DIGITAL DOOR LOCKING SYSTEM

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Introduction:

The main idea of designing the password based locking system is to provide many modern security features than mechanical lock. It comprises a small electronic unit which is in fixed at the entry door to control with the help of a solenoid lock, when an authorized person enters predetermined user password via the infra red remote keypad, the lock is operated for a limited time to unlatch the lock so the door can be open. At the end of preset delay time, the lock is operated in reverse direction and the door gets locked again. When the password has been incorrectly entered three times in a row, the code lock will switch to block mode, this function thwarts any attempt by hackers to quickly try a large number of passwords in a sequence.

The project intends to interface the microcontroller with the solenoid lock and start/stop the lock by sending the predefined messages from the controlling unit. The software application and the hardware implementation help the microcontroller read the messages sent by the user from the remote and accordingly change the status of the lock required. The measure of efficiency is based on how fast the micro controller can detect the incoming message and act accordingly. The system is totally designed using IR remote and embedded systems technology. The controlling unit has an application program to allow the microcontroller read the incoming data through the remote and control the lock as per the requirement. The performance of the design is maintained by the controlling unit. This project uses Arduino Uno as the central processing unit. Specifically the prototype make use of Arduino Uno with programs written in embedded language burnt inside the controller which is used to write the interfacing program and compiled with Arduino IDE software which work perfectly with windows environment. The Global System for Mobile (GSM) technology has not been used here which accounts for increasing the cost of the project.

Objectives:
The main objectives of the project are listed as follows:
1. To design a low cost digital door lock.
2. To prevent or reduce theft attempts.
3. To provide security using a resettable password based locking system.
4. To help handicapped person to open the door using remote.
Methodology:

The main idea of designing the password based locking system is to provide many modern security features than mechanical lock. It comprises a small electronic unit which is fixed at the entry door to control a solenoid-operated lock. When an authorized person enters predetermined user password via IR remote keypad, the solenoid-operated lock will be unlatched so the door can be open. At the end of preset delay time, the solenoid latch will again move in opposite direction and the door gets locked again. When the password has been incorrectly entered three times in a row, the code lock will switch to block mode, this function thwarts any attempt by hackers to quickly try a large number of passwords in a sequence.

The project intends to interface the microcontroller with the solenoid lock and start/stop the solenoid by sending the predefined messages from the controlling unit. The software application and the hardware implementation help the microcontroller read the messages sent by the user from the remote and accordingly change the status of the solenoid required. The measure of efficiency is based on how fast the microcontroller can detect the incoming message and act accordingly. The system is totally designed using IR remote and embedded systems technology. The controlling unit has an application program to allow the microcontroller read the incoming data through the remote as per the requirement. The performance of the design is maintained by the controlling unit.

Design and Implementation:

This work proposes a digital door locking system using IR technology. The project uses very simple components and hardware circuits which are easy to design. The design consists of two sections i.e, Transmitter section and receiver section.

Transmitter:

There are two types of IR communication. i) Point-to-Point: It requires a line of sight between the transmitter and a receiver. That is the transmitter and the receiver should be pointed to each other and there shouldn’t be any obstacles between them. Example: Remote control communication. ii) Diffuse Point: In this communication, it doesn’t require any line of sight and the link between the transmitter and the receiver is maintained by reflecting or bouncing of the transmitted signal by surfaces like ceilings, roof, etc. Example: Wireless LAN communication system. In the present work point-to-point communication is considered. The remote acting as an IR transmitter consists of a 4×3 keypad, a microcontroller and an IR LED. The purpose of remote is to enter the password for unlocking the solenoid lock at the receiver end. The internal blocks and circuit diagram of remote in digital door locking system is shown in figure 1a and 1b respectively.

![Figure 1a](image1a.png)  Remote of digital door locking system  
![Figure 1b](image1b.png)  Circuit diagram of remote controller
Receiver:

The IR receiver consists of a IR photo detector, 4×4 keypad, microcontroller, solenoid lock and a LCD. The block diagram and circuit diagram of IR receiver of digital door locking system is shown in figure 2a and 2b respectively.

![Block Diagram](image1)

**Figure 2a:** IR receiver of digital door locking system

The IR receiver is a photo detector that is sensitive to light and it filters other light frequencies except IR light. The photo detector develops an output electrical signal as light is incident on it. The output of the detector is filtered using a narrow band filter that discards all the frequencies below or above the 38 KHz carrier frequency. In TSOP1838 IR receiver a PIN diode and a preamplifier are assembled on a lead frame while the epoxy package acts as an IR filter. The demodulated output signal from IR filter is decoded by the microcontroller. If the password received or entered is authenticated then the door is unlocked through solenoid else the information is displayed on LCD "IR PWD mismatch", if incorrect password is received or entered three times then the receiver enters into sleep mode. The receiver also has flexibility in changing the password if the password is stolen or shared.

The Design Flow Chart:

Using Arduino 1.6.6 IDE and embedded C, the program has been written. The program is uploaded into microcontroller from personal computer through Universal Serial Bus (USB) cable.

![Flowchart](image2)

**Figure 3:** Flowchart for the proposed system
The flowchart for the project implemented is shown in figure 3. The first step is to initialize the counter to zero. This counter corresponds to the number of times the password to be entered to gain access to the door. Once the counter is set, four digit password is sent through the IR remote. The IR receiver receives the transmitted password. If the received password is correct, door is unlocked else count is incremented by one. If the count is not equal to three, password can be re-entered again else if count is equal to three, the system enters into sleep mode for 30 seconds then the count will be re-initialized to zero. Here 30 seconds time is considered for demonstration purpose. This time can be as long as possible or reprogrammed by the designer.

**Prototype:**

Using the IR technology and Arduino Uno microcontroller concept the final working prototype was developed. The following figure 4 and figure 5 shows the prototype model of IR receiver and IR remote of digital door locking system.

![Figure 4: IR receiver of digital door locking system](image1)

![Figure 5: IR remote of digital door locking system](image2)

**Conclusion:**

The following conclusions are drawn from the work carried out:

1. The purpose of this proposed system is to build a low cost digital door lock operated by an IR remote controller.
2. This system can be used in the places where security is required to prevent theft attempt.
3. This system provides option for resetting of password which helps user to change the password whenever required.
4. System can be operated by handicapped person to open door from distance under 10ft.
5. It can be used in the lockers and other protective doors.
Future Scope:
This prototype developed can be further enhanced in future by following ways:

1. Incase password being forgotten, GSM based technology can be used to send One Time Password (OTP) to the authorized person or fingerprint based system can be used. This technology has not been implemented in the present case looking into cost consideration.

2. A rechargeable battery can be used in place of 9V battery in the IR remote which eliminates the need of replacing battery frequently.

3. Designing a DC supply at the receiver to switch from AC supply during mains failure.

4. For giving more security to the system, encryption can be implemented in data transmission so that password hacking cannot be done easily.