

# Key-less Automatic Lock System using RFID & Smartphone

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**Abstract.** Information is easily obtained over the internet, including how-to tutorial, in the form of text or video, and even tutorial of how to break the house key-lock is also available. Locksmith has the expertise to make a duplicate key quickly. Homeowners can install an alarm system, but if the speaker cord is disconnected then the alarm will disfunction. Alarm systems do not fully guarantee the security of the house. Home-security system using key-lock can easily be broken by duplication key or certain method (which tutorial is even available over the internet). security systems that rely on the key-lock is not effective to keep the house safe. This study uses laboratory experiments to produce models of manual key-less automatic lock system using microcontroller. Door mechanical system is controlled by a microcontroller based on input from RFID or smartphone. RFID tags used in the form of ID card so that when it approaches the door, lock will be released and the door will open, then the door will close and lock automatically after a while. To anticipate if the RFID system is damaged or lost then apps installed in android smartphone is used. Application can be used to open all the doors when connected to the desired door through a Bluetooth connection. Initial testing conducted by testing the readability of RFID tag (transponder) for RFID reader (transceiver). The test results showed the Card RFID tags are easier to read than the Key Chain RFID tags. RFID reader can read RFID tag if the distance < 4,2 cm. Key-less Automatic lock system works according to the created design. Doors will open if the corresponding RFID tag is brought near, 5 seconds later door will then close and lock automatically. As anticipation if RFID system is disturbed, an application for android smartphone via bluetooth media has been prepared.

## I. INTRODUCTION

In general, houses or rooms use a lock and key to keep it secure. Various types and models of lock and key are commercially available. A locksmith can make a duplicate key and make the door lock without knowing the original key. Getting information of how-to tutorial to unlock the padlock over the internet is an easy thing for example on site <http://id.wikihow.com/Membuka-Kunci-Dengan-Klip-Kertas> or through [www.youtube.com](http://www.youtube.com). On the other hand Homeowners can install an alarm, or even use a system of pins or password combinations for opening or clicking on/off the alarm. But an astute thief can turn off the alarm system installed to get in to the house and stealing. Lock and key system allows anyone to unlock the padlock by using a key or with a particular technique. The alarm system c guarantee not fully guarantee the security of the house when the speaker cord is disconnected for instance then the alarm will not ring.

Many research regarding door security has been conducted, among those are by using keypad as digital key [1], barcode passwords and keypad [2], punch cards and keypad [3], magnet sencor [4] and identification cards media and sms by mobile phone [5]. Door Security using the passsword or pin through keypad will raise security gap. Installation of CCTV and IPCam can be used to record the keystrokes of keypad so it can be analyzed to recognize the pin or password.

In its development even social media twitter utilized to control the door remotely [6]. Tapping process is now venturing into a wide variety of networks. sms, internet and social media are also susceptible to eavesdropping. One

attempt to overcome the tapping is data encryption, but now a lot of applications to break the encryption of data scattered in the hacker community.

This study uses direct contact media which are RFID and smartphone applications via bluetooth. RFID tags brought to the door so that the lock and the door open and then close automatically. Smartphone application open the door via bluetooth, so it is only about 11m away from the door.

## II. RELATED WORKS

### II.1. Design System

This key-less lock system in the form of automatic sliding door models that are open-close and lock-unlock automatically. Design system as shown in fig. 1 consists of:

- a. Microcontroller System including: Arduino Mega 2560, 16x2 LCD, Bluetooth Module HC-05, SRF-05 Ultrasonic Sensor, LED, buzzer
- b. RFID: RC522 MIFARE (reader and tag with 13.56 Mhz)
- c. Lock Mechanic: Servo Motor
- d. Door Mechanic: L298N Motor Driver, Motor DC 5V
- e. Android smartphone, POWERBANK, battery etc.

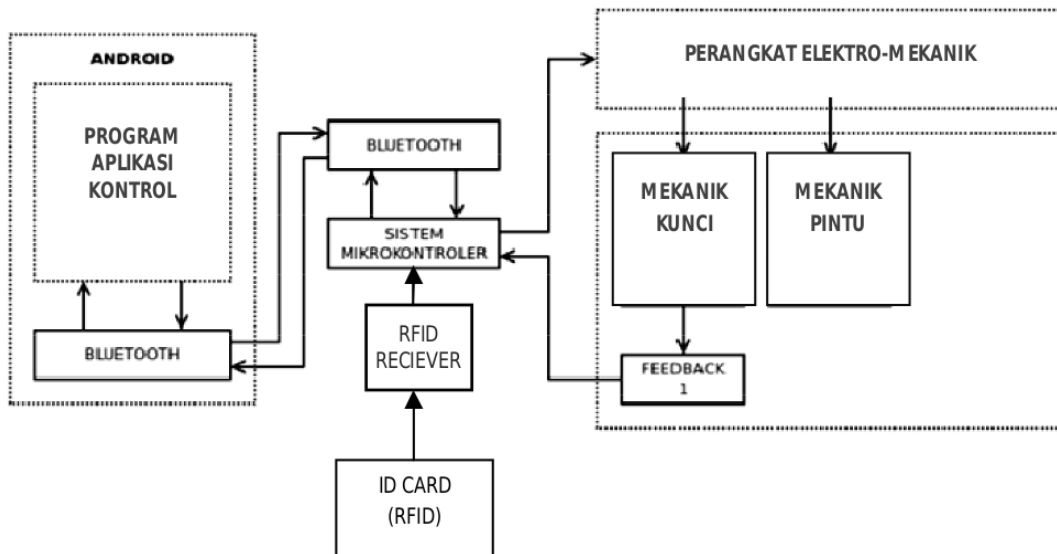
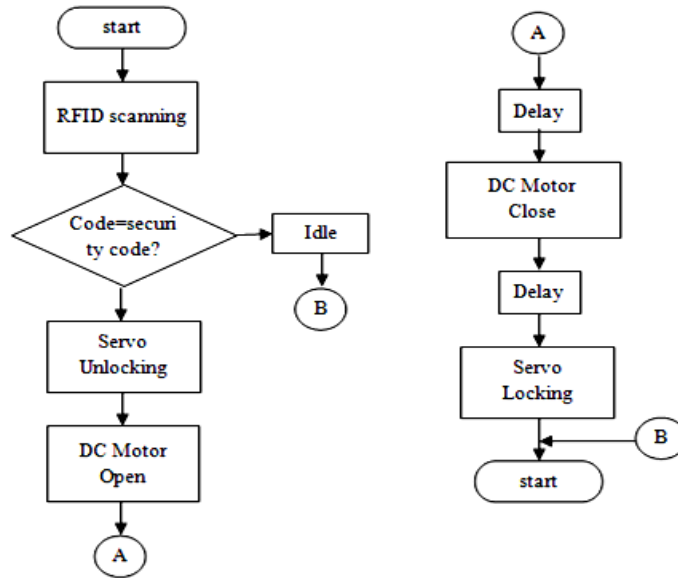


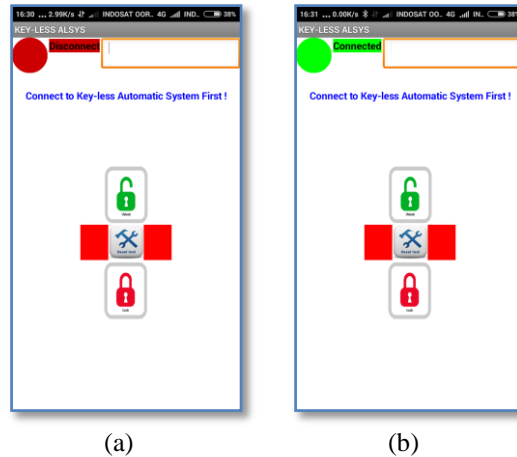
FIGURE 1. Block diagram of Key-less Automatic Lock System

The door can only be opened with the specified RFID tag only. At the time of the specified RFID tag is brought near the RFID reader, the microprocessor will drive the electro-mechanical device to lock-unlock and open-close doors. System flow clearly depicted in flowchart form as fig. 2



**FIGURE 2.** Flowchart of Key-less Automatic Lock System

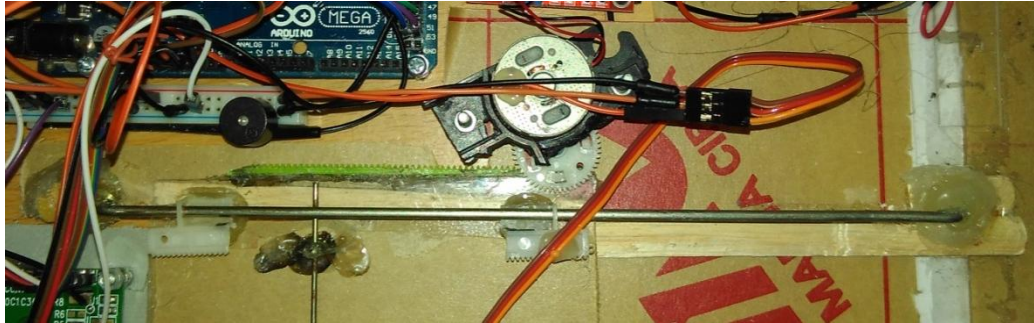
In emergency case eg RFID card is lost or damaged, a KEY-LESS ALSYS installed with android smartphones that can connect to the system microcontroller (fig. 3) can be used. Application can be used to open or close the door by pressing applications button. To replace the damaged RFID card there is button provided to read the RFID code with permitted access.



**FIGURE 2.** Screenshot of KEY-LESS ALSYS Application (a) Application is not connected (b) Application is connected

## II.2. Open and Close Door Mechanism

The sliding door being used is a modification of the automatic sliding door research results [7] by using infrared light that is directed to the photodiode. At the time of the infrared light is blocked it means there will be people who enter, than the servo motor will rotate so that the door opens, and when it is not blocked the door will closes. In this study, the sliding door opens and closes automatically at the behest motorDC direct microcontroller (fig.4). At the time of the RFID-reader read correct RFID tags then the microcontroller will unlock, and the door opens automatically, a few moments later the door will close automatically and the door will be locked. Ultrasonic sensors HY-SRF-05 is used to detect obstructions. The door can not be closed if there is a barrier between the doors.



**FIGURE 4.** Open-close door system

### **II.3. Lock-Unlock Door Mechanism**

Among door lock mechanism uses solenoid [8], magnetic lock [9] and servo motors [10] This study uses servo motors that drive the two pieces of locking lever upwards and downwards (Fig.5). By default the door is locked, if the servo motor rotates counter-clockwise, the lever under will go up and the lever up goes down so that the lock open. The door can only open if the key opened and can be locked if the door in closed position.



**FIGURE 5.** Locking system

The door can only be opened with specified RFID tags or using Key-less ALSYS fitted with smartphones that can connect to the system microcontroller. At the time of specified RFID tags brought closer to the RFID reader, the microprocessor will drive the servo motor to open the lock, then the DC motor will open the door and few moments later the DC motor will changes the direction of the motor rotation so that the door will be closed and the servo motors will return to default position to lock the door.

### III. RESULT AND DISCUSSION

13.56 MHz RFID System is more effective than the 125 kHz [11], so this study uses MIFARE-RC522 [12]. In order for Arduino Mega 2560 microcontroller can read RFID tags, then the library uses MFRC522.h made by Miguel Balboa (<https://github.com/miguelbalboa/rfid>) which is installed on the Arduino application 1.6.3.

HY ultrasonic sensors SRF-05 is used to prevent the door shut as obstacles exist. To estimate the obstacle distance using arduino library which is newping.h with better calculation (<http://code.google.com/p/arduino-newping/>) with cm-size counted by the formula (1) below:

$$\text{distance} = \frac{\text{sonar.ping()}}{US\_ROUNDTRIP\_CM} \quad (1)$$

To open the door using the RFID tag in the form of a key chain or card. If the RFID tag brought near to the RFID reader is incorrect then the microcontroller will turn red LED and LCD will display "ACCESS DENIED" message. If the RFID tag brought closer is correct, the LED will turn green, the LCD displays "access granted" message, the servo motor rotates counter-clockwise (unlocked), the DC motor rotates counter-clockwise (open). If the ultrasonic sensor does not detect obstruction in the door, 3 seconds (delay) later DC motor rotates clockwise (close), and by 5 seconds delay servo motor rotates clockwise (lock) as fig 6.

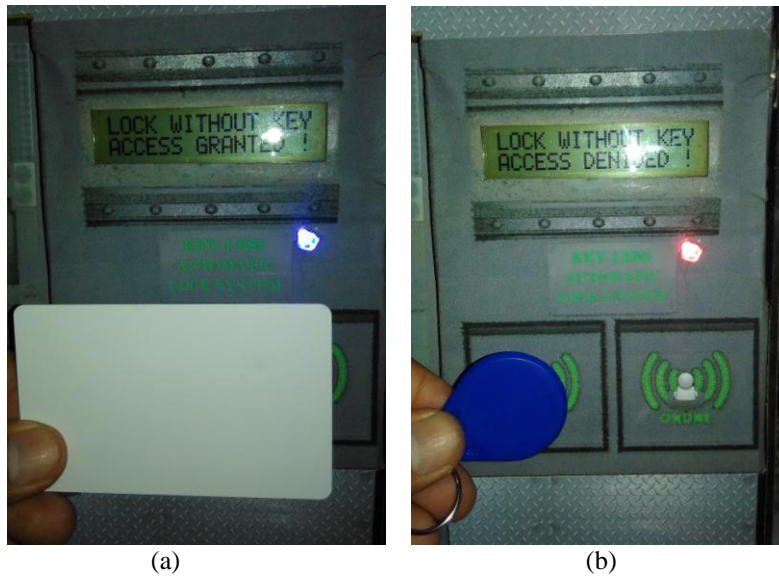


FIGURE 6. Open door using (a) Correct RFID tag (b) Wrong RFID tag

RFID system testing was conducted to determine the distance between the RFID tag and RFID Reader with a conditioned environment. The barrier is taken randomly and test results as in Table 1

TABLE 1. Measurement Max distance of RFID Tag and RFID Reader

Obstacle	Card RFID Tag (cm)	Key Chain RFID Tag (cm)
none	4.2	1,9
Book	3.5	1,9
Wood board	3.5	1,9
DVD	0	0
Iron board	0	0
RAM	0	0
Clothing	4,2	1,9
Handphone	0	0
Alumunium board	0	0

The results of testing in Table 1 shows RFID tags card can be read by RFID Card Reader farther than RFID Tag Key Chain. All RFID tag can not be read by RFID Reader if obstructed by metal plates, similar with previous studies that the reading of the RFID reader does not work when obstructed by metals [13].

The next test of the whole system. Some RFID tags are used to open the door, the result is only the specified RFID tag can be used to open the door. The initial condition of Automatic Key-Less System Lock are the door closed and locked, the LED colour is blue, LCD displays " LOCK WITHOUT KEY Insert Card!". If the RFID tag used is incorrect the LED colour turn into red, Buzzer sounds long, LCD displays " LOCK WITHOUT KEY ACCESS DENIED!" (Fig.6b). If the RFID tag used is correct then the LED became green, Buzzer beeps shortly, LCD appears " LOCK WITHOUT KEY ACCESS GRANTED!" (Fig.6a), unlock, the door opened a few seconds then shut again, 5 seconds later locked as initial conditions. By the time the doors open then barrier given at the doorway, the doors did not close after the barrier is pulled but a few moments later the door closed and locked.

Android smartphone that has been installed KEY-LESS ALSYS connected to door systems via Bluetooth (pairing process) by entering a code. Once connected, UNLOCK button is pressed than the key unlocked and door opened. When the LOCK button is pressed the door closed and locked.

Overall Key-Less Automatic Lock System works in accordance with the designs. KEY-LESS ALSYS Applications taken to anticipate if RFID tags were damaged and could not be used to open the door. Application on the smartphone can be used if connected with Key-Less Automatic Lock System via a Bluetooth connection.

#### IV. CONCLUSION

Key-less Automatic lock system works according to the created design. Doors will open if the corresponding RFID tag is brought near, 5 seconds later door will then close and lock automatically. The test results showed the RFID tags Card are easier to read than the RFID tags Key Chain. RFID reader can read RFID tag if the distance was < 4,2 cm. As anticipation if RFID system is disturbed, an application for android smartphone via bluetooth media has been prepared.

#### ACKNOWLEDGMENTS

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