

DESIGN AND IMPLEMENTATION OF MOTION DETECTION ALARM AND SECURITY SYSTEM

Kamoru Olarewaju Iyapo¹, Olukayode Michael Fasunla¹, Shadrack Alaba Egbuwalo¹,
Akin James Akinbobola² and Olatunji Temitope Oni³

¹Dept. of Sci. Lab. Tech, RUGIPO, Nigeria.

²Dept. of Elect. Elect. Engr. ABU Nigeria.

³Dept. of Elect. Elect. Engr. RUGIPO Nigeria

ABSTRACT: *The need for an effective and reliable intrusion detection with an alarm system have become vital necessity because of the frequent and rampant cases of burglary. Attack on homes offices, factories, banks etc. is on the increase. With the advancement in technology, motion can be detected by measuring change in speed or vector of an object in the field of view. This can be achieved either by mechanical devices that physically interact with the field or by electronic device that quantifies and measures changes in the given environment. The motion detector is not only used as intruder alarm but also used in many applications like home automation system, energy efficiency system, etc. This project is built using an embedded microcontroller system capable of detecting motion of an intruder in a restricted area and then triggering an alarm system, motion detector system, however passive infrared sensor detected the motion of the person using the person body heat. The passive infrared (PIR) sensor which is the motion detector used in this project is attached to a microcontroller which activates the alarm system and any other attached output device to notify the house owner. The initial testing of the design shows that it worked as expected.*

KEYWORDS: Embedded Microcontroller, Passive infrared sensor, Alarm /Siren, Mechanical Device and Motion Detector

INTRODUCTION

It must take into account the actions of people attempting to trespass or cause destruction. Security is the degree of protection against danger, loss and criminals. Throughout history, human have sought to protect their life, property and professions. 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. Now when everything is available to us we can now design something that provides us complete security. The very basic of this began with the simple alarm system which include notifying suspicious activities at a very low cost [1]. The need for security system have rapidly grown from being specialized for high – risk areas such as banks ,companies ,governmental institutions),to be available and demanded rapidly by the average public. Some of the common characteristics of motion detection alarm and security system as follow 24 hours monitoring, difficult to hack, Ability to control doors and motion sensor. The motion sensor used in this work is the pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. Its special features include single bit output small size which makes it easy to conceal, compatible with all parallax embedded microcontroller 3.3V& 5V and operation and operation with<100µA current draw.

A typical motion detection alarm and security system should consist of a control panel, Alarm/siren, Window and door sensor plus at least one motion detector. In addition, some motion detection alarm and security system can incorporate home automation, smoke detectors and glass break detector. The main objective of this research work is to design a system that can sense human movement, buzzes an alarm along with this captures an image of the intruder which is further compared with the image of owner. In this research work, will designed a well-organized and intelligent intruder motion detector alarm and security that can sensed the presence of humanly bodies and notifies this to the owners just immediately. This system provides a very cost effective security system that can be placed anywhere in the house with less maintenance cost.

In most recently, CCTV's usually seen at many places such as banks for continuously record the situation [2]. He also concluded, most system do not absolutely detected the moving object because it causes some darkness and requires large memory to store the video and by using human motion detection system banks safe will be more secured as it will send alerts regarding burglary happening. Meanwhile the CCTV system does not provide any information about what is taking place at particular time. Implementation of the system in real time and testing the system on large number of long sequences, authenticated individual can stop alert for fix time to enter into secured area by remote login. The design Real time security system using Human motion detection is to develop a system to monitor the area using web camera is suitable in the area where no one is permissible to enter and where there is the need to detect if any motion has been done. The camera was used to captured the live images of the area under investigation if any object was moving and the captured images are stored for further work. In surveillance, [3] suggested that, CCTV camera is more costly because of the use of computer. Also required human effort to detect the unauthorized Activity. However, recommended Raspberry pi system to be cheaper for better resolution and low power consumption feature. In the design, the motion is detected through PIR sensor inside the room where the image is being captured through camera and temporarily stored in the raspberry pi module. The smart surveillance system has been developed in such a way that it can fulfil the needs of the user for particular surveillance area.

Motion detection surveillance technology has gained a lot of interests over the past few years. Based on the study and evaluation of current available different methods. The proposed system is quite efficient and convenient for home uses and offices. The system captures images only when the motions exceeded a pre-set value or threshold. This system seem to be more prone to error as there is less 3% chances to skip any detection [4]. There may be some false detection due to the illumination effects which can be overcome for the better performance.

In the design and construction of advance security Guard with PIR sensor for commercial residential use, [5] came up with a standard approach to automation home and industrial equipment these days. The designs of hardware circuit allowed each user deployed this home security system wirelessly. Also, an SMS was sent to the registered user mobile that uses the GSM modem. The embedded microcontroller circuit switches ON and OFF the electrical appliances at houses and industries based on SMS messages received through the GSM modem of the user. It was carried out that, the proposed security system was more advanced than the one earlier used due to some reasons.

In the development of anti-theft device, [6] proposed to determine the performance of anti-theft device using appropriate motion detection and to observed the functionality of the device. The

output of the study was more accurate in terms of detection of moving objects with body temperature during day and night times. The studies showed that, the device has a good performance and acceptable in terms of functionality. Moreover, based on the results of evaluation, the anti-theft device using motion detection and body temperature is acceptable in terms of accuracy, efficient and reliability.

In creating a system that make the surveillance of home devices easily,[7] suggested the development of a system which ameliorates the traditional of fencing to avoid in filtration .It shows that, 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 efficiently In conclusion, As soon as the routing and the communication between control station and user works, new opportunities may arise to make the system viable for people with special requirements.

For home security system ,[8] suggested that ,safety from theft, leaking of raw gas and fire are the most important requirements of home security system for people .He also established a fact that ,Global system for mobile communications based security systems provides an enhanced security as whenever a signal from sensor occurs, a text message must be sent to a desired number to take necessary actions while a traditional home security systems gives signal in terms of alarm. In conclusion, the type of system adopted was useful especially when the owner is out of station and the home is locked.

[9], Focused on the intelligent security system based on image, video and home automation systems. The system is developed to automatically react to every learned situation in a pre-specified way, protection against unauthorized intrusion and supervision over ill persons. The developed design is based on well-known and proven method along with its architecture and algorithms whose focus was put on one of the aforementioned functionalities of the system. However, the threshold values of these parameters determine the moment in which the alarm is triggered and system response is activated .Experimental results has confirmed the effectiveness of the approached used.

[10], developed a real- time intrusion detection system using passive IR sensor, ATmega, SIM 900a etc. which guaranteed home security. Microcontroller continuously fetched signal from infrared motion detector within the desired range as set by the user. An alert is sent to program mobile device via GSM in case of untoward situations. The experimental results showed that, by using this system the security services like police and fire brigade of a nearby region also be informed about the intrusion instantly and they can steps rapidly. So this system is safe and cost effective as well.

In agricultural application,[11] assessed existing technologies and developed a new way of securing a particular area. The system adopted is based on image processing established to determine the identity of individual who trespass and distinguish if the fellow is authorized personnel, an intruder or a crop-destroying animal. CCTV was implored to monitored the area and provide a video record for security purposes. Experimental results showed that ,the image processed during the investigation would helped to checkmate or detect the objects that could harmed the crops or other equipment in the farm if detection is positive, an alarm will sound for the person who guards the farm to be alert.

A home based security control system using raspberry Pi and GSM suitable for usage in homes and offices was design and constructed [12].The features include ability to detect burglary and

as well captured the image of person by camera and send to mobile and email as well as alarm gets on. The design is applicable for magnetic door lock system. Experimental results showed that, the security level is increased due to the usage of Raspberry Pi which sends the images to the users and necessary actions can be taken in short time in the case of emergency condition.

[13], Presented a design using Wi-Fi and GSM based home security system to reduce the increasing rate of crime in most personal housing and office .The design is divided into three main parts which comprises the software, the output part and micro secure digital (SD) data storage card .It is based on the principle of infrared radiation generated by a human body heat .Embedded microcontroller is used in the design to processed the signal which later sent to user's mobile phone via SMS. Experimental results showed that, the design would help to increase the safety of the private premises because the user can monitor premises from anywhere in real time.

There exists certain limitation as regard the security system which is the commonest form of protection to lives and properties [14]. Some of these limitations are real time monitoring and control of activities such as intruders in the form of human beings, etc. The features include analysis and calculation which was carried out through modelling, Simulated in proteus electronic stimulator environment. Experimental results showed that, the design analysis and calculations were carried out and finally, a positive result was achieved.

Hardware Design Considerations

This section describes briefly the different hardware used in the design as well as the software algorithm implemented in the embedded microcontroller unit. Fig. 1 shows a pictorial description of the proposed motion detection alarm and security system. The core of the system is an advanced microprocessor unit for the control of the entire system. However, the unit is equipped with a port for control of an alarm system which is activated in the case of security violation detected by any of the input devices.

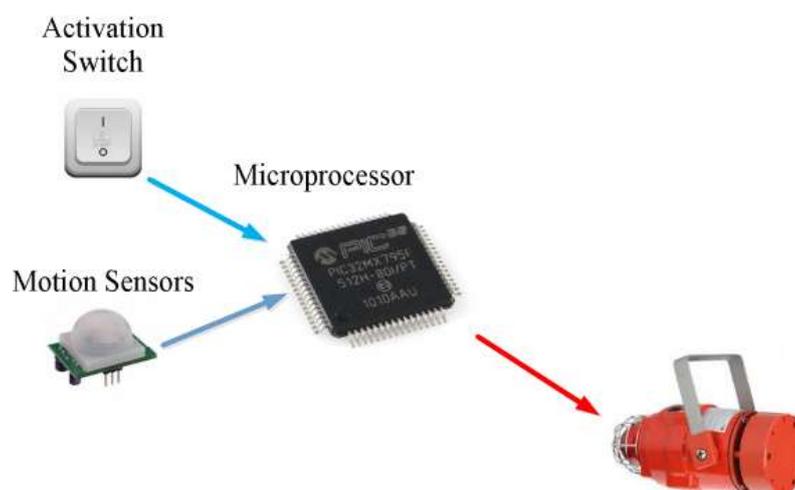


Fig. 1. A block diagram of the burglar alarm system

Microcontroller and Sensor Unit Design

Fig. 2 shows the circuit diagram of the entire burglar alarm system with microcontroller IC. The central controller is the microchip PIC18F2423. The design include an ICSP inputs for the programming of the microcontroller which is a connector attached to RB6, RB7 and the MCLR pin 1 of the microcontroller unit .The microcontroller also accepts input from switch sensors which can be placed on the hinges of doors or any hidden place for the purpose of activation of the device. Also included in the design is the PIR connector input for the motion sensor. The microcontroller is set to operate at 4MHZ by the crystal oscillator and the paired 22pF capacitors. The PORTC0 of the microcontroller is configured to control a relay attached to the alarm system. The system also contains 5 LED for visual display of actions performed by the system .The LEDs are powered from PORTB of the microcontroller system. The entire system receives its power from a 5V regulator circuit built with a LM7805 IC and filter capacitors .The circuit was implemented into a double sided printed circuit board with the component connections on top side. As shown in Fig. 2:

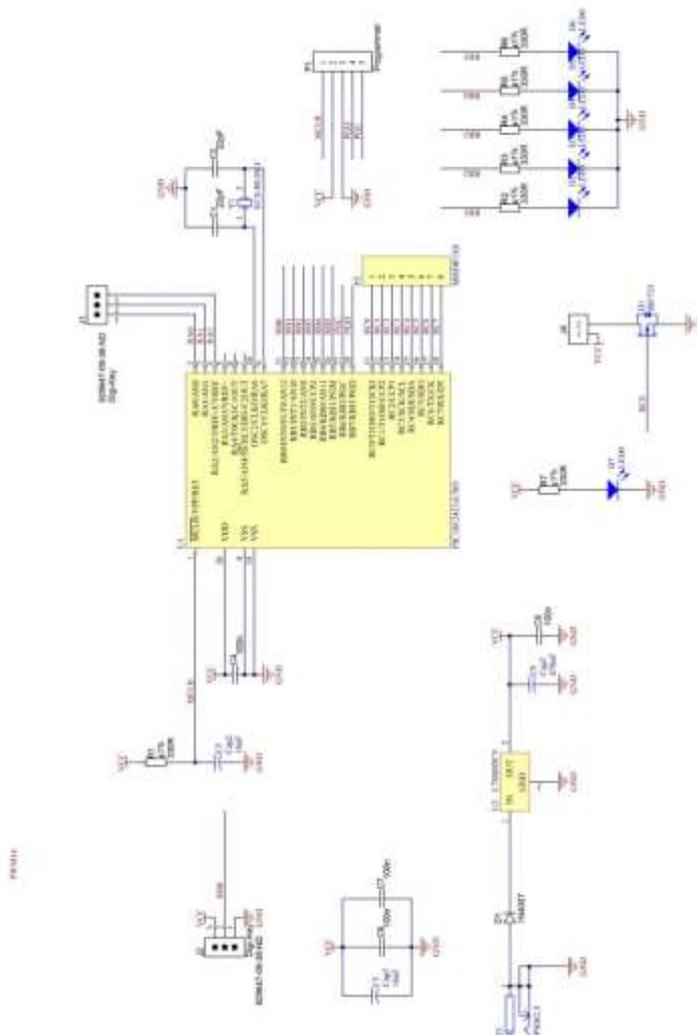


Fig. 2: Circuit diagram implemented for the system

System Design and Implementation

This section gives a details description and experimental procedure used in this project. The project was designed to provide a close circuit security using commercially available PIR sensors and microcontroller for device control. The highlights of the system are long range pickup and robust coordinating software with a data base containing information about the user (client) setting. The design was in three main phase: The sensitivity, central processing and action. The study also utilized developmental design to observe the functionality of the device. Anti –theft device detected motion from a moving object for those with body temperature like human being and animal [6]. The processors will receive inputs from a switch which may be hinged to a door or any hidden place to activate the alarm system. Light emitting diode was used as an indicator in the design. It is a basic pn-junction diode which emits light when activated .The design contains five diodes as an indicator.

Motion Sensor

Motion sensor or detectors are widely used in security system. It contains a motion sensor either integrated with or connected to other devices that alert the user of pre-sense of motion. It typically positioned near exterior doorways or windows of building to monitor the area around it. Motion sensor offers for protection and security the average homeowner as well as commercial organisations. The motion sensor used for this work is the pyroelectric Infrared PIR Motion Sensor Detector Module shown in Fig. 3. The device contains a special filter called



a Fresnel lens, which f
infrared signal onto the element.

ocuses the

Fig. 3: the infrared sensor used for this work

PIC18F2423 Microcontroller

In this design the PIC18F2423 microcontroller was used. The PIC18F2423 is a high-performance enhanced flash ,microcontroller from microchip with nano watt technology .This microcontroller offers the advantages of all PIC18 microcontrollers- namely, high computational performance at an economical price with the addition of high-endurance, Enhanced flash program memory. In addition to these features, the PIC18F2423 introduces design enhancements that make these microcontrollers a logical choice for many high – performances, power sensitive applications. The devices incorporate a fully featured serial Bus communications module that is compliant with the RS232 specification. The module support both low-speed and full-speed synchronous and data transfer types. It also incorporates its own

on-chip transceiver and 3.3V regulator and supports the use of external transceivers and voltage regulators .Figure 4. shows pin diagram of the DIL package and the block diagram of the block diagram of the PIC18F2423 family respectively, it consist of a 32Kbytes flash program memory, 10 channel 12bits A/D channels, 3 bi-directional ports, one standard capture compare port (CCP) and an enhanced capture port (ECCP).

28-Pin PDIP, SOIC

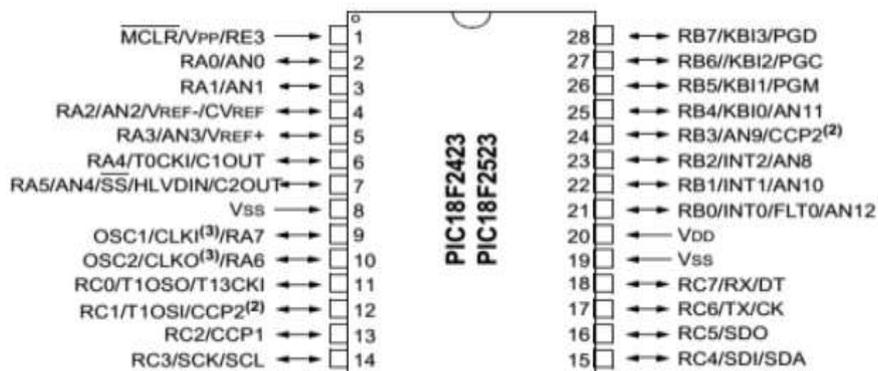


Figure 4: The PIC18F2423 Microcontroller used for this work

Alarm Siren

Electronic sirens incorporate circuits such as oscillator, modulators, and amplifiers to synthesize a selected siren tone which is played through external speakers. For this project, an alarm siren Horn Buzzer Speaker was chosen .Figure 5 shows a typical siren speaker system. The device is made of fireproof ABS material and operates at a rated voltage: DC 12V power with an output of 15W. The sound Pressure level is 110dB with a time delay of 1s.



Fig. 5: The Alarm/speaker used for this work

Software Design Consideration

The software design for this project was implemented using a CCS C compiler for PIC microchip. This compiler consists of an optimized C compiler program as well as improved functions for many microcontroller operations. The flow chart on Figure 6 shows the implantation of the algorithm used in the programming of the microcontroller. The program on starting initializes the microcontroller unit on boot up. The controller routinely circles round the sensors polling the inputs for a brake in. If either motion or a brake in switch is detected this initiates an action for the triggering or activating the alarm system.

At start up the system initializes and then check for activation of the system by the user. If this switch is set on the system switches to the security mode. First it wait for a time delay of 60 seconds to allow the house owner to leave before the security mode is activated. At this point the system is armed and then continues to sample the output of the motion sensor continuously. It remains in this state as long as no motion is detected. When a motion is detected the motion sensor sends an interrupt via the interrupt request of the microcontroller on PORTB0. This information is processed , then the alarm system is activated .The alarm remains on until the house owner switches it off through the activation switch.

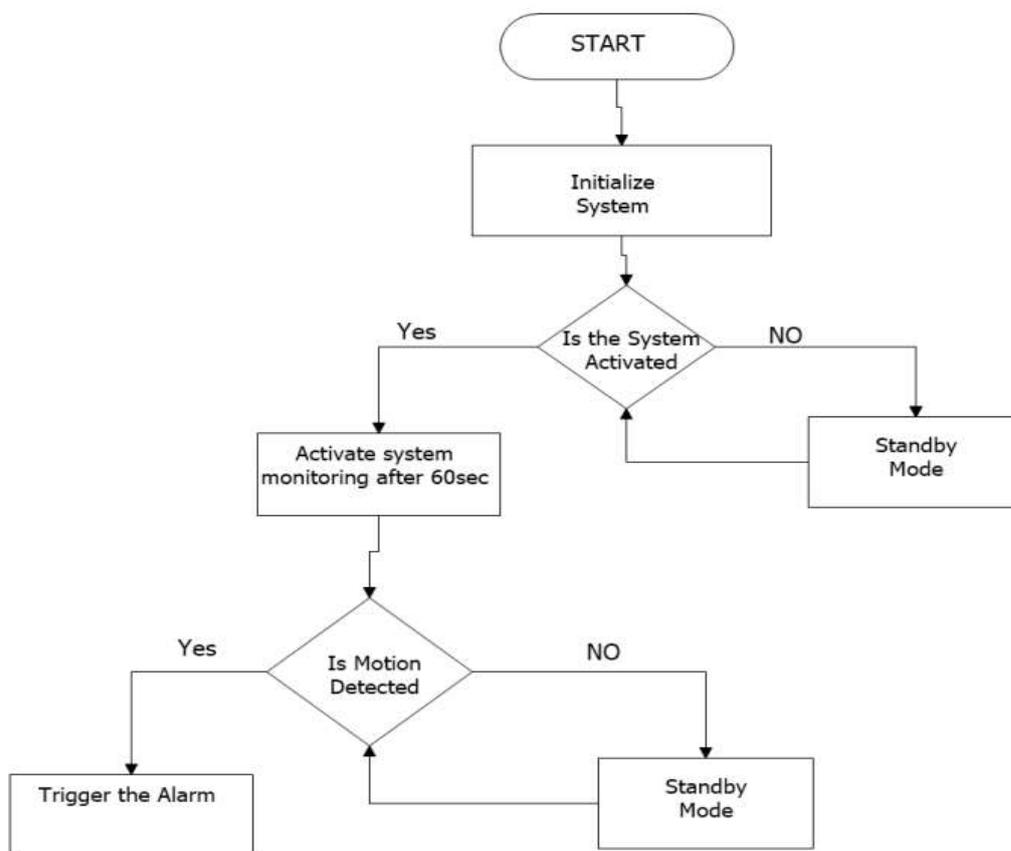


Fig. 6: The flow charts for the program in the embedded processor

PCB Implementation

The actual translation of the circuit of the burglar alarm system in a printed circuit board pattern as carried out using Altium PCB software. First the circuit was compiled and checked for errors before the transfer to a PCB layout for onward processing as a PCB file. On the layout the different component foot points were carefully placed on a dimension of (80 X 100mm). The placement was done to ensure the shortest possible distance between related components. An electrical rules violation check (ERC) was performed on the design and the placed footprints before processing with the routing. The entire component electrical connection was then auto routed using the routing component of Altium software. Figure 7 shows the final PCB layout drawing of the design implemented for a dual layer PCB board. Figure 8 and figure 9 show the 3D image of both layers of the finished PCB design as derived from the 3D view of the Altium software. The actual implementation of the PCB design was achieved using the tonner.

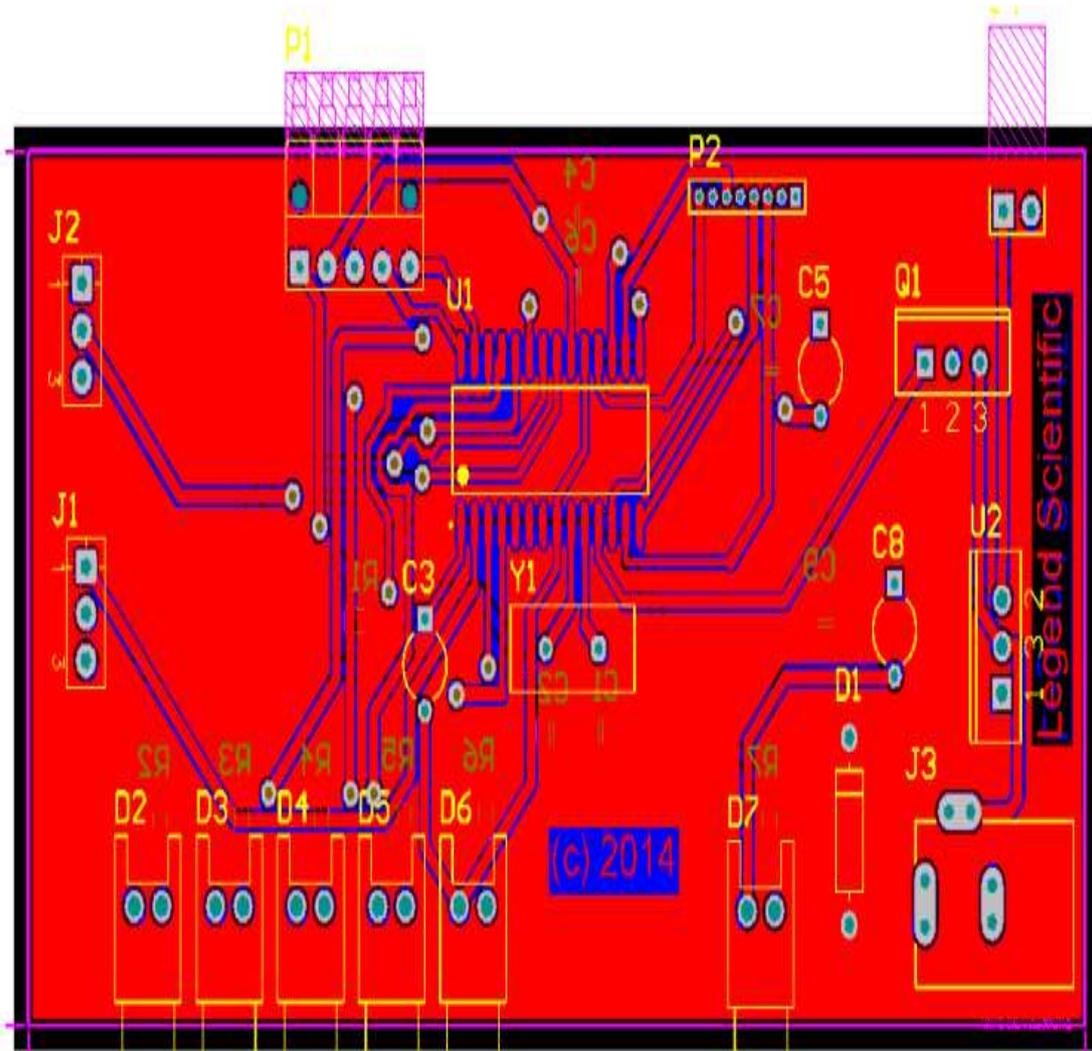


Fig.7: The PCB design of the module

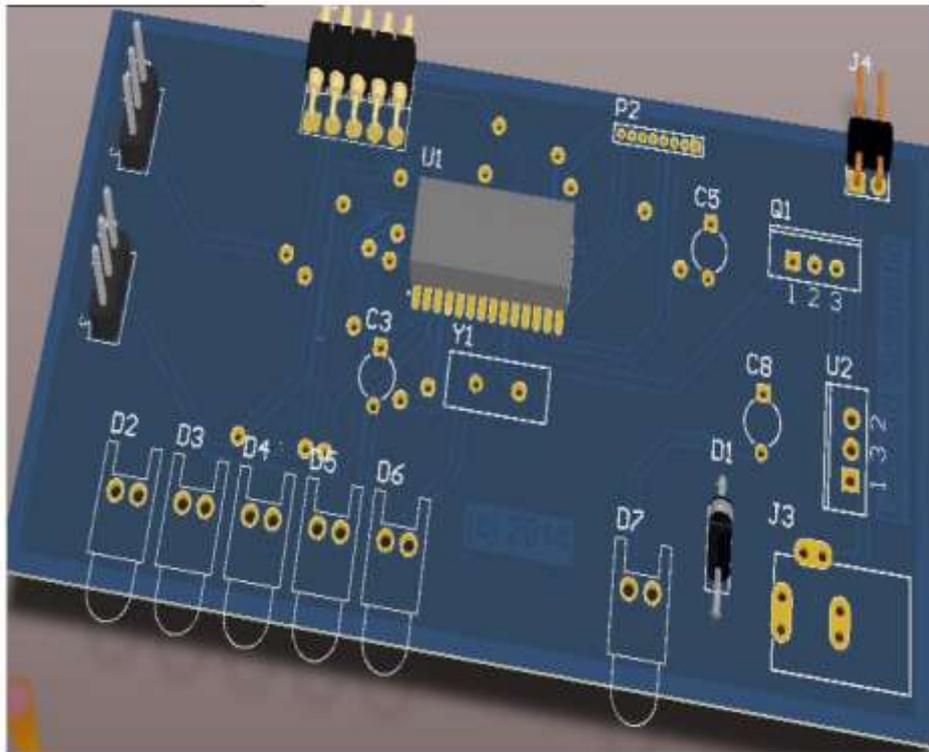


Fig. 8: The 3D top view of the finished design

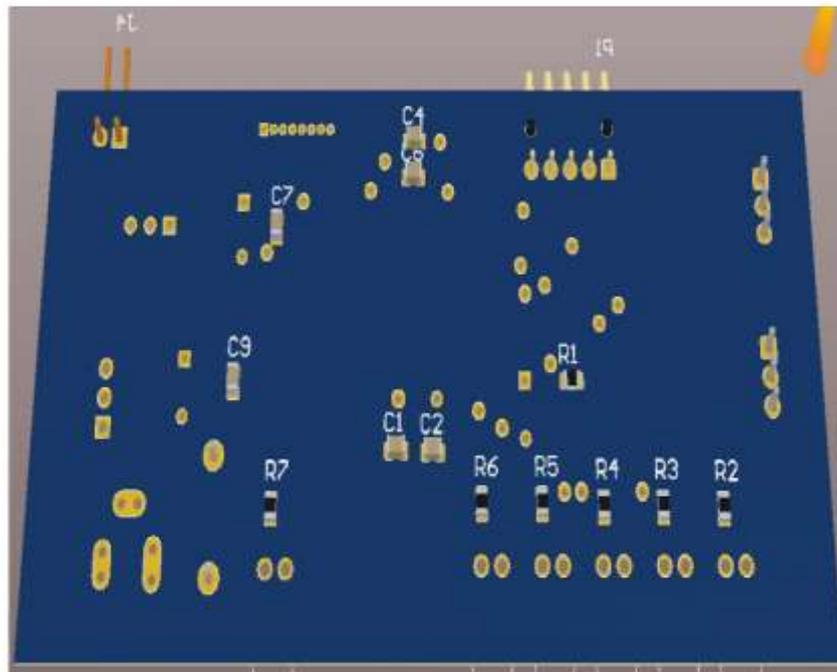


Fig. 9: showing the 3D bottom view of the finished design

Constructed Device

The physical implementation of the design was carried out on the manufactured PCB boards using mainly surface mounted components. The component was then soldered into the respective component slots using a 30W soldering iron [15]. Figure 10 shows the completed project with the PIR motion and siren speaker system in place.



Fig. 10: The completed work with the PIR motion Sensor and siren speaker system under test.

TESTING AND RESULT

Initial testing of the board was carried out using continuity meter to ensure all short circuit fault are properly cleared. The sensory circuitry was tested to ascertain the level of sensitivity as expected. In the connection each component on the PCB was then tested. The implemented design was initially tested on an open area after construction and the system performed as expected. The device was further install in a household to determine how effective the device can detects an intruder. The test result shows that both the braking switches attached to the door hinges and the motion sensors perform adequately as expected.

CONCLUSION

The developed motion detection alarm and security system gives good response to the motion sensor when it detects intrusion at the windows or doors. The test result shows that both the braking switches attached to the door hinges and the motion sensors performed adequately as expected. The entire decision making was carried out with the aid of a PIC18F2423 microcontroller. One of the main features of the design, it is built with a time delay of 60 seconds to allow the house owner to leave before security mode is activated. This work is useful in the area of security usage, Industries and in automation.

FUTURE IMPROVEMENTS

The future implementations of the project are great considering the amount of time and resources it saves. This system can be used as a reference or as a base for realizing a scheme to be implemented in other projects of greater level including audio –visual cameras by sending the captured image to an e-mail instantly.

REFERENCES

- [1] B.P.Urbana, and G.G. Modi, “Domestic Intruder”, System. Indian Journal of Computer and Engineering., Vol.2, PP. 506-515, Sept.2011.
- [2] A. Upasana, B.Manisha,, G. Mohini,, and K .Pradnya,” Real Time Security Using Human Motion Detection,” International Journal of Computer Science and Mobile Computing. ,Vol. 4,PP 245-250, Nov. 2015
- [3] P.B. Patel, V.M Choksi, S.J adhav, and M.B Potdar,” Smart Motion Detection Using Raspberry Pi” .International Journal of Applied Information Systems. ,Vol. 10, PP37-40, Feb.2016
- [4] M.J Charadva,, R. V Sejpal, and N .P Sarwade, “ of Motion Detection Method for Smart Home System”. International Journal of Innovative Research in Advanced Engineering.,Vol. 1, PP. 148-151, June.2014
- [5] S.S.Kapre, S.S.Salunkhe, R.M.Thakkar, A.P.Pawar, and O.A. Malusare ” Advanced Security Guard with PIR sensor for Commercial and Residential use”. International Journal for Advance Research in Engineering and Technology.,Vol.2, PP. 29-34,Nov.2014.
- [6] R.Delloso,” Development of an Anti- Theft Device using Motion Detection and Body Temperature”. Asian Pacific Journal of Multidisciplinary Research., Vol. 2, PP. 121-124, Dec.2014.
- [7] P. Kharat, and J. Kharat, ”Wireless Intrusion Detection System Using Wireless Sensor Network: A Conceptual Frame”. International Journal of Electronics and Electrical Engineering.,Vol. 2,PP. 80-84, June.2014.
- [8] J. Bangali, and A. Shaligram, (2013). Design and Implementation of Security System for Smart Home based on GSM technology. International Journal of Smart Home. Vol.7, PP. 201-208, Dec.2013.
- [9] D. Frejlichowski.,K. Gosciewska, P.Forczmanski, and R. Hofman, ”SmartMonitor-An Intelligent Security System for the Protection of Individuals and Small Properties with

- the Possibility of Home Automation”. Open Access Sensors.,Vol. doi: 10.339, PP .9923-9948, May.2014.
- [10] G.M.Joseph, 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 and Engineering Research., Vol.6 , PP. 232-241, Dec. 2015.
- [11] R.K.Mendoza.,B.J. Malijan, and R.B.Caldo,” Development of Smart Farm Security System with Alarm Mechanism Using Image Processing”, Lpu-Laguna Journal of Engineering and Computer Studies., Vol 3, PP. 73-84, Oct.2016.
- [12] A.V Bhatkule, U.B .Shinde, and S.R .Zanwar, “ Home based Security Control System Using Raspberry Pi and GSM”. International Journal of Innovative Research in Computer and Communication Engineering.,Vol. 4, PP. 16259-16264, Sept.2016.
- [13] M.H. Jusoh, M.F .Bin Jamali , A.F.Bin Zainal Abidin ,A.A.Sulaiman and M.F. Husin ,” Wi-Fi and GSM Based Motion Sensor for Home Security System Application”. 4th International Conference on Electronic Devices, Systems and Applications, Vol. doi: 10,1088, PP. 1-7, June.2015.
- [14] O. Eseosa, and E. Promise,” GSM Based Intelligent Home Security System for Intrusion Detection, “International Journal of Engineering and Technology.,Vol. 4, PP. 595-605, Oct.2014.
- [15] B.O. Oyebola,,” Microcontroller based motion detection alarm System using PIR sensor”. The Saapade Journal of Management, Science and Technology. Vol.1, PP .230-236, Oct.2015.