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ARDUINO CONTROLLED SMART DOOR LOCKING SYSTEM USING FINGERPRINT INTERFACE

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ABSTRACT

This research work comprises a fingerprint-enabled smart and inexpensive door lock. The Atmel Atmega328p, a fingerprint sensor, a GSM module, a motor driver, and other hardware devices will be used to complete this study. The fingerprint sensor will be incorporated into the door panel, facing the outside of the door, to prevent outsiders from accessing the controlling system. The latches will be

INTRODUCTION

This study aims to address the issue of unauthorised persons trespassing in our homes, shops, and offices. Traditional locks can be used to solve security difficulties, however with the use of a duplicate key, it is always possible for someone to enter the locks without destroying them. Using these types of locks also poses a problem if we misplace our keys, and we must always have a case with us. Using a pattern in the locks can boost security, but it can also be unlocked if the password or pattern is known in some way. So, instead of implementing every system in this project, we will create a biometrics-based system. In the case of biometrics, a fingerprint will be used as a key (Wildes, 1997). This Arduino project will employ a variety of devices to construct security locks with a variety of features to boost the level of security. In simple word we are implementing a door access system using Arduino which makes use of fingerprint to identify who to allow and whom not to allow inside our home, office, shops etc. This work implemented using a normal and simple door lock which is fitted in every home so as to minimize the cost of the

installed inside the door panel, where the thickness of the door will aid in latch strength. If you try to force your way in, we'll deploy a few latches within the panel to distribute the force. The fingerprint sensor will take the user's fingerprint and send it to the microcontroller for matching. If the print matches one of the microcontroller's memory fingerprints, the latch will be locked or unlocked depending on the microcontroller's present state. The buzzer will sound if the fingerprint is unfamiliar to the microcontroller, and the user will have to try again. If the system detects incorrect fingerprints five times at large, it will notify the owner, alerting him or her to a break-in. The system will also enter a secure mode, continuing to sound the buzzer to inform the neighbors that something is wrong. Once a known print is entered, the system will be reset.

Keywords: *Fingerprint sensor; GSM Module; Motor Driver; AT 328 mega Microcontroller; Door panel; Latches; Buzzer.*

device as a product. The fingerprint door lock can be created with an Arduino UNO development board, a fingerprint module, an electromagnetic or solenoid lock and a relay. The fingerprint door lock can register up to 170 persons with the help of the software and the fingerprint sensor. The origins of door locks can be traced back to ancient Egypt, where a basic wooden pin lock was invented around 6,000 years ago. This lock was made up of a wooden bar that was attached to the door and a bolt that fit into it. The bolt included multiple wooden pins that could be lifted using a huge wooden key manufactured specifically for the job. The key resembled a modern tooth brush, and when the teeth hit the pins, they were freed, allowing the door to open. While this lock may appear simple by today's standards, it is the forerunner of the modern door lock, which offers security to homes all around the world (Anil, 2010).

During the Roman era, metals such as silver, copper, and gold were used to create the same type of lock mechanism. Only the wealthy could buy locks, and a gold key was viewed as a symbol of prestige and riches. The industrial revolution was well underway by the nineteenth century, and the creation of metal parts fuelled the development of increasingly secure locks. Pin locks have been replaced with robust and lasting tumbler mechanisms made of stainless steel and titanium in the last 100 years, thanks to many innovative types and adaptations in the locking

mechanisms. It may be hard to imagine the world without the door lock. For many, it brings security and peace of mind knowing that they are safe behind locked doors. There are 21 different types of locks that are utilized in everyday life, ranging from padlocks to deadbolts, and each one has a certain purpose (Anil, 2004). While the essential concepts of the door lock have not changed in over 6,000 years, the materials and design have been considerably more streamlined and improved.

A keypad door lock system is a relatively new type of door lock that employs a pin code or password to identify an authorized user. This code/password is set to be unique and shared with only those who have been granted access. Another form of lock system is an RFID-based door lock system, which uses access cards to identify authorized people and grants access when the correct card is detected by the system. The following components are used in this sort of door lock system: an 8051 microcontroller, a 4x4 matrix keypad, a 16x2 LCD, an L293D motor driver board, a DC motor, a 10k potentiometer, connecting cables, a power supply, and an 8051 development board. The 8051 controller bored is the circuit's key component. The password is entered using a 4x4 matrix keypad and the entered password is compared to a list of predetermined passwords (Fernando, 2002). If the password is correct, the system rotates the door motor to open the door and displays the state of the door on the LCD. If the password is incorrect, the door remains closed and the LCD reads "PWD is incorrect. The following components are used in the building of this system: 5v relay, LED, Buzzer, Connecting wire, Resistors, Arduino Uno, EM-18 Reader module with tags, 5v relay, LED, Buzzer, Connecting wire

This door lock system is primarily an electricity-based device that operates by supplying an appropriate voltage. The door will automatically open after the card has been recognized. When the card is correctly recognized, a beep sound will be heard and an LED will blink. The buzzer will ring to inform the reader if the wrong card is placed in front of the reader. This lock system is more secure than a keypad lock since it restricts access to those with an access card. In the event of a keypad, someone may guess the password and gain access automatically (Mary, 2010). This system's construction entails the following steps: This lock system is made up of an Arduino Uno, a fingerprint module, a relay module, and a solenoid lock. The Arduino Uno is the circuit's principal component, controlling the circuit's operation according to its programming. Only if the fingerprint module recognizes

the finger placed on its sensor by comparing it to the previously enrolled fingerprint, which is done by the Arduino as a microcontroller, will the system be unlocked. This sort of door lock is more secure than RFID-based locks since it uses a fingerprint image that is unique to every person on the planet. An unauthorised individual cannot share, lose, forget, or guess the fingerprint since it is unique (Baidya, 2017).

As a security system, the keypad lock system is insufficiently safe, allowing intruder's access to the secured area if the pin/password is known or guessed by them. As a result, our project contributes to the improvement by restricting access to just those who are authorized. The fingerprint door lock system can be utilized in a variety of settings where safe access is required. It is something we can use in our own houses (Sarma, 2020). Only family members will be allowed access to the main entrance. Access to certain rooms in the house may be restricted. For example, only the parents have access to the house's store. Access to the main bedroom and the children's room will be restricted as well. Only teachers and specific pupils will have access to a class in schools. Teachers will only be able to use their offices. Some of the advantages of this system are that it can provide the use of a fingerprint which cannot be stolen or shared by making access more distinctive. It is impossible for the user to forget. There is also no need to carry a card around with you that could be lost, it is extremely difficult to be hacked and only enrolled users are allowed, which makes it more effective. This technique can be used by hospitals and businesses to restrict access to specific areas within their facilities. Some of the objectives of this study are to develop an Arduino-based method, door lock mechanism, to keep unauthorised people out of one's possessions, to raise public understanding about security and access control and to test the use of an electronic device in a lock system.

MATERIALS AND METHODS

Table 1: Materials Used

S/No.	Components
1	Arduino Uno Development Board
2	AT Mega 328 Microcontroller
3	Buzzer
4	Relay module
5	Solenoid door lock

6	9V Battery
7	Female-female battery connector
8	Fingerprint module
9	Connecting wire and jumper
10	9Volt battery connector
11	Arduino 9V battery connector

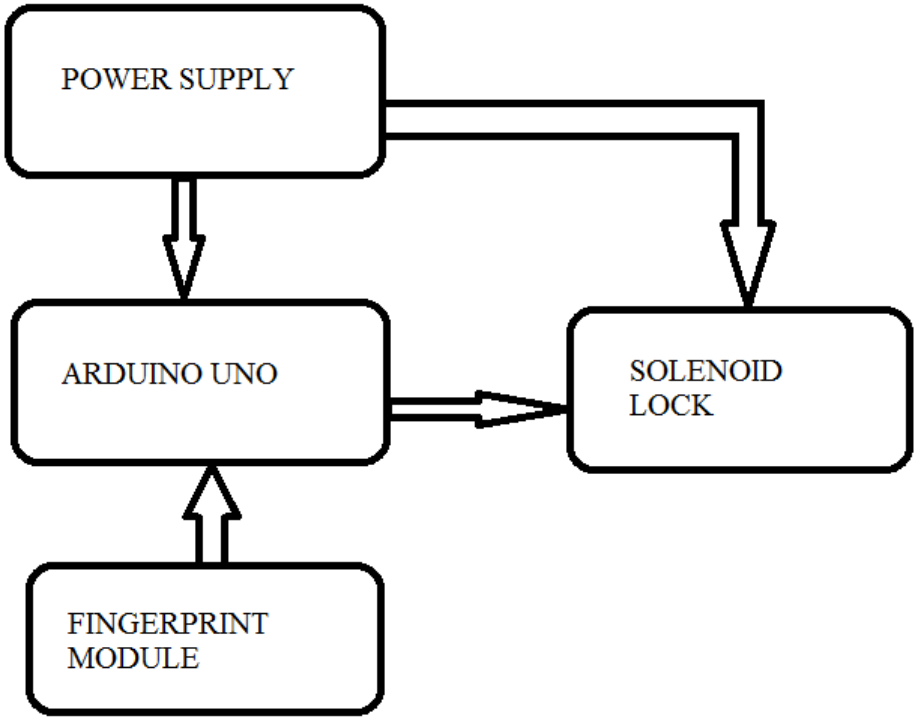

Fig 1: Block Diagram

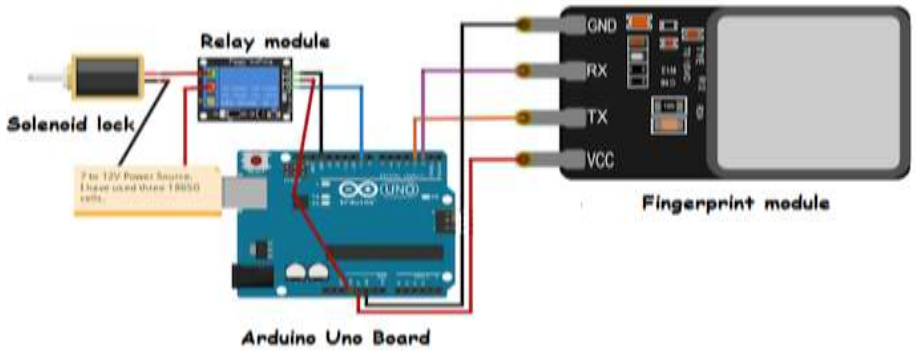

Fig 2: Circuit Diagram

Arduino Uno

The Arduino Uno R3 is an AT Mega 328-based microcontroller board. It contains 14 digital input/output pins, 6 analogue inputs, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It has everything needed to support the ***Fig 2:***

Fig 3: Arduino Board

Microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

One channel Relay Module

The one-channel Relay module is a handy board for controlling high-voltage, high-current loads such motors, solenoid valves, lamps, and AC loads. It's made to work with microcontrollers like Arduino, PLCs, and so on. Screw terminals are used to connect the relay terminals (COM, NO, and NC). It also has an LED that shows the state of the relay.

Fig 4: Relay module

Solenoid Door Lock

A solenoid door lock is a remote door locking machine that uses an electromagnetic solenoid to latch or unlock the door. The actual locking mechanism of a solenoid door lock will, in most situations, be identical to that of a traditional key driven door lock. The low-voltage solenoid in the mechanism, which pulls the latch back into the door when a push button or other controller is engaged, is the only difference between the two.

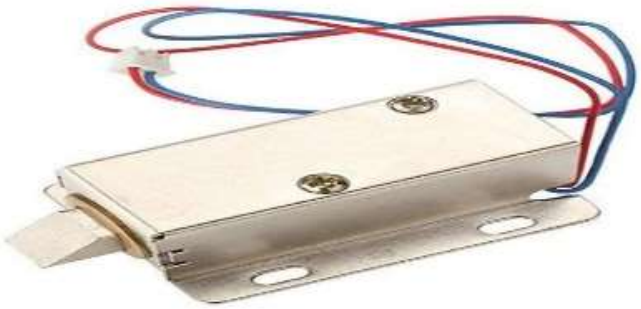

Fig 5: Solenoid Door Lock

The latch will remain in the door for as long as the button is pressed, or forever in the case of a latching solenoid, until the button or controller is pressed again. Remote security access and car doors both employ different sorts of door locks.

Fingerprint Module

This module made fingerprint recognition more accessible and simple to use into a project. This means that collecting, registering, comparing, and searching fingerprints is a breeze.

The module has flash memory for storing fingerprints and can be used with any microcontroller or system that supports TTL serial communication.

Fig 6: Finger Print Module

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It can be integrated into security systems, door locks, time clocks, and other devices.

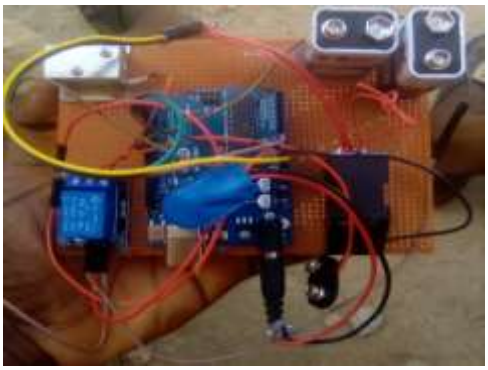

Fig 7: Components layout on Vero board

Fig 8: Casing

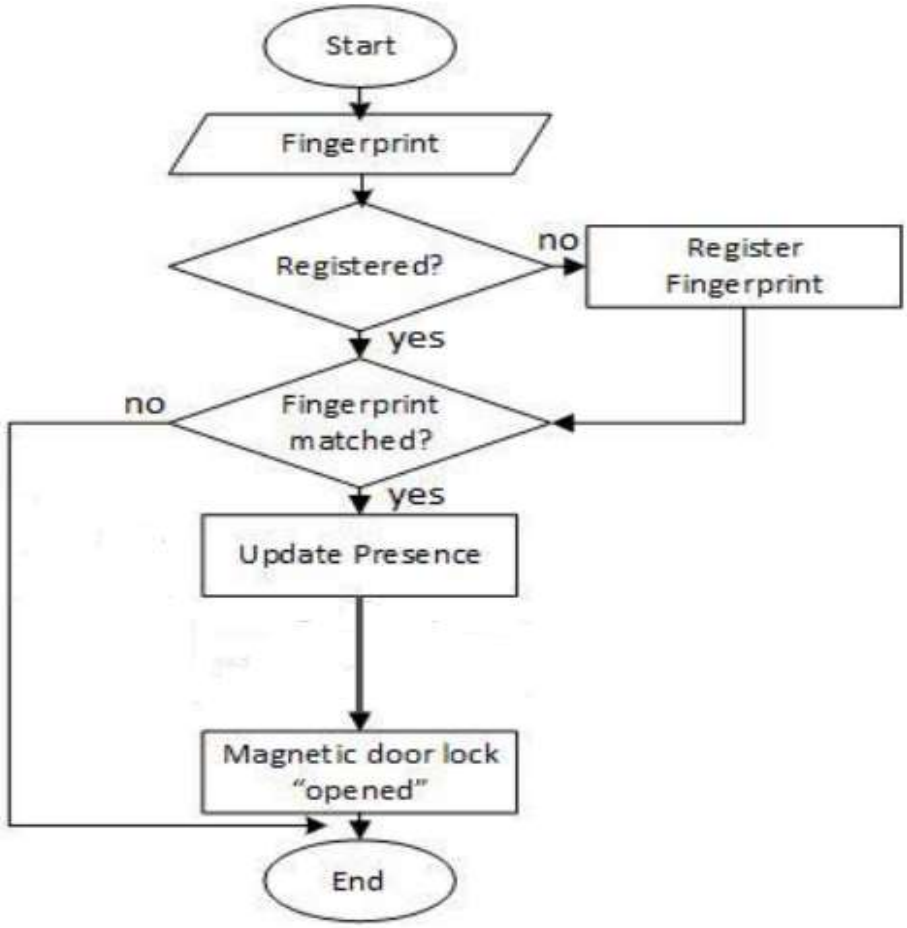

Fig 9: System flow chart

RESULTS AND DISCUSSIONS

The creation of a fingerprint door lock using Arduino is a significant project in terms of improving society's security by limiting access to a certain facility or document to only authorized people or persons. When the system recognizes a fingerprint using the fingerprint module, it automatically grants admission to the building. However, if the fingerprint on the sensor is not detected, access is refused (i.e. the system remains locked).

Sub-system test

S/N	Sub-system	Test Type	Result
1.	Arduino Uno board	Continuity	✓
2.	Battery	Voltage	9volt
3.	Solenoid lock	Functionality	✓
4.	Fingerprint Module	Functionality	✓

After construction, the system was working properly in the sense that when an enrolled user inserts his finger on the fingerprint sensor, it is compared to the predetermined ones. If the finger image matches, the system will automatically unlock for 3 seconds before locking again. However, if the image of the finger does not match, the system will remain locked.

Functionality Test

Input(fingerprint module)	Output (solenoid lock)
No fingerprint	Locked
Matched fingerprint	Unlocked
Fingerprint not matched	Locked

CONCLUSION

The fingerprint-based door lock system can be customized and used in a variety of ways. This door locking mechanism is less expensive than the lock systems now available on the market. Our fingerprint-based lock system has a high accuracy rate and recognizes fingerprints quickly, allowing for seamless interaction with users and increased security. Security is a major concern for both private and government enterprises. Many businesses want to use this form of locking

mechanism, but the systems that are now available are highly expensive to install. Many small businesses are unable to afford such systems due to the high cost.

RECOMMENDATION

More extensive development can improve this concept, and other features such as more locks can be added to the system. As a result, we don't need to spend as much money on a single lock if it can manage multiple doors. It is possible to store prints without using a computer, although this would require more parts than the ones we used. The entire mechanism should be located inside the door panel or on the other side of the door to maintain sufficient security. A battery system or even a solar-powered system might be built. The adaptability of this system is one of its key features. This can be used to implement a variety of other systems.

REFERENCES

Anil K., Jain, J. F. & Nandakumar, K. (2010). *Matching Fingerprints,* IEEE Computer, 43(2), pp. 36-44.

Anil. K. J., Ross, A. & Prabhakar. S. (2004). *An Introduction to Biometric Recognition. IEEE Transactions on Circuits and Systems for Video Technology*, Special Issue on Image and Video Based Biometrics, 14(1), pp 16-23.

Baidya, J., Saha, T. & Palit, R. (2017). *Design and Implementation of a Fingerprint Based lock System for Shared Access,* IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC), pp. 1-6

Fernando L. P. (2002). *Personal authentication through biometric technologies*. IEEE 4th International Workshop on Networked Appliances, Gaithersburg, MD, pp. 57-66.

Mary, L. R. & Khosla, D. (2010) *Fingerprint Identification in Biometric Security Systems*. International Journal of Computer and Electrical Engineering, 2(5), pp 142-150.

Sarma, M., Gogoi, A., Saikia, R. & Bora D. J. (2020). *Fingerprint Based Door lock System Using Arduino*. International Journal of Scientific Research in Engineering and Management (IJSREM), 4(8), pp 32-36.

Wildes, R. P. (1997). *Iris recognition: an emerging biometric technology.* Proceedings of the IEEE, 85(9), pp. 1348-1363.