UNIVERSITY OF NAIROBI

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A MOBILE ORDER MANAGEMENT SYSTEM

FOR SMALL BUSINESSES

BY

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ABSTRACT

The development and adoption rate of mobile technologies is rapidly increasing on a global scale. Mobile based e-business solutions are also emerging as applications that small businesses could adopt to boost their business performance and lower their costs of operation. This is especially relevant in Kenya where most small businesses have no access to sophisticated e-business solutions that can support critical business processes such as Order Management, which encompasses the process of delivery of products and services, and management of customer service. This can be attributed to the lack of low cost solutions that can be operated on readily available, low cost hardware such as smartphones and tablets. The objective of this research was to assess effectiveness of the application of mobile technologies to solve the problem of order management for Small and Micro Enterprises in Kenya. The methodology used involved an initial pre-study to determine how such an application should look like, followed by the development of the application as per the identified requirements and finally an evaluation of the application with potential users to assess its effectiveness in meeting the requirements. The target respondents for the pre-study and the system evaluation were small business located in Nairobi and its environments. The prestudy involved understanding what the business does, observing the unique environment in which each of the small businesses operate on and finally understanding the key requirements and system features that would be useful to the small businesses in an order management system. The evaluation of the developed application was carried out using researcher administered interviews and involved giving the businesses an opportunity to test the application of their own mobile phones in their unique business environments in carrying out order management functions. It was concluded that mobile technology can effectively be used to provide sophisticated e-business solutions to small businesses in Kenya that do not have the infrastructure and capital to setup full-fledged computer based e-business solutions.

ACKNOWLEDGEMENTS

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Special thanks to my Wife Gloria Mutunga and the rest of my family members for their continued support and patience.

DECLARATION

The material presented in this research project is the original work of the candidate except as acknowledged in text. It has not been previously submitted, either in part or whole, for a degree at this or any other University.

Sign _____ Date_____

Ndunda, Simon

P58/79547/2015

This research has been submitted for examinations with my approval as a university supervisor.

Sign _____ Date_____

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1.1 RESEARCH BACKGROUND

The estimated number of Internet users in Kenya stands at 26.1 million with 99.9% of these accessing their Internet through mobile devices. While feature phones still dominate, smartphone usage has been growing steadily, making up to 58% of all phones that were sold in the country in 2015, Zab (2015).

Mobile technologies, such as laptops, smartphones and tablets, have helped small businesses increase productivity among workers and lower their cost. According to Wamuyu (2011), all enterprises are using mobile telephones with the most common use cases being to make voice calls and send Short Message Service (SMS) texts. The usage of internet enabled mobile devices is also quite high with 77% of the enterprises using some form of cellular internet either through wireless modems, mobile telephones or wireless desktop telephones.

In Kenya, Customer to Customer (C2C) and Customer to Business (C2B) payment transactions have greatly benefited from mobile technologies specifically Mobile Money Transfer Services (MMTS) with most customers using such services to pay for their goods and services and perform peer-to-peer money transfers, Wamuyu et al (2011). Paying of utility bills using MMTS is the most acceptable and readily used type of C2B e-commerce transactions in Kenya today.

At a global scale, E-business tools are becoming more affordable as technological advances drive down costs, this has especially been facilitated by innovative Software as a Service (SAAS) models bringing down acquisition costs associated with business software. Faisal (2012) describes benefits from the adoption of e-business from three perspectives: financial, marketing, and performance perspectives. From a financial perspective, adoption of e-business solutions increases profitability while lowering costs. E-business solutions can also facilitate matching of buyers and sellers at minimal cost. From the marketing perspective, e-business enhances customer satisfaction by establishing interactive two-way relationships with customers while also providing a medium for advertising and brand building. On company performance, the adoption of e-business is necessary for enhancing the efficiency of communication, information gathering, business transactions.

1.2 PROBLEM DEFINITION

According to a study by (Cragg and Mills, 2011) on the importance of all businesses processes as listed by the American Productivity and Quality Center's (APQC) process classification framework, two core business processes were identified as strategically most important for small businesses: delivery of products and services, and management of customer service. These should be strategically prioritized for an acceptable level of IT support usually through application of an appropriate e-business software.

Most small businesses in Kenya have no access to sophisticated e-business solutions that can support the most critical process of Order Management, which encompasses the process of delivery of products and services, and management of customer service. This could be attributed to lack of low cost solutions that can be operated on readily available, low cost hardware such as smartphones and tablets. Only 38% of small and medium enterprises in Kenya have a website for providing enterprise information and the usage of sophisticated e-business solutions is limited with a low usage rate of less than 10%, Wamuyu (2011).

1.3 OBJECTIVES

The overall objective of this research is to assess the application of mobile technologies to solve the problem of order management for Small and Micro Enterprises in Kenya. The specific objectives are:

- ❖ To survey the current state of art technologies for order management systems for small businesses
- ❖ To extract key functionalities required by small businesses through interacting with them.
- ❖ To develop a mobile enabled order management system that provides the key functionalities required by small businesses.
- ❖ To assess the effectiveness of mobile enabled order management system on meeting business needs.

1.4 PROBLEM JUSTIFICATION

The development and adoption rate of mobile technologies are rapidly increasing on a global scale and Mobile order management systems are consequently emerging as applications that small businesses may adopt to boost their financial performance and lower their costs of operation.

1.5 RESEARCH ASSUMPTIONS

1. It was assumed that the individuals who were interviewed for this research gave honest and true responses.
2. It was assumed that the technology adoption and usage behavior for small businesses in Nairobi and its environs reflects the general pattern across the country especially in other major towns.

1.6 SCOPE OF STUDY

This study will be carried out on small business in Kenya, specifically those located in Nairobi and its environs.

The application to be developed will be limited to the following functionalities:

- Allow business to receive orders made online on their mobile devices.
- Allow businesses to record manual orders
- Allow businesses to update stock balance of their items
- Allow businesses to automatically update stock balances based on sales
- Allow businesses to automatically acknowledge customer orders
- Allow businesses to generate reports for orders and sales activity

The application is not going to have the following functionalities:

- Full-fledged Enterprise Resource System (ERP) features
- SMS or USSD mobile interface

2 LITERATURE REVIEW

In this section, a description m-commerce, e-business and order management processes is done in the context of Small Businesses in Kenya. A review of challenges facing small businesses in the traditional management of businesses processes and the winnings achieved by usage of mobile technologies are also discussed. The order management technologies available in the Kenyan market are also reviewed and critiqued. Finally there is a review of theoretical frameworks that have been applied in past studies to guide the evaluation of technological needs.

2.1 INTRODUCTION

Information technology has over the last 5 decades been applied to address the need to process and store vast amounts of data, a feat that was not possible before the invention of computers. Although the emphasis of information technology was initially on designing systems such as management information systems, automated decision systems, and transaction processing systems to both support management and improve the efficiency of business activities (Kling, 1980), more recent studies suggest that technology adoption is gradually moving more toward supporting business activities rather than simply replacing business functions. Accordingly, businesses are adopting technology and strategically positioning it to establish differentiation, pursue new opportunities, add value to the existing business process and create new customer value. Economic and consumer needs are also changing both worldwide to align with new technological advances hence pressuring business leaders to continually adopt relevant technology to maintain business growth.

Technology clearly has immense benefits when selected, implemented, and used within the proper context and timing to create competitive advantages and establish near real-time connectivity with other parties. However, according to Zhang & Lado (2001), firms should still be cautioned about the level of resources used in order to adopt the information technology that will generate competitive advantage and performance improvement. This is especially true for small businesses that have limited financial resources and therefore need to prioritize and target technological investment efficiently.

2.2 E-BUSINESS

E-business has been defined as the approach to achieving business goals in which networked, computer-based technology for information exchange enables or facilitates execution of activities in and across value chains as well as supporting decision making that underlies those activities, Liang (2013).

E-business is a broader definition of e-commerce which is defined as the buying and selling of products an services over telecommunication networks by King et al. (2002, p. 881). E-business includes servicing customers, collaborating with business partners, and conducting electronic transactions within an organization.

E-business implementations must be adopted before benefits can be realized, Zhu et al (2006), as such, technology adoption theories and technology diffusion theories have been applied in the context of e-business. Zhu et al (2006) draws on innovation diffusion literature to conceive of e-business assimilation as the three stages shown in the figure below: initiation, adoption, and routinization.

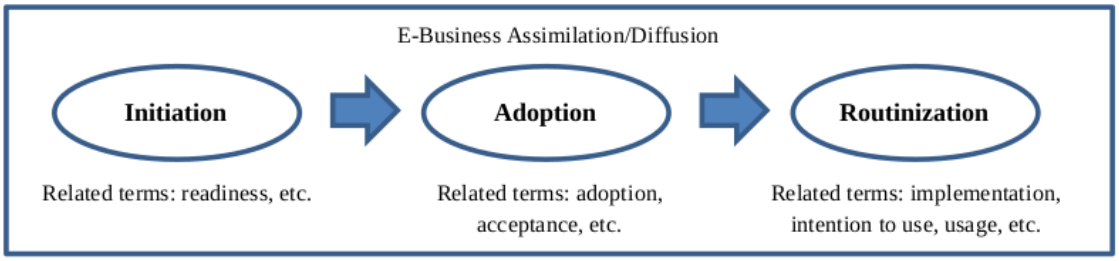


Figure 1: Three stages of E-Business Assimilation

Types of E-Business

There are two main categories of E-business: Business-to-Business (B2B) and Business-to-Consumer (B2C). B2B is defined as business transactions, including e-business transactions, between firms. Specifically, it refers to a firm's supply chain members, intermediaries, and business customers (Trites et al., 2006). B2C, on the other hand, refers to business transactions conducted between firms and individual non-business customers (Trites et al., 2006).

2.3 M-COMMERCE

Mobile Commerce is an evolving area of e-commerce, where users can interact with the service providers through a mobile and wireless network, using mobile devices for information retrieval and transaction processing, Rani et al (2013).

2.4 MOBILE TECHNOLOGIES USAGE IN KENYAN BUSINESSES

Kenya has seen widespread adoption of mobile subscriptions with a total of 37.7 million mobile subscribers at the end 2015, a 87.7% mobile penetration rate. 70% of all subscribers also have mobile money accounts (CAK, 2016). The most common uses of mobile money are: peer-to-peer money transfer, business-to-customer payments, customer-to-Business payments, loans and savings. The main benefits of mobile money services cited are: increased availability of products and services, convenience for both end users and businesses, lower risk of handling cash, increased sales and lower costs of doing business. According to Patrick wamuyu (2011), utilizing MMTS positively and significantly influenced organization's performance through operational, transactional and interactional benefits.

At the same time, the usage of smart mobile devices by small businesses has exploded. The diagram in figure 1 below shows the most common applications of smartphones by businesses as illustrated by the Small Biz Mobility Report (2012).

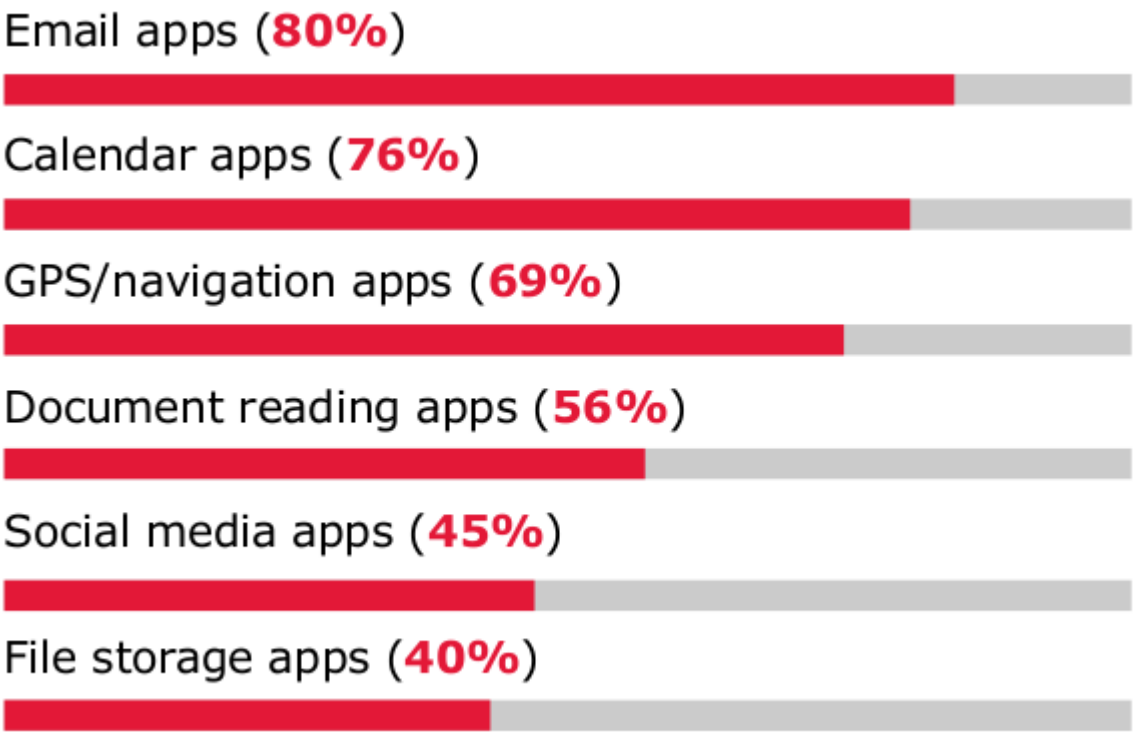


Figure 2: Common applications of smartphones by businesses

2.5 Business Processes in Small Businesses

A business process is a collection of linked tasks which find their end in the delivery of a service or product to a client. A business process has also been defined as a set of activities and tasks that, once completed, will accomplish an organizational goal. According to the American Productivity and Quality Center's (APQC) process classification framework, there are 13 major types of business processes. These are:

- Develop Vision and Strategy
- Develop and Manage Products and Services
- Market and Sell Products and Services
- Deliver Physical Products
- Deliver Services
- Manage Customer Service
- Develop and Manage Human Capital
- Manage Information Technology (IT)
- Manage Financial Resources
- Acquire, Construct, and Manage Assets
- Manage Enterprise Risk, Compliance, Remediation, and Resiliency
- Manage External Relationships
- Develop and Manage Business Capabilities

According to a study by (Cragg and Mills, 2011) on the importance of each process and how well IT supported each process, two core business processes were identified as strategically most important: deliver products and services, and manage customer service. Although the evidence indicated that the most important business processes were supported at an acceptable level, IT support was found to be low for many business processes.

2.6 PAYMENTS AND LEVELS OF INTEGRATION

Every small business struggles with creating the systems environment to grow and do business effectively, this mostly arises from having acquired different independent computer systems as they've developed – such as for accounting, sales, inventory and e-commerce – small businesses find their growth is being hampered by a tangle of separate, standalone, non-integrated applications and data-sources that don't 'speak' to each other. There are considerable benefits to be derived from tighter systems integration, these are:

- Boosting productivity: dealing with several standalone systems can be time consuming, with employees manually inputting data into separate programs, which can cause problems if any of that data is entered incorrectly.
- Better management information: it can be nigh on impossible to get a 360° view of how the business is performing when you run several different systems and there can be a time lag for managers knowing what's actually going on until information is manually inputted.
- Cost: the cost and time involved in maintaining and updating several systems can be big.
- Greater customer satisfaction: having multiple systems mean it can take extra time to fulfill clients' orders or respond to their enquiries and complaints.

The only drawback to tight systems integration security vulnerabilities that arise from the gateways through which data flows from one system to another. If one system is hacked, the attacker can potentially have access to all linked systems ("The Pros And Cons Of Systems Integration For Small Businesses - Hiscox Business Blog").

2.7 DEFINING MOBILE ORDER MANAGEMENT

An order management system (OMS) automates and streamlines order processing for businesses. An OMS provides constantly updated inventory information, a database of vendors, a database of customers, a record of customer returns and refunds, information on billing and payments, order processing records, and general ledger information, Financial Applications (2016).

The following are modules that are typically included in an order management system: General Ledger, Inventory Sub-ledger, Accounts Receivable, Accounts Payable, Point of Sale Interface.

2.8 ORDER MANAGEMENT PROCESSES

An order management system helps to organize and streamline the order fulfillment process. It also helps manage the critical aspects of doing business. These processes include: customer service, accounting, inventory management, warehouse management, marketing, and sales forecasts. An OMS helps these processes work together to keep a business running as efficiently and smoothly as possible. The following is a typical order management process in a Small or Medium Size business.

1. The customer shops

Whether it's at an online store, in person, or through a catalog, the customer browses what is available. The Order management system at this stage displays correct inventory to the customer, and ensures your inventory numbers are updated and correct.

2. The order is processed

Inventory numbers are updated and Order Management System begins the tracking process, generating a unique tracking number for the customer that's linked to their order in the system. The order management system also updates the projected sales information with this order.

3. The customer pays for the order

The customer pays for their items, and your order management system updates the accounting system and generates an invoice or receipt for the customer. Payment information is verified within the Order Management System.

4. Delivery process begins

If the customer is shopping online, they have the option to get their order delivered or picked up in-store, in this case, the order management system will send the customer's delivery information to the preferred shipping outlet. The order tracking process is updated within the OMS, all the way up to successful delivery.

2.9 Challenges facing Small Business in Order Management

From the review of existing literature, we established the main issues faced by small businesses that have not adopted order process automation (Order process management for C2B).

Firstly, manual order processing is error prone and slow, this is mainly because users must rely on paper records for references, resulting in slow lookup of records such price information, customer history etc. Manual data entry and calculations are also slow and error prone since no automatic validation can be performed.

Secondly, in a manual system, there is no way to automatically receive and acknowledge orders. This limits the business to only serving customers at a slow rate depending on the number of employees available. Mostly, customers must walk into the business premises to request the orders, further limiting the market reach of the business.

Thirdly, a manual system does not take advantage of systems integration with complementary systems such as mobile payments, messaging platforms, supplier databases etc.

Lastly, the lack of an automated order management systems necessitates cumbersome and time consuming physical visits to examine stock levels frequently coupled with the lack of real-time visibility to stock movement. With an automated system, stock levels only need to be examined at period close dates only.

2.10 Mobile Order Management Solutions in Kenya

In this section, we reviewed the current solutions available to Kenyan small businesses. We restricted our review to only solutions that provided businesses with some or all of the following features:

- A mobile interface to enter and/or enter orders and manage order statuses
- Ability to receive and process payments
- Inventory management
- General ledger accounting.

2.10.1 Weza Tele - MyOrder

Weza Tele is a Kenyan technology company that provides a number of value added mobility solutions in commerce, supply chain, distribution and mobile payment integration, in Kenya, Tanzania, Zimbabwe and Nigeria.

Weza Tele has created innovative supply chain solutions for SMEs in the informal sector by using basic mobile technology. The company's MyOrder enterprise solution is a quick and easy-to-use ordering platform that increases the visibility between retailers and distributors, and streamlines the overall supply chain management process," Frost & Sullivan (2015).

The order management system provided by Weza Tele is targeted to suppliers and distributors of Fast moving products, who have a sales team and are working at scale and comes with mobile money integration and other third party systems integration capabilities such as messaging. The MyOrder platform however does not provide sophisticated e-business features such as Inventory management and General ledger accounting on top of the order management features. This solution is therefore does not meet the most pressing needs of small businesses in Kenya.

2.10.2 Beinafuu

Beinafuu is a Kenyan company that provides order management solutions for both C2B and B2B transitions. Orders can be captured through SMS or their online web interface. While the platform is a suitable system for sellers of digital products or businesses that have a small portfolio of products especially those with an online presence, it is not practical for regular small businesses mainly due to the limitations to SMS as the channel for sending orders. The company does not provide an offline-capable smartphone application and businesses must rely on the online portal to receive and manage orders and payments.

2.10.3 Think Tank

Think Tank is a Kenyan company established which focuses on developing and integrating mobile solutions including mobile applications, tablet applications and SMS/USSD applications. The company provides an Order management system delivered on a mobile platform using SMS, USSD and a mobile App that users can download on their smartphones. Their solution however like Weza tele does not provide sophisticated business functionalities beyond Order processing.

2.11 Theoretical Background

The main goal of this study is to assess the application of mobile technologies to solve the problem of order management for Small and Micro Enterprises in Kenya. The study aims to understand the most important features, requirements and characteristics of an e-business application that meets the need of the average small business and design and implement an application that meets most of those needs for use in the Kenyan context. Under this section, we reviewed theoretical frameworks that may shed light on the process of understanding new innovation adoption, this review contributed to the pre-study design.

2.11.1 Technology Acceptance Model

The technology acceptance model (TAM) is a theory that describes how users accept and use information technology (Davis, 1989). The model associates the attitude and intention of users to use a certain technology with two preceding factors, namely, perceived ease-of-use and perceived usefulness of the technology. The TAM model has been very influential in the information systems field and has undergone several developments in the past two decades (Parker & Castleman, 2009). The model specifically discusses the customer point-of-view and attitude toward the use of a technology. In this study, we aimed to understand the most important characteristics and features that for small businesses in an order management system. As such, the study was designed to gauge the perceived ease-of-use and the perceived usefulness of the e-business solutions guided by this model.

2.11.2 Diffusion of Innovation (DOI)

Another theory that was considered in this study is the diffusion of innovation (DOI). According to Rogers (2003), DOI describes the relationship between members of a social system and innovation adoption. He argues that the decision to adopt a technology innovation is based on relative advantage, compatibility, trial ability, observe- ability, and simplicity of the technology. DOI follows certain steps: Knowledge to gain initial interest and awareness about the innovation; persuasion to gain detailed information about the innovation; decision, to decide whether to implement or reject the adoption of the innovation; implementation to adopt the innovation gradually; and confirmation to fully adopt the

innovation. From the perspective of adopting technologies over time, the process follows an S-shaped curve where adopters can be classified as innovators, early adopters, early majority, late majority, and laggards. The DOI theory addresses important issues that relate to innovation adoption and social network effects and is widely accepted and used in the literature (Parker & Castleman, 2009. This study involved understanding the system characteristics that are considered useful in a particular technology rather than the factors that influence the process of adoption and the spread of a technology, the DOI theory was therefore not deemed to be relevant to this research.

3 METHODOLOGY

3.1 PRESTUDY

The overall objective of this research is to assess the application of mobile technologies to solve the problem of order management for Small and Micro Enterprises in Kenya. The purpose of the prestudy was to better understand the specific requirements of small businesses and their order management processes. The target respondents were small business located in Nairobi and its environments. The prestudy involved understanding what the business does, observing the unique environment in which each of the small businesses operate on and finally understanding the key requirements and system features that would be useful to the small businesses in an order management system.

We performed pre-test interviews with 6 small businesses in 3 different sectors i.e. retail, hospitality and education. In each business we talked to at most 2 people, the owner and one other main stakeholder in the business who is involved in the day to day running of the business. We analyzed the results of our pretest surveys. The output of the prestudy was a list of features to be included into the system.

3.1.1 Study Design

This was a qualitative and exploratory study targeting 6 small businesses around Nairobi and its environs. We targeted representation from main sectors of small businesses.

Purposive sampling was used in this study, so as to target small businesses with organized processes of dealing with orders and who are likely to adopt automated systems. Purposive sampling was appropriate for the prestudy because the aim of this study is to gain an overall understanding of common business requirements in order management systems within the context of small businesses in Kenya, the study does not aim to generalize the results to the population.

The instrument used was a researcher administered questionnaire, this is because this is a new area with little prior research and also because the some of the questions involved highly technical terms that most of the respondents may not understand without detailed and contextualized examples. A researcher administered questionnaire also gave us a chance to gain a deep understanding of the area.

3.1.2 Data Collection

The interview questions were based on the literature review performed. A sample of the questionnaire followed in the interview can be seen under Appendix 1.

A total of 6 businesses were interviewed, this process took six days with a separate day for each interview.

The interview process started with an introduction of the researcher and statement of the overall goal of the study. This was then followed with interview questions guided by the questionnaire with brief pauses to describe the technical terms used, this usually took between 30 and 45 minutes. After the interview, the researcher then stayed for about 1 hour to observe the businesses processes in practice and thereafter ask any follow-up questions.

The questions were divided into the following sections:

1. **General Information:** This was used to record the business details including sector and name.
2. **Customer to Business Solutions:** This was used to establish the most common C2B solution used in the market. This would help in the prioritization of integrations in the final application.
3. **Order Management Solutions:** This was used to capture any alternative e-business solutions already in use in the market and also identify the most critical e-business needs and requirements. Under

this section, we also recorded any challenges and shortcoming arising from business processes design and the environment. All these information was adopted in the design of the final application.

4. **Mobile Device Adoption in Business:** Since the overall objective of this study is to establish how mobile technologies can be used to solve the problem of order management, it was deemed critical to validate the assumption that small businesses have access to mobile devises capable of accommodating an e-business solution. This section was also used to measure the comfort levels of the target users in installing and using a mobile based application to run a business.

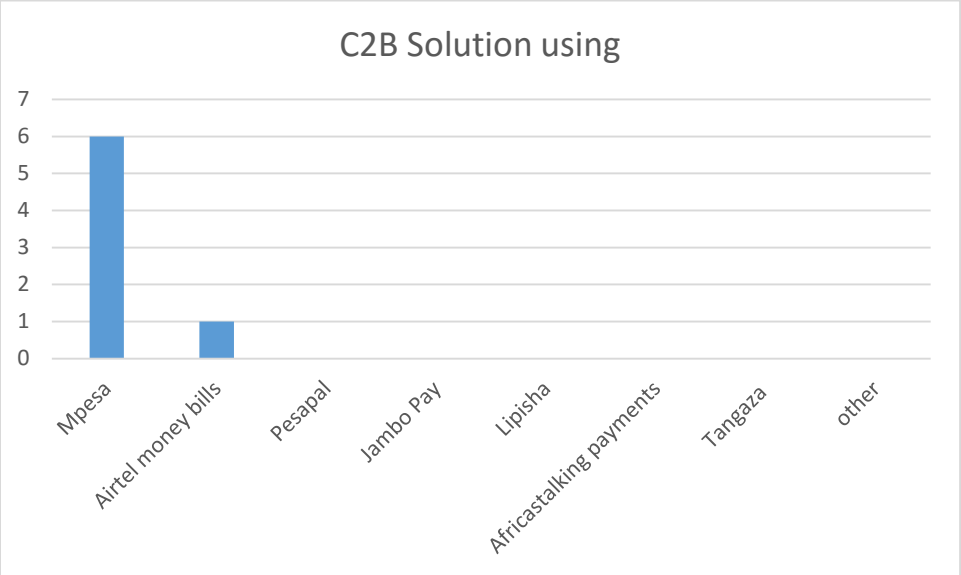
3.1.3 Results

3.1.3.1 Data Analysis

The collected from the interviews was analyzed qualitatively, looking for themes or patterns in the requirements for a order management system. Analysis was performed mainly using Excel. Frequency distribution across the codes and percentages were used to summarize the results as shown below.

Use of customer to business solutions

All businesses interviewed were found to be using at least one C2B payment solution. Mpesa was the most common C2B payment channel used by 100% of all businesses.



Order Management Solutions

It was found that some (33%) small businesses were already using order management solutions. This was true for small businesses that handle large volumes of orders in this case a restaurant and a private school.

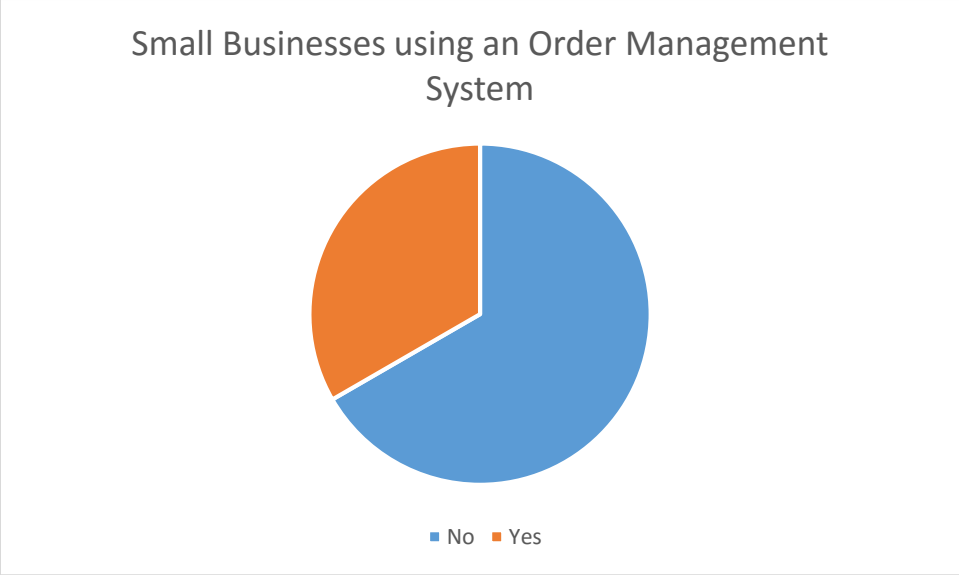


Figure 3: Small Businesses using an Order Management System

The order management solutions in use were customized proprietary software and were not mobile enabled. None of them supported any form of integration with C2B solutions. This was a major challenge reported by the users since it resulted in cumbersome and often error prone payment reconciliation process when reporting mobile payments.

The most important features reported for an order management system were: Order processing, Billing and payments, General ledger account and reports. Other useful features were Point of Sale interface and Inventory management. Most of the small businesses interviewed showed little interest in online marketplaces and advanced e-businesses features such as Fixed Assets management, Payables and Receivables.

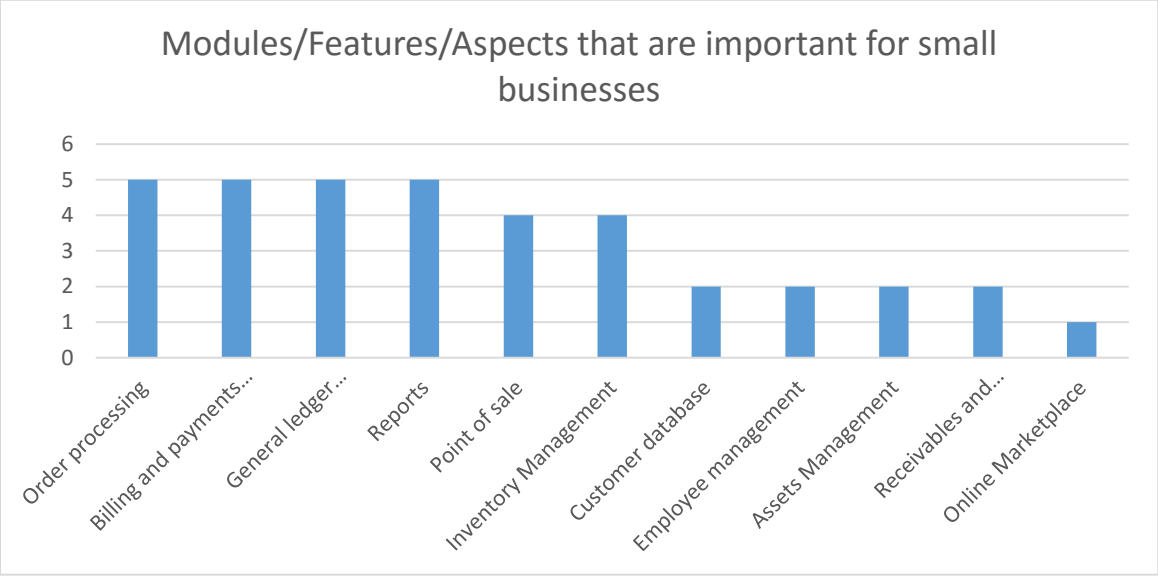


Figure 4: Features that are important for small businesse

The most common challenges reported by small businesses in working with current e-business offerings were: low computer literacy, lack of mobility, lack of remote/online access and lack of useful integrations such as payments and messaging services.

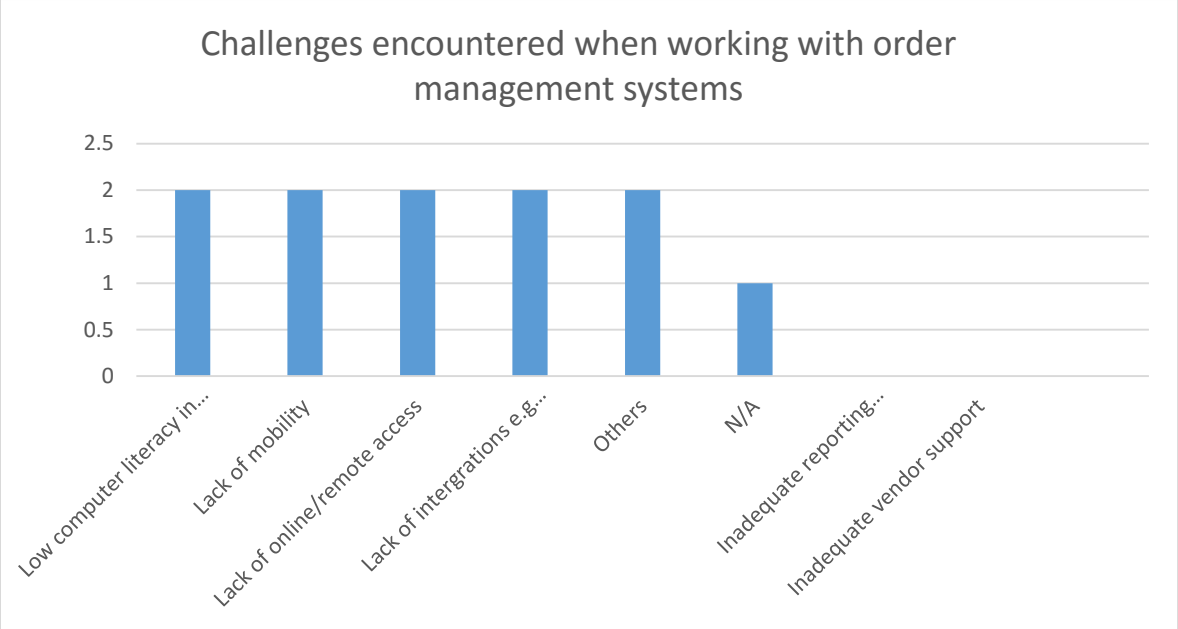


Figure 5: Challenges encountered when working with order management systems

Mobile Devices Usage in Small Businesses

All individuals in the businesses interviewed were found to have access to a mobile device for both personal and business use. This was expected given the high penetration rate of mobile phones in Kenya and the fact that all the businesses interviewed were in close proximity to a major town.

The most common type of mobile device was the Smart phone.

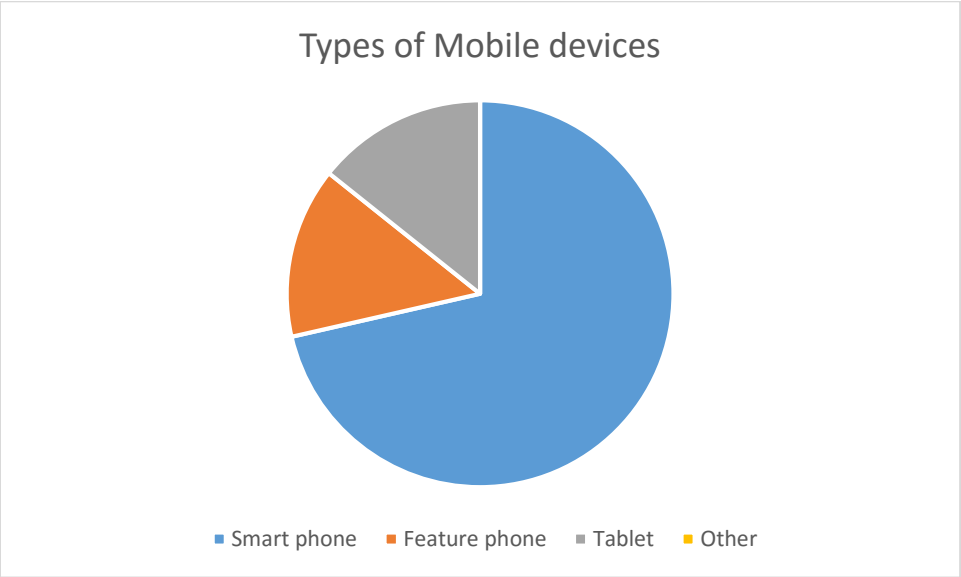


Figure 6: Types of Mobile devices used

It was established that most individuals running small business are comfortable with using smart phones and always have access to their phone at any time of day.

It was established that the smart phone users always have access to the internet either through shared wirelesss networks (WIFI) or 3G mobile data.

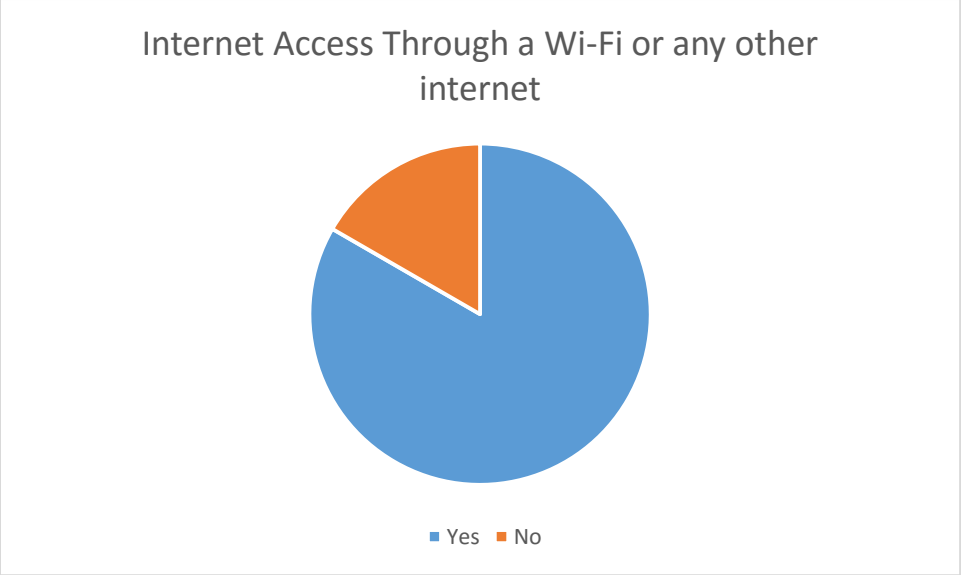


Figure 7: Internet Access Through a Wi-Fi or any other internet

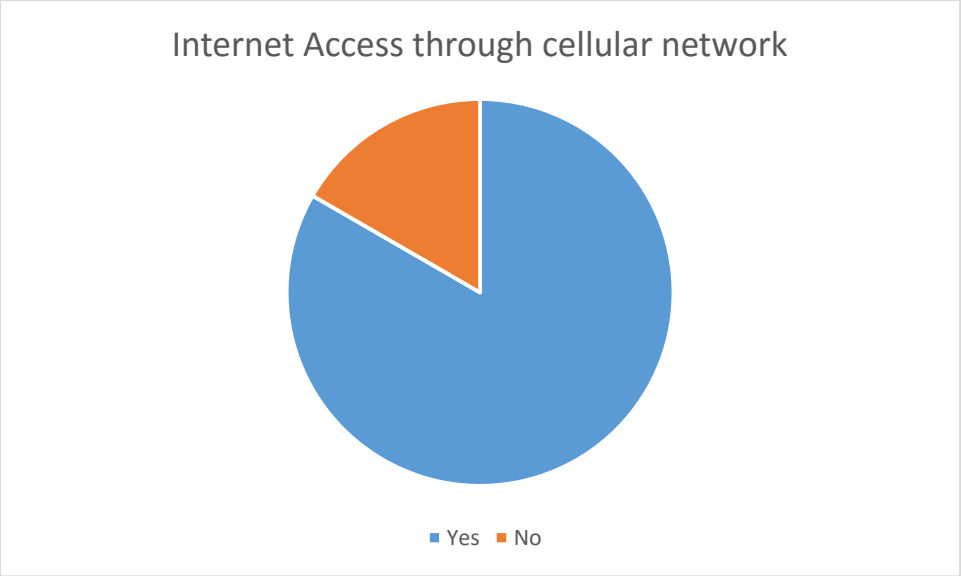


Figure 8: Internet Access through cellular network

3.1.3.2 Requirements

Functional requirements

The following functional requirements of the order management system were derived from the data analysis above.

- Order processing
- Billing and payments
- General ledger account and reports.
- Point of Sale interface
- Inventory management.

Non-Functional Requirements

The following system characteristics were identified as desirable to enable smooth operation of the order management system.

- Mobile Accessible
- Remote/Online Access
- Easy extensibility for integration with independent services (messaging, payments)
- User-friendly and easy to use

Other Key Observations

The following observations were also made during the interview process, and were considered important factors in the design of the solution.

- Tax Compliance: Some businesses were uncomfortable with idea of a business application that can potentially contain records that can be used as evidence against tax avoidance by tax authorities.
- Businesses have very well established order processes with separation of duties between cashiers and the accounting officers who audit daily records and carry out banking tasks. As such a system must support multi-user access with different levels of access.

3.2 Application Development

3.2.1 Application Development Methodology

The Agile development methodology was adopted for this research. Agile seeks to help teams respond to unpredictability through incremental, iterative work cadences, known as sprints. Agile methodologies are an alternative to waterfall, or traditional sequential development.

Agile development methodology provides opportunities to assess the direction of a project throughout the development lifecycle. This is achieved through regular cadences of work, known as sprints or iterations, at the end of which teams must present a potentially shippable product increment. By focusing on the repetition of abbreviated work cycles as well as the functional product they yield, agile methodology is described as “iterative” and “incremental.” In waterfall, development teams only have one chance to get each aspect of a project right. In an agile paradigm, every aspect of development: requirements, design, etc. is continually revisited throughout the lifecycle.

3.2.2 System Design Process

Below is a diagram visualizing the agile design process adopted for the application development.

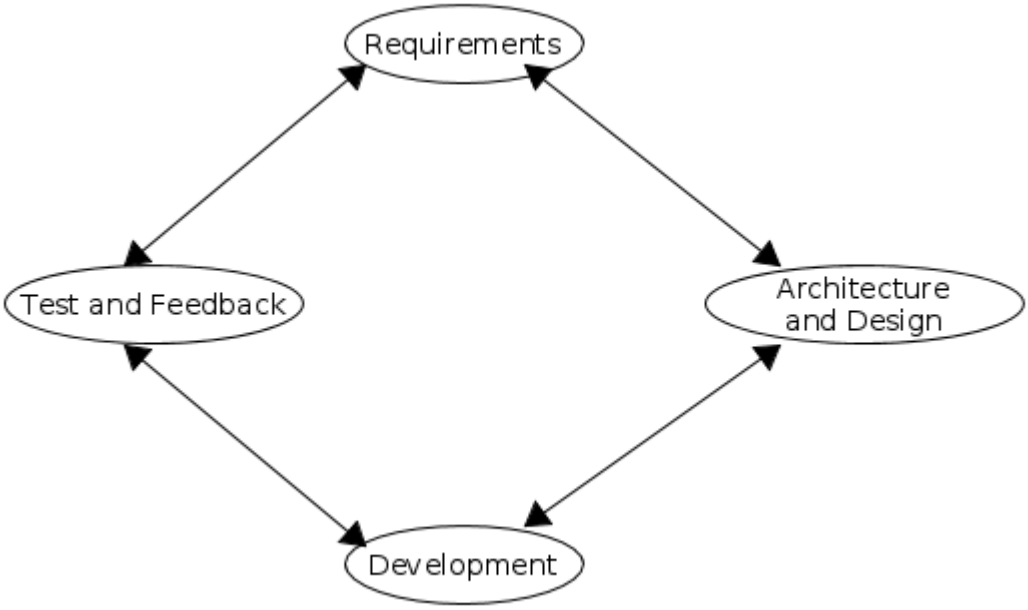


Figure 9: The Agile design process

3.2.3 System Requirements

3.2.3.1 Requirements

The following are the functional requirements for the proposed order management system based on the prestudy

1. Mobile and online access
2. Ability to Manage stock information
3. Ability to capture both manual and online orders
4. Ability to automatically capture mobile money payments and relate them to an order
5. Ability to perform all order management functions on a smart phone

3.2.3.2 Assumptions

The assumptions made in the architecture and design of this system are:

1. The target MSEs shall have access to an Android based smartphone.
2. The MSEs that need to process mobile money payments shall acquire a business mobile money account such as Kopo Kopo.

3.2.4 High Level System Architecture

Below is a diagram depicting the high level architecture of the Mobile Order Management System.

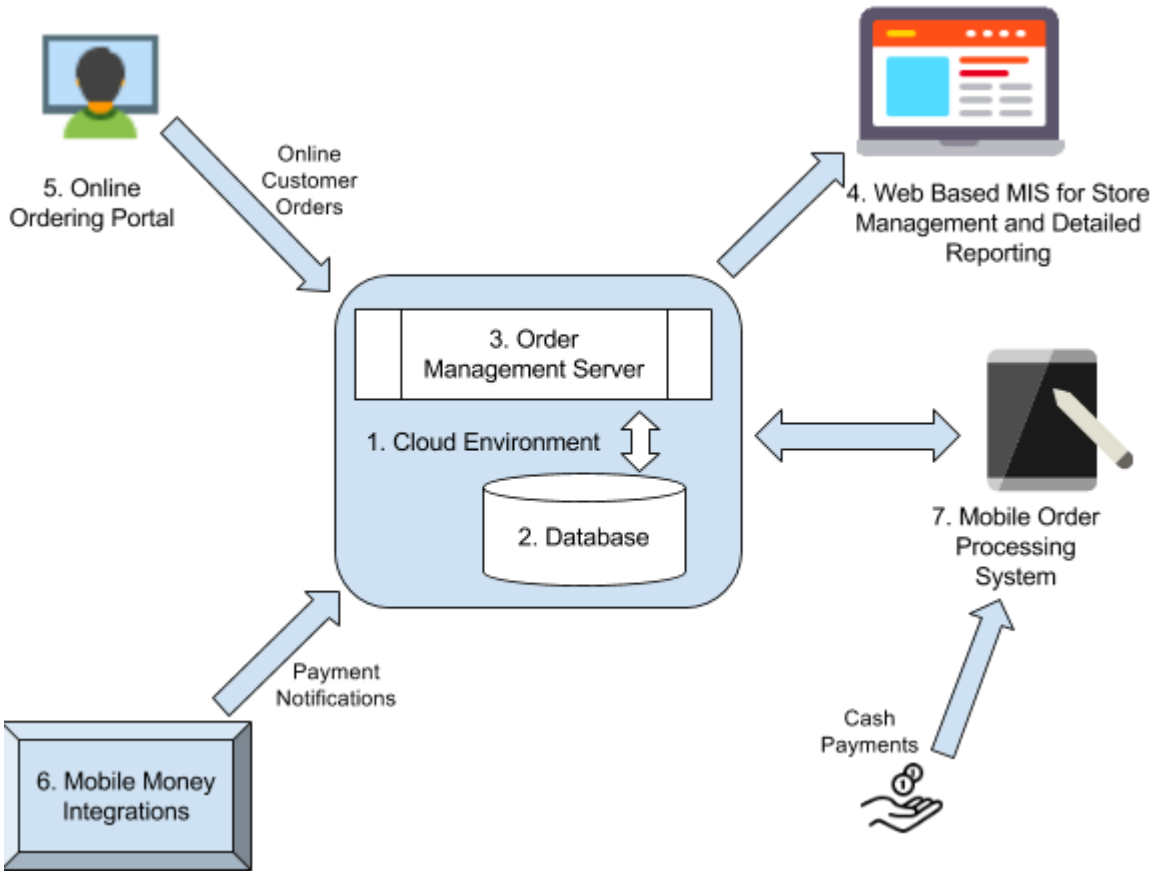


Figure 10: System Architecture diagram

The main components of the system map are described below:

1. **Cloud Environment:** The order management system resides in the cloud. In particular, the cloud platform is composed of the Database and the Order management server.
2. **Database:** All data in the system is stored in a highly scalable datastore in the cloud. This includes inventory, customer data, accounting entries etc.
3. **Order Management Server:** This is the application server than handles all business logic and serves requests from the online ordering portal, the web based MIS and the mobile order processing system.
4. **Web Based MIS:** This is an interface for back office system administration such as accounts setup, store management, user management etc. It is also provides dashboards for detailed reporting.
5. **Online Ordering Portal:** This is a publicly available space for customers to place orders to selected businesses that have enabled this functionality.
6. **Mobile Money Integrations:** The system includes support for a wide variety of integrations including Lipa na MPESA via KOPOKOPO APIs.
7. **Mobile Order Processing System:** This is the core interface for small business operators to access the e-business system and manage orders, payments and customers as well as viewing of basic reports.

3.2.5 Use Case Diagram

The use case diagram below provides an overview of the major users of the system and their most important use cases on the platform.

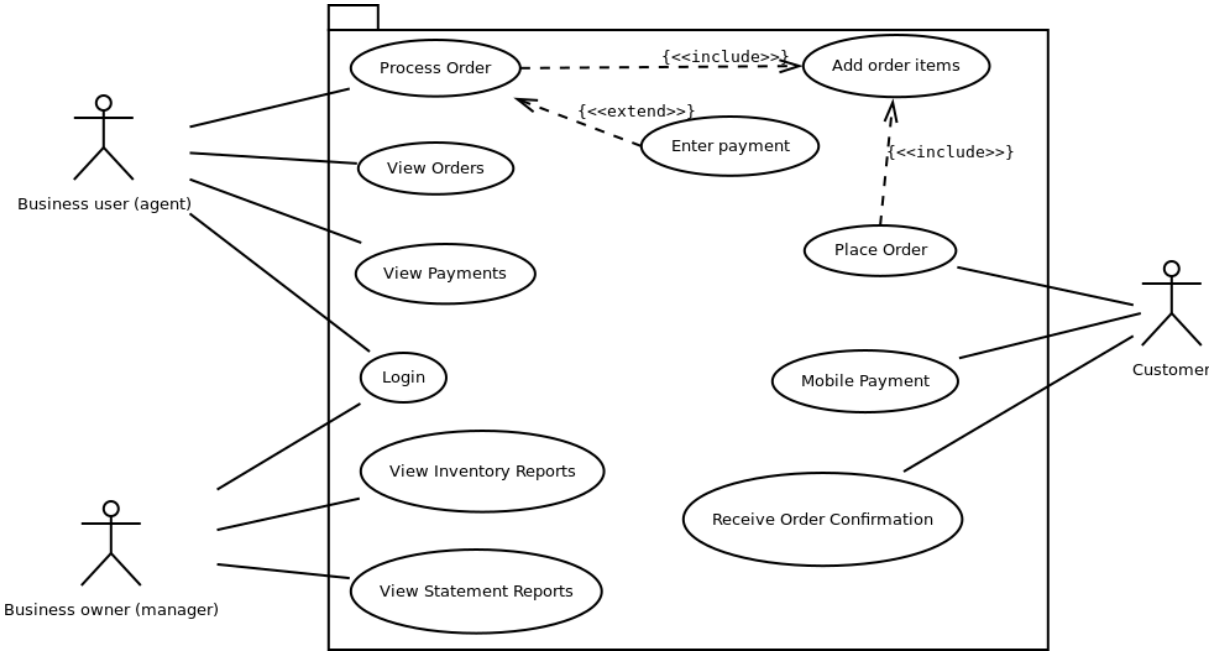


Figure 11: Use case diagram

Below is a description of each of the actors

1. Business user: The employee who manages the day to day business processes
2. Business Owner: The owner who may want to see real time information remotely.
3. Customer: The buyer who places orders in the business

Below is a detailed description of each use case

1. Login: This is require for both the Business owner and Business user
2. Process Order: This are the actions taken in the lifetime of order fulfillment. They include.
    a. Adding order items
    b. Entering payments
3. View orders: Viewing the list of recent orders and their statuses
4. View payments: Viewing recent payments and their statuses
5. View Inventory report: This is the report that includes inventory item balances, costs and prices.
6. View Statement report: This includes the Balance sheet and the Income statement.
7. Place order: This the act of requesting to buy a product/service.
8. Mobile payment: Payment using a mobile based channel e.g Mpesa
9. Receive order confirmation: This is a notification sent to buyer to acknowledge receipt of the order.

3.2.6 Component Diagram

The component diagram below shows the structural relationships between the components of the system.

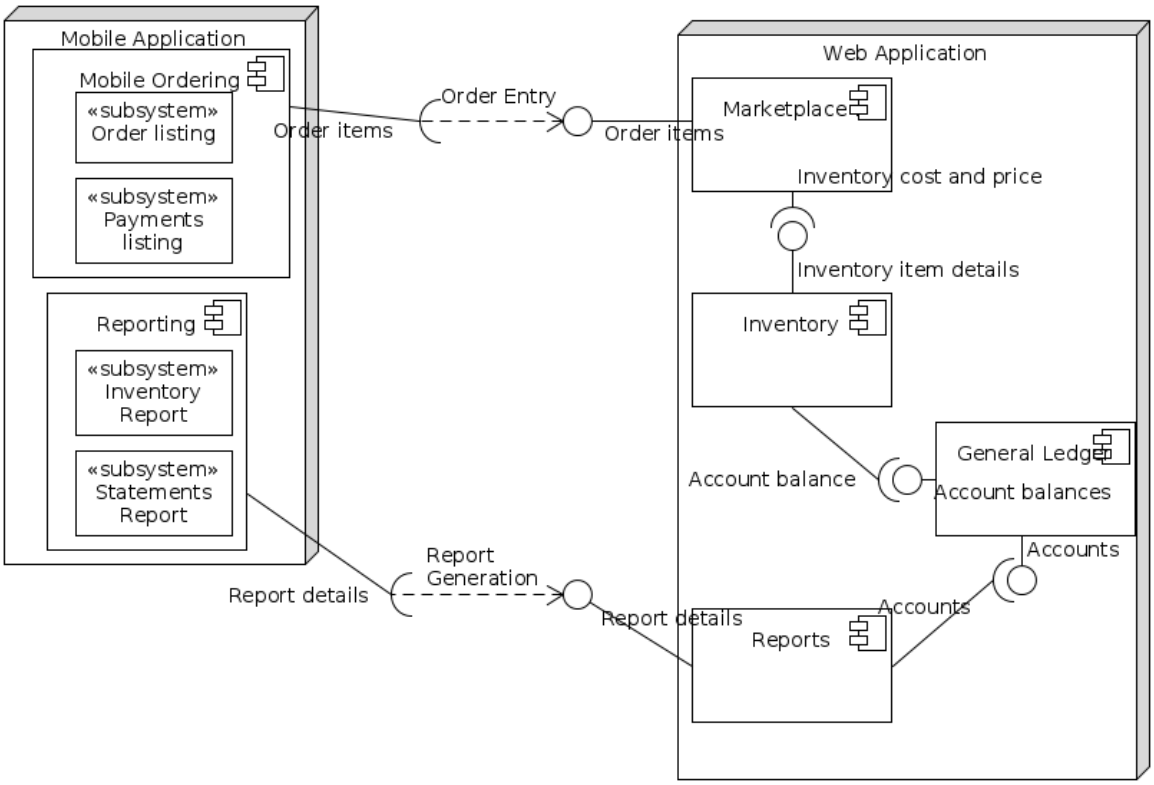


Figure 12: Component diagram

3.2.7 Entity Relationships Diagrams

The diagram below illustrates the database design for the Order management system.

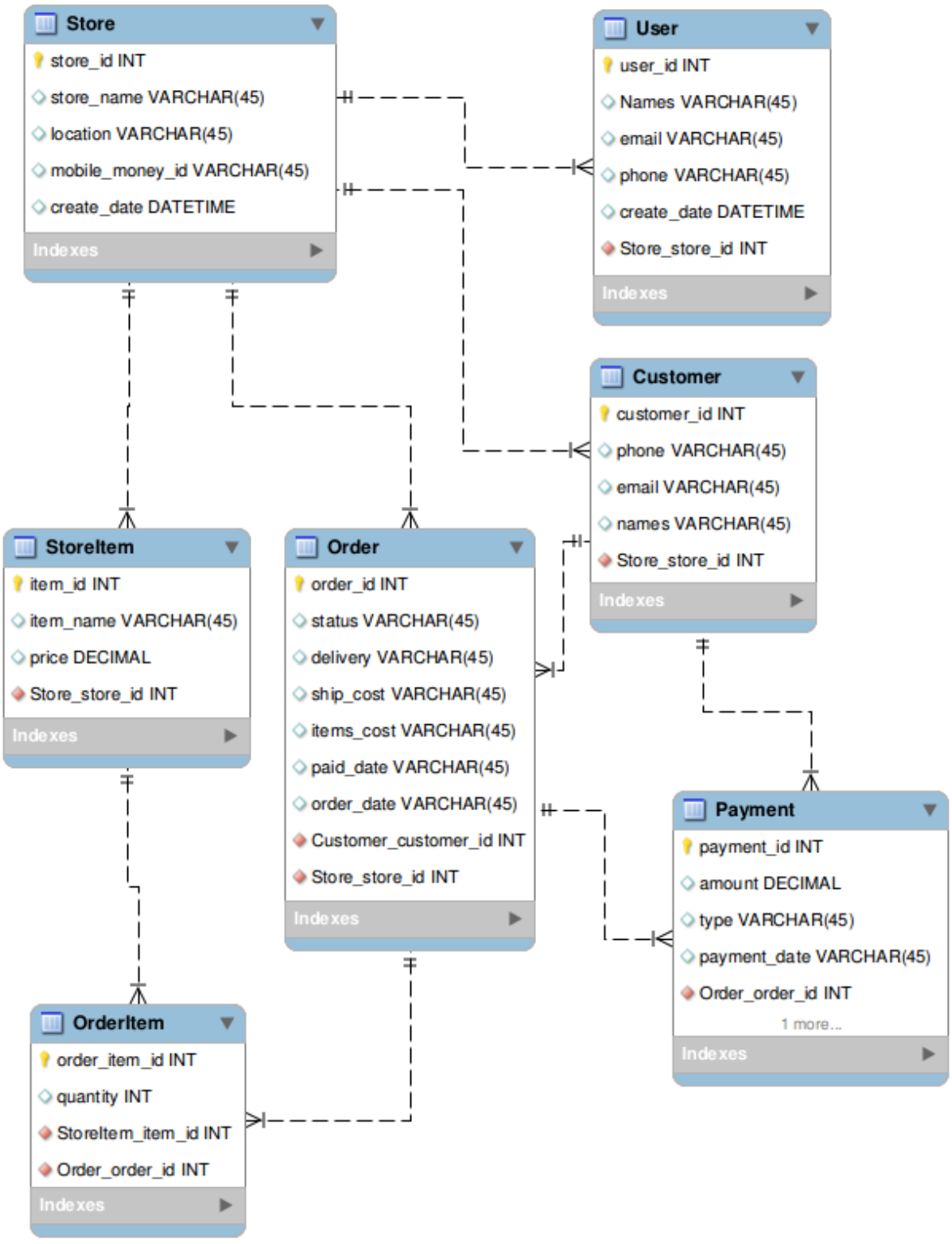


Figure 13: Entity Relationship Diagram

3.2.8 Deployment Diagram

The deployment diagram below models the physical architecture of the order management system.

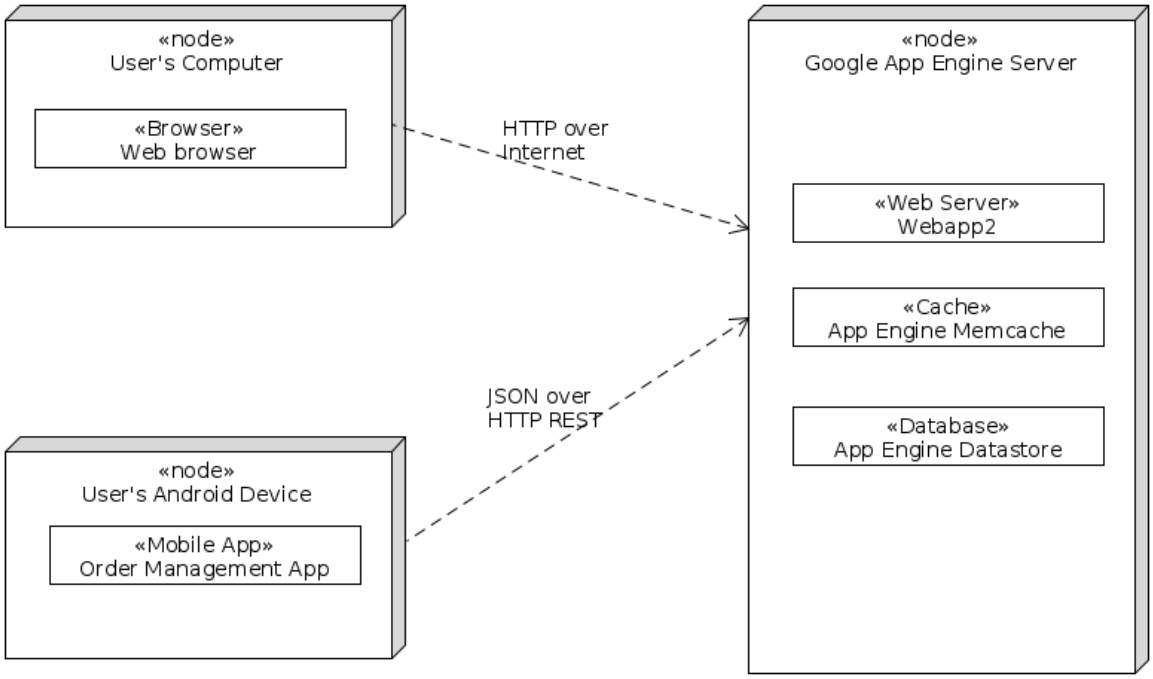


Figure 14: Deployment diagram

3.2.9 Tools and Techniques

The web application was developed on the Google Cloud Platform using the Webapp2 framework to design the server side request handlers and the Google datastore for data storage. Python, Javascript and HTML were the main languages used for the implementation.

The mobile application was developed using the Java Android programming language using the Android Studio Integrated Development Environment (IDE).

3.3 System Evaluation

The evaluation of the developed system was carried out using another study with the aim of measuring the effectiveness of the developed system in meeting the business requirements identified in the pre-study. The evaluation process was specifically aim to measure the following key requirements:

- Ability to capture both manual and online orders
- Ability to automatically capture mobile money payments and relate them to an order
- Ability to Manage stock information
- Mobile and online access

3.3.1 Study Design

The methodology for assessing effectiveness of the system was a qualitative research. The instrument used was a researcher administered questionnaire so as to provide an opportunity to clarify complex technical terms to the respondents and also ask open-ended follow up questions. Purposive sampling was adopted to target the same businesses that were interviewed in the prestudy. The study was contacted in the course of 1 week starting from 12th September 2016.

3.3.2 Data Collection

The interview questions were based on the functional and non-functional requirements identified in the pre-study. A sample of the questionnaire followed in the interview can be seen under Appendix 2.

All the survey questions had likert-type scale responses which were coded as follows:

- Strongly Agree – 5
- Agree – 4
- Not sure – 3
- Disagree – 2
- Strongly Disagree -1

The survey questions were grouped into the following categories:

1. **Mobile devices can be effectively used to run e-business applications:** This included questions to evaluate the effectiveness of mobile based application in performing the key functional requirements of the system i.e. order processing, billing and payments, general ledger accounting and reporting, inventory management and Point of Sale.
2. **Mobile device accessibility in business:** This measure the compatibility of the developed applications with the mobile devices accessible to the businesses.
3. **Remote and Online Access:** This measured the effectiveness of the mobile application developed as a remote and online viewer of business activities.
4. **Integrations:** This measured the effectiveness of the integrations provided in the system i.e payment and messaging integrations.
5. **User-friendliness**: This measured how effective the interface design elements used in the applications were in delivering a user-friendly experience to the users.

The interview process started with an introduction of the researcher and statement of the overall goal of the study. This was then a quick demo of the developed application, the interviewee was also given an opportunity to try the mobile application. Finally, the interview questions were asked guided by the questionnaire with brief pauses to describe the technical terms used, this usually took between 60 and 90 minutes.

3.3.3 Results

3.3.3.1 Data Analysis

The collected data from the interviews was analyzed qualitatively, specifically mean was used to summarize the central tendency of the likert items. The results of the analysis have been visualized below.

Effectiveness of mobile enabled order management system on meeting business needs.

All the aspects of the applications measured were ranked above 4 signalling a general agreement from the user interviewed that the mobile application was an effective tool for providing e-business applications to small businesses. This is show in the visualisation in figure 15 below.

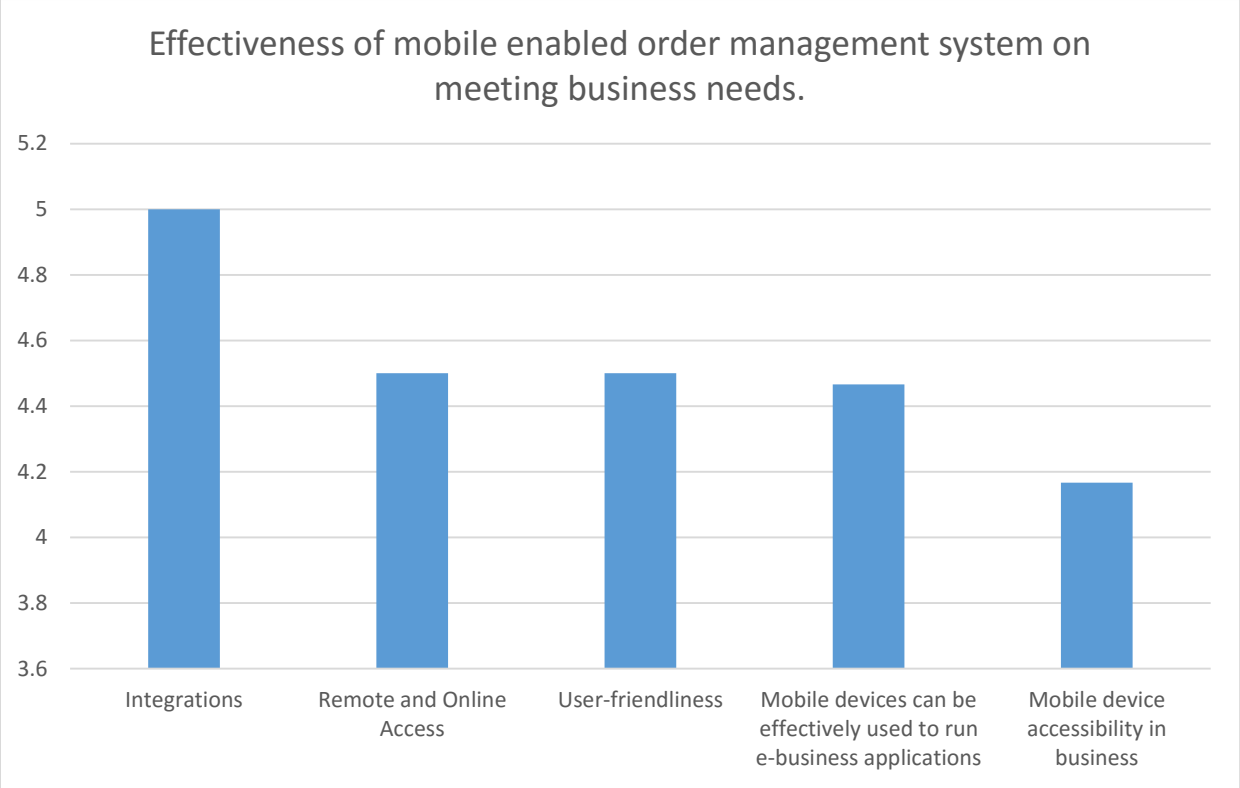


Figure 15: Effectiveness of mobile enabled order management system on meeting business needs.

The highest ranked feature was the integrations with payments and messaging which received a perfect score of 5. Users particularly found the ability of the application to automatically pick up new payments very efficient and useful.

Remote and online access received the second highest score with 4.5. Some of the concerns raised here were the need to train other business users in-order to be able to trust them with the application and rely on the records viewed remotely.

User-friendliness of the application also received an average score of 4.5 with the agreement that some training was required in-order for users to be able to use the application effectively.

The effectiveness of the e-business features of the application got a mean score of 4.4. The main issues raised here were the lack of a complete understanding of some of the sophisticated features such as the general ledger, the inability of the app to handle transactions when there is a high traffic of customers and the large percentage of cash transactions in small businesses wiping out some of the benefits of the payments and billing features.

The mobile device accessibility in business received the lowest score of 4.1, this was due to some of the user's interviewed having incompatible devices.

3.4 System Performance Testing

3.4.1 Scope of Performance Test

The overall object of the performance test was to determine if the Mobile Order Management System is capable of functioning in a real world environment. The application should be responsive and scalable to handle spikes in user traffic and changes in usage behavior.

The scope of performance testing was limited to the testing of the interface between the mobile application and the cloud web server. The interface is based on HTTP REST APIs (Application Programming Interfaces). This is the highest risk interface which if not functioning as expected is likely to affect the overall performance of the mobile application and user-friendliness.

The tests were limited to the most frequently accessed APIs that are likely to suffer the most during a traffic spike. These are: Orders, Payments, Statements and Inventory APIs.

3.4.2 Approach

The performance tests were implemented using Google Stackdriver, a performance monitoring, logging and diagnostic tool that is natively integrated in the Google app engine environment that was used to develop the web APIs for the mobile order management system.

3.4.3 Performance Goals

The Google App Engine cloud environment is built from ground up for scale. The environment includes elastic scaling features that enables automatic spin up of new server instances in the event of increased traffic. While platform can scale automatically, it still requires an acceptable throughput rate to efficiently and transparently maintain the same performance metrics irrespective of traffic load. Thus, the most important aspects to be tested are those that have a direct impact on throughput. These are:

- Total Request duration (seconds): This is the amount of time it takes to generate a complete response to a request. The acceptable maximum duration for this system is 2 seconds for HTTP POST request and 1 second for HTTP GET requests.
- Number Remote Procedure Calls (RPCs): RPCs on Google App Engine are calls to Google services that provide key functionality in the application environment e.g. Cloud Data storage, Caching, Task Queues etc. A large percentage of request latency is usually a result of latency in RPCs. For this application, the acceptable maximum number of RPCs is 50 for HTTP GET requests and 30 for HTTP POST requests.

3.4.4 Load Testing Process:

To simulate requests traffic, the Mobile Order Management APIs under test were spoofed using a REST API client Google Chrome (Browser) extension. This allowed the APIs to be called simultaneously and concurrently within a short span of time.

All performance statistics were generated and exported from the Google Stackdriver online interface.

3.4.5 Testing Report

Statements API

The request API did not meet the performance goals set for request duration (1 seconds). It is therefore a candidate for improvement in a future iteration of this system.

- Request type: HTTP GET
- Request duration: 1.1 seconds
- Number of RPCs: 36 (Excluding the request and memcache RPCs)

Timeline Summary Insights 1

http://mobile-dot-hesabu1.appspot.com/api/statements?email=simon%40ndunda.com

Name	RPCs	Total Duration (ms)
/api/statements	1	1125
/datastore_v3.Get	35	389
/datastore_v3.RunQuery	1	8
/memcache.Get	42	102

Figure 16: Statements API Performance

Order API

The Orders API performed with the set performance thresholds for both request duration and number of RPCs.

- Request type: HTTP GET
- Request duration: 1.0 seconds
- Number of RPCs: 27 (Excluding the request and memcache RPCs)

Timeline Summary

http://mobile-dot-hesabu1.appspot.com/api/orders/create?email=simon%40ndunda.com

Name	RPCs	Total Duration (ms)
/api/orders/create	1	1039
/datastore_v3.Get	9	61
/datastore_v3.Put	13	754
/datastore_v3.RunQuery	5	43
/memcache.Delete	8	17
/memcache.Get	5	8

Figure 17: Order API Performance

Payments API

The Payments API performed with the set performance thresholds.

- Request type: HTTP POST
- Request duration: 2.3 seconds
- Number of RPCs: 20 (Excluding the request and memcache RPCs)

Timeline Summary

http://mobile-dot-hesabu1.appspot.com/api/mpesaipn/live

Name	RPCs	Total Duration (ms)
/api/mpesaipn/live	1	2294
/datastore_v3.Get	9	80
/datastore_v3.Put	7	404
/datastore_v3.RunQuery	2	21
/memcache.Delete	4	8
/memcache.Get	3	7
/urlfetch.Fetch	2	1635

Figure 18: Payments API Performance

Inventory API

The Inventory API did not meet set performance thresholds for both request duration (2 seconds) and number of RPCs (30).

- Request type: HTTP GET
- Request duration: 6.7 seconds
- Number of RPCs: 250 (Excluding the request and memcache RPCs)

Timeline Summary Insights 2

http://networth.ndunda.com/api/inventory/items?email=simon@ndunda.com

Name	RPCs	Total Duration (ms)
/api/inventory/items	1	6712
/datastore_v3.Get	42	462
/datastore_v3.Put	41	3205
/datastore_v3.RunQuery	167	1874
/memcache.Get	41	162
/memcache.Set	1	1

Figure 19: Inventory API Performance

4 DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

4.1 DISCUSSIONS AND CONCLUSIONS

The overall objective of this research is to assess the application of mobile technologies to solve the problem of order management for Small and Micro Enterprises in Kenya. This was achieved with the evaluation of the fully developed application with selected businesses. It was concluded that mobile technology can effectively be used to provide sophisticated e-business solutions to small businesses in Kenya that do not have the infrastructure and finances to setup full-fledged computer based e-business solutions.

4.2 RECOMMENDATIONS FOR FURTHER WORK

The application that was developed was ranked highly in all requirements except accessibility. We therefore recommend further work to investigate how to design and implement more user-friendly and accessible e-business solutions for small businesses based on mobile technologies.

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6 APPENDICES

6.1 APPENDIX 1: PRE-DEVELOPMENT SURVEY

UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS (SCI)

A MOBILE ORDER MANAGEMENT SYSTEM FOR SMALL BUSINESSES

This survey is being undertaken to assist in a mobile order management systems research at UoN, SCI department.

1. General Information

a. Business name:
_____

b. Industry?
- ☐ Agriculture
- ☐ Retail
- ☐ Technology
- ☐ Entertainment
- ☐ Hospitality
- ☐ Other:
_____

2. Customer to Business (C2B) Solutions

a. Are you using C2B Solutions?
- ☐ Yes
- ☐ No

b. If Yes, which C2B Payment Solutions are you using?
- ☐ Mpesa/Cipa na Mpesa/Paybill
- ☐ Pesapal
- ☐ Jambo pay
- ☐ Airtel money bills
- ☐ Lipisha
- ☐ Africastalking Payments

☐ Tangaza
Other: _____

3. Order Management Solutions

a) Are you using Order management Solutions? i.e. systems/technology solution for processing customer orders
- ☐ Yes
- ☐ No

b) If Yes, which Order Management Solutions?
- ☐ Weza tele
- ☐ Custom-developed solution.
- ☐ Other:
  _____
  ___

c) If Yes, what do you use if for?
- ☐ Customer database
- ☐ Online Marketplace
- ☐ Order processing
- ☐ Billing and payments management
- ☐ Employee management
- ☐ Point of Sale
- ☐ General ledger accounting
- ☐ Inventory Management
- ☐ Assets Management
- ☐ Receivables and Payables management
- ☐ Reports
- ☐ Others:
  _____
  ___

d) What modules/Features/Aspects are important for you in an order management system?
- ☐ Customer database
- ☐ Online Marketplace
- ☐ Order processing
- ☐ Billing and payments management
- ☐ Employee management
- ☐ Point of Sale
- ☐ General ledger accounting
- ☐ Inventory Management
- ☐ Assets Management

- ☐ Receivables and Payables management
- ☐ Reports
- ☐ Others:

  _____

e) What are the challenges encountered when working with order management systems?

- ☐ High acquisition and running cost
- ☐ Low computer literacy in users
- ☐ Lack of mobility
- ☐ Lack of online/remote access
- ☐ Lack of integrations e.g mobile payments
- ☐ Inadequate reporting capabilities
- ☐ Inadequate vendor support
- ☐ Others:

  _____

f) What characteristics of an Order Management System are most important for you?

- ☐ Mobile money integration
- ☐ Mobility (Mobile access)
- ☐ Seamless Integration of modules and third party services e.g. SMS
- ☐ Cloud-backed data
- ☐ Userfriendlyness
- ☐ Secure Access

Others: _____

4. Mobile Device Adoption in Businesses

a) Do you own a mobile device

- ☐ Yes
- ☐ No

b) What mobile devices do you own?

- ☐ Feature phone
- ☐ Smart phone
- ☐ Tablet
- ☐ Other: _____

c) How often do you have your mobile device with you?

- ☐ Almost always
- ☐ Always
- ☐ Sometimes
- ☐ Infrequent
- ☐ Almost Never

d) Is there any specific time that you do not carry your mobile device?

- ☐ Morning
- ☐ Early Afternoon
- ☐ Late Afternoon
- ☐ Night
- ☐ I always Have My Device

e) Where do you most often use your mobile device?

- ☐ Home
- ☐ In transit
- ☐ At work
- ☐ Recreational clubs
- ☐ Other

g) Do you have internet access through a Wi-Fi or any other internet connection on your mobile device?

- ☐ Yes
- ☐ No

h) Do you have internet access through a cellular network on your mobile device?

- ☐ Yes
- ☐ No

i) Do you feel comfortable installing and operating third party software on a mobile phone?

- ☐ Completely uncomfortable
- ☐ Somewhat uncomfortable
- ☐ Not Sure
- ☐ Somewhat comfortable
- ☐ Completely Comfortable
- ☐

j) Would you use software installed on your mobile device to manage some of your business processes?

- ☐ No
- ☐ Probably not
- ☐ Not Sure
- ☐ Probably
- ☐ Yes
- ☐

Thank you for your participation!

k) Which activity do you most often engage in on your mobile device?

- ☐ Short Message Services (SMS)/Multimedia Message Services (MMS)
- ☐ Device Calls
- ☐ Internet Access
- ☐ Email
- ☐ Entertainment

l) Would you agree that having a mobile e-business application on your mobile phone would be beneficial to your business?

- ☐ Completely disagree
- ☐ Somewhat disagree
- ☐ Not Sure
- ☐ Somewhat agree
- ☐ Completely agree

6.2 APPENDIX 2: POST-DEVELOPMENT SURVEY

UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS (SCI)

A MOBILE ORDER MANAGEMENT SYSTEM FOR SMALL BUSINESSES - EVALUATION

This survey is being undertaken to assist in a mobile order management systems research at UoN, SCI department.

5. General Information

c. Business name:
_____

d. Industry?
- ☐ Agriculture
- ☐ Retail
- ☐ Technology
- ☐ Entertainment
- ☐ Hospitality
- ☐ Other:
_____

6. Mobile devices can be effectively used to run e-business applications

c. Does the mobile order management system allow you to perform order processing tasks effectively?
- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

d. Does the mobile order management system allow you to perform Billings and Payments tasks effectively?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

e. Does the mobile order management system allow you to perform General ledger accounting and reporting effectively?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

f. Does the mobile order management system have an effective Point of Sale interface?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

g. Does the mobile order management system allow you to perform Inventory Management effectively?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

7. Mobile Device Accessibility in Businesses

h. Is the mobile application compatible with your android device?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

i. Would you use the application on your mobile while away from the business location?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

8. Remote/Online Access

j. Would you use the application on your mobile while away from the business location?

- ☐ Strongly agree

- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree

9. Integrations

k. Payments integrations on the mobile order management system are effective?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

l. Messaging integrations on the mobile order management system are effective?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

10. User-friendliness

m. Did you enjoy using the application?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

n. Would you recommend mobile order management system to others?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐
- ☐

o. Navigating through the mobile application was easy?

- ☐ Strongly agree
- ☐ Agree
- ☐ Not Sure
- ☐ Disagree
- ☐ Strongly disagree
- ☐

Thank you for your participation!

6.3 APPENDIX 3: MOBILE USER INTERFACE

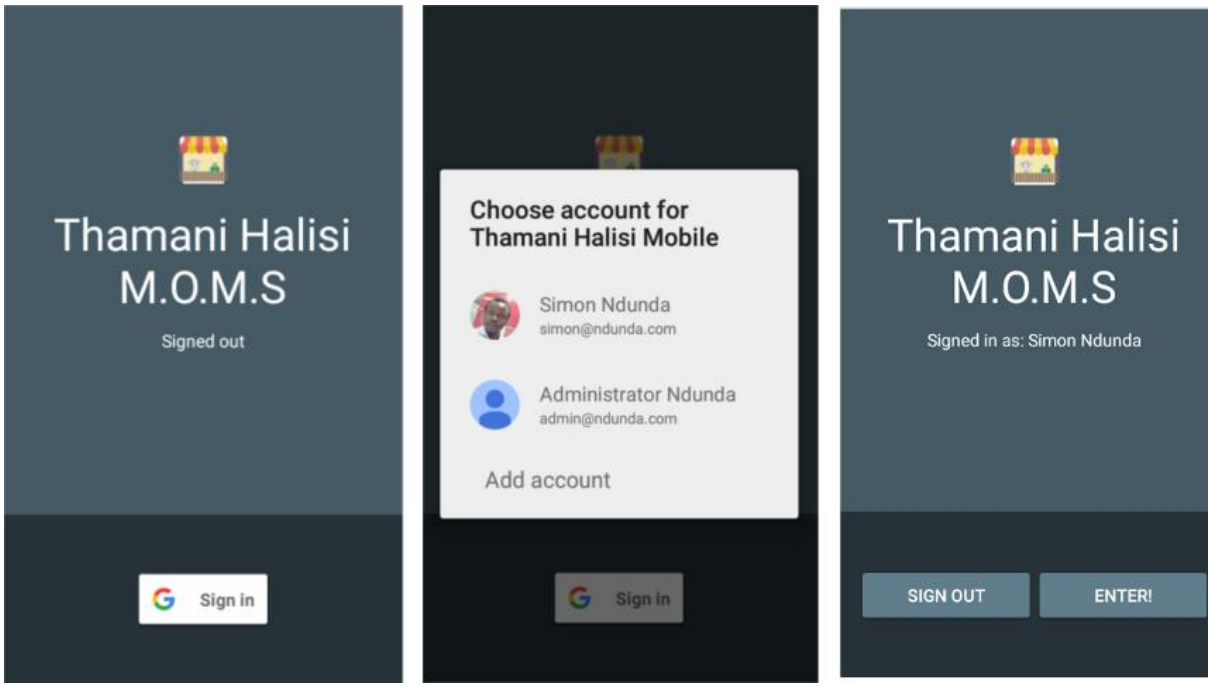

Figure 20: Mobile Interface - Login Screens

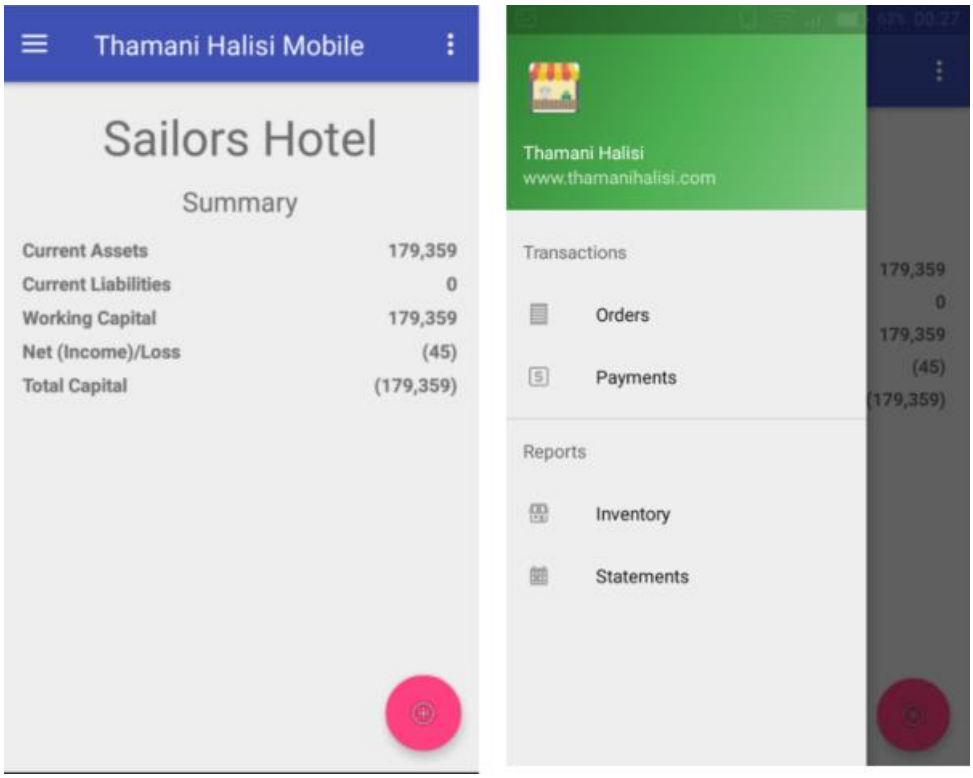

Figure 21: Mobile Interface - Summary and Main Navigation

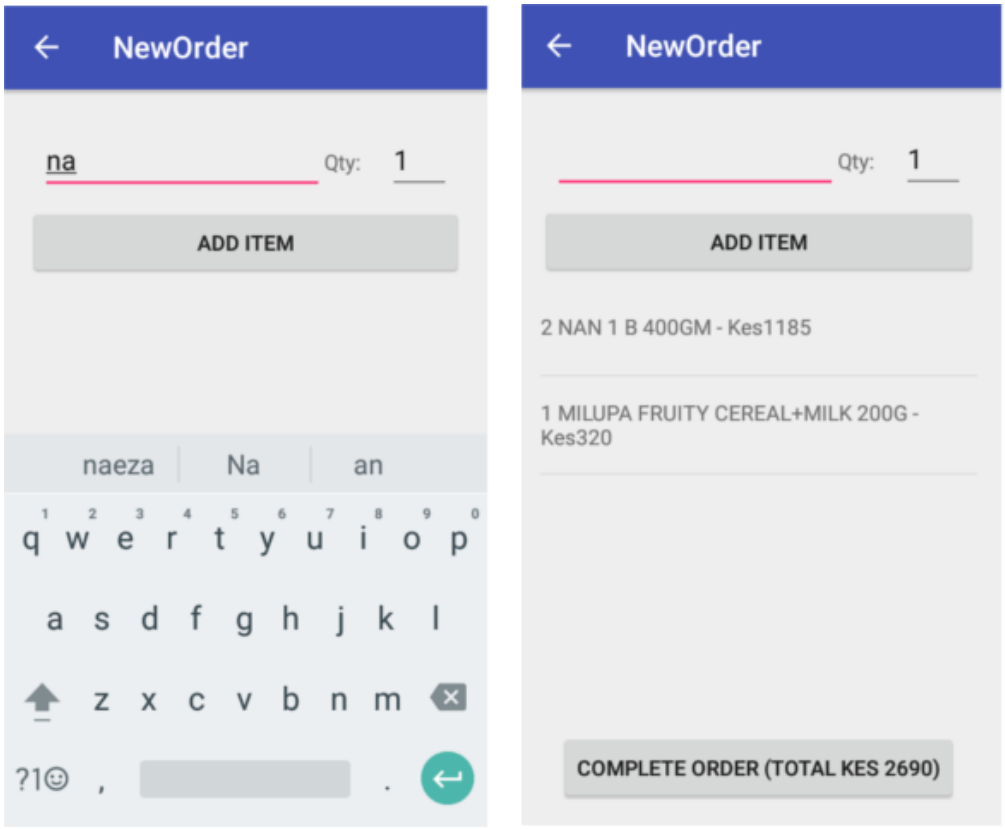

Figure 22: Mobile Interface - Order Processing

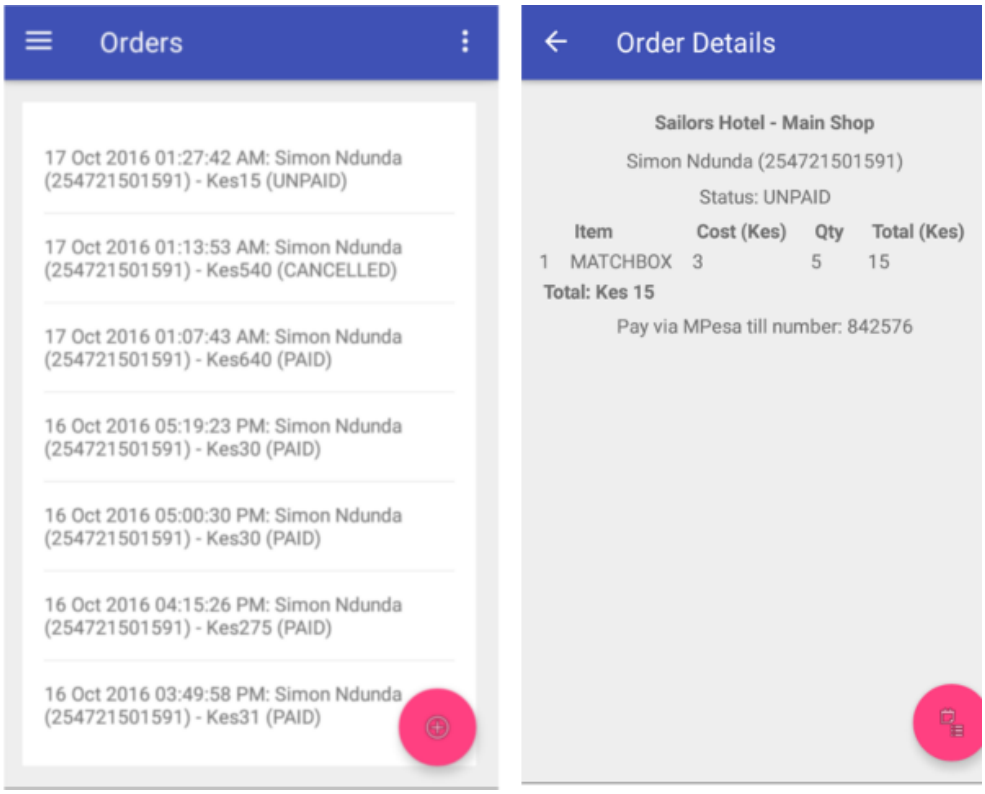

Figure 23: Mobile Interface - Order Listing

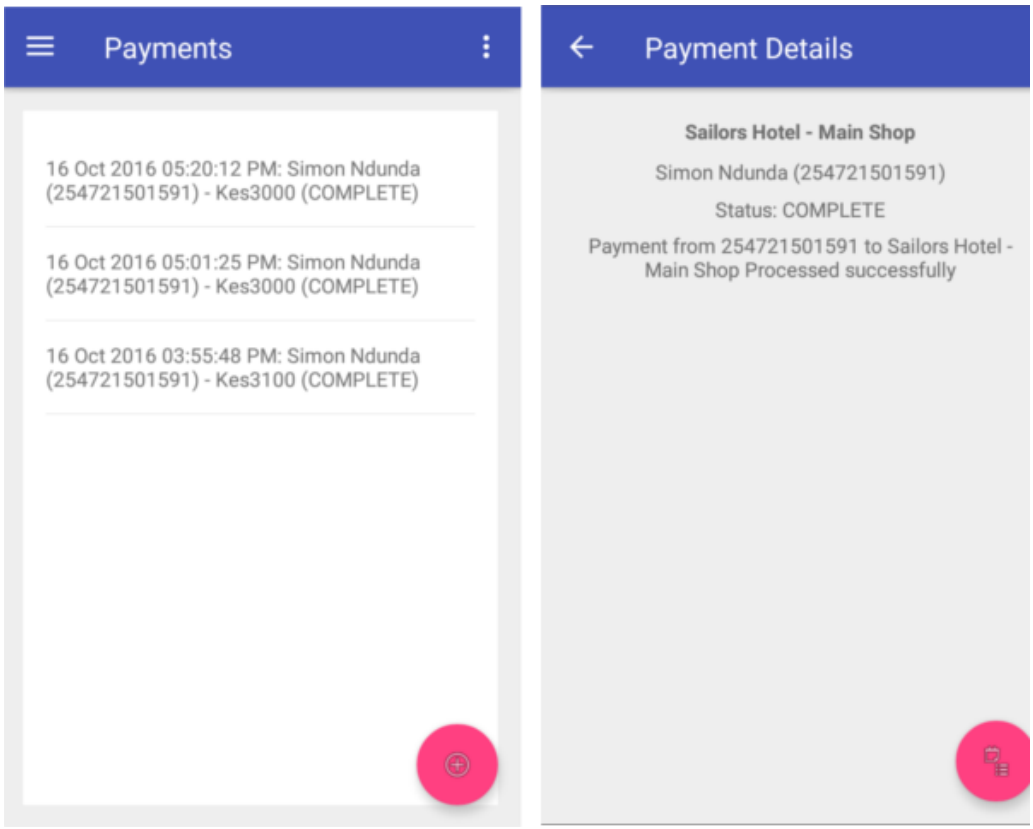

Figure 24: Mobile Interface - Payment Listing

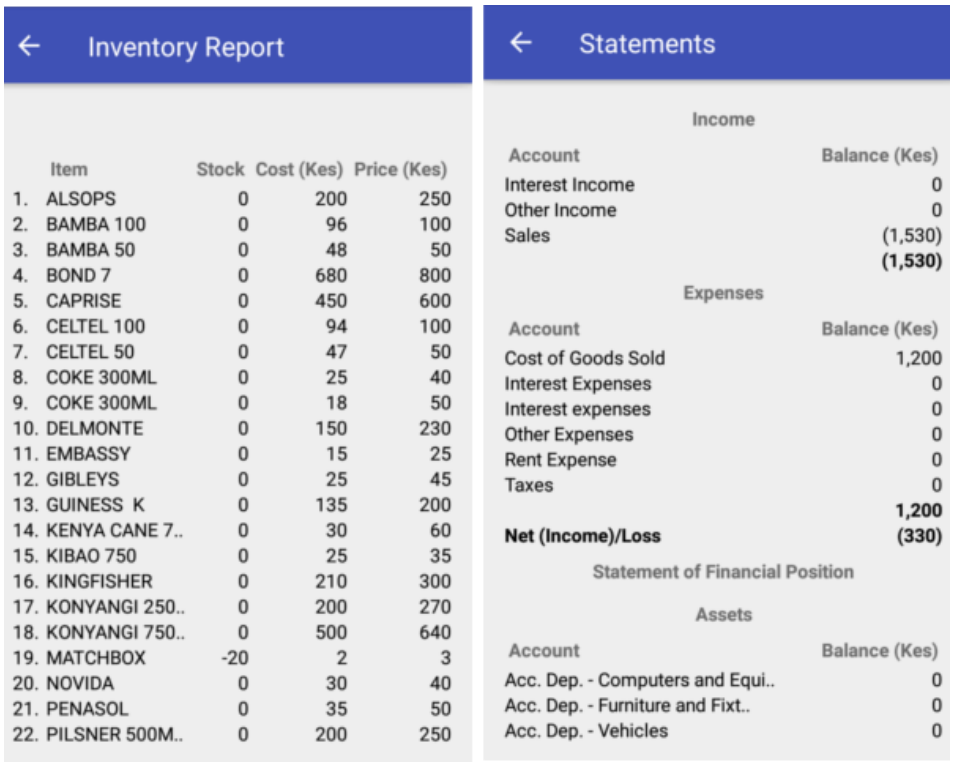

Figure 25: Mobile Interface - Inventory and Statements Reports

6.4 APPENDIX 4: WEB INTERFACE

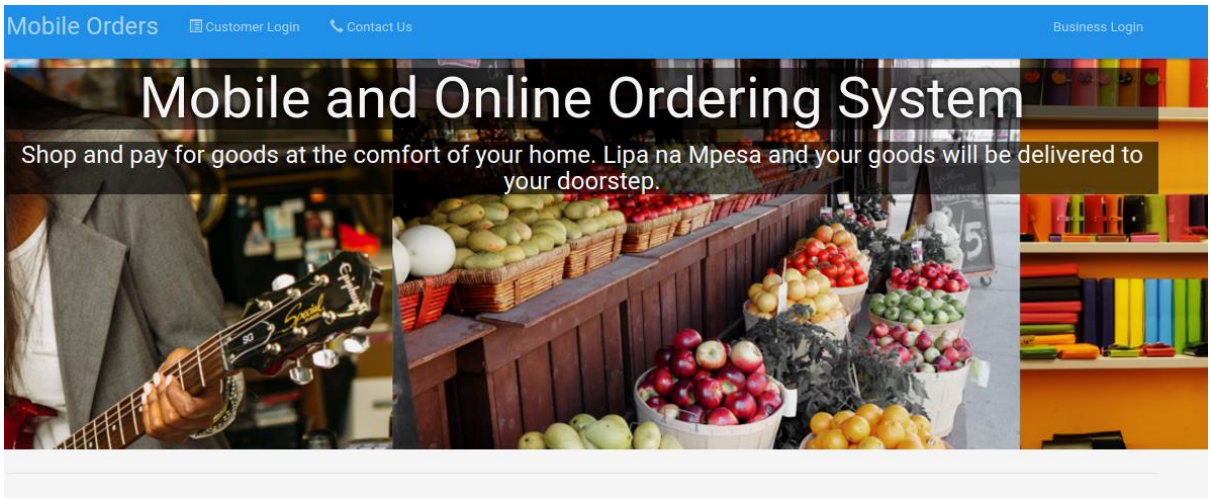

Figure 26: Web Interface - Welcome Screen

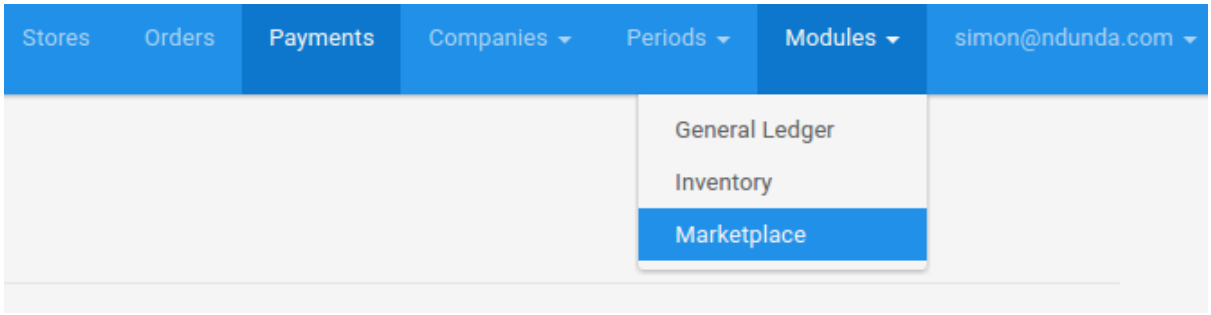

Figure 27: Web Interface - Module Selector

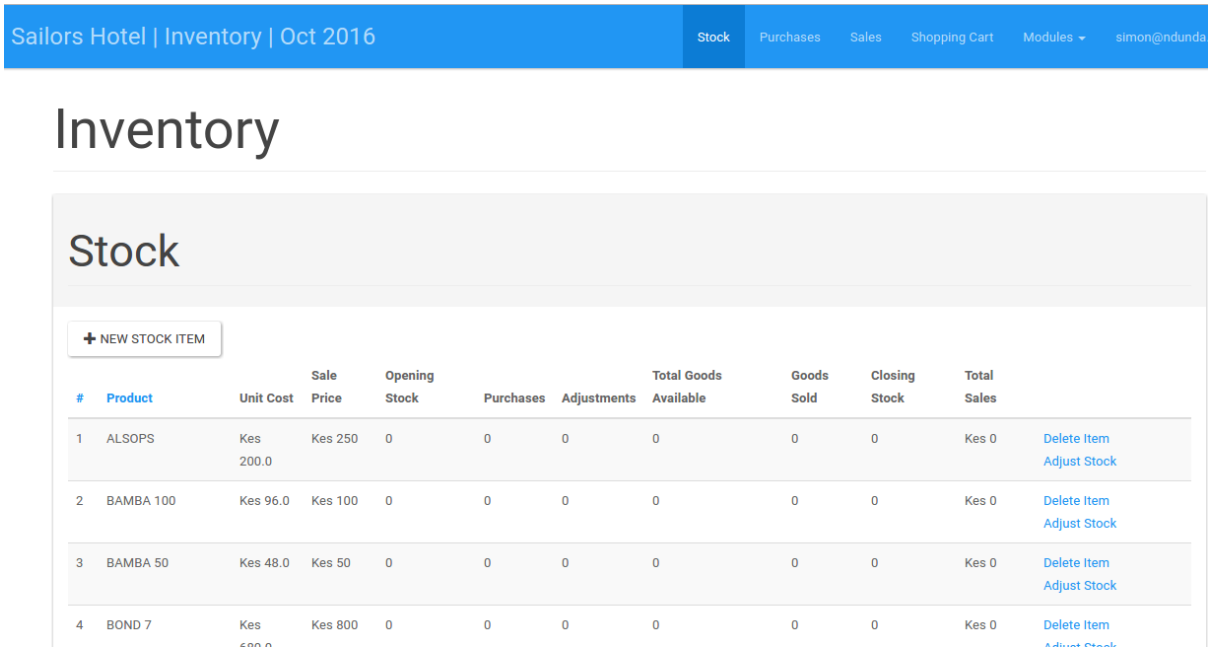

Figure 28: Web Interface - Inventory Management

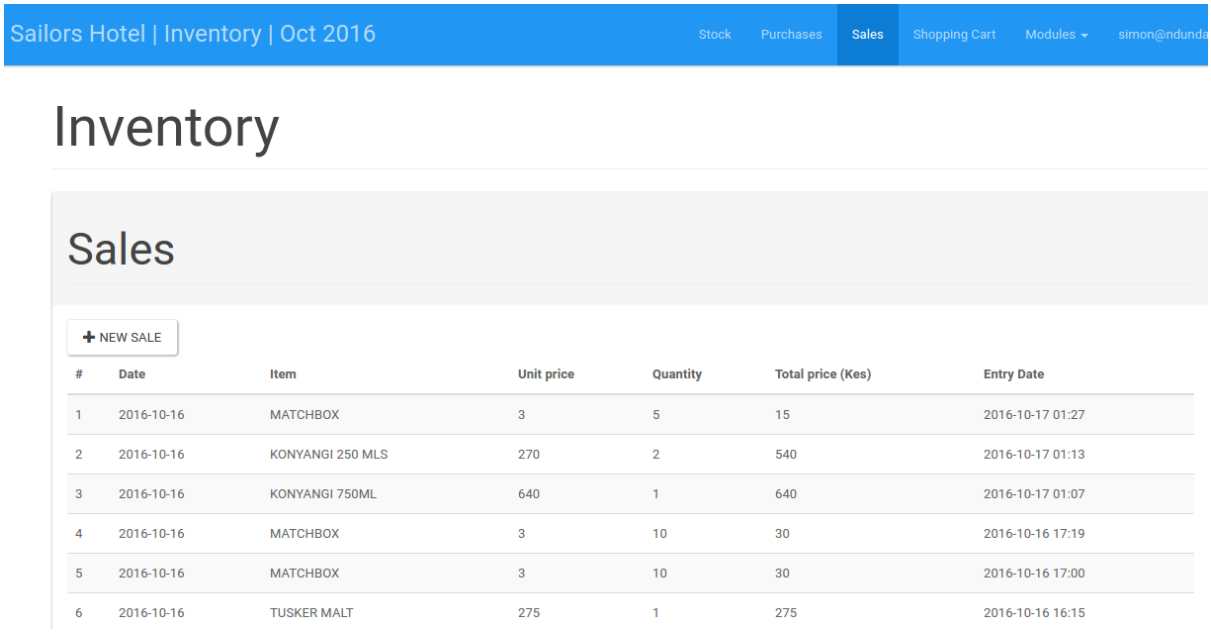

Figure 29: Web Interface - Sales View

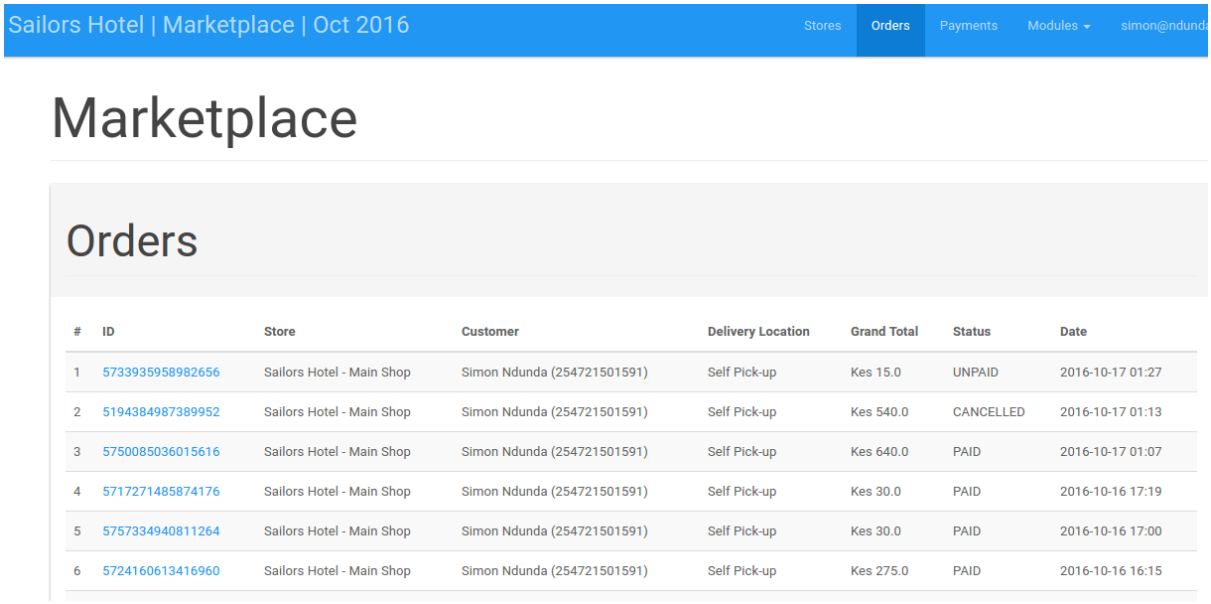

Figure 30: Web Interface - Orders View

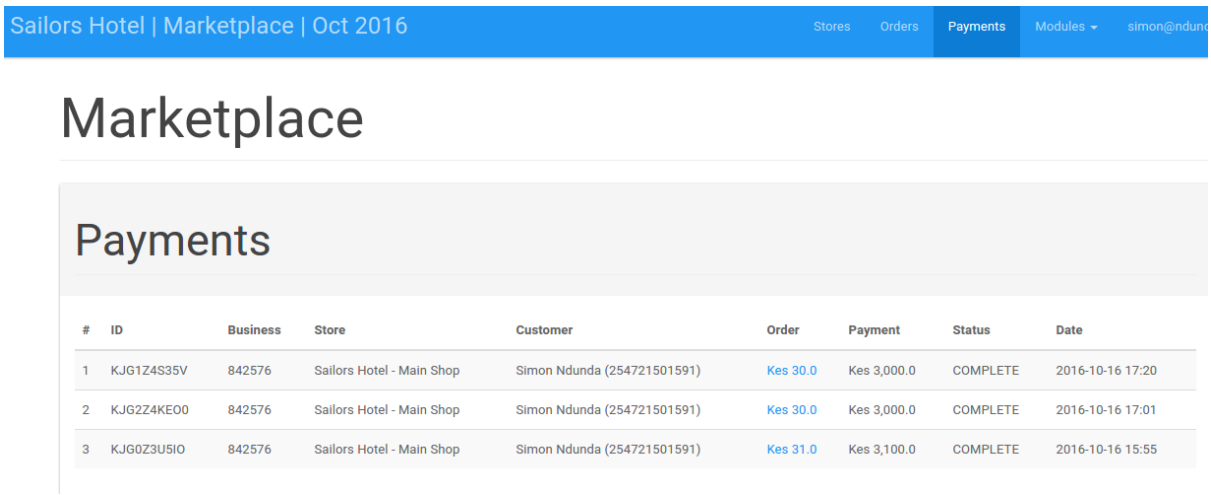

Figure 31: Web Interface - Payments View

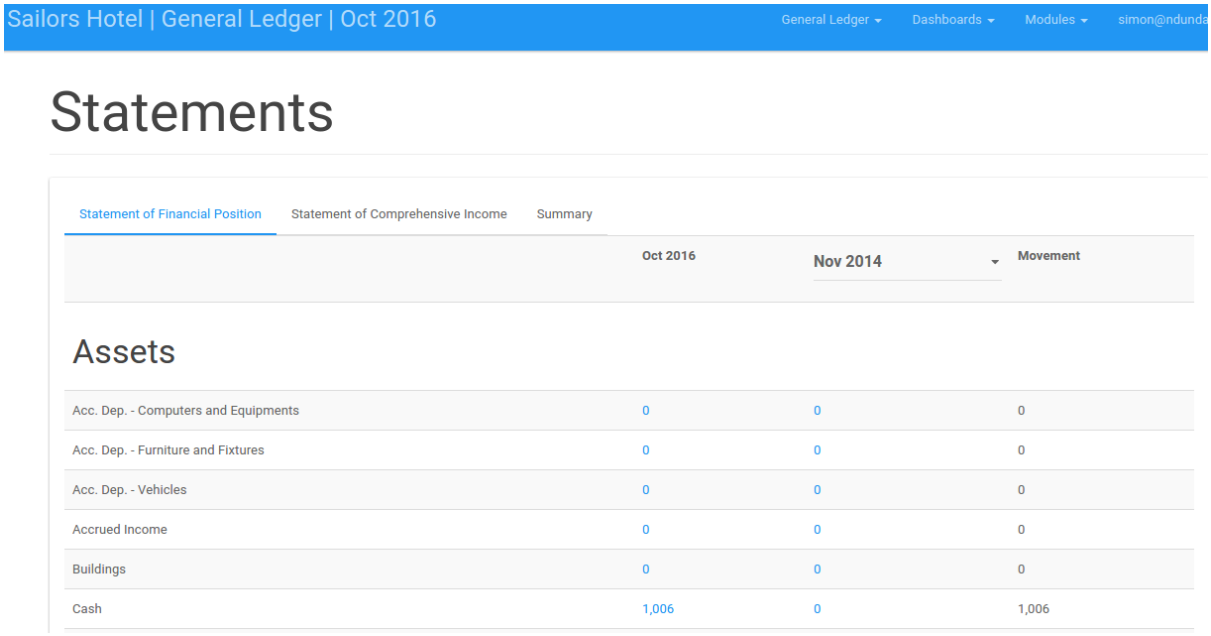

Figure 32: Web Interface - Statements

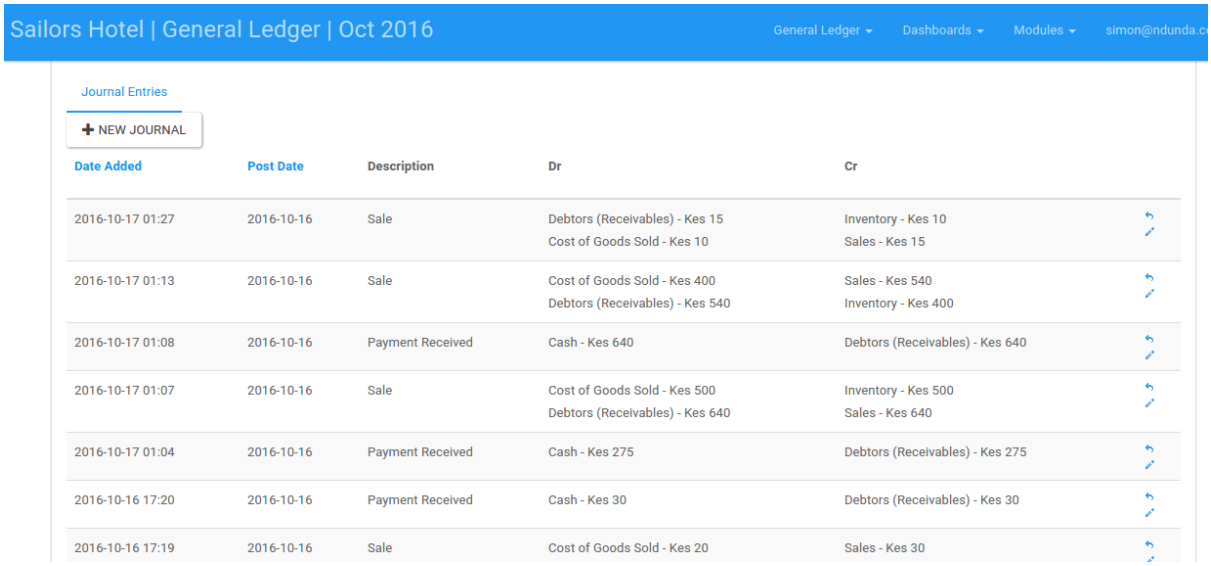

Figure 33: Web Interface - General Ledge Journals

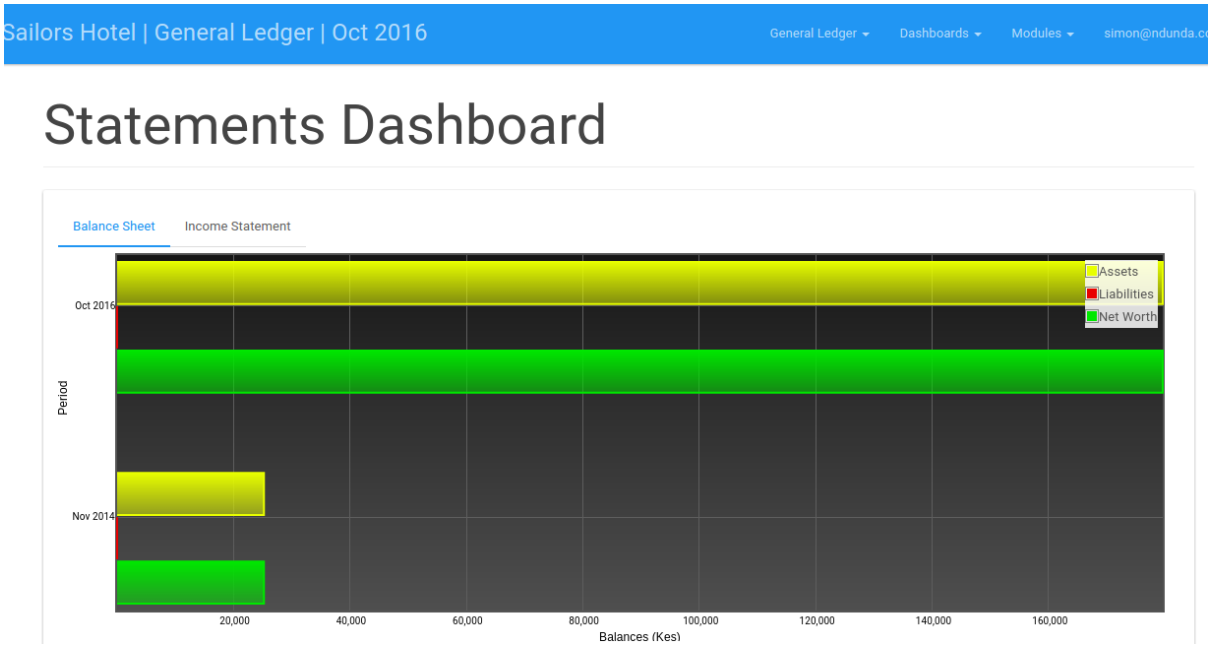

Figure 34: Web Interface - Statements Dashboard (Balance Sheet)

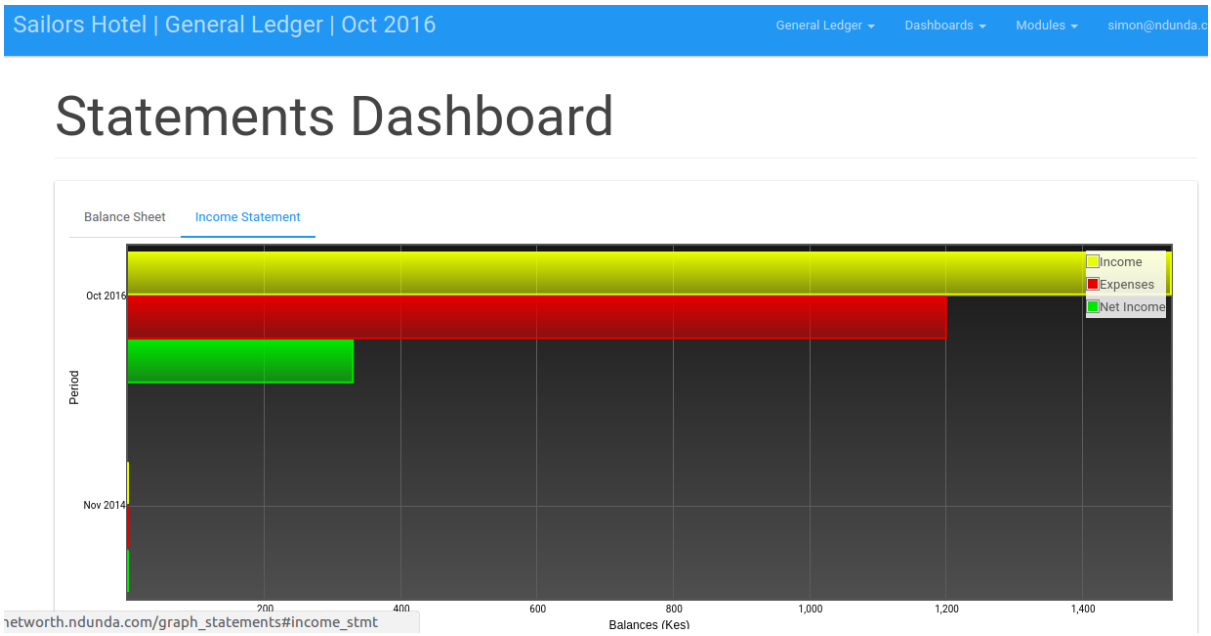

Figure 35: Web Interface - Statements Dashboard (Income Statement)

6.5 APPENDIX 5: SAMPLE SOURCE CODE

6.5.1 NewOrder.Java (Android)

```
package com.thamanihalisi.simon.thamanihalisi;
import android.content.Intent;
import android.net.Uri;
import android.os.Bundle;
import android.support.design.widget.Snackbar;
import android.support.v7.app.AppCompatActivity;
import android.support.v7.widget.Toolbar;
import android.util.Log;
import android.view.View;
import android.widget.AdapterView;
import android.widget.ArrayAdapter;
import android.widget.AutoCompleteTextView;
import android.widget.Button;
import android.widget.EditText;
import android.widget.ListView;
import com.thamanihalisi.simon.thamanihalisi.models.Order;
import com.thamanihalisi.simon.thamanihalisi.models.OrderItem;
import com.thamanihalisi.simon.thamanihalisi.models.StoreItem;
import com.thamanihalisi.simon.thamanihalisi.utils.BackgroundTask;
import com.thamanihalisi.simon.thamanihalisi.utils.Helpers;
import org.json.JSONArray;
import org.json.JSONException;
import org.json.JSONObject;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Date;
import java.util.List;

public class NewOrder extends AppCompatActivity {
    private ArrayAdapter<String> itemsAdapter;
    private ArrayAdapter<String> orderAdapter;
    private AutoCompleteTextView itemSelectorView;
    private EditText qtyEditText;
    private int currentItem;
```

```
    private String[] itemIndex;
    private Order order;
    private ArrayList<StoreItem> itemsList;
    Button completeOrderButton;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_new_order);
        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
        setSupportActionBar(toolbar);
        getSupportActionBar().setDisplayHomeAsUpEnabled(true);
        order = new Order();
        itemsList = new ArrayList<>();
        itemIndex = new String[0];
        itemsAdapter = new ArrayAdapter<String>(this,
                android.R.layout.simple_dropdown_item_1line, new
ArrayList<String>());
        itemSelectorView = (AutoCompleteTextView)
                findViewById(R.id.autoCompleteTextView);
        itemSelectorView.setAdapter(itemsAdapter);

        itemSelectorView.setOnItemClickListener(new
AdapterView.OnItemClickListener() {
            @Override
            public void onItemClick(AdapterView<?> adapterView, View view, int i,
long l) {
                currentItem = i;
                Log.i("selection", "i=" + i + " l=" + l);
            }
        });
        qtyEditText = (EditText) findViewById(R.id.qty);
        String[] data = {};
        List<String> orderList = new ArrayList<String>(Arrays.asList(data));
        orderAdapter =
                new ArrayAdapter<String>(
                        this, // The current context (this activity)
                        R.layout.list_item_forecast, // The name of the layout ID.
                        R.id.list_item_forecast_textview, // The ID of the textview
to populate.
```

```
                        orderList);
        // Get a reference to the ListView, and attach this itemsAdapter to it.
        ListView listView = (ListView) findViewById(R.id.order_list_view);
        listView.setAdapter(orderAdapter);
        Button addItemButton = (Button) findViewById(R.id.add_item_button);
        completeOrderButton = (Button) findViewById(R.id.complete_order_button);
        addItemButton.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                int qty = Integer.parseInt(qtyEditText.getText().toString());
                Log.i("currentItem", currentItem + "");
                String desc = itemsAdapter.getItem(currentItem);
order.addItem(itemsList.get(Arrays.asList(itemIndex).indexOf(desc)), qty);
                orderAdapter.add(qty + " " + desc);
                itemSelectorView.setText("");
                qtyEditText.setText("1");
                completeOrderButton.setVisibility(View.VISIBLE);
                completeOrderButton.setText("Complete Order (Total Kes " +
order.getTotal() + ")");
            }
        });
        completeOrderButton.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                PostNewOrderTask newOrderTask = new PostNewOrderTask();
                Uri.Builder builder = new Uri.Builder()
                        .appendQueryParameter("phone", Helpers.getPhone());
                for (OrderItem oi : order.orderItems) {
                    builder.appendQueryParameter("item_keys", oi.item.item_key);
                    builder.appendQueryParameter("item_qtys", oi.item_qty + "");
                }
                String query = builder.build().getEncodedQuery();
                newOrderTask.execute(Helpers.getEmail(getApplicationContext()),
query);
            }
        });
    }
    private void fetchItems() {
        FetchStoreItemsTask task = new FetchStoreItemsTask();
        task.execute(Helpers.getEmail(this));
```

```
}
public void onStart() {
    super.onStart();
    fetchItems();
}
private class FetchStoreItemsTask extends BackgroundTask {
    private final String LOG_TAG = FetchStoreItemsTask.class.getSimpleName();
    public FetchStoreItemsTask() {
        super("api/inventory/items");
    }
    protected ArrayList getDataFromJson(String ordersJsonStr)
            throws JSONException {
        JSONArray ordersArray = new JSONArray(ordersJsonStr);
        ArrayList<StoreItem> results = new ArrayList<>();
        for (int i = 0; i < ordersArray.length(); i++) {
            JSONObject item = ordersArray.getJSONObject(i);
            String item_key = item.getString("item_id");
            String item_name = item.getString("item_name");
            int price = item.getInt("selling_price");
            results.add(new StoreItem(item_key, item_name, price));
        }
        return results;
    }
    @Override
    protected void onPostExecute(ArrayList result) {
        if (result != null) {
            itemsAdapter.clear();
            itemsList.clear();
            itemIndex = new String[result.size()];
            for (Object it : result) {
                StoreItem item = (StoreItem) it;
                String desc = item.item_name + " - Kes" + item.item_price;
                itemsAdapter.add(desc);
                itemsList.add(item);
                itemIndex[itemsList.size() - 1] = desc;
            }
        }
    }
```

```
    }

    public class PostNewOrderTask extends BackgroundTask {
        public PostNewOrderTask() {
            super("api/orders/create", "POST");
        }
        protected ArrayList getDataFromJson(String jsonStr)
                throws JSONException {
            JSONObject result = new JSONObject(jsonStr);
            return new ArrayList<>(Arrays.asList(result));
        }
        @Override
        protected void onPostExecute(ArrayList result) {
            View parentLayout = findViewById(R.id.complete_order_button);
            Snackbar.make(parentLayout, "Order posted successfully!",
Snackbar.LENGTH_LONG)
                    .setAction("Action", null).show();
            JSONObject orderResult = (JSONObject)result.get(0);
            Intent intent = new Intent(getApplicationContext(),
OrderDetails.class);
            try {
                intent.putExtra(Intent.EXTRA_TEXT,
orderResult.getJSONObject("order").toString());
                startActivity(intent);
            } catch (JSONException e) {
                e.printStackTrace();
            }
        }
    }
}
```

6.5.2 Order_api.py (Web Server)

```
import logging
import authorise
import handlers
from models.gl_models import Account, Period
from models.marketplace_models import Store, Order, Payment,\
    Customer
```

```
from models.inventory_models import InventoryItem
import tools
from constants import Order_Status, AC_Category

class OrderAPI(handlers.BaseHandler):

    @authorise.api_access()
    def order_list(self, d):
        orders = map(lambda o: o.json_dict(), Order.GetOrders(
            d["user"].company, limit=10))
        self.render_json(orders)

    @authorise.api_access()
    def create_order(self, d):
        phone = tools.clean_phone(self.request.get("phone"))
        store = Store.all().ancestor(d["user"].company).get()
        item_keys = self.request.get_all("item_keys")
        item_qtys = self.request.get_all("item_qtys")
        items = zip(item_keys, item_qtys)
        data = {}
        success = False
        message = ""
        if phone:
            if store:
                if items:
                    customer = Customer.CreateCustomer(phone)
                    if customer:
                        delivery_location = "Self Pick-up"
                        order = Order.CreateOrder(
                            store, customer, delivery_location)
                        if order:
                            for key, qty in items:
                                item = InventoryItem.get_by_id(int(key))
                                if item:
                                    order.add_order_item(
                                        item, int(qty))
                                else:
```

```
                                logging.error(
                                    "Unabled to find item %s" % key)
                            order.complete_order()
                            success = True
                            data["order"] = order.json_dict()
                        else:
                            message = "Failed to create order"
                    else:
                        message = "Unable to create customer"
                else:
                    message = "Cart is empty"
            else:
                message = "Store is required"
        else:
            message = "Phone is required"

        if not success:
            logging.error(message)
        data.update({"success": success, "message": message})
        self.render_json(data)

    @authorise.api_access()
    def update_order(self, d, okey, status):
        order = Order.get(okey)
        data = {}
        data["success"] = False
        if order and status:
            if status == "paid":
                order.pay_order()
                data["success"] = True
                data["order"] = order.json_dict()
        self.render_json(data)
```