Push Pull Services Offering SMS Based m-Banking System in Context of Bangladesh

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Abstract *m-Banking technology has become one of the most familiar banking features throughout the world. Nowadays millions of inhabitants of Bangladesh are within a network through mobile network coverage. But in the commercial sectors like banking, m-Commerce technology has not been adopted broadly yet. In context of Bangladesh where almost 95% of geographical areas including Chittagong Hill tract region is under cellular coverage and having insufficiency in Internet infrastructure in remote regions, m-Banking via mobile phones can be the right choice for the promising banking sector. Considering m-Commerce and m-Banking perspective in Bangladesh, a Push Pull services offering SMS (Short Messaging Service) based m-Banking system has been proposed which is able to provide several essential banking services only by sending SMS to bank server from any remote location. This proposed system is divided into five major phases: Interfacing Module, SMS Technology Adoption Module, SMS Banking Registration Module, Push Pull m-Banking Services Generation Module, and Modified Data Failover Module. This push-pull services specified system facilitates bank customers by carrying out real time m-Banking utilities by categorizing services into five major on the basis of their homogeneity. They are Broadcast, Scheduling, Event, Enquiry and m-Commerce services. Fifteen push pull services underlying these categories are implemented in this proposed system which are most desired to customers. The proposed system not only brings banking transaction in hand's grip but also makes it easier, robust and flexible with highest security. Moreover, modified data failover algorithm handles unexpected SMS server failure with any congestion or service request loss. At last, after evaluating each module of our proposed system a satisfactory accuracy rate 94.95% has been obtained.*

1. Introduction

The physical world gradually becomes more and more integrated due to the vast development of information and communication technologies. Email and messaging have become part and parcel of today's daily life for communication. The ICT departments of different financial institutions are struggling to keep up with the demand for computing, rapid technology changes and the fundamental transformation of work [9]. As a result, E-Commerce brings the universal access of the Internet to the core business processes of buying and selling goods and other services [1]. Electronic Banking – the execution of financial services of a Bank via the Internet – is one of most appreciable examples of E-Commerce. Because it has changed the business of retail banks significantly, at the same time reducing costs and increasing convenience of customer [6]. Banks and other financial institutions are exploring the use of mobile commerce to allow their customers to not only access account information, but also make transactions, such as purchasing stocks, remitting money via mobile phones

and other mobile equipments. This service is often referred to as m-Banking .Since cellular networks has become an essential component of the economic and social infrastructure of the developed and developing countries, a new subset of electronic banking has created, mobile banking (m-Banking). m-Banking refers to that technology which covers account management via mobile devices [6].

Bangladesh is amongst the poorest countries in the world, with 50% of people living in poverty and a gross national income (GNI) per capita of $470. Despite of the difficult business environment, the mobile communications sector is growing rapidly and is cited as the fastest growing industry in Bangladesh. The mobile communications sector began in Bangladesh with the licensing of a single company, Pacific Bangladesh Telecom Ltd (PTBL) in 1991. In 1996, three national GSM (Global System for mobile communication) licenses were granted and this opened upon the mobile communications sector to a wider subscriber base [10]. Currently, six mobile network operators are currently licensed to operate in Bangladesh. Geographic coverage increased from 48% in December 2004 to over 85% in December 2007

including rural and Chittagong Hill Tract areas. In Bangladesh the numbers of GSM mobile subscribers 44.64 million at the end of January, 2009 while number was 36.42 million at the end of January 2008. So, mobile devices become prominent to every level of people of Bangladesh. [3]. And gradually people accept mobile not only their communication device but also an information transfer media which is highly necessary for their livelihood [2].The fall in prices of handsets, SIM and calling services, primarily due to reductions in handset import duties and the SIM activation tax alongside the impact of competition, has increased the affordability of mobile telephony and lead to the observed increase in penetration rates.

Among different services of mobile phones short Messaging Service (SMS) has become the most popular and cheapest service. It permits us sending message of alphanumeric characters between mobile phones. Considering these issues, SMS technique can be integrated in Bangladesh banking sector. It is the nature of human being to get services within short time. In our country, several private banks such as Dutch –Bangla Ltd, Brac Bank Ltd and STB have introduced the facilities of online banking, phone banking and at last SMS banking with too limited services. But our national banks such as Sonali Bank, Janata Bank, Agrani Banks and other specialized financial institutions like Krishi Bank do not provide such facilities. A huge amount of our country people are the clients of these banks.

In this paper, a m-Banking system has been proposed depending on the current extent of today's banking transactions of Bangladeshi banks. To make our proposed m-Banking system more enriched, robust and secure, PUSH and PULL nature of SMS has been adopted. Through this proposed SMS based m-Banking system, a bank customer can be authorized to carry out any financial transaction from remote place only sending PULL service SMS or receiving PUSH service SMS. It saves not only customers time and energy but also gives a mental satisfaction by providing updates of his/her account related information. The key challenges of m-Banking are security, usability and data failover [6] which are handled more efficiently without any severe system congestion, performance and throughput loss.

2. Related Works and Motivation

The field of m-Banking is not very old. According to the sweeping enthusiasm that characterized much of the news reporting in the years 1999 and 2000 mobile banking should by now have been firmly established as the most important distribution and communication channel for Retail Banking [6]. Dukic and Katic developed such a m-order payment model via SMS for the Republic of Croatia, which give emphasis for increasing security of the user requested information

by Steganography method [4]. The developing countries like Iran have welcomed m-Banking. Shirali et al. has developed a system which is capable to be connected to Bank server from mobile through Bluetooth and offered banking services. This developed system, only works within the bank area, not from any remote locations [7].

In Bangladesh e-commerce and m-Commerce related research works are not so rigorous and also limited. In 2004, Siddique et. al. in their paper proposed a highly secured countrywide e-commerce infrastructure, where e-buyers can use various prepaid cards (Mobile and Internet prepaid cards, various debit cards like ready cash) to purchase products from Sellers website [8]. But unfortunately major percentage of population of Bangladesh have lack in Internet skills, access to PC and on top of all these, lack in sufficient Internet Infrastructure. So this paper proposed system not become so fruitful. After one year, Mahfuz and Shusmita identified an alternative and a prospect of using SMS (Short messaging Service) technology as an effective tool in business sector of Bangladesh. The development, acceptability and implications of SMS technology in B2C (Business to Customer Commerce) also focused on that paper [2]. But no specified technological implementation found their proposal. In the same year, A. Azim et al. analyzed the existing systems from the aspect of developing countries, focused on their limitations and presented alternative frame works for e-commerce and electronic payments, which may be convincingly suitable for the third world countries [1].

Since in Bangladesh, researchers already identify that SMS can be easiest and usable m-Banking tool, but yet no remarkable and standard SMS banking service infrastructure has been developed or standardized for the nationalized, private and other financial institutes of Bangladesh. In 2008, Jamil and Mousumi took an attempt to develop a convenient and hassle free SMS based mobile banking system in context of banking infrastructure of Bangladesh [5]. The main theme of this first proposed system is to adopt the short messaging service technology for the banking financial and non-financial transactions [5]. Since that was an initial attempt, the number of service and facilities was limited which are overcome in this paper. And the PUSH-PULL SMS methodology is introduced to carry out banking transaction requests by customers.

The main aim and objective of our proposed enhance version of SMS based m-Banking system, is to create an extraordinary opportunity for new mode of our Banking facility using Mobile devices .Our proposed SMS banking solutions offer customers a remarkable range of functionality classified by PUSH and PULL services which are further sub classified into broadcast, scheduling, event, enquiry and m-

Commerce services encountering their homogenous nature of utility. SimensC-35, SamSungE250 and Wave COM mobile devices has been used as server modem of our proposed system.

3. The Proposed SMS Based m-Banking System

Our proposed PUSH-PULL service offering SMS based m-Banking provides a new 24 hour banking convenience which helps customers stay on top of any recent changes made in their bank account, DPS or loan through their cell phone. According to our current Banking infrastructure, it is observed that both of National and Private Banks provide much and more same financial services. In our proposed system, at first m-Banking services are categorized as PUSH and PULL services encountering message type. And another categorization has been done by grouping homogenous nature of utility. Services are divided into five categories in accordance with their homogenous utility. They are: Broadcast, Schedule, Events, Enquiry and m-Commerce.

PUSH messages are those that the bank chooses to send out to a customer's mobile phone, without the customer initiating a request for the information. For example, when a bank opens a new brach or any change in current policy making,then a PUSH message will be broadcasted on their registered clients'mobiles. PULL messages are those that are initiated by the customer, using a mobile phone, for execution order of transactions of bank accounts. Examples of PULL messages, for information include an account balance enquiry, or request for transfering balance among authorized accounts only sending SMS. In our proposed system when a customer sends a SMS of PULL service request to bank, the bank server acquires the SMS through modem. Then the SMS server truncates necessary information from SMS and provides corresponding services to customer by retrieving and updating customer accounts related database. In this system, proper tracks have been kept to face any type of SMS server problem due to unwanted failure or unusual behavior of system control software. The proposed system is divided into five major modules are as follows:1) Interfacing Module 2) SMS Technology Adoption Module 3) SMS Banking Registration Module 4) PUSH PULL m-Banking Services Generation Module and 5) Modified Data Failover Module. Some well defined sequential methods are applied in these modules. The schematic view of the architecture of our proposed system is depicted figure1.

3.1. Interfacing Module

In this module, an interfacing technique between bank server PC and server mobile has been developed for our proposed system. At first GSM modem has been interfaced with Bank server PC by Bluetooth or RS-232C cable using COM or serial port. The NokiaN70,
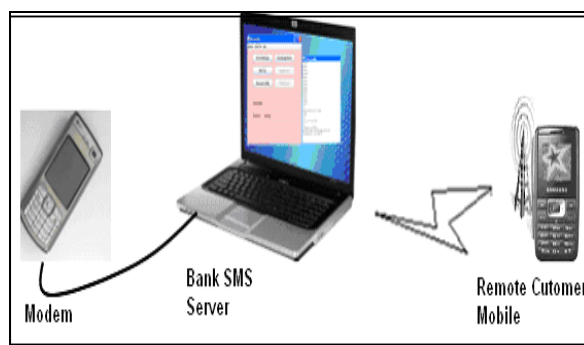

Figure 1. The schematic view of our proposed SMS based m-Banking system

3.2. SMS Technology Adoption Module

Short Messaging Service (SMS) is a communication protocol allowing the interchange of short text messages between mobile telephone devices. Most SMS messages are mobile-to-mobile text messages, though the standard supports other types of broadcast messaging as well [11].The SMS is a store and forward service. In other words, short messages are not sent directly from sender to recipient, but via an SMS center. Each mobile telephone network that supports SMS has one or more messaging centers to handle and manage the short messages [12]. This module describes the process of communicating with the GSM modem which is the most important provider of our SMS service. This process of communication has been done through a number of attention commands (AT). This AT commands makes our bank server modem to be able to send and receive SMS from customers mobile and vice-versa. Table 1 indicates several common AT commands which are used in this proposed system.

Table 1. List of several AT commands

Commands	Description
AT+CMGS	Send SMS Messages
AT+CMSS	Send SMS Message from storage
AT+CMGL	List SMS Messages
AT+CMRR	Read SMS Messages

To check the connection between Bank server computer and GSM modem, hyper terminal is opened and AT commands are sent. If the modem replies with OK then it is the successful communication establishment between modem and bank server. The SMS specification has defined two modes in which a GSM (Global System for Mobile Communication) or GPRS (General Packet Radio Service)modem or mobile phone can operate. They are called SMS text mode and SMS PDU (Protocol Data Unit) .Usually

string values are defined for text mode while numeric values are defined for PDU mode. We used PDU mode for sending and receiving SMS because it supports more features than text mode. PDU includes detailed Meta information with the raw SMS like actual SMSC (Short Message Service Center) number, time stamp, and length of the actual message in hexadecimal octets or decimal semi octets. This PDU format is secured for encoding. And from its octet sequencing, the encoded

data structure can decoded easily. In figure 2, a PDU format of a received message of server modem SimensC-35 is illustrated with a denotation of each octet. For sending and receiving SMS between bank and customer's mobile, software is designed using XML (Extensible Markup Language) and J2EE. The system is developed in Linux platform. In figure 4, the interface of successful running condition SMS server has been shown.
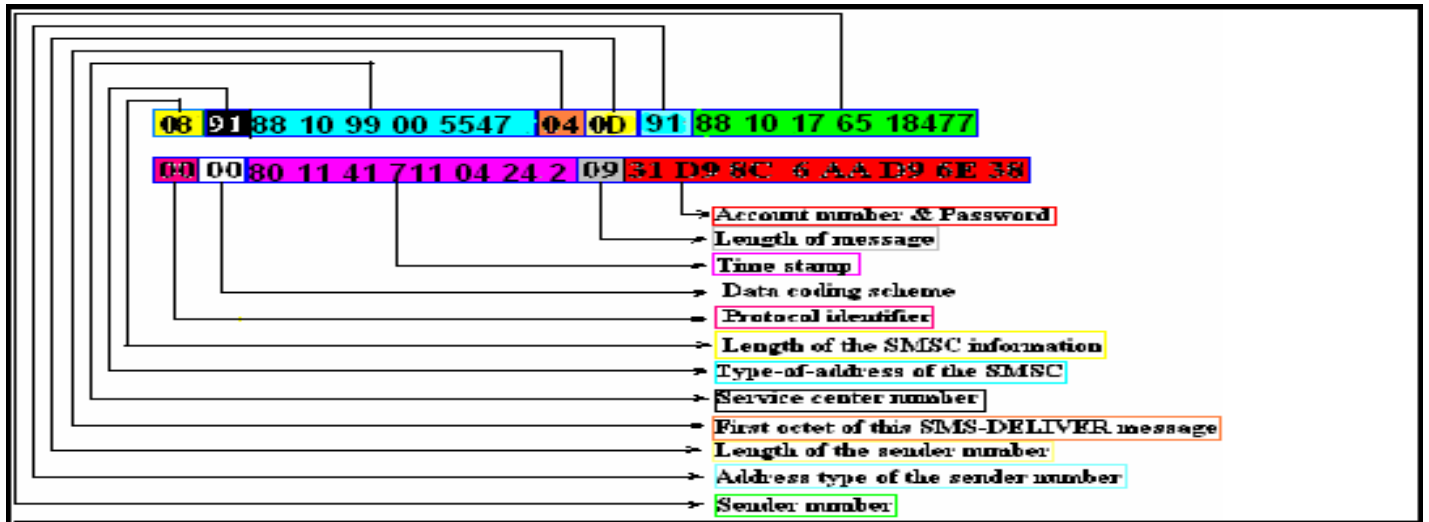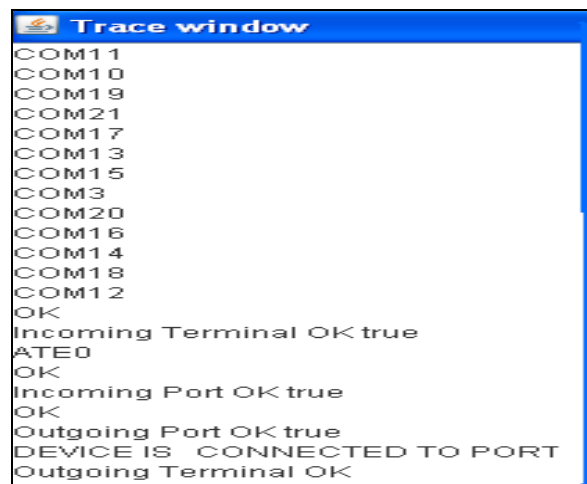

Figure 2.   A PDU format of received SMS on SimensC-35 server modem

Figure 3. HEX to ASCII conversion for decoding and separating account no. and password.

(a) SMS Server activation

(b) Tracing window during modem connection establishment

Figure 4. The interface of Bank Server Software.

3.3. SMS Banking Registration Module

To activate the SMS based m-Banking system and getting its facilities, the customers have to be registered according to our proposed model. Due to increase of mobile crime, to ensure a secure SMS based m-Banking system, the customer must be :
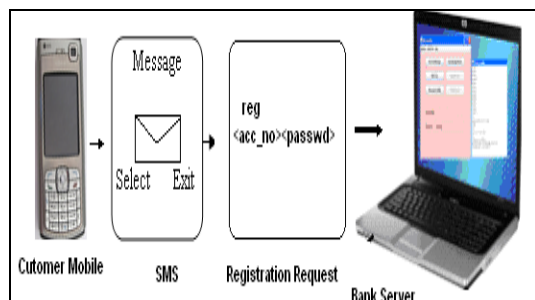

Figure 5. The SMS Request for registration from Remote Customer's Mobile

Through the server modem after receiving customer's SMS, the required information for registration procedure is truncated. Then the encoded information of customer's mobile number, registration request command (reg) with provided account no. and password are decoded.

In decoding Process, the customer (sender) mobile no. is decoded first and store in bank's database. Since during the sending SMS, the sender number is encoded by swapping so original sender number is retrieved by re-swapping like as shown in figure 6. Then from the SMS, the registration request textual syntax part is decoded and segments are separated by using conversion of HEX (Hexadecimal) to ASCII (American Standard Code for Information Interchange) value method. Here the decoding and separation of user provided account number and password data are shown below in figure 3. For the validity of the decoded actual account number, a checking procedure is done on the database of bank which is developed in MYSQL .If the customer account is valid, then bank server broadcast a positive acknowledgement to customer's mobile.

3.4. PUSH and PULL m-Banking Services Generation Module

In this proposed service generation module first of all, m-Banking utilities are specified either as PUSH or PULL depending on SMS intiating type between bank and customers. Then PUSH and PULL services are subcategorized as their homogenous utility. In XML, service tables are generated to implement PUSH and PULL category m-Banking services along with five subcategories: Broadcast, Scheduling, Event, Enquiry and M-Commerce. These tables are generated to synchronize which help to maintain newly developed more and more new real time m-Banking

registered. For this, at first the bank server broadcasts SMS giving a notification of their SMS based m-Banking service. When a customer wants to register for this service, he/she has to send SMS with a specified syntax to bank with account number and password as shown in figure 5.
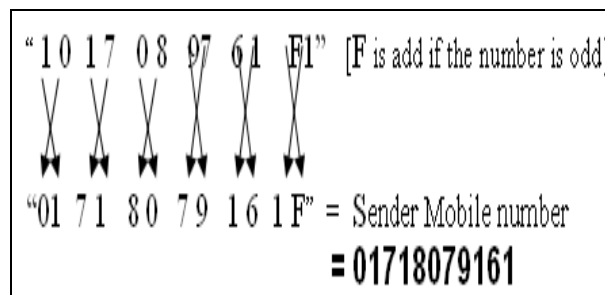

Figure 6. Retrieving original Sender number by Re-swapping

services in according to banking infrastructure of Bangladesh.

3.4.1. PUSH Services Generation

PUSH provides a stanadrd means to send data to a mobile subscriber without an explicit request from the subscriber at the time data is delivered. This service generation submodule composed of three category of m-Banking services: Broadcast, Sceduling and Event category.

The proposed **Broadcast** category of services allows the bank authority to send PUSH SMS with updated information to all of the account holders who are already registered for SMS banking. Three services are implemented under this category: Change in interest rate, Any Change in Bank Policy and Opening a new branch. If any update in bank current interest rate or policy or opening a new branch of their bank, they broadcast this updating news through SMS.

Under **Scheduling** category, three PUSH services are adopted: Monthly delivery of Account Balance, Monthly DPS (Deposit Protection Service) payment Alert and DPS Maturity Alert. Through **Scheduling Service** bank can send messages to its customers on basis of a pre-defined schedule. For affiliating customers these scheduling services, an algorithm is developed which keeps the track of time count with service track and gives alerts on the basis of pre-scheduled date. Without any customer query SMS, throughout these PUSH services, Bank authority send automatically awaking SMS to m-Banking customers. DPS payment service gives alert to the deposit account holder before one week of his/her deposit amount payment deadline .Similarly when DPS is matured also send SMS to DPS holder. The information of SMS is collected by an auto-search of account no and authorized accountholder registered mobile-phone

number in their developed banking database which in MYSQL.

Event based PUSH service generation is too effective for customers. In **Event Service** a PUSH message is sent automatically to the consumer when a certain event happens defined by the bank or it can be by the consumer also. Three event services are generated in this module: Balance below a limit, Cheaque bounce and high value Transaction Notification. Balance below a limit- service notifies customer by sending SMS that his/her account balance exceeds a certain limit. The next service let consumer know by SMS if cheaque is bounced .The last service alerts customer about large amount of cash withdrawal or balance transfer or deposit on his /her account. This service helps to avoid any kind of financial damage which can be occurred in absence of account holder. In case of event service sub table generation special alert status with flag is set and saved in MYSQL database. As a result, if any type of damage occurred in any customer's account by this flag warning it could be easily detected from general case and enhance accuracy.

Algorithm 1: For sending A PUSH service SMS from banking Server
sendmessage(ph,msg)
1. len = get the msg length
2. p_len = get the ph length
3. check for existence of 'F' in ph
4. if exist
5. p_len = p_len-1
6. len = length of msg*2+2
7. msg_len = get binary of len
8. c=27
9. msg = "001100"+get hex of ph_len+num_type+ph+"00"+TP_DCS+TP_VP +get
    hex of msg_len+get PDUformat of msg+c;
10. send the AT command AT+CMGS= and the value of expression
    "((msg.length()/2)-8) +"\r""to the serial port.
11. Wait for the port response
12. send the value of msg to the serial port.
13. Wait for the port response
14. if the response of port ends with 'K'
15.   then show info "MESSAGE SENT SUCCESSFULLY".
16. else
17.   then show info "Massage send failed";

Data from database are converted into sending a pre-specified PDU format. For sending PUSH service SMS to account holders, AT+CMGS is used which prenotifies the mobile phone that a PDU will be sent containing 19 bytes of data. For sending the PUSH service SMS , the algothithm of 1 is developed.

3.4.2. PULL Services Generation

PULL technique provides the required services in reply of customers' service orders. In our proposed system this sub module composed of two type's m-Banking service: Enquiry and M-Commerce service.

Enquiry Service provides interactivity to the customer, who can through SMS make an enquiry and get the answers in real time. Two enquiry services are generated: Balance Enquiry, Mini statement and Loan status.

In case of Balance Enquiry and mini statement request service, when a customer sends a SMS for checking current account balance, the bank server modem replies through SMS with balance information. But before replying to customers, the authentication procedure is performed by matching his/her registered mobile number, account no and password. Similarly for two other enquiry services, the similar procedure is followed and syntaxes of enquiry services SMS is shown below in Table 2:

Table 2. Syntax of SMS of Pull Categorized Enquiry type service request

Service Name	SMS Syntax
Balance Enquiry	<acc_ no> <password> Example: 1234 5678
Mini statement	<M> <acc_no> <password> Example: STM 1100 8854
Loan status	<L> <acc_ no> <password> Example: L 5551 1111

With M-Commerce various commercial transactions can be done using SMS technology which will facilitate the features of SMS Banking. This category PULL services composed of three services: Balance transfer between authenticated account holders, monthly DPS installment payment and Bill Payment.

The first m-Commerce PULL service of our proposed system is to balance transfer only between pre-authenticated account numbers of the same bank that are specified by the registered SMS banking facility adopted account holder. When account holder sends request to transfer balance, at first authentication of customer procedure has been done automatically by extracting related information from customer SMS and matching with bank's central database. Then after authentication of customer, it is also checked in customer's account information table in the MYSQL database that either that customer has enough balance to transfer money without exceeding the lowest balance limit. If the amount of balance is sufficient for transferring to another authenticated account, then the action of balance transfer has been taken. And then adjustment of updated balance is done and positive acknowledgement SMS has sent to account holders with current financial statement.

The monthly installment of DPS payment and Bill payment are two another most customer desired PULL services. Because most of the time due to different

personal working load, bank customers have less time to physically attend for paying DPS installment or electricity bill or postpaid mobile bill payment on scheduled time. By these services, without any hassle, customers get chance to pay bill or DPS premium quickly only sending PULL SMS instead of waiting in a long line.

Before paying bills or DPS premium on the basis of customer PULL service specified request, the status of current balance of the customer have been checked in parallel with registered mobile number. The syntax of these three PULL type service SMS is shown in below table 3:

Table 3. Syntax of SMS of Pull Categorized m-Commerce type service request

Service Name	SMS Syntax
Bill Payment (Electricity or Mobile)	<PM> <acc_no><amount> <PE> <acc_no> <amount>
DPS Installment Payment	<DP> <acc_no> <amount>
Balance transfer in an authenticated account of same bank	<BT><account_no><password> <receiver_account> <amount>

3.5. Modified Data Failover Module

Electricity failure is one of most common scenario of Bangladesh which lefts a lots of obstacles in our IT sector. Since m-baking facility such a one from which customer expects 24 hour service without any inconvenience, so data failure due to server failure must be handled properly. In the first version of Jamil and Mousumi's proposed system, the data failover module was a new inclusion of our proposed SMS based m-Banking system [5]. In this enhanced and more realistic proposed SMS based m-Banking system, we modified the data failover algorithm for overcoming the data failure with keeping track of avoiding any type of service request congestion. According to this algorithm if server fails on the halfway of a SMS request processing, at first server stores that message with a not processed Boolean flag like NO with time and date. Until the again restart of SMS server, all SMS those which are received by modem after that half unprocessed are considered as unprocessed service Request and denoted as 'NO' flag. Then another integer type flag counts the total number unprocessed SMS. If the total number SMS in stack is less than 100, then the unprocessed SMS request is processed one by another and reply is sent to the customer. But if the number is greater than 100, a Push SMS server until processed those unprocessed SMS service request, SMS server do not receive new SMS for little time to avoid any fatal congestion of PULL service request.

4. Experimental Results and Analysis

To measure the accuracy of our proposed SMS based m-Banking system, each module is tested individually with a set of real time 500 SMS data using the following equations: Success Rate = (Total no of Success/ Total no of sample input)*100) %.Failure Rate = (100 – Success Rate) % and Accuracy Rate = (100 – Failure Rate) %. The accuracy of the interfacing module is tested in case of both wireless and guided media. The success this module is 92.25% and failure rate is 7.75% shown in table 4 And from analyzing the output it has been found that, the SMS delivery and receive is independent of interfacing media. Similarly measured each module success or failure rate is depicted in Table 7.The overall system accuracy rate is obtained 94.95%. The module wise success rate and failure rate is portrayed by a bar chart which shown in figure 7 From this figure it is observed that among the success rate of each individual module a linearity has maintained. The success rates of SMS technology adoption module, Push Pull m-Banking services generation module and modified data failover module have improved than that of first version of Jamil and Mousumi's first developed system as described in [5].

5. Benefits of Proposed SMS based m-Banking System in Context of Bangladesh

Our proposed m-Banking system opens a new door of benefits for banking customers.

- It saves valuable time in this machine age where time is more care than money. In Bangladesh, horrible traffic jam is a common scenario. By our proposed system m-Banking customers will get better customer service and satisfaction at the just a press of button on mobile wherever he / she might be.
- Another benefit of our proposed system is multitasking opportunity. For example if the customer goes to the bank physically he or she would have to be engrossed and give time to one task, banking transaction. But in this case, while doing important official tasks if needed, the businessman can request for executing financial transaction over SMS.
- SMS is the most easiest and familiar application in mobile set. So customers need not know any extra knowledge of how to access this m-Banking infrastructure. In case of online banking, not only additional knowledge but also extra cost of computer, modem and internet service has to be encountered. In case of our developed m-Banking system the only cost for an existing mobile user, would be max 2.15Taka (including VAT).Requirement here is very simple just a mobile set with connectivity. Compared to online banking costs 29212.15 Taka (Personal Computer + Modem +Internet cost per minute =25,000 Taka + 4200 Tk.+0.50Tk*10 min), SMS banking costs less. In

case of SMS banking , the solution is of 2500Tk mobile set+300Tk /450Tk/800Tk SIM +50TK recharge card+2.15 TK SMS cost = 2852.15/3002.15/3352.15 TK. Compared to online banking cost of 25005Tk it will just cost customers just 2852.15 TK for the setup, which are undoubtedly a benefit and a better satisfaction.

- Our proposed system can process Push and Pull service request at maximum 25 second. That means within I hour, 144 banking transactions can be done (3600 seconds/25seconds=no. tasks one hours that would be executed). That is faster than manual banking.

Table 4 .Experimental results of interfacing module

Server Modem Name	Interfacing Media (Between Server PC and Modem)	No. of SMS Delivery and Reception	No. Successfully Delivered and Received	Success Rate	Failure Rate
Nokia N70	RS232C Bluetooth	50 50	47 47	94%	6%
Siemens C35	RS232C	30	28	93.33%	6.67%
Wavecom	RS232C Bluetooth	40 40	34 34	85%	15%
SamSungE250	RS232C Bluetooth	30 30	29 29	96.67%	3.33%
Average				92.25%	7.75%

Table 5. Experimental results of SMS banking registration module

No. Sample SMS Received by Modem	No. of SMS Text which are Successfully Decoded and Separated	No. of Successfully Storing Account no and Password in Database	No. of successful Customer Registration by SMS	Success Rate	Failure Rate
30	29	29	29	96.67%	3.33%
20	19	19	19	95.00%	5%
25	24	24	24	96%	4%
Average				95.89%	4.11%

Table 6. Experimental results of PUSH –PULL m-Banking services generation module

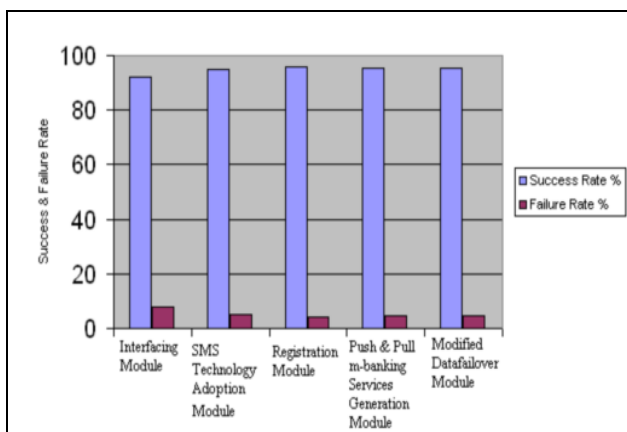| Service Type	m-Banking Service Category based on homogeneity	No of SMS Delivery from Bank Server	No. of Received SMS with service request and send to Customer Mobile	No. of Successfully Delivered SMS	No. Successfully Delivered and Received SMS	Success Rate	Failure Rate
PUSH	Broadcast Services	100	-	97	-	97.00%	3.00%
	Scheduling Services	90	-	86	-	95.56%	4.44%
	Event Services	95	-	90	-	94.73%	5.27%
PULL	Enquiry	-	60	-	59	98.33%	1.67%
	M-Commerce	-	50	-	48	96%	4.00%
Average						96.32%	3.68%

Figure 7. The Module wise success and failure Rate of push- pull service offering SMS based m-Banking system

Table 7. Result of overall SMS based m-Banking system success and failure rate.

Modules	Success Rate	Failure Rate
Interfacing Module	92.25%	7.75%
SMS Technology Adoption	94.76%	5.24%
SMS Banking Registration Module	95.89%	4.11%
Push –Pull m-Banking Services Generation Module	96.32%	3.68%
Modified Data Failover Module	95.55%	4.45%
Average	94.95%	5.05%

6. Conclusion

In today's busy environment, with so many deadlines to fulfill, appointments to keep and meetings, customers of a bank have little time to visit a branch or to wait for customer services operator to come on phone line. m-Banking is a provision and availment of banking and financial services with the help of mobile communication devices. In context of bangladesh, introduce of m-Banking in our national and private banking sector can be more promising and beneficial one. SMS based m-Banking is a technology-enabled service offering from banks to its customers, permitting them to operate selected banking services over their mobile phones using SMS messaging that's cost is low enough. In this paper, a newly proposed cost effective push pull services officering SMS based mobile banking concept has been illustrated for 24 hours banking convenience which helps customers stay on top of any recent changes made in their current or deposit account or loan through SMS. One of most attractive features of our proposed banking system is push pull methodology which is not only fast service provider but also of low cost, secure and easier to handle for bank authority and customers. The sub classified broadcast, scheduling and event category push services provides customers all time update of their current and deposit accounts along with any major change in banking policy and status without customers' request. By the pull services, customers can pay deposit premium, electricity or mobile bill on due date by sending SMS in a pre-defined format from remote. In our proposed system, services are implemented and synchronized in a service table with help of XML such a technique that if new services need to be added, it can be added efficiently by determining which group it satisfy , without any interruption of other services. Through our proposed system, customers would not face problems due to server failure while the server was in processing with customers SMS. Because if bank server become out of order due to some accidental causes , a track of data failure has been kept to handle this situation without any congestion in SMS server. In future we have a plan to convert our system into a decision support which would be able to make actions against unexpected and unauthorized financial transactions.

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