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DESIGN OF A LOCK SYSTEM USING RFID AND GSM TECHNOLOGY

Anaza S. O
Dept.of Research & Development
PEEMADI Okene Kogi, Nigeria

JiyaJ. D., HarunaY. S.
Dept. of Elect/Elect Engineering
Abubakar Tafawa Balewa university, Bauchi, Nigeria

***Abstract*-Security is a key factor to the development of any nation, yet it is a one major challenges faced all over the world. Several measures which ranges from key lock system to a highly intelligent lock system employed to restrict unwanted person to certain areas do have some level of limitations. This paper present the design of security lock using Radio frequency Identification (RFID) system and Global system for Mobile (GSM) communication technology aimed to address some of this limitation. The proposed lock system identifies a user by an RFID tag, authenticate it by sending 4digit codes to its mobile phone using short message services (SMS) and allow (confirm) the user to gain entrance if the correct code is entered. The program was written and builds to debug any error using Mikro C software. The circuit was designed using Proteus software and linked to the hex file generated by Mikro C to simulate. The simulation results were satisfactory which shows that real lock system will work according to design.**

***Keyword*-RFID, GSM, Mikro C, Security lock, SMS.**

I. INTRODUCTION

Places such as banks, houses, offices etc. needs to be secured by an efficient lock system. Security lock are categorize into two: the electronic (automated) identification system and the key (normal door lock) system [1].In summary, locks are generally very simple device that are deployed to tackle an uncomplicated problem [2]. RFID is a new technology where radio wave transmission connecting an electronic reader and a microchip, comprises of data distribution, gathering and management systems has the capacity to recognize or scan information for remote identification of objects with high accuracy and speed [3]. RFID devices comprises of three basic element: an antenna, a chip, and a reader. An important and fourth component of any RFID system is called the database that house the data about the tagged objects. The data about the attached item is stored in the chip [4]. These security features in RFID combine with that of GSM was used to design the lock system.

From the literature reviewed, [5-9] designed a GSM-based security system. [10] applied the technology of face recognition to designed a lock system. [11] designed a hotel door lock based on the android application and Wi-Fi. [12], designed a system to simulate an electronic key. [13], proposed an electronic lock system that issue a Multimedia Messaging Service (MMS) to recognize trespasser by sending Multimedia Message to certain dedicated mobile phone. [14], designed an automatically armed lock system immediately the owner (driver) distance him/herself from the vehicle. [15-18] designed a RFID -based security system. [19], proposed a locking system for a cargo container. [20], designed an electronic which can control different locking mechanisms. [21], designed and build a remotely controlled (prototype) security door. [22], proposed a wireless security lock system.

The rate at which Lock system are been hacked by unauthorized individual allowing uncertified access is alarming. With emerging technology, abundant infrastructure base on intelligent systems have been designed and constructed to guard our well-being and also to protect from illegal invasion but with various degree of limitations. So there is desire to utilize the embedded technology to design an affordable, fully customized and an integrated lock system to address the some of the limitation of earlier design lock system.

This paper present the design of lock system using RFID-GSM based technology by providing the concept of RFID-GSM lock system and the design methodology (which comprises of both the hardware and software). It also include result (simulation) and its discussion.

II. CONCEPT OF RFID-GSM LOCK SYSTEM

An RFID-GSM security system is proposed lock system which uses the security feature in RFID, GSM and password to protect life and property. RFID system is a technology that uses radio signal (wireless technology) to recognize object and is applicable virtually in all real m of life [23].

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Addition of GSM system is to use the security feature in it to increase the reliability of the system. It is a digital form of mobile telephony system, which is in used by virtually all territories and countries. GSM communication is wholly enhanced for full duplex voice telephony [24]. Mobile phones have become a pervasive platform of communication, entertainment and computation.

The proposed security system function as thus: The RFID reader interrogate the Tag and retrieve the ID number from it and convey it to the processing unit (microcontroller), if the ID number is valid then microcontroller generates and dispatch 4-digit codes to the authenticated person mobile number using SMS, then the authenticated person keyed in the codes in the keypad. If the generated and entered codes matched then the lock will be opened else the microcontroller dispatch a caution message a dedicated GSM and it remain locked as depicted by a block diagram in Figure 1.

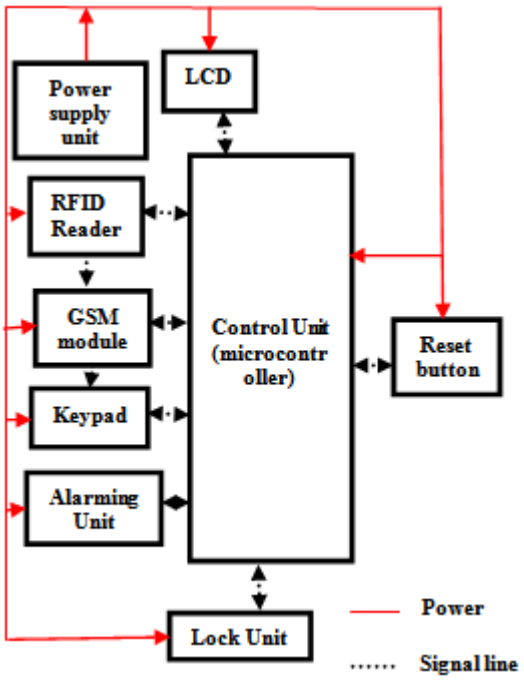

Fig. 1: Block Diagram of the proposed Lock system

III. DESIGN OF THE LOCK SYSTEM

3.1 Design of the Hardware

The hardware has several parts which are the power supply, the RFID system, the GSM system, the display unit and the alarming unit. The designs of this unit are presented as follow.

3.1.1 Power supply unit

The power supply adaptor comprises of a step down transformer, filtering capacitor, rectifier, variable resistor, back-up battery and a voltage regulator.$V_{AC} = 14V$

(1)Estimated load current$(I_{DC}) = 20mA$ (2),

And$V_{IP} = 0.637V_{AC}$ (3)

$= 0.637 \times 14V = 9.706V$:

According to [25],

ripple factor $= \frac{I_{DC}}{4\sqrt{3}} \times fCV_{IP}$ (4)

$V_{DC} = V_{IP}/(1 + \left(\frac{Idc}{4fCVip}\right)$ (5)

For a ripple factor of 1%,$C = 40\mu F$,

Then a '7805' regulator was used to regulateV_{IN} to $V_{CC} = 5V$:

Thus a 5V power supply unit as shown in Fig 2.

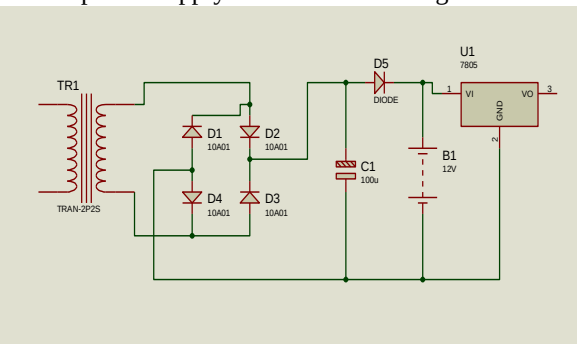

Fig 2: Circuit Diagram of power supply Unit

3.1.2 RFID System

In the design of RFID system, capacitor is requires across power supply terminal to curtail power surge. The value of C5 and C6 was chosen to be 160µF and 2n7F respectively as recommended by the manufacturer. The RFID module used is product of Wiegand. Mostly, a buzzer is attached which is actuated when a tag is read.

D_2 is placed to prevent feedback signal from the buzzer.

To limit the current to base of the transistor not to exceed 6mA (from data sheet), applying ohms law,

$$R = \frac{V}{I} \quad (7)$$

$= \frac{5}{0.006} \cong 834\Omega$, 1kΩ is chosen.

The buzzer discharges through R_2, to prevent short circuit, R_2 was chosen to be 1kΩ as shown in Fig 3.

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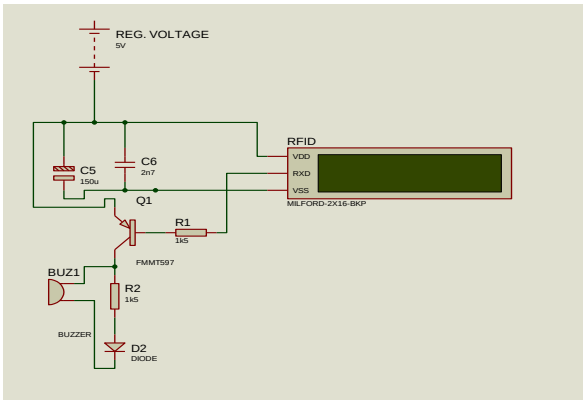

Fig 3: Circuit Diagram of RFID Unit

3.1.3 GSM System

The range of voltage for SIM800L GSM module is from 3.2V to 4.5V but 4.0V is recommended. The transmitting burst will cause voltage drop and the power supply must be able to provide sufficient current up to 2A. For the voltage supply (VBAT) to the power supply input of the module, a bypass capacitor such as 100µf is applied as recommended. The 33PF and 10PF capacitor is also recommended to reduce surge due to sudden voltage drop but can Increase the high frequency interference. To curtail it, a 5.5V/500mW Zener diode is applied as depicted in fig4.

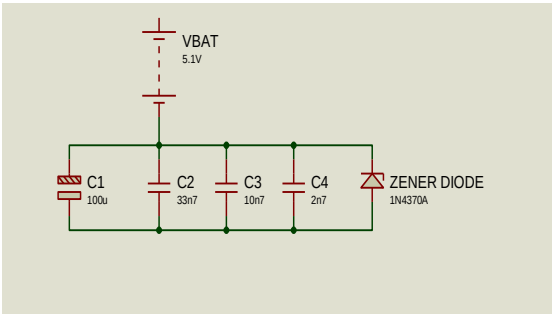

Fig 4: Power Supply to GSM Unit

3.1.4 Microcontroller and the keypad

The microcontroller unit comprises of PIC 16f877a and other integral components that is chosen base on the information available on the data sheet of the manufacturer. They includes: crystal oscillator (8MHz), two stabilizing capacitors and 10k pull-up resistor.

In the design of the keypad, the pull down resistor are placed at output pin are used to determine the logic zero (o) in idle state. The value of current passing through LED D_1 and D_2 has to be lower than 20mA,

Therefore using ohms law (equation 7), $R = \frac{5}{0.02} = 250\Omega$thus 330$\boldsymbol{\Omega}$ is chosen (available resistor).

Limiting the current in the idle state to be less than 6mA, using ohms law (equation 7), $R = \frac{5}{0.006} \cong 834\Omega$ 1kΩ is chosen. The complete circuit diagram of the lock system used in simulation is shown in fig 5.

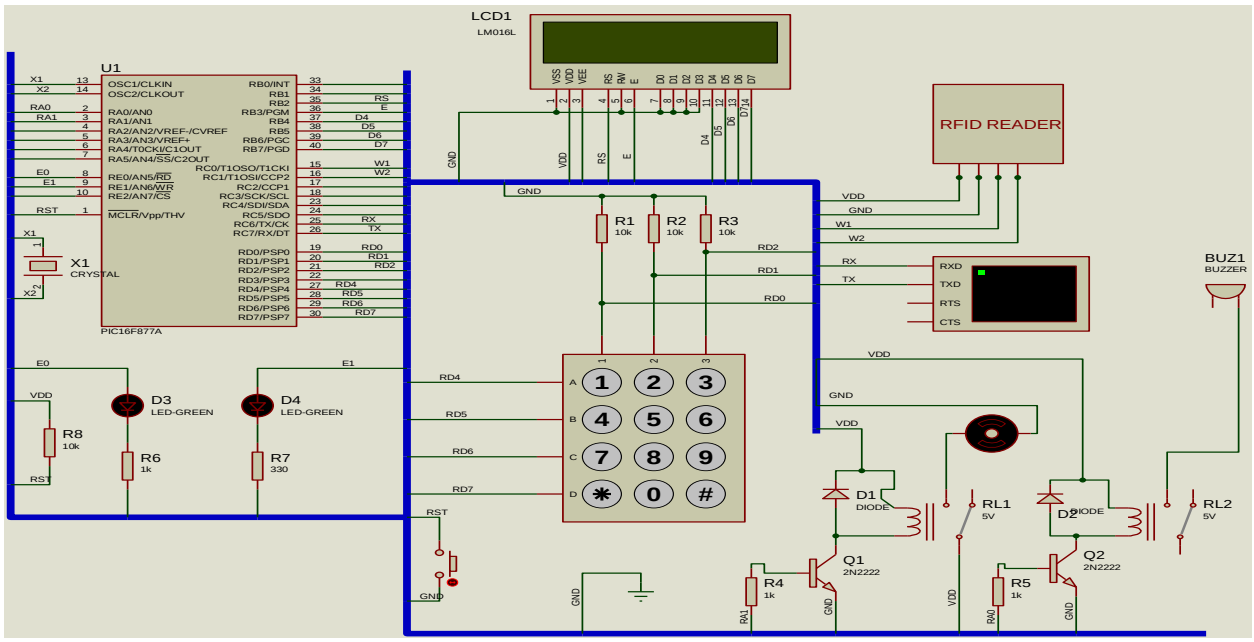

Fig 5: complete circuit diagram of RFID-GSM based lock system

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3.2 Design of the Software

The software used is Mikro C, programs were written in modules and build to debug any error. This modular build program generates 'hex file' which are series of '1' and '0' in certain order representing the codes. The hex files generated were linked to their respective circuit drawn using Proteus software for simulation. Subsequently, the entire program was written which is the combination of these modular programs. Flow chart illustrating the programming sequence is show in Figure 6.

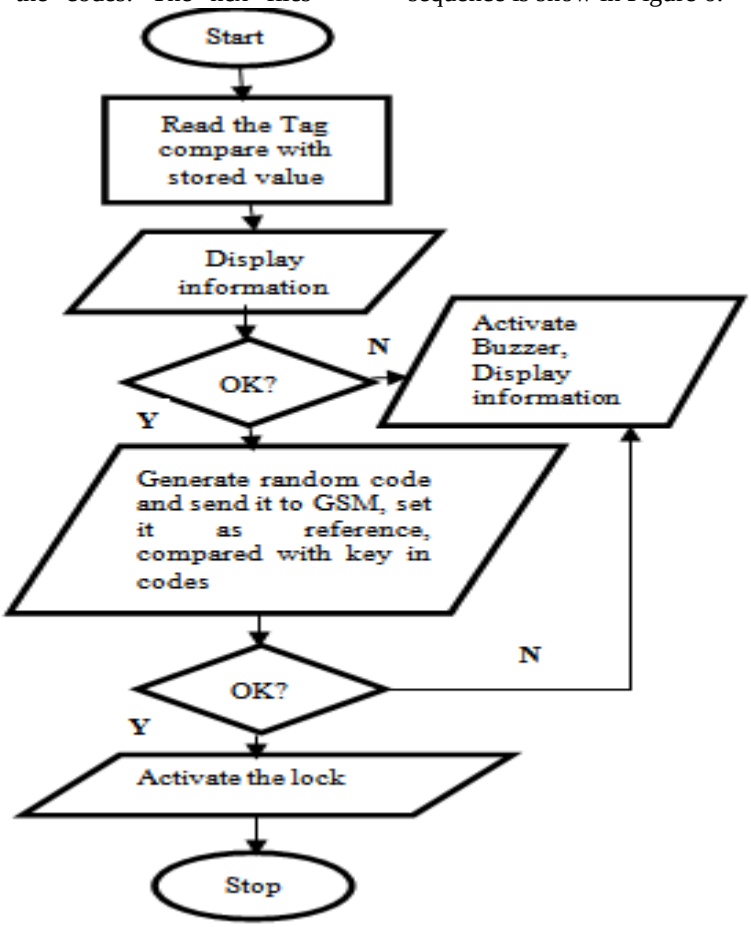

Fig 6: flow chart illustrating programming procedure

IV. SIMULATION RESULTS AND DISCUSSION

The program for the system written in Micro C was simulated using Proteus in parts and in whole. In the simulation of RFID system, a slave microcontroller (representing RFID) was created to transfer data to the main microcontroller using Wiegand protocol. This was because version of Proteus used has no RFID tool in its library. Wiegand protocol is a special sequence of data exchange between the microcontroller and RFID scanner. For simulation of the Tag holders named "Ag. U" to ascertain tag identification as in fig 7, raw data was send with command to display any Tag identified.

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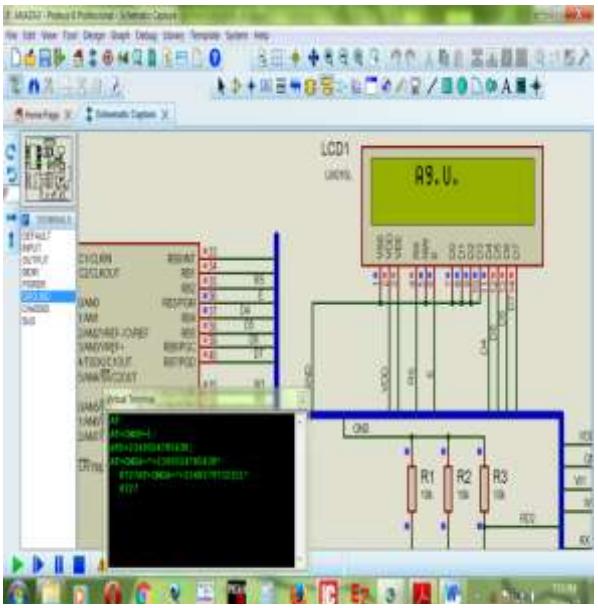

Fig. 7: Simulation of RFID for a tag holder named Ag. U.

The result is as shown (fig 7) which displays "Ag. U", the simulation result was satisfactory. Similar protocol was used to simulate the tag identification of the second tag holder named Okon P. It was programmed to display the name once identified as shown in fig 8. The simulation result was successful. The simulation result was also in consonant with the written program.

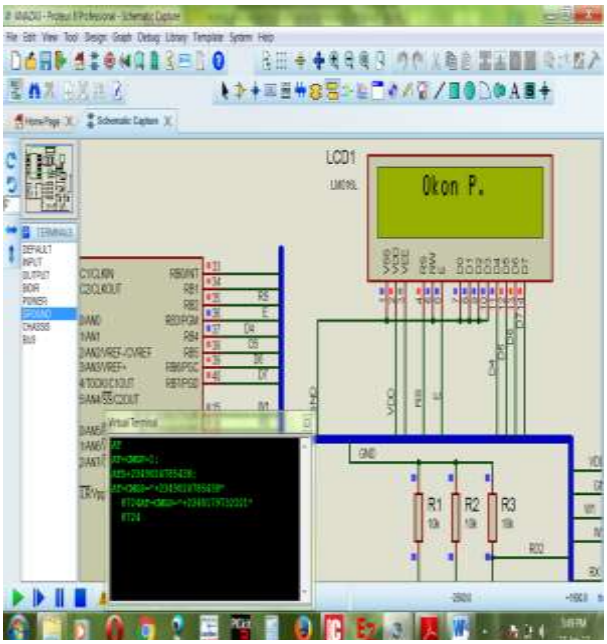

Fig. 8: Simulation of RFID of another tag holder named Okon P.

Code generation is an important security feature of this system. Auto-code generation routine was experimented, the software (mikro C) was written with a routine to display a any code generated on the LCD with the name of the user. During simulation, variety of codes were generated and displayed on the LCD. As shown in fig 9, the code generated was 8724 and was displayed with the name of second user Okon P. The simulation result was satisfactory.

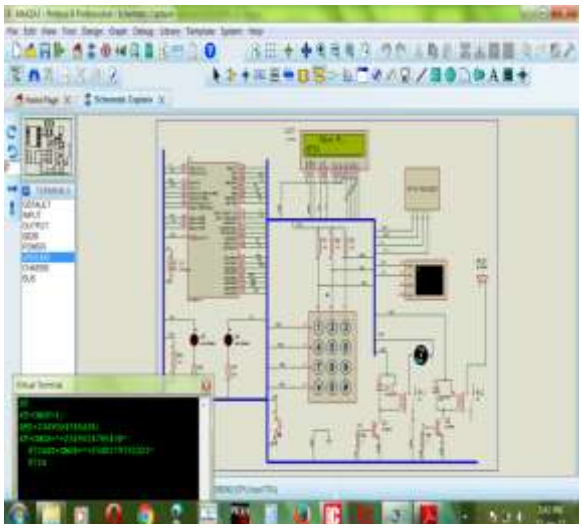
Fig. 9: simulation of code generation for second user.

The GSM module was an important security feature of the security system, and was simulated using the virtual terminal of proteus software. The Rx and Tx terminal of virtual terminal (GSM module) which symbolize reception and transmission respectively flags red indicators(as shown in fig 10), which indicates the GSM module transmits and receive signal from the microcontroller. Simulated using AT command as depicted in fig 10, the result is successful.

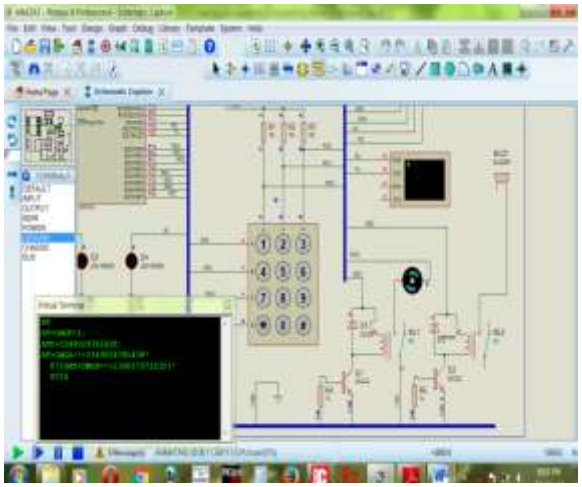
Fig. 10: simulation of GSM module

V. CONCLUSION

In this paper, the design of an RFID-GSM based Lock System is presented. Steps involved in achieving the simulation result, the designs of the circuit and software component of proposed device were discussed. And the simulation of RFID system, code generation routine and GSM module were all successful and the result were also presented in plates and discussed. Obviously, No system can be developed to ensure absolute security but improving existing structure is important. It can only be achieved by recognizing the crucial threats area and evaluating the risks involve.

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