Security Design In Doors And Windows Arduino Based Using Fingerprint And Sms Gateway (Case Study At Pesona Asri Tembalang Housing)

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Submission date: 14-May-2024 11:22AM (UTC+0700)
Submission ID: 2378895708
File name: jtie_vol_2_no_2_August_2023_hal_48-88.docx (4.63M)
Word count: 6477
Character count: 32033

Journal of Technology Informatics and Engineering
Vol 2 No 2 August 2023
e-ISSN :2961-8215;.p-ISSN :2961-9068 Page 48-88
DOI: https://doi.org/10.51903/jtie.v2i3.164

Security Design In Doors And Windows Arduino Based Using *Fingerprint* And Sms Gateway (Case Study At Pesona Asri Tembalang Housing)

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Abstrack: This research discusses security design for Arduino-based doors and windows using fingerprint technology and SMS Gateway. The case study was conducted at Pesona Asri Tembalang Housing. The main goal of this research is to improve household security by combining fingerprint authentication technology and text messaging (SMS) as a safer and more efficient access mechanism.This system development method includes analyzing household security needs, designing an Arduino-based system, integrating fingerprint modules and SMS Gateway, as well as testing and evaluating system performance. The research results show that this system is able to provide a high level of security with accurate fingerprint authentication and direct notification via SMS Gateway when suspicious activity occurs.In conclusion, an Arduino-based door and window security design with fingerprint technology and SMS Gateway is an effective solution for increasing household security. Implementing these systems can help reduce the risk of intrusion and give homeowners better control over access to their property.

Keywords: Household security, Door and window security design, Arduino.

CHAPTER I
INTRODUCTION

1.1 Background

Technological advances are needed to create security systems. Because it is difficult for the economy moment This , create a tora n gb e act a k k r i m inal with way to do crime of theft WHERE ARE THE CURRENTS y a i t u r uma h - house a h the blank that is placed in the box go by the owner .

The Semarang Police recorded data on public security and order disturbances in March 2018, of 94 conventional crime incidents, 30% of which were theft crimes, namely 28 incidents.

Table 1.1 Theft Crime Data March 2018

No.	Type of crime	Amount	
		Report	Finished
1.	Currat	8	7
2.	Theft	19	5
3.	Curras	0	0
4.	Ordinary Cur	1	1
Amount		28	13

Received: July 29, 2023; Accepted: August 27, 2023; Published: August 31, 2023
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Rampant theft what happens in this p o u c t i o n these people make it owner House the more paying attention to the unknown security And threat Which Possible happen p a d a r u m a hn y a.

The crime of aggravated theft (currat) regulated in Article 363 of the Criminal Code is ordinary theft which in its implementation is accompanied by certain aggravating circumstances. One of the specific circumstances referred to is that it is carried out at night in a closed house or yard where there is a house, by dismantling, breaking, climbing, or by using a fake key or a fake order.

In the case study in Tembalang District, there are several subdistricts that are prone to theft cases, including Bulusan Subdistrict, Kramas Subdistrict, Kedungmundu Subdistrict, and Mangunharjo Subdistrict. In February 2018, a theft case at Boarding House Jl. In Gondang Timur, Bulusan Subdistrict, it was revealed that the police arrested the perpetrator who was also a suspect in 4 cases of theft last year in the same subdistrict. Thieves take advantage of the night conditions when boarding house residents are asleep and enter through doors or windows. In March 2018, there was another case of theft at the boarding house in Kedungmundu Village, which also took advantage of the night conditions by prying open the room window with a crowbar or screwdriver. There are also several housing complexes where there have been cases of theft in the last three years. These include Pandanaran Hills Housing, Tembalang Pesona Asri, Graha Taman Bougenville, and Tembalang Villa. The same mode of operation as using an empty house at night is to use a crowbar or screwdriver to break into the house door or window.

The rise in theft by breaking into or forcing open doors and windows means that the security of manually locked doors and windows is deemed less effective. Therefore, we need a control device that can secure the doors and windows of the house, even when the owner is away. As technology develops, security systems become automated is the proposed solution p a l i ng r e l e v an to come in t e re ap t .

Based on the problem above, the solution offered by the author is to design your own security structure which automatically uses *fingerprints* to access the house, a *magnetic door lock sensor to detect when the doors and windows of the house are forced open without fingerprint* access , an SMS gateway to send

notification messages to the owner when theft occurs through doors and windows, and an alarm that sounds when a door or window is forced open. This security system uses the Arduino Uno microcontroller as its *operating system* . Implementing this door and window security device can prevent theft crimes in boarding houses or residential homes.

1.2 Problem Identification

1. Theft crimes generally pass through the doors and windows of the house.
2. There was no early warning when the doors and windows of the house were forced open.

1.3 Problem Formulation

1. How to design home door and window security using fingerprints?
2. How to create an alert for homeowners when doors and windows are forced open using SMS gateway?

1.4 Problem Limitations

1. This security device is only limited to the front door and windows.
2. This tool uses the Arduino Uno microcontroller as its *operating system* .
3. This tool uses *a fingerprint* to access the house and an SMS gateway to send notification messages when the doors and windows of the house are forced open.
4. This tool uses a *magnetic door lock sensor* to detect if the doors and windows of the house are opened without access via *fingerprint* .
5. The tool created is only a *prototype* , and can still be developed further.

1.4 Research purposes

1. Designing Arduino-based home door and window security using *fingerprints* .
2. Create warning messages for home owners when doors and windows are forced open using SMS gateway.

1.5 Benefits of research

1. Theoretical Benefits

   Contributing to the field of computer science, especially in developments in the field of microcontroller security .

2. Practical Benefits

   a. For researchers

      As one of the requirements for graduation in computer systems degree 1.

   b. For academics

      Adding literature sources in making security system tools at STEKOM.

   c. For research sites

      This prototype can be further developed for the security of the Pesona Asri Tembalang Housing Complex or can be applied to other environments.

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CHAPTER II
RESEARCH METHODS

3.1 Development Model

In this research the author uses the *Research and Development (R&D)* development model , namely the research method used to produce products and test the effectiveness of these products.

According to Borg and Gall there are several stages, namely:

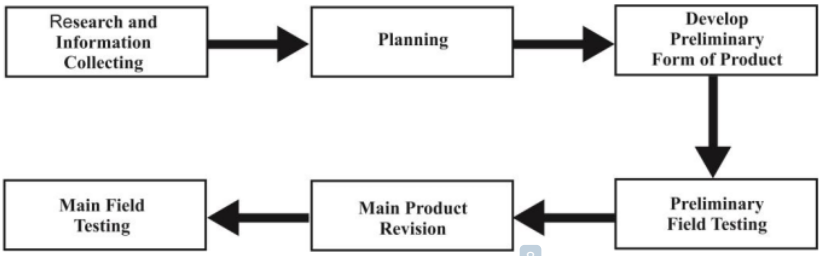


Figure 3.1 Steps for using *Research Methods and Development* (R&D)

Apart from research methods, the tools used in this research are *flowcharts* . *A flowchart* is a series of parts that describe the flow of a program. *A flowchart* is also a picture or chart that shows the sequence and relationship between processes and their instructions. This description is expressed by symbols. Thus, each symbol describes a particular process, while the relationships between processes are depicted with connecting lines.

3.2 Development Procedures

The stages of the development procedure are as follows:

1. *Research and information collecting* (Preliminary Study)

   This step includes studying literature related to the problem being studied. Literature studies are carried out for a temporary introduction to the product to be developed. This literature study was carried out to collect research findings and other information related to the planned product development. At this stage the author visits the library looking for references for making products that the author will develop. Writer looking for information related to security of the doors and windows of the house and collect them. Collect data then summarize it into a data problem for which a solution will be sought .

2. *Planning* (Planning)

   This stage includes formulating the problem, determining objectives, estimating research time and determining indicators that influence the security of the doors and windows of the house.

   At this stage the author follows up on the problem data to find a feasible solution, namely by creating a questionnaire to obtain the required data.

3. *Develop preliminary form of product* (Product Development)

   Create product designs and develop prototypes for home door and window security using Arduino and SMS gateway.

4. *Preliminary field testing* (Product Design Trial)

   Carrying out initial trials on product designs, namely validating them with a team of experts. At this stage, the finished product design is submitted to a team of experts to test whether the system is feasible or not. The results of the data analysis will determine whether or not this system can continue to work.

5. *Main product revision* (Product Revision)

   Make revisions based on input from validators. This step is a model or design improvement based on limited field testing.

6. *Main field testing* (Product Trial)

   Test the product in the field more widely. By validating the user or home door security device users, to analyze whether this system is suitable for use or not. If the evaluation model does not meet the requirements, it will be revised and tested again until a final prototype that meets the requirements is obtained.

3.3 Research Design

3.3.1 Trial Design

The products produced in *Research and Development* (R&D) research are varied . In the field of technology, products that can be used for human life are products that are quality, economical, low price, light weight, economical and have multiple benefits. In research at the Bulusan Tembalang Village Boarding House, the author prepared a detailed system design such as *a flowchart* . *A flowchart* is a description

in the form of a flow diagram of an algorithm in a program that states the direction of the program's flow in solving a problem.

3.3.2 Research Objects

In this study, the object of the research trial was Pesona Asri Tembalang Housing, Semarang. The system that will be created can help house residents in providing security warnings for the doors and windows of their house.

3.3.3 Data Types

The type of data used by the author in this research is seen from the source using primary and secondary data. *Primary data* is data obtained or collected by the author directly from the data source. To obtain primary data, the author must collect various kinds of data information directly. Techniques that writers can use to collect primary data include observation, interviews and literature studies. Then for secondary data , the data used by the author is the fingerprints of the house occupants .

3.3.4 Data Collection Instruments

In this research, the data collection instruments are as follows:

a. Questionnaire or Questionnaire

A questionnaire is a research instrument in the form of a list of questions to obtain information from a number of respondents. A questionnaire or questionnaire can be called a written interview, because the contents of the questionnaire are a series of written questions addressed to the respondent and filled in by the respondent himself.

b. Interview

An interview is a form of verbal communication or a kind of conversation, which aims to obtain information. Interviews are made for a more systematic research instrument.

c. Observation

Observation is a researcher's activity through the process of observing using the five senses. This activity is carried out to obtain information about human behavior, circumstances or situations of the object being studied and to record every situation observed.

3.3.5 Data Analysis Techniques

The data analysis technique used to process value data is obtained from the questionnaire system assessment. Quantitative data for each item is calculated using the average value analysis technique. With the following assessment criteria:

Table 3.1 *Form scores* on validation sheet

Score	Mark
$1 \leq n \leq 10$	Not good
$11 \leq n \leq 20$	Enough
$21 \leq n \leq 30$	Good
$31 \leq n \leq 40$	Very good (Valid)

The results of the research can be seen through the scores obtained, whether the product design in the form of a system design meets or is in accordance with what was desired. Through this score, it can be assessed whether the system design is valid or not. The following is a conclusion on the validation assessment criteria .

Table 3.2 Conclusions on the validation sheet *form*

No	Conclusion
1	It cannot be used yet and must be replaced
2	Can be used with multiple revisions
3	Can be used with minor revisions
4	Can be used without revision

3.4 System Design

3.4.1 System Requirements Analysis

a. Minimum software requirements (*Software*)

The minimum software required to develop this level measurement system is as follows:

1. *Windows XP* operating system or above
2. *Software* Arduino IDE
3. Proteus *Software*
4. *Software* Vision

b. Detailed cost breakdown

Below are details of the costs required to support a prototype door and window security system using fingerprint and SMS gateway based on Arduino U no.

Table 3.3 Cost Details

No	Component Name	Cost (Rp)
1.	Arduino Uno R3 and cables	65,000
2.	Fingerprints	170,000
3.	Sim 900A	230,000
4.	Door Lock Solenoids	120,000
5.	Buzzers	9,000
6.	1 Channel Relay	12,000
7.	Board	30,000
8.	FM and MM Jumper Cables	12,000
9.	Power Supply Adapter	25,000
10.	LEDs and Resistors	20,000
11.	Magnetic Switch Sensor	24,000
12.	Push Button Switch	8,000
11.	Telkomsel Card	20,000
12.	Miniature House	1 50,000
Amount		895 000

3.4.2 Block System Circuit Diagram

Block diagram of a door and window security system circuit using fingerprint sensor and SMS gateway technology Arduino Uno based. The block diagram of the circuit can be seen in the picture.

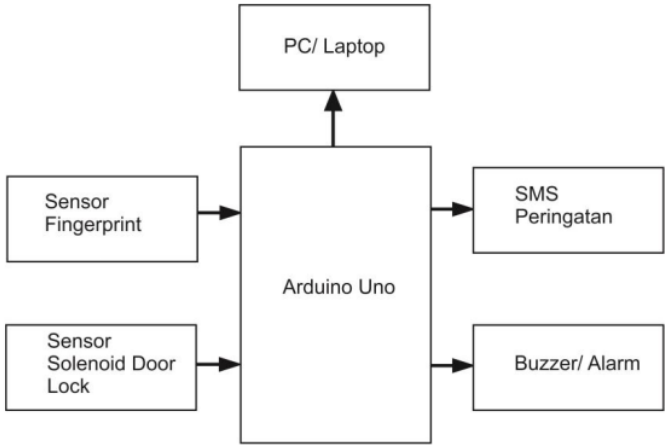


Figure 3.2 Block diagram of a door security system circuit

From the block diagram above, it can be seen that the system configuration of this door and window security system consists of *input* , controller and *output* . From the input side , it consists of sensors *fingerprint* , *door lock solenoid sensor* . And the controller used is Arduino Uno . Meanwhile, on the output side , there are SMS warnings and *buzzers* /alarms.

3.4.3 Flow Of Document System

Old system flowchart diagram

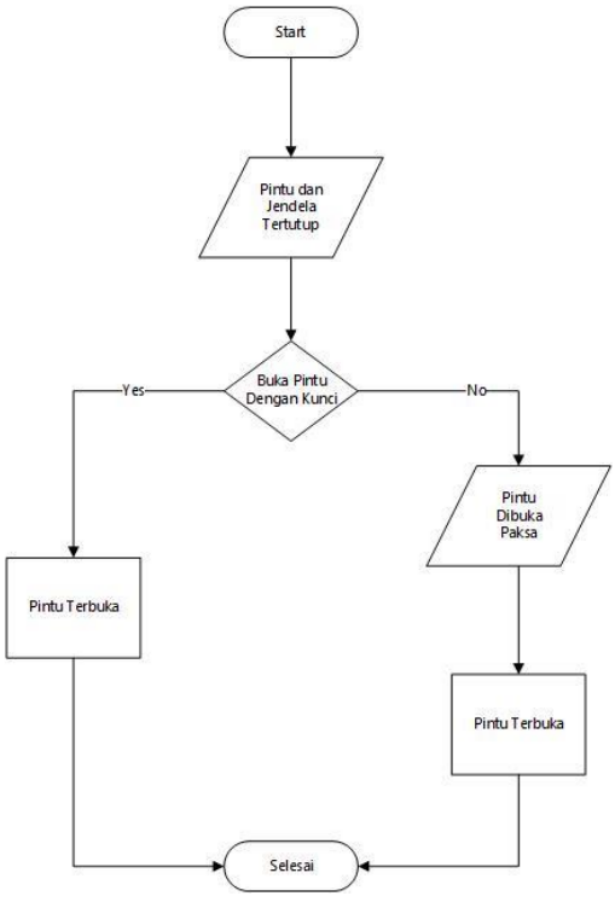


Figure 3.3 Old system flowchart diagram

Information :

Starting from the condition of the doors and windows being closed, the occupant opens the door with a manual key so that the door will open. If the door is not opened with a key but the door is forced open, the door will also open.

New system flowchart diagram

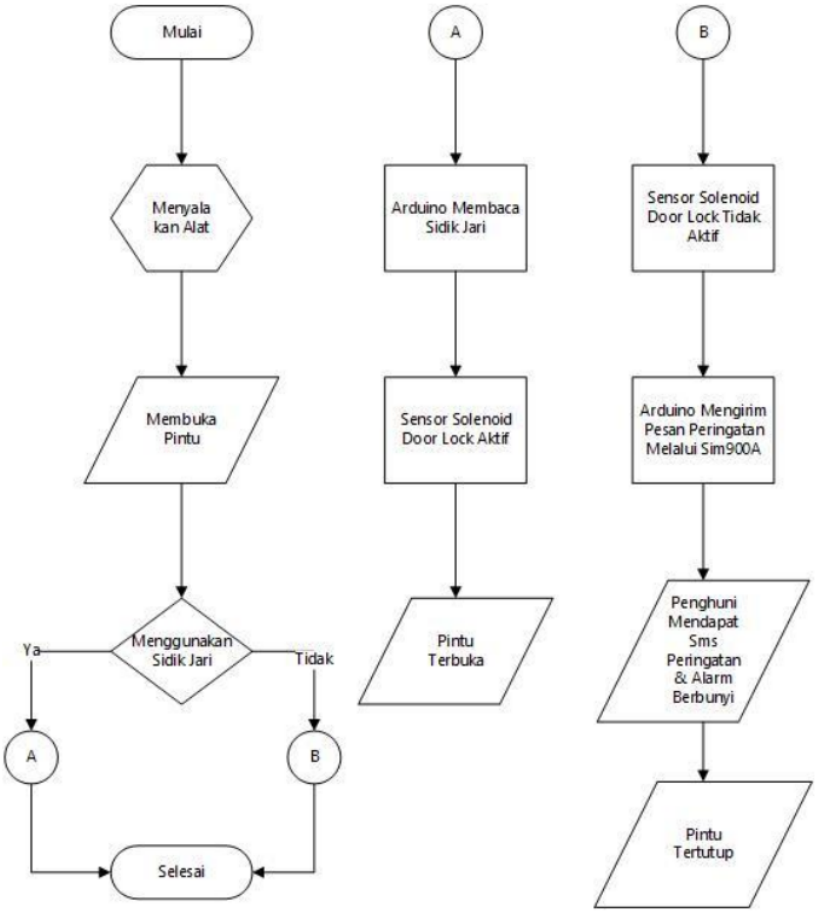


Figure 3.4 New system flowchart diagram

Information :

Starting from turning on the security system tool. When you open the door using your fingerprint via the *fingerprint sensor* , the sensor will start reading your fingerprint. If the fingerprint is correct, the *door lock solenoid sensor* will be active and the door will open automatically. If you don't open the door using *your fingerprint* , the Sim900A shield will be active. The Arduino processes this by sending a warning message to the occupant via the Sim900A. The occupant receives a warning message and another output alarm will sound.

3.4.4 Circuit Schematic

a. Schematic of Arduino and fingerprint sensor

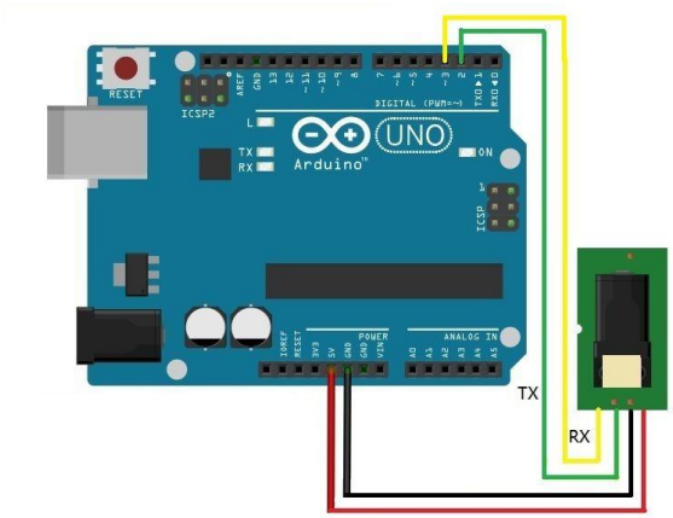


Figure 3.5 Schematic Arduino and fingerprint sensor

The image above is a schematic of the Arduino and fingerprint sensor. The fingerprint sensor functions to detect the fingerprints of house occupants. The TX and RX pins of the fingerprint sensor are connected to the Arduino input pins. The Ground pin is connected to another Ground, and the VCC pin is connected to another VCC.

b. Arduino schematic and *door lock solenoid*

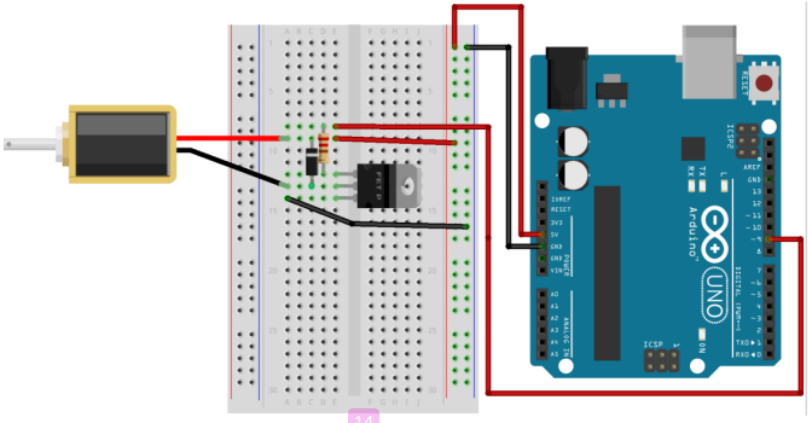


Figure 3.6 Schematic of Arduino and *door lock solenoid*

The image above is a schematic of the Arduino and the *door lock solenoid sensor* . The *door lock solenoid* sensor functions to detect

when the doors and windows of the house are forced open without *fingerprint* access . One Solenoid pin is connected to the relay, while the other pin is connected to the power supply adapter. The two relay legs are connected to the VCC and Ground pins, the other pin is connected to the Arduino input.

c. Arduino and sim900a schematic

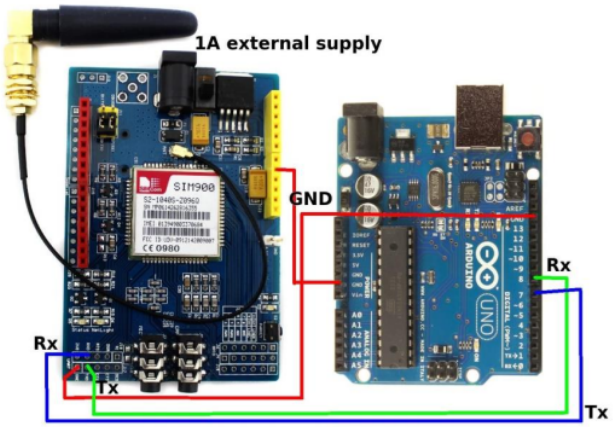


Figure 3.7 Schematic Arduino and SIM900A

The picture above is a schematic of Arduino and SIM900A as an SMS gateway. Sim900A to send warning messages to house occupants when doors and windows are opened or forced open without fingerprint access. The TX and RX pins of the Sim900A are connected to the Arduino input pins. The Ground pin is connected to another Ground, and the VCC pin is connected to another VCC.

Arduino schematic and *buzzer* / alarm

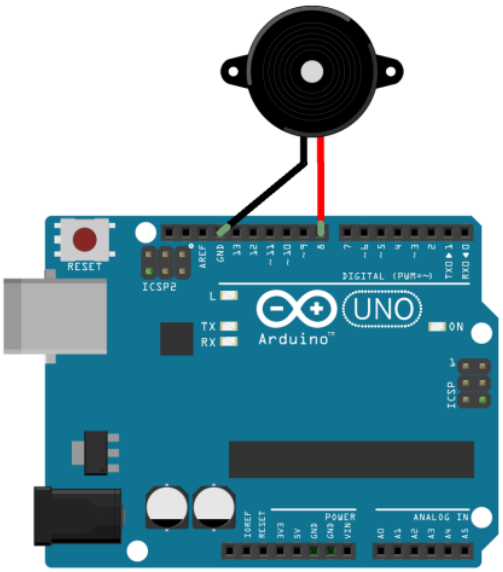
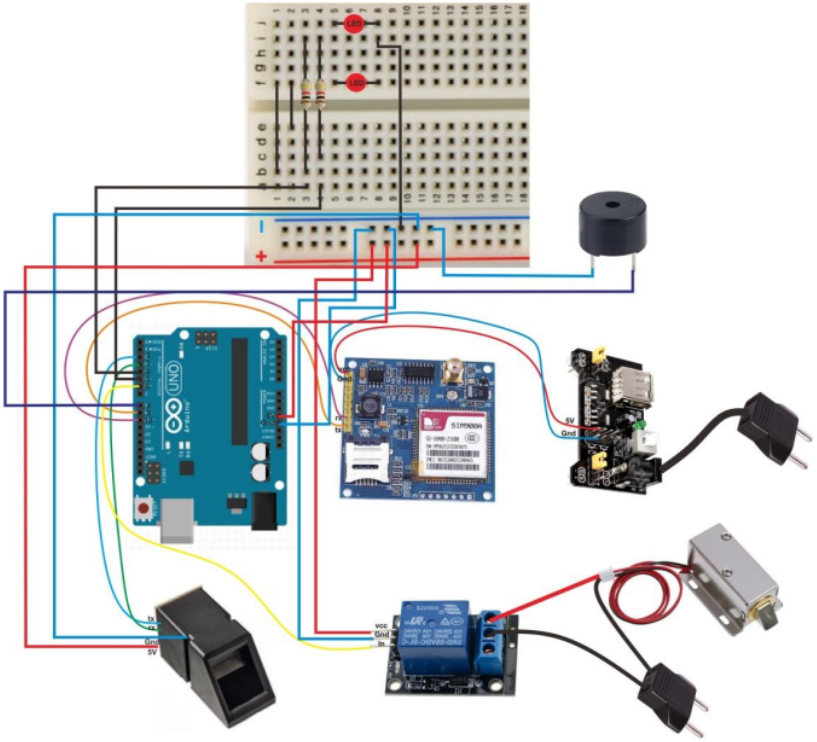


Figure 3.8 Schematic Arduino and buzzer

The image above is a schematic of the Arduino and *buzzer* /alarm. The alarm functions as a warning sound when a door or window is opened without access via fingerprint, and when the fingerprint sensor detects a fingerprint that has not been registered. One *buzzer pin* is connected to Ground, and another pin is connected to the Arduino input.

d. Overall schematic



Picture 3.9 Overall schematic

3.4.5 Overall System Work Flow Diagram

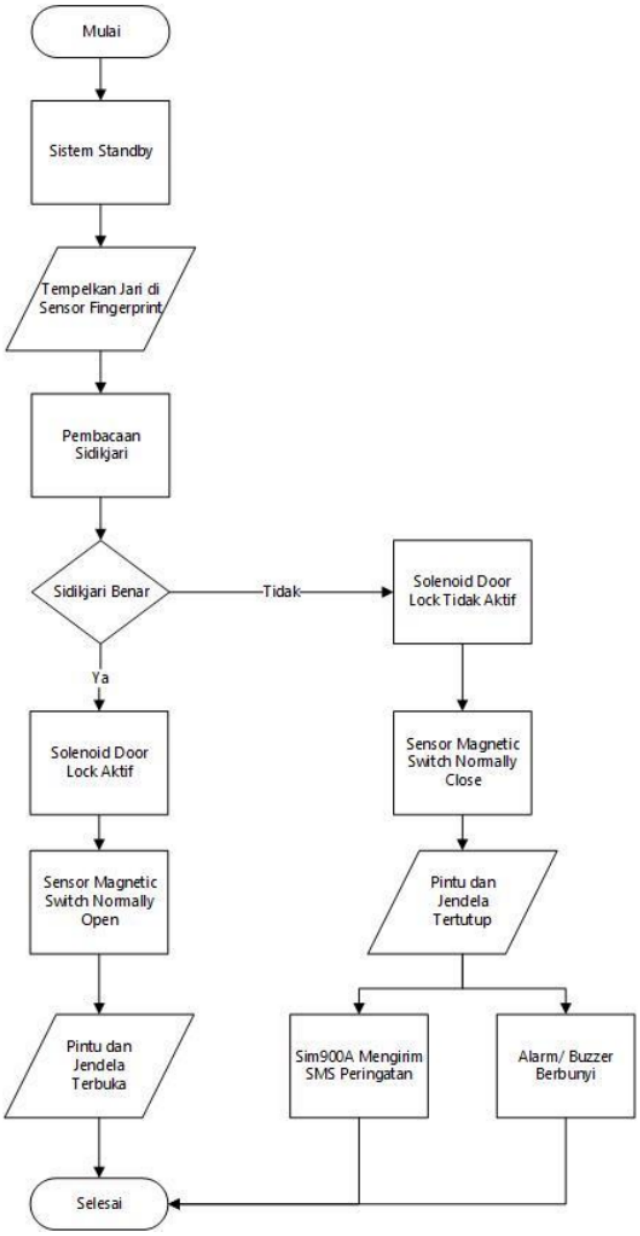


Figure 3.10 Work flow diagram of the entire system

The way the entire system above works is that when the device is on, it initializes the sensor. When a fingerprint is placed on the sensor, it will read the fingerprint. If the fingerprint is correct or registered , *the door lock solenoid* will be active, the *magnetic door switch* sensor will

normally open, and the door can be opened. If the fingerprint detects an incorrect or unregistered fingerprint , then *the door lock solenoid* is not active , *The magnetic door switch* sensor will normally close, and the door cannot be opened or is still locked. If the door is forced open without accessing the fingerprint sensor, the *magnetic door switch* sensor will normally open, then the Sim900A will activate and send a warning SMS to the occupants of the house and the alarm will turn on/sound.

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CHAPTER III
RESEARCH RESULTS AND DISCUSSION

4.1 Research result

Research and development (R&D) is a process or steps to develop a new product, which can be accounted for. This product will later be tested for its effectiveness so that it can be developed into an application that is easy to implement in reality. Apart from that, to get the accurate data needed, researchers used questionnaires and observations.

4.1.1 Questionnaire

The definition of a questionnaire according to Kusumah (2011), a questionnaire is a list of written questions given by the subject under study to collect the information needed by the researcher. Questionnaires are divided into two types, namely:

a. Structured Questionnaire

   A structured questionnaire is also called a closed form, which contains questions accompanied by answer choices.

b. Unstructured Questionnaire

   An unstructured questionnaire is also called an open form, which contains questions that are not accompanied by answer choices.

Meanwhile, according to Sugiyono (2013), a questionnaire is a data collection technique that is carried out by giving a set of questions or written statements to respondents for them to answer. A questionnaire is an efficient data collection technique if the researcher knows exactly the variables to be measured and knows what not to expect from the respondent. Questionnaires as a data collection technique are suitable for collecting large amounts of data.

Advantages of the questionnaire method:

a. Saves time, meaning you can obtain data in a short time.
b. Saves costs, because it doesn't require a lot of equipment.
c. Save energy.

Disadvantages of the questionnaire method:

a. There is a possibility that the answers to the questions asked are dishonest.
b. If the question is not clear it can result in various answers.

The steps to create a questionnaire are:

a. The author first makes a list of questions.
b. Then given to the respondent.
c. After the respondents have finished answering, they are prepared for processing according to previously established standards. Next, it is presented in the research report.

This method was used to reveal respondents' opinions about the security design of house doors and windows. The respondents here are addressed to residents of houses in the Pesona Asri Housing Complex, Bulusan Village, Tembalang Semarang. Experts were given a questionnaire containing a number of questions regarding the device's working system, process *input* and *prototype output* . Meanwhile, users are given a questionnaire containing how they respond to the operation of the home door and window security design.

4.1.2 Observation

Observation according to Sugiyono (2013), observation or observation as an assessment tool is widely used to measure individual behavior or the process of an activity that can be observed, whether in actual situations or in artificial situations. In this research, the researchers carried out observations directly at the Pesona Asri Tembalang Housing Complex to determine problems related to home security warnings.

This questionnaire is used to measure individual attitudes, opinions and perceptions. Furthermore, the results of the questionnaire research data are entered into the research scale criteria (Validation *Form*). This validation *form* contains an assessment that is reviewed from several aspects of the indicators, by ticking according to the value criteria 1 = not appropriate / not appropriate, 2 = not appropriate / interesting shell, 3 = quite good, 4 = good / appropriate.

The working principle of this door and window security design is that the user only needs to connect this device to electricity so that it can work automatically. To enter the house, the *fingerprint sensor first* detects the user's fingerprint. If the fingerprint has been registered by the system, the door and window locks will open automatically. When the doors and

windows of the house are forced open without *fingerprint access* , the Sim900A will send a warning SMS to the occupants of the house and an alarm will sound. Likewise, when the fingerprint sensor detects fingerprints that have not been registered, Sim900A will send a warning SMS to the occupants of the house and an alarm will sound.

4.2 Development Results

Results of the development of "Security Design for Doors and Windows Based on Arduino Using *Fingerprint* and SMS Gateway " which was carried out using the *Research and Development* (R&D) method has produced a home security prototype.

Simulation design testing

Figure 4.1 Front view of the tool design

Figure 4.2 Side view of the tool design

The image above is a simulation of the design of security doors and windows from the front view (4.1) and side view (4.2).

1. Fingerprint testing

Figure 4.3 Registered fingerprint test

Figure 4.4 Unregistered fingerprint test

If the *fingerprint sensor* detects a registered fingerprint, the door and window solenoids will open (4.3). If the *fingerprint sensor* detects a fingerprint that has not been registered, the door and window solenoids do not open (4.4).

2. Door and window solenoid testing

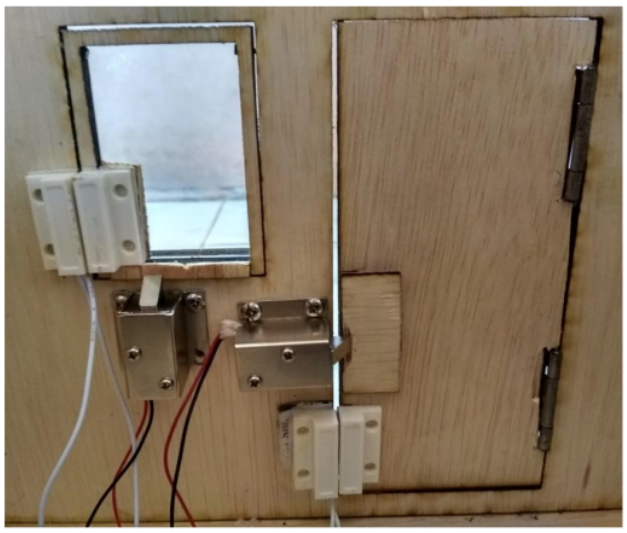

Figure 4.5 Door and window lock solenoids

Figure 4.6 Door and window open solenoids

The initial state of the door and window solenoid is locked (4.5). Door and window solenoids open when the fingerprint detects a registered fingerprint (4.6)

3. Testing door and window *magnetic switch sensors*

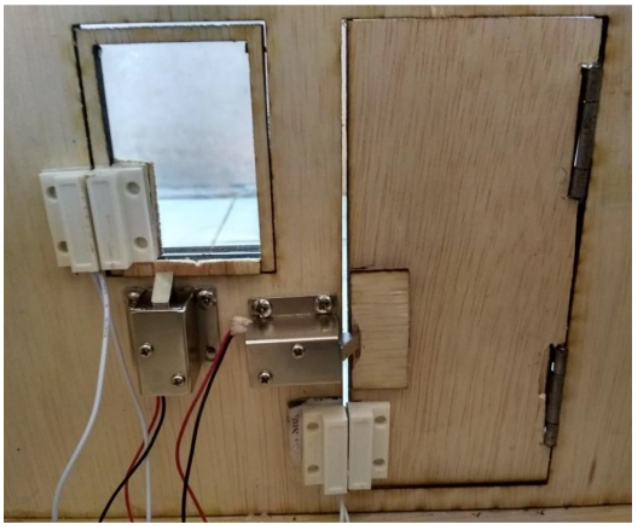

Figure 4.7 *Normally close door and* window magnetic switch sensor

Figure 4.8 Magnetic sensor switch *for normally open* doors and windows

The initial state of the door and window magnetic switch sensor *is normally close* or ON (4.7). When the door is opened without fingerprint access , the magnetic switch sensor for the door and window *is normally open* or OFF, so that the occupant will receive a warning SMS accompanied by an alarm that sounds (4.8) .

4. Alarm testing

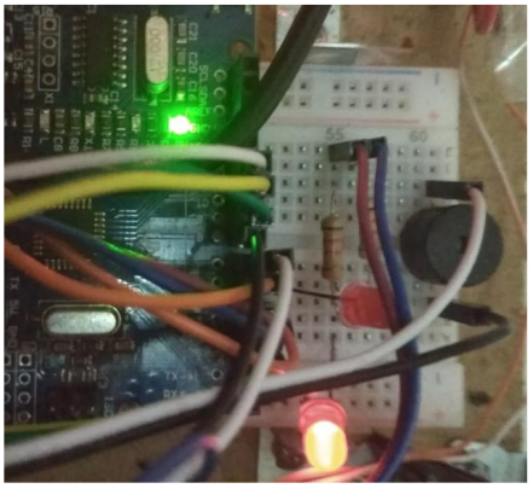

Figure 4.9 The alarm is not active and does not sound

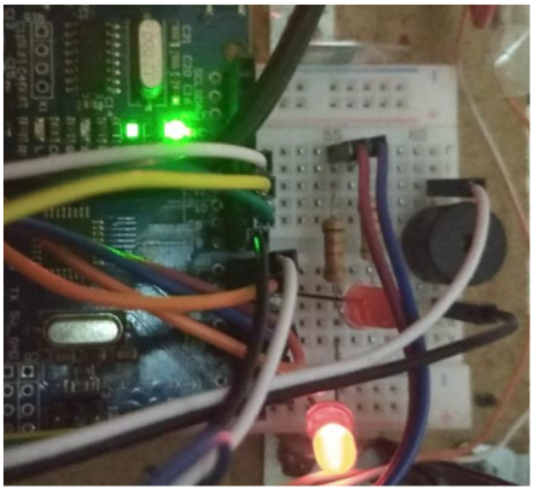

Figure 4.10 The alarm is active and sounds

The initial state of the alarm is not active and does not sound (4.9). When *the fingerprint* detects a fingerprint that has not been registered or the windows and doors are forced open, the alarm will activate and sound, indicated by the Arduino RX light flashing green (4.10).

5. *Push Button* Switch Testing

Figure 4.11 Off switch

Figure 4.12 On switch

The initial state of the push button switch has not been pressed or is OFF (4.11). When the switch is pressed it will be ON and the solenoids on the doors and windows will open (4.12).

6. SMS Testing

Figure 4.1 3 Sim900A searches for a signal

Figure 4.1 4 Sim900A gets a signal

The initial state of the Sim900A is still searching for a signal (4.1 3). The condition of the Sim900A has received a signal, indicated by the NET light flashing green (4.1 4).

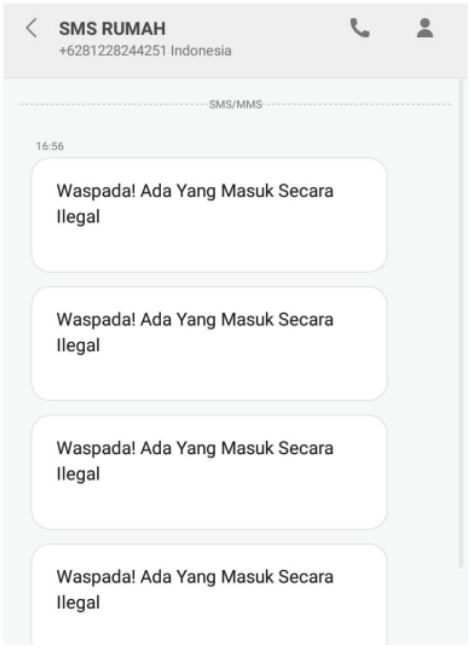

Figure 4.1 5 SMS warning sent

When *the fingerprint* detects fingerprints that have not been registered or windows and doors are forced open, Sim900A will

send a message to the registered house occupants. Screenshot of the warning SMS sent to the user (4.1 5).

4.3 System Performance Experiment

1. *Fingerprint* Experiment

Table 4.1 *Fingerprint sensor testing*

Test	Fingerprint Value	Status	Time
1	1	Work	2 second
2	1	Work	2 seconds
3	1	Work	3 seconds
4	1	Work	2 seconds
5	1	Work	3 seconds

Information:

1 = working

0 = not working

In experiment 1, the *fingerprint* sensor detected fingerprints within 2 seconds and worked well .

In experiment 2 , the *fingerprint* sensor detected fingerprints within 2 seconds and worked well .

In experiment 3 , the *fingerprint* sensor detected fingerprints within 3 seconds and worked well .

In experiment 4 , the *fingerprint* sensor detected fingerprints within 2 seconds and worked well .

In experiment 5 , the *fingerprint* sensor detected fingerprints within 3 seconds and worked well .

2. Solenoid Experiment

a. Door solenoid

Table 4.2 Testing *solenoid locks* on doors

Test	Solenoid Value	Status	Time
1	1	Work	2 seconds
2	1	Work	3 seconds
3	1	Work	2 seconds
4	1	Work	3 seconds
5	1	Work	3 seconds

Information:

1 = working

0 = not working

In experiment 1, when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the door opened within 2 seconds and worked properly .

In experiment 2 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the door opened within 3 seconds .

In experiment 3 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the door opened within 2 seconds .

In experiment 4 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the door opened within 3 seconds and worked properly .

In experiment 5 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the door opened within 3 seconds and worked properly .

b. Window solenoid

Table 4.3 Testing *solenoid locks* on windows

Test	Solenoid Value	Status	Time
1	1	Work	2 seconds
2	1	Work	2 seconds
3	1	Work	2 seconds
4	1	Work	2 seconds
5	1	Work	3 seconds

Information:

1 = working

0 = not working

In experiment 1, when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the open window within 2 seconds could work properly .

In experiment 2 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the open window within 2 seconds could work properly .

In experiment 3 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the open window within 2 seconds could work properly .

In experiment 4 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the open window within an interval of 2 seconds could work properly .

In experiment 5 , when the *fingerprint sensor* detected the registered fingerprint, *the solenoid lock* on the open window within 3 seconds could work properly .

3. Magnetic Switch Sensor Experiment

Table 4.4 Magnetic switch sensor testing

Test	Magnetic Sensor Value	Status	Time
1	1	Work	2 seconds
2	1	Work	2 seconds
3	1	Work	2 seconds
4	1	Work	2 seconds
5	1	Work	2 seconds

Information :

1 = working

0 = not working

In experiment 1, when the door or window is opened without fingerprint access, the *magnetic switch* sensor will detect it in the *normally open state* within 2 seconds it can run fine .

In experiment 2, when the door or window is opened without fingerprint access, the *magnetic switch* sensor will detect it in the *normally open state* within 2 seconds it can run fine .

In experiment 3, when the door or window is opened without fingerprint access, the *magnetic switch* sensor will detect it in the *normally open state* within 2 seconds it can run fine .

In experiment 4, when the door or window is opened without fingerprint access, the *magnetic switch* sensor will detect it in the *normally open state* within 2 seconds it can run fine .

In experiment 5, when the door or window is opened without fingerprint access, the *magnetic switch* sensor will detect it in the *normally open state* within 2 seconds it can run fine .

4. Push Button Switch Experiment

Table 4.5 Testing push button switches

Test	Push Button Switch Value	Status	Time
1	1	Work	2 seconds
2	1	Work	2 seconds
3	1	Work	2 seconds
4	1	Work	2 seconds
5	1	Work	2 seconds

Information :

1 = working

0 = not working

In experiment 1, when the push button switch was pressed, the solenoids on the doors and windows would open within 2 seconds and work properly .

In experiment 2, when the push button switch is pressed, the solenoids on the doors and windows will open within 2 seconds it can run fine .

In experiment 3, when the push button switch is pressed, the solenoids on the doors and windows will open within 2 seconds it can run fine .

In experiment 4, when the push button switch is pressed, the solenoids on the doors and windows will open within 2 seconds and can work properly .

In experiment 5, when the push button switch is pressed, the solenoids on the doors and windows will open within 2 seconds and can work properly .

5. Alarm Experiment

Table 4. 6 Alarm testing

Test	Alarm Value	Status	Time
1	1	Work	2 seconds
2	1	Work	2 seconds
3	1	Work	3 seconds
4	1	Work	1 second
5	1	Work	2 seconds

Information:

1 = working

0 = not working

In experiment 1, when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, The alarm will sound in an interval of 2 seconds which can work properly .

In experiment 2 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, The alarm will sound in an interval of 2 seconds which can work properly .

In experiment 3 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, The alarm will sound in an interval of 3 seconds which can work properly .

In experiment 4 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, The alarm will sound in an interval of 1 second which can work properly .

In experiment 5 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, The alarm will sound in an interval of 2 seconds which can work properly .

6. Sim900A Trial

Table 4. 7 Tests of Sim900A sending SMS

Test	SMS Value	Status	Time
1	1	Work	1 0 second
2	1	Work	9 seconds
3	1	Work	10 seconds
4	1	Work	8 seconds
5	1	Work	9 seconds

Information :

1 = working

0 = not working

In experiment 1, when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, SMS will be sent to the user within 10 seconds, which can work well .

In experiment 2 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, SMS will be sent to the user within 9 seconds, which can work well .

In experiment 3 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, SMS will be sent to the user within 10 seconds, which can work well .

In experiment 4 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, SMS will be sent to the user within an interval of 8 seconds which can work well .

In experiment 5 , when the *fingerprint sensor* detected an unregistered fingerprint or the doors and windows were forced open, SMS will be sent to the user within 9 seconds, which can work well .

4.4 Final Product Discussion

At this stage the author carries out product testing, namely validation testing. Design and function validation was carried out by STEKOM lecturers who are competent in their fields, namely Mr. Dr. Unang Aclison, ST,

M.Kom. Meanwhile in the field, the validation test was carried out by Fifi Yulia, with the following questionnaire :

Table 4. 8 Conclusion Tables

Mark	Conclusion
1	It cannot be used yet and must be replaced
2	Can be used with multiple revisions
3	Can be used with minor revisions
4	Can be used without revision

The data analysis technique used to process value data is obtained from the assessment questionnaire system. Quantitative data for each item is calculated using the average value analysis technique. Based on the explanation above, validation can be formulated:

$$\mu = \frac{\sum x}{n}$$

Information :

μ = average value

$\sum x$ = total number of validation values

n = number of validators

With validation assessment criteria as follows:

Table 4. 9 Assessment score on the validation sheet

Mark	**Validity Criteria**
3.00-4.00	Very good
2.00-3.00	Good
1.00-2.00	Enough
0-1.00	Not good

The results of data analysis by filling out a questionnaire based on the validation value scale are as follows:

a. Assessment by Experts

Table 4. 10 Expert Assessment Results

No	Input activities	Indicator			
		1	2	3	4
1	Does the appearance of the product design match user expectations?				*
2	Can the *Fingerprint* sensor detect registered fingerprints?				*
3	Do door and window solenoids open when *Fingerprint* detects a registered fingerprint ?				*
4	Can doors and windows be opened when *Fingerprint* detects a registered fingerprint ?				*
5	Do users receive SMS alerts when unregistered fingerprints are detected?				*
6.	Do users receive SMS alerts when doors or windows are opened without *fingerprint access* ?				*
7.	Does an alarm sound when an unregistered fingerprint is detected?				*
8	Does the alarm sound when a door or window is opened without *fingerprint access* ?				*
9	*hardware* circuit work well?			*	
10.	Can the need for a home security warning design be answered?			*	
	TOTAL SCORE			6	32
	TOTAL SCORES	38			

The expert assessment results are as follows:

$$\mu = \frac{\sum x}{n} = \frac{38}{10} = 3{,}8$$

So it can be concluded that the results of the tool validation by experts are classified as VERY GOOD.

b. Ratings By Users

Table 4. 11 Assessment Results by users

No	Input activities	Indicator			
		1	2	3	4
1	Can the system work well?				*
2	Ease of system application				*
3	you access tool activation easily ?				*
4	Does the tool work process run smoothly/well ?			*	
5	*fingerprint* sensor detect registered fingerprints accurately?				*
6.	Do doors and windows open after the user accesses *the fingerprint* ?				*
7.	Can users receive SMS warnings?				*
8	Does the alarm sound loud and clear?			*	
9	Can SMS alerts help provide early warning to users?				*
10.	Can this design reduce the number of people entering the house illegally?			*	
	TOTAL SCORE			9	28
	TOTAL SCORES	37			

user assessment are as follows:

$$\mu = \frac{\sum x}{n} = \frac{37}{10} = 3{,}7$$

So it can be concluded that the results of the tool validation by users are classified as VERY GOOD.

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CHAPTER IV
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion About the Product

Based on the results of tests carried out by experts and users, the conclusions from the research that has been carried out are:

1. Tests carried out by experts, this product received a score of 3.8 which is classified as very good and valid.
2. Testing carried out by users, this product received a score of 3.7 which is classified as very good and valid.
3. The design created by the author can provide automatic early warning to house occupants when someone accesses illegal *fingerprints* or someone enters through doors and windows by force.

5.2 Advice About Products

From the conclusions above and the tools that have been created, several suggestions can be put forward for consideration for further development, namely as follows:

1. Can add initial information about the condition of the doors and windows of the house when the occupants are outside the house.
2. House occupants can give commands via SMS when the doors and windows are not locked.

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