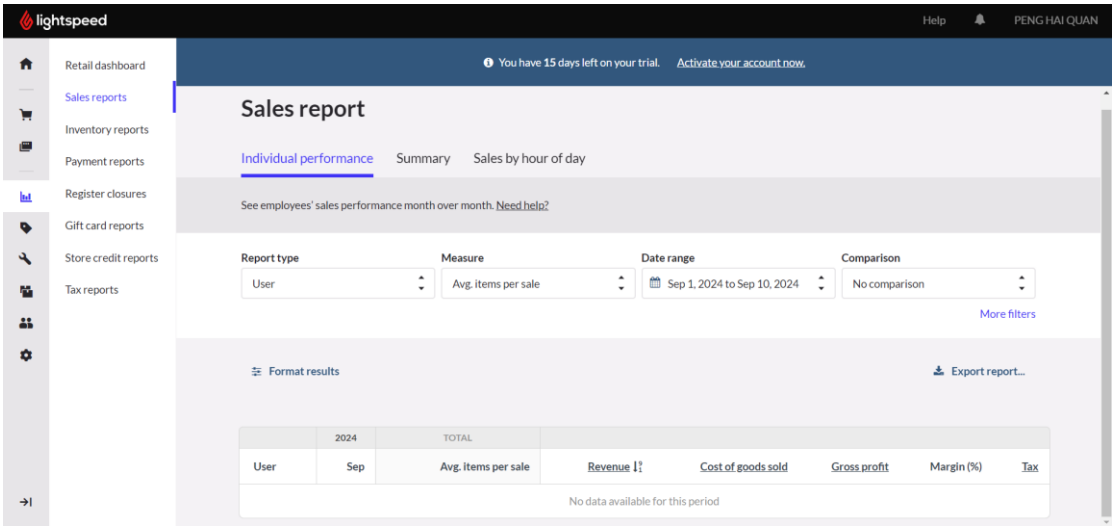


Figure 2.1.12 Lightspeed of Reporting Page (Sales Report)

Strengths of the Application

The key strength of Lightspeed is the comprehensive point-of-sale (POS) solution. Lightspeed provides powerful and versatile POS systems that cater to a variety of industries, from retail and restaurants to e-commerce and hospitality. Additionally, Lightspeed offers advanced inventory management to users. Users can use real-time inventory tracking, inventory alerts and supplier management tools to provide businesses with a high level of inventory control, helping to prevent stock-outs and overstocking. In addition, Lightspeed offers detailed reporting tools that allow businesses to track all parts of their business, such as sales, inventory and employee performance, providing data-driven insights that help optimize business operations.

2.1.3 Odoo

General Introduction of the Application

Odoo is an open-source enterprise resource planning (ERP) platform that provides a suite of business management tools for various operations, including customer relationship management (CRM), inventory, accounting, eCommerce and project management. [4] Odoo was established by Fabien Pinckaers on Year 2005. [4] Odoo allows business owners to integrate different applications into one centralized system. Odoo aims to streamline the operation and enhance the productivity for the business. [4] After users logged into Odoo, the homepage (Figure 2.1.13) will be displayed to users.

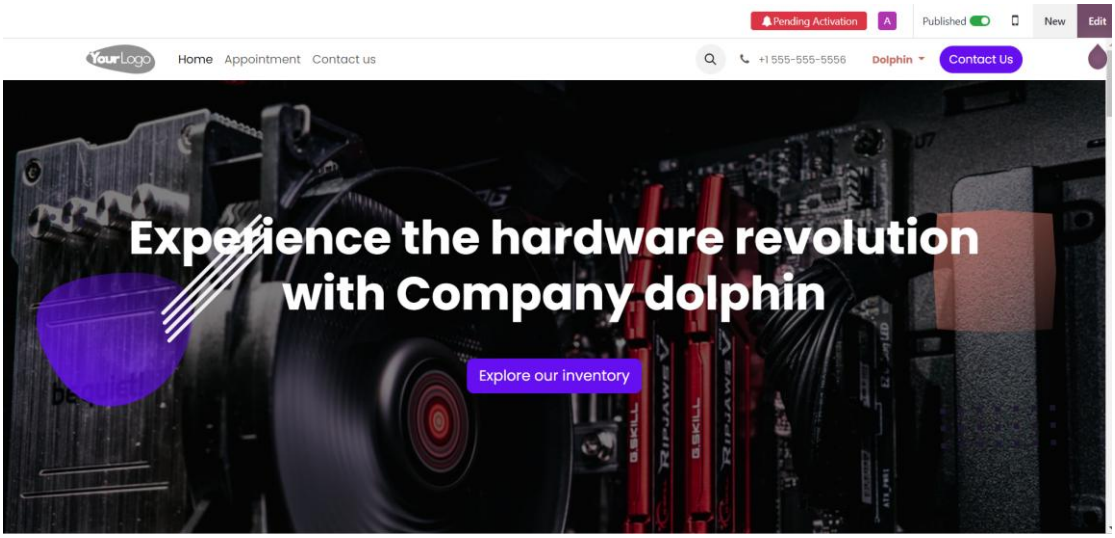


Figure 2.1.13 Odoo Homepage

Features of the Application

By selecting Dashboard modular approach, a simple dashboard (Figure 2.1.14) will be displayed to users. In this page, users can observe the sales analysis result which are presented in chart or summarize form. Additionally, there are different types of dashboard provided for users. Users can select the dashboard type by clicking on the left panel.

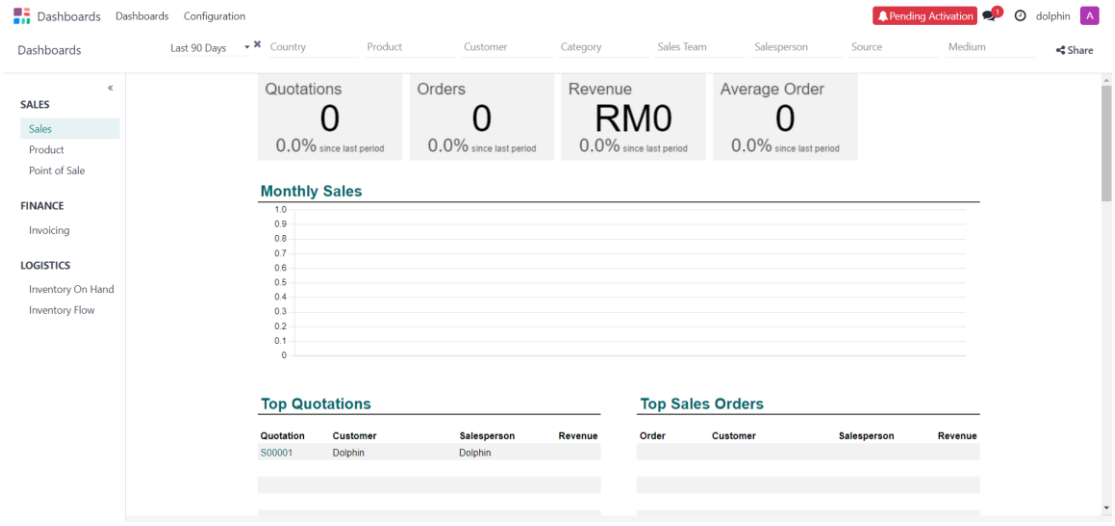


Figure 2.1.14 Odoo of Dashboard Page

By selecting Sales modular approach, the details of sales order (Figure 2.1.15) will be displayed to users. In this page, users can view the sales order details by clicking on that sales order, add new sales orders by clicking on the New button and update or delete the existing sales order by clicking on that sales order. There are the filter field for users entered the value for filter the

sales order. Additionally, there are some different types of representation for data, which are List, Kanban, Calendar, Pivot, Graph and Activity.

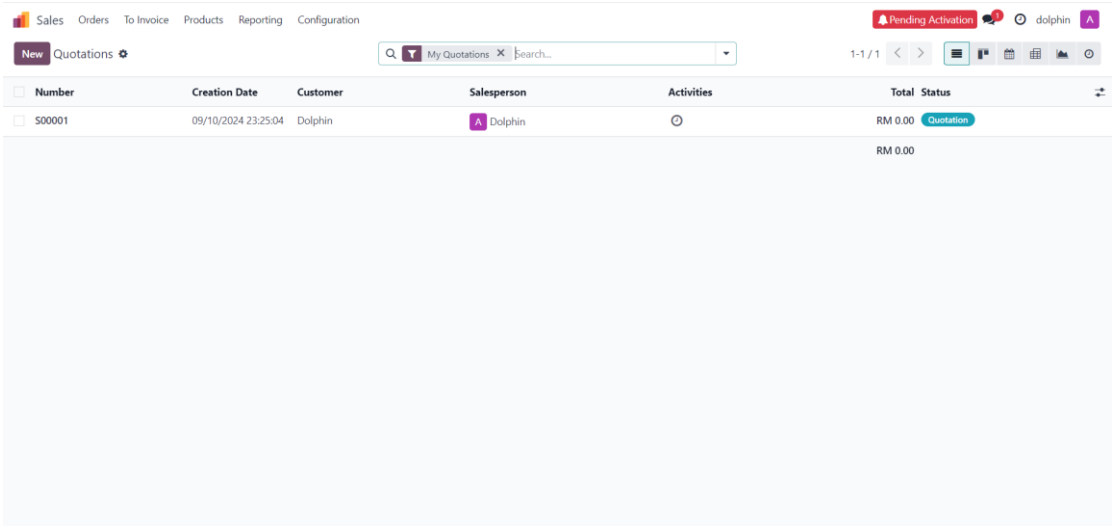


Figure 2.1.15 Odoo of Sales Modular Approach Page

By selecting Inventory Modular Approach, a summary of inventory detail (Figure 2.1.16) will be displayed to users. In this page, users can observe the three different summary of inventory data that represented in the chart form. If users want to implement create, read, update and delete (CRUD) function for this chart, users can click on the chart, it will redirect to details page for users implementing CRUD functions on inventory data.

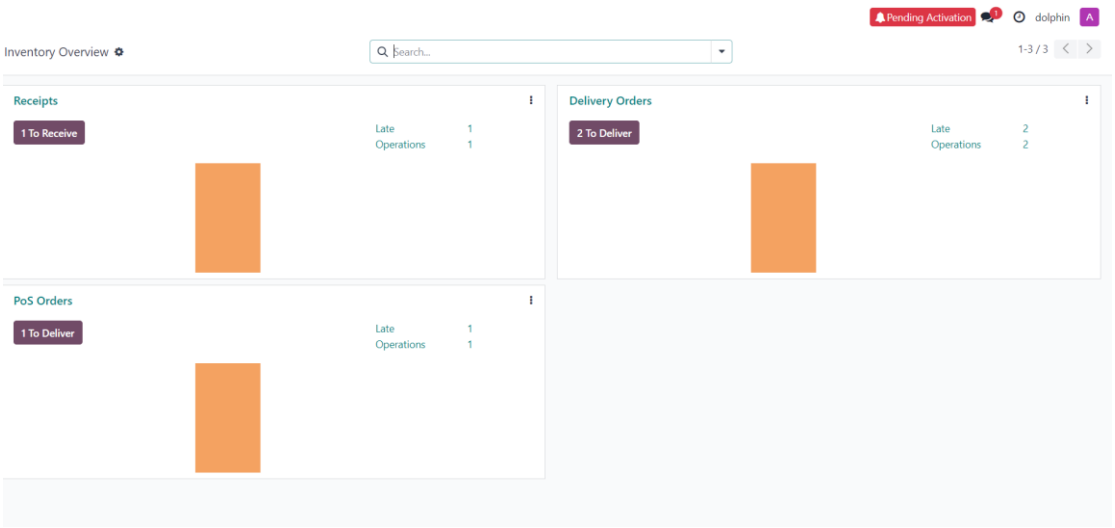


Figure 2.1.16 Odoo of Inventory Modular Approach Page

Strength of the Applications

The main advantage of Odoo is its modular architecture. Business owners can select the specific modules they need, resulting in a highly customizable and scalable solution that can

grow with their business. Apart from this, all-in-one solutions and seamless integration are also the strengths of Odoo. Odoo covers every aspect of business operations, allowing companies to manage everything from one place without relying on multiple software platforms. Integration between different modules is seamless, providing a unified experience across various business processes. Sales orders can automatically affect inventory, thus automatically updating accounting, making the flow of information smooth and efficient.

2.1.4 Cin7 Core

General Introduction of the Application

Cin7 Core is a cloud-based inventory management system designed to help business manage their stock, streamline operations and integrate with various sales channels. [5] Cin7 Core was established by Danny Ing on Year 2011. [5] Cin7 Core focuses on providing businesses with a comprehensive solution for inventory management order fulfillment, warehouse management and omnichannel retailing. After users logged into Cin7 Core, an overview dashboard (Figure 2.1.17) will be displayed to users.

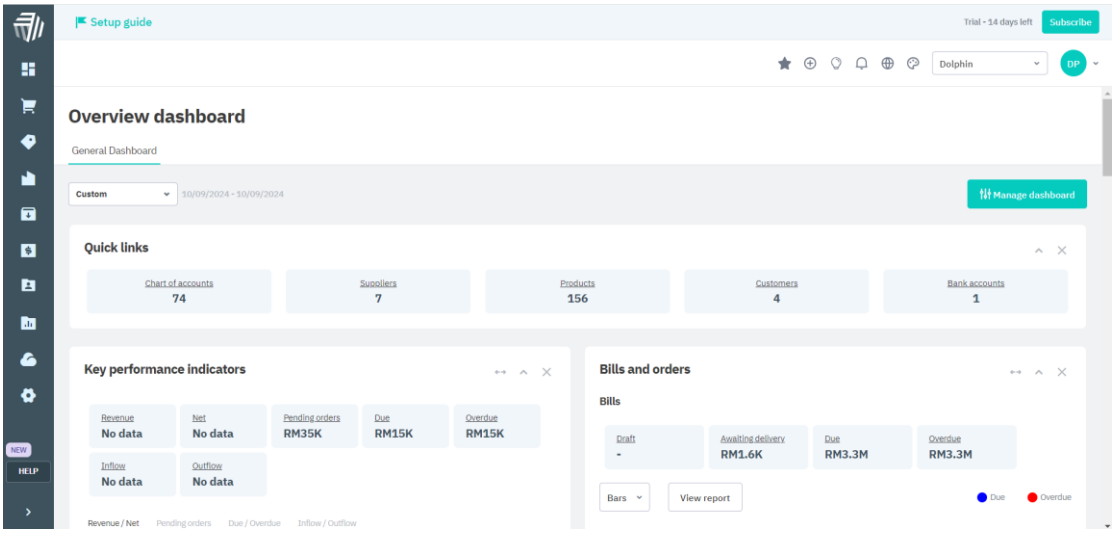


Figure 2.1.17 Cin7 Core of Dashboard (Homepage)

Features of the Applications

After selecting Purchases in the menu, the purchase details (Figure 2.1.18) will be displayed in a listed table form to users. In this page, users can view the details of purchase order by clicking on that purchase order, add new purchase order by clicking on the add icon and update or delete the existing purchase order by clicking on the pencil icon for each purchase order. Additionally, there are provided a search field for users enter value for filtering the purchase order.

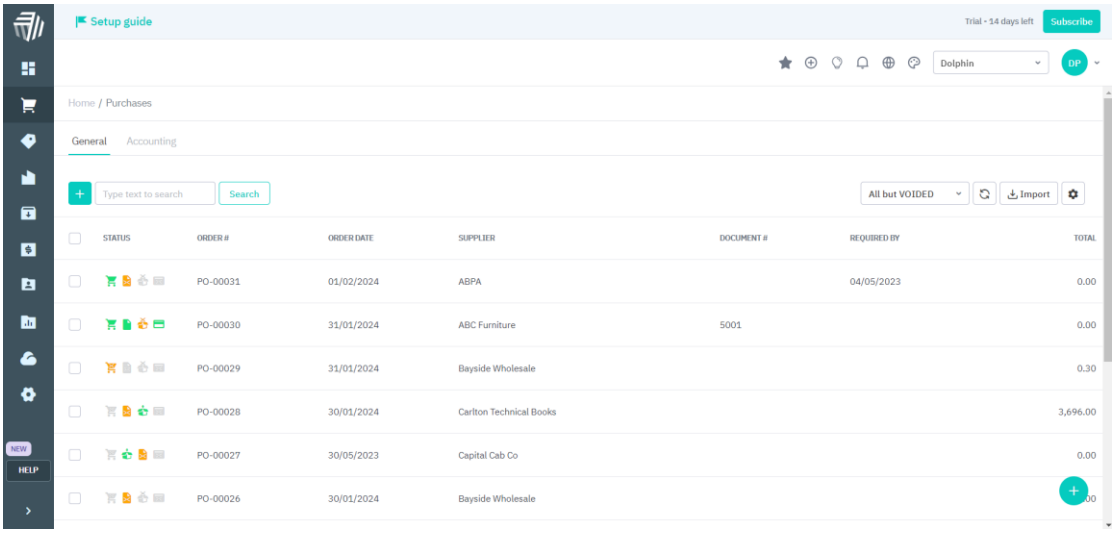


Figure 2.1.18 Cin7 Core of Purchases Page

By selecting Suppliers in the menu, the details of supplier (Figure 2.1.19) will be displayed to users in listed table form. In this page, users can view the supplier details by clicking on that supplier, add new supplier by clicking on the add icon and update or delete the existing supplier details by clicking on that supplier. Additionally, there are provided a filter search field for users entering some value for filter supplier details.

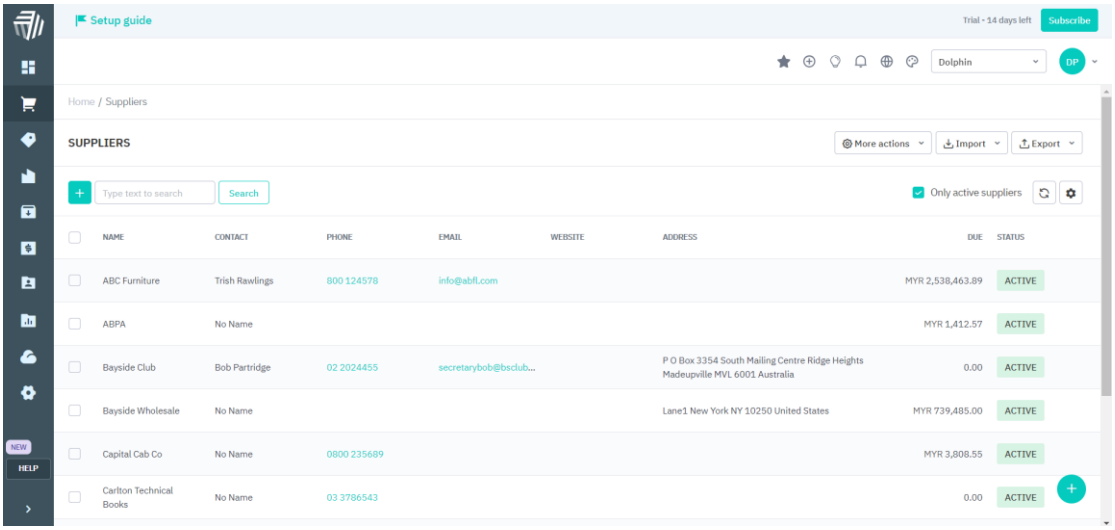


Figure 2.1.19 Cin7 Core of Suppliers Page

After selecting Sales in the menu, the sales details (Figure 2.1.20) will be displayed in a listed table form to users. In this page, users can view the details of sales order by clicking on that sales order, add new sales order by clicking on the add icon and update or delete the existing sales order by clicking on the pencil icon for each sales order. Additionally, there are provided a search field for users enter value for filtering the sales order.

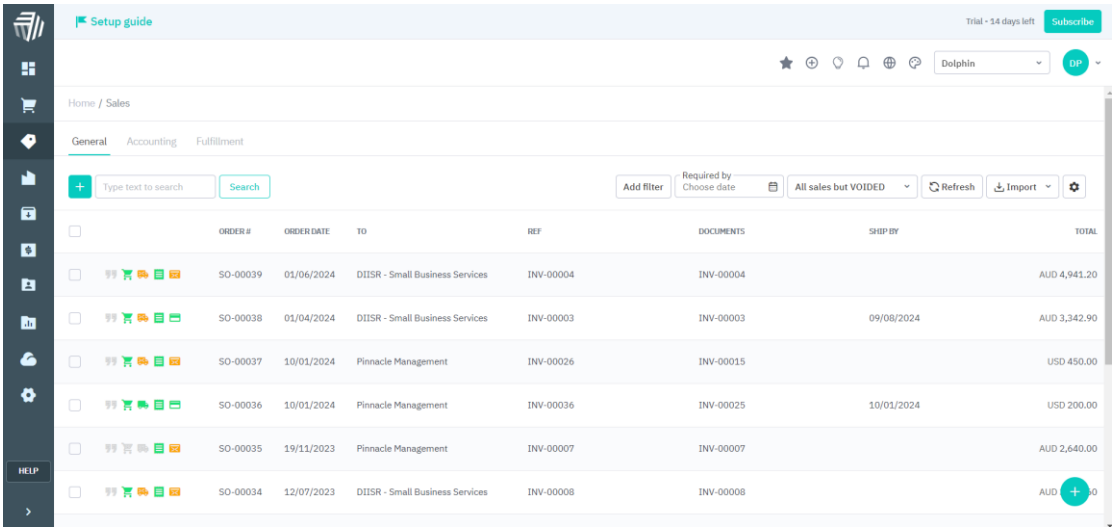


Figure 2.1.20 Cin7 Core of Sales Page

After selecting Products in the menu, the product details (Figure 2.1.21) will be displayed in a listed table form to users. In this page, users can view the details of product by clicking on that product, add new product by clicking on the add icon and update or delete the existing product details by clicking on the pencil icon for each product. Additionally, there are provided a search field for users enter value for filtering the product.

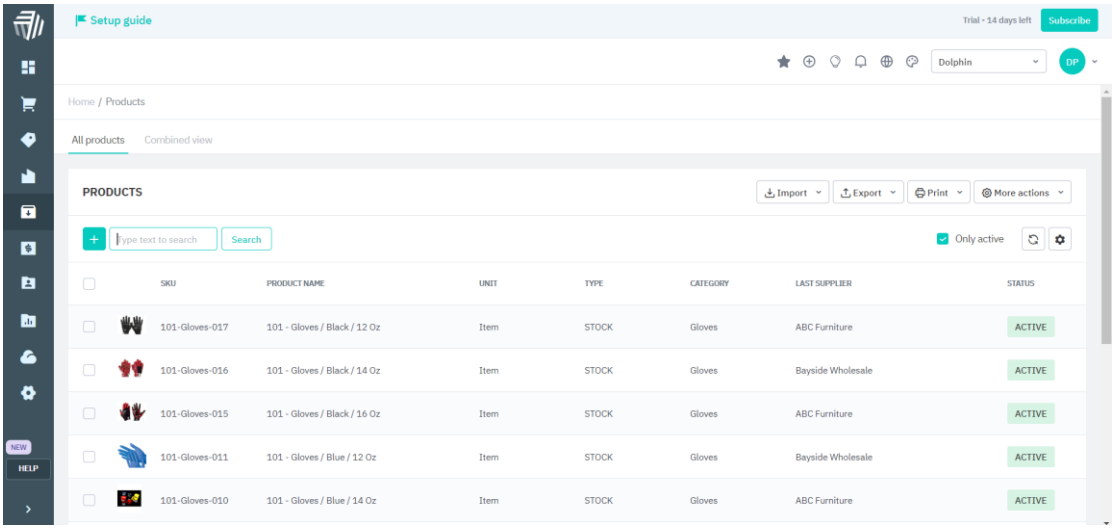


Figure 2.1.21 Cin7 Core of Products Page

By selecting Reporting in the menu, there is a list of different type of report (Figure 2.1.22) provided for users. Users can select the report type to generate the report. In the reporting page (Figure 2.1.23), users can customize the filter for report. Additionally, there are export report function provided in the report page (Figure 2.1.23). Users can use it to export the report to Excel format with totals, Excel format without totals, PDF and RTF format.

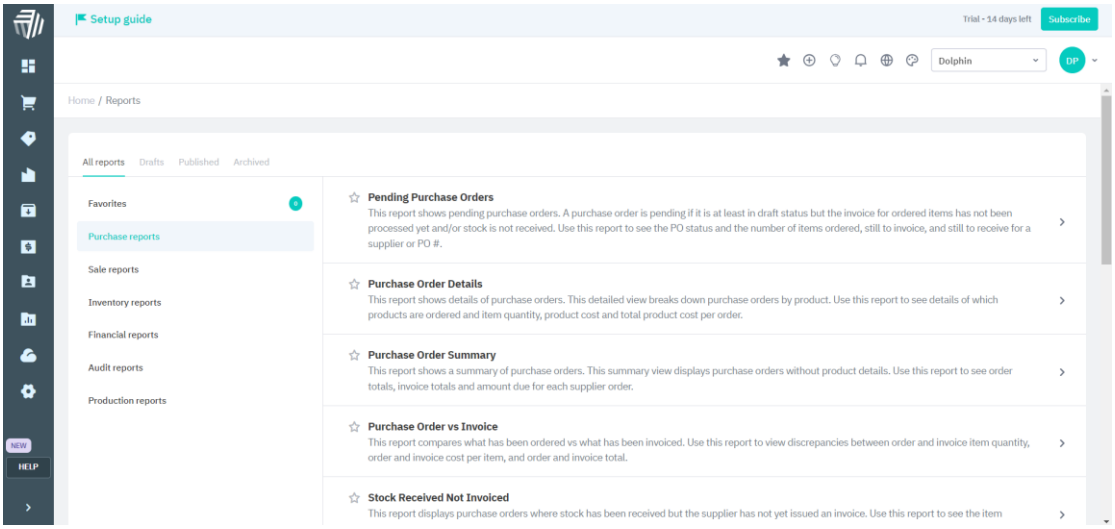


Figure 2.1.22 Cin7 Core of Reporting Page (Overall)

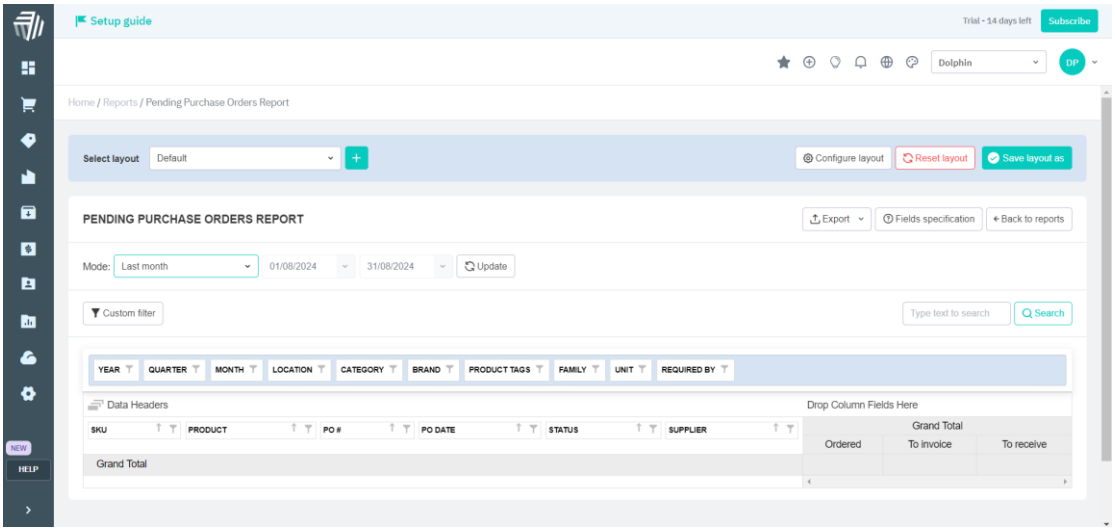


Figure 2.1.23 Cin7 Core of Reporting Page (Pending Purchase Orders Report)

Strengths of the Applications

The key strength of Cin7 Core is its comprehensive omnichannel solution. Cin7 Core is designed to manage sales from multiple sales channels through a single platform, making it an ideal solution for businesses operating across different sales streams. Advanced inventory control is one of the strengths of Cin7 Core. Cin7 Core provides superior inventory control, including real-time tracking, automatic inventory updates and multi-warehouse management, helping business owners avoid stock-outs and overstocking. Additionally, Cin7 Core automates many manual processes such as order routing, inventory updates and purchasing, saving business time and reducing the risk of human error.

2.2 Limitation of Previous Studies

1. **Dashboard Feature Not Detailed and Lask of Interactivity**

   In some existing systems, dashboard primarily used as data presentation tools. It often display basic charts, graphs or data summaries but lack od detailed insights or interactive features that allow users to interact with the data. Users cannot drill down into specific metrics, adjust parameters or customize the data. This limits the effectiveness of the dashboard in helping users make informed decisions because users cannot fully explored the underlying data.

2. **Complex User Interfaces with Poor Usability**

   In some existing systems, the user interfaces are too complex and difficult for users to navigate. These interfaces can be cluttered, lac intuitive navigation or require too many steps to complete basic tasks. As a result, these existing applications are not user-friendly and users need to spend more time in learning how to use the applications rather than performing tasks efficiently. This complexity reduces user satisfaction and adoption, especially for non-technical users.

3. **Limited Interactivity in Supplier Management for Handling Product Issues**

   Most of the existing systems are lack of powerful supplier management tools that enable dynamic interactions between business owners and suppliers, especially when there is a problem with a product, such as damaged of defective goods. The existing system may only track the supplier details and orders but not provide the direct channel to resolve the issues or discuss product returns and exchanges. This limits the ability to resolve product issues quickly, which can lead to delays in resolving issues and negatively affect business operations.

2.3 Proposed Solutions

1. **Develop Interactive Dashboard**

   Develop a more advanced and interactive dashboard that allow users to interact directly with data. The dashboard can provide the filtering options, like specific categories and let user frill down into more detailed reports. The dashboard also includes tools such as interactive charts, data comparisons and customizable KPI to help users gain the deeper insights. In addition, add on the real-time data updates and visual alerts when some special conditions happened such as low inventory to enhance user interaction with the dashboard.

2. **User Interface Optimization**

   By simplifying the layout and making navigation more intuitive, the application focuses on optimizing the user interface (UI) and user experience (UX). The application can feature a minimalist design with clear labels, intuitive icons and easy-to-access menus. The application can leverage user feedback to understand the weakness of the applications and improve the

overall usability of the applications. A combination of tutorials, tooltips and guided steps can be provided to help users easily navigate the platform and shorten the learning processes.

3. **Implement Live Chat Function in Supplier Management Feature**

   Introduce a live chat function in the supplier management feature to enable real-time communication between business owners and suppliers. The platform can be used to report product issues, discuss solutions and track the resolution process. Implement a ticketing system to allow business owners to raise issues related to product defects, track their status and communicate with suppliers. This function will simplify problem solving, improve collaboration and ensure that product issues are resolved quickly and effectively.

2.4 Comparison Table between Existing System and Proposed System

Table 2.4.1 Comparison Table between Existing System and Proposed System

Feature	Unleashed Software	Lightspeed	Odoo	Cin7 Core	Proposed System
General Introduction	Cloud-based inventory management system	Cloud-based POS and eCommerce solution	Open-source ERP platform with modules	Cloud-based inventory management system	Cloud-based comprehensive business management system
User Interface (UI)	Simple, user-friendly	Clean and simple	Modular and customizable UI	Streamlined UI with clear navigation	Streamlined UI with clear navigation
Order Management	Have CRUD operations and advanced filtering options	Have CRUD operations	Have CRUD operations and advanced filtering options	Have CRUD operations and filtering options	Have CRUD operations and advanced filtering options
Inventory Management	Have CRUD operations and filtering options	Have CRUD operations	Have CRUD operations and advanced filtering options	Have CRUD operations and filtering options	Have CRUD operations and advanced filtering options
Supplier Management	Have CRUD operations and filtering options	Have CRUD operations and filtering options	Have CRUD operations and advanced filtering options	Have CRUD operations and filtering options	Have CRUD operations, advanced filtering options and seamless operations.

					Live chat function with supplier.
Customer Management	Have CRUD operations and filtering options	Have CRUD operations and filtering options	Integrated CRM to manage customer relationships	Have CRUD operations and filtering options	Have CRUD operations, advanced filtering options and seamless operations
Report and Analytics	Provides various report types and exportable to multiple formats	Offers sales reporting with export options	Customizable reports with export options	Comprehensive reporting with customizable filters and export options	Comprehensive reporting with customizable filters and export options. Real-time analytics.

CHAPTER 3

SYSTEM METHODOLOGY/ APPROACH

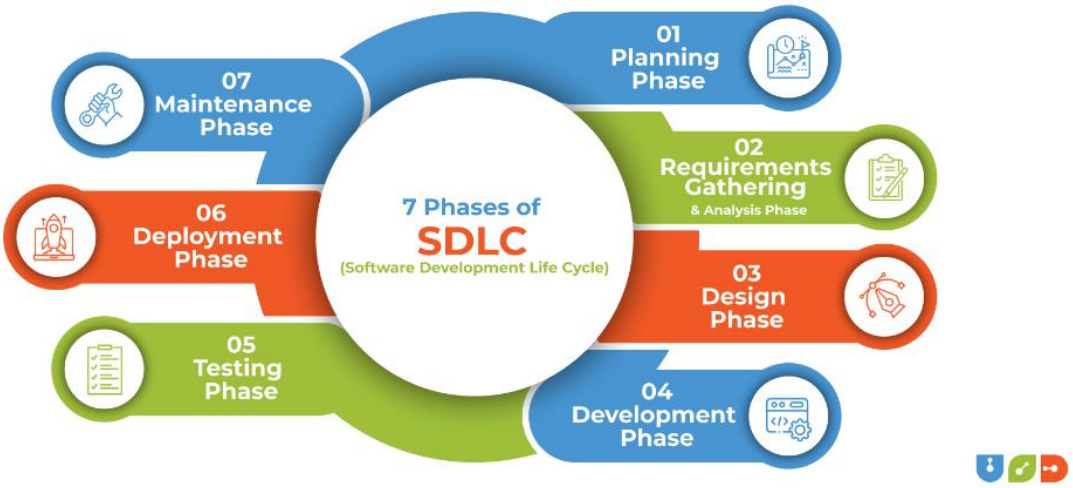


Figure 3.1 Software Development Life Cycle

This project follows Software Development Life Cycle (SDLC) to divide the development progresses into seven different phase, which are Planning Phase, Analysis Phase, Design Phase, Development Phase, Testing Phase, Deployment Phase and Maintenance Phase. [6] The Planning Phase will set the foundation of project and define the goals. The Analysis Phase will gather the user requirements by analysis the existing system. The Design Phase will design an user interface for applications. The Development Phase will code and develop the system. The Testing Phase will test the debug the developed system. The Deployment Phase will deploy the developed web application in devices. Finally, the Maintenance Phase will give maintenance and support for improvement based on user feedback.

3.1 System Design Diagram

3.1.1 System Architecture Diagram

Wireframe

A wireframe is a two-dimensional visual representation of the layout and structure of an application or web page that serves as a blueprint for a user interface (UI). [7] It focuses on the placement of key elements, navigation and functionality, giving a clear overview of how the system will look and operate without including detailed design elements such as colour or imagery. For hardware business management systems, wireframes typically include screens representing the database and core functionality identified in use case diagrams. Figure 3.1.1 is wireframe for login. Figure 3.1.2 is wireframe for register. Figure 3.1.3 is wireframe for home. Figure 3.1.4 is wireframe for sales order management. Figure 3.1.5 is wireframe for order item management. Figure 3.1.6 is wireframe for product management. Figure 3.1.7 is wireframe for customer management. Figure 3.1.8 is wireframe for supplier inventory management. Figure 3.1.9 is wireframe for supplier management. Figure 3.1.10 is wireframe for inventory management. Figure 3.1.11 is wireframe for user account.

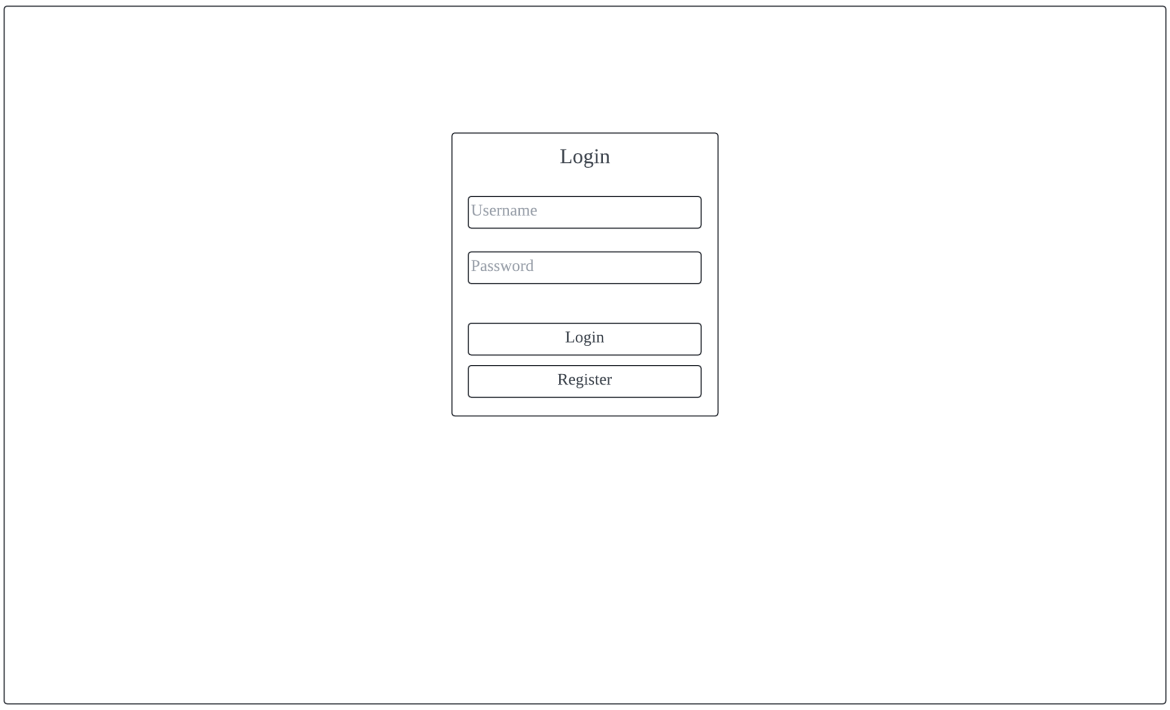


Figure 3.1.1 Login Page Wireframe

Figure 3.1.2 Register Page Wireframe

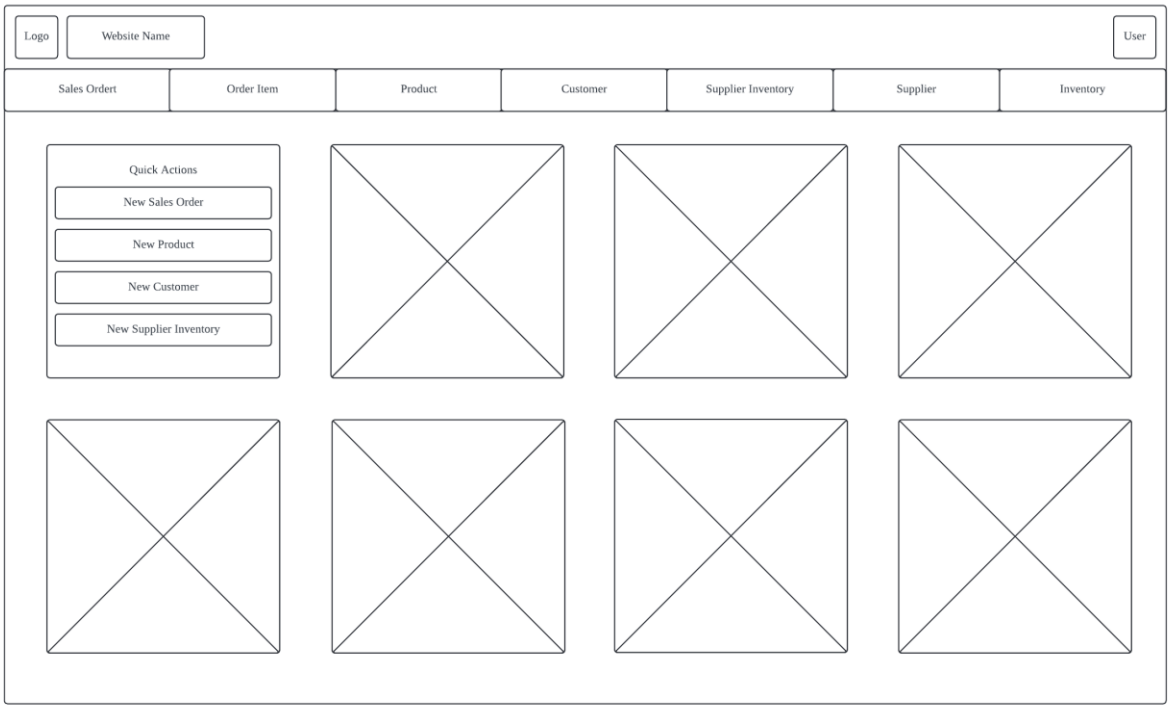


Figure 3.1.3 Home Page Wireframe

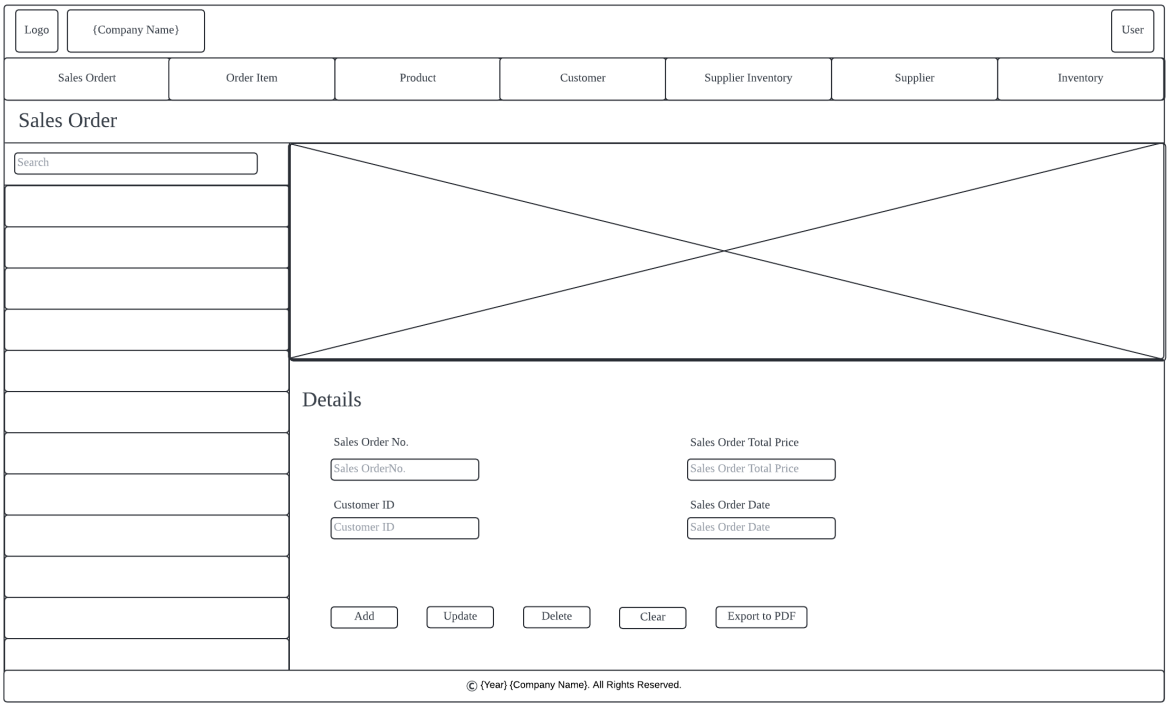


Figure 3.1.4 Sales Order Management Page Wireframe

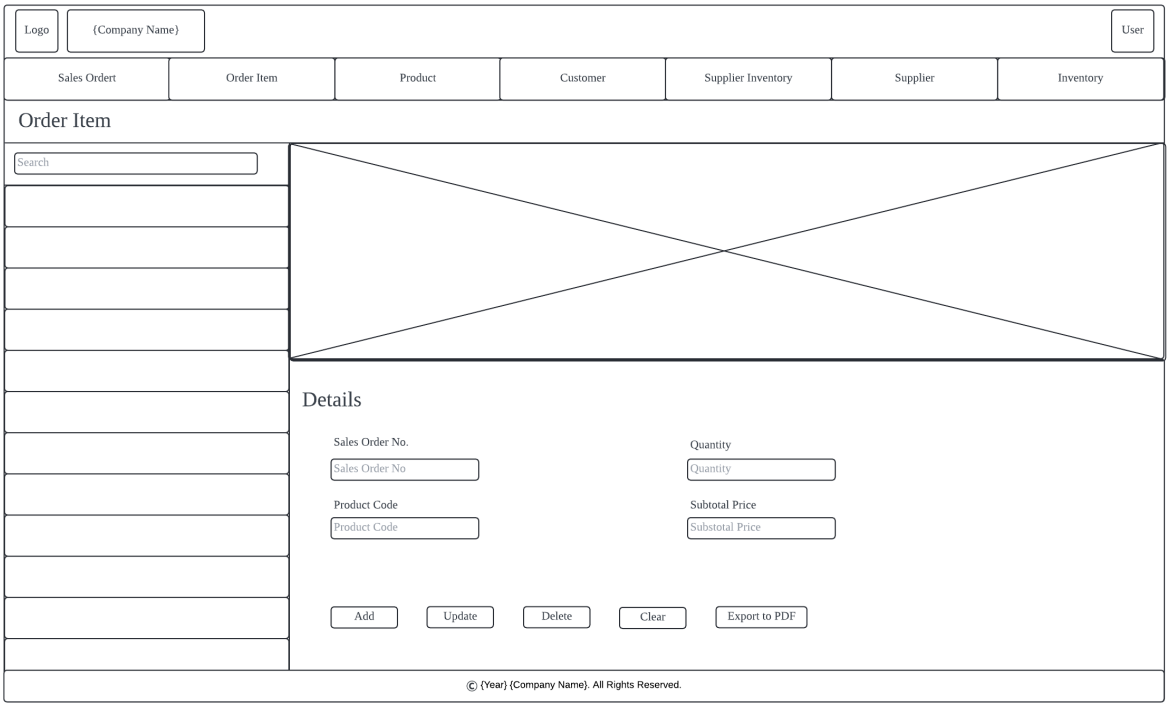


Figure 3.1.5 Order Item Management Page Wireframe

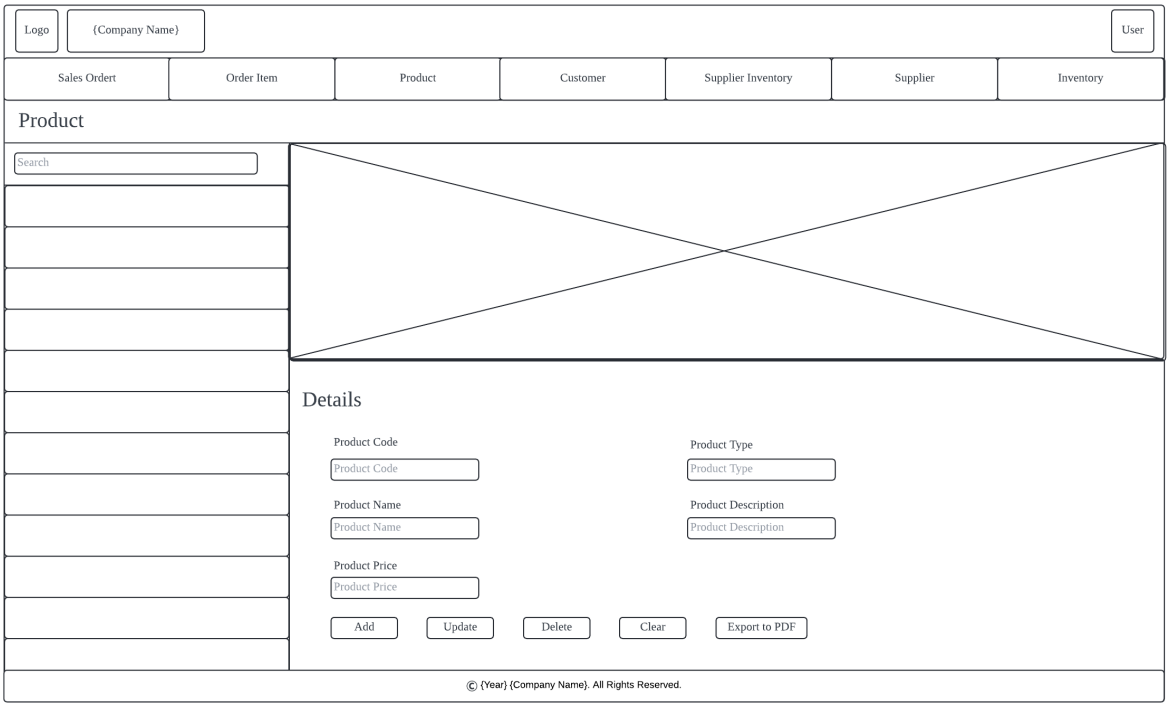


Figure 3.1.6 Product Management Page Wireframe

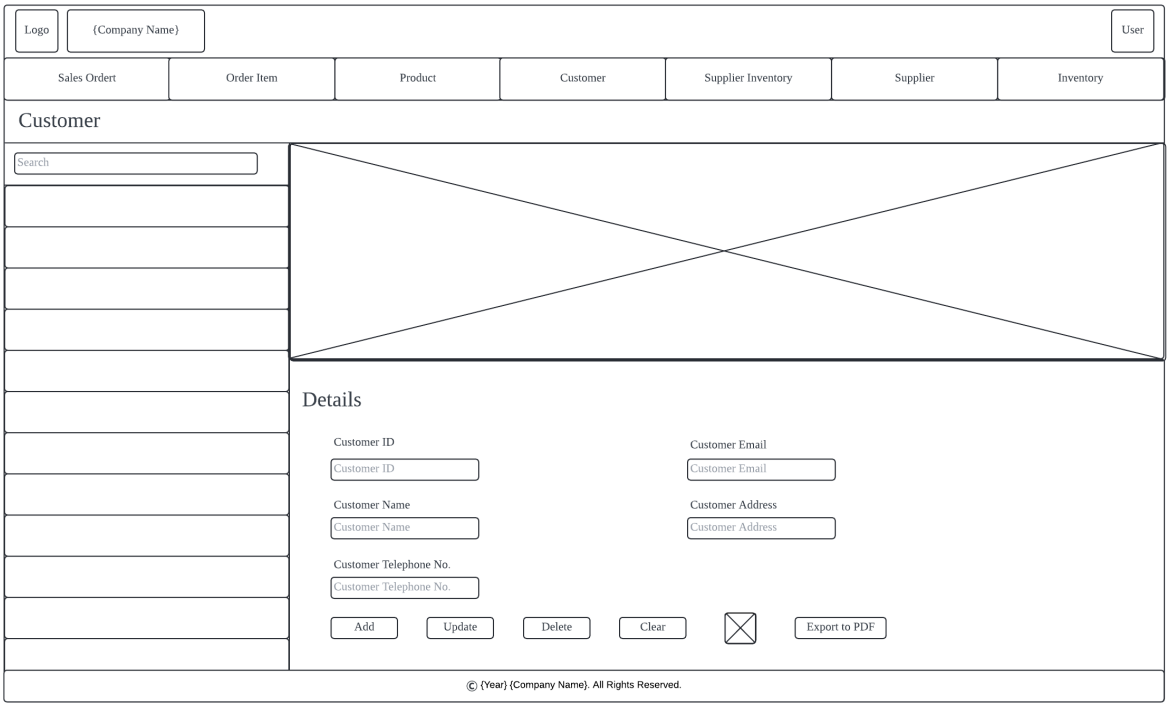


Figure 3.1.7 Customer Management Page Wireframe

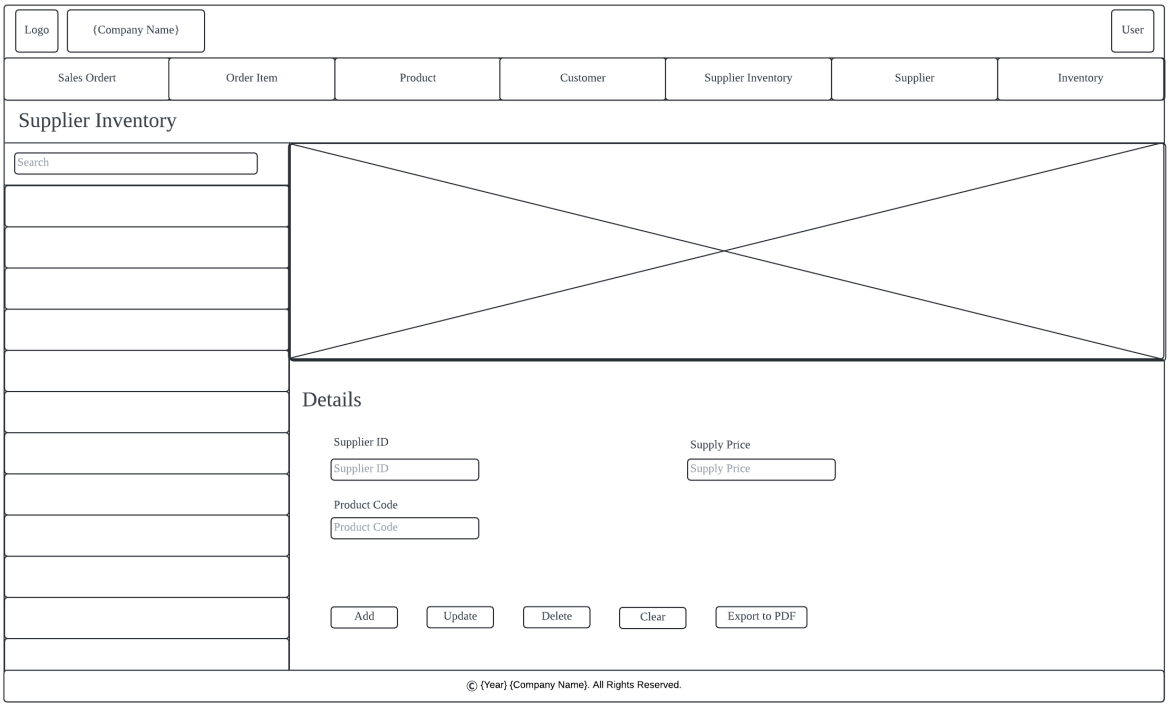


Figure 3.1.8 Supplier Inventory Management Page Wireframe

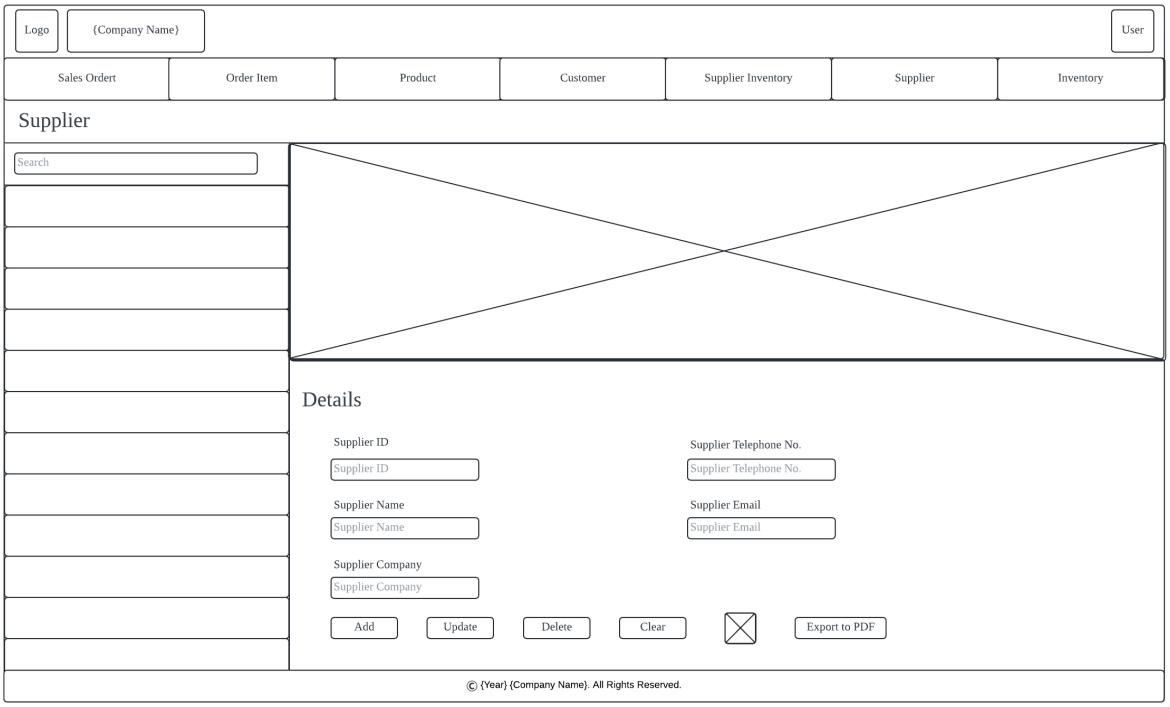


Figure 3.1.9 Supplier Management Page Wireframe

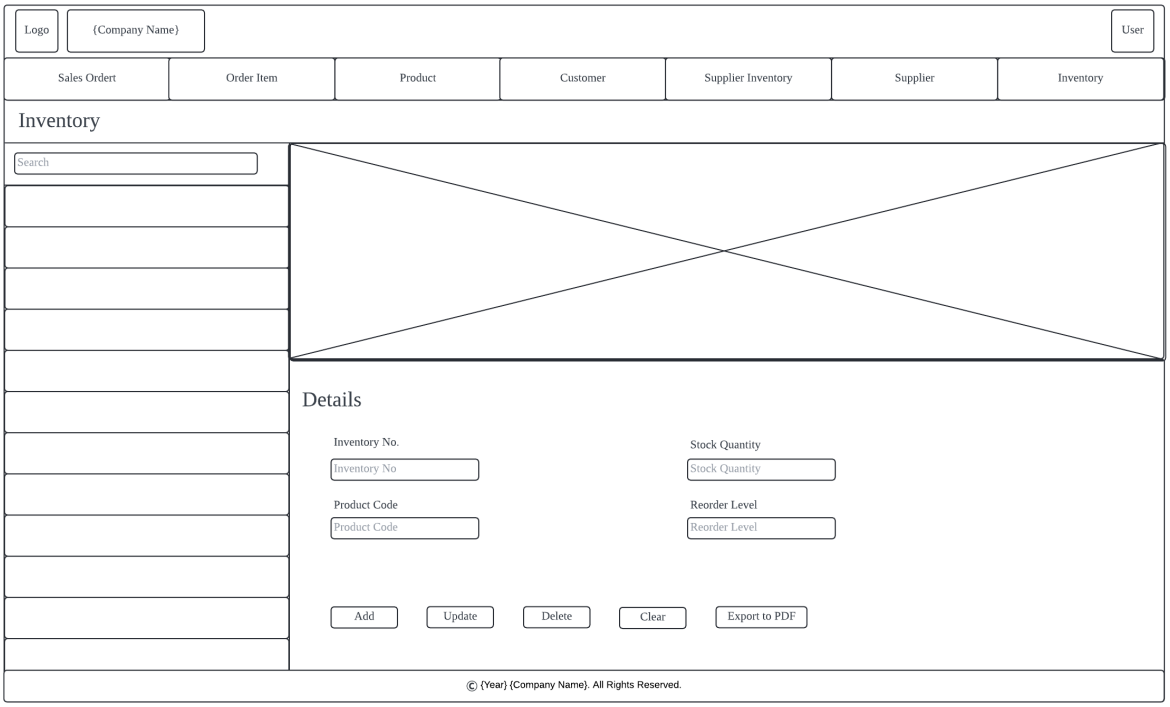


Figure 3.1.10 Inventory Management Page Wireframe

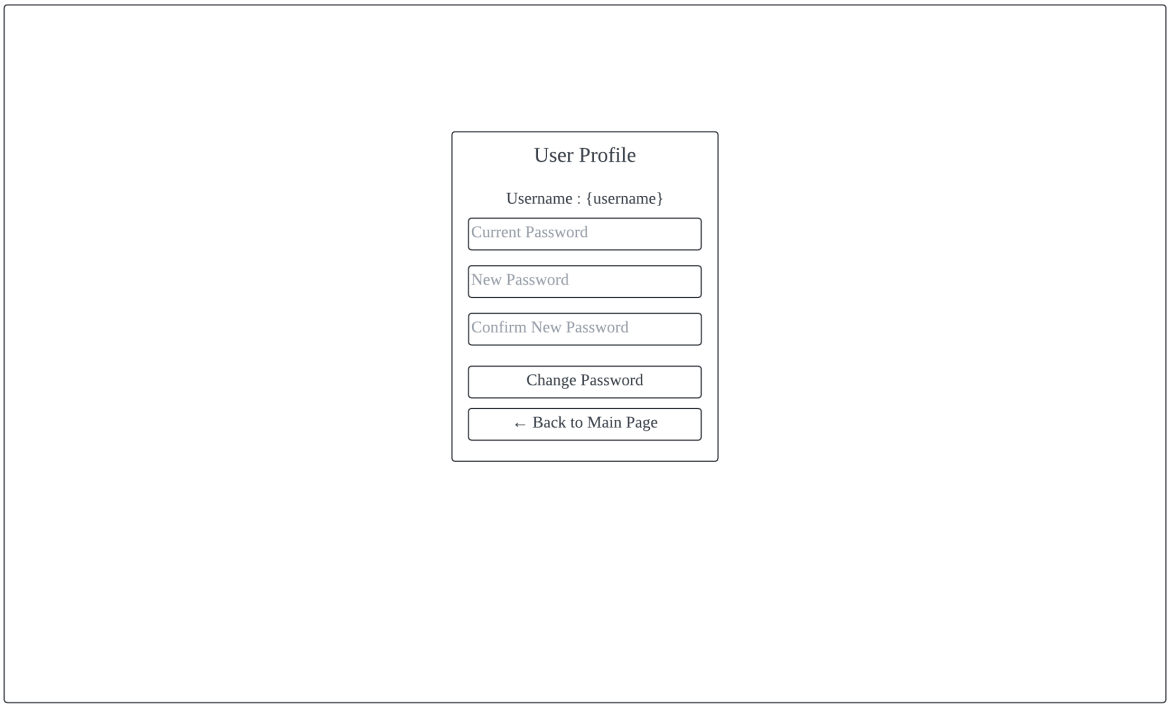


Figure 3.1.11 User Account Page Wireframe

3.1.2 Use Case Diagram and Description

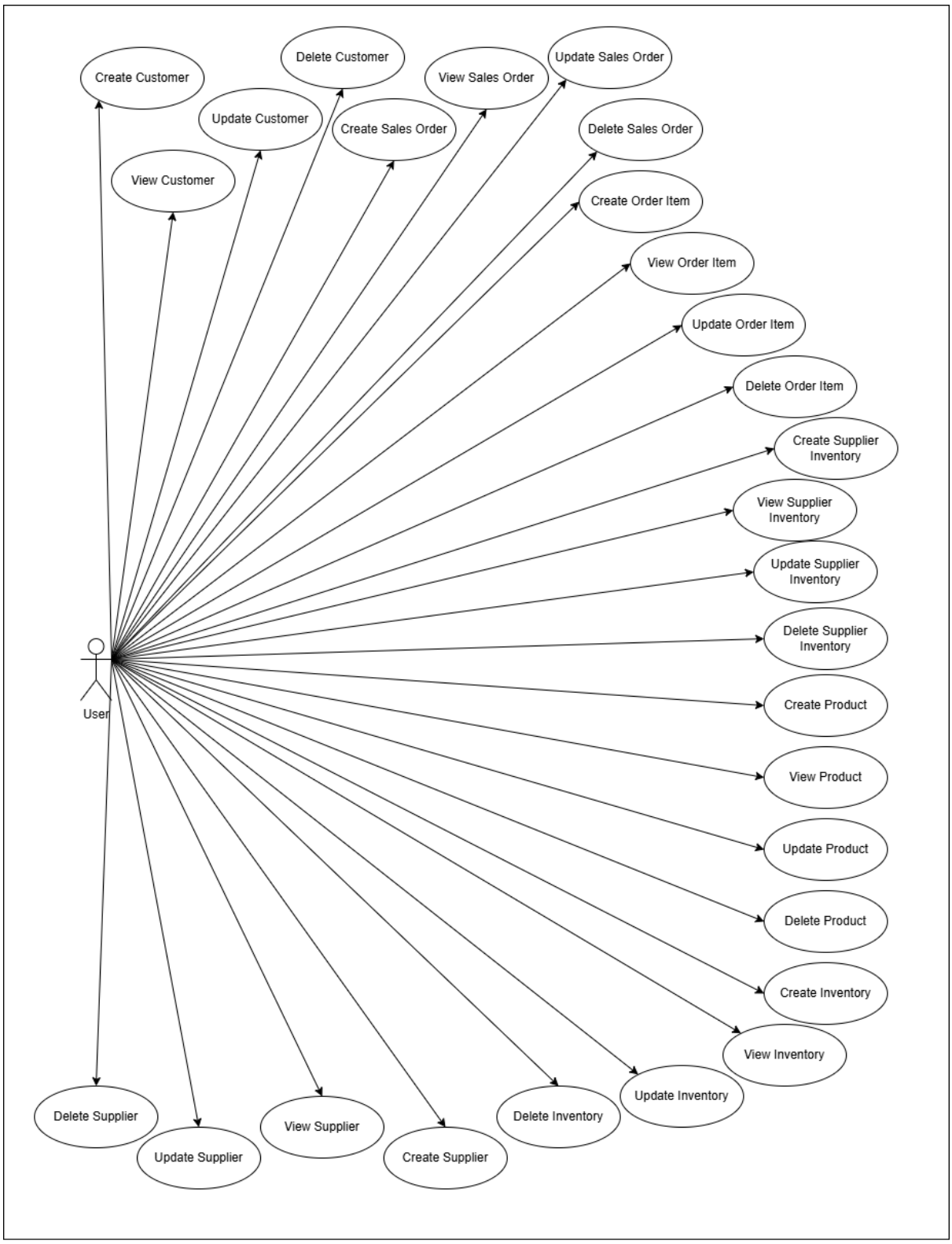


Figure 3.1.12 Use Case Diagram

Figure 3.1.12 is use case diagram for hardware business management system.

In Unified Modelling Language (UML), use case diagrams summarize the details of system users, also called actors and their interactions with the system. [8] For a new software that have not been developed, use case diagrams are the primary form of system requirements. [9] The use case diagram illustrates the interactions between a single actor, which is user and a comprehensive business management system. The diagram highlights all the operations that the user can perform, covering seven modules, which are Customer, Sales Order, Order Item, Supplier Inventory, Inventory, Product and Supplier management. For each module, the user is capable of performing full CRUD (Create, Read/View, Update, Delete) operations. This extensive set of use cases ensures the user can manage customers, sales orders and sales order items, supplier data, inventory records and product information efficiently. The straight lines connecting the user to each use case indicate that the user is the initiator of all system operations, making the diagram representative of the centralized management interface typically found in enterprise systems controlled by administrators. This diagram reflects the scope of functionality and access levels that system administrators or power users have in the application.

3.1.3 Activity Diagram

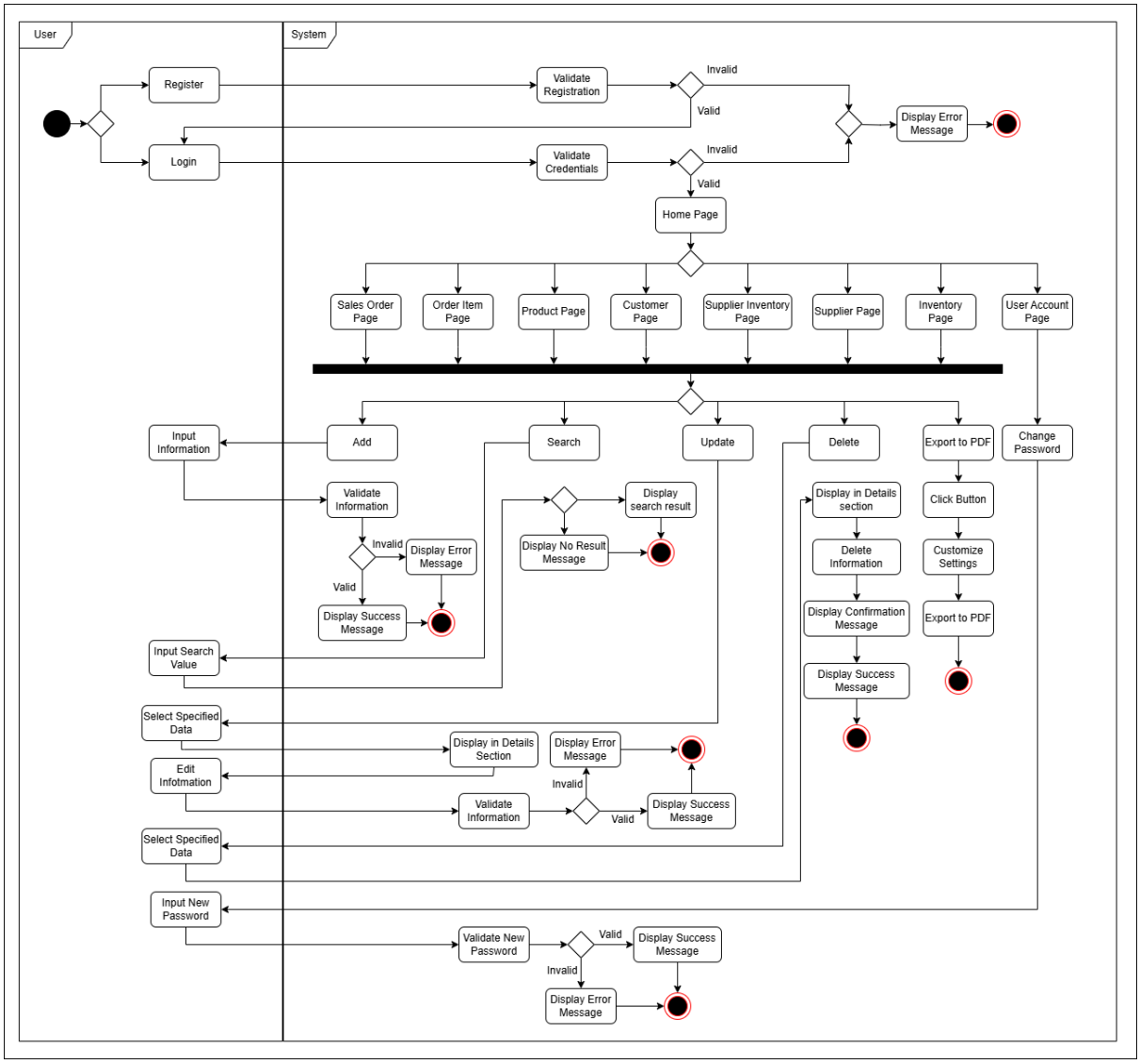


Figure 3.1.13 Activity Diagram

3.1.4 Entity Relationship Diagram (ERD)

An Entity Relationship Diagram (ERD), also known as ER Diagram or ER Model represents the relationships between entities in a database. [10] Figure 3.1.14 is Entity Relationship Diagram that represents the relationship between the entities in a database design for a hardware business management system. The core of the model is the Product entity, which serves as a key reference to multiple tables, including Inventory, Sales Order Item and Supplier Inventory through the common attribute, productCode. Customer information is recorded in the Customers table and linked to the Sales Orders table through attribute, customerID, allowing the system to track the person who placed the order for each order. Each Sales Order can contain multiple Sales Order Item entries, representing the individual products ordered and their respective quantities and subtotals. The Inventory table tracks the inventory levels and reorder thresholds for each product, while the Supplier Inventory table records which suppliers offer which products at what price and is linked to the Supplier and Product entities. The Suppliers table stores the contact and company information for each supplier. Lastly, the users table handles login credentials for system access. Overall, the ERD is normalized to ensure data integrity and efficient management of customer relationships, sales tracking, product inventory and supplier coordination.

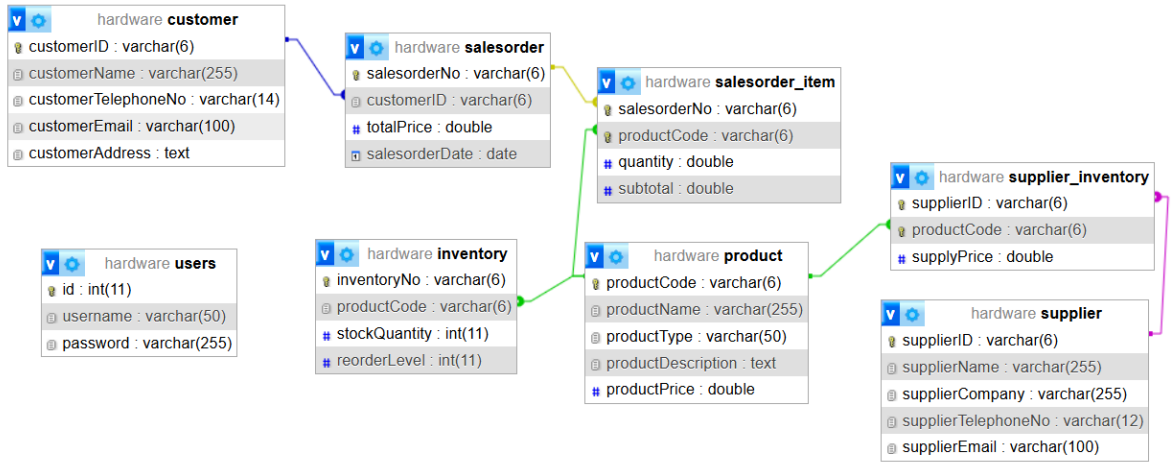


Figure 3.1.14 Entity Relationship Diagram (ERD)

CHAPTER 4

SYSTEM DESIGN

4.1 System Block Diagram

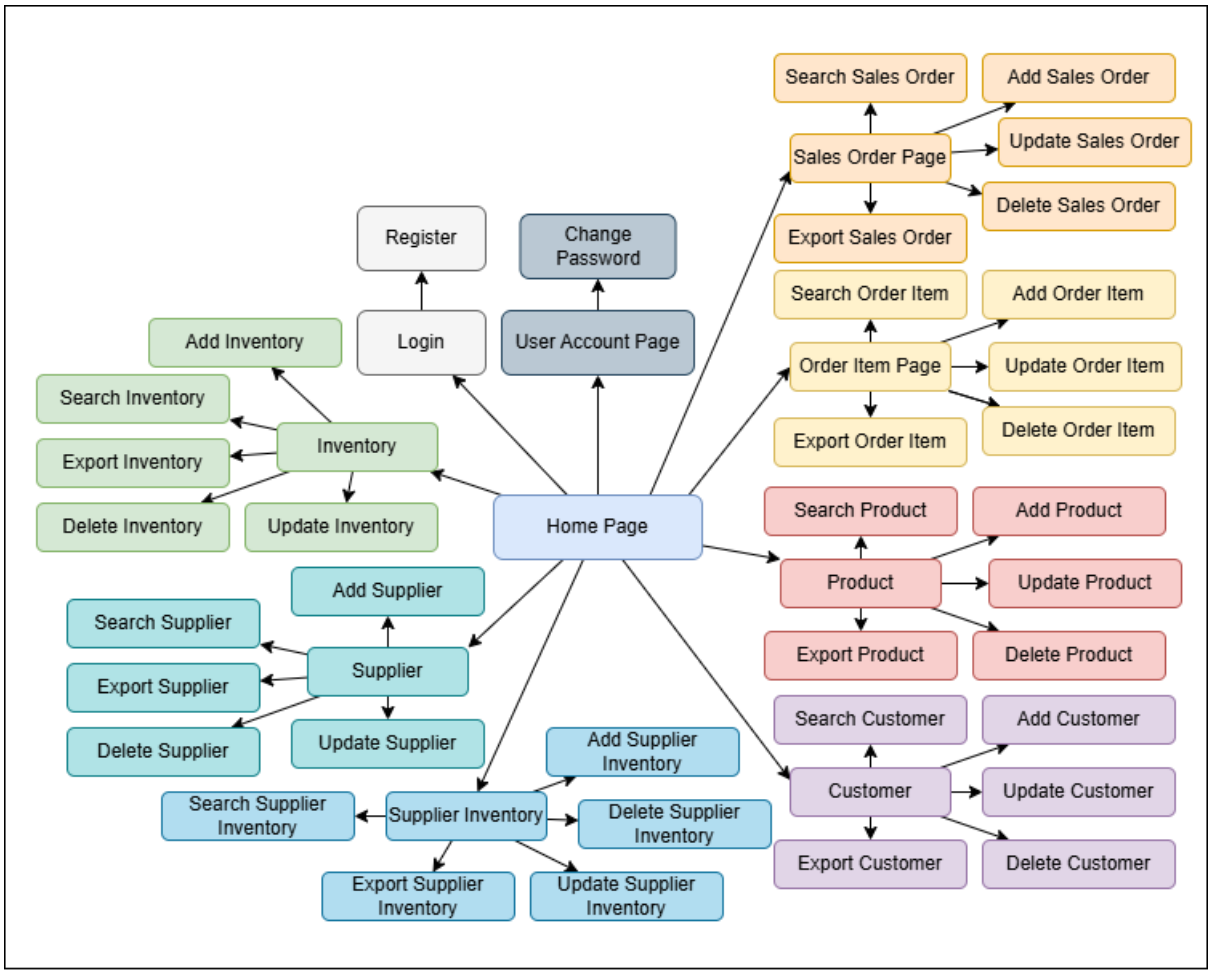


Figure 4.1.1 System Block Diagram

A system block diagram is a specialized, high-level flowchart used in the engineering field. [11] Its structure provides a high-level overview of the main system components, key process participants and important working relationships. [11] The system block diagram provides a clear visual representation of the main modules and user operations within the Hardware Business Management System. At the centre of the diagram is the Home Page, which serves as the primary navigation hub for the entire system. From the home page, users can access various modules such as Inventory, Supplier, Supplier Inventory, Product, Customer, Sales Order and Order Item, each providing a full set of CRUD (Create, Read, Update, Delete)

operations. On the Inventory module, users can add, search, update, delete and export inventory data. Similarly, the Supplier module allows users to manage supplier records and their corresponding inventory, including tracking supply prices.

The Product section offers tools to manage all product-related information, including search, add, update, delete and export functionalities. The Customer module enables customer data management, supporting similar operations. The Sales Order module includes not only managing sales orders but also their associated order items. It breaks down into two subpages: Sales Order Page and Order Item Page, each offering detailed controls over adding, updating, searching, exporting and deleting. At the top centre, user-related functionalities are managed through Login, Register and a User Account Page, where users can also change their password. These elements ensure system access control and user management. Overall, this block diagram illustrates a modular and user-centric system architecture, designed to streamline operations in a hardware business environment through structured navigation and feature-rich modules.

4.2 System Components Specifications

The development of a hardware business management system involves multiple core components at the front-end, back-end and database layers. On the front-end, the system is developed using standard web technologies such as HTML, CSS and JavaScript to create responsive and interactive user interfaces. In addition, the JavaScript library Chart.js is integrated to generate dashboard visualization graphics such as pie charts, bar charts and line charts to enhance data presentation and user experience.

On the back-end, the system is implemented using PHP, a widely used server-side scripting language. The application is developed using pure PHP without a framework, ensuring full control over the logic implementation and structure. During the development process, the Apache server provided by XAMPP was used as a local server environment to run and test PHP scripts. The database used is MySQL, which is also managed by the XAMPP software package. It is used to store and manage all persistent data including inventory records, customer details, sales orders, supplier information and user credentials. MySQL's relational structure is essential for maintaining data integrity and executing efficient queries.

In addition to the core technology, we use a variety of supporting tools to enhance the development process. XAMPP serves as a local development environment that bundles Apache, MySQL and PHP into a single interface. Visual Studio Code is used as the primary code editor

due to its flexibility, extensibility and debugging capabilities. For database management, we use phpMyAdmin for visual interaction with MySQL databases to easily insert data, modify tables and execute queries.

4.3 System Components Interaction Operations

The interaction between system components in the Hardware Business Management System is designed to ensure smooth communication and data flow across the frontend, backend and database layers. When a user performs an action on the frontend interface, such as submitting a new product, updating inventory or deleting a customer record, the HTML and JavaScript code captures the user's input and sends it to the server via HTTP requests. JavaScript may also perform some client-side validation before the data is submitted.

Upon receiving the request, the backend PHP scripts process the input data accordingly. These scripts handle core operations such as inserting new records into the database, updating existing entries, retrieving filtered data or deleting specified information. The backend logic ensures that all user actions are validated, sanitized and securely processed to prevent issues like SQL injection or data corruption.

The MySQL database acts as the central repository that stores all persistent data, including user accounts, product details, sales orders and inventory records. Backend scripts use SQL queries to interact with this database. For instance, when a user views the inventory page, a `SELECT` query is executed and the results are returned to the PHP script, which then dynamically generates an HTML response.

For data visualization, the system uses Chart.js on the frontend. Chart.js is a JavaScript library for making various types of charts to present the simplest visualizations. [7] The backend provides the necessary data in JSON format, which is then parsed by JavaScript and passed to Chart.js to generate real-time charts and graphs, such as sales performance and product stock levels.

All components are interconnected through the XAMPP environment, which ensures that the Apache server properly hosts the PHP application and facilitates communication between the backend scripts and the MySQL database. This seamless interaction between components allows users to manage the hardware business efficiently through a unified and responsive system.

4.4 Summary and Challenges Faced

Summarize

Some parts of the proposed system are already complete, including real-time analytics displayed on the home page, as well as order management, inventory management, supplier management and customer management. Users can perform CRUD operations in Sales Order Management, Inventory Management, Supplier Management and Customer Management. Furthermore, the four different data visualizations, which are Pie Chart, Column Chart, Line Chart and Bar Chart, were implemented in the proposed system for real-time analysis. These visualizations allow users to understand market trends and identify the highest-selling items in inventory.

Challenges Faced

The development of hardware business management systems faces several challenges, especially in system integration, database design, real-time analysis and user interface design. Integrating multiple modules such as inventory management, sales order management and supplier management into a cohesive system required significant effort to ensure seamless communication between components. This process is further complicated by the need to maintain data consistency across the entire system while supporting real-time updated analytics. Database design poses another challenge, as managing complex relationships between entities such as customers, suppliers and inventories requires a well-structured schema. Ensuring that database queries are optimized to efficiently handle large data sets is critical, especially for real-time data processing. Real-time analytics presents a range of difficulties, including maintaining data accuracy, instantly updating dashboards and creating meaningful visualizations to provide users with actionable insights. Finally, designing a user-friendly interface is a challenge as it requires a balance between simplicity and functionality. Ensuring that the interface was intuitive and responsive across different devices while meeting the varying needs of users added additional complexity to the project.

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 Hardware Setup

The hardware involved in developing this web application is a laptop. The laptop will serve as a development workstation to develop web applications. The laptop will be a crucial infrastructure to ensure the processes such as coding, debugging and testing executed smoothly and seamlessly. The specifications of the hardware that will be used are described in Table 5.1 Specifications of Laptop.

Table 5.1 Specifications of laptop

Description	**Specifications**
Model	ASUS VivoBook 15
Processor	11th Gen Intel(R) Core(TM) i5-1135G7 @ 2.40GHz 2.42 GHz
Operating System	Windows 11
Graphic	Intel(R) Iris(R) Xe Graphics
Memory	12GB RAM
Storage	476GB SSD

5.2 Software Setup

Before starting to develop web-based hardware business management system, there are some software needed to be installed or prepared in my laptop:

1. Microsoft Visual Studio Code (1.93 version)
2. XAMPP (3.3.0 version)
3. MySQL
4. Lucid Chart
5. Draw.io
6. Canva

5.3 Setting and Configuration

5.3.1 Database Configuration

This system verifies access to phpMyAdmin via the URL http://localhost/phpmyadmin/. A new database named hardware was created in phpMyAdmin. The hardware.sql file was imported to create the required tables, such as customer, inventory, product, salesorder, salesorder_item, supplier, supplier_inventory and users. Figure 5.3.1 shows the successful import of hardware.sql in phpMyAdmin. The database connection settings were configured in the database.php file. Figure 5.3.2 shows the PHP code for the database connection configuration.

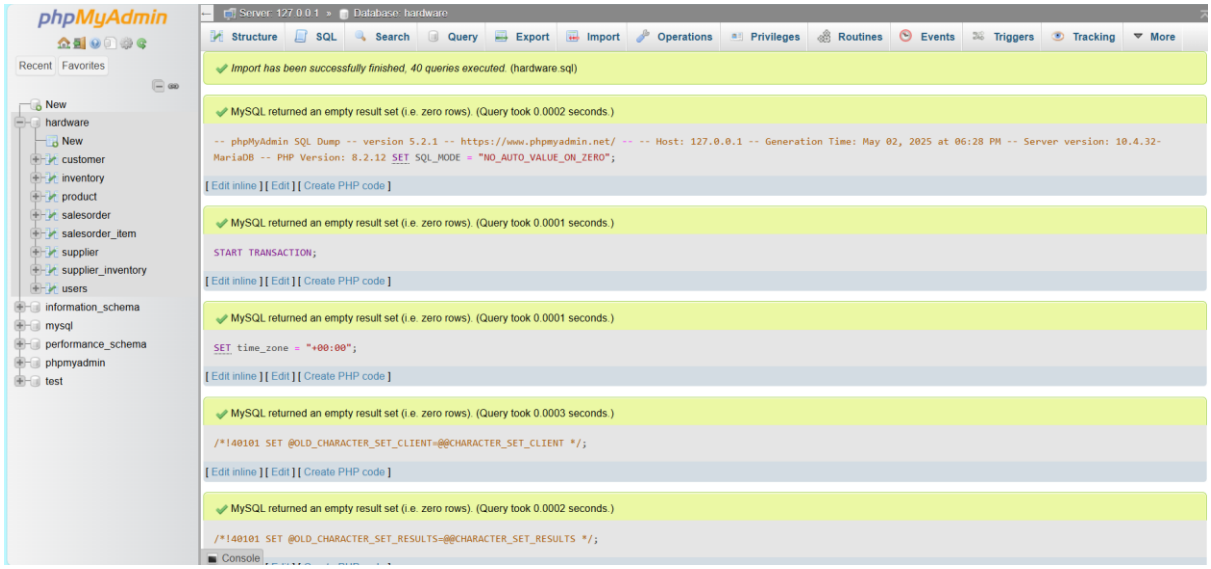


Figure 5.3.1 Successful Importing of hardware.sql

Figure 5.3.2 Database Connection Configuration PHP Code (database.php)

5.3.2 Session Management Configuration

An authentication PHP file (auth.php) was created to verify user login before accessing restricted pages. PHP sessions were initialized at the top of pages that require authentication. Figure 5.3.3 shows the PHP code used for user authentication.

auth.php

```php
<?php
    if (session_status() === PHP_SESSION_NONE) {
        session_start();
    }

    include('database.php');

    if ($_SERVER['REQUEST_METHOD'] === 'POST') {
        $username = $_POST['username'] ?? '';
        $password = $_POST['password'] ?? '';
        if (empty($username) || empty($password)) {
            header(header: "Location: login.php?error=Please enter both fields.");
            exit();
        }
        $query = "SELECT * FROM users WHERE username = ?";
        $stmt = $conn->prepare(query: $query);
        $stmt->bind_param(types: "s", var: &$username);
        $stmt->execute();
        $result = $stmt->get_result();
        $user = $result->fetch_assoc();
        if ($user && password_verify(password: $password, hash: $user['password'])) {
            $_SESSION['username'] = $user['username'];
            header(header: "Location: index.php");
            exit();
        } else {
            header(header: "Location: login.php?error=Invalid username or password.");
            exit();
        }
    }

    if (!isset($_SESSION['username'])) {
        header(header: "Location: login.php");
        exit();
    }
?>
```

Figure 5.3.3 Authentication Configuration PHP Code (auth.php)

5.4 System Operation (with Screenshot)

5.4.1 User Login Page

When the user launches the Hardware Business Management System, the system will display the Login Interface, which requires the user to enter their login credentials, such as username and password, into the respective text fields. After entering the correct username and password, the user must click the “Login” button to proceed. The system will then verify the credentials. If the username and password are validated successfully, the user will be redirected to the Home Page.

Figure 5.4.1 shows the User Login Page. If the user enters an invalid username or password, an error message stating “Invalid username or password.” will be displayed, as shown in Figure 5.4.2.

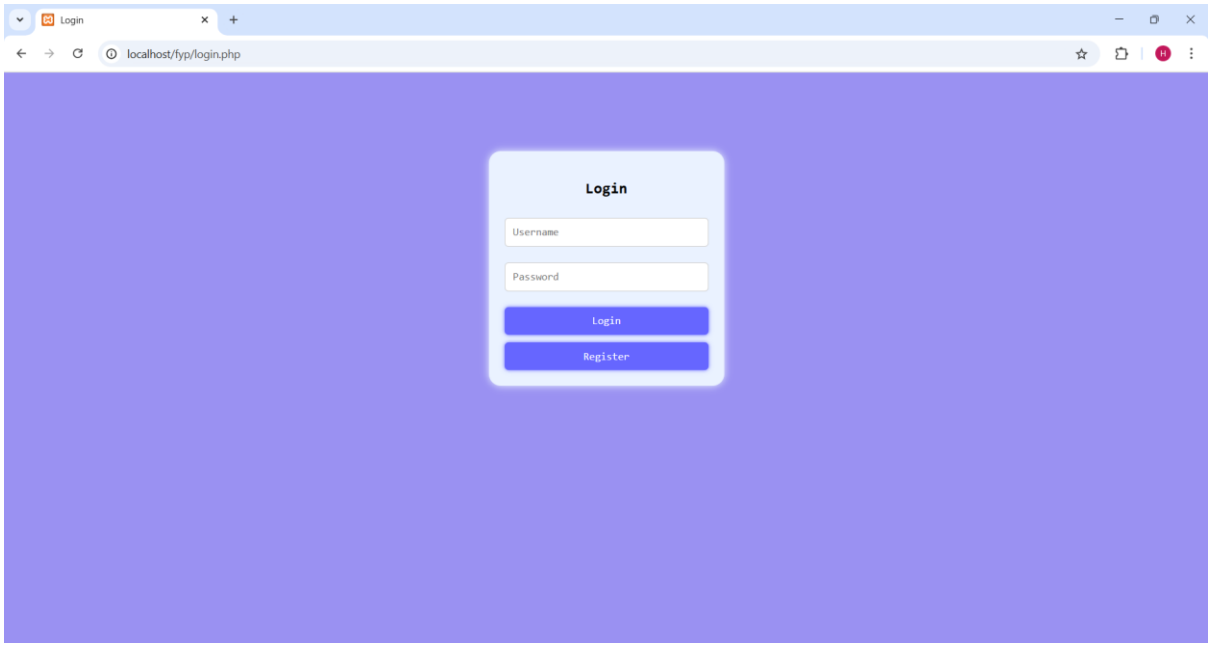


Figure 5.4.1 User Login Page

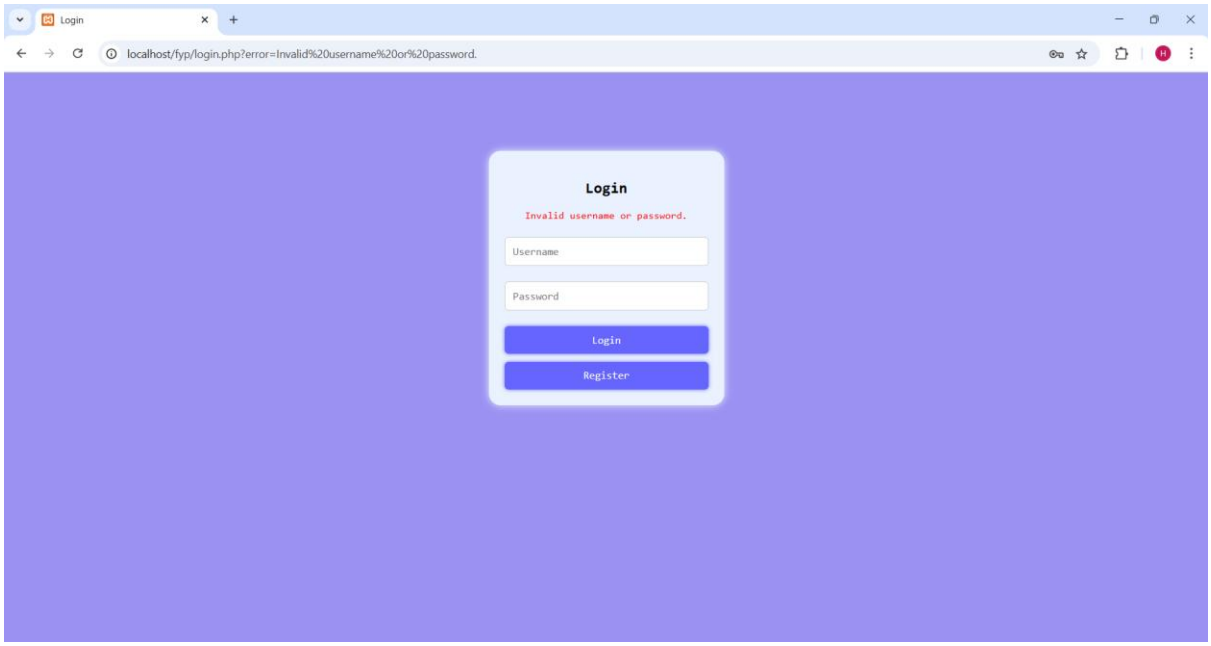


Figure 5.4.2 Error Message “Invalid username or password.”

5.4.2 User Registration Page

When a new user first launches the Hardware Business Management System, they need to create a new account by clicking the “Register” button. This will redirect the user to the User Registration Interface. The user is required to enter a username, password and confirm password to create an account. After entering the required information, the user must click the “Register” button. Upon successful registration, the system will redirect the user to the Login Interface to log into their account.

Figure 5.4.3 shows the User Registration Interface. If the username entered by the user already exists, the system will display an error message stating “Username already exists.”, as shown in Figure 5.4.4. If the password and confirm password do not match, the system will display an error message stating “Password do not match.”, as shown in Figure 5.4.5.

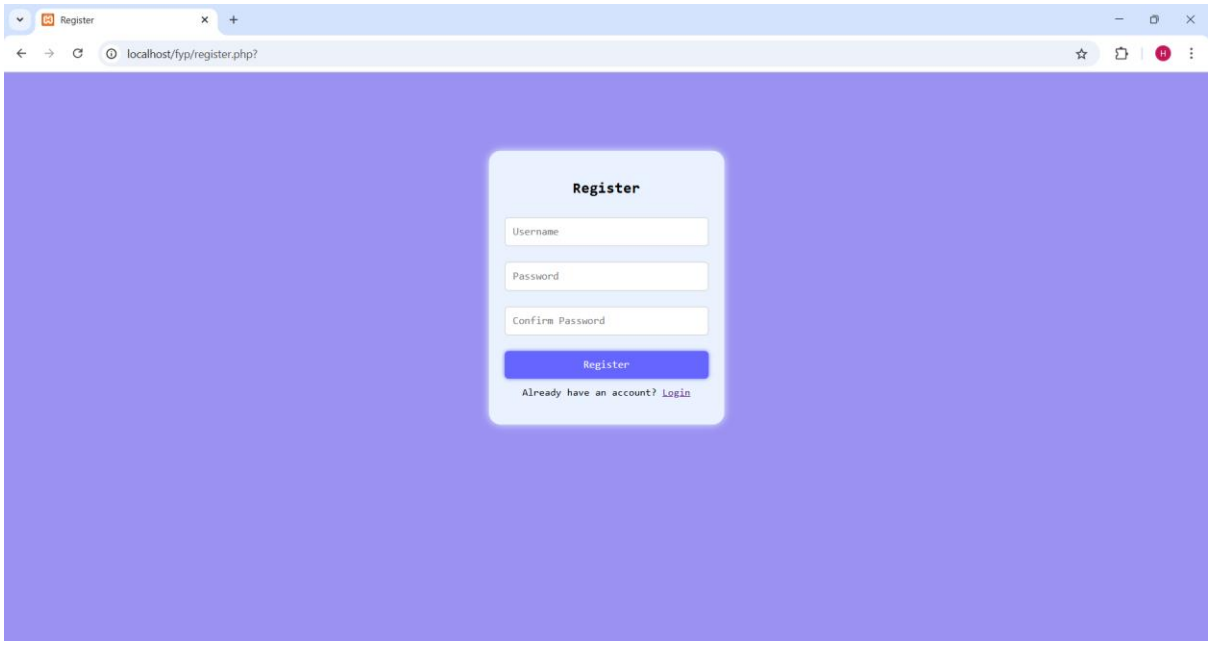


Figure 5.4.3 User Register Page

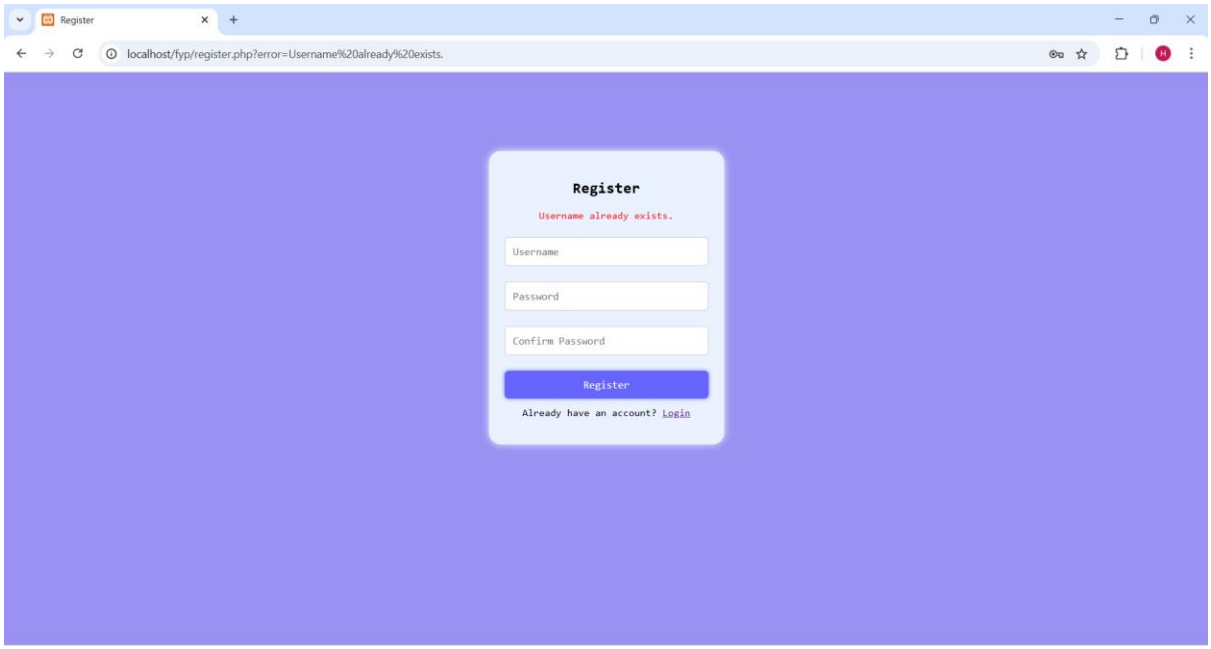


Figure 5.4.4 Error Message “Username already exists.”

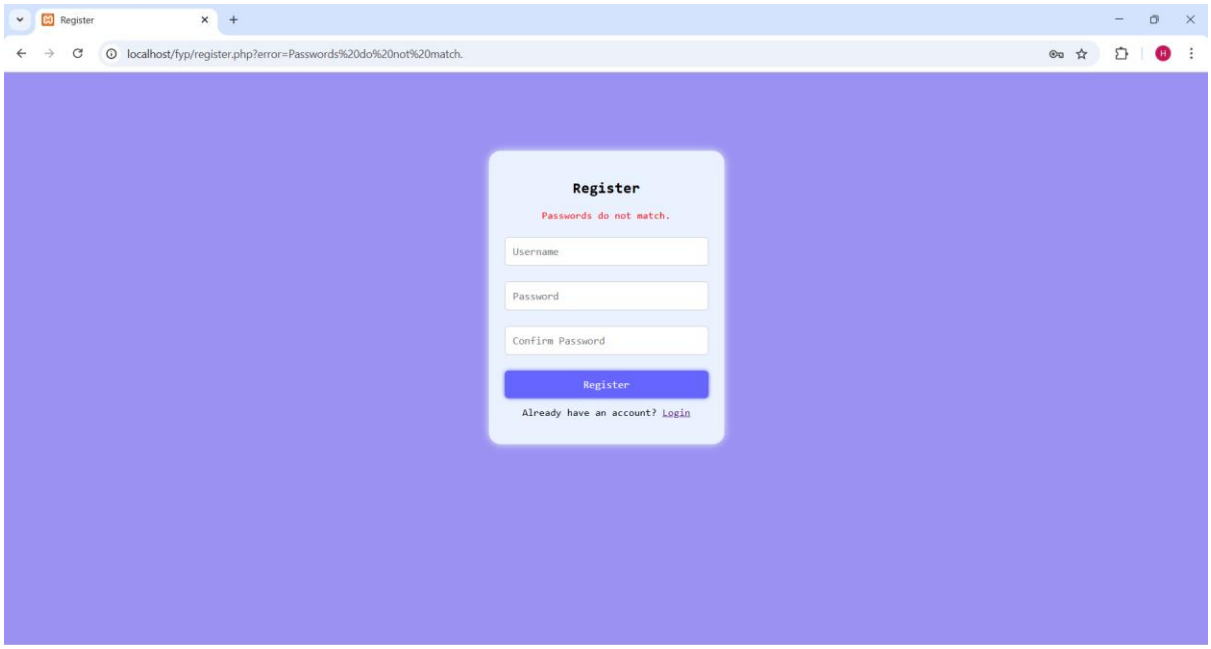


Figure 5.4.5 Error Message “Password do not match.”

5.4.3 Home Page

When users successfully log into their accounts, they are redirected to the Home Page, as shown in Figure 5.4.6. On the Home Page, users can perform several quick actions such as creating a new sales order, adding a new product, registering a new customer and managing supplier inventory by clicking on the respective buttons. In addition to these functions, the Home Page also features several data charts designed to help users analyze the business performance. These charts provide a clear and visual representation of the current status of the hardware business.

The types of charts available on the Home Page include Total Price by Sales Order (Column Chart), Products Purchased by Customers (Stack Chart), Purchase Count by Customer (Line Chart), In-Stock Quantity by Product (Bar Chart), Sales by Product (Pie Chart), Daily Sales Trend (Line Chart) and Monthly Sales Trend (Line Chart). These visual tools assist users in making informed decisions and tracking business trends effectively.

A navigation bar is also available on the Home Page, allowing users to easily access other sections of the system such as Sales Order, Order Item, Product, Customer, Supplier Inventory, Supplier and Inventory pages by clicking on the corresponding buttons. Additionally, a user icon is provided, which redirects users to the User Account page where they can change their password.

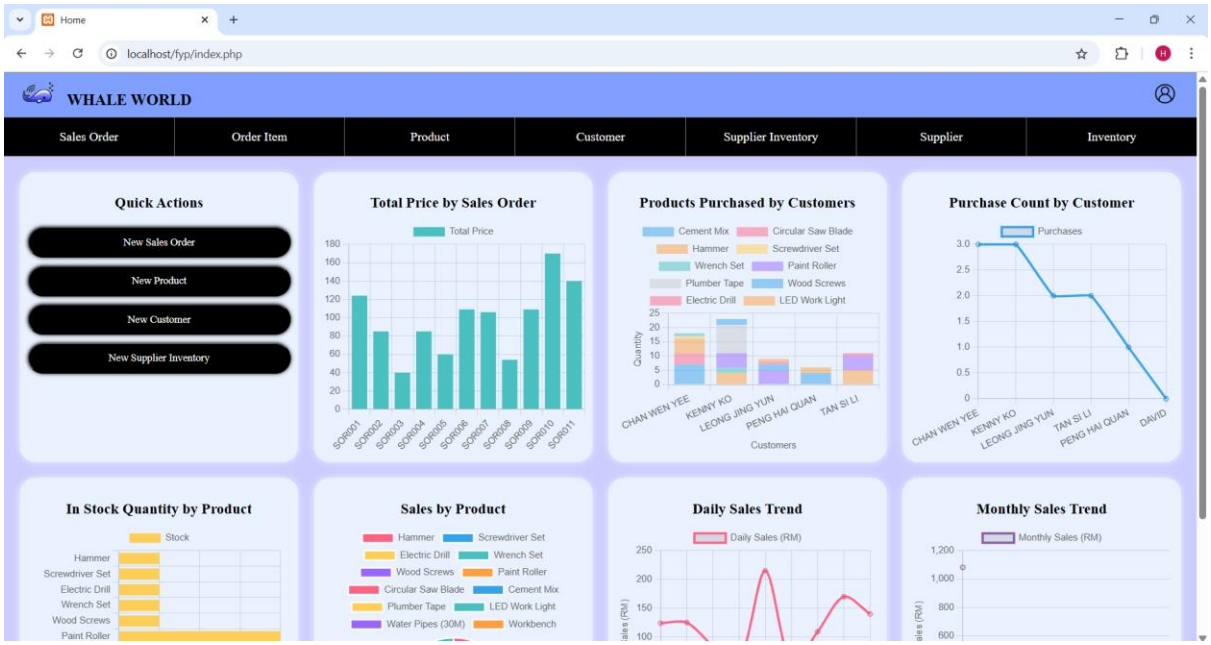


Figure 5.4.6 Home Page

5.4.4 User Account Page

In the User Account page, users can change their existing password by entering their current password and then entering the new password twice for confirmation, as shown in Figure 5.4.7. If the current password is entered correctly and the two new passwords match, the system will display a success message: “Password updated successfully.”, as shown in Figure 5.4.8. If the user enters an incorrect current password, the system will display an error message: “Current password is incorrect.”, as shown in Figure 5.4.9. Similarly, if the new password and its confirmation do not match, the system will display another error message: “New password do not match.”, as shown in Figure 5.4.10. This feature ensures the security of user accounts by verifying identity and preventing password mismatches.

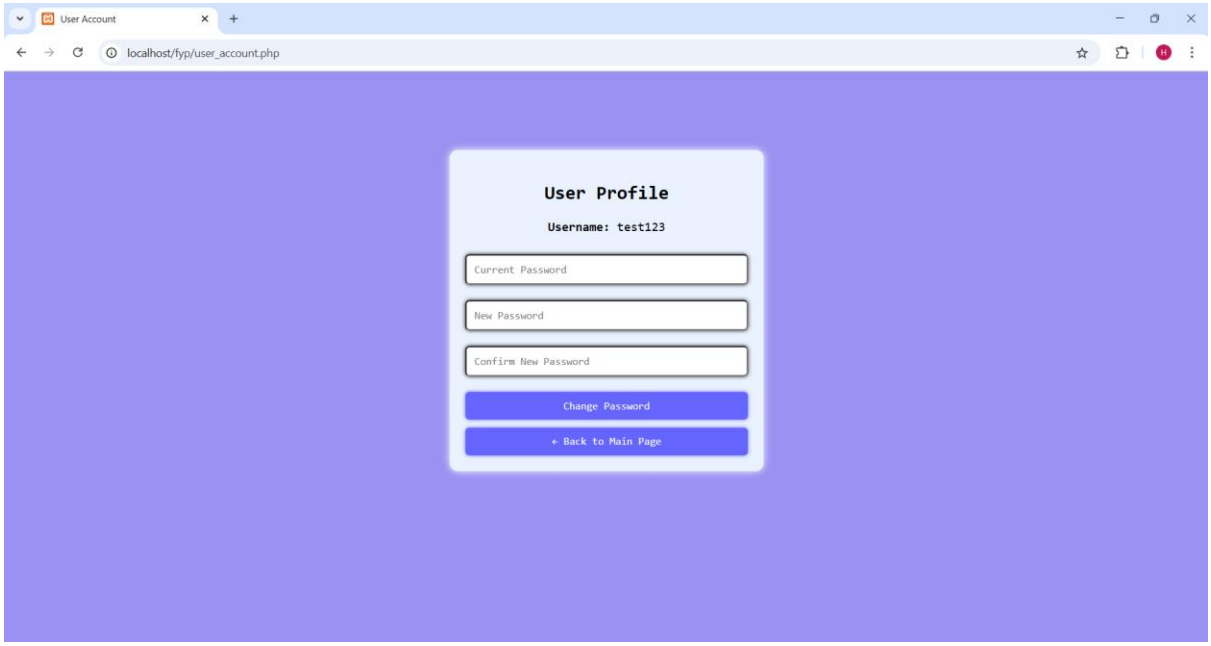


Figure 5.4.7 User Account Page

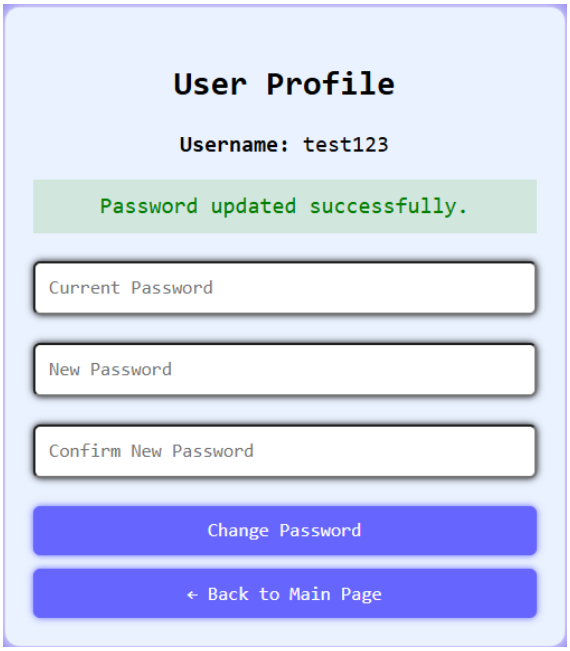


Figure 5.4.8 Success Message "Password update successfully"

Figure 5.4.9 Error Message "Current password is incorrect."

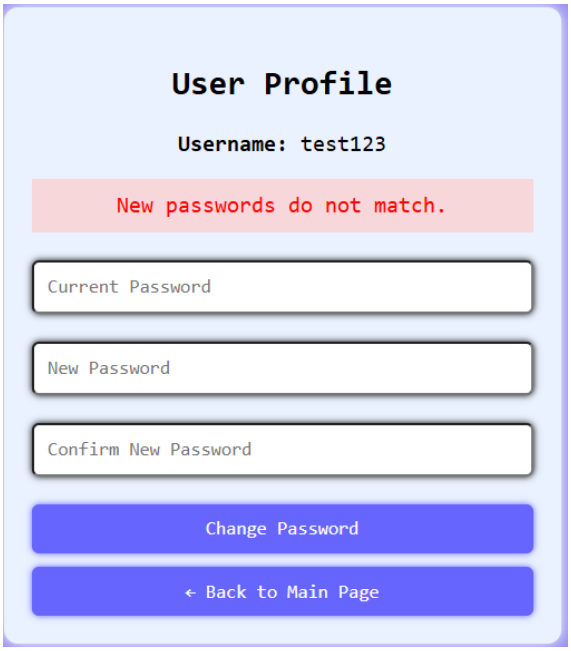


Figure 5.4.10 Error Message "New password do not match."

5.4.5 Sales Order Management Page

On the Home Page, users can access the Sales Order Management page by clicking on the "Sales Order" button in the navigation bar, as shown in Figure 5.4.11. This page displays all existing sales order records in a tabular format. A search function is provided to help users quickly locate specific sales orders. If the search yields no results, the system will display the message "No Result", as shown in Figure 5.4.12.

To create a new sales order, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the "Add" button. If the new sales order is created successfully, the system will display the message "Record added.", as shown in Figure 5.4.13. However, if the entered sales order number already exists, the system will show an error message "Sales order number already exists.", as seen in Figure 5.4.14. In cases where the input fields are left empty, the system will prompt the user with "All fields are required.", as shown in Figure 5.4.15.

To update an existing sales order, users must first select a record from the search result area. The selected sales order details will automatically populate the Details section. After making the necessary modifications, users must click the "Update" button. If the update is successful, the system will display the message "Record updated.", as shown in Figure 5.4.16. If users mistakenly change the sales order number to a new one that does not exist, the system will return the error message "Cannot update. Sales order number does not exist.", as shown in Figure 5.4.17.

To delete a sales order, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the "Delete" button, the system will prompt a confirmation message "Are you sure you want to delete this record?", as shown in Figure 5.4.18. If the user confirms by clicking "OK", the system will display a success message "Record deleted.", as shown in Figure 5.4.19.

To export sales order record to PDF form, users need to click the "Export" button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the sales order record in PDF format, as shown in Figure 5.4.20.

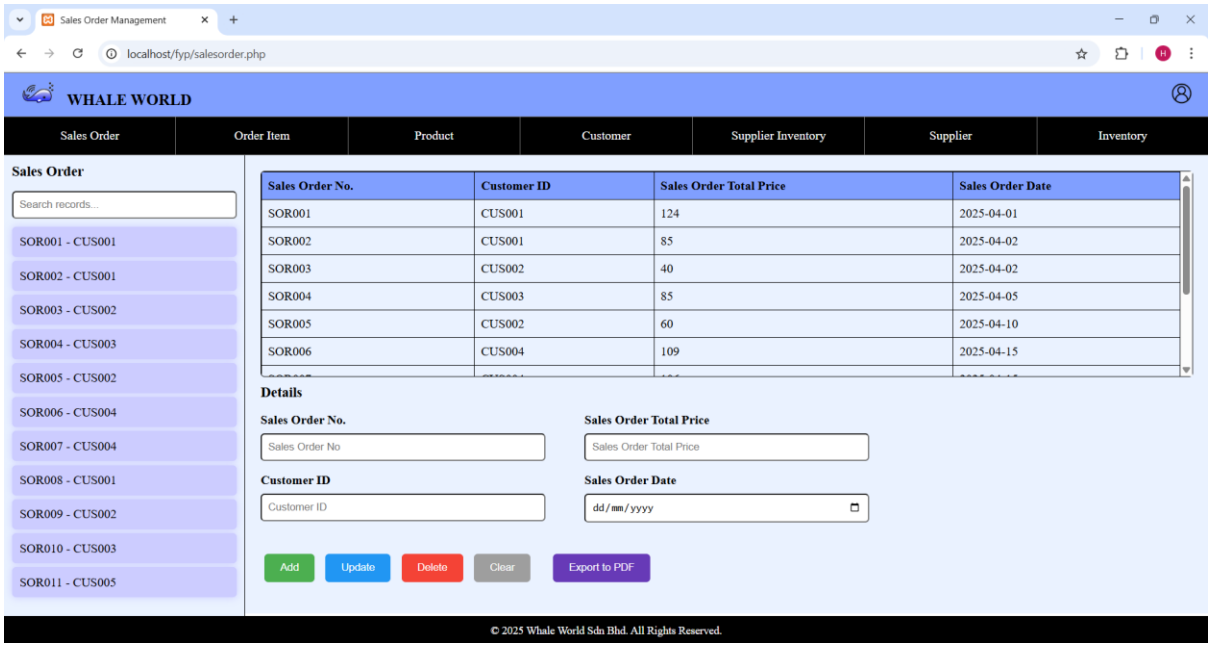


Figure 5.4.11 Sales Order Management Page

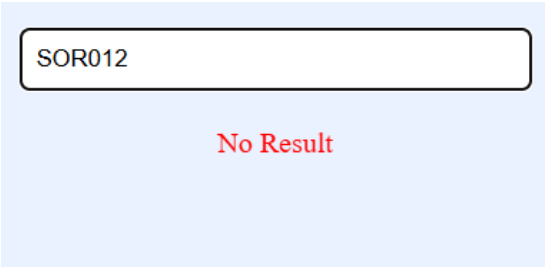


Figure 5.4.12 No Result Message in Search Function

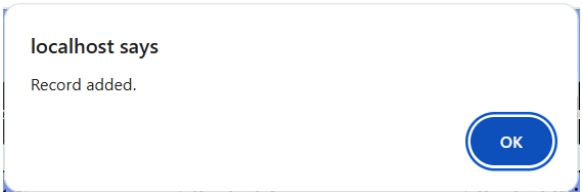


Figure 5.4.13 Success Message "Record added."

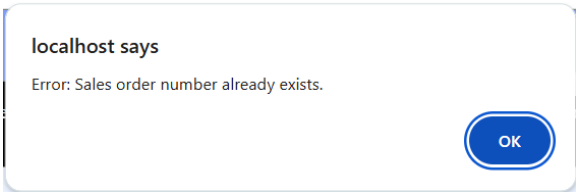


Figure 5.4.14 Error Message "Sales order number already exists."

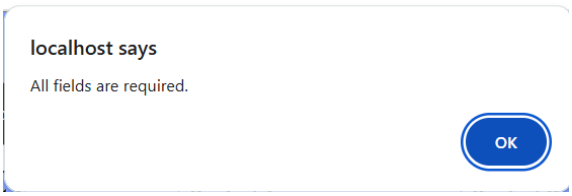


Figure 5.4.15 Error Message "All fields are required."

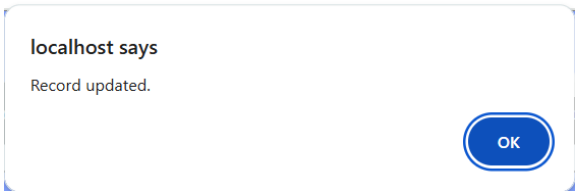


Figure 5.4.16 Success Message "Record updated."

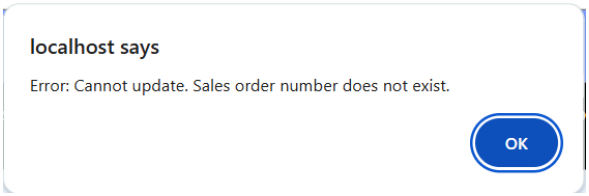


Figure 5.4.17 Error Message "Cannot update. Sales order number does not exist."

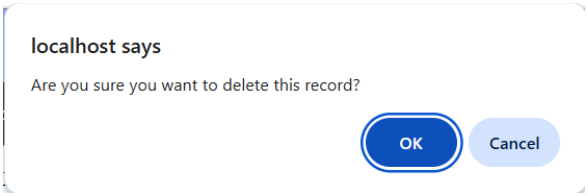


Figure 5.4.18 Confirmation Message "Are you sure you want to delete this record?"

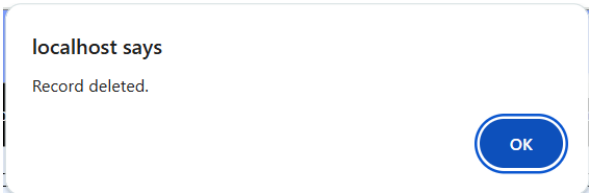


Figure 5.4.19 Success Message "Record deleted."

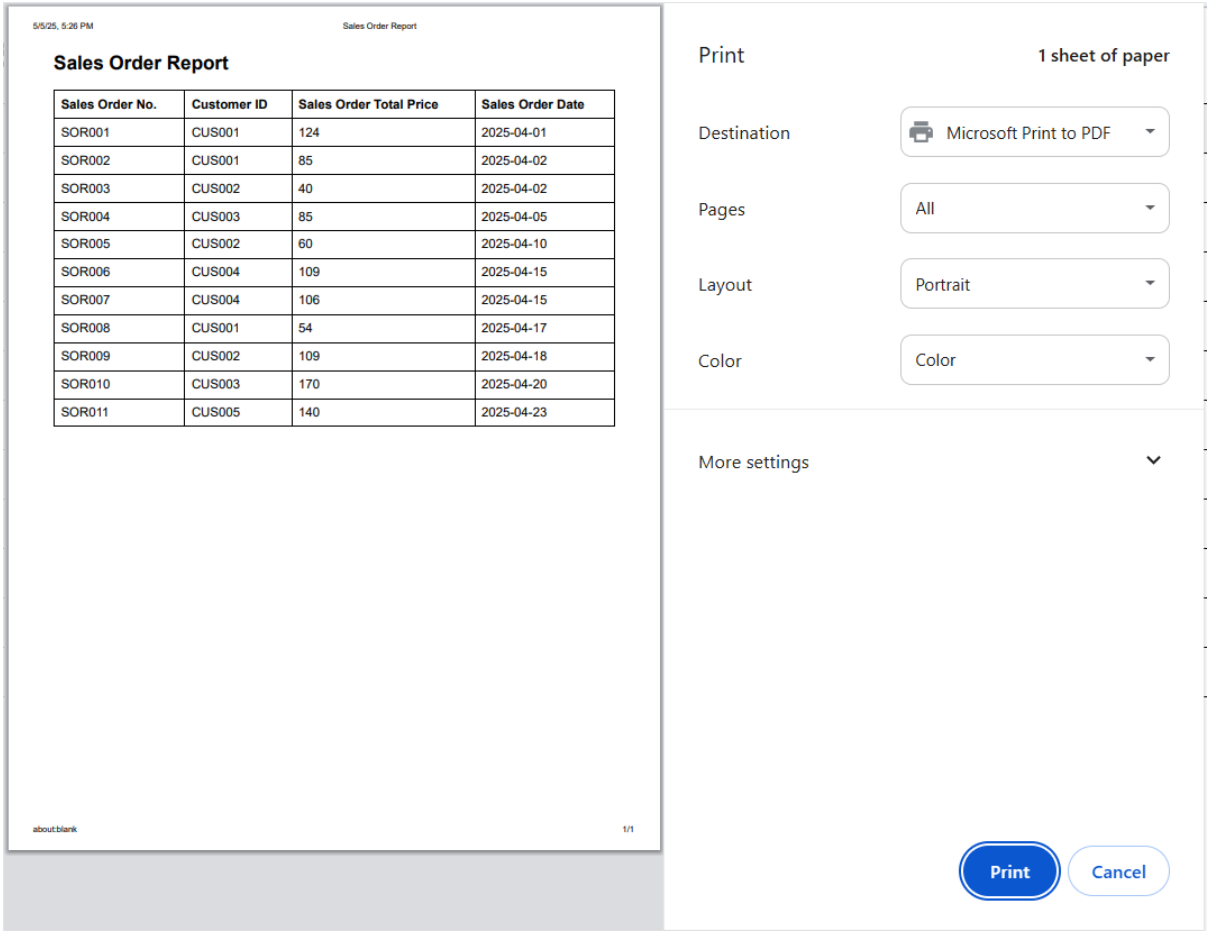


Figure 5.4.20 Export To PDF Function (Sales Order Report)

5.4.5 Order Item Management Page

On the Home Page, users can access the Order Item Management page by clicking on the "Order Item" button in the navigation bar, as shown in Figure 5.4.21. This page displays all existing order item records in a tabular format. A search function is provided to help users quickly locate specific order item. If the search yields no results, the system will display the message "No Result", as shown in Figure 5.4.12.

To create a new order item, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the "Add" button. If the new order item record is created successfully, the system will display the message "Record added.", as shown in Figure 5.4.13. However, if the entered sales order number does not exist but the entered product code is exist, the system will display an error message "Sales order number does not exist.", as shown in Figure 5.4.22. If the entered sales order number is exist but the entered product code does not exist, the system will display an error message "Product

code does not exist.", as shown in Figure 5.4.23. If the entered combination of of sales order number and product code already exists, the system will show an error message "Sales order number and product code already exists.", as shown in Figure 5.4.24. In cases where the input fields are left empty, the system will prompt the user with "All fields are required.", as shown in Figure 5.4.15.

To update an existing order item, users must first select a record from the search result area. The selected order item details will automatically populate the Details section. After making the necessary modifications, users must click the "Update" button. If the update is successful, the system will display the message "Record updated.", as shown in Figure 5.4.16. If users mistakenly change the sales order number or product code to a new one that does not exist, the system will return the error message "Cannot update. Sales order number and product code does not exist.", as shown in Figure 5.4.25.

To delete an order item, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the "Delete" button, the system will prompt a confirmation message "Are you sure you want to delete this record?", as shown in Figure 5.4.18. If the user confirms by clicking "OK", the system will display a success message "Record deleted.", as shown in Figure 5.4.19.

To export order item record to PDF form, users need to click the "Export" button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the order item record in PDF format, as shown in Figure 5.4.26.

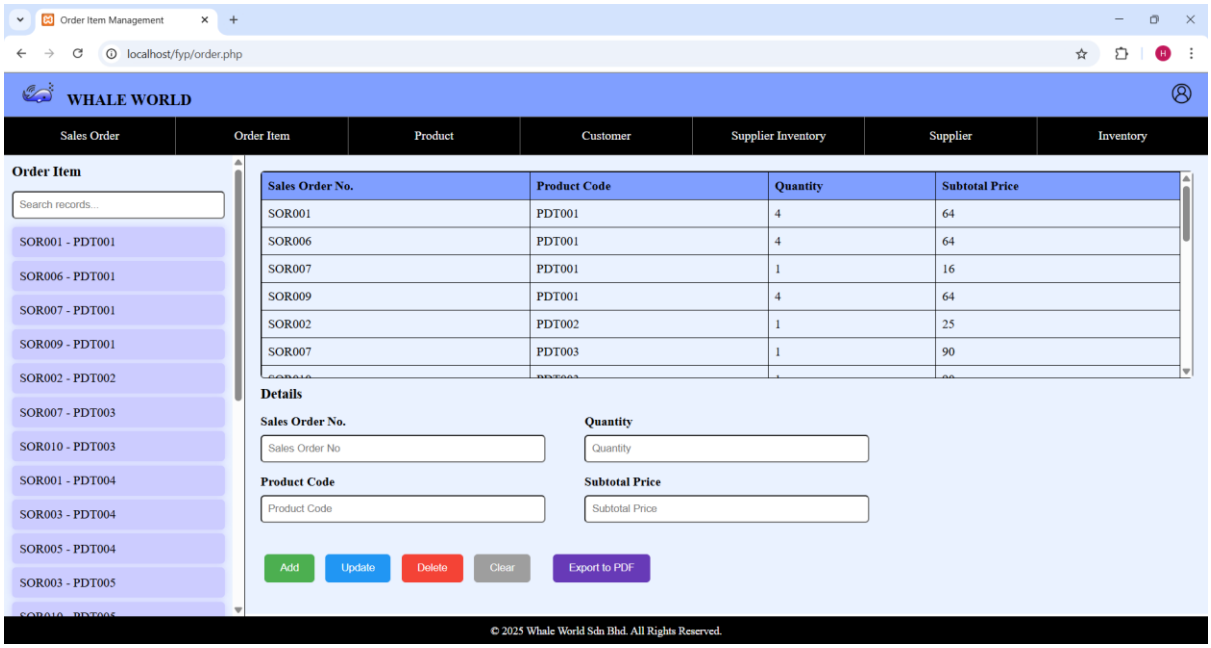


Figure 5.4.21 Order Item Management Page

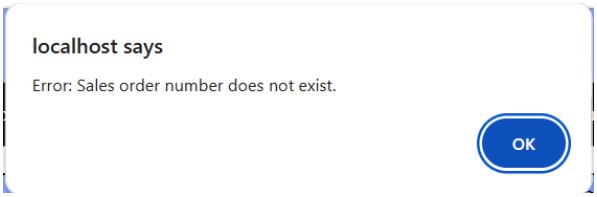


Figure 5.4.22 Error Message "Sales order number does not exist."

Figure 5.4.23 Error Message "Product code does not exist."

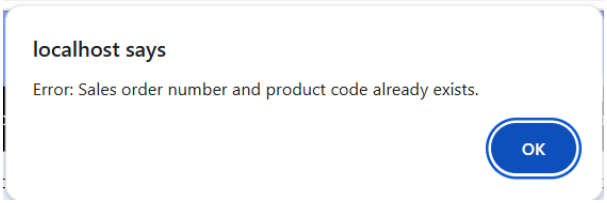


Figure 5.4.24 Error Message "Sales order number and product code already exists."

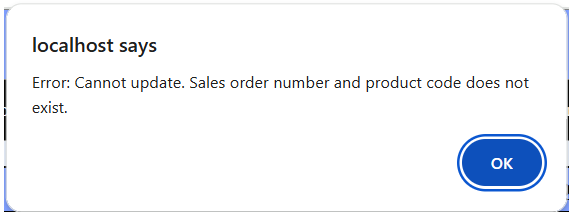
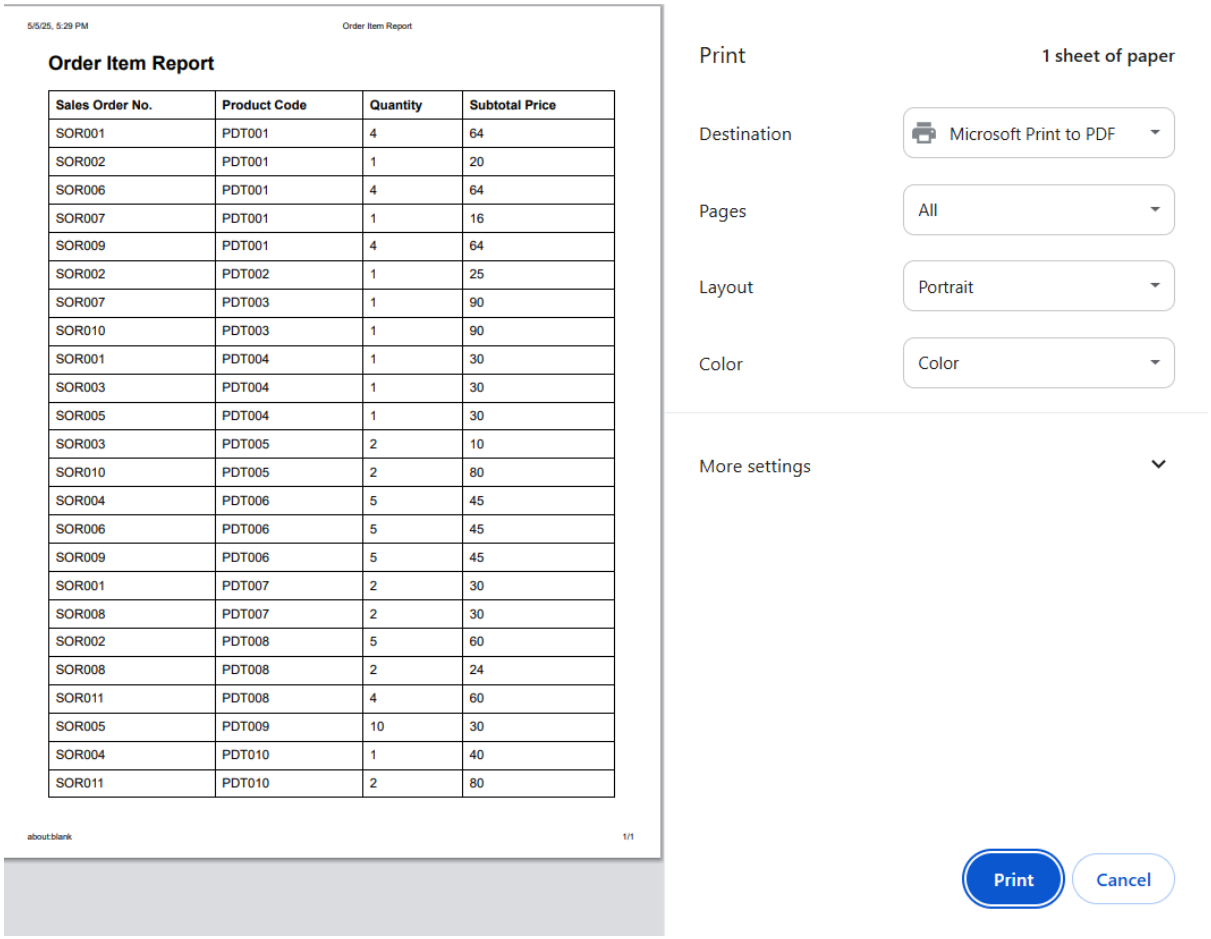


Figure 5.4.25 Error Message "Cannot update. Sales order number and product code does not exist."



Sales Order No.	Product Code	Quantity	Subtotal Price
SOR001	PDT001	4	64
SOR002	PDT001	1	20
SOR006	PDT001	4	64
SOR007	PDT001	1	16
SOR009	PDT001	4	64
SOR002	PDT002	1	25
SOR007	PDT003	1	90
SOR010	PDT003	1	90
SOR001	PDT004	1	30
SOR003	PDT004	1	30
SOR005	PDT004	1	30
SOR003	PDT005	2	10
SOR010	PDT005	2	80
SOR004	PDT006	5	45
SOR006	PDT006	5	45
SOR009	PDT006	5	45
SOR001	PDT007	2	30
SOR008	PDT007	2	30
SOR002	PDT008	5	60
SOR008	PDT008	2	24
SOR011	PDT008	4	60
SOR005	PDT009	10	30
SOR004	PDT010	1	40
SOR011	PDT010	2	80

Figure 5.4.26 Export To PDF Function (Order Item Report)

5.4.5 Product Management Page

On the Home Page, users can access the Product Management page by clicking on the “Product” button in the navigation bar, as shown in Figure 5.4.27. This page displays all existing product records in a tabular format. A search function is provided to help users quickly locate specific product. If the search yields no results, the system will display the message “No Result”, as shown in Figure 5.4.12.

To create a new product, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the “Add” button. If the new product record is created successfully, the system will display the message “Record added.”, as shown in Figure 5.4.13. However, if the entered product code already exists, the system will show an error message “Product code already exists.”, as seen in Figure 5.4.28. In cases where the input fields are left empty, the system will prompt the user with “All fields are required.”, as shown in Figure 5.4.15.

To update an existing product, users must first select a record from the search result area. The selected product details will automatically populate the Details section. After making the necessary modifications, users must click the “Update” button. If the update is successful, the system will display the message “Record updated.”, as shown in Figure 5.4.16. If users mistakenly change the product code to a new one that does not exist, the system will return the error message “Cannot update. Product code does not exist.”, as shown in Figure 5.4.29.

To delete a product, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the “Delete” button, the system will prompt a confirmation message “Are you sure you want to delete this record?”, as shown in Figure 5.4.18. If the user confirms by clicking “OK”, the system will display a success message “Record deleted.”, as shown in Figure 5.4.19.

To export product record to PDF form, users need to click the “Export” button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the product record in PDF format, as shown in Figure 5.4.30.

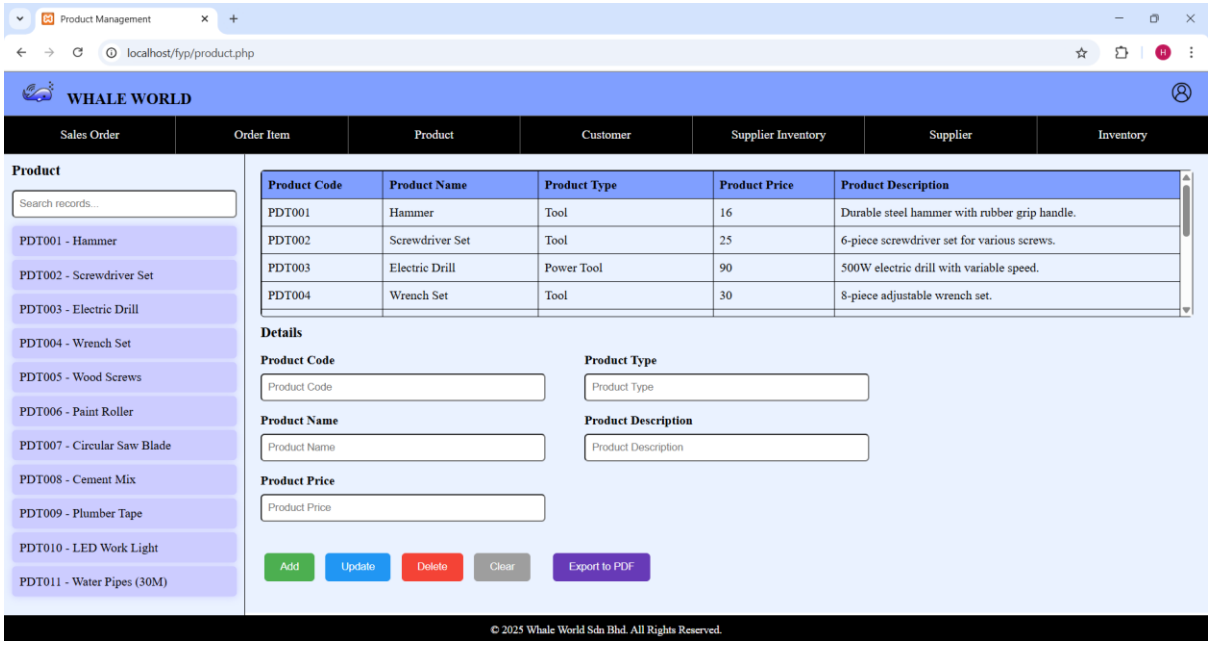


Figure 5.4.27 Product Management Page

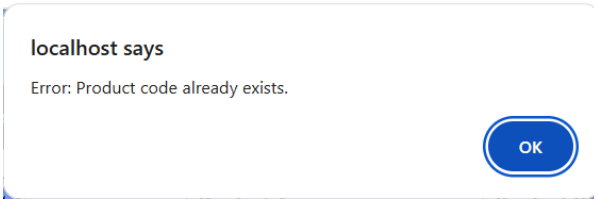


Figure 5.4.28 Error Message "Product Code already exists."

Figure 5.4.29 Error Message "Cannot update. Product code does not exist."

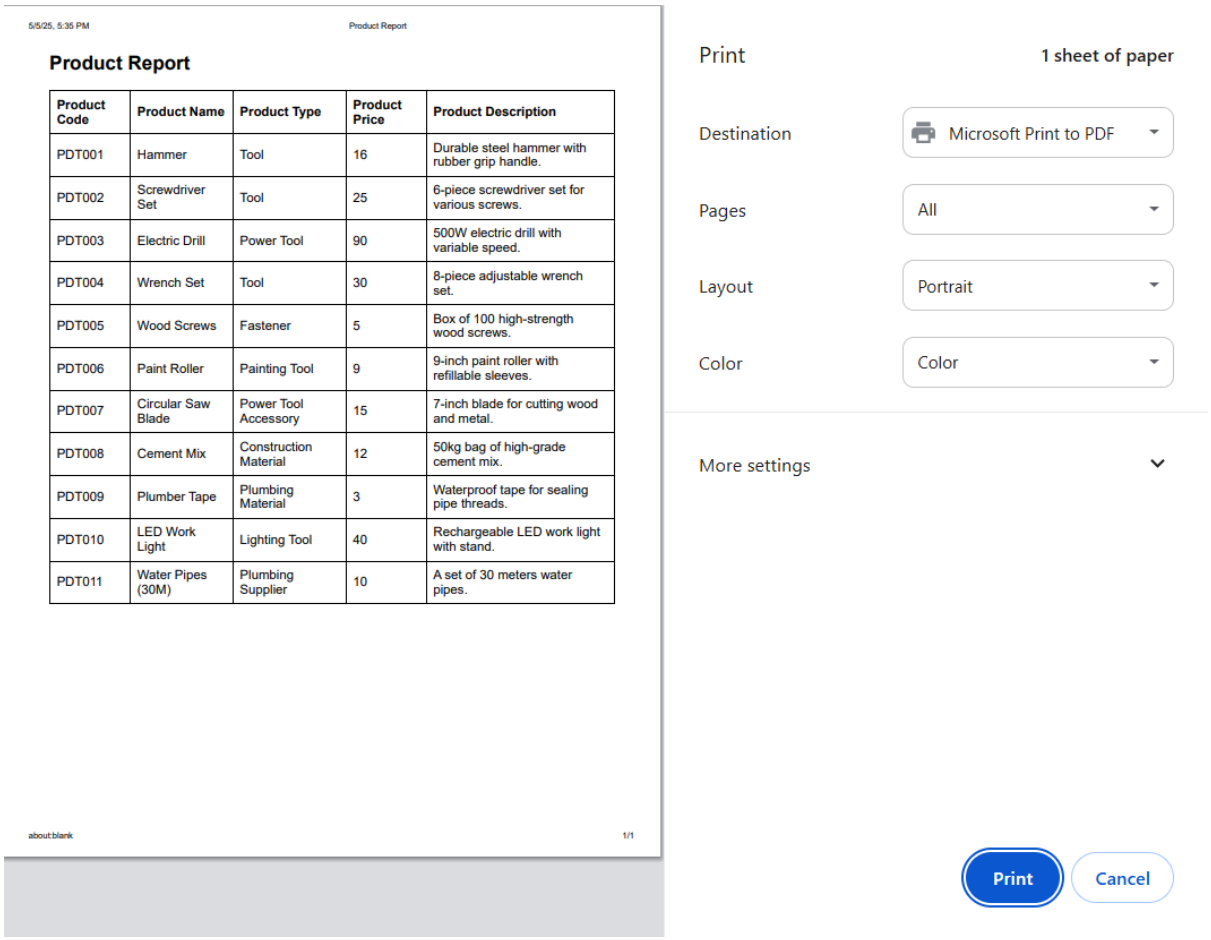


Figure 5.4.30 Export To PDF Function (Product Report)

5.4.5 Customer Management Page

On the Home Page, users can access the Customer Management page by clicking on the "Customer" button in the navigation bar, as shown in Figure 5.4.31. This page displays all existing customer records in a tabular format. A search function is provided to help users quickly locate specific customer. If the search yields no results, the system will display the message "No Result", as shown in Figure 5.4.12.

To create a new customer, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the “Add” button. If the new customer record is created successfully, the system will display the message “Record added.”, as shown in Figure 5.4.13. However, if the entered customer id already exists, the system will show an error message “Customer ID already exists.”, as seen in Figure 5.4.32. In cases where the input fields are left empty, the system will prompt the user with “All fields are required.”, as shown in Figure 5.4.15.

To update an existing customer, users must first select a record from the search result area. The selected customer details will automatically populate the Details section. After making the necessary modifications, users must click the “Update” button. If the update is successful, the system will display the message “Record updated.”, as shown in Figure 5.4.16. If users mistakenly change the customer id to a new one that does not exist, the system will return the error message “Cannot update. Customer ID does not exist.”, as shown in Figure 5.4.33.

To delete a customer, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the “Delete” button, the system will prompt a confirmation message “Are you sure you want to delete this record?”, as shown in Figure 5.4.18. If the user confirms by clicking “OK”, the system will display a success message “Record deleted.”, as shown in Figure 5.4.19.

To export customer record to PDF form, users need to click the “Export” button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the customer record in PDF format, as shown in Figure 5.4.34.

To direct call to the customer, users must first select the desired record form the search result area. The selected customer details will automatically populate the Details section and a WhatsApp icon will display in Details section. Users can click the WhatsApp icon to direct WhatsApp to the customer. Upon clicking WhatsApp icon, the system will redirect to the WhatsApp page with the URL, https://wa.me/{telephone_number}.

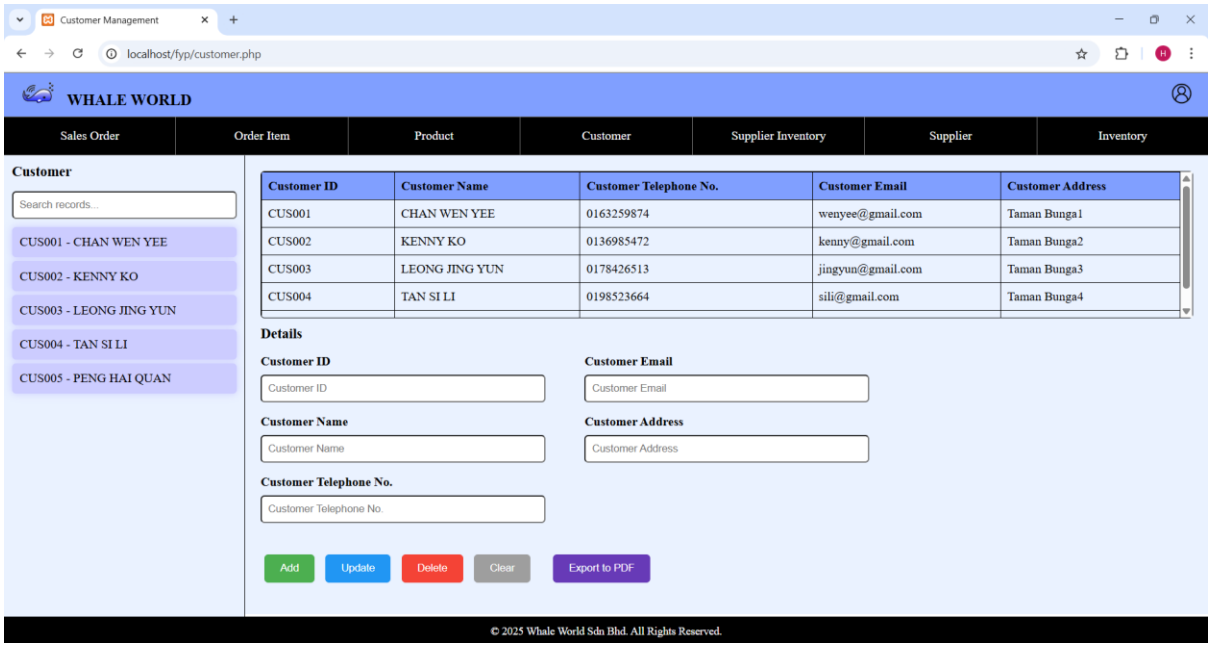


Figure 5.4.31 Customer Management Page

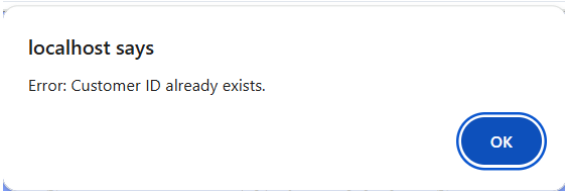


Figure 5.4.32 Error Message "Customer ID already exists."

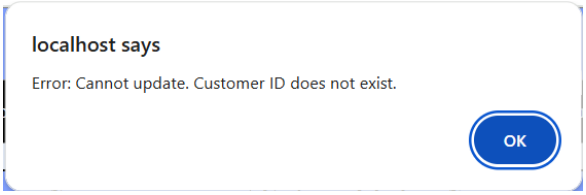


Figure 5.4.33 Error Message "Cannot update. Customer ID does not exist."

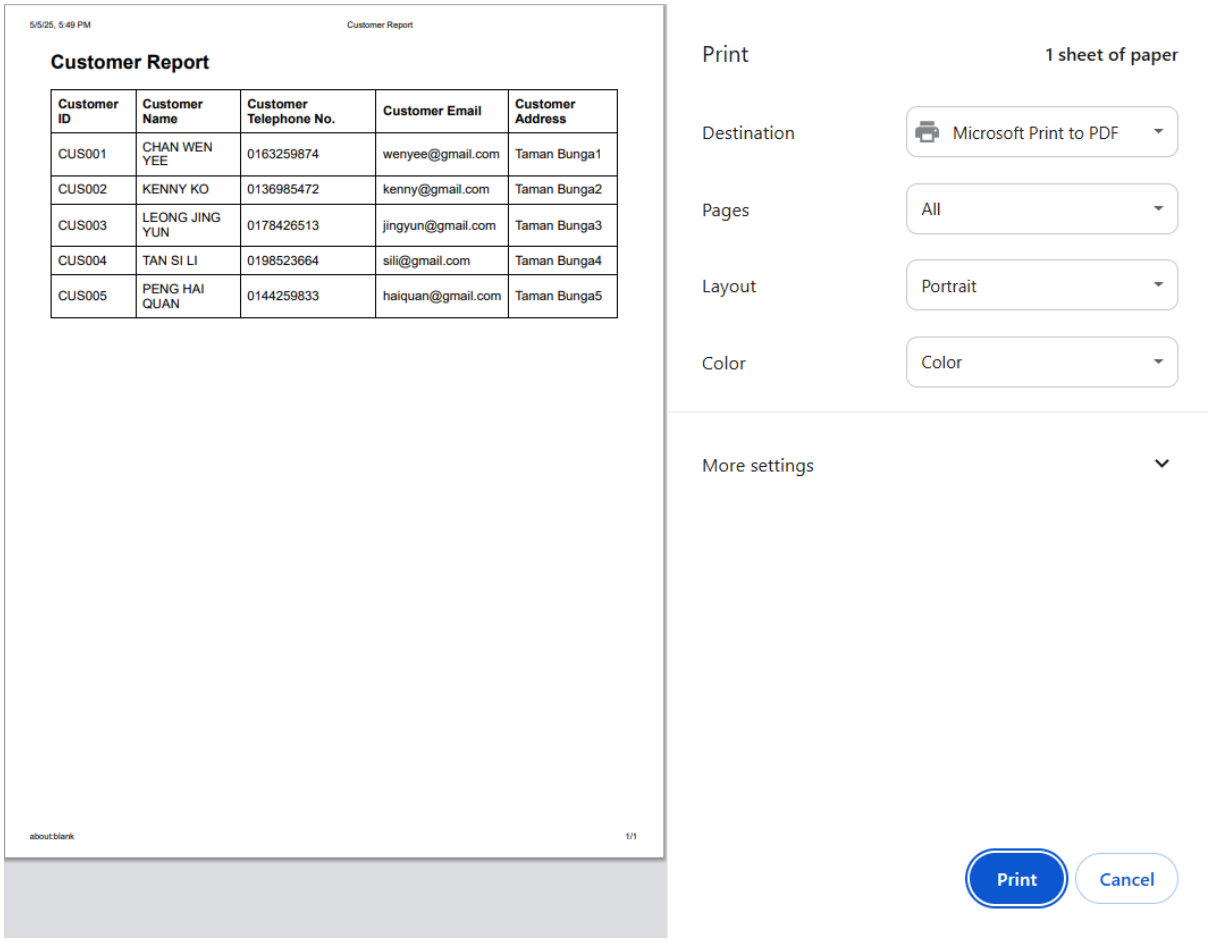


Figure 5.4.34 Export To PDF Function (Customer Report)

5.4.5 Supplier Inventory Management Page

On the Home Page, users can access the Supplier Inventory Management page by clicking on the “Supplier Inventory” button in the navigation bar, as shown in Figure 5.4.35. This page displays all existing supplier inventory records in a tabular format. A search function is provided to help users quickly locate specific supplier inventory. If the search yields no results, the system will display the message “No Result”, as shown in Figure 5.4.12.

To create a new supplier inventory, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the “Add” button. If the new supplier inventory record is created successfully, the system will display the message “Record added.”, as shown in Figure 5.4.13. However, if the entered supplier id does not exist but the product code is exist, the system will display the message “Supplier ID does not exist.”, as shown in Figure 5.4.36. If the entered supplier id is exist but the product code does not exist, the system will display the message “Product code does not exist.”, as shown in Figure 5.4.37.

If the entered supplier id and product code already exists, the system will show an error message “Supplier ID and product code already exists.”, as seen in Figure 5.4.38. In cases where the input fields are left empty, the system will prompt the user with “All fields are required.”, as shown in Figure 5.4.15.

To update an existing supplier inventory, users must first select a record from the search result area. The selected supplier inventory details will automatically populate the Details section. After making the necessary modifications, users must click the “Update” button. If the update is successful, the system will display the message “Record updated.”, as shown in Figure 5.4.16. If users mistakenly change the supplier id or produc code to a new one that does not exist, the system will return the error message “Cannot update. Supplier id and product code does not exist.”, as shown in Figure 5.4.39.

To delete a supplier inventory, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the “Delete” button, the system will prompt a confirmation message “Are you sure you want to delete this record?”, as shown in Figure 5.4.18. If the user confirms by clicking “OK”, the system will display a success message “Record deleted.”, as shown in Figure 5.4.19.

To export supplier inventory record to PDF form, users need to click the “Export” button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the supplier inventory record in PDF format, as shown in Figure 5.4.40.

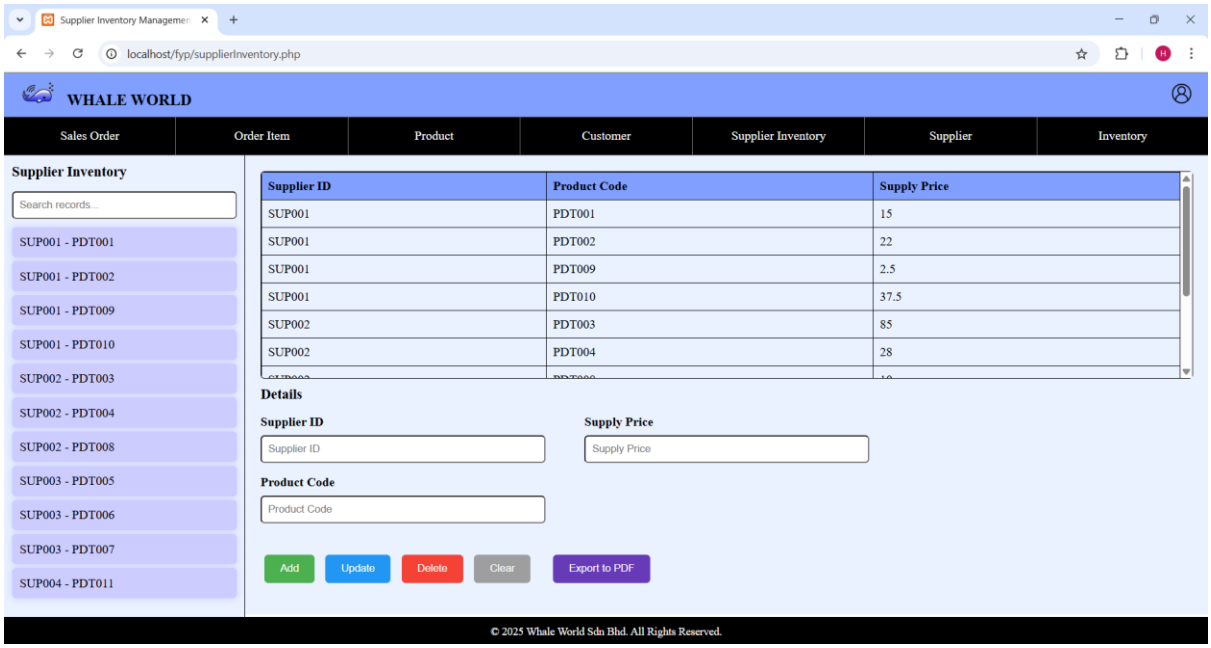


Figure 5.4.35 Supplier Inventory Management Page

Figure 5.4.36 Error Message "Supplier ID does not exist."

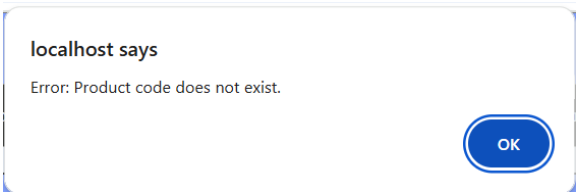


Figure 5.4.37 Error Message "Product Code does not exist."

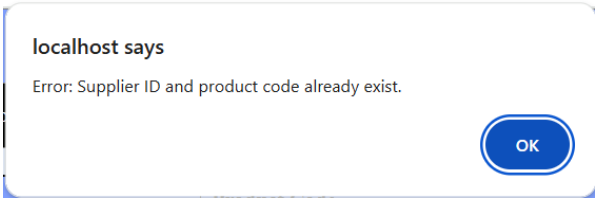


Figure 5.4.38 Error Message "Supplier ID and product code already exist."

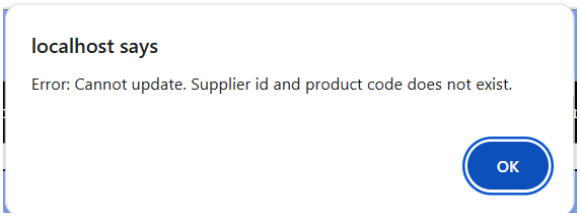
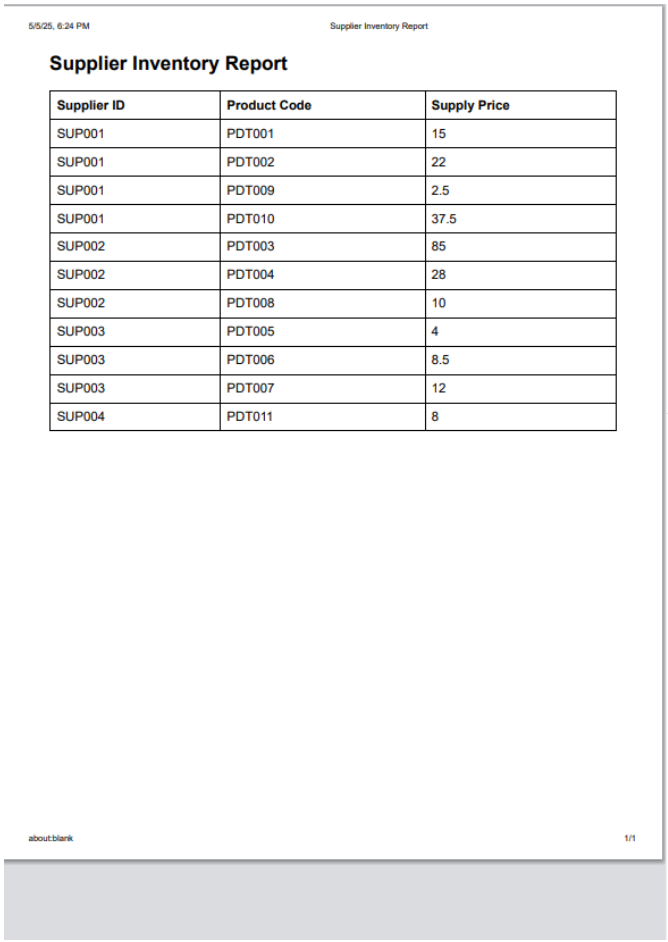


Figure 5.4.39 Error Message "Cannot update. Supplier id and product code does not exist."


5/5/25, 6:24 PM Supplier Inventory Report

Supplier Inventory Report

Supplier ID	Product Code	Supply Price
SUP001	PDT001	15
SUP001	PDT002	22
SUP001	PDT009	2.5
SUP001	PDT010	37.5
SUP002	PDT003	85
SUP002	PDT004	28
SUP002	PDT008	10
SUP003	PDT005	4
SUP003	PDT006	8.5
SUP003	PDT007	12
SUP004	PDT011	8

about:blank 1/1

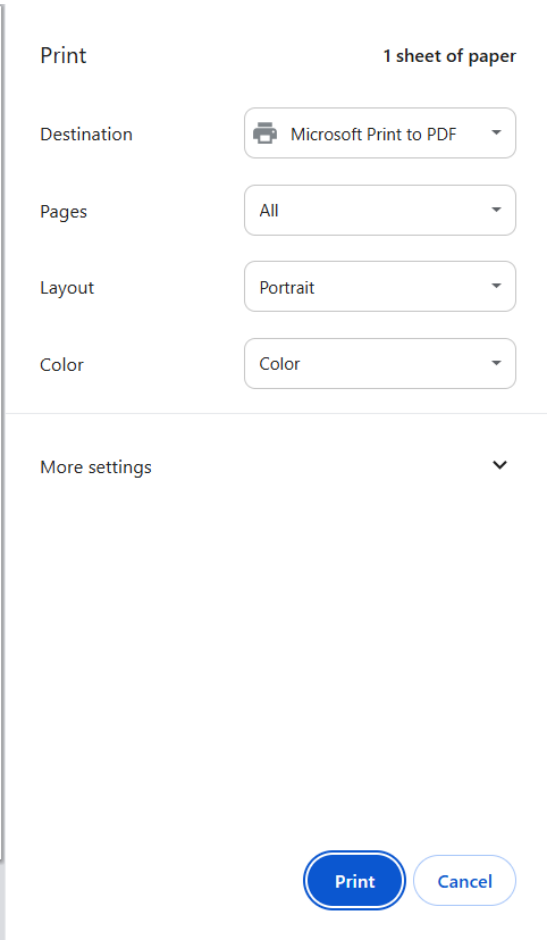


Figure 5.4.40 Export To PDF (Supplier Inventory Report)

5.4.6 Supplier Management Page

On the Home Page, users can access the Supplier Management page by clicking on the "Supplier" button in the navigation bar, as shown in Figure 5.4.41. This page displays all existing supplier records in a tabular format. A search function is provided to help users quickly locate specific supplier. If the search yields no results, the system will display the message "No Result", as shown in Figure 5.4.12.

To create a new supplier, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the "Add" button. If the new supplier record is created successfully, the system will display the message "Record added.", as shown in Figure 5.4.13. However, if the entered supplier id already exists, the system will show an error message "Supplier ID already exists.", as seen in Figure 5.4.42. In cases where the input fields are left empty, the system will prompt the user with "All fields are required.", as shown in Figure 5.4.15.

To update an existing supplier, users must first select a record from the search result area. The selected supplier details will automatically populate the Details section. After making the necessary modifications, users must click the "Update" button. If the update is successful, the system will display the message "Record updated.", as shown in Figure 5.4.16. If users mistakenly change the supplier id to a new one that does not exist, the system will return the error message "Cannot update. Supplier ID does not exist.", as shown in Figure 5.4.43.

To delete a supplier, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the "Delete" button, the system will prompt a confirmation message "Are you sure you want to delete this record?", as shown in Figure 5.4.18. If the user confirms by clicking "OK", the system will display a success message "Record deleted.", as shown in Figure 5.4.19.

To export supplier record to PDF form, users need to click the "Export" button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the supplier record in PDF format, as shown in Figure 5.4.44.

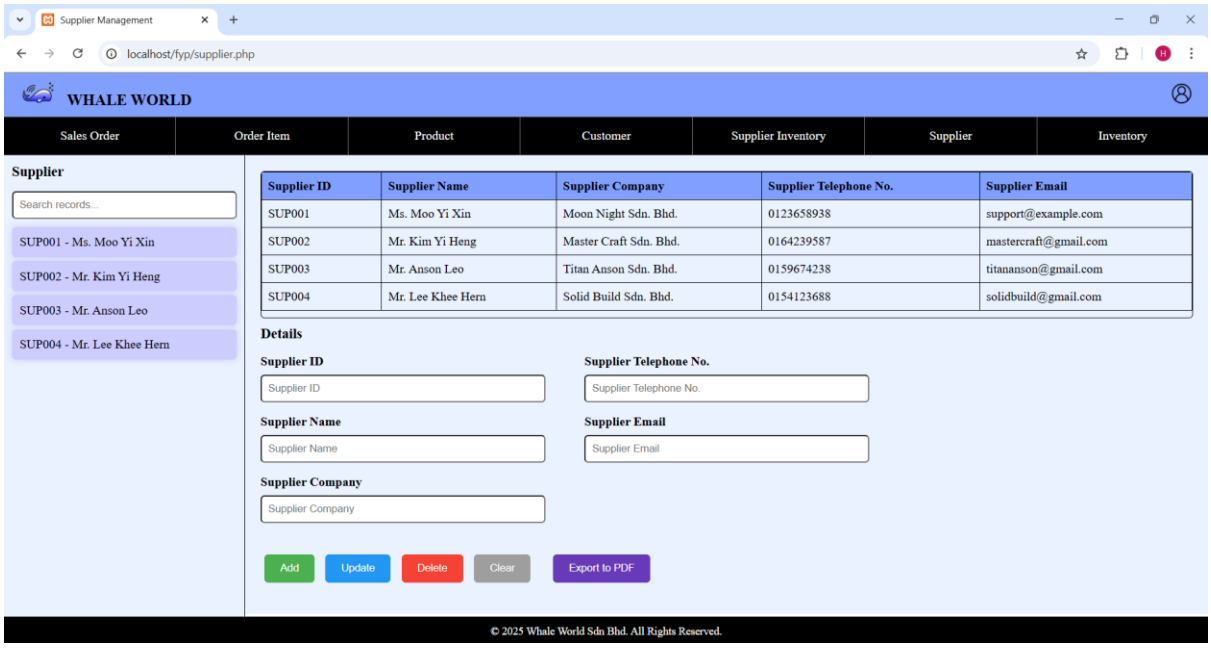


Figure 5.4.41 Supplier Management Page

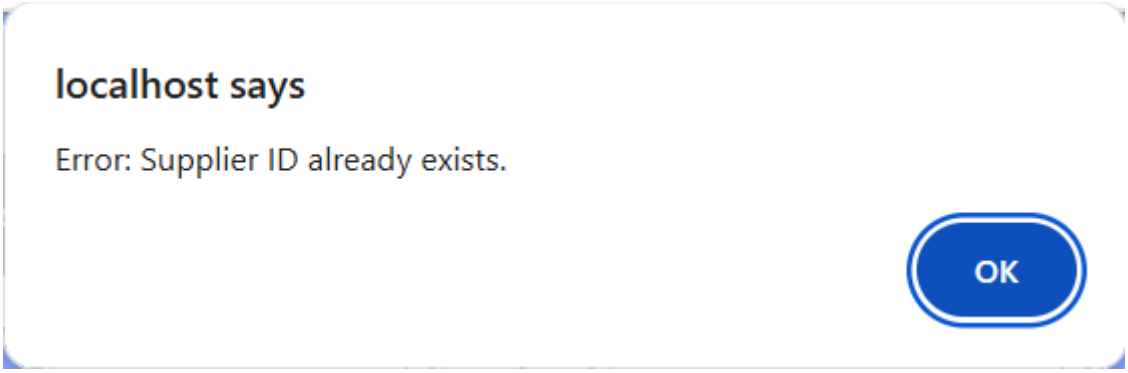


Figure 5.4.42 Error Message “Supplier ID already exists.”

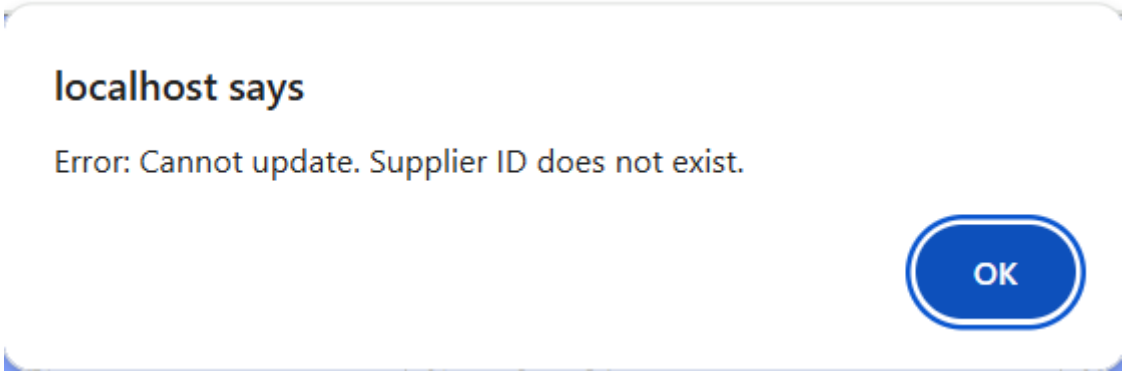


Figure 5.4.43 Error Message “Cannot update. Supplier ID does not exist.”

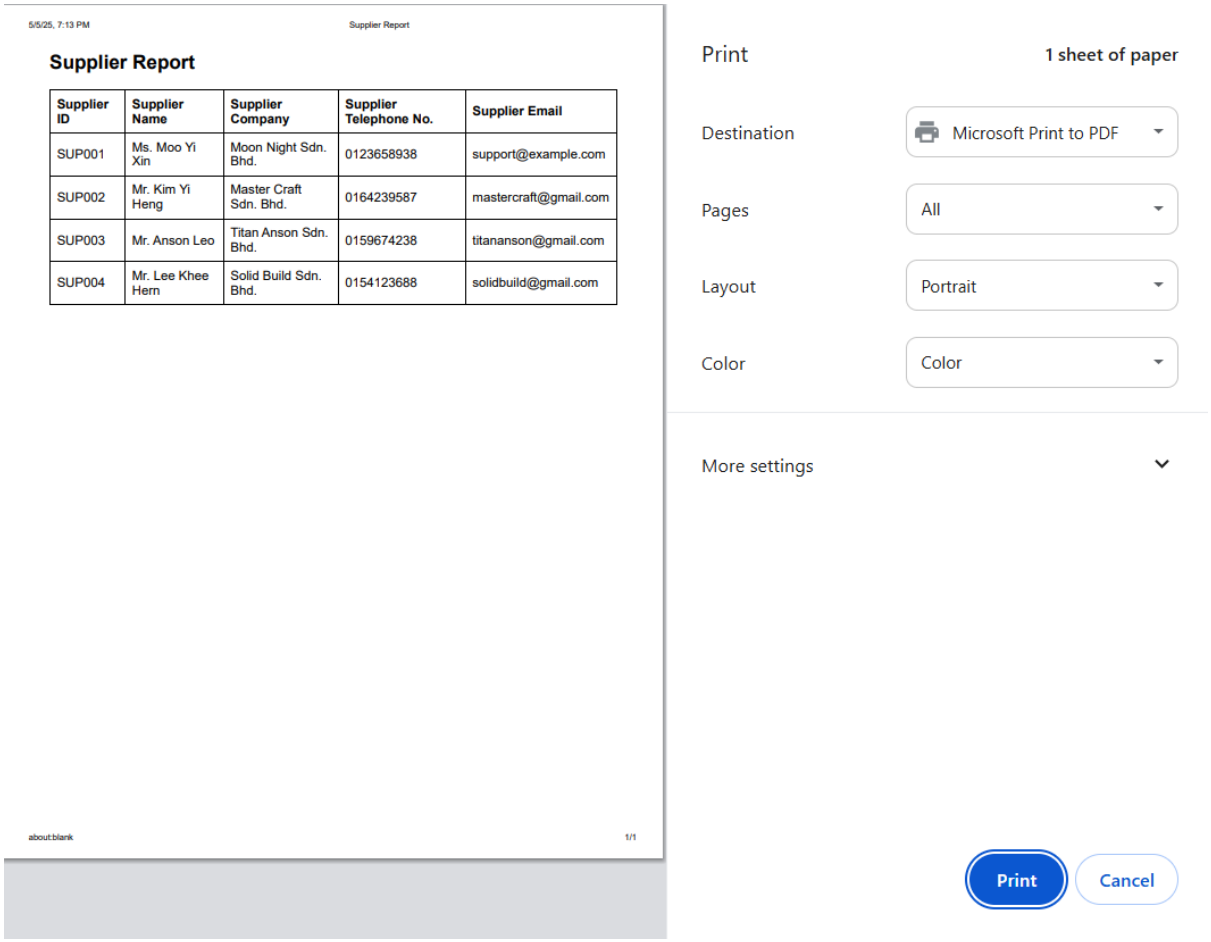


Figure 5.4.44 Export To PDP Function (Supplier Report)

5.4.6 Inventory Management Page

On the Home Page, users can access the Inventory Management page by clicking on the "Inventory" button in the navigation bar, as shown in Figure 5.4.45. This page displays all existing inventory records in a tabular format. A search function is provided to help users quickly locate specific inventory. If the search yields no results, the system will display the message "No Result", as shown in Figure 5.4.12.

To create a new inventory, users must enter the required details into the corresponding fields in the Details section. After all fields are filled in, users need to click the "Add" button. If the new inventory record is created successfully, the system will display the message "Record added.", as shown in Figure 5.4.13. However, if the entered inventory number already exists, the system will show an error message "Inventory number already exists.", as seen in Figure 5.4.46. In cases where the input fields are left empty, the system will prompt the user with "All fields are required.", as shown in Figure 5.4.15.

To update an existing inventory, users must first select a record from the search result area. The selected inventory details will automatically populate the Details section. After making the necessary modifications, users must click the “Update” button. If the update is successful, the system will display the message “Record updated.”, as shown in Figure 5.4.16. If users mistakenly change the supplier id to a new one that does not exist, the system will return the error message “Cannot update. Inventory number does not exist.”, as shown in Figure 5.4.47.

To delete a inventory, users need to select the desired record from the search results. Once selected, the details will appear in the Details section. Upon clicking the “Delete” button, the system will prompt a confirmation message “Are you sure you want to delete this record?”, as shown in Figure 5.4.18. If the user confirms by clicking “OK”, the system will display a success message “Record deleted.”, as shown in Figure 5.4.19.

To export inventory record to PDF form, users need to click the “Export” button. Upon clicking this button, the system will redirect to the export function, allowing the user to generate and download the inventory record in PDF format, as shown in Figure 5.4.48.

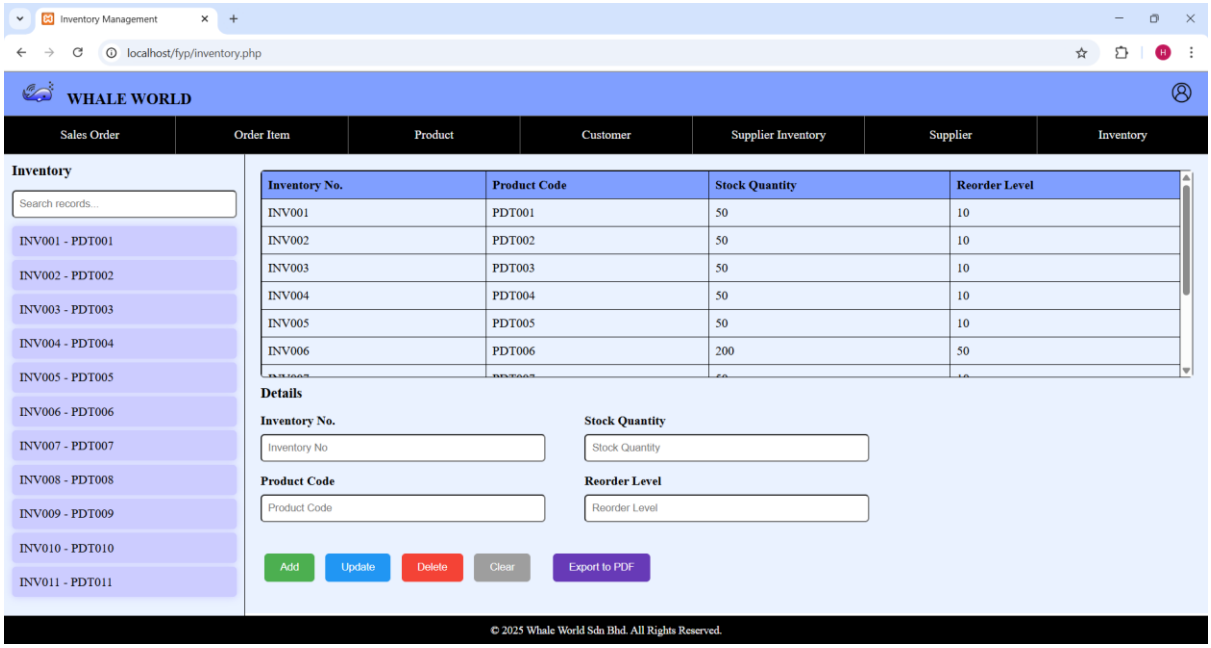


Figure 5.4.45 Inventory Management Page

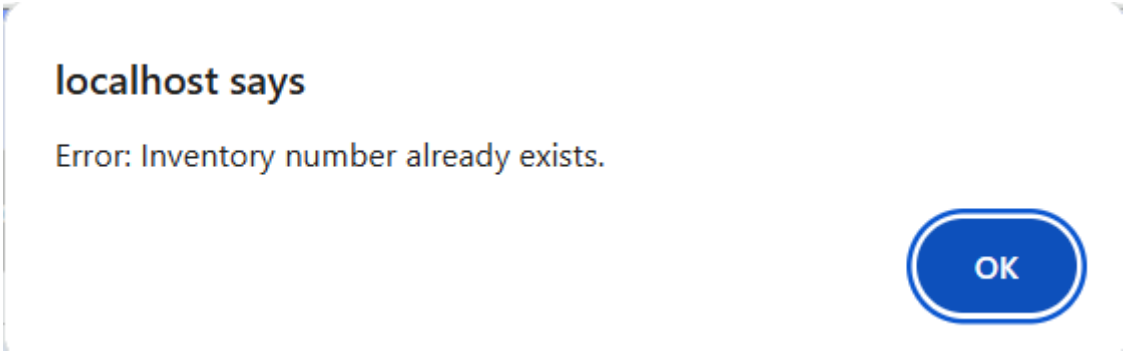


Figure 5.4.46 Error Message “Inventory number already exists.”

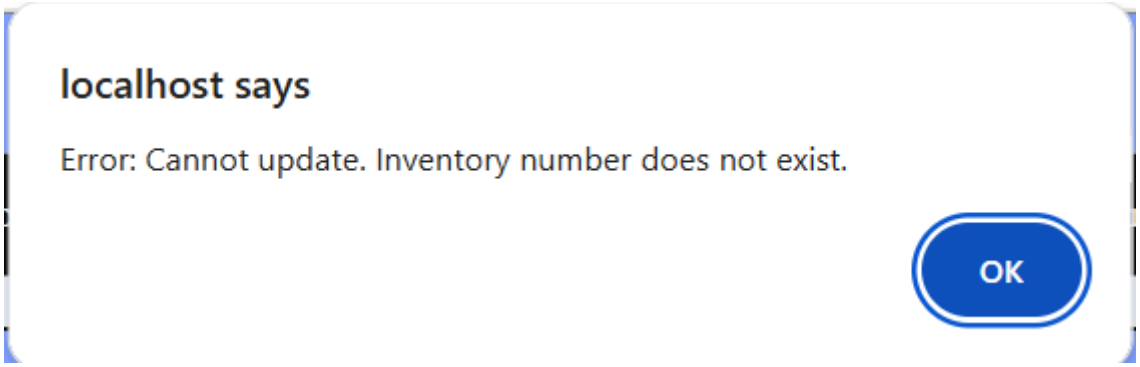


Figure 5.4.47 Error Message “Cannot update. Inventory number does not exist.”

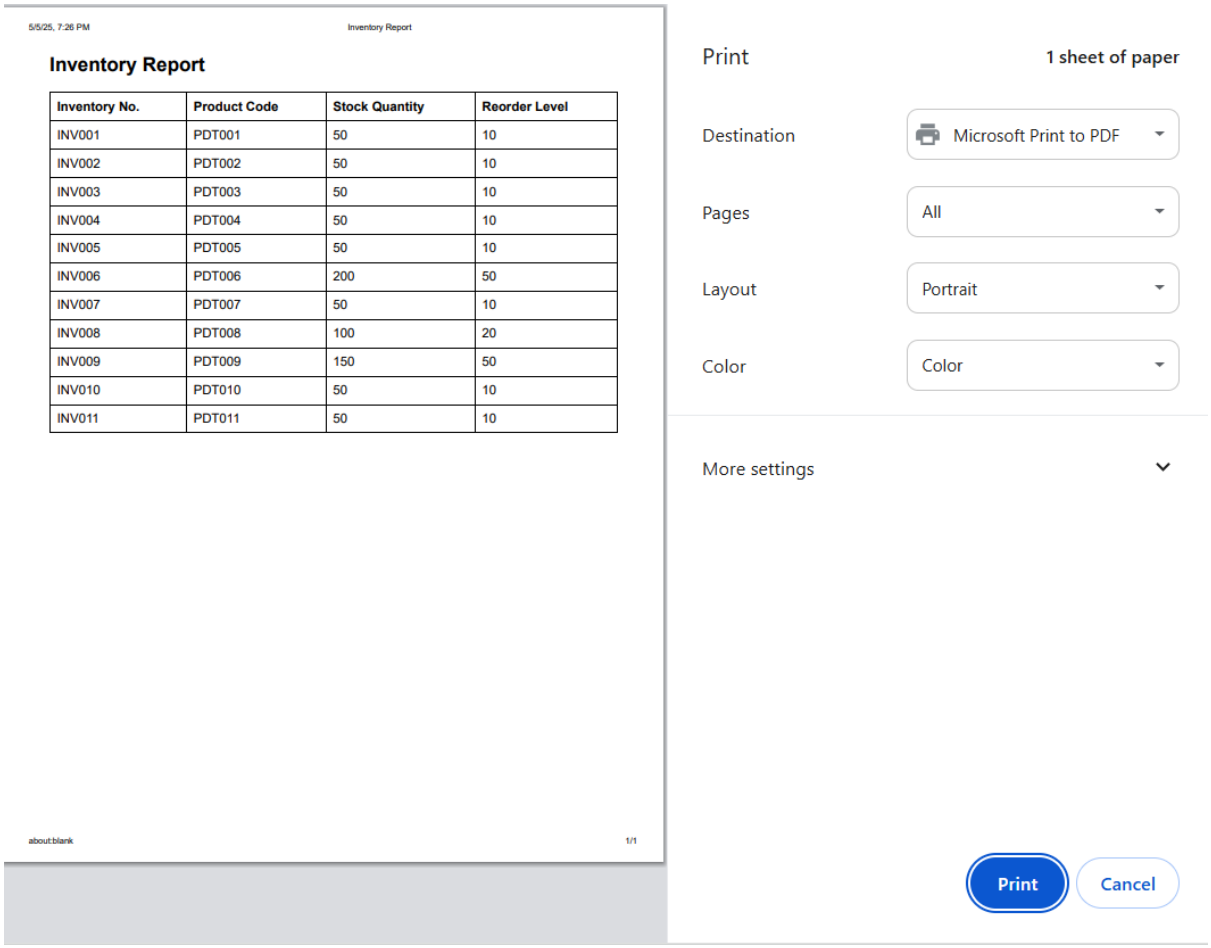


Figure 5.4.48 Export To PDF (Inventory Report)

5.5 Implementation Issues and Challenges

Throughout the development of the Comprehensive Hardware Business Management System, several implementation issues and challenges were encountered.

One of the most common technical obstacles was the use of XAMPP for local server and database hosting. XAMPP has proven to be very sensitive, especially when managing Apache and MySQL services. Sometimes, these services would fail to start due to port conflicts or unexpected crashes, requiring manual intervention to restart the modules. Additionally, even minor configuration errors in database credentials or connection scripts can cause connection failures, which highlights the importance of maintaining accurate settings and ensuring that the MySQL service is always active. Figure 5.5.1 shows the error message of MySQL in XAMPP.

Another significant challenge was how to maintain data integrity between relational database tables. Since the system relies on multiple interrelated tables, such as product table, supplier table, sales order table order item table and supplier inventory table, it is necessary to ensure that every insert, update or delete operation follows the defined relationships. For instance, the application needed to verify that a product code or supplier ID actually existed before allowing any entry in the related tables, supplier inventory table. Implementing these business rules required thoughtful validation logic to prevent problems such as orphaned records or duplicate entries, which added complexity to the backend code.

Finally, error handling also presented its own set of challenges during implementation. Initially, many operations failed silently or displayed generic error messages, resulting in poor debugging and user experience. As development progressed, the system was enhanced with specific and informative feedback messages. For instance, when a user attempts to insert a duplicate record or reference an ID that does not exist, the system clearly notifies the user of the specific problem. This level of error handling greatly improves usability and helps to quickly identify and resolve operational issues.

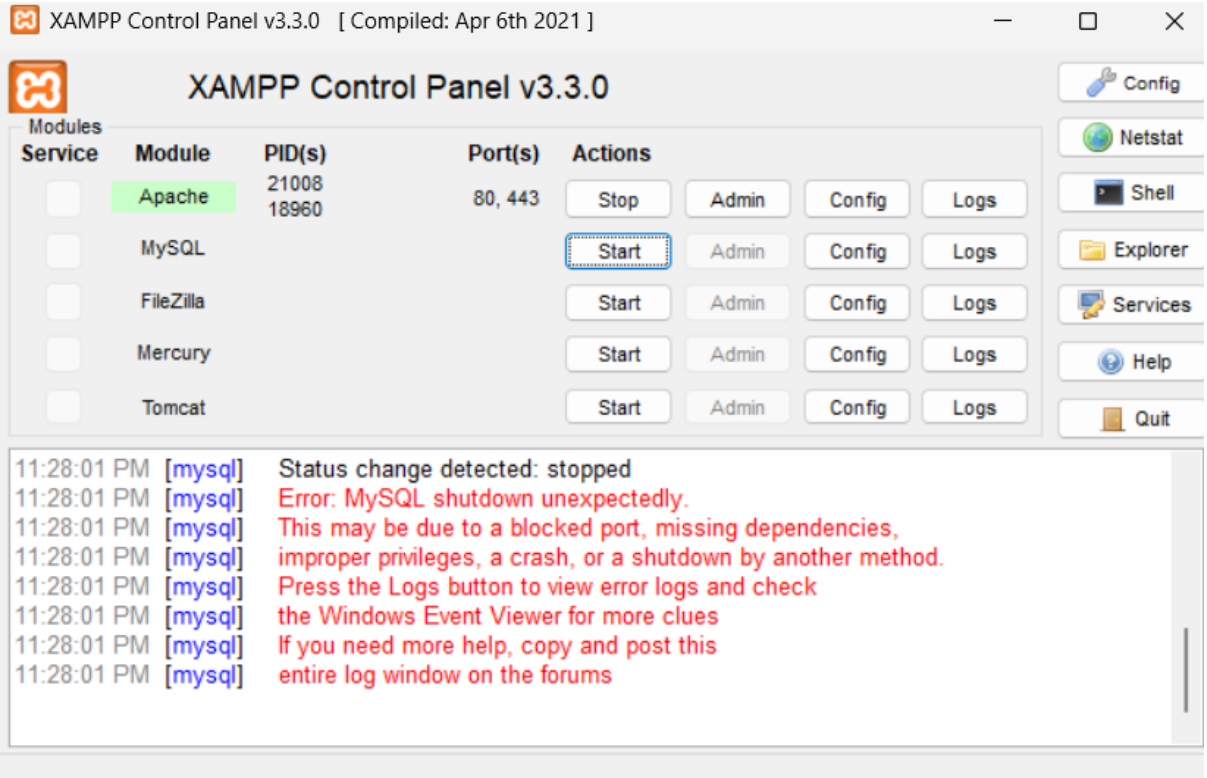


Figure 5.5.1 Error Message for XAMPP

5.6 Concluding Remark

In conclusion, Chapter 5 detailed the implementation phase of the Comprehensive Hardware Business Management System, highlighting the process from design to a fully functional system. The development process involved the integration of various modules such as sales order management, item management, product management, customer management, supplier inventory management, supplier management and inventory management. Through the use of PHP and MySQL with the support of the XAMPP environment, the system was built to support essential business operations effectively.

Despite encountering several challenges, the system was successfully developed with a focus on usability, accuracy and business logic compliance. These implementation experiences not only enhanced the robustness of the application but also helped to improve the architecture and logic of the system.

CHAPTER 6

SYSTEM EVALUATION AND DISCUSSION

6.1 System Testing and Performance Metrics

System testing is designed to verify that all core functionality operates as expected and that the application operates reliably under a variety of scenarios. Functional testing covers CRUD functionality, including adding, updating and deleting sales order data order item data, product data, customer data, vendor inventory data, supplier data and inventory data. Integration testing ensures that the various modules work together synchronously, especially in relational database operations.

6.2 Testing Setup and Result

6.2.1 Log In Module

Project Name	Hardware Business Management System	
Module Name	Log In Module	
Test Case ID	TC_01	
Test Scenario (Purpose)	To test the functionality of log in module.	
Expect Result	User is able to log in to their account and navigate to Home page.	
Actual Result	User is able to log in to their account and navigate to Home page.	
Test Result	PASSED	
Test Step		**Test Data**
1. Enter username.		test123
2. Enter password.		test123
3. Click on “Log In” button.		Log In
4. Navigate to Home page.		Log In successful

Figure 6.2.1 TC_01 Test Result 1

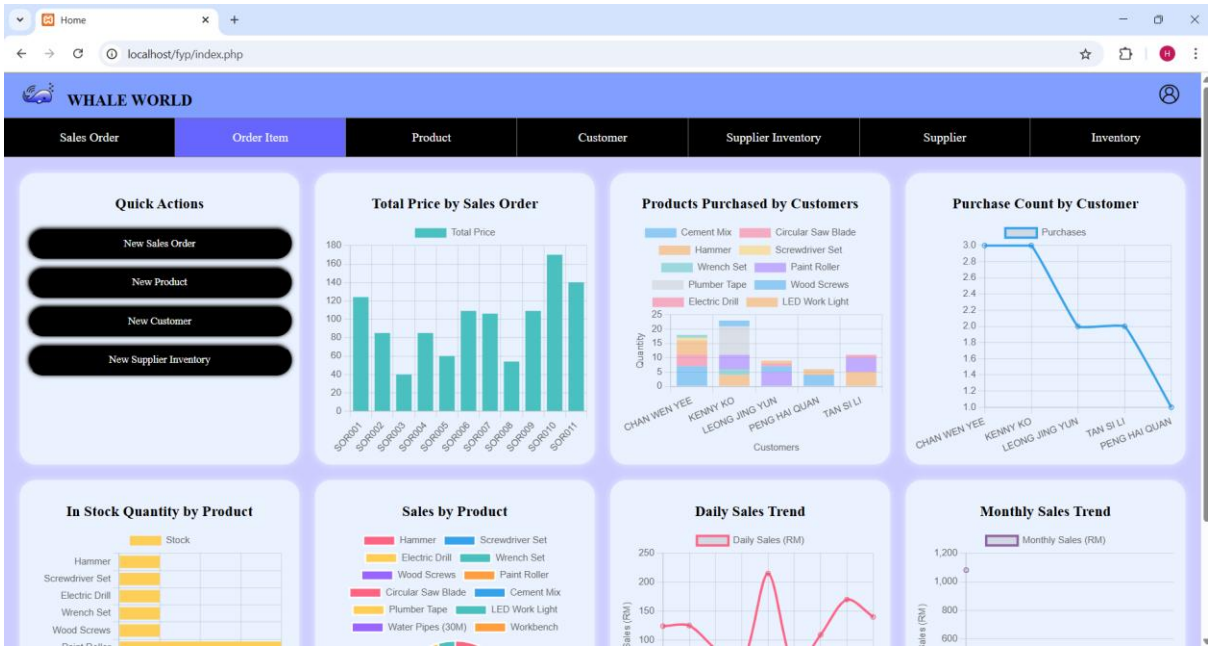


Figure 6.2.2 TC_01 Test Result 2

Project Name	Hardware Business Management System
Module Name	Log In Module
Test Case ID	TC_02
Test Scenario (Purpose)	To test the functionality of log in module with invalid log in credentials.
Expect Result	User is unable to log in to their account.
Actual Result	User is unable to log in to their account.

Test Result	PASSED
Test Step – Invalid Username	**Test Data**
1. Enter username.	test111
2. Enter password.	test123
3. Click on “Log In” button.	Log In
4. Display error message	Log In unsuccessful
Test Step – Invalid Password	**Test Data**
1. Enter username.	test123
2. Enter password.	test1111
3. Click on “Log In” button.	Log In
4. Display error message	Log In unsuccessful

Figure 6.2.3 TC_02 Invalid Username

Figure 6.2.4 TC_02 Invalid Password

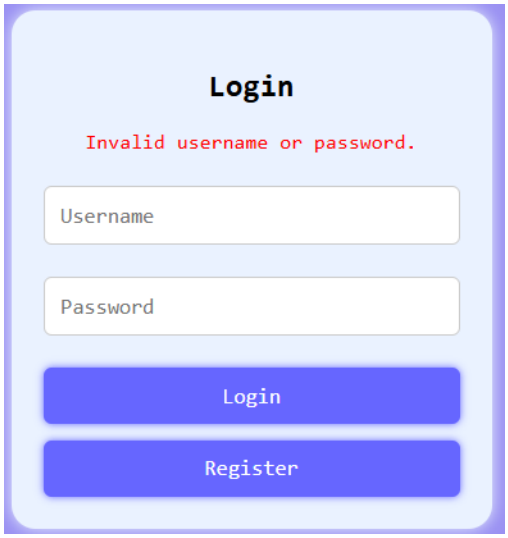


Figure 6.2.5 TC_02 Test Result 1

6.2.2 Register Module

Project Name	Hardware Business Management System
Module Name	Register Module
Test Case ID	TC_03
Test Scenario (Purpose)	To test the functionality of register module.
Expect Result	User is able to register a new account.
Actual Result	User is able to register a new account.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User click “Register” button. 3. User navigate to Register page.

Test Step	**Test Data**
1. Enter username.	test12345
2. Enter password.	test12345
3. Enter confirm password.	test12345
4. Click on “Register” button.	Register
5. Navigate to Login page.	Register successful

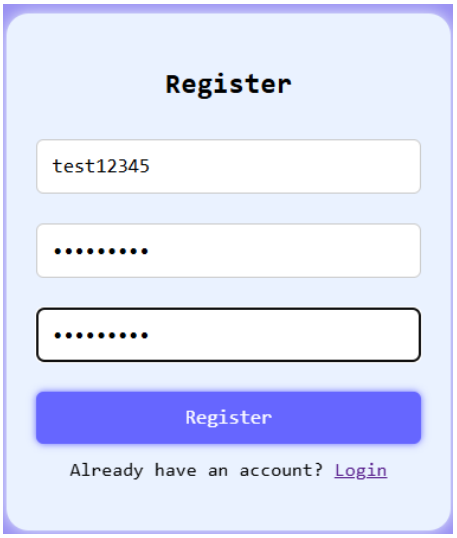


Figure 6.2.6 TC_03 Test Result 1

Project Name	Hardware Business Management System
Module Name	Register Module
Test Case ID	TC_04
Test Scenario (Purpose)	To test the functionality of register module with invalid register credentials.
Expect Result	User is unable to register a new account.
Actual Result	User is unable to register a new account.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User click “Register” button. 3. User navigate to Register page.

Test Step – Username exist	**Test Data**
1. Enter username.	test123
2. Enter password.	test123
3. Enter confirm password.	test123
4. Click on “Register” button.	Register
5. Display error message	Register unsuccessful
Test Step – Passwords does not match	**Test Data**
1. Enter username.	test222
2. Enter password.	test2223

3. Enter confirm password.	test2224
4. Click on “Register” button.	Register
5. Display error message	Register unsuccessful

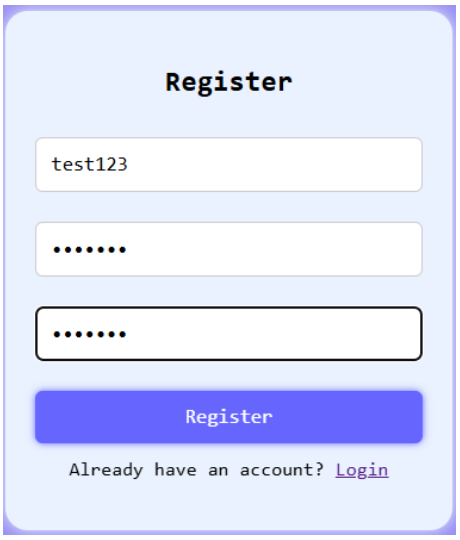


Figure 6.2.7 TC_04 Username Exist

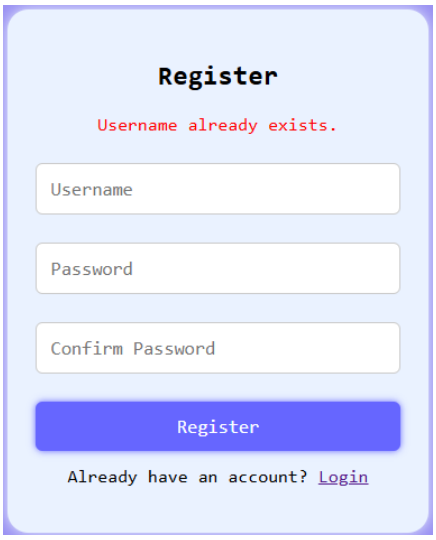


Figure 6.2.8 TC_04 Test Result 1

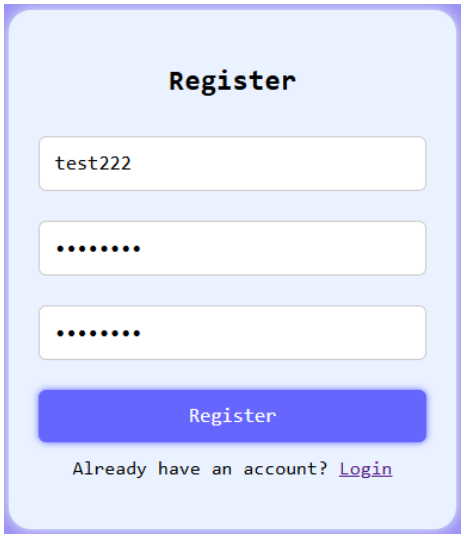


Figure 6.2.9 TC_04 Password Does Not Match

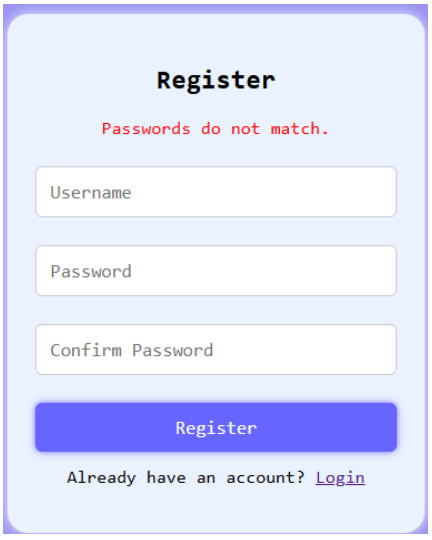


Figure 6.2.10 TC_04 Test Result 2

6.2.3 Sales Order Module

Project Name	Hardware Business Management System
Module Name	Sales Order Module
Test Case ID	TC_05
Test Scenario (Purpose)	To test the functionality of sales order module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click "Login" button. 4. User navigate to Home page. 5. User click "Sales Order" button. 6. User navigate to Sales Order page.

Test Step - Search	**Test Data**
1. Enter specify sales order number.	SOR001
2. Display the specified sales order number in search result.	Search successful
Test Step – Add	**Test Data**
1. Enter sales order number.	SOR012
2. Enter customer ID.	CUS001
3. Enter sales order total price.	200
4. Select sales order date.	05/05/2025
5. Click "Add" button.	Add sales order
6. Display success message	Add successful
Test Step – Update	**Test Data**
1. Select and click specified sales order from search result.	SOR012
2. Display details of selected sales order in Details section.	Display details
3. Update sales order total price.	200 → 250
4. Click "Update" button.	Update sales order
5. Display success message.	Update successful
Test Step – Delete	**Test Data**
1. Select and click specified sales order from search result.	SOR012

2. Display details of selected sales order in Details section.	Display details
3. Click “Delete” button.	Delete sales order
4. Display confirmation message.	Delete confirm
5. Display success message.	Delete successful
Test Step – Export	**Test Data**
1. Click “Export to PDF” button.	Export sales order data
2. Navigate to export to PDF function page.	Customize settings
3. Click “Print” button.	Export successful

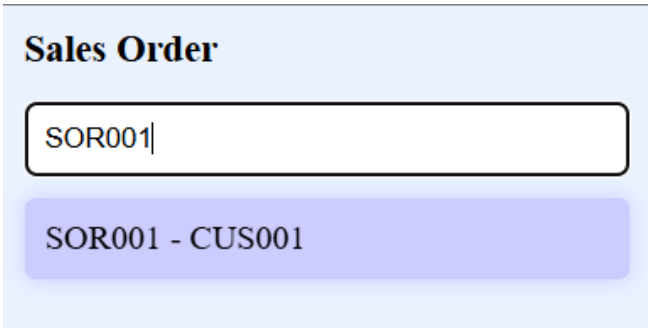


Figure 6.2.11 TC_05 Test Result 1

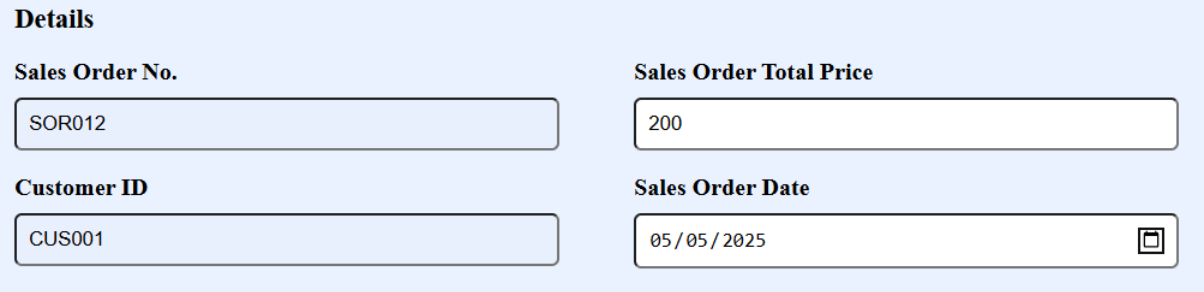


Figure 6.2.12 TC_05 Test Result 2

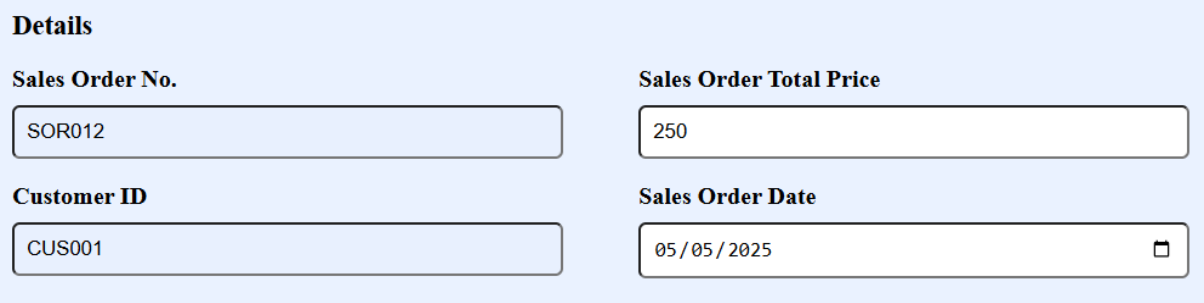


Figure 6.2.13 TC_05 Test Result 3

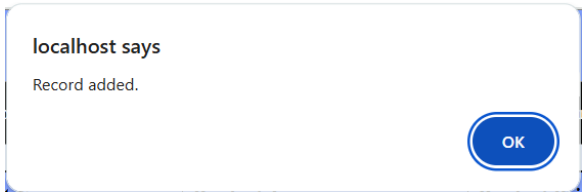


Figure 6.2.14 TC_05 Test Result 4

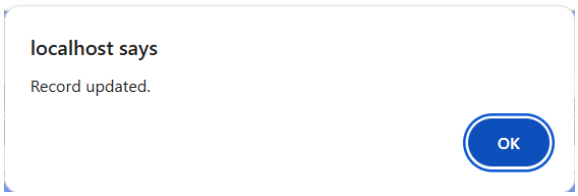


Figure6.2.15 TC_05 Test Result 5

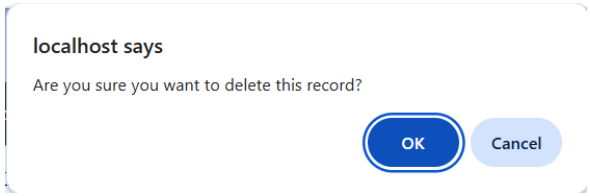


Figure 6.2.16 TC_05 Test Result 6

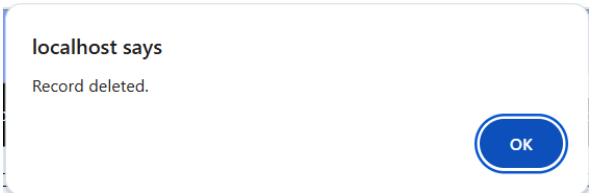


Figure 6.2.17 TC_05 Test Result 7

Project Name	Hardware Business Management System
Module Name	Sales Order Module
Test Case ID	TC_06
Test Scenario (Purpose)	To test the functionality of sales order module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Sales Order” button. 6. User navigate to Sales Order page.

Test Step – Add (Sales Order Exist)	**Test Data**
1. Enter sales order number.	SOR001
2. Enter customer ID.	CUS001
3. Enter sales order total price.	200
4. Select sales order date.	05/05/2025
5. Click “Add” button.	Add sales order
6. Display error message	Add unsuccessful

Test Step – Update (Sales Order Does Not Exist)	**Test Data**
1. Select and click specified sales order from search result.	SOR012
2. Display details of selected sales order in Details section.	Display details
3. Update sales order number	SOR012 → SOR014
4. Click “Update” button.	Update sales order
5. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
1. Click “Add” button	Add sales order
2. Display error message.	Add unsuccessful

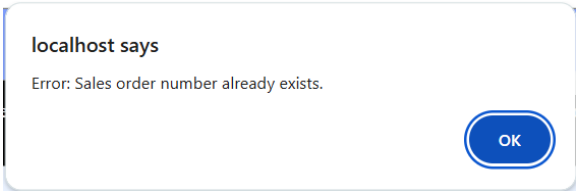


Figure 6.2.18 TC_06 Test Result 1

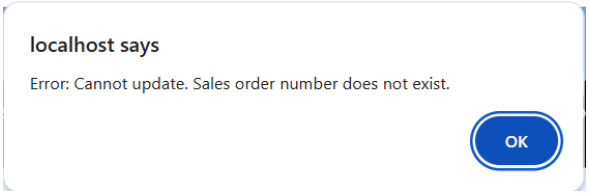


Figure 6.2.19 TC_06 Test Result 2

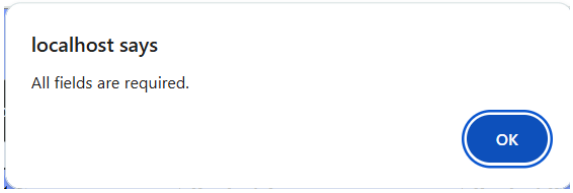


Figure 6.2.20 TC_06 Test Result 3

6.2.4 Order Item Module

Project Name	Hardware Business Management System
Module Name	Order Item Module
Test Case ID	TC_07
Test Scenario (Purpose)	To test the functionality of order item module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button.

	4. User navigate to Home page. 5. User click “Order Item” button. 6. User navigate to Order Item page.

Test Step - Search	**Test Data**
1. Enter specify sales order number.	SOR001
2. Display the specified sales order item in search result.	Search successful
Test Step – Add	**Test Data**
1. Enter sales order number.	SOR011
2. Enter product code.	PDT011
3. Enter quantity.	2
4. Enter subtotal price.	20
5. Click “Add” button.	Add order item
6. Display success message	Add successful
Test Step – Update	**Test Data**
1. Select and click specified combination of sales order and product from search result.	SOR011 – PDT011
2. Display details of selected sales order in Details section.	Display details
3. Update subtotal price.	20 → 30
4. Click “Update” button.	Update order item
5. Display success message.	Update successful
Test Step – Delete	**Test Data**
1. Select and click specified order item from search result.	SOR011
2. Display details of selected sales order in Details section.	Display details
3. Click “Delete” button.	Delete sales order
4. Display confirmation message.	Delete confirm
5. Display success message.	Delete successful
Test Step – Export	**Test Data**
1. Click “Export to PDF” button.	Export sales order data
2. Navigate to export to PDF function page.	Customize settings
3. Click “Print” button.	Export successful

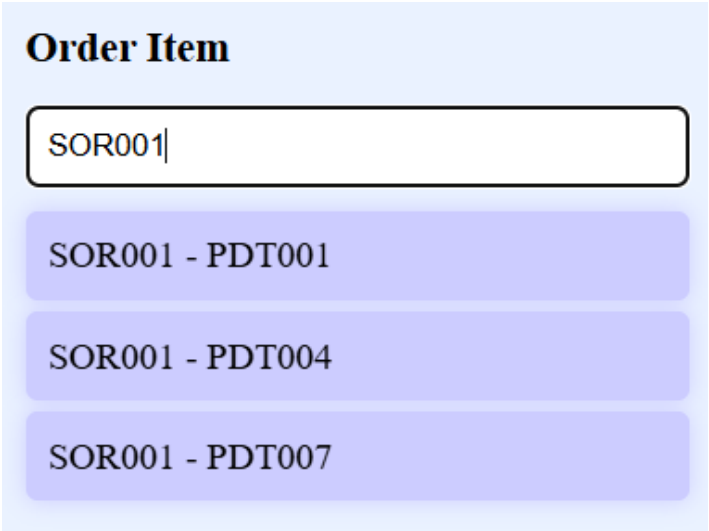


Figure 6.2.21 TC_07 Test Result 1

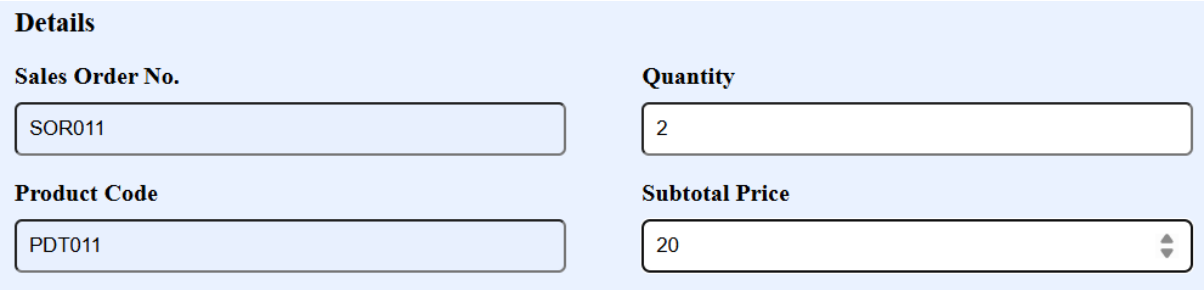


Figure 6.2.22 TC_07 Test Result 2

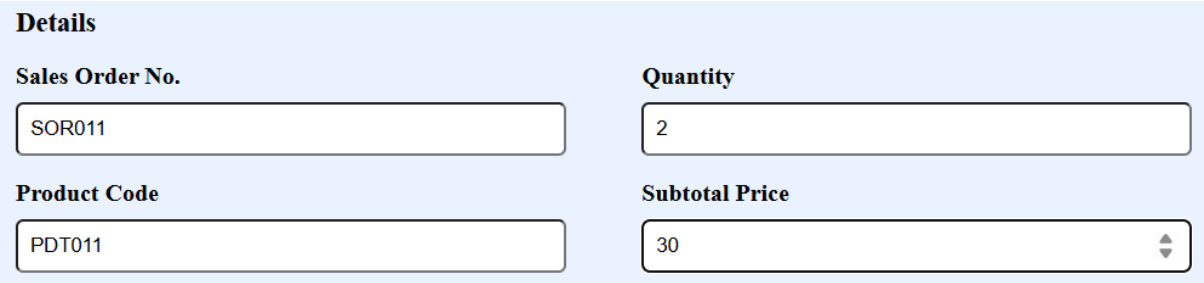


Figure 6.2.23 TC_07 Test Result 3

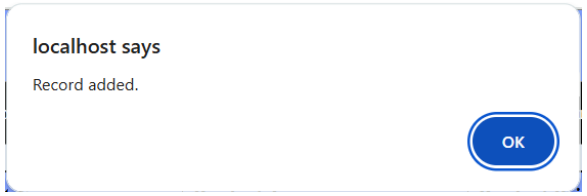


Figure 6.2.24 TC_07 Test Result 4

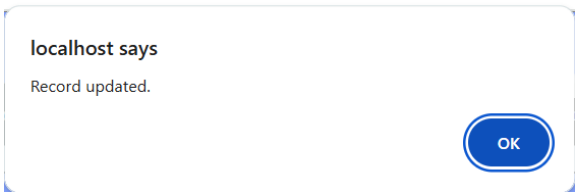


Figure6.2.25 TC_07 Test Result 5

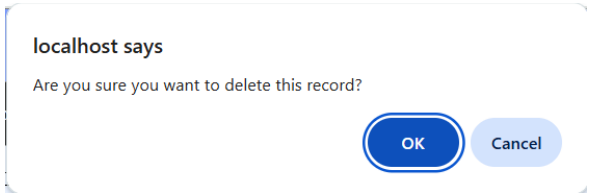


Figure 6.2.26 TC_07 Test Result 6

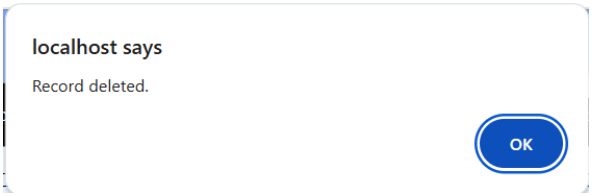


Figure 6.2.27 TC_07 Test Result 7

Project Name	Hardware Business Management System
Module Name	Order Item Module
Test Case ID	TC_08
Test Scenario (Purpose)	To test the functionality of order item module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Order Item” button. 6. User navigate to Order Item page.

Test Step – Add (Sales Order Exist, Product Not Exist)	**Test Data**
1. Enter sales order number.	SOR001
2. Enter product code.	PDT014
3. Enter quantity.	2
4. Enter subtotal price.	50
5. Click “Add” button.	Add order item
6. Display error message.	Add unsuccessful

Test Step – Add (Sales Order Not Exist, Product Exist)	**Test Data**
1. Enter sales order number.	SOR014
2. Enter product code.	PDT001
3. Enter quantity.	2
4. Enter subtotal price.	50
5. Click “Add” button.	Add order item
6. Display error message.	Add unsuccessful
Test Step – Add (Sales Order Exist, Product Exist)	**Test Data**
1. Enter sales order number.	SOR001
2. Enter product code	PDT001
3. Enter quantity.	3
4. Enter subtotal price.	48
5. Click “Add” button.	Add order item
6. Display error message	Add unsuccessful
Test Step – Update (Sales Order Does Not Exist)	**Test Data**
1. Select and click specified sales order from search result.	SOR011
2. Display details of selected sales order in Details section.	Display details
3. Update sales order number	SOR011 → SOR012
4. Click “Update” button.	Update order item
5. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
1. Click “Add” button	Add order item
2. Display error message.	Add unsuccessful

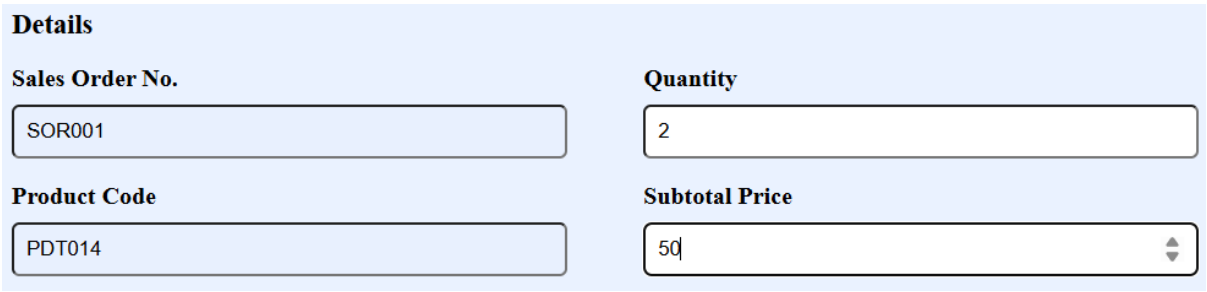


Figure 6.2.28 TC_08 Product Code Does Not Exist

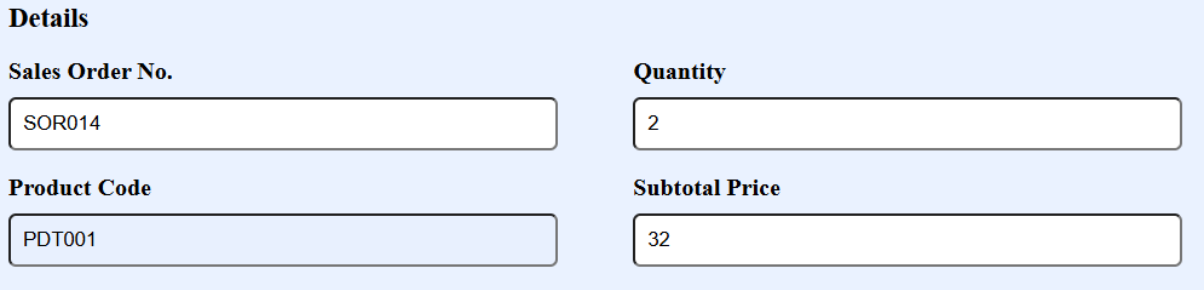


Figure 6.2.29 TC_08 Sales Order Number Does Not Exist

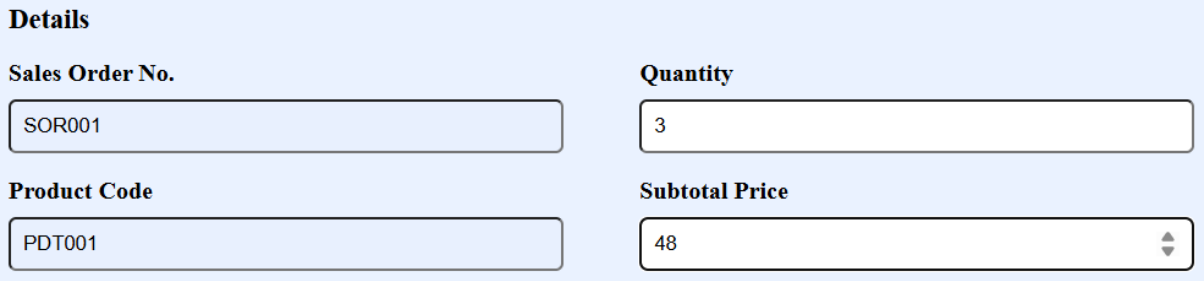


Figure 6.2.30 TC_08 Sales Order Number and Product Code Already Exist

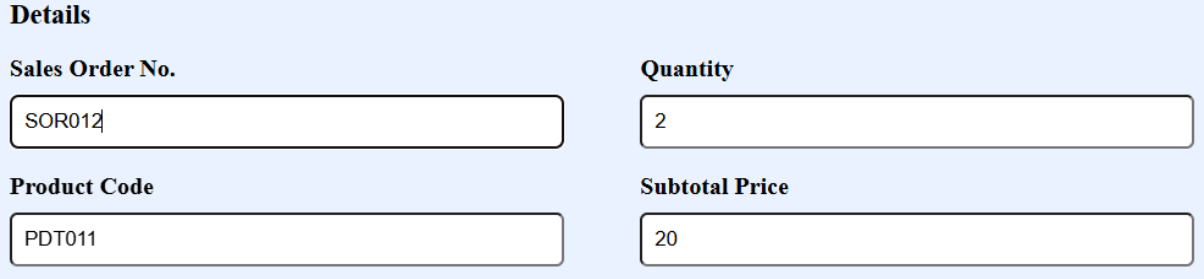


Figure 6.2.31 TC_08 Cannot Update. Sales Order Number and Product Code Does Not Exist

Figure 6.2.32 TC_08 Test Result 1

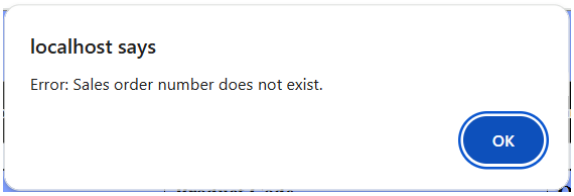


Figure 6.2.33 TC_08 Test Result 2

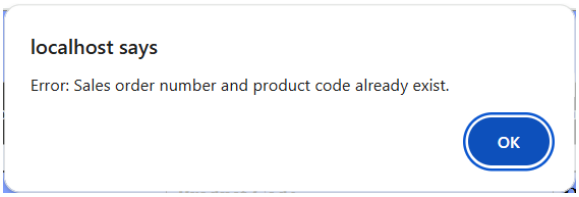


Figure 6.2.34 TC_08 Test Result 3

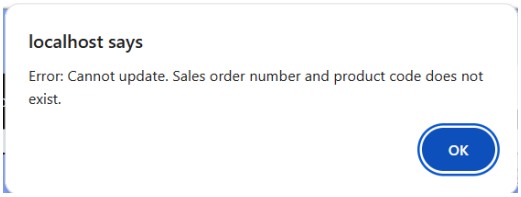


Figure 6.2.35 TC_08 Test Result 4

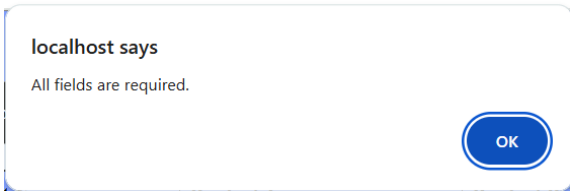


Figure 6.2.36 TC_08 Test Result 5

6.2.5 Product Module

Project Name	Hardware Business Management System
Module Name	Product Module
Test Case ID	TC_09
Test Scenario (Purpose)	To test the functionality of product module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Product” button. 6. User navigate to product page.

Test Step - Search	**Test Data**
1. Enter specify product code.	PDT001
2. Display the specified product in search result.	Search successful

Test Step – Add	**Test Data**
1. Enter product code.	PDT012
2. Enter product name.	Workbench
3. Enter product price.	60
4. Enter product type.	Workshop Tools
5. Enter product description.	A heavy-duty steel workbench with a wooden top and adjustable height.
6. Click “Add” button.	Add product
7. Display success message	Add successful
Test Step – Update	**Test Data**
6. Select and click specified product from search result.	PDT012
7. Display details of selected product in Details section.	Display details
8. Update product price.	60 → 65
9. Click “Update” button.	Update product
10. Display success message.	Update successful
Test Step – Delete	**Test Data**
6. Select and click specified product from search result.	PDT012
7. Display details of selected product in Details section.	Display details
8. Click “Delete” button.	Delete sales order
9. Display confirmation message.	Delete confirm
10. Display success message.	Delete successful
Test Step – Export	**Test Data**
4. Click “Export to PDF” button.	Export product data
5. Navigate to export to PDF function page.	Customize settings
6. Click “Print” button.	Export successful

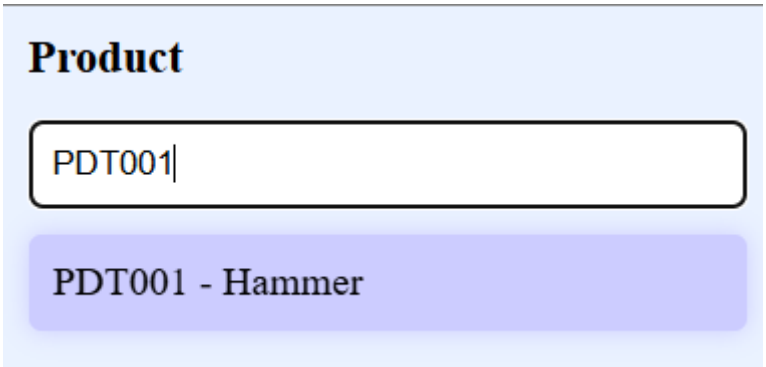


Figure 6.2.37 TC_09 Test Result 1

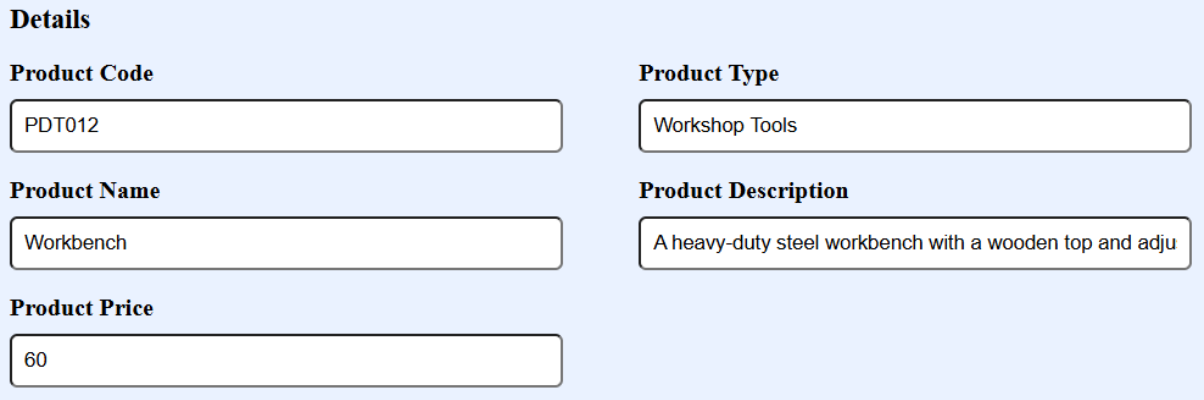


Figure 6.2.38 TC_09 Test Result 2

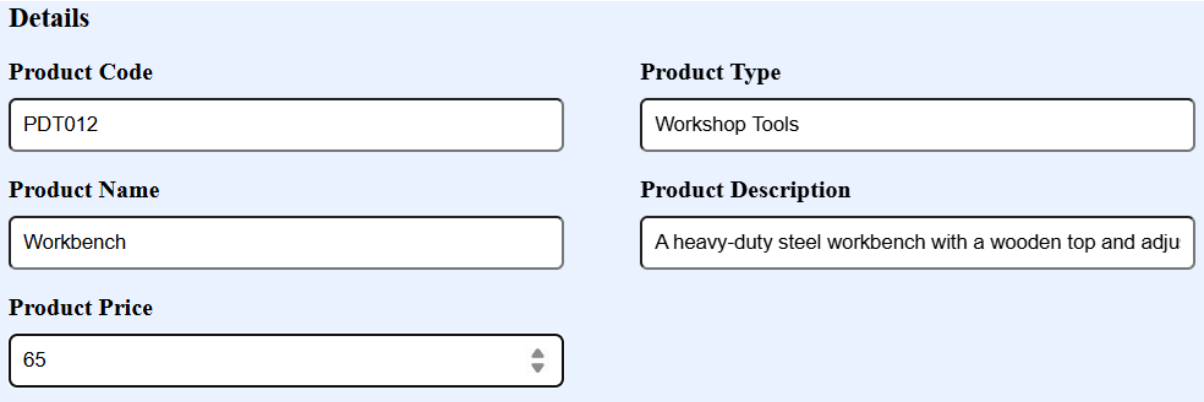


Figure 6.2.39 TC_09 Test Result 3

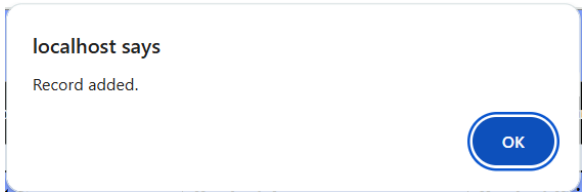


Figure 6.2.40 TC_09 Test Result 4

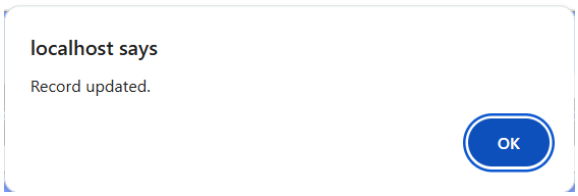


Figure 6.2.41 TC_09 Test Result 5

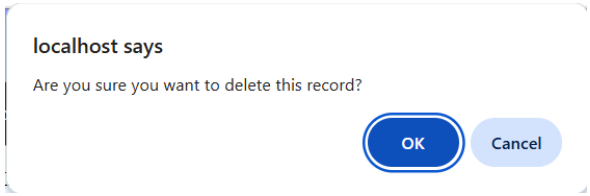


Figure 6.2.42 TC_09 Test Result 6

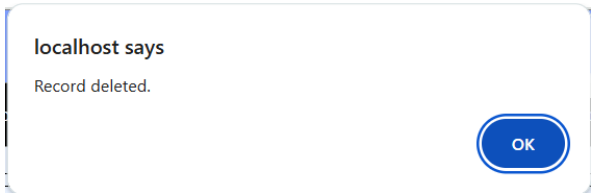


Figure 6.2.43 TC_09 Test Result 7

Project Name	Hardware Business Management System
Module Name	Product Module
Test Case ID	TC_10
Test Scenario (Purpose)	To test the functionality of product module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Product” button. 6. User navigate to product page.

Test Step – Add (Product Exist)	**Test Data**
1. Enter product code.	PDT001
2. Enter product name.	Hammer
3. Enter product price.	16
4. Enter product type.	Tool
5. Enter product description.	Durable steel hammer with rubber grip handle.

6. Click “Add” button.	Add product
7. Display error message	Add unsuccessful
Test Step – Update (Product Does Not Exist)	**Test Data**
1. Select and click specified product from search result.	PDT012
2. Display details of selected product in Details section.	Display details
3. Update product code.	PDT012 → PDT014
4. Click “Update” button.	Update product
5. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
1. Click “Add” button	Add product
2. Display error message.	Add unsuccessful

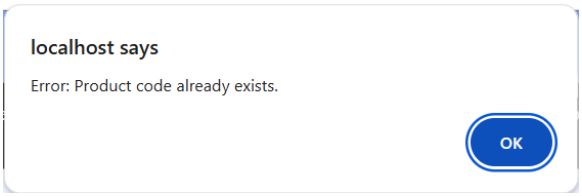


Figure 6.2.44 TC_10 Test Result 1

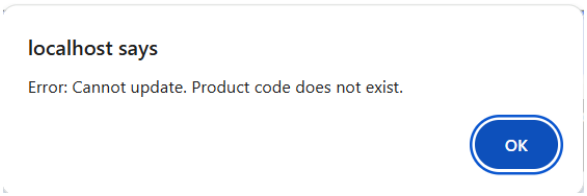


Figure 6.2.45 TC_10 Test Result 2

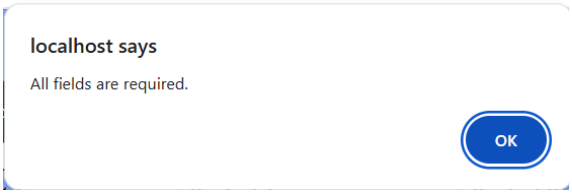


Figure 6.2.46 TC_10 Test Result 3

6.2.6 Customer Module

Project Name	Hardware Business Management System
Module Name	Product Module
Test Case ID	TC_11
Test Scenario (Purpose)	To test the functionality of customer module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED

Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Customer” button. 6. User navigate to customer page.

Test Step - Search	**Test Data**
1. Enter specify customer id.	CUS001
2. Display the specified customer in search result.	Search successful
Test Step – Add	**Test Data**
1. Enter customer id.	CUS006
2. Enter customer name.	David
3. Enter customer telephone number.	0156859856
4. Enter customer email.	david@gmail.com
5. Enter customer address.	Taman Bunga6
6. Click “Add” button.	Add customer
7. Display success message	Add successful
Test Step – Update	**Test Data**
1. Select and click specified customer from search result.	CUS006
2. Display details of selected customer in Details section.	Display details
3. Update customer telephone number.	0156859856 →0156859857
4. Click “Update” button.	Update customer
5. Display success message.	Update successful
Test Step – Delete	**Test Data**
1. Select and click specified customer from search result.	CUS006
2. Display details of selected customer in Details section.	Display details
3. Click “Delete” button.	Delete customer
4. Display confirmation message.	Delete confirm
5. Display success message.	Delete successful
Test Step – Export	**Test Data**
1. Click “Export to PDF” button.	Export customer data

2. Navigate to export to PDF function page.	Customize settings
3. Click “Print” button.	Export successful

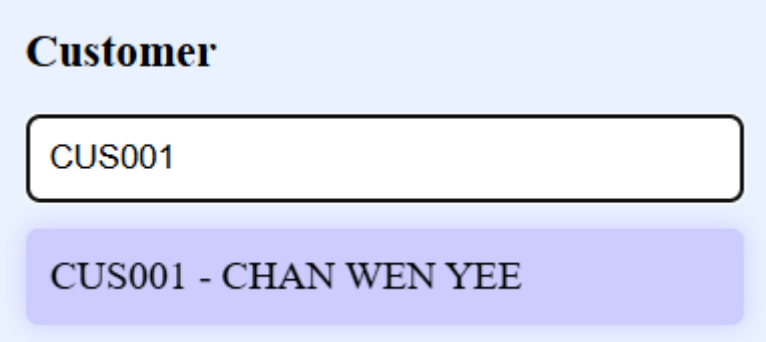


Figure 6.2.47 TC_11 Test Result 1

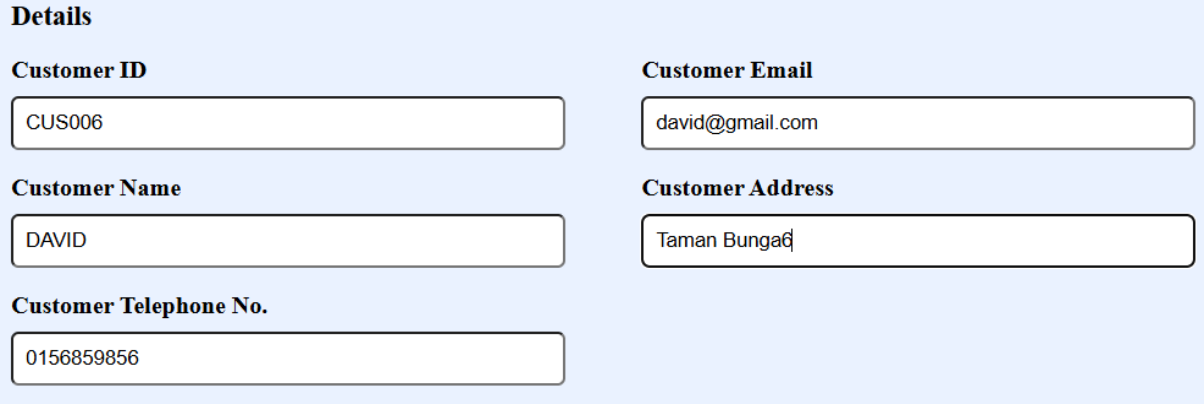


Figure 6.2.48 TC_11 Test Result 2

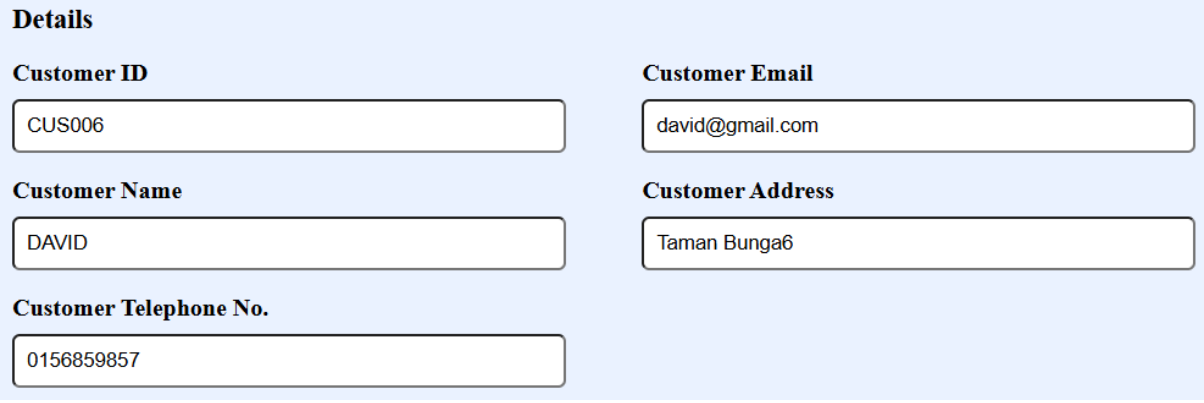


Figure 6.2.49 TC_11 Test Result 3

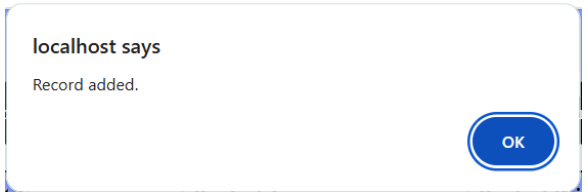


Figure 6.2.50 TC_11 Test Result 4

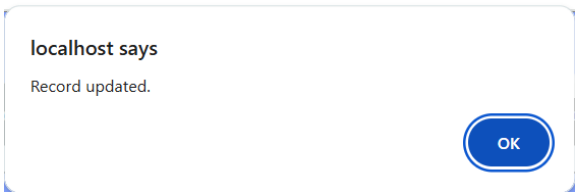


Figure 6.2.51 TC_11 Test Result 5

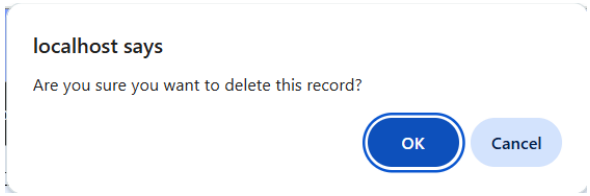


Figure 6.2.52 TC_11 Test Result 6

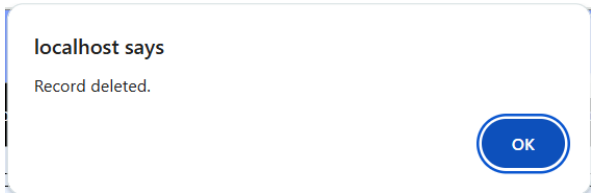


Figure 6.2.53 TC_11 Test Result 7

Project Name	Hardware Business Management System
Module Name	Customer Module
Test Case ID	TC_12
Test Scenario (Purpose)	To test the functionality of customer module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Customer” button. 6. User navigate to customer page.

Test Step – Add (Customer Exist)	**Test Data**
1. Enter customer id.	CUS001
2. Enter customer name.	CHAN WEN YEE
3. Enter customer telephone number.	0163259874
4. Enter customer email	weeyee@gmail.com
5. Enter customer address.	Taman Bunga1
6. Click “Add” button.	Add customer
7. Display error message	Add unsuccessful

Test Step – Update (Customer Does Not Exist)	**Test Data**
6. Select and click specified customer from search result.	CUS006
7. Display details of selected customer in Details section.	Display details
8. Update customer id.	CUS006 → CUS007
9. Click "Update" button.	Update customer
10. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
3. Click "Add" button	Add customer
4. Display error message.	Add unsuccessful

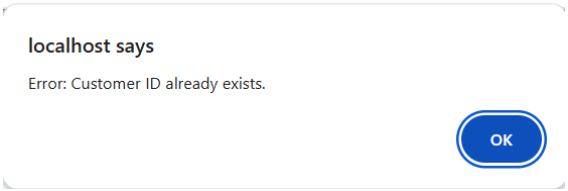


Figure 6.2.54 TC_12 Test Result 1

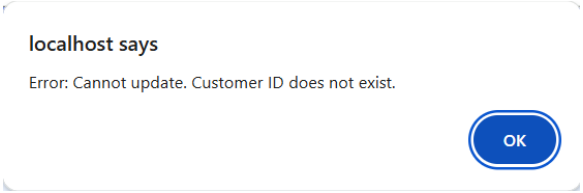


Figure 6.2.55 TC_12 Test Result 2

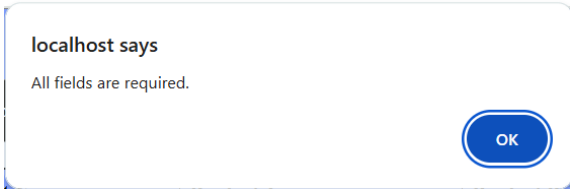


Figure 6.2.56 TC_12 Test Result 3

6.2.7 Supplier Inventory Module

Project Name	Hardware Business Management System
Module Name	Supplier Inventory Module
Test Case ID	TC_13
Test Scenario (Purpose)	To test the functionality of supplier inventory module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click "Login" button.

	4. User navigate to Home page. 5. User click “Supplier Inventory” button. 6. User navigate to Supplier Inventory page.
Test Step - Search	**Test Data**
1. Enter specify supplier id.	SUP001
2. Display the specified supplier inventory in search result.	Search successful
Test Step – Add	**Test Data**
1. Enter supplier id.	SUP001
2. Enter product code.	PDT012
3. Enter supply price.	50
4. Click “Add” button.	Add supplier inventory
5. Display success message	Add successful
Test Step – Update	**Test Data**
1. Select and click specified supplier inventory from search result.	SOR011
2. Display details of selected supplier inventory in Details section.	Display details
3. Update supply price.	50 → 55
4. Click “Update” button.	Update supplier inventory
5. Display success message.	Update successful
Test Step – Delete	**Test Data**
1. Select and click specified combination of supplier and product from search result.	SUP001 – PDT012
2. Display details of selected supplier inventory in Details section.	Display details
3. Click “Delete” button.	Delete supplier inventory
4. Display confirmation message.	Delete confirm
5. Display success message.	Delete successful
Test Step – Export	**Test Data**
1. Click “Export to PDF” button.	Export supplier inventory data

2. Navigate to export to PDF function page.	Customize settings
3. Click “Print” button.	Export successful

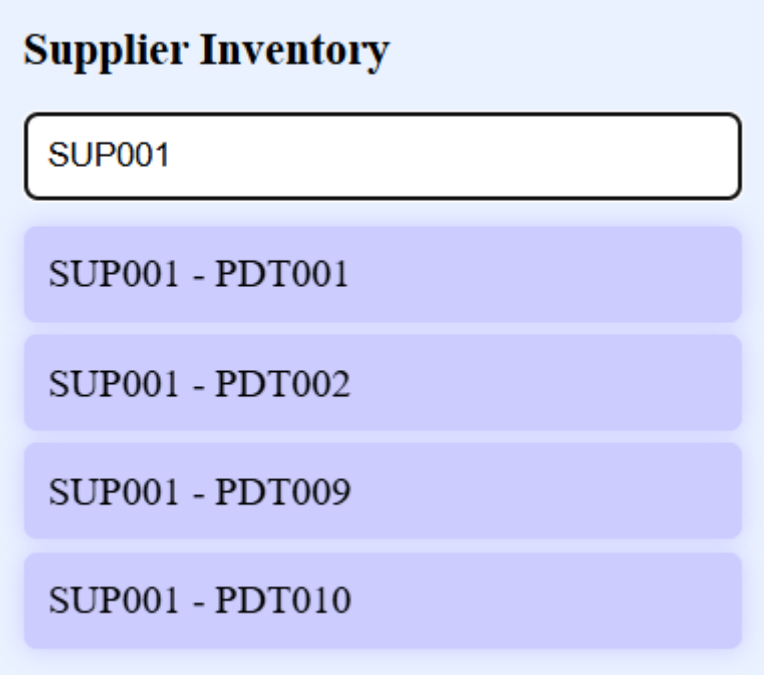


Figure 6.2.57 TC_13 Test Result 1

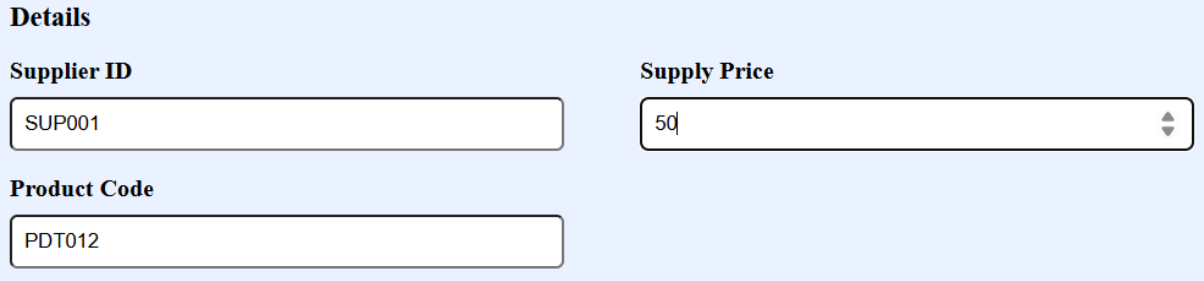


Figure 6.2.58 TC_13 Test Result 2

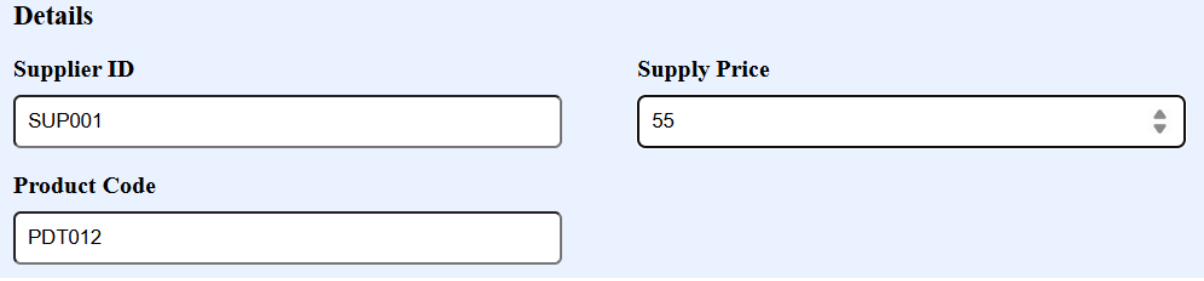


Figure 6.2.59 TC_13 Test Result 3

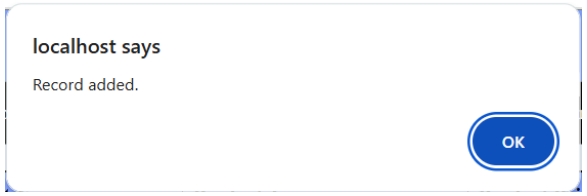


Figure 6.2.60 TC_13 Test Result 4

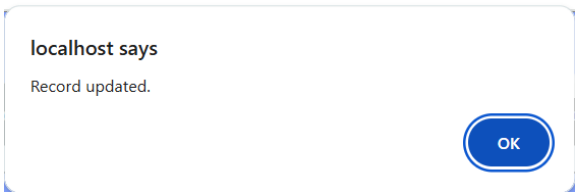


Figure6.2.61 TC_13 Test Result 5

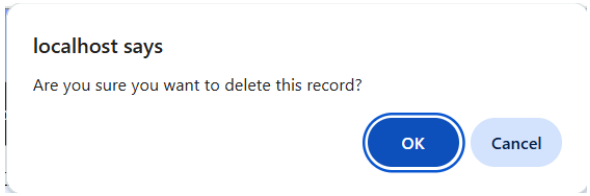


Figure 6.2.62 TC_13 Test Result 6

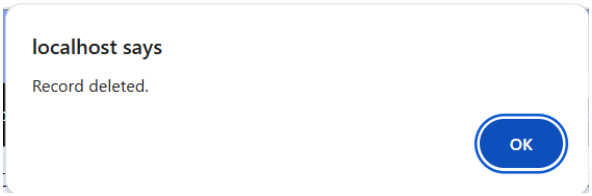


Figure 6.2.63 TC_13 Test Result 7

Project Name	Hardware Business Management System
Module Name	Supplier Inventory Module
Test Case ID	TC_14
Test Scenario (Purpose)	To test the functionality of supplier inventory module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Supplier Inventory” button. 6. User navigate to Supplier Inventory page.

Test Step – Add (Supplier Exist, Product Not Exist)	**Test Data**
1. Enter supplier id.	SOR001
2. Enter product code.	PDT014
3. Enter supply price.	50
4. Click “Add” button.	Add supplier inventory
5. Display error message.	Add unsuccessful
Test Step – Add (Supplier Not Exist, Product Exist)	**Test Data**
1. Enter supplier id.	SUP005

2. Enter product code.	PDT012
3. Enter supply price.	55
4. Click “Add” button.	Add supplier inventory
5. Display error message.	Add unsuccessful
Test Step – Add (Supplier Exist, Product Exist)	**Test Data**
1. Enter supplier id.	SUP001
2. Enter product code	PDT001
3. Enter supply price.	15
4. Click “Add” button.	Add supply inventory
5. Display error message	Add unsuccessful
Test Step – Update (Supplier Does Not Exist)	**Test Data**
6. Select and click specified combination of supplier inventory and product from search result.	SUP001 – PDT012
7. Display details of selected supplier inventory in Details section.	Display details
8. Update supplier id.	SUP001 → SUP006
9. Click “Update” button.	Update supplier inventory
10. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
3. Click “Add” button	Add supplier inventory
4. Display error message.	Add unsuccessful

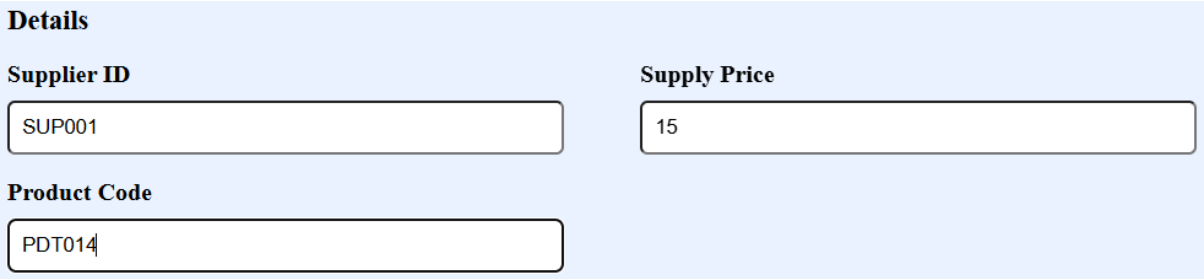


Figure 6.2.64 TC_14 Product Code Does Not Exist

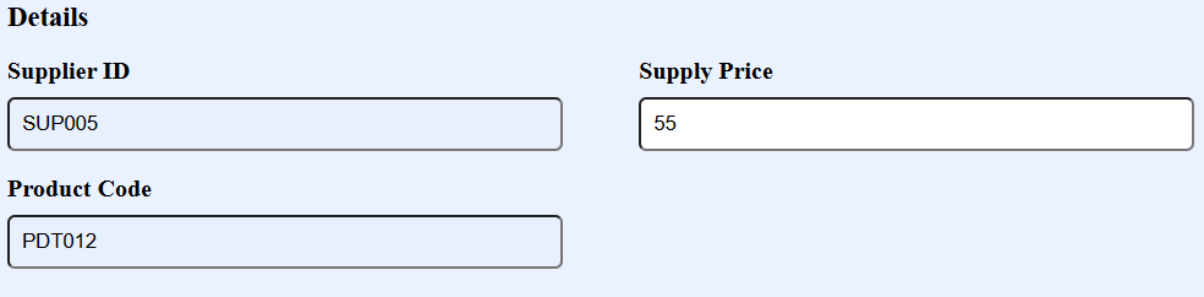


Figure 6.2.65 TC_14 Supplier ID Does Not Exist

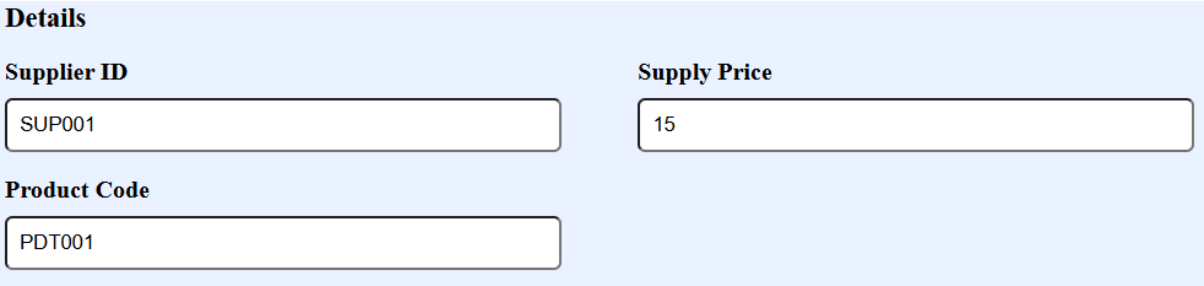


Figure 6.2.66 TC_14 Supplier ID and Product Code Already Exist

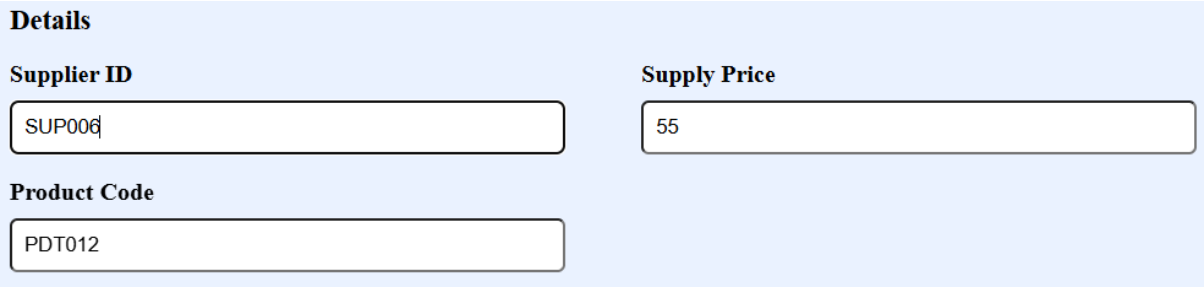


Figure 6.2.67 TC_14 Cannot Update. Supplier ID and Product Code Does Not Exist

Figure 6.2.68 TC_14 Test Result 1

Figure 6.2.69 TC_14 Test Result 2

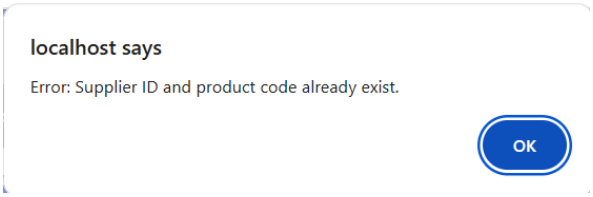


Figure 6.2.70 TC_14 Test Result 3

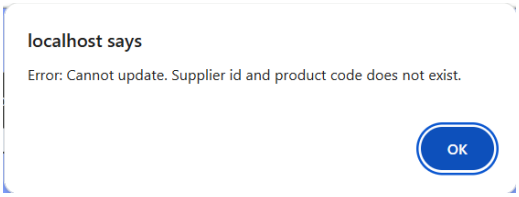


Figure 6.2.71 TC_14 Test Result 4

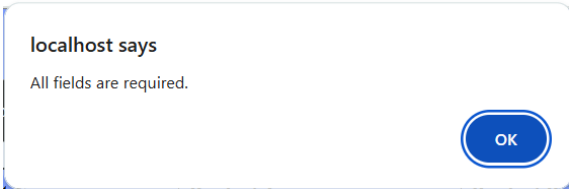


Figure 6.2.72 TC_14 Test Result 5

6.2.7 Supplier Module

Project Name	Hardware Business Management System
Module Name	Supplier Module
Test Case ID	TC_15
Test Scenario (Purpose)	To test the functionality of supplier module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Supplier” button. 6. User navigate to Supplier page.

Test Step - Search	**Test Data**
1. Enter specify supplier id.	SUP001
2. Display the specified supplier in search result.	Search successful

Test Step – Add	**Test Data**
1. Enter supplier id.	SUP005
2. Enter supplier name.	Mr. William
3. Enter supplier company.	Express Solid Sdn. Bhd.
4. Enter supplier telephone number.	0147548211
5. Enter supplier email.	expresssolid@gmail.com
6. Click “Add” button.	Add supplier
7. Display success message	Add successful
Test Step – Update	**Test Data**
6. Select and click specified supplier from search result.	SUP005
7. Display details of selected supplier in Details section.	Display details
8. Update supplier telephone number.	0147548211 → 0147548122
9. Click “Update” button.	Update supplier
10. Display success message.	Update successful
Test Step – Delete	**Test Data**
6. Select and click specified supplier from search result.	SUP005
7. Display details of selected supplier in Details section.	Display details
8. Click “Delete” button.	Delete supplier
9. Display confirmation message.	Delete confirm
10. Display success message.	Delete successful
Test Step – Export	**Test Data**
4. Click “Export to PDF” button.	Export supplier data
5. Navigate to export to PDF function page.	Customize settings
6. Click “Print” button.	Export successful

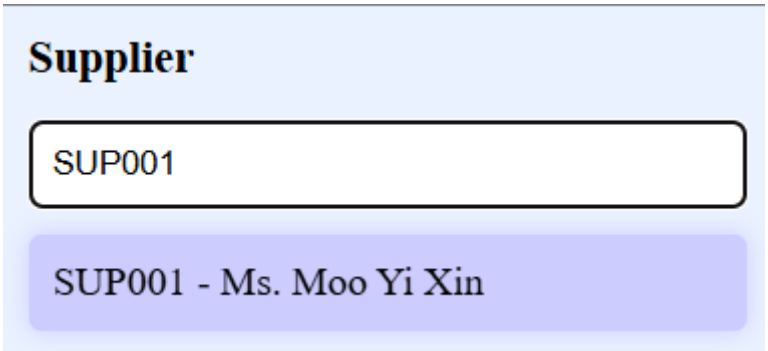


Figure 6.2.73 TC_15 Test Result 1

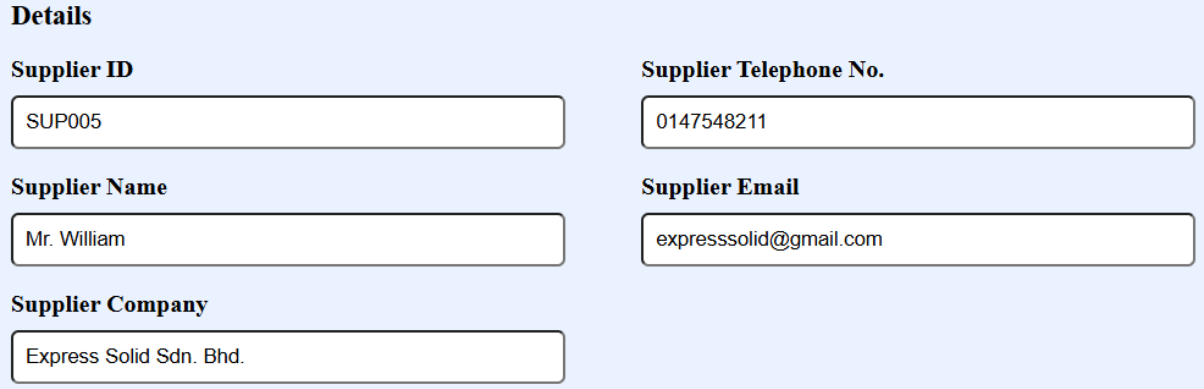


Figure 6.2.74 TC_15 Test Result 2

Figure 6.2.75 TC_15 Test Result 3

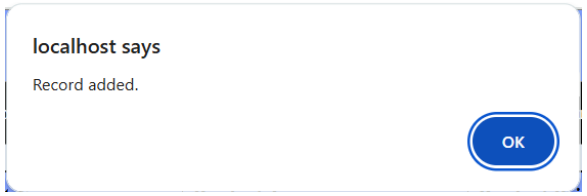


Figure 6.2.76 TC_15 Test Result 4

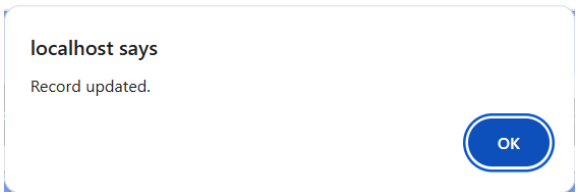


Figure 6.2.77 TC_15 Test Result 5

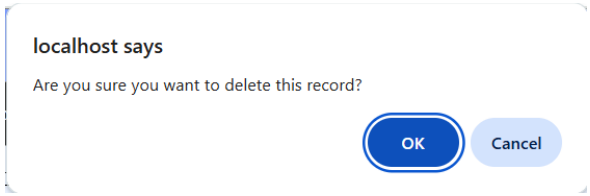


Figure 6.2.78 TC_15 Test Result 6

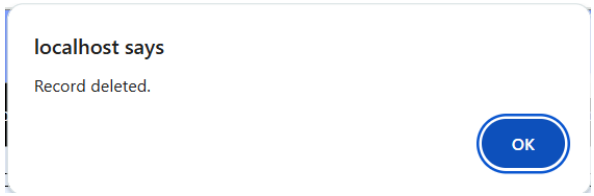


Figure 6.2.79 TC_15 Test Result 7

Project Name	Hardware Business Management System
Module Name	Supplier Module
Test Case ID	TC_16
Test Scenario (Purpose)	To test the functionality of supplier module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “Supplier” button. 6. User navigate to Supplier page.

Test Step – Add (Supplier Exist)	**Test Data**
1. Enter supplier id.	SUP001
2. Enter supplier name.	Ms. Moo Yi Xin
3. Enter supplier company.	Moon Night Sdn. Bhd.
4. Enter supplier telephone number.	0123658938
5. Enter supplier email.	moonnight@gmail.com
6. Click “Add” button.	Add supplier
7. Display error message	Add unsuccessful

Test Step – Update (Supplier Does Not Exist)	**Test Data**
1. Select and click specified customer from search result.	SUP005
2. Display details of selected customer in Details section.	Display details
3. Update supplier id.	SUP005 → SUP006
4. Click “Update” button.	Update supplier
5. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
5. Click “Add” button	Add customer
6. Display error message.	Add unsuccessful

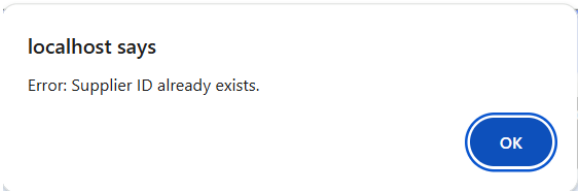


Figure 6.2.80 TC_16 Test Result 1

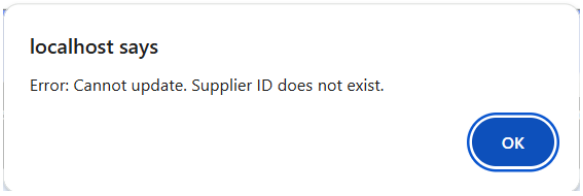


Figure 6.2.81 TC_16 Test Result 2

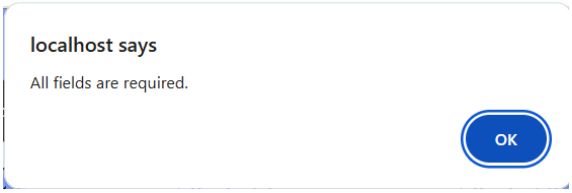


Figure 6.2.82 TC_16 Test Result 3

6.2.8 Inventory Module

Project Name	Hardware Business Management System
Module Name	Inventory Module
Test Case ID	TC_17
Test Scenario (Purpose)	To test the functionality of inventory module.
Expect Result	User is able to search, add, update, delete and export the data.
Actual Result	User is able to search, add, update, delete and export the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button.

	4. User navigate to Home page. 5. User click “Inventory” button. 6. User navigate to Inventory page.
Test Step - Search	**Test Data**
1. Enter specify inventory number.	INV001
2. Display the specified inventory in search result.	Search successful
Test Step – Add	**Test Data**
1. Enter inventory number.	INV012
2. Enter product code.	PDT012
3. Enter stock quantity.	20
4. Enter reorder level.	5
5. Click “Add” button.	Add inventory
6. Display success message	Add successful
Test Step – Update	**Test Data**
1. Select and click specified inventory from search result.	INV012
2. Display details of selected inventory in Details section.	Display details
3. Update stock quantity.	20 → 25
4. Click “Update” button.	Update inventory
5. Display success message.	Update successful
Test Step – Delete	**Test Data**
1. Select and click specified inventory from search result.	INV012
2. Display details of selected inventory in Details section.	Display details
3. Click “Delete” button.	Delete inventory
4. Display confirmation message.	Delete confirm
5. Display success message.	Delete successful
Test Step – Export	**Test Data**
1. Click “Export to PDF” button.	Export inventory data
2. Navigate to export to PDF function page.	Customize settings
3. Click “Print” button.	Export successful

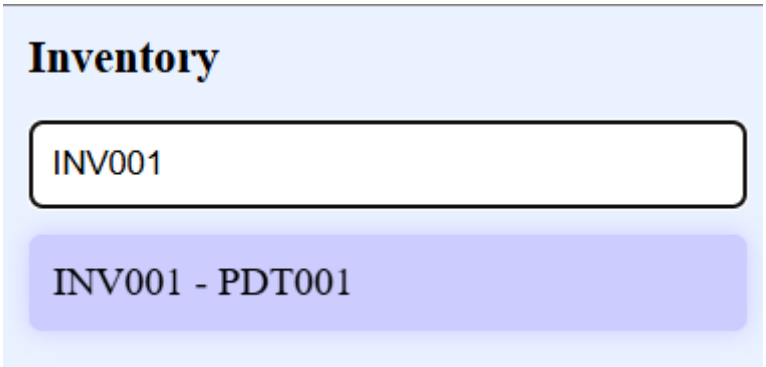


Figure 6.2.83 TC_17 Test Result 1

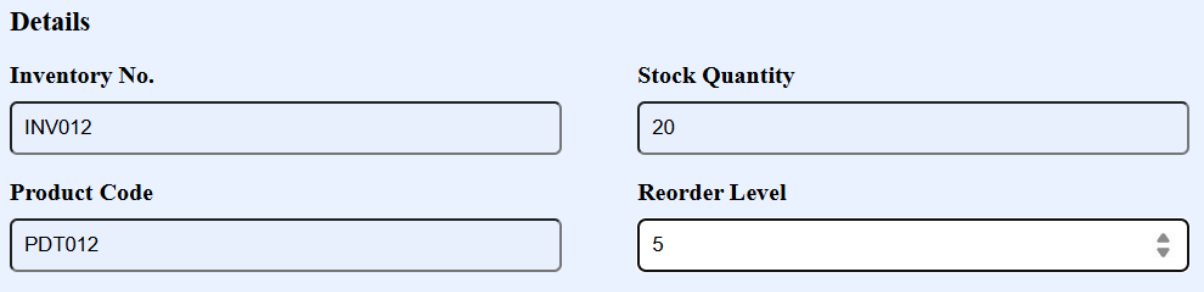


Figure 6.2.84 TC_17 Test Result 2

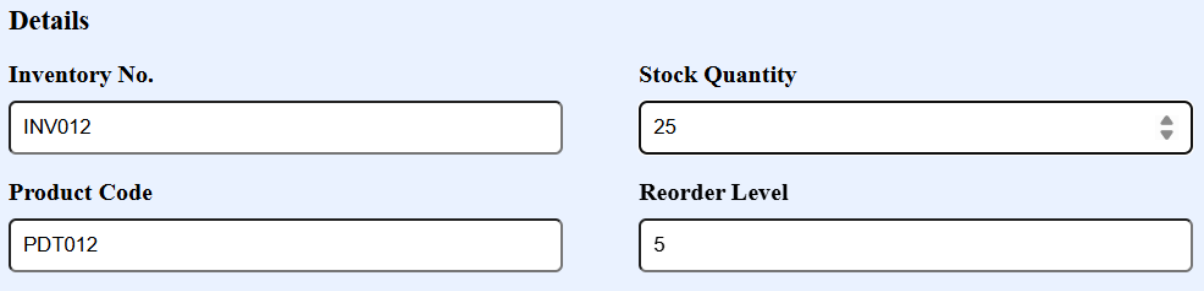


Figure 6.2.85 TC_17 Test Result 3

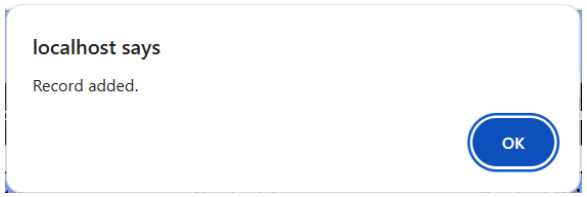


Figure 6.2.86 TC_17 Test Result 4

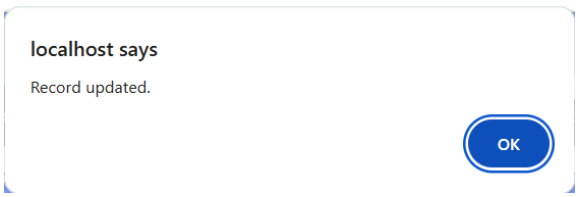


Figure 6.2.87 TC_17 Test Result 5

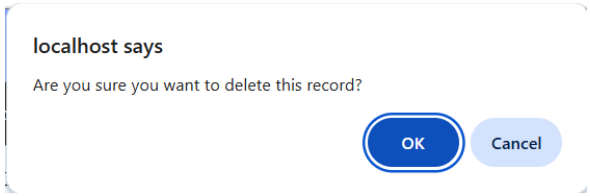


Figure 6.2.88 TC_17 Test Result 6

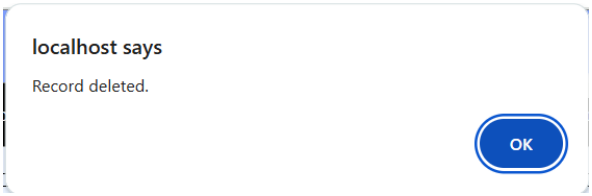


Figure 6.2.89 TC_17 Test Result 7

Project Name	Hardware Business Management System
Module Name	Inventory Module
Test Case ID	TC_18
Test Scenario (Purpose)	To test the functionality of inventory module with invalid credentials.
Expect Result	User is unable to add and update the data.
Actual Result	User is unable to add and update the data.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click "Login" button. 4. User navigate to Home page. 5. User click "Inventory" button. 6. User navigate to Inventory page.

Test Step – Add (Inventory Exist)	**Test Data**
1. Enter inventory number	INV001
2. Enter product code.	PDT001
3. Enter stock quantity.	50
4. Enter reorder level.	10
5. Click "Add" button.	Add inventory
6. Display error message	Add unsuccessful
Test Step – Update (Inventory Does Not Exist)	**Test Data**
6. Select and click specified inventory from search result.	INV012
7. Display details of selected inventory in Details section.	Display details
8. Update inventory number.	INV012 → INV014
9. Click "Update" button.	Update inventory
10. Display error message.	Update unsuccessful
Test Step – Empty Fields	**Test Data**
7. Click "Add" button	Add inventory
8. Display error message.	Add unsuccessful

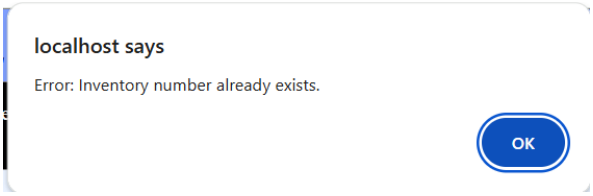


Figure 6.2.90 TC_18 Test Result 1

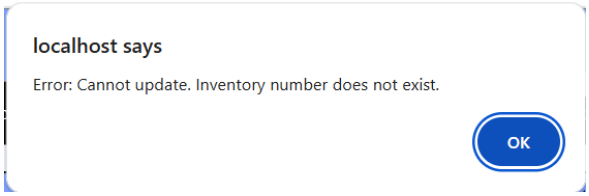


Figure 6.2.91 TC_18 Test Result 2

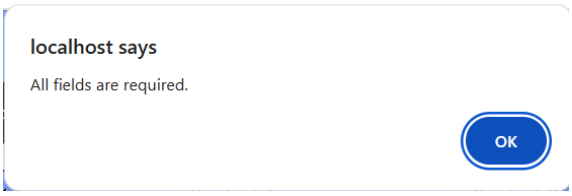


Figure 6.2.92 TC_18 Test Result 3

6.2.9 User Account Module

Project Name	Hardware Business Management System
Module Name	User Account Module
Test Case ID	TC_19
Test Scenario (Purpose)	To test the functionality of user account module.
Expect Result	User is able to change the password.
Actual Result	User is able to change the password.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “User” icon. 6. User click “User” button in drop down menu. 7. User navigate to User Account page.

Test Step – Change Password	**Test Data**
1. Enter current password.	test123
2. Enter new password.	test1234
3. Enter confirm new password.	test1234
4. Click “Change Password” button.	Change password
5. Display success message	Change password successful

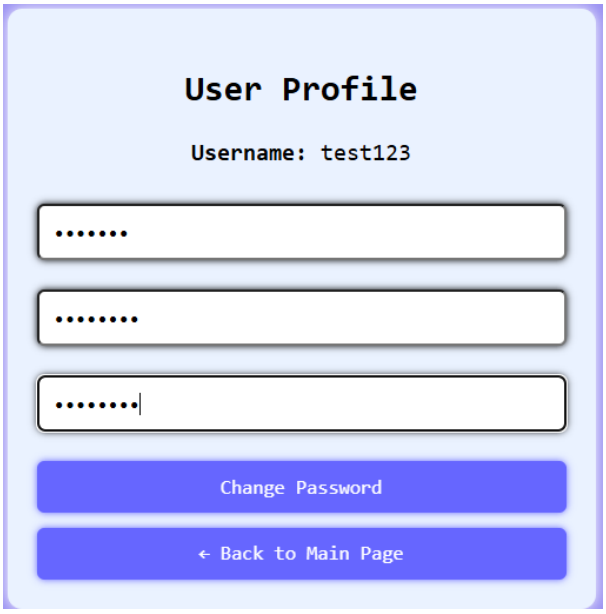


Figure 6.2.93 TC_19 Test Result 1

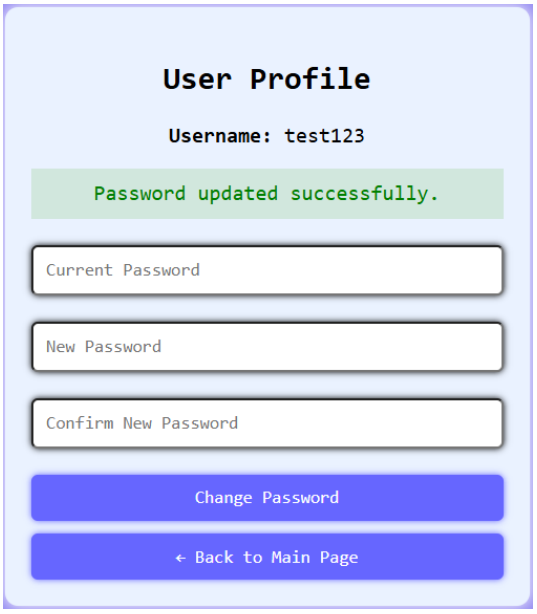


Figure 6.2.94 TC_19 Test Result 2

Project Name	Hardware Business Management System
Module Name	User Account Module
Test Case ID	TC_20
Test Scenario (Purpose)	To test the functionality of user account module with invalid credentials.
Expect Result	User is unable to change password.
Actual Result	User is unable to change password.
Test Result	PASSED
Pre-Requisite Step	1. User launch the system. 2. User enter username and password. 3. User click “Login” button. 4. User navigate to Home page. 5. User click “User” icon. 6. User click “User” button in drop down menu. 7. User navigate to User Account page.
Test Step – Invalid Input (Current Password Invalid)	**Test Data**
1. Enter current password.	test1234
2. Enter new password.	test12345
3. Enter confirm new password.	test12345

4. Click “Change Password” button	Change password
5. Display error message	Change password unsuccessful
Test Step – Invalid Input (Password Does Not Match)	**Test Data**
1. Enter current password	test123
2. Enter new password.	test1234
3. Emter confirm new password.	test12345
4. Click “Change Password” button.	Change password
5. Display error message.	Change password unsuccessful

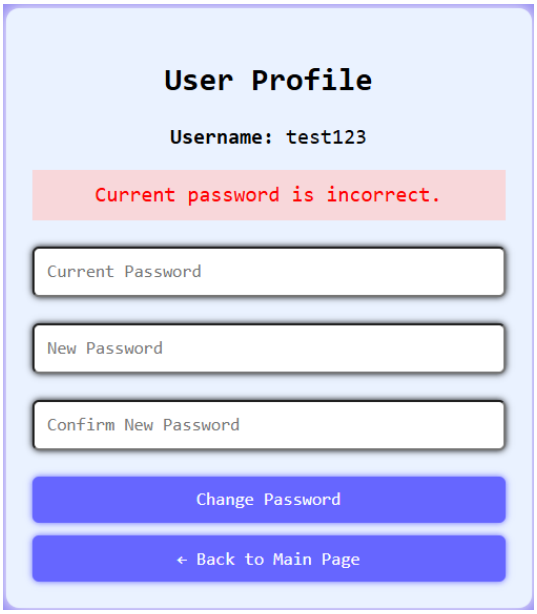


Figure 6.2.95 TC_20 Test Result 1

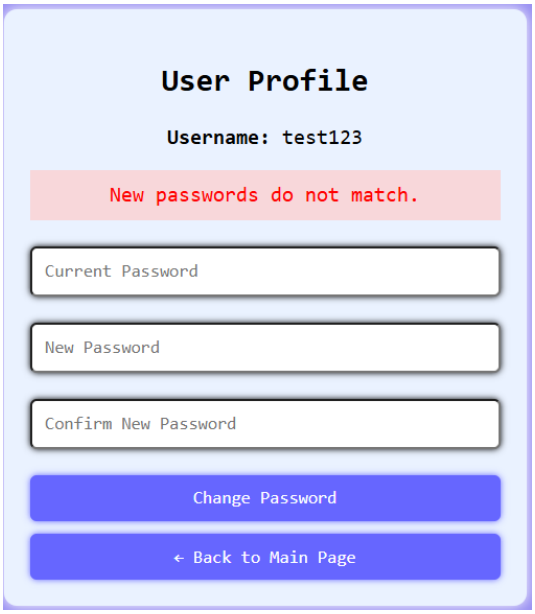


Figure 6.2.96 TC_20 Test Result 2

6.3 Project Challenges

The development of hardware business management systems faces several challenges, especially in system integration, database design, real-time analysis and user interface design. Integrating multiple modules such as inventory management, sales order management and supplier management into a cohesive system required significant effort to ensure seamless communication between components. This process is further complicated by the need to maintain data consistency across the entire system while supporting real-time updated analytics. Database design poses another challenge, as managing complex relationships between entities such as customers, suppliers and inventories requires a well-structured schema. Ensuring that database queries are optimized to efficiently handle large data sets is critical, especially for real-time data processing. Real-time analytics presents a range of difficulties, including maintaining data accuracy, instantly updating dashboards and creating meaningful visualizations to provide users with actionable insights. Finally, designing a user-friendly interface is a challenge as it requires a balance between simplicity and functionality. Ensuring that the interface was intuitive and responsive across different devices while meeting the varying needs of users added additional complexity to the project.

6.4 Objective Evaluation

The objectives of this project were systematically evaluated based on the completed system functionalities, user feedback and performance outcomes. The first objective was to streamline and automate business operations, which was successfully achieved through the development of an integrated web-based business management system. The system implemented key modules such as inventory control, sales tracking, supplier management and customer records to eliminate manual processes and minimize errors. The system significantly reduced redundancy and improved operational efficiency compared to traditional methods and fragmented tools.

The second objective focused on enabling data-driven decision-making through real-time analytics and reporting. This was achieved by integrating dynamic dashboards and charts using Chart.js, which provide users with real-time insights into sales performance, inventory levels and customer activity. The reporting function allows users to export and analyze key business metrics to support strategic planning and informed decision-making. The use of structured

database relationships and backend logic ensured that the reports are accurate and reflective of real-time data.

The third objective emphasized improving user experience. We developed a responsive and intuitive user interface using HTML, CSS and JavaScript. The design of the system shows that the interface is easy to navigate, the modules are clearly defined and the learning curve is low. Overall, the project objectives were successfully achieved and the system represents a significant improvement over existing solutions in terms of automation, decision support and user interaction.

6.5 Concluding Remark

This chapter provides a comprehensive evaluation of the developed hardware business management system. Through system testing and performance analysis, the system meets its functional requirements and operates reliably. The integration of core modules such as inventory management, sales order processing, supplier tracking and customer management successfully solves common inefficiencies in traditional systems. Although there were challenges in system integration, database optimization and user interface design, each issue was solved through iterative development and careful design considerations.

Furthermore, the system achieves its three main goals, which are the automation of business operations, data-driven decision-making and user-friendly interface. Test results confirmed that the system not only simplifies daily operations but also enhances decision-making capabilities through real-time analysis and intuitive visual reporting. Its responsiveness and easy navigation help provide a smooth overall user experience.

All in all, the developed system represents a significant improvement over traditional solutions, providing a reliable, integrated and scalable tool for hardware business management. The evaluation confirmed the effectiveness of the system in supporting business operations and provided the basis for future improvements and potential deployment in real-world settings.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

In conclusion, the proposed hardware business management system has made significant progress and successfully implemented core functions such as real-time analysis order management, inventory management, supplier management and customer management. The system enables users to perform CRUD operations across these modules, while advanced data visualizations including pie charts, column charts, line charts and bar charts facilitate real-time analysis. These visualizations provide users with valuable insights into market trends and inventory performance, allowing them to effectively identify high-demand products.

Despite this progress, the development process encountered challenges in system integration, database design, real-time analysis and user interface design. Integrating multiple modules into a cohesive system requires considerable effort to ensure seamless communication and data consistency between all components. Database design poses challenges in managing complex relationships between entities such as customers, suppliers, inventory and sales order and optimizing queries to effectively process large data sets. Real-time analytics require high levels of data accuracy, instant updates and meaningful visualizations, which increases the complexity of the development process. Furthermore, designing an intuitive and responsive user interface that strikes a balance between simplicity and functionality requires careful planning to meet the varying needs of users.

The system currently has several limitations, including scalability restrictions when processing larger data sets, limited customization options in analytical visualizations and a lack of advanced automation capabilities such as predictive analytics or AI-driven decision-making tools. These limitations highlight areas for future improvement and expansion. Moving forward, the system will focus on enhancing scalability to support growing data volumes and concurrent users. Future plans include integrating machine learning algorithms for predictive analytics, improved data visualization customization and automating repetitive tasks such as restocking and supplier notifications. Additionally, improving the user interface to ensure a more seamless and engaging user experience will be a priority. With these planned

enhancements, the system aims to become a comprehensive and efficient solution for hardware business management.

7.2 Recommendation

To further improve the functionality and usability of the system, we have identified several areas for improvement and future development. First, we will focus on scalability enhancements to ensure that the system can adapt to growing data volumes and concurrent user sessions, especially when deployed in large retail environments. Optimizing database queries and optimizing backend logic are critical to achieve better performance under high load conditions.

Second, we plan to integrate machine learning algorithms for predictive analysis. This will give hardware businesses a strategic advantage by enabling the system to predict demand trends, automatically generate replenishment alerts and support advanced sales analytics. In addition, we will expand analysis capabilities to include customizable visualization and reporting tools, allowing users to explore their data with greater flexibility and depth.

We will introduce automation of routine tasks such as generating purchase orders, sending notifications to suppliers and monitoring low inventory levels to improve operational efficiency. We will also continue to improve the user interface with a focus on making the system more responsive, accessible and engaging across different platforms and screen sizes. Overall, these future developments are designed to transform the system into a more intelligent, scalable, and comprehensive solution that not only supports daily operations but also enables business owners to make proactive, data-driven decisions.

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APPENDIX

Poster