International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 06 | Jun 2024 www.irjet.net p-ISSN: 2395-0072

Smart Solution for Smart Schools: NFC-Based Attendance System

Oguzhan Sali[1], Hatice Okumus[1]

[1] *Department of Electrical and Electronics Engineering, Karadeniz Technical University, Trabzon, Turkey*

Abstract - *The use of Near Field Communication (NFC) technology offers significant advantages such as increasing security through encrypted data transfer, enhancing scalability for larger classes or institutions, reducing environmental impact by minimizing paper use and many more. This study explores the integration of NFC technology into educational settings to enhance the process of taking attendance. Utilizing NFC-equipped student ID cards, the system captures card IDs through an NFC tag reader. These IDs are processed by a Raspberry Pi, which verifies them via an internet connection to retrieve corresponding student information. This data is then relayed to a computer interface, culminating in the generation of an attendance list. The proposed system offers significant advantages including reducing administrative burden and improving accuracy in attendance tracking underscoring its potential for broader applications within educational institutions.*

Key Words: Near Field Communication, Raspberry Pi, Attendance System, University Education, Prototype Process

1.INTRODUCTION

In recent years, technological advancements have transformed the operations of many industries and brought profound changes to our daily lives. Wireless communication technologies such as Near Field Communication (NFC), Radio Frequency Identification (RFID), biometric systems, and QR codes are effectively utilized in various applications in technological devices. These technologies are widely preferred for granting access permissions [1-2], paying public transport fees [3], and executing banking transactions [4,5]. The education sector, in particular, has been significantly affected by digitalization and automation processes. While traditional manual attendance systems are time-consuming and prone to data entry errors, these technological solutions accelerate processes and enhance accuracy in educational institutions. Research in this area can be found in the literature [6-7].

In his thesis, Dindar explored the topic of 'NFC and Its Applications', developing a mobile payment application by researching secure payment methods. The study extensively examined the working modes and hardware architectures of NFC in comparison with other contactless communication technologies like Bluetooth, and discussed potential security breaches in mobile payment transactions using NFC cards, such as data corruption, eavesdropping, and Man in the Middle attacks, highlighting necessary preventive measures. The implementation of the application required the use of an Application Security Domain (ASD) to ensure the security of NFC communications [8]. Another thesis by Karabulut focused on developing a mobile facial recognition application named 'Davetli', utilizing near-field communication technology in wireless applications. During its implementation, Microsoft's Face API and JSON (JavaScript Object Notation) were used for face recognition and data transfer. In this application, previously invited guests' photos and personal information were recorded in the database. The design allowed entry to the event by reading guests' personal data from NFC cards and verifying their location and date [9]. Mazumdar et al. worked on developing a contactless student tracking system for higher education students returning to education after the Covid-19 pandemic. This application, using RFID technology and NFC, was designed to record student and faculty information and create a database. Students and faculty performed the registration by scanning their NFC-enabled mobile devices against each other's devices, offering a contactless, healthy, and time-efficient solution [10]. Research by Singh et al. in India, the world's second most populous country, developed an IoT-based project to prevent the wastage of the high volumes of consumed drinking water. This project integrated NFC and SCADA systems to monitor water usage, facilitating the tracking of sensors in the SCADA system and interactions between users and devices through this integrated system [11]. Attaran et al. developed an NFC reader antenna design for use in automotive door handles and operating mechanisms. This design aimed to leverage the security features of near-field communication in key parts of automobiles and door handles. The study used the NFC antenna of a Samsung Galaxy S8 and a chrome plate, with a ferrite plate added to enhance connection quality and power efficiency [12].

This study implements the application of NFC technology in the field of education. Students' ID cards, equipped with NFC tags, are scanned by an NFC tag reader. Following this process, the card ID from each student's card is retrieved and sent to a Raspberry Pi. The card ID is then verified over an internet address to fetch student information. This step is performed using the wireless capabilities of the Raspberry Pi. The retrieved student information is transmitted from the Raspberry Pi to a computer interface, where an attendance list is generated. This system allows for a faster and more reliable method of taking attendance during class without the need for circulating paper lists. This approach not only speeds up the process through contactless card scanning but also offers a more hygienic and safer way to manage

attendance, ensuring that students' attention is not diverted during the lesson.

2. PROPOSED SYSTEM

In the proposed application system, NFC-enabled PN532 tag readers is utilized to scan the tags on campus cards, thereby retrieving the card IDs. Following this procedure, these IDs are queried in the database via a Raspberry Pi that has been previously connected to the internet through Wireless. The information obtained is then transmitted to the corresponding interface on the computer using Wi-Fi. The general block diagram of the system is presented in Fig. 1.

Table 1 details each piece of equipment and component utilized in the development of this system. The Raspberry Pi 4 Model B was selected for its integrated Wireless and Bluetooth capabilities, minimizing the physical footprint of the prototype system [12]. The PN532 stands out as a versatile module that supports both NFC and RFID communications, offering faster read speeds at short distances compared to other readers. The LCD screen provides visual feedback to the user, displaying the success or failure of the student information registration process on the interface. Finally, the computer serves as the platform where student information, collected via the Raspberry Pi, is input into the interface.

In the designed student attendance system, the card reading process is carried out using the PN532 Adafruit library. The data obtained are processed via an Application Programming Interface (API). As the data contain student-specific information, it undergoes a filtering process before creating the attendance list. The filtered data are then transmitted to the interface screen for generating the attendance list. This process is conducted over the university's internet IP. Upon successful completion, the LCD screen displays the message 'Record successful.' If an API communication error occurs, the student's registration is determined to be unsuccessful. The process of obtaining student data and the data transmission algorithm is detailed in Fig. 2.

Table -1: lists the equipment and components used in the development of this attendance system

Component	Name/Model	Functionality
Embedded Board	Raspberry Pi 4 Model B	For control and decision making
NFC Reader	PN532	Reads student ID cards
Laptop	Any personal computer	For interface
AC/DC Power Adapter	-	Supplies voltage to the board
LCD Display	2x16 LCD Display with I2C	Displays information

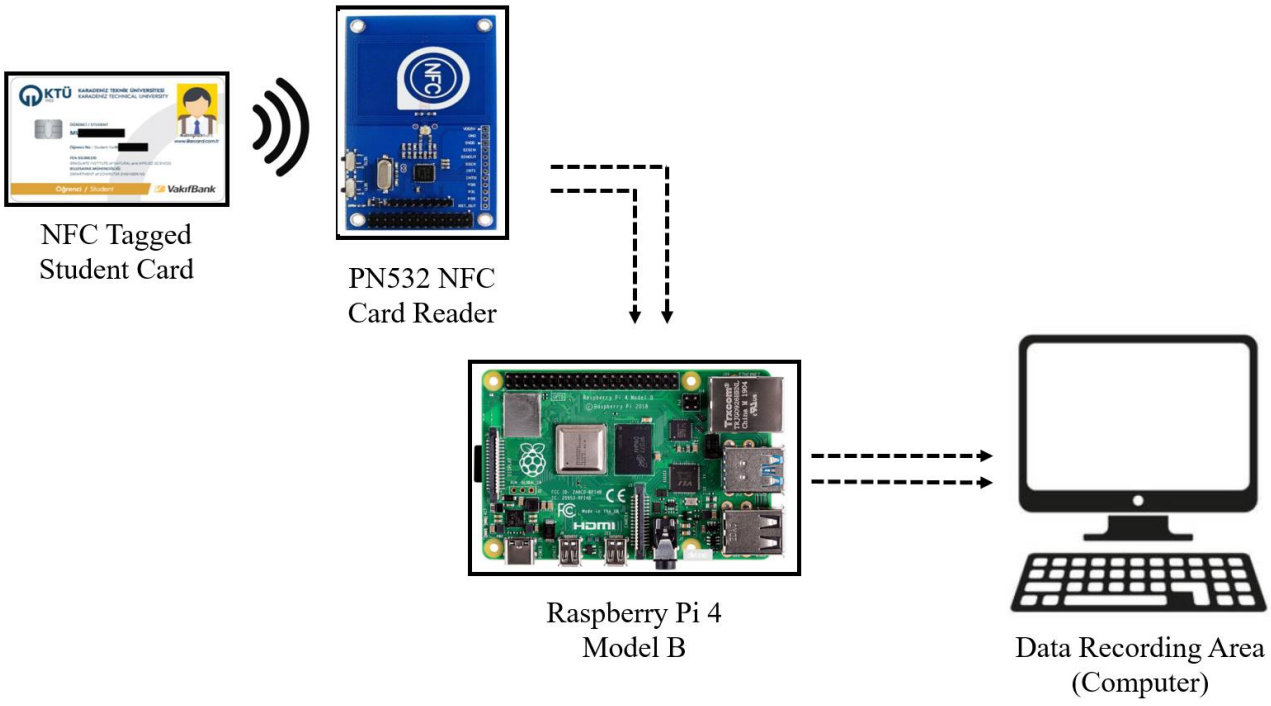


Fig -1: The general block diagram of the system

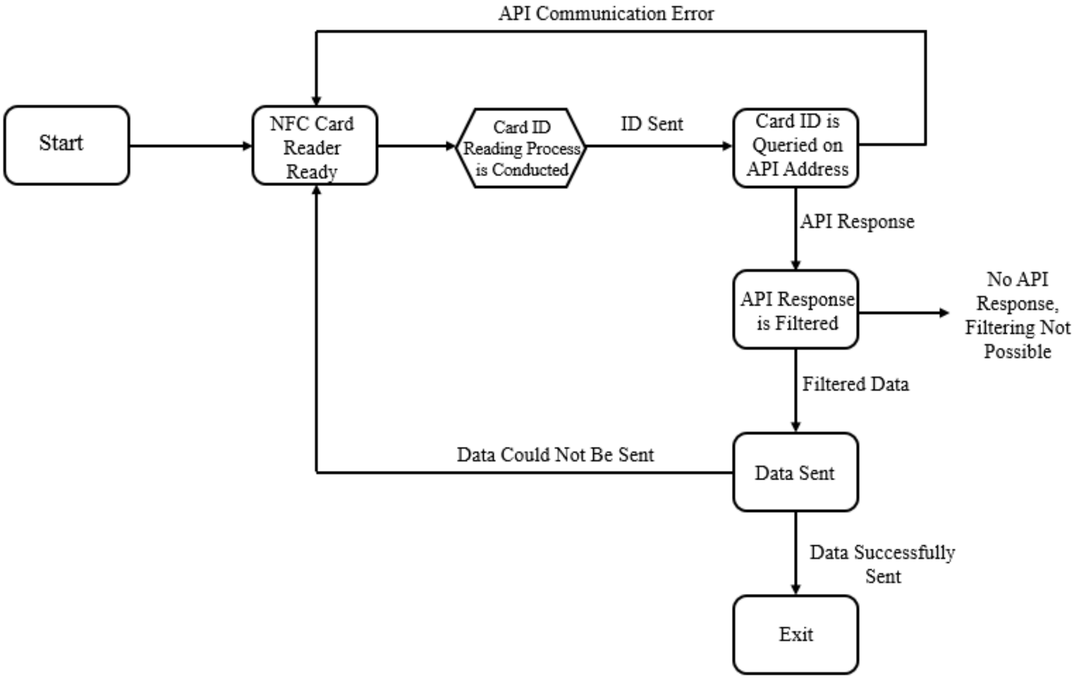


Fig -2: Algorithm for student data collection and transmission process

3. EXPERIMENTAL RESULTS

The prototype of the NFC-based attendance system has initially been tested by the authors. When an NFC tagged identity card is scanned, a unique API address is generated for each student. Information in Javascript Object Notation (JSON) format is returned from this address, which can only be called from the university network. As shown in Fig. 3, it includes the student/registration number (sicil No), full name (Adı-Soyadı), Turkish identification number (TC kimlik NO), and card number (Kart No). The student/registration number is formatted to be an 11-digit number by adding leading zeros. Example output would be; [{"sicilNo":"00000365104","adi":"OĞUZHAN","soyAdi":"SALİ","tcKimlikNo":"*********","kartNo":"09E08A9E","aktif":1}].

The proposed system has also been tested at the Department of Electrical and Electronics Engineering in Karadeniz Technical University. Students in the department were requested to scan their NFC-enabled student ID cards into the newly established system. When students scanned their cards, their information was captured and displayed in real time on the developed interface, as illustrated in Fig. 4. The exact time of the card scan is also displayed on the Python-developed interface screen. The attendance list can be saved directly from the interface screen in .txt file format.

The hardware structure and internal connections of the system created are presented in Fig. 5 (a) and (b). The dimensions were designed to be compact and practical, and parts were produced using a 3D printer and then assembled. In the final stage of the study, there were problems with the display, and unfortunately, it did not work afterwards.

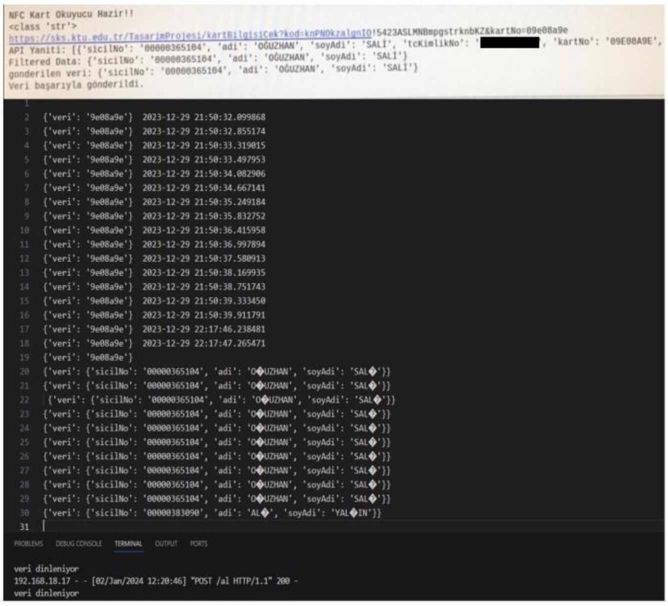


Fig -3: An example output

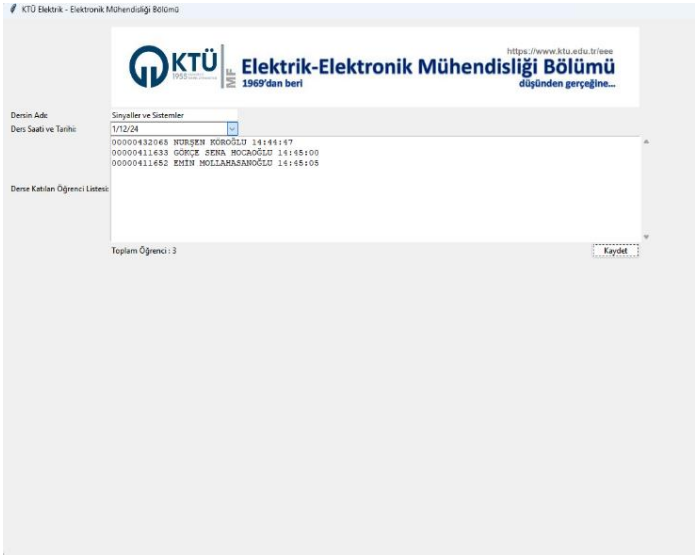
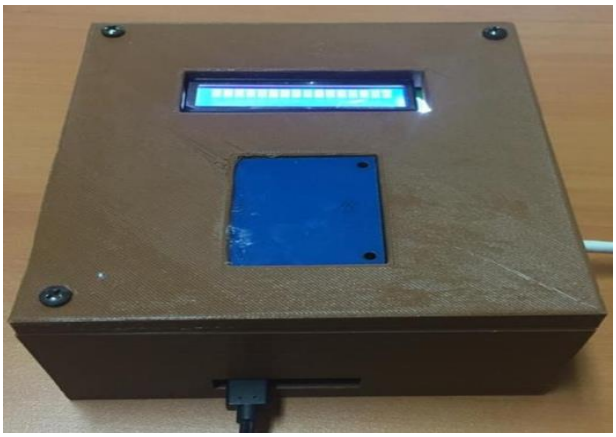
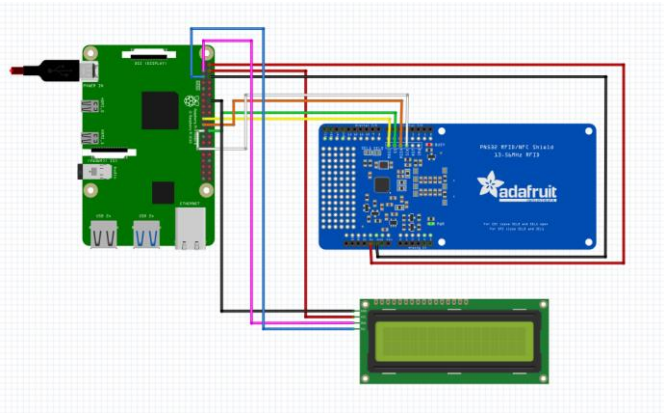


Fig -4: The developed interface



(a)



(b)

Fig -5: The hardware structure and internal connections

3. CONCLUSIONS

This paper has demonstrated a novel application of NFC technology to enhance attendance tracking in educational settings. The proposed system leverages NFC-enabled student ID cards and a Raspberry Pi to streamline the process of attendance recording. By scanning the NFC tags embedded in the ID cards with a reader connected to the Raspberry Pi, student IDs are swiftly collected and verified through an online interface. The performance of the system was validated with real-time data taken from the students in Karadeniz Technical University. The system facilitates a quicker and contact-free method of recording attendance. Based on the findings, it is evident that the implemented NFC technology provides a reliable and efficient solution for managing attendance in classrooms, maintaining minimal disruption to the educational process. Future enhancements could aim to expand the capabilities of this system by incorporating facial recognition technology, thereby broadening its applicability to various educational administrative functions. This advancement has the potential to fundamentally transform how educational institutions manage their routine operations.

ACKNOWLEDGEMENT

We would like to thank Karadeniz Technical University for providing laboratory facilities.

REFERENCES

[1] K. Panchal, et al. 'RFID Based Attendance System for Department', International Journal of Intelligent Systems and Applications in Engineering, vol. 12, no. 14s, pp. 505-514, 2024.

[2] P.S. JosephNg, BrandonChan, & K.Y. Phan, 'Implementation of Smart NFC Door Access System for Hotel Room', Applied System Innovation, vol. 6, no. 4, 67, 2023.

[3] F. Dávila, G. Gonzales & J.P. Mansilla, 'Mobile App for the Payment of Electronic Tickets Using NFC Technology in the Public Transport System in Lima Metropolitana', In International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability, pp. 50-64, Spain, October, 2023.

[4] S.S. Ahamad, 'A novel NFC-based secure protocol for merchant transactions', IEEE Access, vol. 10, 1905-1920, 2021.

[5] S. Chabbi, S., & C. Araar, 'RFID and NFC authentication protocol for securing a payment transaction', In IEEE International Conference on Pattern Analysis and Intelligent Systems (PAIS), pp. 1-8, Algeria, October, 2022.

[6] M. Qureshi, 'The proposed implementation of RFID based attendance system', International Journal of Software Engineering & Applications (IJSEA), vol. 11, no. 3, 2020.

[7] M.T. Tombeng, et al. 'Integrated Attendance System using NFC Technology', In IEEE International Conference on Cybernetics and Intelligent System (ICORIS), pp. 1-6, Indonesia, October, 2023.

[8] M.S. Dindar, 'Yakın Alan Haberleşmesi(NFC) ve Uygulamaları', Master's Degree, Sakarya University, Sakarya, Türkiye, 2010.

[9] Z.E. Karabulut, 'Mobil Sistemler Üzerinde Biyometrik NFC ve Konum Bilgilerini Kullanarak Kişi Tanıma', Master's Degree, Istanbul University, İstanbul, Türkiye, 2018.

[10] A.T.I. Mazumdar et al., 'NFC-based mobile application for student attendance in institution of higher learning', In IEEE International Conference on AI in Cybersecurity (ICAIC), pp. 1-5, USA, May, 2022.

[11] D. Singh, et al., 'IoT Based Municipality Drinking Water System through NFC and SCADA', IEEE International Conference on Information Technology (OCIT), pp. 478-483, India, December, 2021.

[12] A. Attaran et al., "NFC Reader Antenna Design and Considerations for Automotive Applications", IEEE Antenna Measurement Techniques Association Symposium (AMTA), pp. 1-6, USA, October, 2021.