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QR-Code based Digital Wallet

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Abstract— With the proliferation of the mobile Internet, E-commerce has become pervasive across all types of trading transactions. Vendors of Point of Sale (POS) machines, like vending machines, as well as brick-and-mortar merchants, are attempting to find ways to perform transactions digitally. The smart phone, amongst other things, is also finding itself to be a digital wallet (DW). A digital wallet (an application installed on a smart phone), similar to a physical wallet, holds (or keeps track of) your cash and other personal information. An individual sets up a Digital Wallet Account (DWA). The DWA stores your account balance, which can be traded for goods and services with participating merchants as well as be used to transfer funds between two peer DWs. In order to purchase goods or services from a merchant or point of sale machine like a vending machine, the smart device first identifies the merchant using a QR code through a camera. The buyer then enters the amount necessary for the purchase and initiates a "buy" transaction with this vendor via the Digital Wallet App. A similar mechanism is used for implementation of the peer to peer transactions as well where one peer takes on the job of the seller and the other participating peer is the buyer and the transaction is facilitated using a QR-Code.

The project is implemented using a website that provides access to the account data to the DWAs and maintain logs of all the transactions conducted on the database that stores the data for all the account holders. It is used to recharge the accounts held by the users. It also consists of a mobile application (Android) used to perform all the transactions remotely and emulate the function of a physical wallet, i.e. transferring funds as a cash transaction. In the future, this project can serve as the basis for a more highly functional digital wallet capable of providing services such as user identification, purchasing goods and services over a larger range of vendors and more secure transactions. A digital wallet will provide all the functionalities of a real wallet with the added advantage of being secure and more traceable, making accounting and tracking of finances easier.

Keywords: Mobile-Computing, Mobile-commerce, android, e-wallet, QR-code, micro-payment, real time, digital-currency, POS transaction, centralized payments

I. INTRODUCTION

A digital wallet is a software component that allows a user to make an electronic payment with a financial instrument and hides the low-level details of executing the payment protocol that is used to make the payment.

As the mobile phone continues to take on an ever more central role in our lives, it is increasingly replacing old activities and practices. It is commonly accepted, for example, that the mobile phone is superseding the wrist watch, especially among the younger generation. Further, Internet-enabled smart phones that also include cameras, music and video players, large storage, and navigation services are reducing the need to carry multiple devices. In response to these significant changes, we have been experimenting with ideas about how the mobile phone might also entirely replace the function of a physical wallet.

One of the first things to come to mind when a mobile digital wallet is mentioned is digital cash. But when we examine our own wallets, we find many other objects there in addition to money. Among the principal functions of a wallet is to carry our identification such as a driver's license, employee badge, and other forms of id. We also carry credit and debit cards, loyalty cards, health insurance cards, and membership cards for the local library or professional association in our wallet. Wallet items are often grouped by function – for example, shopping lists, coupons, and receipts all support shopping. We might carry business cards in our wallet, both our own as well as those we receive from others.

Beyond the analogy with a physical wallet, a mobile digital wallet provides additional functions and benefits, such as virtually unlimited storage, location awareness, and quick sorting or searching of its contents, making it an even more compelling replacement for the physical wallet. Doing away with paper receipts, business cards and other paper artefacts, and the potential for optimizing or eliminating trips, all have environmental benefits. Note that some of the same security and privacy concerns associated with a physical wallet are also present for the mobile version -- losing either can be enormously disruptive.

We define a mobile digital wallet as a heterogeneous managed store of content items related to daily transactions, both electronic and physical, providing secure, automated multi-channel access to the user and other parties. What issues does the research community need to address to make a mobile digital wallet a reality?

II. NEED AND SCOPE

Consider the following scenario: "Jill is at the supermarket checkout line. She fumbles through her wallet to find her credit card X; rejecting many other cards in the

process, to pay for the transaction. Later in the day, she falls victim to a pickpocket who steals her wallet. Jill is now in a state of panic; she has to remember which cards she had in her wallet and then manually cancel those cards".

The above scenario highlights problems with a physical wallet; namely that finding particular items is time consuming, and evocating a lost wallet is extremely hard. In addition, managing multiple monetary and identification implements is not easy. Monetary implements include cash, debit and credit cards, and stored value cards while identification includes national and/or state identification cards and driver's licenses.

A solution would be to replace the physical wallet with a digital wallet integrated into an existing mobile device like a cell phone. This digital wallet would allow the owner to carry multiple monetary and identification implements. These implements could be quickly searched by name, type, or other keywords. In addition, with the right software, these implements could be managed far more effectively. Finally, security would be enhanced as all data on the digital wallet would be encrypted and back up options would make recovering from loss easier.

However, the idea of a digital wallet is not new. Indeed, Japan and South Korea have already rolled out cell phone-based digital wallet solutions. Consumers in those countries can use their cell phones to pay for groceries, order drinks from a vending machine, and even identify themselves at airline ticketing counters. Other countries, such as America and Sweden, are slated to roll out digital wallet-type solutions within the next two years.

Recently, the convergence of two phenomena has made India ready for a digital wallet solution. First, Indians are very tech savvy and almost all of Indian population, ≈90.4%, carries a cell phone. Indians are thus more likely to use a digital wallet if it is integrated with their cell phones; similar to solutions provided in South Korea and Japan.

Second, cell phone technology is now mature enough to support a digital wallet solution. In particular, the cell phones have the computational capability, battery lifetimes, memory, input mechanisms, and a usable screen necessary for such a solution. In addition, newer cell phones are being developed that incorporate near field communication (NFC) chips such as Sony's FeliCa chip.

III. LITERATURE SURVEY

The majorities of contemporary proposed digital cash techniques have many disadvantages in being directly or indirectly account based or not anonymous and offer no offline peer-to-peer transferability. This is for the majority of users – in general – not acceptable. Such an approach fails to replace the role of cash in e-commerce systems. The basic result of this research is a new prepaid multi-hop (transferable) cash payment system solution based on hardware technology implementing an electronic wallet (e-wallet) to accommodate digital cash [1].

IBM has proposed the following design considerations for a digital wallet system:

a) Wallet as a centralized managed service.
b) Heterogeneity of a digital wallet.
c) Wallet must be a competitive asset.
d) Wallet must allow for identification.
e) Wallet must have a satisfactory lifespan.
f) Wallet must have a good degree of automation
g) Wallets must be adaptable to follow different work-flow environments.
h) Different wallet services must be capable of communication.
i) Monetization of the Eco-system must be possible.
j) Client programming model must be available [2].

Much of the previous work in this area has been concerned with mobile payments—the use of the mobile phone as a surrogate for a credit card or smart card. The device is linked to a bank account or credit card or phone account; alternatively, it may be supplied with a fixed amount of digital cash, which may then be spent anonymously [3].

A somewhat broader approach is demonstrated by prototypes that combine mobile payments with organization of credit and loyalty cards, based on an NFC phone [4].

In other efforts, there are now numerous commercial or free mobile applications to store and organize various individual content types, for example passwords, loyalty cards, shopping lists, business cards, coupons, and so on [5].

IV. FEASIBILITY STUDY

Given the above mentioned reasons, it can be safely said that in countries like India, the concept of a digital wallet is highly feasible, provided certain challenges are overcome. These challenges are basically of three types as explained below:

A. Mass Market Appeal:

Ensuring a mass market appeal for the digital wallet is important to leverage scale economies. One way to increase the mass market appeal is to make the digital wallet usable for all day-to-day transactions. Hence it is important to support both point of sale transactions and peer-to-peer transactions between individuals. Both of these require support from financial institutions, retailers and government bodies; coordinating these stake holders is a real challenge.

B. Stake Holder Dynamics:

Any successful digital wallet deployment will need the cooperation of multiple stake holders such as banks, retailers, regulatory bodies, and consumer. This is a challenge because satisfying the business and strategic goals of multiple stake holders is difficult. For example, bank A may choose not to be a part of a consortium where competing banks play a leading role. In addition some stake holders may have already invested in alternative technologies and may not be in a position to make further investments. Achieving buy-in from all stake holders may require the support of the government and regulatory bodies.

C. Compelling user experience:

The third challenge is designing a digital wallet that consumers want to use. This requires a usable interface, and support for all financial transactions that a user may want to perform. We plan to reuse some of the user interfaces and design principles developed. However there are many important features that still need to be created. These include comprehensive backup and restore solutions, integration of a large number of monetary and identification implements, and support for peer-to-peer cash transactions.

D. Supporting Cash Transactions:

From the consumer's perspective, cash transactions have many benefits; they are fast and easy to perform, they provide a built-in spending limit, and they are anonymous. The anonymity factor is crucial for consumers who, for various reasons, want certain transactions to remain anonymous while the spending limit is used, for example, by parents to limit their children's spending. Supporting cash transactions require two key technology components;

a. A mechanism for placing cash in the digital wallet, and
b. Mechanisms for transferring that cash to a retailer or another digital wallet.

An on-line method for adding cash to the wallet, this would allow a consumer to log into his Digital Wallet account, purchase the required credits, thus recharging his digital wallet. We are currently discussing various methods of achieving this on-line cash transfer with the financial institutions. To support peer-to-peer cash exchange or make merchant payments, use the phone's camera via the Digital wallet android app with an easy to use cash transfer functionality. Using the application, the payer can enter how much cash she needs to send to the other person. The payer then enters his transaction password and the cash is transferred instantaneously. The recipient is then informed of the exact amount transferred. Developing this peer-to-peer mechanism will require solving a number of challenges. For example, from a technical perspective, how do you ensure that the transfer of cash to and from a digital wallet takes place securely, atomically, and idempotent? Furthermore, what happens to cash in a digital wallet when the wallet is lost? Is it possible for the owner of the wallet to not be penalized for the stolen cash (which is encrypted and thus cannot be used except by the owner without compromising the anonymity of cash transactions? Finally, there are also the regulatory challenges of issuing digital cash. For example, is digital cash identical to physical cash? If so, who provides the financial backing for the cash? In addition, how do you ensure that a financial institution is able to verify and accept digital cash issued.

V. TECHNOLOGY

A. Quick Response Codes (QR-Codes):

QR Code is a form of 2D bar codes. A sample is shown in Figure 1. It was developed by Denso-Wave, a Japanese automatic data capture equipment company (Denso, 2009), in 1994. "QR" stands for "Quick Response." It is readable by moderately equipped mobile phones with cameras and QR scanners. Information such as URL, SMS, contact information and plain text can be embedded into the two dimensional matrix. With smart phones, we can visit the Website linked by the URL quickly, we can send the SMS message directly or we can save the contact information onto the address book easily. This format of 2D bar codes is so popular in Japan and emerges gradually around the world because (a) the patent right owned by Denso Wave is not exercised (Denso, 2010a), (b) its specification is disclosed to the public by the company so as the specifications, ISO/IEC 18004:2000&2006 (International Organization for Standardization) and JIS X 0510 (Japanese Industrial Standards), can be formed (ISO, 2010; JISC, 2010), and (c) it has a large data capacity in a small printout size and high speed scan utilities via mobile devices are readily available.[6]

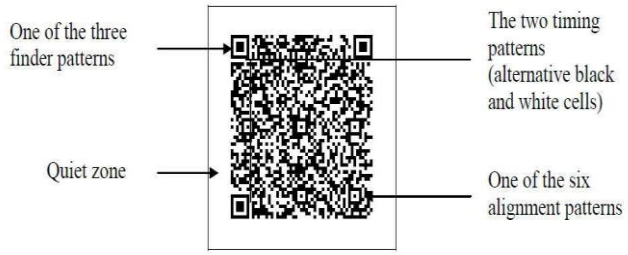

Figure. 1: QR Codes

A QR code is capable of holding 7,089 numeric characters, 4,296 alphanumeric characters, 2,953 binary bytes, 1,817 Kanji characters or a mixture of them. The data capacity is much higher than other 2D codes such as PDF417, Data Matrix and Maxi Code (Denso, 2010b). It stores information in both vertical and horizontal directions. A QR code can be read from any direction in 360° through position detection patterns located at the three corners as shown in Figure 1. A QR code can be read even it is somewhat distorted by either being tilted or on a curved surface by alignment patterns and timing patterns. The error correction capability against dirt and damage can be up to 30%. A linking functionality is possible for a QR code to be represented by up to 16 QR codes at maximum so that a small printing space is possible. The size of a QR code can vary from 21x21 cells to 177x177 cells by 4 cell-increments in both horizontal and vertical direction.

Data can be easily encrypted in a QR code to provide a confidentiality of information embedded in the code. It can also handle various languages. For examples, there are a number of standards adopted by Asian countries like GB/T 18284 by Chinese National Standard in 2000, KS-X ISO/IEC 18004 by Korean National Standard in 2002, and TCVN7322 by Vietnam National Standard in 2003.[6]

VI. BLOCK SCHEMATICS OF THE SYSTEM

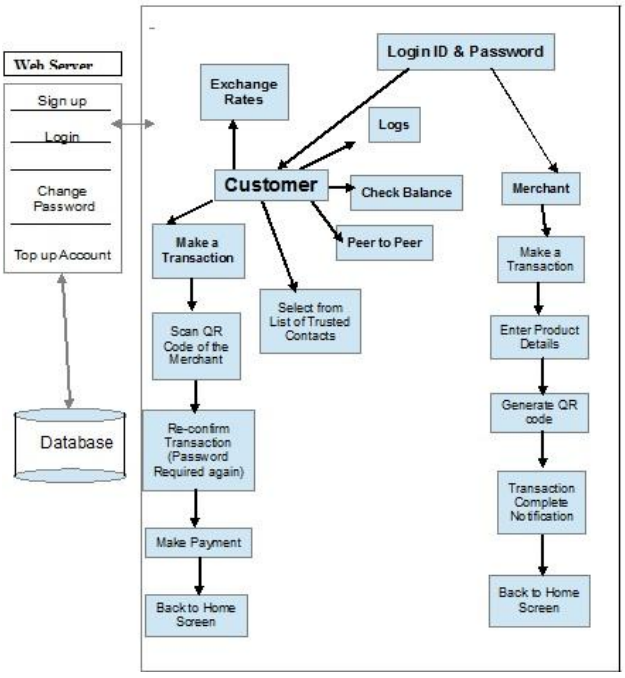

Figure. 2: Work Flow Diagram

The work-flow model shows the various components within the digital wallet environment. There exists a centralised server which maintains a record of the accounts of various users and their transaction logs. Depending on the action the user wishes to perform, there are different logical paths that the system follows, assuming the user is authorised.

Initially the user registers with the service via a web browser on the home screen. This data is then stored on the main server and a new account is created for the user.

The user can then use his username and password pair to access the digital wallet environment and to perform transactions.

Upon logging in successfully, the user will choose what he wishes to do. He is presented with options on making a transaction as well as options such as checking his current balance and viewing a brief history of the transactions done till now.

If the user chooses to make a transaction, then they must choose which side they wish to participate in the transaction i.e. as the sender or as a receiver. Depending on the option, if they are the sender then they enter the amount they wish to send and re enter the password. If verification is correct, the barcode is generated and displayed on user device. If the user is the receiver, then the user device initializes a QR code reader to scan the incoming bar code. It then analyses the barcode to get the transaction details and completes the transaction.

The QR code itself is a string that uses tags so as to differentiate between the various fields of data being sent to the receiver machine. This string is then encrypted to protect confidentiality and then fed to a QR code generator.

When the receiver scans the QR image, a string is obtained from it. This string is then decrypted and the data is used to complete the credit transaction.

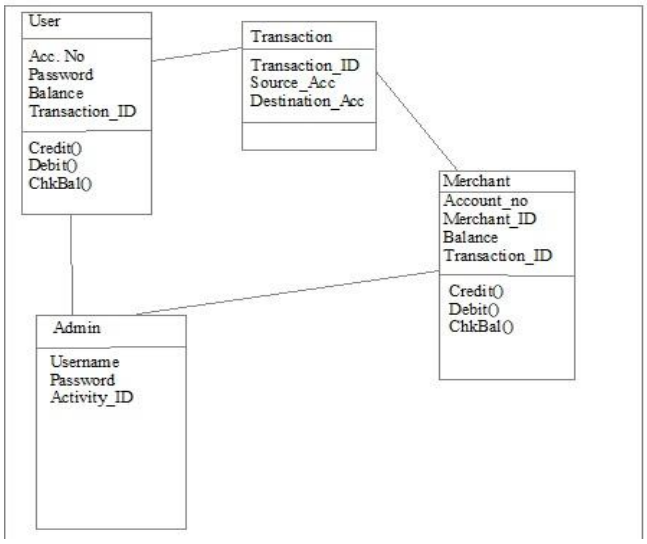

Figure. 3: Class Diagram

The class diagram displays the four main classes that the digital wallet system is anchored around. The first class is the User class which contains the data about the users such as the user name, password, the account balance and log of transactions by the user.

The Merchant class has an added merchant ID which allows the system to uniquely identify an individual merchant. The Transaction class contains the data that is recorded from each transaction that is stored in the database in the form of logs.

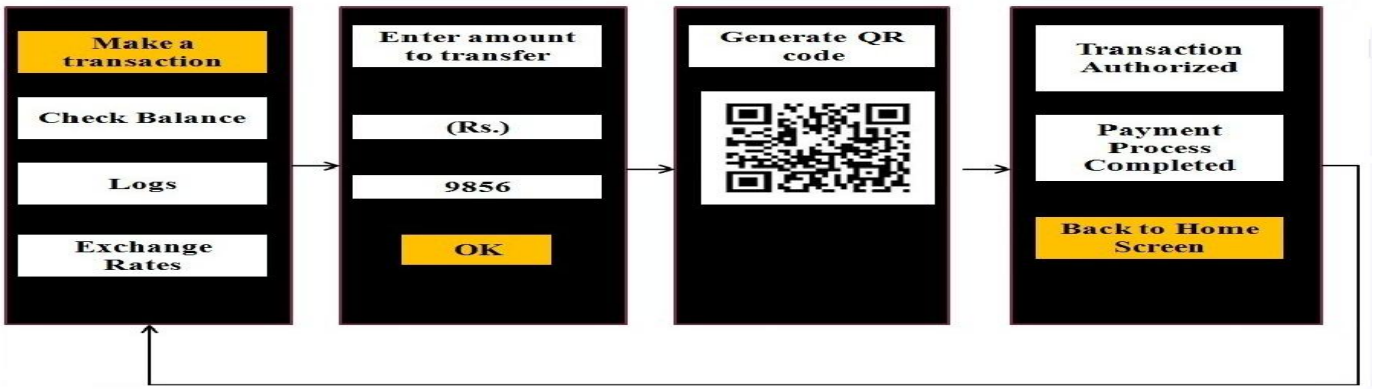

Figure. 4: Sender Side

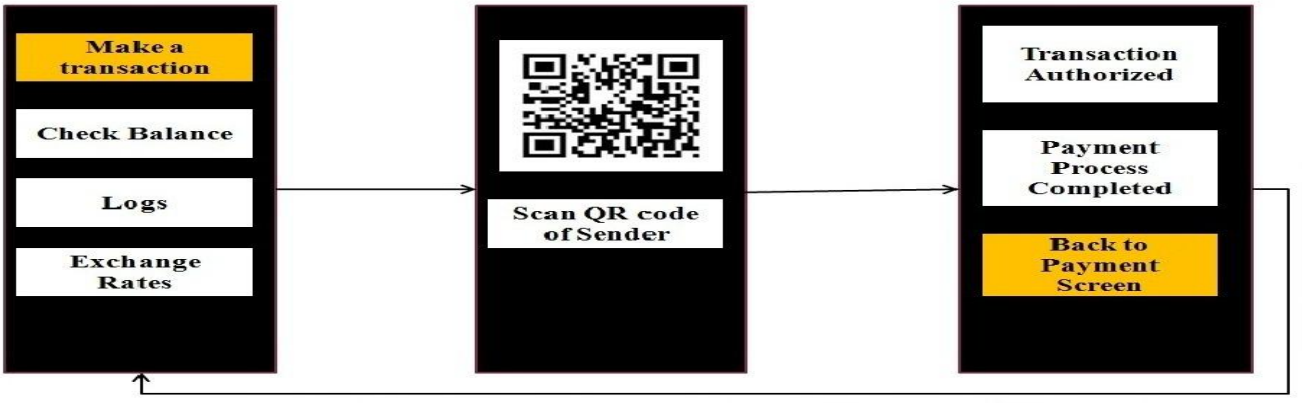

Figure. 5: Receiver Side

The above diagrams show us the flow of the mobile application part of the digital wallet. At the start up, the application will verify the authenticity of the user by using a user name/password verification dialogue. If the user is verified it will progress to the next step, otherwise it will redirect to a sign up screen where new accounts can be registered.

If user is authenticated, the home screen opens up. This page allows the user to select what he wishes to do with his session. It offers options like credit, debit, view logs and other management functions. User can perform multiple functions consecutively via their home screens. The credit and debit functions are used to exchange credits between two parties be it a peer-to-peer exchange or a customer vendor transaction.

There are various transactions that take place in the span of one transfer and if all of them execute without any problem then both the parties get a successful transaction notification.

VII. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware requirements:

The cloud service must be provided as a feasible and with minimal hardware requirements for the users hence the basic hardware requirements are as follows.

a. Intel Pentium 4, 2.6 GHz
b. 512 MB ram
c. IO devices
d. Stable internet connection
e. Android Smartphone (v2.3.3 or above)

B. Software requirements:

The customer base that we intend to provide services is students, colleges and business organisations intending to work with a collaborative application working platform.

Thus the service must run on system with trivial requirements.

a. Digital Wallet Android Application (installed on smart phone).
b. Browser Mozilla Firefox 10 or higher, IE 8 0r any equivalent browser.

VIII. CONCLUSION

Much of the previous work in this area has been concerned with mobile payments—the use of the mobile phone as a

Surrogate for a credit card or smart card. Our project aims to change the notion that a mobile wallet is only a surrogate for your credit card.

Our aim is to create a simple hassle free mechanism for allowing our users to micro payments & transfer their funds as easily and comfortably as out of their own pockets. Also the entire transaction will be secure, traceable and easy to verify.

This project will allow the users to have the same ease of use as a traditional wallet on a device they already use extensively, i.e. their mobile phones and also provide them with a host of other features like transaction history, device portability, secure payment and most of all security from theft. We wish to bring about a new dimension in personal commerce through this system that in the future will have widespread use due to its mobility, speed and security.

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