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NFC BASED SMART IDENTIFICATION AND PAYMENT SYSTEM

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Abstract- **Registering for attendance in education environments especially universities is a highly demanding activity as a result of increasing number of students. The identification process normally involves circulating a paper for the students to register their names, or the lecturer calling the names and registering the students either in a paper or from PDA/PC. In the first case the students' attention may be attracted while taking the lectures and at the same time they can register for students who do not being present in the class. While in the latter case the issue of cheating in the form of registering for their friends can be solved but imaging the number of students to be from 50 and above, a great portion of the lecture time will be wasted performing this process. In this paper we propose a smart identification system using NFC that will simplify the identification process, by using NFC enabled id cards and reader. It is not only used for attendance but also to make payments automatically within the organization or campus. The work is developed using an Arduino Microcontroller with PN532 based NFC reader and card. The performance of the system is evaluated by using VB.NET.**

Keywords—NFC technology, NFC Reader and card, Ardunio microcontroller and VB.NET.

Introduction

The issue of attendance registration in present-day institutions is really posing a great challenge in academic setting, because of the way the process is done and various hurdles surrounding it. The attendance is an important part of students academic record; since in some institutions without a certain percentage student cannot sit for an examination, while in some other institutions it is part of the continuous assessment. However, the traditional way of attendance registration is time consuming and prone to cheat by some students. The process involves the lecturer passing a paper to the students in a class to write their names and sign, or find their names in the paper to sign along their names. In this situation some students may deceive the lecturer by signing attendance for their friends who are not present in the class. Another way which is more difficult and time consuming is the lecturer will be calling names from the list of the students that are enrolled into the course, and mark present for each and every student who is in the class. Imagine how many minutes it will take to register attendance in a class of like 100 students in this fashion. These are some of the challenges that call for an improvement in the attendance registration process. Several technologies like Biometric, RFID, NFC, etc can be used to simplify and improve the attendance system, since user identification is the most important aspect that needs to be handled cautiously in this type of applications. In this work we propose a web based identification system using Near Field Communication (NFC) technology. The NFC technology is now integrated into mobile devices which can be used for online payment, access control, user identification, transfer of personal and private information, etc. NFC is a new, short range, high frequency, low bandwidth, and wireless communication technology. NFC communication is activated by touching two NFC enabled devices together, or bringing them into close range. The range is usually few centimeters, and it operates at the frequency of 13.56 MHz. The maximum data transfer rate is 424kbit/s. NFC is based on Radio frequency Identification (RFID) thus its communication involves initiator and a target,the initiator actively generates a Radio Frequency (RF) field that can be used as a signal to power a passive target. The initiator (active) has its own internal power that can be used to power the ICs that generate the outgoing signal; while the target (passive) has only ICs with no internal power, which makes it to be in different forms like tags, stickers or cards NFC support three modes of operation they are: reader/writer mode, card emulation mode, and peer to peer mode. The communication in reader/writer mode is between NFC device and a tag in which device either read from a tag or write to a tag. Peer-to-Peer mode involves exchange of data between two NFC devices. While in card emulation mode the NFC device acts as a tag which will appear to a NFC reader as a contact-less smart card. One popular application of NFC is Smart Poster. The concept of Smart Poster is to keep information like URL, phone number, SMS into a tag and attached the tag to a physical object. This information can be accessed by touching the tag with NFC enabled device. The Smart Poster has some actions that can initiate a phone call, can launch a URL, or can send an SMS In our proposed system two modes of operation will be used: Reader/writer mode (like smart poster) and Peer-to-Peer mode

This paper presents our works in developing an NFC supported identification system as well as updating the student database .Today NFC has been integrated in mobile phones and has a wide range of applications associated with it. Now a days there exists multiple applications like smart payment systems, access control, ticketing system etc. developed using NFC incorporated in the mobile devices which can be used within an organization or campus. These applications are short go in a single device which makes the day to day life easy. Present work deals with the secured, low cost, less complex smart campus payment system developed using NFC technology along with the RFID integrated personal identity cards of individuals within the campus. The work replaces the use of mobile phones for smart payments as an application of NFC. The proposed work doesn't use mobile phones which reduces the cost of the system largely. Authentication through password is developed in the system which provides ATM type secure environment with the ID card for making the payment. This work can be implemented in schools, organizations, college campus etc. The proposed work is developed using PN532 NFC/RFID controller shield V2.0 of seed studio, Arduino UNO, Lab View and Microsoft access. The presentation in this paper is organized as follows: Section II presents a review Section II presents a review on works done by some researches related to attendance management system and payment system which include computer-based attendance systems, and mobile-based payment systems using various technologies like biometric, RFID and NFC. Section III discussed about the proposed system with its components. The working of the system is explained in Section IV. Finally, the last part presents the conclusion and future improvement.

I. RELATED WORKS

In an effort to improve attendance registration system, researchers worked on the improvement from different perspective. Some systems are computer-based which may be online or offline system. For instance, a desktop application developed by Jain *et al*. [3] in which all the list of registered students for a particular course will be displayed when the lecturer start the application. The attendance registration is done by clicking a check box next to the name of students that are present, and then a register button is clicked to mark their presence. Another similar project was proposed, but in this case the student will have to register individually using client server socket program from their device (laptop) [4]. Registering the attendance by proxy is eliminated in the first project since the lecturer will see each and every student in the class, while in the latter case student snapshot is taking by the client application. Even though in both projects the time wastage is also there, but still it is an improvement on the manual process since attendance data can be stored safely and reports can be easily generated. However, Zhang *et al*. [5] are with the opinion that attendance management is ignored by current educational administration management system, focusing only on register management, education plan, course management, etc. as a result they developed attendance management system using Visual Studio.NET and Oracle. Their system is a web based that used card technology for student's identification and registering attendance into the database. Mohamed *et al*. [6] designed a fingerprint device that is used in fingerprint attendance system. The students mark their presence by placing their finger on the device's sensor. The system components are: Handheld device which was constructed and controlled by microcontroller (PIC18F4550) with components (fingerprint module, Real Time Clock RTC, buttons, Graphic Liquid Crystal Display GLCD, Memory, etc). Host computer with GUI application for managing the attendance, the application is used to transfer the students‟ data to the device. The attendance details can be accessed through USB interface and finally store in to the database. [6] On the other hand, BIS [7] presents a commercial system based on RFID for attendance management for schools and colleges. The system can send SMS and email alert to parents/guardians of the students automatically. The student will register at the gate by touching RFID device with their RFID tag and send the data to BISAM server in the school. The server will process the attendance data and send an SMS to the parents/guardians of the absentee student through BISAM SMS gateway server. The system also has Time Manager Software for managing employees attendance and HR related functionalities. In [8], [9] RFID reader was designed with microcontroller, transceiver chip, serial communication IC, LCD, USB interface, power supply module, etc as components. When a staff member touches the reader with their card the data is sent to PC manager application which will validate the data and extract information like staff ID and access time into the database [8]. While in [9], when a student touch the reader it sends the data to the microcontroller for comparison with the ID stored in the microcontroller's memory; if ID exist the name, ID and attendance will be displayed on the LCD then transfer the data to PC via RS323 port [9]. Also [10] proposed another system based on RFID where the RFID terminal read the student ID, date and time; and store it into a database in an online server. The NFC-based applications simplify various human day-to-day activities by simply touching an object fixed or integrated with NFC tag. For instance, SmartTouch is one of the early NFC projects that focuses on NFC technology which was coordinated by VTT Technical Research Centre Finland; applications in various areas were developed under this project such as mobile payment and ticketing, smart poster, attendance system for schools, home use, household access control and security, blood glucose meter, etc. [11]. NFC-enabled services were piloted in schools in Oulu. Some of the services include VIKSU Info Channel that provides homework assignment, meeting, and timetable functionalities. Another project is attendance supervision for secondary and primary

school. This service will allow lecturers, administrators and parents to instantly know the attendance status of their children. Laanila upper secondary school students were used for pilot test whereby they will touch a tag on the teacher's desk with their NFC-enabled mobile phone to register their attendance. They receive a response immediately on their phone. The system by default mark the student absent if they did not log in by touching the tag. The system initially calculate lateness after 3 minutes of the starting time, but later changed to 3 minutes after first student register since the teachers can themselves sometimes be late due to other responsibilities. The primary school attendance is aim at providing parents real-time information about their children's arrival and departure. Children at Hintta Primary School were given NFC card holding their information that will be used to touch a reader that will register their arrival or departure and their parents can check it online or choose to receive the information as an SMS. The card can also be used to touch the teachers phone in order to control the attendance for afternoon care centre. [12]. Data was collected from the users in order to find their experience when using the system; also the analysis revealed that the system will benefit mainly parents and teachers [13].European Higher Education Area (EHEA) is working on promoting the modernization of the universities throughout Europe, the Technical University of Cartagena worked on developing and implementing Smart University model for realization of intelligent environment. This project has two goals: creating a ubiquitous computing system where relation between people, practice, and technology happen as a part of a natural interaction paradigm, and to deliver applications that replace some of the tasks that cause the teachers, students, and other staff to spend time daily. Two projects were developed they are attendance registering system and administrative payment system (like matriculation charges, transcript of record, certified document charges etc) which are all based on NFC. The hardware used in the project includes NFC-based active devices (Nokia 6212 and Samsung Nexus S), NFC-enabled passive devices (Topaz,Touch a tag, and Nokia), NFC readers (ACS-ACR-122U), and NFC Server Hosts linked to the university network which handle the communication with the readers. This host runs the software applications that provide access to the reader. In the attendance system each room has NFC reader which is connected to teacher's PC which is connected to the university's network. The students and teachers must download and install the mobile application on their phones that will be automatically run upon touching on the reader.The teacher will activate the lecture group. When the students and teachers application started they will fill a form and transfer the data to the server through the reader, and receive a response also via the reader [14].Contactless technology especially NFC can be utilized to make university life easier. Therefore, Budapest University of Technology and Economics (BME) introduced NFC-based student attendance monitoring system [15], [16].The system can be used to track attendance percentage, in order to put the university's rule concerning writing exam without a certain attendance percentage into practice. Biometric identification is added to NFC to avoid impersonation. The students register their attendance from a terminal that has NFC and fingerprint reader using only card that stores student ID and fingerprint. The terminals store the attendance data and it periodically send the data during the day to a back-office system. The terminals as well as back-office store timetable and identification policy . The back-office generates the report from the data received from the terminals. The terminal is capable of storing attendance data for a complete semester [16]. Similarly, a mobile phone attendance system for small office employees was presented[17]. The employee will touch the NFC-enabled mobile device with their card, and then the employee data (ID, Photo, Time in/Time out, and Date) will be sent to the backend system. Ninomiya *et al.* [18] proposed a design of NFC and Social Network Service (SNS) based Event management attendance system. In their system the meeting participant when registering for the event will provide their SNS ID (twitter).The goal of the system is to bridge the gap between SNS ID and user using NFC and SNS, since in some situations the participants may be friends in a particular SNS without knowing it while they are in the event. The organizers prepares NFC tags with meeting and session names on the tag, and the participants are assumed to have smart phones or tablets with NFC capability. Although the participants register their SNS ID in the pre-meeting registration website, when they attend they will download application software in their NFC enabled device. The meeting name, session name, and SNS ID must be set by the participant in the application. When the participants touch the tag in the session a message will be send to a server notifying it that the user is in the meeting. The NFC device of the user will receive the SNS ID of the participants who are in the meeting and those that are supposed to attend. With this information the organizers will have the list of those attended the meeting [18]. From the works above it appears that some of the systems developed require the use of computer for attendance registration, while others involve the use of fingerprint, RFID . Therefore, we are proposing an easy to use web based attendance registration system that will require simply a NFC id card and reader. We can make online payment inside the campus by simply touching the id card with the reader.

II. PROPOSED SYSTEM

The system proposed in this paper is a web based identification system utilising NFC technology. The units are reader unit and web server unit. Each of these units has hardware and software components. Essentially, the hardware components for the NFC based reader units and tags, while for the web server unit is a computer that can host web services.

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Whereas, the software required in the reader unit is the client application that will be installed on NFC-enabled devices. The software requirement for the web server unit is the web based identification application and payment system.

A. Reader Unit

Reader unit is the unit that is responsible for reading the student information like student ID from either student's NFC-enabled mobile device or a tag. If the student is using NFC-enabled mobile devices then the student ID is retrieved from a file stored in the device. But if the student is using an NFC tag in the form of card or wristband then the student ID will be retrieved from the tag. Furthermore, for NFC-enabled mobile device user; device ID is used as a way of verifying the student. This ID is read from the device and passes together with the student ID into the server. Apart from student ID, course code is another important field that is needed for the attendance registration. The course code and the address (URL) of the web based application are stored in an NFC tag before starting any class. The type of tag used in this work is NFC forum type 2 (MIFARE) tag with 716 bytes size. In developing this system issue of not having NFC-enabled device by some students and or unstable Internet service were taking into consideration; this is because both NFC-enabled device and Internet are mandatory requirements for the system. Consequently three different scenarios will be discussed related to the two issues. From the three scenarios discussed in the next subsections, we can clearly see that the best option is the first case, where the student has an NFC enabled device and Internet connection. The rationale is that the students can be verified with their device ID, and they can get a response immediately on whether their attendance registration is successful or not. Another advantage is, we can have more than one smart poster for a larger class to reduce the waiting time for the registration. In the second case, we can still verify the students with their device ID but they cannot get a response.Also, for larger classes there will be delay in the process since every student will use the lecturer's mobile device. The last scenario is the least secured especially if student is using a tag since only the student ID is kept in the tag, but it will be a bitsince only the student ID is kept in the tag, but it will be a bit more secured if using NFC tag integrated into student ID. However, this has same limitation as in the second scenario. The next application is campus payment system every individual is provided with a NFC which is integrated in the identity card. A database associated with the unique NFC is maintained for every individual. During the payment one should authenticate by tapping the ID card to NFC antenna and enter the password. Then the respective amount is debited from the account and data base is updated with the remaining balance. The amount is credited in the same way after successful authentication.

Fig1:BLOCK DIAGRAM

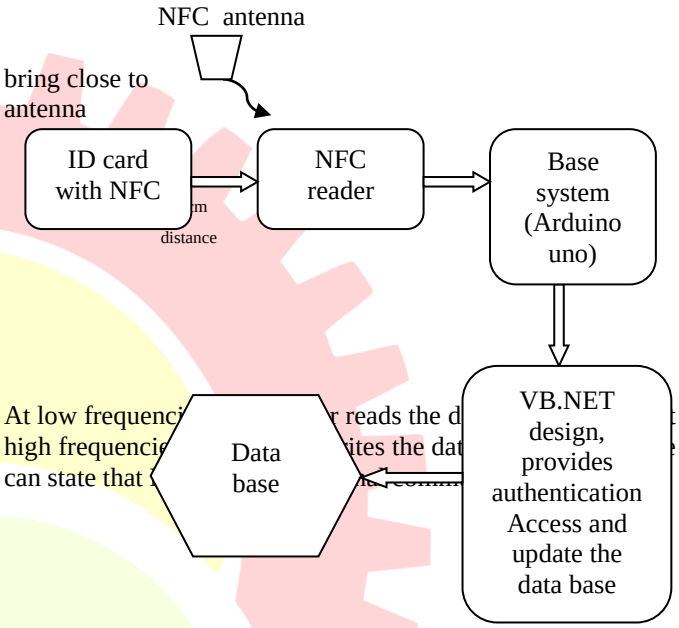

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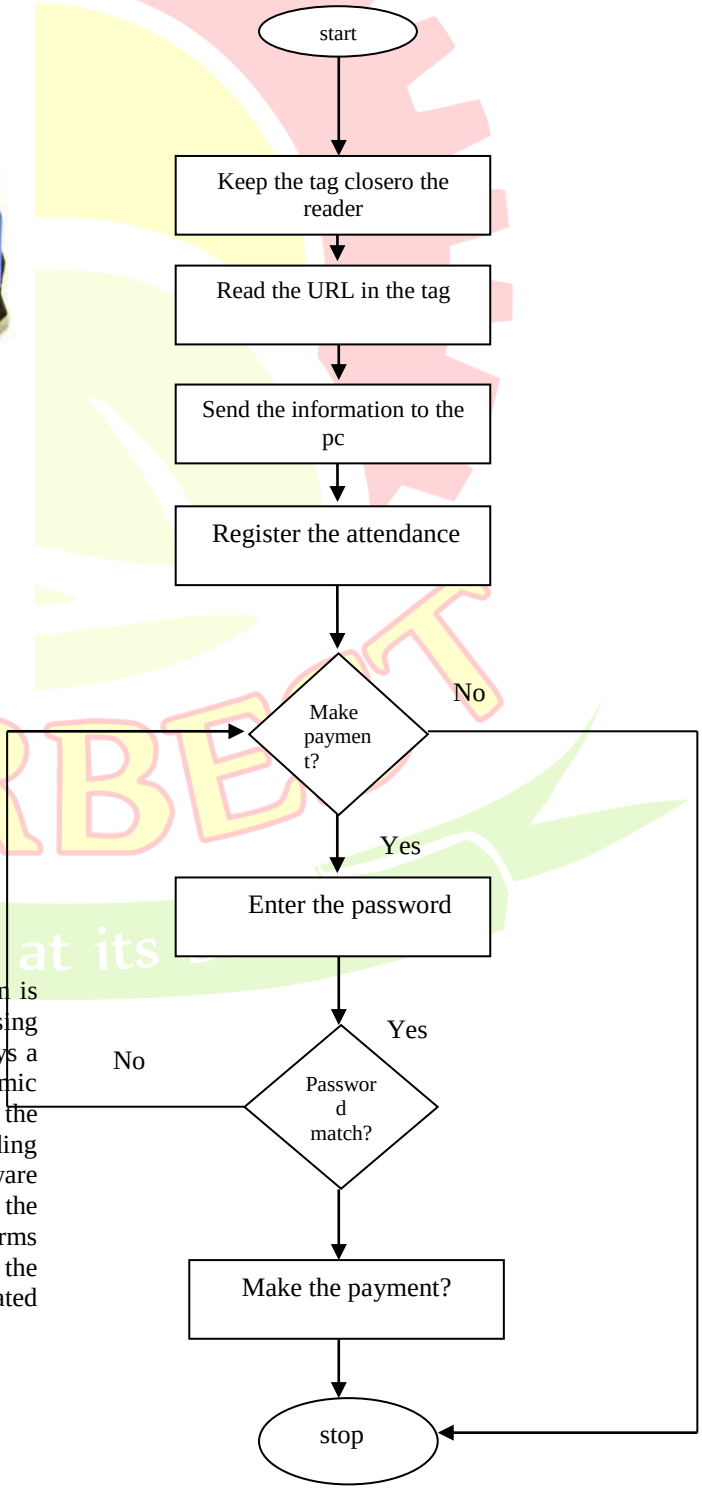
Fig2:NFC Reader

B.Accessing the Database through VB.NET

A database is created using Microsoft access and a design is developed in the by generating the SQL syntax for accessing the database. The SQL syntax comprises of the which plays a vital role in reading the data of respective person. A dynamic SQL syntax is generated whenever NFC antenna reads the RFID from the ID card. NFC shield is activated by uploading the code in the Arduino IDE after making proper hardware connections. Once the NFC starts reading the data the VB.NET design should be executed. In addition, performs authentication with the password and then process the payment. After the payment is done the database is updated with available balance. The balance can be credited in the same way after proper authentication.

Fig3:FLOW CHART



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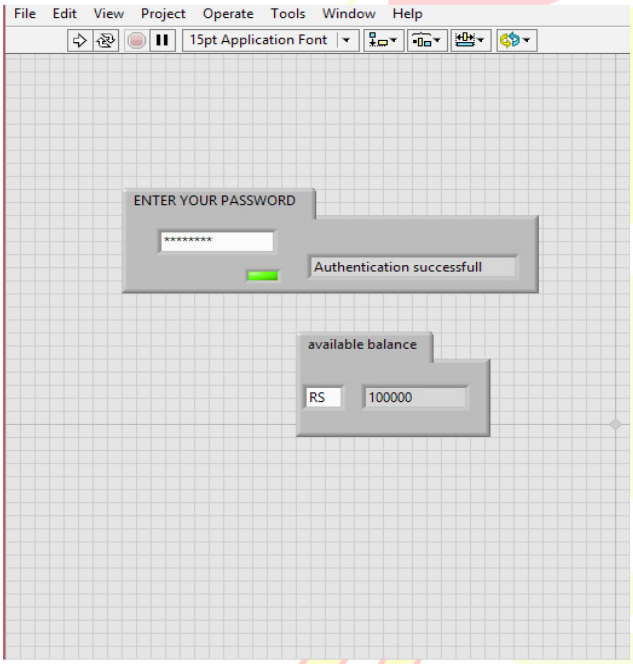
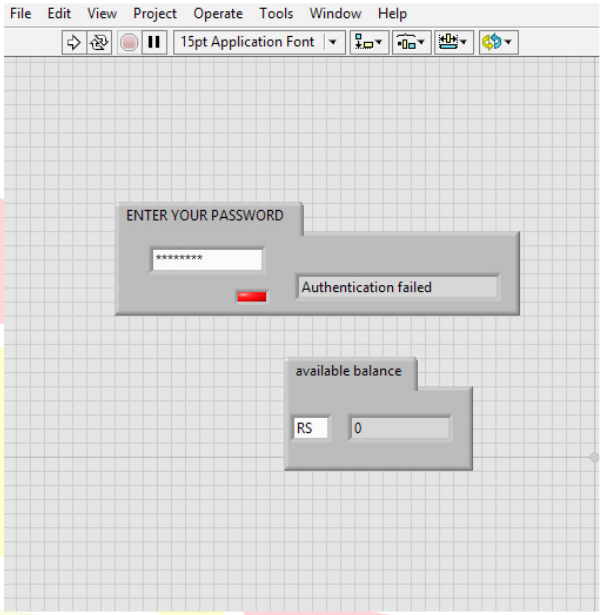


Fig 4. (a) Front panel of overall design when authentication successful



(b) Front panel of overall design when authentication unsuccessful

IV. RESULTS

Usage methodology and implementation of this work just utilizes present NFC technology on the smart cards accordingly actualizing the procedure completed. The Arduino UNO board is interfaced with PN532 NFC/ RFID controller shield utilizing the libraries developed for SPI protocol. An RFID integrated campus ID card is tapped to the NFC antenna in order to launch the correspondence. NFC follows the RFID standards that include ISO14443-A/B and Felica. Figures 4(a) and 4(b) shows the front panel of overall design after concatenating the individual modules. Thus a smart campus payment system is developed using PN532 NFC/RFID controller shield**.**

V.CONCLUSION

An application which uses RFID integrated campus ID card instead of mobile phones to communicate with NFC shield has been made for identification system as well as smart campus payment system which reduces the cost of the system which are available today and complexity of the design. The system is hacking free as it is impossible to hack from distance more than 10cm, without ID card. In addition it is password protected which overcomes the issue in case of ID card missing or stolen. Since it doesn't need any keying or encryption techniques, design complexity is reduced. Since the work is developed using individual identity cards valid with inthe campus, it is flexible for every individual to use the payment system effectively and easily. No extra gadgets are required for authenticating and making the payment. This work adds feature to the existing systems which uses ID card scanning for granting access into an organization or a campus. The proposed work is successfully developed using PN532 based NFC shield V2.0 of seed studio.

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