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Designing Automatic Safe Security Devices Using Microcontroller Based RFID and Fingerprint

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Abstract: A safe is a fire-resistant metal cabinet or box that is usually used by the owner to store valuables (such as money, valuable papers, jewelry, etc.) from thieves/burglars. Safes are generally in the form of cubes/blocks or cylinders. Safes are usually wall-mounted, as well as large room-shaped safes. But not a few also know the weaknesses of the security so that the safe is easily stolen. Based on the description above, in this study the authors are interested in designing an automatic safe system using a fingerprint microcontroller-based in the main system, this automatic safe is regulated by the Arduino Atmega 2560 microcontroller with the Arduino IDE programming language. The safe system automatically works when the user enters the fingerprint and RFID tag correctly, the safe will open. Based on data analysis, it is obtained in the form of a mechanical tool in the test, the characteristics of the sensor, accuracy and precision of the tool are obtained. The characteristics of the sensor can be seen from the fingerprint sensor and RFID sensor. The accuracy value of the sensor on the tool, namely the fingerprint sensor and RFID sensor, the accuracy is very good, the accuracy of the RFID sensor voltage is 99.73% while the accuracy value of the RFID sensor has very good accuracy

Keywords: Security System, Fingerprint, RFID, Arduino Atmega 2560.

1. Introduction

In modern times, the crime rate occurs a lot, especially the increasing crime rate of theft, therefore the security system is needed in various areas of life today. Material and privacy factors are important aspects that must be taken care of. With the development of technology today, you also help and develop a reliable security system, one of which is by creating a security system in the safe. Brankas comes from the Dutch language, the word branden means to burn and kast means cabinet, so the cabinet is fireproof. While in Indonesian a vault, which is a cabinet made of iron. In English it is called Safes" [1]. Safes are generally in the form of cubes/blocks orcylinders.

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Generally, existing safes now lack a good security system and are less practical. One of them is the security system on the safe door which is vulnerable and the possibility of theft is very large. In today's safe, a security is needed, so that it can anticipate the danger of theft that can occur unexpectedly. Usually, the safe used is a conventional safe, which has a working principle to open and close it by rotating the combination on the key. The security of the conventional safe is no longer guaranteed because the way to rotate the combination on the lock (padlock) can still be broken by entering the combination continuously until it gets the correct code and can also be damaged using pliers and hammers, compared to the current technological developments where security is more guaranteed [2]. So that the manufacture of microcontroller-based safes is a solution at this time.

A microcontroller is an electronic circuit that functions as a controller and controller of the work process of an electronic circuit. Microcontroller ICs have CPU, memory, timer, serial and parallel communication channels, input or output pins, etc. Examples of modern electronics that use microcontrollers are computer keyboards, household electronic equipment, robots, cars, medical equipment, modems, electronic measuring instruments (Such as oscilloscopes, multimeters, frequency synthesizers) and others [3]. Arduino is a microcontroller-based board on the Atmega2560. This board has relatively many I/O Pins, 54 digital Inputs/ Outputs, 15 of which can be used as PWM outputs, 16 analog inputs, 4 UART. Arduino Mega 2560 is equipped with entered 16 crystals. For relatively simple use just connecting power from USB to PC/Laptop or via DC Jack using a 7-12 V DC Adapter [4]. In Arduino atmega2560 this is programming through the Arduino IDE [5].

Fingerprint is a tool to meet the needs of fast data by using fingerprint verification. Before the Fingerprint sensor was invented, in the past a data was secured using a password or ID, some used patterns to secure data [6]. The working principle of this fingerprint sensor is to use the refraction of frustration over the glass prism. The light source (usually LED) is directed to one side of the prism and a finger is placed on one side of the prism. The fingerprint ridge absorbs light while the fingerprint valley makes no contact with the prism, allowing the light to be reflected. CCD (Charge Coupled Device) or CMOS cameras take reflected light, which is a representation of mountains and valleys. The optical path of light in physics is denoted by S, which is as the total optical length between the surface of the finger and the sensor array [7].

RFID is equipment and technology that uses radio signals to provide data that has been identified. This RFID is included in the form of a tag or small label that can identify an object data received through a radio signal, then translated back in the form of numbers or other information. RFID is a combination of radio frequency-based technology and microchip technology. The information contained inside the microchip tag and affixed to the library material can be read using radio frequency technology. A reader (a sensor, scanner, or interrogator) looks for the antenna on the tag and retrieves information from the microchip in the RFID device. RFID chips have become a very important part, because the chips used have become smaller and smarter to the point where they can be added to every type of document and can be read and updated from a distance. The definition of RFID in general is a new technology to identify or detect an object (object / person) using radio waves, which consist of one or more interrogator readers / transponders and RF data transfers achieved in the appropriate way inductive modulated or emitting electromagnetic carriers. In addition it can be used as a data carrier, with information written and updated for the tag at the time of use. The RFID system carries the corresponding transponder data, commonly known as

the tag, and retrieves the data, with a machine that can read out the meaning, at the appropriate time and place to meet the needs of a particular application [8]. After the Fingerprint is registered or recognized in the programming and the RFID tag is identified by the RFID reader then the solenoid will open.

Selenoids are one of the types of coils made of long wires tightly winded and it can be assumed that their length is greater than their diameter. While the selenoid key is a combination of a key and a selenoid which is commonly used in the electronization of a tool as an automatic lock and others. The selenoid principle was discovered by a French physicist named Andre Marie Ampere. In the field of engineering this term denotes in tranduser devices that convert energy into linear motion. When the coil is electrified by a litric current, the electromagnetic force will appear and pull the iron in the middle of the coil linearly [9].

In the previous research [10] an automatic safe device based on a microcontroller was built that uses a pin code (keypad) and fingerprint sensor as the main security system of the tool. In this tool, a security system is designed using Arduino Uno as its microcontroller which will control the inputs and outputs of the tool. However, this tool also has a disadvantage where the security system using a pin code (keypad) is not very effective because users can forget the pin code contained in the safe. Based on this, in this study, a safe security system can be designed with a sophisticated security system using Arduino as the microcontroller that will control the inputs and outputs in the safe. To open the safe door, use two ways, namely using RFID and Fingerprint. The safe door will open with RFID which functions as a reader to read the id tag used as the opening key and Fingerprint that has input data in arduino while selenoid and buzzer as the output or output of this tool and this tool also uses AC and DC electricity is useful in the event of a power outage then the safe can still be used [11].

2. Materials and Method

This research is classified as an engineering research. Engineering research (engineering) is a design activity that is not routine, so that in it there are new contributions, both in the form of processes and products / prototypes. In engineering research, the discussion of design activities in it involves relatively new things, if the design activity refers to certain standards or design codes, then the activity is not a research activity in the field of engineering. The main stages in engineering research are shown Figure 1.

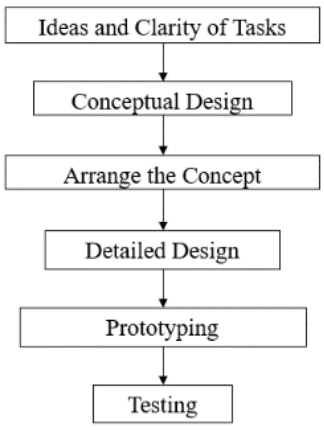

Figure 1. Stages of Engineering Research

Figure 1 is the stages of engineering research starting from finding ideas and task clarity, conceptual design, arrangement, geometric and functionality, detailed design, making prototypes / models and finally the testing stage. From this research, an Automatic Safe Tool Design Using RFID and Microcontroller-Based Fingerprints will be produced. The design of the Automatic Safe Tool Using RFID and Microcontroller-Based Fingerprint can be seen in Figure 2.

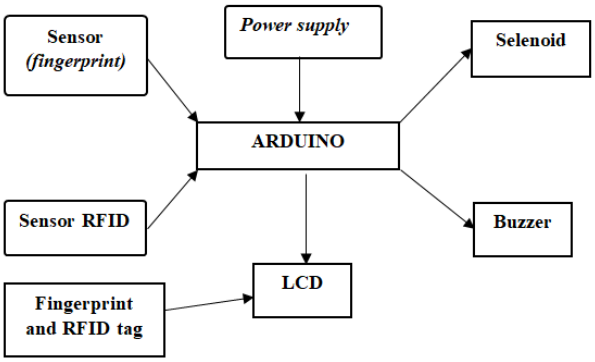

Figure 2. System Diagram Block

In Figure 2 the Design of the Automatic Safe Tool consists of a power supply, Fingerprint sensor, RFID, LCD to display the output of the tool. Arduino Atmega2560 as a system controller, selenoid and buzzer as input/output of the tool. Software Design The software used to operate the tool is Arduino Atmega 2560 as a microcontroller. For programming on Arduino Atmega2560 used Arduino IDE. The programming language that Arduino IDE uses is the C++ language. For the programming flowchart shown in Figure 3.

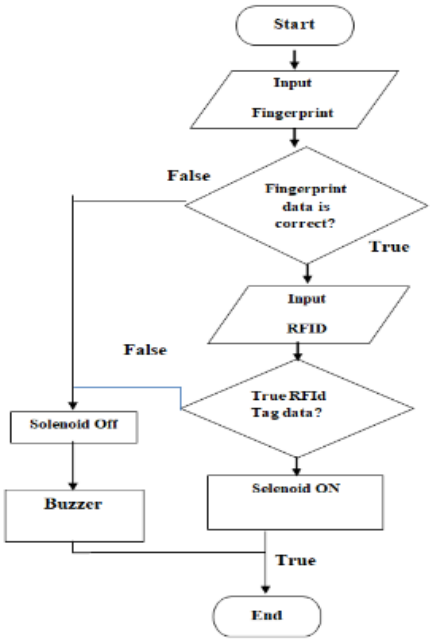

Figure 3. Flowchart Tool Design

Figure 3 is the flow of designing the tool. At this stage, it begins with entering the fingerprint by attaching the finger that has been inputted in the Arduino microcontroller, if the input fingerprint is in accordance with the data that has been stored in the microcontroller, the next process is to enter the RFID tag by attaching the RFID tag that has been inputted in the Arduino

microcontroller, if the RFID tag affixed is correct according to the data that has been inputted in the microcontroller then the selenoid will be active and the door the safe will open automatically, and if the fingerprint is previously entered incorrectly, the selenoid will be off and the safe will not be able to open and the buzzer will activate as a warning to the owner that someone else is trying to open the safe. System Hardware Design in this tool consists of several electronic components, namely Fingerprint Sensor, RFID, Arduino Atmega 2560, power supply, LCD, Selenoid and Buzzer. The design of the Auto Vault can be seen in Figure 4.

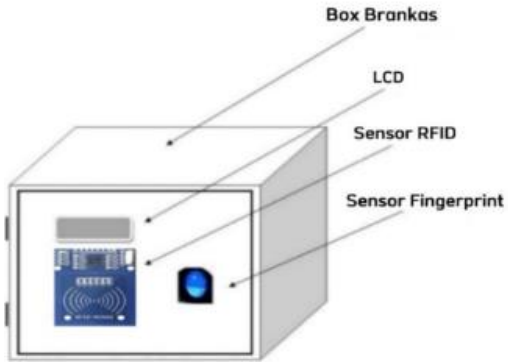

Figure 4. Automated Vault Design

In Figure 4 can be seen that the design of the Automatic Safe, where there is an RFID sensor and Fingerprint sensor as input from the safe tool and LCD is useful for displaying the correct or false inputs entered. In this automatic safe tool, it uses Arduino as the microcontroller, power supply as a voltage source. Selenoids and buzzers as the output of this tool.

3. Results and Discussion

Based on the data obtained, it can be seen how the specifications of the tool have been made. The specifications obtained later are the tool performance specifications and tool design specifications. The presentation of the data obtained will later be displayed in the form of tables and graphs. Performance specifications are an identification of sensors intended as system builders by testing the tool, and also analyzing data in order to see the performance of the tool whether it is running well or not. To see the performance specifications of the tool in this study can be seen from the series of RFID sensors, fingerprint sensors and tool mechanics.

A series of fingerprint sensors is needed so that the fingerprint sensor can detect both registered and unregistered fingers and work according to the given program. The series of fingerprint sensors can be seen in Figure 5.

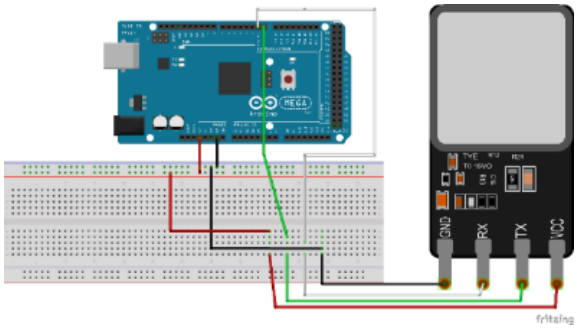

Figure 5. A series of fingerprint sensors.

In Figure 5, it can be seen that the fingerprint sensor has 4 pins, namely Vcc, Gnd, Rx, and Tx. Vcc pins of the sensor are connected to the 3.3 V pin of the arduino, the Gnd pin of the sensor is connected to the GND pin of the arduino, the Rx pin of the sensor is connected to pin 2 of the digital output on the arduino, and the Tx pin is connected to pin 3 of the arduino digital output. After everything is connected and the program has been inputted into the Arduino, then the circuit can be used, so that the sensor can detect fingerprints that have been registered or those that have not been registered. And after the fingerprint is detected then the next step RFID reader detects the RFID tag. In this study, the RFID tag used was a card-shaped RFID. In this circuit Arduino Atmega 2560 is connected to an RFID reader, Arduino Atmega 2560 is useful for processing by giving commands to the RFID reader. This set is needed for the vault to have an additional security system. The RFID sensor circuit can be seen in Figure 6.

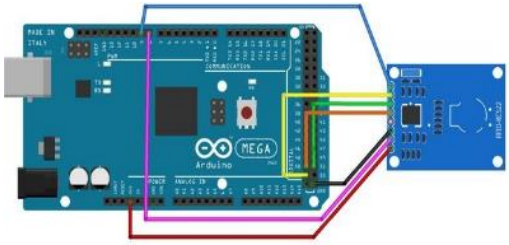

Figure 6. RFID Sensor Circuit

In Figure 6, it can be seen that the RFID reader sensor has several pins that are used to connect the RFID reader with the Arduino Atmega 2560. The pins on the RFID reader, namely RST, are connected to pin 9 of arduino, SDA is connected to pin 10 arduino, SCK is connected on pin 13 arduino, MISO is connected on pin 12 arduino, and MOSI is connected on pin 11 arduino. Then the RFID reader sensor has a Vcc pin connected to 3.3 V and for ground RFID reader is connected to Arduino ground. The following are the results of making a mechanical automatic safe security system that will be made into a prototype using acrylic base material, where acrylic is useful for protection from sensors. The mechanics of the safe safety system can be seen in Figure 7.

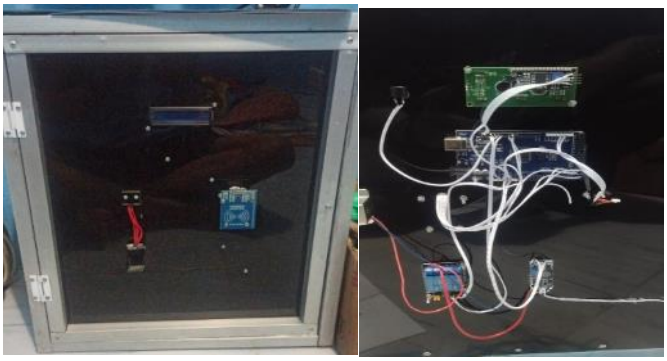

Figure 7. Safe security system mechanics

In Figure 7, you can see the mechanical form of the entire safe security system based on Arduino Atmega2560 using fingerprints and RFID. This box is made of plastic material with a size of 50cm x 40cm x 55cm. and you can see the design specifications of the tool in this study can be seen from the characteristics, accuracy, and precision of the RFID sensor, fingerprint sensor and tool testing. To see the characteristics of the fingerprint sensor, use the SFG demo application to display the fingerprint template used. For the input required, the sensor is 3.3 v. The characteristics of the sensor can be seen in Table 1.

Table 1. Characteristics of fingerprint sensors

No	Templates registered fingerprint	
1		
	right thumb	left thumb
2		
	right index finger	left index finger
3		
	right middle finger	left middle finger
4		
	right ring finger	left ring finger
5		
	Right little finger	Left pinky

In Table 1 it can be known that the output of the fingerprint sensor is in the form of a fingerprint template which later the fingerprint to be identified will be compared with the fingerprint template that has been registered on the sensor.

The characteristic of this RFID sensor can be seen by the conformity of the identity number issued from the RFID tag. RFID sensor output data is needed to identify how sensitive the sensor is used. Where data retrieval on the RFID sensor is measured using a certain distance. Data retrieval using RFID reader and RFID tag. The characteristics of the RFID sensor can be seen in Table 2.

Table 2. RFID Characteristic Data

No	RFID	Open Code	Code on ID card
1	RFID tags 1	994121302	994121302
2	RFID tags 2	71213219123	71213219123
3	RFID tags 3	99732152300	99732152300
4	RFID tags 4	171851313400	171851313400
5	RFID tags 5	581129417300	581129417300
6	RFID tags 6	1541868418900	1541868418900
7	RFID tags 7	1863813718900	1863813718900
8	RFID tags 8	2182215819000	2182215819000
9	RFID tags 9	25017412318900	25017412318900
10	RFID tags 10	2501946317400	2501946317400

In Table 2, it can be seen that the output of the RFID sensor is in the form of a different identity number from each card which will later be identified on the work of the sensor by comparing the identity number that has been registered on the sensor with programming in the Arduino IDE. The next characteristic of RFID is by varying the distance for identification of the output of the RFID which is in the form of output voltage and information detected or not can be seen in Figure 8.

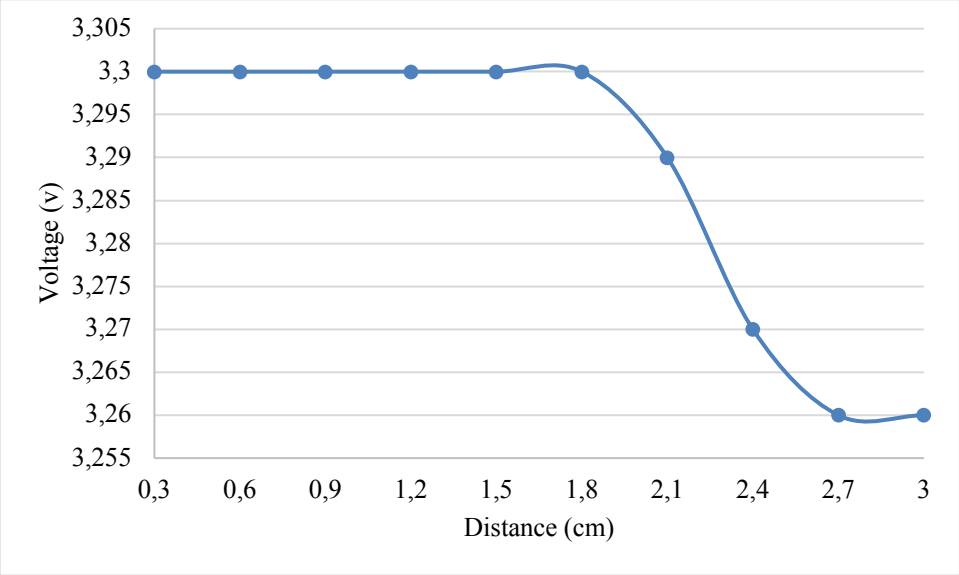

Figure 8. RFID sensor characteristic graph

It can be seen in Figure 8 that the measurement results at the measurement point of the average voltage are 3.29 volts at the output condition after detecting the RFID tag. The RFID sensor can only detect tags with a distance of 2.4 cm.

The accuracy of the fingerprint sensor is obtained by comparing the fingerprint template that has been registered with the fingerprint template taken directly. If on the application the reading of the fingerprint template states that it matches, it means that the fingerprint template registered with the one taken directly is the same finger. Then the fingerprint sensor used can be declared accurate. The accuracy of the fingerprint sensor can be seen in Table 3.

Table 3. Fingerprint sensor accuracy

No	Subject	Templates registered fingerprint	Templates fingerprint identified	Information
1	Right thumb			Right
2	Index right			Right
3	Right middle finger			Right
4	Right ring finger			Right
5	Right little finger			Right
6	Left thumb			Right

No	Subject	Templates registered fingerprint	Templates fingerprint identified	Information
7	Left index			Right
8	Left middle finger			Right
9	Left ring finger			Right
10	Left little finger			Right

In Table 3, you can see the accuracy of the fingerprint sensor. On each finger it is said that the compared fingerprint template is suitable. Then the fingerprint sensor used is accurate.

The accuracy of the fingerprint sensor is obtained by comparing fingerprint templates from several different people. The accuracy of the fingerprint sensor was carried out using 10 fingerprint scans from different people and resulted in data acquisition which can be seen in table 4.

Table 4. Fingerprint Measurement Data from 10 different people

No.	Fingerprint	Name	Information
1		Rivals	Not open
2		Nando	Not open
3		Fikhri	Not open

No.	Fingerprint	Name	Information
4		Azca	Not open
5		Irfan	Not open
6		Alwi	Not open
7		Iqbal	Not open
8		Revelation	Not open
9		Owner	Open
10		Owner	Open

In Table 4 it can be seen that the accuracy of the fingerprint measurements from 10 different people, where the fingerprint measurement measured was the right thumb finger. And the results obtained from each fingerprint sample are not the same. From the data obtained, it can be concluded that the fingerprint sensor used in this safe security system has very good accuracy.

The accuracy of the fingerprint sensor of the safe security system is done by comparing the fingerprint template 10 times compared to the same finger. Accuracy will be seen from the information on the fingerprint reading application. If the fingerprint is declared suitable, it can be said that the fingerprint sensor has very good accuracy. The results of the fingerprint sensor accuracy test can be seen in the fingerprint compatibility test on 7the right thumb finger. The accuracy of the fingerprint sensor can be seen in Table 5.

Table 5. Fingerprint sensor accuracy

No	Trial to-	Templates registered fingerprint	Templates identified fingerprint	Information
1	Trial 1			Suitable
2	Trial 2			Suitable
3	Trial 3			Suitable
4	Trial 4			Suitable
5	Trial 5			Suitable
6	Trial 6			Suitable
7	Trial 7			Suitable

No	Trial to-	Templates registered fingerprint	Templates identified fingerprint	Information
8	Trial 8			Suitable
9	Trial 9			Suitable
10	Trial 10			Suitable

The results obtained from Table 5 can be seen that the accuracy of reading the fingerprint sensor on the right thumb on the Atmega2560 android-based safe security system is very good. Where each fingerprint reading in each experiment is declared matched.

The accuracy of the RFID sensor of the motorcycle security system is carried out by comparing the identity of the card as much as 10 times the comparison of the same identity. Accuracy will be seen from the information on the serial monitor reading the card identity. If the identity of the card is declared correct or suitable, it can be said that the RFID sensor has very good accuracy. The results of testing the accuracy of the RFID sensor can be seen in testing the identity compatibility of the RFID tag card. The accuracy of the RFID sensor can be seen in Table 6.

Table 6. Card Identity Accuracy on RFID Sensor

No	Trial to-	Detected card identity
1	Trial 1	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
2	Trial 2	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
3	Trial 3	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02

No	Trial to-	Detected card identity
4	Trial 4	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
5	Trial 5	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
6	Trial 6	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
7	Trial 7	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
8	Trial 8	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
9	Trial 9	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02
10	Trial 10	PICC type: MIFARE 1KB A new card has been detected. The NUID tag is: In hex: 63 29 D5 02 In dec: 99 41 213 02

Based on the results obtained from Table 6, it can be seen that the accuracy of reading the identity card on the RFID tag card. By attaching the tag card to the RFID reader with the same distance, the test of the RFID sensor is obtained which can read information from the tag. In each trial of the accuracy of the identity of the card above, it is declared true or suitable.

Overall testing of the tool is carried out by running a safe system based on android atmega2560. Testing the tool requires 10 subjects with 5 of them having their fingerprints registered so that they can be detected by the security system and 5 others are not registered. And this test also requires 10 RFID tags that have been registered. Later, the response from the security system will be seen whether it is in accordance with what is desired. The table of tool testing results can be seen in Table 7.

Table 7. Tool test results

Subject	Fingerprint	RFID	Buzzer	Solenoid door lock
Subject 1		994121302	Off	Open
Subject 2		71213219123	Off	Open
Subject 3		99732152300	Off	Open
Subject 4		171851313400	Off	Open
Subject 5		581129417300	Off	Open
Subject 6	Not listed	1541868418900	On	Not open
Subject 7	Not listed	1863813718900	On	Not open
Subject 8	Not listed	2182215819000	On	Not open
Subject 9	Not listed	25017412318900	On	Not open
Subject 10	Not listed	2501946317400	0n	Not open

In Table 9, the results obtained in testing the tool are that the tool works according to the program that is input to the Arduino ATmega2560. When the registered fingerprint and RFID tag

access the device, the door lock solenoid will open and the alarm will turn off. The working system of this tool is in accordance with the desired.

Based on the analysis that has been obtained in the form of tables and graphs, the results have been obtained according to the research objectives. The results of the study include performance specifications and design specifications for Automatic Safe Security Systems Using Fingerprint Sensors and Microcontroller-Based RFID. The performance specifications of the tool are obtained from the function and circuit of each sensor, while the design specifications of the tool are obtained from the results of the accuracy and thoroughness of the data analysis of the Arduino Atmega2560-based safe security system.

The first result of the device performance specification is seen from the fingerprint sensor circuit. The fingerprint sensor circuit is used as a system that will read the user's fingerprint. The fingerprint sensor records specific fingerprint characteristics, stores each user's data into a template, when the user tries to access the software will compare the data stored in the template with the fingerprint reading from the scanner [12].

The second result of the tool performance specification is seen from the RFID sensor circuit. The RFID sensor circuit is used as a system that will read the card identity from the user. The RFID tag transmits signals via radio waves to the RFID reader, the data is assisted by the Arduino ATmega2560 microcontroller. When the user tries to use the RFID tag by bringing the RFID tag card closer to the RFID reader, the tool identifies an object such as an RFID tag card or an RFID tag card such as a keychain where the sensor reads data in the form of a code on the card. The data is sent from the RFID to the microcontroller, namely the arduino atmega2560 to be adjusted whether the data has been registered in the tag register or not.[13].

The third result of the tool performance specification is the mechanical fabrication of the tool. The mechanical manufacture of the tool serves to combine several components into one as a constituent of the security system in the safe. Several components of the safe security system are arranged in a black plastic box. [6] With the establishment of a mechanical device, a safe system can be made according to the needs and benefits. After everything is combined, a system is formed Automatic Safe Security Using Fingerprint Sensor and RFID Microcontroller Based.

Furthermore, the description of the system design specifications Automatic Safe Security Using Fingerprint Sensor and RFID Microcontroller Based. To see the security system design specifications seen from the characteristics of the sensor, the accuracy and precision of the tool, and the overall testing of the system Automatic Safe Security Using Fingerprint Sensor and RFID Microcontroller Based [3].

The first result of the device design specifications is the fingerprint sensor characteristics. A fingerprint sensor is an electronic device used to capture a digital image of a fingerprint pattern. The digital image of this fingerprint pattern is the result of direct scanning from digital processing and stored in the database storage memory in the form of an image of the fingerprint surface used for matching [7]. To get the characterization results, a PC application is used which can display the fingerprint template contained in the fingerprint sensor and can see the compatibility of the fingerprint template.

The second result is the characteristics of the RFID sensor. An RFID sensor is a device that uses radio waves to transmit an identity which can be a unique number. The RFID sensor is used as an identification card in the safe security system. To see the characteristics of the RFID sensor, it can be seen by the suitability of the identity number issued from the RFID tag which can be seen

on the serial monitor display and can see whether the identity received is correct or incorrect. Then the characteristics of the RFID sensor can also be seen from the reading distance on the sensor[14].

The third result of the tool design specifications is the accuracy and overall system of Automatic Safe Security Using Fingerprint Sensors and Microcontroller-Based RFID. To determine the accuracy and precision of the Arduino-based safe system that is made, it can be seen from the accuracy and accuracy of the sensors used in the safe security system, namely the fingerprint sensor [12]. The accuracy is obtained from the results of the comparison of the output of each sensor, in this fingerprint sensor the comparison data is the fingerprint template registered with the fingerprint template taken directly. While the accuracy is obtained from repeated measurements 10 times from the sensor output to one subject.

The fourth result is the accuracy and precision of the Fingerprint sensor. The accuracy of the fingerprint sensor is obtained by comparing fingerprint templates from several different people. The accuracy of the fingerprint sensor is carried out using 10 times scanning fingerprints from different people and resulting in data acquisition. the results obtained from each fingerprint sample are not the same. From the data obtained, it can be concluded that the fingerprint sensor used in this safe security system has very good accuracy

The fifth result is the accuracy and precision of the RFID sensor. The accuracy of this RFID sensor can be seen from the suitability of the identity of the card that has been registered with the identity that is detected directly, the accuracy of the data obtained in the experiment is very good or called accurately. While the accuracy of the RFID sensor can be seen from the results of repeated experiments using the same identity card, the accuracy obtained in testing the accuracy of the RFID sensor is accurate [15].

The sixth result is the accuracy and precision of the voltage on the RFID sensor. The accuracy of the voltage is by identifying the RFID tag by an RFID reader with a certain distance variation. Then look at the output voltage of the sensor and compare with the actual voltage the percentage of accuracy obtained is 99.73%. In the measurement of the RFID reader, it can only identify RFID tags with a distance of 2.4 cm.

The seventh result is the result of overall tool testing. In testing the tool, it will be seen whether the system work is in accordance with what was programmed. [16] Testing the tool when the registered fingerprint and RFID tag access the device, the door lock solenoid will open and the alarm will turn off when the user whose fingerprint has not been registered, the solenoid will remain closed and when the user tries to open the door by force, the alarm will sound. For the results obtained, the tool works according to the program entered so that the tool can be used.

4. Conclusion

The results of the performance specifications of the Arduino Atmega2560-Based Safe Security System are seen from the running of the fingerprint sensor circuit, the RFID sensor circuit, and, the overall circuit. After everything is combined into a safe security system. The system works when the fingerprint sensor reads the registered fingerprint and continues with the RFID reader sensor receiving a signal in the form of radio waves by the RFID tag, then if the identity received by the RFID reader is correct or has been registered then the Arduino will make the solenoid door lock open so that the door can open. The results of the arduino-based safe security system design specifications are obtained from the characteristics of fingerprint sensors and RFID sensors,

accuracy, accuracy of tools and testing of tools. The characteristics of the fingerprint sensor are seen from the fingerprint template taken and stored by the sensor memory. The characteristics of the RFID sensor are seen from the suitability of the card identity registered and not registered with the card identity detected directly. The accuracy of the tool is obtained from the comparison of the output results of each sensor. In the fingerprint sensor, the result obtained is a template for each finger that is compared to the fingerprint template taken directly. The accuracy of the identity on the RFID sensor that is measured directly is stated to match the identity that has been registered. The precision at the voltage of the RFID sensor has a percentage of accuracy of 99.73%. The accuracy of the tool is obtained from repeated measurements made by each sensor with 10 repeated measurements. In the fingerprint sensor, the results obtained in the accuracy of the fingerprint sensor on the right thumb finger are any fingerprint readings that are compared to match. As for the accuracy of the RFID sensor, it can be seen from the results of repeated experiments using the same identity card, the accuracy obtained in testing the accuracy of the RFID sensor is accurate. In testing the tool as a whole, it is seen whether the tool is running according to the given program. The result obtained is that the safe security system based on arduino atmega2560 runs according to the given program.

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