

Keypad/Bluetooth/GSM Based Digital Door Lock Security System

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Abstract. This paper discusses the design and implementations of an electronic door lock/unlock compact system using the arduino platform. These security systems enable to lock/unlock the door using three different modes i.e. Keypad, Bluetooth and Global System for Mobile (GSM) modules. These three modules operate on a 4-digit password. We can open or close the door by using keypad, bluetooth application from smart phone and also by using 4 digit message from GSM phone. If any unknown person does the three consecutive unsuccessful attempts to enter the password in any one of the system, then arduino controller will send a warning message to preset owner GSM mobile number and also initiate the buzzer alarm as a warning of unauthorized intrusion. We have got the good experimental results and promising analysis in all these three modules.

Keywords: Arduino, Servo motor, 16x2 LCD display, Keypad, Bluetooth, GSM module.

1 Introduction

In 2011 the study report by National Crime Records Bureau (NCRB) [1], 58862 burglary cases was registered in India. According to the study by Alarm Industry Research and Educational Foundation (AIREF) [7], thief spends less than 60 seconds for breaking the normal door lock. The report of “Home Safety Fast Facts” conducted by the Electronic Security Association’s (ESA) [6] concludes that 9 out of 10 burglars avoid homes which are having door alarm security system. These facts have encouraged the development of numerous security systems for both residential and commercial applications.

Today it is essential to provide the security system employing various sensors and alarm system in residential communities. Mallory Jone [5] implemented a security alarm system that has a number of sensors for smoke, fire, intrusion and application operation. A central monitoring system was provided for continues indication of sensors. Transmitters were connected with sensors and receivers were connected with monitoring system for effective communication. The central monitor then display the indication with respect to each transmitter connected with particular sensor. Pratiksha [3], described a home security system with the GSM/GPRD technology services to achieve controlling of door lock by short message service (SMS). Also Adnan Ibrahim discussed the design and development of PIC supported security system with the GSM system for sending the alert message on mobile for continues three unsuccessful attempts of password [2]. Another system was proposed by Ushie [4], in which door can be remotely controlled by a GSM phone set like a transmitter and another GSM phone set with a dual tone multi frequency (DTMF) connected to the door motor with DTMF decoder interfaced with microcontroller chip.

At present time door security is the most important and so we designed and implemented a digital door lock system which works in three different modules. From the keypad module we can directly enter the 4 digit password to lock and unlock the door. In bluetooth module, first we establish connection between our smart phone and door lock system bluetooth kit, then enter the password to lock/unlock door. Bluetooth module range is approximately 10 meters. GSM module is the most secured mode in which the owner has to enter the password through his mobile via text message to open or close the lock. The main advantage of GSM module is that it enables user to lock/unlock the door from remote location. The main advanced feature in all three modules is that if unknown person enters three consecutive wrong passwords, it will send an alert message on GSM mobile number of the owner which is stored in arduino program and also start the buzzer alarm for security alert of the society.

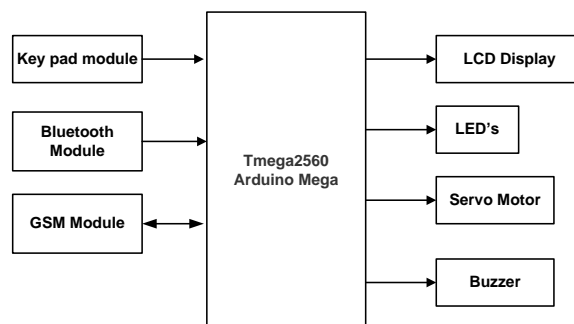


Fig.1. Block Diagram

2 Components

2.1 Keypad

We used a 4x4 keypad which has four columns and four rows which are connected to Arduino board. The password will be passed from keypad to the Arduino and Arduino will respond accordingly.

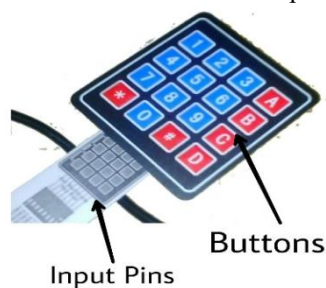


Fig. 2. Keypad

2.2 Bluetooth Module HC-05

Bluetooth module is used for wireless transmission. Its range is 10 meters. This module is based on Cambridge silicon radio BC417 2.4Ghz bluetooth chip. It is a complex chip which uses an external 8 bit flash memory. It is a small module which works on very less power that is 3.3V. It has transmitter (Tx) and receiver (Rx) pins which are used for the transmission of data. The Tx of the module is connected to the Rx of the Arduino and Rx of the module is connected to the Tx of arduino.

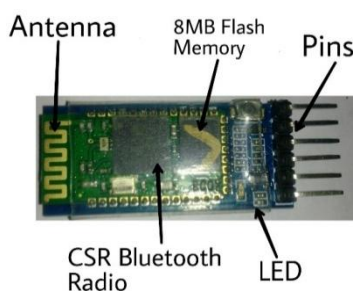


Fig. 3. Bluetooth Module HC-05

2.3 Arduino

Arduino is an open source platform used for building electronics project. Arduino is often referred as a micro-controller. Different types of Arduino and Microcontroller boards are available, we preferred the two different Arduino boards and its specifications are as follows:

- ATmega328 Boards : 32kB Program Space, 1 UART, 6 PWM, 4-8 Analog Inputs, 9-14 Digital I/O ports.

2.5 Servo motor

The servo motor operates the door lock key to open or close the door lock. The torque and the speed of the motor depend upon the power supply. We are giving the power supply through the adaptor. It has a torque of 9 kg/cm and speed of 0.2 sec/60°. On servo motor blades we have attached two small metal strips, between this two metal strips we attached the key of our lock. The key with servo motor is fixed at inside of the door lock. The key of motor rotates clock wise and anti clock wise as per the command given by arduino controller to open and close the door. To open the lock we provide the password 1234 and to close the lock 4321 from all three modules.



Fig. 7. Servo Motor

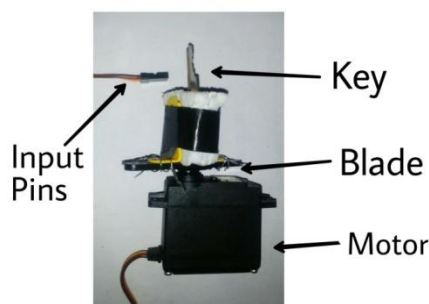


Fig.8. Servo Motor Mechanism with Key

2.6 16x2 LCD display

We have used 16x2 liquid crystal display (LCD) for displaying the process, like entering the password, wrong password detection. When Bluetooth module is connected with the GSM mobile bluetooth then the message appears on the screen.



16x2 LCD Display

Fig. 9. LCD Display

2.7 GSM SIM300

It is a plug and play GSM Modem kit with a serial interface which is used to send SMS. The other GSM operations are done by controlling it through simple programming commands from arduino controller and computers. It comes with a standard RS232 interface which can be connected to interface of the arduino controller and computers. The modem consists of all the external circuitry required to start experimenting with the SIM300 kit like the power regulation, external antenna, GSM SIM Holder, etc.

Features of GSM SIM300 are:

- Provides the industry standard serial RS232 interface for easy connection to computers and other devices.
- Provides serial Transistor Transistor Logic (TTL) interface for easy and direct interface to microcontroller and arduino controller.
- Onboard 3V Lithium Battery holder with appropriate circuitry for providing backup for the modules.
- Can be used for GSM based Voice communications, Data/Fax, SMS, General Packet Radio Service (GPRS) and Transmission Control Protocol/Internet Protocol (TCP/IP) stack.
- Comes with an onboard wire antenna for better signal reception.
- The SIM300 allows an adjustable serial baud rate from 1200 to 115200 bps (9600 default).
- Modem a low power consumption of 0.25A during normal operations and around 1A during transmission.
- Operating Voltage: 7 – 15V AC or DC

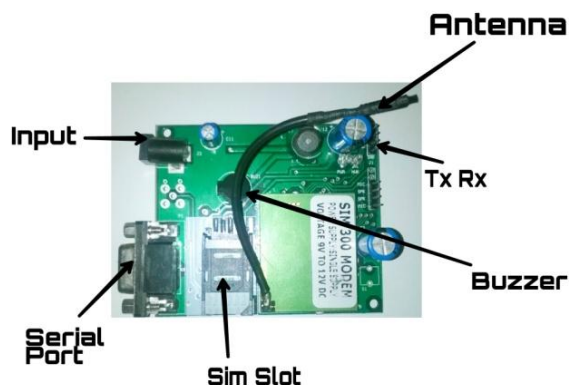


Fig. 10. GSM SIM300 Module

3 Working of Door Lock system

3.1 Keypad Module

In keypad module we have attached GSM module to TX RX pin of the Arduino kit. We have also attached servo motor, keypad and LCD to the arduino kit. The password for this module is given from keypad which is verified by the Arduino programme and if it gets the correct input from the keypad then it will rotate the servo motor to open or close the door lock. We have kept two codes that is one for locking and another is for unlocking. Also a LCD displays the current status of the system for every execution of command.

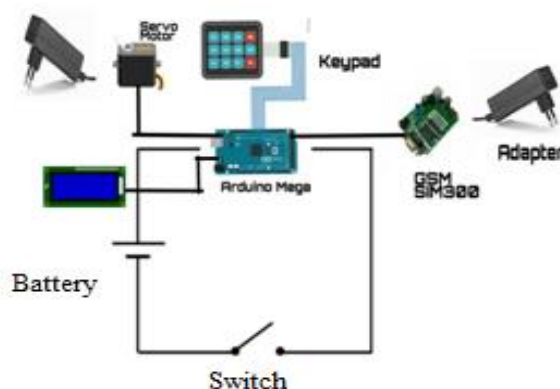


Fig. 11. Connection Diagram of Keypad Module

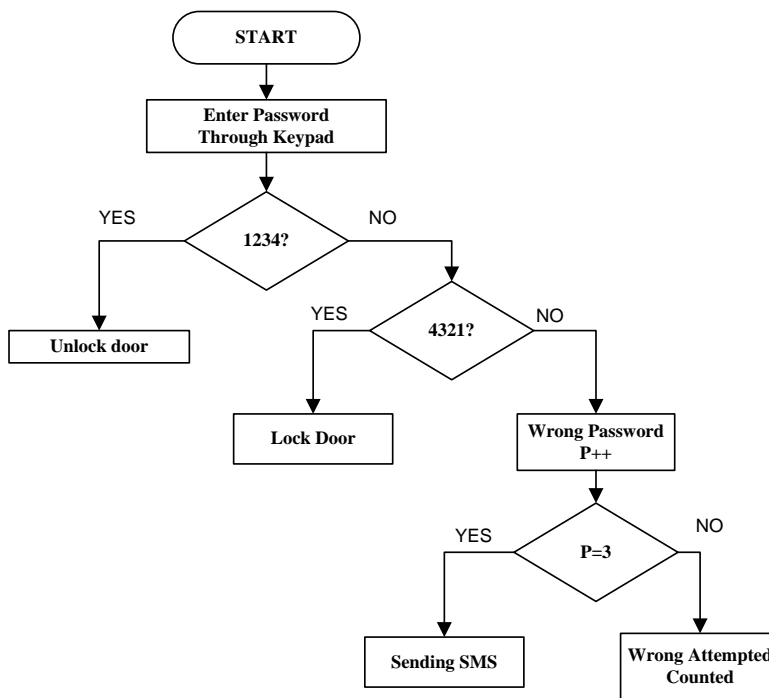


Fig. 12. Flowchart for Keypad Module

3.2 Bluetooth Module

The smart phone bluetooth application is used to lock/unlock the door lock in bluetooth module, which has a range of approximately 10m. Bluetooth HC-05 device is connected with the arduino kit. To open and close the door lock first we establish connection between smart phone bluetooth with arduino controller bluetooth device. As the connection has been done between these two bluetooth devices LCD show that connection is done. Then we enter the password from our smart phone to open or close the door lock.

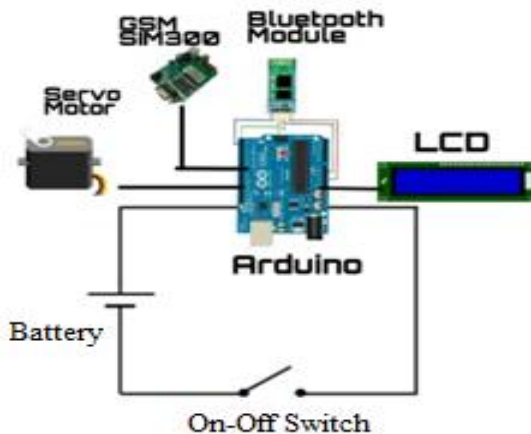


Fig. 13. Connection Diagram of Bluetooth Module

3.3 GSM Module

It is most secured and most suitable module in all three modules. In which we can open and closed the door lock using GSM mobile SMS. We can store the owner multiple GSM numbers in the arduino program. The owner sends the text message from the GSM mobile to the GSM kit connected with the arduino controller, then the arduino controller give the command to servo motor to open or close the door lock as per the password given. If the password detected from unknown number for three consecutive attempts, then the arduino controller starts the buzzer and also send a warning message of false entry at the door to the owner mobile number. As this system work with the GSM network the owner can send or receive the message at remote location

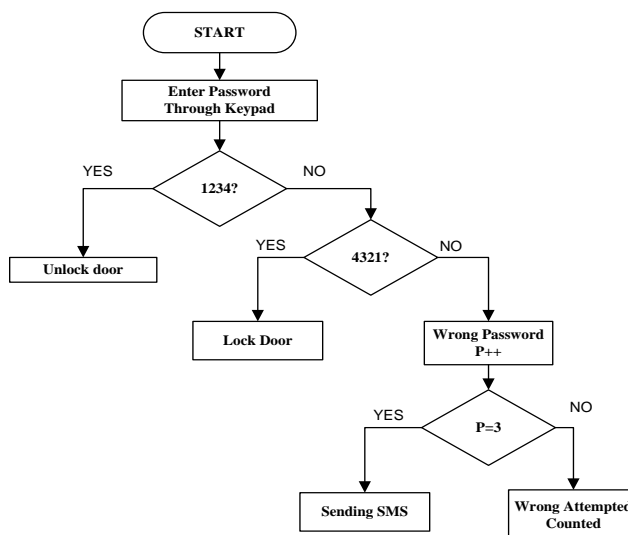


Fig.14. Flowchart for Bluetooth Module

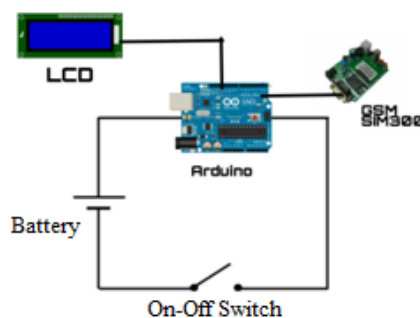


Fig. 15. Connection Diagram of GSM Module

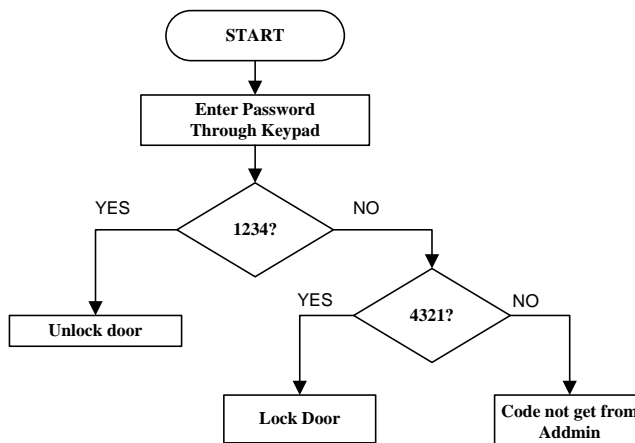


Fig.16. Flowchart for GSM Model

4 Results

For all three modules i.e. keypad, bluetooth and GSM we successfully operate the servo motor to open and close the door lock. If known person attempts the three consecutive wrong password then the digital door lock system generate an alert message to GSM mobile number and also start the buzzer alarm for security alert. Figure 18 show the screen shot of alert message received on owner GSM mobile number for consecutive three wrong password entry done and bluetooth application screenshot is shown in figure 17.

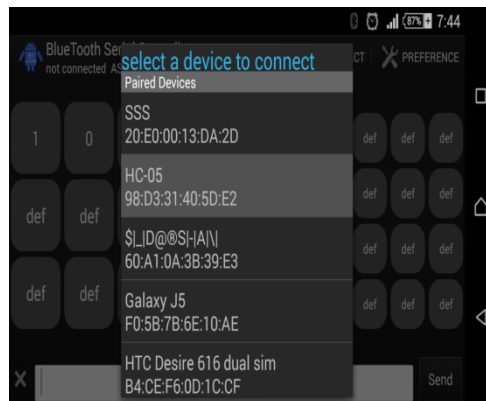


Fig. 17. Bluetooth application screenshot



Fig. 18. Alert message in owner mobile phone.

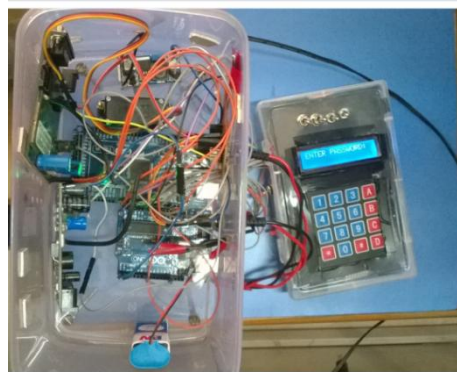


Fig. 19 Complete Setup of Door Lock Security System

5 Conclusion

The prototype of the Keypad/bluetooth/GSM Based Digital Door Lock Security System was designed and implemented successfully. All modules provide security alert with buzzer alarm and SMS facility to the owner, so it is very useful to avoid the unwanted entry from our premises. We have practically demonstrated all three modules in our lab and all are working properly. Our future work is to operate the door lock security system by face detection method which will be much more secured.

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