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Design of a Mobile Banking Application for Rural Banks in Ghana

[1]G.O. Ofori-Dwumfuo and [2]Betty A. Dankwah
[1]Methodist University College, Ghana
[2]Ghana Telecom University, College

Abstract: This research is aimed at enabling the use of mobile phones as a tool to conduct convenient banking to customers at any time and at any place. It attempts to design an application system that will support the mobile phone banking infrastructure. The system is aimed at rural banks in Ghana - local banks with a much lower minimum capitalization than regular commercial banks. Traditionally, banks have always sought secured and reliable media through which they could serve their clients more cost-effectively. They have extensively employed electronic and communications technologies in their operations for many years, but these have not eliminated the various inconveniences that clients encounter while doing business with them. Our study starts by analysing questionnaires that were conducted for stakeholders in the banking industry in order to determine users' expectations on mobile banking. The stakeholders include mobile phone operators, the Ghanaian banks and users of mobile phones who have active bank accounts. The questionnaires tried to find out among other things, how people carry money to transact business, whether they have heard of electronic banking, how they use their mobile phones and whether they currently subscribe to mobile banking. We also tried to establish the main services that users would like to have on such a mobile banking platform if it becomes available on the Ghanaian market. For our design, we also analysed reliable mobile technology (WAP) that will support such an application.

Keywords: Application design, banking application system, Ghana rural banks, mobile banking, rural banking application software

INTRODUCTION

In sub-Saharan Africa, developments in Information and Communication Technology (ICT) are radically changing the way business is done. Electronic commerce is now thought to hold the promise of a new commercial era by offering an inexpensive and direct way to exchange information and to sell or buy products and services. This move in international marketing has set in motion a revolution in the banking sector for the provision of a payment system that is compatible with the demands of the electronic marketplace (Al-Mudimigh, 2007; Anamuah-Mensah and Marfo, 2009; Bakos, 1998). Financial institutions now rely heavily on technologies to effectively and efficiently perform their business.

The traditional way of banking is gradually giving way to a new banking order that is e-banking, internet banking and now mobile banking (Kabir, 2007, 2009). Mobile banking is the way people can get access to their banking activities, banking information in real time anywhere, anytime using their mobile devices, especially, smart phone or any entry level phones that support some platforms like J2ME, WAP (Mas and Kabir, 2008). Also, the proliferation of handheld mobile devices with lots of functionalities and capabilities of handling large amounts of data promises a working solution of banking in the pocket (Fulton Bank, 2010).

A lot has been said about the potential for cell phone banking following the rapid increase in cell phone usage in the world. A recent survey shows that about 85% of adults have used a mobile for one activity or another but no one (0%) has used it for a financial transaction in Ghana. AudienceScapes (2009), In developing countries, the role of the mobile phone is more extensive than in developed countries, as it helps bridge the digital divide. The use, then, of mobile phone for financial service offerings, could dramatically lower the cost of banking and more effectively, reach the mass market (Idowu *et al*., 2002). Early pioneers such as MTN Banking, Globe, Smart, Celpay and WIZZIT Bank have all been showcased as leading innovators who are using technology to expand access to personalised and mobile financial services in their various jurisdictions (Jørstad *et al*., 2004).

Mobile phones represent a cost-effective solution for users, financial institutions and operators, allowing them to conduct business in places where traditional banking and Internet services are too expensive or simply non-existent- effectively offering branchless banking (Mas, 2009). Ubiquitous and versatile, wireless devices can give

Corresponding Author: G.O. Ofori-Dwumfuo, Methodist University College, Ghana

users easy, daily, access to financial services, bringing the next market revolution (mobile banking, mobile payment, mobile wallet, mobile money transfer and other financial services) to users everywhere (Fulton Bank, 2010). Easy access to financial services is widely accepted as good; users have access to credit and can securely manage their money, financial institutions expand their user base and process more transactions and governments benefit from the effect credit has on lower-income sectors of the population and can better track funds distribution within their country.

Over the years, technology has increased in importance in Ghanaian banks. Traditionally, banks have always sought media through which they would serve their clients more cost-effectively as well as increase the utility to their clients. Their main worry has been to serve clients more conveniently, increase profits and eventually be competitive within the financial market. Electronic and communications technologies have been used extensively in banking for many years just to advance the main policies and objectives of banks. The earliest forms of electronic and communications technologies used in Ghanaian banks were mainly office automation devices. Telephones, telex and facsimile were employed to speed up and make the process of serving clients more efficient. For years, they remain the main information and communication technologies that have been used for delivering banking services.

As Personal Computers (PCs) became popular in the late 1980s, competition among banks intensified and Ghanaian banks saw this as an opportunity to have comparative advantage over their counterparts. They began using PCs in back-office operations as well as tellers, to serve their clients faster. Further technological advancements saw the banks networking their branches and operations thereby allowing their clients to conduct banking business at any of their branches.

The most revolutionary electronic innovation in Ghana has been the Automatic Teller Machines (ATM). Banks with ATM services have them networked thereby further improving their services to customers. The first ATM in Ghana was installed in 1995. Not long after, most of the major banks began their ATM networks at strategic and competitive positions across the major cities. Currently, almost all banks in Ghana operate ATMs. The ATM has since become the most successful medium for banking operations in the country. Customers consider it important when choosing banks to do business. ATMs have been able to entrench the one-branch philosophy in the country by being networked and so people do not have to go to their branches to do banking.

Though ATMs have enjoyed great success, it has been recognized that it is possible for banks to further improve their competitive stance and profitability by providing their clients with even more convenience. This led to some banks offering PC banking services, mainly to corporate clients where the banks provided the customers with the proprietary software, which they could use to access their accounts, mostly through the World Wide Web (www). This was, however, on a limited scale due to security challenges.

PROJECT OBJECTIVES

Despite the promising future of m-banking and the successful experiences in countries in sub-Saharan Africa, there are no visible mobile banking experiences in Ghana. Even though, there has been a tremendous increase in mobile phone penetration in the country, the main unresolved issue in the development of mobile payment systems is how to use mobile phones as a platform to deliver timely banking services to customers. This project, carried out at the Ghana Telecom University College in 2011, focuses on the development of a mobile application that will support the following functionalities to enhance rural banking in Ghana (Dankwah *et al*., 2011):

- **Ubiquitous Banking:** Customers having full access to their accounts anytime, anywhere
- **Funds Transfer:** Paying or receiving payments using the cellular phone
- Person to Person or business payments: Paying from the mobile phone for business or individual services
- **Utility Bills payments:** Get various bill amounts and pay them from the mobile phone
- **Money transfer:** Send money to recipients from the mobile phone wherever they are at the customer's convenience in a cost effective, secure and real time manner
- **Mobile Top-Up:** Airtime recharge on mobile phones.

The Rural Banking Concept in Ghana: In the middle of the 1970s, the central Bank of Ghana identified some structural rigidities prevailing in the countryside due to the low level of financial intermediation as compared to the situations at the urban centres. Furthermore, although the banking penetration ratio is currently low by international standards (at one bank branch per 54,000 people), the situation was worse in the 1970s due to the strong urban bias. For example, even though the Greater Accra region of Ghana represents only 13% of the country's population, it commands 35% of the total national commercial bank concentration (Buchs and Mathisen, 2005).

Even at the urban centres, most of the potential microfinance clients could not access the services of the commercial banks because their conditions are outside the means and capacity of the poor. Hence in 1976 the Bank

of Ghana issued a regulation allowing rural communities to establish local banks with a much lower minimum capitalization than regular commercial banks. The rural banking concept was thus introduced to bridge the rural-urban gap of financial management (Andah and Steel, 2003).

The rural banks were expected to operate in an environment of high illiteracy rate. As rural development institutions, they require effective local participation, hence they are to be owned and managed by the poor communities within which they operate. Once established, they were given the basic responsibility of providing banking services to the rural and community folks – people with low income (Morawczynski and Pickens, 2009; Gautam and Pickens, 2006). These services include banking and generating interest for funds deposited and make available loans to qualified rural folks especially those in agri-business, petty trading as well as small scale manufacturing. Consequently, they have been at the forefront of designing innovative products and modifying their operations to suit the specific needs of the rural farmer, the underserved, micro-enterprises and other low income operatives of the rural economy, since their formation (Bank of Ghana, 1997).

With the initial rural bank established in 1976, the number has increased to about 125 actively operating, with a total of about 460 branches nationwide (despite the closure of 23 distressed ones in 1999 (Osei-Bonsu, 1998). In 2002, the Association of Rural Banks (ARB) Apex Bank was established with the rural banks as its shareholders. The Apex Bank was to serve as a mini central bank to strengthen and monitor the rural banks.

In recent times, however, the major commercial banks have extended their activities to target markets reserved for the rural banks, thereby giving them profound competition (Nair and Fissha, 2010, Hunter and Timme, 1991). Unlike the commercial banks, the rural banks lag behind with regards to the use of technology, especially computers and networking. To date, most of their processes are undertaken manually thereby reducing their competitive edge in the banking industry. For them to be able to compete, they will need to improve their services by improving upon their technical infrastructures and human resources The focus of this project is to develop a mobile application that will support some functionalities to enhance rural banking in Ghana (Botchway-Anang, 2011).

Electronic delivery channels: Technological innovations have been identified to contribute to the distribution channels of banks. The electronic delivery channels are collectively referred to as Electronic Banking. Electronic banking is actually not one technology, but an attempt to merge several different technologies. Each of these evolved in different ways, but in recent years, different groups and industries have recognized the importance of working together. Bankers now see a kind of technological evolution in their business. Some of these electronic delivery channels are discussed below:

Automated Teller Machines (ATMs): Rose (1999), describes ATMs as a facility that combines a computer terminal, record-keeping system and cash vault in one unit, permitting customers to enter the bank's book-keeping system with a plastic card containing a Personal Identification Number (PIN), or by punching a special code number into the computer terminal, linked to the bank's computerized records, twenty-four hours a day. Once access is gained, it offers several retail banking services to customers. They are mostly located outside of banks and are also found at airports, malls and places far away from the home bank of customers.

ATMs were introduced first to function as cash dispensing machines. However, due to advancements in technology, ATMs are now able to provide a wide range of services, such as making deposits, funds transfer between accounts as well as bill payments. The combined services of both the automated and human tellers imply more productivity for the bank during banking hours. ATMs are thus a cost-efficient way of yielding higher productivity as they achieve higher productivity per period of time than human tellers banks even after banking hours (Rose, 1999).

Telephone Banking: Telephone Banking (Telebanking) is a form of remote or virtual electronic banking, which is essentially the delivery of branch financial services via telecommunication devices, where the bank customers can perform retail banking transactions by dialling a touch-tone telephone or mobile communication unit, which is connected to an automated system of the bank by utilizing Automated Voice Response (AVR) technology (Balachandher *et al*., 2001). According to Leow (1999), telebanking has numerous benefits for both customers and banks. It provides increased convenience, expanded access and significant time saving for customers and from the banks' end, the costs of delivering telephone-based services are substantially lower than those of branch based services.

Personal Computer (PC) Banking: This is a service which allows the bank's customers to access information about their accounts via a network, usually with the help of proprietary software installed on their personal computers. Once access is gained, the customer can perform a lot of retail banking functions, thereby offering 24-hour service, seven days a week. It also has the benefits of Telephone Banking and ATMs.

Internet Banking: The idea of Internet banking according to Essinger (1999) is to give customers access to their bank accounts via a web site and to enable them to enact certain transactions on their accounts, given compliance with stringent security checks. It may be described simply as the provision of traditional banking services over the internet. It also offers convenience and flexibility to customers (Krugel, 2007).

SMS Banking: SMS (Short Messaging Service) allows customers to send and receive banking information and text messages over a mobile phone since all mobile phones have the SMS functionality.

METHODOLOGY

To help in the development of our banking application, a survey was conducted on the stakeholders; the banking institution, customers/users, the mobile phone service providers and the vendors (these are agents who will collaborate with the financial institutions to act as vendors of the mobile banking products). The data collection method adopted involved questionnaires. The questions were designed to ascertain respondents' knowledge on the provision of banking products over mobile phones,

A sample size of 100 respondents was targeted, involving students, professionals (bankers included) and the general public out of which 73 were returned, representing 73%. Although this sample size may appear to be low, we noticed that majority of the Ghanaian banks are just beginning to introduce this e-product to their customers. Most customers, therefore, find it difficult to comprehend the m-banking services.

Initially, we realize that majority of our respondents (about 73%) are city-dwellers (Table 1).

On the question of profession, respondents are mostly an educated population; administrators and tertiary students represent 24.7% each of the population, bankers and secretaries form 13.7% each, security officers 12.3% and lecturers represent 11.0% (Fig. 1). This result was inevitable because the project targeted the educated populace, since in Ghana, few indigenous and uneducated people do business with banks; the majority of bank clients are government employees who take their salaries through the banks.

We asked respondents as to what they use their mobile phones for during a week. We realized that phone calls take 37%, SMS messages take 40%, listening to radio 19%, internet access and television take 3% and 1% respectively - with none using their phones for financial transactions (Fig. 2).

On the mode of carrying money to transact business 58.9% of respondents use physical cash and 41.1 % use

Table 1: Where Do You Stay

	Frequency	Percent
City	53	72.6
Town	20	27.4
Total	73	100.0

Table 2: How People Carry Money to Transact Business

	Frequency	Percent
Bank Cheque	30	41.1
Physical Cash	43	58.9
Total	73	100.0

Table 3: Have You Heard Of E-Banking?

	Frequency	Percent
Yes	65	89.0
No Response	8	11.0
Total	73	100.0

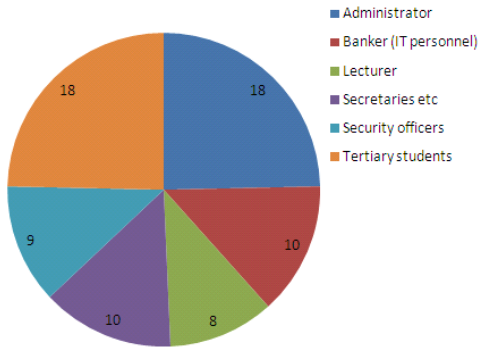

Fig. 1: Profession of Respondents

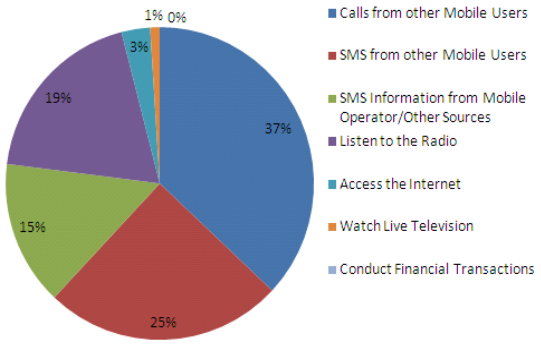

Fig. 2: How Mobile Phones Are Used

bank cheques (Table 2). From interaction with the respondents, the two variables seem to be equal because respondents from both categories are indifferent to the risks associated with the physical handling of cash money.

Since majority of respondents prefer to carry physical cash on them, we wanted to know if they had heard of electronic banking. We gather that almost ninety per cent have done so (Table 3).

Only few respondents are subscribers of mobile banking services, 78.1% are non-subscribers as against

Table 4: Subscriber of Mobile Banking?

Frequency	Percent	
Subscriber	16	21.9
Not Subscriber	57	78.1
Total	73	100.0

Table 5: Services used on Mobile Banking

	Frequency	Percent
Mini Statement, C/D Alert, Fund Transfer, Bill Payment, Bal Inquiry	16	21.9
None	57	78.1
Total	73	100.0

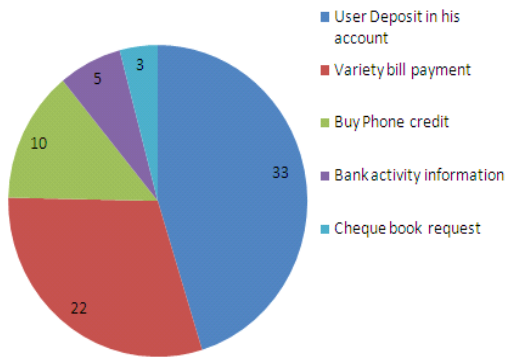

Fig. 3: Services Expected On M-banking

21.9% subscribers (Table 4). This may be because these services are rather new in the Ghanaian banking system; m-banking application is in its infant stage in the country and not all banks are on mobile banking.

With respect to services expected in mobile banking, (Fig. 3) user deposit was the dominant expectation of respondents. Respondents who answered this question to the affirmative were both mobile bank subscribers and non subscribers, 45.2% of them would want a way to deposit funds into their accounts using scratch card as a medium for deposit, 30.1% want a variety of utility bill payment and 13.7% would like to use the banking services to buy cell phone pre-paid credits to activate their mobile phones with. Only 6.8 and 4.1% want bank activity information and check book request services.

From the survey, Table 5 shows services currently running on respondents' mobile phones; 21.9% of the subscribers are enjoying mini bank statements, bill payment facility, balance inquiry and fund transfers, while 78.1% enjoy nothing because they are not subscribers. This low patronage may be attributed to the fact that the mobile banking services are still new to the Ghanaian mobile phone users.

User requirement specifications: From the survey conducted on the need of users, the following services are required in a banking application by about ninety per cent of the respondents.

- **Account Balance inquiry:** Users would want to know their account balances in real time anywhere anytime.
- **Account statement inquiry:** Users would want a display of detailed account information on their transactions over a period of time. This information would be voluminous if not limited to a couple of days.
- **Cheque status inquiry:** This requirement is to give users access to know whether their cheques have been cleared, pending or bounced as dud.
- **Cheque book request:** Here, users would want to make requisition for cheque books and be notified when it is ready for collection.
- **Fund transfer between accounts:** This will facilitate the transfer of funds between two accounts of the same person within the same bank or another. With this service, users involved must operate accounts with banks providing this facility. The challenge here is that a secure channel for the transfer of money is needed.
- **Information request (Interest rates/exchange rate, etc):** Users would like to be informed about bank rates frequently via their mobile phones.
- **Credit/debit alert:** Users will like to have ringing tones that will alert them whenever their accounts are credited or debited. However, there will need to be a mechanism that will alert the accounts holders to give their consents before debits are made.
- **Minimum balance alert:** Even though most banks in Ghana require that customers maintain a minimum balance on their accounts, especially, for savings accounts, users would want to set their own thresholds so that their funds do not go beyond certain minimums.
- **Bill Payment with alert:** This is to enable payment for utilities like electricity and water directly from the customers' accounts and payment alerts given on their phones.
- **Other notification alerts:** Users would want alerts for other reasons as:
  - **Account Balance:** When their account balances drop below a specified amount or their credit balances exceed some limits.
  - **Transactions:** When debit or credit transactions occur to their accounts or cards that exceed some specified amount.
  - **Cheque Clearing:** When cheques are cleared on their accounts.
  - **Irregular Activity:** When there is any irregular activity on their accounts.

System technical requirements: Looking at some technologies available for mobile banking we adopt a web-based application using the Wireless Access Protocol (WAP), which is available on most smart phones (HCI Blog, 2004). Consequently, we examine some

requirements that might impose some constraints on the overall system like performance, quality standards and design constraints:

- **Interoperability:** Although banks have similar functions, different protocols are being used for mobile banking, like WAP, HTML, XML, WML, JDBC, etc., Our application would either have to support multiple protocols or use of a common and widely acceptable set of protocols for data exchange and interoperability.
- **Scalability and reliability:** With a mobile banking application, there is the need to scale-up the structure to manage large numbers of customers; customer may want to transact business with the bank anytime, from anywhere and reliability must ensure that the banks' systems structures are up and running in a true "24/7" manner.
- **Personalization of service:** For a mobile banking application to interact with users to give value added services, it is must support some personalisation facilities like preferred language and alert ring tones.
- **Security requirement:** For financial transactions and information sent from some remote location over air the mobile application requirement needs to implement a very secure channel with end to end encryption. This security issue must involve all stakeholders; the mobile application developers, wireless network service providers and the bank's information technology department.

As stated above, we adopt a web-based application using the Wireless Access Protocol (WAP). With WAP data security, the WAP opens a GPRS session between the handset browser (client) and the web application at the bank. The session is protected by the GSM communication layer encryption and further encrypted by the bank's site encryption. This over-the-air communication is threatened, however, by masqueraders just as with internet banking, but the security can be further strengthened at the client's SIM.

Apart from hardware and software tools required for the development of our application, one requirement of a mobile application is that it must be downloaded onto the client device before it can be used, which further requires the mobile device to support one of the many development environments (like WAP). Using WAP, the WAP server must be installed on the bank site (web server machine). The mobile phone of the bank customer must have the WAP browser setup from his GSM provider.

SYSTEM PROTOTYPE

Below, we present some of the application interface screenshots.

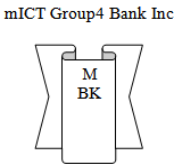

Fig. 4: Main Menu

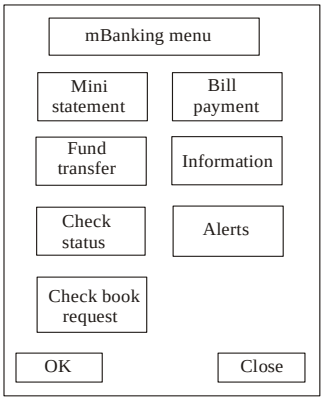

Fig. 5: Sub menu interface

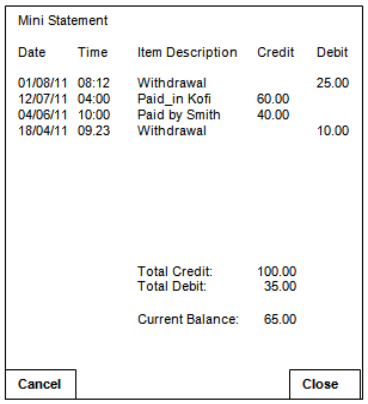

Fig. 6: Mini statement

Fig. 4 and 5 show the screens that lead the user to choose the service he wants.

Suppose the Mini Statement item is selected, a screen similar to Fig. 6 will appear and you can then see your current balance for the period stated in the application.

When the Fund Transfer icon is selected; the screens Fig. 7 and 8 appear. The Cancel button takes you to the pervious screen, Ok takes you to the next screen and Close takes you to the main menu. When the transfer is completed a confirmation message is displayed and an SMS Text Message will be sent to your phone confirming the transfer. The recipient's interface after fund transfer is shown in Fig. 9.

When the cheque is paid into your account two beeps precede an SMS message below. The screen in Fig. 10 displays the View tab as shown. When the view tab is

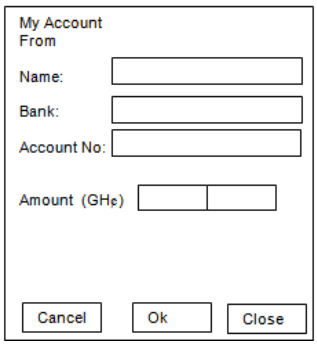

Fig. 7: Fund Transfer From

Fig. 8: Fund Transfer to

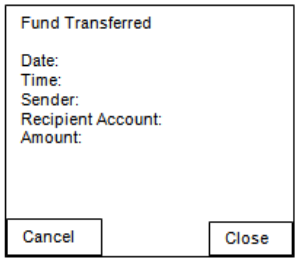

Fig. 9: Funds Transfer Complete

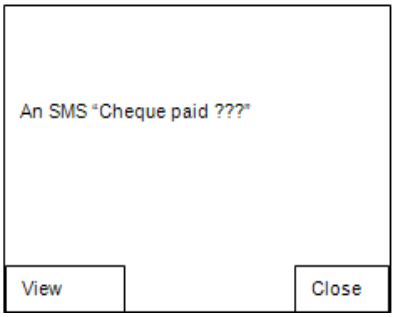

Fig. 10: Cheque Status

clicked the enter transaction code screen appears (Fig. 11). The user has a transaction code issued by the mobile Financial Service Provider (mFSP).

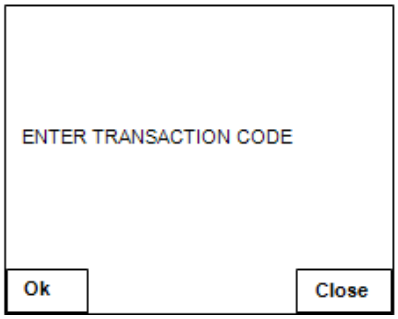

Fig. 11: View

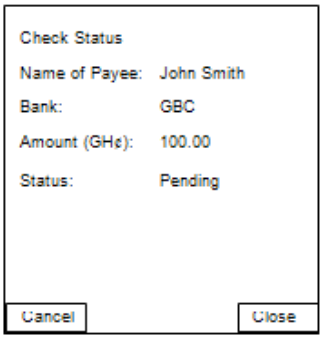

Fig. 12: Cheque Pending

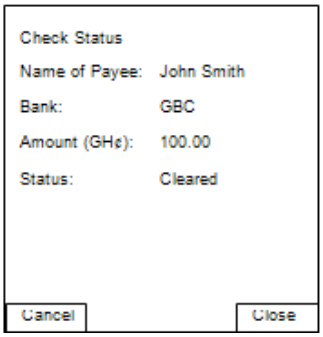

Fig. 13: Cheque Cleared

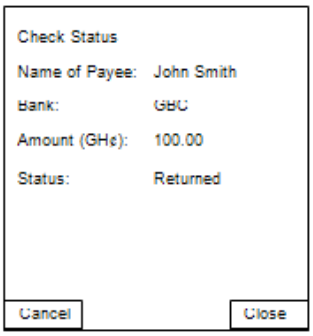

Fig. 14: Cheque Returned

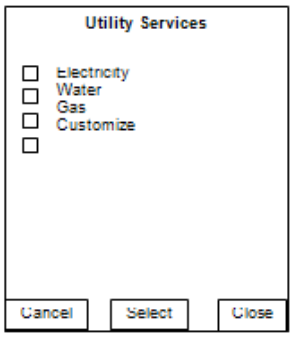

Fig. 15: Utilities

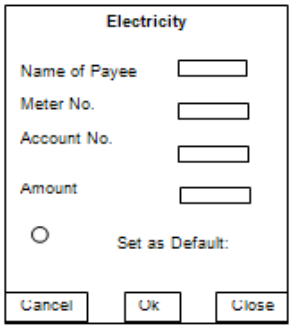

Fig. 16: Utilities - Electricity

When you click Ok, either one of the three screens Fig. 12, 13, 14 will be displayed. For Bill Payment, we have the screens in Fig. 15, 16, 17 and 18

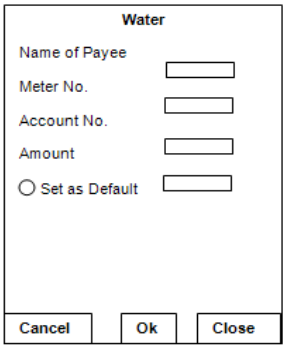

Fig. 17: Utilities - Water

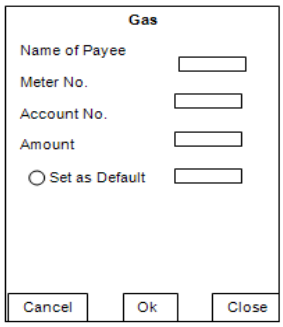

Fig. 18: Utilities - Gas

Application functionality: Figure 19 shows a schematic view of the functionalities of our banking application which we elaborate upon below.

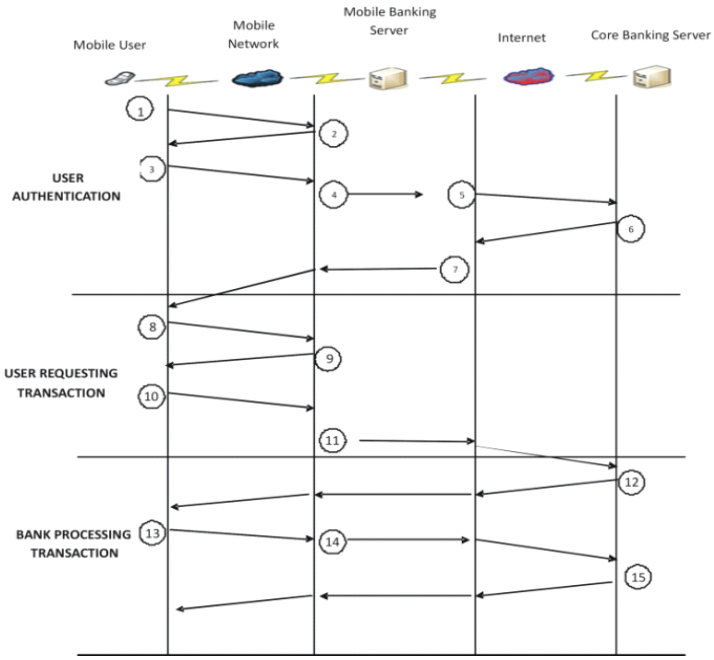

Fig. 19: Application functionalities

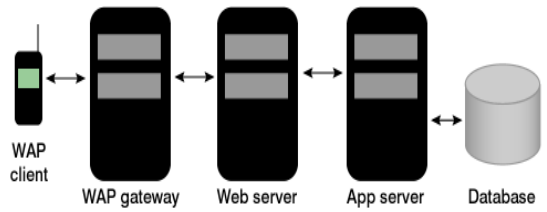

Fig. 20: WAP application structure

Case: User Authentication:

- User connects to the mobile banking server located at the third party site. The connection over the mobile network is encrypted. The encryption keys can be transferred during the client installation on the mobile phone or when the client first communicates with the server using the browser.
- The mobile banking server asks for authentication. Here, there are two layers of authentication, one for the third party and the other for the bank. The credentials required for the third party are encrypted by the client-side application. The credentials required for the bank would be encrypted using the bank's encryption keys.
- Since both credentials are required, the user has to register with a vendor by providing personal details like name, e-mail-id, mobile number and bank account number; and the vendor creates a Personal Identification Number (PIN) for the mobile user. These credentials can be used for authentication with the vendor. The server then forwards the encrypted data to the bank's server. Since the application will be provided to multiple banks, the bank name would be encrypted using the vendor's keys, so that it can pass the data encrypted by the bank's keys to the correct bank. (The idea behind having different encryption keys is to ensure that only data required by a vendor is accessible to that vendor but the entire data is available to the bank.)
- Mobile user is authenticated with the mobile banking server.
- The credentials entered by the user (which are required for authentication with the bank) are forwarded to the bank.
- The bank authenticates the user and provides a list of services available to the mobile banking server.

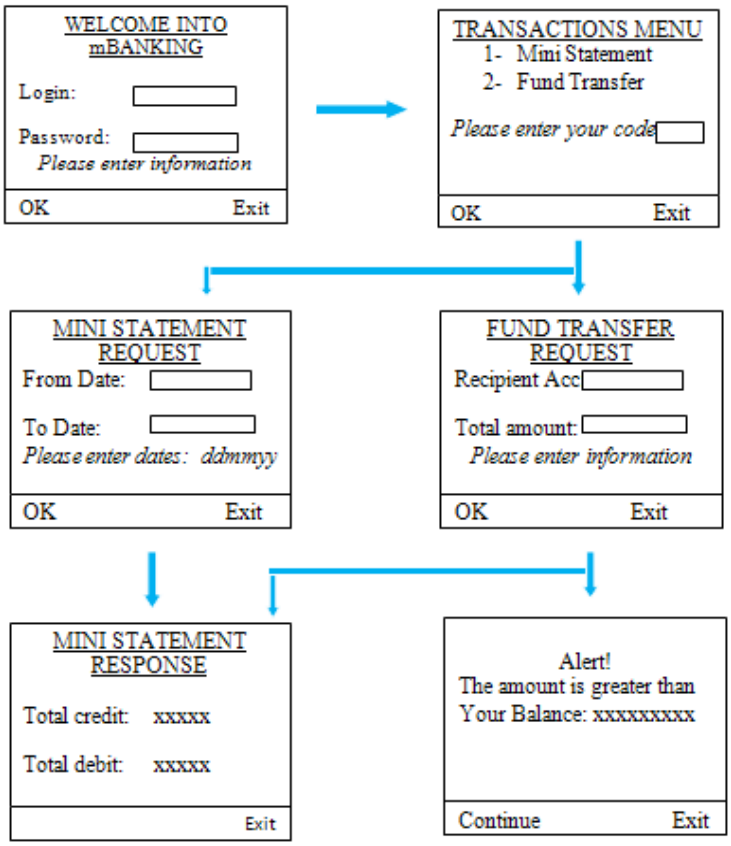

Fig. 21: Application flow screens

Table 6: Mini-statement request transaction

1.	Start mBanking
2.	Choose Mini-Statement option in the menu
3.	Enter Starting date
4.	Enter ending date
5.	Enter account number
6.	Submit
7.	Security client encrypts the information
8.	Transmission by telecom server (Mobile operator)
9.	Reception by the security server of the bank.
10.	Decryption of the information by the security server.
11.	Transmission to bank WAP server.
12.	The bank WAP server requests information from the database server.
13.	The database server replies.
14.	The bank WAP server elaborates the response
15.	The bank security server encrypts the information.
16.	The telecom server transmits the information to the client security.
17.	The client security decrypts the information.
18.	The WAP client displays the information.

- The mobile banking server forwards the data to the mobile user.

Case: User requesting a transaction:

- The user selects the service he wants to perform.
- The mobile banking server asks for re-authentication for critical transactions. (Re-authentication with the mobile banking sever ensures that critical transactions are verified and mapped to the user. The re-authentication can be restricted with the vendor only; the user need not authenticate with the bank every time a transaction is performed. Again, this depends on the role played by the vendor.)
- User re-enters the credentials.
- Server authenticates the mobile user and forwards the information to the bank on how to process the mobile user's service request. For example, to check an account balance, the mobile banking server will contact the bank's server on how to process the request.

Case: Bank processing the transaction

- The bank server will ask for details required to service the user request. Taking the above example, the bank will ask for the account number and this is forwarded by the mobile banking server to the end user.
- The end user enters the details and sends it to the mobile banking server.
- The server again asks for authentication. Once authenticated, the mobile banking server will forward the account number to the bank's server.
- The bank's server will check the status of the account and provide the details to the mobile user via the mobile banking server.

The sequence below (Table 6) gives the activities involved in a mini-statement request transaction.
In the situation where the security server at any point detects that the information is not correct due to wrong input or any form of attack, it is sent back to the system for verification. After a number of system verifications, the flow then proceeds or rejects the transaction.

WAP-based applications: The most common development option for this kind of application is a Java 2 Platform Enterprise Edition (J2EE), which consists of a set of services, application programming interfaces (APIs) and protocols that provide the functionality for developing multi-tiered, web-based applications. Figure 20 gives a WAP/J2EE application structure with a WAP device as a client. Relative to Fig. 19, the WAP client corresponds to the Mobile User, the WAP gateway to the Mobile Network, the Web server to the Mobile Banking Server and the Applications Server corresponds to Core Banking Server.

In WAP applications, dynamic Wireless Markup Language (WML) pages are generated. Thus, in order to alter a standard J2EE application for use with mobile any

Table 7: Application Code Sequence: Authentication and Transaction Choice

User side	Web Server side
USER AUTHENTICATION **:**	
The user selects mBanking on his device screen.	The Bank web server executes *LoginJSP.jsp* and sends a WML content (the "Login.wml" deck) to the user device through the wireless mobile operator WAP gateway.
The WELCOME INTO mBANKING screen appears. The user enters his identity confidential bank code and submits them.	The web server runs the servlet file *LoginServlet.java* and gets the user's information. The web server uses these codes to extract the user names from the database. The user names are inserted into the *MenuJSP.jsp* file and the web server sends this file to the user's device (in the "Menu.wml" deck).
USER TRANSACTION CHOICE:	
The user device executes the deck Menu.wml (the transformed file of *MenuJSP.jsp*). The screen TRANSACTIONS MENU is displayed. The user enters his choice and submits it.	The web server gets the user choice by executing the *MenuServlet.java* file and sends the transaction to the EJB App Server, obtains the result of the transaction and puts them into either the *TransFormJSP.jsp* file (if the choice was a Fund Transfer) or into the *State Form JSP.jsp* file (if it is a mini-statement request). It then sends the appropriate file to the user device through the WAP Gateway. Depending on his choice, the user's device receives either "TransForm.wml" or "StateForm.wml" deck.

Table 8: Application code sequence: Fund Transfer and Mini Statement Request

User side	Web server side
FUND TRANSFER REQUEST:	
Here, the user device runs the "TransForm.wml" deck and allows the user to fill and submit the FUND TRANSFER REQUEST	The web server gets the funds transfer information from the user device by executing the *TransFormServlet.java* file. After the fund transfer is issued, the web server runs the *State RespJSP.jsp* file to report to the user device in the "StateResp.wml" deck through the Wireless operator gateway server. Otherwise, (if any errors) the *AlertJSP.jsp* is run into the "Alert.wml" deck on the user device in order to invite him to repeat the process, if necessary
MINI STATEMENT REQUEST:	
In this case, the user device runs the "StateForm.wml" deck and displays the screen MINI STAMENT REQUEST which the user would then fill and submit	The web server gets the statement request information by executing the *StateFormServlet .java* file. When the request is satisfied, the web server runs the *StateRespJSP.jsp* file to report the result to the user device in the "StateResp.wml" deck. Otherwise, (if any errors) the *AlertJSP.jsp* is run into the "Alert.wml" deck on the user device in order to invite him to repeat the process, if necessary
The user device performs the "StateResp.wml" deck and displays the screen MINI STATEMENT RESPONSE	

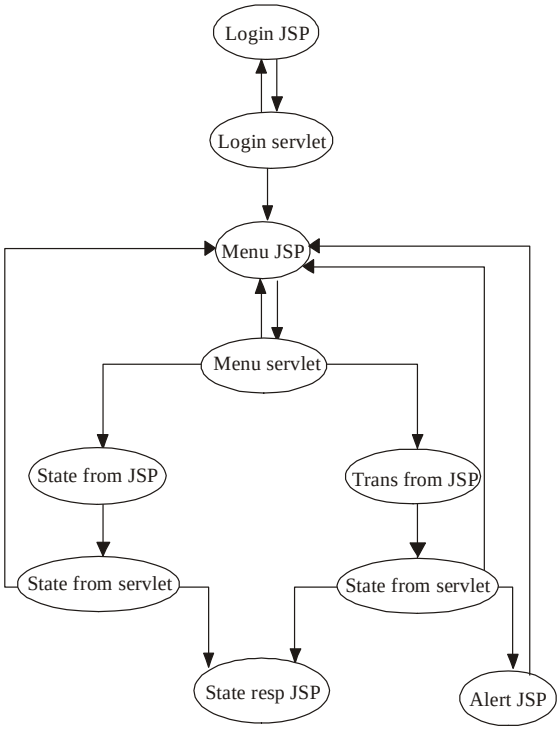

Fig. 22: Application flow diagram

place, especially with basic customer account activities, they should move away from their traditional usage of banking halls and ATMs. They should encourage devices, one will have to write new Java Server Pages JSPs and, in some cases, new servlets. In Fig. 21, we have screens showing the application flow pages. These pages will be coded in Login.wml, Menu.wml, Statereq.wml, Fundreq.wml, StateRep.wml, FundRep.wml and Alert.wml. These codes will then be integrated in JSP files and uploaded on the Bank Web server. Fig. 22 shows the diagram of the application flow. In Table 7 and 8 we show the Application Code Sequence. In these tables, we elaborate on Fig. 22 regarding User activities and the corresponding Web Server activities. These involve User Authentication and User's Transaction Choice and then either Fund Transfer or Mini Statement Request.

CONCLUSION

For banks to satisfy their clients at any time and at the use of the mobile phone as a tool. This study attempts to design an application system that will support the mobile phone banking infrastructure. The system is aimed at rural banks in Ghana - local banks with low minimum capitalization. The study determines how Ghanaians carry money to transact business, whether they have heard of electronic banking, how they use their mobile phones and whether they currently subscribe to mobile banking. We also tried to establish the users' expectations with respect to mobile banking services if it becomes fully available on the Ghanaian market. We would note however that, for their rural customers to adopt such mobile banking systems, the banks should ensure that the systems are made secured and reliable and the confidentiality of customers' data is guaranteed, considering the challenges of rural mobile telephony.

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