



**CENTRAL UNIVERSITY FACULTY OF SCIENCE AND TECHNOLOGY**

## **DEPARTMENT OF TECHNICAL SCIENCE**

## **1 SILICON HILL MILE 91**

SIERRA LEONE

## A STUDY ON

# MULTI-VENDOR ECOMMERCE PLATFORM

## A DISSERTATION

*submitted by*

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submitted on

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## **DECLARATION**

We hereby state that this bachelor's thesis entitled " Multi-Vendor ECommerce Platform" is our original work and has not been submitted to any institution for the award of a degree or diploma. We conducted the research according to the guidelines set by the institute and observed all ethical principles in preparing this paper. All information, computer programs, figures, references, and other content contained in this thesis have been properly cited and acknowledged. We understand that the Institute has a zero-tolerance policy against the use of unfair methods in the production of this academic document and that penalties may be imposed at any time if violations are found. We are solely responsible for any misstatements or plagiarism in this paper.

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## **CERTIFICATION**

I certify that Alhaji Bangura, Alusine Kayten Koroma, and Abubakarr Fofanah jointly wrote the paper entitled "Multi-Vendor E-Commerce Platform" they are students in the Faculty of Computer Science and Business Information Technology. This document is part of the requirements for the Bachelor of Science (Honors) in Computer Science and Business Information Technology. I monitor their work and can guarantee that the result is a true reflection of their efforts.

.....

Mr. Osman Kanu

(Project Supervisor)

.....

Date:

## **DEDICATION**

This dissertation is dedicated to our family for their love and support throughout our academic journey. To our parents who taught us the value of education and resilience, and to our siblings whose encouragement and understanding strengthened our resolve. Their trust in us was the source of our strength. This success is as much yours as it is ours.

## **ACKNOWLEDGEMENT**

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## **ABBREVIATIONS AND ACRONYMS**

SMEs: Small and Medium-sized Enterprises

SDLC: System Development Life Cycle

IT: Information Technology

E-commerce: Electronic Commerce

ICT: Information and Communication Technology

SSR: Server-Side Rendering

HTTPS: Hypertext Transfer Protocol Secure

npm: Node Package Manager

CORS: Cross-Origin Resource Sharing

MERN: MongoDB, Express.js, React, Node.js

CRUD: Create, Read, Update, Delete

UI: User Interface

UX: User Experience

OS: Operating System

RAM: Random Access Memory

CPU: Central Processing Unit

ATLAS: MongoDB Atlas (Managed Database Service)

GUI: Graphical User Interface

## ABSTRACT

This paper describes the development of a new multi-vendor e-commerce platform aimed at addressing Sierra Leone's key economic and market challenges. A design science methodology was used, including a literature review, agile software development approaches, and vendor research. The platform is designed to provide local vendors in Sierra Leone with an online marketplace to connect with customers and offer features such as user-friendly design, easy ordering process, secure payments, chat functionality, email notifications, and reliable delivery services.

Key findings from literature and market research include challenges due to lack of online marketplaces, limited economic opportunities and business growth, limited market access for suppliers, and unreliable transportation options impacting domestic trade. Key constraints related to were identified. The platform developed in this paper provides a solution to these obstacles.

A fully functional proof-of-concept platform will enable Sierra Leone vendors to reach a broader customer base online while overcoming their current reliance on offline commerce and accommodation. Testing and demonstration of this platform has confirmed its ability to expand sales channels, its efficiency in reaching more customers, and its potential to significantly improve economic opportunities in the region.

This project is about the development of an e-commerce website for different types of online products. Provide users with a catalog of different types of products that can be purchased in your store. To facilitate online shopping, users are provided with a shopping cart. The system is implemented using three-tier approach with a back-end database, a middle layer in the Typescript programming language using best-in class e-commerce frameworks such as React, and a web browser as the front-end client. Payment methods are Cash on Delivery or via Visa /Master card.

**Key words:** Multi-vendor, E-commerce platforms, Local vendors, Customer relationships, Trust in social commerce, Vendor characteristics, User interactions, Economic growth, and Transportation challenges

# **CHAPTER ONE**

## **Introduction**

### **1.0 Introduction**

E-commerce has quickly become the preferred method of shopping, prompting businesses to open online stores for seamless commerce. Our project is dedicated to building a dynamic online marketplace that offers diverse products including clothing and electronics and provides consumers with a convenient shopping experience at home. Our particular focus is the development of a multi-vendor e-commerce platform that allows a large number of sellers to present their products on our platform, increasing the diversity of customers.

This virtual store allows customers to easily navigate products, add items to their shopping cart, and complete their purchases securely online. During the ordering process, customers provide important details such as their preferred payment method, delivery address, and contact information. After the registration process, customers receive an instant confirmation email, making the transaction process more transparent and reliable.

Importantly, our project extends its scope to consider the experience of sellers within the Multi-Vendor Ecommerce Platform. Vendors are equipped with a seamless mechanism to withdraw their earnings, streamlining financial interactions and contributing to the overall efficiency of the platform. By examining these details, our objective is to elevate the online shopping experience for customers while concurrently establishing an intuitive and effective platform for sellers. Our endeavor is rooted in creating a mutually beneficial digital marketplace that optimally caters to the needs of both buyers and sellers, fostering a harmonious and prosperous e-commerce environment.

### **1.1 Statement of the Problem**

Sierra Leone's economy is suffering from a lack of online marketplaces that connect local vendor and customers. This limits economic opportunities and slows the growth of local businesses. Furthermore, the lack of accommodation in Sierra Leone's markets limits access to markets where local products can be obtained. Online marketplaces have the potential to expand sales channels and provide local vendors with a platform to reach a broader audience. Additionally, unreliable roads and transportation hinder Sierra Leone's internal trade. Online marketplaces with delivery services could lessen these hurdles and provide help with a more efficient way to reach customers.

## **1.2 Aim**

The purpose of this study is to build a centralized online marketplace that connects local vendors and customers with user-friendly design, ordering, secure payments, chat, email notifications, and reliable delivery services.

## **1.3 Objectives**

- i. To develop a user-friendly, centralized online marketplace platform specifically for connecting local vendors and customers across Sierra Leone.
- ii. To integrate an easy ordering process, secure payment options, chat functionality, and email notifications into the platform to facilitate vendor-customer transactions.
- iii. To build reliable, integrated logistics and delivery services into the platform to enable vendors to easily reach customers nationwide.

## **1.4 Significance of the Study**

This research is important because it has the potential to boost economic growth and improve access to local goods in Sierra Leone. This study aims to address the challenges of limited market access and unreliable transportation options by providing a centralized online marketplace that connects local vendors and customers. This could expand distribution channels for local goods and provide a more efficient way for vendors to reach customers. The ultimate goal is to build an online marketplace that benefits both local vendors and customers in Sierra Leone.

## **1.5 Scope of the Study**

The purpose of this research is to design and develop an innovative recommendation system for a multivendor e-commerce platform that allows small businesses and individual sellers to sell products online. The platform's target groups are customers and Sellers (Vendors), with a particular focus on providers who are small business owners and small online retailers rather than large corporations.

Online platforms focus on web functionality rather than mobile apps and focus on providing a streamlined user experience for buyers and sellers. Key features include vendor registration and onboarding tools, inventory and order management systems, secure payment processing, and user ratings and review capabilities.

This study does not aim to provide a detailed competitive or market analysis of the relevant e-commerce platforms. However, user feedback and usability testing help determine the functionality and design of the platform.

The main technical contribution is the development of a sophisticated recommendation system that can effectively suggest relevant products based on the interests and purchasing habits of platform users. Additional features may be limited by fixed implementation schedules and limited access to technology and skills training.

The scope of the platform is specifically focused on enabling e-commerce for small and medium-sized businesses in Sierra Leone, so the results may not reflect broader global trends in digital commerce. There are also inherent limitations in terms of study duration, reliance on external tools, and inability to control various external factors that may impact adoption and user experience.

### **1.6 Research Limitation**

- i. Limited access to technology development tools and training resources can impact the successful implementation of proposed interventions.
- ii. The focus of our study on Sierra Leone may limit our ability to develop a more comprehensive understanding of digital trade trends in Sierra Leone. Our results may not be fully representative of the larger digital environment.
- iii. External factors beyond our control can also affect research

## **CHAPTER TWO**

### **Literature Review**

#### **2.0 Introduction**

This chapter focuses on what other researchers have done regarding the topic under study. Clarify the theories and concepts developed. It focuses on the different technologies used in the researched area, related works, and their relationship with this multi-vendor e-commerce platform.

#### **2.1 Online marketplaces connecting local vendors and customers**

The literature on online marketplaces connecting local vendors and customers encompasses various aspects crucial for understanding the dynamics of these platforms (Kumar et al., 2021). emphasize the importance of a mutually beneficial relationship between vendors and online marketplaces to ensure error-free and delightful service on each order, highlighting the significance of sustainable long-term relations (Kumar et al., 2021). Trust-building mechanisms in e-commerce play a pivotal role in shaping customer repurchase intentions, as evidenced by Liu & Tang (2018) and (Trivedi & Yadav, 2020; Liu & Tang, 2018; (Trivedi & Yadav, 2020; . Additionally, the role of social media in enhancing trust and perceived effectiveness within online marketplaces is explored by (Chong et al., 2018). Furthermore, the sense attributed to local marketplaces by vendors and factors contributing to e-marketplace popularity and users' reluctance are investigated by and (Adanan et al., 2022; Petrović et al., 2021; (Adanan et al., 2022; . The impact of e-commerce innovation, e-service quality, and product diversity on customer loyalty through marketplace image is also a significant area of study, as indicated by (Zuhri & Sabarudin, 2022). Moreover, the role of blockchain-based smart contracts in decentralized marketplaces is gaining attention, reflecting the evolving nature of online marketplaces (Yutia et al., 2022).

#### **2.2 Ecommerce functionality: ordering, payments, communication tools**

E-commerce functionality encompasses various aspects such as ordering, payments, and communication tools. The success of e-commerce platforms is influenced by factors such as customer trust, security, and infrastructure (Al-Ghaith et al., 2010). Additionally, the development of e-commerce has led to revolutionary changes in customer behavior, emphasizing the importance of understanding the impact of digital trends and new payment models in the B2C e-commerce context (Jílková & Králová, 2020). Furthermore, the adoption of e-commerce, e-banking, and e-

government is influenced by individual models, highlighting the significance of understanding the determinants of the method of payment in mergers and acquisitions (Muñoz et al., 2019; , Ismail & Krause, 2010).

In the context of payments, the emergence and growth of mobile money, as well as mobile payment technologies, have been studied extensively, particularly in regions with high mobile penetration such as India and China (Jakhya et al., 2020). The impact of different payment methods on M&A performance has also been empirically analyzed, emphasizing the need for a comprehensive understanding of the implications of payment methods in various business contexts (Yuan et al., 2016). Moreover, the influence of mobile QR code payment on payment pleasure has been investigated, providing insights for merchants in selecting appropriate payment methods and managing customer payment experiences (Liu et al., 2021).

Security is a critical aspect of e-commerce functionality, and research has been conducted on internet payment security based on strong authentication and multi-factors, highlighting the importance of security and convenience in user selection of internet payment methods (Wang et al., 2017; , He et al., 2016). Additionally, the development of trust measures in biometric technology has implications for e-commerce businesses, as biometric technology functions similarly to an e-commerce business to some extent (Semnani-Azad et al., 2019).

### **2.3 Delivery services for vendors to access regional customers**

The literature review on delivery services for vendors to access regional customers encompasses various aspects. Daru & Kallista (2022) discuss a collaborative vendor-managed inventory model using a multi-agent system and continuous review replenishment policy, which can be relevant to the management of delivery services and inventory for regional customers. Weisbrod & Goldberg (2022) explore the relationship between regional, freight, and intermodal market access to industry location and productivity, shedding light on the importance of market access for vendors targeting regional customers. Additionally, Weerasinghe et al. (2013) investigate the role of private pesticide vendors in preventing access to pesticides for self-poisoning in rural Sri Lanka, highlighting the impact of vendors on regional communities and customer access to certain products.

### **2.4 Design and Functionality of Multi-Vendor Ecommerce Platforms**

The design and functionality of multi-vendor ecommerce platforms have gained significant attention in recent literature. Platform ecosystems are viewed as semi-regulated marketplaces that

facilitate entrepreneurial action under the guidance of the platform sponsor (Jacobides et al., 2018). Multi-cloud platforms have been extensively reviewed, highlighting various solutions and architectures (Imran et al., 2020). Additionally, the reproducibility of measurements with multiple vendors has been emphasized, guiding the design of multi-center studies (Lee et al., 2018). A scoping review evaluated SMS/text messaging platforms for mHealth projects, emphasizing the assessment of platform functions and features (Iribarren et al., 2017). Furthermore, the Multi-Centre, Multi-Vendor and Multi-Disease Cardiac Segmentation Challenge was proposed, addressing segmentation in a multi-vendor context (Campello et al., 2021). A multi-agent system approach has been proposed for sustainable supplier selection and order allocation in partnership supply chains (Ghadimi et al., 2018). Research challenges in eCommerce search and recommendations have been outlined, encompassing matching textual queries to multi-modal documents and ranking optimization for two-sided marketplaces (Tsagkias et al., 2020).

Moreover, the impact of live streaming on product sales has been studied, shedding light on the effects of live streaming on ecommerce (Chen et al., 2019). Challenges in adopting ecommerce in agriculture have been investigated, focusing on internet connectivity, cost implementation, delivery risk, and platform fraud among farmers (Huda et al., 2022). A hybrid multi-criteria approach has been developed for the vendor selection problem, demonstrating the contributions of agent technology in addressing communication and information exchange challenges (Radulescu & Radulescu, 2023). Visual search behaviors of consumers watching live ecommerce have been explored, providing valuable insights for operators and researchers of live streaming platforms (Chen et al., 2022). Additionally, equilibrium in the market with competing vendors has been investigated, shedding light on the optimal licensing strategy and commission in a software platform ecosystem (Wei & Guo, 2023). Security issues faced by customers and vendors in ecommerce platforms have been identified, along with the evaluation of security management frameworks (Kuruwitaarachchi et al., 2019). The resources and capabilities required for creating multi-vendor solutions have been assessed, focusing on the offerings of the largest manufacturers in various sectors (Raddats & Burton, 2014).

## **2.5 Strategies for Supporting Small Business Growth in the Digital Realm**

The literature on strategies for supporting small business growth in the digital realm encompasses various dimensions, including digital business strategy, digital capabilities, entrepreneurship, and

digital transformation. emphasized the need for a broad view of digital resources in the context of digital business strategy (Bharadwaj et al., 2013). Additionally, conducted a literature review to examine the growth of digital small and medium-sized enterprises (SMEs) and highlighted the importance of strengthening digital capabilities and entrepreneurship, particularly in the creative economy sector during the pandemic (Cahyani et al., 2023). focused on analyzing how SMEs cope with environmental changes, particularly during the COVID-19 pandemic, through business model transformation supported by digital technologies (Priyono et al., 2020). Furthermore, emphasized the significance of knowledge- and innovation-based business models, particularly those leveraging digital technologies for future growth (Bouncken et al., 2019).

The importance of state support for the digitalization of SMEs was underscored by , who highlighted the necessity of digital strategies, capabilities, and talent growth initiatives for successful digital transformation (Strilets et al., 2022). aimed to enhance the understanding of technology orientation and innovation capabilities in small businesses through Digital Transformation 4.0 by reviewing empirical literature (Mamduh & Pratikto, 2022). Moreover, conducted a systematic literature review to provide an overview of different disciplines of digital transformation research from a holistic business perspective, filling a gap in the literature (Hausberg et al., 2019). provided a theoretical foundation on how SMEs can harness digital technology to support their business strategy for sustainable growth (Li et al., 2016). Additionally, explored the role of agility in helping SMEs navigate the volatile, uncertain, complex, and ambiguous (VUCA) environment during the digital transformation era (Troise et al., 2022).

The literature also delves into specific contexts, such as the Indonesian MSME sector. discussed the digital MSME development in Indonesia during the COVID-19 pandemic, emphasizing the emergence of digital SMEs (Primadona, 2020). highlighted the acceleration of digital transformation and business model innovations, which fundamentally improve business growth and performance, particularly in the Indonesian context (Legowo & Sorongan, 2022). Furthermore, focused on the formulation model of power-based technopreneurship in the digital technology era, supporting the development of a digital SME mindset on a global scale (Elyta et al., 2021). conducted research based on a literature review and a small field survey of women

holding MSMEs in Semarang, emphasizing the role of women in the digitalization strategies of micro, small, and medium enterprises in the new normal era (Laksmanawati & Yuniawan, 2021).

The literature also addresses the utilization of digital marketing, digital transformation barriers, and the analysis of digital marketing processes to improve business performance in the context of SMEs. focused on the utilization of digital marketing for MSME players as value creation for customers during the COVID-19 pandemic, examining and solving research content issues through a qualitative approach and literature review (Redjeki & Affandi, 2021). Additionally, highlighted the digital transformation barriers for small and medium enterprises in Vietnam, emphasizing the transformation of products and services combined with digital technology from a business-centric perspective (Hai, 2021). analyzed digital marketing processes to improve business performance, particularly in the foods and beverages MSMEs in Indonesia, using a qualitative approach with a descriptive research method and employing literature review, interviews, and observation to collect data (Santoso et al., 2022).

The literature provides a comprehensive understanding of the strategies for supporting small business growth in the digital realm, encompassing various dimensions such as digital business strategy, digital capabilities, entrepreneurship, digital transformation, and specific contextual factors.

## **2.6 Digital Skill Acquisition and Training for Online Sellers**

Digital skill acquisition and training for online sellers is a crucial aspect of e-commerce development, particularly for small and medium-sized enterprises (SMEs) in both developed and developing countries. The readiness of technology infrastructure and relevant technical skills within businesses significantly influences the adoption of e-commerce (Rahayu & Day, 2015). Furthermore, the adoption of e-commerce by SMEs is influenced by factors such as social media usage and digital learning, which can enhance interpersonal, peer learning, and collaborative skills (Abed et al., 2015; Yusof et al., 2022). Additionally, the sentiment analysis of online reviews plays a vital role in understanding customer opinions and evaluations, providing valuable insights for sellers and customers (Sun et al., 2022). Moreover, the development of digital literacy skills is

essential for students and employees, as it forms the basis for effective online learning implementation and can significantly impact e-commerce potential (Perdana et al., 2019; Petković et al., 2021; Elmunsyah et al., 2018).

The literature also emphasizes the importance of entrepreneurial skills in supporting technology readiness for e-commerce adoption (Harini et al., 2023). Additionally, the role of digital literacy in enhancing digital marketing courses and the successful implementation of digital literacy in marketing education is highlighted (Johnson et al., 2012). Furthermore, the potential of online learning for adults, especially those with high digital problem-solving skills, has been recognized, indicating the significance of digital skills in online education ("The potential of online learning for adults: Early lessons from the COVID-19 crisis", 2020).

Moreover, the impact of digital learning and social media usage on SMEs' adoption of e-commerce, particularly in developing countries, has been extensively studied, providing valuable insights into the factors shaping electronic commerce practices (Yasin et al., 2014). The relevance of digital literacy skills in enhancing the effectiveness of online simulations and positively impacting students' digital literacy skills has also been established (Perdana et al., 2019).

## CHAPTER THREE

### System Design and Methodology

#### 3.1 Design Methodology

The System Development Life Cycle (SDLC) serves as a comprehensive framework for project management, delineating the stages involved in creating an information system, from the initial feasibility study to the continuous maintenance of the finalized product. SDLC is applicable to both technical and non-technical systems, encompassing a range of IT technologies such as hardware and software. The collaborative efforts of system and software engineers, development teams, and end-users are crucial throughout the SDLC process.

##### 3.1.1 Agile Methodology



Figure 1: agile software methodology

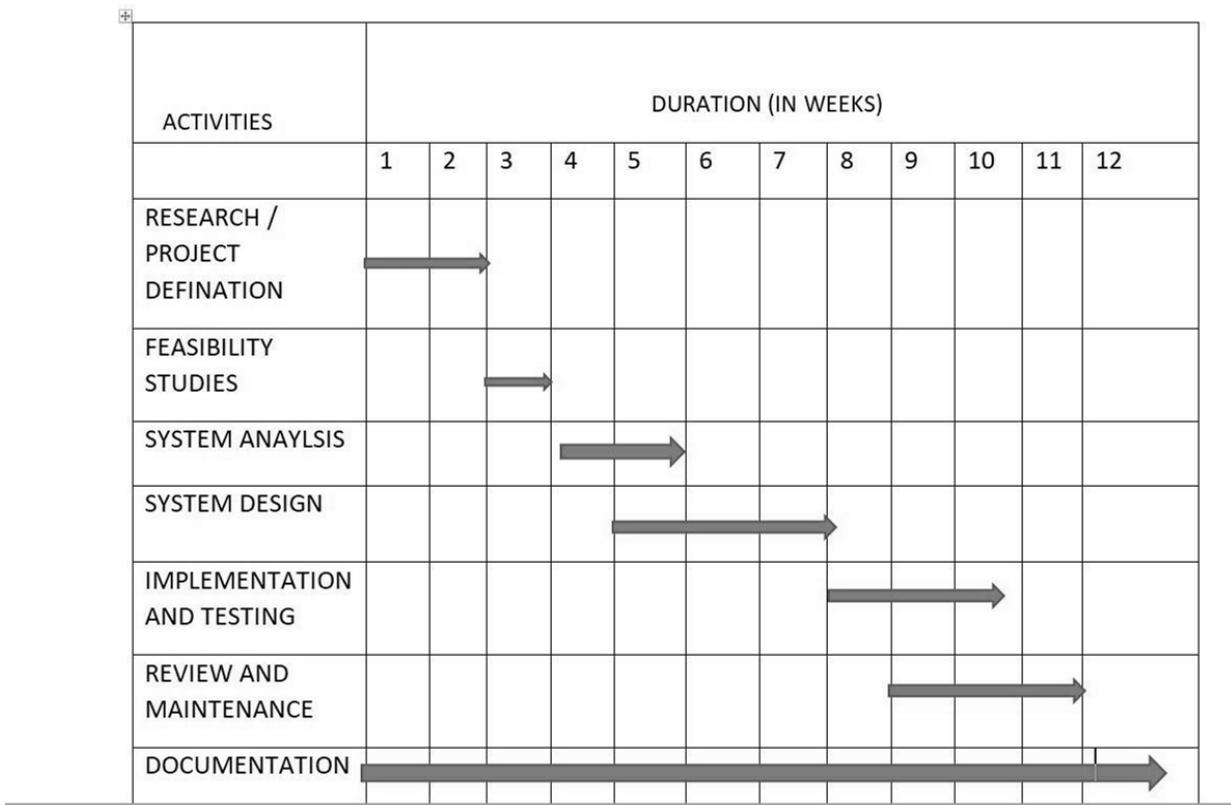
Source: Taken from (asana articles, 2022)

The development of the Multi-Vendor E-Commerce Platform is guided by agile software development methodologies, known for its iterative, incremental approach that emphasizes flexibility and collaboration within cross-functional teams. This methodology is particularly suited to dynamic projects, enabling continuous feedback loops and adaptability throughout the development process

### 3.1.2 Development Duration

The development of this student Multi-Vendor Ecommerce Platform is planned over a 12-week

**Gantt chart**



*Table 1: Gantt chart*

*Source (Research work)*

### 3.2 System Architecture

## Multi-Vendor Marketplace Structure

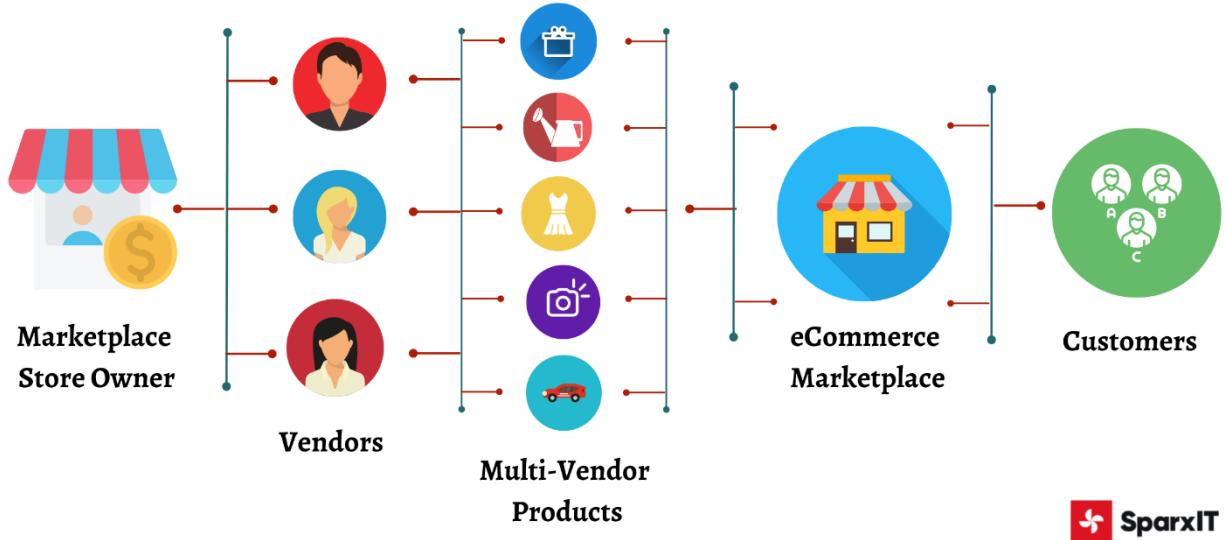


Figure 2:: System Architecture Diagram

Source: Taken from (SparxIT articles, 2021)

The following diagram above shows the high-level architecture of the multivendor e-commerce platform, the platform is comprised of multiple components that work together to provide a seamless experience for vendors and customers.

### 3.3 Functional Requirements

E-commerce marketplace solutions have important features that allow you to add vendors to the platform, manage vendor inventory and products, and add vendor products. As more vendors add products, the inventory on the site will also increase. Applications are intended to perform multiple functions to ensure a seamless and user-friendly experience. First, users must register by entering information such as a username and password of their choice on the login page. You can then log in using your credentials on a special login/login page.

Anyone wishing to become a seller on the platform is required to create a vendor's account, subject to administrator verification. Once approved, vendors will have access to a personalized panel to

add products and manage sales. The platform provides users with search options to easily find products. Once selected, a section page will open where you can select the desired item.

Managing product inventory is the responsibility of the product owner, and low inventory will result in the product being displayed as "unavailable." User can add selected products to his shopping cart and remove items if desired. The platform allows users to click on the invoice option to view the total invoice for the selected products.

Users who purchase products have two purchase options: Cash on Delivery or Visa/Master Card. Once complete, users can log out with a simple click. The platform features an intuitive user interface with built-in quick search functionality for customers. Users can leave reviews and ratings, save products using Wishlist, and benefit from discounts and coupons. Additionally, the platform supports communication between vendors and customers through chat functionality.

### **3.4 Non-functional Requirements**

The platform focuses on ease of use, ensuring a user-friendly interface that is easy for vendors and customers to navigate. Tasks can be completed quickly and efficiently, improving the overall experience for all users.

- i. Security is a top concern as the platform implements strict measures to protect user data. These measures include encryption and access controls to prevent unauthorized access, theft, or loss of sensitive information.
- ii. To improve accessibility, the platform aims for continuous availability and 24/7 operation with minimal downtime or maintenance windows. This initiative allows users to access the platform at any time, contributing to a seamless experience.
- iii. As your company grows, the platform is designed to scale to accommodate a large number of vendors and customers. This scalability feature allows you to adapt and expand your platform to meet the changing needs of your growing user base.
- iv. Performance is the focus, and the platform prioritizes speed and responsiveness. Fast page load times and minimal lag provide an efficient and pleasant user experience.
- v. Reliability is platform-specific and aims to provide consistent performance with minimal errors and downtime. This reliability allows users to rely on the platform without interrupting their daily activities.

- vi. Modular architecture simplifies maintainability and allows for easy updates and changes. This design allows the platform to be efficiently maintained and updated as needed without causing any disruption to users.

### 3.5 Data Flow Diagram (DFD)

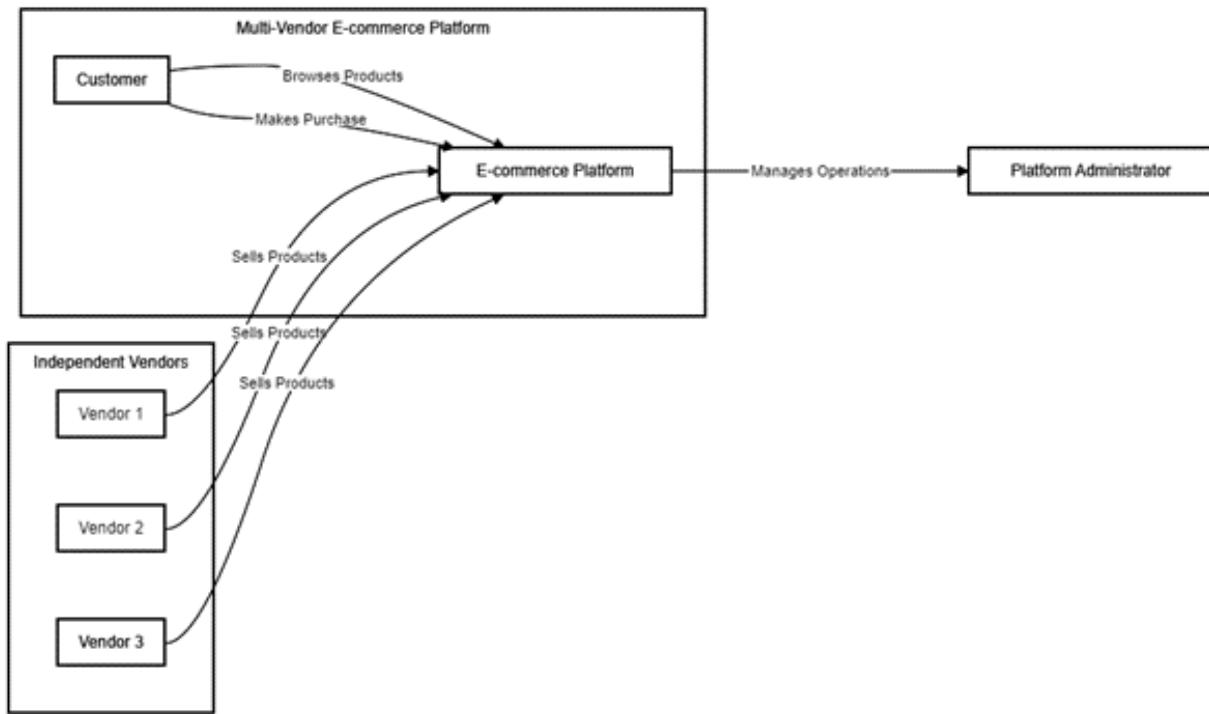


Figure 3:Level 0 DFD

Source (Research work)

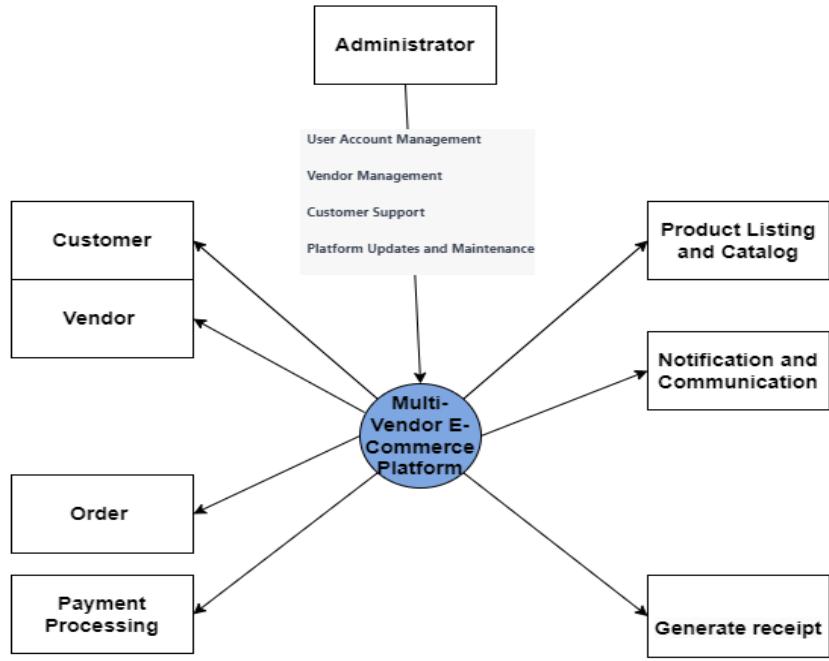


Figure 4: Level 1 DFD

Source (Research work)

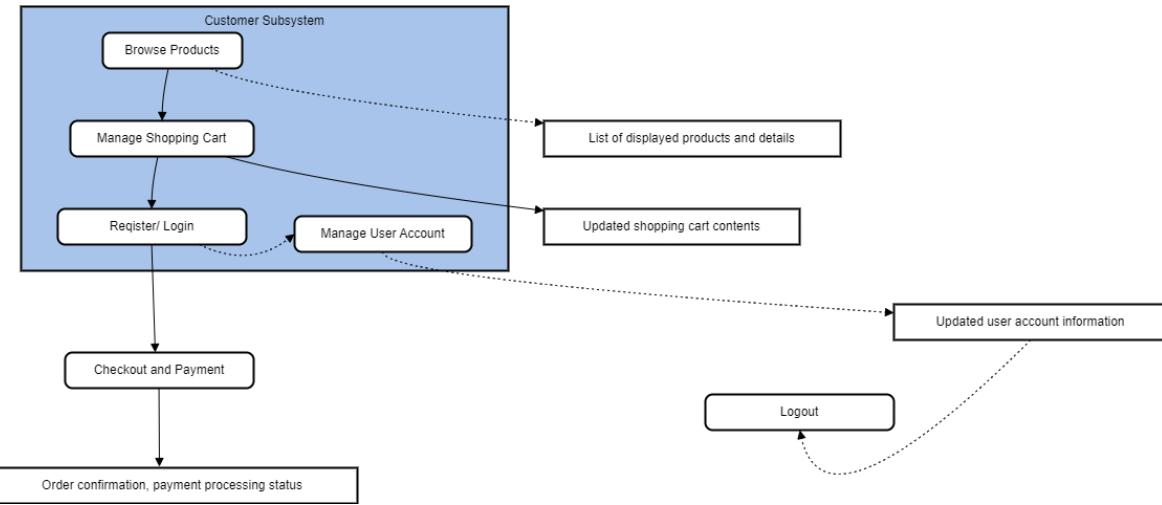


Figure 5: Level 2 DFD

Source (Research work)

Multivendor e-commerce platforms use data flow diagrams (DFDs) to visually represent the flow of data, processes, and data stores. Basic processes include supplier registration, product listing, order fulfillment, payment processing, and user authentication. The most important data stores include product databases, user databases, order databases, and supplier information. Data flows

include collecting user registration details, updating product information, managing order details, securing payment data submission, and checking user authentication status. These processes and data stores form the core of the system architecture, ensuring seamless supplier management, comprehensive product information, and secure financial transactions within the platform.

### 3.6 Use Case Diagram (UCD)

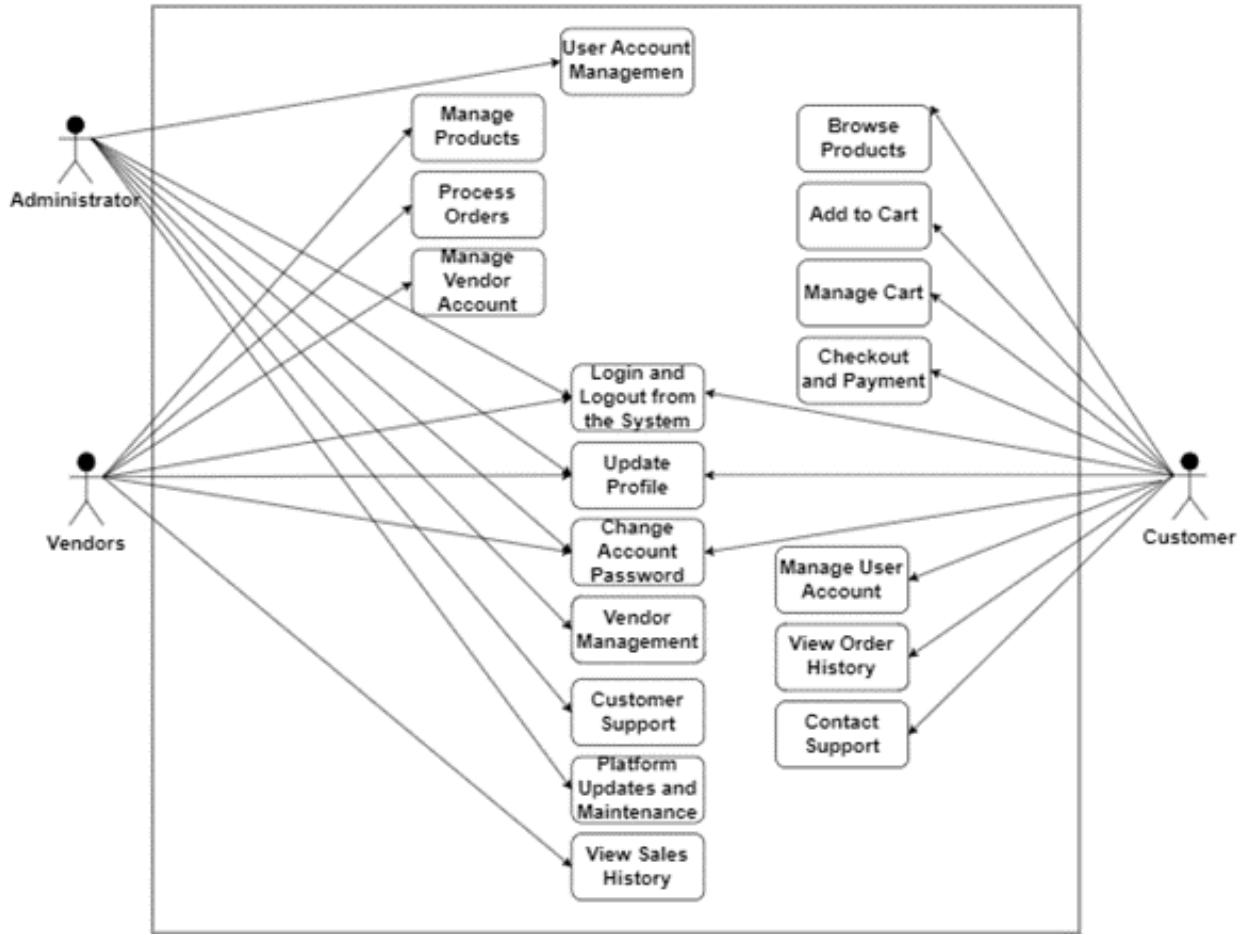


Figure 6: Use Case Diagram

Source (Research work)

A Use Case Diagram (UCD) is a visual representation of the dynamic interactions in the multivendor e-commerce system, where key stakeholders include customers, vendors, and management. Use Cases include browsing products, adding items to cart, ordering, vendor registration, managed product management, and payment processing. This diagram provides a comprehensive scope of user interactions and system functionality, and provides a concise overview of the dynamic relationships within a multivendor e-commerce system.

### 3.7 Entity Relationship Diagram (ERD)

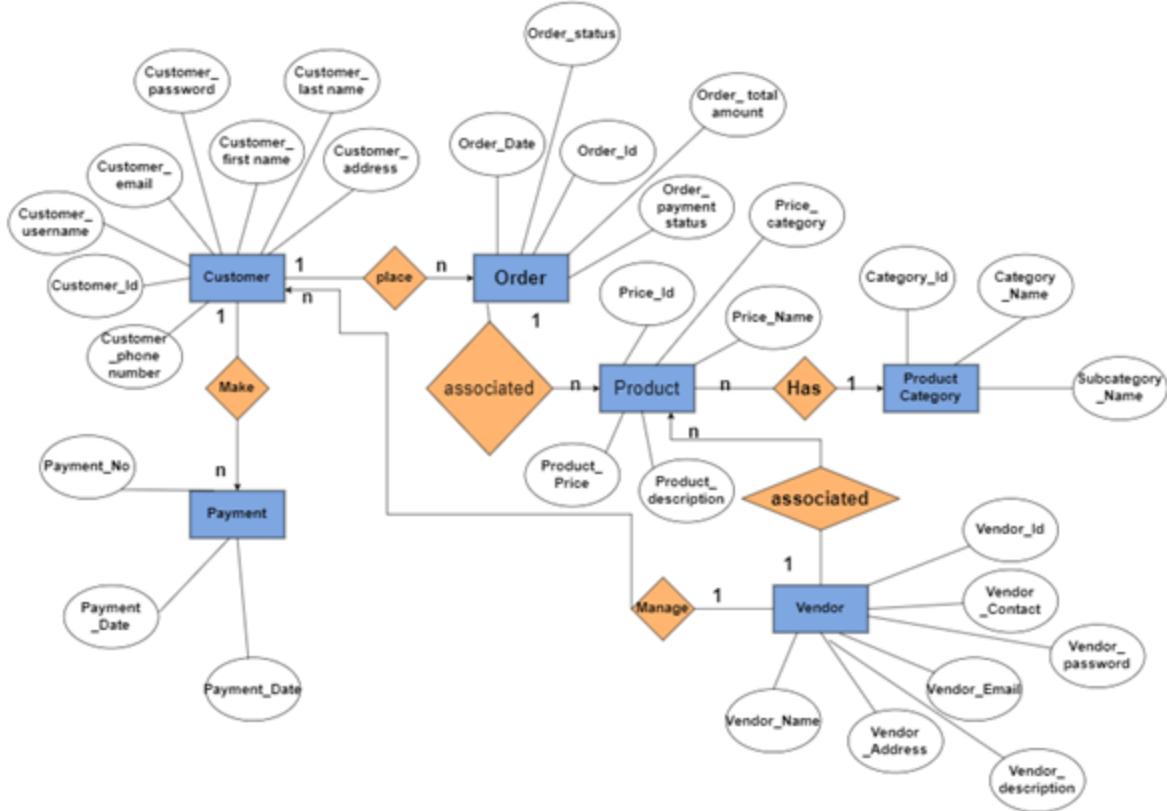


Figure 7: Entity Relationship Diagram

Source (Research work)

Entity relationship diagrams (ERDs) are important visual tools that illustrate the complex relationships between key entities within the multivendor e-commerce system and support efficient database design. Entities include users, vendors, products, orders, and payments, which are linked by well-defined relationships. Users place orders, vendors manage products, orders include products selected by users, and payments are tied to specific orders. This ERD provides a clear representation of entity interactions and forms the fundamental basis of the system's database structure.

### 3.8 Input Module

Input module is an essential part of managing and validating user input in multivendor ecommerce systems. Key modules such as user registration, product listing, ordering, and vendors registration forms streamline data entry and maintain consistency. These modules serve as the primary gateways for collecting and validating critical data, improving overall system functionality and reliability.

#### Key Input Modules:

- i. User Registration Form
- ii. Product Listing Form
- iii. Order Placement Form
- iv. Vendor Registration Form

### 3.9 Activity Diagram

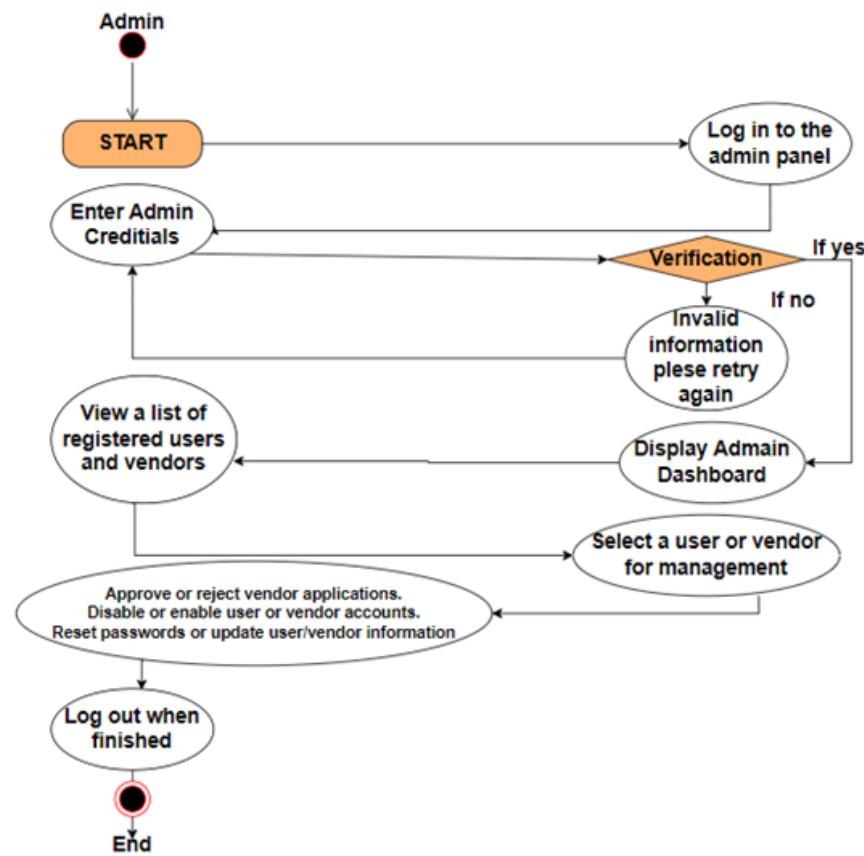


Figure 8:Activity Diagram for Admin

*Source (Research work)*

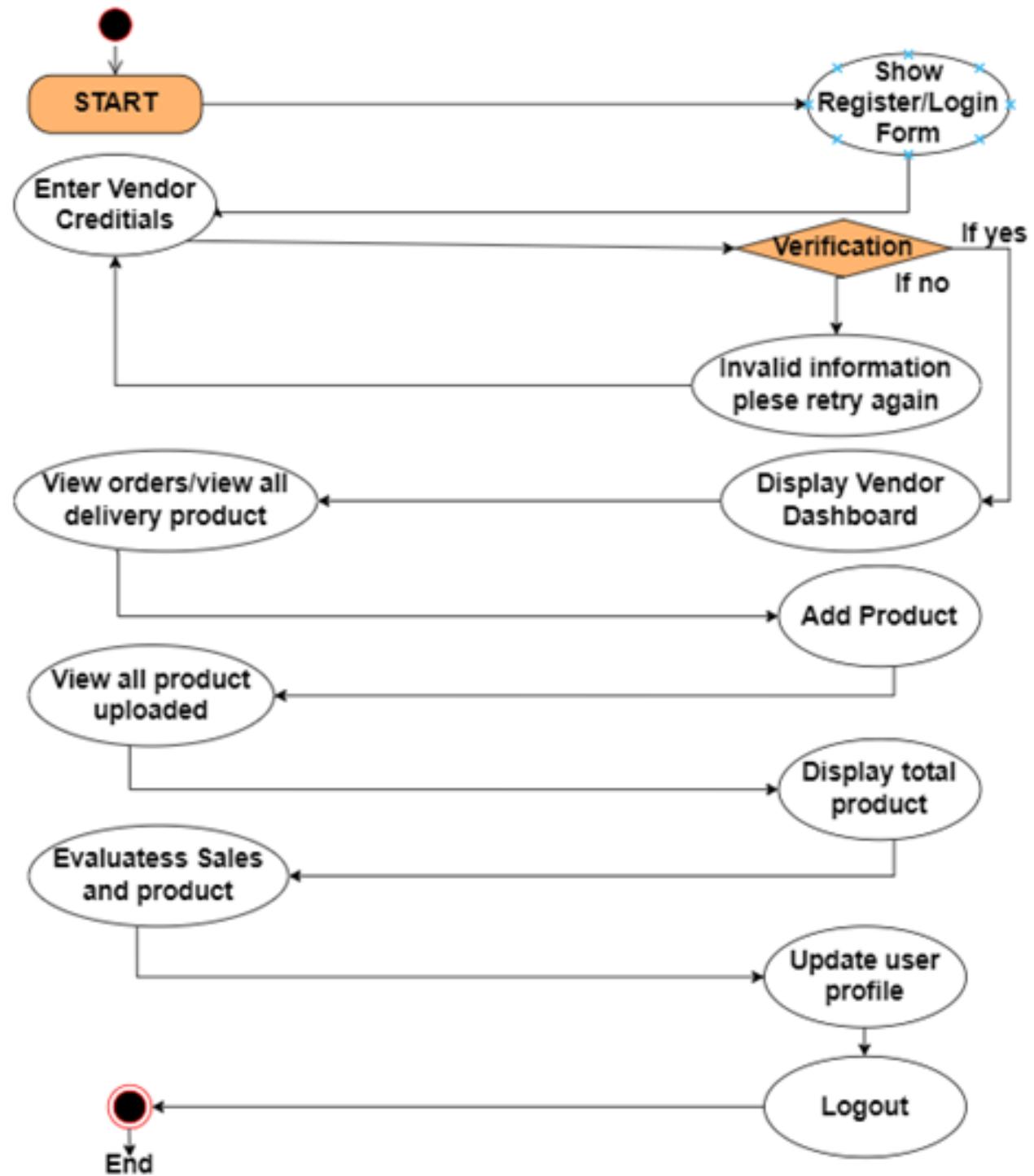


Figure 9:Activity Diagram for Vendor

Source (Research work)

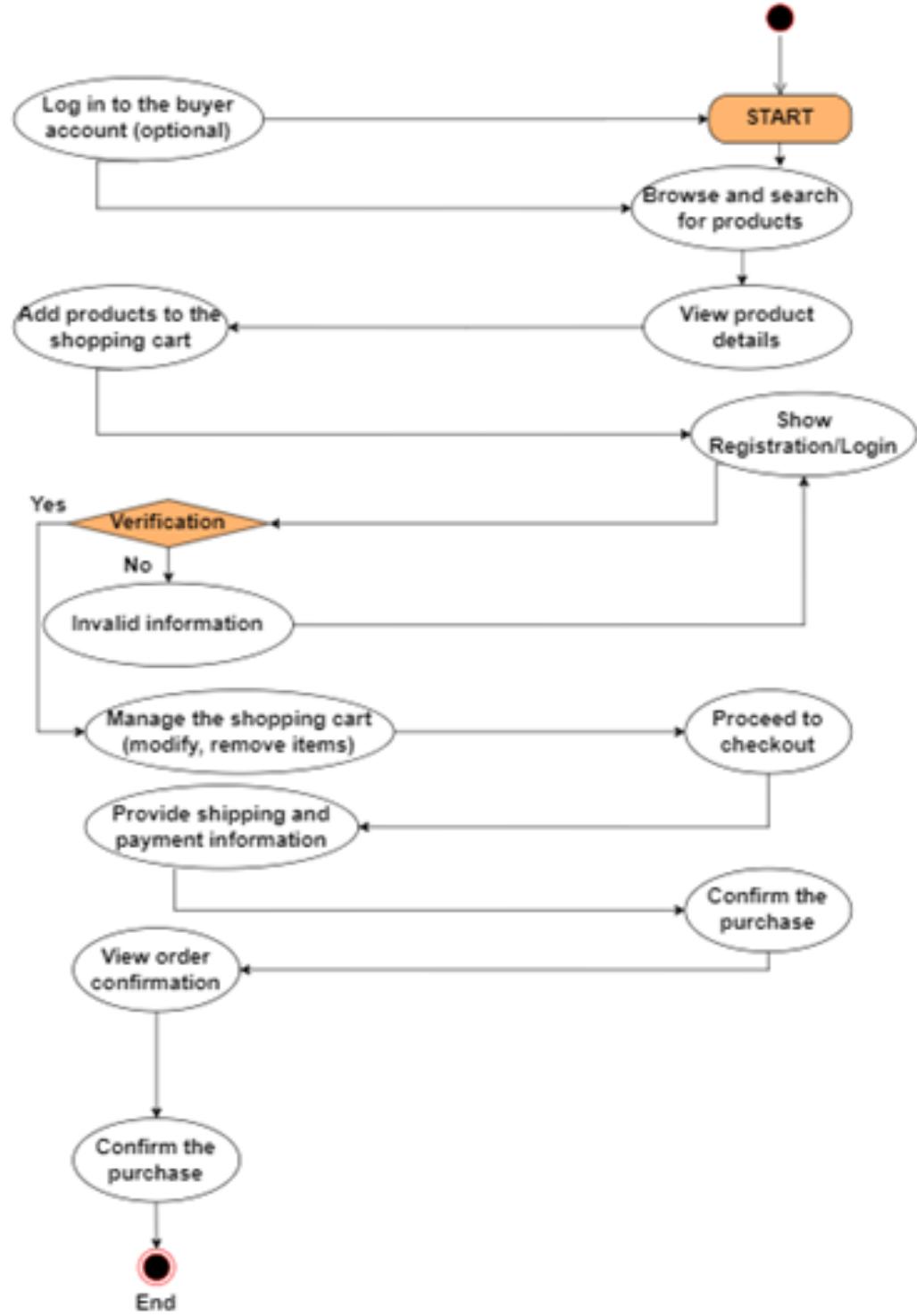


Figure 10: Activity Diagram for Customer

Source (Research work)

Activity diagrams visually represent dynamic activities within the multivendor e-commerce system and describe processes such as user registration, product listing, order processing, and payment processing. It shows the sequence of important processes and provides a comprehensive overview of the dynamic aspects of the system. This diagram provides insight into the flow of activities and contributes to the smooth operation of multi-vendor e-commerce platforms.

### 3.10 Class Diagram

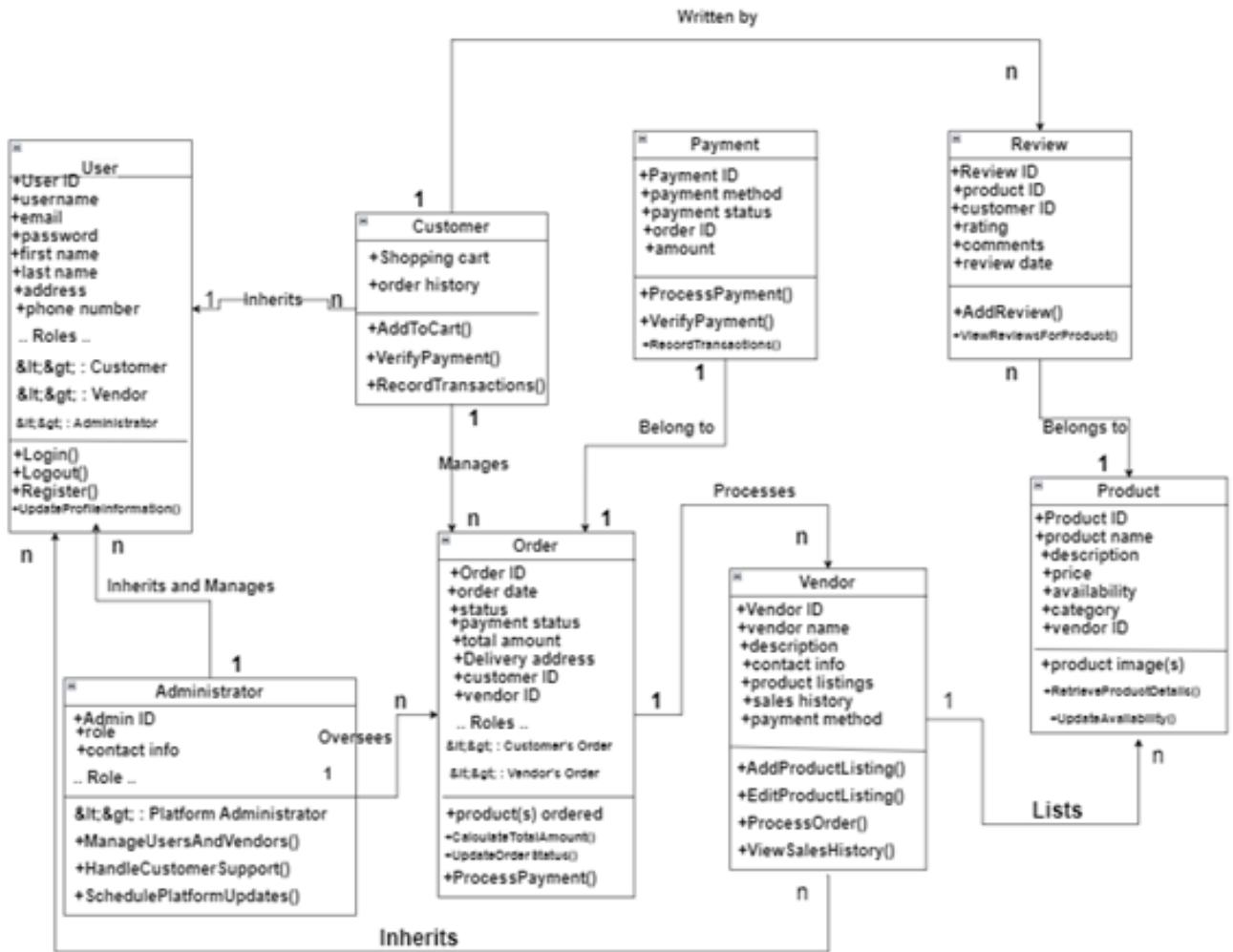


Figure 11: Class Diagram

Source (Research work)

Class diagrams visually represent the static structure of the multi-vendor e-commerce system and provide an overview of major classes such as users, vendors, products, orders, payments, etc. It

shows their attributes and relationships and highlights their relevance. The user who places the order, the vendor who sells the product, and the payments associated with a particular order. This structured representation provides valuable insight into the interdependencies between core classes and defines the structure of a multivendor e-commerce platform.

### 3.11 Database Schema

A database schema is a detailed blueprint for the multivendor e-commerce system that outlines the major tables and specific fields for each, such as users, vendors, products, orders, and payments. Critical relationships maintain data integrity, such as one-to-many user order to vendors to product connections, many to many orders to product connections, and his one-to-one connection between payments and orders. This structured framework is essential for efficient data management and querying on multi-vendor e-commerce platforms.

## Key Tables

### Users Table

Table 2: Users Table

Source (Research work)

## Vendors Table

The screenshot shows the MongoDB Cloud Atlas Data Services interface. The left sidebar lists collections under the 'shops' database: Users, conversations, coupuncodes, events, messages, orders, products, users, and withdrawals. The 'shops' collection is currently selected. The main area is titled 'Find' and contains a query builder with the placeholder 'Type a query: { field: 'value' }'. Below the query builder, a document is displayed with the following fields:

```
_id: ObjectId('65a0482737617c126abdc06e')
name: "Alshecon Grocery Shop Limited"
email: "alshecon@gmail.com"
password: "$2a$10$g9.MTERx/azyjDK2PxC..3k2PUHE2kjhbVn7Smp9k5n1.zcU6mDC"
address: "3 Kissy Road, Freetown."
phoneNumber: 80654786
role: "Seller"
avatar: "Grocery-1705003011167-127253253.png"
zipCode: 80467834
availableBalance: 183.6
createdAt: 2024-01-11T19:35:53.123+00:00
transactions: Array (empty)
```

At the bottom of the interface, there are status indicators: 'System Status: All Good', copyright information ('©2024 MongoDB, Inc.'), and links to 'Status', 'Terms', 'Privacy', 'Atlas Blog', and 'Contact Sales'.

Table 3: Vendors Table

Source (Research work)

## Products Table

Table 4: Products Table

Source (Research work)

## Order Table

Table 5: Orders Table

Source (Research work)

## Payment Table

The screenshot shows the MongoDB Cloud Atlas interface. The top navigation bar includes tabs for Data Services, App Services, Charts, and Billing. The main area is titled "mvep" and shows the "withdraws" collection. A sidebar on the left lists other collections: Users, conversations, coupontcodes, events, messages, orders, products, shops, users, and withdraws. The central panel displays a query result for a withdrawal document:

```

_id: ObjectId('65a086d2eca2e23265aab90')
  > seller: Object
    amount: 50
    status: "succeed"
    createdAt: 2024-01-12T00:11:22.515+00:00
    ...V: 0
    updatedAt: 2024-01-12T00:33:44.985+00:00
  
```

System Status: All Good  
©2024 MongoDB, Inc. Status Terms Privacy Atlas Blog Contact Sales

Table 6: Payment Table

Source (Research work)

## Admin Table

The screenshot shows the MongoDB Cloud Atlas interface. The top navigation bar includes tabs for Data Services, App Services, Charts, and Billing. The main area is titled "mvep" and shows the "Database Access" section. The sidebar on the left lists sections: Overview, DEPLOYMENT, Database, Data Lake, SERVICES, Device Sync, Triggers, Data API, Data Federation, Atlas Search, Stream Processing, SECURITY, Backup, and Database Access. The central panel displays a table of database users:

User Name	Authentication Method	MongoDB Roles	Resources	Actions
admin	SCRAM	atlasAdmin@admin	All Resources	<button>EDIT</button> <button>DELETE</button>

System Status: All Good  
©2024 MongoDB, Inc. Status Terms Privacy Atlas Blog Contact Sales

Table 7: Admin Table

Source (Research work)

### 3.12 Sequence Diagram

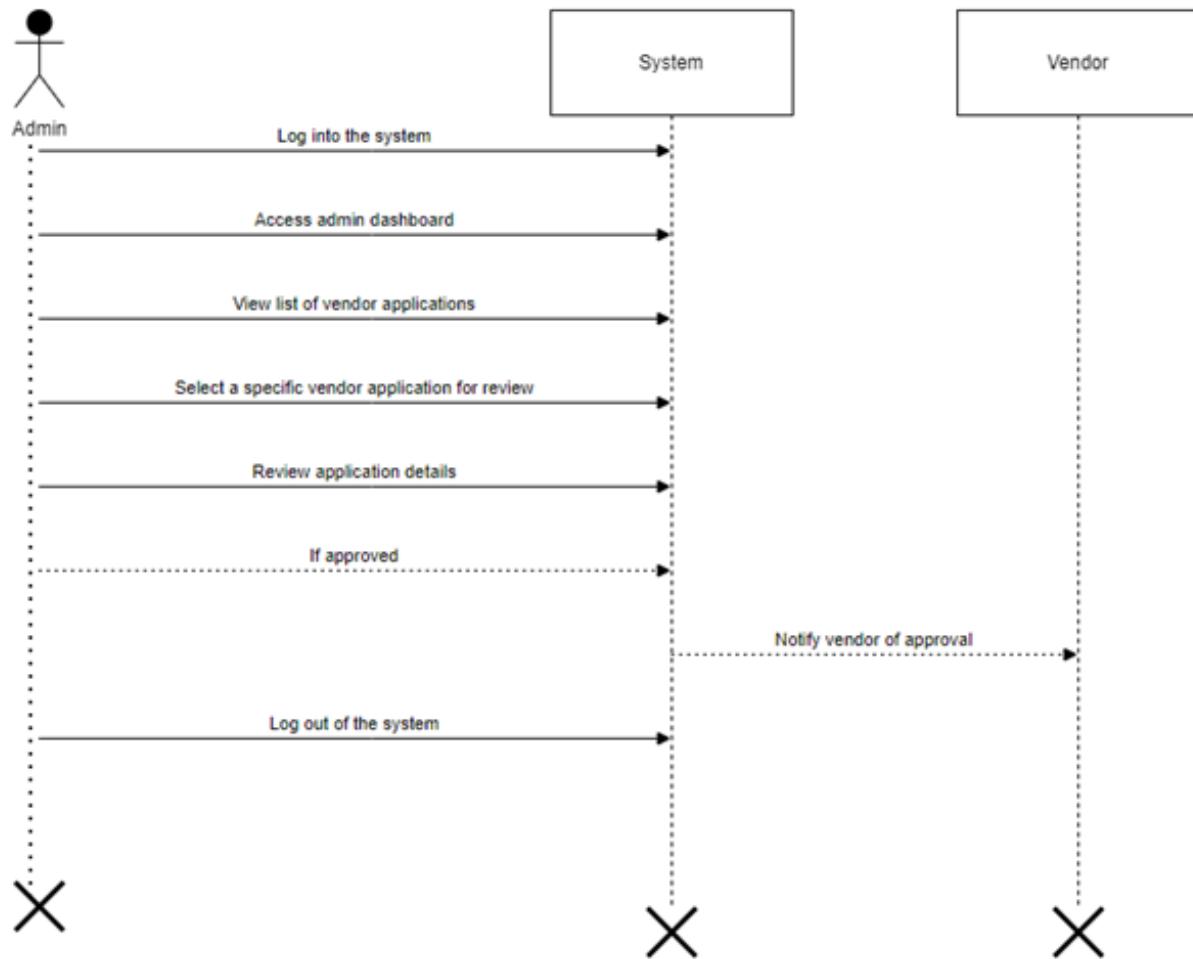


Figure 12: Sequence Diagram for Admin

Source (Research work)

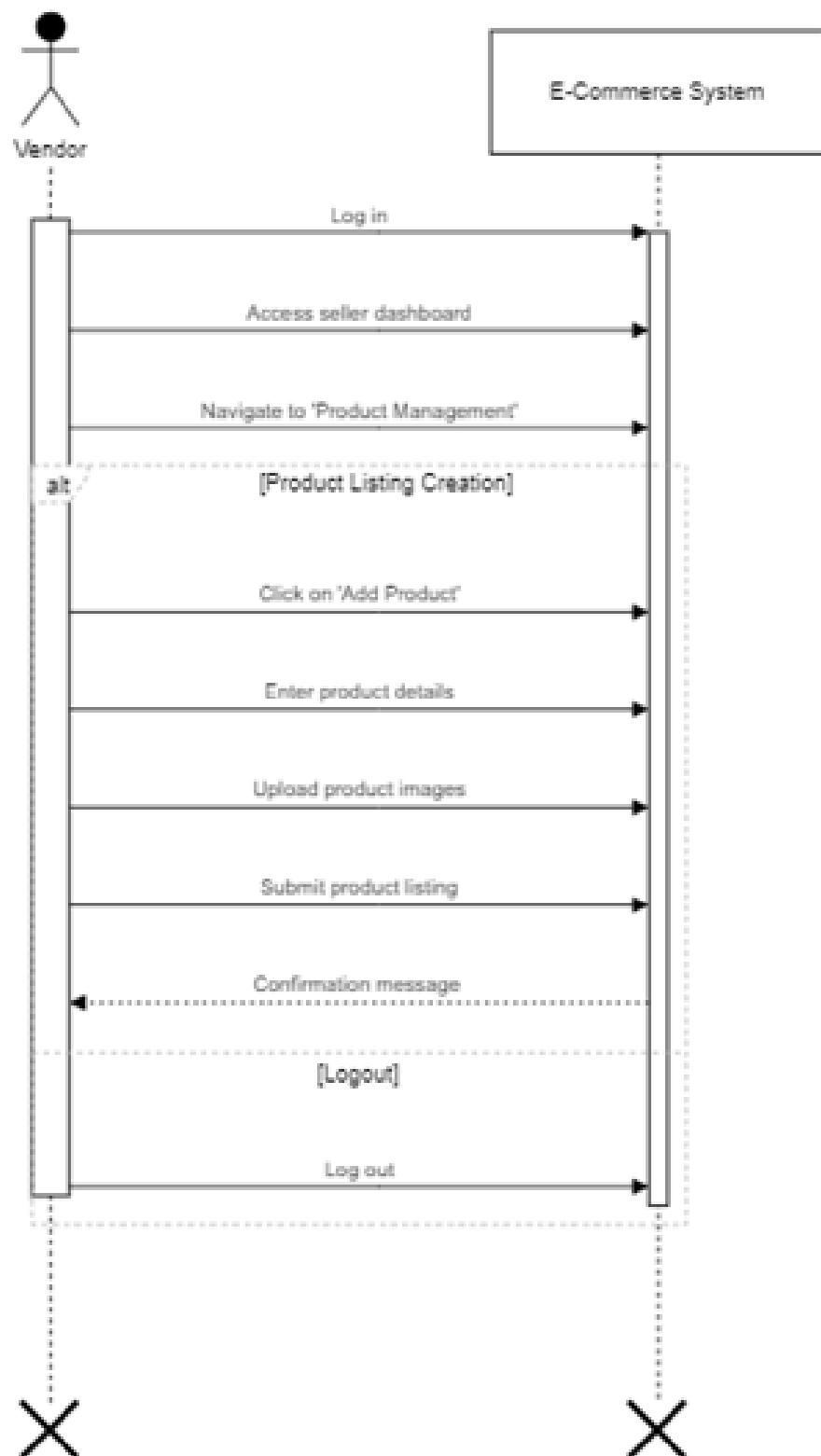


Figure 13: Sequence Diagram for Vendor

Source (Research work)

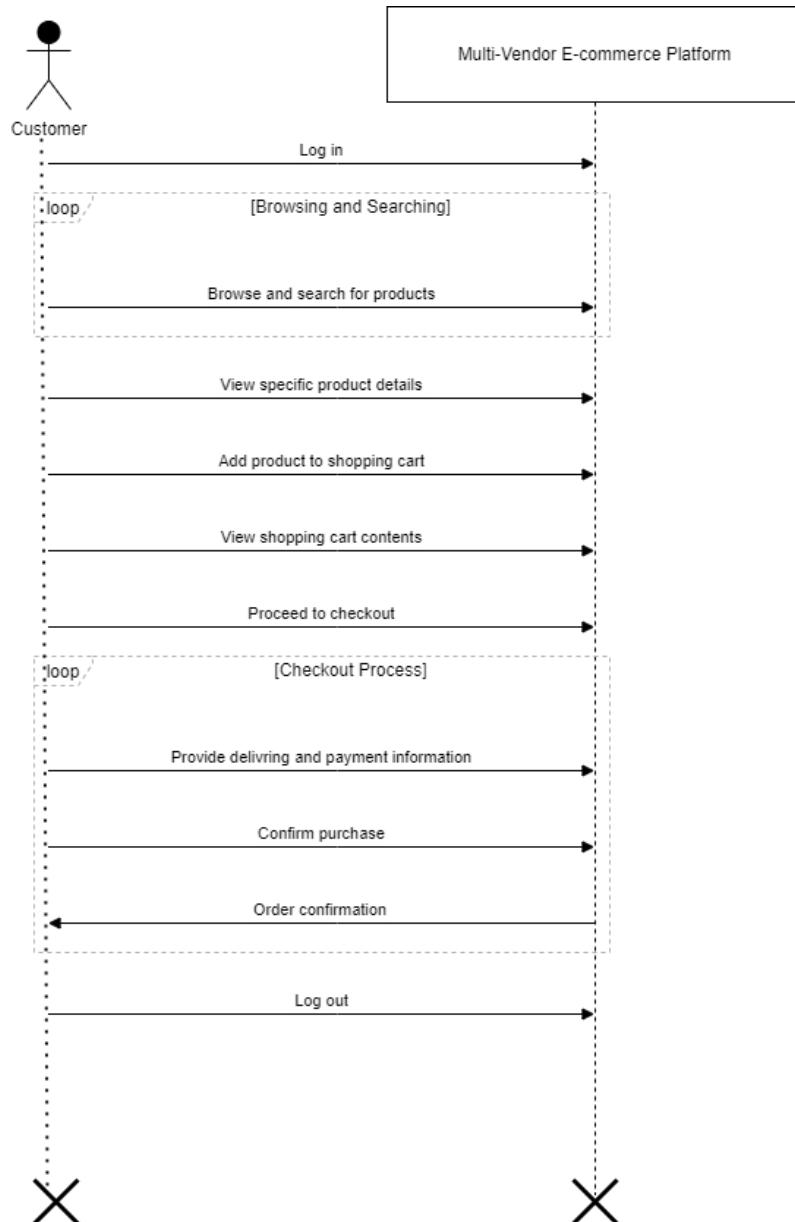


Figure 14: Sequence Diagram for Customer

Source (Research work)

Sequence diagrams visually represent interactions over time in the multivendor e-commerce system, showing events such as user registration, product listing, ordering, and payment processing. It describes step-by-step processes and provides dynamic insights into the timing of

interactions. It also shows that multi-vendor e-commerce platforms are working in concert and coordination over time.

## **CHAPTER FOUR**

### **Implementation And Testing**

#### **4.1 System Implementation**

System implementation is the process of building and setting up a computer system or software to make it work in the real world, ensuring that it does what it's supposed to do according to the plans and designs created for it. In the context of Multi-Vendor Ecommerce Platform, it refers to the practical execution of the software development process, encompassing tasks such as coding the Multi-Vendor Ecommerce Platform, configuring the database, designing user interfaces, integrating system components, conducting thorough testing, deploying the system to the production environment, and providing user training. This phase translates the Multi-Vendor Ecommerce Platform design and specifications into a functional system, ready for use in educational institutions.

#### **4.2 System Development**

The system development aspect of the Multi-Vendor Ecommerce Platform has to do with the Technical Feasibility (TF) solution of the system. It focuses on both the Software and Technical requirement of the system. Each aspect has to do with what are the software specification as well as the hardware specification of the system.

##### **4.2.1 Hardware Specification**

Hardware requirements for optimal performance include a processor with an Intel® Core™ i3 4800MQ CPU running at 2.0 GHz or faster, 4 GB of RAM, and at least 40 GB of hard drive storage space. These specifications ensure smooth functioning of the system and enable it to effectively handle the needs of e-commerce platforms.

##### **4.2.2 Software Specification**

On the software side, the platform uses key technologies to improve its functionality. MongoDB serves as a suitable database for e-commerce platforms, offering data modeling flexibility, automatic scaling, and high availability. Express.js, the popular Node.js web application framework, provides a simple and flexible API for building web applications and APIs. React, a

widely used front-end library, uses a component-based architecture that makes it easy to create complex user interfaces. Node.js acts as a server-side JavaScript runtime environment, providing a fast and scalable platform for building web applications and APIs. This software stack also includes Redux Toolkit for efficient state management of React applications and Socket.IO, a popular library that facilitates real-time communication between servers and clients. These software components work together to form a strong foundation for our e-commerce platform

### 4.3 System Testing

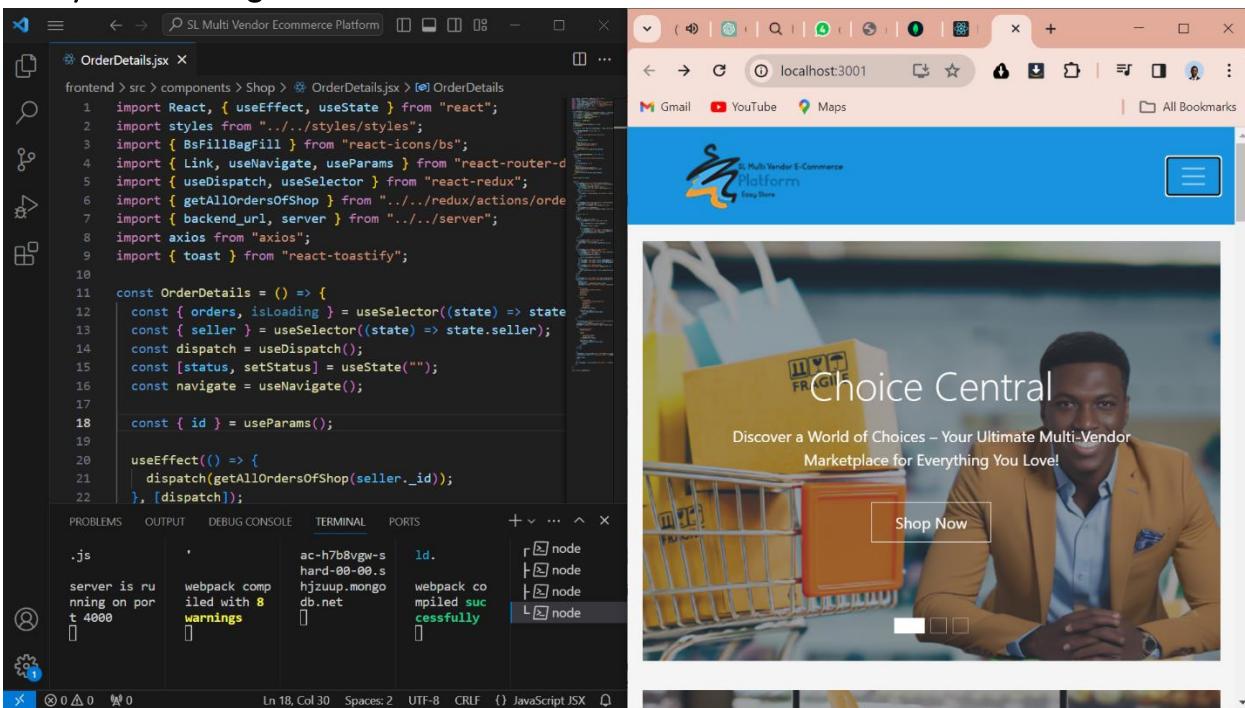


Figure 15: System Testing

Source (Research work)

Software testing is the process of finding bugs in software. Software testing ensures software quality and is the final validation of other software phases such as specification, design, and code generation.

### 4.3.1 Unit Testing

```

1 import React, { useEffect, useState } from "react";
2 import styles from "../../styles/styles";
3 import { BsFillBagFill } from "react-icons/bs";
4 import { Link, useNavigate, useParams } from "react-router-dom";
5 import { useDispatch, useSelector } from "react-redux";
6 import { getAllOrdersOfShop } from "../../redux/actions/order";
7 import { backendUrl, server } from "../../server";
8 import axios from "axios";
9 import { toast } from "react-toastify";
10
11 const OrderDetails = () => {
12   const { orders, isLoading } = useSelector((state) => state.order);
13   const { seller } = useSelector((state) => state.seller);
14   const dispatch = useDispatch();
15   const [status, setStatus] = useState("");
16   const navigate = useNavigate();
17
18   const { id } = useParams();
19
20   useEffect(() => {
21     dispatch(getAllOrdersOfShop(seller._id));
22   }, [dispatch]);

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

ln 211, Col 1 Spaces: 2 UTF-8 CRLF

Something is already running on port 3000.  
Would you like to run the app on another port instead? (Y/n)

Figure 16: Unit Testing

Source (Research work)

Unit testing focuses on verifying the smallest unit of software design i.e., a Components or Modules. Unit testing is a dynamic verification method where the program is actually compiled and executed. Unit tests are run in parallel with the coding phase. Unit tests test units or modules rather than the entire software. We tested each view/module of my application individually. During the construction of the module, tests were run simultaneously to track each type of input and check the corresponding output until the module worked properly.

The functionality of the module was also tested as a separate unit. Each of the three modules was tested as a separate unit. All functionality was tested individually in each module. In the Shop Products module, when you add an item to the shopping cart, if the item is already in the shopping cart, the quantity is guaranteed to increase by one. Otherwise, a new item will be created in your shopping cart. Additionally, the state of the system after you drag an item to the shopping cart is the same as the state of the system when you click the Add to Cart button to add the item. We also made sure that all product images displayed on product pages in your store are draggable and have product properties that allow them to be placed in the shopping cart section.

The Product Description module has been tested to ensure that all images display correctly. Users can add reviews. When a user adds a review, the review is updated in the View Customer Reviews tab. We checked whether the entire page or just part of the page is updated when a user writes a review. Cart details have been tested so that when users change quantities or remove products from the cart, the total price updates accordingly. We checked whether the entire page or parts of the page are updated when a user edits the cart. Visual Studio Code has built-in support for testing applications. Unit tests can be run using Visual Studio Code without the need for an external application. Various methods have been developed for unit testing. Test cases for these methods are automatically generated.

#### 4.3.2 Integration Testing

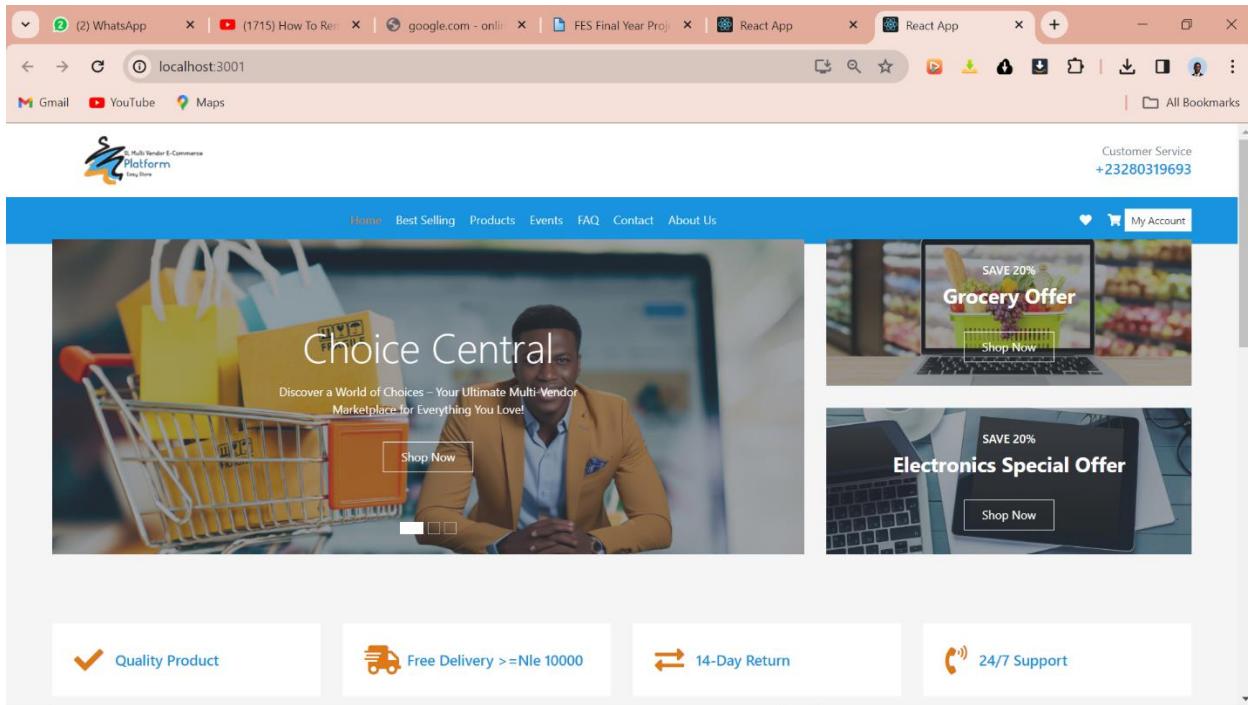


Figure 17: Integration Testing

Source (Research work)

Integration testing involves testing a system that is made up of different modules and testing for problems that arise from the interactions of the components. Integration tests must be developed based on system specifications. First, you need to integrate and test your minimal configuration.

In our project, we performed integration testing from the bottom up. In this project, we started designing and testing using atomic modules. After unit testing, modules are integrated individually and the system is tested for issues arising from component interactions.

#### **4.3.3 Validation Testing**

This ultimately ensures that the software meets all functional, operational, and performance requirements. Black box testing techniques are used. There are three main components

- i. Validation test criteria (numbers for numbers, letters for letters)
- ii. Configuration validation (to ensure the integrity of the software configuration)
- iii. Alpha and Beta Testing – Alpha Testing is as follows: carried out at the developer's site; carried out; Beta will be tested after deployment.

#### **4.3.4 White Box Testing**

With white box testing, knowledge of the internal workings of a product allows you to perform tests to ensure that the internal workings are performing according to specifications and that all internal components are under appropriate stress. White box testing involves testing logical paths through software by providing test cases that execute a specific set of conditions and loops. White box testing allows software developers to derive test cases that guarantee that all independent paths within a module are executed at least once.

- i. Practice every logical decision in its true and false aspects.
- ii. Train every loop to its limits and within its operating limits.
- iii. Checks internal data structures to ensure their validity.

At each stage of project development, we tested the logic of the program by specifying invalid inputs and generating corresponding error messages.

#### **4.3.5 Performance Testing**

Performance testing is important for evaluating the responsiveness and scalability of the applications built with Visual Studio Code and key technologies such as Express, React, Node.js, Redux Toolkit, and Socket.IO. Using tools like MongoDB, applications undergo rigorous load, stress, and scalability testing to identify and resolve potential performance bottlenecks under varying user loads. Continuous monitoring with tools like New Socket.IO ensures real-time

performance tracking, and browser compatibility testing ensures a consistent user experience across platforms. Optimizing database queries, evaluating caching mechanisms, and integrating performance testing into our Continuous Integration or Continuous Delivery (CI/CD) pipeline contributes to the overall efficiency and reliability of your application and provides a seamless, responsive experience for your users.

#### **4.4 Implementation**

In the Implementation phase, the Multi-vendor E-commerce platform undergoes a crucial transition from testing to live deployment. This involves configuring the production environment, migrating relevant data, establishing version control, and conducting user training. The deployment process includes measures like backup procedures and a rollback plan to address unforeseen issues. Continuous monitoring and performance optimization activities are implemented to ensure the platform's efficiency and reliability. Real-time monitoring, performance tuning, security audits, and user feedback collection are integral components. Post-implementation, a comprehensive review assesses deployment success, resolves any outstanding issues, evaluates scalability, and updates documentation. This meticulous approach ensures a seamless and successful introduction of the Multi-vendor E-commerce platform to users, offering a secure and responsive online marketplace.

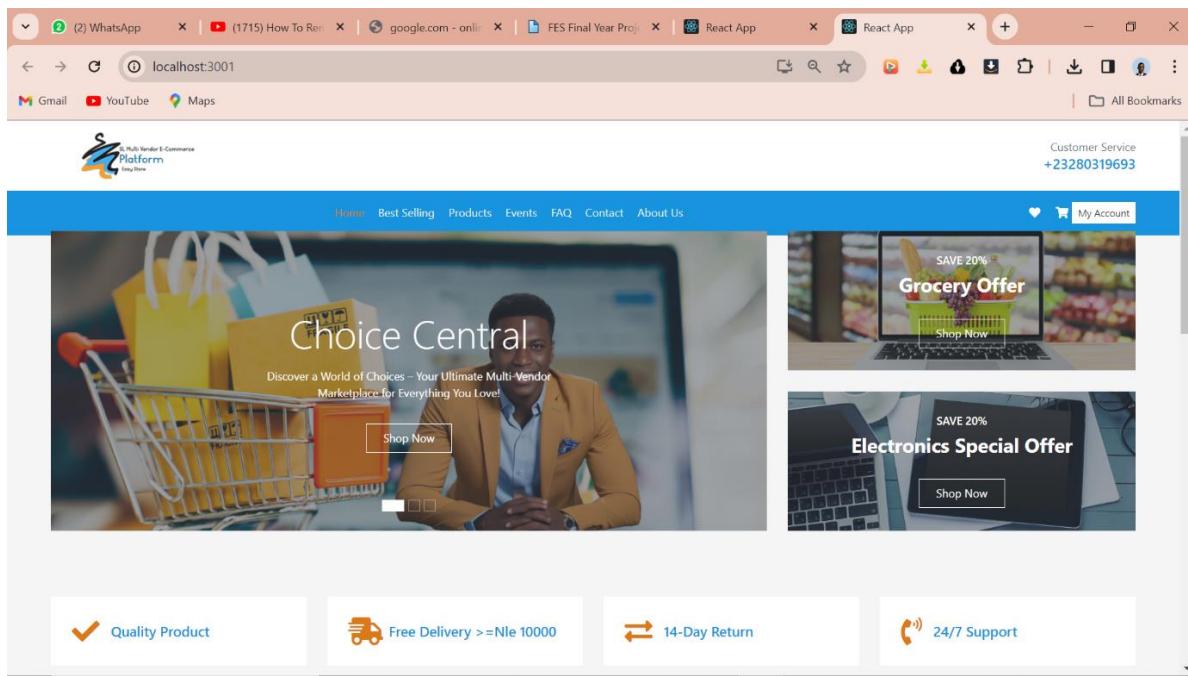


Figure 18: System Homepage

Source (Research work)

The home page of a multi-vendor e-commerce platform acts as a central marketplace where multiple sellers can set up online stores to sell their products within an integrated system. This allows buyers to easily search for products from all vendors to browse and purchase. Key home page features include product search, category browsing, recommended/recent seller sections, daily deals, buyer reviews, filtering and comparison tools, personalized recommendations, and easy ordering and account management. It includes a well-designed seller registration portal and buyer account pages.

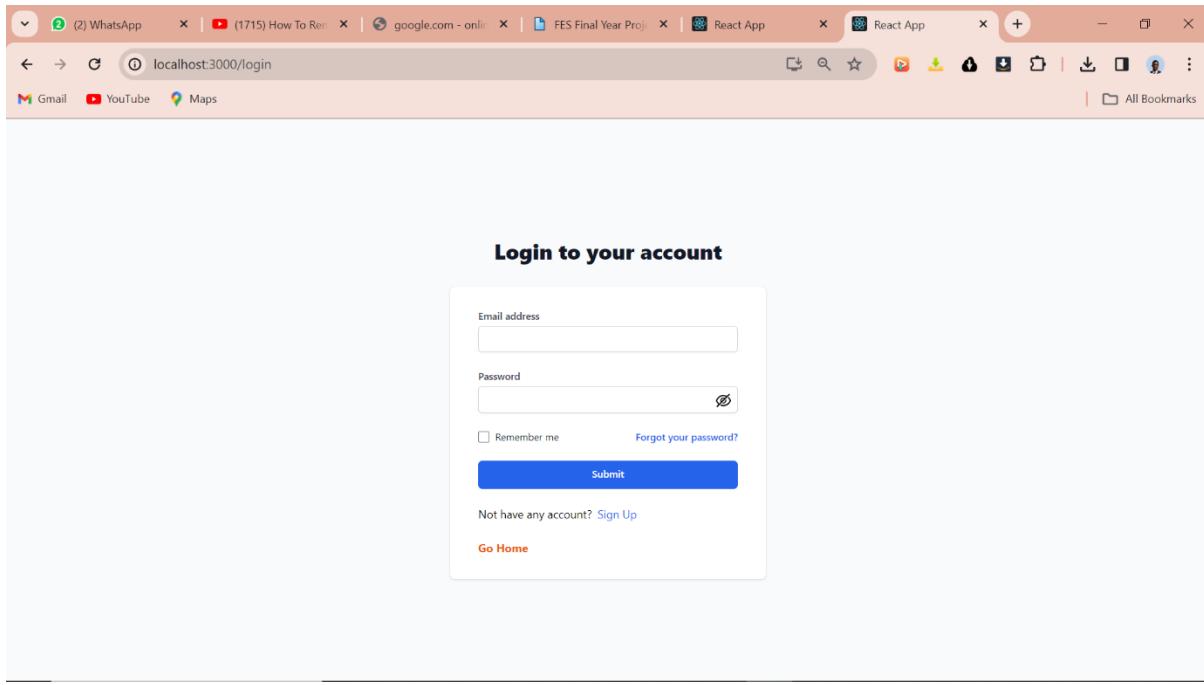


Figure 19: Login Page

Source (Research work)

The login page allows both buyers and sellers to securely access their personal accounts within the integrated multi-vendor marketplace by authenticating with email address and password. Once logged in, buyers can access their order history, reviews, wishlists, and other personal account features, while sellers can manage their digital storefront, including product listings, inventory, and orders, track sales, and use a central You can promote your business right from your dashboard.

The screenshot shows a web browser window with two registration forms. The left form is for 'Register as a new customer' and the right form is for 'Register as a vendor'. Both forms include fields for name, email, password, and file upload, along with a 'Submit' button.

Figure 20: Customer/Vendor Registration Page

Source (Research work)

The customer registration page allows new buyers to quickly and easily create an integrated account to access and purchase products from all integrated sellers in your multi-vendor e-commerce marketplace. Customers register for an account by entering their name, email address, password, and other important information. Your account includes personalized features such as saving payment methods, creating wish lists, writing product reviews, collecting loyalty rewards, receiving recommendations, tracking orders, and setting preferences. Notifications enable an efficient shopping experience across all providers and devices. The unified customer account seamlessly connects buyers to the inventory, payment systems, and order fulfillment functionality provided by the multivendor platform on the back end, facilitating transactions with all participating sellers in the marketplace.

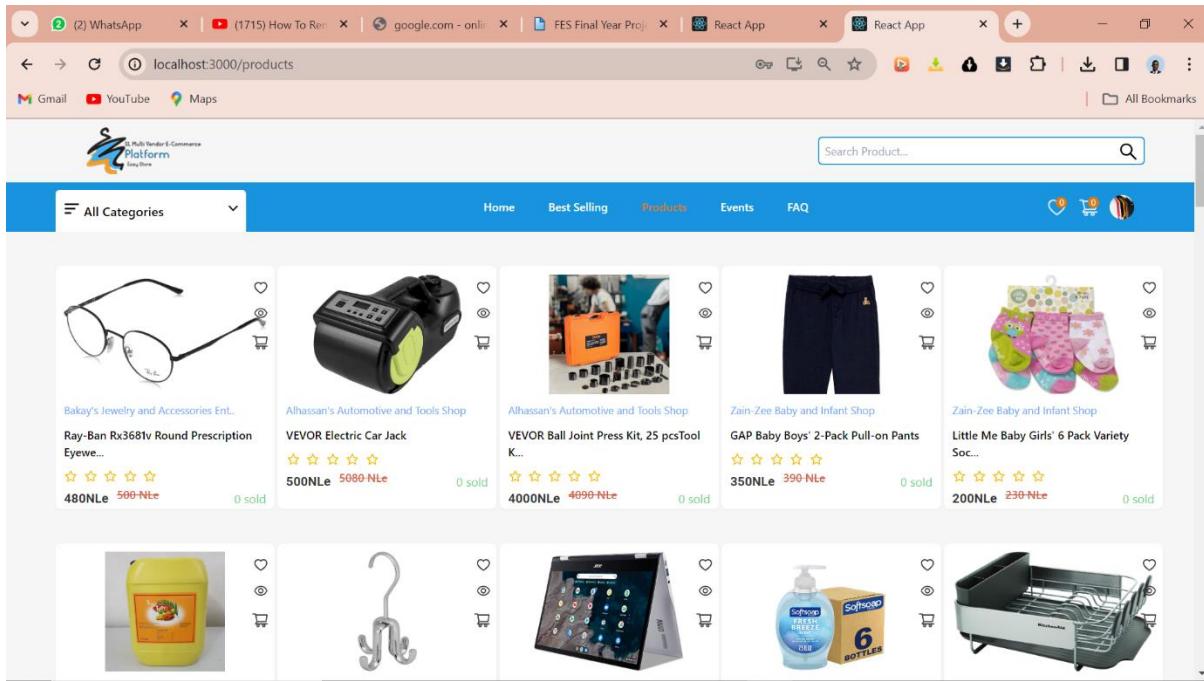


Figure 21: Product Page

Source (Research work)

Product pages seamlessly integrate inventory from all vendors in your multi-seller marketplace, giving shoppers a single, comprehensive place to explore and purchase all products. See vendor-aggregated product images, prices, seller details, descriptions, attributes, shipping policies and ratings, as well as personalized recommendations for complementary products from all sellers. Add to cart functionality connects to an integrated checkout and payment processing system to complete transactions, while wishlist and customer service options ensure an integrated experience regardless of product provider. While the unified product page remains focused on the buyer, the multivendor platform handles mapping the purchase to the appropriate seller on the backend.

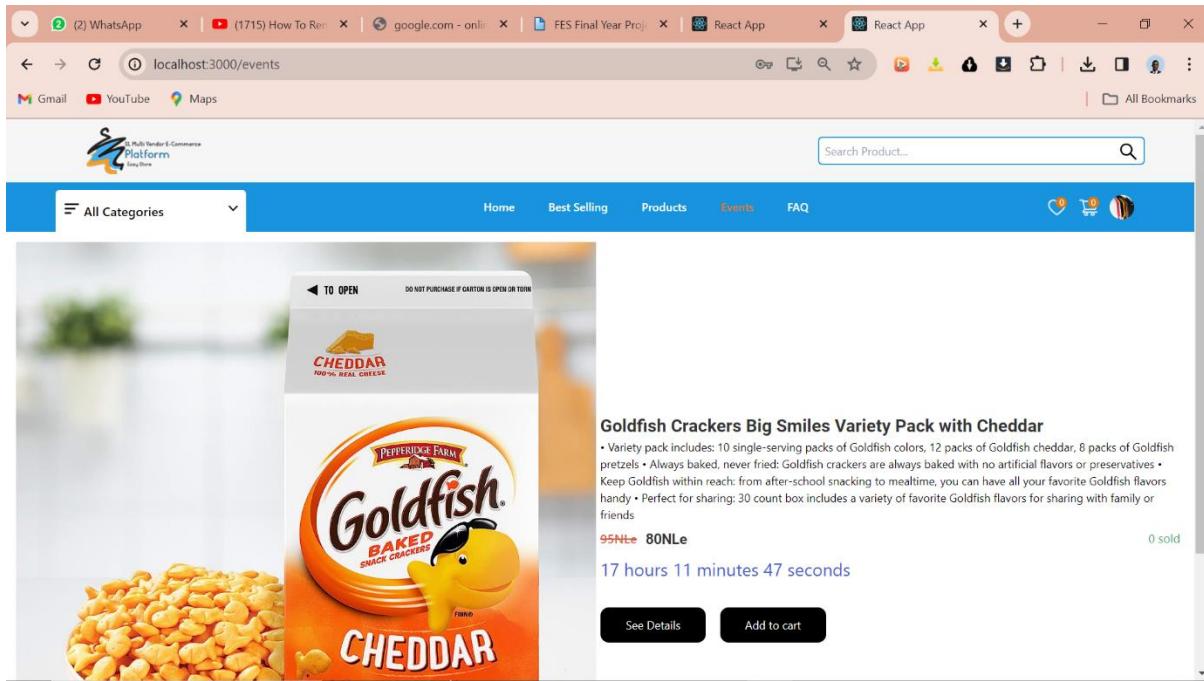


Figure 22: Events Page

Source (Research work)

The Events page serves as a centralized list of all sales events, webinars, and partner promotions offered by the many sellers integrated into the multivendor e-commerce marketplace. Shoppers can visit the site to easily discover and take advantage of special offers and discounts, including flash sales and site-wide coupons. You can also register for informative seller webinars that provide e-commerce tips and further engage with your target audience. A unified event page will drive more sales engagement by better coordinating and highlighting the myriad of marketing activities that the platform's various providers have to offer their customers in one convenient place.

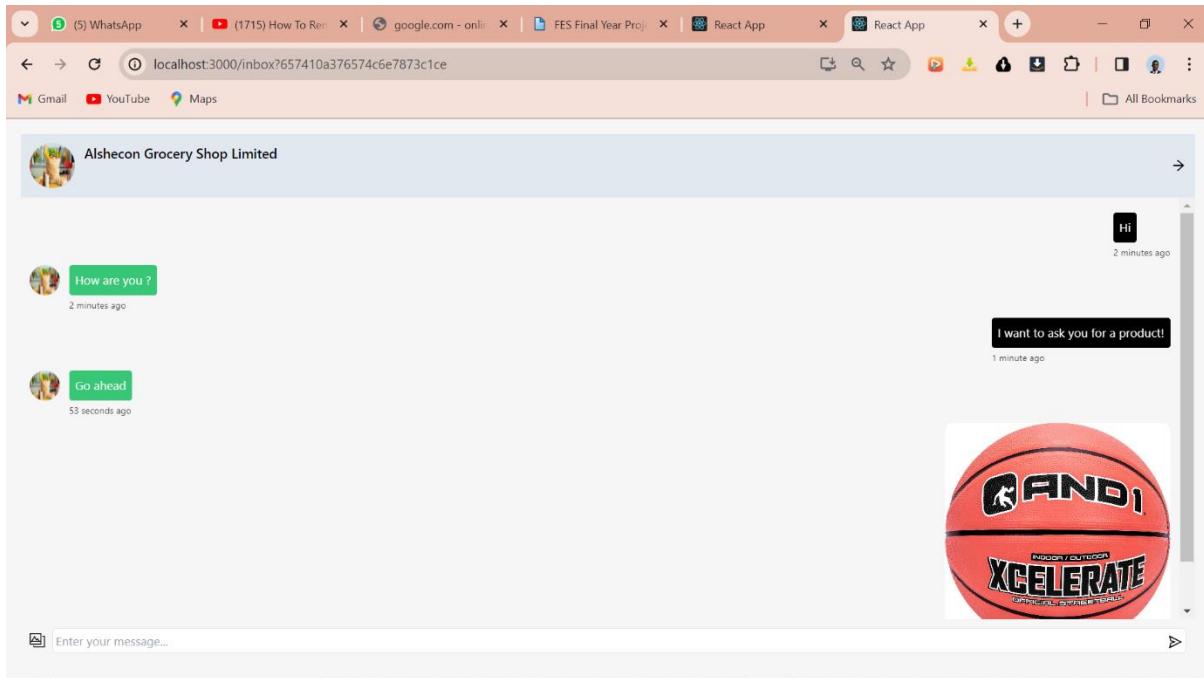


Figure 23: Chat Page

Source (Research work)

Chat sites provide a centralized messaging system that seamlessly connects buyers and sellers in multivendor marketplaces, allowing for real-time help and support. Customers can use chat to interact with all sellers on the platform through a unified inbox, eliminating the need to search through various vendor contacts. This allows buyers to ask questions about products, receive ordering support, and provide feedback, while empowering sellers to provide fast, personal customer service that builds brand loyalty. With intelligent routing and team assignment on the backend, chat sites provide a streamlined communication experience between consumers and many businesses using multi-vendor e-commerce platforms.

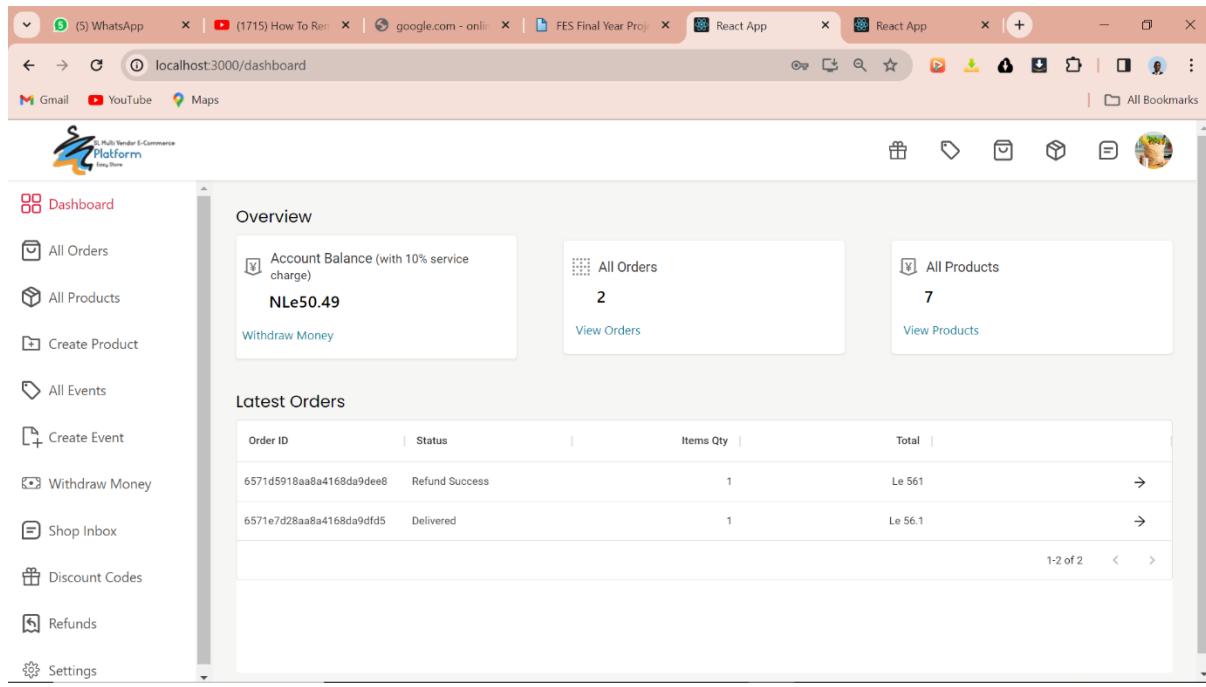


Figure 24: Vendor Dashboard

Source (Research work)

Vendor Dashboard provides all sellers in the multi-seller marketplace with a centralized, easy-to-use portal to manage all aspects of their e-commerce operations from one place. Key features include uploading product catalogs, processing orders, tracking sales and revenue reports, managing promotions and inventory, connecting to payment systems, responding to customer inquiries, and reviewing product and seller performance analytics.

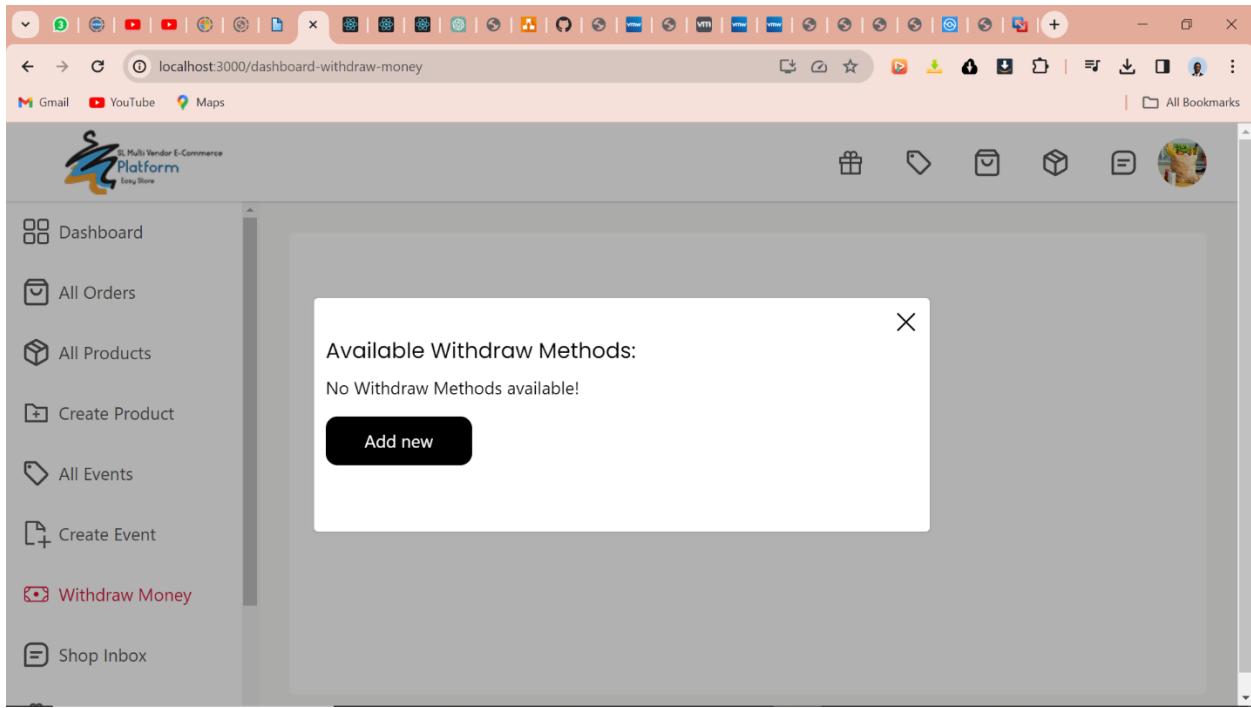


Figure 25: Withdrawal Page

Source (Research work)

Through the multi-vendor e-commerce platform's payment page, sellers can initiate payments of earned commissions from the marketplace to their preferred payment account. The most important elements of this page include the merchant's current account balance available for withdrawal, input fields to enter the withdrawal amount and verify the connected payment account, and a confirmation button to complete the withdrawal request. Platforms can set minimum withdrawal thresholds and processing fees. Automating the direct payment of commissions to merchant accounts is a hallmark of multi-vendor marketplaces.

The screenshot shows a web browser window with multiple tabs open. The active tab is 'localhost:3000/admin/dashboard'. The page itself is a multi-vendor e-commerce admin dashboard. On the left, there's a sidebar with various navigation options: Dashboard, All Orders, All Vendors, All Users, All Products, All Events, Withdraw Request, and Settings. The main content area is divided into sections: 'Overview' and 'Latest Orders'. The 'Overview' section contains three boxes: 'Total Earning' (Le 61.71), 'All Vendors' (9), and 'All Orders' (2). Below this is the 'Latest Orders' section, which is a table with the following data:

Order ID	Status	Items Qty	Total	Order Date
6571e7d28aa8a4168da9df5	Delivered	1	56.1 Le	2023-12-07
6571d5918aa8a4168da9dee8	Refund Success	1	561 Le	2023-12-07

At the bottom of the 'Latest Orders' section, it says '1-2 of 2'.

Figure 26: Admin Dashboard

Source (Research work)

The admin dashboard is a central control center for managing your multi-vendor e-commerce marketplace. Key metrics include total sales volume across markets, number of sellers and products, traffic analysis, and fees charged. Through the dashboard, administrators can view and approve seller account registrations, monitor product submissions, manage website content and layout, process payments, handle disputes, and track payments and transactions.

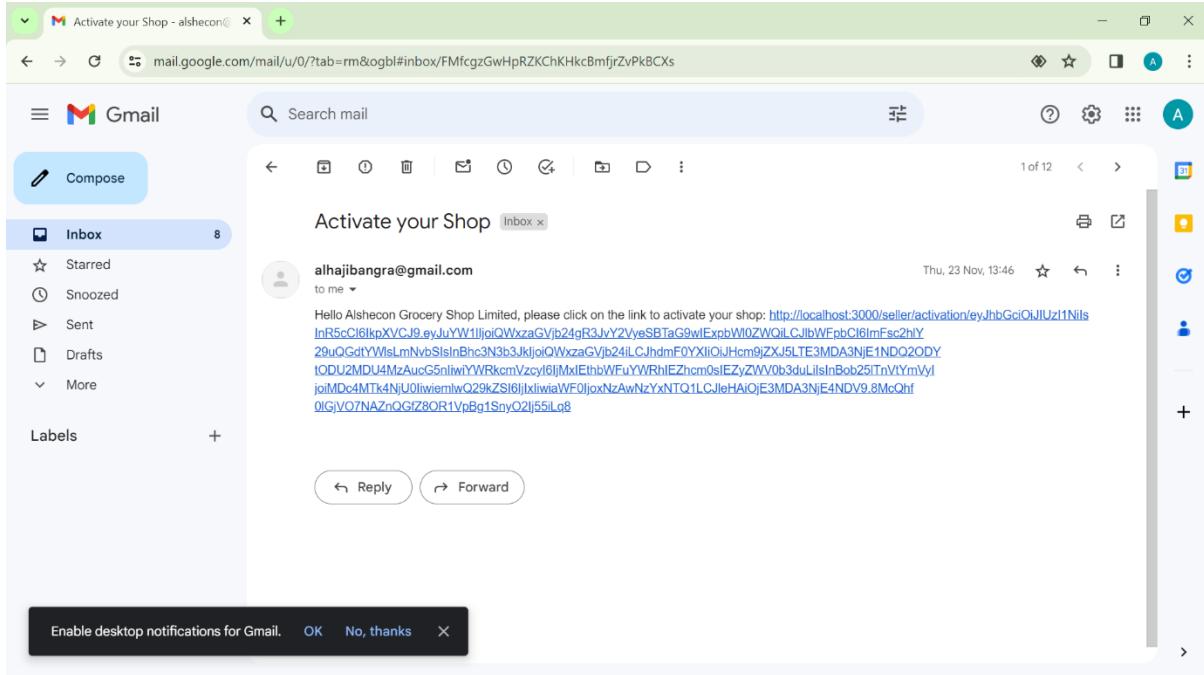


Figure 27: Email Notification Page

Source (Research work)

The multi-vendor e-commerce platform's email notifications page allows administrators to configure and manage the notifications sent to marketplace buyers and sellers. Key features include creating email templates for account login, order status changes, promotional campaigns, and subscriber list management. Automated, trigger-based notifications based on order flow can be set up for events such as new purchases, shipping confirmations, returns/exchanges, and merchant payments. Email analytics provides open, click, and unsubscribe rates to optimize your communications. A seamless customer notification system fosters marketplace trust and operational transparency for sellers. Marketplace administrators can use email pages to facilitate communication that improves the user experience.

## **CHAPTER FIVE**

### **Discussion, Recommendations and Conclusion**

#### **5.2 Discussion**

This result means that the multi-vendor e-commerce platform implementation was successful and the intended goals were achieved. Increased participation of local vendors will contribute to the socio-economic impact of the platform. A user-friendly interface and search engine improve accessibility and convenience, promoting a positive user experience. Online shopping cart functionality not only optimizes the purchasing process, but also allows you to effectively promote your products. The key is to build a vibrant and inclusive online marketplace that provides a valuable platform for both suppliers and customers.

#### **5.3 Limitations**

##### **5.3.1 Limitations**

- i. This system is not configured to accept Orange Money, Afri Money, or mobile money transactions.
- ii. The system runs on localhost. This means that not everyone has access to it.
- iii. This system cannot work business-to-business (B2B).
- iv. Website administrators cannot make additional features available. Examples: View a specific customer's profile, product books that need to be reordered, etc.

##### **5.3.2 Recommendations**

Future work should focus on improving the payment module by incorporating support for popular mobile payment services such as Orange Money and Afri Money. This expansion expands our user base and allows us to support a variety of payment settings. Deploying the system to a web server is important to extend its reach. Future efforts should prioritize migrating from localhost to a web-based platform to ensure global user access and maximize platform effectiveness. Future work should consider and implement business-to-business (B2B) functionality to cover a wider range of transactions. This improvement expands the utility of the platform and enables seamless interaction and transactions between companies in the ecosystem.

## **5.4 Conclusion**

In summary, our multivendor e-commerce platform has proven to be a valuable asset, achieving our goals of increasing vendor participation and providing a user-friendly experience. The contribution of this system goes beyond online sales and has a positive impact on the local economy. Despite its limitations, the platform's success highlights the importance of continued innovation in e-commerce. Contributions from this project will help foster digital inclusion, support local businesses, and enrich the online shopping experience for both vendors and customers.

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## APPENDICES

### Appendix A: Tools for Drawing UML Diagrams (Drawio)

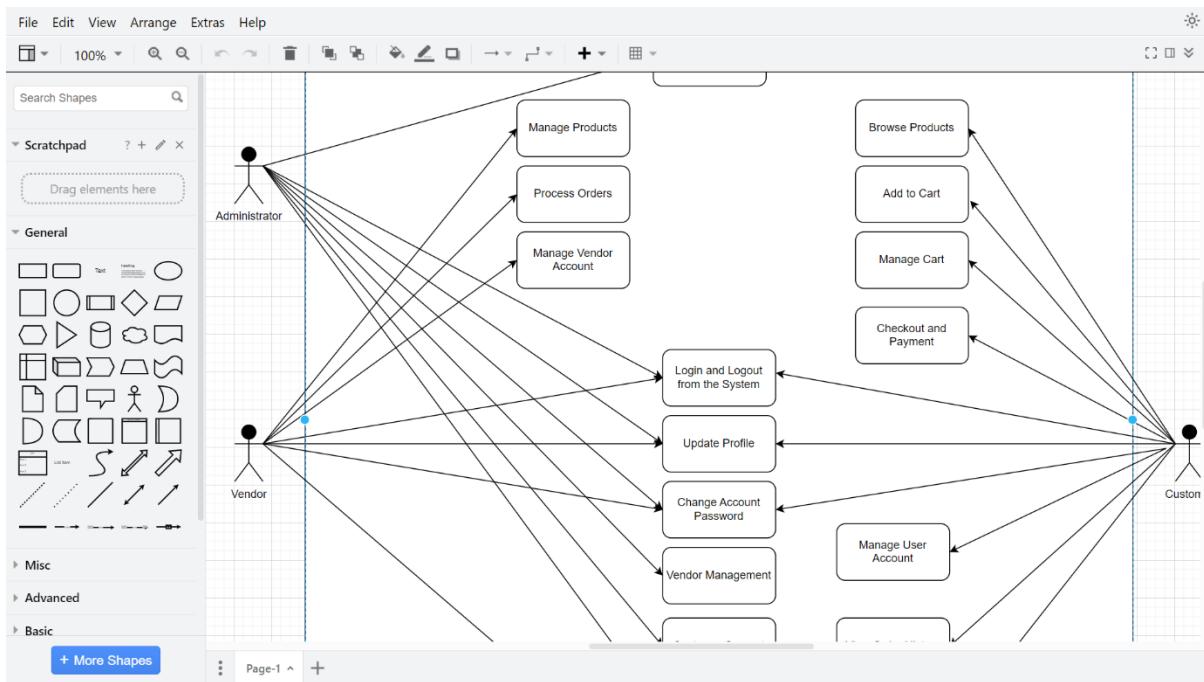


Figure 28: Tools for Drawing UML Diagrams

Source (Research work)

### Appendix B: The UML Diagrams used

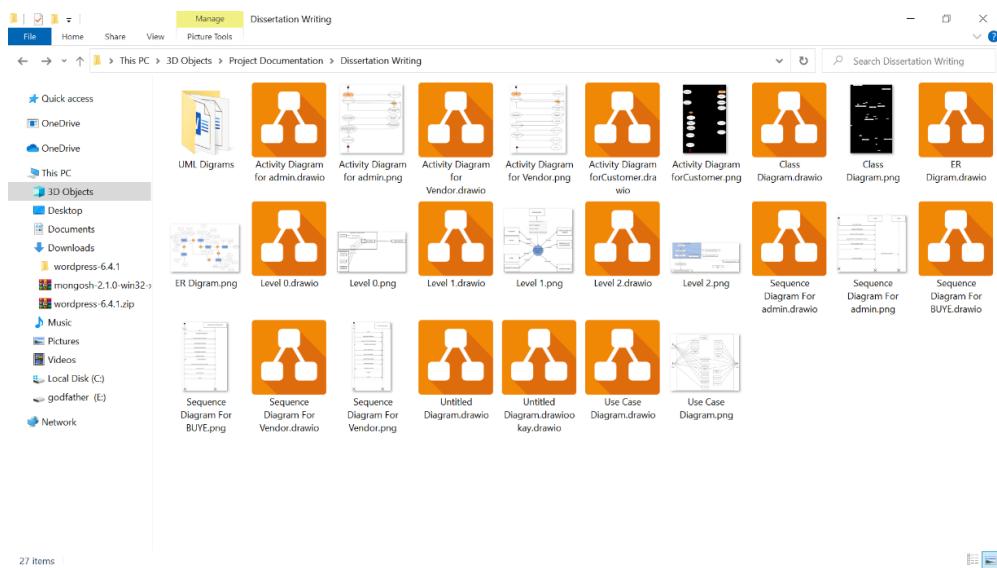


Figure 29: The UML Diagrams used

Source (Research work)

## Appendix C: Source Code

The screenshot shows a code editor interface with the following details:

- File Menu:** File, Edit, Selection, View, Go, Run, ...
- Toolbar:** Includes icons for file operations like Open, Save, and Print.
- Search Bar:** SL Multi Vendor Ecommerce Platform
- Code Editor Area:** Displays the content of `ShopLogin.jsx`. The code is a functional component named `ShopLogin` that handles user login via axios POST requests to the server's login endpoint. It uses useState and useEffect hooks to manage state for email, password, and visibility, and includes error handling with toastify.
- Explorer Panel:** Shows the project structure under "SL MULTI VENDOR ECOM...". The `Shop` folder contains `Layout`, `AllCoupons.jsx`, `AllEvents.jsx`, `AllOrders.jsx`, `AllProducts.jsx`, `AllRefundOrder...`, `CreateEvent.jsx`, `CreateProduct.jsx`, and `Dashboard.jsx`.
- Bottom Status Bar:** Shows Ln 1, Col 1, Spaces: 2, UTF-8, CRLF, {}, JavaScript JSX, and a search icon.

Figure 30: Source Code

Source (Research work)