Password Enabled Door Locking System using Arduino and IoT

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***Abstract*:- In this day and age, security has become of an utmost importance, be it one's house, car or their digital accounts. The solutions currently available in the market are satisfactory but high security solutions come at an expensive price. Hence, an economically feasible security system has become the need of the hour.**

In this paper, we present an electronically controlled door locking system that employs Arduino, an open source microcontroller board that can sense, monitor, store and control applications. This system also employs an IoT based log that monitors the entry and exit of the users.

General Terms:- Embedded System, Automation

Keywords:- Arduino, ESP8266P Module, Solenoid Lock , 4x4 Matrix Keypad Module

1. INTRODUCTION

The password enabled door locking system can be used for households, offices, desk units, etc. The system will check for the validity of the password entered by the user and will unlock only for the authorised users. This system proves to be an optimal solution for preventing the unauthorised entries.

The door lock is a two unit system, where one unit monitors the entry of the user and the other monitors the exit of the user. The number of passwords in practice would depend on the user. Each user gets his/her unique 5-digit password which he/she will use to unlock the door. With different users having different passwords, this enables us to maintain a log of people who have used the door lock. This log will be stored on a document on the cloud. The document will comprise of the name, time of entry and time of exit of the user. This feature helps provide an added security to the door locking system. The door lock also comes equipped with anti – guess mechanism, where the system is blocked after 5 wrong attempts. The system has to be reset in order to re-use the lock.

2. COMPONENTS REQUIRED

2.1 Arduino Mega

Arduino Mega is a microcontroller board based on ATmega2560 manufactured and designed by the company Arduino. This open source development board provides a platform for easily making a digital or analog system. The board comprises of 54 digital input/output pins (including 15 PWM pins), 16 analog input pins, 4 UARTs (hardware serial port) and a 16MHz crystal oscillator among other features. This board's microcontroller can be pre-programmed with a bootloader which would make uploading of the code on the on-chip memory easier.

Fig 1: Arduino Mega based on ATmega2560

2.2 4x4 Matrix Keypad Module

The 4x4 Matrix Keypad module is interfaced to the Arduino Mega to take the input from the user. This input is then matched with the preset password to check the validity of the password. If the password is valid, the door lock will be unlocked. If invalid, the door lock will remain locked. The 4x4 Matrix Keypad Module consists of 4 rows and 4 columns. There is a switch that connects each row and column. The same is shown in the below figure:

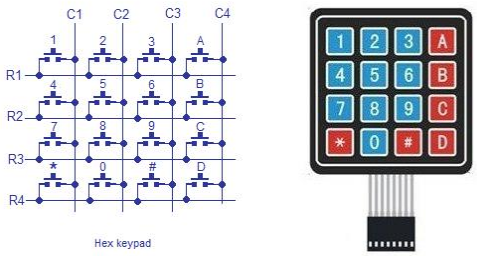

Fig 2: 4x4 Matrix Keypad with schematic

In the Keypad module shown in Fig. 2, we are not going to use all the available keys. We will use only the numeric 0-9 keys along with * and #.

2.3 ESP8266P Module

This module is the wireless module which is used to connect the Arduino mega board to the internet. The Arduino board will act as a web client connected to the cloud to record entries. The ESP8266P module cannot be directly connected to the Arduino, hence, Arduino/USB-to-TTL converter is used.

2.4 Solenoid Lock

Solenoid lock, also known as Actuator Lock, is used for the actual locking. Solenoids are basically electromagnets: they are made of a big coil of copper wire with an armature (a slug of metal) in the middle. When the coil is energized, the slug is pulled into the center of the coil. This makes the solenoid able to pull from one end. This solenoid in particular is nice and strong, and has a slug with a slanted cut and a good mounting bracket. It's basically an electronic lock, designed for a basic cabinet or safe or door. Normally the lock is active so you can't open the door because the solenoid slug is in the way. It does not use any power in this state. When 9-12VDC is applied, the slug pulls in so it doesn't stick out anymore and the door can be opened.

Fig 3: Solenoid Lock

3. ARDUINO IDE SOFTWARE

The Arduino can be programmed using the Arduino IDE. keypad.h header file is added to the library for the functioning of the keypad. The ATmega2560 on the arduino mega can be pre-programmed with a bootloader that allows to upload new code to it without the use of an external hardware programmer. Esp8266 Library has to be added to the list of libraries for using the Wi-Fi module.

4. CIRCUIT DIAGRAM

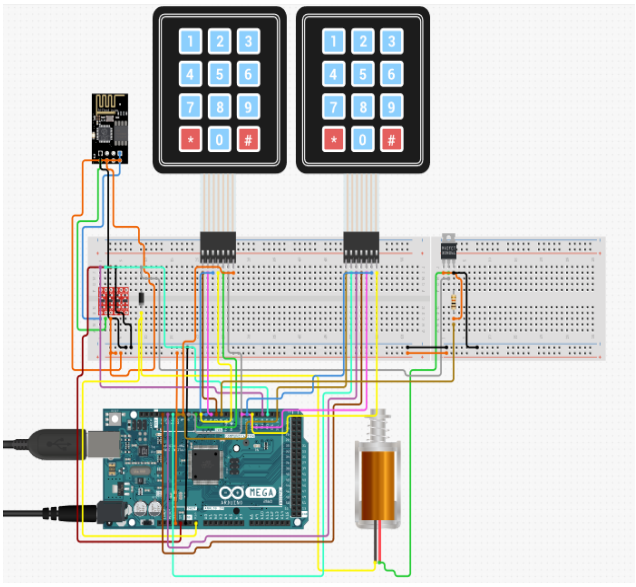

Fig 4: Circuit Diagram

4.1 WORKING

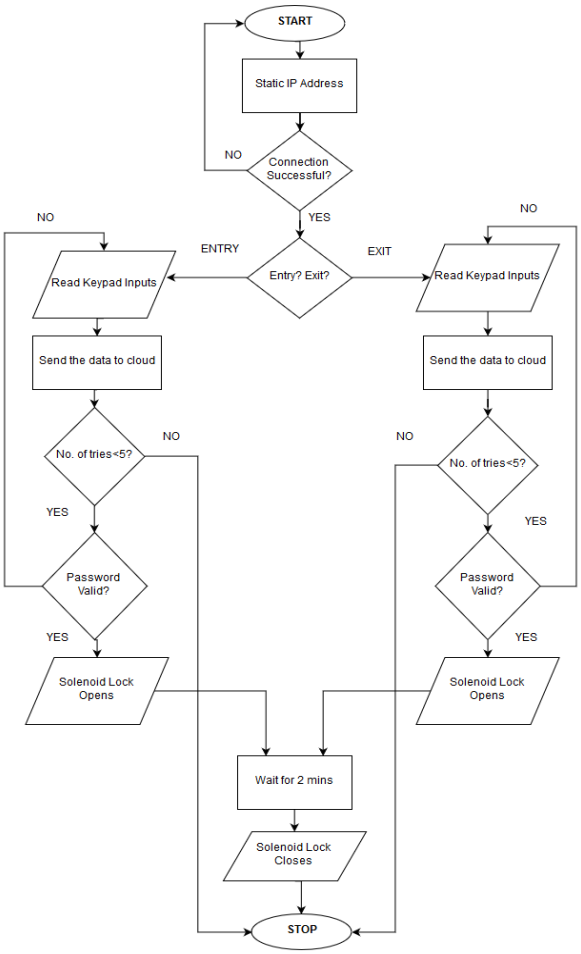

Fig 5: Flowchart of the operation of door lock mechanism

First, the Wi-Fi Module sets up the connection. Following which the user enters the his/her 5-digit password into the 4x4 matrix keypad. Typically, the keypad will have eight connection wires through resistors R1, R2, R3 R4 and C1,C2,C3,C4 representing the rows and columns respectively. The matrix encoding scheme requires fewer output pins and thus fewer connection that have to be made for the keypad to work. Since, each user have unique password, we determine which user has accessed the door lock and send this data to the cloud. The password is matched with the preset password. If it is a match, The solenoid lock is actuated, and the door lock opens. For a default value, the door lock stays open for 2 mins after the lock has been opened, after which the solenoid coiled is de-energised and the door is locked. The same operation is shown in the flowchart below.

For additional security, anti-guess element is present i.e. after 4 wrong attempts, the system is blocked and has to be reset for further use. The reset button would only be known to the primary user.

5. CONCLUSION

The above model of password enabled door locking system has designed and tested. The outcomes of the model was as per the expectation. This system can prove to be a cheaper alternative for the expensive door locking system that use retina scan, iris scan and fingerprint scan. The future work for this project involves arranging the controller and its peripherals in a compact setup as well as adding a biometric scanner in place of the keypad.

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