

**DESIGN AND IMPLEMENTATION OF A M-COMMERCE PLATFORM FOR
BUYING AND SELLING**

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Abstract

Computers and other ICT gadgets has become a ubiquitous asset in all facets of life including buying and selling. This has made it easy for many organizations to take the advantage of the web coverage and cost saving features of internet to place their businesses on the World Wide Web for customers to access anywhere in the globe. Although personal computer (PC) is generally accepted, mobile devices are overtaking its acceptability, especially in developing countries, like Nigeria. Therefore, online business is fast enjoying paradigm shift from the use of PC to mobile phones and as such, users have closed enough experience to business transaction. This paper presents a mobile commerce (m-commerce) platform that brings both sellers and buyers together. The development of the platform follows Object-Oriented Design approach using HTML 5, JQuery-Mobile, JavaScript and XML for the client side and on the server side, PHP and MySQL were used as scripting language and database respectively. The platform is supported by Android operating system because of its current high market share and usability. Responses received from the users during the test phase showed that the platform performed adequately well to users' satisfaction in terms of security, sales and profit.

Keywords: M-Commerce, Android, Mobile phones, buying and selling, Consumer-to-Consumer model, Waterfall model

INTRODUCTION

Trading starting from ancient time, '*trade-by-barter*', has evolved through several modifications. Physical establishment like kiosks, stores and market gave both suppliers and consumers an opportunity to meet and carry out transactions. In order to improve sales, some producers/suppliers introduced a "salesman approach"; the salesman goes from point to point displaying their wares and attempting to convince people to purchase their wares (Yaser, 2013).

The evolution of computer from punch cards through big mainframes and now to current supercomputers has impacted every facet of human living experience. From education, security, commerce, communication and so on, the use of computing devices has become an essential amenity for human. A further evolution in the computing world that transforms the way of life of man is the advent of the internet, the ability to connect to various parts of the world, communicate both audibly and visually bring new scope of business transaction. Suddenly, the low price of reaching millions worldwide, and the possibility of selling to or hearing from those people at the same moment when they are reached, promised to overturn established business dogma in advertising, mail-order sales, customer relationship management, and many more areas (Wikipedia, 2015).

An application of the internet in business transaction is '*e-commerce*', that is electronic commerce. Electronic commerce refers to economic activity that occurs online. E-commerce includes all types of business activity, such as retail shopping, banking, investing and rentals (Niranjanamurthy and Dharmendra 2013). Major business transactions have shifted from the usual physical to electronic format, billions of dollars in goods are being traded on daily basis using electronic format. Forex trading, Online market, Online banking, Conference meetings, even trade-by-barter are now carried out through electronic means. Producers can now reach beyond their geographical location to different part of the world without being physically present; areas which even the suppliers might have never been before. The evolution of computer and the internet did not exclude Africa, and Nigeria a big economic country in Africa is being transformed in the way services and operations are being carried out (Shikar, 1998).

In education, several educational institutions have changed from the traditional way of education to computer based systems, recruitment processes are now mostly online based, and media outlets are reaching more people through online media. Although the adoption of the internet was low due to slow establishment of required infrastructures, adoption of the technology is growing on yearly basis (Kambil, Ginsberg and Bloch, 1996). Now, the country has major online commercial services worthy by measuring them with international scale. Companies like Jumia, Konga, Cheki, OLX, tolet and others are becoming household names, each focusing on several human needs. Internet banking is now becoming a standard for Nigeria banks nowadays because of the convenience it affords people.

An explosion in the number of mobile phones occurred when cheap Android phones were made available to users and the number is still growing daily. A 2015 first quarter report by Criteo, a company that does personalized performance advertising says that 29% of e-Commerce transactions in USA and 34% globally are from mobile phones. It was projected that by the end of 2015, business transaction via mobile devices would reach 33% and 40% in USA and globally respectively. Also, the cost of data subscription is reducing and the quality

of service is getting better with time, therefore, more people are connecting to the internet daily for various activities.

Mobile commerce (simply put as m-commerce) according to Tiwari, Buse and Hertstatt (2006) is defined as any transaction, involving the transfer of ownership or right to use goods and services, which is initiated and completed by using mobile access to computer-mediated network with the help of an electronic device. M-commerce is also known as mobile electronic commerce or wireless electronic commerce. It is a subset of electronic commerce that involves the use of mobile computing devices in carrying out different types of economic transactions including marketing, buying and selling products and services (Jahanshai et al., 2011; Rashad et al., 2011). From the above definitions, it can be inferred that m-commerce described the act of performing an electronic transaction that has financial consequents from a mobile device and personal digital assistant.

There are four existing e-commerce model upon which any e-commerce system and its derivatives could be built. They are business-to-business (B2B), business-to-customer (B2C), customer-to-customer (C2C) and customer-to-business (C2B) models. In a B2B model, companies sell their online goods and services to other companies, with or without physical presence of parties involved. Also, in a B2C model, companies sell their online goods to consumers who are the end users of their products or services. The C2C model involves transaction between customers. In this model, a consumer sells directly to another consumer through a facilitator (i.e., auction sites) such as eBay, Google play-store, Online eXchange (OLX) etc. Finally, in a C2B model, consumer post their products or services online while companies are at liberty to post their bids which will be reviewed by the consumer. Consumer therefore selects the company that meet his/her price expectations (Constantions and Khaled, 2006).

In the opinion of Palwinder (2012), *“consumers respond positively to businesses that take the time to understand their needs and offer excellent customer service. Mobile technology allows businesses to become more service-oriented in what they do and to tailor what they provide to better meet the needs of individual consumers”*. In order to improve users experience and optimize profit, applications that will allow sellers to post products for sale with their phone and buyers too access and inspect the products they desire to buy need to be developed. Two-way communication between the buyer and seller therefore may be initiated, thus increasing chances of sale. Based on the above premise, this research proposes the development of a secured m-commerce platform that will bring the seller and buyer into contact over their mobile devices and wireless network. The development was based on C2C e-commerce model. Specifically, a development of a m-commerce application that allows sales of product, allows buyer and seller to communicate, and provides security for user’s transaction using password entry is reported in this study.

SYSTEM DESIGN METHODOLOGY

A system design methodology refers to the framework that is used to structure, plan, and control the process of developing an information system. In this research, an object-oriented design approach was adopted. This methodology was based on the use of process model,

activity diagrams and use case modelling. Common system process models include waterfall, prototyping, iterative and incremental development, spiral development, rapid application development, extreme programming etc. Due to its simplicity and ease of adoption, this research adopted a waterfall process development model (figure 1). The waterfall model also referred to as linear or sequential life cycle model, illustrates the software development process in a linear or sequential flow, implying that any phase in the development process begins only if the previous phase is complete. In this model there is no room for phase-overlap, therefore, the model reinforces the notion of “*define before design*” and “*design before code*”. Waterfall model of Figure 1 shows how the phases connect with one another for the development of the proposed system (Aggarwal and Singh, 2007).

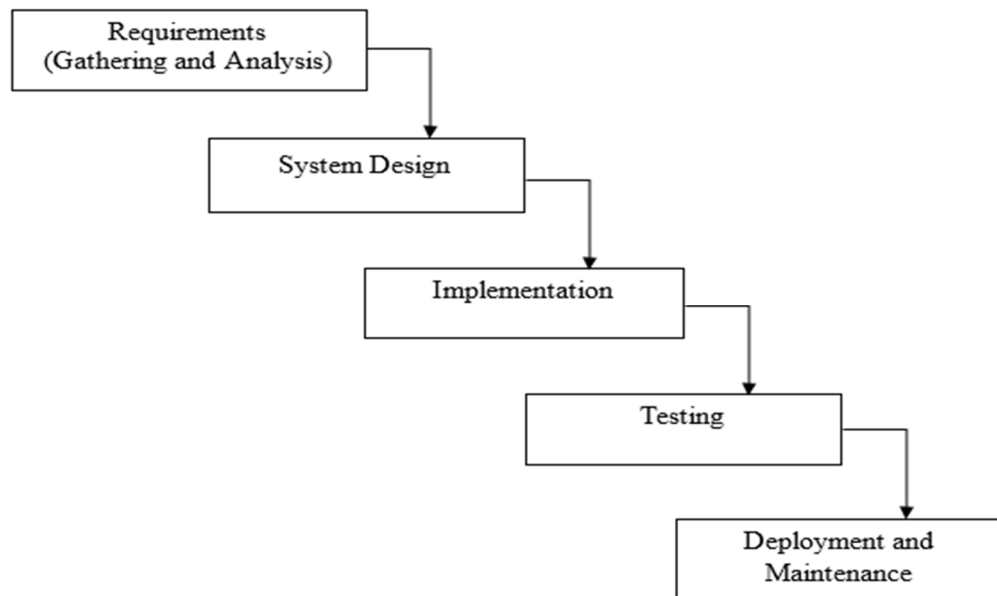


Figure 1: Waterfall representation of proposed M-Commerce platform

As shown in figure 1, the requirements are specified, gathered and analyzed in the first phase, proceeded by system design, which involves the preparation of the information gathered to show how they are linked to one another. In gathering our requirements, we adopted studying and documentation of the existing system such as OLX. This guides our system design. System design helps in specifying hardware and system requirements and also helps in defining overall system architecture. System design tools such as flowcharts, Use Case diagram and Unified Modelling Language (UML) are used in this study to present the layout of the proposed system as it is expected. Consideration for usability, performance, scalability and robust-fullness were made.

The flowchart of figure 2, presents the flow of operation of the proposed m-commerce platform design.

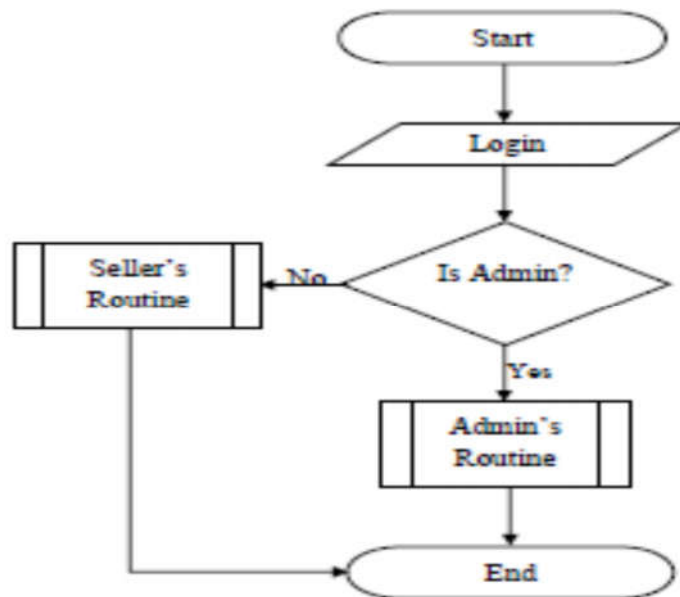


Figure 2: Flowchart of the proposed M-Commerce App

Figure 2 presents the overview of the operation to be performed by the administrator or sellers. The buyer's flowchart is presented in latter flowchart. In the above flowchart, the application user logs in and the system checks for the user type. If the person is a seller, the user is directed to the sellers' subroutine but if the user is the administrator, the user is directed to the administrator's subroutine. Since the seller need not register to the system, the user's type cannot be determined, therefore the need to separate the user from the flow logic, although they all will use the same application. Figures 3, 4 and 5 depict the activity flows for administrator, seller, and buyer respectively. In each of these figures (flowcharts), the activities to be performed by the stakeholders are detailed. The login, which has been included in the application's architecture (figure 1), provides the security medium for user's transaction history.

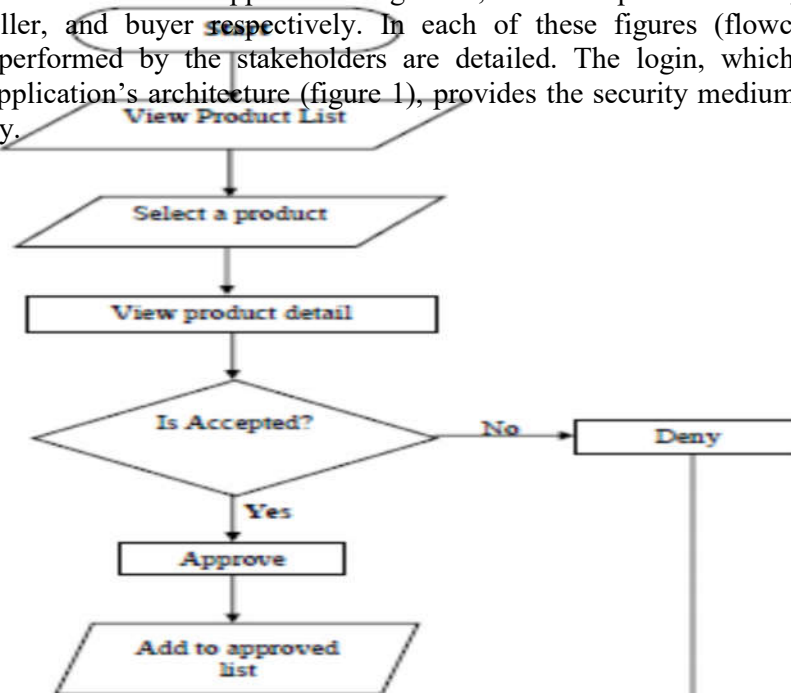


Figure 3: Flowcharts of the administrator's subroutine

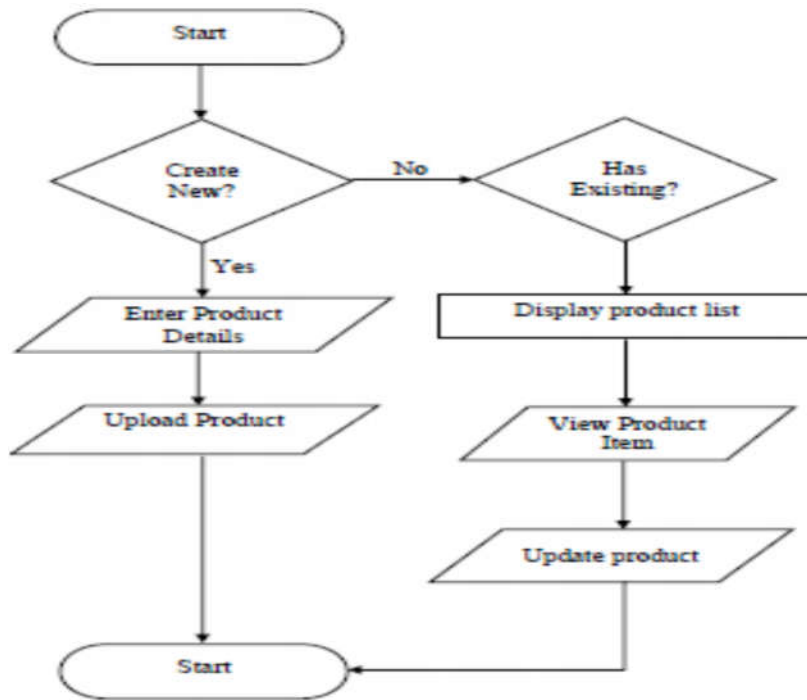


Figure 4: Flowcharts of the seller's subroutine



Figure 5: Flowchart of buyer's subroutine

MODELLING INTERACTION BETWEEN THE USERS AND THE PROPOSED M-COMMERCE PLATFORM

To model the interaction between the users and the proposed system, use case diagram was adopted. The use case diagram helps us to identify the actors of a system and how they interact with one another. According to Rumbaugh et al. (2004), in use case diagram, there are internal and external agents known as actors, which depict the behaviour of the system. Key actors in our proposed m-commerce system are the buyers, sellers and the moderator; they all interface with the server through the client side application as shown in the use case diagram below (figure 6).

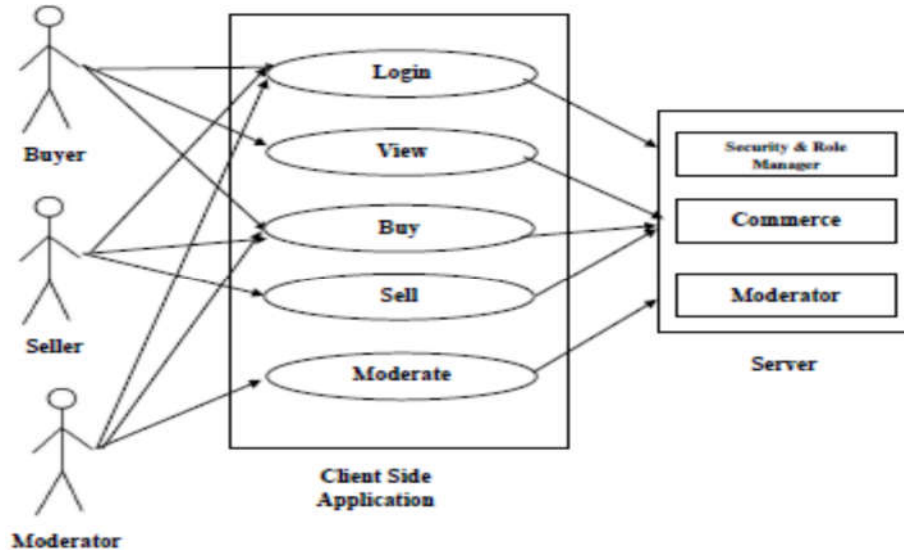


Figure 6: Use case diagram of the proposed M-Commerce platform

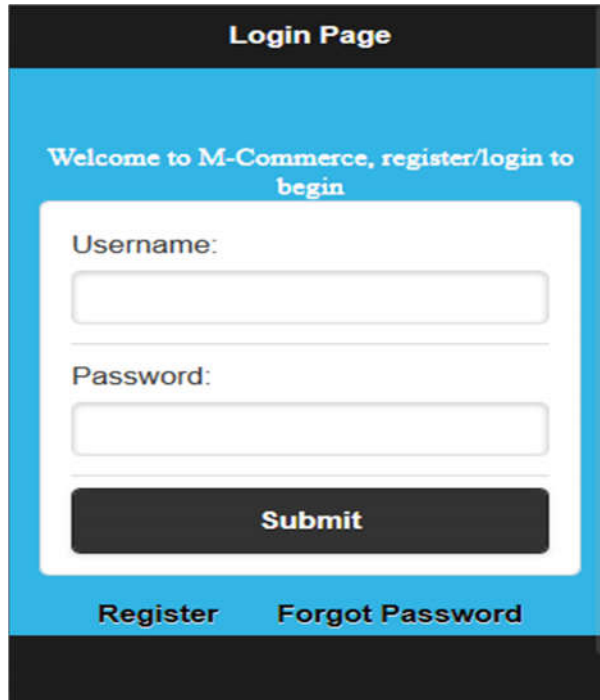
Using client-server network architecture, the actors perform specific actions which correspond to particular request on the server, and invoke a response for the actions performed.

IMPLEMENTATION AND TESTING

In developing the mobile application, some specific tools were used to develop the module that accepts users' request on the server. To implement the client application, Hypertext Markup Language 5 (HTML5) and JavaScript were combined (called *PhoneGap*) with Android Software Development Kit (SDK) for coding whereas server side scripting language-PHP and MySQL were used to develop server module and database respectively. XML was used to specify the configurations and values of the application to be developed. The emulator was used to test and check the performance and validity of operation of the proposed m-commerce platform. Errors discovered in the development were debugged and a retest occurred. The propose platform has been deployed and is available on 'Google Play Store' for download by regular users (alternatively: <http://www.filedropper.com/mcommerceapplication>). The implementation of the proposed M-Commerce platform is discussed under the sub-headings below:

i. The Client Application Interface

Figure 7 shows the login page through which users: administrator and others can login to the proposed platform. Note that the administrator can only be created by another super administrator while anyone can register as a seller or as a buyer.

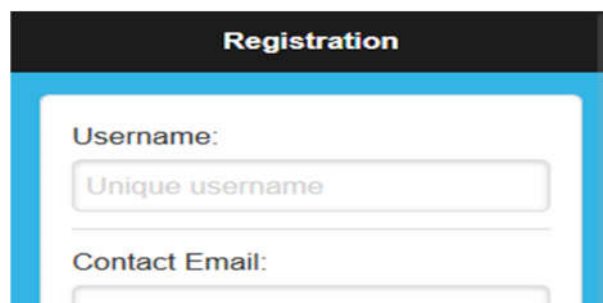


The screenshot shows a login page with a black header containing the text "Login Page". Below the header is a blue banner with the text "Welcome to M-Commerce, register/login to begin". The main content area is white and contains two input fields: "Username:" and "Password:". Below the password field is a black "Submit" button. At the bottom of the white area are two links: "Register" and "Forgot Password".

Figure 7: The login page

ii. Registration Panel

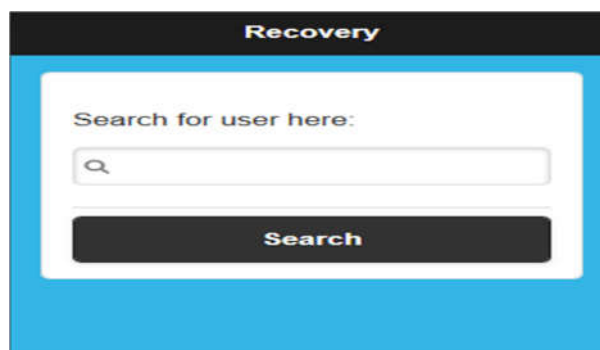
New users of the application must first create an account while existing users must login using their username and password. Figure 8 shows the registration panel of the proposed platform.



The screenshot shows a registration panel with a black header containing the text "Registration". Below the header is a blue banner. The main content area is white and contains two input fields: "Username:" and "Contact Email:". The "Username:" field has a placeholder text "Unique username".

Figure 8: Registration page for new users

The proposed platform has been developed in such a way that, it provides for user-friendliness (GUI). For instance, if a user forgets his/her password, he/she needs not to create another account. All that is required is to click on **'Forget Password'**, key-in the **username** and click on **'search'** then the password will be recovered. The interface that manages this operation is shown in figure 9. Apart from this, application also allows for the change of password as shown in the subsequent figure (figure 10).



The image shows a mobile application interface for password recovery. At the top, there is a black header with the word "Recovery" in white. Below the header is a white search box with a magnifying glass icon on the left. Above the search box, the text "Search for user here:" is displayed. Below the search box is a black button with the word "Search" in white.

Figure 9: Password recovery page

Recovery

Security Message:

Answer:

New Password:

Confirm Password:

Change Password

Fig 10: Password reset page for lost password

iii. The Administrative Side

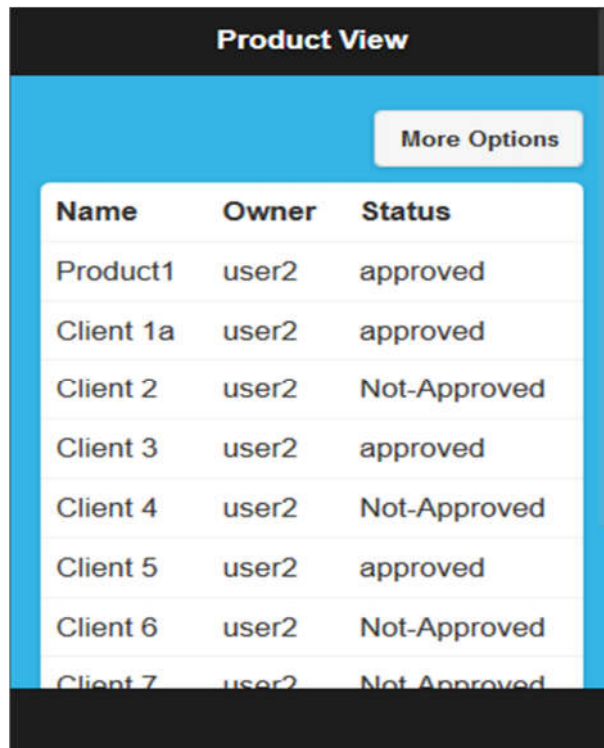
The administrator manages users of the system by monitoring, activating and deactivating accounts. He can also approve or disapprove uploaded products. This is done to reduce or possibly prevent scam, and if a fraud product is detected, it can be deleted or reported to the appropriate authorities. Figure 11 and 12 show the administrative home page and list of all uploaded products respectively.

Admin Page

Welcome user1

- View All Products
- Add Admin User
- Manage Users
- Log out

Figure 11: Administrative home

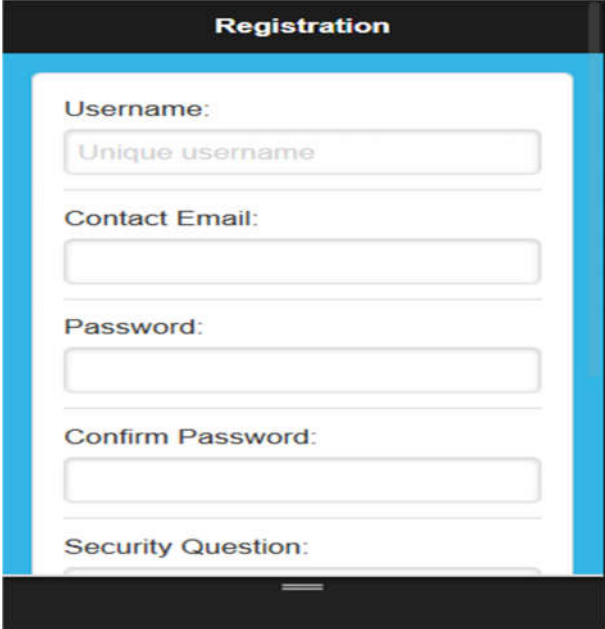


The screenshot displays a web interface titled "Product View". It features a blue header bar with a "More Options" button. Below the header is a table with three columns: "Name", "Owner", and "Status". The table contains eight rows of data, including "Product1" and seven "Client" entries, all associated with "user2" as the owner. The statuses vary between "approved" and "Not-Approved".

Name	Owner	Status
Product1	user2	approved
Client 1a	user2	approved
Client 2	user2	Not-Approved
Client 3	user2	approved
Client 4	user2	Not-Approved
Client 5	user2	approved
Client 6	user2	Not-Approved
Client 7	user2	Not-Approved

Figure 12: List of all products in the system

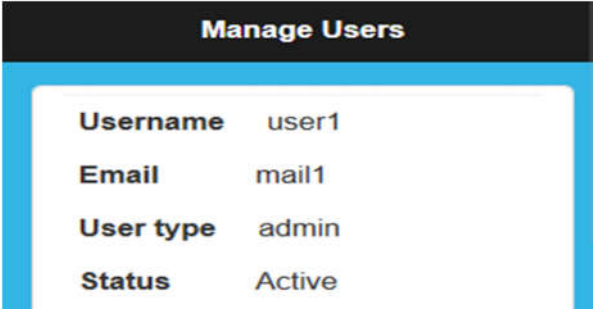
As established above, only existing administrators are permitted to register other administrators which can be done on the administrative page shown in figure 13.



The image shows a mobile application registration screen. At the top, there is a black header with the word "Registration" in white. Below the header is a white registration form with a blue border. The form contains five input fields, each with a label above it: "Username:" with a placeholder "Unique username", "Contact Email:", "Password:", "Confirm Password:", and "Security Question:". The bottom of the screen shows a black bar with a white home indicator.

Figure13: Registration panel for new admin

The interface shown in figure 14 allows administrators to manage activities of the existing users.



The image shows a mobile application screen for managing users. At the top, there is a black header with the text "Manage Users" in white. Below the header is a white area containing a list of user details. The details are as follows:

Username	user1
Email	mail1
User type	admin
Status	Active

Fig 14: Managing existing users page

iv. The Sellers' Panel

The product seller after login is directed to a different view shown in figure 15, where he/she can upload new products or manage existing products. Information relating to the new products can be registered (uploaded), viewed and updated on the pages shown in figures 16, 17 and 18 respectively.

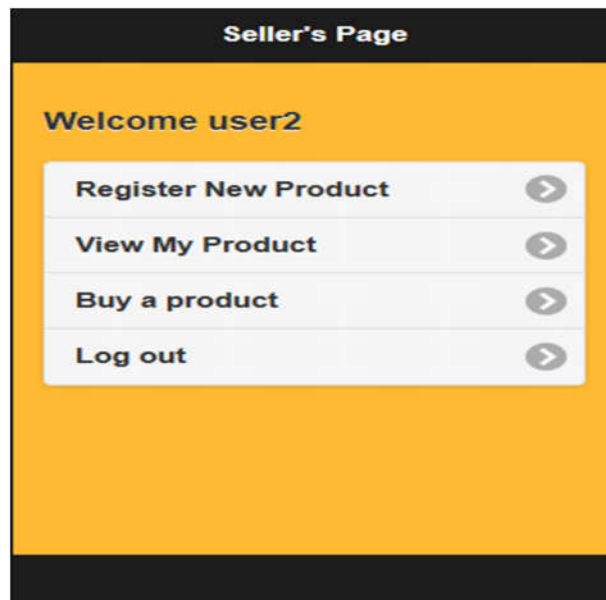


Figure 15: Product sellers' home page

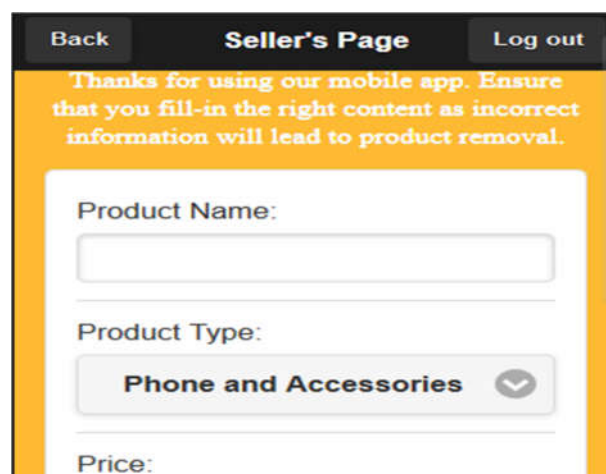


Fig 16: Register and upload new product information page

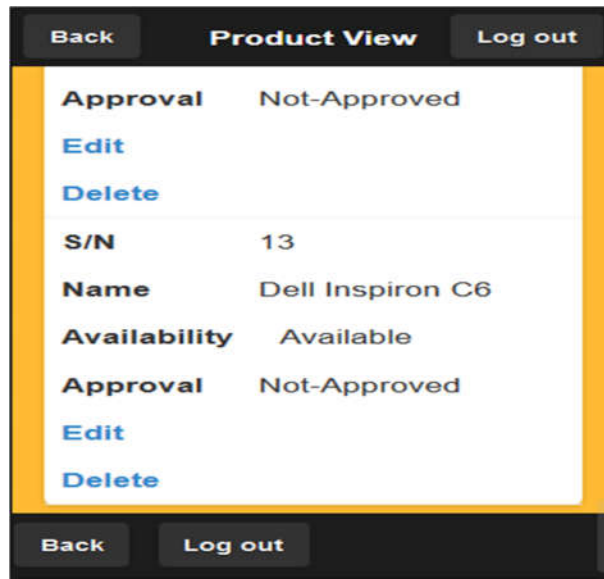


Figure 17: View available products page

The screenshot shows a mobile application interface titled "Item View". At the top, there are three buttons: "Back", "Item View", and "Log out". The main content area is enclosed in a yellow border and contains the following fields:

- Product Name:** A text input field containing "Dell Inspiron C6".
- Product Type:** A dropdown menu currently showing "Phone and Accesso..." with a downward arrow.
- Price:** A text input field containing "182000" and a currency symbol icon.
- Description:** A text input field that is currently empty.

At the bottom of the form, there are two buttons: "Back" and "Log out".

Figure 18: Updating product information page

v. The Buyers' Panel

Buyers can search for or view products, based on category. Specific product information can be accessed and contact established with the seller. These activities can be done on the pages shown in figures 19, 20 and 21. Note that sellers can perform all activities available to the buyers. The platform allows the buyer to simply click the phone number or email of the seller on the specific information page to establish contact.

The screenshot shows a mobile application interface titled "Buyer's Portal". It features a search engine with the following elements:

- Search for product here:** A text input field with a magnifying glass icon.
- Search:** A black button with white text.
- Category List:** A list of product categories, each with a right-pointing arrow:
 - Phone and Accessories
 - Laptops
 - Household Appliances
 - Wears
 - Log out

At the bottom, there are two buttons: "Back" and "Log out".

Figure 19: Buyers' search engine

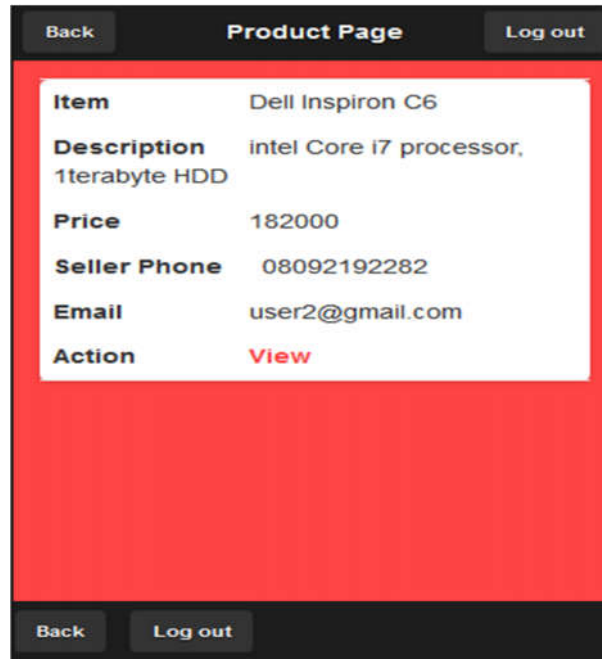


Figure 20: Viewing products page



Fig 21: Specific product information view page

The proposed m-commerce platform can be downloaded using any of the URL below:

- i. Google Play Store or
- ii. <http://www.filedropper.com/mcommerceapplication>
- iii. <https://www.dropbox.com/s/8ecw6tsf16nbf94/mcommerce%20application.apk?dl=0>

SUMMARY AND CONCLUSION

E-commerce platforms allow sellers and buyers to transact business without their physical presence. By this practice, huge profits have been made and more clients' satisfactions have been derived. M-Commerce is a derivative of electronic commerce, which allows product contents to be shared between businesses or consumer depending on consumer-to-consumer (C2C) approach discussed in the previous sections. The huge profit made from e-commerce has attracted huge investment from sales-focused organizations. Technology innovation has allowed the interconnectivity of several devices; therefore more people can access the content online. Mobile phones is becoming more popular daily with lead technology companies targeting emerging countries, therefore more people are connected anywhere and anytime. Customer targeting can be more mobile focus and the user experience improved.

In order to demonstrate the possibility of developing a successful mobile application, a C2C model was chosen for implementation. This model uses a client-server approach to facilitate communication between users of the application. The software development process follows waterfall process model, design, testing and deployment. The design specification required that we have three user groups, which are administrator, sellers, and buyers.

Given the popularity of Android Operating System (OS) and the usability it provides, the implementation of the application was based on Android OS, although this does not imply that same application cannot be developed and deployed for other mobile operating systems. After the specification has been analyzed, we developed a mobile application using a multiplatform framework called PhoneGap. Our application development makes use of HTML5, JavaScript, Java, and XML.

The application was developed and tested to ensure if it conforms to the specification. After testing, the application was deployed to phone. Since mobile commerce cannot be effectively implemented without internet connection, connectivity therefore becomes a primary requirement in order to allow communication between client and server.

The design and development of this mobile application reflects that mobile phones are powerful enough as tools for e-commerce. Users can have nearly the same experience as they would have if they are using their personal computer and this experience comes anywhere and anytime. Sales companies can reach out to more consumers, thereby making more profits; customers can also benefit from the portability of the proposed system, to maximize their profit.

Further study can therefore be channeled towards comparing the performance of the proposed M-Commerce platform with the existing ones in terms of users' satisfaction, scalability, usability and security so as to know where further improvements need to be made to the already developed platform.

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