

# Design and Development of an Automatic Lock System for Cupboards Using Fingerprint Based Microcontrollers

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## Design and Development of an Automatic Lock System for Cupboards Using Fingerprint Based Microcontrollers

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**Abstract:** Seeing the current condition of the community, most of them still use simple security, such as the cupboard security system at Weleri Muhammadiyah 3 Vocational School, the situation is that schools still use one key in one cabinet where only one person is employed while more than one TU officer is if other officers will use the cupboard, they must look for or wait for the key holder first and the method is not effective for emergency matters. The importance of making security in the closet is because the school is the school with the highest number of students and requires safe storage media for diplomas (not yet taken). Therefore, it is necessary to make a cabinet lock application system using microcontroller-based fingerprints. This cabinet lock system uses a fingerprint scanner as the main determinant of whether the cabinet can be opened automatically. From research at Weleri Muhammadiyah 3 Vocational School, this system was able to add a security system to the cabinet to control access rights in the cabinets that were considered important.

**Keywords:** Microcontroller, Arduino Uno, Automatic Lock, Security System.

### I. PENDAHULUAN

Currently, various kinds of systems have been developed using modern technologies, one of which is fingerprint scanner technology . A *fingerprint scanner* is one of the most commonly used *biometric technologies* , namely by capturing images of human fingerprints. A fingerprint scanning system has two jobs, namely taking a fingerprint image, and deciding whether the fingerprint flow pattern from the captured image is the same as the fingerprint flow pattern in the database . There are several ways to take a picture of someone's fingerprints, but one of the most widely used methods today is *optical scanning* . The heart of an optical scanner is a *charge coupled device (CCD)*, the same light sensor system used in digital cameras and *camcorders* . A CCD is a simple array of light-sensitive diodes called *photosites* , which produce electrical signals that respond to photons of light (Oroh, 2014) . Each *photosite* records a pixel, a small dot that represents light and hits it. These pixels form a pattern of light and dark from a scanned image of a person's fingerprint.

The need for an access control system is the most important thing in everyday life, considering the current condition of society, most of them still use simple security measures, such as the cupboard security system at Muhammadiyah 3 Weleri Vocational School, looking at the current situation, schools still use one key for one cupboard, where there is only one key holder while there is more than one TU officer, then if another officer wants to use the cupboard they have to look for or wait for the key holder first and this method is less effective for emergency matters . It is important to create a fingerprint automatic lock system which aims to simplify access rights for users who do not need to rely on just one key.

Therefore, it is necessary to create a cabinet lock application system using *microcontroller- based fingerprints* that uses as few devices as possible so that the system size specifications can be applied to real objects . The assembled system consists of a fingerprint scanner , *LCD* , and *Arduino Uno* . This cupboard lock system uses a fingerprint scanner as the main determinant of whether the cupboard can be opened automatically. This fingerprint scanner will be controlled by *a microcontroller*. *The microcontroller* is the main brain/controller which receives input in the form of fingerprint recognition to control the cupboard lock. *The LCD display* will display reports in the form of commands to the cabinet user.

It is hoped that the design of this application system will increase the practicality of using cupboard locks. Based on the background presented above, the title " Design of an Automatic Lock System for Cabinets Using *Microcontroller- Based Fingerprints* " was chosen .

### **1.2. Identification Problem**

Based on setting behind above , obtained a number of problem among them is :

1. Currently cupboards still use one key on one cupboard .
2. User cupboard more than one person, whereas cupboard must still locked For guard security .
3. Manual keys cannot be attached to the user, so the key may be lost or forgotten.

### **1.3. Formulation of the problem**

Problem formulation is carried out to facilitate the research process so that it does not deviate from the problem being studied. Based on the background that has been mentioned , the author will formulate the problem faced, namely:

1. How to apply a fingerprint scanner as a security system in cupboards as a replacement for the current key, which can be accessed by all TU officers without relying on one object (the key) but remains safe.
2. How impact positive And negative usage system key automatic fingerprint fingers that will applied on cupboard ?

### **1.4. Restricting the problem**

The scope of this research is as follows:

1. This system only focuses on key design.
2. Does not include information when a cupboard door is forced to open .
3. This system is designed using a fingerprint scanner and *an Arduino Uno microcontroller*

### 1.5. Research purposes

objectives of this decision support system include:

1. Applying a fingerprint scanner to the cupboard using *an Arduino Uno* thus increasing security in the cupboard for storing diplomas and equipment at school.
2. Research and determine the impact of using the system key automatic fingerprints on the cupboard at SMK Muhammadiyah 3 Weleri.

### 1.6. Benefit Study

research benefits of this decision support system include:

#### a. Theoretical Benefits

1. Contribute ideas for the development of systems related to microcontrollers.
2. As a basis and reference for further research related to improving the development of microcontroller systems and as material for further study.

#### b. Practical Benefits

##### 1. For Researchers

To find out to what extent the author can design an automatic lock system for cupboards using *a microcontroller* based fingerprint scanner .

##### 2. For Academic

Becomes reference material for students to create a system that also uses a fingerprint scanner and *Arduino Uno microcontroller* .

##### 3. For Research Place

Makes it easier system right access cupboard at Muhammadiyah Vocational School 3 Weleri to get used all employee without depend on One key .

## II. THEORETICAL BASIS

### A. Design

Design Get up is depiction , planning , and making sketch or arrangement from a number of separate elements into the something complete unity And works . With *thereby* understanding design get up is activity translate results analysis to in form package device soft Then create system the or repair existing system There is . (Hasyim, Hidayah, & Latisuro, 2014)

## **B. System**

Jaluanto Sunu Punjul Tyoso (2016) stated, system is something gathering from the components that make up it One unity . An organization and information system are physical and social systems that are organized in such a way to achieve certain goals.

## **C. Key Automatic**

lock is a mechanical or electrical one that is controlled by an object that is capable of working on its own. Auto lock is easy to apply for general users However Also capable applied For protection room or object .

## **D. Fingerprint Sensor**

Joyner R. Oroh (2014) states, a system *fingerprint scanner* has two work , that is take picsidic finger user , and decide is pattern channel fingerprint finger from picture taken The same with pattern channel fingerprint finger in the *database* .

## **E. Microcontroller**

Hari Arief Darmawan (2017) stated , *microcontroller* is *chips* microcomputer which is physique form an IC ( *integrated circuit* ). Microcontrollers are usually used in systems that are small, cheap and do not require very complex calculations such as in PC applications.

## **F. Arduino**

Arduino is a microcontroller that is designed to be used easily by artists and designers (who are not technical people). Thus, without knowing a programming language, Arduino can be used to produce sophisticated work. This is as expressed by Mike Schmidt. (Dinata, 2016)

## **G. LCD**

LCD ( *liquid cell display* ) is an electronic component whose function is to display data in the form of characters. The LCD used is the M1632 type. This type of LCD has 2 lines where each line contains 16 characters. Apart from being very easy to operate, this LCD's power requirements are very low. (Merucahyo, Sadewo, Karuru, Martanto, & Priantoro, 2016) .

## **H. Relays**

A relay is a switch that is controlled by current. The relay has a low voltage coil wrapped around a core. There is an iron armature that will be attracted towards the core if current flows through the coil. This armature is mounted on a spring-loaded lever. When the armature is pulled towards this, the common path contacts will change position from normally-closed contacts to normally-open contacts. (Turang, 2015)

### III. RESEARCH METHODS

#### A. Development Methods

##### 1. Research and Development (R&D) Methods

<sup>6</sup> *development* methods are research methods used to produce certain products and test the effectiveness of these products. To produce certain products, research is used in the form of needs analysis and to assess the effectiveness of the product so that it can function in society. <sup>15</sup> The following are the stages of the R&D method according to Sugiyono:

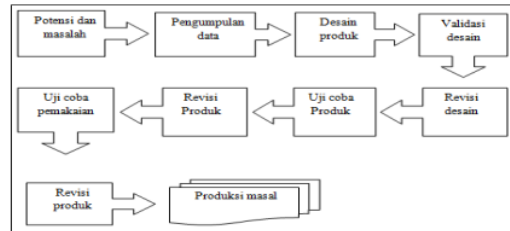
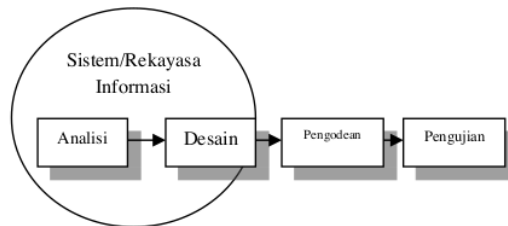


Figure 3. 1 Research and Development (R&D) Methods

##### 2. SDLC method

According to Sukanto and Shalahuddin (2013:26) stated that "<sup>4</sup>SDLC or *Software Development Life Cycle* or often also called *System Development Life Cycle* is the process of developing or changing a software system using models and methodologies that people used to develop previous software systems, based on *best practices* or methods that have been well tested." Following This is picture SDLC loop .



Picture 3.2 . SDLC Circle

##### 3. Flow chart

###### 1. Registration

The fingerprint registration flow involves the admin and user where the admin acts to register the user's fingerprint.

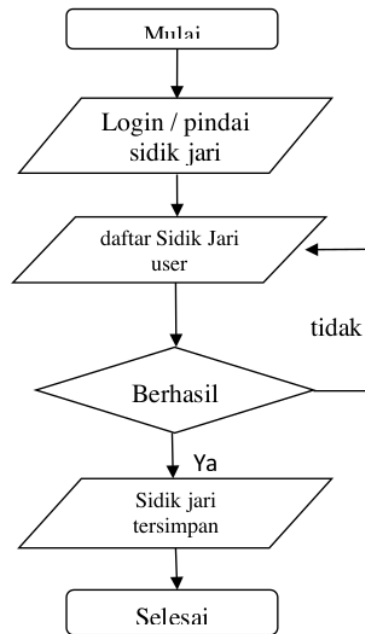


Figure 3.3. Flow chart user registration

Narration:

- c. The system is ready to use as seen from the green light on *the fingerprint* .
- d. Scan or *scan* the admin's fingerprint to log in to the system before registering *the user* .
- e. The admin needs *to manage the user* , then *the user* scans the fingerprint twice to ensure that the fingerprint to be registered is the same.
- f. *the user's* fingerprint can be used or can access the cupboard door.
- g. If it fails, *the user* needs to repeat the registration again.

## 2. Cabinet lock system

The key system can be accessed by admins and registered users.

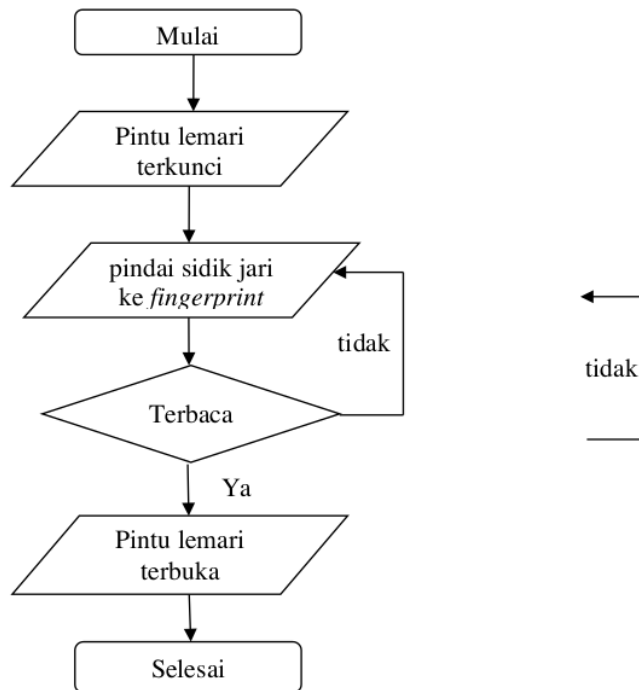


Figure 3.4. Flowchart of the automatic lock system on the cupboard

Narration:

- The system can be started as seen from the green light on *the fingerprint* .
- When there is no *scanning action* , the door is closed.
- Then the user or admin starts scanning fingerprint to fingerprint.
- If successful, the cupboard door will open.

If it fails then the cupboard door is still closed, the user or admin repeats the fingerprint scan.

## IV. RESULTS AND DISCUSSION

### A. Research result

#### 1. Current System

The lock system for cupboards at SMK Muhammadiyah 3 Weleri which is currently running is as follows:

- Still using one child key on One cupboard .



- b) The importance of assets and archives that must be maintained at school means that keys are still needed.
- c) There is only one key and it is kept by one person who is given responsibility for one workspace, while there is more than one employee in one workspace.

For this reason, we need a system that can facilitate the things mentioned above, so that cupboard users are able to access the cupboard without relying on one person.

## 2. Proposed Problem Solving

The solution proposed by the author to solve the problems that exist in the automatic lock system running at SMK Muhammadiyah 3 Weleri is to create an automatic lock system for cupboards using *fingerprint technology which will later be used for the process of opening cupboards, replacing the current locks which still use keys as a security system*. Now. This system consists of making a key device using a fingerprint sensor connected to a solenoid lock which will open if the fingerprint is correct.

## **B. Development Results**

### 1. How the System Works

- a) The first step when the system gets voltage is that the system will configure *port usage* and data speed ( *baudrate* ), then the system will declare several supporting variables, where these variables function to store data from sensors.
- b) The system can be used with the *fingerprint sign* lit up in bright green and the LCD lit up in blue.
- c) The cupboard door is locked and cannot be opened just by pulling the cupboard handle.
- d) When the fingerprint sensor is touched or in other words the door is closed, the system will turn on the solenoid and the door can be opened.

The cupboard door remains locked if the fingerprint that touches the sensor is not a registered fingerprint.

### C. Final Product Discussion

#### 1. Components before assembly

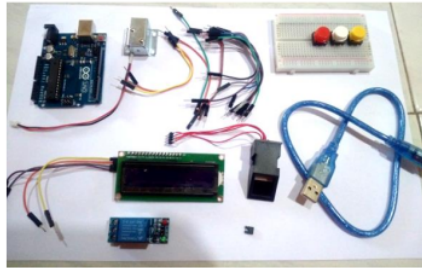


Figure 4.2. System components before assembly

Consists of Arduino Uno, solenoid key,  *jumper cable* ,  *bread board* ,  *LCD, fingerprint* ,  *Arduino USB, adapter and relay* .

#### 2. Arduino Uno circuit with *Bread Board*

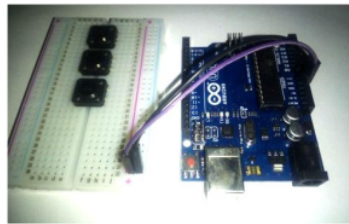


Figure 4.3. Arduino circuit with *bread board*

Functions to receive a current  *supply of 5 volts from the Arduino Uno to the bread board*

#### 3. *Fingerprint* sequence

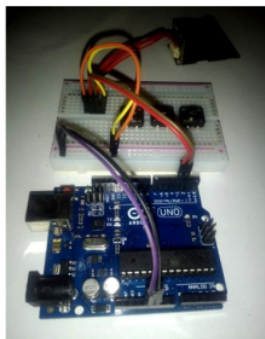


Figure 4.4. *Fingerprint* and Arduino circuit

Functions to read or detect fingerprints whether they are correct (registered) or wrong (not yet registered).

4. *Push Button* Circuit

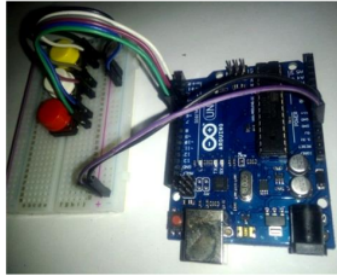


Figure 4.5. *Push Button* and Arduino circuit

*The push button* functions to determine the options provided via the LCD screen.

5. LCD circuit

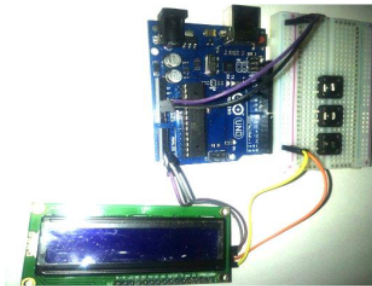


Figure 4.6. LCD and Arduino circuit

Functions to display information in the form of open key reports and display options when registering a new user.

6. Solenoid Circuit

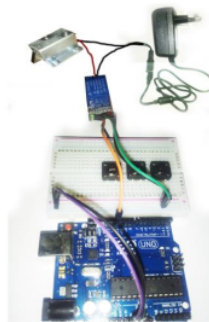


Figure 4.7. Solenoid Circuit

Functions as *an output* in the form of movement of the solenoid lock which is given a current voltage of 12 volts to unlock the cupboard if the fingerprint sensor is successful.

## 7. Application to Objects



Figure 4. 8 . Application of the system to objects

After testing, the system can be applied/applied to cupboard objects.

### D. Testing and Analysis

#### 1. First Test

The first test of the system was tested using the author's fingerprint, using the right thumb print, before the testing process the right thumb was first registered on the *fingerprint sensor* . Figure 4.9 below is a picture of the thumb for carrying out the first test.

The test step is to place your finger on the *fingerprint sensor area* , noting that the door is closed. So if the sensor succeeds in identifying and reading the fingerprint, the system will turn on *the relay* once and *the solenoid* will activate so that the door can be opened, as well as measuring the time required by the system to read the fingerprint.

The first test using the right thumbprint (thumb) showed that the system could work well with the reading time interval from placing the finger on the sensor area until the door opened was 2 seconds. Or it could be said that in this first test it was found that the system took 2 seconds to recognize the right thumb print until the door opened.

#### 2. Second Test

The second test is almost the same as the first test, both in terms of procedure and everything else, only in the second test the test object is replaced with the author's left thumb. To see more clearly, see Figure 4.11 below.

So from the second test it was found that the system could recognize and read the left thumbprint with a reading time interval until the door opened of 2 seconds, or the same as the first test data.

#### 3. Third Test

To speed up the testing process, in this third test the author took 2 tests in carrying out the test, namely with the test object of the index finger of the right hand and the left

hand. From this test, data was obtained that the two times required by the system to read until the door opens (solenoid/relay on) is 2 seconds, both on the right finger and 2 seconds on the left finger. For more clarity, pay attention to table 4.1 below.

Table 4.1 Third Test Data.

No	Finger	Status	Reading Time
1	Right index finger	Read	3 seconds
2	Left index finger	Read	2 seconds

4. Fourth Test

The fourth test used the object of the middle finger of the author's right hand and left hand, so the following test results were obtained in table 4.2.

Table 4.2 Fourth Test Data

No	Finger	Status	Reading Time
1	Center right	Read	2 seconds
2	Center left	Read	2 seconds

5. Fifth Test

The fifth test is not much different from the previous test where the test object uses the ring finger on the author's right and left hand. The ring finger test aims to find out how far the system can recognize the five fingers so that it is hoped that the author can draw conclusions from the system later, as for the test result data The five can be seen in table 4.3 below.

Table 4.3 Fifth Test Data

No	Finger	Status	Reading Time
1	Sweet right	Read	2 seconds
2	Sweet left	Read	2 seconds

6. Sixth Test

The sixth test used the object of the little finger of the author's right and left hand, with the same system test procedure as the previous one, so that the following table 4.4 was obtained.

Table 4.4 Sixth Test Data

No	Finger	Status	Reading Time
1	Right pinky	Read	2 seconds
2	Left pinky	Read	1 second

### 7. Seventh Test

The seventh test uses an object that is different both in terms of the physical size of the finger and the age of the finger. This seventh test uses the finger of a 17 year old student weighing 48 kg, female. The test with the student object aims to find out the system parameters, whether the system can recognize and reading the student's finger or not, which does not rule out the possibility that the condition of the writer's and student's fingerprints is different.

Table 4.5 Seventh Test Data

No	Finger	Status	Reading Time
1	Right thumb	Read	2 seconds
2	Left thumb	Read	2 seconds
3	Right index finger	Read	2 seconds
4	Left index finger	Read	2 seconds
5	Center right	Read	2 seconds
6	Center left	Read	2 seconds
7	Sweet right	Read	2 seconds
8	Sweet left	Read	2 seconds
9	Right pinky	Read	2 seconds
10	Left pinky	Read	2 seconds

### 8. Eighth Test

The eighth test uses fingerprints in different conditions, namely wet, dusty and dry. This test aims to determine whether conditions like this affect access to the cupboard or only affect the access time to *the fingerprint*.

Table 4.6 Eighth Test Data

No	Finger Condition	Status	Reading Time
1	Clean and Dry	Read	2 seconds
2	Dusty	Can not be read	-
3	Wet	Can not be read	-

### 9. System Test Results

After carrying out several tests as above, the author got some data, including that the system can identify or recognize fingerprints, that the fingerprints a person has vary in thickness and width, thus affecting the time to access the fingerprint.

The condition of the fingerprint certainly affects fingerprint access. The results obtained by the author after testing showed that the fingerprint only accepts fingerprints

in clean and dry conditions, while dirty and wet conditions are unacceptable or unreadable.

## **V. CONCLUSIONS AND RECOMMENDATIONS**

### **A. Conclusion**

As a result of implementing an automatic lock system on cupboards using a microcontroller-based fingerprint, the author can conclude as follows:

1. After designing the system and testing, it can be seen that the fingerprint scanner can be applied to cupboards as a security system.
2. System security fingerprint finger capable read fingerprint finger man more from one , then from That system capable register more from one user/ users . So that user cupboards that use system This capable accessed more from one person.

### **B. Limitations of Research Results**

The implementation of this system certainly <sup>14</sup> does not rule out the possibility of deficiencies in the system. The following are the disadvantages of this system, namely:

1. This system depends on the electricity supply when used, System This can used with Genre available electricity , if No There is intake electricity so system This No can used .
2. fingerprint system cannot read dirty (dusty) and wet fingerprints.

### **C. Suggestion**

In the research carried out by the author, suggestions for an automatic lock system were taken as follows:

1. Create portable device storage so that it can be used in several other cupboards.
2. *supply* (UPS) is needed so that it can still be used in the event of a power outage.

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