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MOBILE DIGITAL CASH PAYMENT FOR MOBILE PHONE USERS

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Abstract

As mobile communications become increasingly sophisticated and ubiquitous, the use of portable devices aims to exploit the increasing processing power of these consumer devices. This paper proposes a new computing model that tries to provide user mobility service to all applications through a system-level solution. It present the design and implementation of a model for mobile computing called Web-based Mobile Computing (Mobile Digital Payment System). The central idea behind this model is to use web languages to describe a user? personal computing environment and extend the web browser to use this document to support user mobility. This model enables users to access user-defined computing environment from anywhere, at anytime and with any kind of Internet-connected computers. Mobile Digital Payment System is proposed to be a general solution to the current challenges in higher-layer mobile computing. In Nigeria, we presently do not have a technology in which one can make payments from one account to another within a financial institution (bank) via the mobile phone, as an important side-benefit, Mobile Digital Payment System provides a generalized approach to customizable human computer interface design and generic application operating system interaction. While Mobile Digital Payment System described in this paper along with the prototype demonstrated its feasibility and usability, it is only a starting point. Future research should be carried out to make this technology commercialized to meet user? needs.

1. Introduction

Mobile payment system can be defined as "A group of related components, which work together to carry out payments, that are carried out via a mobile device." The introduction of m-commerce offers the possibility to pay for goods and services anywhere and anytime [1]. As users get connected with smart phones and Personal Digital Assistants (PDAs), they use these devices to pay for various transactions. The spread of hand-held devices, new generation of programmable cellular phones and the availability of development environments for such devices have made possible the design and development of new kind of software that satisfies the users?needs about mobility support and personal information management. With the advancement of network technology these past years, the ability to connect different networks across different platforms has become a complex task [2]. There have been many proposed solutions, some of it are J2SE?and J2EE? the J2ME?platform which are Sun Microsystems technologies that provides a solution to bridge the communication gap between a PC and a mobile phone, technologies that directly transfers information without need for format conversion; J2ME is a technology for mobile devices [1].

A mobile payment system is typically built of several technologies with all their different possibilities and limitations. There are many different technologies available and new technologies arrive continuously. J2ME?is a new technology that has recently been introduced at the wireless market and many believe that J2ME?will improve the diffusion of m-commerce [4].

As mentioned above, m-payment is one of the fundamental issues for m-commerce why this paper seeks to answers the following question:

"To what extent is J2ME?suitable for the client technology in a successful mobile payment system?" To answer that question, the paper will initially describe the market, technologies and fundamental aspects of mobile payment systems.

Furthermore the paper will describe a set of critical success factors (CSFs) and example of requirements. The CSFs shall outline the requirements from the market and describe the challenges of providing a successful mobile payment system. On that basis the paper will analyze the J2ME?technology as a building block of a mobile payment system. Comparisons to existing systems and technologies are made during the analysis and the strengths and weaknesses of J2ME?are described.

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The expected conclusion will be an evaluation of the J2ME?as a building block of a mobile payment system, by describing a set of statements of what eventually needs to be done, to introduce successful m-payment systems with J2ME[1].

2. MATERIALS AND METHODS

Project Description

This paper provides users of J2ME, J2SE, J2EE enable applications the ability to make transactions from one account to another within a financial institution via the mobile phone. Future designs will be able to make payment from one account to another within two different financial institutions, but for our purposes, transfer of funds within a financial institution is enough.

Architectural Design

Description of Components

The mobile digital cash payment has three key components with which to build upon and these include the following:

? The mobile phone: this facet serves as the client; it is the medium in which transactions are been perform. J2ME (Java Micro Edition) is the edition / technology of java that is used in this facet to ensure full support of user mobility. When a customer goes to a particular supermarket and makes a purchase, instead of carrying cash about, the customer simply uses his/her phone (in which the Mobile Digital Payment application has been enabled) and simply collects the account number of the supermarket and makes payment via the enabled phone.

? The Central Database System: this is the second facet of this application and it acts as a crosslink for the other two facets of this application. The Database is necessary in this application since we will be dealing with records of various customers, transactions, accounts etc. and database serves as an efficient and effective way to keep and store records. We have various database systems in use today; we have Oracle, MySQL, MSSQL (which is windows based), JDB and so on. Oracle is the most compatible with java but it is meant for companies running large scale on line enterprise application and requires not less than 5g of RAM. Oracle is not used in this thesis because of memory consumption thus making it expensive. MySQL is used in this thesis as the database system because it economizes resources and easy to use. Besides, it contains all the things Oracle has.

? The Web Application Server: this facet serves as the server. When a customer sends a request (e.g. to pay N5000 for a particular good into a particular account via a phone), the client (the phone sends the request to the Web application server).The Web application automatically checks the database to confirm the authenticity of both accounts and the authenticity of availability of funds in the account to be transferred from and automatically sends a respond either positive or negative to the client (phone). J2EE (Java Enterprise Edition) is the

edition/technology of java that is used in this facet to ensure full support of user mobility via the web.
Netbeans IDE 6.0 is the platform in which the three facets of this application are interlinked and run.
Setting up of the Environment
The Figure below shows the operating environment for a mobile phone capable of the Mobile Digital Payment Application communication. The system is split into two different worlds, the mobile- and the contact-less world. The mobile world represents the cellular phone and the GSM network. The contact-less world depicts networked infrastructure and contactless reader capabilities.
Figure 1: The operating environment for an NFC enabled Nokia mobile phone.
The figure is a high-level conceptual view of the involved entities and it is important to understand their functionality in order to identify with problem of this master thesis. The operating environment consists of the following elements [7]:
Antenna: The antenna of a contact-less reader. It generates a RF-field in order to read data from the NFC enabled phone.
RFID Reader: The software that requests data from the mobile phone and processes it. Transport / Payment System: These are the back-end systems that offer payments, connectivity between end-system devices, PSTN etc.
Internet: Represents the Internet and the service offerings it provides.
The mobile phone as a contact-less ticket
GSM: Represents the GSM network and the capabilities provided by GSM.
The network can be operated by any network operator. The arrow to the mobile phone represents the capability of interchanging SMS, and the arrow to the Internet represents the connectivity between GSM networks and content providers operating over the Internet.
Mobile Phone: Represents a mobile phone providing regular GSM services and NFC capabilities. Nokia SDK: A software development kit for custom development of Java MIDlets. It also offers the ability to interact with the smartMX chip.
J2ME: The Java environment on the mobile phone. Its virtual machine offers a runtime environment that executes Java MIDlets.
OS: The operating system of the mobile phone. The operating system receives SMS and will start the addressed MIDlet.
NFC: The contact-less communication scheme of the NFC standard. It can either operate as a reader or as a contact-less smartcard.
Java Card: The Java environment on the smartcard included in the payment and ticketing shell. It holds a java card applet which is responsible for internal reads and writes to the MIFARE memory. MIFARE: A smartcard with hardware coprocessors offering secure memory storage. Antenna: The antenna on the mobile

phone generating and sensing RF-fields in the case of contact-less communication.
The link between the Internet and the J2ME entity depicts the ability of the Java environment to handle SMS from the GSM network. This ability is important because a Java MIDlet is started when a SMS is received destined to it. It will then extract and process the data the SMS contains. The blue line represents a domain boundary between the mobile world and the contact-less world. The link labeled CPA between the mobile world and the contact-less world represents a gateway enabling content providers to deliver content to mobile network subscribers and at the same time bill the subscribers for using the service. The contact-less link between the two antennas represents the new possibility of communication between the two domains using NFC [5].
The system shows the involved entities when a mobile phone is used as a device for contact-less payment and ticketing. The following steps are involved in a typical ticketing transaction: ? An order is placed and sent to the payment/banking system
? The Mobile Digital Payment application is sent to the mobile phone.
? The user receives the application and installs it on his/her phone.
? The enabled phone is then used via the application installed on it to make transactions.
Procurement and Deployment of Related Software
All of the needed software for development is easily obtainable throughout the Internet. There are mainly three items to download and install unto the system. Of course, it is understood that the system of development is a Windows XP system running on Intel Centrino technology ? J2SE J2ME
The base developmental platform, J2SE can be obtained from Sunfs Java website, http://java.sun.com. The additional APIs for J2ME can also be downloaded from the same website. Programmers knowledgeable of Java can easily install these two development kits. It is recommended that all these are installed in a directory with no spaces. Development of the thesis used Java 2 SE 1.6 and Java Wireless Toolkit 2.5.2. Development in the toolkit is unique, as one can only create folders within the $\backslash WTK22\backslash appsdirectory, asj2merequiresspecificfoldersandfilesthatareautomaticallygenera$
$?NetbeansTheNetbeansIDE6.0wasusedinthedevelopmentofthisthesisanditistheplatforminwhichtheth$
$?MySQLTheDatabaseisnecessaryinthisapplicationsincewewillbedealingwithrecordsofvariouscustome$

3. SYSTEM DEVELOPMENT

The Graphical User Interface
There are so many phones (such as Nokia) that can be used for this application but I used Sony Ericsson K800i since it is currently the phone I am using. A user will be equipped with a Sony Ericsson K800i mobile phone with payment and ticketing shell. A user will download and install a MIDlet which can save

accounts, check balance and make transactions. The application is sent to the phone when a user goes to his/her bank which is then installed on the phone. When the user enters the Mobile Digital Payment application environment on the phone, the user first sees the splash screen, after which, the user? username and password is required. The interface is shown below:
Figure 2: Screenshot of the prototype of the mobile payment MIDlet.
After checking your balance, to make transaction, from the screen above, you click the back button and it takes you back to the check balance / make transaction screen (Fig.3), then this time instead of clicking the check balance option, you click the check balance. Once you click the ?heck balance?option, it gives you the following screen:
Figure 3: Screenshot of the prototype of the mobile payment MIDlet After entering your account number, the amount you want to pay and the account number you want to pay to, the success alert screen comes up as follows:
Figure 4: Screenshot of the prototype of the mobile payment MIDlet The Web Application Environment Interface The Web application acts as a server in the client server communication. It is pertinent to note that all application servers are web servers but not all web servers are application servers. We have various applications and web servers some of which are: Glassfish(app server), Sun system(app server), Jboss(app server), BEAlogic(app server), Apache tomcat(webserver) and IIS(Internet Information System, an app server) which is window based.
Application servers are more robust, have more APIs (Application Program Interface) and supports advanced enterprise application development than the web servers.
Apache Tomcat was the web server used in the web application environment of this thesis and JEE (Java Enterprise Edition), a technology of java programming language was used in the programming aspect during the development of the web application environment.
The JEE used during the development of web application of this thesis comprises of the following tools: JSP(Java Server Pages)-this enabled us to have dynamic web pages in the web application environment of this paper.
Servlet-this enabled us to have secured dynamic web pages in the web application environment. Java Classes-this provided the opportunity of call the same task several times in a particular java class instead of writing the code for the same task several times on different web pages.
Flow of Activities In The Web Application Environment
1. You run the web application environment from Netbeans (the platform interlinking the various facets of the Mobile Digital Payment application and running them) software already installed in your system.
2. Running the application automatically loads the web page below:
Figure 5 - Web interface for the login page 3. You then login by entering your

username and password.
4. Finally you can view any of the following pages:
Figure 6 - Web interface for the home page
Figure 7 - Web interface for the transaction page (to make transactions)
Figure 8 - Web interface for the Balance page (to view balances of all customers)
Figure 9 - Web interface for the Customer View page (to view all customers)

4. RESULTS AND DISCUSSION

User mobility is another degree of mobility that is less pursued in the area of mobile computing. This paper proposed a new computing model that tries to provide user mobility service to all applications through a system-level solution. This solution utilizes a platform-independent interface to fit a user? personal computing environment on a platform-dependent middleware that provides two services to web-top applications. A prototype middleware has been built to prove the feasibility of the Mobile Digital Payment System. This prototype uses a file system to support web-top applications access user? PCE files.

5. CONCLUSION AND RECOMMENDATIONS

A system to support user mobility faces several challenges. First, a user? personal computing environment must fit in a heterogeneous environment [3]. Second, local resources on a Mobile Digital Payment System client must be integrated into the user? computing environment to best support user [5]. There are also security issues and adaptation issues. However, these two issues are not addressed in this paper.
Mobile Digital Payment System model opens new opportunities for future work. The Mobile Digital Payment System, including the prototype could be improved in many aspects even within the definition in this work. In this Mobile Digital Payment System, one can only make payment via the mobile phone from one account to another only within the same financial institution; improvements can be made to enable one to make transaction between accounts from different financial institutions. Beyond that, there are also many new directions that could be developed and integrated into Mobile Digital Payment System systems[7].

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