



IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY



VOLUME : 4 ISSUE : 12 Print / Issue Publication Date: 10-Jun-2020



ISSN : 2455-2143



DOI : 10.33564/IJEAST.2020.v04i12.010

Indexed In



WWW.IJEAST.COM

editor@ijeast.com



DEVELOPMENT OF A PROTOTYPE RFID-GSM BASED LOCK SYSTEM

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Abstract: One of the major challenges faced all over the world is insecurity. Loss of life and property arises from bridge of restriction to certain area has become a daily routine. Several efforts to prevent unwanted access which ranges from key lock system to intelligent lock system do have various degrees of limitations. This paper present the development of prototype of such security device which combine the security feature in radio frequency identification (RFID) system, global system for mobile communication (GSM) and password. The system identifies a person by its tag, authenticate by sending generated 4-digit code to its mobile phone and confirmed the true user if the correct code are entered. The circuit was designed and simulated using Proteus and Micro C software. the prototype of the lock system was developed and its worked satisfactorily.

Keyword: Insecurity, Intelligent Lock System, RFID, GSM, Risk Assessment

I. INTRODUCTION

The high rate of insecurity has become a major concern worldwide. These necessitate the design of a low cost electronic security system in co-ordination with other security measures. In real life, security system plays an important role by preventing unauthorized users into a secured place. Radio frequency identification (RFID) system is a technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label, attached to an object, to a reader for the purpose of identifying and tracking the object. There are over billions of people who own mobile phones around the world with current wireless technologies, like Wi-Fi and Bluetooth. Mobile phones have the ability to interact with other devices to execute data exchange and access control. For example exchanging text message, business personal cards, and controlling appliances like air conditioner and TV sets.

Currently, a new short-range technology is introduced in mobile phones called Near Field Communication (NFC) [1]. These technologies (RFID and GSM) have good security features

Over the centuries, access control systems were put in place to prevent access to unauthorized persons. They are called locks on doors [2]. First step towards security was Lock and key system. Security protocol followed in this system was “Single key for a single lock”. Initially, this system was considered to provide utmost security. But this belief was soon proved wrong by the fact that multiple keys can be easily made for a single lock [3]. Vehicles follow the same trends where early modern vehicle uses non-electronic key in order to restrict open and start access. If the key matches, the vehicle user is able to turn it and is thereby authorized to start and drive the vehicle. This kind of security mechanism does provide some protection against theft, but can quite easily be exploited by duplication of keys [1]. Electromagnetic lock was considered to be the best option. But it has common disadvantages such as low break-in force, and requires continuous power supply in order to maintain the locked state, higher power consumption and limited life of the back-up battery. Power supply failure may drain the back-up battery due to the necessity of providing continuous supply of electrical energy to maintain the locked state of the door. Solenoid now becomes preferable instrument for automatic door locking as they can save energy up to 50 percent or more [4], though with limitations. These aforementioned limitations and challenges necessitate the need for a lock system to possess some level of intelligent and automation.

From the survey of related works, [2] Designed a Security Lock system using Pass code and smart card. [5- 8] designed a security lock system using the RFID-based technology. [9-11] design and develop Implemented biometric-based lock system. [12] Developed an anti-theft door system for security room through controlling the "Time Zone". [13] Proposed a two wheeler vehicle security system in



which the handle lock is operated by servo motor and controlled by the Remote Keyless System (RKS). [14] Designed security door that opened by pressing the keys of the assigned codes on the mobile phone, or by entering the corresponding code in a computer set interfaced with the system. [15] Developed a programmable electronic digital code lock system. [16-19] designed a GSM-based security system. [20] proposed a car security system that can add various images to database and with the help of face recognition technology. [21] Designed and implemented a Microcontroller based security system for home and office devices. It uses an Electronic Keypad arranged to send signals to the control unit.

Considering the current global security environment, the importance of good physical security is imperative. Initially, normal key locking was the security locks used to restrict entrance, but were hacked by unwanted people by either duplication of key or physical means. There were several automatic identification technologies including barcode, magnetic stripe and Radio-frequency identification (RFID) system that were applied in security system, though with limitations. With technological advancement, electronic automatic identification systems with varying degree of security feature were deployed to restrict entrance.

This paper presents the development of a prototype RFID-GSM Based security Lock System by presenting the concept of lock system. The development of the basic component to achieve the prototype will also be presented. The experimentation of the device before achieving the desired device will also be presented (in plates) and discussed. The result which was the prototype of the device will be presented (in plates) in sequential order.

II. RFID-GSM BASED LOCK SYSTEM

An RFID-GSM Based Lock System was developed to address some of this limitation. The lock system is a multiprotocol security device that combined the security feature of RFID, GSM and password. The working principle of this device is illustrated by flow chart in Figure 1.

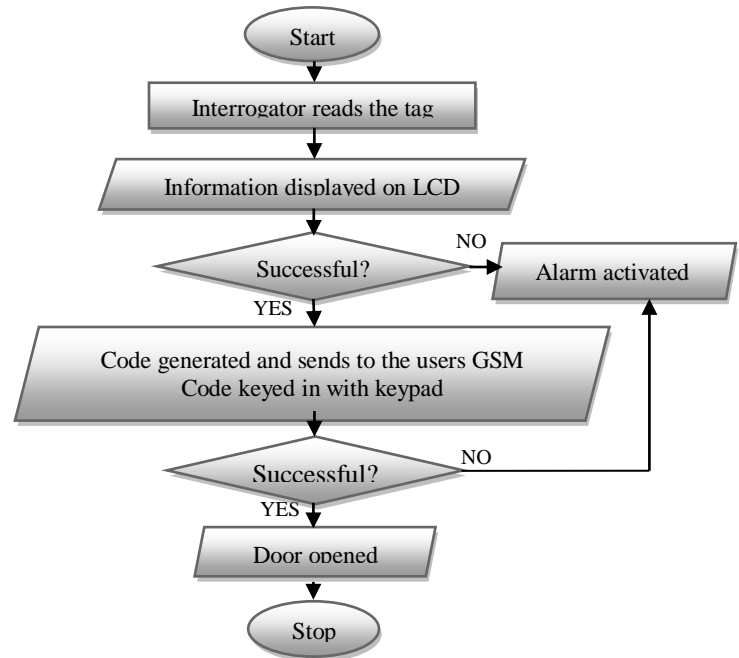


Figure 1: Flow Chart Illustrating Working Principle

One of the most critical aspects of a truly intelligent system is the ability to learn, that is, to improve its own functionality by interacting with the environment and exploring it [22]. A standard intelligent lock system must have the following basic features: (i) Provides environmental monitoring, access control and management system. (ii) Prevents unauthorized access. (iii) Allows doors to be opened using a proximity card, keypad or via a web interface. (iv) Accommodates sensors to monitor temperature, humidity, smoke, presence of water or liquids, etc. (v) automatically generates an audio alert. (vi) Records all the security information you need every time the door opened – who, where and when [23].

III. DEVELOPMENT OF THE LOCK SYSTEM

The development of the lock system was achieved by development of the component parts such as the microcontroller system, the printed circuit board (PCB), the RFID system, the GSM system, the keypad and the mechanical system which will be discussed in the section

3.1 Development of Microcontroller System.

The unit is implemented using a PIC microcontroller (PIC 16f877a) and some complimentary components whose choices are based

on specifications by the manufacturer on the data sheet. These components include a crystal oscillator of rating 8 MHz, a 10k Ω pull-up resistor and two stabilizing capacitors. In application where great time precision is not necessary, RC oscillator offer additional savings during purchase. Resonant frequency of RC oscillator depends on supply voltage rate, resistance R, capacitance C and working temperature [24].

The program is loaded into the microcontroller through RB6, RB7 and MCLR corresponding to pin 39, 40 and 1 respectively as shown in Figure 2. The programmer (pic-kit3) is the interface between the computer system (connected using USB) and the microcontroller. Once the program is written and is build to debug any error, the RUN icon in the mikro C window is clicked and the program is loaded into the microcontroller.

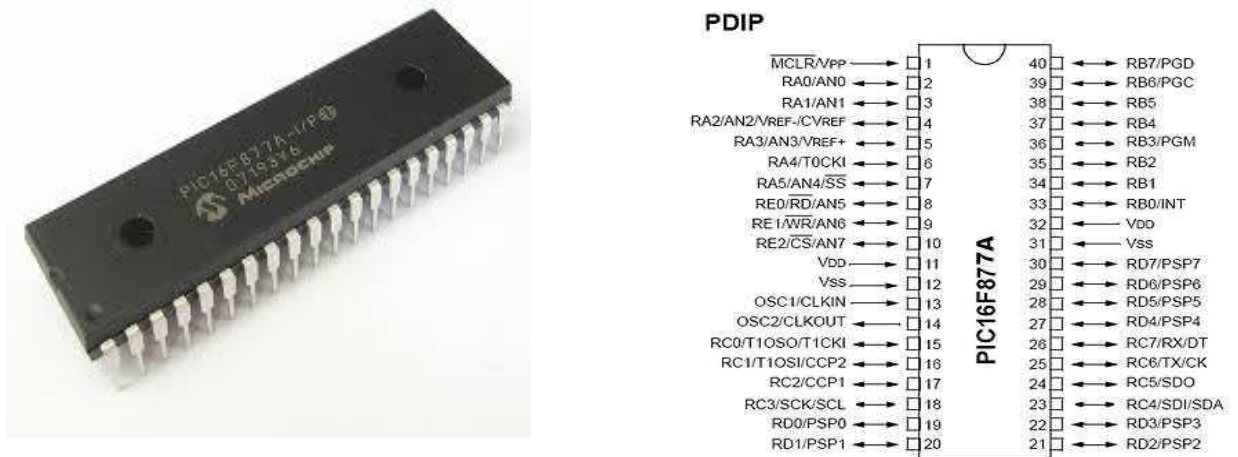


Figure 2: Diagram of Microcontroller [25]

3.2 Development of Printed circuit Board (PCB).

The circuit was designed using Proteus software, the printed circuit board (PCB) layout was simulated to ascertain the possible arrangement of the component. Several adjustments were made so that

terminal socket are closer to the edge and some are made to be as free as possible. As shown in plate 1, the LCD terminal socket (extreme right) was at the edge and other terminal sockets were made free for connection.

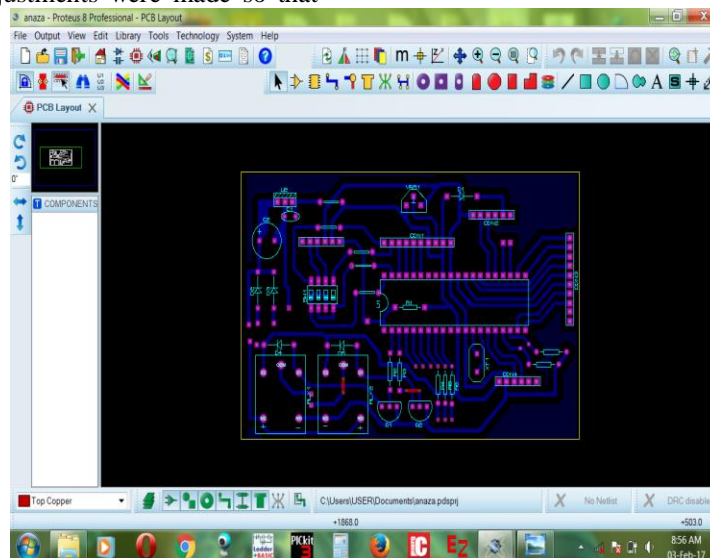


Plate 1: screenshot of PCB Layout (wiring)

Adjustment were also made on the position of the relays to be at edge to give access to the connection to the motor as shown (plate 2) in the 3D solid view. Form the view, necessary dimension of

the board was obtained for planning of parts assembling. Necessary adjustments were made to accommodate fastening of the board to the casing. The simulation result of solid view was satisfactory as shown in plate 2.

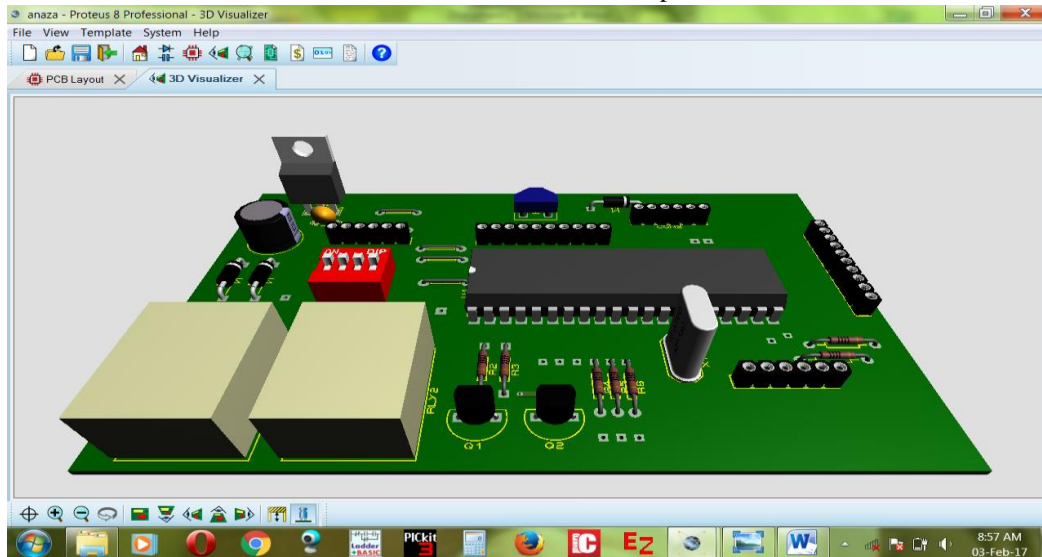


Plate 2: solid view of the circuit

The PCB layout was printed on a transparent material. The circuit was transferred to the copper clad by placing the circuit printed on transparent on the copper clad. Pressing iron regulated to temperature of about 75⁰C was then moved over it to transfer the ink to the clad. Cold water was poured over it to lower the temperature and the transparent material was removed gently.

Ferric chloride (FeCl₂) was diluted to prepare a solution of FeCl₂. FeCl₂ was the chemical used to etch out unwanted parts (not covered with ink). Copper clad containing the printed circuit was gently immersed inside the solution. It was monitored for about 10 to 15 minutes to ascertain the level of etching. The copper clad was removed and washed inside water; hence the printed circuit board (PCB) was obtained. Holes were drilled at the mounting places of the component with the aid of drilling machine.

3.3 Development of Passive Component, RFID, GSM and Keypad System

During the developmental stage of the device, provisions were made on the PCB to accommodate the female sockets. Abiding by the pin out configuration, adequate female socketS were made on the board, male socket to an ends of optical cord and the other ends to RFID reader, the GSM module and the Keypad system respectively. The

connecting cords were made dismantable using sockets for flexibility and ease in troubleshooting. The components were neatly arranged on the board and soldered.

3.4 Developments of Casing and the Mechanical System

During the construction of the casing the dimension of the board, the RFID reader, the keypad, the GSM module etc were the basic factor considered in casing dimension and openings. The RFID reader, the keypad are arranged to be on the front of the device (prototype). Provision for reset switches was made on the front. An opening was also created where a prototype of the door will be placed.

The door (mechanical system) was also positioned in the front which is a combination of pulley, gear system, plates of plastic material, and a DC motor. The DC motor is activated by a signal from the microcontroller. it can rotate in both forward and reversed direction with the aid of relays which direct the flow of current to achieve any desired rotation.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

Testing of the device begin by testing the code generating capability of the microcontroller.

The microcontroller was programmed to display any code generated on the LCD to check the code generation routine. As shown in Plate 3, in which

2740 was the code generated and it was displayed as programmed. The testing result was satisfactory.



Plate 3: Testing of Code Generation

Testing of the response of the device if a right code was entered was also carried out. As shown in Plate 4, the microcontroller was programmed to display both generated and entered

codes. The generated code was 8279, the code was entered and DC motor was actuated which symbolize the opening of the door. It was successful.



Plate 4: Entering of Right Code in Progress

Testing the response of the device if a wrong code was entered was also carried out. The microcontroller programmed to display both generated and entered codes. The generated code

was 2740, a different code was 4441 was entered as shown in Plate 5, the alarming mechanism was actuated. The result of the testing was satisfactory.



Plate 5: Entering of Wrong Code

One of the drawbacks of this device is its reliability on GSM network provider for its operation. There are possibilities that in this device, the GSM module may delay to send the generated codes due to network failure or not sending at all. To

localize the fault (due to network failure) if generated code are not received, the microcontroller was programmed to turn ON an LED if the command has been given to the GSM module. It was tested as shown in Plate 6 and the result was satisfactory.



Plate 6: The LED Turned ON

The prototype of the security lock system works satisfactorily, Plates of completed working prototype

are shown in Plates 7.



Plates 7: Prototype of the Lock System

V. CONCLUSION

In this paper, development of a Prototype RFID-GSM Based Lock System was presented. The methodology involve in achieving this security device was also discussed using flow chart. During

the construction of the prototype, code generation, matching of codes and testing of execution of SMS command were conducted and it was successful. Plates of the prototype of the lock system were presented and discussed. It is impossible to guarantee absolute security, identifying the threats and



assessing the risks of this system are vital steps toward improving security.

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