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Door Security Design Using Fingerprint and Buzzer Alarm Based on Arduino

Mario Junianto Manurung[1)*], Poningsih[2)], Sundari Retno Andani[3)], Muhammad Safii[4)], Irawan[5)]
[1)]STIKOM Tunas Bangsa, Indonesia [2)3)4)5)]AMIK Tunas Bangsa, Indonesia
[1)]mario.manurung1997@gmail.com, [2)]poningsih@amiktunasbangsa.ac.id, [3)]sundari.ra@amiktunasbangsa.ac.id, [4)]m.safii@amiktunasbangsa.ac.id, [5)]irawan@amiktunasbangsa.ac.id

Abstract

The level of crime of theft in people's homes from time to time is increasing and increasingly unsettling for many people and various groups, from leading sources claiming that there has been an increase in theft in people's homes from the previous year, by conducting research objects in the community by identifying existing problems. It can be concluded that this happens because the house door security system still uses conventional which is classified as unsafe or easily broken into, by carrying out research method steps in the form of analysis and data collection and in the form of designing tools by describing some of the main supporting tools that the problem can be minimized by using technology that is currently developing that is already well systemized, namely using a microcontroller or Arduino as the main control center, assisted by using a fingerprint sensor as a process for recording and identifying fingerprints and NodeMCU for to connect to a wifi network where later on that the door can also be controlled using android via a wifi network as a remote control and an alarm buzzer which will function if when the fingerprint identification process fails, the alarm will sound as a warning sign, it will be concluded to design a safety device The door uses Arduino-based fingerprint and alarm buzzer for a better system. Which only registered fingers can open the door. This research is expected to be able to optimize the security of doors in people's homes to avoid crimes such as thieves.

Keywords: Arduino Uno, Buzzer Alarm, Fingerprint Sensor, NodeMCU, Door

INTRODUCTION

Referring to previous research, namely the design of a motorbike safety system with fingerprint recognition carried out by (Oroh, Kendekallo, Sompie, & Wuwung, 2014) research was carried out to secure motorbikes from thieves by utilizing Arduino and fingerprint, by looking at the same problem. which is the same as securing valuable objects from thieves, therefore this research will implement a security system inside the door of the house with a more coordinated system and of course the addition of certain tools. The crime of theft at home often occurs from time to time this happens because, the house is often inhabited or empty by the owner so that the house becomes the main target for thieves. (Asep, Didik, & Fiddiansyah, 2019) because the door locks generally still use conventional locks where conventional door locks are generally easily broken into, not only that, conventional locks that we generally use can be lost or left behind (Yudhana, Sunardi, & Priyatno, 2018) which of course becomes a problem, because home security is a necessity for people in a house(Siswanto, Yulianti, & Costaner, 2017).

Seeing this incident, security is an absolute thing to do, need to be careful so that this does not happen to anyone, so everyone is required to further improve door security because if you get better security then you can get a sense of comfort.

By utilizing current technology, there are many ways we can improve door security, such as using a retina sensor (eye), a voice sensor (voice), and a fingerprint sensor (fingerprint). Fingerprint is a biometric series that can be used as a systematic identification tool that has been measured and checked extensively(Peter Komarinski, 2005) easy to get.

At this stage the fingerprint sensor uses additional tools, namely the alarm buzzer and nodeMCU. By working, it will record the pattern of lines on the skin tips of the fingers of the right and left hands then save the distinctive pattern, because everyone has a different fingerprint pattern (Sabar, Ismail, & Riyanto, 2017) in other words, fingerprints cannot be faked, Then scanning is carried out to verify if the fingerprint pattern matches the previously recorded fingerprint pattern then the access rights will be granted. But if the fingerprint has not been identified or the fingerprint has never been recorded before, the doorlock solenoid will not open and an alarm will sound and the door can be opened using the wifi network as a remote control. The buzzer alarm is made to avoid nosy hands who

* Corresponding author

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want to damage the fingerprint sensor

LITERATURE REVIEW

In a study, of course, there is no word perfect, it must have its own weaknesses and strengths, so a literature review is needed to support a research that has been done before to support a theory or study in it that makes sense, because current research is the development of researchers Previously, here are some of the previous research literature that has values that can be used as a reference: the first is research conducted by (Daulay & Alamsyah, 2019) with the research title "Monitoring of Door Security Systems Using RFID And Fingerprint Based On Web And Database" in this study. Discussing the security of the security monitoring process using fingerprint plus using the web will be read by the microcontroller and will be matched into the database, in this study it is classified as utilizing existing tool sources. Furthermore, the research conducted by (Oroh et al., 2014) with the research title" Design and Build a Motorcycle Safety System With Fingerprint Recognition" in this study discussed how to secure a motorbike using a fingerprint where the user only stores five finger scale patterns to the database and if the fingerprint pattern has not been stored in the database, the motor vehicle cannot be started by another party. Research conducted by (Wibowo, Rabi', Suprayogi, & Mujahidin, 2019) with the research title "Design and Build a M16 Weapon Rack Security System Using Rfid and Fingerprint" in this research the writer wants a more optimal and more up-to-date level of security because the agency which uses the military agency which is used to secure the M16 type weapon rack by using RFID and fingerprint sensors using a network of servers for administrative processes, so that weapon monitoring can be centralized so that the monitoring process can be easier. Research conducted by (Dian Nisa'a & Ifa Aldini Sani Pane, 2019) with the research title "Design and Build a Luggage Security System Using Fingerprint and GPS Based on Arduino Mega" this study uses a complete system where fingerprints are used for luggage security and GPS is used to track the whereabouts of the suitcases. This is where the location of the suitcase will be sent to our mobile transmission via SMS. Research conducted by (Muhammad, Samopa, & Wibowo, 2013) with the research title" Making Fingerprint-Based Lecture Attendance Applications" this research uses a fingerprint sensor as a security process and also as access to attendance where the recorded fingerprint patterns will be sent later to the SQL server. Research conducted by (Akrom Zulhij Fajri & Mauludin, 2020) with the research title "Design and Build a Fingerprint Safety System for AC Power Using the Arduino Nano" This research discusses how to secure AC electricity and avoid irresponsible external factors. Research conducted by (Tobing, 2014) with the research title" Door Security Design Using Fingerprint and Android Smartphone Based on Atmega8 Microcontroller " in this study discusses securing doors using fingerprints using ATMEGA8 type storage Arduino which has good storage capacity. which control doorlock can be connected to the mobile via bluetooth network. Research conducted by (Suwardi, Ashydikky, Baehaki, & Sopiandi, 2019) with the title of the research "Development of Arduino Uno R3 Based Door Security Prototype with Fingerprint Sensor" in this study discussed door security using a fingerprint sensor using the Arduino R3.

METHOD

This research method summarizes how the systematic method used by researchers with the intention of producing acceptable answers by describing the tools and materials used, system design, work system tools, as a reference or comparison of previous researchers.

System Requirements Specifications

Arduino Uno

Arduino is an electric kit or board filled with devices that are open to other programs that use a microcontroller designed to make it easier for electronic users (Iskandar, Muhajirin, & Lisah, 2017) can be seen in the picture below :

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Fig 1. Arduino Uno

This Arduino microcontroller is equipped with a USB connector to allow programming of the processor from a PC. Arduino can also be programmed using In System Programming (ISP). The 6 pin ISP programming connector is on the opposite side of the board from the USB connector. The specifications of the Arduino Uno can be seen in table 1 below:

Table 1. Arduino specifications

Microcontroller	Atmega 328P
Operating Voltage	5V
Input Voltage Recommendation	7 – 12 V
Limit Input Voltage	6 – 20 V
Pin I/O Digital	14 Pin (6 of which can be used output PWM)
Pin Input Analog	6
Current DC every Pin I/O	20Ma
Current DC For Pin 3,3V	50Ma
Flash Memory	32 KB (Atmega328P) around 0,5 KB use for bootloader
SRAM	2KB (ATmega328P)
EEPROM	1KB
Clock Spedd	16Mhz

Fingerprint

Fingerprint is a biometric authentication system to identify a person using one of the person's body parts, namely Fingerprint. Using fingerprint as a medium for authentication will increase the security of the system. Fingerprints are often used in authentication systems because they have high enough security, because each individual human has a different fingerprint so that they can easily identify and minimize counterfeiting (Padeli, Febriyanto, & Suprayogi, 2019) The fingerprint sensor has two processes, namely the recording process and the scanning process when the fingerprint recording process is scanned using the fingerprint sensor, the scan results are then stored on the fingerprint module in digital format after the fingerprint scan results are stored then perform a scan if appropriate then the access right is granted otherwise the door does not open.

Fig 2. Fingerprint

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Solenoid Doorlock

Inside the doorlock solenoid there is a wire coiled to the iron core. When an electric current flows through this wire, a magnetic field occurs to attract energy which will attract the iron core in (Pratama, et al, 2015). The doorlock solenoid is a key that is moved by an electric current, the doorlock solenoid will work if it is given an electric voltage of 12 VDC or 24 VAC because in the doorlock solenoid there is a wire that is coiled in the iron core, where the Door Access Control System is required for its regulation. The types of locks on the selenoid doorlock are as follows:

1. Electromagnetic Lock (protection through magnetic forces).
2. Electric Door Strike (protection using a latch - lock tongue and electric face plate).
3. Electric Drop Bolt (protection using selenoid which is moved mechanically).

Buzzer Alarm

According to some experts Stating "Buzzer is an electronic component that can convert electrical signals into sound vibrations." Sound is obtained from the membrane which has a coil. In general, the Buzzer which is an audio device is often used in anti-theft circuits or as an early warning to others. Which works on DC voltage is inversely proportional to speakers that use AC voltage. Each coil that is attached to the diaphragm which moves back and forth will make the air vibrate so that it produces a sound or a buzzer example can be seen in Figure 3. below.

Fig. 3 Buzzer Alarm

NodeMCU

nodeMCU is an open source IoT platform and a development kit that uses a programming language to assist in making prototypes of IoT products or you can use sketch with the Arduino IDE. The development of this kit is based on the ESP8266 module, which is inter-enerrated. NodeMCU is about 4.8 cm long, 2.54 cm wide, and 7 grams in weight. This board is equipped with wifi features and opensource firmware.

Relay

Relay is an electronic component in the form of an electric switch or switch that is operated electrically and consists of two main parts, namely electromagnet (coil) and mechanical (a set of switch contacts). This electronic component uses the electromagnetic principle to move the switch so that with a small electric current (low power) it can deliver higher voltage electricity. Relays have several functions including controlling high voltage circuits using the help of low voltage signals. Running logic function or logic function, can also provide time delay function or time delay function and protect motor or other components from short circuit or over voltage.

Research Design

This research design summarizes how the systematic method used by researchers, starting from the existence of a problem to finding alternatives to find solutions to problems.

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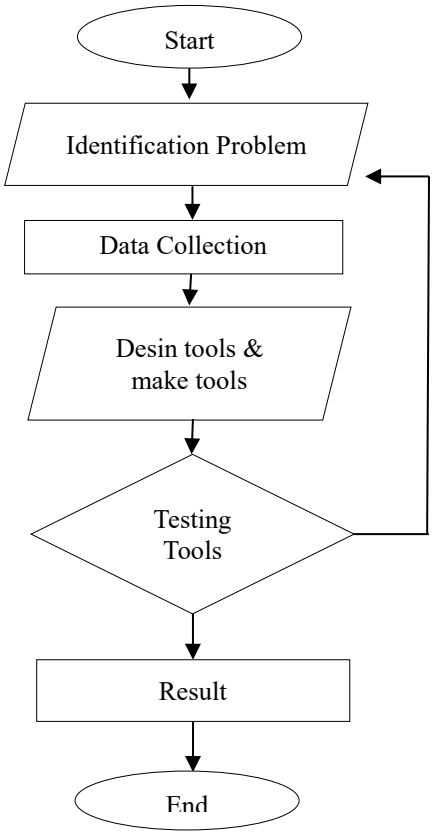

Fig. 4 Research Design

The explanation of the research flowchart made by the author is as in Figure 4 as follows:

1. Identification Problem
   The introduction of a problem and the initial stage in the research process of this research problem is the crime of theft which is increasingly happening in people's homes because the security of doors is very adequate nowadays or is classified as easy to break into.
2. Data Collection
   The data in this study were obtained from houses, by going directly into the field and seeing samples of doors that still used conventional keys.
3. Data Processing
   In this step the data that has been obtained from the problem identification study and data collection are then processed to solve the problems found.
4. Literature Study
   The data collection method uses several journals as a reference for the author.
5. Observation
   The method of collecting data is by observing doors in houses, trying to get as much information as possible by looking at samples of doors that are classified as unsafe.
6. Making Tools
   Next is designing a tool that can solve the problems experienced.
7. Testing Tools.
   Perform tool testing by carrying out the process of recording and identifying fingerprints.
8. Results
   Produce tools that are designed and implement tools that are made so that they can be used.

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Block system

The block diagram of a door security system using a fingerprint can be seen in the following image:

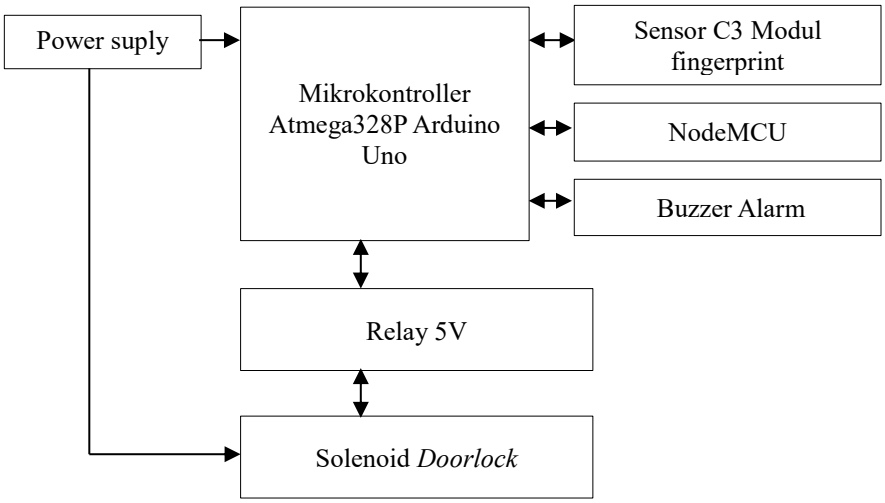

Fig. 5 Block System

In Figure 5 there are several hardware components (hardware) prototype of a door safety device, which are as follows:

1. The power supply is a useful component for providing electrical energy to the circuits in the system.
2. The fingerprint sensor has two main processes, namely the fingerprint recording process and the identification process which will be stored on the microcontroller.
3. The microcontroller is the main center for giving orders in the form of an ATMEGA328 microcontroller IC series.
4. Alaram Buzzer is sound-producing hardware that is obtained from the membrane that has the coil.
5. Solenoid doorlock is a component that functions to lock a door that is driven by an electric current and will open if the fingerprint identification matches.
6. NodeMCU As additional security for controlling the solenoid doorlock via a WiFi network that can be controlled via Android.

RESULT

Arduino Circuit Schematic

Before describing the Arduino Uno work procedure, the writer will first describe the circuit scheme of making a door safety using a fingerprint sensor based on the Arduino Uno microcontroller, in the process of assembling the tool, namely by connecting the Arduino Uno ATmega328P with a fingerprint sensor, doorlock solenoid, NodeMCU, 5 volt relay, and jumper cables. The scheme of the door safety circuit using a fingerprint sensor can be seen in Figure 6 below..

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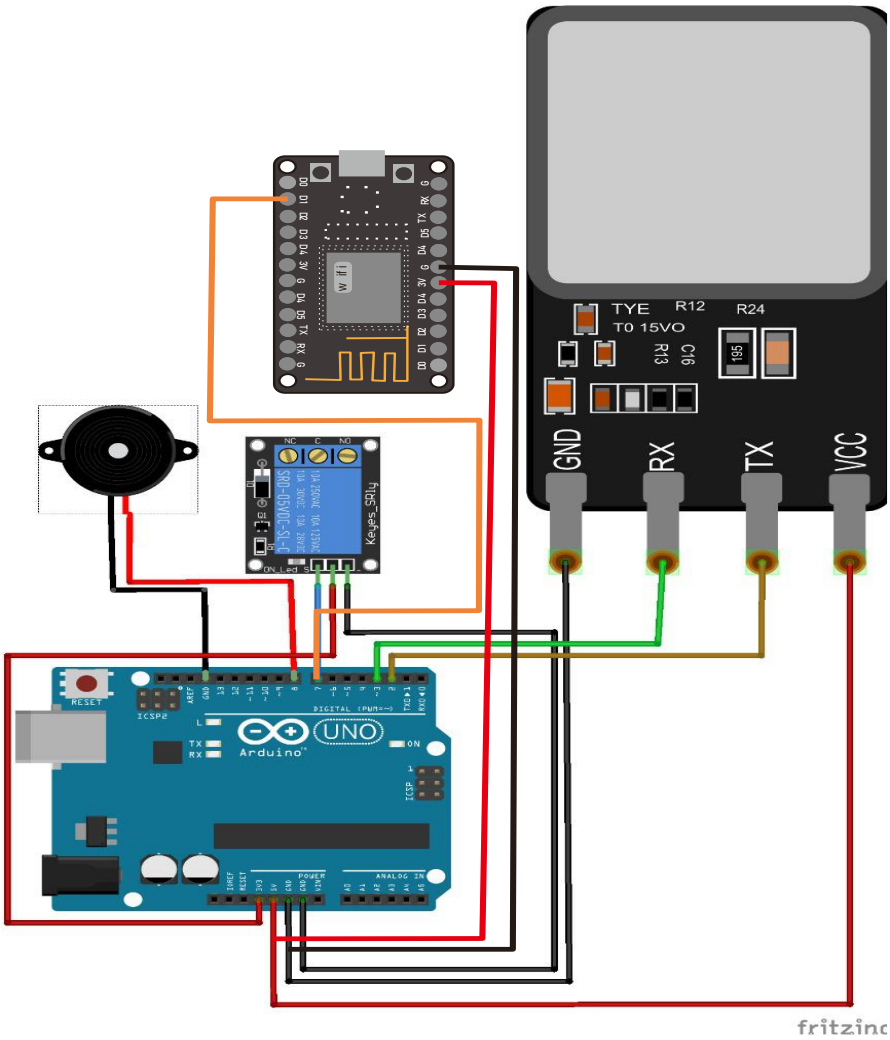

Fig. 6 Arduino Circuit Schematic

From the circuit scheme in Figure 6, the installation and installation of Arduino Uno and several other components by connecting the pins in each pin module contained in the Arduino Uno, the pins that are connected to each other above can be seen as follows:

1. The 3V pin of the C3 Modulefingerprint Sensor is connected to the 3V Arduino
2. Pin Gnd Sensor C3 Fingerprint module is connected to the Arduino Gnd
3. Pin RX Sensor C3 Fingerprint module is connected to pin 3 Arduino
4. Pin TX Sensor C3 Fingerprint Module connected to pin 2 Arduino
5. The black buzzer is connected to the Arduino Gnd digital pin
6. The red buzzer is connected to the Arduino digital pin 12
7. The 5 volt VCC Relay pin is connected to the 5v Arduino
8. The 5 volt Gnd Relay pin is connected to the Arduino Gnd
9. Pin IN Relay 5 volts connected to digital pin 8 Arduino
10. Pin 3,3 of NodeMCU is connected to pin 3,3 of Arduino
11. The GND NodeMCU pin is connected to the Arduino GND pin
12. Pin D1 of NodeMCU is connected to pin 7 of the Arduino
13. The black Doorlock Solenoid leg is hooked on to the 5 volt relay NO pin
14. The red Doorlock Solenoid leg is connected to the 12 volt adapter

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System Work Process

In the system work procedure the writer will explain and ensure that the entire system performance is working properly, stable, and in accordance with the design that has been discussed previously. The system work procedure that has been previously designed can be seen in Figure 7 below.

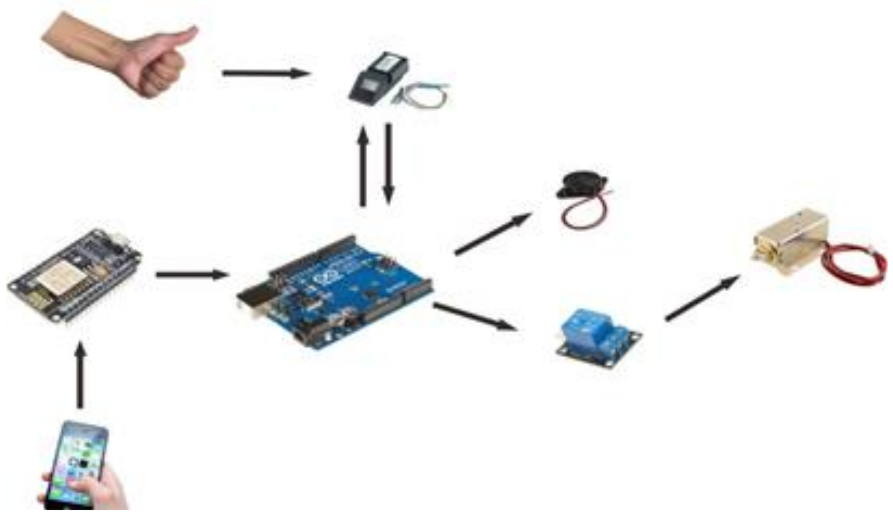

Fig. 7 System Work Process

The initial stage of testing the entire system by providing a power source of 12V DC electricity, with an electric current from the adapter, each component will configure itself, this stage serves to ensure all components and sensors can work properly, Solenoid Doorlock can move in and out to open and lock the door. After the system we first carry out the fingerprint recording process where the fingerprint recording result is in the form of a digital code, then the next process is the identification process whether the fingerprint is in accordance with the previously recorded fingerprint if the fingerprint identification process is suitable then the solenoid can be opened and if The fingerprint identification process is not appropriate, the buzzer will sound to give a warning and the doorlock solenoid can also be opened using an android connected to the network and controlled using the Blynk application as a remote control.

Final Result

After designing the tool, the next step will go to making a prototype and simulation. Where the Fingerprint Sensor Module will carry out the identification and verification process, by placing the fingerprint on the surface of the sensor it will read the pattern and shape of the fingerprint, if the fingerprint is not identified then the alarm buzzer will sound and the dorlock solenoid will not open, and if the fingerprint has been identified then The solenoid doorlock opens so that the door can be opened apart from being able to be opened using a fingerprint, the solenoid doorlock can also be opened using an android connected to the network using the Blynk application downloaded via Playstore. Furthermore, the author will describe the benefits, objectives, and stages of this tool.

The design that the authors do starts from the process of fingerprint recording, the fingerprint identification process, the process of connecting the android to the MCU node, the process of selecting the position of the Arduino tools that are connected to each other. The final result of the device that has been designed can be seen in Figure 8.

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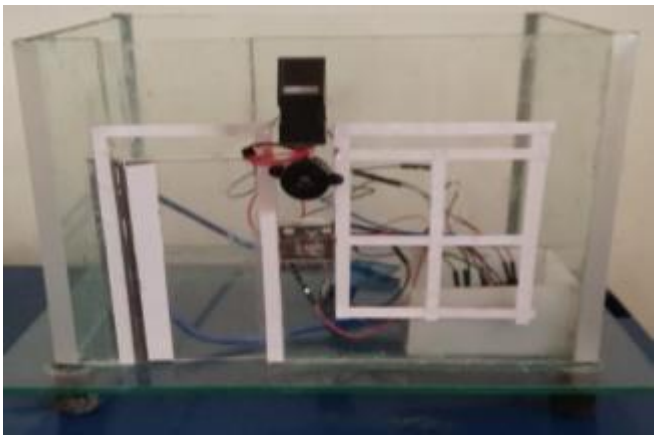

Fig. 8 Final Result

System Pros

In carrying out the development of research on door security using this fingerprint, it has the following advantages:

1. It is more optimal in the process of the door security system because only people who have recorded their fingerprints have access to the house.
2. Using a prototype tool that saves electricity, namely using a 12V adapter to operate the Arduino uno and adding an additional 5 volts of energy to drive the doorlock solenoid
3. The Fingerprint Module sensor is able to record 127 different fingerprint patterns in other words, one fingerprint can be used by 127 people with different identities because we have a relatively large internal memory capacity.
4. Selenoid Doorlock can be opened using an android connected to the network so that it functions as a remote control.

System Weaknesses

In doing research on door safety using the Fingerprint sensor, of course it has weaknesses or weaknesses that are obtained, so that later researchers can develop the existing weaknesses, here are the weaknesses of this system:

1. If the power goes out, the fingerprint identification process cannot be carried out, therefore a spare resource is required which requires additional costs.
2. 2.Because the size of this Fingerprint sensor has a very small size, there is often an error in the fingerprint identification process, this happens because during the scanning process the finger often crosses the scan area so it needs to be repeated several times until the identification process is correct.

CONCLUSION

Based on the results of research and discussion in accordance with the design of tools carried out by the author about door security using a fingerprint and alarm buzzer based on Arduino, it is concluded that the system is running as expected that the door can be opened with a registered fingerprint if the fingerprint identification process fails then the buzzer will sound for 8 seconds as a warning sign and only open that door can also be controlled via Android via the Blynk application which is connected to the internet, and other supporting facts are found such as Baudrate fingerprint sensor of 9600 bps, this is the default data transmission speed of the module, increasingly The higher the baudrate, the faster the data transmission process is, and it is also concluded from the results of the fingerprint sensor testing that it takes about 1.3 - 5 seconds to identify stored or unsaved fingerprints. Fingerprint registration takes 5-7 seconds to register, it can be described that the system is running with what you want to be applied in people's lives in optimizing door security.

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