Hardware and User Perspective Assessment on Application of Smart Door Access

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Abstract. Nowadays, applications of technology in various aspects of human life have been widely adopted. This increasing application relies on the degree of technology involvement, which supports an interconnected communication among resources available in the location. A smart room, for example, is a room equipped with this interconnected mechanism, which allows communication among each other [1]. Hence, it becomes a unified system that can be controlled systematically and efficiently. One common resource to be implemented is door access. The door is an important part of a room or building. The door function is to connect one room to the other rooms and also to connect the outside of a building with the inside.

Applications of smart door, in larger scale, constitutes to smart room terminology and this is achieved typically by utilising electronic door locks. The door lock works by using electricity and electrical components to control the lock activation. This control can be done in various ways such as using RFID technology, fingerprint, PIN code, and so on. The technology has advantages and disadvantages of each, but whether the shortcomings and advantages of these technologies can be well received by users. This study will examine user satisfaction with the use of RFID technology, PIN codes, infrared sensors and fingerprint on electrical doors.

1. Introduction

Nowadays, applications of technology in various aspects of human life have been widely adopted. This increasing application relies on the degree of technology involvement, which supports an interconnected communication mechanism among available resources in the location. A smart room, for example, is a room that equipped with this interconnected mechanism, which allows communication among each other [1]. Hence, it becomes a unified system that can be controlled systematically and efficiently. One common resource to be implemented is door access. The door is an important part of a room or building. The door function is to connect one room to the other rooms and also to connect the outside of a building with the inside.

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2. Related Studies
Electronic locking technology has been widely used and one of them is the one used by Anshar et al. [1] on smart room door access. Which on the smart room door uses RFID tag technology, Fingerprint technology, PIN code, and Infrared sensor technology. RFID tag technology is also used by Farooq [2] as a user identifier for access in and out of doors. Verma [3] also applies RFID tag technology to digital doors from a special room so that only certain RFID tags can access the room, namely RFID tags registered on the system. Padmajothi [4] uses fingerprint to access car vehicles, he judges that the use of fingerprints is safer because it cannot be used by others as well as conventional keys and PIN codes. Fair [5] also prefers to use fingerprint compared to RFID technology and password because according to him fingerprint is more efficient and reliable.

3. Method
This study will examine the use of satisfaction in two different systems. One system will use Arduino Mega 2560, magnetic door lock, UPS 12V / 5A, RDM6300 along with antennas as RFID Reader tags, relays, and Infrared sensor modules. The other system uses ZKTeco X6 with fingerprint, RFID Reader tag and PIN code, Infrared sensor module, relay, magnetic door lock, UPS 12V / 5A.

![Figure 1. Block diagram of system 1](image1)

![Figure 2. Block diagram of system 2](image2)
System 1 uses Arduino Mega 2560 as a controller. Each RFID card has its own unique code, the unique code is read on RDM6300 using an antenna on the outside of the door, then the data is read by Arduino as a controller. Arduino then determines whether to give access to the card owner or not, based on the suitability of the unique code registered with Arduino that was registered during programming. If the code reads on RDM6300 and is registered with Arduino accordingly, Arduino will send the control signal to the relay and forward it to the magnetic door lock via UPS.

To access the door, the user uses an infrared sensor installed in the room. Only by covering the sensor so that the infrared beam sent by the transmitter LED is received on the receiving LED, then the door can be opened. The process is almost the same as access. The difference lies in the suitability of the data. Exit access does not require data compatibility so that anyone can access the door to exit. Unlike the entry access, only certain people can use it.

System 2 uses ZKTeco X6 on access to the door. ZKTeco has its own controller so that reading RFID cards, fingerprints, PIN codes, and infrared sensors does not need to use Arduino. After reading in accordance with those registered with ZKTeco X6 then send a control signal to the UPS to deliver electricity or not to magnetic door lock. Likewise, with the infrared sensor installed next to the room. The control signal is then channeled to the UPS with the help of relay components.

To obtain the results of satisfaction from users, a survey was conducted in the form of filling out a questionnaire. The questionnaire consists of several things including satisfaction regarding the operating time on the system. Another parameter is about operating distance in the system. And also, satisfaction with the system as a whole. Questionnaires were also asked about satisfaction with the door access method used, namely the RFID tag technology, PIN code, fingerprint, and Infrared sensors.

4. Result
The number of respondents in this study is 28 people, all of them are students with 25 men and 3 women with an age range of 18-22 years. The questionnaire was distributed on 26-27 September 2018. Most respondents had the experience of using an electronic key on the door, which is about 19 out of 28 respondents as shown in the circle diagram in Figure 3. 10 of them had used it at the hotel, 7 had used it on campus, and 2 have used it elsewhere. 9 out of 28 respondents claimed they had never used it.

![Figure 3. Circle diagram of the experience of using electronic lock](image)

4.1. Satisfaction with operating time
The operating time on access in and out of system 1 is for 10 seconds the door is open, while for the operating time on the access to system 2 is 1.5 seconds the card reads and opens for 4.5 seconds. And the operating time on the outgoing access on system 2 is for 3 seconds. Most respondents considered the time provided by the two systems was enough as shown in the Table 1. 20 of the 28 respondents considered the time on system 1 enough, while 5 respondents considered it a bit long and 2
respondents rated it rather quickly and 14 of 28 respondents considered the time on system 2 enough. While 8 respondents considered it a bit long and 5 of them considered it rather fast. 1 person on system 1 and 2 chose not to answer. From these results, the time used in systems 1 and 2 is good enough and according to needs.

**Table 1. Respondent's assessment of usage time**

| Type of System | too slow | rather slow | enough | rather quickly | too fast | no answer |
|----------------|---------|-------------|--------|----------------|---------|-----------|
| System 1       | 0       | 5           | 20     | 2              | 0       | 1         |
| System 2       | 0       | 8           | 14     | 5              | 0       | 1         |

4.2. **Satisfaction with operating distance**

The operating distance of the access exit is in system 1 which is around 4.2 cm, while the operating distance of access is on system 1 which is about 3.5 cm. And the operating distance of access out on system 2 is about 3.8 cm. while the operating distance of access in system 2 is about 3.6 cm. the questionnaire in this section is an open questionnaire. 12 respondents considered the distance that was quite good on system 1 and on the system 2. 4 respondents considered the distance close enough to system 1 and system 2 and 1 respondent rated the distance very close. While other respondents chose not to answer. From these results, the distance used in both systems is good enough and appropriate. Respondents who answered others considered the distance to be close.

4.3. **Satisfaction with the technology used**

Respondent's assessment of the use of RFID tag technology, PIN code, fingerprint technology, and Infrared sensor technology can be seen in Table 2. Based on the results, it can be seen that most respondents considered the technology used was appropriate.

**Table 2. Respondent's assessment of the technology used**

| Technology used | very appropriate | appropriate | do not know | not appropriate | very inappropriate | no answer |
|-----------------|------------------|-------------|-------------|------------------|--------------------|-----------|
| RFID tag        | 7                | 15          | 5           | 1                | 0                  | 0         |
| Infrared        | 8                | 14          | 3           | 2                | 1                  | 0         |
| Fingerprint     | 4                | 14          | 2           | 7                | 1                  | 0         |
| PIN code        | 5                | 16          | 3           | 3                | 0                  | 1         |

4.4. **Satisfaction with the overall system**

Respondent satisfaction with system 1 was about 79% and 74% in system 2. It can be seen in Figure 4 and Figure 5. So that it was assessed that respondents were quite satisfied with system 1 which used RFID tag technology and Infrared sensor technology. Respondents were also considered quite satisfied with system 2 which used RFID tag technology, PIN code, Fingerprint, and Infrared sensor technology. And Figure 6 describes which system is preferred by respondents to their homes. Respondents chose system 1, which was 11 respondents, then system 2 with 9 and then 7 respondents chose to keep using conventional keys. 1 respondent chose to use another system.
5. Conclusions
Most respondents or about 20 of the 28 respondents considered the time used in system 1 was 10 seconds of sufficient operating time and 14 of 28 respondents rated the time in system 2 as 6 seconds for access and 3 seconds for outgoing access was considered sufficient, so that the time was assessed used in system 1 and system 2 are appropriate. Also, most of the respondents who answered questions about distance considered that the distance used was quite good at around 3.5 - 4.2 cm, although some of the other respondents tended to judge the distance to be rather close. The technology used was considered appropriate according to the majority of respondents, namely RFID tag technology, PIN code, and Fingerprint technology for access, as well as the use of Infrared sensor technology for outgoing access. Respondent's satisfaction with system 1 was around 79% while in system 2 it was around 74%. With system 1 that uses RFID tag technology for incoming access and Infrared sensors for access out is the most desirable system, after which is system 2 with the addition of fingerprint technology and PIN code.

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