NFC-based Mobile Application for Student Attendance in Institution of Higher Learning

Conference Paper · May 2022

DOI: 10.1109/ICAIC53980.2022.9896975

4 authors, including:

Adnan Mazumdar
UCSI University
4 PUBLICATIONS **9** CITATIONS
SEE PROFILE

Thong Chee Ling
UCSI University
49 PUBLICATIONS **115** CITATIONS
SEE PROFILE

Kay Hooi Keoy
UCSI University
63 PUBLICATIONS **577** CITATIONS
SEE PROFILE

NFC-based Mobile Application for Student Attendance in Institution of Higher Learning

Adnan Tajul Islam Mazumdar
Institute of Computer Science and Digital Innovation
UCSI University
Kuala Lumpur, Malaysia
1001852856@ucsiuniversity.edu.my

Shayla Islam
Institute of Computer Science and Digital Innovation
UCSI University
Kuala Lumpur, Malaysia
shayla@ucsiuniversity.edu.my

Chee Ling Thong
Institute of Computer Science and Digital Innovation
UCSI University
Kuala Lumpur, Malaysia
chloethong@ucsiuniversity.edu.my

Kay Hooi Keoy
Institute of Computer Science and Digital Innovation
UCSI University
Kuala Lumpur, Malaysia
keoykh@ucsiuniversity.edu.my

***Abstract*—Manual student attendance taking has become a tedious and time-consuming task for lecturers in Institution of Higher Learning (IHL). When pandemic is becoming endemic, more countries are opening their borders for international students retuning to campus and attending in-person classes. While lecturers circulate the manual attendance list to students in class, the list may be a contaminated object. According to WHO, a person could catch COVID-19 by touching the contaminated objects and then touching their mouth, eyes, or nose. In order to address these problems, a NFC-based mobile application is proposed. The proposed method is making use of NFC technology in the mobile devices. Students just need to tap the lecturers' NFC-enabled mobile devices while entering the lecture hall, then student attendance are recorded automatically in the database. The findings show that the proposed method improve students' attendance taking more efficiently in terms of reducing time and efforts. At the same time, reduce chances of getting COVID-19 by avoid touching on possible contaminated objects during attendance taking in class. In this study, constraint of the proposed method is unstable and low coverage of WiFi or mobile network in lecture hall. The constraints disable the attendance taking to be completed in stipulated time. This constraint needs to be addressed in future work.**

Keywords—NFC, mobile devices, students' attendance, mobile application

I. INTRODUCTION

As technology advances and becoming more ubiquitous towards human nature. ICT has been contributed to many industries in terms of innovation and especially towards the higher education sector. Moreover, recently monitoring the attendance of every student at an educational institution has been a major factor because it is related directly to their academic success. In addition to that, the traditional way of recording students' attendance has a couple of drawbacks. For instance, when the lecturer circulates the manual attendance list, students have to sign on a paper which later gets migrated to the system. The manual input to the system is time consuming and some efforts required as well as error prone. Besides that, while lecturers circulate the manual attendance list to students in class, the list may be a contaminated object. According to World Health Organization (WHO), a person could catch COVID-19 by touching the contaminated objects and then touching their mouth, eyes, and nose particularly during the post-pandemic or endemic era [1]. Based on studies, there is attendance system developed using Radio Frequency Identification (RFID) which solving the promising problems such as time-consuming, chances of making mistakes, no contact with students (lecturers) and not efficient, because of roll call as taking attendance manually [2]. Qureshi study [2] found that RFID attendance system is able to solve the problems by providing a robust and secure attendance system. The attendance system is also able to generate daily attendance report and send short message to parents/guardians informing them the attendance of the students. Although RFID is a useful technology, it incurs cost in purchasing devices/readers. This triggers the study in using Near-Field Communication (NFC) technology which is more cost-effective. This study aims to develop an NFC- based student attendance system in a mobile environment. This would give students the most efficient and secured way to sign attendance in class. The following sections present literature study on NFC related research.

II. BACKGROUND

A. NFC

Near Field Communication (NFC) is a type of communication technology that gives the ability to transfer data wirelessly in a short distance within a range of 5 to 10 cm. It is an updated version of RFID technology that integrated both a reader and smart card interface into a single stand-alone device. This can be used as a contactless system for recognizing, authenticating, and transmitting the information. In addition to that this technology packs more versatility in data integration and much higher security in comparison to the conventional approach. This kind of secure communication in NFC is achieved by the implementation of cryptographic algorithms [3]. This encouraged many technology companies like Samsung, Google, and Apple to support NFC for their payment system [4]. Therefore, it shows that there would be no compromise in terms of security while using NFC as a method for the attendance system. This communication does not require any kind of initial setup as it uses magnetic field induction to start communication

between the devices. The radiofrequency of the NFC is 13.56 MHz which does not require any type of permission or licenses to operate [5]. It is intended to act as a short-range wireless technology and the operating distance is between 0 to 10 cm [6]. This technology has three types of operating modes which are basically Peer-to-Peer mode, Reader/ writer mode, and Card Emulator mode.

In Card emulator mode, the NFC-enabled device functions as an actual card where the user interaction is acknowledged. Provides a way of replacing a credit or debit card with an NFC-enabled device. Instead of using a credit or debit card, you rely on the NFC-enabled device to make the transaction. This mode also involves other forms of card-type applications, such as identity cards, hotel passcards, credit cards, ticketing, access control, and any other card-related tasks you might think of. The Read/Write mode helps users to store a piece of short information on the computer that will be used later and allow users to communicate with different sources of information. This type of communication application lets users connect with smart advertising, downloading coupons. It is also possible to write information to these smart sources of information using the right NFC-enabled computer. Furthermore, the peer-to-peer mode enables users to share information between NFC-enabled devices. It connects between two NFC-enabled computers. When users sharing information with any other smartphone users or build an ad-hoc network to collaborate on tasks, NFC's peer-to-peer mode can be used. In this mode, using NFC is like getting a secure network in users' pocket that can be used at any place with full peace of mind. The various methods how NFC operate are presented in Figure 1.

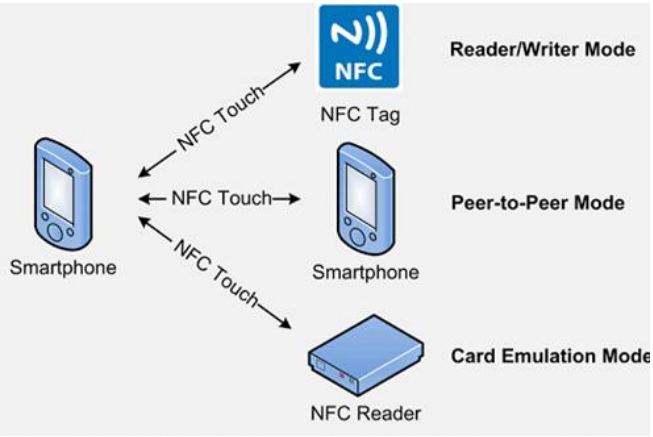

Fig. 1. The various methods NFC operate [7]

There are other types of communication are available, e.g., Bluetooth, Radio Frequency Identification (RFID), or WIFI can be used but they are not as power-efficient and cost-effective as NFC, the table below will demonstrate how and compare each module's specification. Table 1 shows all their features and user specifications all the available connectivity. However, As seen above, the NFC connectivity range is the least of all that enables the user to have secured connectivity with the least setup time between the others. Then, the time to establish the connection of NFC is very low, which gives the lecturer and students a huge advantage in communicating between applications, plus this will help to remove the long queue when entering the class, and the use of NFC is an easy and immediate way to use it as the connections are quick. Also, in recent years, manufacturers have added NFC to most of their android devices for their payment system, helping to reduce the initial costs of investing in NFC smart cards.

Specifications	NFC	Bluetooth	RFID	WIFI
Range	0.1 m	100 m	3 m	100 m
Frequency	13.56 MHz	2.4 GHz	Varies	2.4 GHz, 5GHz
Communication	Two way	Two way	1 way	2-way
Data rate	106, 212, 424 Kbps	22 Mbps	Varies	20Mbps-1Gbps
Time to establish connection	< 0.1s	< 6s	<0.1s	<1s
Power Consumption	Low	Varies in class	low	High

Table 1. Comparison of connectivity types [8]

Table 1 shows all their features and user specifications all the available connectivity. However, the NFC connectivity range is the least of all that enables the user to have secured connectivity with the least setup time between the others. Then, the time to establish the connection of NFC is very low, which gives the lecturer and students a huge advantage in communicating between applications, plus this would help to remove the long queue when entering the class, and the use of NFC is an easy and immediate way to use it as the connections are quick. Also, in recent years, manufacturers have added NFC to most of Android mobile devices for their payment system, helping to reduce the initial costs of investing in NFC smart cards.

B. Various Attendance Systems and technology used

Based on the literature study, there are various attendance systems such as e-attendance system using waterfall software development life cycle simulation [9], sensor- enabled smart atendance system [10], Swyft Tapp using fingerprint authentication [11] and Smart attendance and location tracking using IoT [12]. Table 2 presents the summary table of their strenghts, limitations and technology used.

No.	Attendance System	Technology	Strength	Limitation
1	E-attendance system using waterfall software development life cycle simulation [9]	An online method is used with SDLC and Linear Sequential Life cycle	It is a web-based application that reduces paper waste	There is no base of the authenticity of the user as it is using a username and password to sign in.
2	Sensor- enabled Smart Attendance system [10]	NFC and RFID	It is fast and monitors student's location using RFID	Additional readers and tags are required. Beyond that initial setup, the cost is higher in terms of RFID
3	Swyft Tapp [11]	An NFC based Attendance system using fingerprint authentication	Fast and effective was to register the attendance	Fingerprint might not be accessible all the time due to dust or if the user has injury over that assigned finger
4	Smart attendance and location tracking using IoT [12]	Registering attendance using NFC tag with ID card and track location using GPS and WIFI RTT	Live Tracking of the student and easy registration using via NFC	Cannot track users indoors since GPS cannot receive signals from the satellite, sometimes needs external power to use additional devices

III. METHODOLOGY

In order to achieve the objectives of the study, the methodology used are: 1) To study the existing prototype or framework of a student attendance system in the mobile environment through literature review and to gather/collect requirements from users; 2) To design and develop an NFC-based student attendance system in the mobile environment; 3) To evaluate the usefulness of the system,

A. User Requirement Gathering

During this phase, the information gathering is done through Google Form. The Uniform Resource Locator (URL) of the form is shared in Community Network (CN) and Microsoft Teams. The survey is conducted in six universities in Malaysia and four universities in Saudi Arabia using snowball sampling technique. The total respondents participated in the survey is 119.

B. Design and Development of the system

Waterfall model is selected as system development method. This approach is selected because it is easy to understand as all the stages are self-explanatory right before the design phase and secondly, this approach is more suitable because this model is used for small scale project.

C. User Acceptance Test

Online survey conducted by eight respondents to evaluate the usefulness of the system.

IV. IMPLEMENTATION

The implementation of NFC system to register student's attendance would be significant in removing the problems of calling out names or signing on papers and transferring them to the system's database as shown in Figure 2. It is time saving and less effort of lecturers and students. Furthermore, implementing this method reduces papers (or paperless) and more eco-friendly.

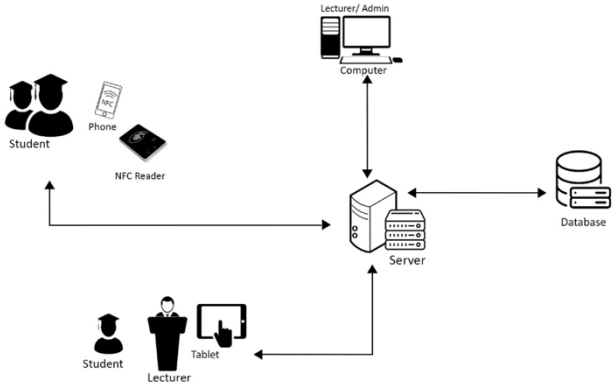

Fig. 2. System Architecture of NFC-based Attendance System

A. Results and Findings

The overall findings are presented in Table 2 where all the requirements are categories into product features, operating and system requirements.

Category	Description
Objective and goals of the system	To record the student's attendance with the technology of NFC in real-time and develop the application natively to have inbuilt features to enhance the process of secure login in the application like fingerprint or pin.
Product Features	Login, logout, user profile, create users, add user information to NFC card, take attendance, admin control access, see user schedule, reset passwords.
User classes and characteristics	Students, access the portal and check their attendance besides that, they will also be able to communicate through Learning Management System via the application. Lecturers will be able to record the attendance of the students by adding the classes. Admin, manage users (Lecturer/Students), manage records and edit records, limit access of users.
Operating Environment	As this is developed using android studio and coding was based on java so the system is accessible via the application but the database is accessible through the browser.
System requirements	Since the application development is Android based, the minimum OS version is Android 3.0 (Honeycomb), and devices compatible with NFC

Table 2. User requirements

The overall system functionalities are as follows:

1. Log in page: This page allows only the authenticated user to sign in which has been created by the administrator.
2. Attendance page: This page allows the lecturer to record the attendance of the student using NFC-based mobile application and assure a contactless in mobile environment.
3. Student resource page: On this page, the user would be able to access all the various resources and allow them to create their task. The class diagram sequence diagram and activity diagram are presented in Figure 3, Figure 4 and Figure 5.

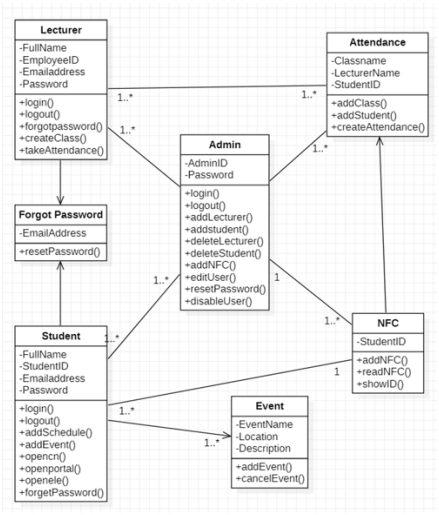

Fig. 3 Class diagram

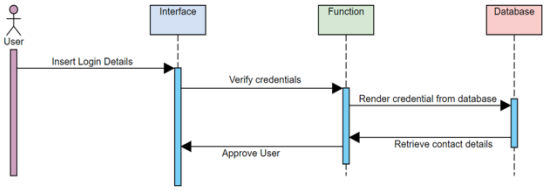

Fig 4 Sequence diagram

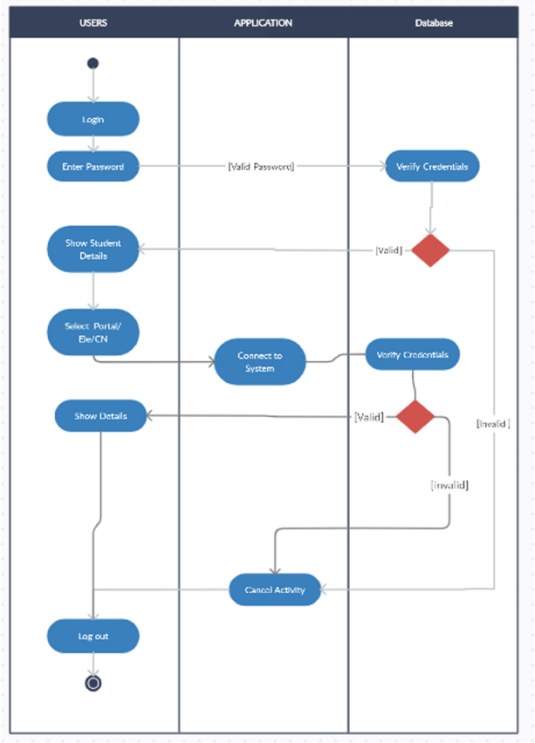

Fig. 5 Activity diagram

The use case diagram in Figure 6 describes the high level functions and scope of the system. Table 3 describes the details of the use case diagrams.

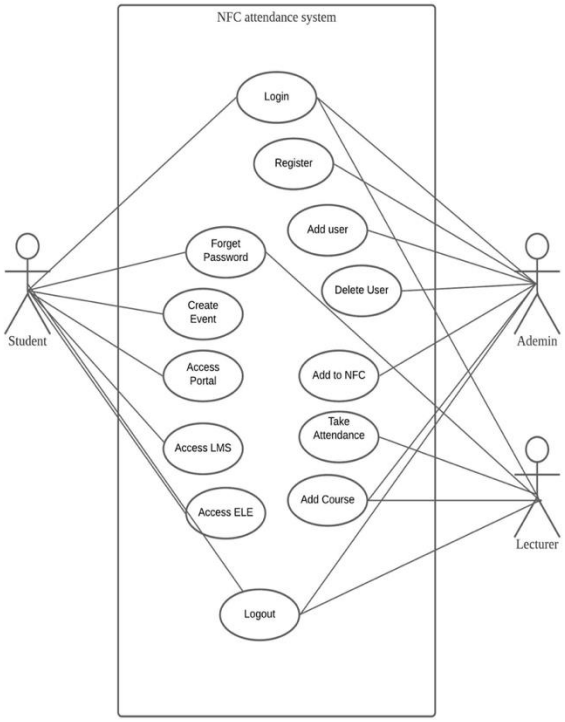

Fig.6 Use case diagram

Use Case	Function and Description
Login	The users (Student and Lecturer) will be able to log in with the credential which has been set by the admin during the registration process.
Register	The admin will register the lecturer and student details and add them to the database of the system.
Add user	The admin can add users in the class of a specific user if the lecturer has forgotten to take attendance.
Delete User	The admin will be able to delete students and lecturers from the database and alter their details if needed
Add NFC	Once the admin has registered the student details then the admin will be able the add the details to the NFC card
Take Attendance	At the beginning of the class, the lecturer will record student's attendance using the NFC card.
Add courses	Lecturers will create the class to register the attendance with NFC
Forgot Password	Lecturers and the student will be able to request to change their password when they forget it during login
Create Event	Students will be able to create tasks for their schedules.
Access portal	Students will be able to log in to the university portal and check for current updates from the university.
Access LMS	Students will be able to log in and access their Learning Management System (Course Networking) and view their coursework which was distributed by the lecturers
Logout	Users will be able to log out from the application once they are done with their desired work.

Table 3. Descriptions of Use case diagram

Selected user interfaces in lecturers' login page are presented in Figure 7. On this page, the lecturer would be greeted with their name and email address. The lecturers take attendance by pressing the record attendance button and that lead to a page where they are able to create a class. Students use their own NFC-based mobile application (serve as a card) that installed in their mobile devices with their credentials on it and taps on the mobile devices of the lecturer. The mobile devices of the lecturer then scan and record the details from the card of students Once the lecturer presses the record attendance button, attendance is recorded in the cloud real-time database. When lecturers have completed their task then logout and exit the application and back to the main screen.

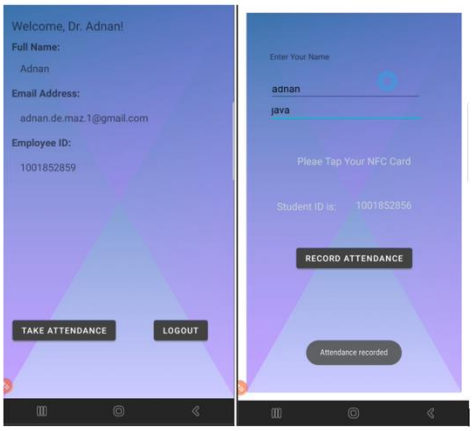

Fig. 7. User interface (Lecturer Login page)

B. User Evaluation

A total of 8 students from eight universities participated in the online survey. Table 4 presents the results of user acceptance test, which was conducted to determine the level of satisfaction with the NFC-based Attendance System. The overall results show more than 100% of the users are satisfied with system. Users indicated that the system is user friendly, helpful, functions and features are useful, meet their expectations and high performance (respondents rated 4 and 5 in the survey).

Questions	1	2	3	4	5
Was the NFC based application user friendly?				50%	50%
The features that have been developed in the application is helpful?				62.5%	37.5%
How would you rate the adding event from the application function useful?			12.5%	50%	37.5%
Does the application meet your expectation of NFC based attendance system?			12.5%	50%	37.5%
Were the product features useful?				50%	50%
How much would you rate the performance of the application?				50%	50%

Note: [1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree]

Table 4. Overall User Evaluation Results

V. CONCLUSION AND RECOMMENDATION

There are various techniques to monitor student attendance that are effective in terms of attendance recording, but NFC is increasingly being utilized in conjunction with biometric technology for security. The non-contact, non-line-of-sight feature of RFID systems is a key advantage. As a result, this study can be highly beneficial and can be utilized in a real-time application of an attendance monitoring system in a mobile environment, which making traditional methods of taking attendance less burdensome, time-saving, and simply controllable. Based on findings, the system in this study has significantly improve attendance system and eliminate tedious attendance processes such as using paper or calling out names. Another advantage is the attendance data are recorded in the real-time database. However, the limitations of the study are: the application is only supported one android platform; user interfaces could be more refined such as adding more items to the application and lecturers could be given more authority to filter out the course details. In future work, more features to be added to the application such as notification sent students for classes, using NFC-based mobile application as student id (or digital card) and enable multiple languages support.

VI. REFERENCES

[1] Qureshi, M. Rizwan Jameel, The Proposed Implementation of RFID based Attendance System (2020). International Journal of Software Engineering & Applications (IJSEA), Vol.11, No.3, pp. 59-69. May 2020, Available at SSRN: https://ssrn.com/abstract=3635316 or http://dx.doi.org/10.2139/ssrn.3635316

[2] Z. Cao, P. Chen, Z. Ma, S. Li, X. Gao, R.-x. Wu and L. Pan, "Near-Field Communication Sensors," sensors, vol. 19, no. 1, pp. 39-47, (2019).

[4] Apple.com, "Apple Pay security and privacy overview –Apple Support," [Online]. Available: https://support.apple.com/en-us/HT203027.

[5] G. W.-H. T. Keng-Boon Ooi, "Mobile technology acceptance model: An investigation using mobile users to explore smartphone credit card," Elsevier, vol. 59, no. 2016, pp. 33-46, 2016.

[6] Y. K. Hooi, K. S. Kalid and S. Tachmammedov, "Multi-Factor Attendance Authentication System," International Journal of Software Engineering and Computer Systems (IJSECS), vol. 4, no. 2, pp. 62-79, (2018).

[7] P. C. Lai and W. Scheela, "Convergence of Technology in the E-Commerce World and Venture Capital Landscape in South East Asia," Global Entrepreneurship and New Venture Creation in the Sharing Economy, vol. 2, no. 6, pp. 149-168, (2017).

[8] Time-n-Attendance, "Time and attendance," March 2016. [Online]. Available: https://time-n-attendance.com/.

[9] B. R. Oluwaseun, O. Muyiwa, B. A. Olanrewaju, B. B. Omolaran and B. S. Iyabo, "E-Attendance System using Waterfall Software Development Life Cycle Simulation," Journal of Computer Science and Control System, vol. 10, no. 2, pp. 10- 15, October 2017.

[10] C. B. Chew, M. Mahinderjit-Singh, K. C. Wei, T. W. Sheng, M. H. Husin and N. H. A. H. Malim, "Sensors-enabled Smart Attendance Systems Using NFC and RFID Technologies," International Journal of New Computer Architectures and their Applications, vol. 5, no. 1, pp. 19-28, 2015.

[11] B. Kommey, O. Anyane-Lah and W. Amuzu, "SwyftTapp: An NFC based attendance system using fingerprint," International Journal of Engineering, Science and Technology, vol. 10, no. 1, pp. 23-39, 2018.

[12] M. S. Mane, "Smart Attendance and Location Tracking using IoT," International Journal of Engineering Research & Technology (IJERT), vol. 8, no. 11, pp. 681-623, 2019.