Design and Implementation of Intruder Detector System with SMS Alert

[1]Nicholas N. Tasie, [2]Ikechi Risi, [3]Judah A. Robert

[1,2]*Department of Physics, Rivers State University, Port Harcourt, Nigeria*
[3]*Department of Electronics, Institute of Management Technology, Owerri Nigeria*

ABSTRACT - *The frequent and widespread cases of burglary in homes, offices, factories etc. is on the increase. The advancement in technology has intensified such that motion can be detected by electronic device that calculates and measures changes in the given environment. This project is designed and constructed using an ATmega8 microcontroller, system connected to a GSM module with SIM (subscriber identification module) from a network provider. Light dependent resistor (LDR) sensor which is used in this project is connected toa microcontroller unit, GSM module and other electronic deviceswhichdetects any intruder in a classified area and then activates the alarm system and sends out text message notifications to the house owner specifying the location and time of intrusion to the programmed phone number of the house owner.The initial testing of the design shows that it worked in real-timein area with good network coverage as expected. It has wide range of application in surveillance especially in industrial and home security, especially when internet connectivity is not available.*

KEYWORDS:- *Intruder, LDR, Microcontroller, Sensors. Sim,*

I. INTRODUCTION

The need to have home protection gadgets that will alert home owners against intruders cannot be over-emphasized considering the alarming rate of insecurity in Nigeria and indeed other countries all over the world in the last few decades. Prior before now, homes were guarded by security guards who manually provided surveillance during day and nights, but it was not fool-proof as it was only normal for them to have momentary lapse in concentration. Hence, the first home alarm system was invented in Boston by Edwin Holmes in 1852 and was first patented in 1853 by Bostonian invertor Augustus Russell Pope [1].Security is the degree of protection against danger, loss and criminals. Throughout history, human have sought to protect their life and property. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their home [2;3]. With advancement in security systems monitor and applications, intruder detector systems can be more enhanced with new dimensions of capabilities that were hitherto not available. In particular is the remote detector systems which acceptability have increased due to its economical viable application

In view of this development, in this paper we present the design and implementation of an intrusion detector system which is aimed at the security of home or offices against intruders and burglar. The design based on short message system (SMS) and uses GSM (Global System for Mobile communications) technology to send the SMS to the owner via the emergency number which is provided to the system. This proposed system is made up ofthree components: light dependent resistor (LDR) and passive infrared (PIR) sensor, GSM-GPRS Module (sim900a), Atmega8L microcontroller, relays to control the device and buzzers to give security alert signal in terms of sound.

We present the design of the system and implementation of it with all aspects. The design of the developed intruder detection system is shown in figure 1. Similar type of system can be used for various applications related to intruder security systems.
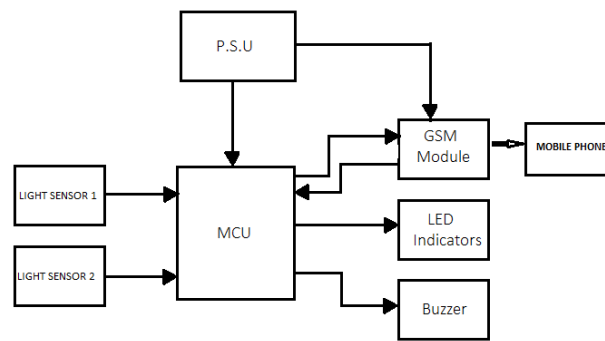
Figure1: Proposed Design of Intruder Detector System

The intruder detector system is shown in figure 1 above. A block diagram for the system was developed and then the algorithm for the firmware. The circuit is powered by a 9V DC and a voltage regulator which regulates the voltage to 5V used to operate the circuit. The input is a light dependent resistor (LDR)sensor mounted on the door and window to detect motion of object at approximately of 5 meters range. The control unit comprises of Atmega8L microcontroller with its associated circuits like the resistors, the preset, connectors and SIM 900A GPRS/GSM module. This data from the sensors is continually processed by the microcontroller and an alert is sent to the mobile station if something is sensed or something reaches beyond the limit of proximity. The output unit consists of GSM module which sends message to the owner GSM mobile phone in real time and the buzzer sound alarm at the same time. Preset information embedded during the programming unto the microcontroller is executed as text message via the mobile station to the owner upon any intrusion. However, it does not require any special feature or any special application for the mobile phone to be a part of the system. Any mobile phone supporting the messaging application is suitable for the system.

The paper is organized as follows. In section II, a brief review of existing intrusion detection systems is given. Section III will cover the technical aspect of this paper, where the proposed and implemented solution is described. The testing and result of the proposed system isdiscussed in IV. Conclusion of the developed systems is covered in section V.

II. EXISTING INTRUSION DETECTION SYSTEMS

An intrusion detection system basically includes CCTV/webcam, alarms, SMS and various sensors. Different technologies have advanced over the years in the monitoring, detection and control of security systems. These ranges from systems that allow compactible products to communicate with each other through wired connections to wireless connections. Wireless intrusion security systems today can easily control the home or office mechanical systems and applications over cellular phone or internet. GSM technology nowadays provides a viable ubiquitous access to most systems security and control.

[2] identified that CCTV's record most places such as banks continuously but do not absolutely detect the moving object and so designed real time security system using human motion detection to develop a system to monitor the area via web camera installed at restricted locations to capture live images and stores it for further evaluation. [4] added an alarm alert to CCTV image and video record of the security system in the farm. However,[5] stated that CCTV camera is expensive due to the use of computer and human effort to detect unauthorized activity. However, recommended Raspberry PI module system to be cheaper for better resolution and low power consumption.[6] also used Raspberry PI and GSM for magnetic door lock application system in detection of burglary and as well capture the image of person by camera and send to mobile and email as well as sounding alarm.

In the work done by [7] on web based intruder alert system, they described new developments for distributed web-based intruder alarm system monitoring and control hardware. The work explained that web-based intruder alert system may include the use of distributed nets (grids) giving each node the ability to dynamically configure its functions. They described a basic intruder alert system as one composed of at least a control panel, rechargeable battery, power backups and internal or external keypads, several interior and perimeter intrusion detectors and one external sounder.[8]also suggested using web camera base intruder alarm system to detect the intruder.On detection of intruder, the system sounds alarm and delivers mail to the owner

[9]suggested the development of a system which enhances the traditional fencing to avoid infiltration. In the evaluation the image and video along with the location of the intrusion are sent to the central control station through the dual-radio board for the authorities to take actions effectively.

[10]proposed to determine the performance of anti-theft device by using appropriate motion detection to observe the functionality of the device. The results showed accuracy efficiency and reliability in the detection of moving objects with body temperature during day and night times.

A smart home system based on LabVIEW was designed and implemented by [11] using wireless sensor network system. The fan control system uses temperature sensor and the lighting system uses light dependent resistors (LDR) to sense the light and PIR motion sensor detects the movement in the room and accordingly the system automatically turns on or off the lights. Fire and burglar are detected by PIR sensors mounted on the windows and doors. The system can be connected to internet to monitor the security of the home from anywhere in the world.

[8]established a fact that GSM/SMS based security system provides improved home security. On detection of any intrusion by the sensors signal from theft, leaking of raw gas and fire, the system sounds alarm and sends out SMS to the owner via the emergency number which is provided to the system by the owner to take appropriate action.[12] proposed a low cost GSM/SMS based technology which is equipped with microprocessor which controls the motion, smoke, temperature, humidity and light sensors.[13]proposed a home secure system which monitors the obstacle like touch, heat, smoke and sound. It collects information from the sensors and sends SMS to the corresponding number by using GSM module.

Similarly, [14] proposed an advanced security Guard with PIR sensor for wireless home security system which switches ON and OFF electrical appliances based on SMS received via the GSM modem of the user. [15]also developed home security with GSM/SMS messaging system. [16]security, control and remote via SMS. [17] wireless GSM/SMS technology.

[18] developed cost effective real-time intrusion detection system using passive IR sensor, ATmega, SIM 900a and other electronic devices for home security. ATmega microcontroller continuously fetched signal from infrared motion detection within the desired range as set by the user. An alert is sent to program mobile device via GSM in case of unpleasant intrusion. [19]presented a design using Wi-Fi and GSM based home security based on the principle of infrared radiation generated by a human body heat. Microcontroller is used to process the signal and send SMS to user mobile via GSM module which can be monitored anywhere in real-time.

This study is geared towards design and implementation of an intruder detector system with SMS alert at a very low cost using similar approach but different control units and sensors.Its objectives are geared at combining security system technology and GSM technology. The function of SMS is to inform the user of any intrusion in the absence of the owner in real time. The sensor is a light dependent resistor (LDR). The GSM technology is used for SMS notification to user mobile phone. The short notification message will be sent using AT (attention) command.
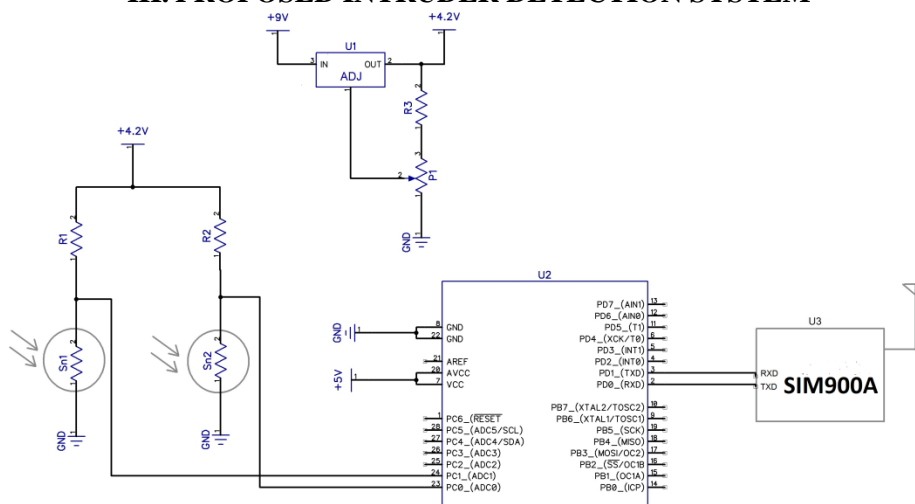
III. PROPOSED INTRUDER DETECTION SYSTEM

Figure 2: Circuit diagram implemented for the system

Fig. 2 shows the circuit diagram of the intruder detection system. The hardware of the proposed system comprises a voltage regulator unit, two LDR sensors, Atmega8L microcontroller unit, sim 900a (GSM module) unit,buzzer, in system programmer and other devices

The microcontroller IC is built with the control module. The central controller is Atmega8L which is 8-bit microcontroller with 16/32/64K Bytes and in system programmable flash. It is having advanced RISC

architecture. It consists of two 8-bit timer/counters with separate prescalers and compares modes, one 16-bit timer/Counter with separate prescaler, compare Mode, and captures mode, Real time counter with separate oscillator, six PWM channels, 8-channel 10-bit comparator and 32 programmable I/O Lines. The main feature of Atmega8 Microcontroller is that, all the pins of the microcontroller support two signals except 5-pins. The Atmega8L microcontroller consists of 28 pins where pins 9,10,14,15,16,17,18,19 are used for port B, Pins 23,24,25,26,27,28 and 1 are used for port C and pins 2,3,4,5,6,11,12 are used for port D.

The GSM module unit comprises a sim 900a based quad band which supports GPS technology for satellite navigation is used. It provides GPRS multi-slot class10 / class8 capabilities and supports GPRS coding schemes CS-1, CS-2, CS-3, and CS-4. This module takes care of all your GSM-GPRS based communication requirements as well as provides live GPS data.Its short message service allows you to send and receive 126 character text messages. The module is supplied with continuous energy (between 34v and 45v) and absorb maximum of 0.8A during transmission.AT command is a set of language or instructions which can be used to communicate (talk) with a GSM modem/mobile phone. These commands are used to automatically receive the call on system from the preconfigured number and system and also send the message to a preconfigured number about the intrusion indication via AT command [20].

The LDRsensors used for the system areto detect the obstruction of light intensity 3-5 meters away from door and windowwhere they are mounted. Upon any intrusion on the sensor mounted on the window, it triggers an alarm and simultaneously send preset SMS to the owner's mobile phone via GSM modem for appropriate action. The other sensor is mounted at the door and it is treated as authorized entry. The LDR senses the light in a room accordingly; lights will be turned ON after checking the light intensity in the room.

The power supply unit supply electrical power to the circuit. The supply is 9V and a voltage regulator was used to regulate the voltage to 5V that the circuit will work with.

The software design for the proposed systemuses AVR microcontroller, C programming language embedded within it and compiles using C-compiler to burn the program using Flash Magic software. ".HEX" file will be burn in the microcontroller. And to download the program intoAVR chip, eXtreme burner is used.
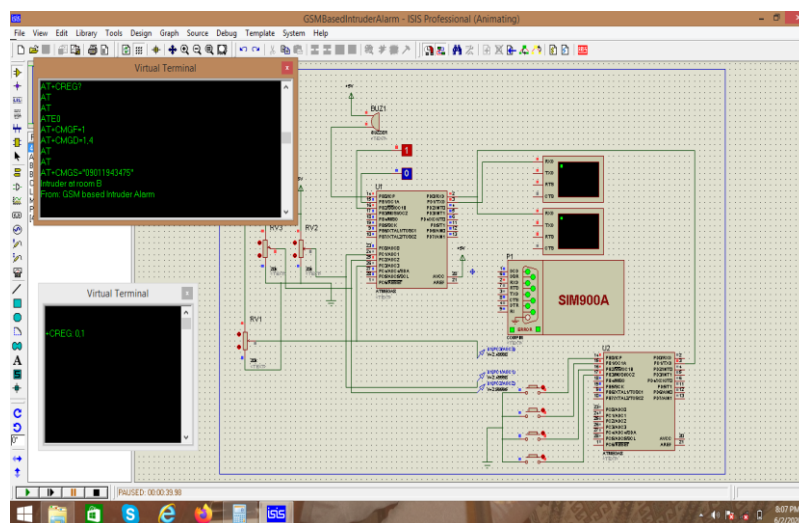
IV. TESTING AND RESULT

Figure.3: Circuit simulation layout

The proposed system sensor/receiver unit was tested and also the entire circuitry worked accordingly.

Figure 3 shows that the software program was simulated and checked, to show no error in the assembler before burning it into the microcontroller chip. The LDR sensor was powered by 5V from the voltage regulator. Test was conducted to check the sensitivity of the sensor to motion (shadow of human). The reference was set at 0.77V.

From the test conducted, the respective sensors upon sensing a shadow triggered the buzzer alarm and also lighted the respective LED for each room/location. Text messages were received on the GSM whose numbers were entered into the system. The message described the room/location where the intrusion was sensed. The sensor sensed up to five (5) meters in range. When powered off and then on, it is noticed that the system resets itself as if nothing had happened before, ready to sense an intruder again.

The developed GSM based security system responded to the sensor and sends SMS when it detects a shadow/obstruction on the sensors. The response time taken by the system to deliver the SMS is dependent on

the coverage area or range of the specified mobile network. If the mobile network is in the range of the system then the SMS is delivered in 10-15seconds.

In as much as this system is cost effective, low power consumption and easy to deploy. There also exists some limitation like when user mobile is out of coverage area, no visual display of intruder, no directly connectivity with government/private security agency.

V. CONCLUSIONS

The GSM based intruder detection system has been designed and tested with the mobile networkon the model of smart home and further it will be tested in actual home. The owner can receive alerts anywhere through the GSM network thereby making the system location independent. The communication with the home is only through the SMS which has been tested with the mobile network and is working on any mobile network.The device worked perfectly, meeting our expectation and lays the foundation for a future work as the mind would suggest to any innovator.

The implementation of GSM technology in this work has three major advantages. First, an alert message can be received by user in time of intrusion. Secondly, ease with less wire or cable applied and lastly due to its low power consumption.

Since a microcontroller is used for this research, the flexibility of the algorithm of the system can be increased by introducing more sensors and then editing the program code instead of making separate circuit board with components to consume more power. This means small installation space is required and less power consumption.

Further improvements can be made to the system to enable it differentiate between a human intruder and a household pet by computer vision technology to minimize false positives and false negatives to the system.

REFERENCES

[1].   Donnelly, Karen. "Domestic Security: The Holmes Burglar Alarm Telegraph, 1853-1876." (1992)
[2].   Upasana, Ahire, Bagul Manisha, Gawali Mohini, and Khairnar Pradnya. "Real time security system using human motion detection."In International Conference on IEEE. 2014.
[3].   Iyapo, KamoruOlarewaju, O. M. Fasunla, S. A. Egbuwalo, A. J. Akinbobola, and O. T. Oni. "Design and Implementation of Motion Detection Alarm and Security System."International Journal of Engineering and Advanced Technology Studies 6, no. 1 (2018): 26-38.
[4].   Mendoza, R., B. Malijan, and Rionel B. Caldo. "Development of smart farm security system with alarm mechanism using image processing."Lpu-Laguna Journal of Engineeringand Computer Studies 3 (2016): 73-84.
[5].   Patel, P. B., and V. M. Choksi. "SJ adhav, and MB Potdar," Smart Motion Detection Using Raspberry Pi"."International Journal of Applied Information Systems 10 (2016):37-40
[6].   Bhatkule, Akash V., Ulhas B. Shinde, and Shrinivas R. Zanwar. "Home Based Security Control System using Raspberry Pi and GSM." International Journal of Innovative Research in Computer and Communication Engineering 4, no. 9 (2016): 16259-16264.
[7].   Antunes, Rui Manuel, and FredericoLapaGrilo. "Intruder Alarm Systems-The Road Ahead."In Advanced Technologies.IntechOpen, 2009.
[8].   Bangali, Jayashri, and Arvind Shaligram. "Design and Implementation of Security Systems for Smart Home based on GSM technology." International Journal of Smart Home 7, no. 6 (2013b): 201-208.
[9].   Kharat, Prashant, and Jayashree Kharat. "Wireless Intrusion Detection System Using Wireless Sensor Network: A Conceptual Framework." International Journal of Electronics and Electrical Engineering 2, no. 2 (2014): 80-84.
[10]. Dellosa, Rhowel. "Development of an Anti-Theft Device using Motion Detection and Body Temperature."Asian Pacific Journal of Multidisciplinary Research 2, no. 6 (2014): 121-124.
[11]. Bangali, Jayashri, and Arvind Shaligram. "Energy efficient smart home based on wireless sensor network using labview." American Journal of Engineering Research (AJER) 2, no. 12 (2013a): 409-413.
[12]. Azid, Sheikh Izzal, and Sushil Kumar. "Analysis and performance of a low cost SMS based home security system." International Journal of Smart Home 5, no. 3 (2011): 15-24.
[13]. Khan, Sadeque Reza, Ahmed Al Mansur, AlvirKabir, ShahidJaman, and Nahian Chowdhury. "Design and implementation of low cost home security system using GSM network."International Journal of Scientific & Engineering Research 3, no. 3 (2012): 1.
[14]. Kapre, SarveshSuhas, SaurabhSahebrao Salunkhe, RohanManoj Thakkar, AkshayPrakash Pawar, and Omkar Ashok Malusare. "Advanced Security Guard with PIR Sensor for Commercial and Residential use."International Journal for Advance Research in Engineering and Technology 2, no.XI (2014).
[15]. Zungeru, A. Murtala, U. Victoria Edu, and A. James Garba. "Design and implementation of a short message service based remote controller." Computer Engineering and Intelligent systems 3, no. 4 (2012): 106-118.
[16]. Raghavendran, G. "SMS based wireless home appliance control system." In Proceedings of International Conference on Life Science and Technology (ICLST 2011), vol. 542. 2011.
[17]. Sarode, Chetana, and H. S. Thakar. "Intelligent Home Monitoring System."International Journal of Engineering Research and Applications (IJERA) ISSN (2013): 2248-9622.
[18]. Joseph, G. M., E. L. Nwankwo, O. M. Eniola, and C. D. Eneh. "Design of a real-time microcontroller based GSM-embedded intrusion security system." International Journal of Scientific & Engineering Research 6, no. 12 (2015): 232-241.
[19]. Jusoh, MohamadHuzaimy, Muhammad Firdaus Bin Jamali, Ahmad Faizal bin ZainalAbidin, Ahmad AsariSulaiman, and MohamadFahmiHussin. "Wi-Fi and GSM Based Motion Sensor for Home Security System Apllication." In IOP Conference Series: Materials Science and Engineering, vol. 99, no. 1, p. 012010. IOP Publishing, 2015.
[20]. Butt, Marriam, MamoonaKhanam, Aihab Khan, and Malik Sikandar Hayat Khiyal. "Controlling home appliances remotely through voice command."International Journal of Advanced Computer Science and Applications, Special Issue on Wireless and Mobile Networks (2011): 35-39.