

Fingerprint lock and unlock system using arduino nano

Assigned By:
Professor Rutu Parekh.



Members:

Dhruva vala	201701095
Shah Kushal	201701111
Jay Patel	201701148
Kishan Sakdasariya	201701158
Bhautik Koladiya	201701159
Rohinee Sarvaiya	201701172
Keshvi Bhimani	201701186
Vinay Bhingaradia	201701192
Dhvanil Pipaliya	201701263
Biren Karena	201701457

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1. Abstract:

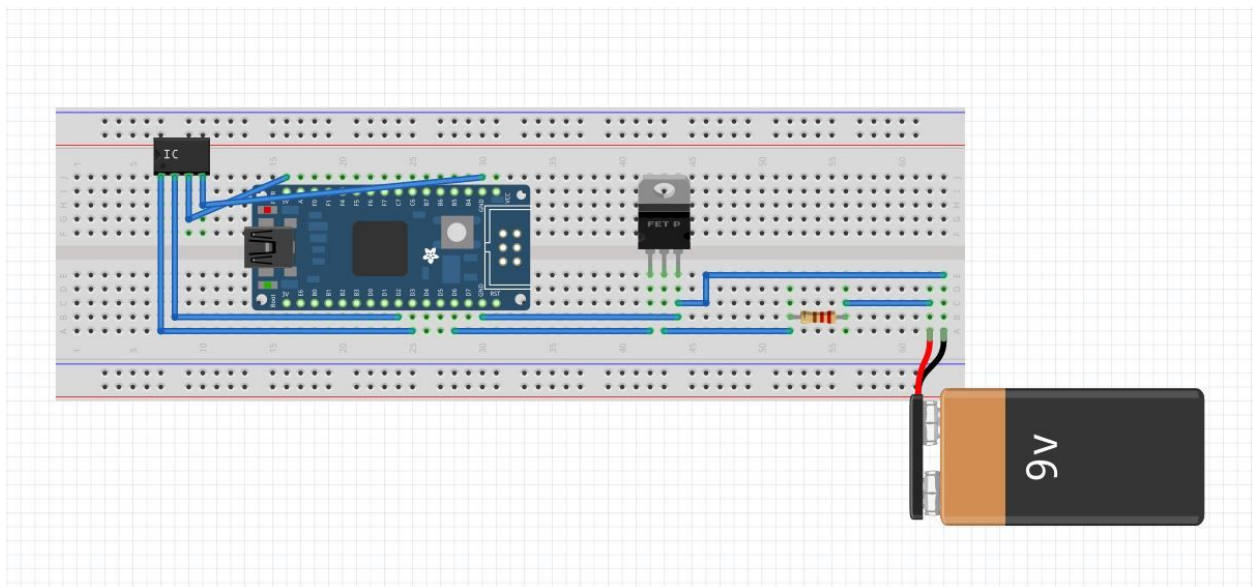
The purpose of our project is, we intend to make a system, wherein our fingerprint can unlock a door. The project involves use of fingerprint sensor, Arduino nano, solenoid lock, Transistor TIP-122. The fingerprint Sensor checks whether or not is the fingerprint matched with previously enrolled fingerprint. In either cases Arduino gets message. In case Arduino gets message that image is previously enrolled fingerprint, it activates the Transistor connected to it. Due to logical high at base, Transistor allows current to flow which in turn results in Voltage drop across Solenoid lock.

2. Project Objective:

To lock/unlock a door using fingerprint sensor, Arduino Nano and solenoid lock.

To unlock the door when entered fingerprint matches with our stored fingerprint and after few seconds closes eventually.

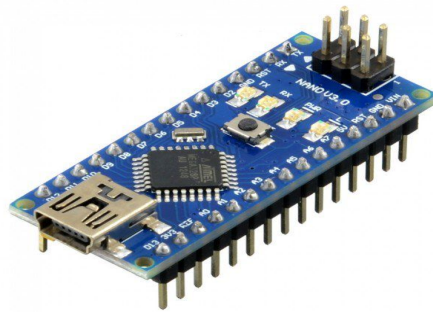
3. Block Diagram:



4.Components :

- Arduino Nano
- Fingerprint sensor (R-305)
- Transistor (TIP-122)
- Solenoid Lock
- Battery(12 V)

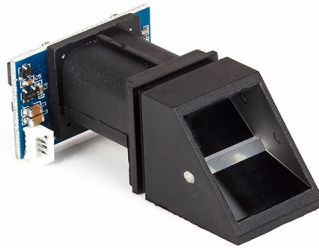
1).Arduino Nano :-



Arduino microcontroller (Arduino Nano) contains IC *ATmega328P*. That operates on 5V, however it should take 7V to 12V as a input voltage. It has 32KB flash memory with 2KB SRAM and the clock speed given to arduino is 16MHz. It contains 8 Analog pins and 22 Digital I/O pins where 6 can provide PWM output. Arduino can be powered via mini-B USB connection. Fingerprint enroll code and detection code has to be uploaded in arduino. Arduino's 1(RX) pin connected to fingerprint sensor which receives data from the sensor and make decision as per the code. Arduino's 2(TX) pin connected to transistor TIP122 where arduino can transmit data.

- Pin no. 1 - Tx (Digital input/output)
- Pin no. 2 - Rx (Digital input/output)
- Pin no. 4 - GND (Supply ground)
- Pin no. 30 - Vin (Supply voltage)

2).Fingerprint sensor (R-305):-



This fingerprint sensor module makes adding fingerprint detection and verification super simple. You can also enroll new fingers directly- up to 127 fingerprints can be stored in the onboard FLASH memory. There's a red LED in the lens that lights up during a photo so you know its working. The supply voltage is 3.6 - 6.0 volt . The fingerprint imaging time is less than 1 second .

Fingerprint processing includes two parts: fingerprint enrollment and fingerprint matching (the matching can be 1:1 or 1: N). When enrolling, a user needs to enter the finger two times. The system will process the finger images two times, then generate a template of the finger based on processing results and store the template. When fingerprints match, the user put the finger through an optical sensor and system will generate a

template of the finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1: N matching, or searching, the system will search the whole finger library for the matching finger. In both circumstances, the system will return the matching result, success or failure.

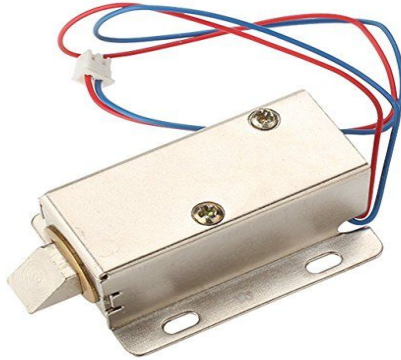
3).Transistor (TIP122) :-



This is NPN type of transistor. This transistor is known for its high current gain and high collector current hence it is normally used to control loads with high current or in applications where high amplification is required. It has a good collector current rating of about 5A and its gain is upto 1000. This transistor has a low Base-Emitter Voltage of the only 5V hence can be easily controlled by a Logic device like microcontrollers. Although care has to be taken to check if the logic device can sou up to 120mA.

- It has three pins:-
 - Pin no-1. Base
 - Pin no-2. Collector
 - Pin no-3. Emitter

4).Solenoid Lock :-



This DC 12V Cabinet Door Electromagnetic Solenoid Lock can be used for locking. The lock gets “Locked” as the circuits disconnects, and it will unlock as the instant power-on. After connecting to the circuit and when the current is available, the electric lock can control the door’s opening and closing. It has rated Current 0.8 A.

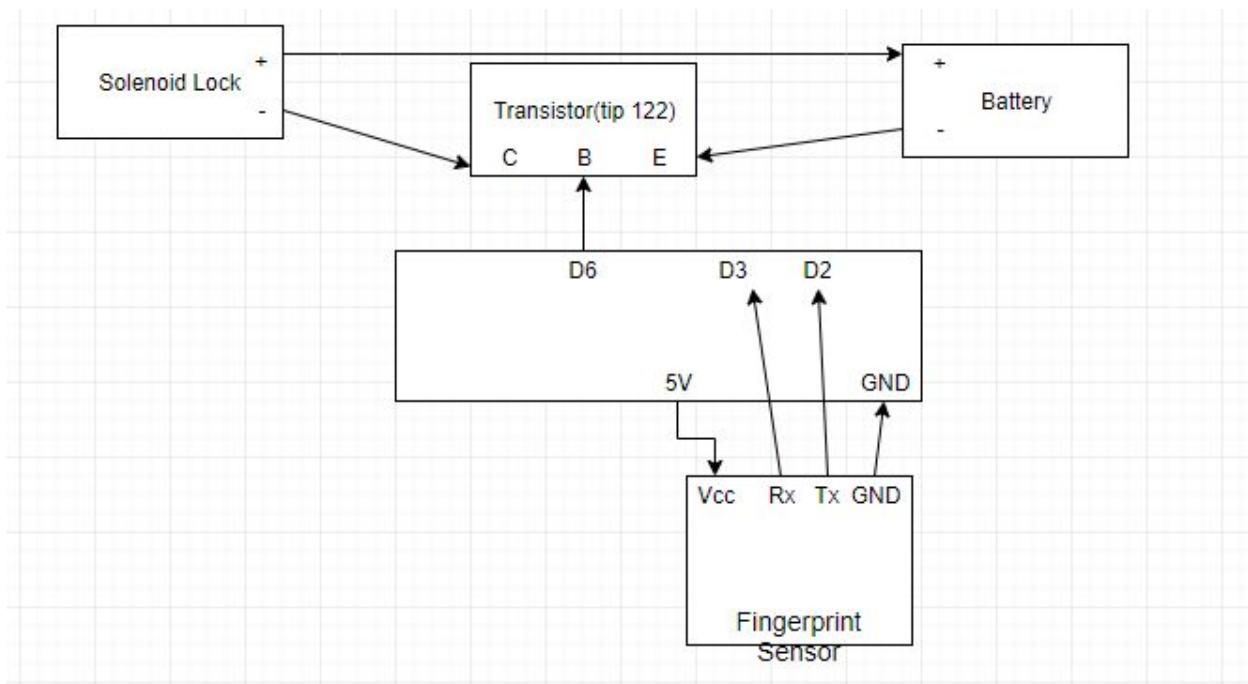
5.Description and working:

We first attach Arduino Nano with breadboard. Here the pins of Arduino which are used as serial input output are pin 2 and 3 (Default Pins are 1 and 0). Now we will connect the fingerprint sensor with Arduino Nano. Rx and Tx wires are connected with pin 2 and 3 of Arduino. Gnd and Vcc wires are connected to their corresponding slots in Arduino. Now we connect the Arduino to computer via cable. In Arduino IDE we download Adafruit fingerprint sensor library and upload the code for fingerprint enrollment in it and enroll some fingerprints. Now using the code for enrollment given in the library we check whether the fingerprint is being detected or not and test the same by connecting an LED at the output pin. To get an output of 5V on detecting a finger we will go the block of code that is being executed on detecting a fingerprint and write the following command.

```
digitalwrite(6,'High');  
delay(5000);  
digitalwrite(6,'Low');
```

Thus, we are ready with a 5V output on detecting a valid enrolled finger. Now the task is to give an input of 12V and give it to the solenoid lock. For this we will use the property of transistor as a switch. We will connect the base transistor to the output of arduino(pin 6) and the emitter to the ground. Now we will connect a 12V battery to the solenoid lock's positive terminal and the negative terminal of solenoid lock to collector. With this arrangement we can consider the solenoid lock as a resistor to understand how the circuit functions. Now when the output from the arduino which acts

as an input to the base of transistor is zero volt then no current flows because the transistor is in cut off region. But when the output from the arduino is 5V (i.e. The fingerprint is detected) current flows through the transistor due to the forward biasing of BE junction and thus the solenoid lock is pushed back.



Code:

- Recognition:

The code initially sets serial pins 2, 3 as input and output pin 2 is receiving pin and 3 is Transmitting pin. We set the data rate (9600) pin 6 as output pin. Once fingerprint sensor is detected it goes for detecting finger. If no finger is detected, it puts the message and checks for the case if there is any other error like communication error. If it detects correct finger than it passes, fingerprint ID to void loop().

- Enrollment:

Enrollment code initializes in same way as the recognition code does. It takes the ID from user through *readnumber()* function. It waits for valid finger. If it detects valid finger it checks for error if there are none it takes a copy of it. It takes the same finger once more and tests with previously taken image. Finally, if they match, finger is enrolled.

6.Test Results:

On detecting a valid finger the pin number 6 gave an output of 5V volt which leads to the solenoid lock to open due to the functioning of circuit at the output as explained above.

Also, when we put wrong fingerprint deliberately, the lock did not open. Since Pin D-6 did not become “Logical High”.

Hence, we concluded that the lock worked correctly.

7. Conclusion:

To conclude we can say that this is a crude version of FingerPrint lock. We, made a lock/Unlock system that can detect fingerprint and open the lock in case correct fingerprint is detected using Arduino Nano. There are certain low lying fruits like making it on PCB which can make project aesthetically better.

As an extension to this project we can miniaturise the system using 5 V solenoid lock (Which in turn needs no triggering by Transistor since Arduino can provide +5 V to lock). This can be used in purse or as small locks and drawers. In addition to this, a smaller version of fingerprint sensor can be used with extremely similar code and working mechanism. This can also be on economical side since lock is cheaper (Cost of lock is approx. 25% of total).

As a bigger version we can also fit a LCD screen that is capable to display the ID/ Name of the detected fingerprint. This can be used as a proper door lock and other such real life applications.

8.References:

https://www.youtube.com/watch?v=aYUFmRckc_k

<https://www.youtube.com/watch?v=qXjjVqQwLyY>

<https://www.youtube.com/watch?v=FpOC089UlwY&t=151s>

<https://www.instructables.com/id/Arduino-Fingerprint-Lock/>

<https://www.creativitybuzz.org/make-arduino-fingerprint-lock/>

Code is from Examples of Arduino Software.

