A Model for Implementing Mobile Banking in Developing Countries (e.g. Nigeria)

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ABSTRACT

Mobile banking has developed over the years due to massive increase in mobile phones penetration globally. This however, has brought about significant social change in the way we approach things generally. It has transformed the banking culture in places like Kenya, Tanzania, Afghanistan, India, South America etc. This paper is projected to improve on the use of mobile phones as a communication device to a banking platform. It outlines the proposed third party banking solution through the mobile phone tagged *mobile banking*. The proposed solution here is a combination of a scratch card, (PIN generation), mobile phone, telecommunication network, SIM-based server and the Banking solution. This system gives more ease to users, making the bank to be on their palms, assures convenience, more security (avoiding cash at hand), reduced cost of money transfer, encouraging trusted banking culture, improving the use of technology and embracing better future.

Keywords: *2G/3G Systems, M-banking, E-banking, Mobile Phone, Recharge Card, SIM-based Server.*

1. INTRODUCTION

Banking can simply be expressed as the business of keeping, lending, exchanging and issuing money [1]. It can also be referred to as the business of bankers [2]. With mobile technology, banks can offer the following services to their customers- funds transfer while travelling, receiving online updates of stock price while being stuck in traffic. Smart-phones and 3G connectivity provide some capabilities that previous text message-only phones do not. Mobile Banking refers to provision of banking and financial services with the help of mobile telecommunication devices. The scope of offered services may include facilities to conduct bank and stock market transactions, to administer accounts and to access customized information. The advent of the Internet has enabled new ways to conduct banking business, resulting in the creation of new institutions, such as online banks, online brokers and wealth managers. Such institutions still account for a tiny percentage of the industry. Over the last few years, the mobile and wireless market has been one of the fastest growing markets in the world and it is still growing at a rapid pace. According to the GSM Association and Ovum [3], the number of mobile subscribers exceeded 1.5 billion in September 2005, and in 2008 exceeds 2.5 billion (of which more than 2 billion are GSM).

2. LITERATURE REVIEW

Mobile banking first appeared in the Philippines in 2001, when two operators, Globe and Smart, introduced their own domestic payment plan. In most mobile banking models, the person sending a payment sends the amount by text to the recipient's phone number. The person receiving the payment goes to an authorized local agent, typically a mom-and-pop retailer that also sells prepaid mobile phone cards, and withdraws the cash. In Tanzania, a hospital sends money by text message to women in remote areas so they can pay for bus fare to travel for critically needed surgery. In Afghanistan, the idea was to enable users to send minutes to family members in rural areas, who were not otherwise able to buy prepaid phone cards. However, Kenyans quickly came up with other uses. Lots and lots of people were using it as a surrogate for currency. One could literally pay for taxi cab rides using cell phone credit. Today you can use your phone to pay for cab rides and electricity, to get money out of ATMs without owning an ATM card or even having a traditional bank account. Globally, the number of mobile banking users is expected to surge more than sixteen-fold to 894 million by 2015 from 55 million in 2009 according to the Berg Insight, an industry research firm based in Stockholm [4]. In Kenya, Vodafone has 13 million customers, six million customers for its mobile banking service, which generated half of its earnings [5].

3. OVERVIEWOF M-BANKING AND E-BANKING

3.1 Mobile Banking

Mobile banking refers to provisions of banking and financial services with the help of mobile telecommunication devices. The scope of offered services may include facilities to conduct bank and stock market transactions, to administer accounts and to access customized information [6]. Mobile banking in Nigeria in some instances is called SMS banking. It is used for performing transaction alert via mobile devices. This

however has opened up avenue for communication growth as researches are been made on mobile banking services. The greatest change mobile banking will bring is, the way we do business (i.e. the impact it will have in the way we trade and pay as well). Even some school of thought regards mobile banking as "naked banking" to emphasize the customers' freedom to conduct routine banking transaction from the comfort and security of his/her home. The latest revolution seems to happen with respect to mobile banking attempt to leverage on the synergies of mobile banking technology in telecommunication and information technology in the banking services. Mobile banking started from the transaction based activities, whereby bank customers are notified via SMS when transaction is conducted on their account via ATM. This is a one way event and only for information purpose. In Nigeria, GT Bank was one of the earliest Banks to provide this service to their customers. Despite the "watch and see" attitude that some very leading Banks are taking about mobile banking, the mobile remains the only and most available feasible means to provide mass market alternative to Branch banking in Nigeria. The key challenges in developing a sophisticated mobile banking application are interoperability. The single reason for this is the manner in which mobile phones applications evolve with time, device manufacturers focused on particular standard and this led to proliferation of applications [8]. If the m-banking application is SMS-based, then the low end phones are not technically excluded.

3.1.1 Mobile Banking Services

Mobile banking services includes the following but not limited to:

- Account alerts, security alerts.

- Account balances, update and history.

- Customer services via mobile phone platform.

- Branch or ATM location information.

- Registered merchants delivered online payments by secure agents and mobile client applications.

- Transaction verifications.

3.1.2 The Technologies Behind Mobile Banking

Technically speaking, most of these services can be deployed using more than one channel. Presently, Mobile Banking is being deployed using mobile applications developed on one of the following four channels: IVR (Interactive Voice Response), WAP (Wireless Access Protocol), Standalone Mobile Application Clients and SMS (Short Messaging Service) [7].

IVR - Interactive Voice Response: IVR service operates through pre-specified numbers that banks advertise to their customers. Customer's makes a call at the IVR number and are usually greeted by a stored electronic message followed by a menu of different options. Customers can choose options by pressing the corresponding number in their keypads, and then the corresponding information is read out, mostly using a text to speech program.

WAP - Wireless Access Protocol: WAP uses a concept similar to that used in Internet banking. Banks maintain WAP sites which customer's access using a WAP compatible browser on their mobile phones. WAP sites offer the familiar form based interface and can also implement security quite effectively.

Standalone Mobile Application-Clients: Standalone mobile applications are the ones that hold out the most promise as they are most suitable to implement complex banking transactions like trading in securities. They can be easily customized according to the user interface complexity supported by the mobile. In addition, mobile applications enable the implementation of a very secure and reliable channel of communication.

SMS – Short Messaging Service: SMS uses the popular text-messaging standard to enable mobile application based banking. Here, the customer requests for information by sending an SMS containing a service command to a pre-specified number. The bank responds with a SMS reply that contain the specific information. This is the most available means of doing m-banking for mobile penetration. It seems to be the simplest in sending account details to the SIM-Based server of the system's network. The proposed solution in our paper uses the SMS-based banking system (details are provided in section 4).

3.1.3 The Use of M-Banking/ M-Payment

Most M-Banking / M-Payment systems in the world enable users to do the followings:

- Store value (currency) in an account accessible via the handset if the user already has a bank account, this is generally a question of linking to a bank account. If the user does not have an account then the process creates a bank account for her or creates a pseudo-bank account, heed by a third party or the user's mobile operator.

- Convert cash in and out of the stored value account. If the account is linked to a bank account, then users can visit banks to cash-in and cash-out. In many cases, users can also visit the mobile service provider's retail stores. In the most flexible services, a user can visit a corner kiosk or grocery store-perhaps the same one when he or she purchases airtime-and transact with an independent retailer working as an agent for the transaction system.

- Transfer stored value between accounts users can generally transfer funds between accounts linked to two mobile phones by using asset of SMS messages (or menu commands) and PIN numbers. The advent of 3G communication systems have also enable Banks to offer more robust mobile banking technologies.

Some mobile Banking applications in Nigeria use pre-programmed configurations settings. Nigeria Banks are now deploying full-fledged banking via the mobile phones with array of services which were only possible in the Banking Halls before. Zenith bank, UBA, GT Bank, Diamond and Intercontinental Banks are the forerunners of this innovation. The mobile remains the only and most available feasible means to provide mass market alternative to Branch Banking in Nigeria [8].

3.2 Electronic Banking (E-Banking)

Electronic banking generally implies services that allow customers to use some form of (hand-held, mobile) computer to access account specific information and possibly conduct transactions from a remote location such as at home or at a work place. The major and outstanding piece of electronic banking to customers is the convenience that is enjoyed along with it. In a recent research carried out, it was learnt that electronic payments constituted about 360 billion naira worth of transaction in 2008. It seems the practice of carrying notes around for transaction is changing with the introduction of the ATM. Information gathered reveals that there are about 7500 POS terminals installed, while 97% of Nigerians that are aware of ATM use this service. Out of the 67% of the respondents that are aware of SMS banking, only 48% use it. Out of the 45% that are aware of MasterCard (an ATM-based system), only 10% use the service [9].

3.3 Difference between M-Banking and E-Banking

The main reason why Mobile Banking (m-banking) demand is more than Internet Banking (e-banking) is because it enables Mobility- Anywhere Anytime Banking. Customers don't need access to a computer terminal to access their bank accounts. They can do so on-the-go while waiting for the transport service, travelling or when waiting for their orders in a restaurant. It enables *Simplicity*- can be used by all class of people in the society. Also, it is cost effective and affordable by all kinds of users unlike the Internet.

4. SYSTEM MODEL OF PROPOSED M-BANKING SOLUTION

This section explains the operation and the interaction between objects (users and system) of the proposed banking system before the transaction cycle completes. The technology implemented by our work is the SMS-based. The mobile remains the only and most available feasible means to provide mass market alternative to branch banking in Nigeria. The internet has only a penetration rate of 6% in a population of 140 million, but mobile technology is close to 50% penetration with prospects for growth [5]. With the development of 3G mobiles and networks, virtually every part of the country will experience robust mobile banking technologies. The major attribute of the mobile phone under this platform, is to be able to send SMS messages from the creditors' phone to the bank and also acts as a money medium for transaction. The advent of SMS has brought more powerful technology such as, the Unstructured Supplementary Service Data (USSD). The USSD is a protocol that is used by mobile phones to communicate to the network service providers. USSD is an advance SMS feature and is only compatible with only Java enable phones [10]. USSD possess more secured mechanism than the SMS. From inception, this solution is to be used on all types of mobile phones. If USSD is used, it will only allow certain phones to use this package. Despite the numerous advantage of USSD, all text based phones will still be the preferred option to serve as the basis for transaction in other to reach the last- mile clients.
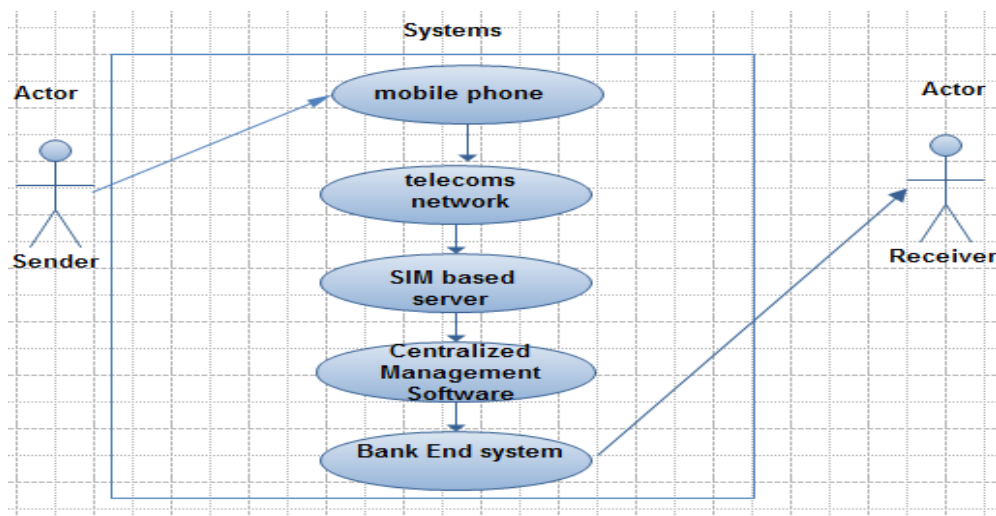

Figure 1. Use-Case diagram of the proposed system.

The network operator provides telecommunication services to customers over a geographical area. The network operators are important because they provide the access in which mobile phone can be used as a tool for m-banking. Based on this context, the network operators provide a gateway for SMS services. When the client initiate the process on his/her phone, the SMS will be sent through the network operator's network (e.g. MTN, GLO etc.). The network operators provide only the access link to the preferred SMS gateway. The contribution of the network operator based on the proposed solution, is that of availability- as long as their network service exist, the m-banking proposed system using this platform can be transacted with minimal or no issues.

There is an SMS gateway which is the recipient of SMS messages sent from the user through the network operator as shown in figure 2. It connects the network operator to

the SIM-based server. It also acts as the carrier of the user. This comprises of the SIM and the hosting server. SIM is an integrated circuit which securely stores the service subscriber key (IMSI) used to identify a subscriber on mobile telephony devices (such as mobile phones and computers).The SIM-based server can either be located at the SMS solution provider end or at the same location of the centralized software platform. The proposed system is to run on a dedicated SIM-based server because of the large number of transaction that will be handling and to avoid high message traffic. One of the greatest benefits of the SIM-based server is the 2-way SMS capability. Two-way Messaging platforms allow the system to send SMS, besides receiving SMS. It allows for complete flexibility in managing incoming messages. However, the SIM number will consist of 13 digits (e.g. +2348048238820) which will be compatible with any network operator in Nigeria.
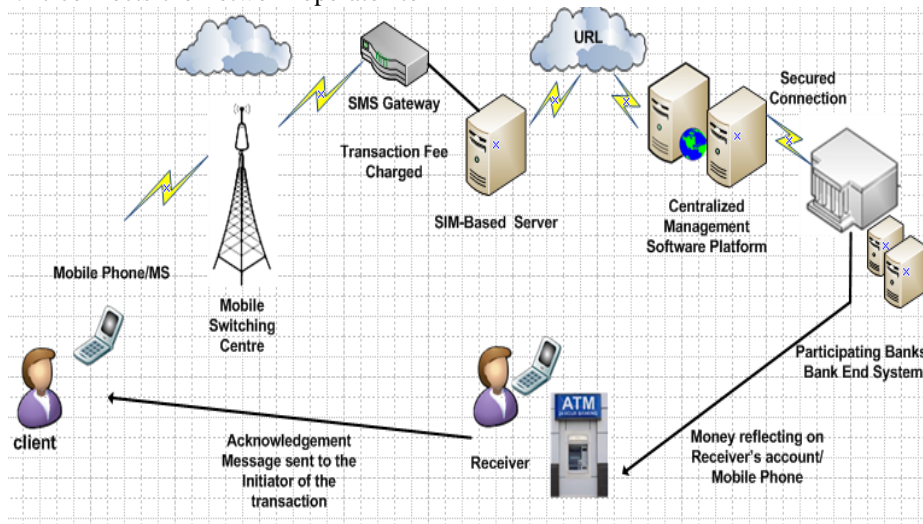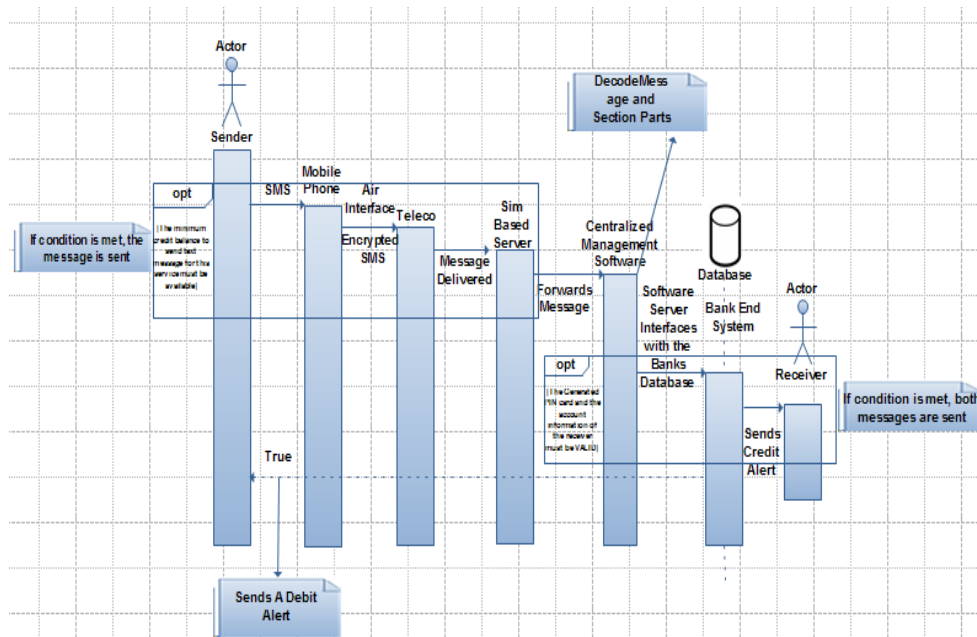

Figure 2: The Network Architecture

Figure 3. The Sequence Diagram of Proposed M-banking Solution System

As shown in figure 3, the centralized software is the heartbeat of the proposed solution. This platform runs on real time software. Real time software applications are popular today as they provide faster accomplishment of tasks, operations and activities on the computer. Real-time software enables the user to execute various tasks and activities all at the same time, as long as the programs are kept open. The performance of real-time programs depends on these two points: the correct development of the program itself, and the reliability of the system on which it operates. Taking a look at several services that will be running on this particular platform, the software must be designed in such a way that several programs can run on it. The functions of the Centralized Software are divided into the followings: decoding of messages, extract and process of message details, interface with Bank's Database, monitors all transactions and originate reply responses. The details of each function are:

a) **Decoding of Messages:** When SMS message is sent through the network operator (MSC), it arrives the SMS gateway in a text format. Hence for security reasons, the text that contains the account information and other parameters specified will be converted to binary from the text format which the system needs for further processing. The SMS gateway provider encodes the SMS received from the text format to the binary SMS format.

b) **Extract and Process Message Details:** When the message is decoded, the next line of action is to process the text received by categorizing the SMS received. The message received should be in this following format:

#131#M2B#Password#Generated_pin#Bank_Code#Acct_No#Acct_Name#Amount#

After decoding, the SMS will appear in the above format. Then, each particular field will be stored into the system's database. Meanwhile before having it stored, each field of the database will map a category of the text message. This is however necessary for easy computation of data and as such send such information which will have to interact with the bank's database. Thus, the interaction process performs the field checks in the database to verify if the account name and the account number of the received SMS tallies with the receiver's information in the banks' database.

c) **Interfaces with the Bank's Database:** The communication between the software and the bank will be possible using IP (internet protocol) instead of us having to access their database directly. This is necessary as information from the bank will be passed through a secured channel so that information between the two parties will be shared with less or negligible security breach. All Information (transaction details) will be routed through a secured connection (e.g. https) which gives a higher secured channel.

d) **Monitors and Stores all Transaction:** The centralized software also has a platform running on it that enables it track and monitors the state of each transaction. Since all transaction that takes place will have to go through the centralized system, it will also deem fit for it to retrieve information of every transaction. This will enable all clients in return has access to all transaction information despite various bank accounts. This is very necessary for future referencing, account auditing, statistics generation and other purposes.

e) **Rely Messages:** The Centralized Software handles response, creation and sending of messages on several instances:

- **Incomplete details**: If an item in the message sent by the user is incomplete a section is missing, the software sends the message automatically back to the user since it doesn't have the complete information to process the details.

- **Invalid Recharge (Generated) PIN**: In this case, the software replies the user if the recharge pin inserted in the message does not correspond to the one on the database of the recharge PIN generators. Also if the recharge PIN has been in use before then.

- **Delivery message**: When the recharge PIN and other account details of the recipient have been sent to the bank successfully, the software automatically sends a message to the user on a successful transaction.

A bank account is a financial account with a banking institution, recording the financial transactions between the customer and the bank and the resulting financial position of the customer with the bank. Bank accounts may have a positive, or debit balance, where the bank owes money to the customer; or a negative, or credit balance, where the customer owes the bank money[11]. Such bank details include information that will be supplied before transaction between the intended user and the receiver through the mobile phone. While sending the message, the following information is required:

- Account Name

- Account Number

- Bank of interest (Code Named)

- Currency

- Secured Password

The above information will be sent to the SIM-based server used by the solution provider.

5. SECURITY IMPERATIVES OF THE PROPOSED SYSTEM

In every system, there is the need for security features and mechanisms for proper operation of the system to avoid loss of information and money in transit. This security mechanism will help users who transact via this solution to entrust the system. Security mechanism for secured transaction is via the Password which will serve as the user's Personal Identification Number (PIN). The PIN will consist of both alpha numerical keys. For security concerns, the PIN will have 2 alphabets (between A- Z) and 2 numbers (ranging between 0-9) making a total of 4 digits. For this proposed system to attain some height of protection, it required some level of security and measures. Below are the security mechanisms in three different regions employed:

a) **First Generated Card - - - - -MS (Mobile Station):** The security feature present here is already in use and catered for by the mobile station designers, considering the fact that you buy a scratch card and follow the instruction provided to perform transactions on your phone, then the mobile station or bank account is credited. This security feature has a 95% success rate. This security here restricts the system from processing randomly inputted numbers to reload their MS or bank account. The digital numbers are achieved by some permutation and combination of mathematical theory.

b) **MS - - - - - SIM-Based Server:** This feature is also catered for by mobile device manufacturer. There is a need for the protection of message details by encryption; this mechanism is in use in the industry till date, whereby the users sends a message to SIM number without being hacked into it, stating the account information of the receiver.

c) **Third Software - - - - Bank:** This is the most delicate part in this system. The level of security here has to be at its maximum. This is where the money is protected to either change or send the money to the bank. The software's duty is to match the account information with the details the bank has and (the system) also has the information of the sender through the SIM registration with the facial recognition as a security measure.

5.1 Treat to the System

- Inputting random numbers to credit account.

- Human error: wrong data input that may slow down the process such as in section 4 (ii).

- Non availability of telecoms network will obstruct communication between devices and may hinder merchants from using this service.

5.2 Mobile Phone Requirements for the Proposed Solution

Mobile phones are increasingly being used for financial services in Nigeria. Banks are encouraging customers to conduct some banking services such as, account enquiry and funds transfer. Therefore, the following guidelines apply:

- Networks used for transmission of financial data must be demonstrated to meet the requirements specified for data confidentiality, integrity and non-repudiation.

- An audit trail of individual transactions must be kept [12].

6. IMPACTSOF M-BANKING TO THE SOCIETY

Productivity gains to individuals: Much has already been written and estimated about the productivity gains from use of mobile telephones. Productivity gains are on account of higher efficiency or more business/work to the users. The savings can be quantified in terms of time and money saved due to avoidance of travel, having a low cost of funds transfer and also gives room for convenience to users. Also transactions can be done on weekends.

Productivity gains to other businesses: Mobile phones enable faster and more efficient decision making, improved logistics, etc. They also double up as productivity tools like Sales Force Automation, **ERP** data input devices, etc. M-banking enables easy payment to workers, also for little transactions for small enterprises.

Productivity gains to banks: This system gives a better banking culture and service to users, bring money to their hands and covering last mile. It reduces the number of manual deposits and withdrawals making auditing less stressful.

Productivity gains to Telecoms Industry: Due to this system there is an increase in the use of the text message service bringing more profit to the telecom organization.

Inclusive financial services: The mobile phones outnumber the bank accounts by a large distance. Mobile phones can double up as bank accounts. Mobile technology has the potential to expand the reach of financial services to the poor. Branchless banking using mobile phones and a network of third-party agents (e.g. small retailers) can reduce the two biggest costs associated with providing financial services: building and maintaining a physical presence, and handling small

transactions. A new area of interest is micro-finance. Micro-finance using mobile phones can greatly reduce the cost of funds to a financial institution.

Remittance: Remittances play an important role in the development of a developing country. Mobile phones can play an important role in this market by making it quick, cheap and easy to transfer funds. Currently, sending funds through traditional money transfer operators such as Western Union and MoneyGram is expensive, with fees as high as $16 to send $100 [13]. Poor migrants send small amounts of money, so these fees are very regressive. In the Philippines, wireless providers like Smart Communications allow Filipinos working overseas to send money home in minutes with a text message for a fraction of the cost of money transfer operators.

Empowerment of the poor: Bringing easy and affordable access to telecommunications services to rural families, will increase access to education and health services, and provide a forum for interaction with government services. Governments across the world are likely to look at mobile industry to fulfil its basic responsibility.

Emergency situations: There is a more likelihood of an emergency situation in developing nation than developed country. The emergency response to infrastructure is also lacking in developing countries. The mobile phones cut down the time to mobilize response teams and also make payments without cash at hand.

Foreign Direct Investment (FDI): "The Relationship between Mobile Telecommunications Infrastructure and FDI in Africa study shows that the FDI tends to be higher in countries where the mobile penetration is higher" [13].

7. CONCLUSIONS

The advent of mobile phones in Nigeria has helped in boosting the economy and technological growth of the country thereby making it the most widely used electronic device. This proposed m-banking system will help to enhance the banking industry, making banking a user friendly and less stressful business. It is obvious that going to the bank to make little payments is inconveniencing and not worth the stress. This proposed m-banking solution brings banking to customers' doorstep, making it convenient and available everywhere they may be.

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