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TOWARDS MINIMIZING PHYSICAL PRESENCE IN THE BANKING HALLS DURING FUNDS DEPOSIT USING UNSTRUCTURED SUPPLEMENTARY SERVICE DATA

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Abstract

Since the advent of the Global System of Mobile Communication (GSM) in Nigeria in 2001, there has been an upsurge of the use of Information and Communication Technologies (ICT) to revolutionize the way banking is conducted today. This has resulted in several appealing banking services leading to an increase in the customer base of banks. However, little has been done in the area of bank deposits. The banks still have the continuous and unending queues to deal with at the banking halls whenever a cash deposit is to be made. This research looks into the Unstructured Supplementary Service Data (USSD) technology, and proposes a proof-of-concept solution for bank cash deposits which could save time and resources on the part of the customer and the bank. To achieve this, an information system is developed, which will operate a Voucher Card technology (like our network recharge card system) and help reduce waiting and service times. Also the USSD communication will be simulated using wireless connection between two computers acting as user's mobile phone and the banks deposit voucher system respectively. It is expected that the effectiveness of this solution will spur a prototype implementation that could be employed for use regularly, and consequently, help Nigerians develop a proper and more efficient saving culture for sustainable economic development.

Keywords: GSM, USSD, simulated, ICT, technology, cash deposits

1.0. Introduction

According to **[**1**]**banking system is the backbone of financial intermediation through the mobilization and channeling of financial resources and without a good savings culture, there cannot be investments. One major obstacle to developing a good savings culture in Nigeria is the extreme poverty situation that a large percentage of Nigerians find themselves in. What an average Nigerian earns today is just enough to eat a day and keep his roof over his head. Another discouraging factor is the distance to the bank, in addition to the long queues and hours of waiting to be attended to. In Nigeria, it is common to have savings schemes where people make daily or certain periodic contributions to a collective pool - Daily saving collectors. They work mostly in collaboration with the Micro finance Banks. It is called ESUSU in Ibo, Ajo in Yoruba and Adashe in the North [2**].** These groups have helped people to grow savings for personal or collective goals. Some of these daily savings collectors move from house to house, shop to shop or even office to office to collect small amount of money from the petty and major traders and artisans to save for them for a period of time as agreed by both parties. There are obvious drawbacks involved in this method. The thrift collector, due to health reasons, or other unforeseen challenges could be unavailable resulting in the money become inaccessible to the owners. Basically, bank deposits are made in order to deposit money (physical cash) into the bank institution via savings accounts or cheques. The account holder has the right to make withdrawals of any deposited funds at any given time of his/her choice according to the terms and conditions setup for the account. The collection of funds from the public by a financial institution through its savings, current, fixed, recurring accounts and other methods is referred to as Deposit mobilization and according to **[**3**],**it is the main function of the banking industry and therefore, an indispensable source of working fund for the bank. Today, the ability of a banking institution to mobilize substantial funds from the public is totally dependent on the systems deployed by the bank through its various account schemes. Currently, the saving habits of people over the years have grown exponentially, which has led to the sprouting of countless banks. The Banking sector has witnessed several changes by way of revamping the systems of activities through various innovations with the aim of transforming the banking experience for all stakeholders involved**.** According to [4], there are many innovations in the banking industry that have been brought about by implementing new electronic technologies that could enhance the banking experience. These changes or innovations in the system are brought about through the vehicle of Information and Communication technologies (ICT), which have provided the electronic distribution channels which most banks in Nigeria have leveraged in order to enhance their services and business processes. Some of these Major technologies include the Automated Teller machines (ATM) and Internet. None of these technologies, hitherto, could assist the customer with direct cash deposits (into his/her bank account). In order to proffer a solution to this, ATM machines with cash deposit capability were introduced with First Bank of Nigeria PLC (FBN) being the pioneer bank in Nigeria to bring in the cash deposit ATM in 2011[5**]**. The banks ATMs have

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unique features including bills payment, cash transfer, air-time top-up, cash deposits among others. The cash deposit function allows customers to make deposit into their accounts without having to queue up at the Banking halls [6]. The challenge of carrying physical cash about in order to make a deposit (whether via the ATMs with cash deposit capability or directly at the bank using the banking halls) still remained unsolved. Although this technology attempts to reduce the queues in the banking halls, it does not literarily eliminate/reduce to the barest minimum the queues when cash deposits are to be made. It simply splits the queues into two, namely: the banking halls, and the cash-deposit ATMs.

Today, banking operations have improved a great deal through diverse information technology channels and devices, namely, internet banking, Automatic Teller Machines (ATMs) and mobile banking. However, banking using Unstructured Supplementary Service Data (USSD) can further improve the service of the banking sector, especially in the areas of bank deposits. USSD is menu-driven and therefore more interactive than traditional SMS. Because it does not perform store-and -forwarding like the regular SMS, it is faster, as the user can quickly send information and commands to the USSD platform during transactions. These features have won it a place in services that include value added services and mobile money, USSD banking allows the customer to open account, make funds transfers, check account balance and make bill payments. This has also improved banking operations as customers see a level of improvement which makes banking easier. However, there still exists the challenge whereby a depositor has to be at the bank physically. This is known as in-person deposit and possesses the potential to cause a drop in number of customers/depositors. This study develops a speed deposit voucher code system that would manage and reduce waiting and service time and simulate a proof-of-concept system that will enable the customer deposit money into his bank account using his mobile device. The system, which is developed in Visual Basic.Net (Vb.Net)is limited to simulating the USSD communication and the user cell phone in other to prove the solution concept.

2.0. Brief Literature Review

The Unstructured Supplementary Service Data (USSD), sometimes referred to as "quick codes", is a communications protocol that is used by GSM phones (or a Mobile Station (MS)) to communicate with the application hosted on the mobile network's computers. It can be used for WAP browsing, prepaid call back services, mobile-money services, location-based content services, menu-based information services and even for the configuration of the phone on the network**[7].**USSD messages are up to 182 alphanumeric characters long and USSD transactions occur only during a USSD session, hence it is said to be session based. They create a real-time connection during the session. It starts normally with asterisk (*) and ends with a hash (#).There is no storing and forwarding of messages as is the case with a typical short-message protocol like SMS. The connection remains open throughout the session, allowing a steady two-way communication of exchange of sequence data. This makes USSD more responsive than regular SMS based services and thus presents better user-friendliness, cost-effectiveness and faster in wrapping up transactions [**7].** USSD does not require the use of internet or the web and all GSM phones are capable of USSD communication. In Nigeria, the Central Bank of Nigeria (CBN) released a Regulatory Framework for the use of USSD in the Nigerian Financial System to further anchor its mandate towards the development and enhancement of the electronic payments system in Nigeria **[**8].

3.0 Systems Analysis and Design

3.1 Present System

Presently, the customer must of necessity, be physically present in the banks to make cash deposit and be required to fill out a deposit slip. Thereafter, the customer joins the queue (if any) and then hands over the deposit slip and cash to the teller officer. The teller officer, after crosschecking the form for correctness, then proceeds to electronically feed in the data into the relevant system for confirmation and further processing. Then the cash amount deposited is credited to the corresponding account, as detailed in the form.

The Business Process Model Notation (BPMN 2.0) approach is used to depict the current Bank Deposit System as shown in Figure 1.

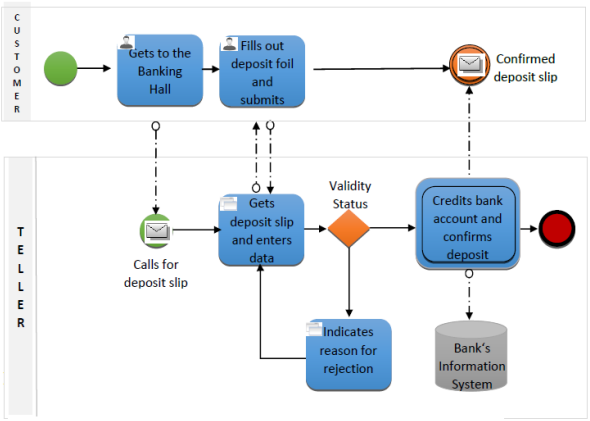


Figure 1 Bank deposit process (Business Process Model Notation)[9]

3.2 Problems with the Present System

Table 1 depicts that the major cause of the problems in the present system is throughput, which leads to a ripple of other effects (Effects 1, 2, 3 and 4). Thus if this problem (of low throughput) is addressed, then its consequent effects (Effects 1, 2, 3 and 4), will be (if not eliminated), reduced to its barest minimum. This ideology is depicted in figure 2, while table2 depicts the goals of the system improvements

Table1 Problems with the present system

PROBLEM	CAUSES AND EFFECTS
1. The system output relative to input (the throughout) is very low. It consumes more energy, time and expense on the customer's part. At the same time, longer waiting and service times.	i. **Cause 1:** The only means of carrying out bank deposits are the banking halls. ii. **Cause 2:** Bank tellers are manually checked for errors such as with dates, account details - depositor's name, matching entries (amount in figures with same amount in words). **a)** **Effects 1:** This leads to growing and winding queues in the banking halls, with high waiting times. **b)** **Effects 2:** The Manual checking leads to longer service times (time it takes to attend to each customer).
2. The resources required for this banking process like papers, etc., will greatly increase running costs.	iii. Cause **3:** This clerk work results in production of excess deposit slips. **a)** **Effect 3:** This will lead to financial losses on the side of the bank due to high budgeting for production of deposit slips.
3. Strict measures need to be taken while auditing information needed in order to eliminate variances in the data.	iv. Cause **4:** Errors due to mathematical and spelling errors, oversights, etc., are a regular occurrence. **a)** **Effects 4:** looking out for these errors certainly wastes the time of other waiting customers. Waiting time is increased.

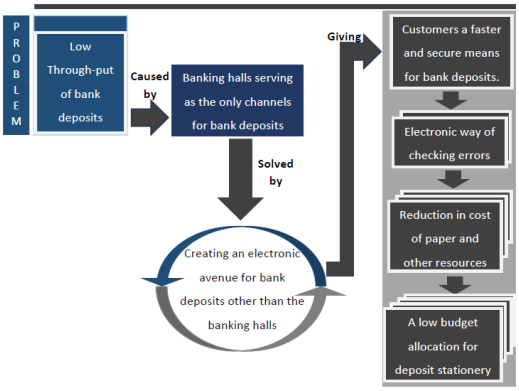


Figure2: Problem-cause Solution Diagram.

Table 2: Goals of System improvement

Problem	Improvement Goals	Constraints
1. The system output relative to input (the throughout) is very low. It consumes more energy, time and expense on the customer's part. At the same time, longer waiting and service times.	i.)To create an electronic channel for bank deposits, thereby reducing the need for physical presence at the banking halls, and also reduce the waiting and service times during bank deposits. **D** $\propto$ **,** **D=SV, (**"S" being the proportionality constant) Deposit **(D)**, Speed of Service **(S)** and Validity of inputs **(V).**	i. Normal banking activities should continue as usual ii. The Bank deposits should be through electronic means and in real time.
2. The resources required for this banking process like papers, etc., will greatly increase running costs.	i. Reduce to the barest minimum, the amount of papers and deposit stationery used for bank deposits.	i. a decrease in the financial commitment to deposit stationery.
3. Stringent measures need to be taken while auditing information needed in order to eliminate variances in the data.	i. Improve on the system/mechanism via which deposits are made.	i. Normal banking activities should continue as usual ii. Error checking should be done via electronic means.

3.3 The Proposed System

The proposed system, called "Recharge and Save System" (R.'n'S.S) is an electronic system of depositing money into the bank using Speed Deposit Vouchers (SDVs). It will allow customers to make deposit into their bank accounts without physically going into the banking halls. The customer, after purchasing the speed deposit voucher, corresponding to the amount needed for deposit, will find a 17-digit number included in the voucher. The customer then has only one channel (the USSD), with which to make deposit to his account.

3.3.1 Unstructured Supplementary Service Data (USSD)

According to the legal guidelines for short code operation in Nigeria, the Nigerian Communications Commission (NCC) issues short codes to network operators and content aggregators. For this study we assumed USSD code (or short code) used for this study to be **(*955#).**

The complete USSD message request for deposit will then appear as follows:

***955*2*09034833975*1*4067-3760-4036-38936#**

Assume the user (customer) has decided to use this USSD channel for bank deposit, and has already been registered on the R.'n'S System, all the customer has to do is to send a complete USSD code that would contain all the commands/instructions and data that would instruct the application program on the network provider of the desire to make a deposit into an account. The USSD message structure for Speed Deposit is depicted in figure 3 and includes the following data:

i. Deposit Request
ii. Depositor's Phone Number
iii. Depositor's Bank Name
iv. Speed Deposit Voucher Number

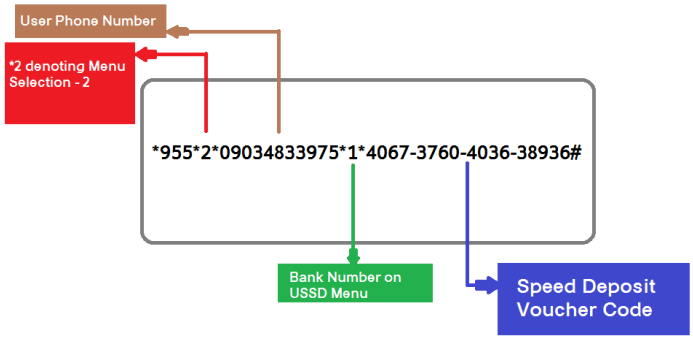


Figure 3: depicts the USSD message structure for Speed Deposit Request

The minute the user enters these information via the USSD, the process of validation begins.

After the USSD message is sent to the Application program on the computer on the network, the entire request is checked to confirm it is in the proper USSD format before actual validation begins. This involves checking for the starting asterisks and consecutive digits (and groups of digits) and the eventual termination with a hash symbol. The system then seeks out the deposit voucher pin, which is made up of 17-digits, separated by hyphens. If the voucher is authenticated, on the server, then the phone number is pulled up from the message and authenticated. This is also followed up by the user or depositors bank. Once all these information has been confirmed, the system requests the amount to be deposited from the user. The user then sends that amount to be deposited back to the system. Figure 4 depicts the USSD request response, prompting user to deposit desired amount.

Figure4: USSD request response - Prompting user for deposit amount.

The system then checks to ensure that amount deposited corresponds to the speed deposit voucher sent, else, the deposit process is terminated and the user notified accordingly. Figure 5 depicts the confirmation received for the deposit made.

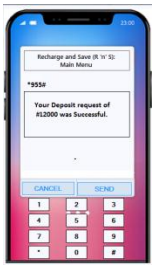


Figure5: User deposit Confirmation

The proposed bank deposit system is shown in Figure 6.

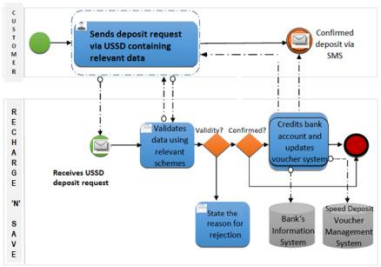


Figure6: The proposed bank deposit process (Business process model notation)

3.4System Development Methodology

This study used the Staged lifecycle (incremental deliveries) methodology. This is because the actual set of functional requirements for the system might not be elaborate enough to encapsulate all requirements with regards to input, processing and output. The appearance of the system (look and feel) might still remain uncertain. Thus, the incremental development methodology will enable the system development progress incrementally until all requirements are captured and the final product is satisfactory to the customer.

3.5 Choice of Tools and Justification

Table 3 depicts the choice and justification for tools used for the implementation.

Table3: Tools used and their Justification

Tools Used	Justification
1. Microsoft Visual Basic. Net 2008 (For development of the Recharge and Save Speed Deposit Voucher Management System)	i. It has well integrated and interactive development environment. ii. The "intellisense" technology makes programming very smooth as it regularly creates pop-ups containing various constructs that facilitate coding. iii. It is highly optimized for Rapid Application Development. iv. It has a look and feel similar to windows (which people are familiar with) and so makes it intuitively easy to use.
2. Microsoft SQL SERVER	i. It has support for several interfaces such as PHP, VB.Net, Java, etc. ii. It can handle virtually any amount of data (the number of rows per Table is limited by available storage). iii. It is scalable enough to adapt to ever increasing transactions.

3.6 Functional and Non-Functional Requirements

3.6.1 Functional Requirements

The functional requirements of this system defines the functions that must be performed with respect to its inputs, behaviour (processing) and output as well as data stored in other to fulfill the improvement objectives. Table 4 depicts the functional requirements of the proposed system.

Table4 :Functional Requirements of the proposed system

Functional Requirement	Description
1. Generate Deposit Vouchers	Generate set of Deposit Voucher numbers with associated denominations
2. Update Deposit Vouchers	Updates Deposit Vouchers with regards to Used or Unused ones
3. Delete Deposit Vouchers	Deletes Deposit Vouchers, preventing usage.
4. Query Voucher Issues	Send queries to the system to retrieve information about deposit vouchers deposited based on various query criteria.
5. Deposit funds	Allows the customer to deposit funds through USSD.
6. Send interactive USSD menu	Sends interactive menu to communicate with and retrieve data from customer during USSD session.
7. Send confirmation SMS	Sends confirmation message to User to regarding final Deposit status (successful or not successful).
8. Query all Deposits made	It send Query to retrieve information about deposit history on all customers

3.6.2 Non - Functional Requirements

The non-functional requirements refer to the systems usability, its learning curve, its performance, budget and cost, security, quality management amongst others. The nonfunctional requirements of the proposed system are shown in Table5.

Table5: Non - Functional Requirements

Requirement	Description
1. Business Process Continuity	1) At all cost, the banking process of activities must not be interrupted by system failure or database loss due to uncertain factors, therefore database must be backed up at regular intervals.
2. Security Requirements	1) The different users of the system have varying access rights 2) Certain key information must be abstracted from certain users
3. Software Quality	1) The interface must be easy to use and navigate. 2) Error should be kept at minimum while processing.

3.7 Speed Deposit Voucher Generation Framework

This is the core module of the Recharge and Save system (RnS). Its main function is to generate Speed Deposit Vouchers (SDVs) associated with certain deposit amounts (or denominations), which will enable customers make deposit into their accounts.

Each deposit voucher will have the following features:

i. The voucher number sill comprise of 17-digits in the format (4digits-4digits-4digits-5digits)
ii. Each Speed deposit voucher will be associated with a Naira denomination or amount.
iii. Each deposit voucher should have a batch number.
iv. Each deposit voucher should have an expiry date.

These numbers are not just simply generated at random; else they could be guessed and thus unsafe for the purpose of improvement objectives. The Recharge and Save system, rather, performs the Voucher numbers generation itself using the results from various mathematical functions and also associate each voucher with a serial number to further minimize the possibility of fraud.

3.8 Use Cases for the Requirements Modeling

Requirement modeling looks at the system from the perspective of the user, with the main focus on how the system is being used, and not how it is developed. Although it is an object oriented modeling, it also cuts across non-object areas.

The use case is the heart of a requirement modeling as it describes how the system functions. It talks about how/ what the user expects the system to do not how the task will be achieved. The use cases basically describe the functional requirements of the system.

3.8.1 Requirement Use Cases

The requirement use cases help answer the question - How does the user wants to use the system or what does the user want the system to do? The use case glossary for the proposed system is shown in table 6 and the diagram depicted in figure 7.

Table6: Use case Glossary

Use Case ID	Requirements	Description	Actors
1. UC1	Generate Deposit Vouchers	Describes the event where speed deposit Vouchers are generated.	Deposit Voucher officer.
2. UC2	Update Deposit Vouchers	Describes the event where vouchers are updated with respect to being used or unused.	Deposit Voucher officer
3. UC3	Delete Deposit Voucher	It describes the event where the Voucher is deleted.	Deposit Voucher officer.
4. UC4	Query Voucher Issues	This describes the event where the system is queried to retrieve information about deposit vouchers deposited based on various query criteria.	1. System Administrator 2. Deposit Voucher Clerk
5. UC5	Deposit Funds	It describes the event where Funds are deposited into the bank account via USSD.	1. Client 2. Deposit voucher system
6. UC6	Send Interactive USSD menu	It describes the event where USSD menu are sent to customer during deposit process.	1. Client 2. Deposit voucher system.
7. UC7	Send Confirmation SMS	It describes the event where confirmation SMS is sent to customer regarding the deposit status (Successful or not)	1. Client 2. Deposit voucher system.
8. UC8	Query all deposits made	It describes the event where Query is sent to retrieve information about deposit history on all customers	1. System Administrator

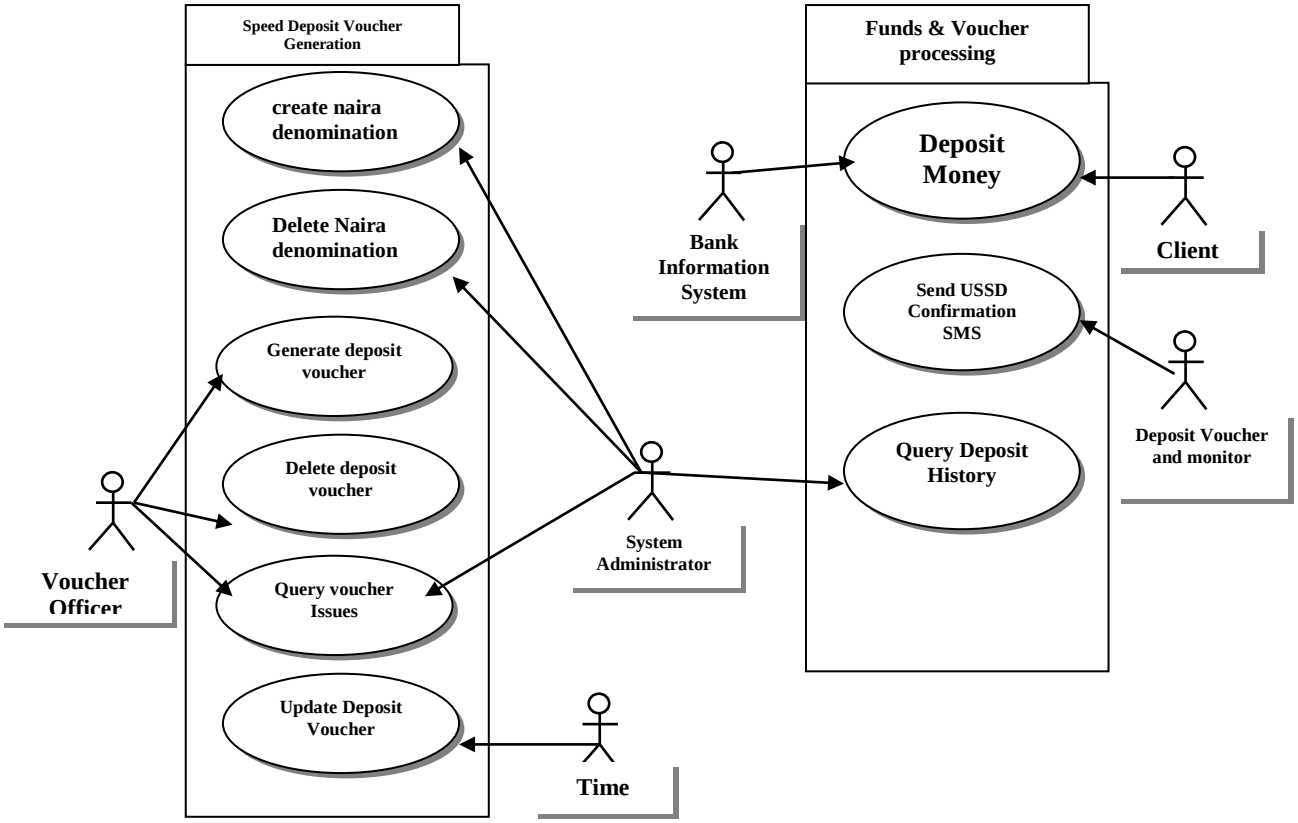


Figure7: Use case Diagram

3.8.2 Actors

In use cases, actors primarily trigger or set off use cases. They are the users/stakeholders in the system who want to carry out tasks and expect certain output from the system. The role to be performed is described, not the person. The actors list for the proposed system is shown in table7.

Table7: List of actors

Actors	Roles/Description	Type
1. System Administrator	A tech savvy personal overseeing the daily activities of the system. He creates users accounts and manages the database. Also generates information for management.	1. Main system actor 2. Main business actor
2. Voucher officer	This is a bank official responsible for the generation of Speed deposit vouchers.	1. Main business actor 2. Main system actor
3. Client	This is the customer who accesses the system in order to make bank deposit using USSD	1. Main business actor
4. Bank information system	System that monitors USSD messages, manages clients deposit history as updates customer account details.	1. Actor - Eternal server 2. Actor - Eternal receiver

3.8.3 The Use case Dependencies

Before the system development, great attention should be given to understand the system. Two or more use cases may have a dependency relationship between then. If the system functionality must be understood, then one must properly understand these dependencies. table 8 depicts the use case dependency matrix of the proposed system.

Table 8: Use case dependency Matrix

Use Cases	UC1	UC2	UC3	UC4	UC5	UC6	UC7	UC8	UC9	UC10
UC1										
UC2	*									
UC3	*									
UC4			*							
UC5			*							
UC6			*							
UC7			*							
UC8							*			
UC9								*		
UC10							*			

LEGEND

***** = Depends On

3.9 Process Modeling (Data Flow)

When designing an information system, the data to be sent as input into the information system, information that is required as output, the source of data and destination are important.

3.9.1 The Functional Decomposition Diagram (FDD)

The Functional decomposition diagram is a top-down structured representation of processes or function, activities and operations to be deployed during development of an information system. Here, the functions/activities are broken down into lower level operations and processes. The functional decomposition diagram for the proposed system is shown in figure 8.

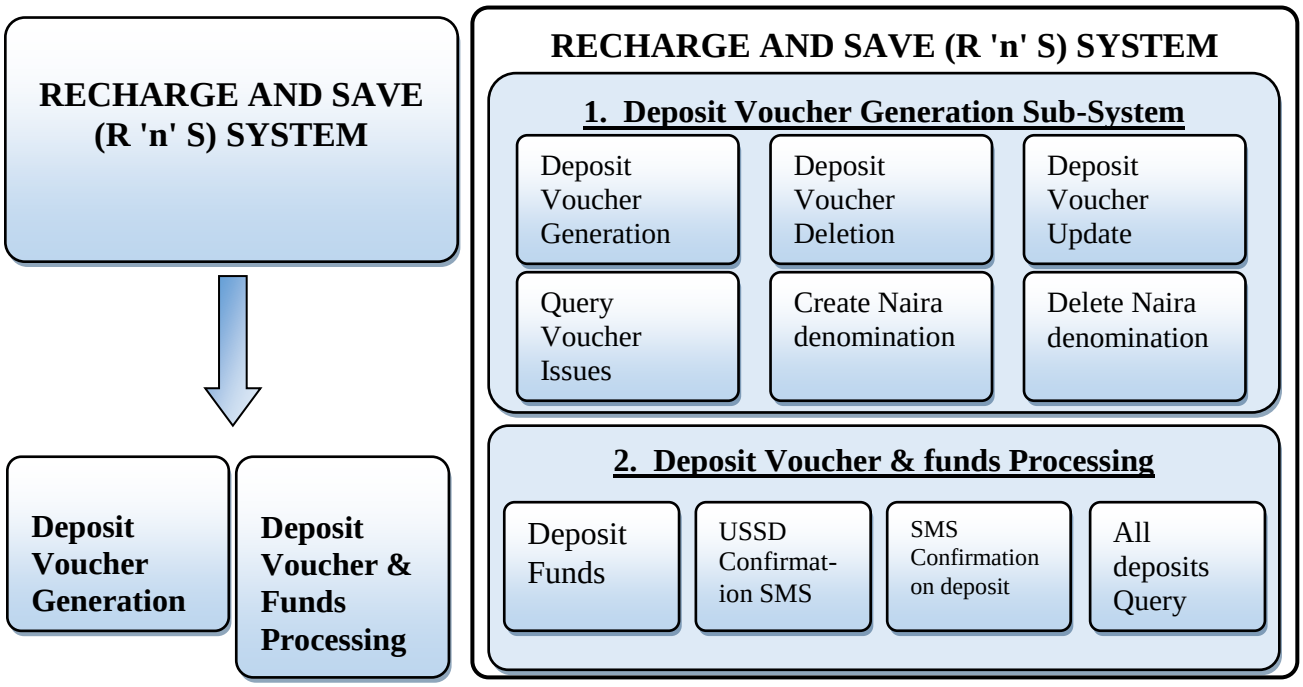


Figure8: Functional Decomposition Model for the Proposed System

3.9.2 Context Data Flow Diagram

A context flow diagram, (a level 0 data flow diagram as it is sometimes called) is drawn with the aim of defining and clarifying the boundaries of the whole system. To achieve this, the entire system is seen as a single process or a single process node, generalizing the system functions in relation to external entities. The context flow diagram for the proposed system is depicted in figure 9.

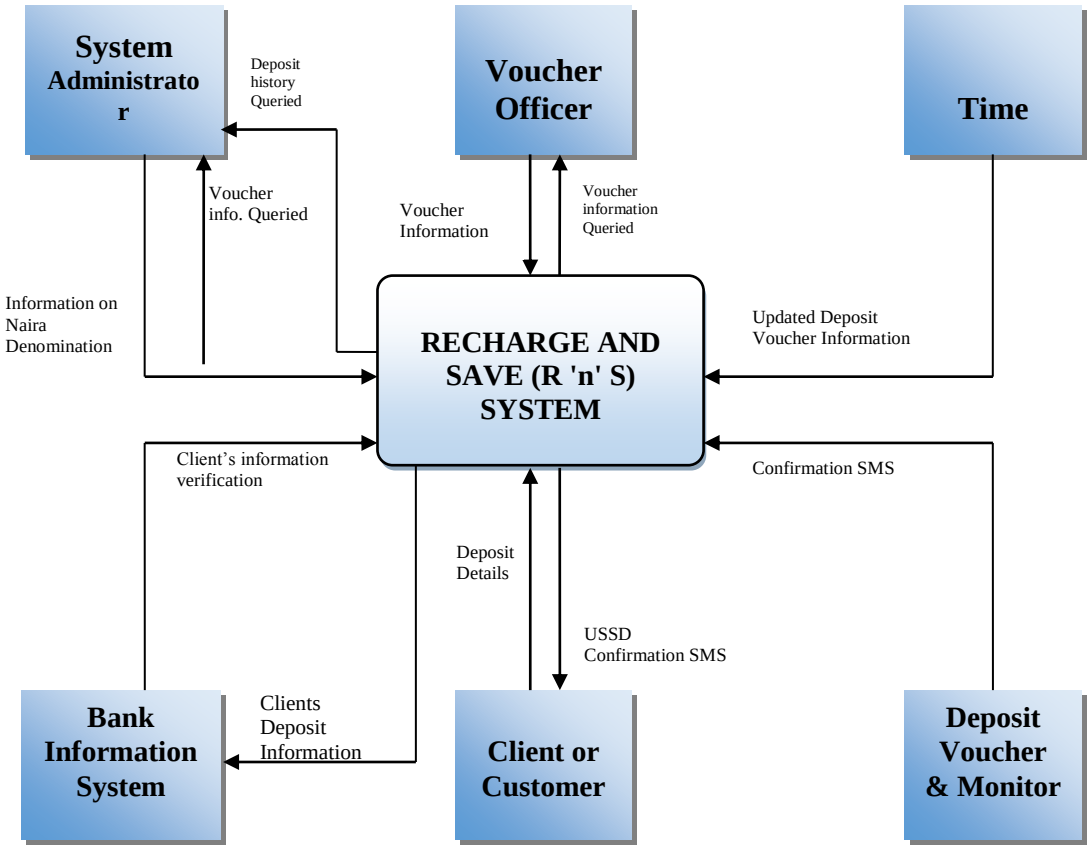


Figure9: Context data flow diagram for the proposed system

4.0 System Implementation

4.1 Justification of Development Tools

The language of choice for this study is Visual basic.Net (2008 and above) .Visual Basic.Net (VB.Net) has an interactive Integrated development environment, which is also very cohesive and highly optimized for Rapid application development and it allows for creation of applications that are easy to use due to its familiar windows appearance (that's the look and feel). Also, VB.Net has a much less learning curve, and so will not be to challenging during the implementation. For this study, Microsoft SQL 2012 Server will be employed for use as the database management system. It has the capability of supporting any amount of data (it is only limited by available storage space) and also accessible to several interfaces.

4.2 Program Modules

The system has the following modules:

i. The Recharge and Save System - Information Management System Module
ii. The Speed Deposit Voucher - Information Management System Module
iii. Bank-Client Incoming financial record monitoring system Module

4.3 System Requirements

This refers to the minimum specifications for the hardware and software components of the system.

4.3.1 USSD Architecture

According to[10]as cited in**[11],**the following are the basic system requirements for effective USSD communication:

i. Any type of cell phone
ii. A Network Carrier or Mobile Network (because it would comprise of the Home Location Register (HLR), The Visitor Location Register (VLR) and the Mobile Switching Controller (MSC)
iii. A USSD Gateway (routes USSD messages from the network carrier to a service application and back. A USSD gateway service is also called a "USSD centre").
iv. USSD Application/Server
v. Simple Messaging Peer-Peer (SMPP) interface.

The USSD Mobile Network Elements is depicted in figure 10

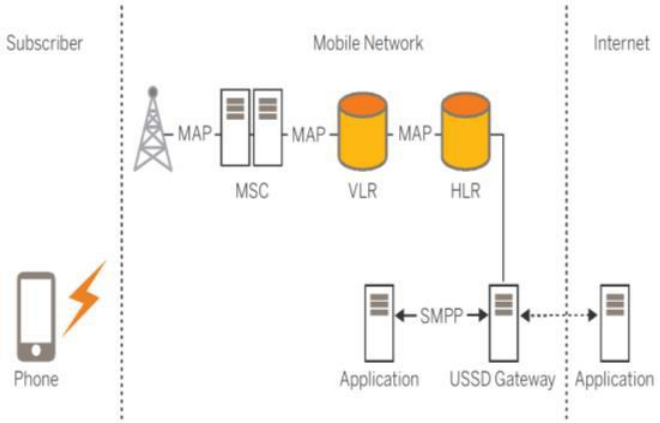


Figure 10: The USSD Mobile Network Elements [10] as cited in [11]

This study, however does not focus on analyzing the elements of the USSD architecture, but ratherwith the subscriber section (that's the mobile phone user) and the USSD service with regards to mobile banking.

4.3.2 Hardware and Software Requirements

The hardware and software requirements for the proposed system are depicted in Table 9 and Table 10

Table 9: Hardware Requirements of the Proposed System

ITEMS	DESCRIPTION	SPECIFICATIONS
1. Server	A high Specification system with a very large amount of Storage Space, Processor, RAM and Network Interface Card.	i. 16GB of RAM ii. 1TB Hard disk Drive (SSD) iii. A Cache Size of 2GB iv. RAID Card v. A Network Interface Card vi. 6GHz speed processor with a 64bit Processor type.
2. Client Workstation	A client system terminal (a single user computer) connected to the Server	i. 4GB - 6GB of RAM ii. Intel Core i7 2.2GHz processor speed or Higher. iii. A Network interface card. iv. 350GB Hard disk drive or Higher. v. An LCD Display, with USB interface for mouse and keyboard.
3. Printer	Peripheral device which is used for printing information on documents.	i. An inkjet or toner type of printer.

Table 10: Software Requirements of the Proposed System

ITEMS	DESCRIPTION	SPECIFICATIONS
1. Operating System (for Server and client workstations)	Software that manages the hardware and software components of the computer system, allowing users to communicate with the system hardware.	i. Microsoft Windows Server 2008/2012 SP2 or higher for Server system. ii. Microsoft Windows 7 or higher for the client workstations
2. Antivirus Program	A Software used to detect, prevent and remove any form of malicious programs (malware, virus, etc.)	i. Bit defender Antivirus Plus 2013 or any trusted Antivirus Provider. ii. Microsoft Security Essentials or Better.
3. Firewall	A program or group of related programs that defend a system or network against unauthorized access from other networks or users.	i. The Microsoft windows server 2008 or higher. comes with its own firewall

An added Requirement may include:

i. A public IP address

4.3.4 System Setup And Configuration

The Recharge and Save System (R.'n'S.S.) architecture will integrate two types of client-server architecture for optimum functionality, they include:

i. A 2-tier System architecture
ii. A 3-tier System architecture

The Speed Deposit Voucher (SDV) management system will run on all client workstations and the server. Thereafter, the Microsoft SQL Server 2012 database Management system will be installed on the R.'n'S.S server only. A switch will connect the client workstations to the server to allow interaction with the database. This will make up the 2-tier system architecture.

The bank's information management system (with its own database) and the R.'n'S.S having its own database are both made accessible through USSD system architecture via the Network carrier in order to enable users make deposits with it. This will make up the 3-tier system architecture. The client server architecture of the system is shown in figure 11.

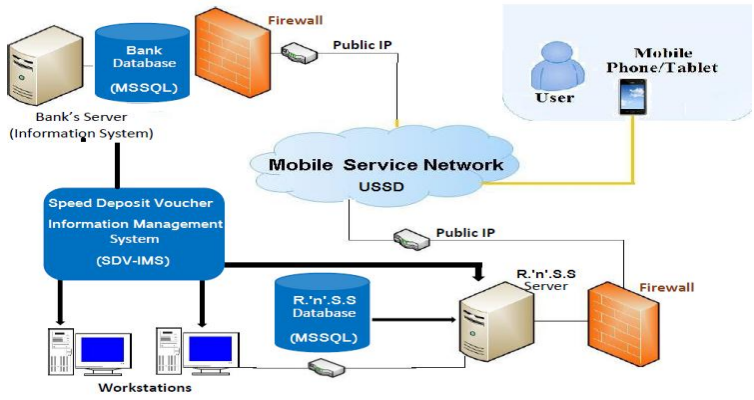


Figure 11: Client Server Architecture of the Recharge and Save System

4.4 System Graphics User Interface (GUI) Implementation

4.4.1 The Recharge 'N' Save System (R. N .S. S.)

The Recharge and Save System (R.'n'S.S) is the primary system that governs the Speed Deposit Voucher (SDV) system. It governs the functionality of the Speed deposit Voucher. Without it, the SDV will not be able to allow users make cash deposit into their accounts. Therefore, every user who wants to utilize the system to make cash deposits must first be registered on the system. This system will be installed and running at the bank location server.

Registration on the R.'n'S System will be done via USSD technology. Once this is done, the user is clear to carry out cash deposit transactions with the system. Its main features include:

a) Register users/customers into the system
b) Manage deposits made by users/customers

The Recharge and Save system Graphical User Interface (GUI) is depicted in figure 12.

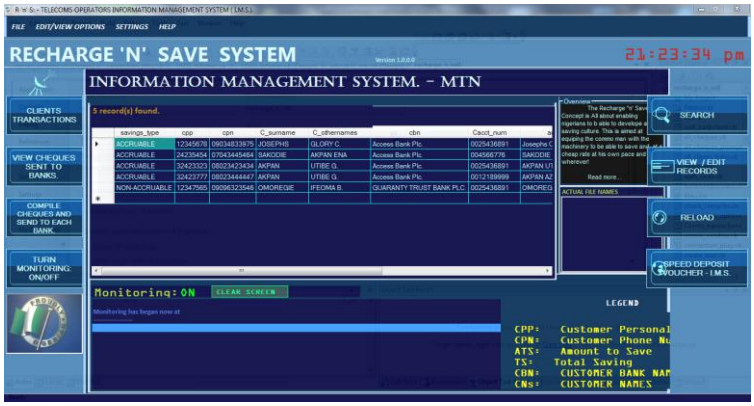


Figure12: The Recharge and Save system GUI

4.4.2 The Speed Deposit Voucher - Information Management System (SDV-IMS)

The purpose of the Speed Deposit Voucher Information Management System (SDV-IMS) is to create SDVs which will enable the client or customer to make deposits easily and quickly without having to be on the queues at the banking halls. Its key features are listed as follows:

a. Generation of Speed Deposit Vouchers with accompanying generation details such as voucher generation date)
b. update voucher status in real-time, (with respect to voucher used or unused, date used and who used the voucher).
c. update clients voucher usage history
d. manages deposit voucher requests

The screen shot of the Speed Deposit Voucher Management System GUI is shown in figure 13.

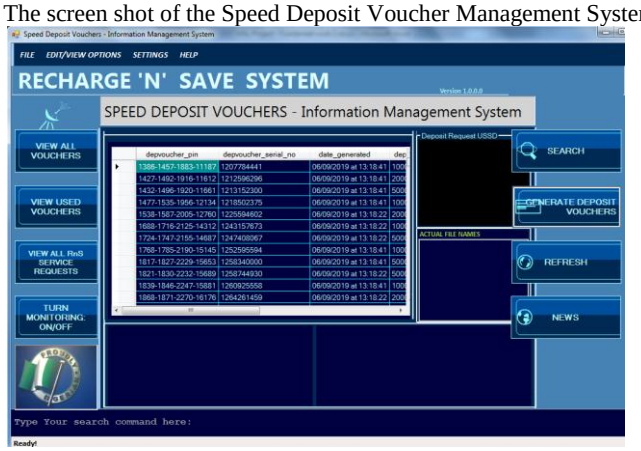


Figure 13: The Speed Deposit Voucher Management System GUI.

4.4.3 The User's GUI

This is the device with which the user/customer can access the system and make USSD deposit request. It is the mobile phone and is depicted in figure 14.

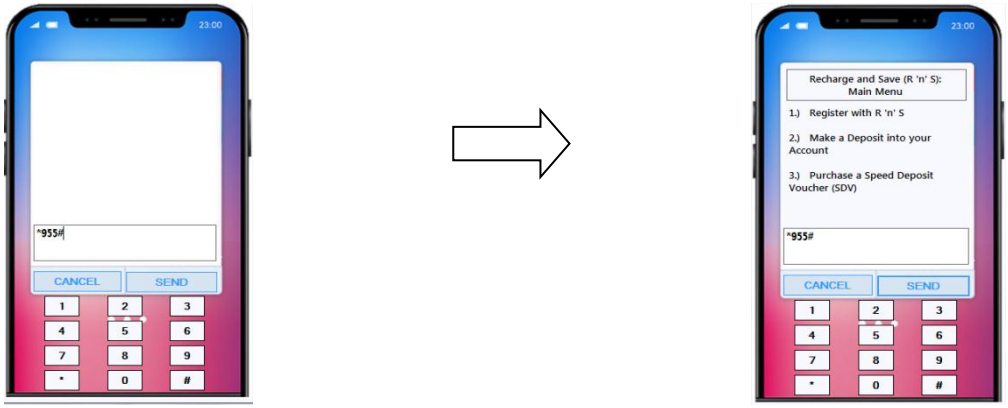


Figure 14: The mobile phone GUI to access the R.'n'S. S using the USSD code - *955#.

4.5 System Evaluation

In System evaluation, the value of the entire system is tested in order to access its response to certain conditions of usage.
Figure 15 (a)-(c) shows screenshots of how the interaction between the user (or customer) and the system occurs. .It depicts user initiating complete USSD code for cash deposits (the deposit voucher code used here is for #10,000).

Fig 15 (a)USSD code to initiate deposit. **Fig 15 (b) The Menu loads for the user** **Fig 15 (c) USSD code to bank via GSM network user to select an action**

Figure 16 depicts the database table view of Speed Deposit Vouchers, with highlighted deposit voucher purchased by user

	depvoucher_pin	depvoucher_serial_no	date_generated	dep_range	depvoucher_status	date_used	voucher_user
4	1839-1846-2247-15881	1260925558	06/09/2019 at 13:18:41	10000	USED	16/09/2019 at 14:10:57	09034833975
5	2209-2164-2544-19710	1304274189	06/09/2019 at 13:18:22	20000	USED	06/09/2019 at 13:24:50	08023444447
6	2229-2182-2561-19919	1306639486	06/09/2019 at 13:18:41	20000	USED	24/09/2019 at 03:10:02	09096323546
7	2233-2185-2564-19959	1307092777	06/09/2019 at 13:18:41	50000	UNUSED		
8	2291-2234-2610-20552	1313804194	06/09/2019 at 13:18:41	20000	UNUSED		
9	2323-2261-2635-20882	1317539399	06/09/2019 at 13:18:22	50000	UNUSED		
10	1868-1871-2270-16176	1264261459	06/09/2019 at 13:18:22	20000	UNUSED		
11	1873-1875-2274-16229	1264856621	06/09/2019 at 13:18:41	20000	UNUSED		
12	1904-1902-2299-16548	1268475033	06/09/2019 at 13:18:41	50000	UNUSED		
13	1942-1934-2329-16939	1272899549	06/09/2019 at 13:18:41	50000	UNUSED		
14	1980-1967-2360-17341	1277452917	06/09/2019 at 13:18:41	10000	UNUSED		
15	2021-2002-2393-[illegible]761	1282209399	06/09/2019 at 13:18:22	20000	UNUSED		

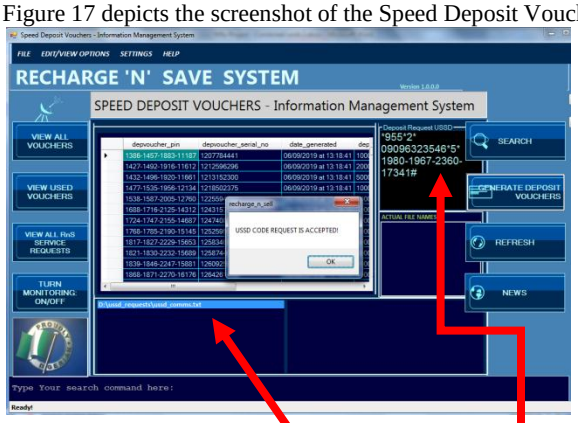
Deposit Voucher purchased by user to make deposit.

Voucher associated denomination, #10,000

Voucher status - UNUSED

Figure 16: Database table view of Speed Deposit Vouchers, with highlighted deposit voucher purchased by user.

Figure 17 depicts the screenshot of the Speed Deposit Voucher system analyzing USSD message received



USSD message request received

Content of USSD message received

Figure 17: The Speed Deposit Voucher system analyzing USSD message received.

The USSD code is accepted because it is syntactically correct. It then goes on to analyze the USSD message in order to get all relevant information embedded in it.

Figure 18 shows the user entering amount to be deposited corresponding to the deposit voucher purchased while figure 19 depicts the success confirmation of a cash deposit sent to the user. In addition, figure 20 shows a screenshot of a deposit voucher that has been previously used for deposit.

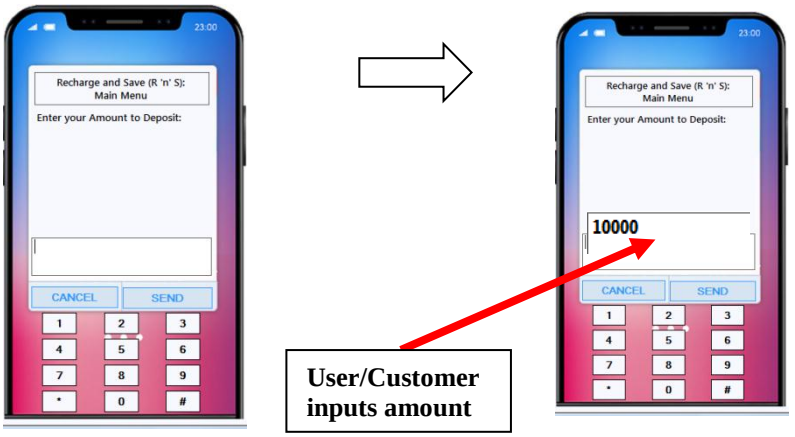


Figure 18: User entering amount to be deposited corresponding to the deposit voucher purchased.

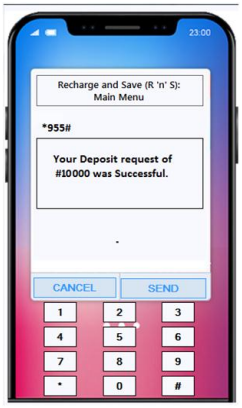


Figure 19: Deposit success confirmation sent to user

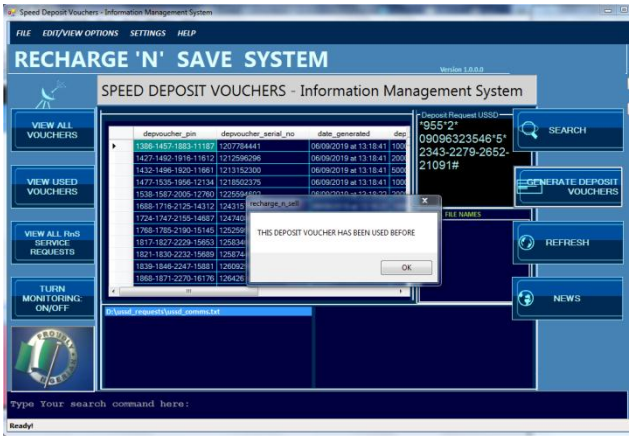


Figure 20: Deposit voucher has been previously used for deposit.

5.0 Conclusion

The Speed Deposit Voucher Management System, which for the most part, is used in the generation of the deposit vouchers affiliated with Naira denominations, has been developed in a way that it makes necessary updates whenever a user makes a transaction. A proof-of-concept for the USSD system of communication between the users (the customer) mobile phone and the Network or Bank USSD application was also simulated to demonstrate how easily and how quickly the customer can have his deposit request successfully granted. The developed Speed Deposit Voucher Technology (Recharge and Save System) shows that customers can make funds deposit into their bank accounts very easily and this ultimately improves quality of service to customer, saves time. It also clearly shows that customers do not have to come toalways the banking halls to make cash deposits into their accounts, thereby promoting the reduction of physical presence at the banking halls during cash deposits.This system is expected to encourage Nigerians to develop a good savings culture, which will in turn increase the nation's gross savings rate and consequently, create a platform for sustainable economic growth in Nigeria.The developed system, however, is limited to personal account deposit only, thus, only a registered user on the R.'n'S.S (Recharge and Save System) can make deposits. This is a constraint for customers who would want to deposit to other bank accounts.

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