WAREHOUSE MANAGEMENT SYSTEM ENHANCEMENT FOR A-TO-Z TEXTILES LIMITED

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ABSTRACT

Technology utilization in industry in developing countries is the challenge, often there are crisis of equipment, goods and items destruction or loss in the warehouses. The enhancement of the warehouse management system for the Company help to utilize resources effectively thus improves Company performance. The aim of this study was to improve warehouse management through the use of information communication and technology. The study developed mobile application for customer registration, order management and stock management but also the study developed web application for account management, order management, invoice generation, client registration and stock management. The study extended the features of the mobile application to web-based application for the easy of the management of the application and reduce the load of the mobile application. Data were collected through observations and interviews for the aim of understanding the current system, how the company is managing the warehouse and getting requirements for these developed systems. The developed web and mobile application of warehouse management system were assessed and verified to evaluate functionalities and usability of the systems. The system enhanced the access of information at the fingertips, increase availability of service for the customer 24 hours per day through making order on spot, easier flow of information between the personnel of the company such as sales personnel, administrator of the systems and storekeeper, but also getting stock level instantly, order management and tracking, invoice generation and status of the invoice.

DECLARATION

I, Beatus Winifrid Mbunda do hereby declare to the senate of the Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being currently submitted for degree award in any other institution.

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CERTIFICATION

The undersigned certify that have read and hereby recommend for acceptance by the Nelson Mandela African Institution of Science and Technology, a dissertation entitled, "*Warehouse Management System Enhancement for A T-O-Z Textiles Limited*", submitted in partial fulfilment of the requirements for award of the degree of Master of Science in Embedded and Mobile Systems.

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LIST OF ABBREVIATIONS AND SYMBOLS

API	Application Programming Interface
BOT	Bank of Tanzania
CSS	Cascading Style Sheet
ERD	Entity Relationship Diagram
HTML	Hypertext Transfer Markup Language
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technology
IDE	Integrated Development Environment
JDK	Java Development Kit
JRE	Java Runtime Environment
JSON	JavaScript Object Notation
MVC	Model View Controller
PHP	Hypertext preprocessor
RFID	Radion Frequency Identification
SPSS	Statistical Product and Service Solutions
SQL	Structured Query Language
TCRA	Tanzania Communication Regulatory Authority
UML	Unified Modeling Language
XML	Extensible Markup Language

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

Warehouse is the place where goods are being stored prior to their use, the goods later are distributed or sold to the place where they are needed (Davies, 2008). Warehousing is the process of storing goods in a large scale, and it involves both raw materials and finished goods, and making the goods easily available when requested (Manzini, 2012). It is necessary because it helps manufacturers to produce goods by predicting the future. Furthermore, keeping the raw materials which will be used for regular production, time utility by making goods available according to the demand and store surplus of goods to meet demand in future (Tejesh & Neeraja, 2018). Warehousing facilitates price stabilization by regulating the supply of goods in the market, minimization of risk from fire, theft, and insurance companies can compensate when damage occurs, and preparing goods for sale through packaging and grading (Karimi & Namusonge, 2014).

Thus, management of warehouses is inevitable for large companies, organization and industries. Warehouse management system is the information and communications technology system which are used for managing daily warehouse operation (Phakiupattart & Chutima, 2019). Activities like goods tracking, order management, stock management, wave planning, picking and packing, issue of goods all are linked to the system for easy management (Yang *et al*., 2015) . The system act as a linking node for all warehouse operations including delivery of goods, handling of inbound and outbound operations, advanced shipping notifications, product lifecycle management, labor management, and support services (Suvittawat, 2016).

The warehouse management system are underutilization in most Companies in developing Countries (Muhalia *et al*., 2021). This leads to overstaffing, overstocking, understocking, pilferage, poor record keeping of goods and items in warehouses, human errors like forgetting to register all goods and items going in and out of the warehouse (Gyawu & Adzimah, 2015). This causes the companies to incur losses of goods and items annually affecting their economy (Hillman, 2012). Most companies in developing countries still use manual ways of keeping information for warehouse storage and transaction which is a very inefficient method for large companies and organizations handling large warehouses (Adebanjo *et al*., 2016). The traditional ways of managing warehouse leads to low productivity (Nikoloski, 2014).

Computerized warehouse management systems for large companies are the recommendable means which is more efficient in reducing items and goods theft, loss and destruction (Anđelković & Radosavljević, 2018). The system which controls and administers warehouse operations helps in space utilization, inventory cost reduction, increases efficiency in labor management, also it helps to reduce operating expenses (Harb *et al*., 2016).

Mobile business application that provides personalization content, incorporate valuable features and provide exceptional customer services leads to increase customer loyalty, improve customer service through availability of resources (Bahtar, 2018). It improves customer loyalty, improves customer engagement, provide push notifications, helps in retargeting and provide personalized shopping experience thus leads to increase company revenue through utilization of resources (Hussain & Mkpojiogu, 2015).

Furthermore, it increases availability of service to the customers, can be used as a marketing tool where by information about the products are accessible through the application (Schaefer & Hetman, 2019). Companies are using web-based application to optimize their performance, as the number of internet users who are accessing internet through their mobile phones increases, the need to have mobile application which increase the user experience, accessibility, availability, resource utilization is needed (Bal, 2013).

The A-to-Z Textile Mills Limited (A-TO-Z) was founded by Nathalal Hirji Shah in 1966 with the objectives of making clothes. The company started with three sewing machines but after four decades of hardworking, the company has grown to become one of the largest manufacturing companies in East Africa (A-TO-Z, 2021).

The Company manufactures textile, plastic, agricultural products, garments, cement bags, bed nets, plastic household items, but also it has value added services like embroidery and screen printing (A-TO-Z, 2021).

Currently the warehouse at A-TO-Z company is managed by using web-based application system. The existing warehouse management system needs enhancement to increase its efficiency and availability. The existing system is not user friendly to mobile user because it was designed only as web-based application, also it takes times to load the content quickly and it is difficult to use. The current system needs enhancements by adding functionality to the warehouse management system.

Therefore, the mobile business application of warehouse management system that covers the gap of existing system by adding more functionality to the existing web-based warehouse management system is developed. It assists in customer registration, making order, order tracking, stock level management and issue items and delivery of items as well as proving reports for decision making (Hussin *et al*., 2017).

1.2 Statement of the Problem

Despite the advantages of mobile warehouse management system of managing stock, meet customer needs, reduce cost of procurement and logistics, increase competitive advantages of the company, reduce cost labor and increase efficiency. However, the technology are not well utilized in organizations in developing countries and this leads to rise of theft, disorganization and reduce company performance (Adebanjo *et al*., 2016). With an existence and a well-managed warehouse system, exercise of managing stock will be automated, labor charges cost will be reduced and efficiency will be highly increased. Warehouse management is important for the company productivity (Hompel *et al*., 2007). Companies are using web-based technologies to manage their systems, however web-based system are not well suited for mobile access. The existing warehouse and spares web-based application at A-TO-Z Company is not mobile optimized, mobile application increases accessibility of the application, increases availability of service, it provides quick response time, increases productivity. Hence, in this study a web and mobile application were developed in order to increase accessibility of warehouse and spares system through mobile and client computers, optimizing the warehouse and spares web application will enable A-TO-Z Company staff to continue working effectively.

1.3 Rationale of the Study

The warehouse management system assists in company utilization of resources and hence improve the performance of the company (Milovanovic *et al*., 2016). The warehouse management system will provide the following contributions to the company:

(i) Help storekeeper to manage stock level of the warehouse.

(ii) Help customer for making order requisition, checking status of the order.

(iii) Manage delivery of the items by store manager.

(iv) Manage multiple warehouses.

(v) Help sales personnel to see incoming order request and make approval.

1.4 Research Objectives

1.4.1 General Objective

The general objective of this research is to develop a mobile and web-based application for warehouse and spares management system at A-TO-Z company.

1.4.2 Specific Objectives

(i) To review the existing warehouse and spares systems in order to know the limitations of the existing warehouse and spares management system.

(ii) To develop mobile and web-based application for warehouse and spares management system.

(iii) To test the developed systems based on its design specifications.

1.5 Research Questions

(i) What are the limitations of the existing warehouse and spare systems at A-TO-Z company?

(ii) How do you develop the web based and the mobile application for warehouse and spare systems?

(iii) How can the developed prototype be tested based on its design specifications?

1.6 Significance of the Research

Web based application advantages compared to office-based solution it increases availability of service all the time, in case of warehouse management system the service will be available to customer whenever requested, the customer can make order online and check order status online.

The web-based application reduces business cost by reducing the time talking with customer, the customer can get most of the information online, in case of our warehouse management system, customer can get information of products which are manufactured by the company, the products price and the stock of the products. Web based application provides wide customer

base, the warehouse management system can be reached anywhere from the world provided internet is available. The advantages of web-based application can be extended by developing mobile application.

Mobile application increases the availability of service to the company, mobile phone is portable, hence having mobile application can be increase productivity and performance (Islam, 2010). Tanzania has 51 million mobile subscribers, and 28 million internet users (Tanzania Communication Regulatory Authority [TCRA], 2021), users of internet has increased in number from 17 million in 2015 to 28 million in 2020 (TCRA, 2021).

A mobile application has potential to enhance the platform for warehouse management, it has increased service availability, it decreases the cost for running the company, it helps in well utilization of resources, it helps in sharing of information easily, it increases the efficiency of the work, moreover, it provides high coverage area signal for the warehouse by using barcode reader installed in the mobile application. With this advancement in technology mobile and web-based applications become the optimum solution for the company managing the warehouse operations.

1.7 Delineation of the Study

This study considers that all company staff have smartphones to install the mobile application of warehouse management system but also the study assumes the users know how to use mobile phones and training will be provided for the intended audience. Furthermore, this study made the assumption that users of the framework had internet access in order to access information from the smartphone and web-based applications.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents studies which has been done before on warehouse management system, it includes web-based application and mobile application which can help companies to manage warehouses and can assist customer in making order and order tracking.

2.2 Mobile Technology in Tanzania

Mobile technology is the type of technology which use cellular network for communication (Vassilakaki *et al*., 2016). The mobile technology provides voice, data and applications for mobile devices. The mobile technology is undergoing tremendous growth, the number of users in Tanzania has increased from 79% in 2015 to 89% in 2020 (TCRA, 2021). Concurrently internet users in Tanzania have been increased from 34% in 2015 to 49% in 2020 (TCRA, 2021). There are 51 million mobile phone subscriptions in Tanzania and 28 internet users by December, 2020 (TCRA, 2021).

Mobile technology enables mobile marketing for communications where many customers can be reached easily. It supports payments wirelessly, increases availability of service, increases access to mobile applications, a medium to deliver information, remote working, reduces operational costs, and saves time. It accelerates innovation and creativity, and is a source of information (Salo, 2012). This study uses mobile technology to link between customers and companies, but also to manage stock in the warehouse through mobile devices which will synchronize with a remote server.

2.3 Web Technology

Web technology enables computers to communicate with each other through markup language (Chawla *et al*., 2017). It allows users to access content across the web (Manzoor *et al*., 2014). The advantage of web technology in the context of business is that it reduces operating costs, wide customer reach, increased availability of service 24 hours a day, online training can be conducted remotely, and it is easy to access information. Moreover, web technology can be used in the supply chain to assist in delivery of products and services at exactly the right place at the minimum cost (Milovanovic *et al*., 2016). In this study web technology is the platform

to link between customers and company with intention to of enabling customer to register, make order, track order, store manager manage stock and storekeeper add items to the warehouse.

2.4 Related Works

The discipline of information communication technology (ICT) is being used to provide solution to the problem the world is facing including the sector of industrialization. Warehouse is the place where goods are being stored prior to their use, and to utilize the warehouse, warehouse management system are being developed.

Wang and Hua (2019) proposed a system of android mobile warehouse management system, the system performed well, However, the system can be extended by making cross platform warehouse management system. Fauzan *et al*. (2020) proposed warehouse management system for Zaeni Convection, the proposed model did well in terms of managing the warehouse, but can be extended by making responsive warehouse web application, as well as mobile application.

Saderova *et al*. (2020) proposed design option for warehouse management system, the system performed well in utilizing company resources but was not mobile optimized. Therefore, the system can be extended by developing mobile application. Hompel *et al*. (2006) proposed web-based warehouse management system in order to automate, organize the warehouse and order picking. The proposed model performs well but the system was not mobile optimized, hence the model can be extended by making optimized mobile application in order to increase accessibility.

Zhu (2016) proposed Warehouse management information system using radio frequency identification (RFID) technology, Zigbee technology and sensor. The technology has advantages that it doesn't require direct line of sight, can cover greater distances, can scan multiple items at a time, but also can read at fast speed rate than barcode. However, RFID are larger in size and heavier but also more expensive than Barcode.

Ling *et al*. (2017) proposed Warehouse management information system for Hongxing logistics company limited, the proposed model automated the company warehouse business model into electronic business using information technology, the model performed well by utilization of

the company resources. However, the model can be enhanced by application of tracking devices.

Xu *et al*. (2019) proposed using internet of things is developing user friendly warehouse management system, the proposed model implemented by using the radio frequency identification technology, barcode technology and embedded technology. The proposed model performed well. Luo *et al*. (2006) designed and developed warehouse management system using aspect-oriented programming. Aspect oriented programming is the technique of breaking codes into different modules, but also it uses aspect in programming, its advantage is crosscutting concerns modularization, easier to add new functions and better reusability.

Phakiupattart and Chutima (2019) proposed warehouse management system at textile manufacture company in Thailand using information technology in order to utilize space. The proposed model performed well by utilizing the space. The result of the model caused reduction in 1342 pallets of unnecessary goods resulting of higher space utilization. However, the study concentrated only in space utilization, and can be enhanced by using tracking technology, information technology to utilize human resource and goods management.

Therefore, this study developed mobile warehouse management system using Flutter technology which uses single codebase, and extended the features of warehouse web-based application using Bootstrap 4 technology. The mobile and web application system will help in enterprise resource sharing, meet customer needs, increase customer loyalty, increase competitive advantages ofthe company, easy to maintain due to single codebase, cross platform mobile warehouse application, responsive warehouse web application, increase productivity by promoting quality and quantity at A-to-Z Textiles Company Limited.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

The methods and materials used to achieve the project objectives are detailed explained in this chapter; it includes the developed mobile application and web-based system. The chapter discusses the architectural design, requirements analysis, data collection, analysis methods, sampling techniques and case study of the research. The answers for the research questions were determined and analyzed to get suitable solution for development of the warehouse management system. The strength and weakness of the existing warehouse management system were studied to fulfill the first objective of identification of requirements and analyzing existing warehouse management system.

3.2 Study Area

The study was conducted at A-TO-Z Textile Mills Ltd located at Kisongo Area, in Arusha Region. The Company was selected because it is a 7 group of companies, it is one of the biggest companies in East Africa, and it has more than 7000 thousand employees (A-TO-Z, 2021). The share of manufacturing Companies to the Gross Domestic Product was 8.5% (Bank of Tanzania [BOT], 2019).

The Company manufactures bed nets, garments, reflective safety wear, plastics, polypropylene woven bags, specialty mesh, agricultural and horticulture related products such as bags, but also it has value added services like embroidery and screen printing. It’s such a big company where management of warehouse is unavoidable for it to be more competitive in the market.

3.3 Data Collection Methods

The data collected for the duration of three months from October to December in 2020, this study was qualitative in nature. Face-to-face interviews and observation were conducted as the means of data collection as explained below.

3.3.1 Interviews

Semi structured interview questions were used. Interview were carried out with 50 personnel from different departments within the ATOZ Company. The interview was conducted

according to the departments and availability of the personnel within the departments. The interview was conducted in order to know how the current warehouse systems was conducted and to know the limitations of the existing warehouse systems. The study used the output of the interview to get requirements of the proposed warehouse management. The questions asked during the interview are attached in the Appendix 4.

3.3.2 Observations

Throughout the study observation was done to see how the warehouse activities were being managed and conducted so as to get insight of how the activities were being done. It involved visiting Net warehouse department, Garment's warehouse department, plastics warehouse department, sales department, main store and ICT department. The objective was to get more understanding on the existing warehouse systems and to know the limitations of the warehouse systems and this leads to fulfil the first objective of the study to analyze the existing warehouse systems and to answer the research question of what are the limitations of the existing warehouse systems.

3.4 Data Analysis Methods

The data obtained during the interviews and observations which was conducted at A-TO-Z Company were quantitative and qualitative data. The inductive approach to analyze the qualitative data, and descriptive statistics (frequency table) was used to analyze the quantitative data for the purpose of comparing the data. The study used Statistical Product and Service Solutions (SPSS) software to analyze the data because of its performance and better functionality the SPSS software provides.

3.5 Development and Implementation of the Proposed Solution

3.5.1 Development Approach

The development approach is used to develop the software according to the gathered requirements, it transforms requirements into the proposed software product.

Agile development model is used to develop the mobile system, which makes it easy to accommodate change, it increases customer satisfaction, focus in business value, product is developed fast, close interaction between business stakeholders and developers, adaption to changing circumstances, it accommodates changing requirements easily, quick delivery to

customer and improve quality. The Fig. 1 presents agile development model for the proposed solution.

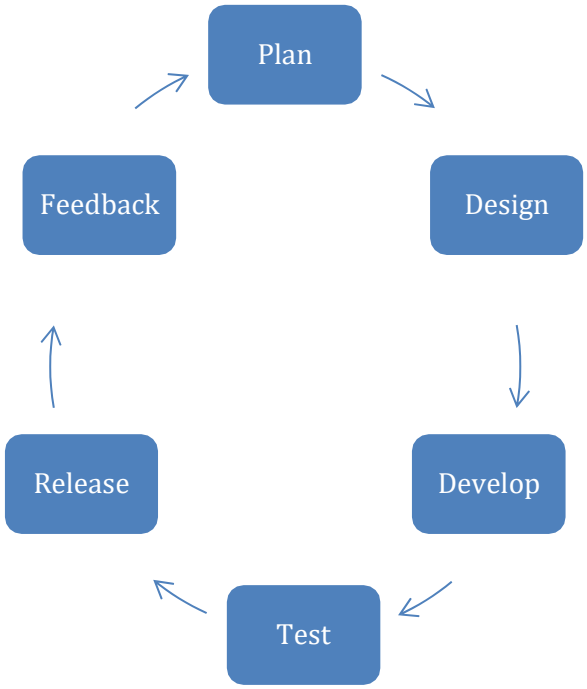


Figure 1: Agile development model

3.5.2 Technologies and Tools Used

The following are the tools, frameworks, libraries, and languages used in the building of warehouse application:

(i) Laravel

This is Open-source Hypertext Preprocessor (PHP) web application framework which support model view control (MVC) architecture. Laravel helps in creation of robust and scalable application, it enables developers write less code which leads to less errors, secure migration of system, intact security, unique unit testing, inbuilt authentication system, and it has built in tool for command line knows as artisan.

(ii) Bootstrap

This is the open-source framework developed by Mark and Jacob (2010) and is used for front end development for making responsive websites and web applications. The framework includes Hyper Text Markup Language (HTML), Cascading Style Sheets (CSS), and

JavaScript. It is easy to use, support responsive features for desktop computers, tablets and smart phones, and multi browser supports.

(iii) Hypertext Markup Language

The language was introduced by Tim Berners-Lee in 1989 for building web pages and structures. It uses tags and attributes to structure a web page and its content. It is simple to learn and use. It features are: multi browsers support such as Google Chrome, user friendly, display changes immediately, light weight markup language, is a core stone of all programming languages, can be used with other languages, easy to edit, and is free.

(iv) Cascading Style Sheet

The language used for styling HTML documents. It shows how HTML elements should be displayed and separates them from presentation layer. It is also easy to maintain, saves time by creating once and using multiple times in different HTML pages, global web standards, support cross platform, pages load faster by using few codes written in CSS, manage layout of multiple web pages together, provide better device compatibility, has power to reposition, lightweight code, consistency in design, search engine improvement benefit, and increases the loading speed of the page. This study used CSS for presentation of the warehouse web application.

(v) JavaScript

This is the open cross platform interpreted language developed by Brendan Eich in 1995, used for creating web applications, is executed on the client computers, JavaScript features are: server load because of being executed on the client machine, is popular scripting language in the world, simple to learn and use, fast because can be executed immediately on the client machine, platform independent, and does not require compiler. This study used JavaScript for enhancing the functionality of the warehouse web application.

(vi) PhpStorm

The multiplatform editor for web applications, it supports fast and safe refactoring, error prevention and code analysis, major framework like Laravel, Joomla, and WordPress. It has built in developer tools like Composer, command line tools and Structured Query Language (SQL), it simplifies debugging process and testing, remote deployment, and code autocompletion.

(vii) Composer

This is an open-source multi-platform dependency manager for PHP. It runs on Windows operating system, Linux operating system, and Mac Operating System. Composer is used to download, install, and update dependencies for PHP. This study used composer to install Laravel libraries dependencies, to update the dependency, and finding the appropriately package for Laravel according to the version.

(viii) Dart

Language developed by Google for client development such as web and server application. Dart features are: Open source freely available, platform independent can run in all platform, object-oriented programming language, has many inbuilt in libraries, easy to learn, flexible compilation, support ahead of time compilation, just in time compilation, support all major browsers such as google chrome, and has wide community support. This study used Dart programming language for warehouse mobile application development, and the study used Dart language due to its performance.

(ix) XAMPP

A cross platform application, it comprises Apache Hypertext Transfer Protocol (HTTP) Server, PHP, Perl and MariaDB database, PhpMyAdmin, Open secure sockets layer, Joomla, WordPress and Mediawiki. It features are: Simple, lightweight, it provides friendly solution for beginners, time server, and deals with administration task such as status and security.

(x) Flutter

Open-source software development kit developed by google for developing application for web, mobile, and desktop from a single codebase. Flutter benefit are: Single user interface design for Android and iOS applications, powerful community support from global community and Google, economical by saving time and money through developing single codebase, high performance compared with other cross platform framework, easy to maintain because of the single codebase, and reduced time to deliver the end product to market.

3.5.3 Other Requirements

Internet connection to communicate with the remote server. It works well within local area network, smartphone device to install the mobile application which supports android smartphone and iPhone smartphone.

3.5.4 Development of Mobile Application

The developed warehouse management mobile application used flutter as software development platform, Dart object-oriented programming language which is the language used for software development in flutter platform. Laravel as the application for developing application programming interface (API) for the mobile application for enabling communication between the mobile application and the remote database, Android Software Development Kit (SDK), and Android toolchain for developing android devices.

This study warehouse management mobile application was used to capture customer details, place order and manage items including to issues, delivery, and stock management.

3.5.5 Dependencies and Assumptions of the Usage of the System

These are requirements which are required in order for the system to work effectively, and the requirements are:

(i) Users of the system should know to use smartphone and computers.

(ii) Users of the system should have smartphone.

(iii) Internet connection is required for sales person to add customer and press order on the application.

(iv) Internet connection is required for administrator to facilitate adding of users to the application.

(v) Internet connection is required for store manager and store clerk for adding, issuing and deliver of the items and manage stock level.

(vi) Internet connection is required for customer to facilitate making order online.

3.6 Validation

The process of determining if the software is developed according to the stakeholder's requirements (Committee, 1998). Its advantages are to make sure that system developed is a right system where by verification is whether the system developed according to the specification. In this study validation of the system was done using testing of the software. The software was tested if the intended outcome was met which helps in increasing the reliability of the system. The warehouse management system was validated through different phases of validation such as unit test, integration test, system test, and user acceptance test.

3.6.1 Unit Testing

Unit Testing is the process of testing the individual components of the software and its advantage is increase software quality by early detection of the faults in the development phases (Daka & Fraser, 2014). The unit testing is written and run by software developer. It is an automated process. It helps in quick and early bugs detection, it increases quality of code, it is increases performance, it simplifying debugging process, and it help in reducing cost. In warehouse management system unit testing was conducted in content display, how data was retrieved from mobile based application to the remote server, and user authentication. Example of the unit testing is user login authentication and the code is in Appendix 3.

3.6.2 Integration Testing

The testing done in software by combining the individual unit and test as whole combined units together (Labiche, 2011). The important of integration testing is to detect defects related to combined modules, combined units work together effectively as intended, help modules to work with application programming interface and other third-party software, increase the reliability of the test by increasing the test coverage. The warehouse management application's integration testing was conducted between the web and mobile application.

3.6.3 System Testing

This the testing done where by the whole complete system is tested in order to check if it meets its specified requirements (Adekanm, 2019). The tested was conducted to verify the mobile based application and web-based application of warehouse management system work effectively according to the user requirements.

3.6.4 User Acceptance Testing

To test its functionality, the built warehouse management system prototype was hosted online. For testing purposes, the web and mobile applications were delivered to A-TO-Z Company, the application's key stakeholders. The web application features are: Customer registration, order management, stock management, invoice generation, and account management. The customers were able to register and login into the system, after login they were able to generate order request and submit it to the sales personnel of the A-TO-Z company. The sales personnel were able to receive the order from the customer and approve it, then generate invoice and submit it to the customer for payment and approve, the customer received the invoice according to the order and paid the amount and submit the invoice to sales personnel, then the sales personnel submit the order to the main store for delivering of the goods and ship it to the customer who made the order.

The administrators were able to login in the web-based application and created account for sales personnel and store personnel, but also the administrator was able to manage warehouses, link warehouses with categories of the products which the warehouses store and finally link categories with items in that category.

The mobile application features are: Customer registration, order management, and stock management. The customers were able to register and login into the warehouse mobile application, and request an order for the bed nets, then the customer submit the order to the sales personnel, then the sales personnel approve the order and send invoice to the customer for payment, then the customer received the invoice and approved it and paid the amount in the invoice, forward the invoice to the sales personnel who login in the web based application and submit the request to the main store for items delivery and shipped to the intended customer.

As shown in the Table 1 below the A-TO-Z Company personnel were well pleased with web and mobile application. They accepted the developed application and were ready to use the developed solution for performing their duties. They agreed that they have application but needed enhancement, and therefore the developed applications will enhance the company performance.

Table 1: User acceptance testing

Query	Strong agree	Agree	Disagree	Not sure
The warehouse web system is user friendly	57	40	1	2
I will be capable to utilize the warehouse system	68	30	2	0
The web application will be helpful for management of warehouse	44	51	2	3
I believe the web application will be helpful to A-TO-Z Textiles Company Limited	75	23	1	1
The web application will help to manage stock level at A-TO-Z Textiles Company Limited	60	36	2	2
Data storage and information access will be enhanced by the warehouse web application	70	27	1	2
The warehouse web interface is well designed for warehouse management	66	29	3	2
This web application will be useful for decision making	46	50	2	2
The mobile application will help clients for getting information at their fingertips	51	47	2	0
The web application is crucial to the society	53	42	2	3

Furthermore, the users of the warehouse mobile system were given the system to test and get feedback from them. The clients were given questionnaires to get their views, and the feedback was recorded and analyzed.

Table 2: Feedback from A-TO-Z personnel

User feedback	Strong agree	Agree	Disagree	Not sure
The mobile application is simple to use	58	39	2	1
I believe I will be able to use this mobile application of warehouse management system	57	34	4	5
The mobile application is enjoyable to use	46	50	2	2
I believe the mobile application will reduce delay in order submission	75	23	1	1
The mobile application increases availability of service for making order	60	36	2	2
The warehouse mobile application will make availability of information at fingertips	65	28	5	2
The warehouse mobile interface is well designed for warehouse management	64	30	3	3
This mobile application will be useful for decision making	48	50	1	1
The mobile application will help clients for getting information at their fingertips	50	47	2	1
I suggest the application to be used to other companies in Tanzania	53	42	2	3

The analyzed data in Table 2 from A-TO-Z Company personnel shows that the satisfaction of the mobile application to be used in the Company.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter explains the system's functional and non-functional specifications. Furthermore, the chapter explains in details of the developed solution, the testing of the solution and results are presented without excluding the discussion on the system.

4.2.1 Requirements for the Developed Mobile and Web Applications

Requirements analysis is a process of understanding the needs of the stakeholders (Gunawardhana, 2019). The process of requirements engineering includes feasibility studies, elicitation, validation and verification (Gunda, 2008). The interviews and observation done at A-TO-Z Textiles Limited learnt that some functions were automated and some functions were done manually like updating the stock during receiving items from production departments, this due to low coverage of barcode wireless scanner. It was discovered that 80% of the warehouse personnel have smartphones and the warehouses have three computers on average.

The 70% of respondents recommend that the client registration, order request, order status and stock management shall be done using mobile application because store personnel and production units owns smartphone, and on the hand more functions shall be done on the mobile application includes order confirmation, stock update, client registration, order request, invoice generation. The light functions shall be performed by the smartphones.

The software requirements can be classified into two categories functional and nonfunctional requirements (Chung & Leite, 2009).

(i) Functional Requirements

Alsaleh and Haron (2016), defined functional requirements as the requirements which are intended to be performed by the system. In this study the functional requirements are:

(a) The system should allow customer to login, register and make order.

(b) The system should allow client to check order status.

(c) Sales personnel should be able to confirm order and generate invoice.

(d) Sales personnel should be able to view stock.

(e) Production personnel should be able to add stock.

(f) Storekeeper should be able to monitor stock and prepare delivery note.

(g) Addition of system users and suspending can be done only by administrator.

(h) Addition of warehouse and item category can be done only by administrator.

(ii) Nonfunctional Requirements

Bajpai and Gorthi (2012), defined nonfunctional requirements as attributes that describe how the system should work and how it meets the functional requirements. In this study the nonfunctional requirements are:

(a) The system should allow 5 seconds response time.

(b) Usability the proposed system should allow usability.

(c) Availability the system should be available 24/7/365.

(d) The system should allow maintainability.

(e) Security the system should allow only authenticated users.

4.2 Research Case Study Area Results and Discussion

The aim of this study was to know the satisfaction level of the users who are using the warehouse management system to perform their duties, in addition to know willingness of users to adopt information technology to enhance the warehouse management process.

4.2.1 Demographic Characteristics

The assessment of the demographic features of respondents participated in this study was done for the purpose of evaluating the prospective of stakeholders of using ICT in warehouse domain. The assessment looked at gender but education and age were not considered in this study. The demographic data provided insights into the study of their needs and views on technology based on their demographic variables. Out of 50 respondents, the majority were male that occupied 60% and female occupied 40%, majority of the respondents were male due

to more staffs are male compared to female in the manufacturing sectors in developing countries. Figure 2 shows demographic information according to gender.

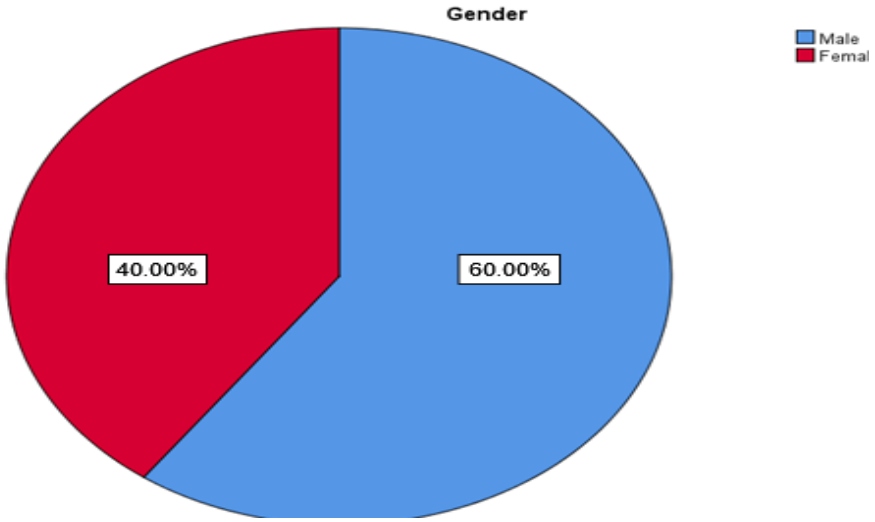


Figure 2: Demographic characteristics

4.2.2 Smartphone Accessibility

The aim was to determine the number of the staffs who have smartphone in order to use the proposed warehouse mobile application. During the study it was revealed that 60% of the correspondences have smartphone and know how to use the smartphone, and 40% doesn't have smartphone as shown in the Fig. 3.

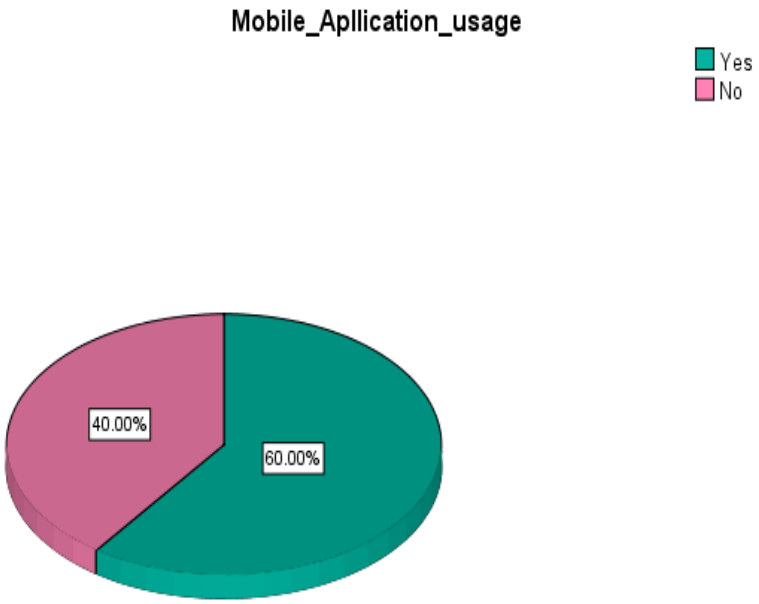


Figure 3: Smartphone usage

4.2.3 Users Experience in Managing Warehouse

The aim of the study was determining acceptance of the information and communication technology methods to enhance warehouse management. During the study it was revealed that 54% of the respondents prefer using information and communication technology tools to manage the warehouse, while 30% prefer using flat files, and 16% of the respondents prefer using paper-based methods to manage the warehouse. The Fig. 4 shows the acceptance of the warehouse management tools.

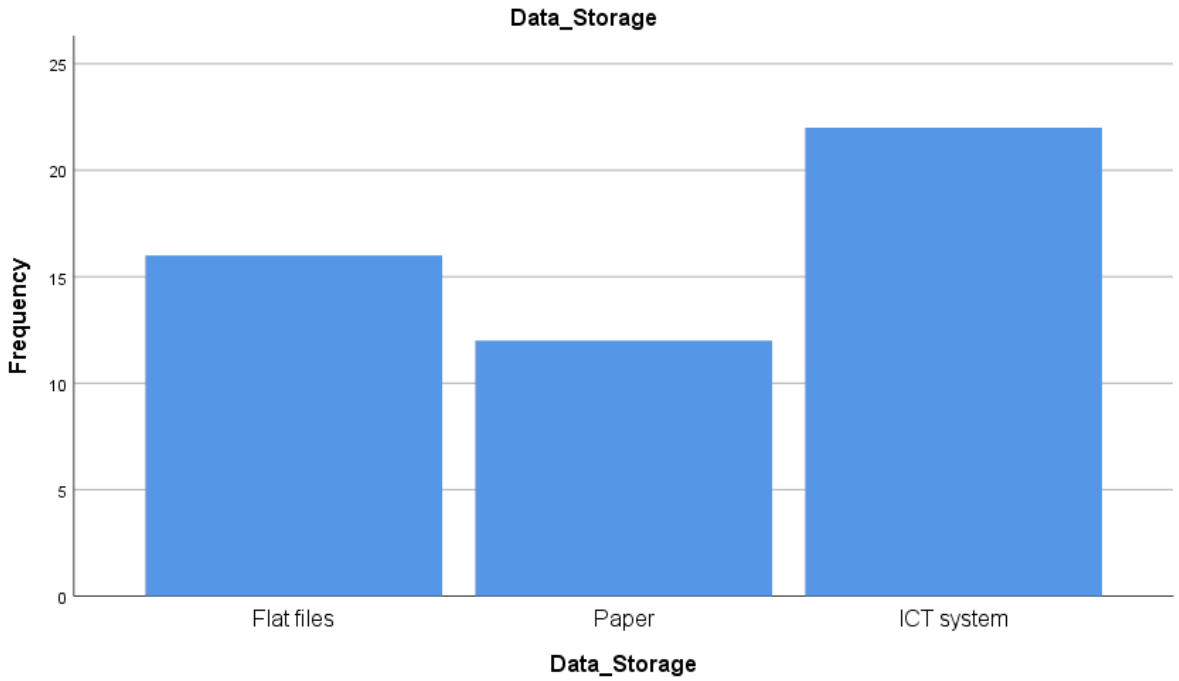


Figure 4: Warehouse management methods

4.2.4 Warehouse Management System Adoption

The aim of the study was to determine the willingness of the users to use the proposed system to manage order, issues and delivery of goods, stake management and invoice generation. During the study it was revealed that 40% of the respondents strongly agree, 54% agree, 6% disagree to use warehouse management system for performing their duties. Therefore, the study finds that 94% of the users agree to develop information technology that can solve the addressed challenges. The Fig. 5 shows the users willingness to use proposed system.

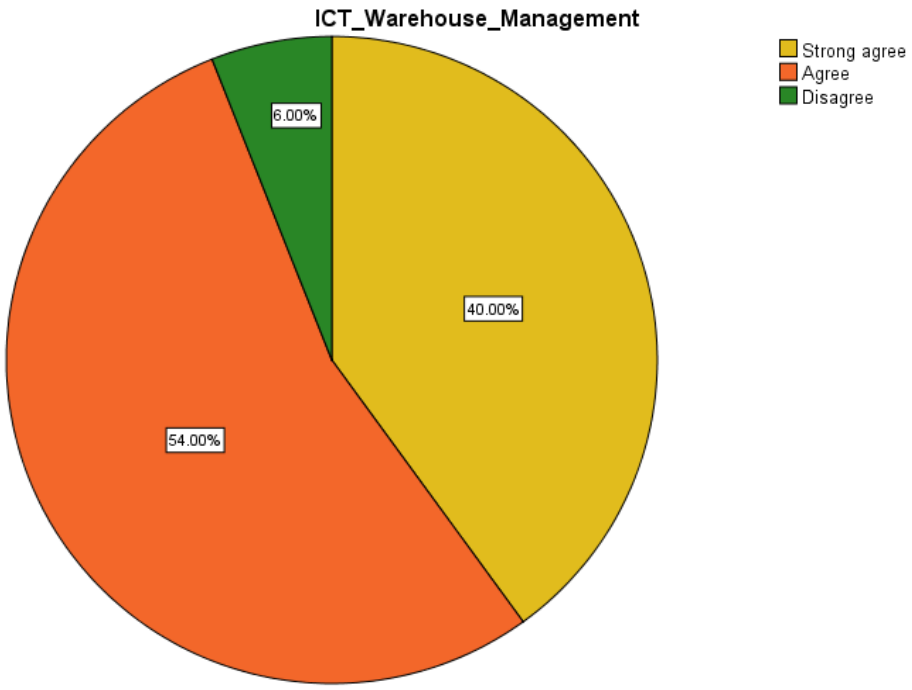


Figure 5: Warehouse adoption

4.2.5 Overview of the Existing System

The study conducted interviews and observations which assisted in examining how the warehouse activities are conducted at A-TO-Z Company. Currently the company has web-based system which needs enhancement of its services and availability. The company produce goods in different departments according to the types of goods, after the goods are manufactured are stored temporary at the production unit stores and later are being delivered to the main store waiting to be shipped to the intended customers.

However, the study discovered that at the main store some of the function like receiving items and delivering items are counted manually, but also the main store has limited number of computers which takes time to update the items in the system, normally the were counting the items manually and then update in the warehouse system, this it takes time to finish counting all items. These were because of lack of ICT system to be accessible at the whole warehouse.

In addition, the study found that the existing warehouse management system are not mobile optimized, and not responsive which cause the system to have low accessibility to mobile devices and tablets devices.

Therefore, the study, has shown the important of enhancing ICT system in order to solve these challenges to assist in warehouse operation including receiving and deliver of items, increase

availability of service at the whole warehouse through mobile application which can be available at the whole warehouse regardless location.

4.2.6 System Architecture

This section gives more details of the design of the warehouse management system presented by entity relationship diagram, use case diagram and database schema.

(i) Conceptual Design

Conceptual design shows system elements. The study finding showed that there are problems related to accessibility of the warehouse management system on smartphone devices due to small screen size of the devices, problem of updating information which is done manually. Therefore, in order to solve the problems, the study made integrated mobile and web application for warehouse management system.

Mobile Application

The application is used for customer registration, order generation, order tracking and stock management, it shows the balance of items which are available so it helps in decision making and increase customer satisfaction by producing availability of service 24 hours.

Web Application

The web application is used by customer for registration, order generation, order tracking. It is used by sales personnel to generate invoice and approve order and by storekeeper to record the receipt of goods and delivery of items. Store manager uses the application to manage stock and report generation and by administrator to manage users of the system including adding users and block the users from the system. The system architecture is indicated in the Fig. 6.

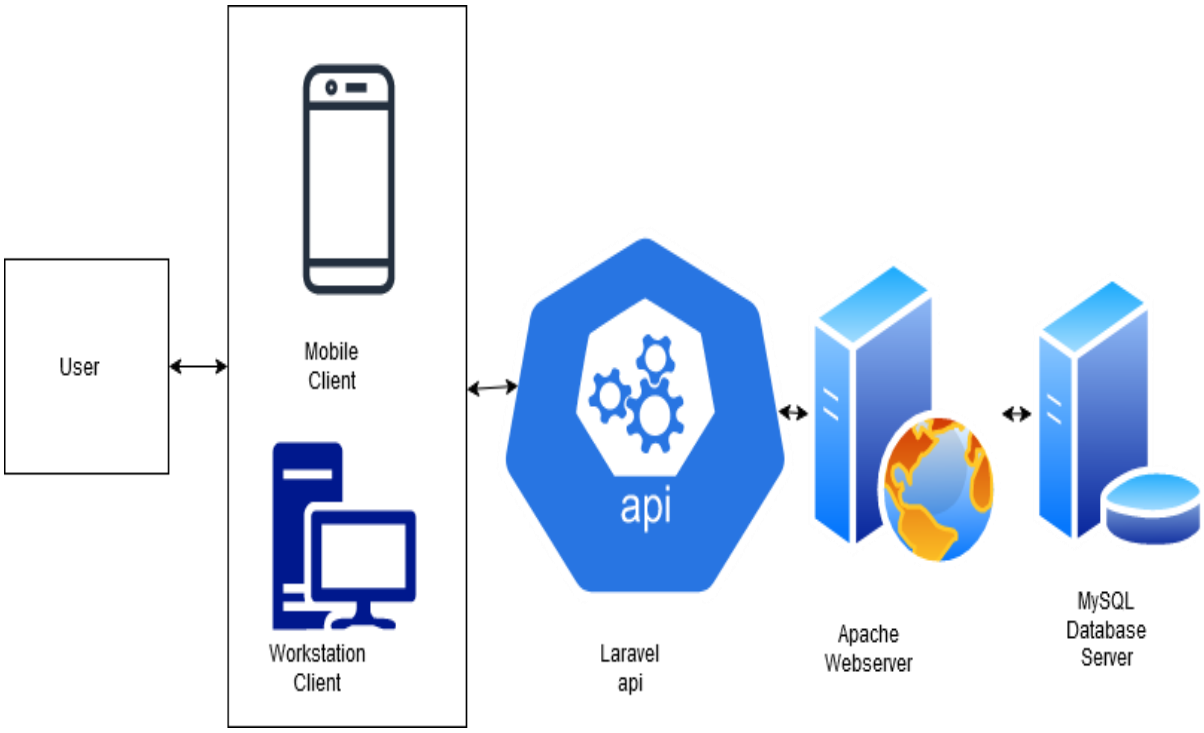


Figure 6: System architecture

(ii) Use Case Diagram

This study used Unified Modelling Language (UML) for designing the diagram of the proposed mobile warehouse management application. In software engineering, UML is a modeling language for visualizing the system architecture (Ahmad *et al*., 2019). It was developed by the Object management Group.

Use case diagram is the diagram which shows the interaction of users and the system using use cases, use cases is the action performed by a user in the system, and the actions performed by a user is known as use cases (Tiwari & Gupta, 2020). Actors are the system users. In this study there are three actors who will interact with the system to perform different roles. The actors who will interact with the mobile and web-based warehouse management application are:

(a) Sales personnel

(b) Storekeeper

(c) Store manager

(d) Administrator

Figure 7 indicates the Use Case Diagram and Table 3 the description of the duties performed by the actors for the Warehouse System.

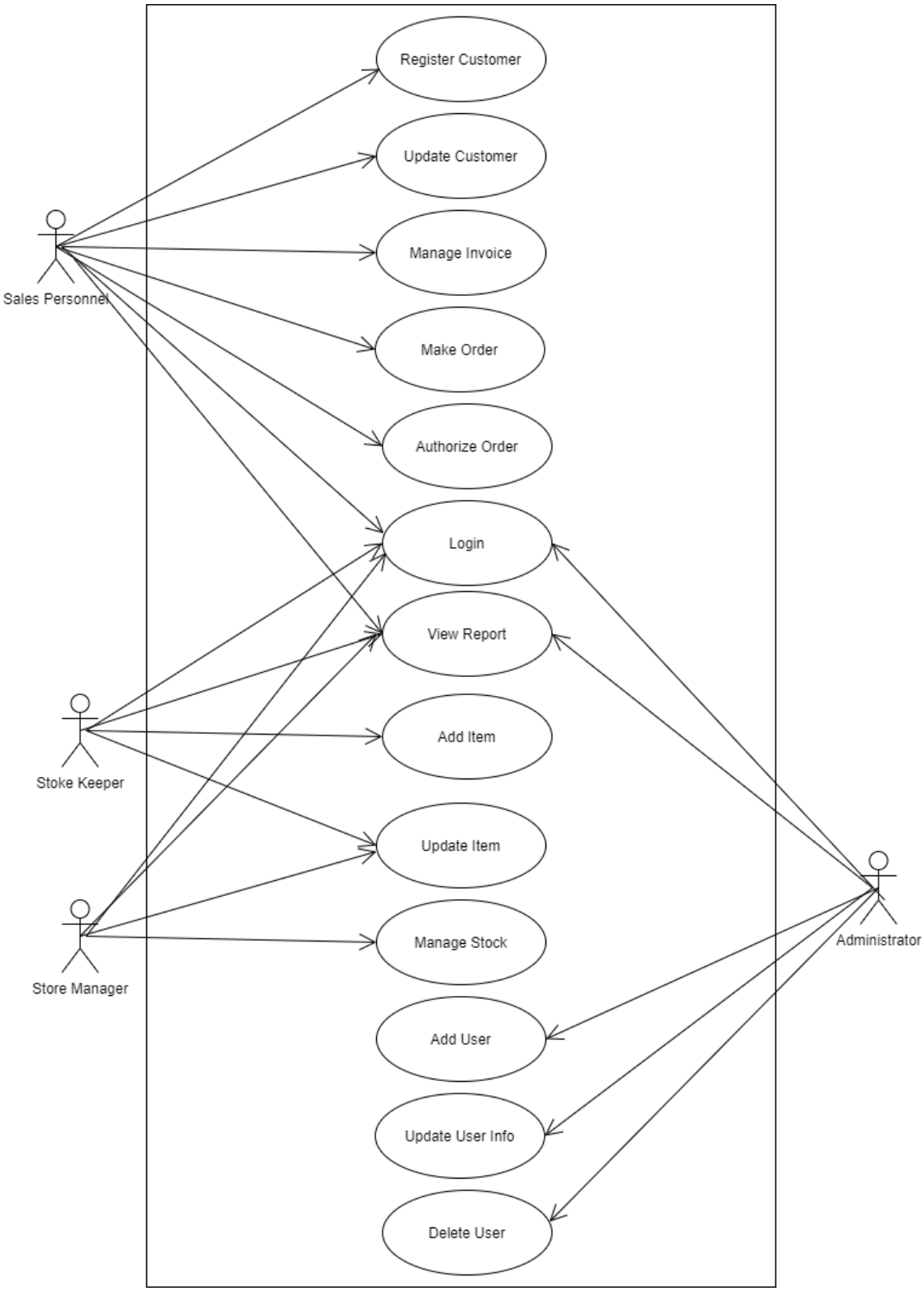


Figure 7: Use case diagram

Table 3: Description of warehouse use case

Use case	Requirement description
Login	Personnel like storekeeper, store manager and sales personnel are required to login in the system to perform their duties
Register Customer	Sales Personnel should be able to perform custom registration
Update Customer	Sales Personnel should be able to update customer
Manager Invoice	Sales Personnel should be able to make invoice, update invoice and delete invoice
Make Order	Sales Personnel should be able to make an order for a customer
Add Item	Store Keeper should be able to add item in the system
Update Item	Store Keeper and Store Manager should be able to update item in the system
Manage Stock	Store Manager should be able to manage stock
Add User	New users of the system should be added to the system by administrator only.
Delete User	Deletion of system users can only be done by administrator.
Update User	Only the administrator of the system has a mandate to update system user's information.

(iii) Class Diagram

The diagram for describing system structure (Kambow, 2012). Class diagram helps in better understanding of general overview of the application, data model could be presented using the class diagram for gaining more information of the system, assist in drawing detailed charts

which shows the code to be programmed. The Fig. 8 indicate the class diagram of the proposed solution.

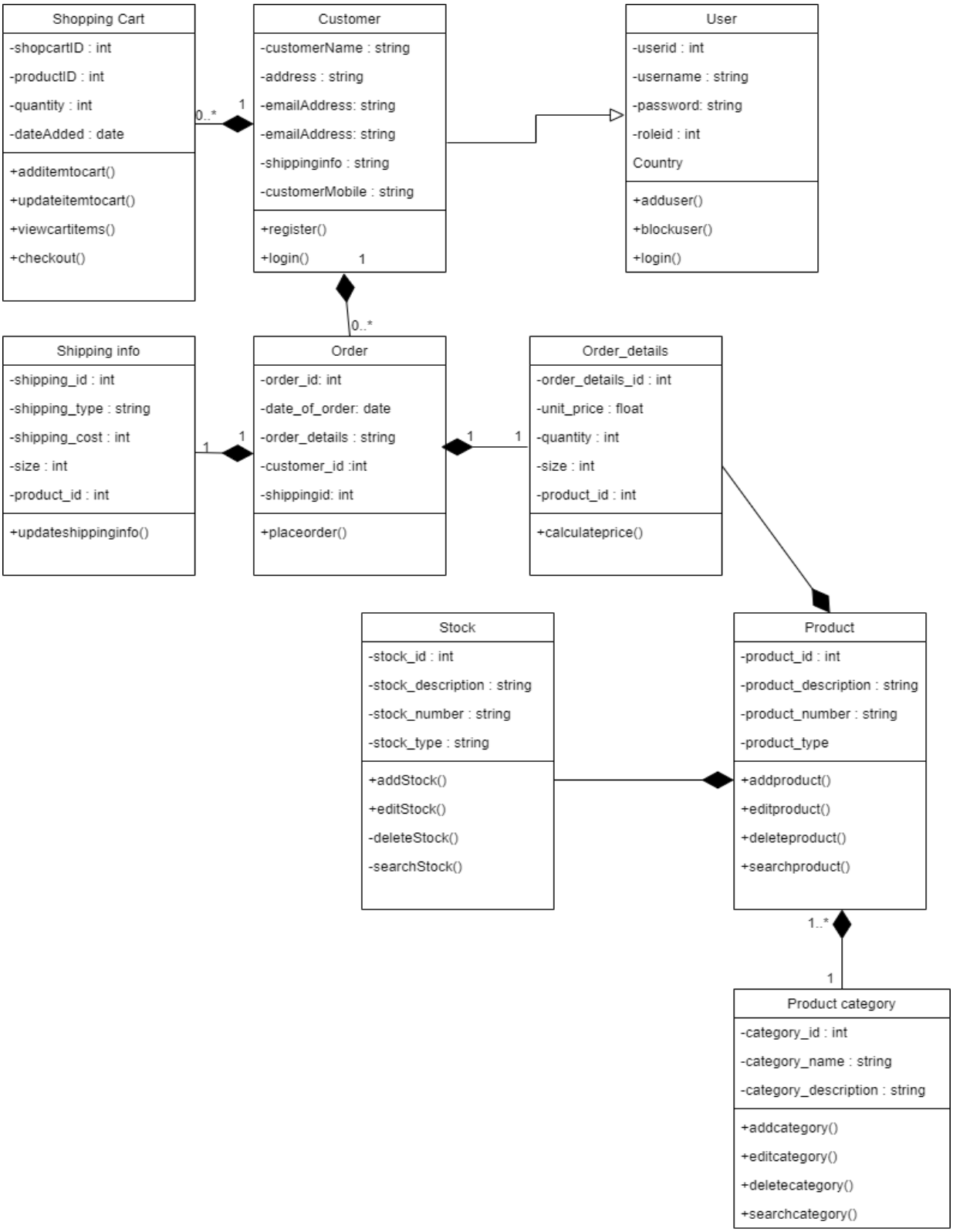


Figure 8: Warehouse class diagram

(iv) Database Schema

This is the roadmap structure which presents the logical presentation of the database which shows the object in the database. It shows the relationship of the database entities such as tables, views and stored procedures (Luković *et al*., 2007). Database schema advantages are: application of security permission on database objects based on user access permissions and sharing of single schema among many users. The Fig. 9 presents the database schema of the developed solution.

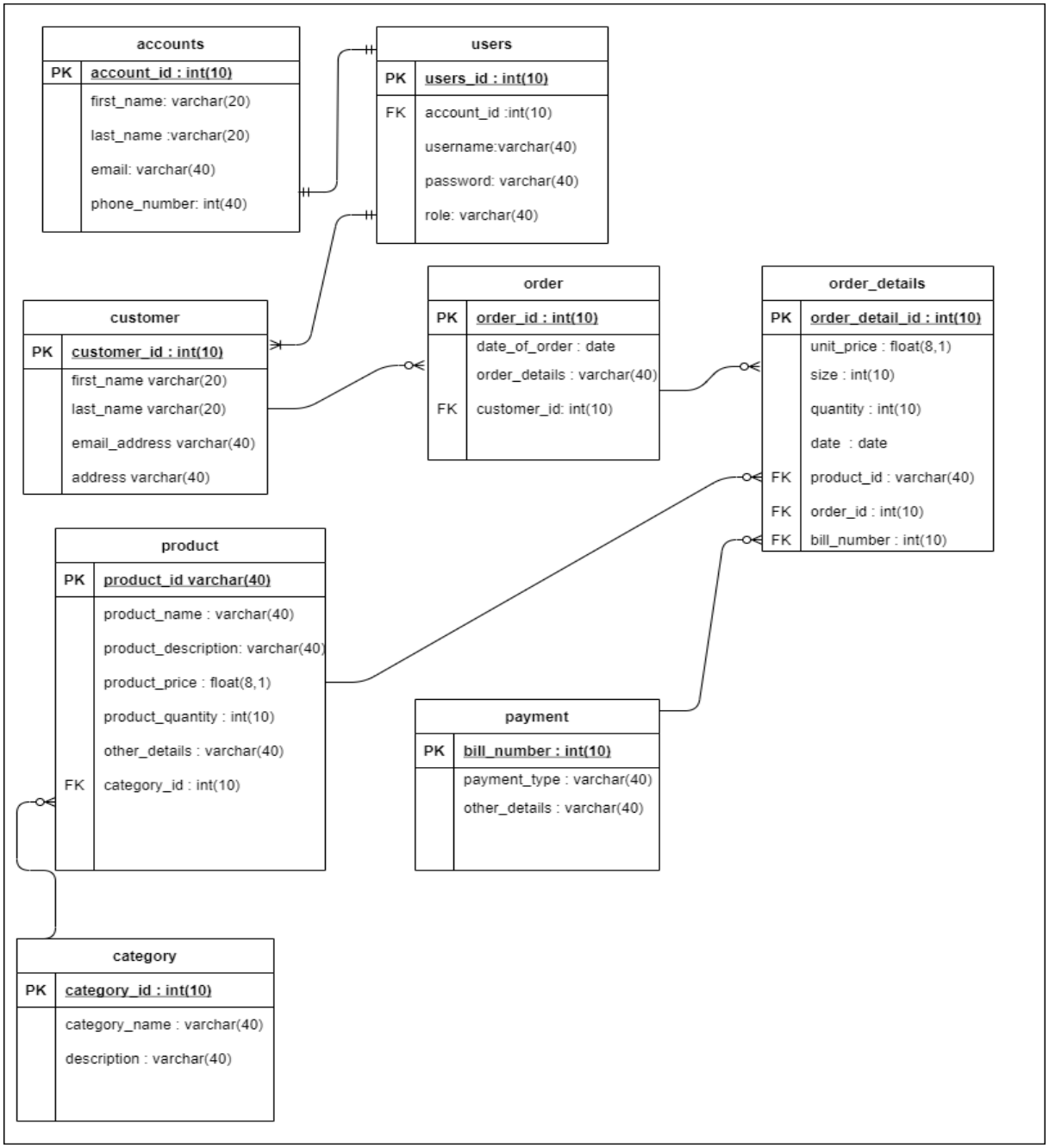


Figure 9: Database schema

(v) Entity Relationship Diagram (ERD)

The graphical presentation diagram which shows the logical structure of the database and contains collection of entities and their relationship between these entities (Cagiltay *et al*., 2013). Entity relationship diagram shows how the tables of the database should be related and which field to be for each table. It can be used as blueprint for data implementation, it helps the database designer to have better understanding of the information to be put in the database. Entity relationship diagram helps the database designer to show entities, attributes and its relationship. Figure 10 indicated the entity relationship diagram for the developed solution.

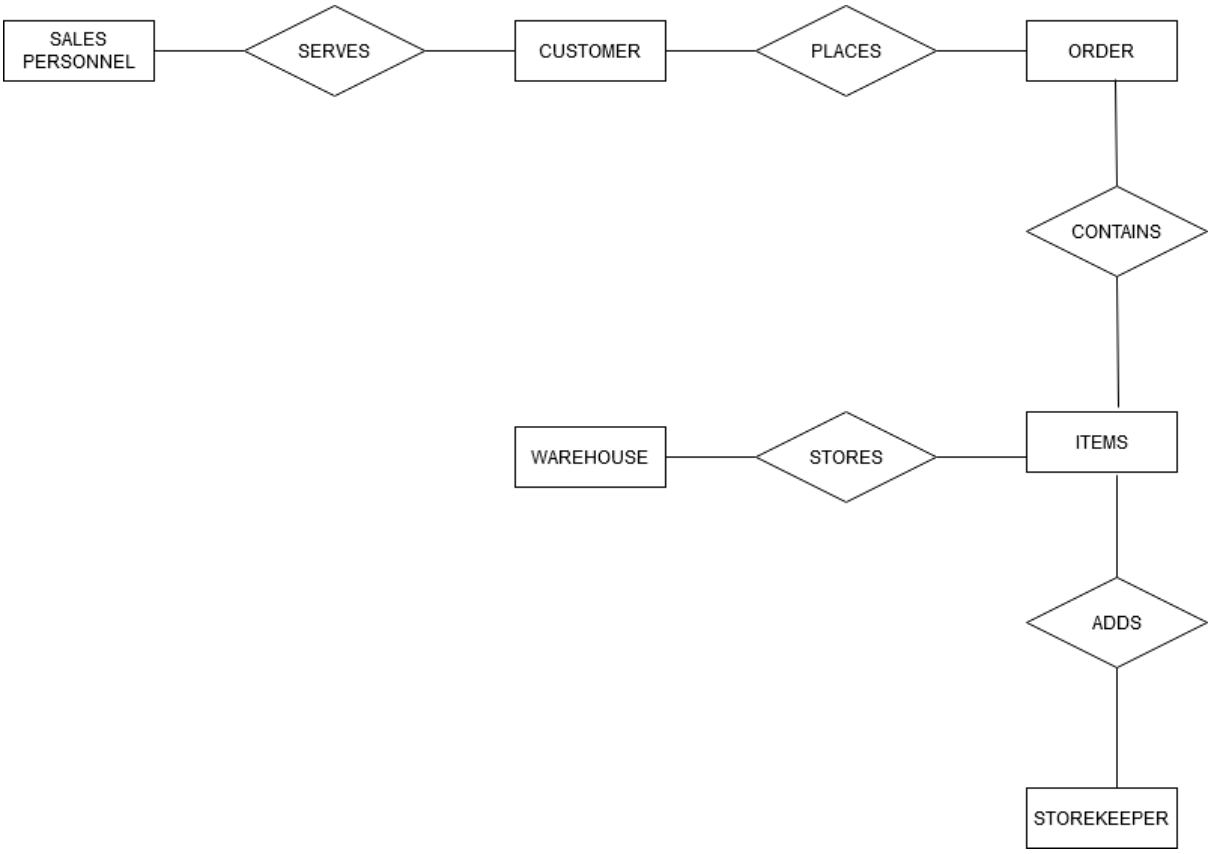


Figure 10: Entity relationship diagram

(vi) Context Diagram

The diagram which shows the boundaries of the software system with external entities, but also shows the flow of information with other external systems (Cagiltay *et al*., 2013). In this study context diagram of warehouse system has interaction with procurement system, finance system, sales system and production system as presented in the Fig. 11.

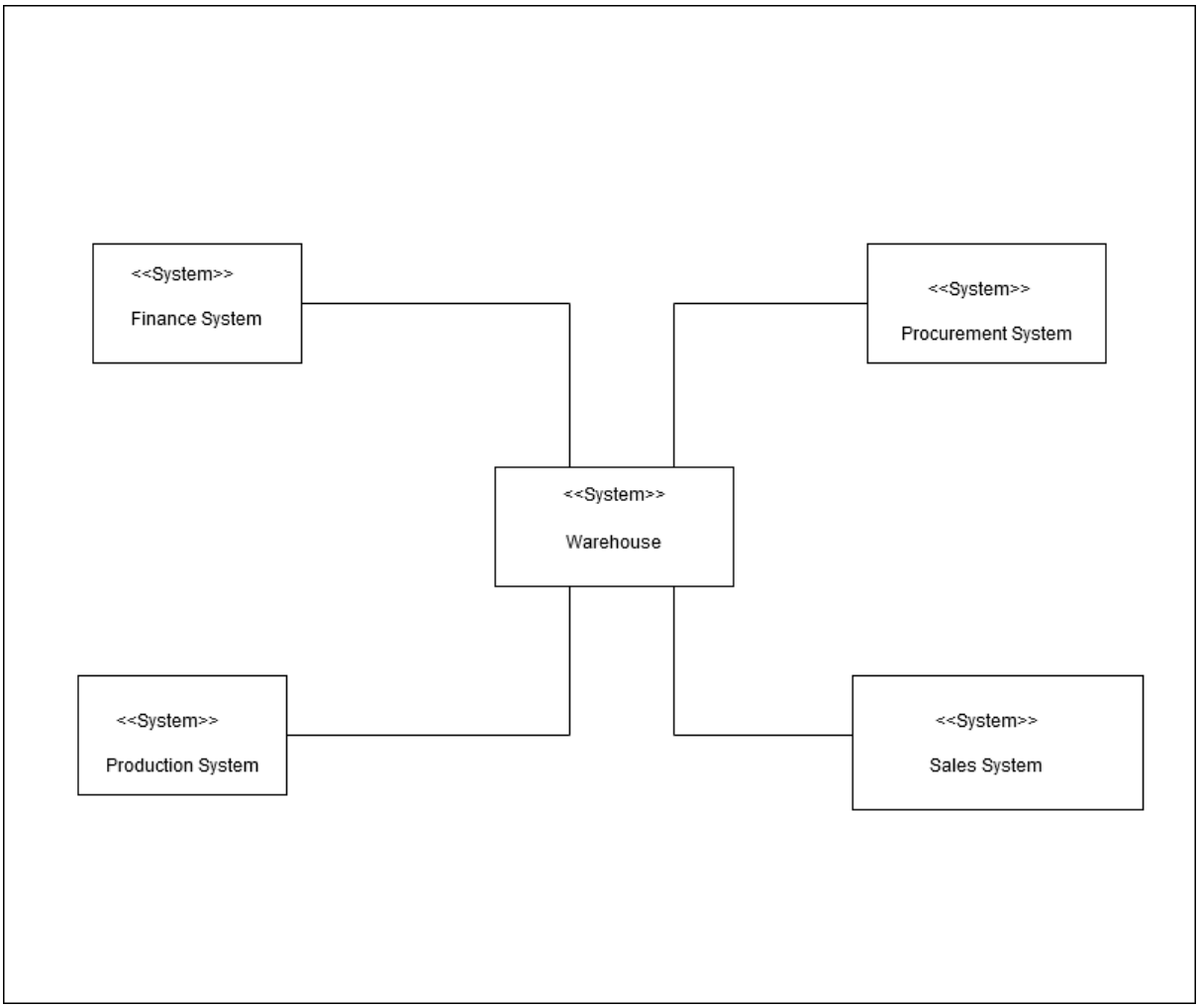


Figure 11: Context diagram

(vii) Warehouse Management Process

Warehouse management processes are the total activities done from first stage of receiving the goods to final stage of shipping the products to the customer. The processes include receiving goods from manufacturing units or from supplier, inspection of goods, put away, stock, delivery of order, picking, packing, inspection and shipping. Figure 12 shows the whole process in sequential order.

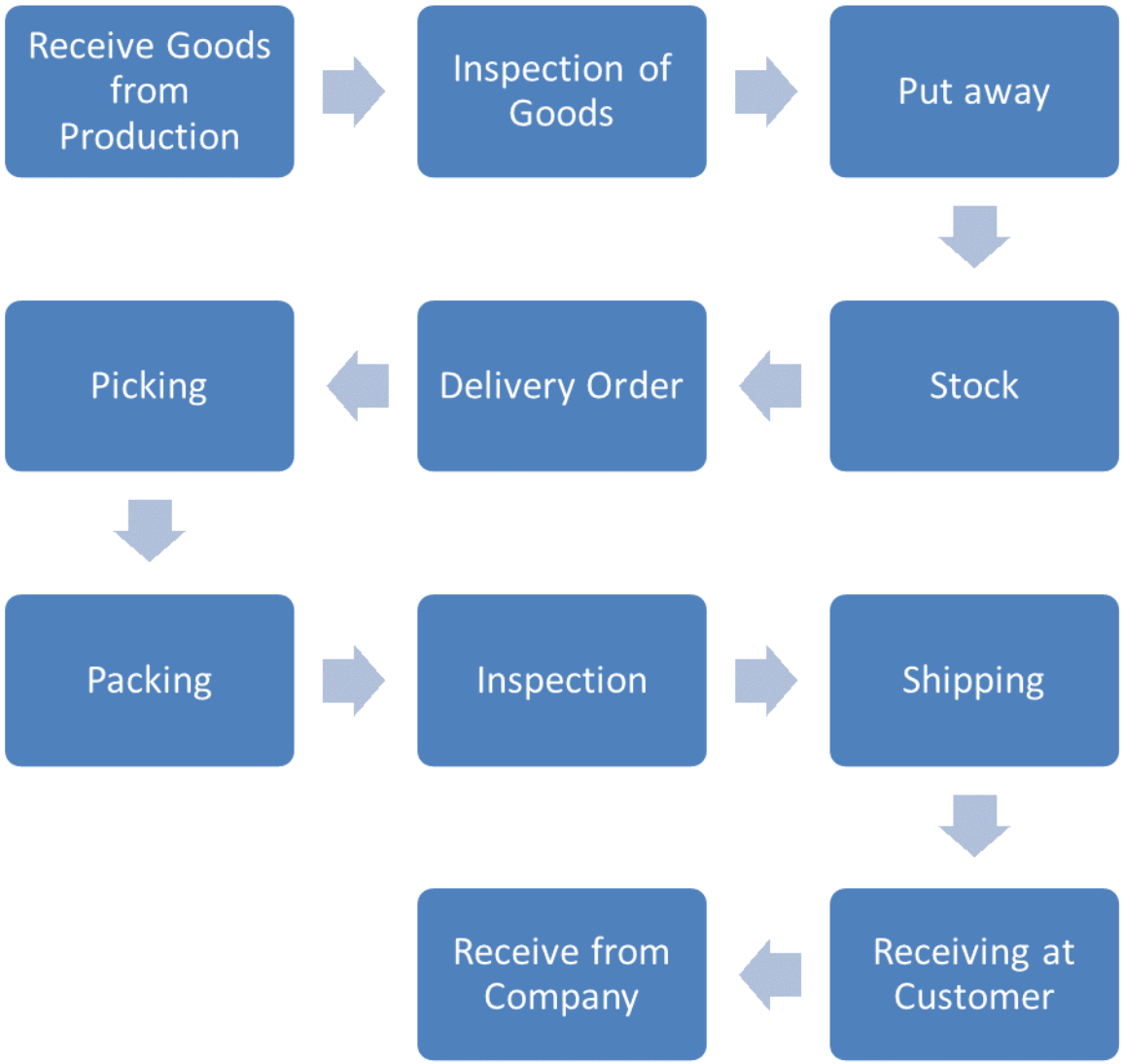


Figure 12: Warehouse management process

4.3 Results and Discussion for the Developed Applications

4.3.1 Developed Mobile Application

The built warehouse management system facilitates client registration, allow customer to make order online, cancel order before approval, order tracking, checking stock level of the items, and delivery of the items. The mobile application communicates with remote database to synchronize. The warehouse mobile application has two parts for client registration and order tracking, but also for store manager can use the application to check stock level. The Fig. 13 presents the login page and splash screen of the mobile warehouse management system.

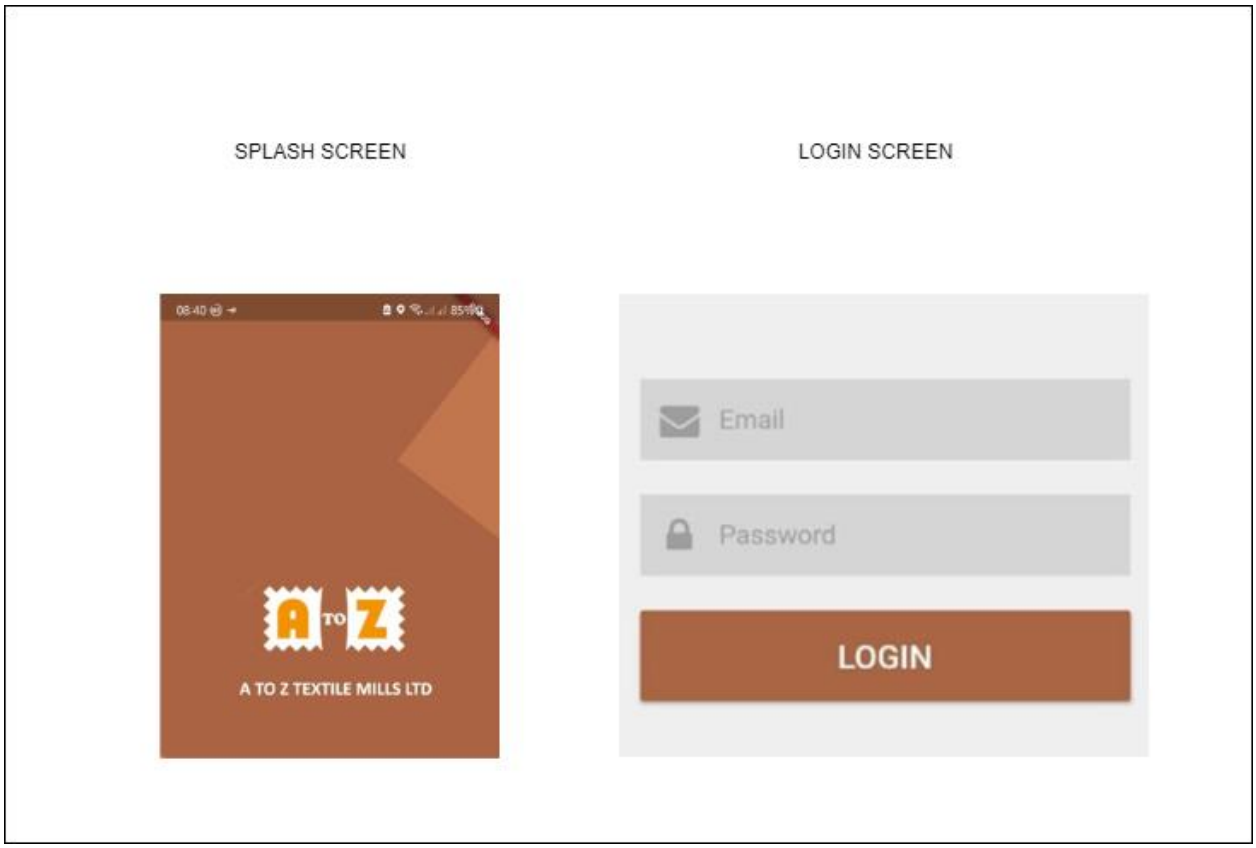


Figure 13: Splash and login screen

(i) Customer Home Page

The Fig. 14 shows the order status screen page, order requisition page for the client, for the order status such as completed it shows the total number of orders which has been approved, pending shows the total number of orders which has not been approved but in progress, cancelled shows the total number of orders which has been cancelled by the client or by the sales personnel. The option for making order where customer can choose from the provided products and make order, and recent order shows just made order.

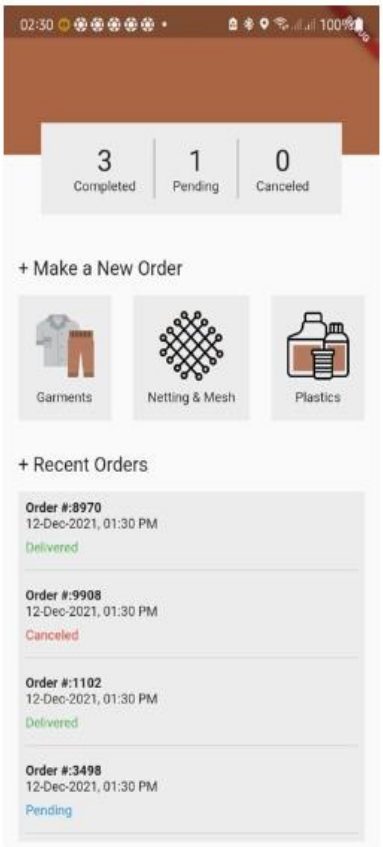
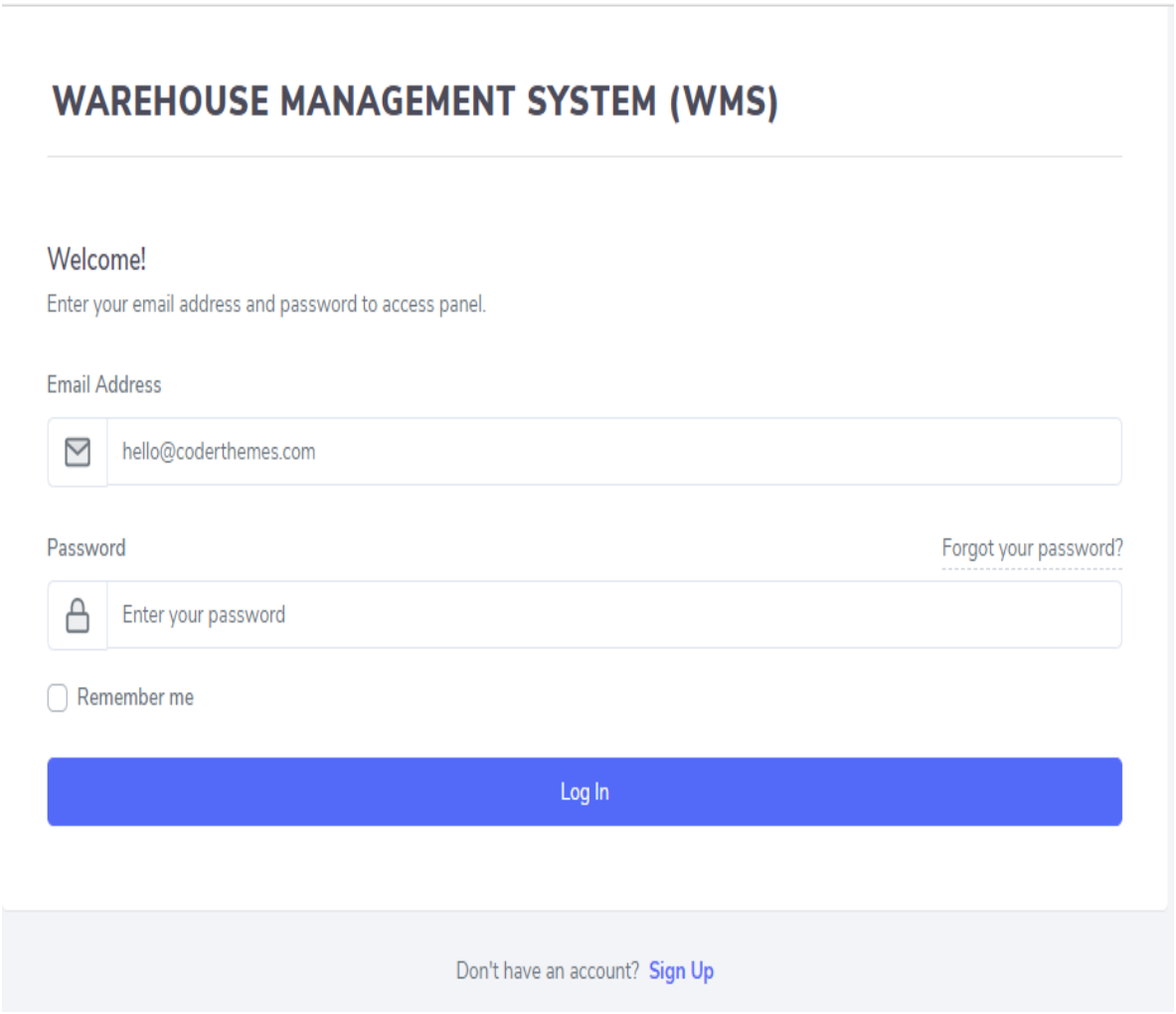


Figure 14: Customer order status

4.3.2 Developed Web Application

The developed web warehouse management system has several features to enhance storage, stock management, customer registration, order management, invoice generation, account

management and store management. The process starts from customer registration, then login page which enables customer, administrator, sales personnel and store keeper to manage, add,



update and delete contents according to the roles. The Fig. 15 shows the login page for the warehouse management system.

Figure 15: Login page

(i) Administration Page

This page enables administrator of the web application to manage the system, the duties of the administrator including managing account like adding account to the system, deactivate account, warehouse management like adding warehouse to the system, adding items category to the main master table, and linking warehouse with items category. The Fig. 16 shows the role of administrator for adding category of products into the warehouse web-based system.

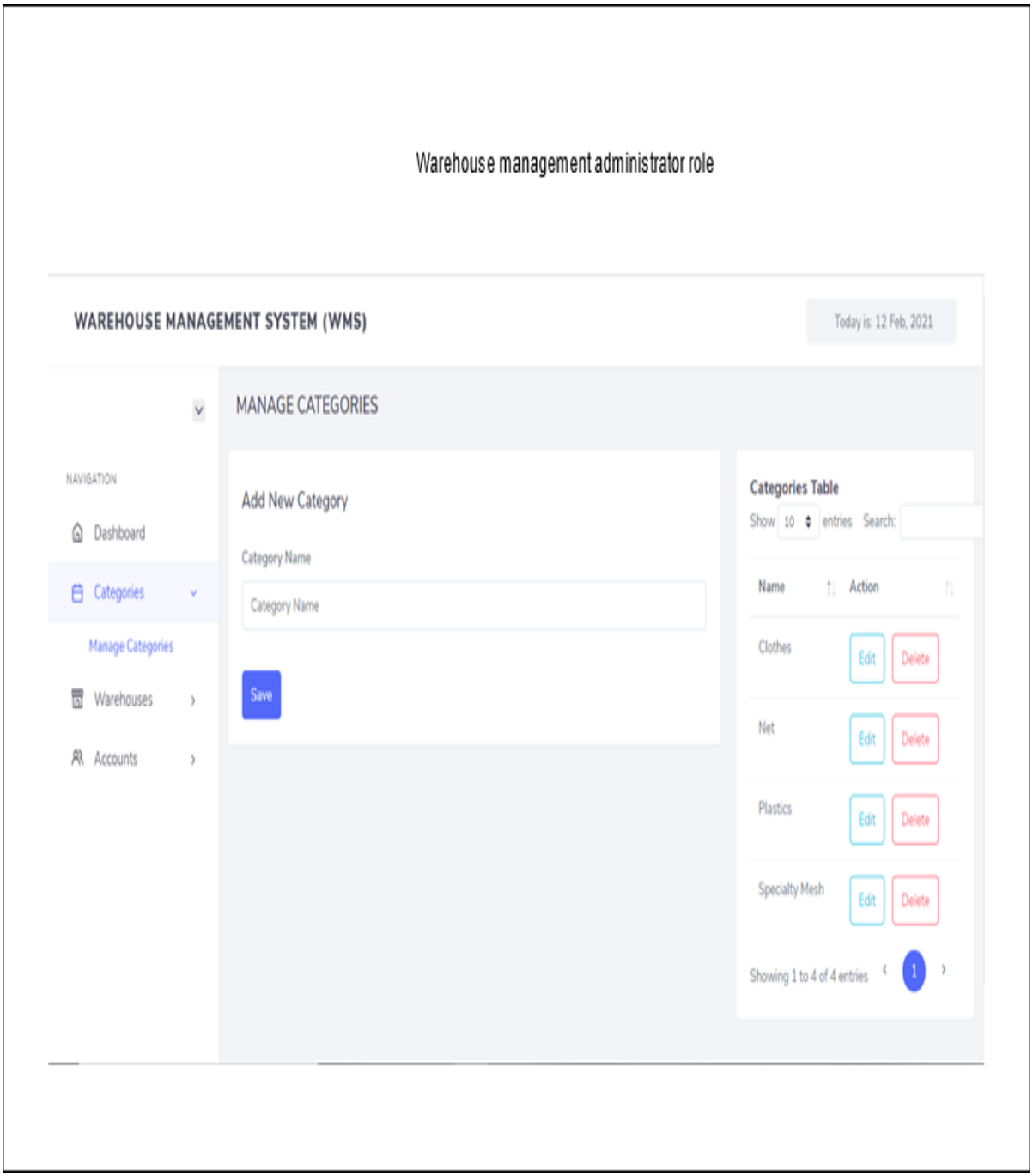


Figure 16: Warehouse manage category

The administrator has a role of adding warehouse and linking the warehouse with the type of products the warehouse belongs, the Fig. 17 shows the warehouse category linkage but also how to add users to the system.

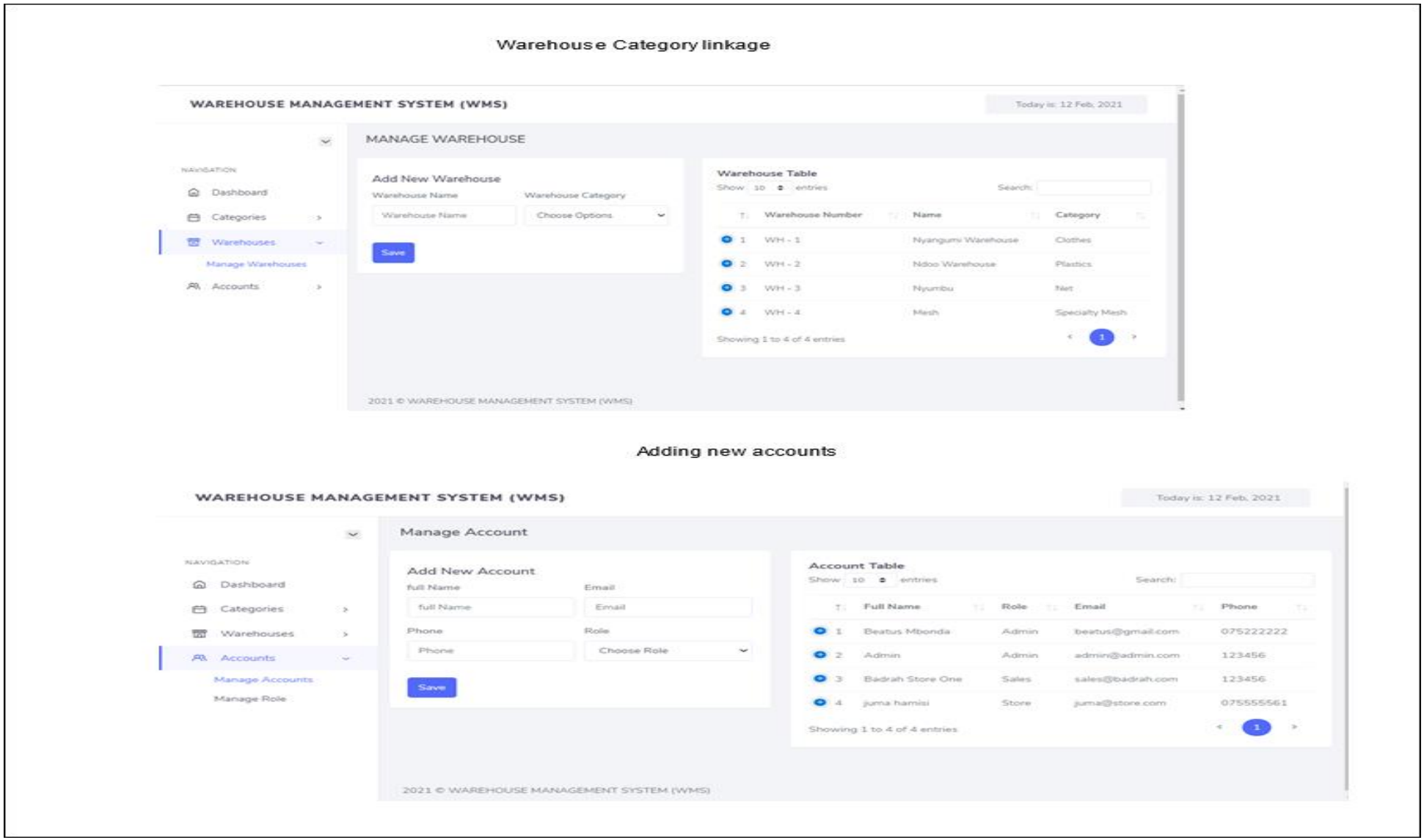


Figure 17: Warehouse option

(ii) Customer

The client first needs to be registered in the system through the registration page by entering information like email address, full name, address, phone number and password. When information is completed to be filled in the form then is submitted for registration. The client information like email address and password can be used to login in the login page. The Fig. 18 shows the registration page for the customer.

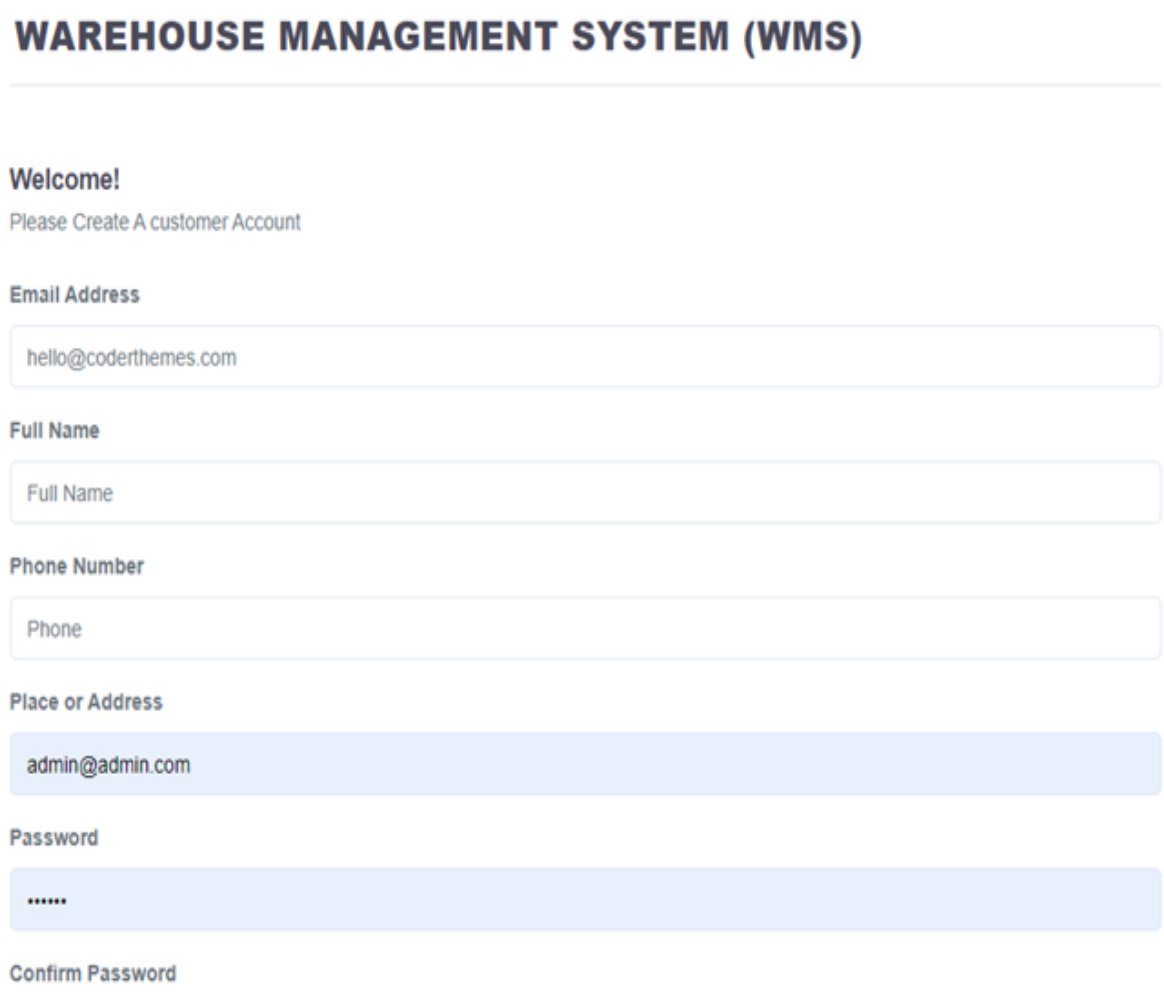


Figure 18 : Client registration page

(iii) Customer Home Page

When client is registered and login to the home page, the page enables the customer to make order, track orders and check status of orders. The customer selects in the items and add to cart, after that initial the order process also the customer can log out and change password from the home page. The Fig. 19 shows how the home page of the client looks.

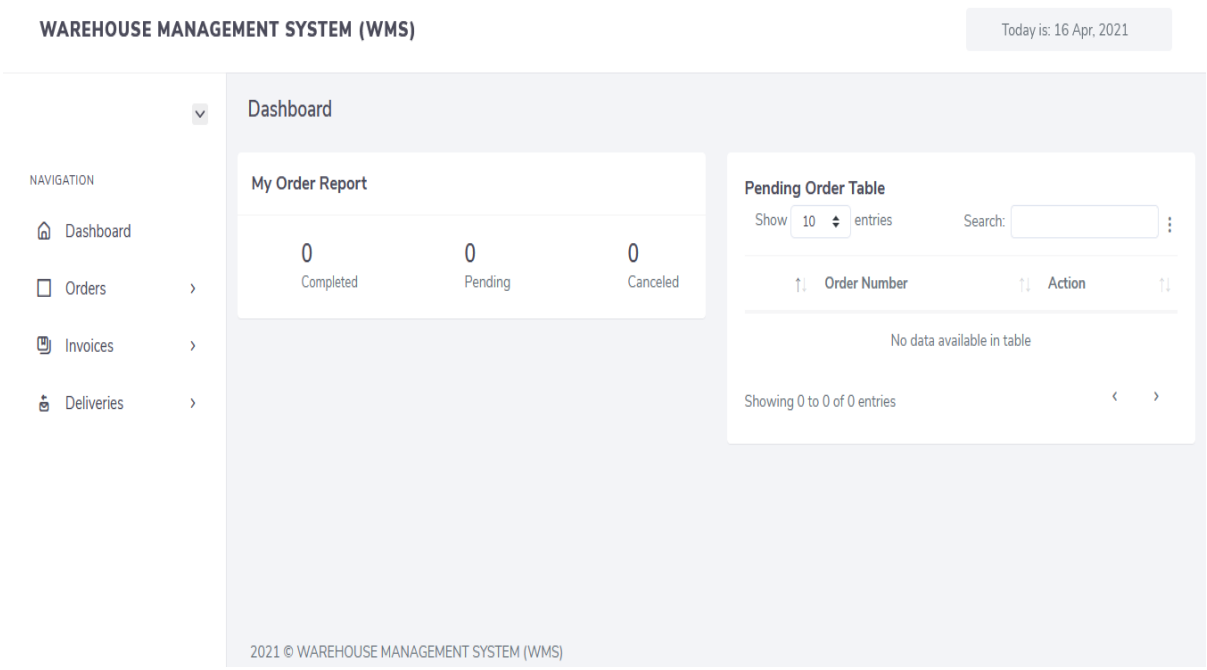


Figure 19: Customer home page

(iv) Sales

The sales home page enables the sales personnel to manage order, can confirm order from customer and generate invoice and send it to the customer for approval or rejection, if the customer accept the invoice and pays the bills as indicated in the invoice, the next stage the sales personnel check if stocks is enough in the main store, then forwards the order to the main store to deliver the goods to the intended customer, otherwise the request is sent to the production unit for production. The page also allows sales personnel to change the account password and log out. The Fig. 20 shows the sales home page.

Sales home page

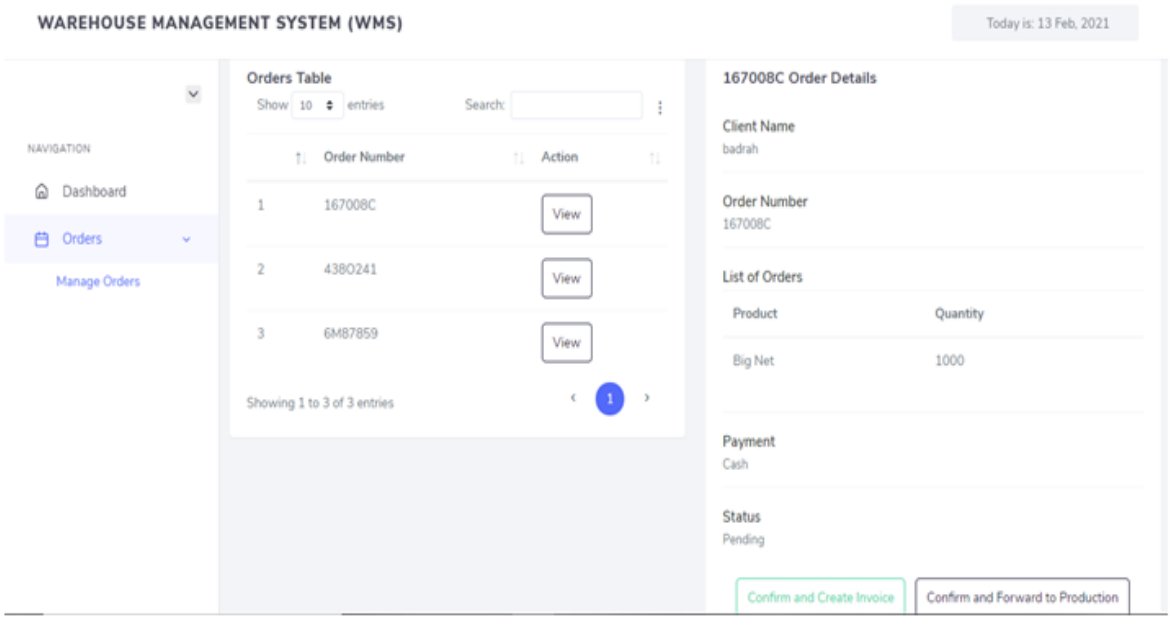
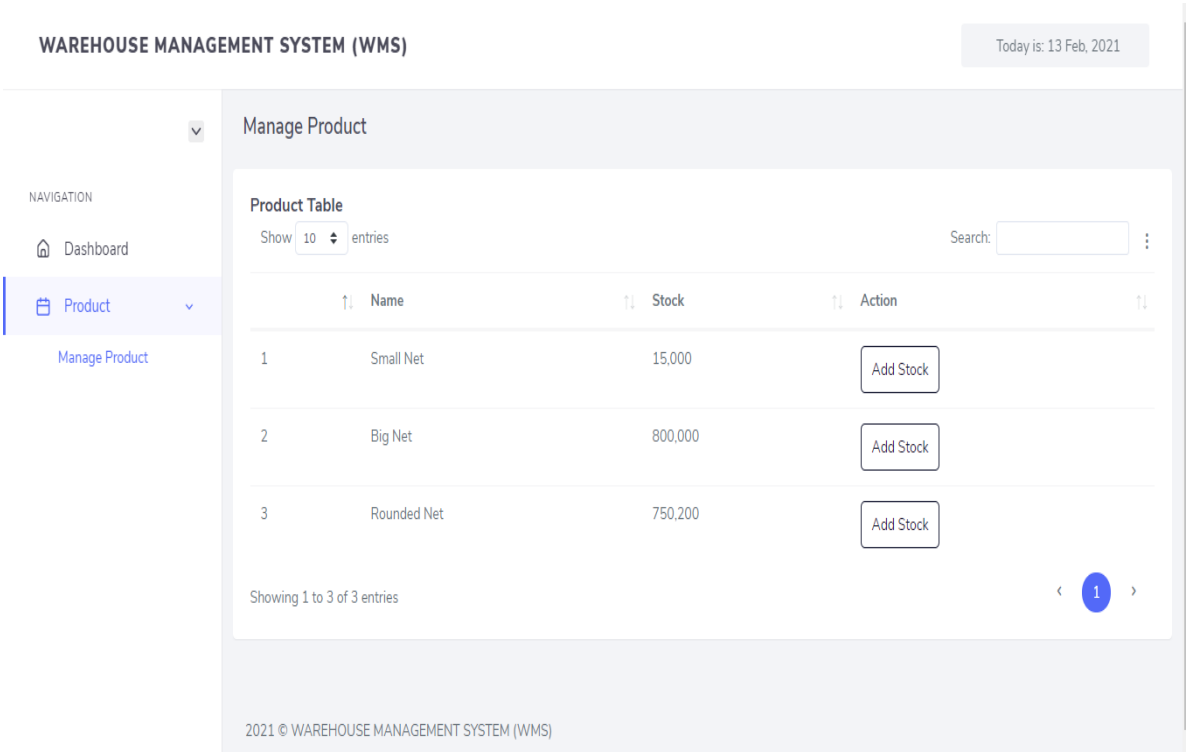


Figure 20: Sales home page

(v) Store

The main function of store is to receive goods from production unit, and this store is the part of the production unit, the store can be classified according to the category of products. The



store

Figure 21: Store home page

update stock and deliver the items to the main store. The page allows the store personnel to change account password and log out. The Fig. 21 shows the home page of the store in production unit.

(vi) Main Store

The function of the main store to receive items from the min store and deliver the items to the customer according to the order forwarded by sales personnel, the home page allows the staff to manage their account and log out. The Fig. 22 shows how the main store home page looks like.

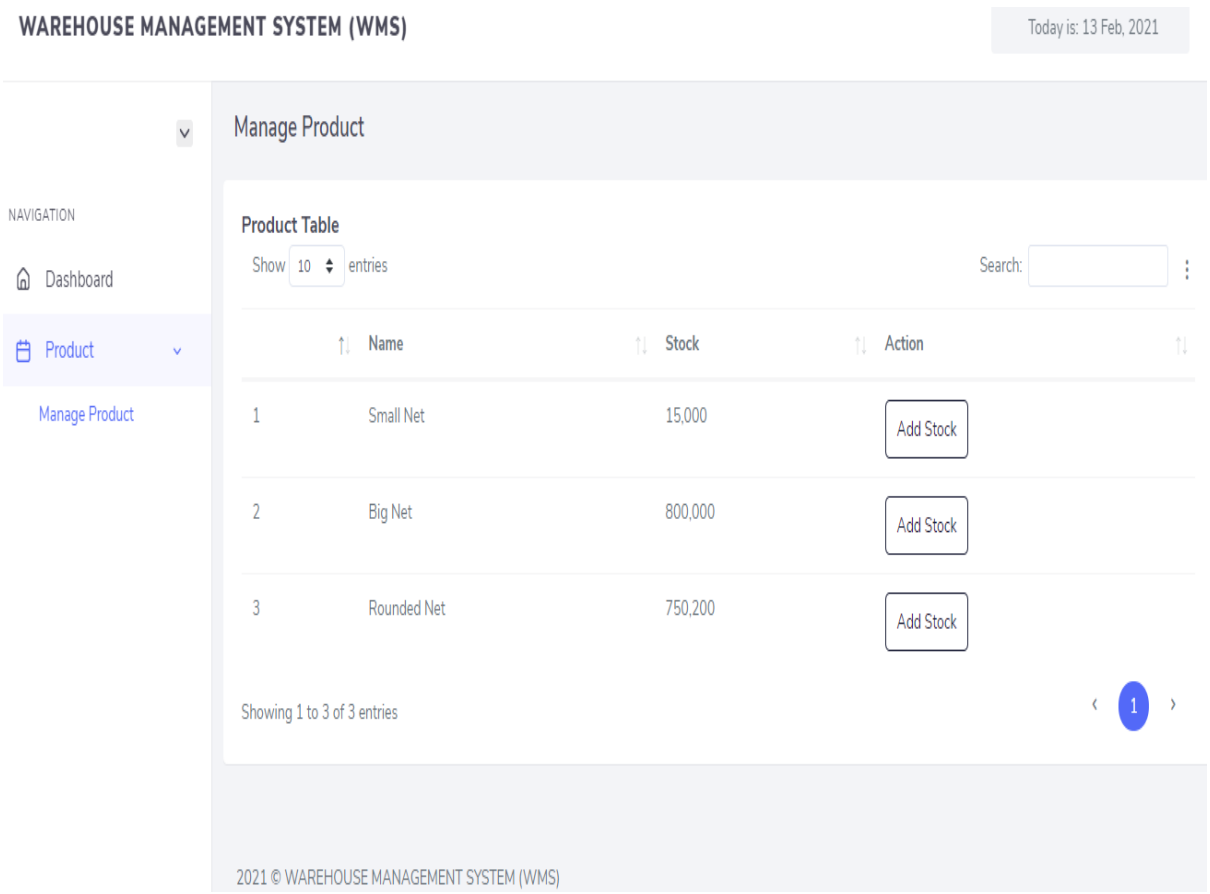
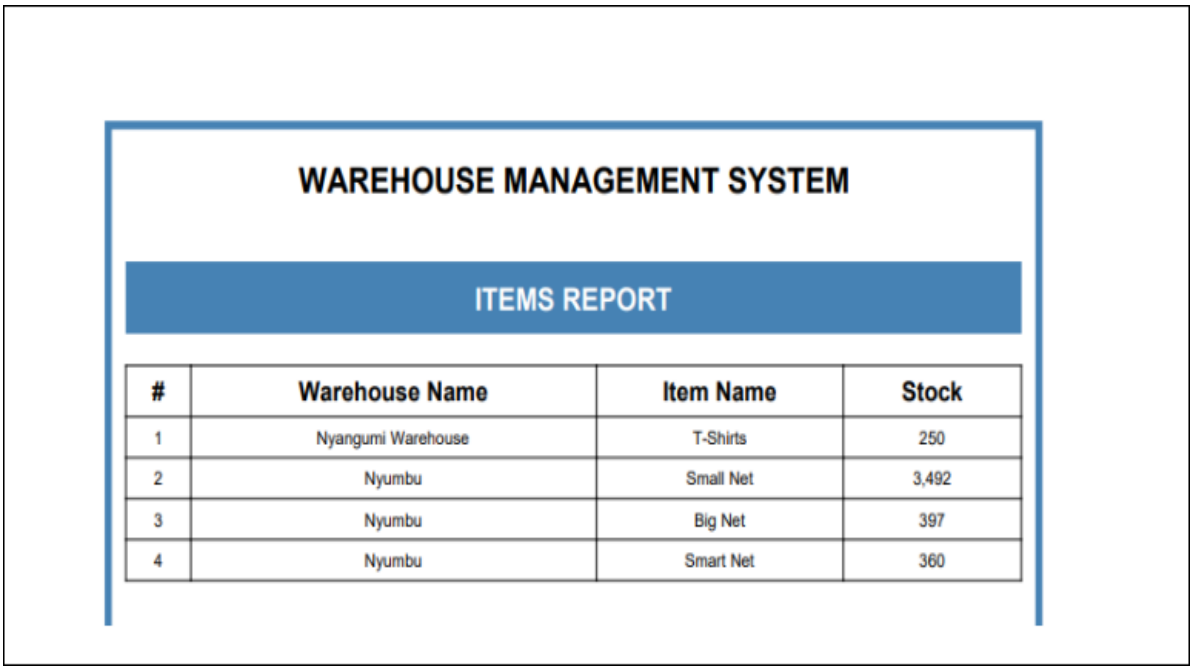


Figure 22: Main store homepage

(vii) Report

The system has reports for sales module, production module and main store module. The Fig. 23 shows the sample report for main store module.



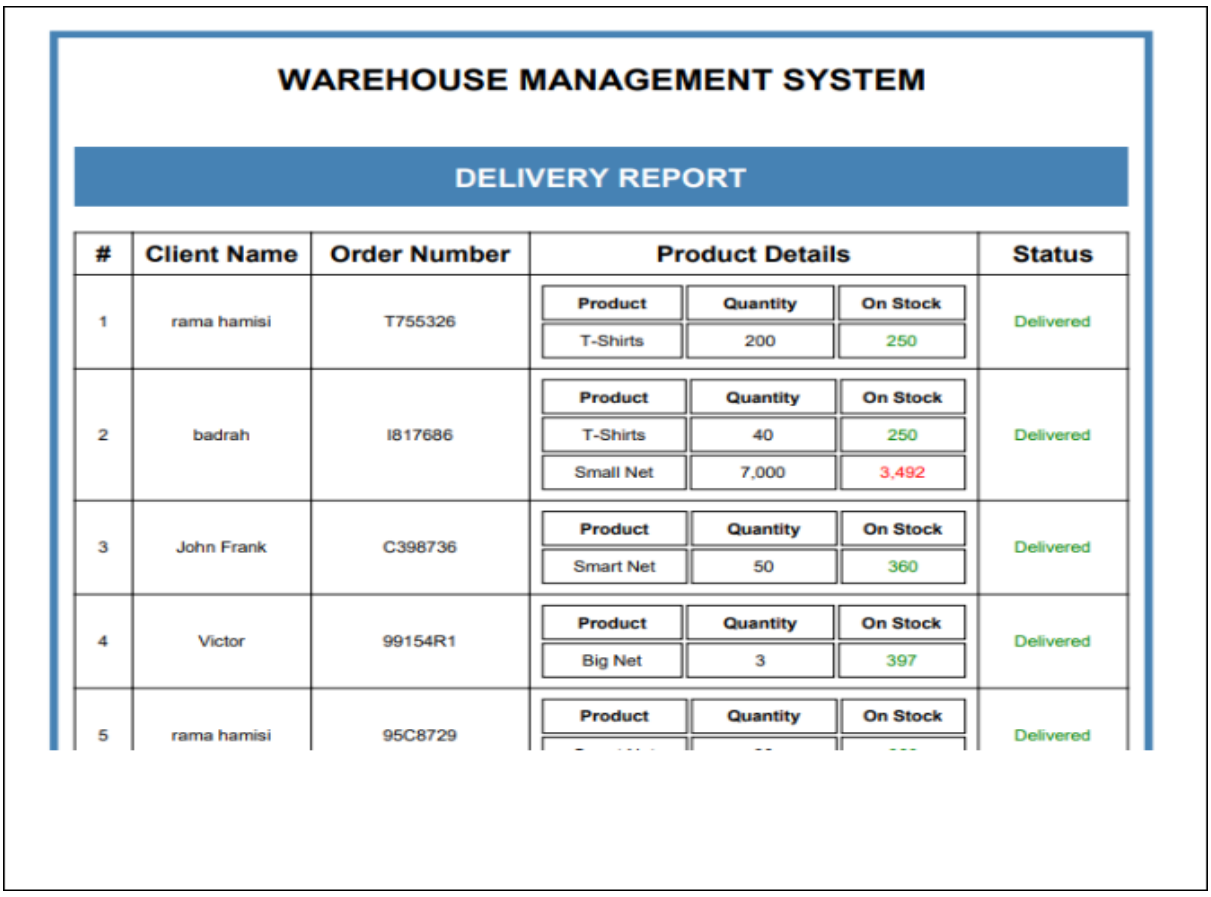
WAREHOUSE MANAGEMENT SYSTEM

ITEMS REPORT

#	Warehouse Name	Item Name	Stock
1	Nyangumi Warehouse	T-Shirts	250
2	Nyumbu	Small Net	3,492
3	Nyumbu	Big Net	397
4	Nyumbu	Smart Net	360

Figure 23: Items report

The Fig. 24 presents the delivery items report.



WAREHOUSE MANAGEMENT SYSTEM

DELIVERY REPORT

#	Client Name	Order Number	Product Details	Status
1	rama hamisi	T755326	Product: T-Shirts; Quantity: 200; On Stock: 250	Delivered
2	badrah	I817686	Product: T-Shirts; Quantity: 40; On Stock: 250 Product: Small Net; Quantity: 7,000; On Stock: 3,492	Delivered
3	John Frank	C398736	Product: Smart Net; Quantity: 50; On Stock: 360	Delivered
4	Victor	99154R1	Product: Big Net; Quantity: 3; On Stock: 397	Delivered
5	rama hamisi	95C8729	Product; Quantity; On Stock	Delivered

Figure 24: Delivered report

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The consequences of not using information technology in managing warehouse results in loss of customers to competitors, overstocking, failure to forecast demand and track trends of the selling products, delay in shipping of goods and delivery of items to the customers, poor decision making because of lacking of reports and statistics for making smart decision, low employee productivity due to staffs doing task that can be easily handled by the warehouse management, time consuming for managing and increased cost due to lack of knowledge which items are demanding more than other items according to the time.

Warehouse management is important for the health of the company, it is used in the supply chain of productions from the point materials reach the company to the end point of delivery of the final products to the intended customer. But also It help to have updated information, information gathering for goods at one point, stock level management to know the amount of available goods at any time is important for decision making, can be integrated with external application like finance system, sales system and procurement system, satisfy customer needs through online service and availability of service for 24 hours per day, reduce operating cost for the company, can be used forecasting and planning for smart decision by the management.

This study explains in details the complete process of managing warehouse. For instance, the study reviewed warehouse activities done at A-TO-Z Company in order to know how the warehouse management activities are being done. The study was done at A-TO-Z Company situated at Kisongo area, Arusha Region.

The developed warehouse mobile based application was able to help customer in registration, customer to make order online, track order, customer to receive invoices for the payment of the goods requested and attach receipt for the payment done for the that particular order made, but also the mobile application was able to help storekeeper in managing stock, and make delivery and shipment of goods to the intended customer according to the order made.

The developed web based application of the warehouse management system was able to help in administration of the system for instance managing account, assign users to departments, manage categories of the products, manage warehouse and link the warehouse to the products

being produced, customer registration, customer order management, order tracking, invoice management, stock management for store personnel, create invoice for customer by sales personnel, alert messages when order and delivery are being proved, messages are sent to the customer through the phone informing the about the status of the order, also the delivery informing that the delivery are ready are being shipped.

The application of both mobile and web-based application of warehouse management system for are for reducing cost, time consumed during data entered manually, therefore increase company productivity.

5.2 Recommendations

This study recommends that Companies and institution should utilize information and communication technology in their activity to enhance productivity. The study can be extended by adding more modules in the web-based application and mobile based application. The application of Radio frequency identification should be considered for future release to track the movement of goods.

For future release the application should be integrated with payments gateway to enable customer to pay through online using mobile money services and electronic banking. Low-cost alert messages should be considered for future release to enable customer to get notification at the finger tips such as when the order is confirmed but also for store manager to have update for stock on time.

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APPENDICES

Appendix 1: Code for client delivery web application

```
//CLIENT DELIVERY
   public function clientDeliveries(){

      $deliveries = Order::select('orderNumber')
         ->where([['status',100],['delivery',2],['userId',Auth::id()]])
         ->groupBy('orderNumber')
         ->orderBy('orderNumber','DESC')
         ->get();

      $firstOrder =  Order::select('orders.*','users.name as clientName','users.email')
         ->join('users','users.id','=','orders.userId')
         ->where([['status',100],['delivery',2],['userId',Auth::id()]])
         ->first();

      $counter = 1;

      if ($deliveries){

         return response()->json(["status" => "access"],200);

      }else{

         return response()->json(["status" => "error"],404);

      }

   }
```

Appendix 2: Code for main store

```
//MAIN STORE
   <?php

namespace App\Http\Controllers;

use App\Product;
use App\User;
use App\Warehouse;
use Illuminate\Http\Request;
use Illuminate\Support\Facades\Auth;

class storeController extends Controller
{

   public function __construct(){

      $this->middleware('auth');
   }

   public function store(){

      $products   = Product::where('storeId',Auth::id())->get();
      $counter    = 1;
      return view('store.store',compact('products','counter'));
   }

   public function mainStore(){

      $stores = Warehouse::select('warehouses.*','categories.name as categoryName')
         ->join('categories','categories.id','=','warehouses.category')
         ->where('type',0)
         ->get();

      return view('store.mainStore', compact('stores'));

   }

   public function viewWhDetailStock($id){

      $user       = User::where([['type',$id],['role','=','Store']])->first();

      $products   = Product::where('storeId',$user->id)->get();

      $counter    = 1;

      return view('store.viewWhDetailStock',compact('products','counter'));    }
```

Appendix 3: API contact code between a remote database and a mobile app

```
<?php

namespace App\Http\Controllers;


use App\Account;
use App\Cart;
use App\Categories;
use App\Invoice;
use App\Order;
use App\Payment;
use App\Product;
use App\User;
use App\Warehouse;
use Illuminate\Http\Request;
use Illuminate\Support\Facades\Auth;
use Illuminate\Support\Facades\DB;
use Illuminate\Support\Facades\Hash;

class authApiController extends Controller
{


   //STORE /WAREHOUSE/ORDERS EN INVOICES
   public function storeOrders(Request $request){

      $store = User::find($request->userId);

      $wh = Warehouse::where('category',$store->type)->first();

      $orders     = Order::select('orderNumber')
         ->where([['production',0],['wh',$wh->id]])
         ->groupBy('orderNumber')
         ->orderBy('orderNumber','DESC')
         ->get();

      $firstOrder =  Order::select('orders.*','users.name as clientName')
         ->join('users','users.id','=','orders.userId')
         ->where([['production',0],['wh',$wh->id]])
         ->first();

      $counter    = 1;

      if ($orders){

         return response()->json(["status" => "success"],200);

      }else{
```

```
        return response()->json(["status" => "error"],404);
    }


}

public function confirmProduction(Request $request){

    $orderNumber = $request->orderNumber;

    $orders    = Order::select('*')
        ->where([['production',0],['orderNumber',$orderNumber]])
        ->get();

    foreach ($orders as $order){

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

        $updateProduction->production = 1;
        $updateProduction->save();

    }

    return response()->json(["status" => "success"],200);

}


//STORE DELIVERY
public function manageDeliveries(){

    $deliveries = Order::select('orderNumber')
        ->where('status',100)
        ->groupBy('orderNumber')
        ->orderBy('orderNumber','DESC')
        ->get();

    $firstOrder =  Order::select('orders.*','users.name as clientName','users.email')
        ->join('users','users.id','=','orders.userId')
        ->where([['status',100],['delivery',0]])
        ->first();

    $counter = 1;

    if ($deliveries){

        return response()->json(["status" => "SUCCESS"],200);

    }else{
```

```
        return response()->json(["status" => "error"],404);
    }

}

public function viewDelivery(Request $request){

    $orderNumber = $request->orderNumber;

    $deliveries = Order::select('orderNumber')
        ->where('status',100)
        ->groupBy('orderNumber')
        ->orderBy('orderNumber','DESC')
        ->get();

    $firstOrder =  Order::select('orders.*','users.name as clientName','users.email')
        ->join('users','users.id','=','orders.userId')
        ->where('orderNumber',$orderNumber)
        ->first();

    $counter = 1;

    if ($deliveries){

        return response()->json(["status" => "SUCCESS"],200);

    }else{

        return response()->json(["status" => "error"],404);
    }

}

public function makeDelivery(Request $request){

    $orderNumber = $request->orderNumber;


    $deliveries = Order::where('orderNumber',$orderNumber)->get();


    foreach ($deliveries as $delivery){

        $checkStock = Product::where('id', $delivery->orderDescription)->first();

        if ($delivery->quantity > $checkStock->stock){

            return response()->json(["status" => "Some of Item is Out of Stock"],404);
```

```
        }

    }

    foreach ($deliveries as $delivery){

        $make = Order::find($delivery->id);
        $make->delivery = 2;
        $make->save();

    }

        return response()->json(["status" => "SUCCESS"],200);

}



//CLIENT ORDERS AND INVOICES
public function cancelInvoice(Request $request){

    $orderNumber = $request->orderNumber;

    $invoices =  Invoice::select('*')
        ->where('orderNumber',$orderNumber)
        ->get();

    $orders =  Order::select('*')
        ->where('orderNumber',$orderNumber)
        ->get();

    foreach ($invoices as $order){

        $invoice = Invoice::find($order->id);

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

    foreach ($orders as $order){

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

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


   return response()->json(["status" => "success"],200);
```

```
}

public function uploadPaidReceipt(Request $request){

   $orderNumber = $request->orderNumber;

   $invoices =  Invoice::select('*')
      ->where('orderNumber',$orderNumber)
      ->get();

   $orders =  Order::select('*')
      ->where('orderNumber',$orderNumber)
      ->get();

   $this->validate($request,[

      'receipt'   => 'mimes:jpg,png,pdf|max:3000',
   ]);

   if ($request->hasfile('receipt')) {

      $file          =   $request->file('receipt');
      $destination   =   public_path('/assets/img/receipt/');
      $extension     =   $file->getClientOriginalExtension();
      $files         =   md5($file->getClientOriginalName());
      $fileName      =   $files.'.'.$extension;
      $file->move($destination, $fileName);

   }else{

      return response()->json(["status" => "error"],404);

   }

   foreach ($invoices as $order){

      $invoice = Invoice::find($order->id);

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

   foreach ($orders as $order){

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

      $orderUp->receipt = $fileName;
      $orderUp->wh      = $invoice->wh;
      $orderUp->status  = 100;
```

```
        $orderUp->save();
    }

    foreach ($orders as $order){

        $productStock = Product::find($order->orderDescription);

        $productStock->stock = $productStock->stock - $order->quantity;
        $productStock->save();
    }


    return response()->json(["status" => "success"],200);


}

public function confirmInvoice(Request $request){

    $orderNumber = $request->orderNumber;

    $invoices =  Invoice::select('*')
        ->where('orderNumber',$orderNumber)
        ->get();

    $orders =  Order::select('*')
        ->where('orderNumber',$orderNumber)
        ->get();

    foreach ($orders as $pay){

        $pay = Order::find($pay->id);

        if ($pay->payment == 'Cash'){

            return redirect(route('uploadReceipt',$orderNumber));
        }

    }

    foreach ($invoices as $order){

        $invoice = Invoice::find($order->id);

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

    foreach ($orders as $order){
```

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

            $orderUp->wh      = $invoice->wh;
            $orderUp->status  = 100;
            $orderUp->save();
        }

        foreach ($orders as $order){

            $productStock = Product::find($order->orderDescription);

            $productStock->stock = $productStock->stock - $order->quantity;
            $productStock->save();
        }

        include 'api/sms.php';
        $account = Account::find($request->userId);

        $str    = ltrim($account->phone, 0);
        $phone  = "+255".$str;
        $msg    = "Your order ( # order number) is confirmed . Visit http://wms.nethub.co.tz for
more info.";

        if (sms($phone,$msg)){

            return response()->json(["status" => "success"],200);

        }else{

            return response()->json(["status" => "error"],404);
        }

    }

    public function viewInvoice(Request $request){

        $orderNumber = $request->orderNumber;

        $orderInv =  Invoice::select('invoices.*','users.name as clientName')
            ->join('users','users.id','=','invoices.userId')
            ->where('orderNumber',$orderNumber)
            ->first();

        $total = Invoice::select(DB::raw('SUM(totalPrice) as totalPrice'))
            ->where('orderNumber',$orderNumber)
            ->first();

        $userId = User::find($orderInv->userId);
        $client = Account::find($userId->accountId);
```

```
    if ($orderInv){

        return response()->json(["status" => "success"],200);

    }else{

        return response()->json(["status" => "error"],404);
    }

}

public function myInvoices(Request $request){

    $invoices = Invoice::select('orderNumber')
        ->where('userId',$request->userId)
        ->groupBy('orderNumber')
        ->orderBy('orderNumber','DESC')
        ->get();

    if ($invoices){

        return response()->json(["status" => "success"],200);

    }else{

        return response()->json(["status" => "error"],404);
    }

}

public function savePaymentClient(Request $request){

    $orderNumber = $request->orderId;

    $orders = Order::where('orderNumber',$orderNumber)->get();

    foreach ($orders as $order){

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

        $payment->orderNumber   = $orderNumber;
        $payment->payment       = $request->methodType;
        $payment->userId        = $request->userId;
        $payment->status        = 0;
        $payment->save();
    }

    $account = Account::find($request->userId);

    include 'api/sms.php';
```

```
        $str    = ltrim($account->phone, 0);
        $phone  = "+255".$str;
        $msg    = "Your order ( # order number) is confirmed . Visit http://wms.nethub.co.tz for
more info.";

        if (sms($phone,$msg)){

            return response()->json(["status" => "success"],200);

        }else{

            return response()->json(["status" => "success"],200);
        }

    }

    public function makeOrder(Request $request){

//        need user id en redirection

        $carts = Cart::where([['userId',$request->userId],['status',0]])->get();

        return response()->json(["status" => $carts],200);


        // 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
        $orderNumber   = str_shuffle($pin);


        foreach ($carts as $orderCar){

            $order = new Order();

            $p     = Product::find($orderCar->orderDescription);

            $order->userId              = $request->userId;
            $order->orderDescription    = $orderCar->orderDescription;
            $order->quantity            = $orderCar->quantity;
            $order->orderNumber         = $orderNumber;
            $order->price               = $p->price;
            $order->totalPrice          = $p->price * $orderCar->quantity;;
```

```
            $order->status              = 10;

            $order->save();
        }


        foreach ($carts as $order){

            $orderCart = Cart::find($order->id);

            $orderCart->status = 1;

            $orderCart->save();
        }

        $checkPayment     = Payment::where([['userId',$request->userId],['orderNumber',$orderNumber]])->first();


        if ($checkPayment == null){

            return response()->json(["status" => "access to payment method"],200);

        }else{

            return response()->json(["status" => "access"],200);
        }

    }

    public function addToCart(Request $request){

        $order                  = new Cart();
        $order->userId          = $request->userId;
        $order->orderDescription = $request->products;
        $order->quantity        = $request->quantity;
        $order->status          = 0;

        if ($order->save()){

            return response()->json(["status" => "access"],200);

        }else{

            return response()->json(["status" => "error"],404);
        }
    }

    public function categoryAll(){
```

```
    $categories  = Categories::all();

    if ($categories){

        return response()->json(['categories'=> $categories,"status" => "access"],200);

    }else{

        return response()->json(["status" => "error"],404);
    }
}

public function itemAll(){

        $products  = Product::all();

        if ($products){

            return response()->json(['categories'=> $products,"status" => "access"],200);

        }else{

            return response()->json(["status" => "error"],404);
        }
    }

public function login(Request $request){

    $userHashedPass  = User::where('email',$request->email)->value('password');

    if (Hash::check($request->password , $userHashedPass)){

        return response()->json(["status" => "access"],200);

    }else{

        return response()->json(["status" => "error"],404);
    }

}

public function register(Request $request){

    $Account      = new Account();

    $Account->name          = $request->name;
    $Account->email         = $request->email;
    $Account->phone         = $request->phone;
    $Account->type          = $request->role;
    $Account->level         = 1;
```

```
    if ($Account->save()){

        $user = new User();
        $user->name = $Account->name;
        $user->email = $Account->email;
        $user->password = hash::make($Account->phone);
        $user->accountId    = $Account->id;
        $user->level    = 1;
        $user->type     = 1;
        $user->role     = $Account->type;
        $user->save();

        return response()->json(["status" => "access"],200);

    }else{

        return response()->json(["status" => "error"],404);

    }

}


//CLIENT DELIVERY
public function clientDeliveries(){

    $deliveries = Order::select('orderNumber')
        ->where([['status',100],['delivery',2],['userId',Auth::id()]])
        ->groupBy('orderNumber')
        ->orderBy('orderNumber','DESC')
        ->get();

    $firstOrder =  Order::select('orders.*','users.name as clientName','users.email')
        ->join('users','users.id','=','orders.userId')
        ->where([['status',100],['delivery',2],['userId',Auth::id()]])
        ->first();

    $counter = 1;

    if ($deliveries){

        return response()->json(["status" => "access"],200);

    }else{

        return response()->json(["status" => "error"],404);

    }
```

```
}

public function viewClientDelivery(Request $request){

    $orderNumber = $request->orderNumber;

    $deliveries = Order::select('orderNumber')
        ->where([['status',100],['delivery',2],['userId',Auth::id()]])
        ->groupBy('orderNumber')
        ->orderBy('orderNumber','DESC')
        ->get();

    $firstOrder =  Order::select('orders.*','users.name as clientName','users.email')
        ->join('users','users.id','=','orders.userId')
        ->where('orderNumber',$orderNumber)
        ->first();

    $counter = 1;

    if ($deliveries){

        return response()->json(["status" => "access"],200);

    }else{

        return response()->json(["status" => "error"],404);

    }

}

public function clientConfirmDelivery(Request $request){

    $orderNumber = $request->orderNumber;

    $deliveries = Order::where('orderNumber',$orderNumber)->get();

    foreach ($deliveries as $delivery){

        $make = Order::find($delivery->id);
        $make->delivery = 1;
        $make->save();

    }

    if ($deliveries){

        return response()->json(["status" => "access"],200);

    }else{
```

```
            return response()->json(["status" => "error"],404);

        }

    }
}
```

Appendix 4: A-TO-Z Company Interview Questions

The interviews questions conducted at ATOZ Company was done with the intention of understanding how the current warehouse and spare parts are being managed

1. Name

2. Designation

3. Gender: Male □, Female □

3.How warehouses are being managed?

4.Which is your preferred method of managing warehouse?

(a) Flat files

(b) Paper

(c) ICT system

4.How the warehouse data are secured?

5.Do you think ICT system can help to manage the warehouses?

(a) Strongly agree

(b) Agree

(c) Disagree

6. do you get reports of different warehouses?

7.A mobile application can increase accessibility of warehouses at the fingertips

(a) Strongly agree

(b) Agree

(c) Disagree

8.What are challenges faced during managing warehouses?

9. How do you manage those challenges?

10. Is there a system which link between the company and the customers?

11. Do you think having multiplatform mobile system will increase availability of the information to the company and its stake holders?

(a) Yes …. give reason

(b) No

POSTER PRESENTATION