MASENO UNIVERSITY

SCHOOL OF COMPUTING AND INFORMATICS

DEPARTMENT OF COMPUTER SCIENCE

CCS 406

COMPUTER SCIENCE PROJECT II

PROJECT TITLE: WAREHOUSE STOCK MANAGEMENT SYSTEM

REGISTRATION NUMBER **CCS/00022/019**

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A project report submitted in partial fulfillment of the requirement of the Bachelor of Science Degree (BSc) in Computer Science

DECLARATION

I, the undersigned, do hereby declare that this project was my original work, and for the best of my knowledge, it has not been presented to any other examination body.

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This project report was hereby presented for examination with my approval as the project supervisor.

Name: …Dr. Lilian Wanzare Signature: ……. Date: 11th May, 2023

ACKNOWLEDGEMENT

I would like to thank God for leading me throughout this project period. I would also like to thank my project supervisor, Dr. Lilian who effectively guided me during this project. She advised and gave me more ideas on how I should handle my project in achieving the desired result. Her constant support and guidance have surely contributed a great deal towards the success of this project.

I also appreciate my group members and everyone who supported me at different instances in enabling me to achieve the realization of this project.

ABSTRACT

Warehouse, having a large building that is secluded for the storage of raw materials and goods that are manufactured before they are dispersed to their various points of use is very beneficial to a production firm. Having a system that is able to manage all the stock that is handled in the warehouse is a plus for any organization. The struggles of manual inventory keeping, inaccurate and mismatching records, delayed time of locating goods will be minimized significantly by the use of an efficient warehouse management system. In the medical sector, narrowing down to our own country Kenya, a warehouse management system will work effectively. Having this system will be a huge boost in the medical field. The current hurdles being faced by some of the Medical Supplies Authority include expiring stock in the shelves, theft of the supplies from the warehouse. Inconsistent records in the inventory, misappropriation of funds are just but a few of the challenges faced by these authorities. These are some of the challenges that motivated me into carrying out this research. The main objective of this study is to develop a full functioning warehouse management system that solves these challenges currently experienced. Other objectives include incorporating a payment facility in the developed system that will help in keeping track of the finances. Developing a monitoring and control feature that will keep track of the stock present. Keeping track of the health supplies, pending orders of the health supplies, the stock still available in the shelves will improve the quality of service that the Kenya Medical Supplies Authority does. The system methodology to be used is the Software Development Life Cycle, iterative waterfall model. This approach is quite useful since it allows review of the developed system at each stage of development. All these will lead to the development of a reliable and efficient warehouse management system. I intend to use PHP, HTML and MYSQL in the development of the system. The use of an efficient medical warehouse management system will improve the current situation of these medical supply authorities. Equity, honesty and transparency, being the driving force of these organizations, will be easily achieved by the use of such a system.

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CHAPTER 1: INTRODUCTION

1.0 Introduction

According to (Ministry of Health, 2020), the Kenya Medical Supply Authority (KEMSA) is the leading medical supply distributor in Kenya, currently. The medical supplies are distributed from the main warehouse, in Nairobi, to eight different depots within the country. The depots aid in distribution of the medical supplies across the country effectively. KEMSA proved effective in its operations in the recent past. During the Covid-19 pandemic, the authority was faced with challenges in its warehouse operations and financial systems. The medical supplies vanishing from the warehouse and financial resources being unaccounted for up to a tune of 7 billion, according to (Transparency International, 2020), that made its trustworthiness by the public reduce significantly.

Disappearing health supplies and drugs. Expiration of the medicines while still on the drugs' shelves. Overstating the prices of the health commodities. A source from (Transparency International, 2020), states that there were citations of irregular expenditure of 7.8 billion following tenders given to 'say' politically connected individuals and businesses. These are some of the critical factors that have led to the crippling and distrust of a well-known medical Supply Authority.

In my perspective poor management strategies of the authority has led to these challenges. There is poor monitoring of the goods hence they expire while still on the shelves. Lack of an accurate inventory management strategy has led to the unexplainable disappearance of the same health supplies and the misuse of the finances that is disbursed in the organization. Because of these faults realized in the running of this authority, it has sparked an interest in research of modelling an efficient warehouse management system.

This research is aimed at coming up with a system that will manage the running of the warehouse very effectively. The system will incorporate a good inventory-keeping module that helps in keeping records of goods and finances that are handled by the system. A monitoring and surveillance module will keep track of goods that ought to expire and raise an alarm to enable them

dispatch the goods for earlier use. I hope that the system will prove efficient in running the warehouse.

1.1 Statement of the problem

Many of the organizations have embraced the use of up-to-date technology in the management of their businesses in the recent past. This has brought about easier ways of handling and keeping track of records and doing analysis of the statistics of the information gathered by the firms. More profits are being realized and better ways of tapping into the market are being used due to the help of technology.

The use of the manual system of keeping records in the KEMSA warehouse has brought about many inconveniences in the Kenyan medical sector. The current system of inventory keeping is filled with data inconsistency. There are records of health supplies, which have been said, were dispersed but they have not been checked out, payment logs do not match with the goods that have been delivered. This situation has lowered the trustworthiness of the firm.

The inconsistency has led to having wrong statistics during the analysis of the data that is used to make informed decisions and predictions. The inaccurate data has been used hence wrong conclusions have been made in making purchases of the health supplies and in making deliveries of the latter. This has also led to wrong figures of finances being injected into the firm. Since there is no efficient way of budgeting and accounting for this money, it has then been misappropriated by some of the employees in the medical supply authority, The Seven Billion KEMSA scandal.

Deliveries of the health supplies have also been a problem. Some of the health supplies have been made later than expected. This is either because there was not enough stock of the medicine in the KEMSA warehouse or the supplies took time to be located and sorted in the warehouse. The storing of the health supplies in the warehouse could also lead to inefficient time management since the supplies are not arranged orderly.

Large stocks of medication also expire in the warehouse unknowingly by the warehouse managers. The medications expire on the shelves making the finance being pumped into the firm going to

waste. The lack of an agent that monitors and does surveillance on the supplies makes the management of the warehouse quite difficult.

1.2 Proposed Solution

This research is sought to bring into realization the most effective and most profitable way of managing stock of health supplies in the medical warehouse. This research aims at developing an automated system that will be a more reliable way of keeping the inventory. It should also provide a way of making use of the data stored to do some statistics and analysis in order to show the purchasing trends of the customers. The information derived from the analysis will also be useful in making informed decisions on the finances required to support the warehousing activities and the goods that need to be supplied frequently.

This research is also aimed at coming up with a monitoring scheme that monitors the arrangement and sorting of the health supplies. This will be able to keep track of the precise location expiry dates of the supplies. Those that have a nearer expiry date to be dispatched earlier than the latest ones. Knowing the exact location of the health supplies will also translate to a better time management. No time will be wasted in going through the warehouse aimlessly in search of a product.

This research is aimed at looking at the most effective way of monitoring the stock present in the warehouse against the ordering frequency. This will enable the managers to keep track of the present stock in the warehouse and schedule when to do the restocking of the supplies. Such will help in preventing the shortage of the health supplies when the orders are quite high.

1.3 Objectives

The objectives of this research work include the following:

General Objective

1. To develop a generalized warehouse management system will aid in simplifying the running of the warehouse of the Kenya Medical Supply Authority.

Specific Objectives

2. To develop a system that will aid in facilitating the payment made by the buyers of the health supplies and a monitoring system that will help in the analysis and inventory keeping.

3. To test the system to assess if it has met the system requirements and if it functions as expected.

4. To do deployment of the system in its respective market and monitor its operations in its market environment.

1.4 Research Questions

1. How well do I develop a warehouse management system that will help in the management of the warehouse activities?
2. How should I develop a payment facility and monitoring and control features that will be incorporated in the system?
3. What are the testing approaches that are efficient in testing the developed system?
4. Which deployment strategy will be used to implement the already developed system to the market?
5. How will the running of the warehouse improve after the adoption of the warehouse management system? What profits will be gained?

1.5 Justification

Due to the strenuous nature of manual systems that involve bulky physical records, inconsistent and inaccurate inventory data, poor time management and among others has led to the poor performance of this firm. When the Medical supply authority is in a wanting state, the effects are being felt directly by those in the health facilities who need urgent medical attention. These

challenges have been a motivation in undertaking this research. The need to improve the running of this authority has brought the need to incorporate the use of a warehouse management system. The system will come in handy in providing efficient services to the public.

Accurate inventory records will be kept hence when analysis will be done, valid outputs will be achieved. Proper decision-making will be done that will improve the services being rendered by the authority. Health supplies will be managed with ease and shortage of the goods will be avoided. Deliveries will be made on time since the health supplies will be easier to locate just with the click of a button.

1.6 Project Scope

The system's main functions and features include the following:

i) Sign up

All the users of the system need to register first in order to gain access to the system. The users will be required to then login after the sign up process is approved.

ii) Inventory Tracking

The system will be able to keep record of the health supplies in the warehouse. When supplies are brought into the warehouse, the system records this information. The first goods into the warehouse will be the first to leave the warehouse. It will work in a First-In-First-Out manner. The system will also check out the purchases made from the warehouse.

iii) Alert generation

When the stocks of the health supplies fall below a certain set limit, an alert will be generated to signal that the stock level is depreciating.

iv) Request for Supply

The warehouse can request for the supply of the goods that are depreciating and need re-stocking.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter is meant to consider other warehouse management systems that are currently in the market and are adopted by organizations. There exists different warehouse management systems that have aided organizations in the running of their warehouse operations. The current system that is used by the Kenya Medical Supplies authority has shown its weaknesses. There is a need to match up to the resources that are granted to the organization by the government. Financial support and human resources that are used by the organization are yet to be maximized.

Warehouse management systems like TECSYS warehouse management system and Körber warehouse management system are the kinds of systems that have been adopted. These systems have really proved to be effective and efficient in their working but they have some shortcomings. These systems are quite difficult to customize according to the needs and requirements of the organization. Hence, the need to have a customized and more efficient system arose.

2.1 Theoretical Review

The systems market provides a variety of warehouse management systems that are usable in a warehouse setup. These systems are used to improve on the management of warehouse processes. Some of the warehouse management systems that are currently in the market include the following:

2.2 TECSYS Warehouse Management System

The most vital asset to ensure delivering of promises made to customers and yet achieve a high level of customer satisfaction is efficient warehouse operations, (Tecsys, 2022). In today's world, a combination of best practices and platform technology helps world-class distribution organizations achieve market differentiation, eliminate inefficiencies, improve order accuracy, reduce operating costs, and attain high levels of service. Tecsys Warehouse management system provides the following special functionalities that enable it perform its operations effectively:

2.2.1 Monitoring and surveillance system

Tecsys has incorporated an analytics capability that has proved to be fundamental to managing any distribution operation. Strategic decisions are needed to be made, such as dropping an underperforming product line or refocusing capital resources into more productive areas. These types of decisions require timely, accessible, and trustworthy information not only to manage your business, but also to drive your business forward. The analytics have made all this possible.

Tecsys does not provide a platform for monitoring and surveillance of the products in the warehouse. This could itself pose a challenge since products could be expiring while on the shelves and yet no alert is generated. There could also be a low stock present in the shelves due to frequent purchases. This will make the purchase of the next buyer not go through due to inadequate stock.

2.2.2 Inventory management

This is made possible by the use of a Personal Computer, which is used at the goods receipt place. The goods are registered before they are stored. The order number is entered then the item's barcode is scanned and the quantity is counted. Depending on the setup of the item, the batch number, shelf life or serial number are also registered. All this information is stored in a database.

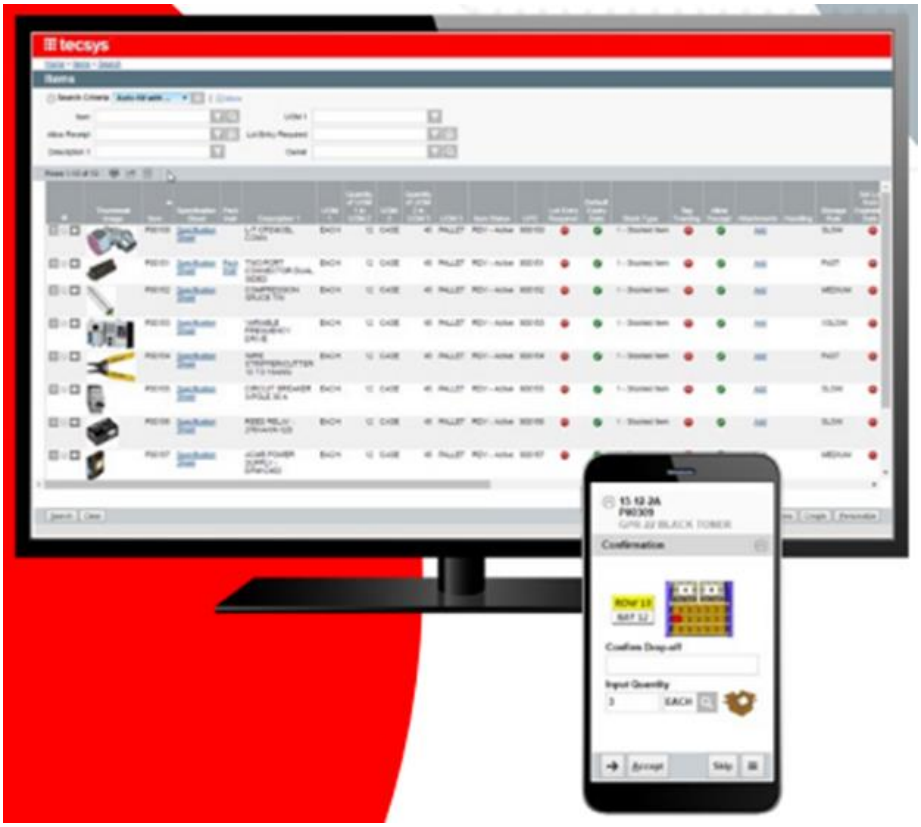


Figure 1 Inventory Management Of The Tecsys WMS

This database helps in the efficient management of all the huge information regarding the warehouse. The inflow of goods and outflow of goods is recorded by the system and updated in the database when there is a change. The database is a very efficient tool in managing the inventory since there is easy recording and retrieval of information when needed.

2.2.3 Existing challenges Tecsys tries to solve

These are the challenges that some of the warehouses experience. Tecsys Warehouse Management System is aimed in solving most of these challenges:

i) There is increased pressure from volatile demands from customers who have high expectations.

ii) There are constant changes in the economic conditions.

iii) Orders must be fulfilled with the highest efficiency and productivity all time while operating at the lowest lost.

iv) There exist unproductive processes and technology that ought to be done away with.

2.2.4 How Tecsys has handled the challenges

Tecsys warehouse management system has helped hundreds of leading organizations to solve their unique warehousing and distribution challenges. Since its inception, it has been contracted by a stream of renowned organizations that have adopted its solutions.

Tecsys has a visual logistics technology that allows users to perform sophisticated tasks in their supply chains without any delays. This feature is not possible with other competing Warehouse Management System technologies. Tecsys also provides an analytics capability. The analysis enables access to actionable information that allows one to stay ahead of the competition. Analytics solutions have enabled the organizations to gain clear and immediate insights to their data assets and helped in informed decision-making.

Tecsys also provides optimum efficiency and accuracy by using a patent visual logistics technology. This technology gives clear instructions to workers to increase efficiency and accuracy in their daily tasks. Tecsys easily adapts to the seasonality and changing needs of the business. One can scale up during growth and scale down for simpler operations using the same software hence provides agile scalability.

2.2.5 Benefits realized

Companies having great visions in having a break-through in the competitive market have also incorporated the Tecsys Management software. Tecsys provides the technology platform and the

expertise that is required by the business to achieve their business objectives. (Lloyd Fabry, 2022).

The Tecsys supply chain platform provides companies with the capability of building great business models. These business models later transform into million dollar companies, as stated by (Richard Beeny, 2022).

These are some of the testimonies by some leaders on how the Tecsys warehouse management system has improved on the running of their warehouses. These are some of the benefits that are experienced after using the Tecsys warehouse management system.

i) Profits have increased.

ii) Building a competitive environment from their competitors.

iii) Increased efficiency and accuracy while utilizing the minimum resources.

2.3 Körber Warehouse Management System

Körber warehouse management system is a system that encompasses all warehouse management solutions. This system can be customized to the exact business requirements, (Körber, 2020). The system can also be integrated with the Enterprise Resource Planning (ERP) module of an existing system. Körber can also be used with small and medium-sized warehouses. Its solutions support end-to-end processes and configurable functionality capabilities.

This system supports multi-client operation with multiple product categories in the same warehouse. The system is efficiently scalable providing simplified onboarding of new clients. The configuration of warehouse processes for each customer as well as other functionalities is quite fast. Key functionalities of this system include:

i) Receiving and put-away

ii) Slotting

iii) Warehouse transfers

iv) Picking and packaging

v) Differentiated inventory management

Major benefits of the system include:

i) Provision of a flexible technology platform – they can deploy the system via cloud or on-premises.

ii) End-to-end functionality that integrates with other management systems ensuring security.

iii) Provision of adaptable solutions that result in accurate, optimized processes that reduce effort cost and increase productivity.

iv) Data from the system can be analyzed for prediction and process optimization.

2.4 Critique of existing system

Feature	**Tecsys**	**Körber**
Packaging and transport	Yes	Yes
Onsite expiry date tracking	No	No
Custom labelling and serial numbering	Yes	Yes
Monitoring and surveillance	No	Yes

Efficient payment facility	No	No

Table 1 summary of the critical analysis of similar systems

2.4.1 Pros of the existing systems.

The systems have the following advantages:

i) Provides advanced functionalities for packaging, shipping and picking.

ii) The system provides services such as custom labeling, expiry date tracking, lot tracking and serial numbering for their products.

2.4.2 Cons of the systems

Though the systems are among the best to use, they have some drawbacks including:

i) The expiry date tracking is only visible through report generation by the system.

This is not available at one glance at the dashboard. With the help of various reports, it is possible to find items that have expired or are close to expiration. (Tecsys, 2021).

ii) There is no feature in place to monitor the products in the warehouse and analytics. (Software Testing Help, 2022)

iii) The payment processing facility of the system is not available.

2.5 Research gap

At this point, a review of the already existing systems has been undertaken. So far, there exist no system that can be fully relied on efficiently. The existing systems are working quite well, on one

side, but they have a major drawback. A system having solved all these challenges needs to be developed and it will be more effective and efficient than the existing systems. This research has brought to light the following research gaps that it strives to solve:

i) Lack of an efficient payment processing facility.

ii) No feature to monitor and analyze stock present in the warehouse.

iii) No feature to track the expiry of goods in real-time.

2.6 Summary

The Tecsys warehouse management system has proved to be worth the use in warehouse management. Despite its shortcomings, many organizations that have employed its use have testified that it realizes a greater percentage of benefits compared to a manual system or other automated systems. Tecsys provides advanced functionalities that makes the running of the warehouse organizations very effective. The functionalities present in the Tecsys system are not available in other systems and the functionalities of the other systems are not available in the Tecsys system. This brings up the need to come up with a complete system that will solve most of the shortcomings in the present systems.

CHAPTER THREE: SYSTEM ANALYSIS AND DESIGN

3.0 Introduction

This chapter gives an overview of system analysis, design, and implementation. Furthermore, according to the requirement gathering and analyzing can draw the entity-relationship diagram, unique use case diagram and sequence diagram. Requirements gathering and analysis was a weighty practice for a successful project. The methodology is describing domain understanding, requirements gathering, organizing the requirements, constructing them in a relevant manner, prioritization and justification. It describes functional requirements, non-functional requirements and hardware requirements of the system.

3.1 System Development Methodology

There are three, different, approaches that can be used in the development of this system. The waterfall model approach was the most preferred in this case. The whole process of software development is divided into separate phases. One phase must be complete for the other to commence.

i) **Requirement Gathering and analysis**

All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification document. During this stage, data from selected personnel is collected in order to gather the system requirements for the project. Questionnaires will be administered to the people who work in a related warehouse environment to get their responses. Interviews of some of the warehouse employees can also be conducted in order to get adequate information in the system specifications requirements.

The data collected is then analyzed and a summary of system requirements of the expected system is drawn up and is used in the system design phase.

ii) **System Design**

The requirement specifications from the first phase are studied, in this phase, and the system design is prepared. Flowcharts and data flow diagrams are used to illustrate the different processes the system will include in its operations. The inputs the system will require and also the system will produce will also be defined in the design phase. This system design helps in specifying hardware and system requirements and helps in defining the overall system architecture.

iii) **Implementation**

With inputs from the system design, actual programming and writing the lines of code for the system is done. A suitable programming language will be selected to develop the system. The system is developed in small program portions called units. The units are then integrated in the next phase. Each unit is developed and tested for its functionality, which is referred to as Unit Testing.

iv) **Integration and Testing**

All the units developed in the implementation phase are integrated into a system after testing of each unit. Module testing, system testing and post integration testing of the entire system is done. This is to check for any faults, failures and if the system meets the requirements specifications outlined in the requirement analysis document.

v) **Deployment of system**

Once the functional and non-functional testing is done; the product is deployed in the customer environment or released into the market, in this case the warehouse environment market.

vi) **Maintenance**

Some issues come up in the client environment. To fix those issues, patches are released. In addition, to enhance the product, some better versions are released. Maintenance is done to deliver these changes in the customer environment. Corrective maintenance is carried out to solve the errors identified while running the system. Perfective maintenance is also scheduled to enhance the efficient and effective functioning of the system. Preventive maintenance to prevent the occurrence of errors and faults within the system is also factored in the maintenance strategies.

3.2 Feasibility study

The undertaking of this feasibility study will aid in determining the practicality of the project. The strengths and the limitations the project may present during its development. Possible solutions to these challenges will be suggested on how to make the project successful. It will also aid in the planning of a course of events to complete the project.

3.2.1 Current Executive Environment

The Kenya Medical Supply Authority (KEMSA) is the leading medical supply distributor in Kenya currently. The medical supplies are distributed from the main warehouse, in Nairobi, to eight different depots within the country, (Ministry of Health, 2020). The depots aid in distribution of the medical supplies across the country effectively. KEMSA proved effective in its operations in

the recent past. During the Covid-19 pandemic, the authority was faced with challenges in its warehouse operations and financial systems. The medical supplies vanishing from the warehouse and financial resources being unaccounted for to up to a tune of 7 billion made its trustworthiness by the public reduce significantly. KEMSA currently has put some strategies in order to enable it to maximize its operations efficiently. The employment of a warehouse management system will surely improve the operation of the supply authority from its headquarters to the depots countrywide.

3.2.2 Technology Considerations

An upgraded technological capability will be required by KEMSA in order to deliver effective warehouse management. The current system being used, Logistical Management Information System, (LMIS) lacks real time visibility of KEMSA stock levels by facilities. The system has a weak monitoring and supervision system. The authority also relies on donors to aid them on infrastructural and systems improvements. (Ministry of Health, 2020).

The recommendation to this is to contract this work out to a system development company who can work with KEMSA to meet its technological needs within the determined timeframe and budget. A permanently employed system expert will prove viable to KEMSA in order to be readily available in case the system needs some upgrades and improvements.

3.2.3 Products and service Marketplace

KEMSA already has an existing marketplace. Public procurement for both medical equipment and pharmaceuticals is done by KEMSA. Most of the health facilities, both public and private, acquire their health supplies from KEMSA. The total market size of medical devices is estimated to gradually increase.

Table 1: U.S. – Kenya Trade Statistics (Medical Devices)

	2019	2020	2021	2022 (Est)
Total Local Production*	-	-	-	-
Total Exports	3.56	3.80	2.94	2.97
Total Imports	125.19	129.47	131.54	133.86
Imports from the US	5.63.60	7.50	7.89	7.64
Total Market Size	125.19	130	131.54	133.86
Exchange Rates	101.5	105	105	111

Figure 2 Kenya trade statistics showing total market size

3.2.4 Organization and Staffing

The improvement of the KEMSA warehouse management system is not expected to significantly affect the organizational structure of the agency. There are, however, few staffing additions required to implement the warehouse management system.

i) System Developers – this is a part-time position that is filled in with a group of people who will develop the system as per the organizations requirements.

They will report to the System Manager and will work in the KEMSA headquarters.

ii) IT Manager – this is a full time position. The IT manager is responsible to monitor the running of the Warehouse Management System. Any faults

incurred he/she should be able to do the repair and maintenance of the system and suggest for upgrades in the system

He will report to the IT director and will work in the KEMSA headquarters and the various depots countrywide.

3.2.5 Financial Estimations

With the use of the current system, there are certain inconveniences brought about:

i) Overstocking and understocking of goods that cause some strain on the organizational finances.

ii) Misappropriation of financial resources supplied to the organization by the government.

Once the system is fully developed, these faults will be reduced significantly and more profits will be gained. The financial resources will be put into their respective use efficiently and will be well accounted for.

3.2.6 Findings and Recommendations

The key findings of this feasibility study are as follows:

i. The existing technology will be used, but it will be advanced further. This will lower the project risk.

ii. There will be minimal addition of staff members that will not change the organizational structure.

iii. There is a high possibility of reducing the operational costs that will lead to the increase of profits.

iv. The market structure of the organization is expected to expand

Based on the info represented in this feasibility study, it is recommended that KEMSA approves the Warehouse Management System project. The findings of this study shows that this project will be highly beneficial to the organization and has a high possibility of success.

3.3 Requirements Elicitation

This chapter shows the overall approaches or methods that will be used to conduct the whole study. It specifically constitutes of the population of the study, sampling design and the data collection technique used.

3.3.1 Target Population

The target population of this research consist of majorly employees who work in a warehouse setup. Since it would be quite difficult to reach the some of the respondents in KEMSA, I selected some few respondents from Maseno University Hospital to conduct interviews with and to deliver the questionnaires and get their responses.

3.3.2 Data Collection

Questionnaire was selected as the primary data collection instrument to be used in this research. This selected method was effective because it is less costly, saves time and the results obtained were to be confidential. The questionnaire includes closed structured and open-ended questions, which collects the views and opinions from the respondents. The open-ended questions give unrestricted freedom of answer to respondents. Google forms platform was selected to distribute the questionnaires. It is quite simple to deliver and get a response from the respondents who are not reachable physically. Interviews were also to be used as a tool for data collection. This would be effective to a few of the respondents who were at a close proximity to us.

The questions on the questionnaire were derived from the system objectives and the research questions. This will guide the researcher to formulate questions based on the specifications of the system that he wants to develop and it will enable the scope of the study be considered.

3.4 Data and System Analysis

Before starting the development of the system, some data ought to be collected in order to get views from the public about the system to be developed. The data is collected using the data collection methods described. The responses are then gathered and analyzed to come up with relevant information concerning the system. Hypothesis can be tried out, patterns and trends can be observed and deeper understanding of the project can be enhanced from the data analyzed.

The respondents who were given the questionnaires and those who were interviewed gave the responses in the table below.

Features	**Positive responses**	**Negative responses**	**Not clear**
Ease of use of the system	37	7	6
Incorporating of the payment system	42	3	5
Provision of real-time statistics of the stocks present	48	0	2
Monitoring the inventory levels	43	3	4

Alert generation capability	45	2	1
Expiry date tracking feature	40	5	3
Keep efficient sections of the system	35	10	2
Sequential processes of the system	38	9	1
Total	328	39	24
N = 391			

Table 2 Responses from the data collection

These data from the respondents can be mapped into the following representation.

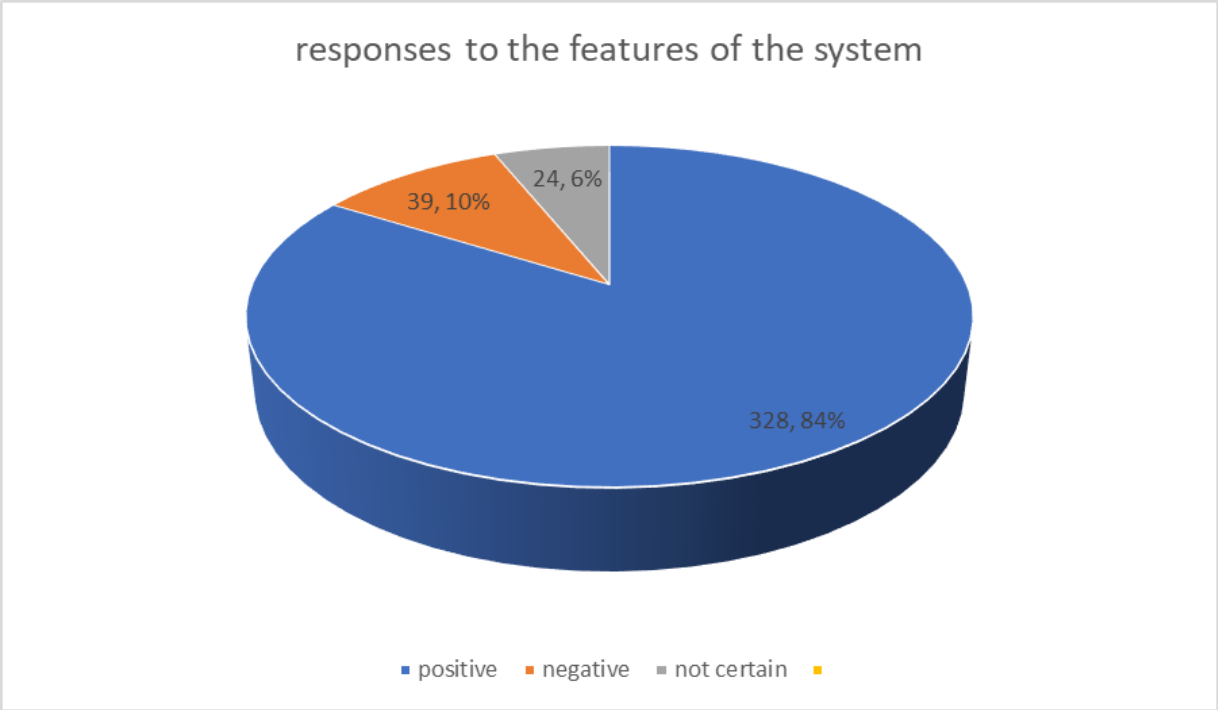


Figure 3 Pie-chart showing distribution of responses

From the data collected, most of the respondents were in support of the proposed system and the development process was initiated

3.5 System Specifications

These are requirements that the system should have as the intended functionality that satisfy the needs by different parties of the system. They are mostly, grouped into, functional requirements, user requirements and technical requirements.

3.5.1 Functional Requirements

This requirement tries to express the required behavior of the proposed system and clarify what the system should do. Listed below were the main functional requirements of the proposed system.

Successfully logging in to the system will display the dashboard, which has several features available for the users.

Once the user has logged in, they system should be able to provide several functionalities. The system should be able to enable the user to:

1. View the current stock of health supplies in the warehouse.
2. View the real-time stock levels of the various products.
3. Request for supplies with respect to the products with low stocks levels.
4. Manage supplies as they are made.
5. Make purchases from the products present in the warehouse.
6. Make payments to suppliers and receive payments from its buyers.
7. Capture the data about the suppliers and buyers present in the system and add more to the system.
8. Generate relevant reports that aid in decision-making.

3.5.2 Non-Functional Requirements

Non-functional requirements are the requirements that are not directly, affected with the basic functions provided by the system. Non-functional requirements are relevant with quality attributes, quality of service requirements and non-behavioral requirements.

The non-functional requirements of the system are listed below:

1. The system would provide a responsive and user-friendly interface that is easy to use.
2. Security to the confidential information of the suppliers and buyers.
3. The system should meet the organizational and follow the business regulation policies.
4. The system should be reliable and available during all times of use.
5. The performance of the system when being accessed should be fast and accurate.

3.6 System Description

The system description provides a deeper understanding of the system and its functions. It will also define the system users and their respective functions and capabilities of using the system. It will also aim in explaining how the system's functional requirements and the non-functional requirements are achieved by the system.

3.6.1 System Modules

This section defines the main modules available in the system. These modules encompass many other functions in each of them.

3.6.1.1 Login module

A client should first sign up to the system. This process registers the user into the system. The user keys in the relevant credentials requested for by the system. The user then logs in with the credentials already in the system to gain access. The login credentials are verified, and if they are approved the user is granted access. When the user has finished the transactions, he wished to process, this module would enable him/her to logout from the system.

3.6.1.2 Supplies module

Once the supplies arrive at the warehouse from the suppliers, the system takes record of the products coming in. The serial code of the products are keyed in and some other details about the product. The expiry date is also recorded. All this information about the new products are stored into a database where they are stored in an organized fashion.

3.6.1.3 Stock module

The, already logged in, user can be able to view the available products of health supplies in the warehouse. The user will be able to see the type of products, the quantity, inventory levels and some brief description of the products. Once supplies are made to the warehouse, the inventory levels increase in this module. During the checking out process, the number of the stock that has been purchased will be deducted from the existing stock. This update will be done in the database. These inventory levels will be shown in in a real-time manner. When the stock level of a certain commodity falls below a set threshold, an alert will be generated to the user. This alert will warn

the user responsible so that he can be able to make informed decisions based on that information. The warehouse manager may opt to make a request for the supply of more products from the suppliers of stock with low stock levels.

3.6.1.4 Purchase Module

If the client wants to make a purchase, he should click the purchase button. The client will then be directed to a purchasing page where he can specify the products he wants and the quantity. The prices of the products ordered will then be calculated and presented to the user. Once the purchase is approved, the products are then prepared and transportation starts.

3.6.1.5 Payment Module

This payment module aids in the purchasing of the supplies by the client and for the warehouse to pay its suppliers. During the purchasing process by the client, he should be able to send the financial support to make his purchase approved. When the funds are received form the client, his purchase is then approved. Then packaging and transportation is done in order to begin the transportation. This facility is also important in the payment of suppliers.

3.6.1.6 Customers Module

This module enables the user of this system in the warehouse side to see the list of all customers the organization is involved with. This module enables this user to view all the buyers and suppliers who have contracted the organization for its services. The user can also add a customer and delete a customer when the need arises.

3.7 Logical Design and Physical Design

The use case diagram below depicts the users of the system and their possible interactions with the system.

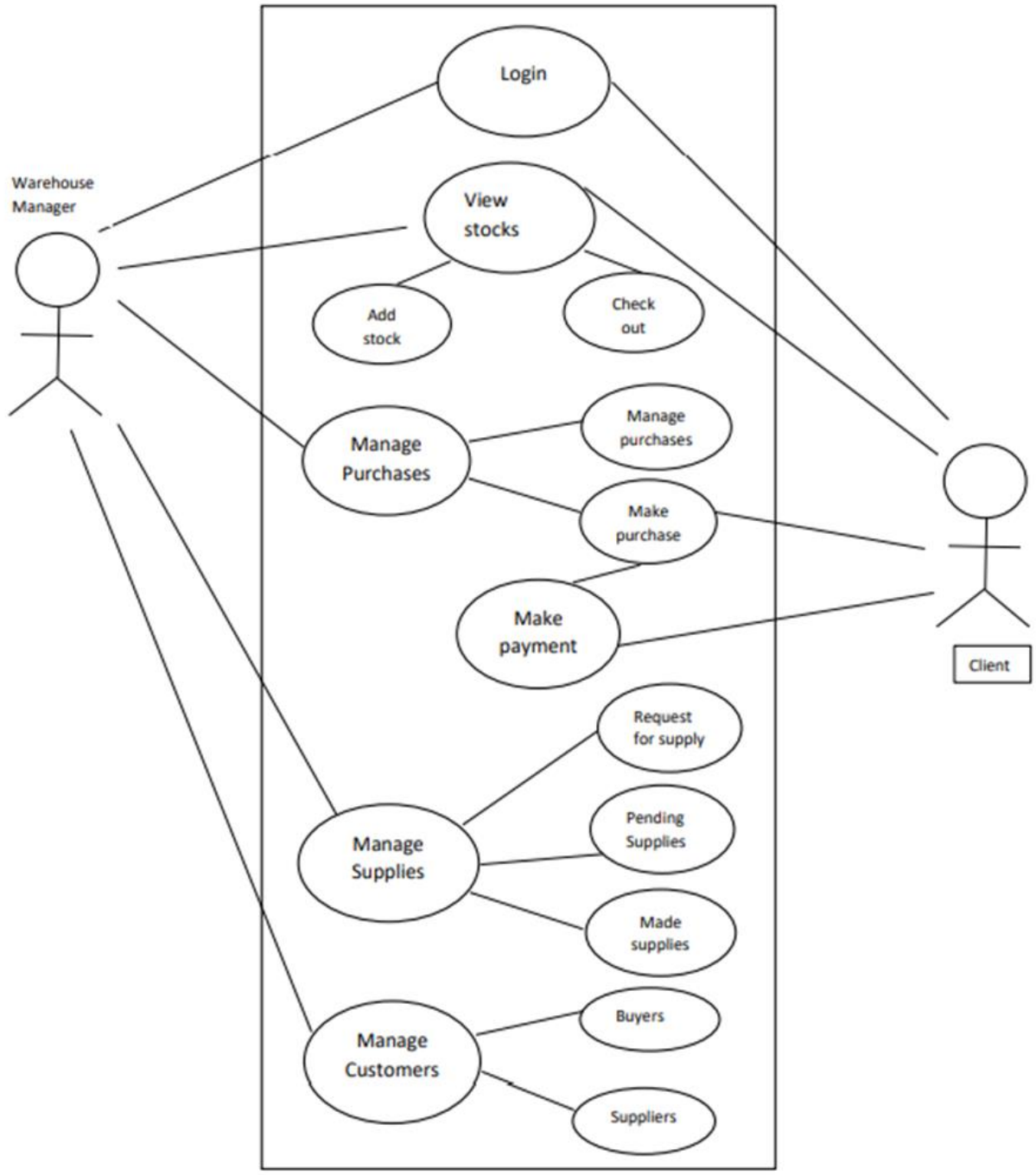


Figure 4 General Use-case Diagram

3.7.1 View Stocks Module

This module enables all the logged in users to view the available products in the warehouse. The warehouse manager and the client will have different functionalities available on their dashboard due to their different levels of access of the system.

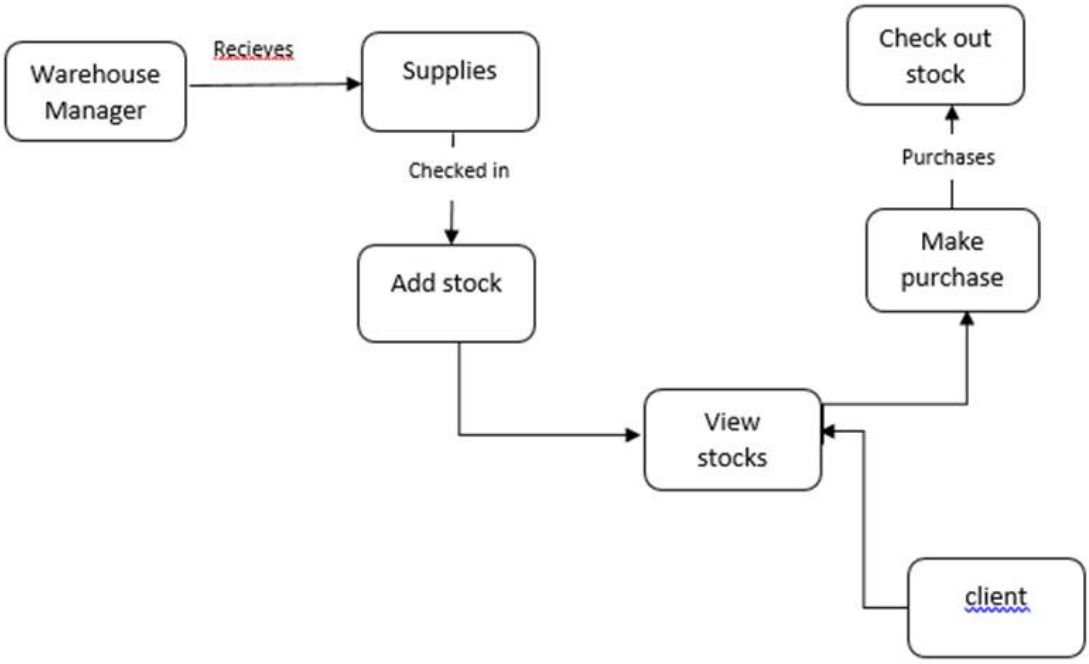


Figure 5 view stocks module architecture

3.7.2 Warehouse manager architecture

The warehouse manager can do the following from the system.

i) Through a higher-level system administrator, he can register himself in the system.

ii) Log in into the system.

iii) Adding stocks into the system once the supply is made to the warehouse.

iv) Managing the customers present, adding new customers and removing customers.

v) Manage the supplies by requesting more supplies from the suppliers.

vi) Manage payments made by the clients during a purchase.

vii) Checking out stock from the warehouse once payment is approved.

viii) Log out of the system.

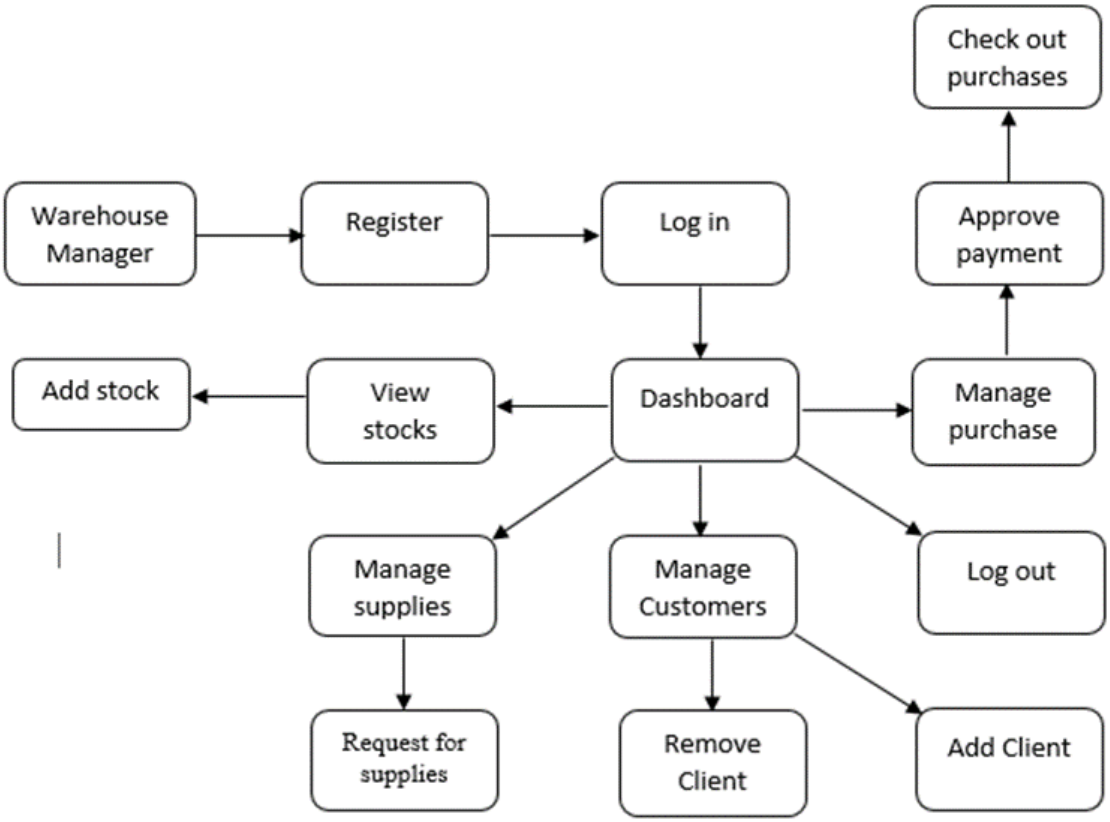


Figure 6 Warehouse Manager Architecture

3.7.3 Client side architecture

On the client's side, the following functionalities will be available

i) If the client's join request is approved by the management, he will be able to register himself into the system.

ii) Login to the system.

iii) View available stocks.

iv) Make purchase of the goods he requires.

v) Make payment of the purchased goods.

vi) Log out of the system.

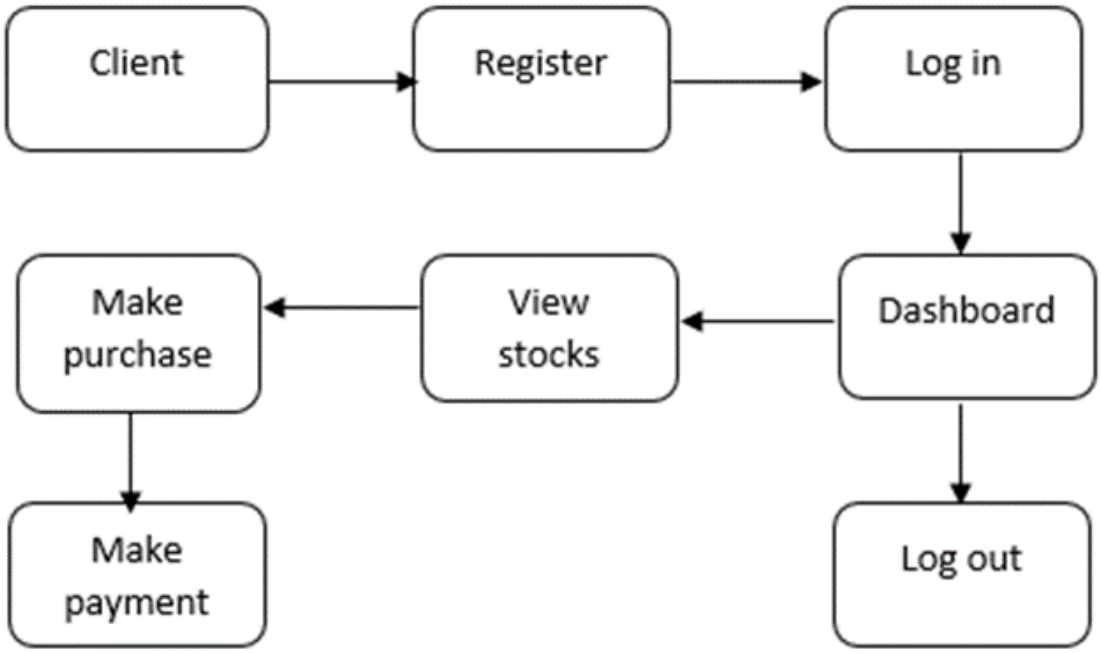


Figure 7 Client Side Architecture

3.7.4 Context diagram

This diagram is an illustration of how all the users of the system interact with the system

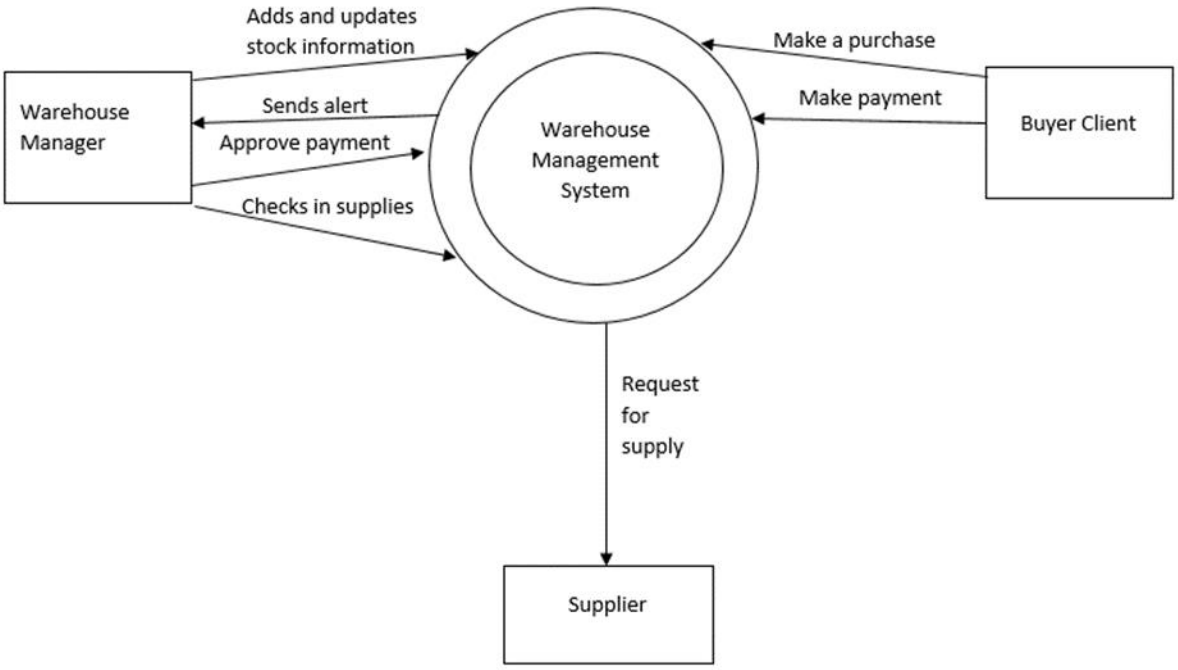


Figure 8 Context Diagram

3.8 Input and Output Design

3.8.1 Input design

In this Warehouse Management System, the input design entails the different formats used in capuring the data of the user into the system. Appropriate methods should be used in order to prevent errors while inputing the data. In my system, I majorly used forms to capture user input. The forms have:

Clear instructions on how the user should fill in.

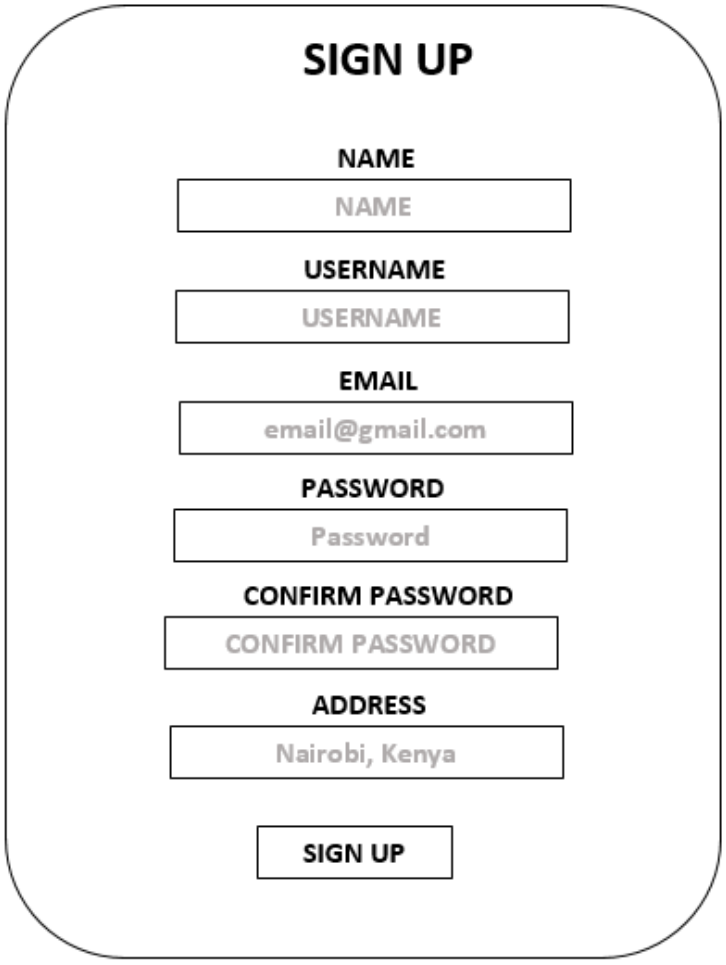
immediate error feedback when an error has been encountered

Clear design that has enough space for typing

This input design has an interactive user interface that ensures there is reduced input volume, only required information is entered. Input integrity controls are employed in order to report back any error when encountered and to develop input controls. They include checks on the value of individual fields, the format and completeness of all inputs.

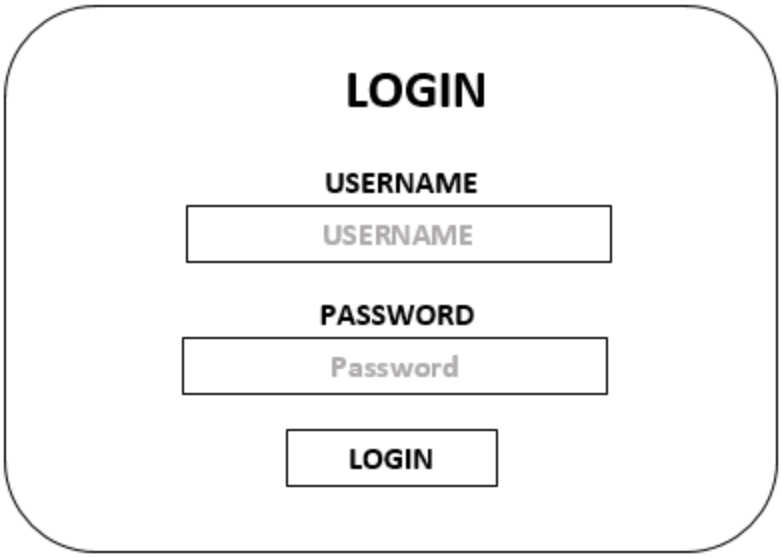
i) signup input

This input form enables each new user of the system to register before he/she can access the system.



The placeholders in the input fields act as guides to ensure the user inputs the required data in the correct format.

Once the user has signed up, the user will then be required to login to the system.



In the case that an administrator(Warehouse Manager) has logged in successfully in to the system, he/she can be able to do make some inputs into the system. The warehouse manager can input new medical supplies of the warehouse into the system. He can also edit the existing supplies, purchases and other modules in the system.

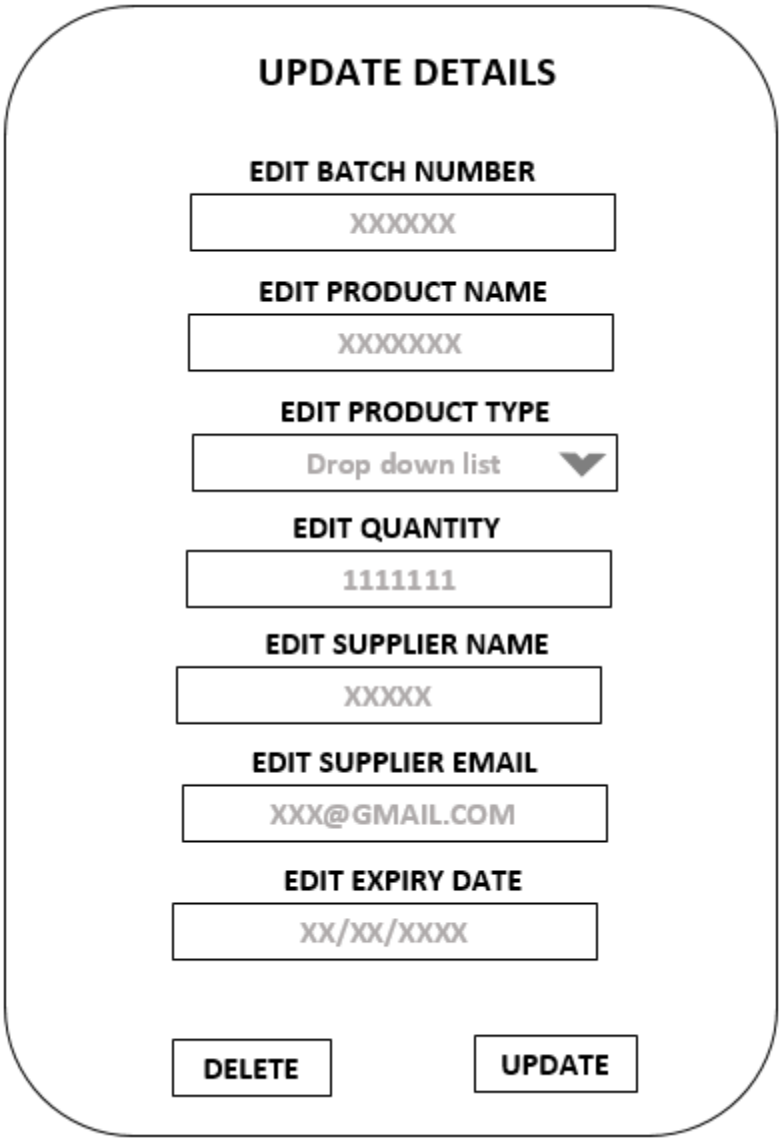
ii) Add supply input design

The image below shows the input design of the add supply module.

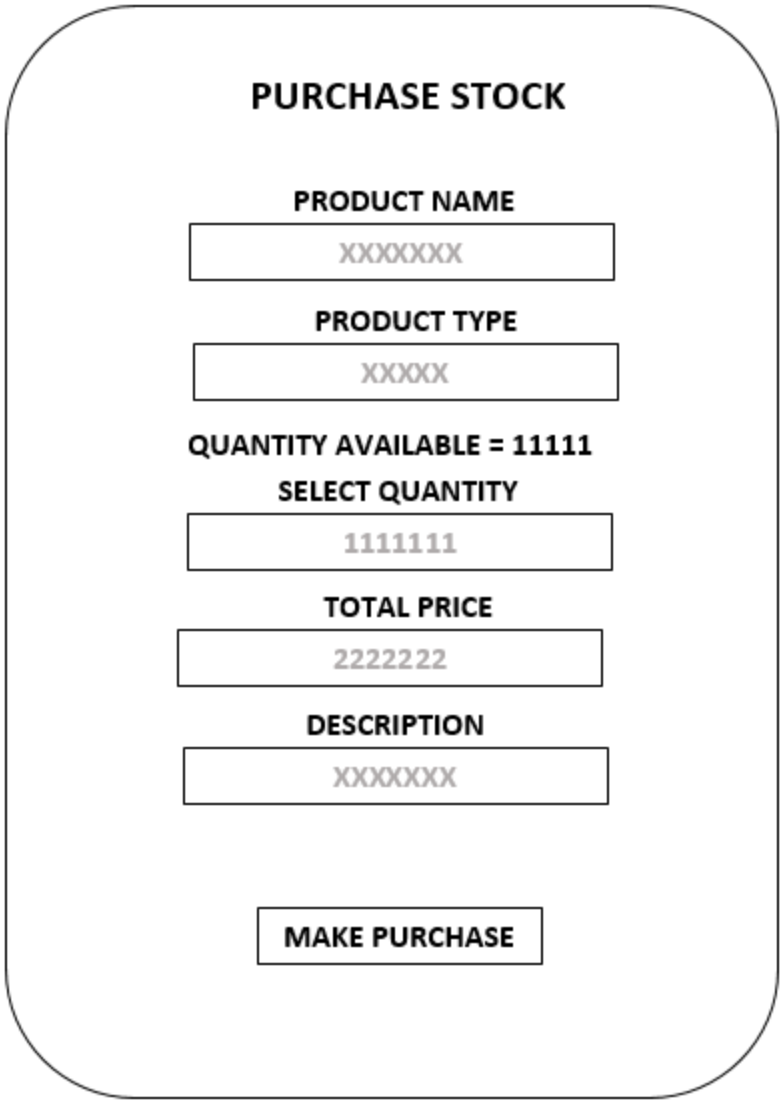
This input has text fields that enable input of the required fields either textual or numeric inputs, dropdown menus that ensure only the applicable entries are made and also ensure the specific date input formats are captured.

iii) Edit/Update details input

Once an entry has been made there might be a slight error that may have occured maybe as a spelling mistake, an input of a wrong quantity of supply or date that needs to be corrected. This can be done by the edit details section. The specific field where the error has been made is selected and the error can be corrected from an input form as shown below.

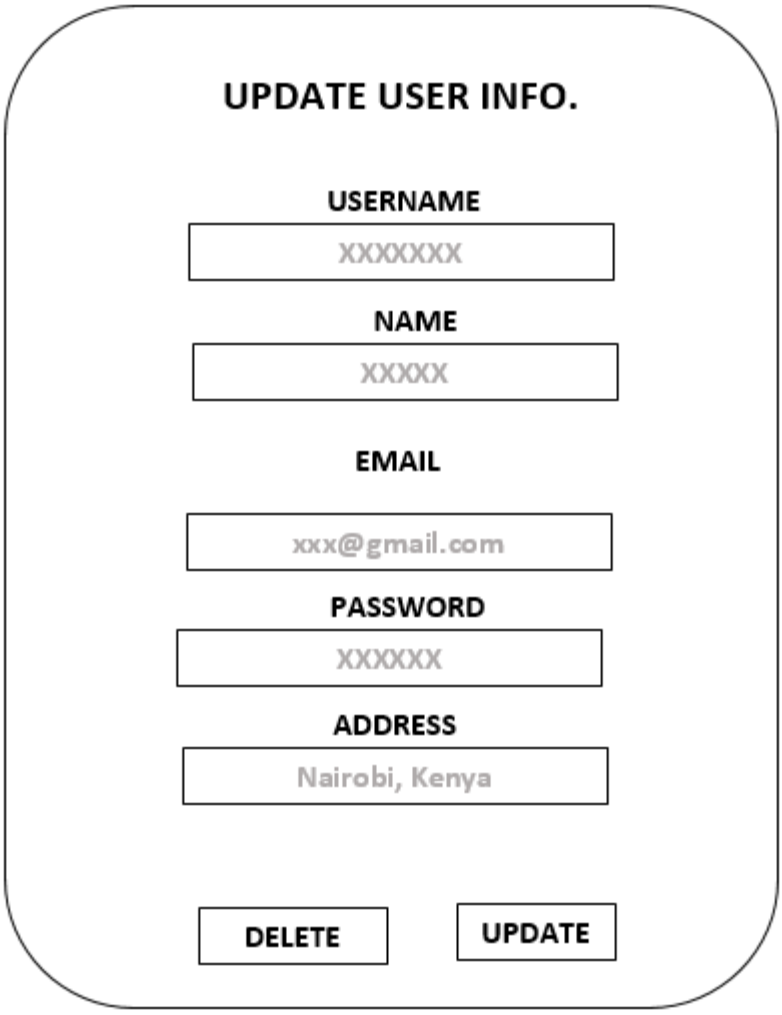


If a user has logged in successfully to the system, he/she will encounter some input forms such as the make purchase, make payment and others. The make purchase input design is as follows



The user will only be required to input the quantity of the product that he wants to purchase and the total price will be calculated by the system automatically. All the other input fields will be provided by the system for the client.

The other input the client can make is editing his/her personnal information. If the user will edit his information he will then be required to login back again into the system. This is because the session will have been disrupted.



3.8.2 Output Design

Output is any response that the system generates when an action is performed byt the users of the system. In the output design, I considered the types of outputs required by the various users, how they will be presented to the user and the necessary report layouts. The output design is important since the output result will be used in making viable decisions by the administration. Relevant output of appropriate quantity should be viewed and it should also be directed to the right person at the right time. These outputs have been distributed across the systems in form of documents that echo results from the database. The documents are downloadable and can also be printed if needed

in hardcopy. The reports the system can generate include the supplies and purchases made, the users of the system, financial reports and a list of the suppliers registered.

These reports can be viewed by the Warehouse manager and also a client, though the client will only view his/her transactions only. The reports are accessible through some buttons at the specific module where the user is interested in. For example, if the manager wishes to view the registered suppliers of the warehouse, he will have to go to the supplers module then click the "Suppliers Report" button and the PDF document will be downloaded and can be accessed easily. The downloaded report will be viewed as shown below.

SUPPLIERS RECORDS
SUPPLIERS

SUPPLIER ID	NAME	EMAIL	ADDRESS
alpamed	Alpha Medical Manufacturers	alphamed@gmail.com	Nairobi, Kenya
bakpharm	Bakpharm Limited	bakpharm@gmail.com	Nairobi, Kenya
biodeal	Biodeal Limited	biodeal@gmail.com	Nairobi, Kenya
galaxyPharm	Galaxy Pharmaceuticals Limited	galaxpharm@gmail.com	Nairobi, Kenya
medina	Medina Chemicals Limited	medina@gmail.com	Nairobi, Kenya
medisel123	Medisel (K) Limited	medisel@gmail.com	Thika, Kenya
rupPharma	Rup Pharmma Limited	rupharma@gmail.com	Nairobi, Kenya
saiPharm	Sai Pharmaceuticals Limited	sai@gmail.com	Nairobi, Kenya
sony	Sony Commercial Agencies	sony@gmail.com	Nairobi, Kenya
surgilinks	Surgilinks Limited	surgilinks@gmail.com	Nairobi, Kenya
TAfrica	Tata Africa Holdings Limited	tatafrica@gmail.com	Nairobi, Kenya

3.9 Database Design

Database design is used to stimulate the construction of business items used in the client/server system. The database tables are normalized to third normal form to avoid redundancies. Below were the respective tables after normalizing.

Users
user_id varchar(12) (PK)
name varchar(30)
email varchar(20)
username varchar(30)
password varchar(30)
role int(1)
address varchar(30)
reg_date date()

Stocks
Stock_id int(7) (PK)
batch_no varchar(12) (FK)
prod_name varchar(30)
quantity int(7)
unit_price int(7)
description varchar(30)

Purchases
purchase_id varchar(12) (PK)
prod_name varchar(30)
quantity int(7)
client_name varchar(30)
email varchar(20)
DOP date()
cost int(30)

status varchhar(10)

Payment

receipt_no varchar(12) (PK)

purchase_id varchar(12) (FK)

prod_name varchar(30)

client_name varchar(30)

paid_amount int(10)

Supplies

supply_id varchar(12)

batch_no varchar(12) (PK)

prod_name varchar(30)

type varchar(30)

quantity int(7)

supplier_name varchar(30)

supplier_email varchar(20) (FK)

date_supplied date()

expiry_date date()

Suppliers

supplier_id int(12)

supplier_email varchar(20) (PK)

supplier_name varchar(10)

address varchar(30)

Types

type_id varchar(12) (PK)

type_name varchar(30)

type_description varchar(50)

3.10 Entity Relationship Diagram

An entity relationship diagram (ERD) shows the relationships of tables stored in a database.

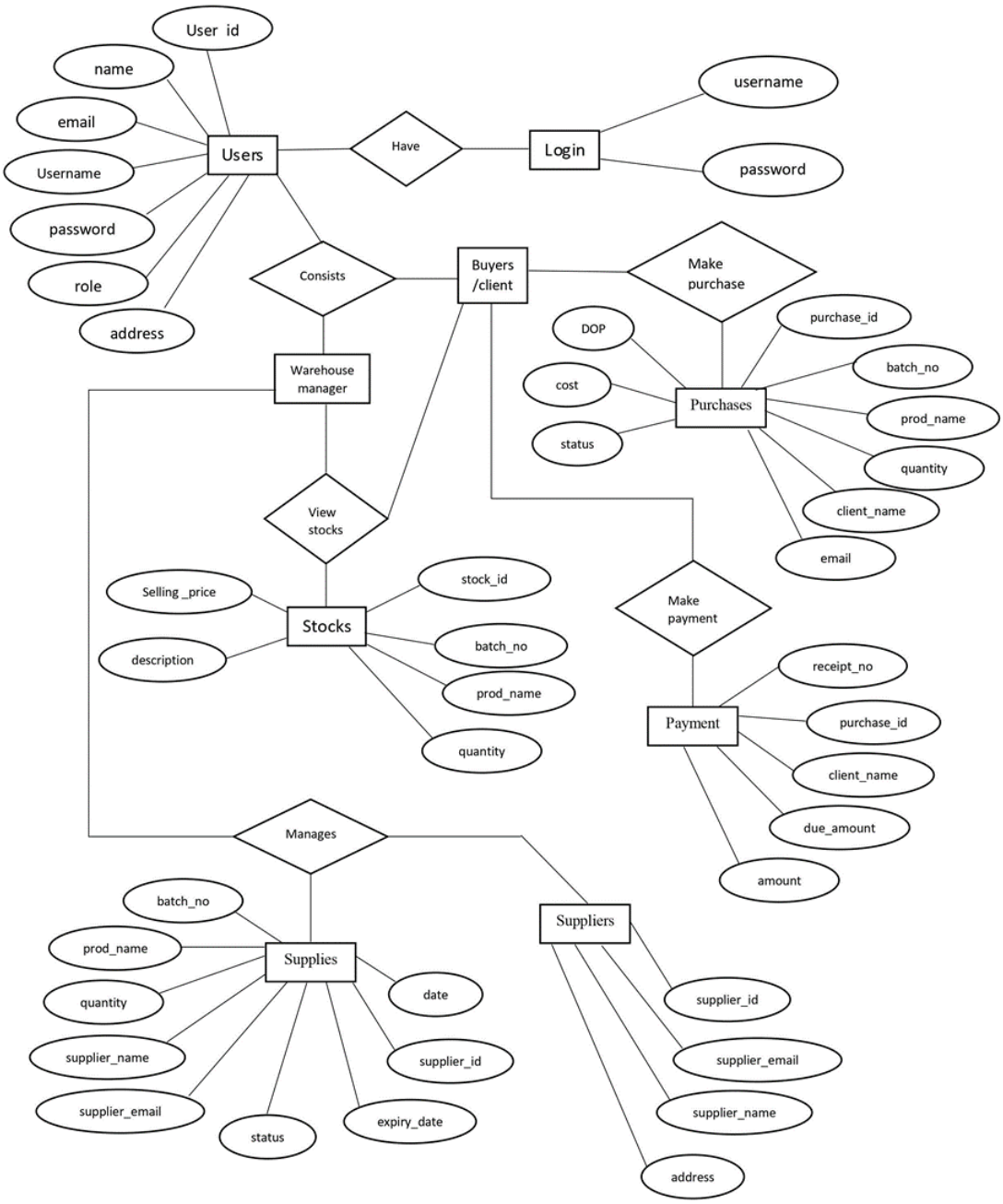


Figure 9 Entity Relationship Diagram

3.11 System Development Tools and Techniques

3.11.1 Programming Languages

The programming languages selected for use in the system development are Hyper Text Markup Language 5 (HTML 5) and PHP together with other scripting languages like JavaScript. HTML codes the documents to be displayed on the web pages. The PHP language is used to make the web pages more interactive and responsive. It is also effective in writing querries that can be used in accessing the database aspect of the system.

3.112 Integrated Development Environment (IDE)

In the system development, Visual Studio Code IDE will be used in the writing the source code of the system. This was preferred because it is free, it can be used to write codes for different languages in one platform and it is also easy to use.

3.113 DBMS

The data that will be relevant to the system will be stored in a database. MYSQL database will be used for that purpose. It will be efficient in storing the tables in a relational manner. It is also usable through a web-interface, PHPMyAdmin, making it easier to use in the manipulation of the data stored.

3.11.4 Hardware requirements

This consists of the collection of physical external devices necessary for the development of the software system. They include:

1) A laptop having the following specifications
    a) Processor standard processor with speed of 1.6 GHz minimum
    b) RAM 4GB RAM minimum
    c) Hard Disk 128GB HDD minimum

2) Optional pluggable keyboard
3) Optional pluggable mouse
4) External Hard disk 20GB for backup purposes.

3.11.5 System Testing Methods

Once the system is developed, the functional testing approach will be used in order to check the functionality of the system based on the objectives. Functional testing involves:

1) Unit testing – this assesses the functionality of each independent unit that the system has if it is performing up to task.
2) Integration testing – it tests the integrated units if they work efficiently.
3) System testing - it involves testing the system as a whole if it has satisfied the requirements that were specified.

Functional testing ensures a high quality product is delivered as per the customer's requirements.

CHAPTER FOUR: SYSTEM CODE GENERATION AND TESTING

4.0 Introduction

This chapter provides a summary of all the processes involved to generate the system code for the Warehouse Stock Management System. It also provides some images showing the functioning of the system as well as providing information about the testing methods that were applied to the system. The different test cases subjected to the system have also been discussed in detail. The conclusion of the project is also brought-out stating if the system resolved the client's requirements and to what extent. Recommendations about the system have also been highlighted on the improvements that can be researched about and be applied to the system.

4.1 System Code Generation

This system is programmed using the HTML, PHP, JavaScript and MySQL programming languages. Part of the the source codes used in the system development are attatched to the appendix of this report.

4.2 System Testing Approaches

The system testing approaches are used to check the functionality of the system based on the objectives declared. System testing was carried out on the whole system either to check on the system requirement specifications or functionality requirement specification. These tests were carried out to detect and solve the errors experienced during the system development. These tests ensure the system is free from errors and has high reliability. The following are the tests carried out on the system:

I. Unit testing
II. Modular testing
III. System Testing
IV. Acceptance testing

4.2.1 Unit Testing

Unit testing involves testing the smallest components of the system individually to assess if they are operating as required. The unit test involves testing the input fields to ensure the correct data format is entered into the system. The hyperlinks and buttons are fully functional to the respective pages. Validation for all the input fields can also be done at this stage. All functions that have been used in the system are also tested to ensure a valid output is recieved by the users.

4.2.2 Modular Testing

Modular testing takes into consideration specific modules of the system. The Warehouse Management system comprises of modules such as payment module, supplies module, stocks module and other modules. A single module was taken at a time and tests are carried out to ensure the module was fully functional. Taking the supplies module as an example, the data should change accordingly when a meidcal supply is made into the warehouse. The warehouse manager can edit and update a record if its entry was made incorrectly. Once all the modules were tested and approved then the next testing phase was carried out.

4.2.3 System Testing

In system testing, all the modules will be intergrated and the system tested as a whole. In the Warehouse Management System there are some specific modules that are dependant on each other. Tests were carried out to see if those modules are synchronous with each other. The supplies module, stocks module, purchases module and payment module work hand in hand. When a supply of a specific product is made, the quantity present in the stocks module should increase with every supply into the warehouse. If a client makes a purchase of the product the quantity should also decrease accordingly. Once the payment has been made successfully thats only when the decrease will be made completely.If the client decides to deregister the purchase the stock will be reflected back into the system.

The sytem testing approach used a specific method to ensure the operation of the system is optimal. The following steps were used:

Creation of test cases - This outlines the specific types of tests that are to be carried out.

Create test data - The data to be used for testing is then selected. Extreme data are chosen to see how the system will respond in extreme cases.

Execute test case - After the creation of the test data the test cases are then excecuted.

Report generation - The results of the test case execution are noted down. All the success and failed test cases are listed.

Regression Testing - This is carried out to test the side effects of the testing process.

Log defects - The failures incured during testing are then addressed and corrected at this stage.

Retest - After the log defects is done, a retest is done to check if the errors encountered were fixed.

4.2.4 Acceptance Testing

Acceptance testing deals with presenting the system to the client once all the other tests have been successfully carried out. The client will then check if the system developed check out with the system and functional requirements specified. If the system fulfils all the required specifications then it is ready to be deployed and be used.

4.3 Test Cases Used

The following table shows the test cases that were carried out and the results gotten.

Test case Number	Test Case Description	Test Data	Expected Results	Actual Results	Pass/Fail
1	Login with wrong/invalid credentials	Username: Root Password: Qwerty01	User should not be able to login	User did not login	Pass
2	Submit Information with a blank input	No data at on or all of the inputs fields	No information will be submitted	As expected	Pass
3	Using letters in numeric	Add supply module	The input will not be filled	The input was not filled. It	Pass

	input fields	Quantity: Many		did not accept the word input.	
4	Stock Reduction after a purchase	current stock: 25000 Purchase 10000 units of Rabies Vaccine	The current stock will reduce to 15000 after successful payment	Successful reduction of the stock quantity to 15000	Pass
5	Stock increment after a new supply	Chloropromazine Tablets: 9500 supplier: Ely Chemical Industries	A new record of the supply will be made in the supply module. An increment of the quantity of the product if it is existing or a new record of the product in the stock module	A new record of the supply was made in the supply module. A new record of the product in the stock module.	Pass
6	Input validation; only valid input will be accepted and pushed to the database.	Enter Product name ‘Rabies Vaccine23’ in the add product module	Reject the data and prompt you to enter data in the correct format.	Prompt the user to enter the data , product name in the correct format.	Pass

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The main objective of the study was to develop a generalized warehouse management system will aid in simplifying the running of the warehouse of the Kenya Medical Supply Authority. I carried out a feasibility study to determine the practicality of the project and found out it was realisable. The data that was collected was quite relevant in coming up with the user and functional requirements the Warehouse Stock Management System was to consist. The system was then programmed and developed using HTML and PHP programming laguages according to the specified requirements. The system was tested to ensure quality, functionality and reliability of the system. The following conclusions and recommendations were made after the development of the system.

5.1 Conclusions

The Warehouse Stock Management System was developed fully and all the main objective was met. Were the payment facility and monitoring and control features incorporated into the system? Definitely, the system was equipped with a payment system that enables the clients pay for their purchases. A monitoring system was also incorporated to enable tracking of the inventory levels of the stocks present in the warehouse. This system will surely impove the running and activities done in the KEMSA Warehouse. The system can not only be used in the KEMSA warehouses, but also in other existing related warehouses.

5.2 Recommendations

This study has contributed to the development of the Warehouse Stock Management System that would aid in the running of the KEMSA warehouses. During the study period, some few points

arose and were noted as areas of interest in further studies. The recommendations are as depicted below:

In this study, the Alerts and notification used are purely in JavaScript language. There was a challenge in incorporating the Email functionality due to the limited resource functionality provided by the local server and the security upgrades by Google, Gmail. The system could function better if it could be developed with better servers at a higher level.

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APPENDIX

Appendix 1: System code

```php
<?php

if (!isset($_SESSION['user'])) {



}



$corepage = explode('/', $_SERVER['PHP_SELF']);

$corepage = end($corepage);

if ($corepage !== 'index.php') {

    if ($corepage == $corepage) {

        $corepage = explode('.', $corepage);

        header('Location: index.php?page=' . $corepage[0]);

    }

}



$query = "SELECT * FROM types";

$dept = mysqli_query($db_con, $query);



$query3 = "SELECT * FROM products";

$result3 = mysqli_query($db_con, $query3);



?>
```

```
<!DOCTYPE html>

<html lang="en">



<head>

    <meta charset="UTF-8">

    <meta name="viewport" content="width=device-width, initial-scale=1.0">

    <meta http-equiv="X-UA-Compatible" content="ie=edge">

    <meta name="Description" content="Enter your description here" />

    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/twitter-
bootstrap/4.6.0/css/bootstrap.min.css">

    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/5.15.4/css/all.min.css">

    <link rel="stylesheet" href="assets/css/style.css">

    <title>SUPPLIES</title>

</head>



<body style="background-color:#e6ffff; ">



    <div class="col-md-6">

        <div class="card card-body">

            <div class="card-header">

                <center>
```

```
                    <h2 class="page-header lead"><b> ADD SUPPLIES
</b></h2><br>

                </center>

            </div>

            <form action="supplies_process.php" method="GET"
class="container " style="width: 75%;">



                <div class="form-group">

                    BATCH NUMBER <br> <input type="text" id="bno"
name="bno" class="form-control" required maxlength="12" pattern="[A-Z0-
9]{1,}">

                </div>



                <div class="form-group">

                    <label for="sel1">ENTER PRODUCT NAME:</label>

                    <select class="form-control" id="pname" name="pname"
onchange="Fetchname(this.value)" required>

                        <option>Select Product Name</option>

                        <?php

                        if (mysqli_num_rows($result3) > 0) {

                            while ($row = mysqli_fetch_assoc($result3)) {



                        ?>

                                <option value="<?php echo
$row["prod_name"] ?>"><?php echo ucfirst($row["prod_name"]) ?></option>
```

```
                    <?php
                        }
                    } else {
                        echo "0 results";
                    }

                    ?>
                </select>
            </div>

            <div class="form-group">
                <label for="sel1">ENTER PRODUCT TYPE:</label>
                <select class="form-control" id="type" name="type"
required>
                    <?php
                    if (mysqli_num_rows($dept) > 0) {
                        while ($row = mysqli_fetch_assoc($dept)) {

                    ?>
                            <option value="<?php echo
$row["type_name"] ?>"><?php echo ucfirst($row["type_name"]) ?></option>
```

```
                        <?php

                            }

                        } else {

                            echo "0 results";

                        }



                        ?>

                    </select>

                </div>



                <div class="form-group">

                    QUANTITY <br><input type="number" id="quan"
name="quan" class="form-control" required maxlength="30" pattern="[0-
9]{1,}">

                </div>



                <div class="form-group">

                    <label for="sel1">SELECT SUPPLIER NAME:</label>

                    <select class="form-control" id="sname" name="sname"
required>

                        <option>Select Supplier Name</option>

                    </select>

                </div>
```

```
                <div class="form-group">

                    <label for="price">ENTER UNIT PRICE</label>

                    <input type="number" class="form-control" id="price"
name="price" required maxlength="7" pattern="[0-9]{1,}">

                </div>



                <div class="form-group">

                    DATE <br><input type="date" id="sdate" name="sdate"
class="form-control" required maxlength="30">

                </div>



                <div class="form-group">

                    EXPIRY DATE <br><input type="date" id="edate"
name="edate" class="form-control" required maxlength="30">

                </div>




                <button type="submit" class="btn btn-info" name="submit">
Submit information</button>



            </form>

        </div>

    </div>

</body>
```

```
</html>



<script type="text/javascript">



    function Fetchname(id) {

        $('#sname').html('');



        $.ajax({

            type: 'POST',

            url: 'ajaxkemsa.php',

            data: {

                prod_name: id

            },

            success: function(data) {

                $('#sname').html(data);

            }

        })

    }

</script>
```

Appendix 3: Questionnaire

Warehouse Management System Questionnaire

Instructions:

Answer the questions as they relate to you. Put either a tick ✓ or an X on your preferred answer. Write the answers on the questions requiring statement responses.

1. Gender:

   Male
   Female

2. Age bracket:

   20 - 30
   31-40
   41-50
   Above 50

3. What position are you currently occupying in the warehouse?

   _____

4. In which department do you work?

   _____

5. What does your work entail on a daily basis?

   _____
   _____
   _____
   _____

6. How frequent are stocks supplied to the warehouse?

Weekly
Monthly
Once in three months
Once in six months
Yearly

Other (specify)
_____
_____

7. How frequent are stocks checked out for delivery out of the warehouse?

Weekly
Monthly
Once in three months
Once in six months
Yearly

Other (specify)
_____
_____

8. What are the challenges you encounter?
_____
_____

9. Is there use of IT (Information Technology) infrastructure in managing the warehouse activities?

Yes
No

10. If “Yes” are there any measures put in place to improve the existing IT infrastructure?

Yes
No
Not sure