

**TECHNOLOGICAL UNIVERSITY (MAWLAMYINE)**

**DEPARTMENT OF INFORMATION TECHNOLOGY**

**STATISTICAL ONLINE POINT OF SALE SYSTEM  
WITH DIGITAL MART MANAGEMENT INTEGRATION**

**PRESENTED BY**

**FIFTH YEAR (IT)**

**FIFTH YEAR PROJECT**

**SEPTEMBER, 2024**

**(MAWLAMYINE)**

TECHNOLOGICAL UNIVERSITY (MAWLAMYINE)  
DEPARTMENT OF INFORMATION TECHNOLOGY

PROJECT REPORT ON  
  
**STATISTICAL ONLINE POINT OF SALE SYSTEM  
WITH DIGITAL MART MANAGEMENT INTEGRATION**

BY  
FIFTH YEAR (IT)

SUBMITTED TO  
THE DEPARTMENT OF INFORMATION TECHNOLOGY  
IN PARTIAL FULFILLMENT OF THE REQUIREMRNTS FOR  
THE ACCOMPLISHMENT OF  
FIFTH YEAR (INFORMATION TECHNOLOGY)

SEPTEMBER, 2024  
MAWLAMYINE

**Fifth Year IT Group**

No	Roll No	Name	Remark
1	V IT - 5	Mg Ye Zarni Ko	Leader
2	V IT - 1	Ma Eaint Mhue Mhue Khin	Member
3	V IT - 2	Mi Thaik Mon	Member
4	V IT - 3	Mg Tin Ko Ko Tun	Member
5	V IT - 4	Mg Moe Zaw	Member
6	V IT(Ex) - 1	Mg Pyay Min Htet	Member

We certify that we have examined, and recommend to the University Steering Committee for Graduate Studies for acceptance of project entitled: "**Statistical Online Point of Sale System with Digital Mart Management Integration**" submitted by fifth year group to the Department of Information Technology as for the accomplishment of fifth year (IT).

**Board of Examiners:**

1. Dr. Thu Thu Mon Oo

Professor and Head

.....

Department of Information Technology

(Chairman and Supervisor)

Technological University (Mawlamyine)

2. Daw Ei Thet Mon

Lecturer

.....

Department of Information Technology

(Co-Supervisor)

Technological University (Mawlamyine)

## **ACKNOWLEDGEMENT**

We would like to express our appreciation and thanks to the following persons whose guidance aided directly or indirectly towards the success of the project.

We would like to express our special gratitude to Dr. Min Zaw Aung, Pro-rector of Technological University (Mawlamyine), for giving us the opportunity to perform this project.

We would like to deeply thank Dr. Thu Thu Mon Oo, Professor and Head of Department of Information Technology, Technological University (Mawlamyine), for her guidance, suggestion and invaluable advice.

We would like to deeply express special thanks to Dr. Thu Thu Mon Oo, supervisor, Department of Information Technology, Technological University (Mawlamyine), for her helpful suggestion, enthusiastic support and valuable knowledge to do this project.

We wish to express our thanks to Daw Ei Thet Mon, Lecturer, and co-supervisor, Department of Information Technology, Technological University (Mawlamyine), for her kind advice and valuable guideline.

We would like to thank all the teachers in our IT Department for kind, helpful, moral support and giving valuable knowledge to do this project. We always remember the gratitude of our teachers. We also thank the project members for cooperating during our project.

## ABSTRACT

A statistical online POS system with digital mart management integration is a user-friendly and accessible online platform that helps businesses manage sales, inventory, and customer interactions. Web-based POS system empowers businesses to streamline sales processes and enhance overall operational efficiency. With this POS system, businesses can process transactions quickly and accurately from any device with internet access. Businesses can update inventory levels and access up-to-date information with real-time data synchronization and cloud storage. It offers the flexibility to customize features like accounting management and reporting to meet specific business needs. With real-time data synchronization and cloud storage, businesses can update inventory levels, access up-to-date information, and also achieve superior performance and growth using Large Language Model.

## TABLE OF CONTENTS

		<b>Pages</b>
	ACKNOWLEDGEMENT	i
	ABSTRACT	ii
	TABLE OF CONTENTS	iii
	LIST OF FIGURES	vi
	<b>CHAPTER      TITLE</b>	
1	INTRODUCTION	
	1.1. Point of Sale (POS)	1
	1.2. Introduction to Web-Based POS System	1
	1.3. Integrating Language Models and Statistics in Web-Based POS System	2
	1.4. Aim and Objectives	3
2	SOFTWARE DEVELOPMENT PROCESS AND PROJECT REQUIREMENTS	
	2.1. Software Development Process	4
	2.1.1. Agile Development Process	4
	2.1.2. Agile Project Planning and Execution	4
	2.2. Requirements Engineering Process	5
	2.3. Project Requirements	6
	2.4. Technical Feasibilities	6
	2.4.1. Technological Stacks	7
	2.4.1.1. Programming languages	7
	2.4.1.2. Front-end development	7
	2.4.1.3. Main-backend infrastructure	7
	2.4.1.4. Cluster backend for LLM and Python	7
	2.4.1.5. Large language model (LLM) deployment	8
	2.4.2. Version Control	8
	2.4.3. Hardware Supports	8
	2.4.3.1. Barcode	8
	2.5. Scheduling Feasibility	9
3	SYSTEM DESIGN	
	3.1. Introduction to System Design	10
	3.1.1. Purpose and Goals of System Design	10

3.2. System Overview	10
3.3. System Components	11
3.4. Users Management System	12
3.5. Core POS System	13
3.5.1. Sale Process	13
3.5.2. Product Management	14
3.5.3. Order Management	15
3.6. Generating Barcodes	16
3.6.1. Check Digit	17
3.7. Accounting Management System	18
3.7.1. Record Module	18
3.7.2. Report Module	19
3.8. Correlation of Two Products	20
3.8.1. Pearson Correlation Coefficient	20
3.8.2. Drawing Linear Regression Line	21
3.9. Introduction to Large Language Models	22
3.9.1. Task-Specific Tuning of LLMs	23
3.9.2. Llama 3.1	23
3.9.3. Model Evolutions	24
3.9.4. Integration of LLM in POS System	24
<b>4 IMPLEMENTATION OF POS SYSTEM</b>	
4.1. Users Management System	26
4.1.1. Create User Account	26
4.1.2. Verify Account	26
4.1.3. Login with Email	27
4.1.4. Forgot Password	28
4.1.5. Login with Google Account	28
4.2. Core POS System	28
4.2.1. Home Page	29
4.2.2. Sale Page	29
4.2.3. Add Products with Barcode Scanner	30
4.2.4. Product Page	31
4.2.5. Add New Product Form	31
4.2.6. Append Product	33

4.2.7. Edit Product	34
4.2.8. Product Logs	34
4.2.9. Products Correlation	36
4.2.10. Sorting and Filtering Products	36
4.2.11. Product Categories and Brands Management	37
4.2.12. Order System	38
4.3. Accounting Management System	38
4.3.1. Sale Logs	39
4.3.2. Purchase Logs	39
4.3.3. Incomes Page	40
4.3.4. Statistics Page	41
4.4. Settings Page	41
4.4.1. Account Settings	41
4.4.2. Branch Settings	42
4.4.3. Large Language Model Training Page	43
4.5. LLM Conversation Section	44
5 CONCLUSION	
5.1. Conclusion	45
REFERENCES	46

## LIST OF FIGURES

<b>Figure</b>	<b>Pages</b>
3.1. Overview of the POS System	11
3.2. Users Management System	12
3.3. Sale Process	13
3.4. Product Management System	15
3.5. Illustration of How Branches Relate with Products	15
3.6. Illustration of How Order System Works	16
3.7. European Article Number (EAN) Barcode Structure	17
3.8. How to Calculate Check Digit	17
3.9. Accounting Management System	18
3.10. Evaluation of LLAMA 3.1 against Other Language Models	24
3.11. Integration of LLMs	25
4.1. Sign Up Form	26
4.2. Verification Message	27
4.3. Email Template	27
4.4. Account Login Form	27
4.5. Reset Password Form	28
4.6. Google Sign-in Popup	28
4.7. Home Page	29
4.8. Sale Page	29
4.9. Illustration of after the User Adds Products to the Cash List	30
4.10. Illustration of Adding Products with a Barcode Scanner	30
4.11. Confirmation Cash Message	31
4.12. Product Page	31
4.13. New Product Form	32
4.14. Successfully Added New Product Popup	32
4.15. Products Page with Options	33
4.16. Append Product Dialogue	33
4.17. Product Page with Edit Option	34
4.18. Product Page with Sale Logs	35
4.19. Product Page with Purchase Logs	35
4.20. Correlation of Products	36

<b>Figure</b>	<b>Pages</b>
4.21. Illustration of Products Filter and Sorting Features	37
4.22. Categories and Brands Dialogues	37
4.23. Order List and Create New Order Dialogue	38
4.24. Order Details Dialogue	38
4.25. Sale Logs Page	39
4.26. Purchase Logs Page	39
4.27. Incomes Page	40
4.28. Incomes Page with Details	40
4.29. Statisitcs Page	41
4.30. Account Settings Page	42
4.31. Branch Settings Page	42
4.32. Create New Branch Dialogue	43
4.33. LLM Training Section	43
4.34. LLM Conversation Section	44

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1. Point Of Sale (POS)**

A Point of Sale (POS) is the spot where customers complete their purchases for goods or services. Think of it as the checkout line in a retail store or the payment station. A POS system usually comprises a device, such as a computer or tablet, along with software that facilitates payment processing, sales tracking, and occasionally inventory management. This system is crucial for businesses to ensure efficient and smooth transactions when customers are ready to pay. Modern POS systems often come with advanced features, such as analytics for business insights, and integration with e-commerce platforms.

#### **1.2. Introduction to Web Based POS System**

Web-based platforms are revolutionizing how businesses handle sales and manage inventory. Nowadays, the demand for efficient and reliable POS systems has surged in fast-paced business environment. Traditional hardware-based POS systems are being replaced by innovative, web application-based POS solutions. These modern systems utilize internet and cloud technology to offer numerous benefits and enhanced functionality.

A web application-based POS system is a software solution that helps businesses streamline their sales processes, manage inventory, and improve user experiences through an online platform. Unlike traditional systems that depend on dedicated hardware and local servers, web-based POS systems operate via web browsers. This allows for greater flexibility and ease of access, enabling businesses to operate more efficiently and effectively.

One of the key advantages of web application-based POS systems is their versatility and scalability. They are suitable for businesses of all sizes, from small boutiques to large retail chains. These systems can easily adapt to the changing needs of a business, whether it is expanding to new locations, increasing product lines, or

integrating with other business applications. This flexibility ensures that businesses can grow and evolve without being constrained by POS systems.

Moreover, web application-based POS systems offer real-time data synchronization and cloud storage. This means that business owners and managers can access up-to-date information and make decisions from anywhere at any time. The ability to monitor sales, track inventory, and analyze customer data in real-time provides a significant advantage in today competitive market. Additionally, these systems are often designed with user-friendly interfaces and intuitive navigation, reducing the learning curve for employees and minimizing the need for extensive training. This ease of use ensures that businesses can quickly implement and benefit from these modern POS solutions.

### **1.3. Integrating Language Models and Statistics in Web-Based POS System**

The advent of web-based Point of Sale (POS) system has revolutionized the way businesses manage sales and inventory, offering unprecedented flexibility and efficiency. However, the integration of advanced technologies such as language models and statistical analysis into these systems represents a new frontier in optimizing business operations. This project explores the benefits and potential of integrating language models and statistical tools into web-based POS system, focusing on enhancing the capabilities of business owners and providing deeper business insights.

Language models, particularly those based on artificial intelligence (AI), have shown exceptional proficiency in understanding and generating human language. Integrating these models into web-based POS system can significantly empower business owners by providing advanced analytical tools and insights. For example, AI-driven language models can help in generating comprehensive reports, summarizing key performance indicators, and identifying trends in sales data. These models can translate complex data into easily understandable narratives, allowing business owners to quickly grasp essential information without delving into raw data.

Statistical analysis plays a crucial role in optimizing business operations by providing actionable insights derived from data. Web-based POS system, integrated with robust statistical tools, can analyze vast amounts of transactional data to identify trends, patterns, and irregularities. For instance, statistical analysis can help businesses forecast demand, optimize inventory levels, and reduce waste. By

accurately predicting which products are likely to be in high demand, businesses can ensure they have sufficient stock, thus avoiding both overstock and stockouts.

The integration of language models and statistical analysis into web-based POS system represents a significant advancement in the retail and service industries. These technologies not only enhance operational efficiency and streamline processes but also provide deeper business insights that drive strategic decision-making.

#### **1.4. Aim and Objectives**

The aim of the POS system is to provide streamline sales process and to improve overall inventory efficiency.

The objectives of this project are

- To streamline the sales process and increase efficiency.
- To provide real-time inventory tracking and management.
- To generate accurate sales reports and data analysis.
- To reduce manual errors in sales and inventory management.
- To provide up-to-date information on sales data.
- To simplify the process of tracking purchases history.
- To provide management with the tools necessary to make informed business decisions based on sales and inventory data.

## CHAPTER 2

### SOFTWARE DEVELOPMENT PROCESS AND PROJECT REQUIREMENTS

#### **2.1. Software Development Process**

The Software Development Process is the structured approach to develop software for a system or project. Various Software Development Process models have been developed over time to accommodate different project requirements, team sizes, and development methodologies. These different approaches focus on different points in the development process. However, each approach is composed of the same basic steps of development.

##### **2.1.1. Agile Development Process**

Agile development is a dynamic and iterative approach to software development that emphasizes flexibility, collaboration, and customer satisfaction. It was born out of the need to adapt to the rapidly changing requirements in software projects and focuses on delivering small, incremental changes rather than a complete overhaul in one go. The Agile methodology is based on the Agile Manifesto, which values individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following a plan.

A significant advantage of agile development is its ability to handle changing requirements with ease. Agile teams are equipped to adapt to new information or shifts in priorities swiftly, reducing the risk of project failure due to outdated or misunderstood requirements.

##### **2.1.2. Agile Project Planning and Execution**

Agile methodologies have transformed software development management by providing a flexible, iterative approach that adapts to changing requirements and ensures high-quality results. The process is divided into four key phases, each essential to the success of project. These four key phases are:

- Requirements Engineering: This initial phase involves the thorough collection and definition of the project essential needs and constraints. It includes identifying the necessary technology stacks, specifying the system requirements, and selecting appropriate design and development tools. This phase lays a strong foundation for the subsequent stages of development.
- Design: The Design phase focuses on creating a comprehensive blueprint for the system architecture and user interface. This involves defining the overall system design, detailing the interaction and integration of various components, and planning the deployment architecture to ensure scalability, security, and efficiency. UI/UX design is also a key aspect, aimed at making the final product user-friendly and visually appealing.
- Development and Testing: This phase encompasses iterative coding and validation to ensure the product meets the specified requirements. Key practices include Test Driven Development (TDD), where tests are written before coding to guide the development process and ensure high code quality. Regular refactoring is performed to improve the performance and maintainability of the existing codebase.
- Deployment and Release: The final phase, Deployment and Release, marks the transition from development to production. This involves preparing the final build, conducting final tests, and deploying the software in the live environment. Continuous monitoring and feedback collection are essential to facilitate future iterations and improvements.

By following this iterative methodology, Agile Project Planning and Execution ensures continuous enhancement and the delivery of high-quality outcomes throughout the project lifecycle.

## 2.2. Requirements Engineering Process

The requirements for a system are the descriptions of what the system should do the services that it provides and the constraints on its operation. These requirements reflect the needs of customers for a system that serves a certain purpose such as controlling a device, placing an order, or finding information. The process of finding out, analyzing, documenting and checking these services and constraints is called requirements engineering (RE).

The term ‘requirement’ is not used consistently in the software industry. In some cases, a requirement is simply a high-level, abstract statement of a service that a system should provide or a constraint on a system. Three fundamental phases are essential for guiding project development: feasibility study, user and system requirements gathering, and requirements specifications.

Feasibility study evaluates the practicality and potential success of a proposed project. It involves assessing various factors such as technical, economic, legal, operational, and scheduling considerations.

User and system requirements gathering aims to comprehensively capture both functional requirements, which specify what the system must do, and non-functional requirements, which define qualities and constraints that the system must satisfy.

### **2.3. Project Requirements**

In any software development endeavor, understanding and addressing project requirements are paramount to success. This project focuses on evaluating feasibility across three essential dimensions: Technical Feasibility, Economic Feasibility, and Scheduling Feasibility.

Technical Feasibility examines the practicality of implementing the proposed system, assessing factors such as technology stack compatibility, scalability, and security measures.

Economic Feasibility explores the financial aspects, examining costs versus benefits to determine the viability of project and potential return on investment.

Meanwhile, Scheduling Feasibility ensures that the project can be completed within the allocated time frame, balancing milestones, resource availability.

### **2.4. Technical Feasibilities**

Technological feasibility is a critical assessment that determines the practicality of implementing a proposed system based on existing technological capabilities.

This evaluation encompasses several key factors:

- Technological Stacks: The combination of software tools, programming languages, frameworks, and libraries chosen to develop projects.
- Version Control: Systems like Git that manage changes to source code, ensuring collaboration efficiency and code stability over time.

- **Hardware Support:** Evaluation of existing or planned hardware infrastructure to ensure it meets the technological requirements of the proposed solution.

#### 2.4.1. Technological Stacks

Choosing the right technology stack is essential for any successful project. In this project, a combination of programming languages, front-end tools, backend infrastructure, and large language models (LLM) were carefully selected to ensure everything runs smoothly and efficiently.

##### 2.4.1.1. Programming languages

Technological feasibility of this project is anchored by a carefully selected stack of programming languages and tools. JavaScript with TypeScript support is utilized to ensure robust and scalable code with enhanced type safety. Additionally, Python3 is employed for backend development and data processing, leveraging its versatility and widespread adoption.

##### 2.4.1.2. Front-end development

The front-end development strategy incorporates React, AntDesign, and Chart.js to construct user interfaces and visualize data effectively. State management is handled using the Context API, while styling is achieved through Sass and Tailwind CSS, ensuring a flexible and maintainable design. The bundling process is optimized with Vite, and rigorous testing is conducted using Jest for unit testing and Vite Test along with React Testing Library for component testing.

##### 2.4.1.3. Main-backend infrastructure

For the main backend, Firebase is adopted as a comprehensive solution, providing authentication, real-time database, storage, and hosting services. This choice ensures a seamless and integrated backend infrastructure.

##### 2.4.1.4. Cluster backend for LLM and Python

The cluster backend for large language models (LLM) and Python utilizes a Linux Server (VPS) to provide a scalable and secure environment. The lightweight web

framework Flask is employed for web development, while numpy and pandas are used for data manipulation and analysis.

#### 2.4.1.5. Large language model (LLM) deployment

The deployment and management of large language models are facilitated by the Ollama platform, incorporating open-source models, llama3.1 8 billion to address various natural language processing tasks.

#### 2.4.2. Version Control

Version control, also known as source control, is a system that helps manage changes to files over time. It is essential for tracking modifications, collaborating with others, and maintaining a history of the project. This system is widely used in software development but can be applied to any type of file. Git and GitHub are exclusively used for version control.

#### 2.4.3. Hardware Supports

In this project, a label printer, a thermal printer, and a barcode scanner will be used. The label printer prints labels with barcodes, prices, and other product details, which is useful for various applications such as product identification, asset tracking, and compliance labeling.

The thermal printer handles receipts and other documents using heat-sensitive paper, making it a reliable choice for quick and efficient printing. The barcode scanner quickly and accurately scans barcodes to input product information into the POS system, helping to streamline processes and reduce errors.

##### 2.4.3.1. Barcode

Barcodes are essential for efficiently managing and tracking products. They come in two main types: European Article Number (EAN) and Universal Product Code (UPC). In the project, EAN Barcode is used. The EAN barcode is a globally recognized 13-digit code used to identify products. It is widely used in Europe, Asia, and Latin America.

The EAN-13 barcode consists of 12 data digits and a single check digit to ensure accurate scanning. The first few digits represent the country or region of the manufacturer, followed by the identification number of the manufacturer, the product

number and the check digit. This system allows for unique identification of products, facilitating efficient inventory management and sales tracking.

## **2.5. Scheduling Feasibility**

Implementing a Point of Sale (POS) system can significantly enhance the business operations, particularly in terms of scheduling. Scheduling feasibility assesses whether a project can be completed within a defined timeframe, considering all constraints, resources, and requirements. To determine feasibility, the project scope and objectives must be clearly defined, breaking down the work into manageable tasks with identified dependencies. Accurate task duration estimates are essential, as is the allocation of appropriate resources while considering potential constraints.

This POS system project is scheduled over 8 weeks to develop, divided into five phases. The first week involves gathering requirements, defining specifications, and planning. The second week covers system design, including architecture and UI/UX. Development spans the next 4 weeks, focusing on core functionalities and integration. The final week is dedicated to writing the project paper.

## **CHAPTER 3**

### **SYSTEM DESIGN**

#### **3.1. Introduction to System Design**

System design is the process of defining and planning the architecture, components, modules, interfaces, and interactions of a complex software or hardware system. It involves making decisions about how different parts of a system will work together to achieve the desired functionality, performance, scalability, reliability, and maintainability.

##### **3.1.1. Purpose and Goals of System Design**

The goal of system design is to create a blueprint or roadmap for building a system that meets the project requirements and objectives. This involves breaking the system into smaller subsystems or components, determining how they will work together to achieve the overall goals, and establishing the communication between these elements. System design considers both technical and non-technical aspects, ensuring that the system is efficient, scalable, secure, and aligned with user needs and expectations.

#### **3.2. System Overview**

This POS system overview highlights the integration of key components, including user management, core POS functions, accounting management, and large language modeling (LLM). The system is designed for robust and scalable operation, ensuring smooth interaction among these elements and offering a comprehensive solution for efficient management and oversight from any location with internet access. Furthermore, the system is structured to easily accommodate future expansions and feature enhancements, ensuring long-term adaptability. The user-friendly interface and modular design make it accessible to non-technical users. It also allows for easy customization and expansion of features as business needs evolve. Figure 3.1 shows the overview of the POS system.

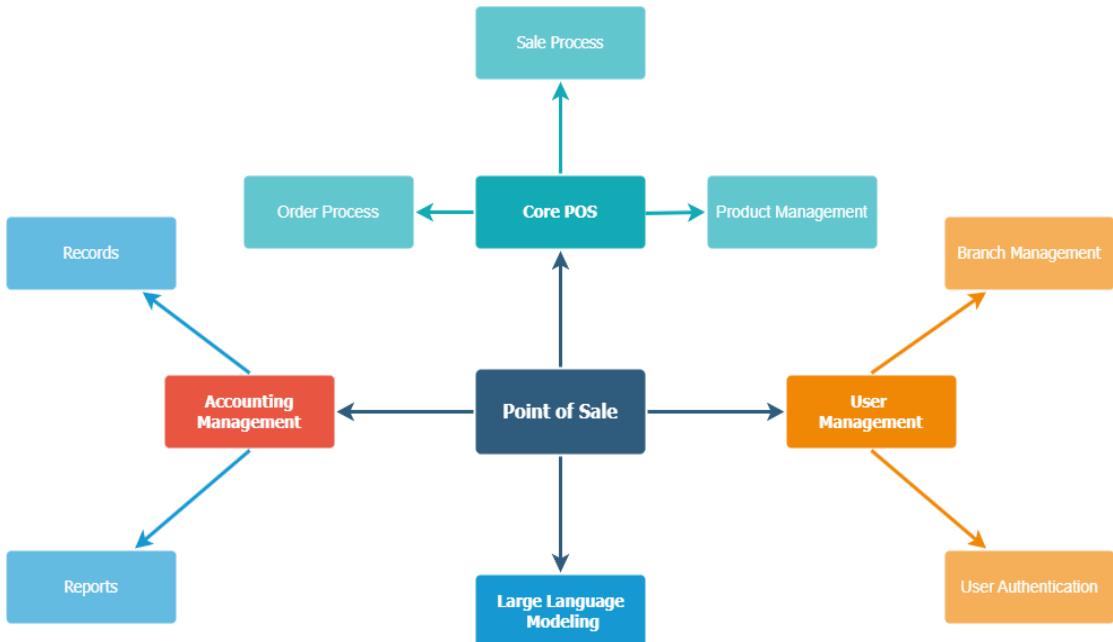


Figure 3.1. Overview of the POS System

### 3.3. System Components

The Point of Sale (POS) system is composed of several components, each serving a distinct function to ensure a comprehensive and efficient operation. The key components of the system include:

- Users Management System: This component is responsible for user authentication and branch management, providing branch assignments and access controls within the Core POS System. Firebase is utilized to support these authentication functions, ensuring secure and reliable user access.
- Core POS System: This system encompasses the sale process, product management, and order processing. It interfaces with the User Management System and relies on Firebase for backend services to manage transactions and data effectively.
- Accounting Management System: This component handles financial transactions and reporting. It processes financial data received from the Core POS System to generate accurate financial records and reports. The system ensures compliance with financial management and decision-making.
- Large Language Model (LLM): This system enhances the POS functionality through natural language processing and advanced analytics, offering improved customer support and valuable insights. It enables more

intuitive interactions and automates complex tasks, making the system smarter and more efficient.

These components form a unified system that supports flexible and comprehensive management of POS operations. These elevate the functionality and efficiency of the system and enable stronger management and provide insightful analytics for better decision-making and enhanced customer support.

### **3.4. Users Management System**

Users Management System is built with simplicity and ease of use in mind, making it accessible to multiple online users. A straightforward Login and Sign-Up feature has been included, allowing users to authenticate either via email or Google account. This feature is designed to provide flexibility and convenience, ensuring a smooth and secure login process. Additionally, users can easily recover passwords if needed, further enhancing the overall user experience. The system also supports the creation and management of multiple shop branches, all controlled from a central main shop, making it easier to oversee operations and ensure efficiency.

The system is designed to scale effortlessly, handling a growing number of users and branches without compromising performance. Further, the user-friendly interface allows non-technical users to operate the system confidently. This design ensures that users can navigate and manage activities with minimal difficulty, offering a smooth and intuitive experience. Figure 3.2. shows how the user management system works.

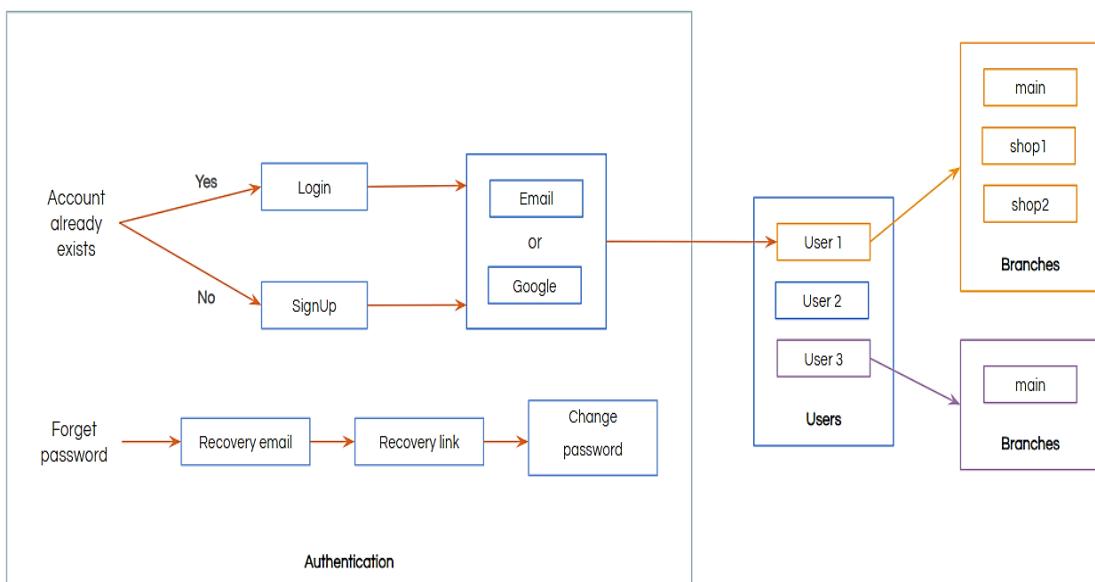


Figure 3.2. Users Management System

### 3.5. Core POS System

The core POS system serves as the primary point of the system within application. This system can be divided into three parts: the sales process, products management, and the orders system.

#### 3.5.1. Sale Process

Figure 3.3. provides the overview of the sales process. The process begins with adding products from the product list to the cash list. After sale, these products are logged for record-keeping and additional processing. There are two types of logs maintained during the sales process: sales logs and accountant logs. These logs play a vital role in recording and tracking various details of sale transactions and financial activities within the system. Sales logs track product details, quantities, and transaction id, while accountant logs record revenue and profits. These logs ensure accurate and support efficient financial analysis. This system not only helps maintain transparency and accuracy in the sales process but also enhances the overall efficiency and reliability of financial operations. By integrating these logs into the system, businesses can make more informed decisions and maintain a robust financial. Furthermore, the automation of logging processes reduces the potential for human error, thereby improving the integrity of financial records. The comprehensive data captured in these logs also facilitates audits, ensuring that all transactions are verifiable and compliant with regulatory standards

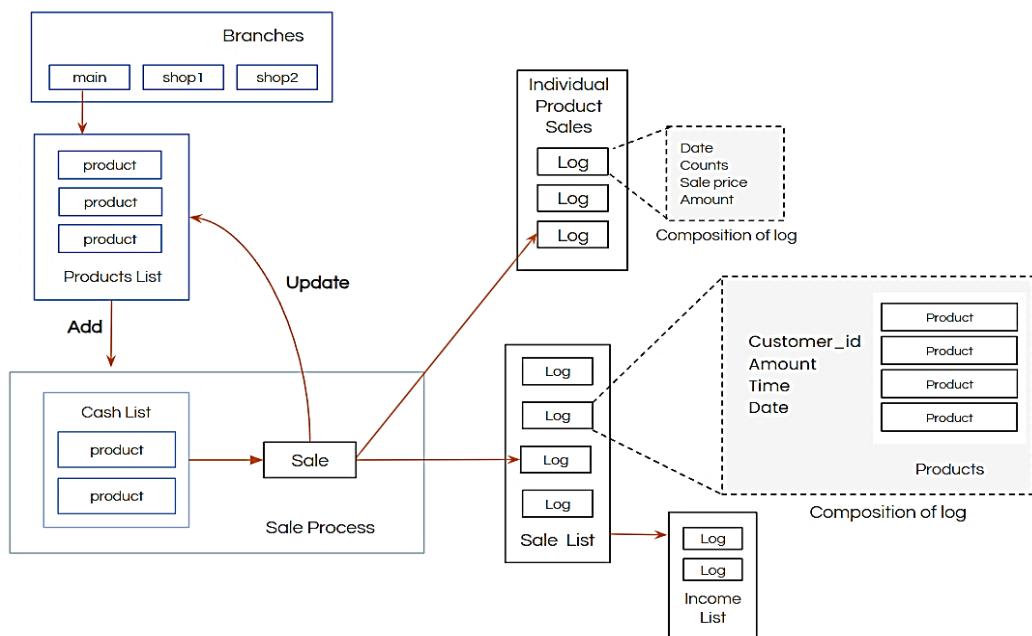


Figure 3.3. Sale Process

### 3.5.2. Product Management

The product management system supports several key operations:

- Create new product: This function allows users to add a new product to the system by specifying its details and attributes, including name, category, price, and any relevant specifications.
- Delete product: This function enables the removal of a product from the system when it is no longer available for sale. Once confirmed, the product is permanently removed from the database.
- Update product: The update function is split into two parts:
  - Edit product: This option lets users modify the details or attributes of an existing product. Changes may include product descriptions, prices and related product image.
  - Append product quantity: This option allows users to increase the available quantity of a specific product. It is particularly useful for managing stock levels and ensuring availability.

When a new product is added or its quantity is increased, a log entry records the time and details of the change. Each product also has its own log that tracks all updates, including quantities and timestamps, ensuring transparency and accuracy. Figure 3.4. shows how the product management system works. In the branch system, each branch maintains its own product list, which manage independently. Access to these product lists is determined by the branch:

- Main Branch: The main branch has full access and control over the product management system. It can view, edit, and update the product lists for all branches, including its own. The main branch oversees the entire system of product management.
- Other Branches: Non-main branch have limited access. Sales can be managed using a specific product list, but adding, deleting, or updating products is not allowed. These tasks are reserved for the main branch.

Thus, the main branch has the authority to manage and oversee all other branches, including inventory control and pricing. The other branches, however, are restricted to conducting sales with the products in the designated lists, without the ability to modify inventory or access broader management function. This centralized control ensures consistency and prevents unauthorized changes. Figure 3.5. shows how branches relate with products.

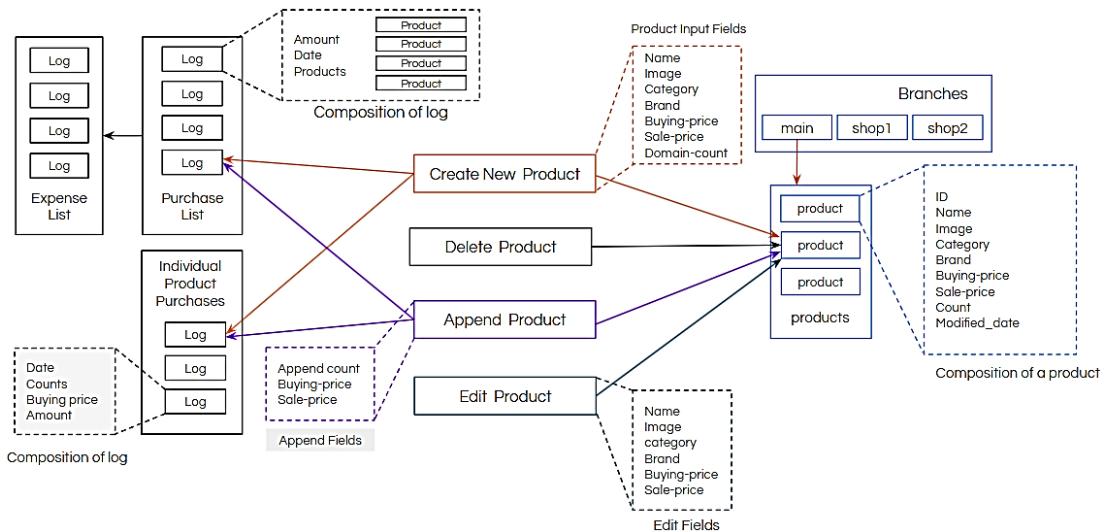


Figure 3.4. Product Management System

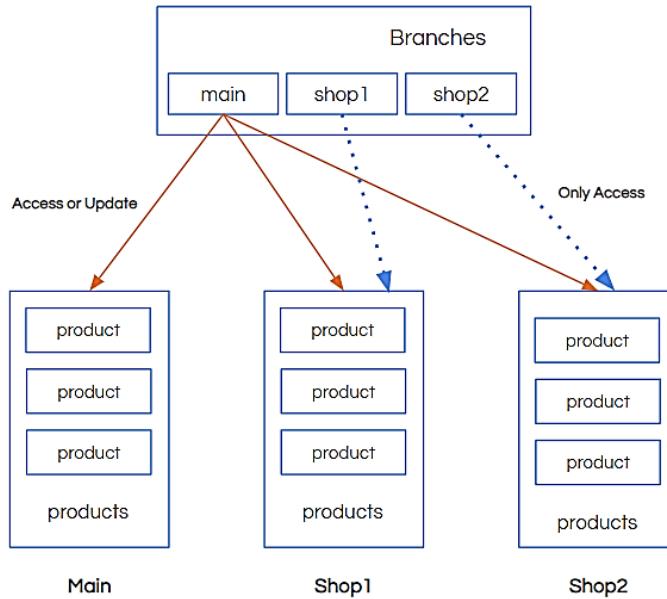


Figure 3.5. Illustration of How Branches Relate with Products

### 3.5.3. Order Management

The order management system is designed to handle customer orders for products that have either never been stocked before or are currently out of stock in the shop. It tracks each order through three key stages:

- **Under Order:** When a customer places an order for a new product that has never been available in the shop, it enters the "Under Order" state. This indicates that the product has been ordered from the supplier or distributor and is awaiting delivery.

- Delivered: Once the ordered product arrives and is added to the list, its status is updated to "Delivered." This means the product is now ready for the customer to purchase.
- Cash: When the customer comes to purchase the newly arrived product, the order status is changed to "Cash." This signifies that the order is completed and the customer has paid for the product. Figure 3.6. illustrates of how order system works.

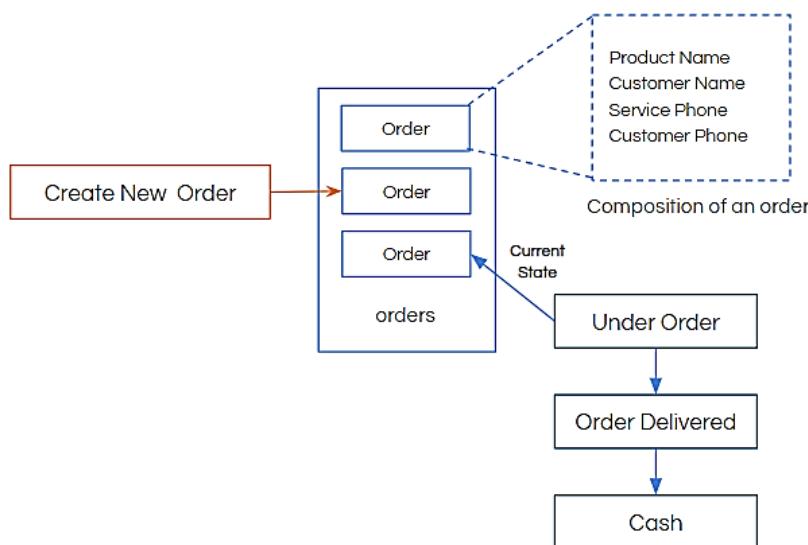


Figure 3.6. Illustration of How Order System Works

### 3.6. Generating Barcodes

Previous chapter introduced barcodes, covering the significance and various types used in this POS system. This section offers a step-by-step guide to creating and implementing barcodes within the system, ensuring seamless integration with the system overall functionality. In this project, EAN barcodes are generated following a four-step process:

- Step 1: The process begins by adding the country code, adhering to standard codes. For example, since the project is based in Myanmar, the country code '883' is used, which aligns with the international standards for barcode identification.
- Step 2: The manufacturer code is added using a multitap method. For instance, if the company name is 'Cash Flow', the manufacturer code '2439' is derived by taking the first and last letters of each word in the name. This

method ensures that the manufacturer is uniquely represented in the global market.

- Step 3: A product code is then randomly generated to uniquely identify each item within the range of products offered by the manufacturer. This code differentiates individual products, making it easier to track and manage inventory.
- Step 4: Finally, the checksum is calculated to ensure the accurate barcode and integrity. The detailed process of calculating the check digit is explained in the following section, highlighting its role in preventing errors during barcode scanning and data entry. Figure 3.7. shows example of EAN barcode structure.

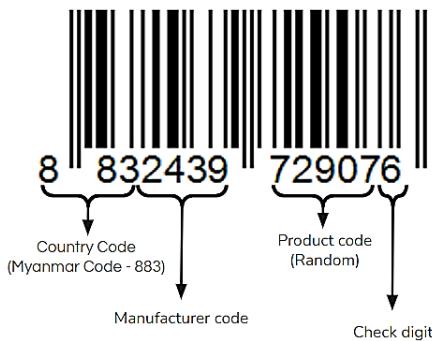


Figure 3.7. European Article Number (EAN) Barcode Structure

### 3.6.1. Check Digit

The figure 3.8 shows how the check digit of an EAN-13 barcode is determined. The check digit, which is the last number in barcode, ensure its accuracy.

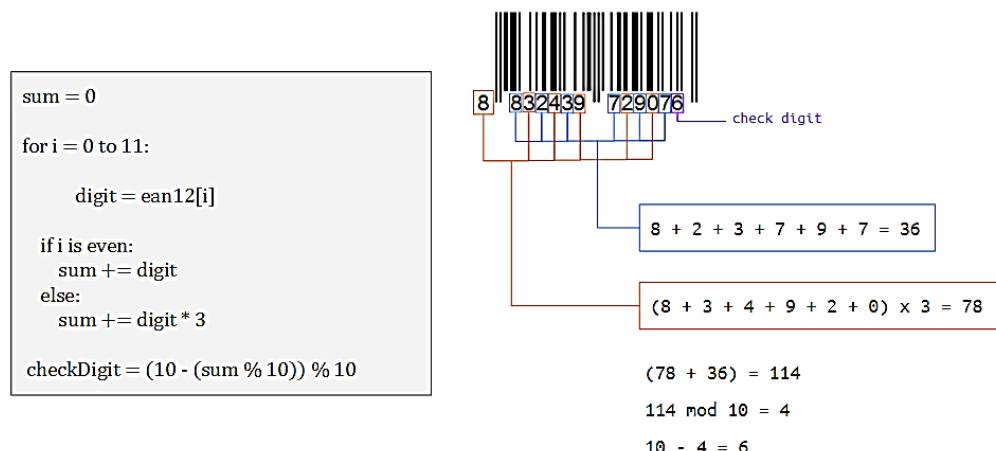


Figure 3.8. How to Calculate Check Digit

To calculate this digit, the first 12 digits are processed: the odd position digits are added directly, while even position digits are added and multiplied by 3 before being added to the total. After summing these values, the figure shows how to determine the difference needed to reach the nearest multiple of 10. This difference becomes the check digit, which helps confirm that the barcode was generated correctly. In the example shown in the figure 3.8, the check digit is calculated to be 6, resulting in the complete barcode 8832439729076.

### 3.7. Accounting Management System

Accounting Management System is designed with two primary modules: Records and Reports, each integrating various features to manage and analyze financial data effectively.

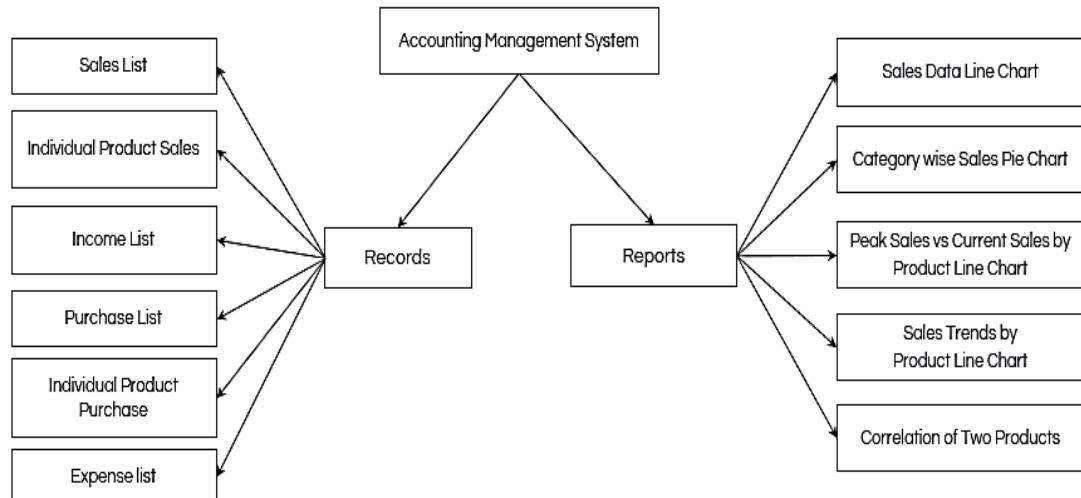


Figure 3.9. Accounting Management System

#### 3.7.1. Record Module

This module focuses on maintaining comprehensive records of financial transactions. It ensures that all relevant financial data is accurately captured and stored for further analysis. Below are the key components of the record module:

- Sales List: These are records of the sales transactions, including sold out items, item codes and dates of sales.
- Individual Product Sales List: This is a record that consolidates the sales of a single product over a specified period. This summary includes details such as the date of sale, quantity sold, unit price, and total sales value.

- Income List: These are records of the income, profits and amounts of the mart.
- Purchase List: These are records of the items purchased by the mart, including item names, codes, dates of purchase, and purchase value.
- Individual Product Purchase: This is a record that consolidates the purchases of a single product over a specified period. This summary includes details such as the date of purchase, quantity purchased, unit cost, and total purchases.
- Expense List: These are records of expenditures, dates incurred, and amounts of the mart. This list helps in tracking the financial outflows and managing the overall business.

### 3.7.2. Report Module

The report module is designed to transform the recorded data into actionable insights. It helps in visualizing sales performance, understanding trends, and making informed decisions based on the data. The report module consists of the following key elements:

- Sales Line Chart: Sales data line charts are used to display the trends in sales over a specified period. This type of chart is particularly useful for visualizing how sales evolve over time, such as daily, weekly, or monthly.
- Category-wise Sales Pie Chart: This pie chart illustrates the sales distribution across different product categories. By segmenting sales data into categories. Each slice of the pie represents a category, with the size of the slice corresponding to the proportion of total sales that category contributes.
- Peak Sales vs Current Sales by Product Bar Chart: A bar chart comparing peak sales and current sales for each product provides insight into the performance dynamics of individual products. Peak sales might refer to the highest sales recorded in a particular period, such as the highest monthly sales. By comparing these peak sales to the current sales figures, businesses can gauge whether popularity of a product is increasing, stable, or declining. This comparison helps in recognizing top performers and identifying products that might need promotional efforts or other interventions.

- Sales Trends by Each Product Line Chart: This involves analyzing the sales trajectory of individual products over time. Such an analysis can be represented through line chart. Tracking sales trends for each product helps businesses understand the lifecycle of their products, identify growth opportunities, and make informed decisions about product development, marketing, and discontinuation.

### **3.8. Correlation of Two Products**

Accounting management system includes a functionality for correlating two products. Correlation analysis measures the relationship between the sales of two different products. By assessing how changes in the sales of one product are associated with changes in the sales of another, businesses can uncover valuable insights. For example, a strong positive correlation might indicate that the products are often bought together, suggesting opportunities for bundling or joint promotions. This analysis is represented using scatter plots or correlation matrices.

#### **3.8.1. Pearson Correlation Coefficient**

To perform analysis process, descriptive statistics, such as means are used to determine the central tendency of the dataset. In determining the best fit between two variables, the process begins by extracting dataset information from the database. The data is then cleaned to prepare for analysis. To calculate the correlation values between the variables, Pearson Correlation method is employed. The following outlines the essential steps to calculate Pearson Correlation Coefficient:

- First, the lengths of the variables are adjusted to calculate the covariance.
- Covariance is a statistical measure used to determine the relationship between two variables and the way in which changes occur together. Mathematically, covariance is defined as the expected value (or average) of the product of the deviations of each variable from their respective means. The following steps are used to calculate and analyze covariance:

Covariance Formula:

$$Cov(X, Y) = \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})$$

Where:

$n$  is the number of data points.

$\bar{X}$  and  $\bar{Y}$  are the population means of  $X$  and  $Y$ .

$X_i$  and  $Y_i$  are the individual data points of  $X$  and  $Y$ .

Interpretation:

Positive Covariance: Indicates that as one variable increases, the other tends to increase.

Negative Covariance: Indicates that as one variable increases, the other tends to decrease.

Zero Covariance: Suggests no relationship between the two variables.

- Pearson correlation coefficient, is a measure of the linear relationship between two variables. The formula for calculating Pearson coefficient  $r$  is:

$$r = \frac{\text{cov}(X,Y)}{\sigma_x \sigma_y} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}}$$

Where:

$r$  is the Pearson correlation coefficient.

$\text{cov}(X,Y)$  is the covariance of variables  $X$  and  $Y$ .

$\sigma_x$  is the standard deviation of  $X$ .

$\sigma_y$  is the standard deviation of  $Y$ .

Interpretation of Pearson  $r$ :

$r = 1$ : Perfect positive linear correlation.

$r = -1$ : Perfect negative linear correlation.

$r = 0$ : No linear correlation.

### 3.8.2. Drawing Linear Regression Line

After obtaining the correlation coefficient, the data points are visualized using a scatter plot, further enhanced by drawing the best fit linear regression line on the chart. This approach facilitates a clear understanding of the relationship between the variables, allowing for the identification of any potential trends or patterns in the data. The following outlines the essential steps to draw the linear regression line:

- The Slope ( $\beta_1$ ) is calculated from the covariance of  $X$  and  $Y$  divided by the variance of  $X$ .

Slope Formula of Simple Linear Regression:

$$\beta_1 = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2 \sum_{i=1}^n (Y_i - \bar{Y})^2}}$$

- Calculate the Intercept ( $\beta_0$ ):

$$\beta_0 = \bar{Y} - \beta_1 \bar{X}$$

This is the value of Y when X is 0.

- Plot the Data Points: Plot the original data points  $(X_i, Y_i)$  on a scatter plot.
- Draw the Regression Line: Using the slope  $\beta_1$  and intercept  $\beta_0$ , draw the line by connecting points on the graph that satisfy the equation.

$$Y = \beta_0 - \beta_1 X$$

Where:

$Y$  is the dependent variable (what want to predict).

$X$  is the independent variable (the predictor).

$\beta_0$  is the y-intercept (the value of Y when  $X=0$ ).

$\beta_1$  is the slope of the line (the change in Y for a one-unit change in X).

### 3.9. Introduction to Large Language Models

Large Language Models (LLMs) are advanced AI systems designed to understand and generate human language with high accuracy. Utilizing neural network architectures like transformers, LLMs are trained on extensive text data to perform various tasks, including text generation and question answering.

Many LLMs are trained on data that has been gathered from the Internet — thousands or millions of gigabytes worth of text. But the quality of the samples impacts how well LLMs will learn natural language, so programmers may use a more curated data set. LLMs use a type of machine learning called deep learning in order to understand how characters, words, and sentences function together. Deep learning involves the probabilistic analysis of unstructured data, which eventually enables the deep learning model to recognize distinctions between pieces of content without human intervention.

The specific kind of neural networks used for LLMs are called transformer models. Transformer models are able to learn context — especially important for

human language, which is highly context-dependent. Transformer models use a mathematical technique called self-attention to detect subtle ways that elements in a sequence relate to each other. This makes them better at understanding context than other types of machine learning.

### 3.9.1. Task-Specific Tuning of LLMs

LLMs are then further trained via tuning: they are fine-tuned or prompt-tuned to the particular task that the programmer wants them to do, such as interpreting questions and generating responses, or translating text from one language to another. Fine-tuning involves training the model on a specialized dataset relevant to the desired task, allowing it to learn specific patterns required for better performance.

This process enhances the ability of the model to generate more accurate, context-aware, and relevant outputs. Prompt-tuning, on the other hand, focuses on optimizing the prompts used to guide the model responses without altering the underlying parameters.

This technique is particularly useful for quickly adapting the model to new tasks or improving performance with minimal computational resources. Both fine-tuning and prompt-tuning allow developers to tailor LLMs for a wide array of applications, such as sentiment analysis, summarization, code generation, and more, enabling them to be flexible tools across various industries.

### 3.9.2. Llama 3.1

Llama 3.1, third-generation Large Language Model produced by Meta, excels in natural language tasks using the Transformer architecture. It provides accurate text understanding and generation, handling dialogue and question answering efficiently. Llama 3.1 405B is the first openly available model that rivals the top AI models when it comes to state-of-the-art capabilities in general knowledge, steerability, math, tool use, and multilingual translation.

The upgraded versions of the 8B and 70B models are multilingual and have a significantly longer context length of 128K, state-of-the-art tool use, and overall stronger reasoning capabilities. This enables Meta's latest models to support advanced use cases, such as long-form text summarization, multilingual conversational agents, and coding assistants. Integrating Lama-3.1 with the POS system enables real-time, insightful responses based on up-to-date data.

### 3.9.3. Model Evolutions

Figure 3.10. presents a comparative evaluation of several state of the art language models, including Llama 3.1 (8B and 70B), Gemma 2 9B-IT, Mistral 7B Instruct, Mistral 8x22B Instruct, and GPT 3.5 Turbo, across a comprehensive array of benchmarks.

Category Benchmark	Llama 3.1 8B	Gemma 2 9B IT	Mistral 7B Instruct	Llama 3.1 70B	Mistral 8x22B Instruct	GPT 3.5 Turbo
General						
<b>MMLU</b> (0-shot, CoT)	<b>73.0</b>	<b>72.3</b> (5-shot, non-CoT)	60.5	<b>86.0</b>	79.9	69.8
<b>MMLU PRO</b> (5-shot, CoT)	<b>48.3</b>	-	36.9	<b>66.4</b>	56.3	49.2
<b>IFEval</b>	<b>80.4</b>	73.6	57.6	<b>87.5</b>	72.7	69.9
Code						
<b>HumanEval</b> (0-shot)	<b>72.6</b>	54.3	40.2	<b>80.5</b>	75.6	68.0
<b>MBPP EvalPlus</b> (base) (0-shot)	<b>72.8</b>	71.7	49.5	<b>86.0</b>	78.6	82.0
Math						
<b>GSM8K</b> (8-shot, CoT)	<b>84.5</b>	76.7	53.2	<b>95.1</b>	88.2	81.6
<b>MATH</b> (0-shot, CoT)	<b>51.9</b>	44.3	13.0	<b>68.0</b>	54.1	43.1
Reasoning						
<b>ARC Challenge</b> (0-shot)	<b>83.4</b>	<b>87.6</b>	74.2	<b>94.8</b>	88.7	83.7
<b>GPQA</b> (0-shot, CoT)	<b>32.8</b>	-	28.8	<b>46.7</b>	33.3	30.8
Tool use						
<b>BFCL</b>	<b>76.1</b>	-	60.4	<b>84.8</b>	-	<b>85.9</b>
<b>Nexus</b>	<b>38.5</b>	30.0	24.7	<b>56.7</b>	48.5	37.2
Long context						
<b>ZeroSCROLLS/QuALITY</b>	<b>81.0</b>	-	-	<b>90.5</b>	-	-
<b>InfiniteBench/En.MC</b>	<b>65.1</b>	-	-	<b>78.2</b>	-	-
<b>NIH/Multi-needle</b>	<b>98.8</b>	-	-	<b>97.5</b>	-	-
Multilingual						
<b>Multilingual MGSM</b> (0-shot)	<b>68.9</b>	53.2	29.9	<b>86.9</b>	71.1	51.4

Figure 3.10. Evaluation of LLAMA 3.1 against Other Language Models

### 3.9.4. Integration of LLM in POS System

In this integration, Llama 3.1 model is connected to the POS database, which serves as the data source for the chat functionality within the POS system. Firebase provides a real-time, scalable database that stores and updates the relevant data. By feeding this data into the Llama 3.1 model, the system ensures that the responses generated by the AI are informed by the most current and pertinent information. This real-time data access allows the model to deliver more accurate, contextually relevant, and personalized interactions. Consequently, this setup enhances the overall user experience by providing timely and precise responses based on the latest updates from the Firebase database, thereby improving the efficiency and effectiveness of the chat functionality within the POS environment.

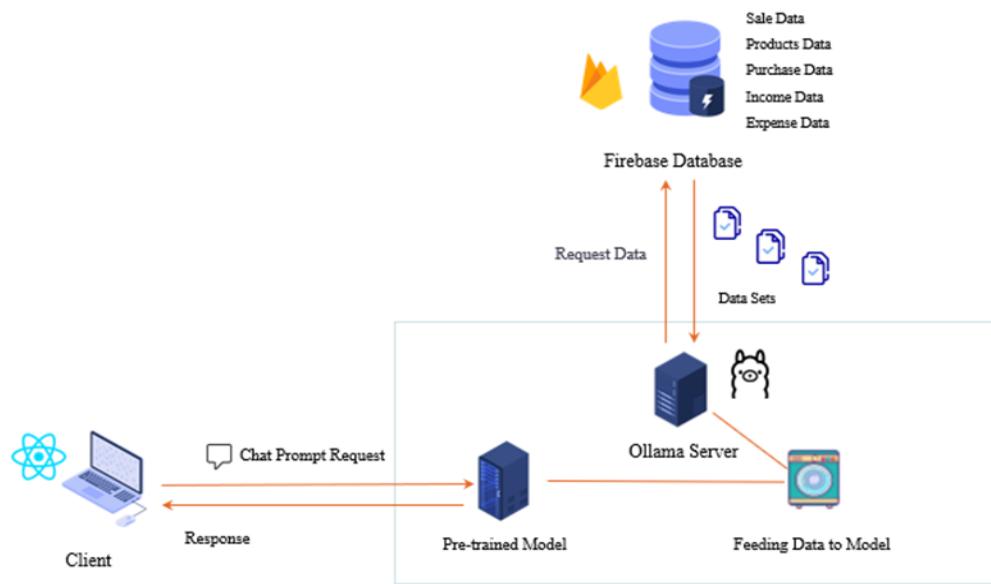


Figure 3.11. Integration of LLMs

## CHAPTER 4

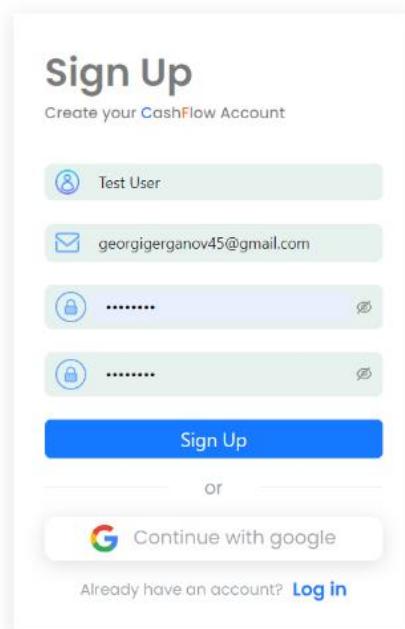
### IMPLEMENTATION OF POS SYSTEM

#### **4.1. Users Management System**

In the Users Account Management System, the core functionalities such as Login, Sign-Up, Password Recovery and Google account integration are implemented. The system also supports the creation and management of multiple shop branches.

##### **4.1.1. Create User Account**

To use this system, the first step is the creation of an account. Figure 4.1 illustrates how account creation process can be initiated.



The image shows a 'Sign Up' form for creating a CashFlow Account. The form has a light gray background with a white input area. At the top, it says 'Sign Up' and 'Create your CashFlow Account'. Below that is a green input field with a user icon and the placeholder 'Test User'. The next field is for an email address, showing 'georgirganov45@gmail.com'. There are two password fields, both with lock icons and placeholder dots. A blue 'Sign Up' button is at the bottom. Below the button is a horizontal line with the word 'or' in the center. Underneath is a 'Continue with google' button featuring the Google logo. At the very bottom, there's a link 'Already have an account? Log in'.

Figure 4.1. Sign Up Form

##### **4.1.2. Verify Account**

Once an account has been successfully created using the user email address, a verification message will be sent to confirm the email address. Figures 4.2 and 4.3 illustrate the process of receiving a verification message after an account has been successfully created.

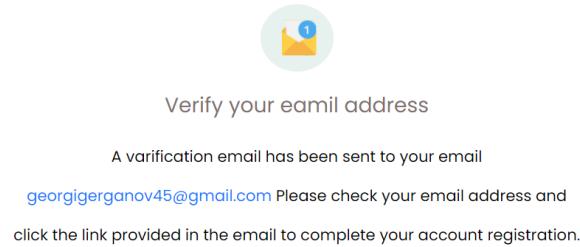


Figure 4.2. Verification Message

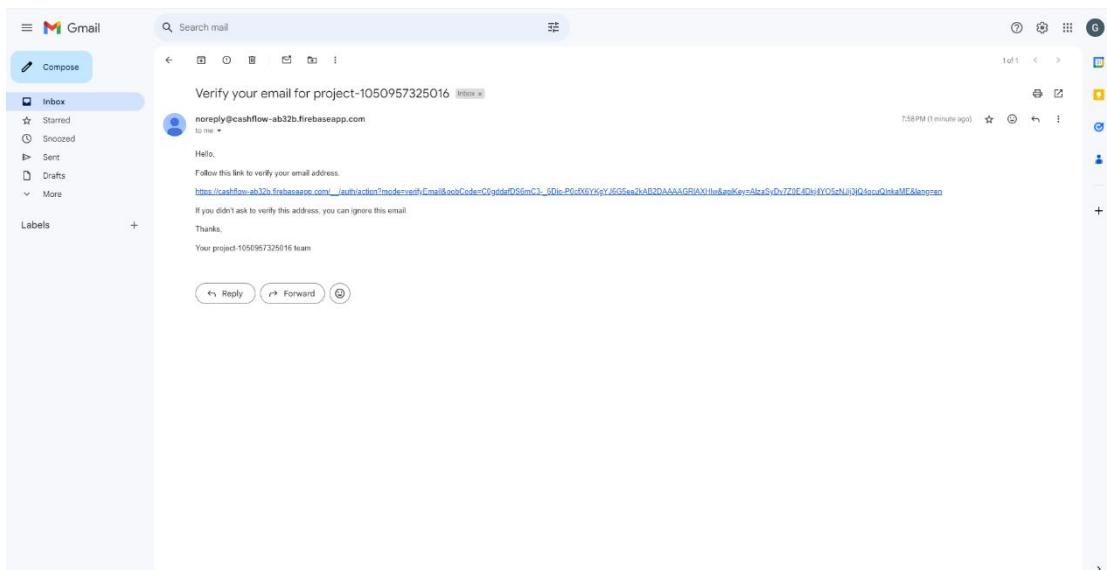


Figure 4.3. Email Template

#### 4.1.3. Login with Email

Figure 4.4 details the process by which users who have previously registered for the account can directly login into their existing account.

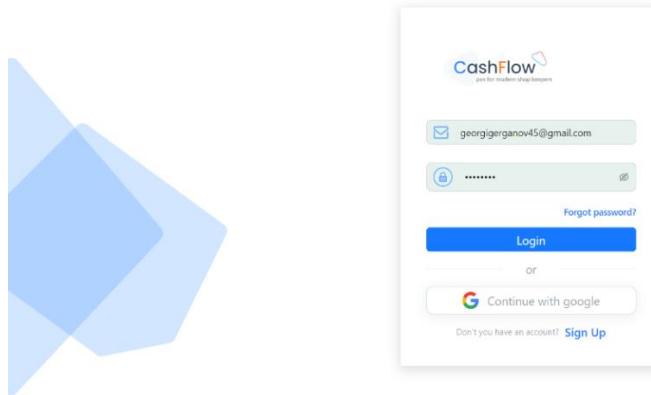


Figure 4.4. Account Login Form

#### 4.1.4. Forgot Password

If a user who forgets password, a new password can be requested through the recovery link. This procedure allows for the creation and confirmation of a new password, as outlined in Figure 4.5.

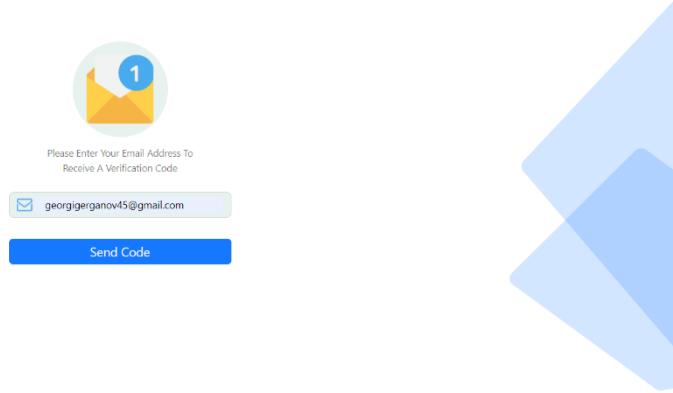


Figure 4.5. Reset Password Form

#### 4.1.5. Login with Google Account

If Google account is available, the POS account can be accessed directly using Google credentials, as shown in Figure 4.6.

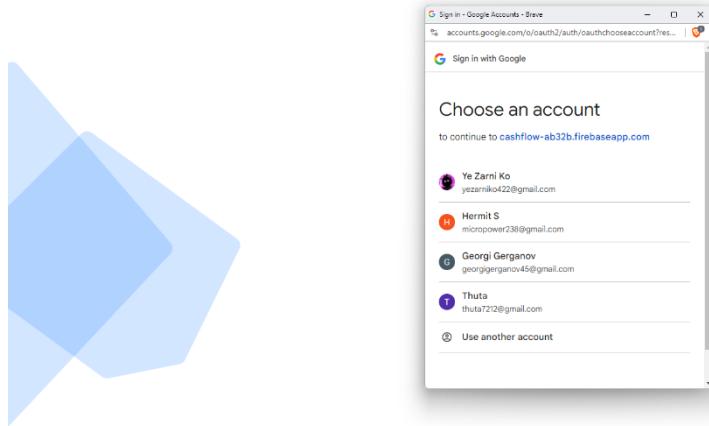


Figure 4.6. Google Sign-in Popup

## 4.2. Core POS System

The core POS system serves as the central component of the overall system. In the Core POS System, key features such as Product Management, Sales Processing, and Order System have been implemented.

#### 4.2.1. Home Page

When a successful login with the correct username and password, the main page is displayed, as depicted in Figure 4.7.

The screenshot shows the CashFlow Home Page. On the left is a sidebar with icons for Home, Sale, Products, Logs, Statistics, LLAMA 3.1, and Settings. The main area displays:

- Today Sale : 43000 ks** at **8:07 PM** on **27/08/24 TUE**
- Recent Sales** table:
 

	Products	Counts	Amounts
1	Horizon Organic Whole Milk	1	4000
2	Green Milk	2	8000
3	Sensitive Toothpaste	2	4000
4	Bavarian	2	7000
5	Apple	3	9000
6	Orange	2	3000
- Today's Upsale** table:
 

Rank	Product	Count
1	Potato Chip	4
2	VCode	3
3	Apple	3
4	Orange	2
5	Bavarian	2
- Order List** table:
 

Lenovo v15	<input checked="" type="checkbox"/> done
Mac Book	<input type="checkbox"/> done

Figure 4.7. Home Page

#### 4.2.2. Sale Page

In the sales page as shown in Figure 4.8 and Figure 4.9, the process starts with adding products from the product list to the cash list and user can perform each sale process.

The screenshot shows the CashFlow Sale Page. On the left is a sidebar with icons for Home, Sale, Products, Logs, Statistics, LLAMA 3.1, and Settings. The main area displays:

- Product Name or ID** input field with **Manual**, **Barcode Scan**, and **Webcam Scan** buttons.
- Product List** table:
 

Khao Shong Coffee	Category: Drinks	Price: 6000ks	<b>+</b>
Apple	Category: Foods	Price: 3000ks	<b>+</b>
Herballine Body Shower	Category: Bath & Beauty	Price: 7000ks	<b>+</b>
Potato Chip	Category: Snack	Price: 500ks	<b>+</b>
TEST	Category: Bath & Beauty	Price: 3000ks	<b>+</b>
VCode	Category: Drinks	Price: 2000ks	<b>+</b>
Orange	Category: Foods	Price: 1500ks	<b>+</b>
Bavarian			<b>+</b>
- Product**, **Qty**, and **Price** summary table:
 

Product	Qty	Price
- Empty Cart** icon.
- Receipt**: 0 ks
- Exchange**: 0 ks
- Total**: 0 ks
- Cash** button.

Figure 4.8. Sale Page

The screenshot shows the CashFlow application interface. On the left is a sidebar with icons for Home, Sale (selected), Products, Logs, Statistics, LLAMA 3.1, and Settings. The main area has a header 'Product Name or ID' with buttons for Manual, Barcode Scan, and Webcam Scan. Below is a list of products:

Product	Qty	Price
Coca Cola	2	1000 ks
Green Milk	1	4000 ks
Horizon Or...	4	4000 ks

Quantity: 4

Receipt: 22000 ks  
Exchange: 0 ks  
Total: 22000 ks  
Cash

Figure 4.9. Illustration of after the User Adds Products to the Cash List

#### 4.2.3. Add Products with Barcode Scanner

The user can utilize the barcode scanner to add products to the cash list, as shown in Figure 4.10. Once the products are added, a confirmation message for the cash transaction is displayed to the user, as illustrated in Figure 4.11. After a sale, these products are logged in the system to keep records and support further processing, such as inventory management and sales analysis.

The screenshot shows the CashFlow application interface. The 'Barcode Scan' button in the header is highlighted. The main area displays the same list of products as Figure 4.9, with the 'Scanning' status indicator above the product list.

Product	Qty	Price
Coca Cola	2	1000 ks
Green Milk	1	4000 ks
Horizon Or...	4	4000 ks

Receipt: 22000 ks  
Exchange: 0 ks  
Total: 22000 ks  
Cash

Figure 4.10. Illustration of Adding Products with a Barcode Scanner



Figure 4.11. Confirmation Cash Message

#### 4.2.4. Product Page

The product page shown in Figure 4.12 presents a detailed list of products from both the main and branch shops. It allows users to manage product data by adding new items, updating quantities, logging changes, editing details, and deleting products as needed.

The screenshot shows the 'Products' section of the CashFlow application. On the left is a sidebar with icons for Home, Sale, Products (selected), Logs, and Statistics. At the bottom are buttons for LLAMA 3.1 and Settings.

The main area has a search bar and a 'Add New Product' button. Below is a table with columns: Product, Product Id, Category, Brand, Buying Price, Sale Price, Initial Stock, Stocks, and Modified Date. The table lists various products with their details and status indicators.

Product	Product Id	Category	Brand	Buying Price	Sale Price	Initial Stock	Stocks	Modified Date
Khao Shong Coffee	8852099100114	Drinks	Khao Shong	4000	6000	50	41	Tue Aug 20 2024 22:49:26
Apple	8832439210529	Foods	Good Fruits	2000	3000	66	60	Tue Aug 20 2024 15:54:53
Herballine Body Shower	8885010032195	Bath & Beauty	Herballines	6000	7000	50	44	Tue Aug 20 2024 15:36:02
Potato Chip	8832439715970	Snack	Shar Jun Htce	400	500	120	98	Mon Aug 19 2024 1:44:40 PM
TEST	8832439499481	Bath & Beauty	Addidas	2000	3000	20	20	Mon Aug 19 2024 11:39:28 AM
VCode	8832439484814	Drinks	Cocacola	1500	2000	70	59	Mon Aug 19 2024 11:06:08 AM
Orange	8832439785348	Foods	Addidas	1000	1500	60	29	Fri Aug 16 2024 4:02:38 PM
Bavarian	8832439276501	Foods	Sara Lee	3000	3500	115	98	Thu Aug 15 2024 2:19:56 PM

Figure 4.12. Product Page

#### 4.2.5. Add New Product Form

Figure 4.13 demonstrates how to fill out the product form. Within this form, users can input and manage vital product information seamlessly. ‘Product Code’ field provides flexibility by offering two options for providing it. Users can either

automatically generate a unique European Article Number (EAN) barcode for each product or can use a barcode scanner to scan Universal Product Code (UPC) or European Article Number (EAN) Code.

The screenshot shows the 'Add New Product' form within the CashFlow software. The left sidebar has links for Home, Sale, Products (which is selected and highlighted in purple), Logs, Statistics, LLAMA 3.1, and Settings. The main form has a header 'Add New Product' and a note: 'Please make sure that new product already exists in the store before adding it.' It contains fields for Product Name (Orange), Product Id (8832439796245), Category (Fruits), Brand (Fresh Fruits), Buying Price (1000), Sale Price (2000), Domain counts (50), and Branch (main). There are 'Generate' and 'Scan' buttons, and 'Submit' and 'Close' buttons at the bottom.

Figure 4.13. New Product Form

After filling out the new product form, users will be greeted with a success message upon successful creation. Figure 4.14 displays the successful addition of a new product. The product added by the user will be displayed in the products page.

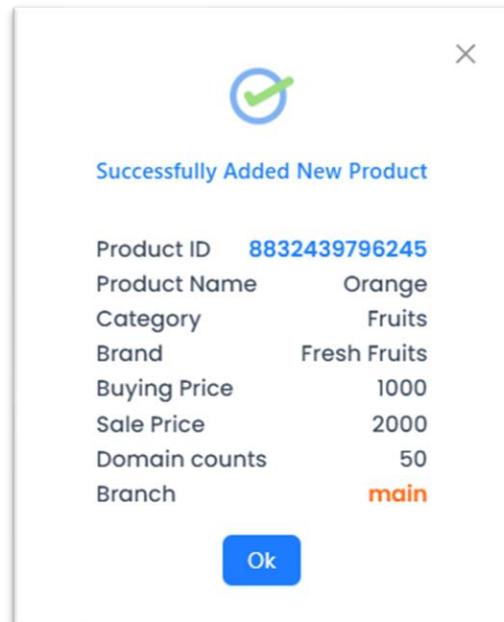


Figure 4.14. Successfully Added New Product Popup

#### 4.2.6. Append Product

The product page provides the flexibility to select the append option for each product, allowing users to modify the quantity of each item as needed. Figures 4.15 illustrates the product page with update options.

The screenshot shows the CashFlow application interface. On the left is a sidebar with icons for Home, Sale, Products (selected), Logs, Statistics, Llama 3.1, and Settings. The main area is a table of products:

Product	Product ID	Category	Brand	Buying Price	Sale Price	Initial Stock	Stocks	Modified Date	Actions
Khao Shong Coffee	885209910014	Drinks	Khao Shong	4000	6000	50	41	Tue Aug 20 2024 22:49:26	... Append
Apple	8832439210529	Foods	Good Fruits	2000	3000	66	60	Tue Aug 20 2024 16:55:28	... Logs
Herballine Body Shower	8885010032195	Bath & Beauty	Herballines	6000	7000	50	44	Tue Aug 20 2024 16:55:28	... Edit
Potato Chip	8832439715870	Snack	Shar Jun Htoe	400	500	120	98	Mon Aug 19 2024 1:44:28 AM	... Correlations
TEST	8832439499481	Bath & Beauty	Addidas	2000	3000	20	20	Mon Aug 19 2024 11:39:28 AM	... Delete
VCode	8832439484814	Drinks	Cocacola	1500	2000	70	59	Mon Aug 19 2024 11:06:08 AM	...
Orange	8832439785348	Foods	Addidas	1000	1500	60	29	Fri Aug 18 2024 4:02:38 PM	...
Bavarian	8832439278501	Foods	Sara Lee	3000	3500	115	98	Thu Aug 15 2024 2:19:56 PM	...

Figure 4.15. Products Page with Options

Upon choosing the append option, the user can access an append product log, with product details, and a dialogue box to update the product quantity. Figure 4.16 for a visual guide on appending to existing products.

**Append Product**

Product Name	Khao Shong Coffee
Product ID	885209910014
Modified Date	Tue Aug 20 2024
Domain Stocks	50
Stocks	41
Append:	20
Buying Price:	4000
Sale Price:	6000
Submit	Cancel

Figure 4.16. Append Product Dialogue

Once the user has made changes to the quantity of each product, a notification will confirm the successful update, and the newly adjusted quantities will be automatically reflected in the main product list.

#### 4.2.7. Edit Product

Users can edit each product according to the preferences for each individual field as shown in Figure 4.17. It includes options to update the product image, name, category, and brand. Users can also adjust the selling price and the purchased.

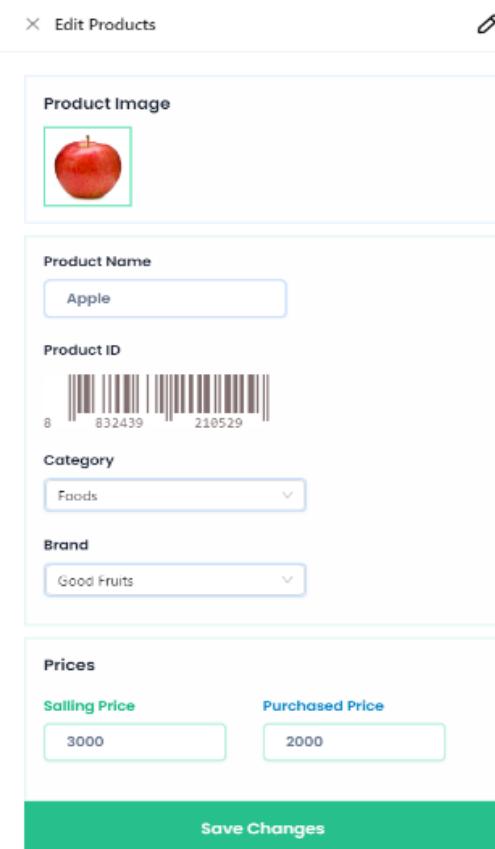


Figure 4.17. Product Page with Edit Option

#### 4.2.8. Product Logs

Product logs offer two key views, Product Sales and Product Purchases, as shown in Figures 4.18 and 4.19 that enable users to monitor performance and inventory flow of a product. Each view features a graph that visually represents the trends of sales or purchases, highlighting patterns such as peak sales periods or restocking dates. Below the graphs, detailed log tables display transaction records, including dates, times, quantities, prices, and total amounts, offering a comprehensive breakdown of each sale or purchase.

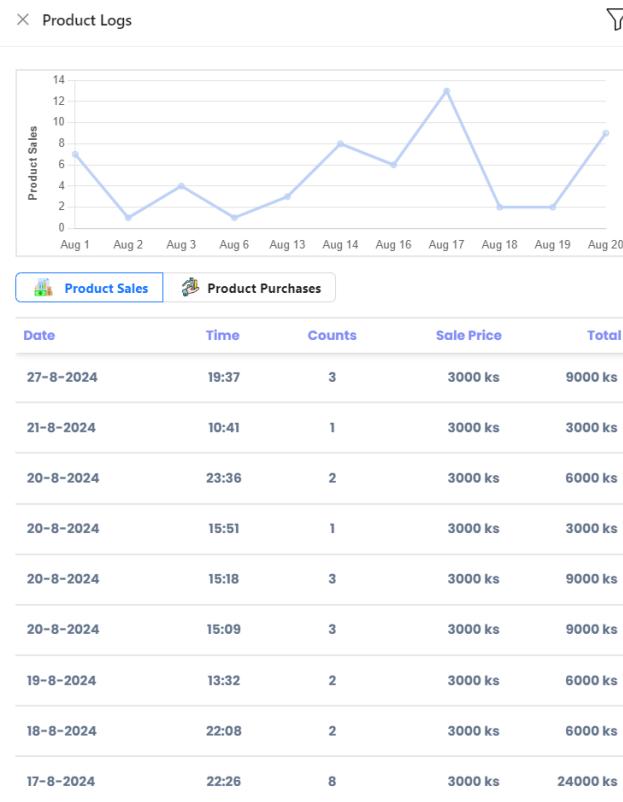


Figure 4.18. Product Page with Sale Logs



Figure 4.19. Product Page with Purchase Logs

#### 4.2.9. Products Correlation

The correlations of products feature as shown in Figure 4.20 allows users to analyze the relationship between the sales of two products. It features a scatter plot that visually represents the correlation between the selected primary product and other products, with a best-fit line indicating the trend of their relationship. A table below lists various products along with their Pearson correlation coefficients, which quantify the strength and direction of the linear relationship with the primary product. By clicking on different products, users can explore and interpret how changes in the sales of one product might correlate to changes in another, aiding in sales trend analysis and decision-making.

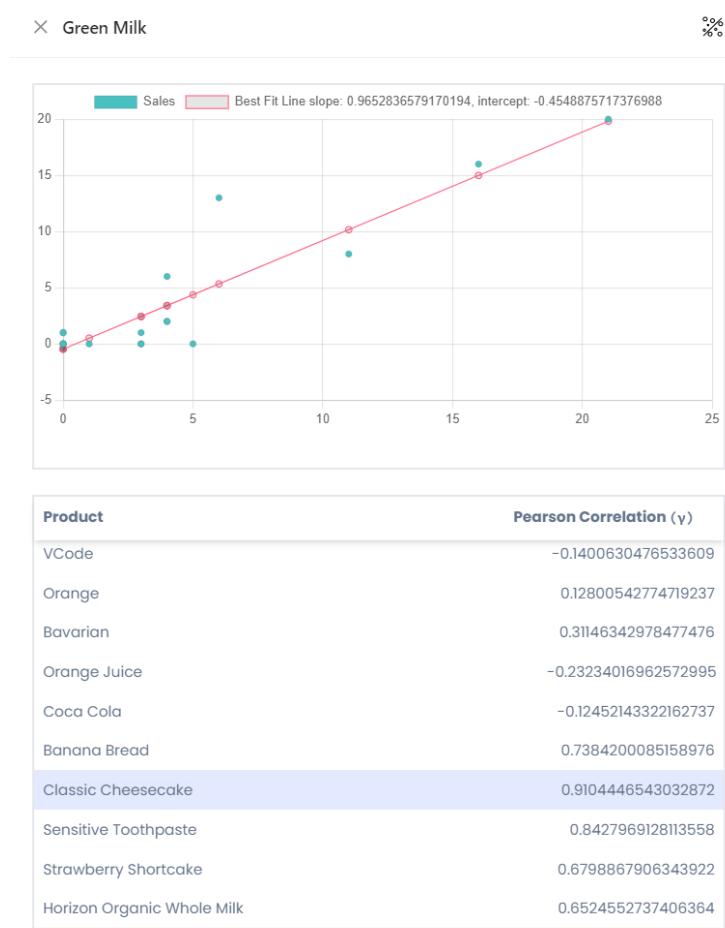


Figure 4.20. Correlation of Products

#### 4.2.10. Sorting and Filtering Products

As shown in Figure 4.21, the sort and filter features on product page enable users to efficiently manage and navigate through products data. The sort feature allows users to organize the product list based on specific criteria, such as "By Name" or "By

"Recently Added" and to arrange the data in either ascending or descending order. This flexibility helps users quickly find products based on their preferences. The filter feature provides options to narrow down the product list by selecting specific categories or brands. By applying these filters, users can easily focus on a subset of products that match particular characteristics or requirements.

Figure 4.21. Illustration of Products Filter and Sorting Features

#### 4.2.11. Product Categories and Brands Management

The POS system provides an intuitive interface, as illustrated in Figure 4.22, for effectively managing product categories and brands. It features options for listing, adding, editing, and deleting entries. Users can easily create new categories or brands with the Add New button, update existing names by clicking the edit icon, and remove entries with the delete icon.

Figure 4.22. Categories and Brands Dialogues

#### 4.2.12. Order System

As shown in Figure 4.23, Order Management System allows user to efficiently add, review, and manage customer orders. To add a new order, click the Add Order button, fill the product, customer, and service details, and save the entry. All current orders are displayed in the Order List, where user can mark orders as complete by checking the corresponding box. To review the details of any order, simply select it from the list to view the product, customer name, and contact information as illustrated in Figure 4.24. This system streamlines the process of keeping track of orders.

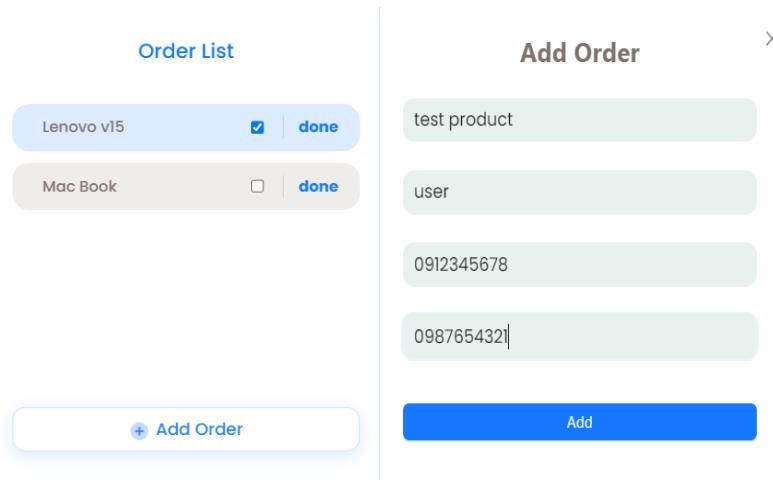


Figure 4.23. Order List and Create New Order Dialogue

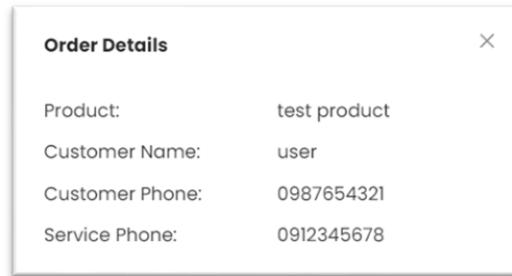


Figure 4.24. Order Details Dialogue

#### 4.3. Accounting Management System

Accounting Management System provides businesses with essential tools to track and analyze financial performance. This system track and analyze various aspects of operations, including sales through sales logs, purchases through purchase logs, and revenue through income logs. Additionally, statistics modules offer visual representations of this data, enabling businesses to identify trends, assess performance, and make informed decisions.

### 4.3.1. Sale Logs

The Sale Logs page as illustrated in Figure 4.25, displays a list of sale records, each associated with a unique Customer ID, showing details such as the transaction amount, time, and date. Each sale record can be expanded to reveal detailed information about the products sold, including product identifiers, names, quantities, and individual prices.

Customer ID	Amount	Time	Date
#075759E9hX4u11slpZ	25000 ks	20:18	27-8-2024
8832439249512	Orange Juice	3	12000 ks
8832439276591	Bavarian	1	3500 ks
8812419912438	Horizon Organic Whol...	2	8000 ks
8832439715970	Potato Chip	3	1500 ks
#0534h2LjBXPAoRCh0XY	22000 ks	20:16	27-8-2024
#051wq-Qk1AmUAnjfI0Q	12000 ks	19:38	27-8-2024
#051wo0jjo20Jeh221118	4000 ks	19:38	27-8-2024
#051wk09mu8kaw@zrMh	7000 ks	19:37	27-8-2024
#051wjocgAkirBsmaint	12000 ks	19:37	27-8-2024
#051sztjq7VGHQDQMyCl	8000 ks	19:21	27-8-2024

Figure 4.25. Sale Logs Page

### 4.3.2. Purchase Logs

Purchase Logs displays a list of purchase records organized by date, with each entry showing the total amount spent on that day. Expanding a record reveals detailed information about the items purchased, including unique product identifiers, product names, quantities, and the corresponding costs. Figure 4.26 presents an illustration of the purchase logs page.

Date	Amount		
27-8-2024	130000 ks		
20-8-2024	1080000 ks		
8832439210529	Apple	50	100000 ks
8999999525613	TEST2	20	40000 ks
8885010032195	Herballine Body Show...	50	300000 ks
8832439210529	Apple	10	20000 ks
8852093180114	Khoa Shong Coffee	50	200000 ks
9794318012473	Laws of Human Nature	30	210000 ks
9794318012473	Laws of Human Nature	30	210000 ks
19-8-2024	378500 ks		
18-8-2024	42000 ks		

Figure 4.26. Purchase Logs Page

### 4.3.3. Incomes Page

As illustrated in Figure 4.27 and Figure 4.28, the Incomes page provides a sequential list of income records, displaying the date, total amount earned, and corresponding profits for each entry. Each record has an option to view detailed information, allowing users to access further insights into the financial data of specific days.

The screenshot shows the 'Incomes' section of the CashFlow app. On the left is a sidebar with icons for Home, Sale, Products, Logs, Statistics, LLAMA 3.1, and Settings. The main area has a header 'Incomes' with a 'main' button. Below is a table with columns: Date, Amount, Profits, and a 'details' button for each row. The data rows are:

Date	Amount	Profits	
Tue Aug 27 2024	90000 ks	30200 ks	details
Wed Aug 21 2024	21000 ks	7000 ks	details
Tue Aug 20 2024	133840 ks	35020 ks	details
Mon Aug 19 2024	99600 ks	25650 ks	details
Sun Aug 18 2024	62520 ks	25010 ks	details
Sat Aug 17 2024	80500 ks	25000 ks	details
Fri Aug 16 2024	44800 ks	12050 ks	details
Thu Aug 15 2024	15500 ks	7000 ks	details
Wed Aug 14 2024	78500 ks	26250 ks	details
Tue Aug 13 2024	25020 ks	7510 ks	details

On the right side of the main area, there are three buttons: 'Sales' (with a bar chart icon), 'Purchases' (with a shopping cart icon), and 'Incomes' (with a cash icon). The 'Incomes' button is highlighted with a purple background.

Figure 4.27. Incomes Page

× Details						
ID	Name	Counts	Sale Price	Buying Price	Total	Profits
8832439249512	Orange Juice	3	4000 ks	2000 ks	12000 ks	6000 ks
8832439276501	Bavarian	5	3500 ks	3000 ks	17500 ks	2500 ks
8832439932438	Horizon Organic Whole Milk	12	4000 ks	2500 ks	48000 ks	18000 ks
8832439715970	Potato Chip	11	500 ks	400 ks	5500 ks	1100 ks
8832439346433	Coca Cola	2	1000 ks	750 ks	2000 ks	500 ks
8832439729076	Green Milk	5	4000 ks	2500 ks	20000 ks	7500 ks
035000525413	Sensitive Toothpaste	2	2000 ks	1500 ks	4000 ks	1000 ks
8832439785348	Orange	2	1500 ks	1000 ks	3000 ks	1000 ks
8832439210529	Apple	3	3000 ks	2000 ks	9000 ks	3000 ks
8832439484814	VCode	3	2000 ks	1500 ks	6000 ks	1500 ks

Figure 4.28. Incomes Page with Details

#### 4.3.4. Statistics Page

The statistics page as shown in Figure 4.29 of the POS system provides a comprehensive overview of sales data, featuring a line graph that tracks total sales over a selected time period (week, month, or year), a pie chart displaying the distribution of sales across different product categories, and a bar chart comparing peak and current sales for various products.

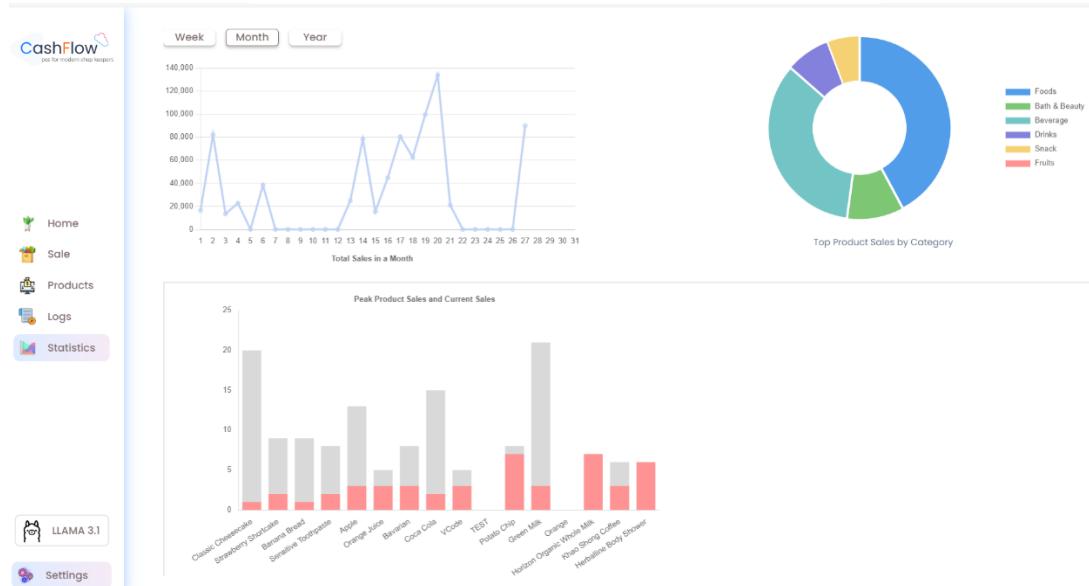


Figure 4.29. Statisitcs Page

#### 4.4. Settings Page

The settings page provides essential management features across three main sections: Account, Branch, and LLM Training. The account section allows users to manage personal information, such as editing the account name and email address, and securely changing passwords to maintain account security. The branch section supports businesses with multiple locations by enabling users to create, view, and switch between different branches, ensuring efficient management of each store. LLM training section is designed for training large language models (LLMs), allowing users to customize and refine the capabilities of the system.

##### 4.4.1. Account Settings

The account settings page of the POS system offers essential features for managing user account details and security. The account name and email address can be viewed and updated, with an option to edit these details as needed. Additionally, the page provides a secure section for changing the account password, requiring the user to

input current password, a new password, and a confirmation of the new password to ensure accuracy. Figure 4.30 presents an illustration of the account settings.

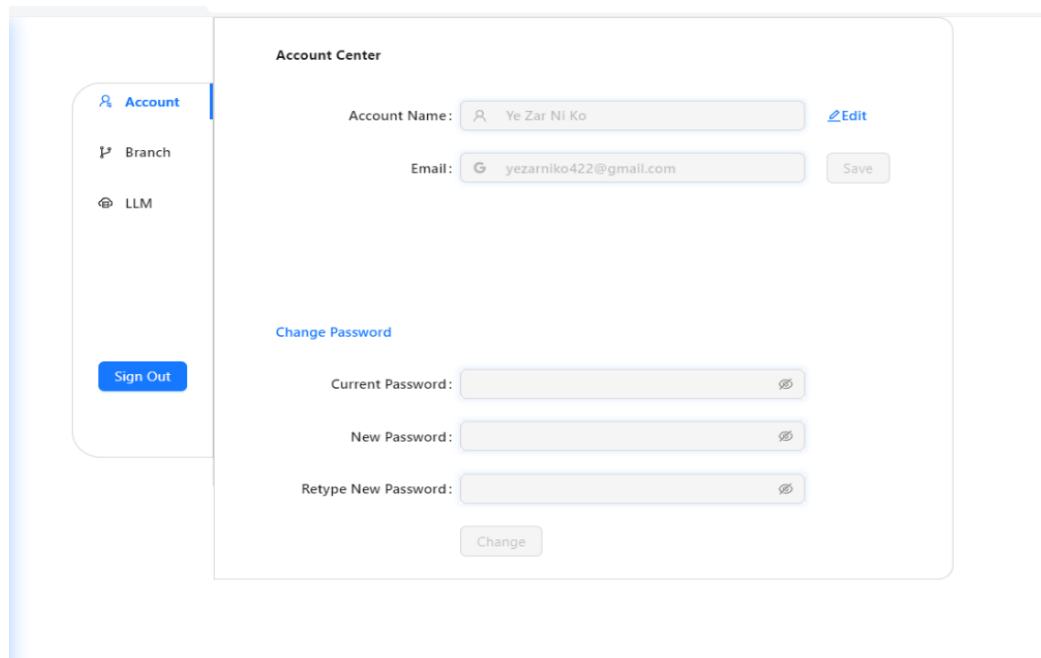


Figure 4.30. Account Settings Page

#### 4.4.2. Branch Settings

The branches system in Figure 4.31 allows businesses to effectively manage multiple store locations by creating and organizing different branches. Users can easily create new branches, assign unique identifiers using dialogue in Figure 4.32 and switch between branches to view specific data or perform branch-specific tasks.

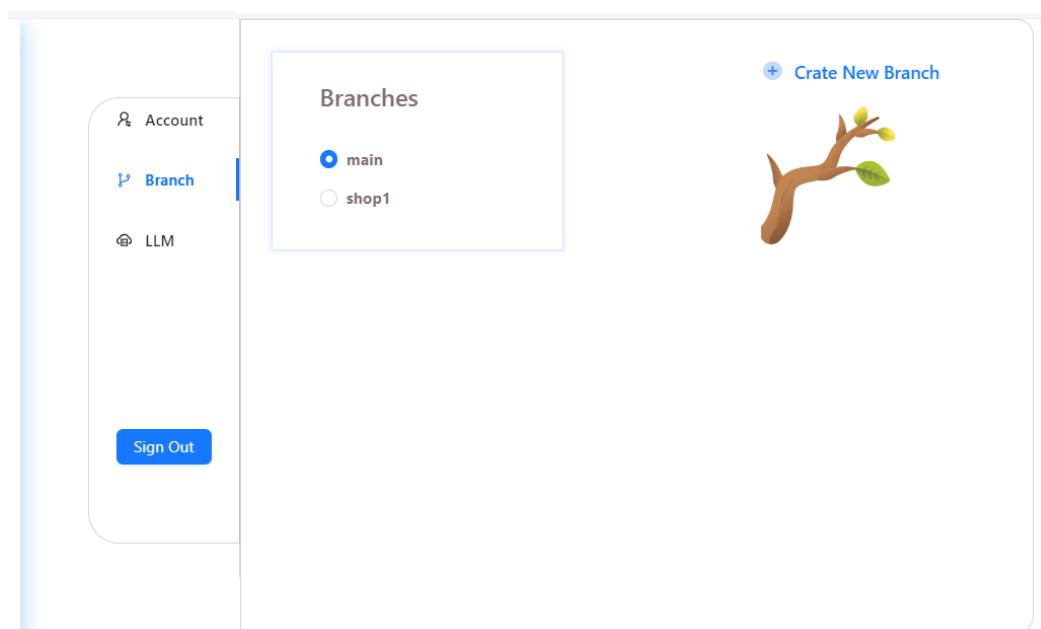


Figure 4.31. Branch Settings Page

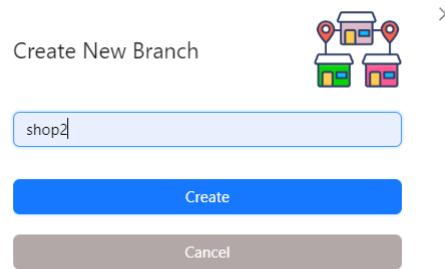


Figure 4.32. Create New Branch Dialogue

#### 4.4.3. Large Language Model Training Page

The LLM Training Section page in Figure 4.33 allows users to monitor and manage the training of a language model named ‘llama3.1:latest’, with a parameter size of 8 billion. It provides key model details such as format, quantization level, and the last training date. Users can connect to the Ollama server and initiate model training via a designated button. The page also shows the preparation of training data, including a preview of product-related JSON data, highlighting various attributes like brand, price, category, and modification dates.

Model:	llama3.1:latest
Parameter Size:	8.0B
Family:	LLAMA
Format:	GGUF
Quantization Level:	Q4_0
Last Trained Date:	8/20/2024, 2:54:49 AM
<a href="#">Train Model</a>	
<pre> Preparing Data... Data size: 16.254 KB  [{"products": [{"brand": "Sara Lee", "buyingPrice": 500, "category": "Foods", "counts": 11, "domainCounts": 20, "productId": "032100020114", "productName": "Classic Cheesecake", "recentModifiedDate": "Sun Aug 04 2024 3:50:49 PM", "salePrice": 800}, {"brand": "Sara Lee", "buyingPrice": 10, "category": "Foods", "counts": 22, "domainCounts": 54, "productId": "032100020169", "productName": "Strawberry Shortcake", "recentModifiedDate": "Mon Jul 29 2024 12:02:03 PM", "salePrice": 20}, {"brand": "Organic Valley", "buyingPrice": 2500, "category": "Foods", "counts": 41, "domainCounts": 50, "productId": "032100082426", "productName": "Banana Bread", "recentModifiedDate": "Sun Aug 04 2024 4:19:19 PM", "salePrice": 3500}, {"brand": "Colgate", "buyingPrice": 1500, "category": "Bath &amp; Beauty", "counts": 60, "domainCounts": 100, "productId": "035000525413", "productName": "Sensitive Toothpaste", "recentModifiedDate": "Mon Jul 29 2024 12:01 PM", "salePrice": 2000}, {"brand": "Addidas", "buyingPrice": 2000, "category": "Foods", "counts": 13, "domainCounts": 30, "productId": "8832439210529", "productName": "Apple", "recentModifiedDate": "Fri Aug 16 2024 11:16:30 PM", "salePrice": 3000}, {"brand": "Cocacola", "buyingPrice": 2000, "category": "Beverage", "counts": 38, "domainCounts": 50, "productId": "8832439249512", "productName": "Orange Juice", "recentModifiedDate": "Wed Aug 14 2024 11:48:17 AM", "salePrice": 4000}, {"brand": "Bavarian", "buyingPrice": 3000, "category": "Foods", "counts": 101, "domainCounts": 115, "productId": "8832439276501", "productName": "Bavarian", "recentModifiedDate": "Thu Aug 15 2024 2:19:56 PM", "salePrice": 3500}, {"brand": "Cocacola", "buyingPrice": 750, "category": "Beverage", "counts": 181, "domainCounts": 200, "prod </pre>	

Figure 4.33. LLM Training Section

## 4.5. LLM Conversation Section

The LLM Chat page in this POS system facilitates interactive communication with a language model. On the left sidebar, users can view and select from a list of previous chat sessions or start a new session. The main chat interface features a "Prompt" input field where users can type queries. The AI responses appear on the right side, where it provides detailed information and insights, such as business performance, sales data, and answers to specific queries about the shop. The chat history is displayed in a conversational format, with the user input and the AI responses clearly delineated, allowing for an ongoing dialogue. This interface, as shown in Figure 4.34, is designed to assist users in managing business by quickly answering queries and providing relevant insights based on the data from the POS system.

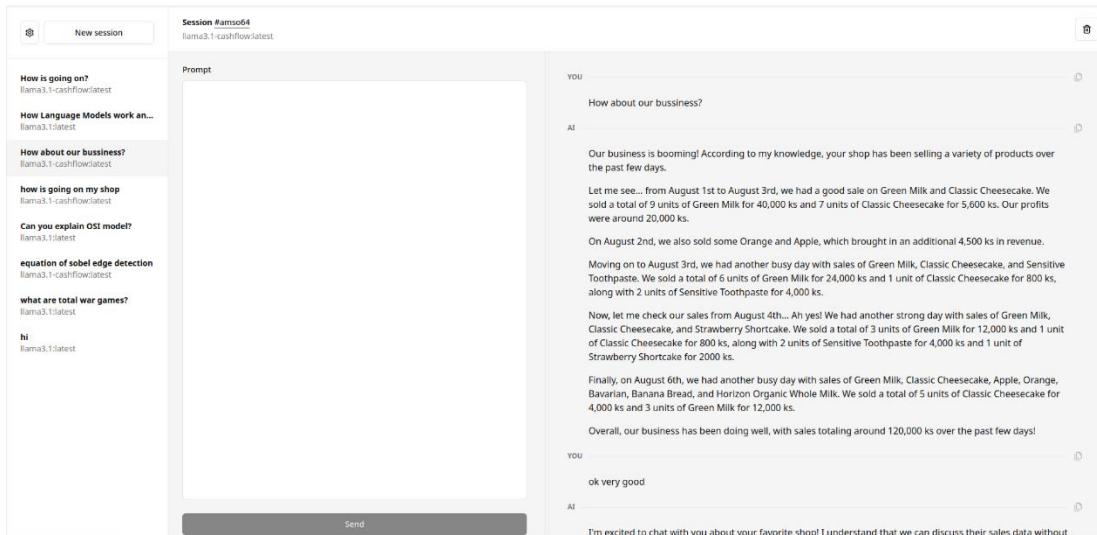


Figure 4.34. LLM Conversation Section

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1. Conclusion**

A web-based Point of Sale (POS) system is merged by advanced statistical analysis, robust core POS functionalities, comprehensive accounting management, and efficient user management. Agile methodologies were applied, ensuring that contemporary retail challenges were addressed with precision and efficiency. Significant strength is found in the sophisticated statistical analysis, particularly the correlation analysis functionality, which provides deep insights into financial metrics and operational performance, enabling informed, data-driven decisions.

Accounting management features were designed to support accurate record-keeping and financial oversight. This includes real-time inventory tracking, comprehensive financial reporting, and precise transaction recording, all essential for effective accounting and auditing processes. User management was seamlessly integrated, ensuring secure authentication, real-time data synchronization, and scalability, thereby enhancing system reliability.

Advanced natural language processing was incorporated through the integration of Large Language Models (LLM), enhancing user interaction through chat-based support and intelligent data analysis.

Future updates will focus on expanding LLM functionalities, including automated report generation, personalized customer interactions, and advanced data analysis. Additionally, planned improvements include enhanced order tracking, supply chain management integration, and advanced inventory tools. The POS system thus provides a comprehensive solution to current retail challenges and is well-positioned for future advancements.

## **REFERENCES**

- [1] Web-Based Point of Sale (POS) System: A Case Study of a Small and Medium-Sized Enterprise (SME) in Malaysia by H. E. Hoque, H. J. Abdul, and M. S. H. Ismail (2019)
- [2] Design and Implementation of a Web-based POS System for Small Businesses by C. C. Onwuchekwa, N. A. Ugwuishiwu, and C. C. Eze (2018)
- [3] Development of a Web-Based POS System for Small Retail Businesses: A Case Study by N. N. Nwankwo, U. I. Obinna, and C. C. Eze (2017)
- [4] Cloud-Based POS Systems: An Evaluation Framework by A. Gunasekaran, E. W. T. Ngai, and T. Papadopoulos (2017)
- [5] Design and Implementation of Web-based POS System by A. Bello (2012)
- [6] <https://firebase.google.com/docs/build>
- [7] [https://simple.wikipedia.org/wiki/European\\_Article\\_Number](https://simple.wikipedia.org/wiki/European_Article_Number)
- [8] <https://chat.openai.com>
- [9] <https://ollama.com/library/llama3.1>