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Mobile-based business-to-business platform for the pharmaceutical industry in Tanzania

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MOBILE-BASED BUSINESS-TO-BUSINESS PLATFORM FOR THE PHARMACEUTICAL INDUSTRY IN TANZANIA

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A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Masters of Science in Embedded and Mobile Systems (EMoS) of the Nelson Mandela African Institution of Science and Technology

Arusha, Tanzania

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ABSTRACT

The right to the uppermost attainable standard of health is a fundamental human right. In everyday life, mobile phones have become essential devices for most people in both developed and developing countries. Paper-based ordering of medicines in the pharmaceutical industry is time consuming and can enhance the spread of diseases such as COVID-19. Electronic ordering and stock management can solve these challenges, but while it has been widely adopted in developed countries, it remains underused in Tanzania. This study aimed to develop a mobile application (DawaFasta) and web application which links wholesale and retail pharmacies in Tanzania, to support electronic ordering and stock management. System and user requirements were collected through questionnaires, interviews and observations from 105 wholesale and retail pharmacies in Arusha, Dar es salaam and Kilimanjaro regions of Tanzania. The developed applications were evaluated for acceptability and usability by 9 wholesale and 15 retail pharmacy personnel to assess serviceability and usefulness. The results show that 96% found it very useful. The main reason is to bridge the gap between wholesale and retail pharmacies and provide easy access to medications. The 4% were not sure because they were unable to distinguish between legitimate and illegitimate online pharmacies. The application was assessed as having good usability for online pharmacy business purposes by wholesale and retail pharmacies. This application would need further development in order to raise awareness and add more features.

DECLARATION

I, Martine Fabian Lyimo, do hereby declare to the Senate of Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor been concurrently submitted for a degree award in any other institution.

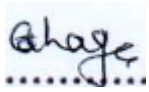
Martine Fabian Lyimo

02/08/2021

Name and Signature of Candidate Date

The above declaration is confirmed

Dr. Edith T. Luhanga



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CERTIFICATION

The undersigned certifies that has read and found the dissertation acceptable by the Nelson Mandela African Institution of Science and Technology.

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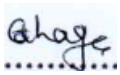

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DEDICATION

This dissertation is dedicated to my parents and family, who have never doubted my abilities.

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LIST OF ABBREVIATIONS AND SYMBOLS

2FA	Two-Factor Authentication
API	Application Programming Interface
B2B	Business-to-Business
COVID-19	Coronavirus Disease 2019
CSS	Cascading Style Sheet
DFD	Data Flow Diagram
EMoS	Embedded and Mobile Systems
HTML	Hypertext Transfer Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICT	Information Communication Technology
IDE	Integrated Development Environment
iOS	iPhone Operating System
MHI	Micro-Health Initiative
MVC	Model View Control
MySQL	My Structured Query Language
NM-AIST	Nelson Mandela African Institution of Science and Technology
OTP	One-Time Password
PHP	Hypertext preprocessor
RDMS	Relational Database Management System
REST	Representational State Transfer
SDLC	System Development Life Cycle
SMS	Short Message Service
SSL	Secure Sockets Layer
TCRA	Tanzania Communications Regulatory Authority

TLS	Transport Layer Security
UML	Unified Modeling Language
URL	Uniform Resource Locator
XAMPP	APACHE, MariaDB, PHP and Perl.
XML	Extensible Markup Language

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

A basic human right is the right to the highest attainable level of health (Federation, 2019). In everyday life, mobile phones have become essential devices for most people in both developed and developing countries (Zumstein & Träger, 2019). At the end of 2019, 5.2 billion people, or 67% of the global population, had signed up for mobile services (Global System for Mobile Communications Association [GSMA], 2020). By 2025, it is expected that there will be about 600 million new mobile subscribers, bringing the total number of subscribers to 5.8 billion (70%of the global population) (GSMA, 2020). Mobile technology provides multiple benefits to end-users including easier and faster communication, opportunities and improved ability to build relationships between organizations or industries, known as business-to-business (B2B) (Łobaziewicz, 2015).

Online/internet pharmacies are pharmacies that deliver, distribute, or dispense drugs directly to consumers over the internet (Fittler *et al.*, 2018). They have been successful in attracting a growing number of customers with their convenient home delivery services, 24 × 7 accessibility, lucrative deals, low transaction, and product cost (Perveen *et al.*, 2020).

According to estimates, about 4.5% of all internet searches are for health-related questions or facts (Fittler *et al.*, 2018). At this time, there are estimated to be 3000 online pharmacies in the world (AjaiKumar, 2020). The global online pharmacy market was worth around USD 42.32 billion in 2018, and it is expected to be worth around USD 107.53 billion by 2025, according to the report, with an annual growth rate of around 14.26% between 2019 and 2025 (Singh *et al.*, 2020). According to a survey, the online pharmacy market in North America and Europe was valued at approximately 29.3 billion dollars in 2014, and it is expected to rise at a rate of 17.7% annually to reach a valuation of US$ 128 billion dollars by 2023 (Zhao *et al.*, 2020).

According to Tanzania Medicine and Medical Devices Authority (TMDA) act, any online pharmacy services shall only be provided by a registered pharmacy and shall comply with the provision of this regulation (The Pharmacy Act, 2020).

The online pharmacy model in Tanzania has a stringent documentation process, since they follow strict protocols, not all medications and medicines can be ordered via the online portal; in that case, customized services can be accessed through their pharmacies. The taxes paid on all

transactions will largely benefit the Government (Goyal *et al.,* 2019). The model is also mostly based on individual websites, whereby most of the individual wholesale and some retail pharmacies run their own websites for online product sales. One example is dawa.co.tz, a wholesale service by Pharview which is an online pharmacy in Tanzania which deals with help in the distribution of needed drugs and medicines to those who have no access to them (PharView, 2020).

After the onset of the COVID-19 pandemic, pharmacies, like other health services, have been on the front lines of fighting the epidemic, and physical pharmacies have stayed open throughout lockdowns, mitigating or preventing population transmission (Hoti *et al.,* 2020). To achieve social-distancing, changes were made to the premises e.g., restricting numbers of customers accessing the pharmacy at a time and implementing delivery of pharmaceuticals. Patient anxiety and violence have increased as a result of these steps, resulting in longer wait times (Hayden & Parkin, 2020). Limited travel opportunities due to restricted movements have also resulted in interruptions in the supply chain, especially for imported products (Hayden & Parkin, 2020).

Therefore, there is a need to broaden the availability of online pharmacy services. Online pharmacies can help patients cope with the problems they face during outbreaks, epidemics, and pandemics. The online pharmacy platform can also help pharmacies find new vendors, track product supply in real time, and place orders from wholesalers with available stock. Overall, this will improve product accessibility for both wholesalers and retailers.

1.2 Statement of the Problem

In Tanzania, pharmaceutical practices include a high level of personal interaction as well as paper-based documentation such as receipts and medical forms. This may result in the spread of pandemic diseases like COVID-19, as well as a loss of time spent visiting the pharmacy. The COVID-19 pandemic has necessitated a shift in thought in order to prevent public interaction and limit movement due to restricted movements. This has resulted in declining stock and a shortage of medical supplies. As a result, digital and online resources become more relevant. Purchasing medicines via an online mobile platform is vital because it allows for easy access in a single click while also ensuring protection. One of the challenges of using this platform is that it may endanger patient safety by selling counterfeit medicines. Therefore, there is a need to understand pharmacies requirements for development of a business-to-business model and having a centralized portal for pharmacies rather than individual websites to support safe online pharmacy business in the country.

1.3 Rationale of the Study

To demonstrate knowledge of online pharmacies, especially mobile B2B platforms, as well as to raise awareness of the use of mobile applications for medical supply to pharmacies in Tanzania. The reasons for and barriers to online pharmacy model adoption, especially individual websites and mobile applications, have been discussed.

1.4 Project Objectives

1.4.1 Main Objective

The main objective of this study was to design and develop a business-to-business (B2B) mobile and web platform, to support adoption of online pharmacy models in Tanzania.

1.4.2 Specific Objectives

The specific objectives of this study were:

(i) To determine wholesale and retail pharmacies requirements for a B2B mobile and web platform that is based on online pharmacy model.

(ii) To develop a mobile application (DawaFasta) and website for wholesale and retail pharmacies with administrative control.

(iii) To validate and deploy the mobile app platform.

1.5 Research Questions

(i) What are the web and mobile requirements for online/internet pharmacy applications?

(ii) How should an online pharmacy's architectural solution be designed?

(iii) How user-friendly are the proposed web and mobile apps?

1.6 Significance of the Study

A platform dedicated to keeping track of medical manufacturers and wholesalers, as well as their locations will help pharma professionals and medical retailers save time while looking for and ordering medicines. The platform will help retailers to place orders from their mobile phone, to track their orders and order delivery status. The platform will include stock monitoring and control, as well as distribution and purchase management, to prevent stock from falling above a predetermined threshold, thus reducing the risk of inadequate drug supply. The platform will help pharmaceutical companies activate new market lines and boost their competitive advantage

significantly. The platform can increase productivity and streamlining internal processes. The mobile platform will help pharmacies to sell medicines during outbreaks, epidemics, and pandemics.

1.7 Delineation of the Study

This study assumes that all pharmacy owners have smartphones with the ability to download apps that allow them to order medicines online. Equally, this project assumes that all wholesale and retail pharmacies personnel have strong internet connectivity to access both mobile and web applications. This research has a few limitations. The small number of responses (105, a pitiful number when compared to the number of pharmacies in Tanzania) restricted the study to descriptive statistics. The timing of data collection was also restricted, which had a negative impact on response rate; however, we had little flexibility in terms of study timing due to the tight time frame for completing the analysis as part of a master's degree. A greater sample size should be used in future studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 General Online Pharmacies

Anyone, regardless of their location, can now purchase drugs from online pharmacies. The distance between an online pharmacy's website and its customers is unrestricted. This allows us to purchase drugs from anywhere without experiencing any problems (Nadia, 2019). The scope of online pharmacy services, according to the Health Science Authority, excludes the wholesale supply of therapeutic goods by signed orders, as well as the retail supply of controlled drugs and compounded medicines (Health Science Authority, 2020).

Despite the fact that online pharmacies provide a consistent range of benefits to patients (e.g., 24-hour availability, time savings, reduced rates, home delivery for chronic drug users, access to own dispensing records, etc.), there are significant drawbacks in terms of consistency and the effect of patient-pharmacist contact, and thus on the consulting service (Ilardo & Speciale, 2020). Also much of the time, patients may not know about items offered by online drug stores and might not have the very quality that a retail drug store may offer (Prashanti & Sravani, 2017).

In their activities, online pharmacies have also had a number of issues. It is difficult to create an effective regulatory mechanism for internet pharmacy logistics activities, for example, due to the reluctance of many illicit websites to reveal their actual locations (Liu, 2020). Patients are at risk from direct access to medications on the internet because it is difficult to distinguish between counterfeit and illicit products. Counterfeit drugs account for 10% of worldwide online drug sales, with 30% of that taking place in developing countries such as Africa, Asia, India, and Latin America (Saraswat & Jain, 2020).

2.2 Mobile Technology in Tanzania

Mobile technology follows the consumer everywhere he or she goes. It is made up of two-way portable communication devices, computing devices, and the networking infrastructure that links them (IBM, 2021). Increased internet penetration, mobile technology adoption, and improved payment and distribution infrastructure are all factors that can help Africa's e-commerce sector to grow (Longo & Chachage, 2015). It has been reported that, in January 2020, Tanzania had 44.13 million mobile connections; additionally, between January 2019 and January 2020, the number of mobile connections in Tanzania increased by 709 thousand (+1.6%), and the number of mobile connections in Tanzania in January 2020 was equivalent to 75% of the total population

(Datareportal, 2020). The easy accessibility of the internet provides the advantage for the community to perform online services in the world. Tanzania had 14.72 million internet users in January 2020, according to reports. Between 2019 and 2020, the number of internet users in Tanzania increased by 428 thousand (+3.0%), with internet penetration reaching 25% in January 2020 (Datareportal, 2020). According to Tanzania Communication Regulatory Authority the trend of subscription on mobile lines in raised from 40 million in 2016 to 51.2 million in 2020 and the estimated number of internet users and penetration was 49% by December 2020 (Tanzania Communications Regulatory Authority [TCRA], 2020). By promoting the delivery of health care and linking patients to their health care services, mobile devices may help cut costs (West, 2013).

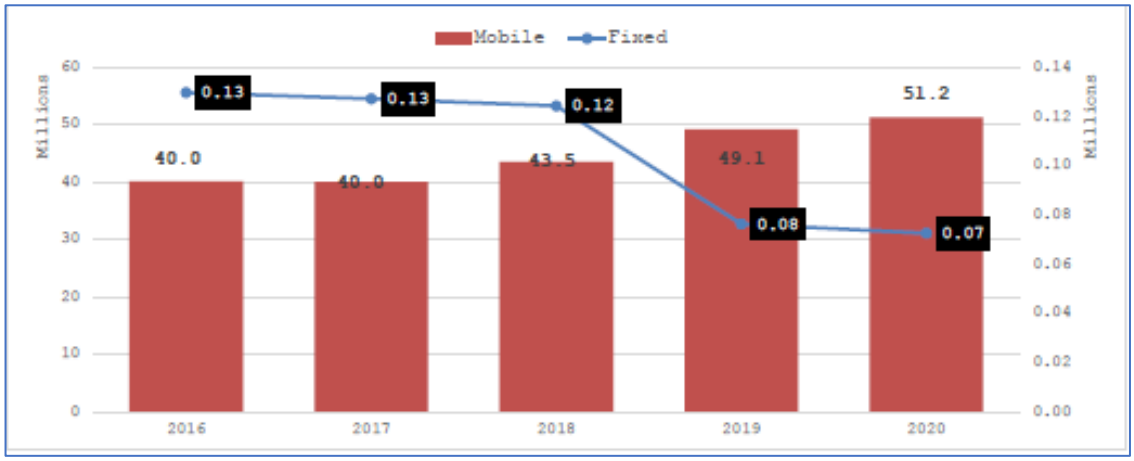

Figure 1: Penetration of both mobile and fixed lines in Tanzania (TCRA, 2020)

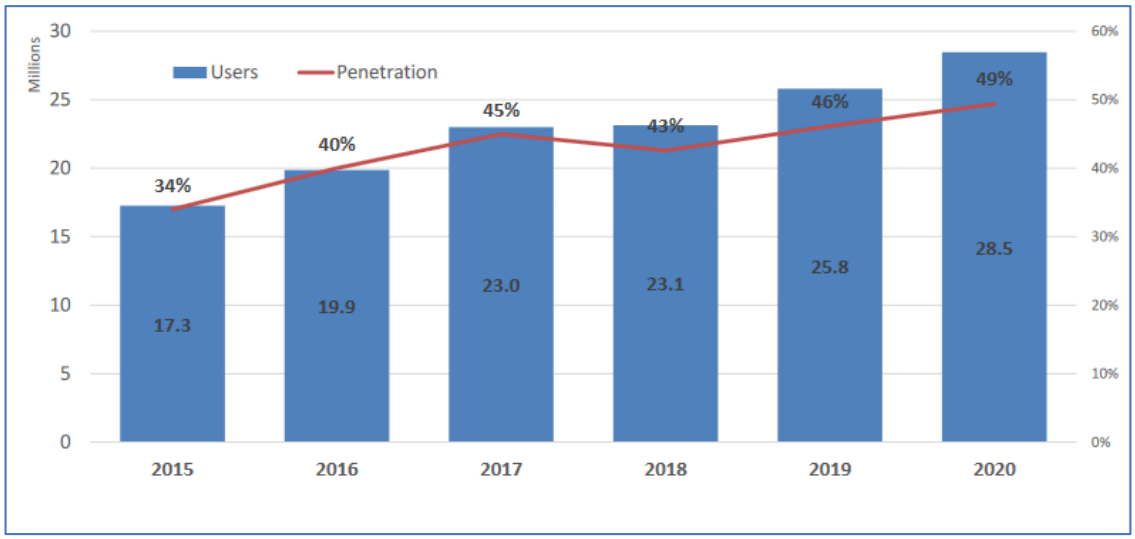

Figure 2: Internet users and penetration estimates by December 2020 (TCRA, 2020)

2.4 Web Technology

Web technologies are the markup languages and multimedia packages that computers use to interact. Because computers are unable to speak with one another in the same manner that humans can, they must rely on codes (TMS, 2018). Web technologies are important in the health sector. They make information and big data more available, improve information sharing among health facilities, and make data storage and reporting easier (Philipo, 2019). In this study, web technology refers to the platform where goods, sales, and user management will be handled.

2.5 Mobile-based Business-to-Business Pharmacy Retail

According to research, mobile drives or affects over 40% of revenue in leading B2B companies, even in industries where revenue is historically driven by sales rather than marketing (Spero, 2017). You will reach out to more customers and break into new markets with B2B platform solutions. Furthermore, if your B2B portal is available 24 hours a day, 7 days a week, 365 days a year, you can accept new orders at any time and from any place (Business-to-Business Wave [B2BWAVE], 2018). There are some efforts that have been done regarding online pharmacy platforms so as to ease accessibility and delivery of medical services.

1 mg is a health-related online website. It delivers affordable health items to over a thousand cities throughout India, including all forms of medications, vitamins, and nutritional supplements. It also has a mobile app, which makes it even more available. It offers free consultations and talks with certified health practitioners. Users can schedule lab tests and even receive reports through the internet. It also attempts to bridge the language divide in India by publishing health-related papers in Hindi. By providing goods and services related to different categories of medicine, it caters to a wide range of consumer interests. As a result, it has transformed the lives of both customers and caregivers (Bharti, 2020).

Frank Arabi created Pharmlinks, a Tanzanian online website, in 2018. The platform connects pharmaceutical wholesalers and retailers in Tanzania, allowing them to purchase high-quality drugs from licensed pharmacies while also keeping an eye on the market. This platform is still in its early stages of development; however, with Pharmlinks, a customer can choose goods and pay for them online, and the items will be shipped to the customer shortly after (Tech in Africa, 2020). The strengths of this platform are to reduce the supply and consumption of expired medicines that are checking whether the specific drugs (products) are original or fake, up to date or expired. This platform also is intended to locate a nearby pharmacy and access the stock with prices for each drug as well as being able to send the orders to the specific shops and get them delivered in real

time. Apart from these strengths the platform has some weaknesses such as, in their platform they specified to have a mobile application which will operate only on android platform and wholesale will operate only on website.

Joanna Bichsel and Amanda Arch founded the Kasha e-pharmacy platform in 2015, which operates in Kenya and Rwanda. Kasha is an e-Commerce platform that specializes in pharmaceuticals and other health-related products. Kasha has excellent and fast delivery (for a small delivery fee) because if a customer selects a product, a Kasha agent may deliver it to the customer directly or by motorcycle. They also distribute to pick-up locations around the country, where women without access to mobile payment systems and who are typically low-income can pay in cash and avoid being charged for delivery. The products are wrapped to ensure confidentiality regardless of distribution process (FastCompany, 2021). Kasha operates in two countries of Kenya and Rwanda. The weakness of this platform is that it's biased, it only deals with women's health and self-care products.

Furthermore, the Accra-based mPharma platform in Ghana and Kenya was founded by chief executive Greg Rockson. The mPharma provides a subscription service for pharmaceutical inventory control. This platform's strengths are that it helps to assist pharmacies in upgrading their physical infrastructure, as well as funding and improving their inventory system, in order to increase the standard of service for their customers. With mPharma, revenue is based on actual drug sales to patients. Instead of buying stock, mPharma gives it to you and handles the expiration dates. Over 250 pharmacies in Ghana, Nigeria, Kenya, Zambia, and Zimbabwe use this process (Quartz, 2020). The weakness of this platform is that it focuses only on inventory systems and it takes more risk in building pharmacies infrastructure and giving stock to pharmacies.

The above are some of related works on pharmaceutical online platforms. Some focus on implementing only android platforms, some concentrate only on women health self-care products and others take risk to supply stocks and build pharmacies infrastructure. Therefore, this project proposed a mobile platform (DawaFasta) that consists of web and mobile based applications which will link wholesale and retail pharmacies in Tanzania. It will be multiplatform (android and iOS), geo-location feature will be implemented to show location of shops and to simplify product delivery on time. Also, wholesale and retail pharmacies can use both mobile and website to upload products, order products, receive and process orders.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study took place in Tanzania's Dar es Salaam, Kilimanjaro, and Arusha regions. Since the survey time was minimal, the regions were chosen for their ease of travel from one to the next. Dar es Salaam is Tanzania's largest economic center, situated on the coast of the Indian Ocean. Dar es Salaam has a total area of 1393 square kilometers. According to the Tanzania Bureau of Statistics, Dar es Salaam has a population of about 4.3 million people (National Bureau of Statistics [NBS], 2017). Also included are social, economic, and industrial activities.

Arusha, Tanzania's northernmost capital, has a population of about 1.6 million people (NBS, 2017). Arusha is a 34 526-square-kilometer area in Tanzania. Kilimanjaro National Park, Serengeti National Park, Ngorongoro Conservation Area, Lake Manyara National Park, and Arusha National Park are among Africa's most prominent national parks and game reserves located in Arusha. The Kilimanjaro region is in Tanzania's mainland's north-eastern corner. It has a population of 1.8 million people (NBS, 2017). The Kilimanjaro area spans 13 209 square kilometers. The Kilimanjaro area contains the prominent highest snow-covered Mount Kilimanjaro, as its name suggests. The motivation was that human health is a top priority; therefore, since the platform connects pharmacies online, the same system could easily be implemented in other parts of Tanzania.

3.2 Participants

Selected 89 pharmacy owners/personnel were interviewed for a total of about 20 minutes. There were 34 (38.2%) wholesale pharmacy 55 (61.8%) retail pharmacy participants. The education level of participants was 23 (25.8%) Secondary level, 19 (21.4%) diploma 39 (43.8%) bachelor degree and 8 (9%) master’s degree. Participants had the following roles; 13 (14.6%) pharmacy owners, 12 (13.5%) managers, 22 (24.7%) pharmacists, 28 (31.5%) pharmacy assistants, 11 (12.5%) pharmacy dispensers and 3 (3.4%) pharmacy clerks. A multi-stage sampling method was used in the study. A multi-stage sampling method is a method of moving from a wide to a narrow sample in a step-by-step manner. Samples that are clustered in a few geographic regions are selected using multi-stage sampling. This method of sampling was chosen because it saves time and money (Taherdoost, 2018).

3.3 Methods of Data Collection

The data for this project was collected over the course of two months in February and March of 2021. As listed underneath, questionnaires, interviews, and observations were used to collect data. Data was gathered in both quantitative and qualitative formats.

3.3.1 Questionnaires

A self-administered questionnaire comprising of 19 questions were provided to pharmacy owners using Google forms. Both closed ended (multiple choice) questions and questions were used. The questions asked were on the following topics; awareness of the existence of medical distribution/supply apps, purchases of medicines via mobile apps in the past, current medicine ordering process, the pricing when ordering online vs other process, delivery cost and time, challenges they face if using the app, the integrity of ordered product, whether they would like to have a medical purchase mobile application and what features they would like to incorporated in the app. The main objective was to determine the knowledge and awareness level of the wholesale and retail pharmacies owners on the availability of medical distribution/supply apps (applications), what would drive them/drove them to use such applications and other system requirements. Survey questionnaires are presented in Appendix 2.

3.3.2 Interviews

Structured interviews were carried out with random selected pharmacy owners/personnel with the purpose of better understanding the requirements raised in the questionnaire.

3.3.3 Observations

Observation was done after interviews. The focus was on how supplies ordering and stock management were conducted. The aim was to collect data on what participants actually do rather than what they claim to do. For instance, to see how medication is ordered and to see if any customers have mentioned using a mobile application to buy medicine.

3.4 Data Analysis Methods

Quantitative and multiple-choice results were analyzed using descriptive analysis. Pie charts were used to visualize the results. Pie charts were used because they visualize and represent data in a simple graphical format. The Microsoft Excel tool was used in this approach. Free data responses were analyzed using thematic analysis. Thematic analysis is a methodology for identifying, analyzing, and reporting patterns (themes) in data, which Braun and Clarke introduced. At the

most basic level, it organizes and describes the data set in (rich) detail. Thematic analysis was chosen because it's a popular and versatile method of analysis (Braun & Clarke, 2006). The R programming was used in this method. Thematic coding was used to code the free responses, and a text network diagram was used to describe the results. One individual did the coding and presented the themes to people who had similar experiences (but were not interviewed) for validation.

3.5 Mobile and Web Application Development

React-native was used in the development of the mobile app. React-native is a popular JavaScript-based mobile app framework that allows you to build natively rendered applications. It uses a single codebase to build iOS and android mobile apps at the same time. Appendix 3 shows some codes for mobile application development using react-native. The web application was created using the Laravel PHP platform, HTML, JavaScript, and CSS programming languages. The web pages were structured using Hypertext Transfer Markup Language, and the graphical layout was done with JavaScript and CSS (visual and aural). Furthermore, MySQL was used to build the database. The Laravel PHP application was used on the server side. Appendix 4 shows ample PHP codes used in web application development.

3.5.1 Development Methodology

The term "methodology" refers to a collection of tasks that must be completed in order to turn user specifications into a software platform. This project will be introduced using the Incremental Model of System Development Life Cycle (SDLC), which involves incrementally implementing and testing the product under development. The advantages of incremental model are as follows: It produces working software quickly and efficiently during the software life cycle; it is more versatile and less expensive to adjust scope and requirements; it is easier to test and debug during a smaller iteration; customers can adapt to each built; and it reduces the initial delivery cost. Danger is easier to control since risky pieces are established and dealt with during iteration (Kyeremeh, 2019). Because of the project's future needs, which would necessitate system adjustments, this approach is the best fit for it (Ernest *et al.*, 2016). Incremental models have the following steps; requirement analysis, design and development, testing/verification, implementation, and maintenance. Figure 3 presents an incremental SDLC.

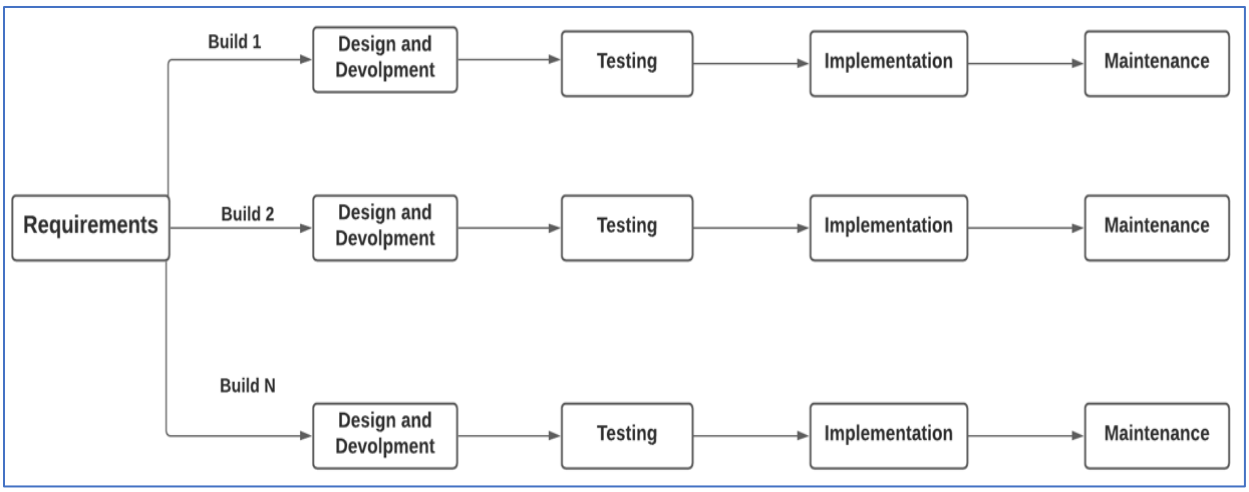

Figure 3: Incremental System Development Life Cycle

3.5.2 Tools and Technologies Used

The following descriptions point out the technologies which were used in this project. Both mobile and web application was developed by using the following tools:

(i) Laravel Hypertext Preprocessor Framework

Laravel is a powerful model-view-control (MVC) Hypertext Preprocessor (PHP) platform for creating full-featured web applications with a simple and elegant toolkit. Laravel is a free open-source PHP platform for developing web applications. Laravel is included in this project because it makes the development process easier by simplifying repetitive tasks that are common in today's web applications. Laravel is a full stack framework, since it offers an improved and smooth workflow for the developer due to its vertically integrated web development environment. Laravel has proper documentations whereby classes, coding style, methods have good and detailed explanations. Furthermore, Laravel reduces the product development cycle because of faster integrations. Also, Laravel gives an easy and very helpful active record implementation for running with the database.

(ii) Model-view-Control

Model-view-control (MVC) is an architectural pattern that divides an application into three logical components: Model, view, and controller. The MVC architecture pattern allows a web application to have several views of a single model (Armel, 2014). The database management and manipulation are the focus of the model variable. It's made up of a layer that sits between the data and the client. Data can be stored in this component in a variety of database types, including MySQL. The view part is in charge of displaying the information that the controller obtained from the model. View also focuses on information and web page generation, which includes the

creation of a footer, header, and the uploading of data for users to access. Finally, control serves as a bridge between the model and view components, processing all logic and requests, manipulating data with the Model component, and interacting with Views to extract the final output. For loading purposes, the control class is connected to the Uniform Resource Locator (URL). It links the model, view, and other critical resources together to process HTTP requests and generate web pages.

(iii) Cascading Style Sheets and Hypertext Markup Language

The key technologies for creating Web pages are CSS (Cascading Style Sheets) and HTML (Hypertext Markup Language). For a number of devices, CSS provides the (visual and aural) layout. It also explains how HTML elements should be presented/displayed in a web page. The layout of a web page is provided by HTML. This project creates a front-end web application interface with CSS and HTML.

(iv) Java Script

JavaScript is a text-based programming language that allows interactive web pages to be created on both the client and server sides. JavaScript adds interactive elements to web pages after they have been developed using HTML and CSS.

(v) React- Native

React-native is a well-known JavaScript-based mobile app framework that lets you create natively rendered mobile apps. The benefits of react-native, which is a framework for creating cross-platform hybrid mobile applications. It uses a single codebase to build mobile apps for both iOS and android at the same time (Tian *et al.*, 2014).

(vi) Apache Server, Mysql, Hypertext Preprocessor, Perl programming language (XAMPP) and Structured Query Language (MySQL)

The XAMPP stands for APACHE, MariaDB, PHP, and Perl and is an open-source cross-platform web server solution. It helps you to build a WordPress site on your computer's local web server. The MySQL, on the other hand, is an open-source Relational Database Management System (RDBMS) that is used to develop and manage databases. The MySQL is used in this project because of its speed, demonstrated reliability, ease of use, and versatility.

3.5.3 Assumptions and Dependencies Relating to the Use of a Mobile Application

(i) Wholesale and retail pharmacies personnel own smartphones.

(ii) Wholesale and retail pharmacies personnel are able to use mobile applications.

(iii) Availability of strong internet connectivity to enable the mobile applications to connect with the database and also users to have access to it at any time.

3.5.4 Assumptions and Dependencies Relating to the Use of a Web Application

(i) To access a web application, you will need a strong internet connection.

(ii) Employees of wholesale and retail pharmacies are computer literate.

(iii) Wholesalers need strong internet access to upload goods and retrieve reports from the database.

(iv) High-speed internet access to enable administrators to handle the network and mobile platforms.

(v) Strong internet connectivity is needed to synchronize goods and sales through a mobile application that is then accessed via a web application.

3.6 Validation

Validating software entails proving by empirical proof that all software specifications have been enforced properly and fully, and that they are traceable to system requirements (Torp, 2003). Validation was done by 16 personnel for system acceptance. The validation steps were: Unit testing, which focuses on validating that the smallest unit in a system satisfies the contract that is defined by its API and documentation (Markus & Markus, 2013). The aim was to test the following modules; - content view, data transfer from the mobile app to the web app, user authentication, SMS notification, and interactivity (mobile and web application).

The conceptual extension of unit testing is integration testing. The interface between two previously tested units is tested when they are combined into a part (Jorgensen, 2014). The aim was to merge the mobile app and the web app to see if everything was working properly. System testing, which is done when all modules are in an integrated state and working as a single application at that time System testing is carried out to determine if the system meets its functional and non-functional requirements (Mahajan, 2016). User acceptance testing is the last step before a device is approved for its intended purpose and it validates both functional as well as nonfunctional requirements (Mahajan, 2016).

3.7 Security

Because of the large number of smartphones on the market and the amount of sensitive data they store, attackers are interested in exploiting them and obtaining information (Ndibwile *et al.*, 2018).

3.7.1 Two-factor Authentication

Two-factor authentication (2FA) is introduced as a security feature on the mobile platform. Two-factor authentication is the mechanism by which a person requesting access demands that an authenticating party attest their identity by providing two attributes, such as something you know and either something you have or something you are, that are connected to the identity (Ali *et al.*, 2020). The 2FA is used because two methods of identification are combined to increase the likelihood that a person, usually a mobile/computer user, is the rightful owner of that identity (Allen & Pickup, 2017). In this study, when a user accesses the login page, he or she must provide a username and password. These credentials are checked on the server, and the user is then prompted for a second step authentication by receiving a one-time-password (OTP) through SMS. The user is given access to the application once the OTP is typed correctly.

Figure 4: Two-Factor Authentication mechanism (Rahav, 2018)

3.7.2 Secure Socket Layer/Transport Layer Security

The Secure Socket Layer/Transport Layer Security (SSL/TLS) protocol is widely used in applications to protect data sent between clients and servers over the Hypertext Transfer Protocol (HTTP) (also known as HTTP over TLS (Hypertext Transfer Protocol Secure- HTTPS)) (Das &

Samdaria, 2014). This protocol was chosen for this project because it protects against phishing and man-in-the-middle (MITM) attacks. In this study SSL Certificates were deployed on the web server in order to establish a secure connection using the https protocol. This helped to prevent data from being intercepted and accessed by unintended receivers when it was sent over the internet. The digital certificate was issued by Let's Encrypt, a nonprofit Certificate Authority that issues SSL certificates to millions of websites.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Results

4.1.1 Knowledge Level of Mobile Supplies Ordering Applications

It was also discovered that 104 (99 %) of wholesale and retail pharmacy personnel own smartphones, then 82 (78 %) of respondents were unaware of the existence of medical distribution/supply mobile apps, and that 101 (96 %) do not use mobile apps for supply or buy medicines. The main reason is the lack of awareness about the medical mobile apps. *"No, I'm not sure, other than a daily customer contact or a visit to our shop directly or information from my sales representatives"* (ID 9), Wholesale pharmacy owner.

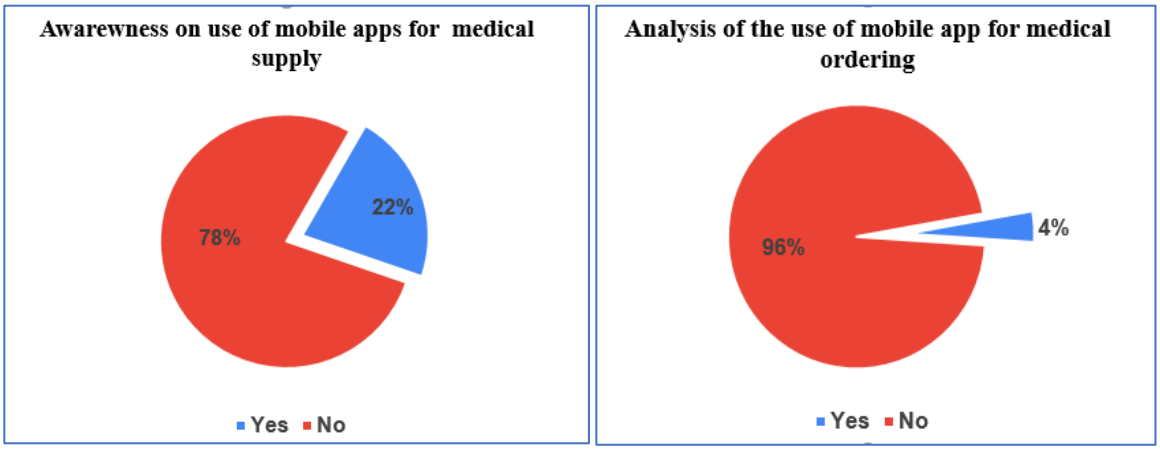

Figure 5: Awareness and use of medical supply mobile applications

4.1.2 Perceived Advantages and Incentives to Use Mobile Supplies Ordering Applications

Out of 105 respondents 97 (92.4%) of the respondents would like to have a mobile app which facilitates supply or purchase and makes easy access and delivery of medical services. The main reason is it will give a wide range of medicines, reduced paperwork, quick delivery and secured payments. *"Yes, that's a good idea due to technological growth. I see it as a benefit to the consumer because it will cut down on paperwork and time spent buying medicines"* (ID 21), Wholesale pharmacy owner.

4.1.3 Perceived Disadvantages and Barriers to Using Mobile

Out of 105 respondents 8 (7.6%) of the respondents didn't like to have the mobile app which facilitates supply or purchase and makes easy access and delivery of medical services. They point

out some barriers such as security of online products, internet theft and network problems. *"Hapana naogopa, siku hizi kuna wizi wa mtandao sana na utapeli. Hata hivo unaweza kuagiza na usiletewe au uletewe dawa feki" (*ID 33), Retail pharmacy owner. It means "*No I am afraid, these days there is a lot of internet theft and fraud. However, you can order and not be brought or be brought fake drugs".*

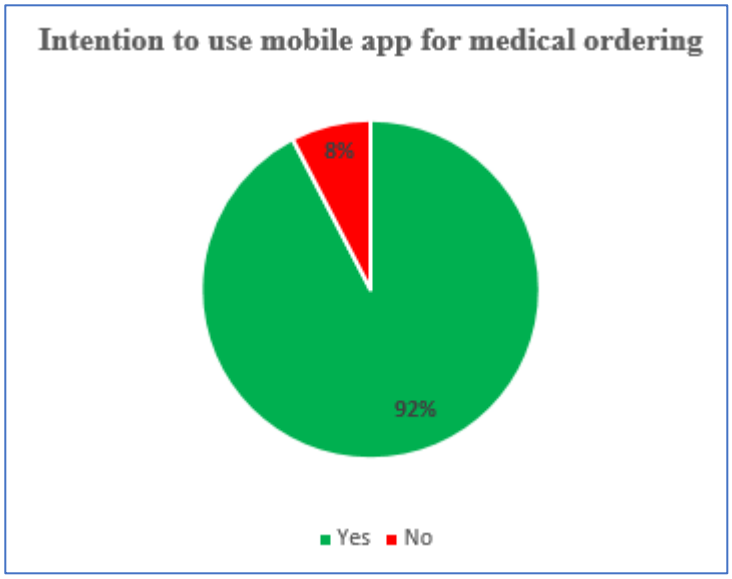

Figure 6: Intention to use of medical supply mobile applications

4.1.4 Supplies Ordering Process, Challenges and Perceived Role of Mobile Applications

It was found that out of 105 respondents 35 (33.3%) respondents use manual ordering, 21(20%) respondents use customer care representatives and sales representatives, 6 (5.7%) use an on-line computer order system, 5 (4.8%) respondents use manual and phone calls and others 38 (36.2%) use some of these processes interchangeably. Challenges include time spent visiting wholesale pharmacies, unavailability of some medicines and delivery costs. Customers will be able to search for different medications and save time by using a mobile application.

> *We always send SMS via WhatsApp the list of medicines we need to the wholesale pharmacy, once availability of medicine is confirmed we pay and they deliver to our shop. Or our boss sometimes visits physically the shop and buy stock (*ID2) Pharmacist retail shop.

4.1.5 Essential Features for a Mobile Supplies Ordering Application

The wholesale and retail pharmacies respondents listed the following features; Mobile app with integrated payment system, ordering medication, quick delivery service, delivery charge, delivery notification, location and list of wholesalers and suppliers, a chat room where they can directly

communicate with wholesalers/suppliers and customer care service. The free responses were thermally coded and the responses were represented in a text network diagram as shown in the Fig. 7.

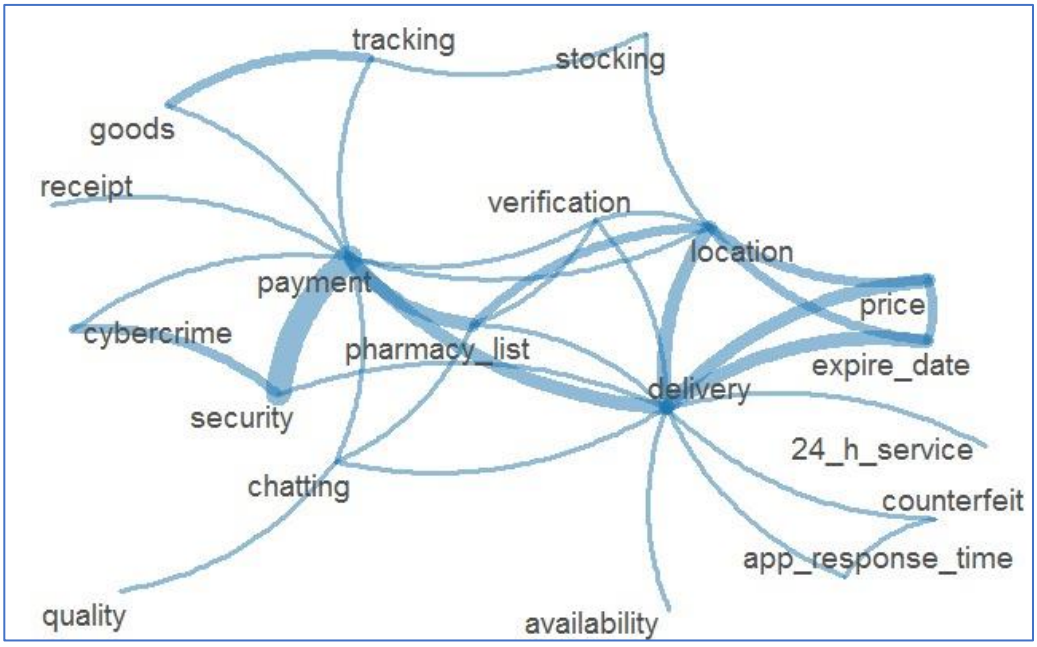

Figure 7: Text network diagram for free responses

Coded responses such as delivery, payment, place, security, chatting, and prices were a high priority for most participants, as seen in the text networks diagram Fig. 7, with numerous occurrences and these themes linked to each other. When you look at delivery, for example, you will see that it's related to prices, locations, and payments. They (themes) are related because it is impossible to deliver goods without knowing the customer's location, payment methods, and price. The Table 1 shows some of the coded responses that were coded and exchanged with those who had had similar experiences for validation. Respondents were asked to list any functionalities or features that the mobile app should have.

Table 1: Examples of coded responses

No	Free response	Coded response (theme)
1	A list of wholesalers and suppliers, a chat room where I can directly communicate with wholesalers/suppliers, means of payment/integration with mobile phone operators or banks.	Pharmacy list, Chatting, Payment.
2	The applications must be fast, show delivery time and fake drugs	App_Response_time, Delivery and Counterfeit
3	Secured payment system	Security, Payment

(i) Functional Requirements

Functional requirements (FRs) specify how a system can operate (Sun, 2010). Both a mobile app and a web app were needed because they provide the best opportunity to reach out to more customers while still providing a unique experience and customized content. In this project functional requirements include: (a) The system should enable users to register, search for products, add them to shopping carts, place orders and track order status, (b) System users must be authenticated to use mobile platform, (c) Wholesale must register before using the platform, (d) The system should generate visual reports which contain user details, geographical locations, list of in and out products, date and time, and (e) The system should consist of an online ordering system and online catalogue/products.

(ii) Non-functional Requirements

Non-functional specifications capture the properties and constraints under which a system must work and identify the non-behavioral aspects of a system (Nguyen *et al.,* 2009). For the case of this project non-functional requirements include; (a) For both mobile and web applications, an appropriate response time of 4 seconds is needed, (b) Security: The platform should be access in the way they were intended to be accessed, (c) The proposed system should be reliable, portable, and (d) The proposed system should be efficiency and maintainability and, (e)The proposed system should maximize battery life and optimize for responsiveness.

4.1.6 Design Architecture

The use case diagram, data flow diagram, and database schema are used in this section to learn more about the proposed platform's architecture.

(i) Conceptual Design

The platform structure/components are presented in the design concept. Based on the project discoveries, there are several problems on pharmaceutical distribution in Tanzania, some of these problems are using manual, phone calls, emails and SMS for ordering medicines. To resolve these issues, a mobile platform will be created. The architectural design is as shown in Fig. 8, it provides links between wholesale and retail pharmacies to the general public of Tanzania.

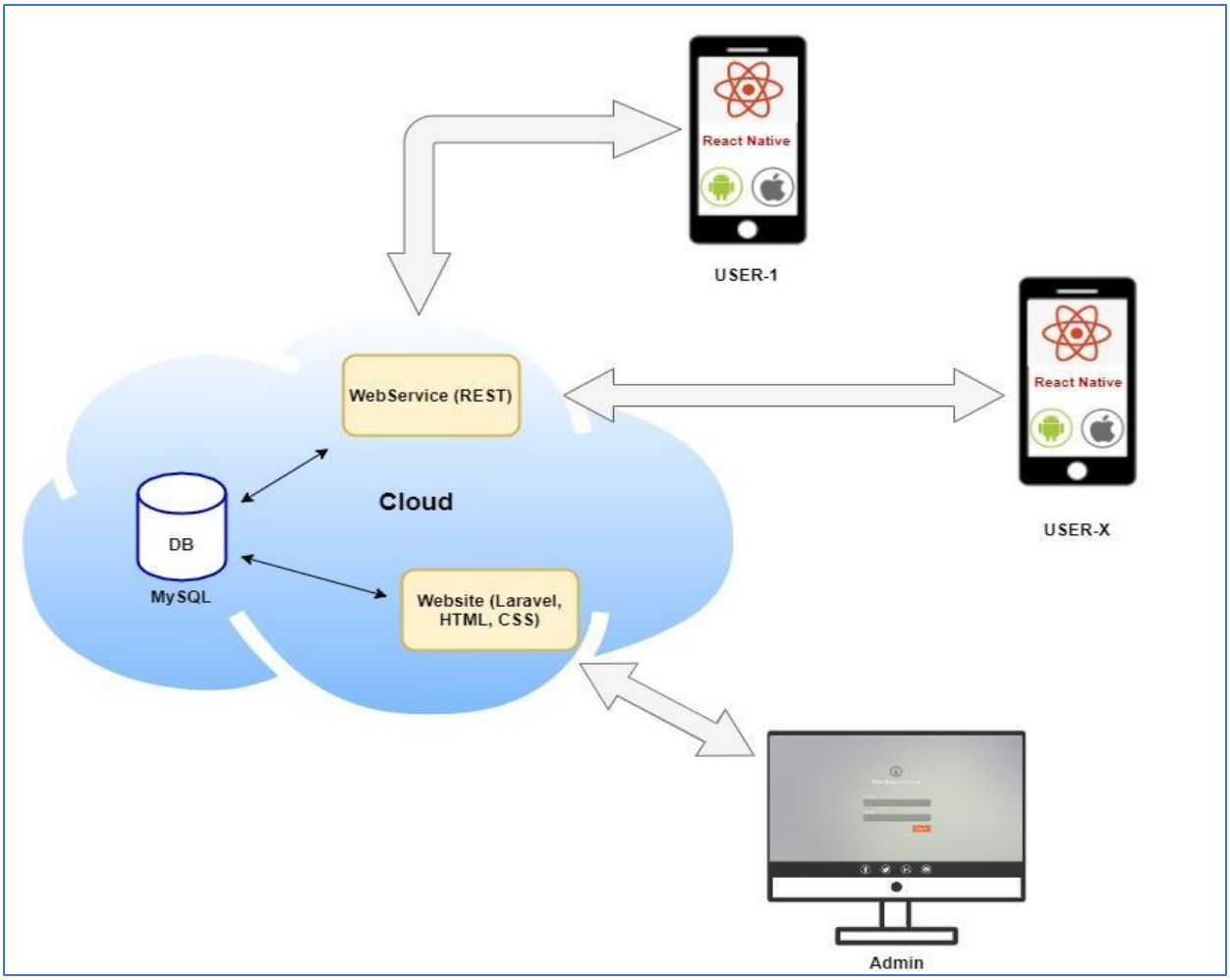

Figure 8: Proposed system architecture

The proposed system consists of the mobile app which will be developed using react-native hybrid platform frameworks, the cloud in which database, web service Application Programming Interfaces (APIs) and website will be hosted. Also, a website for administration purposes will be developed using Laravel PHP framework, HTML (hypertext markup language) and CSS (cascading style sheets) Laravel APIs will be used for smooth communication between database and mobile app.

(ii) Use Case Diagram

A use-case diagram is a straightforward representation of a system's specifications (Jacobson, 2011). This project uses Unified Modelling Language (UML) to design some diagrams of the proposed system solution. The UML is a language for visualizing, defining, building, and recording software-intensive machine objects (Union, 2012). A use case diagram is one of the UML diagrams that captures the system's functional requirements. It depicts the interaction between the system's intended operations and external actors. The proposed device architectural solution would communicate with three actors in a use case diagram whereby each actor plays a

unique function. Actors are the users that interact with a system and they must be external objects that produce or consume data. In this project actors represent various goals of the pharmaceutical industry in Tanzania. The key players in the system are: (a) Retail pharmacies, (b) Wholesale pharmacies, and **(c)** Administrator.

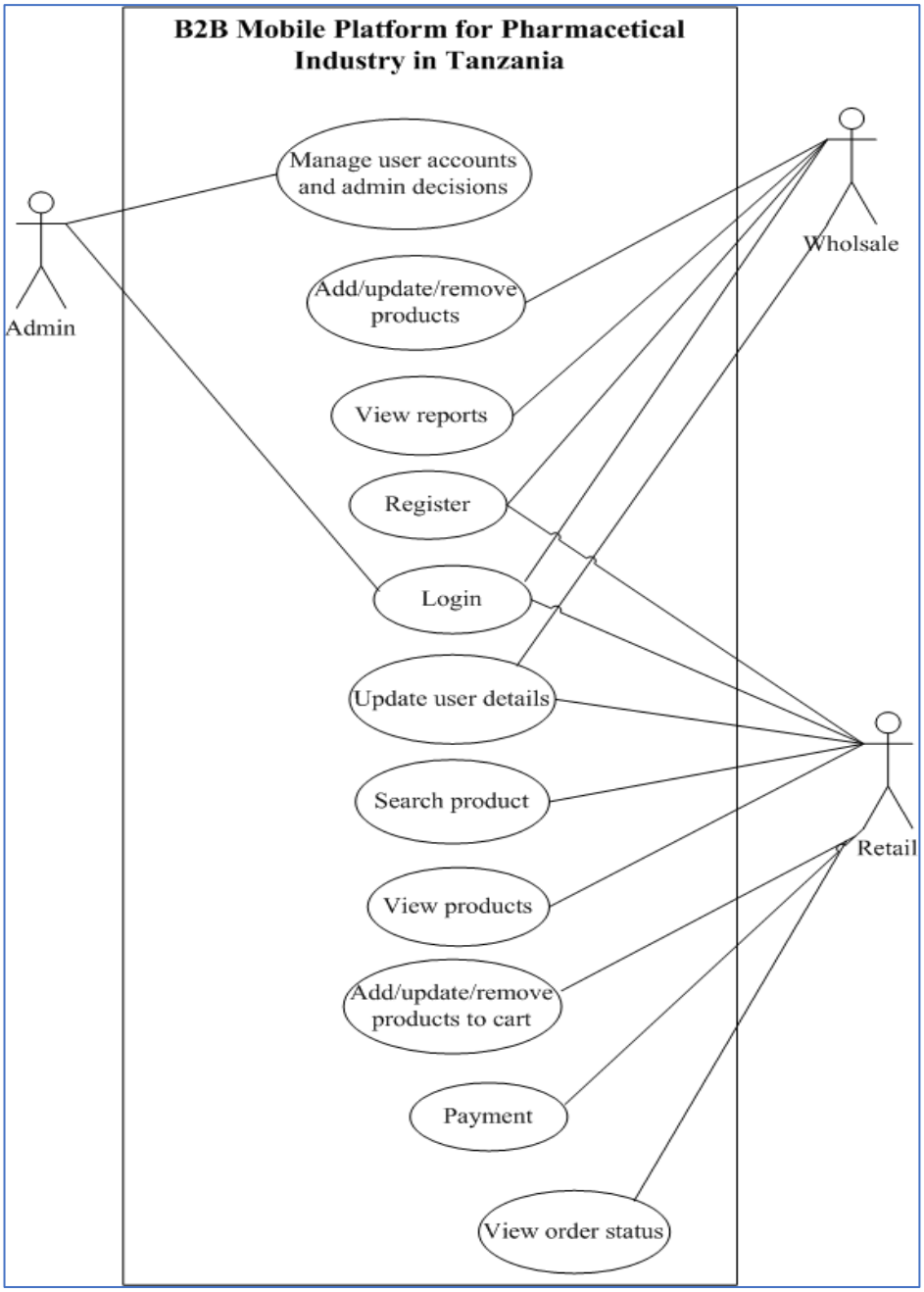

Figure 9: Use Case Diagram

Table 2: Describe the case's requirements

	Use case requirements descriptions	
SN	**Use case**	**Description**
1.	Add/update/remove products	Wholesale should be able to add/update /remove products from the system.
2.	Register	The system should enable users to register, search for products, add them to shopping cart, place orders and track order status.
3.	Login	Administrator, wholesale and retail should be able to login into the system
4.	View reports	The system should allow wholesalers to display reports.
5.	Search products	Retail should be able to search products they need from the system.
6.	View products	Retail should be able to view all products from the system even before login.
7.	View order status	Retail should be able to view order status from the system.
8.	Payment	Retail should be able to either on delivery or mobile payment.
9.	Manage user account	Admin should be able to manage user accounts.
10.	Admin decision	The system admin should be able to login and perform duties such as system.
11.	Add/update/remove products to cart	Retail should be able to add, update and remove products to cart.
12.	Update user details	The system should allow users to update details

(iii) Data Flow Diagram

The data flow diagram (DFD) is a graphical tool that enables system analysts and users to visualize data flow in an information system. Processes, data flows, data warehouses, and external entities are the four symbols that make up a data flow diagram (Ibrahim & Yen, 2010). The DFDs aid system designers and others in visualizing a current system or one that might be required to fulfill new criteria during the early stages of study (Le Vie, 2000).

Context Diagram

A Context Diagram is a component of Functional Modelling that allows a team or a person to create a high-level model of an actual or planned system by defining the system's boundary and interactions with essential elements in its setting (Burge, 2011). Figure 10 shows the background diagram for this study, which depicts a summary of the entire proposed system as well as correspondence between the established system and its external entities. This approach helps developers, system analysts and stakeholders to understand the system.

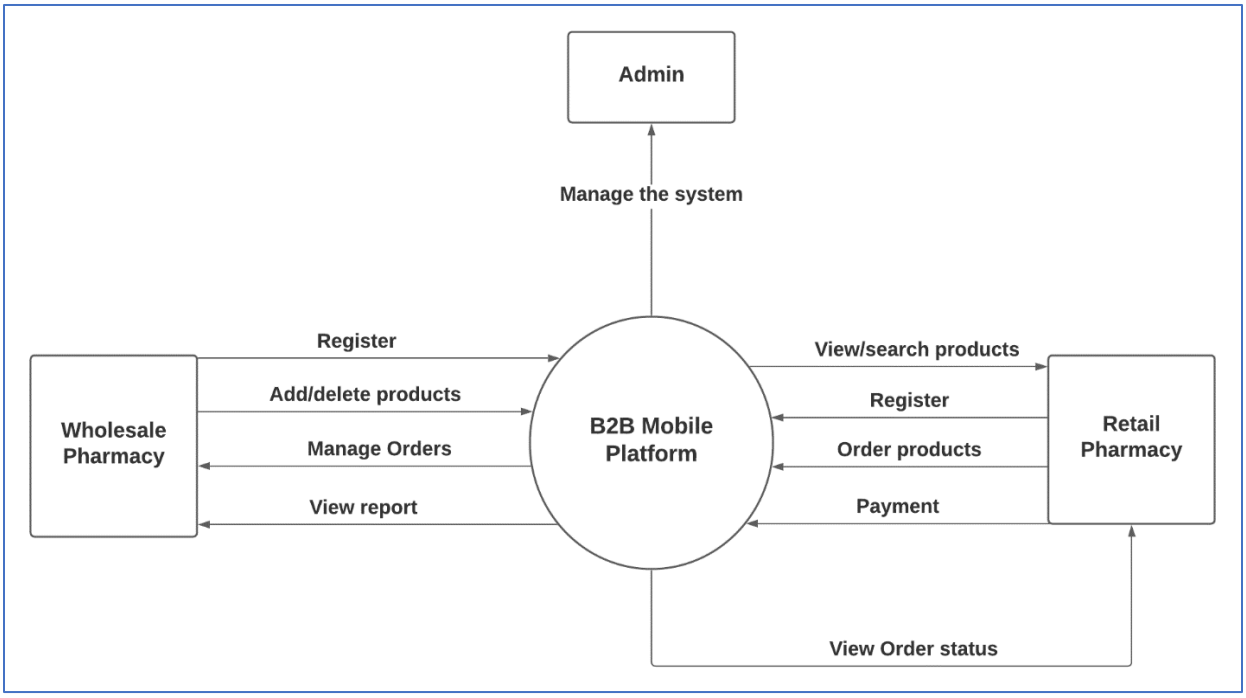

Figure 10: Context diagram

Data Flow Diagram Level 1

The Level 1 Data Flow Diagram (DFD) depicts how the system is broken down into a few sub-processes. Each deals with one or more data flows from or to an external agent, which provides the entire system's data functionality (Nurfarah, 2018). It depicts the flow of data for all processes involved in each step, as well as the data stored until the process is complete. Figure 11 displays the DFD level 1 for wholesale pharmacy profile. The wholesale pharmacy can add wholesale pharmacy details and update wholesale pharmacy details. Wholesale will store all of the program's data (D1).

Figure 12 represents the DFD Level 1 for product management. The DFD Level 1 for product management allows you to add, edit, and remove product information, with all data being saved in product (D2). Figure 13 shows the DFD Level 1 for managing retail pharmacy profiles. Retail pharmacies can add retail pharmacy details and update retail pharmacy details and all program information will be saved in retail (D3). The DFD Level 1 for purchasing management is shown in Fig. 14. Retail can view item lists which the item details will be retrieved from the product data store. Retailers may then add items to their carts, upgrade their carts, and uninstall their carts. After you complete the checkout process, all of your information will be saved in order product (D4). The order information, as well as the inventory details, are then retrieved using product order (D5).

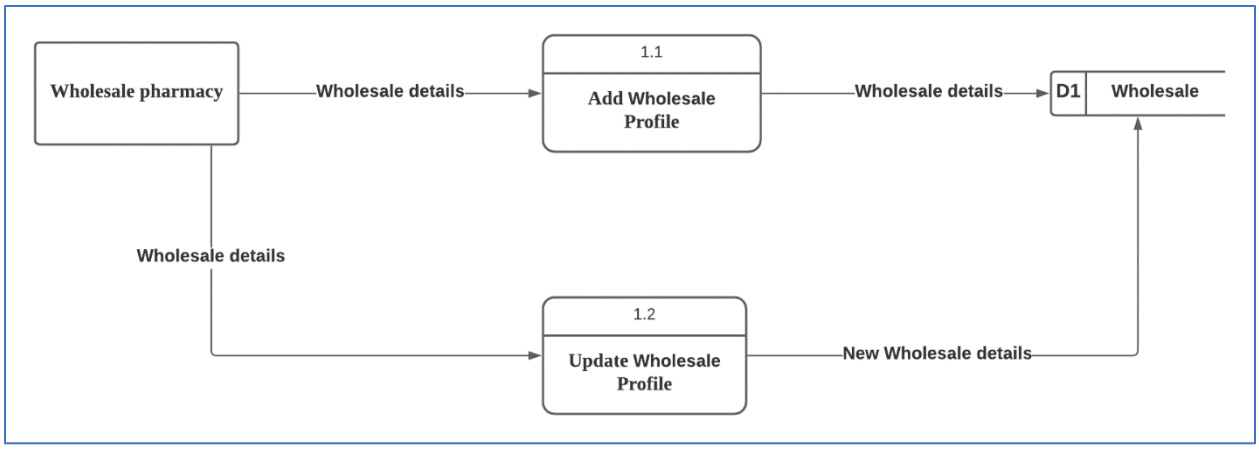

Figure 11: Level 1 Data Flow Diagram for a Wholesale Pharmacy profile

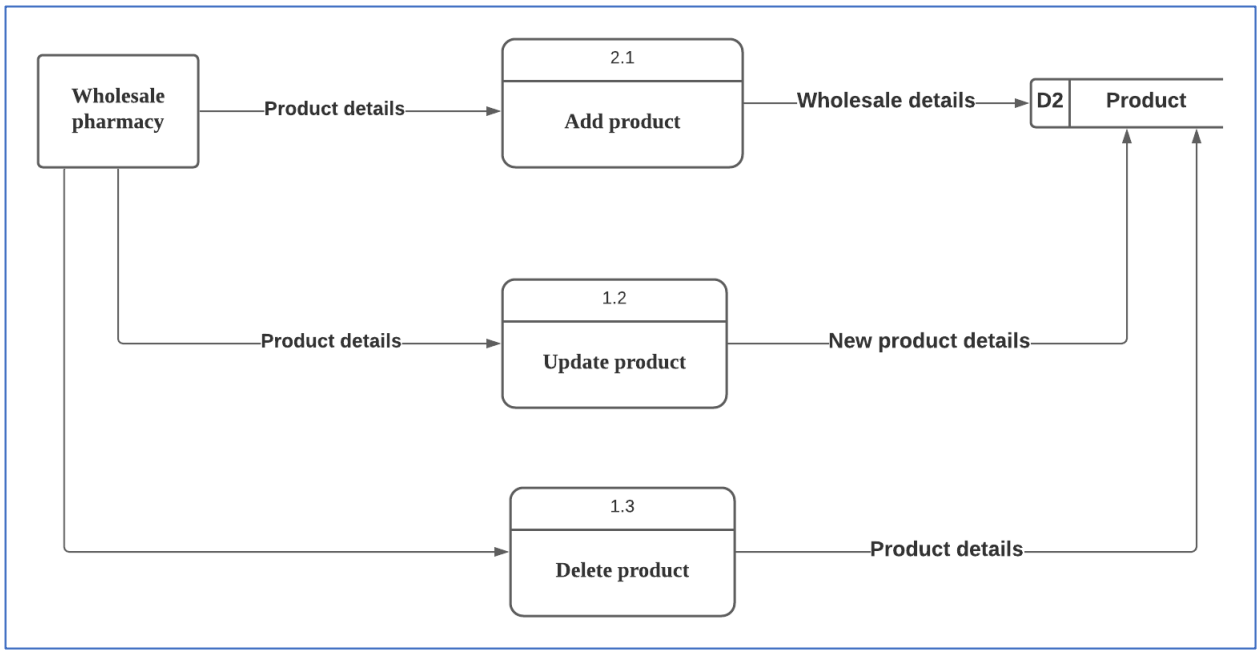

Figure 12: Level 1 Data Flow Diagram for Product Management

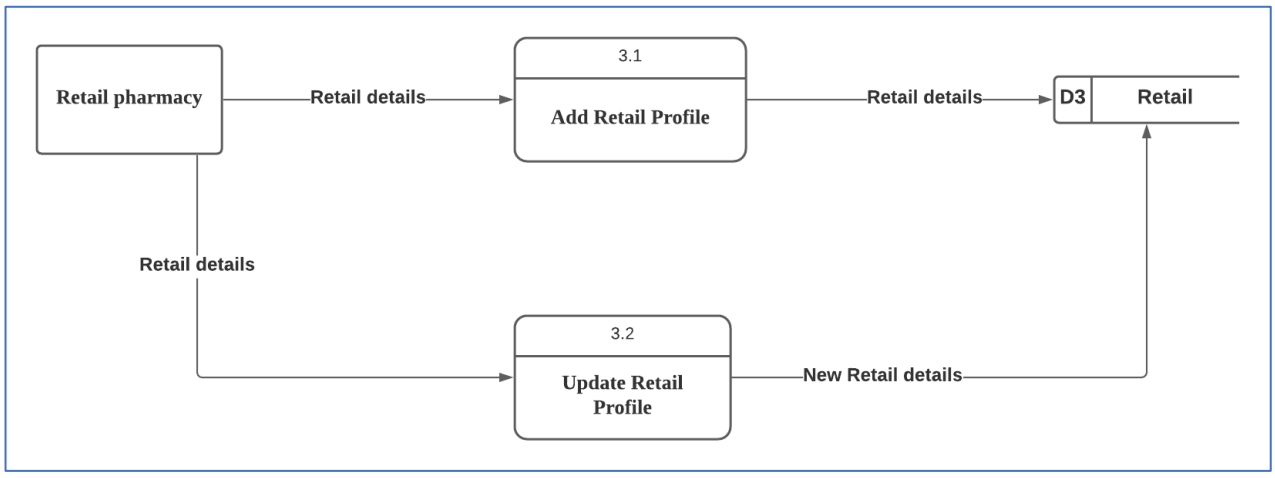

Figure 13: Level 1 Data Flow Diagram for Handling the Retail Pharmacy Profile

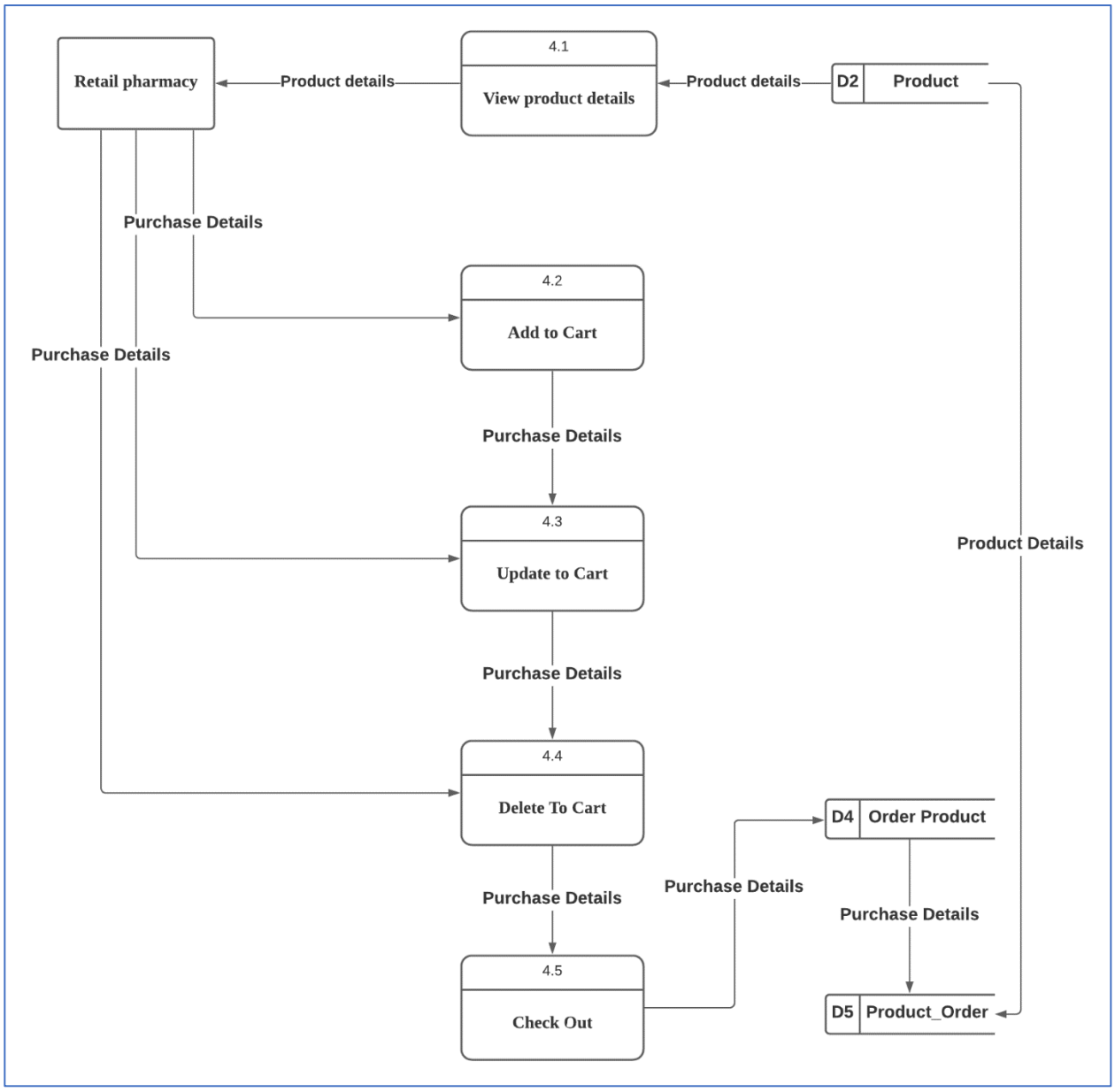

Figure 14: Level 1 Data Flow Diagram for Purchasing Management

(iv) Schema of the Database

A database schema is a formal language description of a database's structure. It is a descriptive detail of the database, which can be shown by means of schema diagrams (Uschold, 2015). Entities, tables, attributes, and relationships between entities are all shown in the database schema diagram. Figure 15 depicts the proposed solution's database schema. The MySQL database is hosted by Hostinger, a secure cloud service provider, which is also responsible for its security. Every 24 hours, a backup is taken. Sending and receiving a request to the database uses Laravel APIs. Laravel is a secure platform with built-in security. The SQL injection, cross-site request forgery, and cross-site scripting are among the most serious security threats that it protects against.

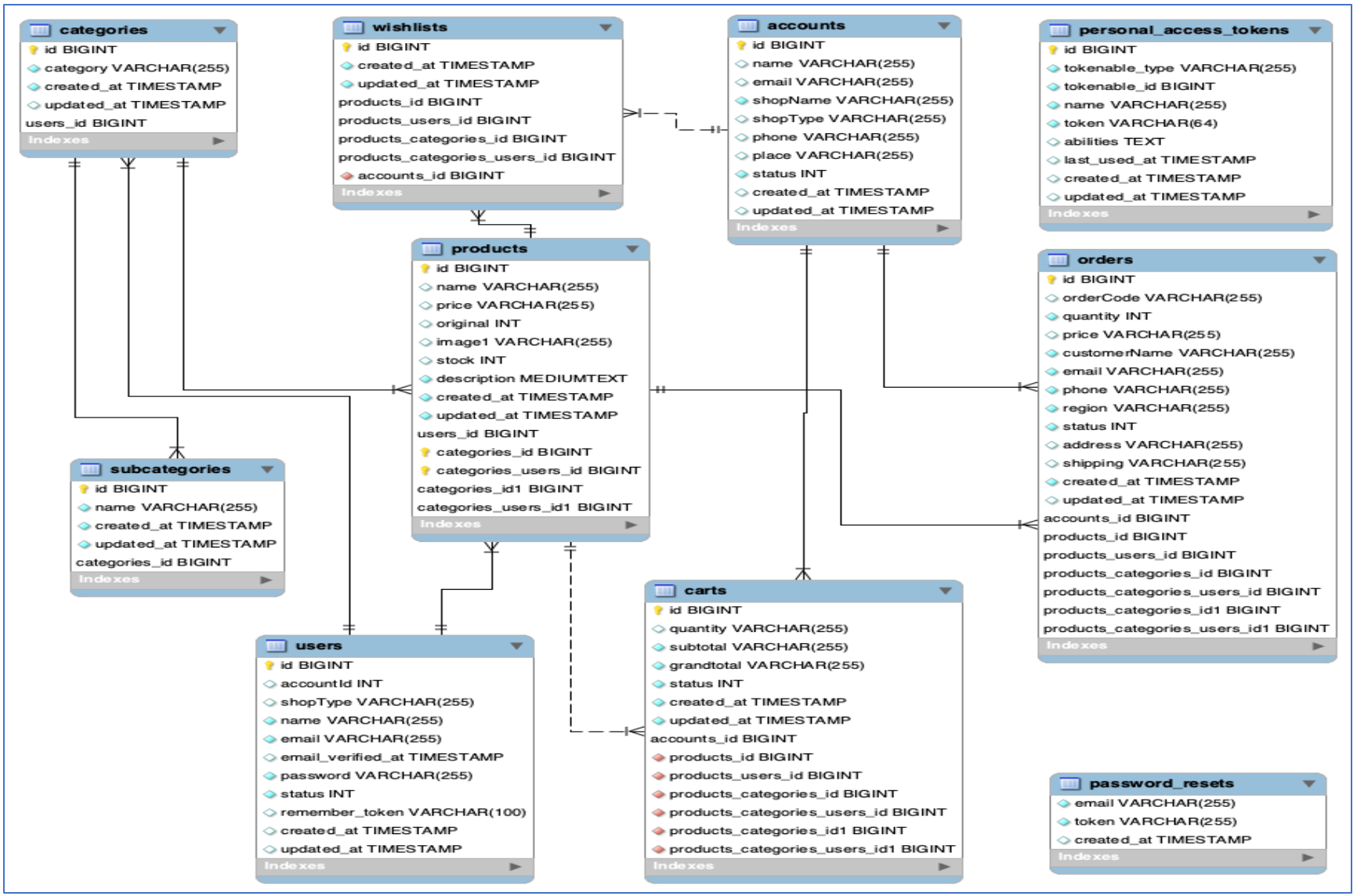

Figure 15: Schema of the Database

4.1.7 The Developed Applications' Outcomes and Discussion

(i) DawaFasta Business-to-Business Medical Supplies Ordering

The name of the created mobile app is “DawaFasta” which links wholesale and retail pharmacies in Tanzania. DawaFasta app comprises functionalities which enable wholesale and retail pharmacies to register and perform online medical purchase. Before being retrieved from the web browser, data from the mobile application was synchronized and stored in the main database. On first launch, the user is presented with a splash screen then wholesale/retail selection page. When the wholesale option is selected it moves to the login page where they have logged in, if they had previously logged in or signed up by filling in pharmacy and personal particulars. After this, they are taken to the wholesale shop page where they can add/delete products, accept/cancel orders, confirm orders, process orders. When the retail option is selected it turns to the home page where they can see all products, categories, list of available wholesale pharmacies. Also, they can search products, add/delete products to cart, order products, make wish lists, they can login/signup and fill pharmacy details, shipping details, check out, make payment. Once the retail order is completed, they will receive SMS notification.

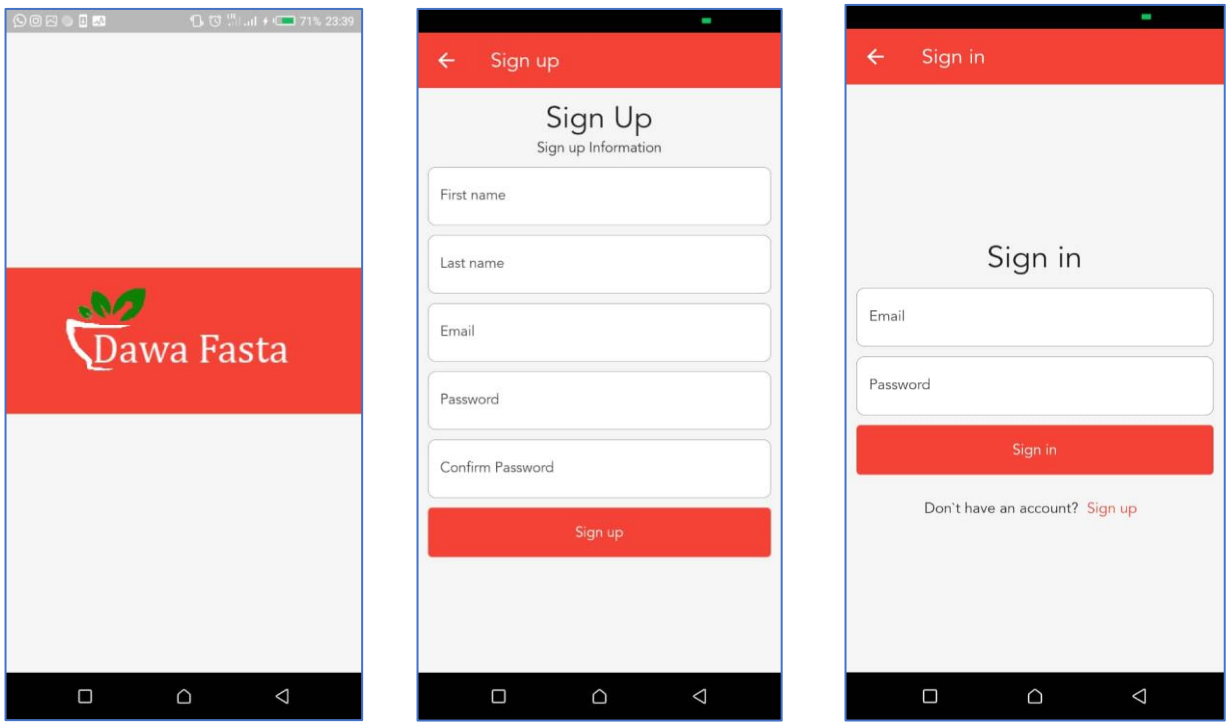

Figure 16: Splash screen, registration and login page for DawaFasta mobile app

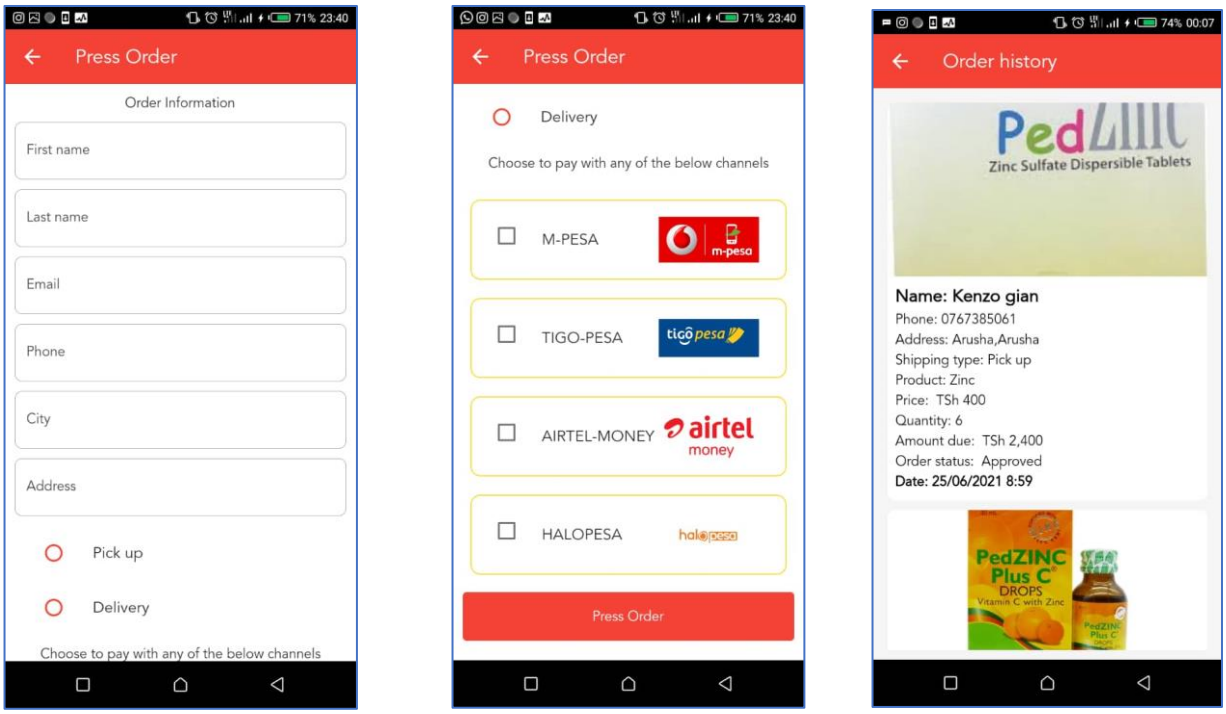

Figure 17: The order information, mobile payment selection and order history pages

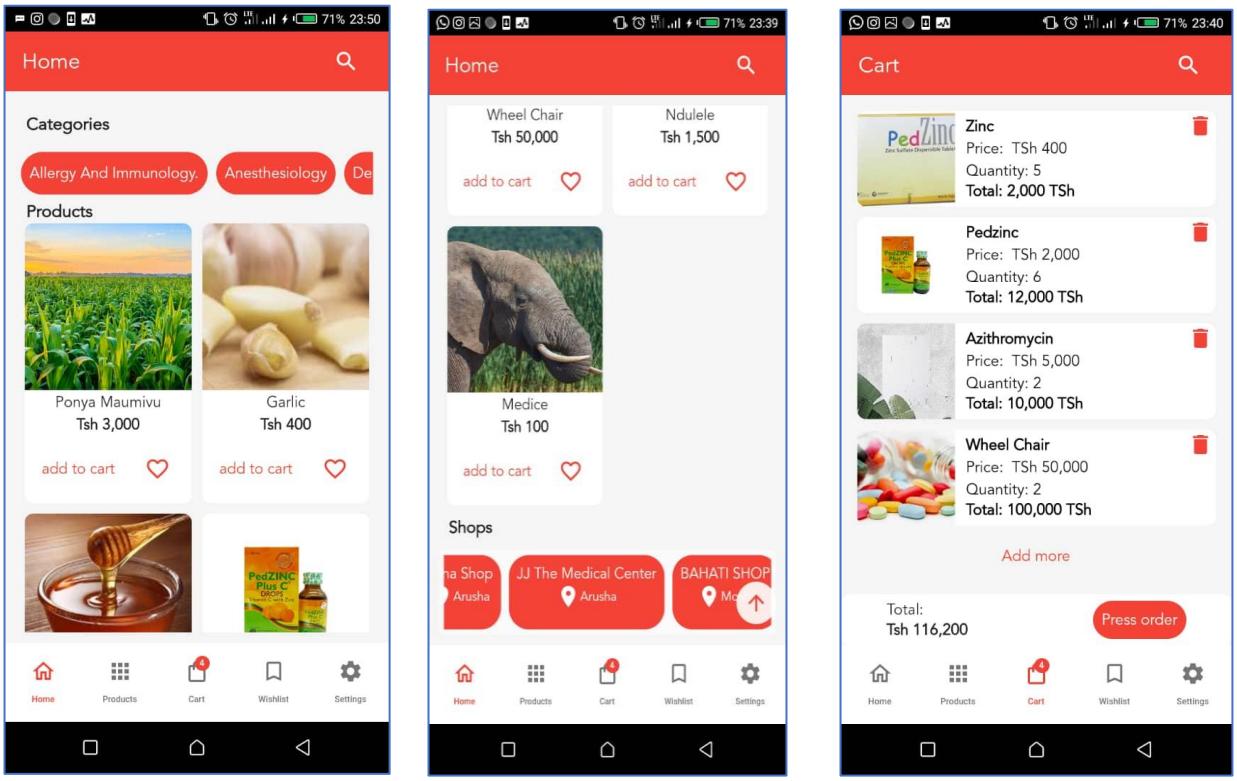

Figure 18: Categories, list of available pharmacies and products page for DawaFasta app

(ii) DawaFasta Web Application

The developed web application is called dawafasta which has several features for synchronizing products, sales, and user management to the database. The dawafasta website starts from the home page, which allows retailers to view, search and add products to cart. It contains the login to allow

wholesalers to login and add or update products and administrator to manage user accounts and other system developments. Through the DawaFasta website wholesalers can register, manage products, orders and categories. Retail can also register, search, order products and also can track delivery status. The difference between web application and mobile application is that products, sales and user management is managed by web application. As a result, the mobile application is combined with the website using APIs for improved functionality and an admin panel to manage the website and mobile application.

Home Page

The web home page shows a list of all products in the system, medical categories, list of registered pharmacies, search interface login/signup interfaces, add to cart and add to Wishlist options. At the home page retail can search products and add to cart even before registration. Wholesale will be required to register either before or while confirming the product ordering. Wholesale is required to register at the beginning so as to manage categories, products, orders and reports.

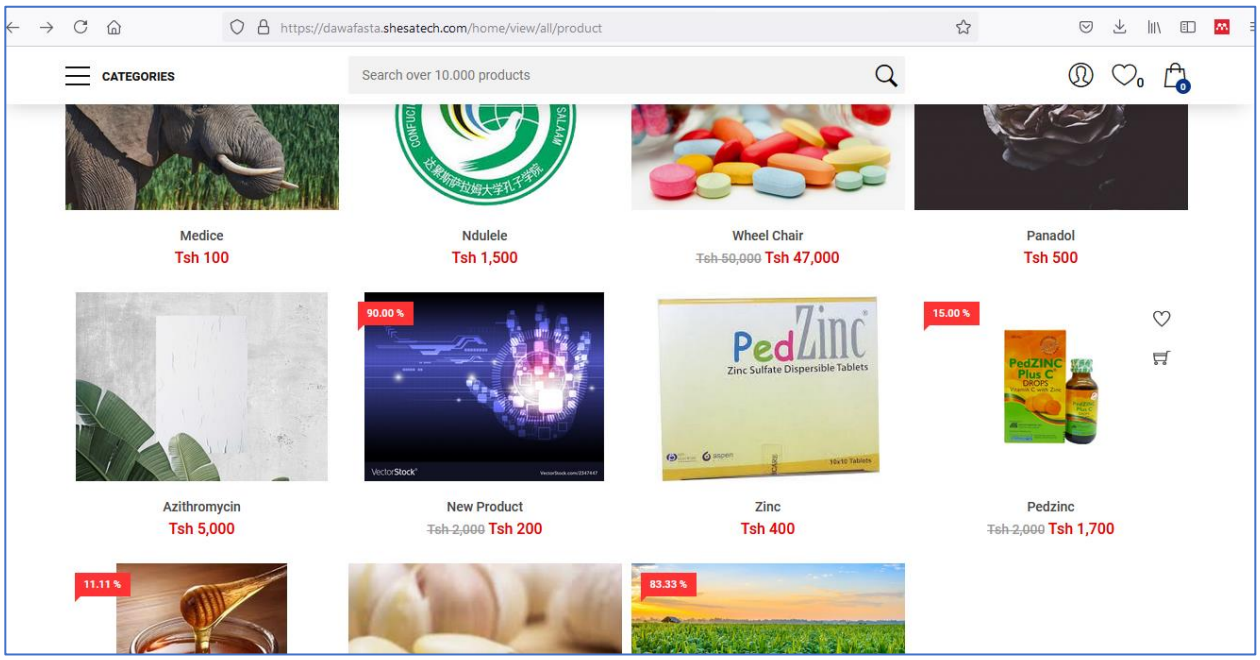

Figure 19: Homepage of the website

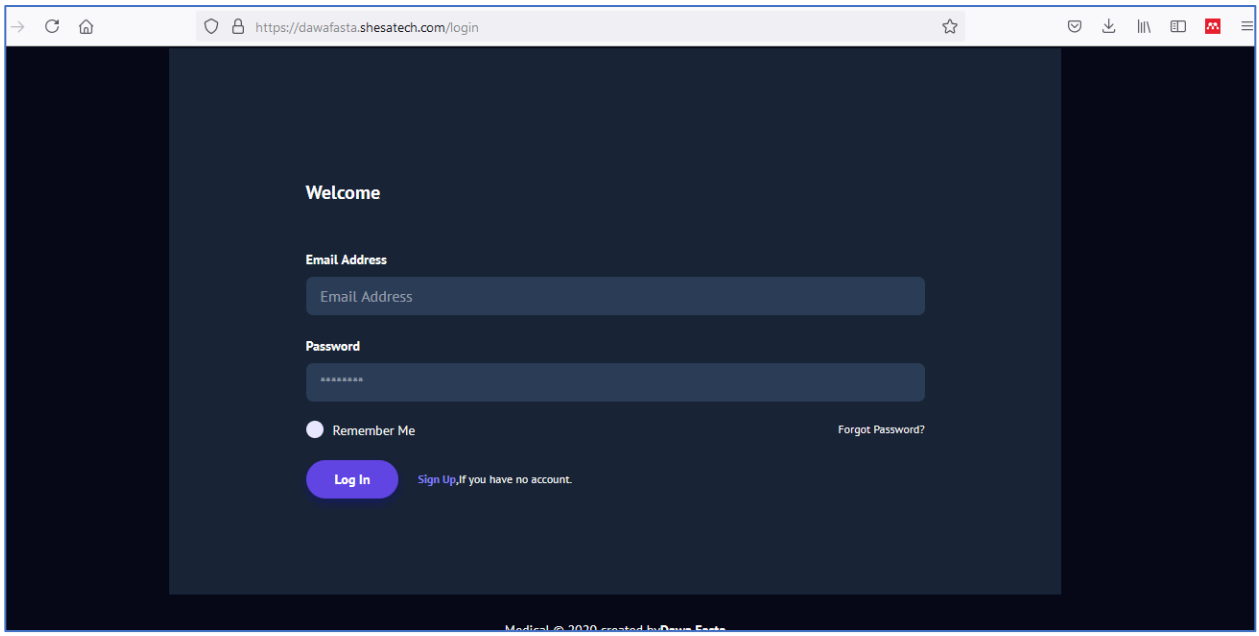

Figure 20: Login to the website

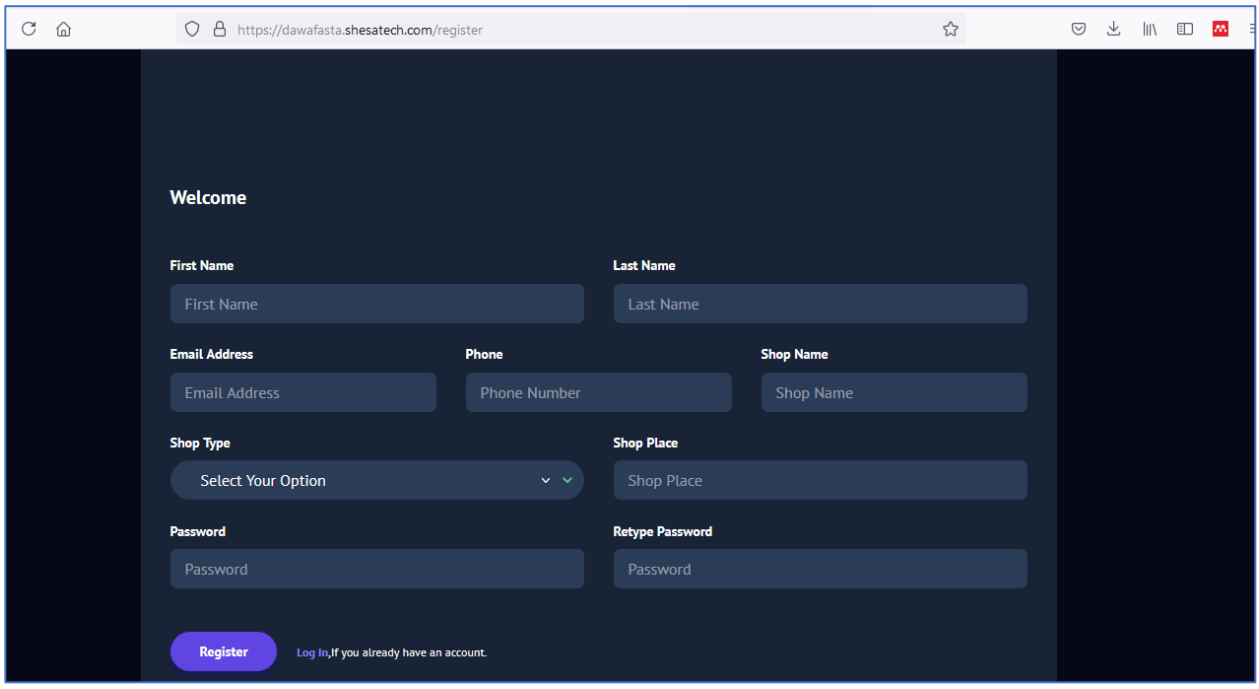

Figure 21: Page for registration

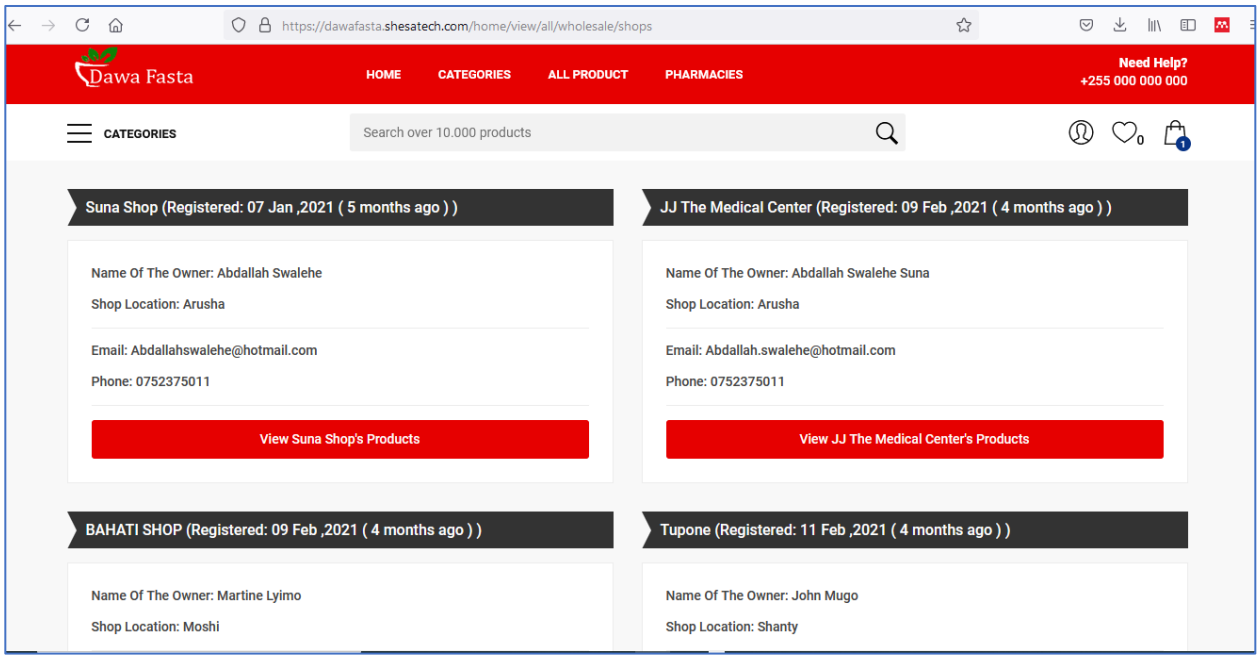

Figure 22: List of registered wholesale pharmacies page

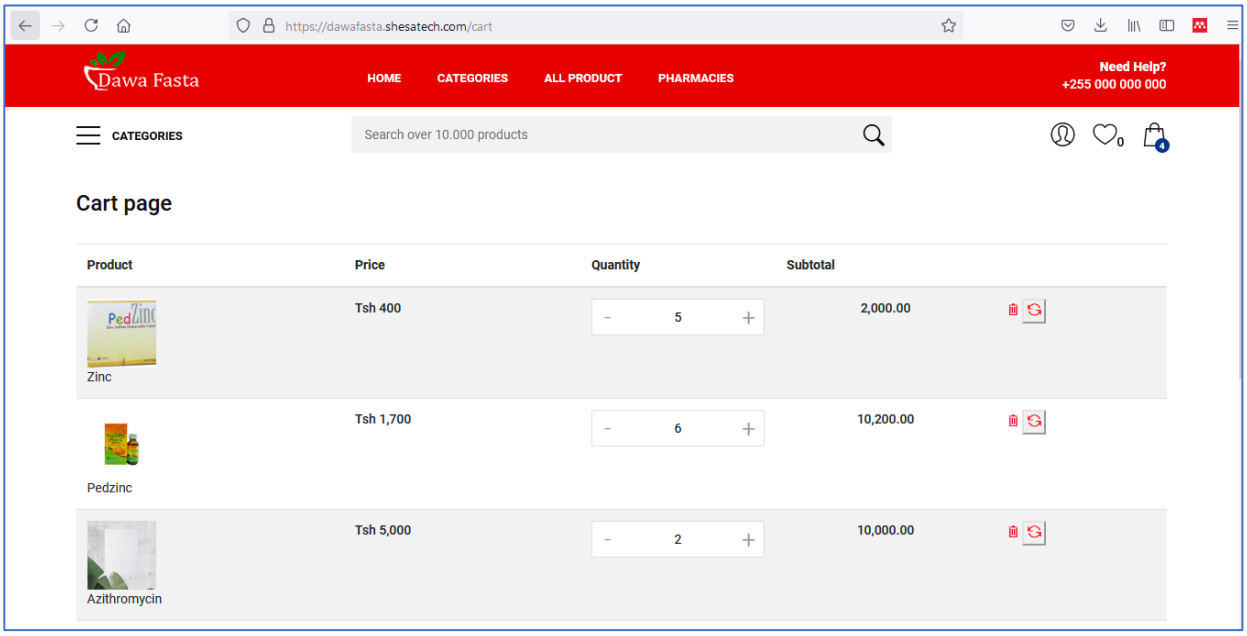

Figure 23: The cart page

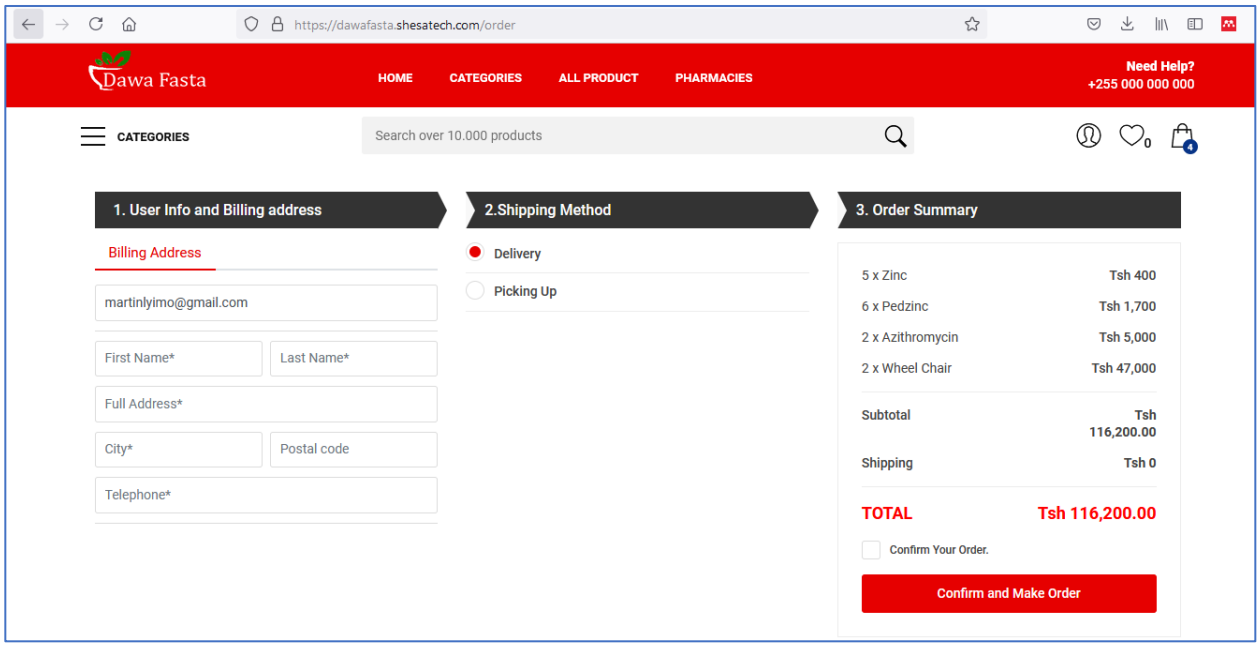

Figure 24: Shipping information and order confirmation page

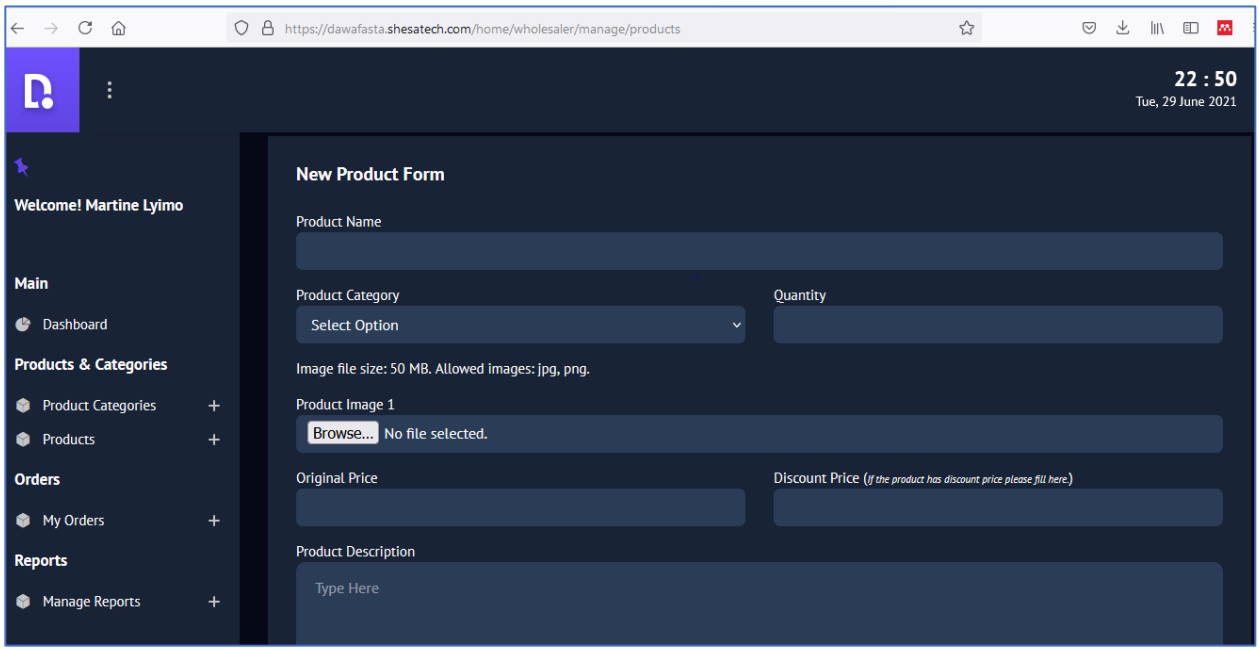

Figure 25: New product uploading form page

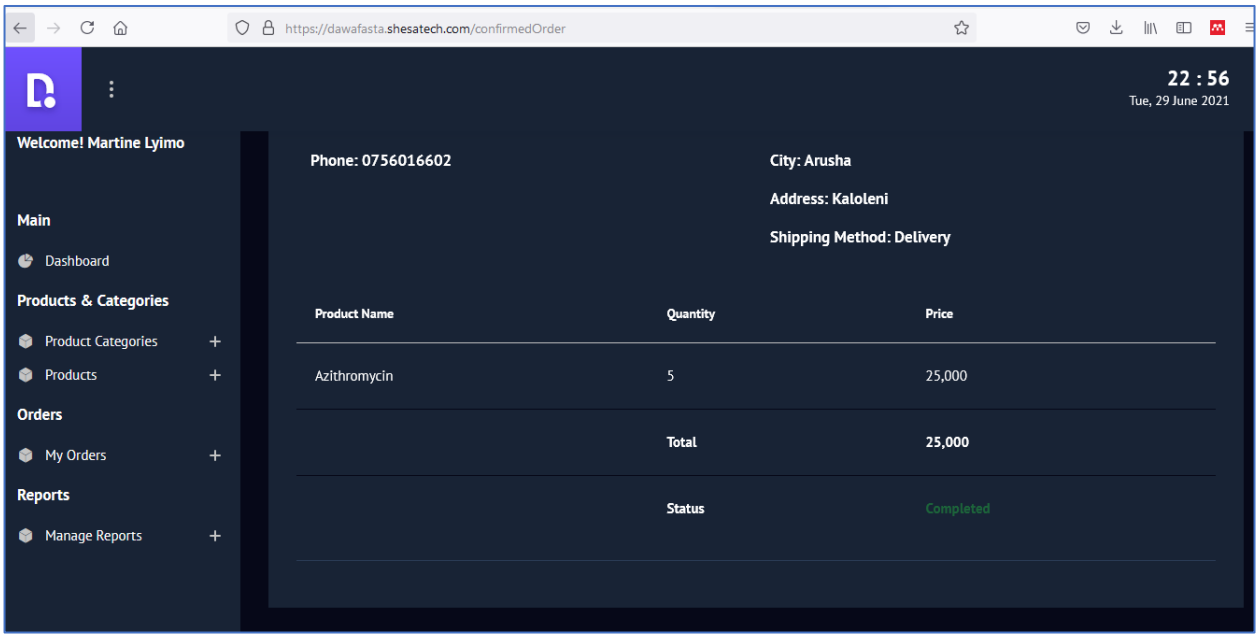

Figure 26: Order management page

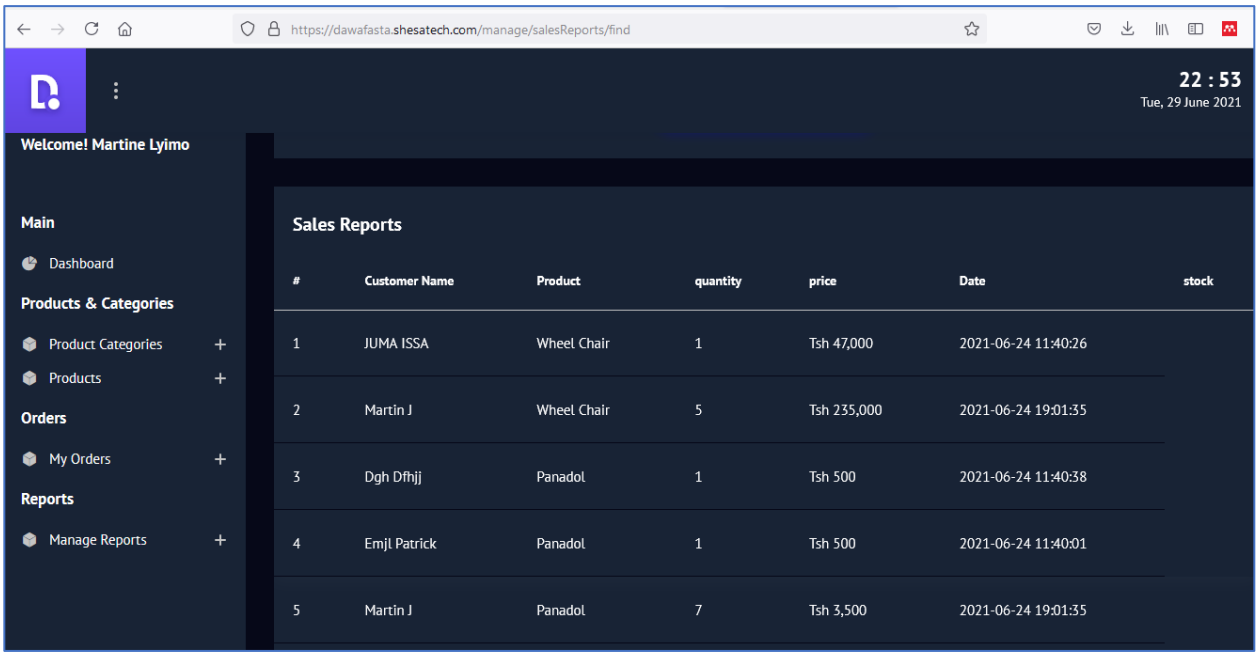

Figure 27: Reports management page

Administration

Admins can use this program to login and control all of the system's registered users. In the event of a security breach, the user account may be suspended by the administrator.

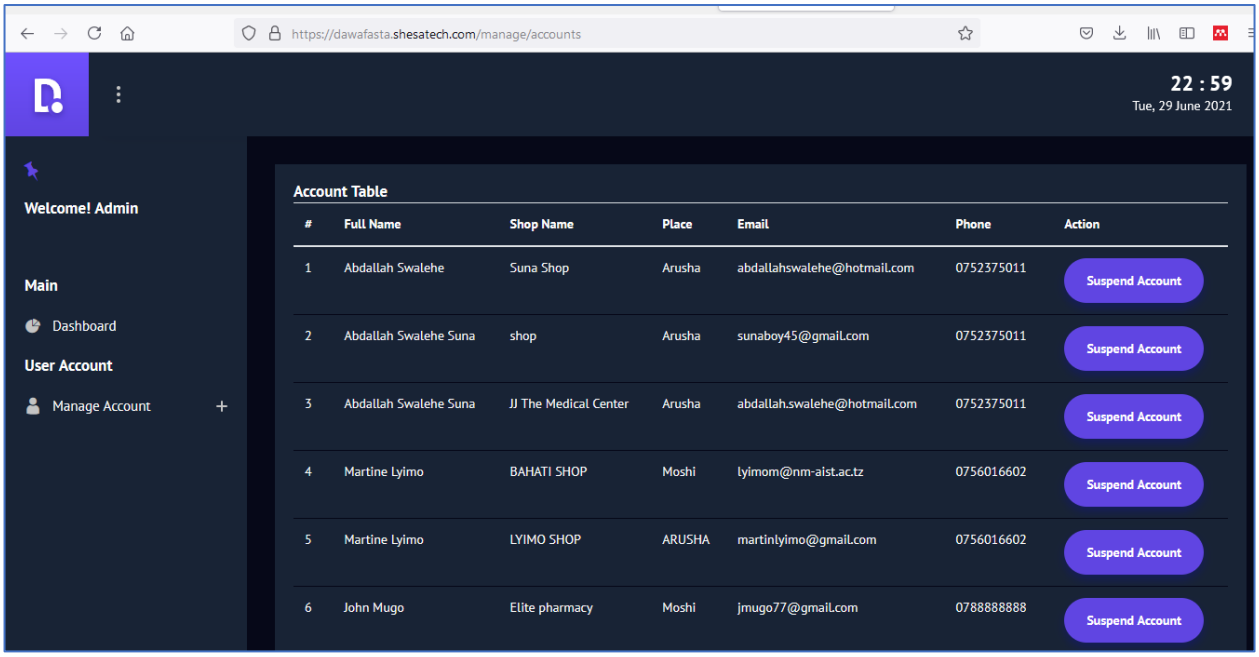

Figure 28: User accounts management page

4.1.8 User Acceptance Results

The user acceptance testing was designed using a four-point Likert scale consisting of strongly agree, agree, disagree and not sure. The main users of the system, wholesale and retail pharmacies, were presented with this platform. User acceptance questionnaires are presented in Appendix 1. All users were given the chance to express their opinions on the newly created application. They strongly agreed on the developed solution and decided to make it a part of their day-to-day operations. They admitted that they don't have such an app and that the built-in solution would make it easier for them to access and buy. Results are presented in Table 3.

Table 3: The user acceptance testing results

User opinions	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
I believe the web app is simple to use.	59	39	1	0
I believe I will be able to make use of this website application.	66	33	0	1
I believe the mobile app is simple to use.	58	42	0	0
I believe I will be able to make use of this mobile app.	69	30	0	1
I think web and mobile applications will be useful to the pharmacy industry.	78	22	0	0
Sales, consumer, and inventory reports can be stored and viewed using the web application.	73	27	0	0
The web and mobile user interface are well presented for online medicine purchase	52	46	0	2
The mobile and web app will help you find a pharmacy and have quick access to medical supplies.	65	34	0	1

Table 4 demonstrates the fulfillment and acceptance of the site and mobile application by consumers, based on information obtained from wholesale and retail pharmacies. They all agreed that the application was extremely useful. The respondents, on the other hand, put a premium on changes to the mobile apps, such as adding a live chat or video space, world medical news, and customer service.

Table 4: The evaluation of the feedback received

User opinions	Strong agree (%)	Agree (%)	Disagree (%)	Not sure (%)
I believe the web app is simple to use.	63	34	0	1
I believe the mobile app is simple to use.	55	44	0	1
The mobile app is simple and easy to use.	50	50	0	0
I believe that this mobile application can reduce the amount of time it takes to retrieve reports and stocks.	45	55	0	0
I think this mobile application will save time of retrieving reports and stocks.	72	26	1	1
I believe that mobile apps can reduce the amount of time and money spent on stationary purchases.	77	22	1	0

4.2 Discussion

The developed DawaFasta platform is a Tanzanian online business-to-business pharmacy portal that connects wholesale and retail pharmacies to make medical supplies easier to access and distribute. Other countries, such as India, have many of these platforms and the requirements for this application are similar to those existing in foreign countries. Platforms such as Arogya, Only My Health, Practo, Healthy India, Med India, and BabyCenter in India have more features, such as answering health and fitness-related questions, creating discussion groups, and connecting with medical professionals, in addition to providing basic healthcare information (Bharti, 2020). As a result, these international applications can be used as a starting point for potential developers who want to add more features to this application. Some of these features were considered unimportant in this study because they are more focused on the business-to-customer model than the business-to-business model.

The findings suggested online business-to-business pharmacy as the most favorable process of ordering medicine between wholesale and retail pharmacies in Tanzania because it ensures the availability of medical supplies in pharmacies. For example, rather than visiting a wholesaler and wasting time, a retailer can search online for a range of medical items and confirm availability. Online business-to-business pharmacy has also aided retail pharmacies in quickly locating nearby

wholesale pharmacies and obtaining contact information, forming a link between them and making information sharing simple. To improve the platform's integrity, the study also suggests implementing a chat room or video conferencing where retailers can chat or communicate live with wholesalers/suppliers. As a result, determining which online pharmacies are legitimate and which are not becomes easier. It also raises pharmacy owners' and employees' awareness of the benefits of using online pharmacies.

This study responds to users' concerns about the existence of an online business-to-business mobile network for the pharmaceutical industry by filling in the awareness gap. This is because the study has proposed a mobile business- to-business platform to guarantee medical ordering between wholesale and retail pharmacies in Tanzania. Any pharmacy considering new technologies to enhance its functionality would benefit from the proposed architecture.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Every human being's health depends on the availability of medical supplies. According to the results of the study, the majority of wholesale and retail pharmacies would like to see a mobile app that would make it easier to supply or order medications as well as provide convenient access and delivery of medical services. Since the majority of them own smartphones, they are ideal candidates for the DawaFasta mobile application.

The DawaFasta app offers a variety of interactive features to wholesale and retail pharmacies that solve the problems of the medication ordering process, a lot of paperwork, and selling medicines during outbreaks, epidemics, and pandemics. It also serves as a connection between wholesale and retail pharmacies and reduces manual work. This app takes advantage of Tanzania's rapidly growing mobile technology and internet penetration. It allows wholesale pharmacies to register their shops and add items for sale. It allows retailers to view lists of registered wholesale pharmacies, stock lists, and perform various tasks such as searching, adding/removing items from carts, and ordering medical products.

Despite the positive features of the DawaFasta app, some suggestions were made during the review, such as adding a chat or video room where retailers can directly connect with wholesalers/suppliers and adding an interface for news about global medical trends. Raising awareness of this platform among wholesale and retail pharmacies would help to ensure easy access to medicine, which would benefit all parties involved.

5.2 Recommendations

This project aimed to use mobile technology in Tanzania's pharmaceutical industry's current ordering process. It was difficult to locate literature on Tanzania's existing retail-to-wholesale medical ordering procedure as well as usage of mobile apps in medical ordering. Therefore, it is recommended more research on usage of mobile apps in ordering medicines so as this platform can be improved and, in the future, research with a larger sample size should be used.

Furthermore, some issues, such as the quality of goods sold online and counterfeit medicines, should be brought to the attention of Tanzanian pharmacies. It is suggested that regulatory authorities and stakeholders work together to promote the safe usage of online pharmacies, such

as by creating a logo to recognize registered pharmacies and enacting legislation to ensure the protection of the medicines sold.

Finally, the Medical Store Department (MSD) serves as a significant distributor of certified vital pharmaceuticals and medical supplies to public health facilities. It is suggested that they use the DawaFasta app through pharmacies licensed by the Tanzania Pharmacy Council so that counterfeit pharmaceuticals marketed over the platform can be detected.

REFERENCES

Ali, G., Dida, M. A., & Sam, A. E. (2020). Two-factor authentication scheme for mobile money: A review of threat models and countermeasures. *Future Internet*, *12*(10), 1–27. https://doi.org/10.3390/fi12100160

Allen, R., & Pickup, A. (2017). Two-Factor authentication. *Digital Identity Management: Technological, Business and Social Implications*, *6*(7), 113–119. https://doi.org/10.4324/9781315257792-20

Armel, J. (2014). *Web application development with Laravel PHP Framework version 4. Media Engineering, April, 59*. https://www.google.com

B2BWAVE. (2018). *B2B Wave Blog: Why B2B eCommerce Is an Opportunity for Medical and Pharmaceutical Wholesalers*. https://www.b2bwave.com/p/why-b2b-ecommerce-is-an-opportunity-for-medical-and-pharmaceutical-wholesalers

Bharti, A. (2020). *Use of Digital Platforms for Health Promotion*. https://www.google.com

Braun, V., & Clarke, V. (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/https://doi.org/10.1191/1478088706qp063oa

Burge, S. (2011). *Context Diagram (CD). The Systems Engineering Tool Box. https://www.google.com*

Das, M. L., & Samdaria, N. (2014). On the security of SSL/TLS-enabled applications. *Applied Computing and Informatics*, *10*(1–2), 68–81. https://doi.org/10.1016/j.aci.2014.02.001

Datareportal. (2020). *Digital 2020: Tanzania — DataReportal – Global Digital Insights*. https://doi.org/https://doi.org/10.1016/j.procs.2015.09.036

Ernest, E, O., Inalegwu, G, O., Solomon, A, F., & Sam-David, C. (2016). Online Pharmaceutical Management System. *European Scientific Journal,* 12(12), 1857-7881. https://doi.org/10.19044/esj.2016.v12n12p139

FastCompany. (2021). *This Company Delivers Reproductive Health Products Directly To Women I*. https:// www. fastcompany. com /40508215/ this-company-delivers-reproductive-health-products-directly-to-women-in-the-developing-world

Federation, I. P. (2019). *mHealth Use of Mobile Health Tools in Pharmacy Practice 2019*. 37.

https://www.google.com

Fittler, A., Vida, R. G., Káplár, M., & Botz, L. (2018). Consumers turning to the internet pharmacy market: Cross-sectional study on the frequency and attitudes of hungarian patients purchasing medications online. *Journal of Medical Internet Research*, *20*(8), 1–11. https://doi.org/10.2196/11115

Goyal, A., Kumar, S. N., & Zanjurne, A. (2019). *In the spotlight: e-Pharmacy in India. An exponential growth opportunity*. https://www.google.com

GSMA. (2020). *Mobile Economy*. https://www.google.com

Hayden, J. C., & Parkin, R. (2020). The Challenges of COVID-19 for Community Pharmacists and Opportunities for the Future. *Irish Journal of Psychological Medicine*, *37*(3), 198–203. https://doi.org/https://doi.org/10.1017/ipm.2020.52

Health Science Authority. (2020). *Health Science Authorit.* https://www.google.com

Hoti, K., Jakupi, A., Hetemi, D., Denis, R. H. J., & Desselle, S. (2020). Provision of Community Pharmacy Services During COVID-19 Pandemic. *International Journal of Clinical Pharmacy*, *42*(3), 1197–1206. https://doi.org/https://doi.org/10.1007/s11096-020-01078-1

IBM. (2021). *Mobile technology*. https://www.ibm.com/topics/mobile-technology

Ibrahim, R., & Yen, S. Y. (2010). Formalization of the Data Flow Diagram Rules for Consistency Check. *International Journal of Software Engineering & Applications*, *1*(4), 95–111. https://doi.org/10.5121/ijsea.2010.1406

Ilardo, M. L., & Speciale, A. (2020). The Community Pharmacist: Perceived Barriers and Patient-centered Care Communication. *International Journal of Environmental Research and Public Health*, *17*(2), 1-16. https://doi.org/https://doi.org/10.3390/ijerph17020536

Jacobson. (2011). *Use-Case 2.0 The Definitive Guide.* https://www.google.com

Jorgensen, P. C. (2014). *Integration Testing*. https://www.google.com

Kyeremeh, K. (2019). *Overview of System Development Life Cycle Models.* https://www.google.com

Le Vie, D. S. (2000). Understanding Data Flow Diagrams. *Proceedings of the Annual Conference on Society for Technical Communication*. https://www.google.com

Liu, J. (2020). Consumers' Satisfaction Factors Mining and Sentiment Analysis of B2C Online Pharmacy Reviews. *Medical Informatics and Decision Making*, *20*(1), 1–13. https://doi.org/https://doi.org/10.1186/s12911-020-01214-x

Łobaziewicz, M. (2015). The Design of Business-to-business System User Interface for Mobile Systems. *Procedia Computer Science*, *65*(Iccmit), 1124–1133. https:// doi. org/ https://doi. org/10. 1016/j.procs.2015.09.036

Longo, K. (2015). E-Commerce Trend in Developing Countries: A Case Study of Tanzania. *International Journal of Computer Applications*, *125*(1), 27–33. https://doi.org/10.5120/ijca2015905220

Mahajan, P. (2016). Different Types of Testing in Software Testing. *International Research Journal of Engineering and Technology*, *03*(04), 1661–1664.

Markus, A., & Markus, A. (2013). *Unit Testing. Modern Fortran in Practice*. https://www.google.com

Nadia, K. (2019). *Scope of online pharmacy in Pakistan:* https:// www. ravimagazine. com/scope-of-online-pharmacy-in-pakistan-research-article-by-nadia-kazi/

NBS. (2017). National Bureau of Statistics. *https:// www. nbs. go. tz/nbs/t akwimu/trade/ HOTEL_ Statistics_September_2016.pdf*. 1–14.

Ndibwile, J. D., Luhanga, E. T., Fall, D., Miyamoto, D., & Kadobayashi, Y. (2018). Smart4Gap: Factors that influence smartphone security decisions in developing and developed countries. *ACM International Conference Proceeding Series*. https://www.google.com

Nguyen, D. K., Heuvel, W. J., Van den, Papazoglou, M. P., De Castro, V., & Marcos, E. (2009). Conceptual Modeling: Foundations and Applications. *Conceptual Modeling: Foundations and Applications*, *5600*(June 2014), 293–318. https://doi.org/10.1007/978-3-642-02463-4

Nurfarah, D. (2018). *Online System Based on E-Commerce Platform* (*Internet Computing*). https://www.google.com

Perveen, S. S., Surve, S., & Rp, N. (2020). Descriptive Analysis of Quality of Information of Drugs on Android-Based Indian Online Pharmacy Applications: A Preliminary Analysis. *Asian Journal of Pharmaceutical and Clinical Research*, *13*(5), 93–96. https:// doi. org/10. 22159/ ajpcr.2020.v13i5.37099

PharView. (2020). *About – dawa.co.tz – Tanzania's E-Pharmacy*. https:// www. dawa. co. tz/elements/pages/about/

Philipo, J. (2019). *Development of a web and mobile application for drug abuse information awareness*. https://www.google.com

Prashanti, G., & Sravani, S. (2017). A Review on Online Pharmacy. *Journal of Pharmacy and Biological Sciences*, *12*(03), 32–34. https://doi.org/https://doi.org/10.9790/3008-1203043234

AjaiKumar, S. A. (2020). Online Pharmacy in India- A SWOT Analysis (2020). *Parishodh Journal*, *IX*(2347), 4464–4479.

Quartz. (2020). *Ghana's mPharma raises $17m, appoints ex-CVS boss to board — Quartz Africa*. https://qz.com/africa/1860227/ghanas-mpharma-raises-17m-appoints-ex-cvs-boss-to-board/

Rahav, A. (2018). *What Is Single-Factor Authentication (SFA)?/ Security Wiki*. https://doubleoctopus.com/security-wiki/authentication/single-factor-authentication/

Saraswat, S., & Jain, R. (2020). *Online Pharmacies: Challenges and Scope in India*. https://www.google.com

Singh, H., Majumdar, A., & Malviya, N. (2020). E-Pharmacy Impacts on Society and Pharma Sector in Economical Pandemic Situation: A Review. *Journal of Drug Delivery and Therapeutics*, *10*(3-s), 335–340. https://doi.org/10.22270/jddt.v10i3-s.4122

Spero, J. (2017). How Mobile is Reshaping the B2B Landscape for Growth. *Think With Google*. https://www.google.com

Sun, H. (2010). *Quantifiable non-functional requirements modeling and static verification for web service compositions. ProQuest Dissertations and Theses*, *191*. https://www.google.com

Taherdoost, H. (2018). *Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research*. https://www.google.com

TCRA. (2020). *October - December 2020*. *December*. https://www.google.com

Tech in Africa. (2020). *Tech Startup PharmLinks to Combat Fake Drugs in Tanzania - Tech In Africa*. https:// www. techinafrica .com/tech-startup-pharmlinks- combat-fake-drugs-tanzania/

The Pharmacy Act. (2020). Pharmacy (Pharmacy Practice and the Conduct of Business of

Pharmacy). *Pharmacy Act*, *267*(267), 1–15.

Tian, J., Jing, J., Eds, M. S., & Ferrari, D. (2014). *International Conference on Security and Privacy in Communication Networks*. https://www.google.com

TMS. (2018). *9 Web Technologies Every Web Developer Must Know in 2021 | TMS*. https://tms-outsource.com/blog/posts/web-technologies/

Torp, C. E. (2003). *Method of Software Validation*. https://www.google.com

Union, E. (2012). *Introduction to Unified Modeling Language (UML) 3rd Inspiration Training Content, Basic introduction and Models*. https://www.google.com

Uschold, M. (2015). Ontology and database schema: What's the difference? *Applied Ontology*, *10*(3–4), 243–258. https://doi.org/10.3233/AO-150158

West, D. M. (2013). *Improving Health Care through Mobile Medical Devices and Sensors*. https://www.google.com

Zhao, H., Muthupandi, S., & Kumara, S. (2020). Managing illicit online pharmacies: Web analytics and predictive models study. *Journal of Medical Internet Research*, *22*(8), 1-12 https://doi.org/10.2196/17239

Zumstein, D., & Träger, C. (2019). *Empirical Findings on the B2B and B2C e-Health Mobile Medical Apps*. https://www.google.com

APPENDICES

Appendix 1: User Acceptance Questionnaire

I am Martine Fabian Lyimo, master's student at The Nelson Mandela Institution of Science and Technology (NMAIST), currently doing project titled " Mobile-based Business-to-business platform for the pharmaceutical industry in Tanzania. I have developed a web and mobile application. The aim of this questionnaire is to assess on the developed prototype sample of the application by giving your views on how you think about the platform hence getting feedback for more improvements.

Please choose the best answer.

1.Your pharmacy type

a. Wholesale

b. Retail

2.Do you own smartphone?

a. Yes

b. No

3. Are you good in computer skills?

a. Strong agree

b. Agree

c. Disagree

4. Is the mobile and web application easy to use?

a. Strong agree

b. Agree

c. Disagree

5. Is this mobile web application comfortable to use?

a. Strong agree

b. Agree

c. Disagree

6. Is this platform well presented for online pharmacy medicine purchase?

a. Strong agree

b. Agree

c. Disagree

7. Will you be able to use this mobile and web application?

a. Strong agree

b. Agree

c. Disagree

8. The web application will be useful for storage and viewing of reports

a. Strong agree

b. Agree

c. Disagree

9. The web application will assist to get statistics on the usage of drug abuse

a. Strong agree

b. Agree

c. Disagree

10. Do you think more features should be added to this platform?

a. Strong agree

b. Agree

c. Disagree

11. This web application will benefit decision making and policy makers.

a. Strong agree

b. Agree

c. Disagree

d. Not sure

12. I think the pharmacy industry will benefit from this application

a. Strong agree

b. Agree

c. Disagree

d. Not sure

13. I think this platform will provide awareness on availability of medical supply mobile apps

a. Strong agree

b. Agree

c. Disagree

d. Not sure

14. What are more features that should be added to the platform?

15. Do you have any other comments?

Appendix 2: Survey Questionnaires

I am Martine Fabian Lyimo, master's student at The Nelson Mandela Institution of Science and Technology (NMAIST), currently doing project titled " Mobile-based Business-to-business platform for the pharmaceutical industry in Tanzania. The aim of the questionnaire is to understand the knowledge and awareness the wholesale and retail pharmacies have on the availability of medical mobile distribution/supply applications.

1. Select your pharmacy category
    - Wholesale Pharmacy
    - Retail Pharmacy
2. In which region are you?
    - Dar
    - Mwanza
    - Arusha
    - Kilimanjaro
    - Other……(Mention)
3. Do you own a smartphone?
    - Yes
    - No
4. Kindly Specify smartphone Operating System
    - Android
    - iOS
    - Windows phone
    - Other
5. Are you aware of the availability of medical distribution/supply apps (applications) for smartphones?
    - Yes
    - No
6. How do you place your orders through?
    - Manual ordering
    - Customer Service Representative
    - Sales Representative
    - On-line computer order system
    - Mobile applications
    - Other…….. (Specify)
7. Do you use mobile apps(applications) for supply/purchase medical supplies?

- Yes
- No

8. If yes, what is the name of the application?.....
9. What are the app functionalities or features?
    - stock tracking
    - delivery service
    - order tracking
    - geo-location
    - Other……. (write)
10. What app functionalities or features are missing?
    - stock tracking
    - delivery service
    - order tracking
    - geo-location
    - Other……. (write)
11. What features are most used in the app?.....
12. What challenges do you face when using the app?.....
13. What is the pricing when ordering online versus manually?
    - Low
    - Same
    - High
14. Is the delivery service charged?
    - Yes
    - No
15. How long does it take to deliver your order?
    - 10-30Min
    - 30Min-1hr
    - 1-2Hr
    - Other ……...(write)
16. What is the integrity of medical supplies ordered, do you receive what you have ordered?
    - Yes
    - No
17. What are the payment modes?
    - Mobile Money (M-Pesa, tigo Pesa etc)
    - Cash

- Debit Cards
- Other ……(write)

18. Would you like to have the mobile app which lets you supply/purchase and make easy access and delivery of medical services?
    - Yes
    - No
19. If Yes, please specify functionalities or features that need to be incorporated ……...

Appendix 3: The Sample Codes for Mobile Application Development

```
import import React, {Component} from 'react';
import Icon from 'react-native-vector-icons/FontAwesome';
import {useSelector, useDispatch} from 'react-redux';
import {View, StyleSheet, SafeAreaView, ScrollView} from 'react-native';
import {
Text,
Input,
Button,
makeStyles,
ThemeProvider,
Divider,
} from 'react-native-elements';
const signInTheme = {
Input: {
containerStyle: {
paddingBottom: 5,
paddingTop: 10,
},
},
Text: {
h3Style: {
textAlign: 'center',
paddingBottom: 20,
},
style: {
paddingTop: 10,
paddingBottom: 10,
},
},
Divider: {
```

```
backgroundColor: 'blue',
},
};

const RT_LoginScreen = () => {
const auth = useSelector(state => state.auth.isAuthenticated);
return (
<SafeAreaView>
<ScrollView>
<View style={styles.root}>
<Text h3> Retailer Login</Text>
<Input
placeholder="email@example.com"
label="Enter your Email"
leftIcon={{type: 'font-awesome', name: 'envelope'}}
/>
<Input
placeholder="password"
label="Password"
leftIcon={{type: 'font-awesome', name: 'lock', size: 30}}
secureTextEntry={true}
/>
<Button
title="Sign In"
onPress={() => this.props.navigation.navigate('retailer-home')}
/>
<Divider />
<Text>Not registered?</Text>
<Button
title="Sign up"
onPress={() => this.props.navigation.navigate('retailer-login')}
type="outline"></Button>
```

```
<Text h4 />
<Divider />
<Text h4 />
<Button
title="Switch to Wholesaler"
onPress={() => this.props.navigation.navigate('app-choice')}
type="clear"></Button>
</View>
</ScrollView>
</SafeAreaView>
);
};

export default RT_LoginScreen;

const styles = StyleSheet.create({
root: {
paddingTop: 100,
paddingHorizontal: 30,
},
});

, {Component} from 'react';
import Icon from 'react-native-vector-icons/FontAwesome';
import {useSelector, useDispatch} from 'react-redux';
import {View, StyleSheet, SafeAreaView, ScrollView} from 'react-native';
import {
Text,
Input,
Button,
makeStyles,
ThemeProvider,
```

```
Divider,
} from 'react-native-elements';
const signInTheme = {
Input: {
containerStyle: {
paddingBottom: 5,
paddingTop: 10,
},
},
Text: {
h3Style: {
textAlign: 'center',
paddingBottom: 20,
},
style: {
paddingTop: 10,
paddingBottom: 10,
},
},
Divider: {
backgroundColor: 'blue',
},
};

const RT_LoginScreen = () => {
const auth = useSelector(state => state.auth.isAuthenticated);
return (
<SafeAreaView>
<ScrollView>
<View style={styles.root}>
<Text h3> Retailer Login</Text>
<Input
```

```
placeholder="email@example.com"
label="Enter your Email"
leftIcon={{type: 'font-awesome', name: 'envelope'}}
/>
<Input
placeholder="password"
label="Password"
leftIcon={{type: 'font-awesome', name: 'lock', size: 30}}
secureTextEntry={true}
/>
<Button
title="Sign In"
onPress={() => this.props.navigation.navigate('retailer-home')}
/>
<Divider />
<Text>Not registered?</Text>
<Button
title="Sign up"
onPress={() => this.props.navigation.navigate('retailer-login')}
type="outline"></Button>
<Text h4 />
<Divider />
<Text h4 />
<Button
title="Switch to Wholesaler"
onPress={() => this.props.navigation.navigate('app-choice')}
type="clear"></Button>
</View>
</ScrollView>
</SafeAreaView>
);
};
```

```
export default RT_LoginScreen;


const styles = StyleSheet.create({
root: {
paddingTop: 100,
paddingHorizontal: 30,
},
});
```

Appendix 4: The Sample PHP Codes Used in Web Application Development.

```
<?php<?php

namespace App\Http\Controllers\api;
use App\Http\Controllers\Controller;
use Illuminate\Http\Request;
use Illuminate\Support\Facades\Auth;
use Illuminate\Support\Facades\DB;

use App\Category;
use App\Product;
use App\User;
use App\Order;
use App\Wishlist;
use App\Cart;
use App\Account;
use Carbon\Carbon;


class ApiHomeController extends Controller
{
/**
* Display a listing of the resource.
*
* @return \Illuminate\Http\Response
*/
public function index(Request $request)
{
$categories = Category::all()->take(10);
$products = Product::all()->take(10);
$productMonths = Product::whereMonth('created_at', Carbon::now()->month)->take(10)->get();

return response()->json([
'categories'=>$categories,
'products'=>$products,
'productMonths'=>$productMonths
]);
}
/**
* View Product by id
*/

public function saveCart(Request $request,$productId){

if (Auth::user()){

$products = DB::table('products')
->where('id', $productId)->first();
```

```
if(isset($products)){
if ($products->price == 0) {

$thePrice = $products->original;
} else {
$thePrice = $products->price;
}
}else{
return response()->json([
'error'=>'Product not found'
]);
}

$checkIfProductExist = Cart::select('id')-
>where([['customer_id',Auth::id()],['product_id',$productId]])->value('id');

if ($checkIfProductExist == null){

$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = $request->quantity;
$cart->subtotal = $thePrice * $request->quantity;
$cart->grandtotal = $thePrice * $request->quantity;

$cart->save();

// return redirect()->back()->with('success', ' Product has been successful added to cart!');
return response()->json([
'success'=>'Product has bee successfully added to cart'
]);

}else{

$cart = Cart::find($checkIfProductExist);

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = $request->quantity + $cart->quantity;
$cart->subtotal = ($thePrice * $request->quantity ) + $cart->subtotal;
$cart->grandtotal = ($thePrice * $request->quantity ) + $cart->grandtotal;
```

```
$cart->save();

// return redirect()->back()->with('success', ' Product has been successful added to cart!');
return response()->json([
'success'=>'Product has been successfully added to cart'
]);
}

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}

//add to cart with single q
public function singleCart($productId){

if (Auth::user()){

$products = DB::table('products')
->where('id', $productId)->first();

if ($products->price == 0) {

$thePrice = $products->original;

} else {

$thePrice = $products->price;
}

$checkIfProductExist = Cart::select('id')-
>where([['customer_id',Auth::id()],['product_id',$productId]])->value('id');

if ($checkIfProductExist == null){

$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1;
$cart->subtotal = $thePrice * 1;
$cart->grandtotal = $thePrice * 1;
```

```
$cart->save();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);

}else{

$cart = Cart::find($checkIfProductExist);

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1 + $cart->quantity;
$cart->subtotal = ($thePrice * 1) + $cart->subtotal;
$cart->grandtotal = ($thePrice * 1) + $cart->grandtotal;


$cart->save();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);
}

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}

public function saveCartWishList(Request $request,$id)
{

if (Auth::user()) {

$productsId = DB::table('wishlists')->select('product_id')
->where('id', $id)->value('product_id');

$products = DB::table('products')
->where('id', $productsId)->first();
if(isset($product)){
if ($product && $products->price == 0) {
```

```
$thePrice = $products->original;
} else {
$thePrice = $products->price;
}
}else{
response()->json([
'message'=>'Product does not exist'
],404);
}


$checkIfProductExist = Cart::select('id')->where([['customer_id', Auth::id()],
['product_id',$productsId]])->value('id');

if ($checkIfProductExist == null) {

$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1;
$cart->subtotal = $thePrice * 1;
$cart->grandtotal = $thePrice * 1;

$cart->save();

Wishlist::find($id)->delete();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);

} else {

$cart = Cart::find($checkIfProductExist);

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1 + $cart->quantity;
$cart->subtotal = ($thePrice * 1) + $cart->subtotal;
$cart->grandtotal = ($thePrice * 1) + $cart->grandtotal;
```

```
$cart->save();

Wishlist::find($id)->delete();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);
}

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}

public function wishlist($id){

if (Auth::check()){

$userId = Auth::id();

$customer_id = User::select('accountId')->where('id', $userId)->value('accountId');

$wishList = new Wishlist;

$wishList->customer_id = $customer_id;
$wishList->product_id = $id;
$wishList->save();

return response()->json([
'success'=>'Product has bee successfully added to Wishlist'
]);

}else{

return response()->json([
'message'=>'Unauthorized'
],401);
}

}

public function myWishList(){

$products = Product::all();
$categories = Category::all()->take(10);
```

```
$loginId = Auth::id();
$wishes = Wishlist::select('*')->where('customer_id',$loginId)->get();

// return view('myWishList',compact('categories','wishes','userId','subTotals','product'));
return response()->json([
'categories'=>$categories,
'products'=>$products,
'wishes'=>$wishes,
'userId'=>$loginId
]);

}

public function cartDelete($id){
$itemToDelete = Cart::find($id);
if($itemToDelete){
$itemToDelete->delete();
return response()->json([
'success'=>'Product removed'
]);
}else{
return response()->json([
'error'=>'Item not found'
]);
}
// return redirect()->back()->with('success',' Product removed');

}

public function cartUpdate(Request $request,$id){

$cart = Cart::find($id);
if($cart){
$product = Product::find($cart->product_id);
}else{
return response()->json([
'error'=>'Product not found'
],404);
}


if ($request->quantity < 1){

// return redirect(route('cart'))->with('error',' quantity Must be One or More');
return response()->json([
'error'=>'Quantity Must be one or more'
],422);

}
```

```
if ($product->price == 0) {

$thePrice = $product->original;

} else {

$thePrice = $product->price;
}

$cart->quantity = $request->quantity;
$cart->subtotal = $request->quantity * $thePrice;
$cart->grandtotal = $request->quantity * $thePrice;
$cart->save();

// return back()->with('success','Cart updated');
return response()->json([
'success'=>'Cart Updated'
]);

}

public function cart(){

$products = Product::all();
$categories = Category::all()->take(10);
$loginId = Auth::id();
$cart = Cart::select('*') ->where('customer_id',$loginId)->where('status',0)->get();

// return view('cart',compact('fb','tw','ig','menus','categories','cart','userId','subTotals','product'));
return response()->json([
'product'=>$products,
'categories'=>$categories,
'cart'=>$cart,
]);
}

public function getOrders(){

$products = Product::all();
$categories = Category::all()->take(10);
$loginId = Auth::id();
$cart = Cart::select('*') ->where('customer_id',$loginId)->where('status',0)->get();
return response()->json([
'products'=>$products,
'categories'=>$categories,
'userId'=>$loginId,
'cart'=>$cart
]);
```

```
}

public function createOrder(Request $request){

$request->validate([
'email'=>'required',
'phone'=>'required',
'region'=>'required'
]);

$loginId = Auth::id();
$cart = Cart::select('*') ->where('customer_id',$loginId)->where('status',0)->get();

// Available alpha caracters
$characters = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ';

// generate a pin based on 2 * 7 digits + a random character
$pin = mt_rand(100, 999)
. mt_rand(100, 999)
. $characters[rand(0, strlen($characters) - 1)];

// shuffle the result
$sendCode = str_shuffle($pin);

foreach ($cart as $counter) {

$makeOrder = new Order();

$makeOrder->customer_id = $loginId;
$makeOrder->product_id = $counter->product_id;
$makeOrder->owner_id = $counter->owner_id;
$makeOrder->customerName = $request->firstName." ".$request->lastName;
$makeOrder->email = $request->email;
$makeOrder->phone = $request->phone;
$makeOrder->region = $request->region;
$makeOrder->quantity = $counter->quantity;
$makeOrder->shipping = $request->shipping;
$makeOrder->price = $counter->subtotal;
$makeOrder->address = $request->address;
$makeOrder->orderCode = $sendCode;

$makeOrder->save();

//DELETE CART AND WISHLIST
Cart::find($counter->id)->delete();

}
```

```
include 'sms.php';

$userx = User::find(Auth::id());
$accountsx = Account::where('id',$userx->accountId)->first();

$str = ltrim($accountsx->phone, 0);
$phone = "+255".$str;
$msg = "Thank you for your order";

sms($phone,$msg);

// return back()->with('success',' You orders has been successful sent!');
return response()->json([
'success'=>'Your orders has been successfully sent'
]);

}

public function getUserOrders(){

if (Auth::user()){

$ordersList = Order::select('orders.*','products.name as productName','products.image1')
->join('products','products.id','=','orders.product_id')
->where('customer_id',Auth::id())
->get();
$categories = Category::all()->take(10);

$counter = 1;

// return view('myOrders',compact('ordersList','categories','counter'));
return response()->json([
'ordersList'=>$ordersList,
'categories'=>$categories,
'counter'=>$counter,
]);

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}
public function myOrdersCancel($id){

$ordersList = Order::select('orders.*')
->where('orderCode',$id)->where('status',0)
```

```
->get();

foreach ($ordersList as $list){

$order = Order::find($list->id);

$order->status = -1;
$order->save();
}

// return back()->with('success',' POrder has been Canceled');
return response()->json([
'success'=>'Order has been cancelled'
]);
}

public function viewProduct($id){

$product = Product::find($id);
$productRelated=null;
$user=null;
$account=null;
$categories=null;
if(isset($product)){
$productRelated = Product::where('categoryId',$product->categoryId)->get();
$user = User::find($product->userId);
$account = Account::where('id',$user->accountId)->first();
$categories = Category::all()->take(10);
}

return response()->json([
'categories'=>$categories,
'product'=>$product,
'productRelated'=>$productRelated,
'account'=>$account
]);

}

public function viewByCategory($id){
$products = Product::select('*')->where('categoryId',$id)->get();
$categories = Category::all()->take(10);
$categoriesName = Category::find($id);

return response()->json([
'categoryName'=>$categoriesName,
'categories'=>$categories,
'products'=>$products
]);
```

```
}

public function allCategories(){
$allCategories = Category::all();
$categories = Category::all()->take(10);
return response()->json([
'allCategories'=>$allCategories,
'categories'=>$categories
]);
}

public function allProduct(){

$products = Product::all();
$categories = Category::all()->take(10);
return response()->json([
'categories'=>$categories,
'products'=>$products,
]);

}

public function allShopsProducts($id){

$categories = Category::all()->take(10);
$account = Account::where('id',$id)->first();
$userId = User::where('accountId',$id)->first();
$products = Product::where('userId',$userId->id)->get();

return response()->json([
'account'=>$account,
'categories'=>$categories,
'products'=>$products,
]);

}
public function autoSearch(Request $request){

$allCategories = Category::all()->take(10);


if ($request->word){

$query = $request->word;

$categories = Category::all()->take(10);

$products = DB::table('products')
```

```
->join('categories','products.categoryId','=','categories.id')
->select('products.*')
->where('products.name','LIKE','%'.$query.'%')
->orwhere('categories.category','LIKE','%'.$query.'%')
->get();

return view('showProductSearched',compact('products','categories'));
}
}

public function allShops(){

$accounts = Account::where('shopType','=','wholesaler')->get();
$categories = Category::all()->take(10);

return response()->json([
'categories'=>$categories,
'accounts'=>$accounts
]);
}

}

namespace App\Http\Controllers\api;
use App\Http\Controllers\Controller;
use Illuminate\Http\Request;
use Illuminate\Support\Facades\Auth;
use Illuminate\Support\Facades\DB;

use App\Category;
use App\Product;
use App\User;
use App\Order;
use App\Wishlist;
use App\Cart;
use App\Account;
use Carbon\Carbon;


class ApiHomeController extends Controller
{
/**
* Display a listing of the resource.
*
* @return \Illuminate\Http\Response
*/
public function index(Request $request)
{
$categories = Category::all()->take(10);
$products = Product::all()->take(10);
$productMonths = Product::whereMonth('created_at', Carbon::now()->month)->take(10)->get();
```

```
return response()->json([
'categories'=>$categories,
'products'=>$products,
'productMonths'=>$productMonths
]);
}
/**
* View Product by id
*/

public function saveCart(Request $request,$productId){

if (Auth::user()){

$products = DB::table('products')
->where('id', $productId)->first();
if(isset($products)){
if ($products->price == 0) {

$thePrice = $products->original;
} else {
$thePrice = $products->price;
}
}else{
return response()->json([
'error'=>'Product not found'
]);
}

$checkIfProductExist = Cart::select('id')-
>where([['customer_id',Auth::id()],['product_id',$productId]])->value('id');

if ($checkIfProductExist == null){

$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = $request->quantity;
$cart->subtotal = $thePrice * $request->quantity;
$cart->grandtotal = $thePrice * $request->quantity;

$cart->save();

// return redirect()->back()->with('success', ' Product has been successful added to cart!');
return response()->json([
'success'=>'Product has bee successfully added to cart'
]);
```

```
}else{

$cart = Cart::find($checkIfProductExist);

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = $request->quantity + $cart->quantity;
$cart->subtotal = ($thePrice * $request->quantity ) + $cart->subtotal;
$cart->grandtotal = ($thePrice * $request->quantity ) + $cart->grandtotal;

$cart->save();

// return redirect()->back()->with('success', ' Product has been successful added to cart!');
return response()->json([
'success'=>'Product has been successfully added to cart'
]);
}

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}

//add to cart with single q
public function singleCart($productId){

if (Auth::user()){

$products = DB::table('products')
->where('id', $productId)->first();

if ($products->price == 0) {

$thePrice = $products->original;

} else {

$thePrice = $products->price;
}

$checkIfProductExist = Cart::select('id')-
>where([['customer_id',Auth::id()],['product_id',$productId]])->value('id');

if ($checkIfProductExist == null){
```

```
$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1;
$cart->subtotal = $thePrice * 1;
$cart->grandtotal = $thePrice * 1;

$cart->save();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);

}else{

$cart = Cart::find($checkIfProductExist);

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1 + $cart->quantity;
$cart->subtotal = ($thePrice * 1) + $cart->subtotal;
$cart->grandtotal = ($thePrice * 1) + $cart->grandtotal;


$cart->save();

return response()->json([
'success'=>'Product has bee successfully added to cart'
]);
}

}else{

return response()->json([
'message'=>'Unauthorized'
],401);

}
}

public function saveCartWishList(Request $request,$id)
{

if (Auth::user()) {
```

```
$productsId = DB::table('wishlists')->select('product_id')
->where('id', $id)->value('product_id');

$products = DB::table('products')
->where('id', $productsId)->first();
if(isset($product)){
if ($product && $products->price == 0) {

$thePrice = $products->original;
} else {
$thePrice = $products->price;
}
}else{
response()->json([
'message'=>'Product does not exist'
],404);
}


$checkIfProductExist = Cart::select('id')->where([['customer_id', Auth::id()],
['product_id',$productsId]])->value('id');

if ($checkIfProductExist == null) {

$cart = new Cart;

$loginId = Auth::id();

$cart->customer_id = $loginId;
$cart->owner_id = $products->userId;
$cart->product_id = $products->id;
$cart->quantity = 1;
$cart->subtotal = $thePrice * 1;
$cart->grandtotal = $thePrice * 1;

$cart->save();

Wishlist::find($id)->delete();

return response()->json([
'success'=>'Product has been successfully added to cart'
]);

}
```

RESEACH OUTPUTS

Poster presentation