

Implementation of NFC for Smart Gate Access Control in Campus Area

Khairunnisa Mansur^{a,*}, Zulfajri B. Hasanuddin^b, Wardi^c

^{a,b,c}Department of Electrical Engineering Department
Universitas Hasanuddin
Makassar, Indonesia

*Email: khairunnisae10@gmail.com

Abstract

An innovative Smart Gate System has been implemented as a smart access control within the campus area. Smart gate uses 'Smart card Near Field Communication' as an identity card for the university's academics. Students or lecturers entering the campus area through the barrier gate and perform the identification process on the reader. Registered smart cards open the barrier gate. The history of the identity card is updated on the online server. Identification and authentication is proceed by entering certain code to the smart card. Security system in smart gate uses two data encryption. Design in the system use PN 532 NFC reader/writer, NFC tag 13.56 MHz rewritable and ultrasonic sensor ping. Through this innovative system, the supervision of an access control in campus area is finely recorded and the academics' identity is maintained through the data encryption in smart card. Response to the sytem services up to an optimum 6 cm in range, and response to the time services at an optimum of 1.829 seconds.

Keywords: NFC, Smart gate, Access control, PN532 NFC reader, NFC tag.

1. Introduction

The needs of trusted security system are required in various aspects, one of them is the use of *gate system* as an access control to the security system in campus area. The control system is simply defined as a technique used to control the entry or exit flow in the residences, offices, and other buildings [1]. Gate system has become the standard of a security system in particular environment. Gate system requires more identity data to identify the vehicles or people entering specific or restricted area. The identity card is the most important element in *gate system*. [2].

Smart Card has the ability to store identity data and can be programmed on the application side that can be used for the authentication process. Radio Frequency Identification is a technology for identifying objects or individuals using radio frequency transmissions at 125K Hz, 13.6 MHz, or 800-900MHz. RFID is a wireless communication technology used for the development of access control system. This technology uses radio signals to transfer data

in identification, administration, categorization and storage [3]The development of RFID technology is NFC (Near Field Communication) working on 13.56 MHz frequencies which can also be used in transportation, identification and payment applications. NFC can be integrated on access control system, check-in control and security alarm. NFC technology meets international communication standards and has the potential to be a highly competitive technology in the area of short range wireless connections [4]. NFC has various working distances and is limited to a maximum distance at 10 cm.

Payment for public transportations, ticketing, and students' class attendance check in, are some of the examples on how the use of NFC helps daily life routines[5]. Access control is one of the smart card application mostly used in campus area. The management of smart card access control in campus area hold a responsibility in access control administration[6]. Nowadays, the entry and exit points of Faculty of Engineering, Hasanudin University use the manual open-close gate by the security staffs. The absence of identification proses through identity card let anyone entering the campus area easily. In this study, Smart Gate Access Control is the solution to help the security system in more sophisticated way.

One of the drawback of access control system using RFID is vulnarable attacked to allow any card/tag cloning to get the free access to Access Control facilities. The solution is by enhancing the security alert on the verification and authentication users. Trusted Execution Environments (TEE) and Identity Based Encryption are some of the solution to overcome the aforementioned drawback [7]. To create stronger data privacy, encryption is done at the same time the information accessed through symmetrical key divided into server and the point[8]. Security authentication in this study is done through Caesar Chipper and Rotate letter encryption methods by inserting key in and key out on the tag/card.

This study presents the using framework of NFC card in access control gate system prototype in Engineering Faculty area of Hasanuddin University. The entry and exit points of univeristy's academics are controlled through the gate system. Identity card or NFC has the information of academics' personal data for identification and authentication proses. Registered NFC card opens and

closed the gate automatically. Fig 1 demonstrate the open/close gate processing by NFC card.

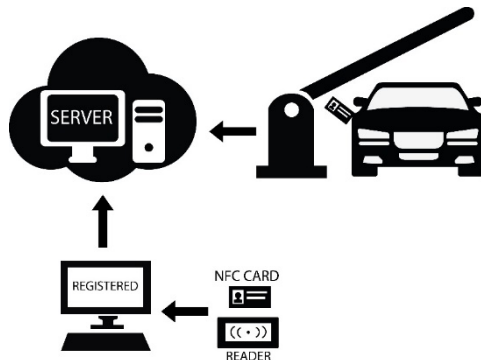


Fig. 1. Smart card identification process

Chapter II explains the card registration, smart gate access control system, and server from this system; findings and discussions are presented in Chapter III; Last, Chapter IV delivers conclusions and suggestions.

After the introduction in section I; In section II described card registration, smart gate access control system, and server program of this system; Results and evaluations are outlined in section III; Section IV is the conclusion and future work.

2. System Description

A. Card Registration

Registration process is done online through the provided website. Information of the data is stored in database server. Uploaded information such as personal name, identity number, address, phone numbers, and other important data. Admin (the administrators from campus who are authorized to access the system) update the Unique Identifier (UID) in NFC and put the personal data in NFC Card. Personal data in NFC card have passed the encryption process. Encryption is done through Caesar Chipper and Rotate Letter methods. To guarantee the safety access control to entry and exit point, secret code "key in" and "key out" are added to entry and exit access of NFC tag/card. The process of information data updating and writing to NFC card is displayed in Fig. 1 flow chart algorithm of card registration.

Administrators validate users' online registered data. After conforming the valid data, NFC tag/ card is tapped near the card reader to scan UID in the card. Next, after UID is obtained, administrators run the registration process. In first registration step, user UID is updated to database server, then writing information process on the card. NFC PN532 is used as both reader and writer of personal data in NFC tag according to ISO 14443A. The parameters used for writing on the card are the memory of data collection, transmitted data, and authentication key "key". The type of NFC card is Mifare Classic 1K ISO / IEC 14443A consist of 16 sectors covered by two different keys (key A and Key B). Each sector consists of 3 data blocks and 1 trailer block where each block contains 16 bytes [9].

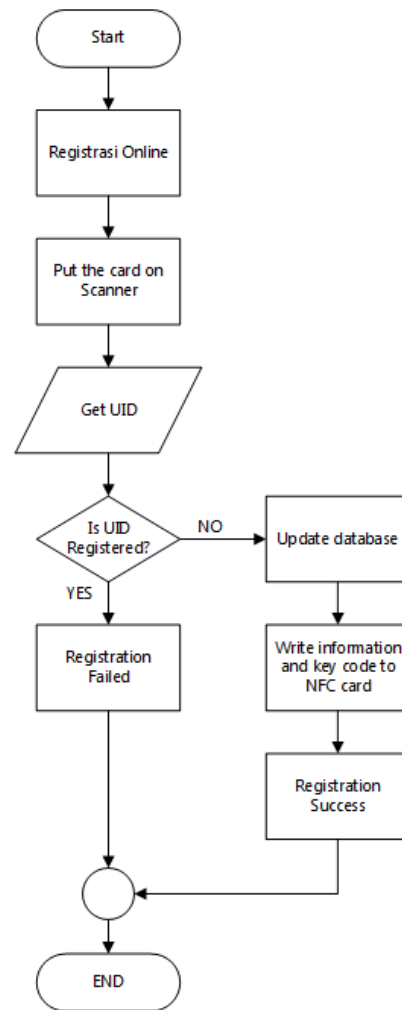


Fig. 2 Flowchart algorithm of card registration

B. System Smart Gate Access Control

Smart gate prototype consists of PN532 NFC RFID module, microcontroller, NFC tag, PING sensor, and ethernet shield. Another supporting part of smart gate access control is the server. The server stored all user data and access history entry and exit of the gate. On the designed prototype, server uses localhost. In previous research, access control using RC522 reader, RFID tag and graphical user interfaces implemented in Matlab but RFID as identity card is not required to write information on card [3].

In this study, the design of smart gate access control system is explained in Fig. 3. The accessing process of entry and exit gate is started by tapping the tag/ card to the reader machine for reading/ scanning the card. Registered NFC tag/ card is identified as the known users who have the access to entry or exit the gate. If UID is finely registered and authentication key is verified, the gate is opened and the chronological order of the user is updated in database server. Gate is closed automatically after PING sensor detect the afore object. Furthermore, previous studies revealed the contactless locked system with portable device connected into three parts, i.e., cloud

server and database; personal mobile device; and fixture and fitting. Then link via internet connection uses Quick Response Code (QR code) to control the open and close gate/ door [10].

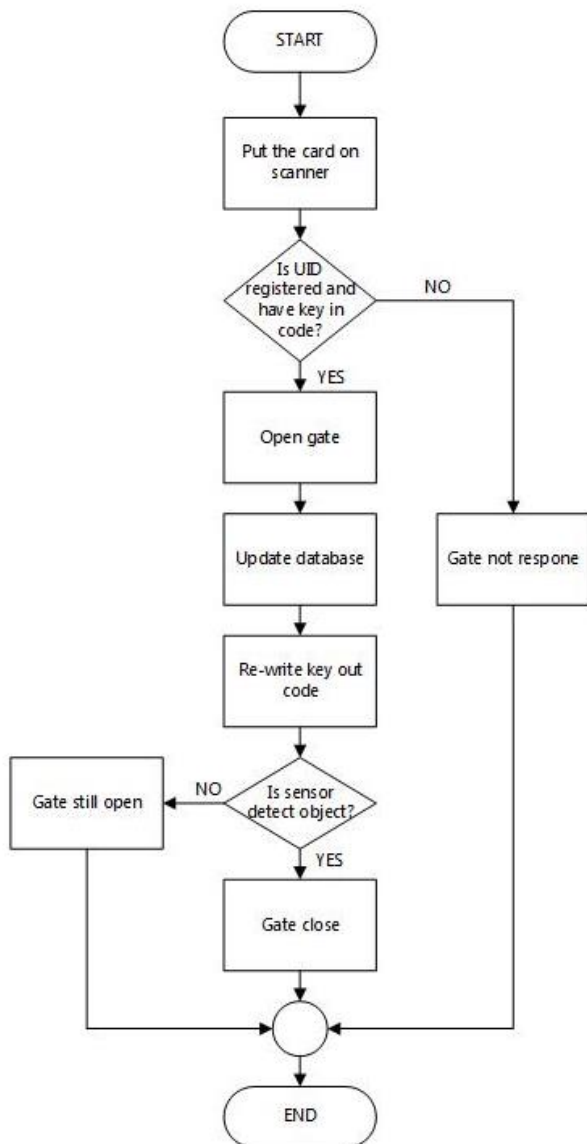


Fig. 3 Flowchart System Smart Gate Access Control

The authentication key is rewritten to NFC tag/ Card to be reused when scanning the identity card to exit the gate. NFC tag/ card can only be used once for the entry access at the same time because of the rewrite of authentication keys on the card. The access of exit gate is the same as the process in entry gate.

3. Result and Discussion

This study was the implementation of NFC card in the Smart Gate as an access control to the security system in the campus area. This study evaluated performance in the aforementioned system. First evaluation was the users'

online registration and written information on the card. Furthermore, this study tested the responding time of NFC tag/ card in the reader/ writer PN532 for authentication process. Last evaluation was observing the chronological order of entry and exit gate.

A. Evaluation of Card Registration

Card registration started by filling online users' data. Information must be completed before the submission process. Users' data information was shown in Fig.4.

Fig 4 User Online Registration

Data must be updated by the users. The next registration process was conducted by the admin by updating users' data in database server. When users' online data was obtained, admin wrote data information in the card. The written data information was already encrypted by key in and key out. Key in was used to enter the gate and key out was used as well as to exit the gate.

Fig 5. Card Registration

B. Evaluation of system prototype smart gate

The implementation of NFC to the Smart Gate access control has been successfully developed by using micro-controller and Mifare classic NFC tag/ card. Fig 6 displayed the Smart Gate prototype system.

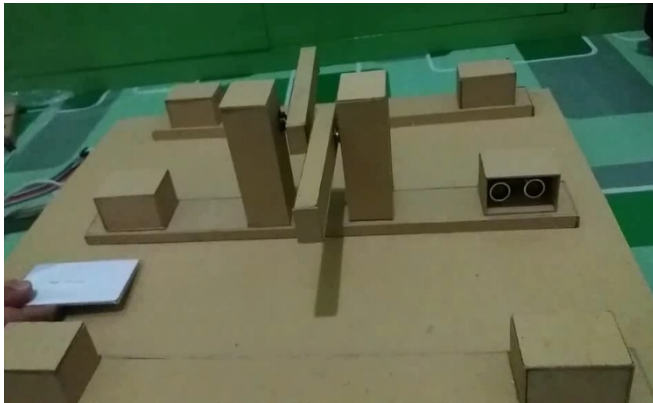


Fig 6 . Prototype Smart Gate Acces Control

System was activated when NFC tag as an identity card was tapping near the reader machine. If the users' card was already registered, the gate was opened. The gate was closed after the users passed out the sensor. Working range of NFC tag/ card was examined in 1 cm and 6 cm. The examination brought 10 random cards. Fig. 7 shown the measurement of the time system in the card.

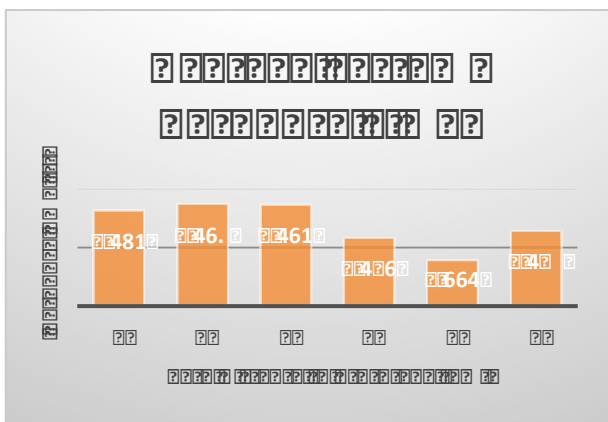


Fig 7 .The average of responding time to the card.

The system responded from the range of 1 cm to 6 cm. Moreover, The system done the authentication process when scanning the card. Last examination was observing the chronological order of entry and exit gate as shown in Fig. 8. The history of entry and exit gate was updated in database server. NFC card can be used once in one time access. This access history provided the admin to fully controlled the security system in campus area.

No	Nama	NIM	Jurusan	Status	Gate			
					IN		OUT	
					Tanggal	pukul	Tanggal	pukul
1	Alvianus Degen	P2700214408	Teknik Informatika	Mahasiswa	22-05-2017	08:30:49	22-05-2017	08:31:59
2	Auf Hidayat	P2700215014	Teknik Geologi	Mahasiswa	22-05-2017	08:30:51	22-05-2017	08:31:10
3	Rida Ariyanti Z	P2700215011	Teknik Mesin	Mahasiswa	22-05-2017	08:32:12	22-05-2017	08:33:23
4	Firman Azl	P2700215002	Teknik Informatika	Mahasiswa	22-05-2017	08:32:34	22-05-2017	08:33:57
5	Kharunnisa Mansur	P2700215017	Teknik Elektro	Mahasiswa	22-05-2017	08:34:23	22-05-2017	08:34:39
6	Rida Ariyanti Z	P2700215011	Teknik Mesin	Mahasiswa	22-05-2017	08:35:05	22-05-2017	08:36:13
7	Jeffy	P2700215007	Teknik Elektro	Mahasiswa	22-05-2017	08:35:21	22-05-2017	08:35:55
8	Nasmi Lembang	P2700215019	Teknik Informatika	Mahasiswa	22-05-2017	08:36:29	22-05-2017	08:36:51
9	Asriyany Nocer	P2700215005	Teknik Arsitektur	Mahasiswa	22-05-2017	08:37:10	22-05-2017	08:37:21

Fig 8. Access History of entry and Exit Gate System

4. Discussion

This study introduces the implementation of NFC card on access control through smart gate. The access control is done using registered NFC card. The method in this study uses written data in the card for the authentication process. Access history will be updated on the database server. Data security in the smart card is maintained by encrypting the data information. Response to the sytem services up to an optimum 6 cm in range, and response to the time services at an optimum of 1.829 seconds.

In light to the result of the study, further studies are encourage to make improvements by using better hardware specifications. More sophisticated reader / writer specifications will improve the system speed. The use of smart cards with larger memory capacity will contain a lot more information to the database.

Reference

- [1] Peng-Loon The, Huo-Chong Ling, and Nyeann-Cheong, "NFC Smart Phone based Access Control System using Information Hiding", IEEE Conference on Open System, February 2014.
- [2] James Gerdeman, "RFID Changing Gates", IEEE Potentials, vol. 34, pp. 40-42, September 2015
- [3] Rosa Ma. Woo-Garcia, U. H. Lomeli-Dorantes, F.Lopez-Huerta, "Design and Implementation of a System Access Control by RFID", International Conference Engineering Summit, II Cumbre Internacional de las Ingenierias (IE-Summit), April 2016.
- [4] Ou Wenxing, Wang Lei, Jhiang Zhipeng, and Yu Changhong, "Implementation of Smart Shopping System Based on NFC Technology", 7th International Conference Measuring Technology and Mechatronics Aotomation, September 2014.

- [5] John Jacob, Kavya Jha, Paarth Kotak, and Shubha Puthran, "Mobile Attendance using Near Field Communication and One-Time Password", IEEE International Conference Green Computing and Internet of Things", pp. 1298-1303, October 2015.
- [6] Zhao Du, Yeming Tang, "Web-based multi-level smart card access control system on university campus", IEEE International Conference Software Engineering and Service Science, pp.1015-1018, October 2014.
- [7] Mohamed Amine Bouazzouni*, Emmanuel Conchon†, Fabrice Peyrard*, Pierre-Francois Bonnefoi†, "Trusted Access Control System for Smart Campus" International IEEE Conferences on Ubiquitous Intelligence & Computing, Advanced and Trusted Computing, Scalable Computing and Communications, Cloud and Big Data Computing, Internet of People, and Smart World Congress, pp. 1006-1012, July 2016.
- [8] Dominik Gruntz, "MOONACS: a mobile on-/offline NFC-based physical access control system", International Journal of Pervasive Computing and Communications Vol. 12 No. 1, pp. 2-22, 2016.
- [9] Product data sheet, "MF1S50yyX_V1," ©NXP Semiconductors N.V., 2014.
- [10] Jih-Fu Tu, "A Contactless door lock which controlled by portable devices", International Journal for Computer-Aided Engineering and Software, vol. 33, pp. 1631-1641, 2016