



Design and Implementation of M-Commerce Platform for Buying and Selling

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Abstract

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Waterfall model

Computers and other ICT gadgets have become ubiquitous assets 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 within 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 testing phase showed that the platform performed adequately well to users' satisfaction in terms of security, sales and profit.

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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.

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 transactions, 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 parts of the world without being physically present. The evolution of computer and the internet did not exclude Africa and Nigeria, the largest economy 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 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 that are worthy, when measured using 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 2019 first quarter report by Criteo, a company that does personalized performance advertising says that 43% of e-Commerce transactions in USA and 47% globally are from mobile phones (smarts phones) to be specific. It was projected that by the end of 2019, business transaction via mobile devices would reach 70% in USA and increases annually by 22% throughout the world. Report also has it that the above company realize over USD600 billion on the sales of data annually. 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, OnlineeXchange(OLX) and so on. 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 to access and inspect the products they desire to buy need to be developed. Two-way communications 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 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 an 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.

RELATED WORK

There are three entities in M-Commerce: mobile businesses, mobile consumers and mobile networks. Mobile businesses refers to service providers that a consumer or business need to remotely interact with for business transactions. In other words, mobile businesses provide online goods and services for consumers to purchase. Mobile consumers are the individuals that interact with service providers to purchase online products and services via their mobile applications and websites. Mobile networks refer to the communication infrastructure owned and accessed by consumers and which form part of the end-to-end transaction (Constantions and Khaled, 2006).

There are good numbers of literatures bordering on benefits of M-commerce, its development frameworks and implementation as well as its

security challenges. Few among them are cited below.

According to Tiwari *et al.*, (2006), M-commerce is gaining increasing acceptance due to ever-increasing convergence of computers and mobile telecommunication devices coupled with dwindling internet connectivity cost.

The benefits of the M-commerce has been felt the in the economy of many developed countries over the years. Going by the statistics of European Information Technology Observatory (2002) and (2004), the total amount of revenues generated by mobile Internet and mobile content services, put together, was reported to be around €19 million in the whole of Western Europe in 2001. Two years later, the revenues in Germany alone had gone up to an impressive growth of €280 million while M-Commerce turn-over in Great Britain and France was reported to be €12 million and €127 million respectively (EITO, 2002; 2004).

Andreouset *al.* (2014) suggested novel approach to designing and developing M-Commerce services and applications based on factors such as mobile users needs and requirements, the classification of the M-Commerce services and applications, the current technologies for mobile and wireless computing, as well as their design constraints.

Ahmad and Ibrahim (2017) highlighted several interface design principles that M-commerce apps must follow in order to be designed for business transactions. This was done on the strength of literature review of some design guidelines sourced from databases such as IEEE, Science Direct, and Google Scholar.

To tackle the security problem of M-commerce in Nigeria, Ayo *et al.* (2004) developed a control-oriented conceptual framework for implementing, monitoring and controlling frauds in mobile commerce business transactions.

The common limitations of the above cited works are each actor on the platform has been restricted to only role. For instance, a seller can only post products for sale only at a time. He or she cannot to buy from other sellers. Also, apart from the system administrators who maximum controls over every transaction have made both the buyer and the seller do not enjoy such privilege. In the proposed M-commerce platform, such restrictions have been removed. Both sellers and buyers can perform dual roles simultaneously.

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 paper, 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 paper adopted a waterfall process development model shown in 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 shows how the phases connect with one another for the development of the proposed system (Aggarwal and Singh, 2007).

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 robustness were made.

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

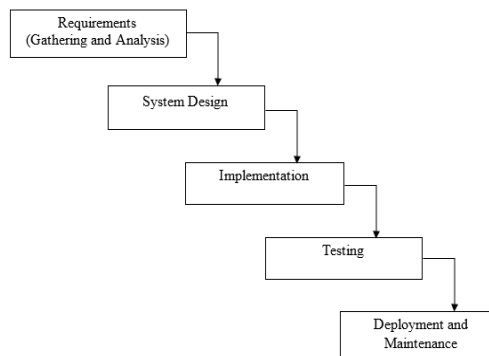


Figure 1: Waterfall representation of proposed M-Commerce platform

Clearly, from Figure 2, overview of the operations to be performed by the administrator and sellers is visible. The buyer's flowchart is presented in latter 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 will all use the same application. Figures 3 (a, b & c) 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, provides the security medium for user's transaction history.

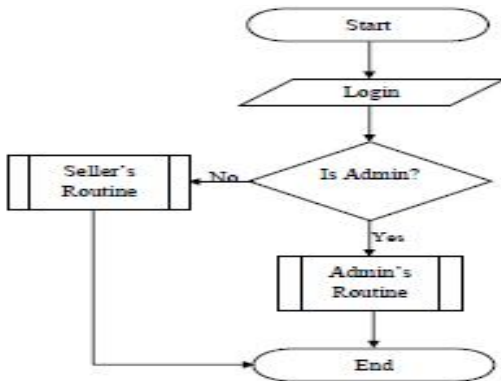
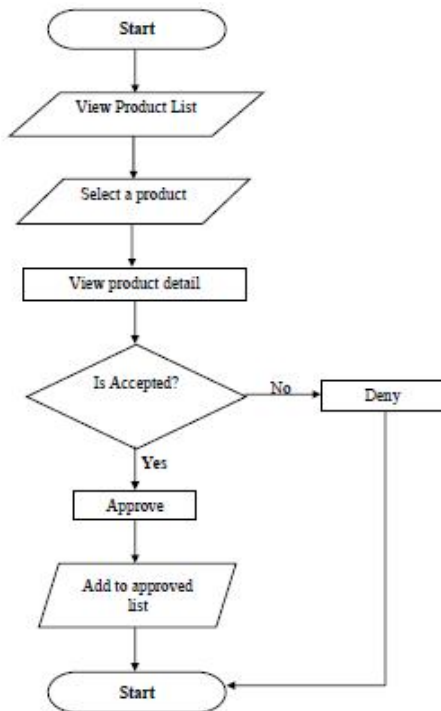
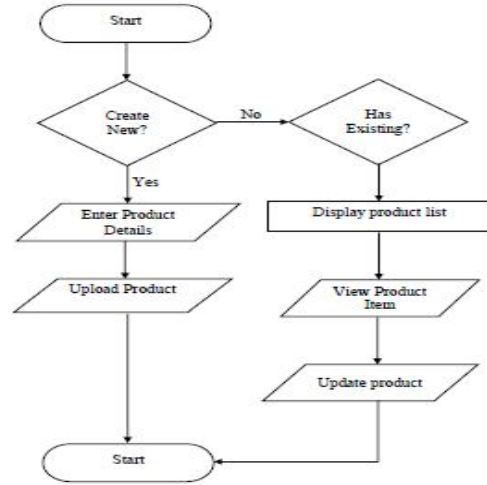


Figure 2: Flowchart of the proposed M-Commerce App

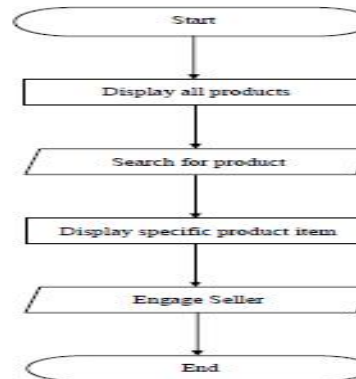


(a) Flowcharts of the administrator's subroutine

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



(b) Flowcharts of the seller's subroutine



(c) Flowchart of buyer's subroutine

Figure 3: Activities flowcharts of the proposed system

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

To model the interactions 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 Figure 4.

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.

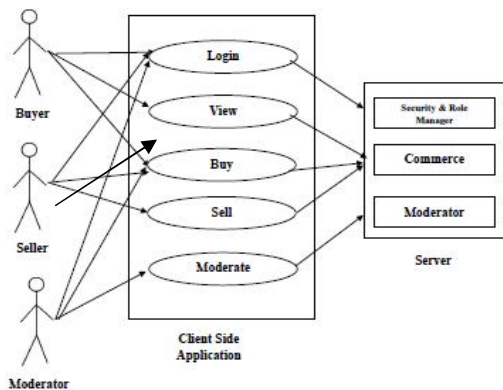


Figure 4: Use-case diagram of the proposed M-Commerce platform

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 5 shows the login page through which users: the 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.

ii. Registration Panel

New users of the application must first create an account while existing users must login using their

username and password. Figure 6 (a) shows the registration panel of a new user. The proposed platform has been developed in such a way that, it provides for user-friendliness, that is Graphical User Interface (GUI). For instance, if a user forgets his/her password, he/she needs not to create a new 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 6(b). Apart from this, application also allows for the change of password as shown in Figure 6(c).

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 fraudulent transaction is detected, it can be deleted or reported to the appropriate authorities. Figure 7(a) and (b) show the administrative home page and list of all uploaded products respectively. As established above, only existing administrators are permitted to register other administrators which can be done on the administrative page shown in Figure 7(c). The interface shown in Figure 7(d) allows administrators to manage activities of the existing users.

iv. The Sellers' Panel

The product seller after login is directed to a different view shown in Figure 8(a), 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 Figure 8(b), (c) and (d) respectively.

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 Figure 9(a), (b) and (c) respectively. 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 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>

Login Page

Welcome to M-Commerce, register/login to begin

Username:

Password:

Submit

[Register](#) [Forgot Password](#)

Figure 5: The login page

Admin Page

Welcome user1

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

Figure 7(a): Administrative home

Registration

Username:

Contact Email:

Password:

Confirm Password:

Security Question:

Figure 6(a): Registration page for new users

Product View More Options

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 7(b): List of all products in the system

Recovery

Search for user here:

Search

Figure 6(b): Password recovery page

Registration

Username:

Contact Email:

Password:

Confirm Password:

Security Question:

Figure 7(c): Registration panel for new admin

Recovery

Security Message:

Answer:

New Password:

Confirm Password:

Change Password

Figure 6(c): Password reset page for lost password

Manage Users

Username	user1
Email	mail1
User type	admin
Status	Active
Action	Deactivate
Action	Delete
Username	user2
Email	mail2
User type	seller
Status	Active

Figure 7(d): Managing existing users' page

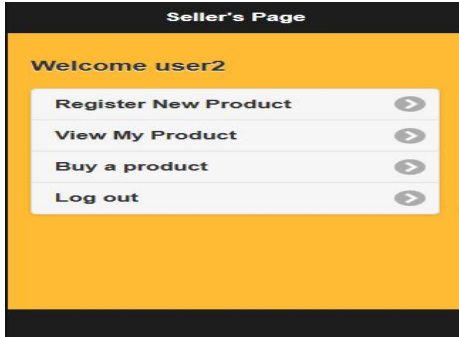


Figure 8(a): Product sellers' home page

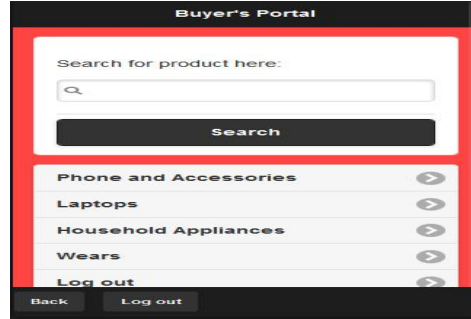


Figure 9(a): Buyers' search engine

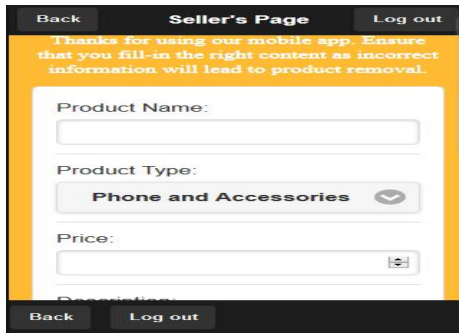


Figure 8(b): Register and upload new product page

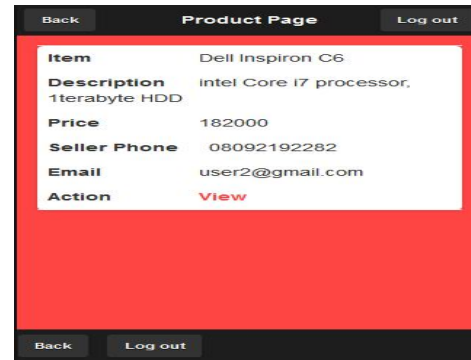


Figure 9(b): Viewing products page

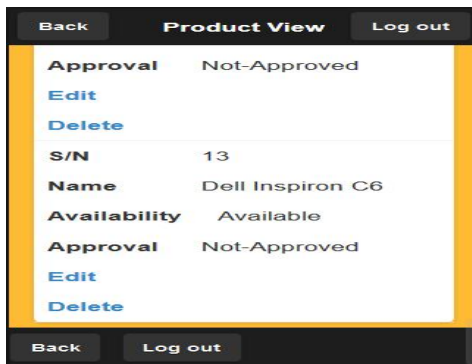


Figure 8(c): View available products page



Figure 9(c): Specific product information view page

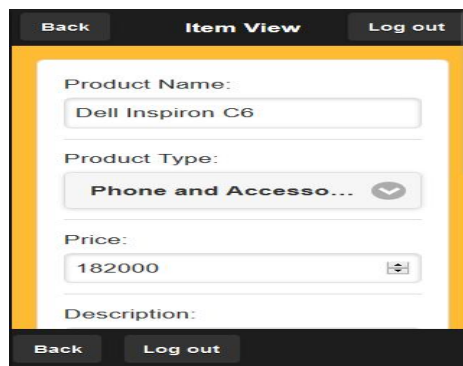


Figure 8(d): Updating product information page

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 at anytime. Customer targeting can be more mobile focus and user experience improved.

In order to demonstrate the possibility of developing a successful mobile application, a C2C model was chosen for the 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 multi-platform 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 mobile phones. 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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