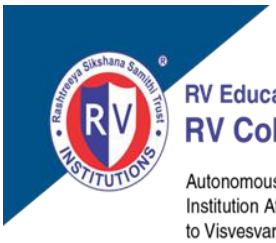

Technical Seminar Report

20MCA42

on

"Near Field Communication (NFC)"

Submitted by

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Under the Guidance

of

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Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF COMPUTER APPLICATIONS

2021-2022

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF

MASTER OF COMPUTER APPLICATIONS

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CERTIFICATE

Certified that the seminar titled **"Near Field Communication (NFC)"** carried out by **ISHITA SARKAR, USN: 1RV20MC028**, a bonafide student of **RV College of Engineering®, Bengaluru** submitted in partial fulfillment for the award of **Master of Computer Applications** of **RV College of Engineering®, Bengaluru affiliated to Visvesvaraya Technological University, Belagavi** during the year **2021-22**. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The report has been approved as it satisfies the academic requirement in respect of the technical seminar prescribed for the said degree.

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DECLARATION

I, **ISHITA SARKAR**, student of fourth semester MCA in **Department of Master of Computer Applications,** RV College of Engineering®, Bengaluru declare that the seminar titled **"Near Field Communication (NFC)"** has been carried out by me. It has been submitted in partial fulfillment of the course requirements for the award of degree in **Master of Computer Applications of RV College of Engineering®, Bengaluru affiliated to Visvesvaraya Technological University, Belagavi** during the academic year **2021-22**. The matter embodied in this report has not been submitted to any other university or institution for the award of any other degree or diploma.

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ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the success of any work would be incomplete unless I mention the name of the people, who made it possible, whose constant guidance and encouragement served as a beacon light and served our effort with success.

I express my wholehearted gratitude to **Dr. Subramanya K N**, Principal, RV College of Engineering®for providing me with an opportunity.

I express my special thanks to **Dr. Andhe Dharani**, Professor, and Director, Department of MCA, RV College of Engineering®, Bengaluru for her constant support and guidance.

I express my sincere thanks and wholehearted credit to my Internal guide **Dr. Jasmine K S**, Associate Professor, Department of MCA, RV College of Engineering®, Bengaluru for her constant encouragement, support, and guidance during the seminar work.

I am also thankful to the lab in-charge staff and all faculty of the department for their help and support during the seminar. On a moral personal note, my deepest appreciation and gratitude to my beloved family, who have been a fountain of inspiration and have provided unrelenting encouragement and support.

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ABSTRACT

Near Field Communication (NFC) is a relatively young technology that has only been around for about a decade. NFC is a short-range, high-frequency, low-bandwidth wireless communication technology that allows two NFC-enabled devices to communicate with each other. NFC devices communicate at a high frequency of 13.56 MHz, which was first utilized by Radio Frequency Identification (RFID). In the fast-pacing world, every individual needs a quick solution that saves time and effort but increases accuracy. Such fast-pacing solutions are needed in the educational institutions too where the student's and teachers' time and efforts can be minimized and provide great results.

NFC operates in a variety of settings on both active and passive devices. Furthermore, NFC may only be used between two devices at a time. E-payment, e-ticketing, loyalty programs, identification, access control, content distribution, smart advertising, data/money transfer, and social services are all possible NFC applications and services. The study focuses on how NFC can be used in an educational institution, such as NFC enabled attendance monitoring, where the students can have NFC enabled watches which they can use to mark their attendance, fee payments are quicker using the watch, the teacher can also share study material using the NFC watches. The steps needed to achieve these functionalities are as follows; First of all, each watch will have a unique user code linked to the student. Secondly, when the watch is pressed against another NFC device let's take the attendance monitor it will read the unique code of the watch's software. Thirdly, it will validate the user's identity as saved in the database. Finally, it will mark them present else absent at the end of the class foe one's who haven't attended the class. The software and hardware requirements for the above are React.Js (Web-based) or Android (Mobile based), a well-written code to validate the code to one saved in the database for frontend, Database (SQL) backend, and the hardware comprises of the NFC chip, a digital watch.

The proposed solution will make attendance monitoring much faster compared to manual monitoring, it will also help to store a clear record of the student's attendance. It can further help in fee payments by making the process quicker and reliable by giving the option to add funds to the watch and later transfer it by just pressing it against the receiver side NFC device

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Near Field Communication (NFC) is a technology for contactless short-range communication. Based on the Radio Frequency Identification (RFID), uses magnetic field induction to enable communication between electronic devices. The number of short-range applications for NFC technology is growing continuously, appearing in all areas of life. Especially the use in conjunction with mobile phones offers great opportunities.

One of the main goals of NFC technology has been to make the benefits of short-range contactless communications available to consumers globally. The existing radio frequency (RF) technology base has so far been driven by various business needs, such as logistics and item tracking. While the technology behind NFC is found in existing applications, there has been a shift in focus — most notably, in how the technology is used and what it offers to consumers.

With just a point or a touch, NFC enables effortless use of the devices and gadgets we use daily. Here are some examples of what a user can do with an NFC mobile phone in an NFC-enabled environment:

- Download music or video from a smart poster.
- Exchange business cards with another phone.
- Pay bus or train fare.
- Print an image on a printer.
- Use a point-of-sale terminal to pay for a purchase, the same way as with a standard contactless credit card.
- Pair two Bluetooth devices.

An NFC-enabled phone functions much like standard contactless smart cards that are used worldwide in credit cards and tickets for public transit systems. Once an application, such as a credit card application, has been securely provisioned to the NFC-enabled phone, the customer can pay by simply waving the phone at a point-of-sale reader. The NFC phone also offers enhanced security, enabling the user to protect the secure applications through the phone's user interface features.

1.2 Description

In a world where time is an important factor in everyone's life so what can one do to make the best out of their time. Even for a student time is a very crucial factor so why waste it, everyone knows that taking attendance is a very time-consuming job but it's still needed to be done for the sake of the student's academic development. So, what if there was a way to make attendance easier and quicker, thus discuss so the topic for the seminar is Near Field Communication, based on which the NFC watch is built to take attendance.

1.3 Applications

NFC technology is intended mainly for use in mobile phones. There are currently three specific three uses of NFC:

- Card emulation: the NFC device behaves like an existing contactless card
- Reader mode: the NFC device is active and reads a passive RFID tag, for example for interactive advertising
- P2P mode: two NFC devices communicating together and exchanging information

The main applications are:

- **Payment & ticketing**

  NFC enables users to make fast and secure purchases, go shopping with electronic money, and also buy, store and use electronic tickets, such as concert/event tickets, plane tickets, travel cards, etc.

- **Electronic keys**

  For example, these can be car keys, house/office keys, etc.

- **Identification**

  In addition, NFC makes it possible to use mobile phones instead of identity

documents. In Japan, for example, student IDs can be stored on cell phones, which allows the students to electronically register for classes, open locked campus doors, buy food at the school cafeteria, borrow books, and even get discounts at local movie theaters, restaurants, and shops.

- **Receive and share information**

  The data stored on any tagged object (e.g. a DVD box or a poster) can be accessed by mobile phones in order to download movie trailers, street maps, travel timetables, etc.

- **Set-up service**

  To avoid the complicated configuration process, NFC can be used for the set-up of other longer-range wireless technologies, such as Bluetooth or Wireless LAN.

Other applications in the future could include:

- Electronic ticketing: airline tickets, concert/event tickets, and others
- Electronic money
- Travelcards
- Identity documents
- Mobile commerce
- Electronic keys: replacements for physical car keys, house/office keys, hotel room keys, etc.
- NFC can be used to configure and initiate other wireless network connections such as Bluetooth, Wi-Fi or Ultra-wideband

1.4 Architecture Diagram

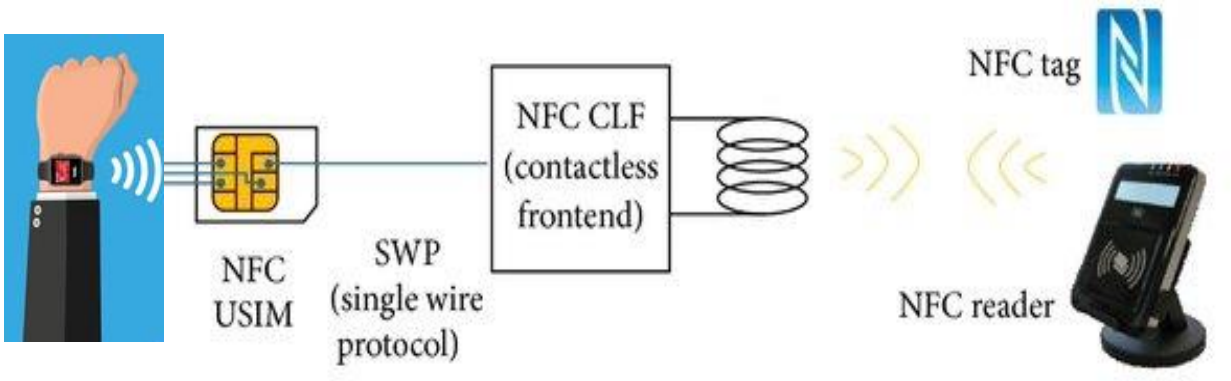

Figure 1.1 Architecture Diagram of NFC Based Watch

Figure 1.1 gives a detailed description of the near field communication process where the NFC-based watch is placed near to the NFC reader where it scans the NFC code for further processing, once the tag/code is verified the transaction between the two devices is successful.

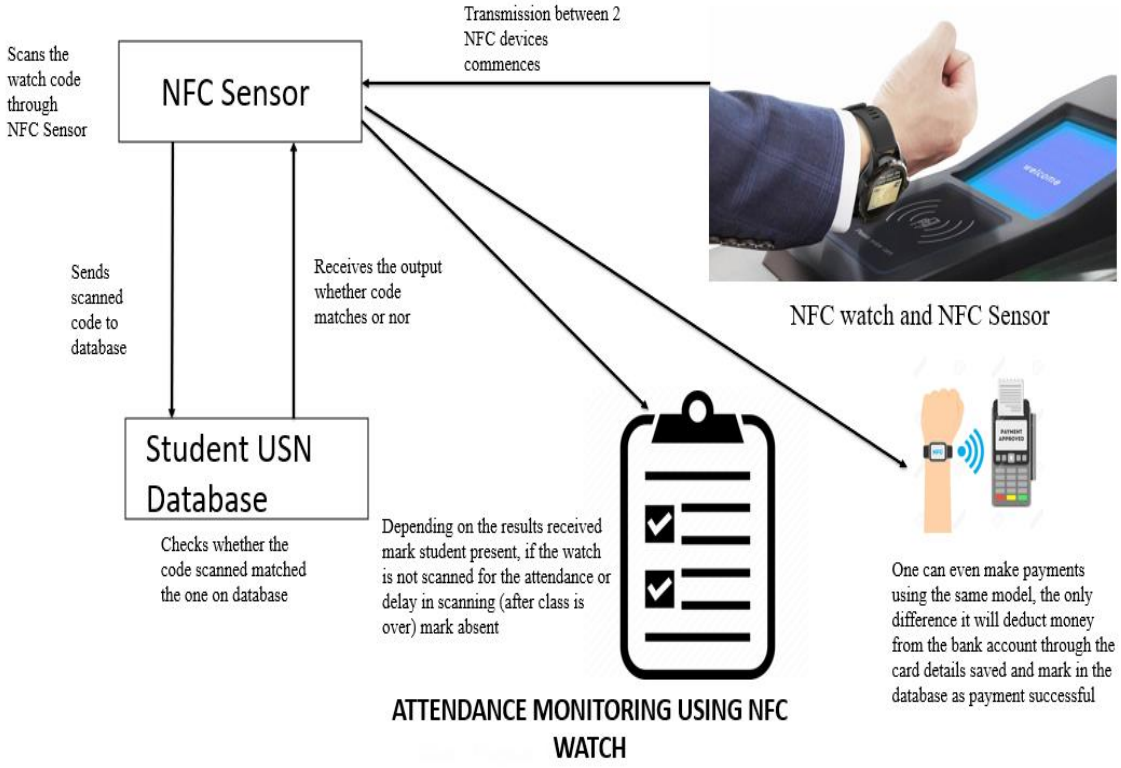

Figure 1.2 Block Diagram of NFC Based Watch

Figure 1.2 shows the flow of the data and the workings of the NFC watch, which will eventually be used for Attendance Monitoring.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Survey

The framework presented in this article allows for gathering additional information about the NFC communication, improves the test results, and decreases time-consuming manual debugging sessions in case of any error [1]. Authentication Protocol for NFC Based Anti-Counterfeiting System in IoT Infrastructure is a novel authentication protocol for anti-counterfeited drug systems based on the Internet of Things (IoT) to check the validity of drugs ‘‘unit dosage’’ [2]. An NFC system with NXP PN 532 chip, is designed and implemented using an antenna for 13.56 MHz to reflect on how NFC communications take place not only that but NFC technology is entering the Bulgarian market and is developing at a very fast pace [4]. Progress in near-field communication sensors, including the development of materials and device design and their applications in wearable personal healthcare devices have been commendable [7].

To ensure effective teaching in electrical engineering, it is essential to provide a continuous adjustment of the practical support to the current requirements. A frequent problem is related to the process of organizing an optimum material base that would allow educators to quickly identify the appropriate items, making it possible to implement more relevant teaching aids. Thus, a method is proposed for organizing the available material resources based on the Near Field Communication (NFC) technology, by which teachers can rapidly identify the required physical parts and approach practically in real-time a wide range of information on the topic, leading to significant streamlining of his work. [8].

The hardware and software implementation of a Near-Field Communication (NFC) reading system which was used to collect student attendance information in a two-year study with University Engineering students. Learning analytics has become popular with an increase in attendance monitoring activity across the higher education sector, a bespoke in-house attendance monitoring system has been created in the School of Engineering to conduct research to consider the benefits of such a system for staff and students. The paper highlights some of the technical decisions and

challenges faced during the implementation of the trial system and considers the accessibility of the system for powered wheelchair users. Electronic card reader hardware was purchased and installed in selected rooms in the University as part of a faculty of technology learning and teaching grant looking at Attendance monitoring. The study has concluded that the introduction of an electronic card reader system at the University of Portsmouth would not cause unacceptable delays for students entering classrooms and would contribute positively to the student experience, however, accessibility measures would need to be put in place to enable powered wheelchair users to engage with the system at all locations across the University premises [9].

Student attendance shapes many aspects of a university; however, it's still widely recorded by hand. While it is common for a professor to pass around a sign-in sheet to enter in attendance to a web-based application later manually, this makes for an unreliable method, leaving many inconsistencies. With today's advances in technology, an automated attendance recording, tracking, and monitoring system will greatly improve the efficiency and reliability of attendance tracking. Several other works have proposed solutions using near-field communication and IoT technologies; however, many use a single point at the start of a lecture to record attendance. This is likely to cause bottlenecks and take away time from the course. Implementation of a system takes place that incorporates NFC, cloud-based services, and a web interface for end-users. Our design introduces a one-to-one method using a student ID with an RFID tag to an RFID reader located at each desk. [10].

An attendance system is a system that is used to track the attendance of a particular person and is applied in industries, universities, schools, or workplaces. The attendance process normally involves circulating a paper for the students to register their names or the lecturer calling the names and registering the students either on a paper or from PDA/PC. The Near Field Communication (NFC) technology provides a good opportunity to support the automated execution of several education-related processes. NFC is an emerging short-range wireless communication technology. This system uses face recognition for the attendance of students at the college gate. Attendance at the gate through face recognition is mapped with attendance which is generated through NFC. This mapping is used to avoid fake attendance and increase accuracy. We have used the NFC technology and we can do it automatically and there is no

need to do it by lectures. Here we are planning to use the database to store a computer or laptop for better performance. Using the Wi-Fi module we can access it from anywhere and anytime which will provide us the better proficiency and flexibility [11].

The use of NFC technology is growing rapidly and is implemented in various applications. It aims to reduce the steps needed to perform tasks by the user in day-to-day operations such as payment, electronic ticketing, attendance system, and other office-related tasks. A university smart environment is implemented using NFC for an attendance monitoring system to reduce the need for tedious tasks. The application involves several different concerns in access control and managing physical and virtual components. These concerns are studied to create an easy-used attendance monitoring system using NFC to be applied in a smart university environment. A survey is conducted to measure students' and lecturers' acceptance of using NFC as an attendance monitoring system. The results provide insights into students' and lecturers' acceptance of using this technology. Additionally, it shows that both students and lecturers agree on the NFC attendance system should be implemented to ease attendance monitoring in the university [12].

NFC technology provides the fastest way to communicate between two devices and it happens within a fraction of a second. It has several applications in Mobile Communications and transactions. An NFC-supported College M-Attendance system for University Students is discussed as one potential use of this technology. The proposed framework replaces manual roll calls and hence, making it resilient to forgery. It gives parents and professors information about the students' attendance. The marking of attendance is quick, unsupervised, and makes use of a One Time Password (OTP) to enhance the security of the system and takes away the possibility of proxy attendance [21]. Everything can be made easier and faster with mobile platforms and smart PCs that almost everyone now has. Different types of technology can be managed and used, in various area such as shopping, banking, education. In this study, a mobile software was developed which enables to report the signature system that is applied in educational institutions as a digital system with minimum error rate. Thanks to the intelligent attendance system developed using NFC technology, NFC tags of users can be used to track their participation according to their location and time of interaction successfully.

2.1 Summary of the Literature Survey

The paper conveys the ways used to improve the efficiency of the NFC [1].Most of the papers are about what NFC is and where it is used or can be used but they do not provide any system to implement anything new [5]. The study also shows that all the devices or applications developed using NFC are not cost-effective for example; NFC chips are installed on all the desks to make the desk NFC enabled, thus installing NFC ships on all the desks will be costly [9]. The present models which are available are suitable for classrooms or universities which has a small group of students [9]. The other NFC model which was IoT based is also not effective cost-wise as everyone cannot afford the IoT mechanism [10]

CHAPTER 3

TECHNICAL SIGNIFICANCE

3.1 Technological Developments

NFC has come a long way since its induction into the market, today we have NFC-based smartphones through which we can make contactless payments, people can transfer data from one device to another, etc. So, the question was what new can be done or implemented using NFC. That's when TATA's child company Titan launched NFC watches which are used for contactless payments.

Using this idea, the idea being proposed here is a watch that can be used for contactless attendance. NFC watch can be used to make payments too but the main agenda here is to make the time-consuming process of taking attendance quicker and easier, so in this proposed system 2 main hardware requirements are there; one of the NFC embedded watch and the other is the NFC reader/sensor. So, the NFC watch when it's close to the NFC reader the reader will read the watches' unique code and then check it with the one saved in the Student Database, so if the code matches then the student will be marked present or else they will be marked absent. Else than that as it's mentioned before that we can use it for payments too, so the watch which has been embedded with the NFC chip has a unique code to it using that same code students can make contactless payments, payments such as college fee, examination fees, payments made for Lab Manuals, etc.

NFC has other uses too apart from the system proposed NFC can be used for contactless charging of phones and tablets, it can be used for contactless data transfer from peer to peer.

3.2 Tools and Technologies

3.2.1 Communication Modes: Active and Passive

The NFC interface can operate in two different modes: active and passive. An active device generates its radio frequency (RF) field, whereas a device in passive mode has to use inductive coupling to transmit data. For battery-powered devices, like mobile phones, it is better to act in passive mode. In contrast to the active mode, no internal power source is required. In passive mode, a device can be powered by the RF field of an active NFC device and transfers data using load modulation. Hence, the protocol allows for card emulation, e.g., used for ticketing applications, even when the mobile phone is turned off.

This yields two possible cases, which are described in Table 3.2.1. The communication between two active devices case is called active communication mode, whereas the communication between an active and a passive device is called passive communication mode.

Table 3.1: Communication Configurations

Communication Description Mode	Description
Active	Two active devices communicate with each other. Each device has to generate its own RF field if it wants to send data. The RF field is alternately generated by one of the two devices.
Passive	In this mode, the communication takes place between an active and a passive device. The passive device has no battery and uses the RF field generated by the active device.

In general, at most two devices communicate with each other at the same time. However, in passive mode, the initiator can communicate with multiple targets. This is realized by a time slot method, which is used to perform a Single Device Detection (SDD). The maximum number of time slots is limited to 16. A target responds in a randomly chosen time slot that may lead to a collision with the response of another target. To reduce the collisions, a target may ignore a polling request set out by the initiator. If the initiator receives no response, it has to send the polling request again.

3.2.2 Code Modulation

The distinction between active and passive devices specifies the way data is transmitted. Passive devices encode data always with Manchester coding and a 10 %ASK1. Instead, for active devices, one distinguishes between the modified Miller coding with 100% modulation if the data rate is 106 kbps, and the Manchester coding uses a modulation the ratio of 10% if the data rate is greater than 106 kbps. As we will discuss later the modulation ratio, defined in is of high importance for the security of the NFC data transfer.

- **Manchester Code**

The Manchester coding depends on two possible transitions at the midpoint of a period. A low-to-high transition expresses a 0 bit, whereas a high-to-low transition stands for a 1 bit. Consequently, in the middle of each bit period, there is always a transition. Transitions at the start of a period are not considered.

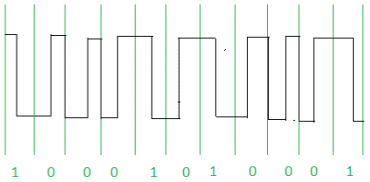

Fig 3.1 Manchester Coding

- **Modified Miller Code**

This line code is characterized by pauses occurring in the carrier at different positions of a period. Depending on the information to be transmitted, bits are coded. While a 1 is always encoded in the same way, coding a 0 is determined based on the preceded bit.

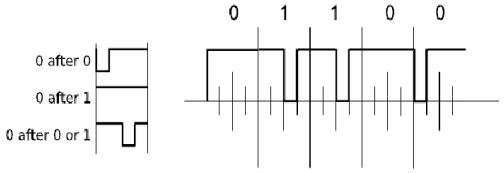

Fig 3.2. Modified Miller Code

3.2.3 Initiator and Target

Furthermore, it is important to observe the role allocation of the initiator and target. The initiator is the one who wishes to communicate and starts the communication. The target receives the initiator's communication request and sends back a reply. This concept prevents the target from sending any data without first receiving a message. Regarding the passive communication mode, the passive device acts always as an NFC target. Here the active device is the initiator, responsible for generating the radio field. In the case of an active configuration in which the RF field is alternately generated, the roles of initiator and target are strictly assigned by the one who starts the communication. By default, all devices are NFC targets and only act as NFC initiator devices if it is required by the application.

In the case of two passive devices communication is not possible.

Table 3.2: Possible Combinations Active/Passive with Initiator/Target

	Initiator	**Target**
Active	Possible	Possible
Passive	Not Possible	Possible

3.2.4 Collision Avoidance

Usually, misunderstandings are rather rare, since the devices have to be placed in direct proximity. The protocol proceeds from the principle: listen before the talk. If the initiator wants to communicate, first, it has to make sure that there is no external RF field, in order not to disturb any other NFC communication. It has to wait silently as long as another RF field is detected, before it can start the communication, after an accurately defined guard time. If the case occurs that two or more targets answer at the same time, a collision will be detected by the initiator.

3.3 Sustainability and Societal Concerns

NFC for Environment

Businesses and individuals alike are realizing the benefits of going green. With the push for greener businesses, homes, and environments becoming a large issue, companies are looking for ways to reduce energy consumption and save paper. Near-field

communication technology takes a step in the right direction by cutting down on paper consumption for advertisements and communications.

Though businesses still print ads to put NFC tags on, they can reduce the amount of extra paper circulated with each ad. Instead of distributing flyers for a house for sale or a clearance event, a large sign can have an NFC tag that users wave their smartphone over to get all the information they need about the event. This cuts down on the amount of material printed for an advertising campaign. This is especially important since all that paper is typically thrown away after the sale ends.

Coupons are another way NFC technology can cut down on paper consumption. When your business switches to coupon distribution electronically, customers can load coupons onto their smartphone and pay without ever needing to pull out a piece of paper. Customers can delete the coupons they don't want instead of throwing piles of unwanted coupons in the trash.

NFC technology not only lets businesses go green but saves money as well. NFC tags are relatively cheap to create and use, and can be altered as needed. Customers will often prefer shopping with a merchant that uses NFC technology over traditional paper coupons and credit card payments. It means the customer has less junk to keep track of, since everything is stored on his smartphone, and can increase repeat visits from that customer.

Benefits of NFC for Individuals

- Contactless Payments
- Information Sharing
- Transportation
- Social Networking
- Health Care

Benefits of NFC for Businesses

- Staff Communication
- Real-Time Updates
- Improved Customer Service

3.4 Conclusion

Near-field, communication can be extremely beneficial in the modern era of technology. NFC is an extremely simple and convenient technology because the data exchange can be done by just bringing two NFC-enabled devices together. It is interactive and secure and does not require any special software to run on. The underlying standards of NFC follow universally implemented ISO, ECMA, and ETSI standards. It also does not require any manual configuration or settings which makes it easier for consumers.

This technology has the limitation that it can be operated only with devices under a short range and has a very less data transfer rate. Consumer privacy and data security are also at risk if there is a cyber-breach. A major challenge is interoperability which is guaranteed only if the devices comply with the standards required. Even after these hindrances, NFC is building on existing systems, a popular example is Google Wallet. So, it has a very good chance to be valued and used for many years to come.

Thus, NFC is a new technology and like other technologies, it is hard to make it mainstream as of now because of technological limitations. But it’s fast-growing and it will be successful once strict security measures are set in place.

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