RFID Application in Developing Key Management System

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Abstract: The RFID application in the lock management system is a lock box product with an automatic control system that works to store and return the key. There are three main objectives namely designing, developing, and testing the functionality of RFID applications in key management systems. The system consists of two main parts namely hardware and software. The hardware consists of an Arduino nano microcontroller, solenoid lock, LCD display, ultrasonic detector, RFID reader and power supply circuit. The RFID used is a passive type, which are lighter and less expensive than active tags. During the development of this project, the research methodology used as a guide is the Design Thinking model which involves five phases namely empathise, define, ideate, prototype and test. In addition, expert evaluations about the functionality of the product indicated this product works well. However, some improvement in terms of reporting and monitoring of key records using the medium of IoT, also the use of ultrasonic detector and keypad were also suggested for the betterment of the product.

Keywords: RFID, Automatic Control System, Design Thinking Model, Arduino Nano

1. Introduction

The emergence of the information technology era has contributed significantly to various sectors especially in the field of technology (Rachmawati, 2018). According to Rachmawati (2018), the awareness of such science and technology has encouraged various agencies to make full use of the capabilities available in the upgrading of information technology. According to Briere and Hurley (2003), safety control is a condition arising from changes in human behavior or physical environment to reduce the risk of harm that may result in injury and accident risk. It is a guide to the world today that will use the internet as a major platform in controlling all kinds of equipment and hardware by reducing the use of physical touch by humans (Dimitriou,2016). According to Briere and Hurley (2003), safety control is a condition resulting from changes in human behavior or physical environment to reduce the risk of harm that may result in injury and accident risk. In addition, the safety of society is often emphasized in addition to natural disasters such as floods and fires, which are the intrusion of

crime when leaving home (Briere & Hurley, 2003). Lack of safety creates a situation that is harmful to humans (Ee, 1996). In addition, according to Zumsteg and Qu, (2018) the key management system is one of the concepts which not only acts as a security system, but also prevents problems that may arise from the use of duplicate keys. The weakness of key control technologies in an organization contributes to the occurrence of key loss cases (Hamidi, 2013).

From the concerns raised in the statement of concerns, recommendations were made to design, develop, and test the functionality of RFID Applications in the Key Management System by the college's own college principal. With this advanced RFID technology, it will be able to improve existing systems. Students only need an access card to access the door lock. This study focuses on RFID applications in key management systems, which use RFID tags as keys for unlocking and locking keyboards. This project was also developed using RFID tags and RFID scanners. The way this system works is to use RFID scanners to read RFID tags at certain distances. The data collected will be processed by the system. Once the identification process is successful, the door will be opened or locked.

The weaknesses of key control technologies in an organization contribute to the occurrence of key loss cases. In many places including universities, manual lock management systems are still used to manage office or classroom locks; this method is inefficient because all keys are marked and possible theft risks. In addition, the key control system still needs manpower to handle this problem. Subsequently, the user's attitude toward the key contributes to the loss of the key. From the following issues, recommendations are made to design, develop, and test the functionality of RFID Applications in Key Management Systems. With this advanced RFID technology, it will be able to improve existing systems. Hence, this study is carried out to design, develop, and evaluate the functionality of RFID applications for key management systems.

Design Thinking is a design methodology that provides a solution-based approach to solving problems. It's extremely useful in tackling complex problems that are ill-defined or unknown, by understanding the human needs involved, by re-framing the problem in human-centric ways, by creating many ideas in brainstorming sessions, and by adopting a hands-on approach in prototyping and testing. The method used to develop this prototype used model design thinking which include five phases which is empathize, define, ideate, prototype and test. RFID is a wireless communication between the reader and the object of the radio frequency recognition device involving the use of tags or transponders that collect and update data and are capable of converting data (Lin, 2009). In general, the RFID system consists of three main components, namely, tag, reader, and database (Figure 2.8). In short, the mechanism involved in the RFID system is that the radio frequency reader scans the data stored in the tag, then transmits the information to the database that stores the data contained in the tag. Arduino is an open source platform based on easy-to-use hardware and software. The Arduino board can read inputs such as light on the detector, fingerprint on the button and turn it into output by activating the motor, turning on the LED, publishing something online. We can control the micro on board by using Arduino programming language (Arduino software (IDE) based on processing (Djuandi, 2011). The programming language is the official language that defines a set of instructions that can be used to produce a variety of outputs. Programming languages generally consist of instructions for computers. To enable a computer to perform a certain task. The software development used is Arduino IDE.

2. Methodology

This study focuses on students staying in residential colleges where, when a student loses a key to get into the dormitory, it is necessary to contact their warden first and it takes time for the warden to come to the office and look for the key. The instrument used was a questionnaire form distributed to three experts in the same field, as lecturer from Polytechnic Kota Bharu (PKB) to evaluate the design, development, and function of this product. The prototype was developed using the model design

thinking which include five phases namely empathize, define, ideate, prototype and test. Model Design Thinking is a systematic approach to solving customer problems and thus creating a better picture for them (Razzouk, 2011). In the context of this study, a flow chart was created to ensure that each step of the work was done in accordance with the phase in the Design Thinking Model. Figure 1 shows selected design model discussed in the flow chart.
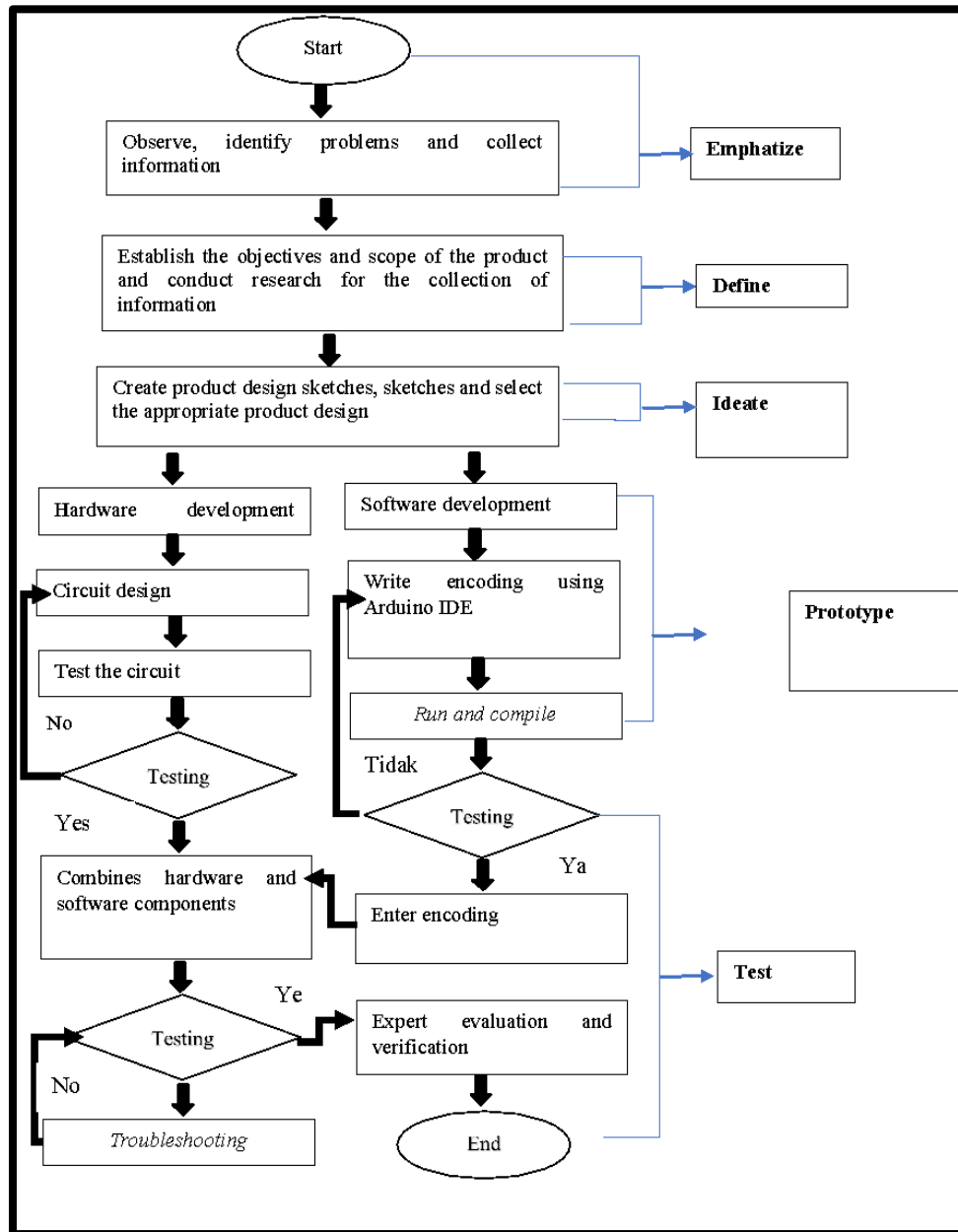

Figure 1: Flowchart of design product

2.1 Empathize Phase

According to Chou (2018), empathy is a tendency for one to feel something done by another. In this phase, the solution starts with the design problem with a clear and unambiguous definition of the problem. From these observations, the analysis was made in relation to the key management system that we want to develop to facilitate and speed up the user to retrieve their key. The identified problems are resolved according to the needs of the user from the analysis performed.

2.2 Define Phase

A study may be initiated when an individual feels the need to improve the existing key management system. During this phase, the identified problems were first formulated. This phase focuses more on the problem's users face. Researchers obtain information in the form of problem statements through readings, observations made. In addition, document research and questionnaires also help the researcher in terms of the problems faced by the users.

2.3 Ideate Phase

Once working on an alternative solution to the design problem, it is necessary to analyze the solution and then decide which solution is most appropriate for its implementation. Analysis is the evaluation of the proposed design. This design phase will only be done once the researcher has obtained information on the functionality of the product being developed. All the issues in the project that have been developed will be evaluated and reviewed to find a more suitable design that will make it easier for the user to have a positive impact in helping to solve the problem. Ideate phases tend to help the researcher to explain the details regarding earlier design of drawing as well to be used. Figure 2 shows the design developed by the researcher.
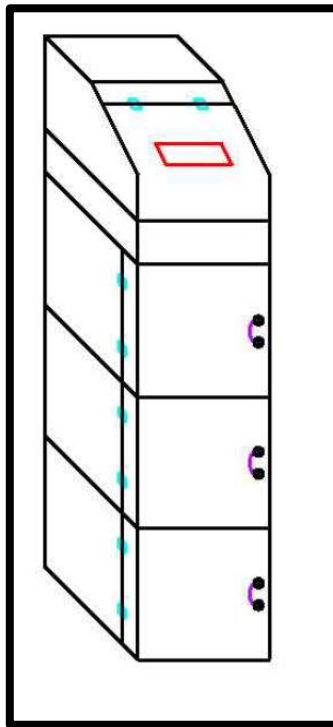

Figure 2: Design was developed by researcher

Next, researcher also develop an operational system so that this product can work systematically. Figure 3 shows the operational system for this product and the component needed to develop this product. The system is important to help researcher follow the flows and understanding the circuit more accurately
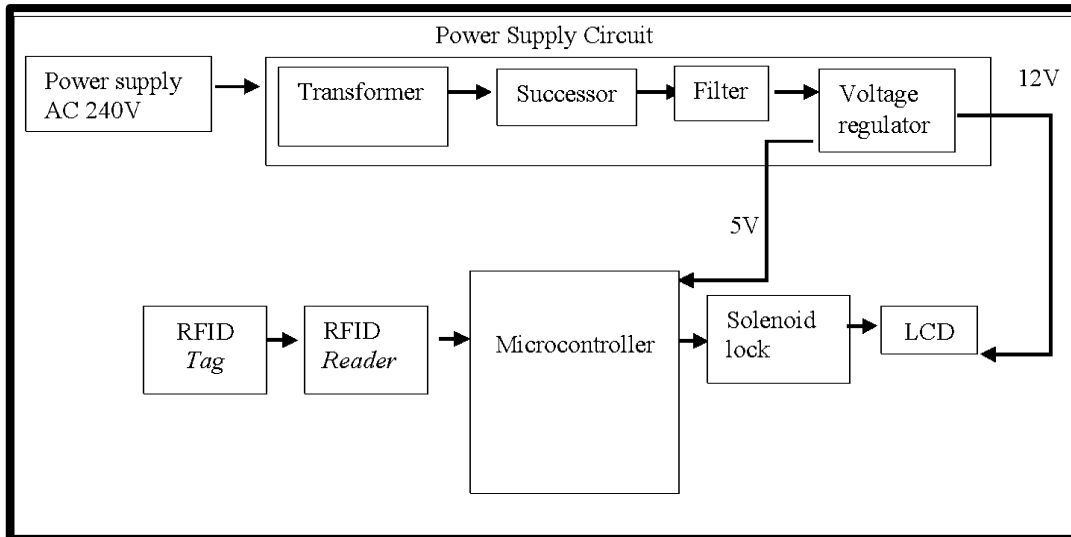
Figure 3: Operational system diagram

2.3   Prototype Phase

The main components for developing this prototype in the main part are the input element, which is the prototype. Component selection is important in prototype development as it depends on needs and requirements at a reasonable cost. In this phase, the prototype phase is used as a guide to develop a product to meet the needs of the user. This process takes a long time because it involves a lot of the processes involved during development. In this phase, researcher has divided into two parts which are hardware development and software development. Figure 4 shows the prototype that has been developed which is hardware development while Figure 5 shows the process of software development.

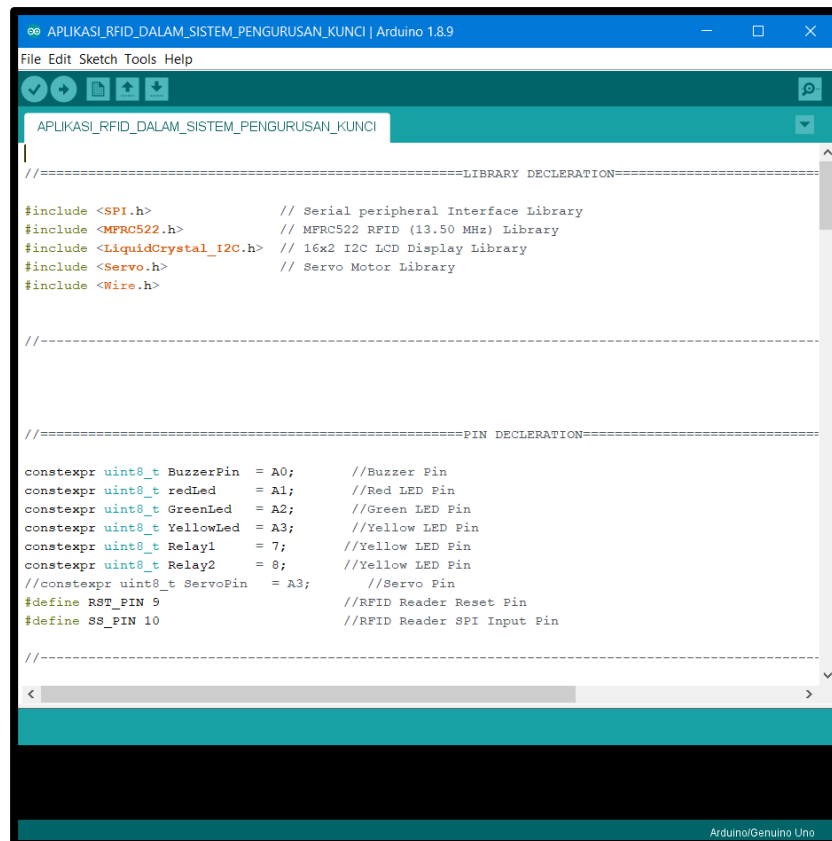**Figure 4: Prototype that has been developed**

Figure 5: Process of software development

In this software development, researcher used Arduino as a software to develop the programming. Arduino was chosen because its programming language is easy to understand which is C language.

2.5 Testing Phase

In this phase, the researcher performs tests such as functionality, expert validity tests and observations in order to assist the researcher in reference to future improvement. The researcher conducts a test of the finished design. The questionnaire was developed to evaluate various aspects of the development of the product. Then three expert lecturers from Polytechnic Kota Bharu (PKB) in the same field of electrical and electronic make an evaluation. After that, the researcher refined and analyzed the comments and suggestions provided by the experts

3. Results and Discussion

The results of the study obtained from the analysis of the data are presented as a percentage. Three expert confirmation responses to the item provided via the questionnaire form. The results of the study are described in the following sections. Table 1 shows the analysed part based on design aspects.

Table 1: Analyzed part based on design aspects

No.	Item	Yes	No	Percentage (100%)
1	This product design can detect the presence of a key	3	-	100%
2	The design is stable.	3	-	100%
3	This design has a good framework.	3	-	100%
4	This design does not endanger the user.	3	-	100%
5	This design has safety features.	3	-	100%

3.1. Expert Analysis for Design Aspects

There are five items in this section which is in section A. The level of expert agreement on the design is high on all items. Table 1 shows the analyses done by the researcher.

3.2. Expert Analysis of The Ideal Aspects of Development

There are five items in this section which is in section B. The level of expert agreement on the design is high on all items. Table 2 shows the analysed part based on ideal aspects.

Table 2: Analyzed part based on ideal aspects

No	Item	Yes	No	Percentage (100%)
1	Products are developed to save user's time.	3	-	100%
2	The product developed can make it easier for the user to handle key storage.	3	-	100%
3	The product developed features a technological system	3	-	100%
4	This product is relevant for development.	3	-	100%
5	This product acts quickly when the power supply is supplied	3	-	100%

3.3. Expert Analysis of the Functional Aspects

There are five items in this section which is in section A. The level of expert agreement on the design is high on all items. Table 1 shows the analysed part based on functional aspects.

Table 3: Analyzed part based on functional aspects

No	Item	Yes	No	Percentage (100%)
1	The product works well.	3	-	100%
2	The power supply unit works well when the supply is.	3	-	100%
3	The Arduino Nano is ideal for use as a micro-controller in product development.	3	-	100%
4	Sensors work well.	3	-	100%
5	RFID can read RFID tags.	3	-	100%

3. 4 Implication

In addition to filling in the questionnaire there is also a section where experts can comment after evaluating the prototype of RFID application in key management systems that is developed in its entirety. There are three experts who evaluate the results of the product. Table 4 shows a summary of the reviews provided by the three experts.

Table 4: Summary of reviews and comments from expert

Expert	Comments
Expert 1	Make improvements on ultrasonic sensor detector. This is because the detector is slow to detect the presence of the key. Additionally, the expert recommends using a keypad system for many users to use the application.
Expert 2	Suggested that future researchers improve on the reporting and monitoring of key records using the medium of IoT. The advantages of IoT-based monitoring help to facilitate key management as well as control and manage data irrespective of place and time.
Expert 3	Recommended upgraded the lock door when the solenoid is opened to open the lock door, the door will automatically close end up after a few seconds.

4. Conclusion

As a result, the research conducted by the researcher has successfully designed, developed, and evaluated the functionality of the RFID applications in key management systems. Then, all the research interests can also be proven by the researcher through the results of the analysis carried out through expert verification that evaluates RFID application in key management systems.

Acknowledgement

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