

RFID Based Security Access Control System with GSM Technology

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ABSTRACT: The security challenges being encountered in many places today require electronic means of controlling access to secured premises in addition to the available security personnel. Various technologies were used in different forms to solve these challenges. The Radio Frequency Identification (RFID) Based Access Control Security system with GSM technology presented in this work helps to prevent unauthorized access to controlled environments (secured premises). This is achieved mainly through the use of a Radio Frequency Identification System with operating frequency of 125 KHz, Microcontroller programmed to send control signals, DC motor, relay, buzzer, Liquid Crystal Display (LCD) and GSM/GPRS Modem. Once the RFID tag which contains the user's unique information is scan by the RFID reader and confirmed match with the information stored in the microcontroller, the microcontroller is instructed to turn ON the DC motor through L293D driver, display "USER NUMBER and CARD NUMBER" on the LCD and activates the GSM/GPRS modem to send SMS alert "AUTHORIZED, valid RFID card shown, User is allowed to enter, user number" to security personnel. Else, the DC Motor remained OFF, LCD displays "READ RFID CARD NOT VALID", buzzer turns ON for about 5seconds and GSM/GPRS modem activated to send " UNAUTHORIZED, invalid RFID card is used to access the security system" to the security personnel. The electronic circuit was implemented, the codes for microcontroller were written in assembly language, debugged and compiled using the KEIL Micro vision 4 integrated development environment. The resultant Hex files were programmed into the memories of the microcontrollers with the aid of a universal programmer. Hardware simulation was carried out using the Proteus Virtual System Modelling (VSM) version 8.0. An importation implication of this paper is that the system is cheaper to maintain and more efficient in comparison with a manually operated type or key lock system. The RFID based access control system can be useful in providing security for homes, organizations, and automobile terminals to increase the level of security.

Keywords: Access control, Authorized, RFID, GSM, Microcontroller, Unauthorized

I. INTRODUCTION

Security systems play an important role to prevent unknown user entry into a secured place, which may include physical and intellectual property, without being authorized. The security system is basically divided into two types; the use of normal door lock key and the use of electronic automatic identification system. In general, locks are very simple devices that are employed to address a straightforward problem. Basically, lock can be easily hacked by unwanted people thereby allowing unauthorized people into secured premises.

There are several automatic identification technologies including barcode, magnetic stripe and Radio Frequency Identification (RFID) applied in security system. Radio-Frequency Identification (RFID) is an emerging technology and one of the most rapidly growing segments of today's automatic identification data collection industry. RFID technology, offers superior performance over other automatic identification systems. Because it is not an optical technology like bar coding, no inherent line of sight is required between the reader and the tagged RFID object [1].

The system described in this work uses an RFID tag which contains integrated circuit that is used for storing, processing unique information, modulating and demodulating the radio frequency signal being transmitted and a Global System for Mobile Communication (GSM) technology to communicate to security personnel via Short Message Service (SMS) in order to enhance the security of a conditioned environment[1][2][3][4].

Radio-frequency identification (RFID) based access control and security system grants access to only authorized persons to secured premises. RFID technology involves the use of a wireless non-contact system that uses radio frequency electromagnetic fields to transfer data from a tag attached to an object. Some tags are passive (require no battery or their own power source) while others are active (use their own local power source) [5].

The system that has been designed in this work is implemented around a microcontroller and it can help to avoid human involvement in checking and keeping of record at the access point of a secured environment. This system ensures accurate access control and record keeping [3].

II. RELATED WORK

Several researchers have done considerable amount of work relating to RFID based security Access Control System.

An Automatic Gate opening system for vehicles with RFID and campus access control system RFID based were proposed in [5][6]. The systems grant access to authorized persons with valid tags and deny the unauthorized persons with invalid tags but the systems lack ability to intimate security personnel through SMS.

In [7], a system with comparative analysis of RFID and wireless Home/Office Automation was proposed. Here three technologies; RFID, Wireless Sensor Network (WSN) and GSM were used. In this system RFID monitor access, sensor to monitor the temperature, lighting and gas leakage and GSM send SMS to the owner of the house when safety of the home is not guaranteed. The system emphasized more of safety than security of the home or office.

An embedded security system using RFID and GSM was presented in [8]. This system uses RFID and GSM technologies to provide security for distribution of petroleum products. The system was made up of control unit and tanker unit that are far from each other but can easily communicate with each other. The tanker unit monitors the fuel level continuously and displayed it on LCD at the front for driver's convenience. The second is RFID assembly which will read the authentication code of the petrol pump. The amount of fuel poured at a particular petrol pump and petrol pump ID will be sent to central office through GSM techniques. The pitfall here remained that the system does not operate as a stand-alone system but require a network provider for reception of signals and it is not a preventive security measure.

In [9], an RFID – based kindergarten Intelligence security system was proposed. It automates the children security supervision and provides integration with current security management system for kindergarten where RFID tags are embedded in children uniforms. However the system could not intimate security personnel when there is threat.

An Access Control by RFID and face recognition based on neural network was design and implemented. This system recognizes the face of the person holding the RFID card and denies access if they do not match. A Radial Basis Function Neural Network (RBFNN) was adopted to learn the face of authorized card holders. Also lack the ability to alert the security personnel through SMS in case of an unauthorized holder [10].

In [11], a paper on security system against asset theft by using Radio Frequency Identification Technology was presented. The aim was to invent a security system against motorcycle theft by using RFID technology (Ultra high frequency range; 905 – 925MHz). In case of incorrect information from the tag, the system alarms the security guards for further investigation. It can signal to activate an additional circuit to shut the motorcycle engine off and turn the Closed Circuit Television (CCTV) on for recording as the theft occurs. The system would have been better with SMS to the guards to avoid commotions.

The present study aims at the design and implementation of a security access control system that uses a wireless and automatic identification system known as Radio frequency Identification (RFID) system, Microcontroller as a control unit, GSM/GPRS modem that can send SMS when signalled by the controller, a relay to close and open the system, the Buzzer that form the alarm system and LCD that displays the result of the controller processing.

III. MATERIAL AND METHOD

3.1 Block Diagram

The block diagram of an RFID based security access control system with GSM technology is shown in fig.1. When the reader is powered and the tag (transponder) is brought within the reading range of the reader, the reader then scans the data present in the tag with the help of its antenna (scanning antenna) and compares it with the data present in the microcontroller. When the data matches with that in the Microcontroller, the DC motor will be turned ON which is operated by a driver being driven from the output of the microcontroller. The microcontroller is programmed to display messages on the LCD if the tag with valid or invalid information is brought close to the reader. In both cases, the GSM/GPRS modem is activated to send SMS alert to the security personnel. The GSM/GPRS modem is RS-232 logic level compatible, it requires a line converter called MAX 232 in between it and the microcontroller to convert Transistor-Transistor Logic (TTL) into RS-232 logic and

vice versa. The presence of any unauthorized user also activates the buzzer and a relay with its driver to close and open the sub circuits operating at different voltages. Also a crystal (12MHz) to give the required clocked pulses to the microcontroller.

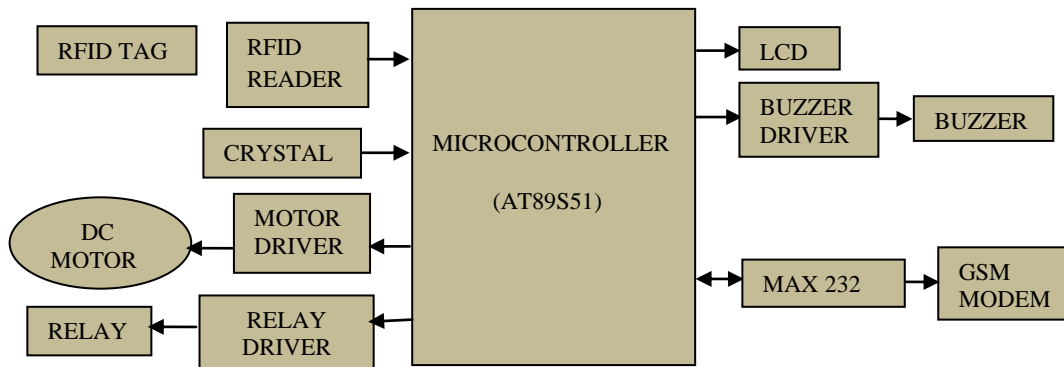


Fig 1: Block diagram of an RFID based security access control system with GSM technology.

The block diagram was developed into the schematic diagram shown in Fig. 2. This circuit diagram was used to simulate the hardware components of the system in Proteus Virtual System Modeling Environment version 8.0.

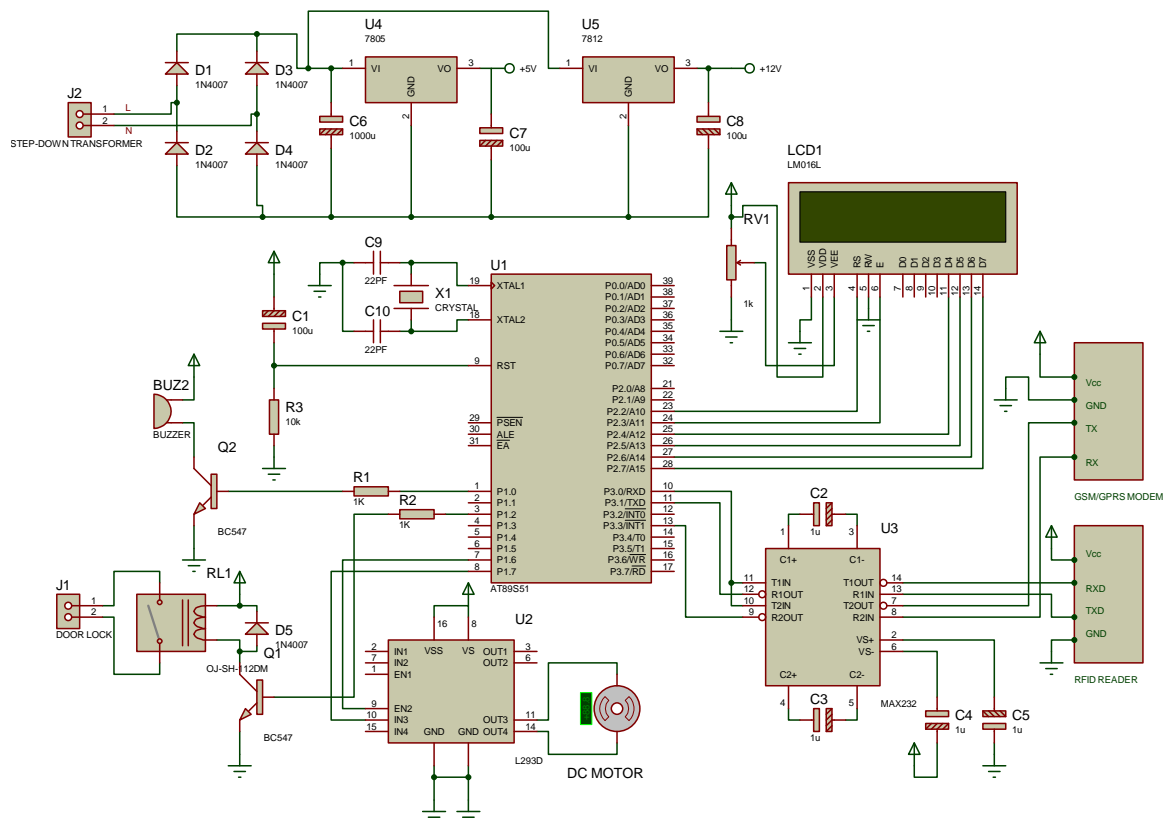


Fig. 2: Schematic diagram of an RFID based security access control system with GSM technology

3.2 Software Development

The AT89S51 microcontroller needs to be programmed first before it can be used in the electronic hardware. An assembly programming language is chosen to program the microcontroller. Correct and functional codes ensure the microcontroller works properly. The functionality of the code is verified using Keil micro vision 4, Proteus Virtual System Modelling (VSM) version 8.0 was used for the simulation and Flash Magic software was used for burning of the code into the microcontroller. After compiler operation, the hex code is generated and stored in the computer. The hex code of the program is burnt into the AT89S51 by using Flash magic software. The software design started with the flow chart shown in Fig.3

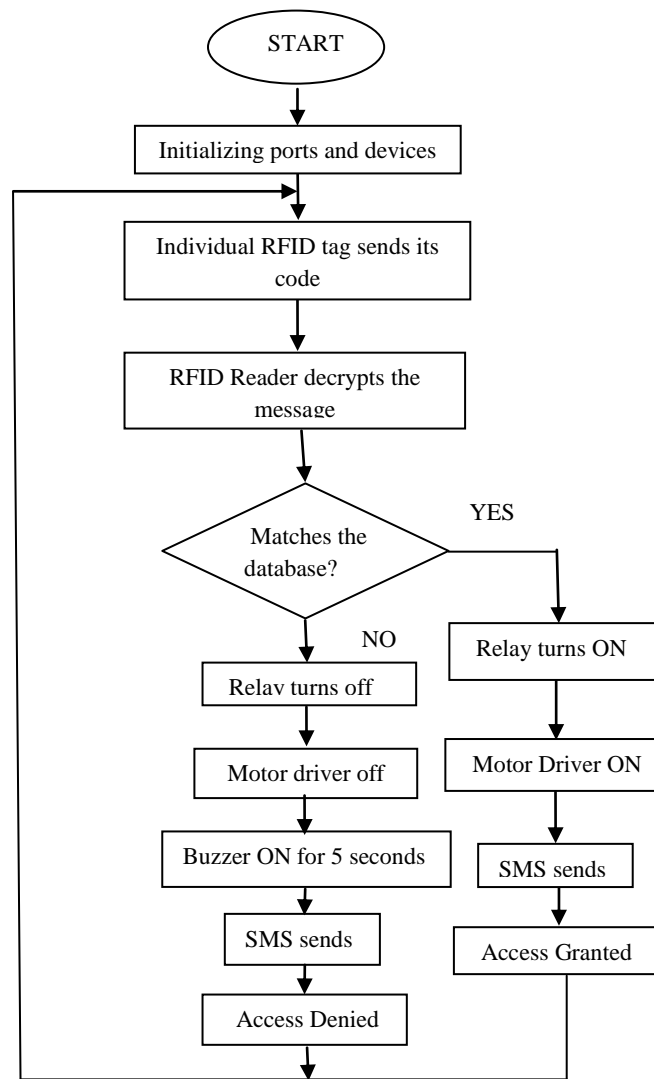


Fig.3: Flowchart of design of RFID Based Security Access Control System with GSM Technology.

IV. RESULT AND DISCUSSION

The simulation test of this work was done using Proteus 8.0 to ensure effectiveness of the design; here the various components in the design were connected to each other in Proteus 8.0 environment beginning with the power supply unit as shown in the circuit diagram of the system. This is to ascertain the workability of each stage before the construction is transferred to the print circuit board (PCB). The RFID card was represented with an interactive single pole single throw (SPST) switch through which the microcontroller receives the signal. The program hex file was loaded and the following results were obtained when running the simulation.

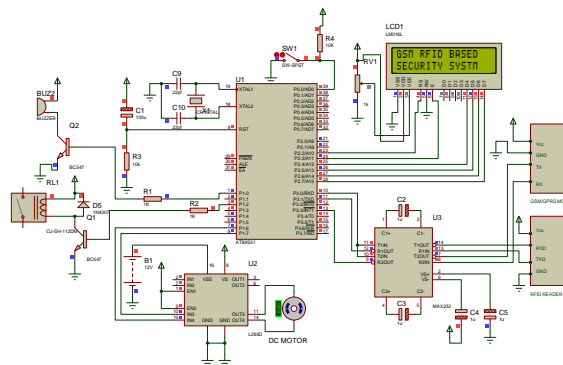


Fig.4: The result of the simulation when switched on

Fig.4 displays the name of the system on the liquid Crystal Display (LCD) when powered ON immediately.

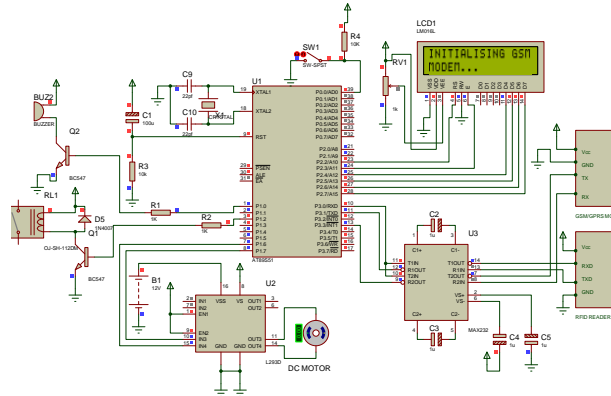


Fig.5: Result of simulation initializing the GSM modem

Fig.5 shows the process of preparing (initializing) the GSM modem to send SMS in text mode using the stored command; AT+CMGF=1 saved in the microcontroller.

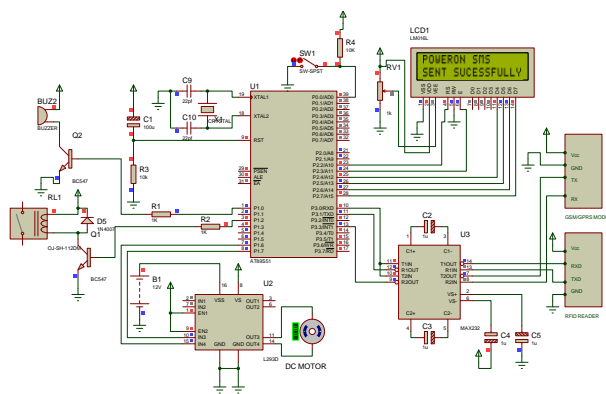


Fig.6: The result simulation showing that an SMS was sent to Security personnel

Fig.6 displays the feedback message that the power on SMS was successfully sent to the security personnel whose numbers were programmed into the microcontroller.

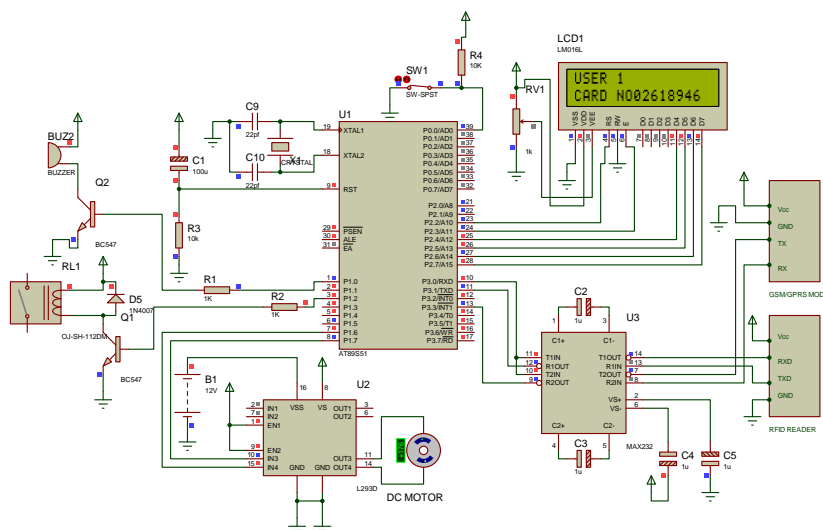


Fig.7: Result of simulation showing the use of valid card by closing the switch

Fig.7 shows the user number (in this case User 1) and the unique identification number of the valid RFID card used. The RFID card which cannot be located in the simulation software (Proteus) was represented with an interactive single pole single throw (SPST) switch. Also, the DC motor turns changing its former position to show that access has been granted.

The single sided Printed circuit Board layout of the simulated circuit diagram was made using the same Proteus 8.0 virtual software, etched, drilled and components were soldered after tracks continuity test using Digital Multimeter (DMM) as shown in fig.8. The Printed Circuit Boards play a vital role here in determining the overall performance of electronic equipment. It ensures that the noise introduced as a result of component placement and track layout is held within limits. It also provides components years of assembly maintenance and performance reliability.



Fig.8: RFID Based security access control system with GSM technology on a single sided PCB

The output of the motor driver L293D was disconnected and connected to the input terminal of the oscilloscope in Electronic Laboratory of University of Agriculture, Makurdi and straight-line waveform as shown in fig.9 was obtained showing the presence of direct current signal.



Fig.9: The resultant waveform from the test of constructed work with an oscilloscope

V. CONCLUSION

The knowledge and application of new techniques in electronics and telecommunication has made our life more secured and comfortable. RFID based security system is one of such applications. RFID security access control system with GSM technology presented in this work is based on microcontroller; hence the hardware requirement is greatly reduced. An RFID based security access control system with GSM technology has been implemented and function as desired. The system can be installed at the entrance of a secured environment to prevent an unauthorized individual access.

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