

NFC Based Multiple Payment Systems

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Abstract- This Paper is based on Mobile transaction for Train ticketing system as well as Car Parking System based on Near Field Communication (NFC) technology. We have developed the system according to the User's convenience. The use of NFC will not only provide a Secured electronic transaction but will also reduce the prize of Parking/tickets as the cost required for paper receipts will be negligible. The Prototype consists of two gates (one for train ticketing system and other for Car Parking system) driven by a motor to show how these systems actually work. An Android Application named NfcShop is developed for the User to perform Transactions and keep track of those using mobile phones. And acknowledgement of the transaction will be in the form of e-Receipt.

Keywords- NFC, train ticketing, car parking, NfcShop e-Receipt.

I. INTRODUCTION

Use of mobile phones has increased drastically in 20th century. Now-a-days we use mobile phones not only for phone calls but also for messaging, sharing pictures, accessing internet, etc. Many companies want to get into mobile transaction business. Secured mobile transaction is possible only by using Near Field Communication (NFC) technology. Powerful new handsets with inbuilt NFC chip, creates small electromagnetic field up to 5 centimetres when activated. Many mid range and high price ranged mobile phones can be used as a medium for payments. The person can just touch and pay for the ticket avoiding the huge lines for buying a ticket. In the future, NFC will be the most successful technology for payment transactions.

II. BACKGROUND WORK

A) BASIC PRINCIPLE OF NFC

Just like Bluetooth and Wi-Fi, NFC works on the principle of sending information over radio waves.

NFC chip has metal strip arranged in circular fashion which continuously emits small electromagnetic field. NFC tags having this chip can be stored with small information (up to 1000 bits). NFC technology enables simple and safe two-way interactions between electronic devices, allowing consumers to perform contactless transactions, access digital content, and connect electronic devices with a single touch.

[1] An NFC enabled cell phone when brought to a close proximity of the NFC tag, receives the information containing in the NFC tag. There is no hardcore programming required to store information in those tags. NFC has wide variety of advantages over other wireless technologies. Unlike other wireless technologies, it can be operated up to 5cm range which makes it difficult for hackers and ID thieves to steal the information. No manual authorization is required to start NFC in the mobile phones. Bluetooth and few other technologies require manual authorization. Also it can be operated without battery. NFC

requires very less set up time and it is operated at frequency of 13.56MHz



Figure 1 Magnetic strip present in NFC chip [2]

B) PN532 NFC READER MODULE

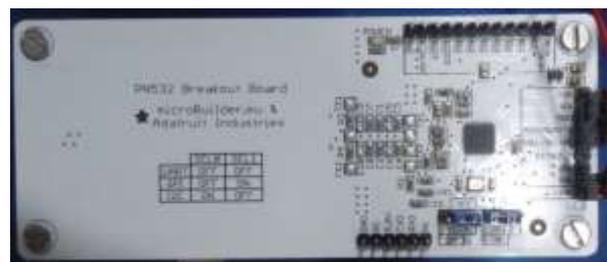


Figure 2 Reader module

We will use PN532 NFC Module in our project for detecting electromagnetic field which is transmitted by NFC chip present in the mobile phone. This module supports peer-to-peer communication. In this module, there are three types of interface's: High Speed UART mode, I2C mode and SPI mode. To select one of these interface, two select lines are present i.e. SEL0 and SEL1.

The following table shows the selection of mode:

Table 1 Interface Selection [3]

Interface	SEL0	SEL1
UART	OFF	OFF
I2C	ON	OFF
SPI	OFF	ON

When UART (Universal

Asynchronous Receiver/Transmitter) is selected, two pins are activated i.e. TX(Transmitter) pin and RX(Receiver) pin. This interface is used to receive and transmit signal's from PN532 module. The contactless UART handles the protocol requirements for the communication schemes in co-operation with the host. [4] When I2C(Inter Integrated Circuit) is selected, three pins are activated i.e. SCK(Serial Clock) pin, SDA(Serial Data Acknowledgement) pin and SS(Slave Select) pin. This interface is used when the data is sent to micro-controller(Slave) serially, and the PN532 module waits for Acknowledge from Slave. When SPI(Serial Peripheral Interface) is selected, four pins are activated i.e. MISO(Master In Slave Out) pin, MOSI(Multiple Out Slave In) pin, SS(Slave Select) pin and SCK(Serial Clock) pin. This interface is used when the operation takes place in the form of Master and Slave. In our project we are going to use this interface. In this, PN532 acts as a Master and micro-controller acts as a Slave. When the data is received by the pn532 module, first, it will send a clock pulse to micro-controller by activating SCK pin, then MOSI pin and SS(for selecting Slave) pin will be activated and it will send data to the particular address of micro-controller. After that, micro-controller will return the data and MISO pin will be activated.

validation is done, the motor is driven and the gates open and close accordingly.

B] WORKING

The idea is pretty much clear from the block diagram shown above. The prototype made by us requires NFC enabled mobile phone, NFC reader module (pn532 module), microcontroller circuit connected with motor driver circuit, dc motor. First, activate the NFC in the mobile phone by bringing down the drop down menu and selecting NFC widget from drop down menu. Once the NFC is activated then select NfcShop app.



Figure 4 NfcShop App Screenshots

III. IMPLEMENTATION

A] BLOCK DIAGRAM

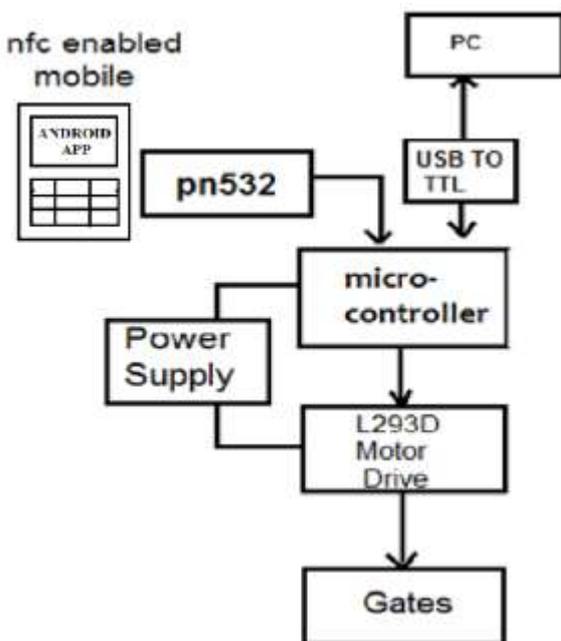


Figure 3 Block Diagram

This is the general block diagram of the System we designed. The data entered through the android app is received by the pn532 module and it is validated through the microcontroller with the data already stored in the Computer. Once the

It will ask for Login in information. Enter the User ID & password. On the next page in the app various options will appear. In this prototype we have created Train ticketing and car parking payment application.

If we select Metro, next page will ask for Source and Destination. After selection of source and destination, app will show the amount to be charged. Then the mobile is taken closer to or touched on the pn532 NFC reader module. The process is so spontaneous that, as soon as reader detects the NFC enabled mobile, gate opens and one can pass easily.

When the user brings NFC enabled mobile phone after selecting source and destination towards the reader, NFC reader detects the signals and its SPI mode, which is interfaced with microcontroller, sends the information to the microcontroller. Microcontroller (ATMEGA328) first detects whether a valid ticket is generated or not and only then it commands L293D Motor Driver Circuit to open the gates for the user. Accordingly the money is charged to the user. If the balance is low, microcontroller will deny the request and will ask the user to refill. Transaction happened will be saved in history for future reference. This is how the metro ticketing application in the android app will work.

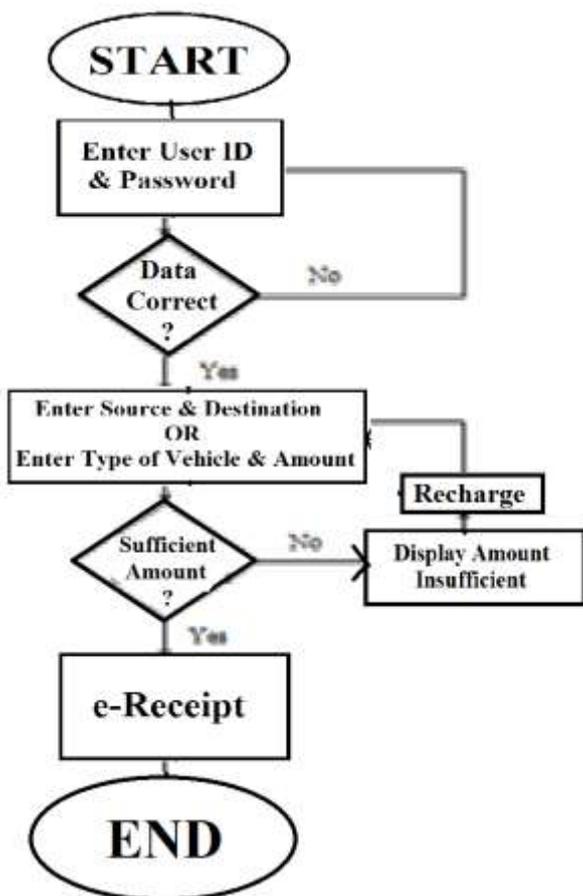


Figure 5 Combined Flow chart for Ticket application and Car Parking Application

For car parking most of the process will be same as mentioned for metro ticketing. From the android app we have to select the car parking option. It will show a list of vehicle type. After selecting the vehicle type, app will show the amount charged and remaining balance. Again the user has to bring this NFC enabled mobile phone in close proximity with the reader. NFC Reader will detect the signals from the mobile phone and send them to microcontroller. Microcontroller will decide whether the balance is sufficient or not. If the balance is sufficient microcontroller will allow the motor driver circuit to open the gate and let the vehicle pass. Transaction happened will be saved in history for future reference.

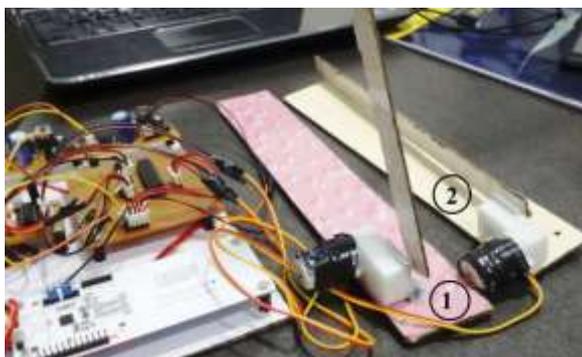


Figure 7 Prototype Photograph

In the above figure gate no. 1 showcases the case when the app is used for train ticketing and gate no. 2 is for the Car Parking. In this case the transaction is successful for train ticketing application and hence the gate is opened.

IV. ADVANTAGES

NFC has many advantages over other wireless technologies.

1. Easier to use as compared to Bluetooth and RFID
2. Now-a-days many handsets comes with inbuilt NFC chip making it easier for the people to understand and use NFC features.
3. It operates on small range i.e. 5 centimeters or less. This makes it difficult for the hackers and ID thieves to steal information.
4. It takes very less set up time as compared to Bluetooth, RFID and Wi-Fi.
5. It also does not require any manual configuration or settings which make it easier for consumers to use.

V. LIMITATIONS

1. NFC is not widely known which makes it difficult for many people to trust this technology.
2. Turning from regular currency to digital currency is always risky and that's why using NFC for mobile transactions will not be encouraged until proper testing is done.
3. Newly manufactured mobile phones are coming with inbuilt NFC chip but the old ones cannot be replaced only to use NFC feature.

VI. FUTURE SCOPE

Despite of its limitations, NFC technology has great potential in making mobile payments a success. Presently there are around 300 million mobile phones with inbuilt NFC chip and this number will keep increasing every year. It is estimated that by end of 2015 around 500 Million mobile phones will be equipped with NFC chip. Also, alternative solutions are being made to add NFC chip to the old mobile phones which do not have NFC chip.

We can use this technology in Restaurants also, to Select a dish from the MENU through the app built for that particular Restaurant and Payment can be Processed with the same app i.e. bringing the NFC enabled mobile phone in close proximity to the NFC Reader attached to the table. Mumbai metro and Chennai metro are taking efforts and creating awareness among the people for using NFC technology for ticketing.

VII. CONCLUSION

Near field communication can be extremely beneficial in the modern era of technology. NFC is an extremely simple and convenient technology as compared to other wireless technologies because the data exchange can be done by

just bringing two NFC enabled devices together. It is interactive and secure which does not require any special software to run on. It also does not require any manual configuration or settings which make it easier for consumers and also overcomes with the drawbacks of credit cards and debit cards.

REFERENCES

- [1] NFC Forum: www.nfc-forum.org
- [2] Image from [https:// www.google.com](https://www.google.com)
- [3] Table on the Reader Module (pn532)
- [4] Datasheet pn532, <http://www.adafruit.com>