

# **An Innovative Micropayment System Based on Near Field Communication**

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**ABSTRACT:** In our daily life ordinary cash payment is replaced by electronic means of payment. Where on other side micropayment are done debit cards, credit cards and some contactless systems which suffer from some technological problems. In my project an innovative payment system is implemented which is based on Near Field Communication Technology. The payment in my system is done by Android Smartphone. An application is developed for Android Smartphone which contains all payment details like credit / debit card number etc. The hardware NFC Reader is build. In point of sale, the amount of bill is entered in LCD. Put Android Smartphone over the NFC Reader. The NFC reader reads data from payment application and sends it to server through Wi-Fi. The server contains user's credit card / debit card balance. It checks whether balance is sufficient or not to pay bill. If amount is sufficient then transaction is completed. If it is not sufficient then message is shown on screen Transaction is not completed.

**KEYWORDS:** Micropayment, NFC, Android, Contactless, NFC Reader, Smartphone

## **I. INTRODUCTION**

Recently, smartphones are playing a very important role between human and virtual worlds. Smartphones can be used for various purposes like updating Facebook status, checking mail, share digital music and more yet to come. The adoption of Near Field Communication (NFC) technology in today's smartphone follows Internet of Thing. Cisco designed the visual representation which shows a simple example of how IoT will affect our day to day life. It shows in future there will be 50 billion things connected to Internet. The special interest of Google's Android towards NFC is spreading of smartphones with embedded NFC. They allow supplying wide range of applications such as consumer electronics, healthcare, information collection, coupons, payments and transport. Smartphone creates lot of secure and convenient conditions for payment e.g. battery, 3G network and storage. In our future life this smartphones will represent the personal electronic wallet (e-wallet) for replacing current plastic credit cards. As reported in, NFC payments are still to attain that market potential. Google wallet mobile application supports NFC micropayments for Android Smartphones in US.

This paper aims to develop an innovative mobile micropayment system which can be easily used. The system must ensure the same security level of traditional credit card payments, without any hardware intervention. The user has only to download the application from the market and install it onto smartphone. Multiple payment networks can be easily configured. The interaction between the user and the system must be bidirectional so the system can return the feedback to the user. It is a simply contactless payment transaction which does not require physical connection between consumer payment device and POS terminal. The contactless payment application is limited for several reasons.

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Figure 1: NFC Micropayment

As credit card has no batteries it is not able to initiate the transaction, limiting the contactless possibilities. NXP Semiconductor splits contactless applications into four categories based on how consumers will use applications. The first two are possible without batteries. The categories are:

- Touch And Go where application such as micropayment allows consumer to wave device over POS terminal without confirming transaction.
- Touch and Confirm, such as mobile payment has to confirm the interaction by accepting transaction.
- Touch and Connect, linking the devices for interaction and to enable a peer to peer transfer of data or money.
- Touch and Explore, where devices offer more than one function. The consumer will explore the device's capabilities to find out which functionalities he wants to use

The card has no screen and keyboard and if the identification of card is easy to realize by POS the card holder PIN code authentication is possible. The contactless payment can be divided into micro payments and macro payments. Micropayment does not require confirmation and transaction is done by waving the contactless payment device over point of sale terminal. In United States the upper limit for micropayment is \$25. If the price is higher than \$25 then it is considered as macro payment. It means the customer who is paying the bill, has to wave the contactless payment device over the point of sale terminal to type the PIN code. This authentication method is not quick and easy.

So to overcome this contactless payment limits we use device which has a screen, a keyboard and batteries: smartphone. We use NFC for contactless capability mobile phone. NFC smartphone is compliant with four categories by NXP and its screen allows confirming the transaction by entering PIN.

Figure 1 shows the way to do the payment from Android smartphone which has inbuilt NFC technology. Put your Android smartphone near the reader and tap on screen. The transaction will be done and get completed.

## II. RELATED WORK

The author Cico has explained the necessity of mobile payment which is based on Near Field Communication Technology. It also highlights the issues that mobile payment has faced which includes both generic and NFC problem.

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The issues are like security, supply and demand and the user's experience. The solution presented adds another software layer to the NFC hardware due to which problems are solved.

Author Hsu Chen Chang has also discussed the issues and advantages of NFC based payment system. Model they have proposed is generic model for making use of Near Field Communication in mobile commerce called as NMC (Near Field Communication Based Mobile Commerce). The model includes 6 phases: Initialization order, payment, services and loyalty. It elaborates these phases and can be implemented independently. In initialization there are 4 steps: backend services, terminal services, handsets and tags. It is typically followed by order, payment and shipping phases. This respective model was implemented in hotel and restaurant successfully.

Mobile Payment proposed by Devendra Mani has aimed at cost, reducing time of generating key and registration for the payment. The system holds 3 stakeholders: The client, merchant and issuer. The client exchanges messages with issuer through merchant to satisfy aspects of mobile transaction and complete it successfully. Once client sends message to issuer the client get message via payment gateway of a successful or failed transaction. The gateway while confirming client also sends message to merchant indicating correct amount has been sent to their account.

## III. NFC TECHNOLOGY

Near Field Communication (NFC) is a high frequency technology with range of <20cm. This technology is derived from Radio Frequency Identification (RFID) family. NFC has been promoted by Sony, Nokia which is founded in 2004. NFC is based on inductive coupling where the loosely coupled inductive circuits share the power and data over distance of <5cm. NFC devices inherit the technology of proximity such as Radio Frequency Identification (RFID) Tags in High Frequency Band i.e. 13.56 MHz and contactless smart card.

NFC is a standardized wireless communication (ISO 18092) that adds wireless functionality to the smartphone devices. Such devices can act as a contactless card and contactless reader and also operate in peer to peer mode with peer devices. Such devices support various contactless communication standard such as Felica and MiFare standard.

The NFC payment model has an ability to evolve into new model from traditional model where consumer can act as an merchant. The existing contactless infrastructure is compatible with the technology used in NFC and the NFC devices offers three different modes.

- Reader / Writer mode: In this mode NFC devices can read or write the information such as smart poster applications, URLs, SMSs in smartcard. Here user touches the smartphone with the tag which is embedded in smart poster, which triggers URL transmission to phone. URL is used to open the web browser without any human disturbance.
- Card Emulation mode: In this mode the NFC enabled smartphones emulates a contactless smartcard. In this mode there is secure element SE embedded in device where the sensitive data can be stored in safe place. The value added services which requires high level of security such as payment app can be made available to customer.
- Peer to Peer mode: In this mode there is connection established between two NFC enabled devices and then data is transferred or can be exchanged between them. The NFC Data Exchange format (NDEF) is used to transmit the data between NFC devices.

## IV. OVERVIEW OF THE MOBILE PAYMENT CONCEPT

In our paper we have proposed the idea of contactless payment using NFC Technology. The application will contain user details like credit card number, pin number.

Application can contain more than one credit card details. Near Field Communication is a contactless communication between two devices with three modes:

- i. Read/Write Mode
- ii. Card Emulation Mode
- iii. Peer To Peer Mode

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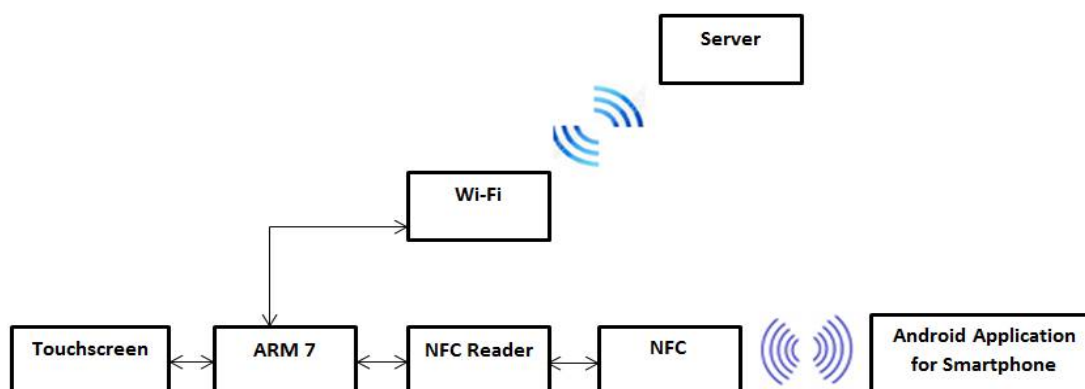


Figure2: Block Diagram of NFC Micropayment

In Figure 2 block diagram of NFC micropayment model is being shown.

LCD (Touchscreen) is used to enter the amount of bill of the customer. NFC Reader reads the data from the application i.e. the account no. pin number which is in Android Smartphone. NFC reader sends the data to server through Wi-Fi. Wi-Fi is used to check account balance which is stored in server. In server there is a database which contains accountant's name, account number, balance. Microcontroller ARM7 is used for serial interface between reader and Wi-Fi. LCD is used to display customer name and balance.

## V. VALIDATION

The prototype of App has been implemented and validated by using Samsung Nexus S Android 4.1.2 (Jelly Bean). We use this device because Nexus S was the first Android Smartphone who supported NFC in both ways hardware and software. It represents the best performance and reasonable cost. Validation scenario is reported. Here we assume that credit card is configured in buyer's smartphone.

1. Cashier inserts and confirms amount in Pay application and tells buyer to touch Android NFC Smartphone to NFC Reader.
2. Buyer starts the Pay App and taps credit card. The App prompts to insert the PIN code and tell buyer to touch smartphone to the NFC Reader.
3. Payment details are transferred to Server.
4. It instantiates payment transaction with right credit card network.
5. The result is formatted and then returned to POS where it is shown to cashier.
6. Plain text response is created and sent back to buyer's smartphone through NFC P2P link. Process notifies the buyer that payment has been done successfully and he can remove smartphone away from NFC Reader.

## VI. RESULTS

Enter the amount in LCD through touchscreen. Place the Android Smartphone near the NFC Reader and tap on the credit card / debit card through which you want to do your payment.

The NFC reader will read the data and take the amount which is entered in LCD. Then it starts processing.

When the payment is completed and transaction is done the result will show payment is successful. If transaction is failed i.e. if card does not have sufficient amount in balance it will show payment failed as shown in figure 3.



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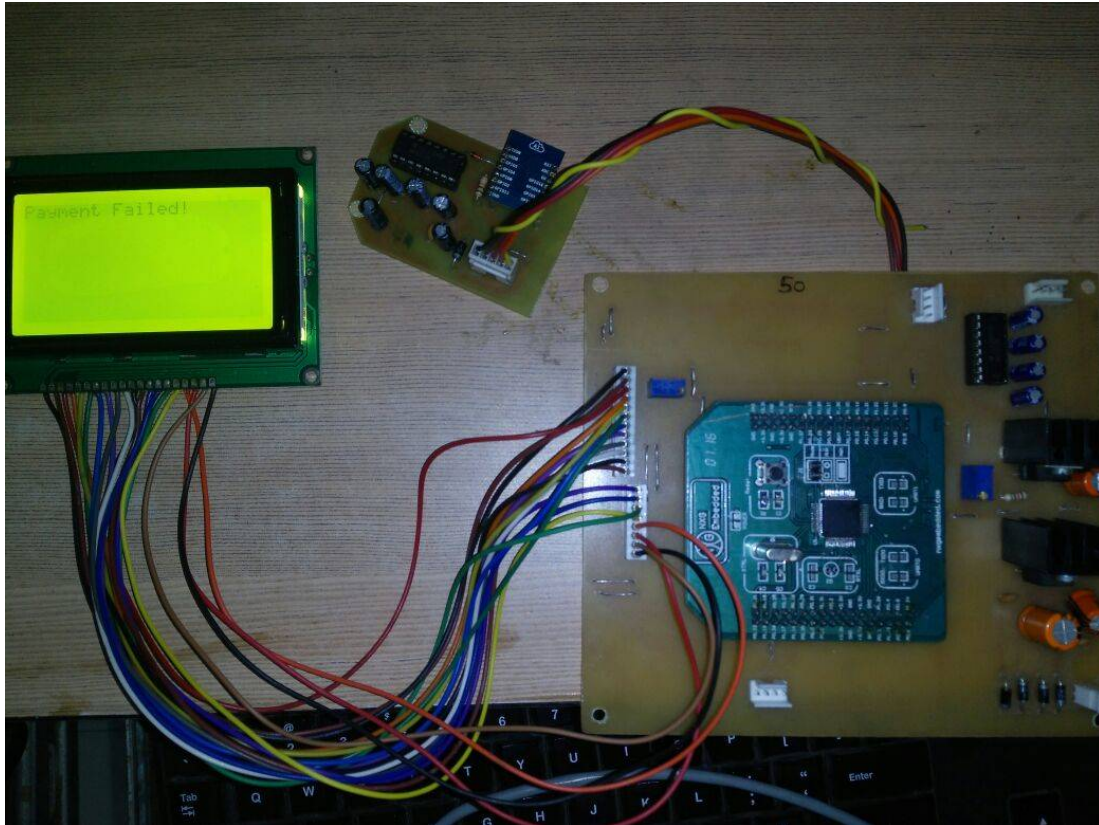


Figure 4: Experimental kit of Micropayment System with result

The hardware kit includes ARM7 microcontroller, LCD (Liquid Crystal Display), Max232, power supply.

The kit show the result on LCD screen when the transaction is done.

There is serial communication between reader and LCD screen.

We have used ARM 7 for 2 serial ports as we require it and LPC2138 requires very less power and is of less cost.

So we have used LPC2138 ARM 7 microcontroller.

LCD screen is a touchscreen which is used to show amount and to enter the amount which acts as merchant.

## VII. CONCLUSION

The paper proposes NFC enabled micropayment system. The model developed provides not only ease and friendliness for customer but also helps to implement business logic. NFC standard has impact at system design level, user interface level, application level with various features. This model should be easy to integrate into the existing networks and point of sale (POS) systems.

## VIII. FUTURE SCOPE

It includes a potential security issues which may arise in a practical deployment of the proposed model. The OTA platforms with an application deployment on secure element. The secure element could be an independent chip or the SIM. Another area of research in NFC development platforms includes context based profile based App store, NFC

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location based and robust web services NFC architectures and Tag management platforms NFC application measurement platform.

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