Development Of Mobile Payment System: An Implementation Of Cashless Economy

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ABSTRACT

This work presents the development of a mobile payment system which implements cashless economy using Nigeria as a case study. The main aim of this development is to reduce some cash-related crimes in our society such as: robberies, the risk of losing cash in the case of fire and flooding incidents, inefficiency and corruption associated with cash usage like leakages, money laundering, amongst other cash-related fraudulent activities. The mobile payment system developed produces services operated under financial regulation and performed from or via a mobile device. With the use of this mobile payment system, instead of paying with cash or check, a consumer can use a mobile phone to pay for a wide range of services, digital or hard goods. This payment system is a service system where the consumer sends a payment request via an SMS text message to a customized code, the system evaluates the request with regards to financial regulations and either accepts the request and carries out the financial transaction or rejects the request by sending an SMS back to the consumer that sent the request. AT commands for VB.Net programming language is the tool used in the development of this mobile payment system with MySQL as the database.

Keywords: AT commands, Cashless, Economy, Mobile, Payment, System

1.0 INTRODUCTION

In Nigeria today, cash payment system is the dominating form of payment with customers, as transactions are completed immediately and it can also be used for another transaction, making them a cash-based economy. Information and Communication Technology (ICT) has advanced to the extent that it has

made life more comfortable and efficient. The comfort of being able to pay for goods and services from any point of transaction, using **mobile phones** has become a vital issue as it saves a lot of time and the risks involved in carrying cash.

Mobile payment system is presently a popular trend of payment system in most advanced countries and allows commercial transactions to be carried out anytime, anywhere and by anyone with a mobile phone which is a form of payment system that supports the emergence of Cashless economy. There are so many problems observed that are associated with Nigerian's cash-based economy, which include:

- Delays in financial transactions which can be caused by queue in the bank or ATM to collect cash.

- Spread of bacteria through handling physical cash

- High rate of crime, illegal drug trade, terrorism, illegal immigration, human trafficking, corruption, due to its cash-based economy. People are always faced with the challenges of violent crimes (insecurity) such as, bank and ATM robberies, store holdups, armed robberies, employee cash theft, armor car heists, kidnap for ransom, and purse snatching as the system of physical cash been used is non-traceable, unaccountable, easy to hide or lose, steal, counterfeit and spend without a trace, as such paper cash has allowed all sorts of criminal activities to thrive.

- Too much cash in circulation which causes inflation to rise, and as inflation rises, it diminishes the purchasing power of consumers, making it undesirable to hold cash.

The purpose of this research is to develop an easy, efficient and a lasting solution to the aforementioned problems associated to cash-based economy which will:

- Make faster transactions – reducing queues at the banks, ATM points and points of sales by eliminate time spent on collecting, counting and sorting cash.

- Improve hygiene on site – eliminating the bacterial spread through handling of notes and coins.

- Help eliminate the crimes associated with the cash economy and improve the security consciousness of individuals and remove the common fear associated with using physical cash.

- Help check inflation by reducing the amount of cash in circulation.

- Enhance the Central Bank of Nigeria (CBN) new policy on cashless economy

The study will foster the reduction of some disadvantages associated with cash-based economy to the government, banks, merchants and customers. It will seek to:

- Offer huge cost savings to the government because the use of Mobile payment system will reduce cost of printing paper currency.

- Obviate the need to transport, handle, store and dispense physical cash as mobile payment system will offer enormous savings to the banks and merchants

- Enable customers to conveniently pay for their goods and services without the inconveniences associates with withdrawing cash, especially those that are staying far from banks or ATMs stands.

- Provide more security to the business owners who will be saved from the stress of ensuring that they deposit the cash realized on daily basis in the bank due to the fear of financial loss in the case of fire, flooding incidents, armed robbery or domestic crisis.

- Also drive development and modernization of our payment system in line with Nigeria's vision 202020 goal of being amongst the top 20 economies by the year 2020. An efficient and modern payment system is positively correlated with economic development, and is a key enabler for economic growth.

2.0   LITERATURE REVIEW

2.1   Payment System

Payment system is seen as a financial system supporting transfer of funds from suppliers (savers) to the users (borrowers), and from payers to the payee, usually through exchange of debits and credits among financial institutions. It consists of a paper-based mechanism for handling cheques and drafts, and a paperless mechanism (such as electronic funds transfer) for handling electronic commerce transactions, also called payment mechanism. (BusinessDictionary).

Payment system has been defined by different author as Bruce (2012) defined payment system as an operational network - governed by laws, rules and standards - that links bank accounts and provides the functionality for monetary exchange using bank deposits. According to Anyanwaokoro (1999), in the theory and policy of money and banking, payment system is defined as a system where settlement of financial obligations are done by the use of credit cards or even pressing some buttons that transfer the amount in

their bank to the account of another person through the computer. But according to World Bank, payment system is the infrastructure (consisting of institutions, instruments, rules, procedures, standards, and technical means) established to effect the transfer of monetary value between parties discharging mutual obligations.

2.1.1 Different Types of Payment Systems

Over the years we have experienced a progression of value transfer system starting from barter, through bank notes, payments orders, cheques, and later Credit Cards, this has finally evolved into electronic payment systems which enables commerce on the Internet (Asokan, et. al. 2000). Ferguson (2008) opined that payment systems have evolved substantially over time, from earliest bartering systems, to systems based on coins of precious metal, to the virtual payment systems of today.

2.1.1.1 The Barter Payment System

Writing some years ago, Temple (1960) described barter as "the exchange of one article for another". Before the evolution of money, exchange was done on the basis of direct exchange of goods and services. This is known as barter. Barter involves the direct exchange of one good for some quantity of another good. For example, a horse may be exchanged for a cow, or 3 sheep or 4 goats. For a transaction to take place there must be a double coincidence of wants. Moreover, under a barer system the value of each good is required to be stated in as many quantities as there are types and quantities of other goods and services. The exchange rate formula given by Prof. Culberston is *n(n-l)/2 (Haruna, 2008).*

2.1.1.2 Bank Coins and Notes (Cash) Payment System

Since the overcoming of barter in the history of mankind, trade usually involve the exchange of goods and services and an equivalent abstract value such as money. (Sadeghi & Schneider, 2001). Ever since money was invented as an abstract way of representing value, system for making payments have been in place.

2.1.1.3 Cheque Payment System

According to Probert Encyclopedia, a cheque payment system is a type of payment made by a bill or draft on a bank, payable on presentation. Unlike cash system, where physical money is used for making

payment, with the cheque system a person can issue a cheque as a form of currency for payments which is withdrawn from a bank.

2.1.1.4 Card Payment System

A card payment system is the use of a plastic card that contains a Personal Identification Number (PIN) that is linked to one's account that can be used to withdraw money from the appropriate terminal. Most cards have a magnetic stripe on which data is stored, and has a Card Verification Value (CVV), which is used to verify the genuineness of the card. The existing card payments globally include: credit cards, debit cards, and smart cards.

2.2 Development of Electronic Banking in Nigeria

Kaleem & Ahmad (2008) observed that Electronic banking is the latest in the series of technological wonders of the recent past and that ATMs, Tele-banking, Internet Banking, Credit Cards and Debit Cards have emerged as effective delivery channels for traditional banking products. The Government of Nigeria further promoted electronic banking with the CBN release on August 2003. This recognizes that electronic banking and payments services are still at the early stages of development in Nigeria.

According to Somoye (2008), between 1952-1978, the banking sector recorded forty-five (45) banks with varying minimum paid-up capital for merchant and commercial banks. The number of banks increased to fifty-four (54) from 1979-1987. The number of banks rose to one hundred and twelve (112) from 1988 to 1996 with substantial varying increase in the minimum capital. The number of banks dropped to one hundred and ten (110) with another increase in minimum paid-up capital and finally dropped from 89 as at end of 2003 to twenty-five in 2006 with a big increase in minimum paid-up from two billion naira in January 2004 to twenty five billions in July 2004. As at the end of 2010 the number of banks licensed to practise in Nigeria stood at 24 (www.cbn.ng 2011).

Agboola (2006) observed that some payments are now being automated and absolute volume of cash transactions have declined under the impact of electronic transaction brought about by the adoption of ICT to the payment system especially in the developed countries. Emmanuel and Sife (2008) observed that positive effects of ICT have continually been noted in business, production, education, politics, governance, culture and other aspect of human life. This view is corroborated by Agboola (2006) and Ayo (2006) that the

growing rate of ICT particularly the internet has influenced at an exponential rate, on line interaction and communication among the generality of the populace.

2.3   Mobile Payment System

A mobile payment is any payment where a mobile device is used to initiate, authorize and confirm a transfer of value in return for goods and services (Pousttchi, 2003; Au and Kauffman, 2008). The challenge of understanding the driving forces in the market for mobile payment system is that there are an accelerating range of solutions that address shortcomings in legacy payment processes.

2.4   The Cashless Economy

Woodford (2003) said contrary to what is suggestive of the term, cashless economy does not refer to an outright absence of cash transactions in the economic setting but one in which the amount of cash-based transactions are kept to the barest minimum. It is an economic system in which transactions are not done predominantly in exchange for actual cash. It is not also an economic system where goods and services are exchanged for goods and service (the barter system).

In a cashless economy, how much cash in your wallet is practically irrelevant. You can pay for your purchases by any one of a plethora of credit cards or bank transfer (Roth 2010). Some aspects of the functioning of the cashless economy are enhanced by e-finance, e-money, e-brokering and e-exchanges. These all refer to how transactions and payments are effected in a cashless economy (Moses 2011).

According to Ezumba (2011), in Nigeria, under the cashless economy concept, the goal is to discourage cash transactions as much as possible. The CBN had set daily cumulative withdrawal and deposit limits of N150,000 for individuals and N1,000,000 for corporate entities (now reviewed to N500,000 and N3million respectively). Penalty fees of N100 and N200 respectively (now reduced to 5% and 3% respectively) are to be charged per extra N1000.

According to Omose (2011), it has to be noted that the operation of the cashless economy (electronic payment) system is not entirely free.

3.0   Analysis of the Existing Payment System

In Nigeria today, the popularly existing payment systems are using physical cash or cheques. Physical cash falls under the currency category of money or are called fiat money, while Cheques fall under

fiduciary money or "demand deposits", also known as "checkbook money", which are the funds people hold in their checking or current account.

3.1   Payment System Using Physical Cash

A cash payment system is simply using physical cash to make payments, this payment system using physical cash involves only two actors, the payer and the payee physically exchanging the cash at the point of purchase of goods and services. Figure 2.0 shows the cash payment system.
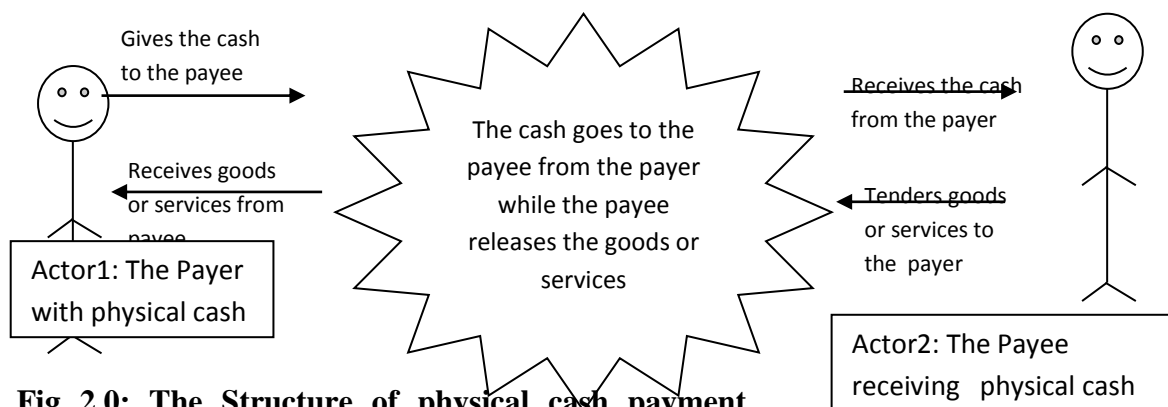

Fig 2.0: The Structure of physical cash payment

3.2   Payment System Using Cheque

A cheque payment system is another popular type of payment made in Nigeria. This is a bill or draft on a bank, payable on presentation. Figure 2.1 shows the pictorial representation of a chaque payment system.
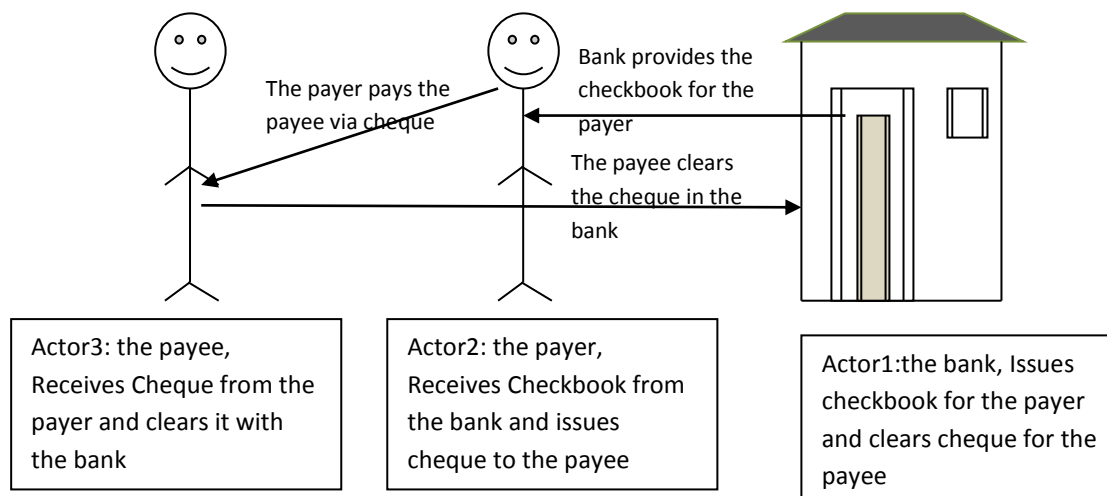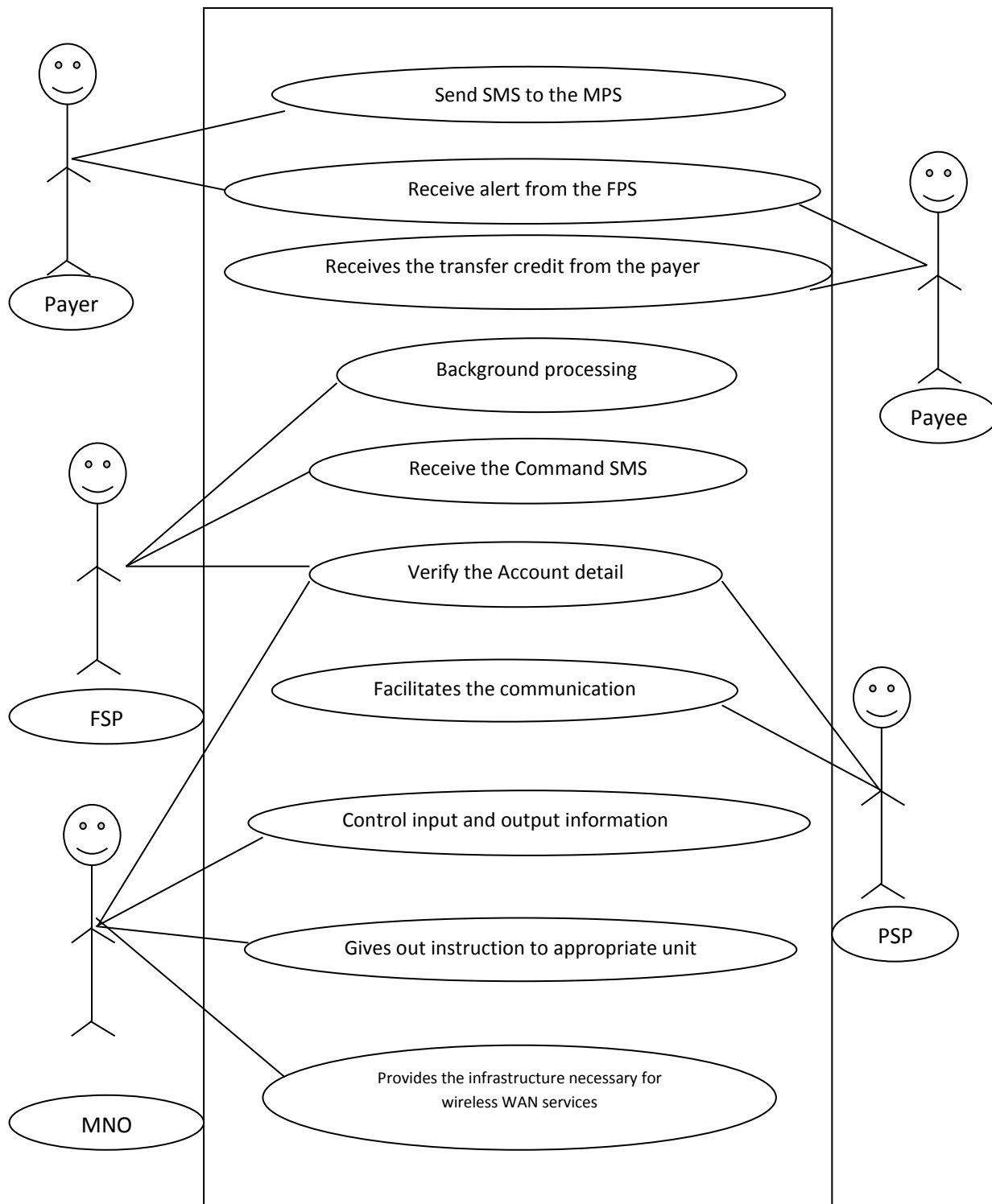

Fig 2.1: The Structure of cheque payment system

3.3 Methodology used for the Analysis

The method used in analyzing this work is Object Oriented Analysis and Design (OOAD). Object Oriented Analysis (OOAD) is a model driven technique that integrates DATA and PROCESS concerns into constructs called objects. OOAD models are pictures that illustrate the system's objects from various perspectives such as structure and behavior. Object-oriented analysis and design (OOAD) is a popular technical approach to analyzing, designing an application, system, or business by applying the object-oriented paradigm and visual modeling throughout the development life cycles to foster better stakeholder communication and product quality.

3.4 The Use case diagram of the system

A Use Case illustrates a unit of functionality provided by the system. The main purpose of the Use-Case diagram is to help development teams visualize the function of the system including the relationship of the "ACTORS" to essential processes, as well as the relationships among different use case. Mobile Payment System typically involves five main actors. These include a Financial Service Provider (FSP), a Payment Service Provider (PSP), a Mobile Network Operator (MNO), a payer and payee. An FSP is usually a bank and is responsible for performing the backend processing required for settling a transaction between two parties. A PSP facilitates the communication between the FSP and the payer/payee by providing the payment software. The MNO provides the infrastructure necessary for wireless WAN service. In addition, there are regulators who are involved in monitoring compliance with the rules and laws related to m-payments. These are generally government bodies or law enforcement agencies. Figure2.3 shows the Use Case Diagram for a mobile payment system.

Fig.2. 3: USE CASE DIAGRAM OF MOBILE PAYMENT SYSTEM

The state chart diagram defines the states of a component and these state changes are dynamic in

nature, so its specific purpose is to define state changes triggered by events. It represents possible sequences of

state change from a particular point of view. State chart Diagram are used to model states and also events operation on the system. When implementing a system it is very import to clarify different states of an object during its life time and state chart diagrams are used for this purpose. Therefore the main usage of state chart diagram is: To model object states of a system, to model reactive system, and to identify events responsible for state changes.

State chart diagram attributes are represented by:

(a) Rounded rectangles labeled with their names.

(b) The transition which is labeled with arrows connecting states.

A state is a condition of an object in which it performs some activity or waits for an event, while a transition is a relationship between two state which is triggered by some event, which performs certain actions. Fig 3.3 shows the state chart of the proposed system.
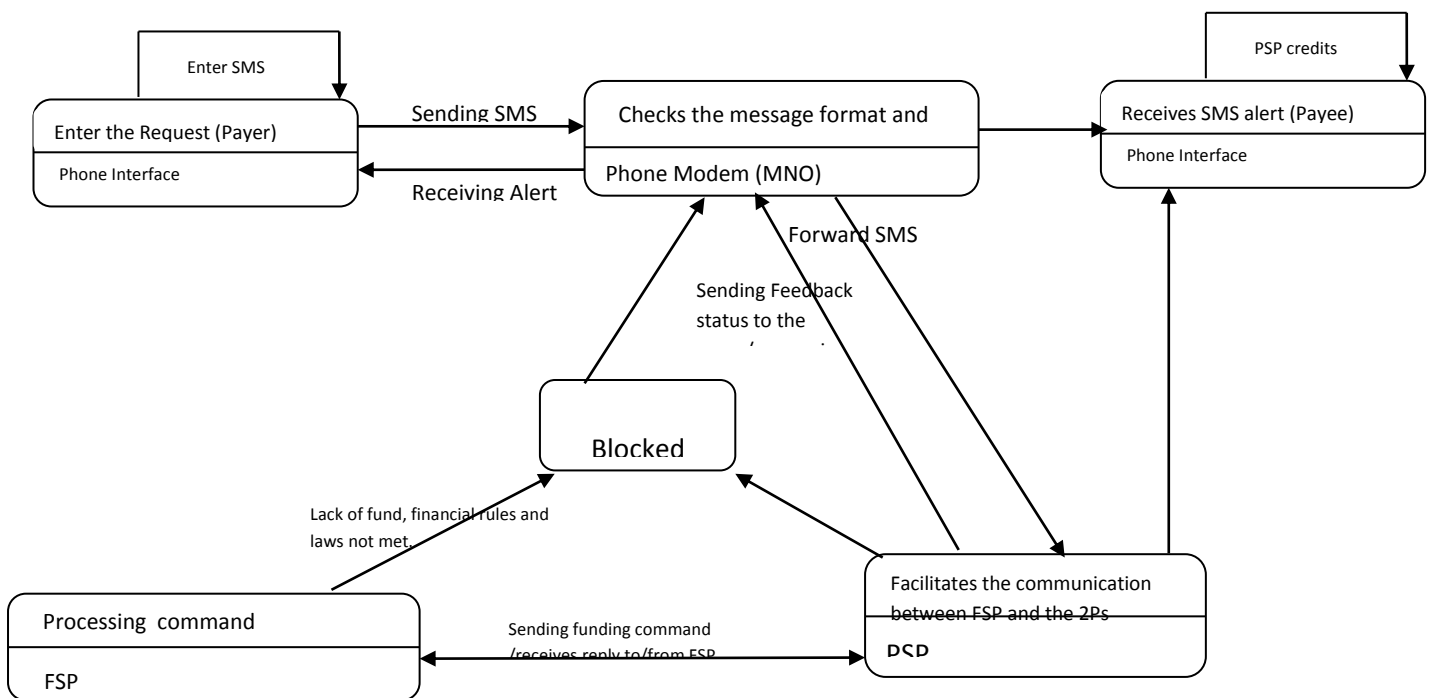
Fig. 2.4: State Chart Diagram of Mobile Payment System

4.0   RESULT AND DISCUSSION

4.1   Design of the Proposed System

The design stage of the proposed system describes a final system and the process by which it is developed; this includes database design, system architecture, input design, output design and the algorithm design.

4.1.1 Database Design

Database design is the process of producing a detailed data model of database. This logical data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a data definition language, which can then be used to create a database. A fully attributed data model contains detailed attributes for each entity.

The process of doing database design generally consists of number of steps which will be carried out by the database designer, usually the designer must:

- Determine the relationship between the different data elements.

- Superimpose a logical structure upon the data on the basis of these relationships.

There are more than one database model which can used but for the case of this project, the relational model was used. In the relational model these are the tables and views.

The Mobile Payment System was designed using MySQL, the database is made up of four (4) tables. Which are: -

1. createaccount Table

2. fundaccount Table

3. recievedsms Table

4. sentsms Table

The detailed structure of each table is shown in tables 4.1.1, 4.1.2, 4.1.3 and 4.1.4 respectively:

Table 4.1.1:   createaccount Table

Field	Data Type	Size	Null	Description	Action	Extra
ID	Int	11	No	Unique Table ID	Primary Key	Auto_increment
LastName	Varchar	50	No	User Last Name		
FirstName	Varchar	50	No	User First Name		
AccountNo	Varchar	10	No	User Account No.		
AccountType	Varchar	15	Yes	User Account Type		

Bank	Varchar	50	No	User Bank		
PinNum	Varchar	50	No	Unique User PIN		Auto_generate
Phone	Varchar	50	No	User Phone No.		

Table 4.1.2   fundaccount Table

Field	Data Type	Size	Null	Description	Action	Extra
ID	Int	11	No	Unique Table ID	Primary Key	auto_increment
PIN	Varchar	50	No	Unique User PIN		
Credit	Varchar	50	Yes	User Account Credite		

Table 4.1.3   receivedsms Table

Field	Data Type	Size	Null	Description	Action	Extra
ID	Int	11	No	Unique Table ID	Primary Key	auto_increment
Phone	Varchar	20	No	User Phone No		
TextMessage	Varchar	200	No	User Account Alert		
RecievedTime	Varchar	50	No	Time Received SMS		

Table 4.1.4   sentsms Table

Field	Data Type	Size	Null	Description	Action	Extra
ID	Int	11	No	Unique Table ID	Primary Key	auto_increment
Phone	Varchar	20	No	User Phone No		
TextMessage	Varchar	200	No	User Account Alert		
SentTime	Varchar	50	No	Time sent SMS		

4.2   System Architecture

The Mobile Payment system works using client-server architecture and can either be implemented as a dependent service or independent service. The system described below is used as a dependent service; this implies that the server (running the SMS application has a modem with a standard SIM card connected to it). Fig 4.2.1 shows the architecture of mobile payment system:
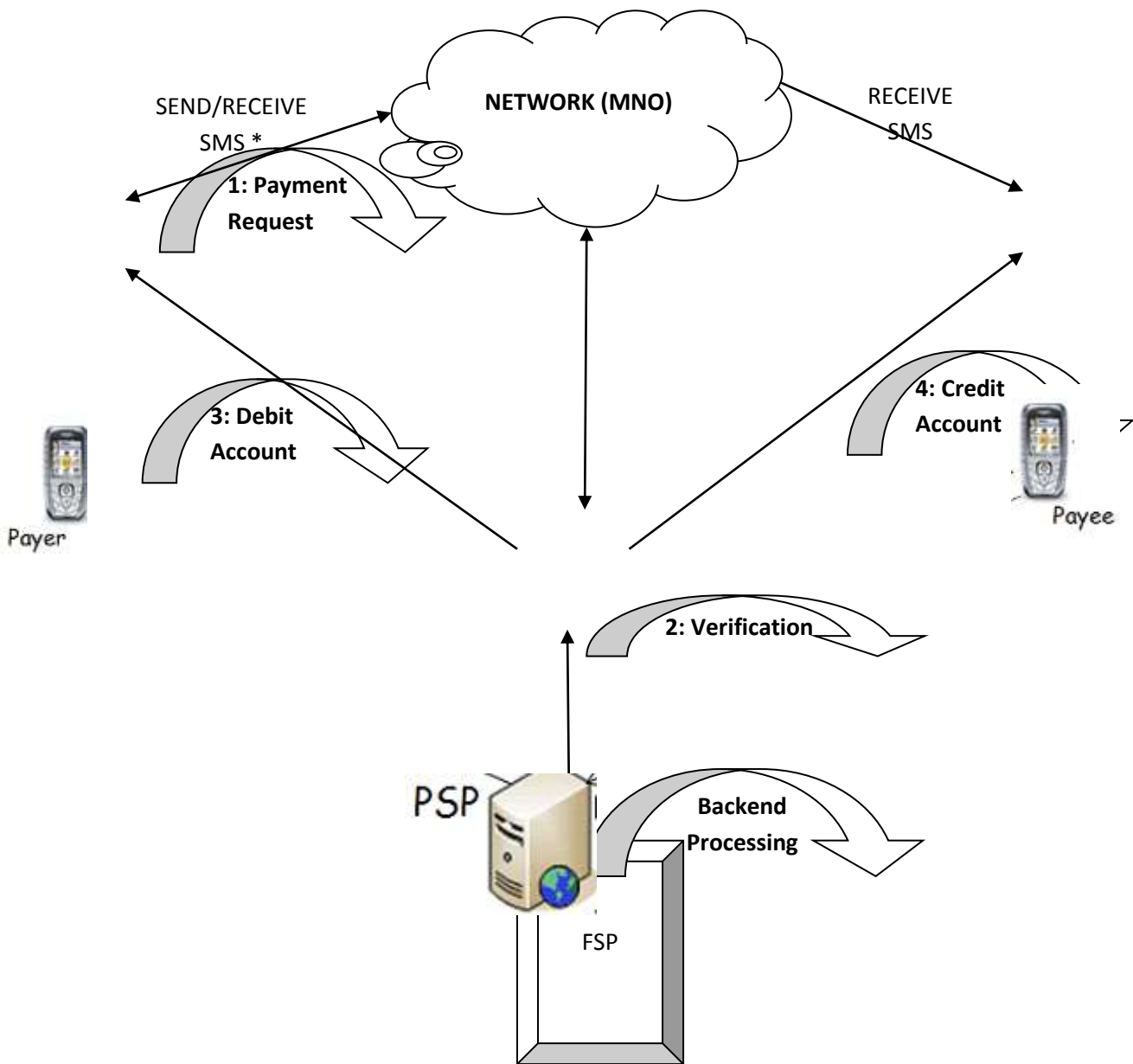
Fig. 4.2.1: Mobile Payment System Architecture

The customer uses his mobile device to send a payment request to a PSP over a wireless network. This request includes the details of the payee ad amount to be paid.

- A PSP verifies the credentials of the customer and the payee (basically it checks whether the customer and payee have registered for such an m-payment service).

- After successful confirmation, the PSP performs backend processing to update the accounts of the payer and the payee.

- It sends a debit receipt via MNO to the payer. It will also send a Credit receipt message to the payee.

4.3   Input Design

Input design refers to the input data, how the input is to be fed into the system. It includes identification, content of the format, and frequency of the recent data expended volume condition requiring its appearance in the system and validation procedure to be used to ensure accuracy. The input format describes how to interpret the contents of an input field as a number or a string, it is used by commands such as data list that read data or syntax files into the PSP active dataset. Fig. 4.3.1 shows the mobile payment system input format:
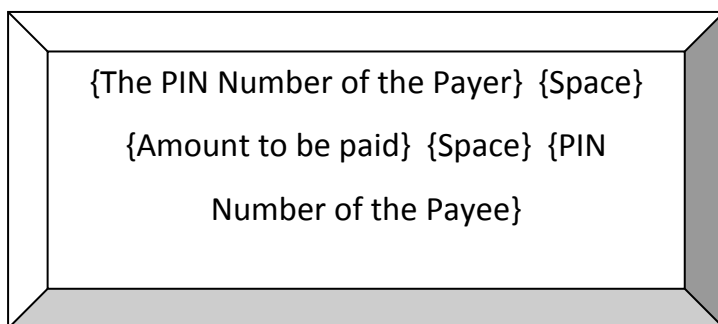
{The PIN Number of the Payer} {Space}
{Amount to be paid} {Space} {PIN
Number of the Payee}

Fig 4.3.1: Mobile Payment System Input Format

4.4   Output Design

Outputs are the reports that the system produces, whether on the screen, on the paper or in other media, such as web. Outputs are the most visible part of any system, because a primary reason for using an information system is to access the information that it produces. The goal of the output mechanism is to present information to users so that they can accurately understand it with the least effort. The fundamental principle for output design reflects how outputs are used and way to make it simpler for users to understand them.

Every input format corresponds to a default output format that specifies the formatting used when the value is output later. There are two output formats for the proposed system, they include, Payee output format and Payer output format. Fig. 4.4.1 and 4.4.2 shows the payee and payer output format respectively:
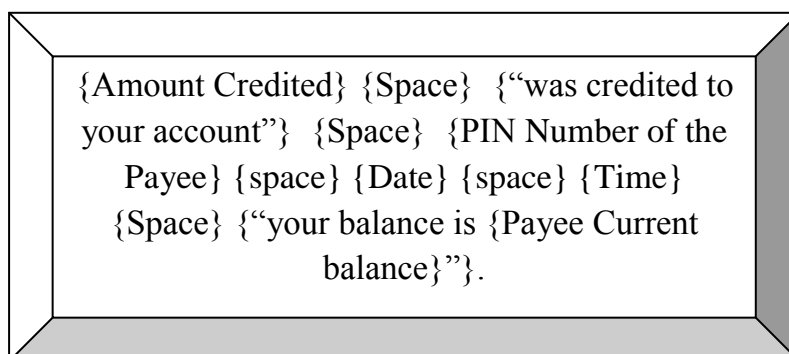
{Amount Credited} {Space} {"was credited to your account"} {Space} {PIN Number of the Payee} {space} {Date} {space} {Time} {Space} {"your balance is {Payee Current balance}"}.

Fig. 4.4.1: **Payee Output Format**

{Amount Credited} {Space} {"was credited to your account"} {Space} {PIN Number of the Payee} {space} {Date} {space} {Time} {Space} {"your balance is {Payee Current balance}"}.
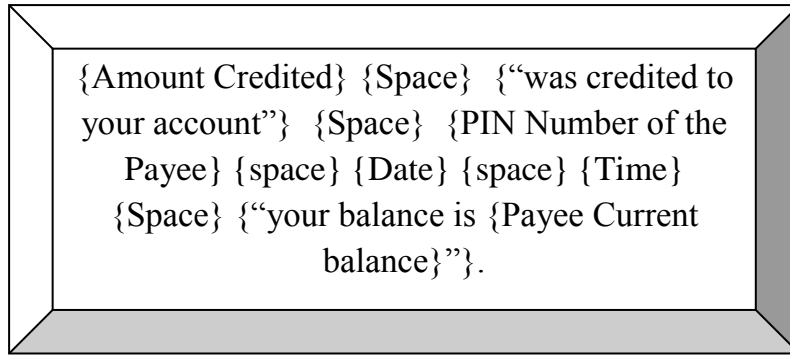
Fig 4.4.2: Payer Output format

4.5 Process Design

Process design involves the activity of determining the workflow, equipment needs and implementation requirements for the translation of input data to output data. Process design typically uses a number of tools including flowchart, process simulation software and scale models. This is a series of steps that is followed to come up with a solution to a problem. In the proposed system, an SMS will be sent to a specified code into the mobile payment software which checks the format of the SMS (whether it is in-line with the specified format), the transaction type, the balance in the account, etc and reply the request based on the findings. Figure 4.5.1 shows the process design of the proposed system (Mobile Payment System).
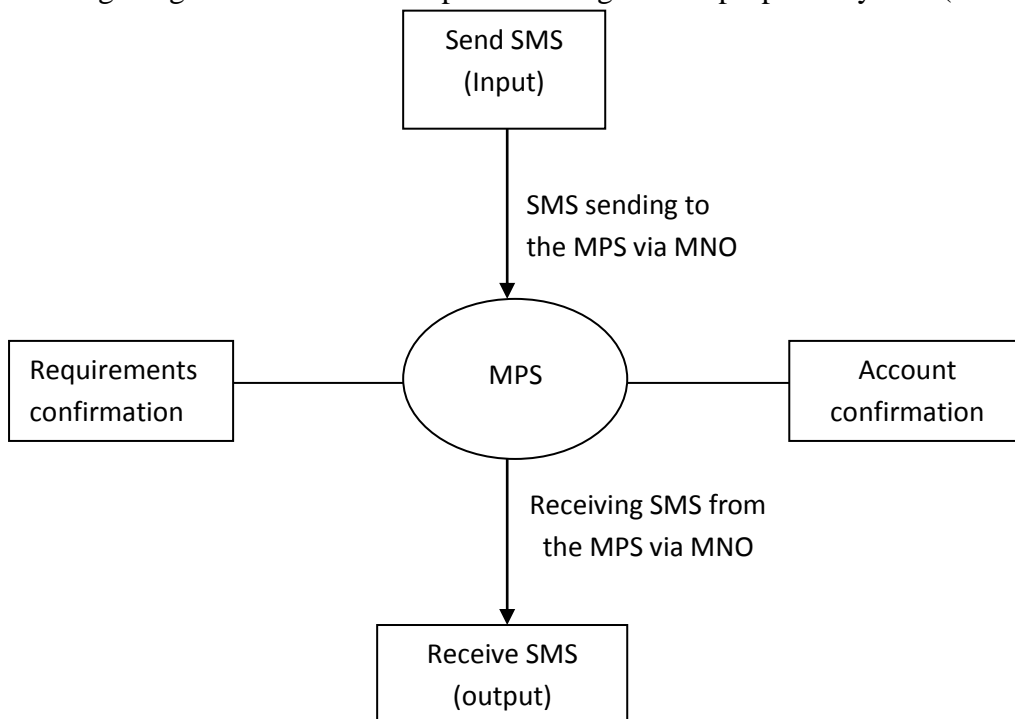
Send SMS (Input)

SMS sending to the MPS via MNO

Requirements confirmation — MPS — Account confirmation

Receiving SMS from the MPS via MNO

Receive SMS (output)

Fig. 4.5.1: Process design of MPS

4.6   Implementation Architecture

The Implementation architecture shows a block diagram identifying the various components of the software and their linkages. The implementation architecture of the mobile payment system is shown in Fig. 4.6.1:
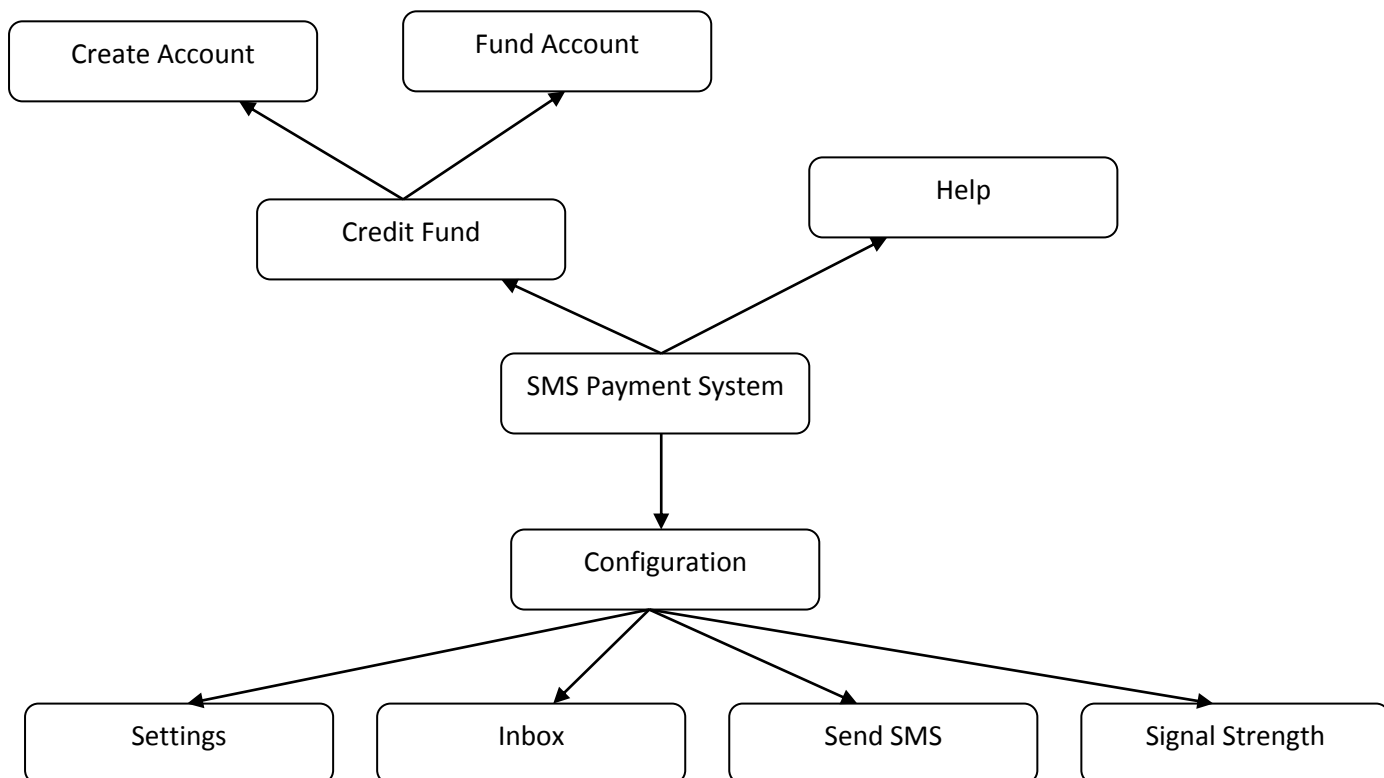

Fig 4.6.1: Implementation Architecture of Mobile Payment System

4.7   Software Testing

The system is tested at every stage of its development in other to be able to detect errors and remove them immediately. Figs. 4.7.1 to 4.7.2 show the system testing with the input and the outputs:

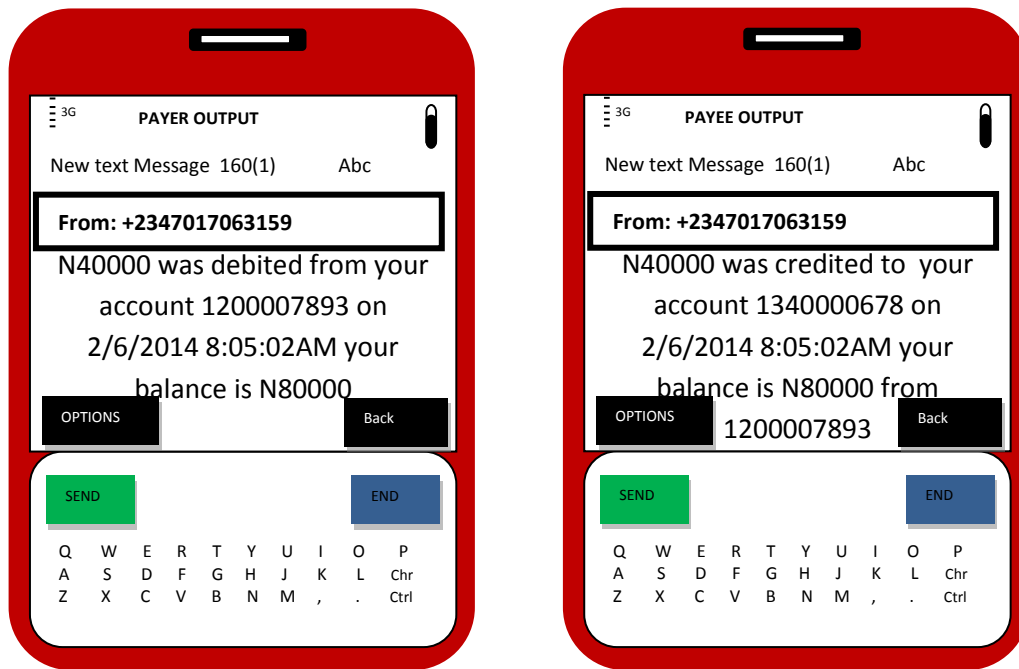**Fig 4.7.1:   The input with sample data**

Fig. 4.7.2: The output for the payer and the payee

5.0   CONCLUSION

The study developed a prototype of mobile payment system which simulates the implementation of cashless economy as payment system in every economy is a reflection of the efficiency of the banking sector. This research work has investigated the payment systems that are prevalent in Nigeria with great emphasis on cashless economy, which is triggered with the increased number of mobile phone users today, due to its easy availability, and the large number of the banking population in the country. Mobile Payment System, which provides the ability for a person to use his/her mobile phone to undertake money related transaction securely, is the new trend in payments systems globally. Individual consumer, distributor, bank sectors and government are the beneficiaries of this research work.

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