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Construction of GSM based home security alert system using passive infrared sensor

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Abstract

Security challenges in Nigeria specifically and the world everywhere have become the best difficulties of man in the ongoing occasions, because of the rising paces of wrongdoings like robberies, theft, seizing, executing and furnished burglary. The point of this undertaking was to develop a GSM based home security alert system, that will be fit for identifying an interloper, send ready message to mortgage holder, and initiate a bell caution. The security ready framework has been effectively built utilizing a uninvolved infrared (PIR) sensor. Arduino microcontroller was utilized to interface between the PIR sensor (input) and the GSM/buzzer (yield) gadgets. The PIR sensor was proposed to recognize the nearness of human and convert the identified sign into electrical voltage signal. The arduino uno was to process the flag and send directions to GSM module and buzzer, at the same time. The developed gadget was tried by enabling human to move before the PIR sensor and the GSM module sent an instant message to the mortgage holder, that there is an intruder, while the ringer sounded simultaneously, affirming its usefulness.

Keywords: Universal Serial Bus; Global System for Mobile Communication; Passive Infrared; Arduino uno microcontroller; Short Message Services; Transistor Transistor Logic

1. Introduction

Security of lives and properties is probably the best test of man today because of the skyscraper pace of violations and catastrophes. As indicated by [1-5], security is one of the primary worry of the present day, and security circumstance isn't from the rising wrongdoings yet additionally from the everyday mishaps. The reality remains that for a happy with living, in the homes, workplaces, and so forth. Security against such wrongdoings like robberies theft, attacks grabbing/killings, furnished burglary and so forth, are unavoidable. What's more, as per [5-10], individuals additionally need security from different family unit mishaps like gas spills, fire, LGP chamber blasts and other related mishaps. The aggregate all things considered and rehearses taken to give security and wellbeing of lives and properties of the property holders is the thing that home security is about. This is the reason [11-14] said that wellbeing and security are necessary piece of the meaning of home, and that we can possibly feel thusly when we are ensured. Along these lines, [15-20], depicted home security as equipment set up on a property just as close to home security rehearses [21-22].

The security equipment incorporate entryways, locks, alert frameworks, lighting, movement locators/sensors, surveillance camera frameworks and so on, that are introduced on a property, while the individual security includes practices, for example, guaranteeing that entryways and windows are shut and bolted, that cautions are actuated, that extra/save keys are not left/kept outside and in an uncovered regions. Home security framework didn't begin today. It goes back to the antiquated occasions [23-28]. In the ahead of schedule of home security, security gatekeepers or security officials were utilized to ensure the homes. Working together the above affirmation, said that home security date backs more distant than innovation as rulers and nobles utilized furnished watchmen and bastions to ensure their homes. Furthermore, to the abovementioned, canals were additionally worked around the homes and drawbridges used

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to keep intruders from the strongholds [29-34]. The above home security rehearses are still summon today as furnished and non-equipped security monitors are as yet being utilized to ensure homes and workplaces today. Most homes and office are vigorously blockaded with high rising dividers to keep interloper and intruder from increasing simple passage into the homes and workplaces. One other type of the customary home security framework that still discover wide applications in the present day home security frameworks is the local watch home security frameworks [23-26].

The main neighborhood watch program was composed in 1927 and the thought was to help the individuals who couldn't bear the cost of high – cost in home security, guard their homes from attacks. The announcement further clarified that in the local watch program, neighbors would go about as the alert by observing each other homes and the watch bunches composed watches during the higher hazard hours so as to forestall or catch lawbreakers before they could work or escape. The local watch home security frameworks are still particularly in application today at our neighborhood networks and towns even with the advanced home security frameworks.

Reality anyway is that the security framework lists and depicted above have not proficiently checked and forestalled these wrongdoings. The wrongdoing rate is on the expansion. There is not really any day that one won't hear the appalling stories (updates on) equipped burglary, robbery, robberies grabbing/murder, and assaults. And so forth similarly LGP chamber blasts, gas holes, and fire flare-ups are making the feature news every day. Without a doubt, security and wellbeing of lives and properties has gotten perhaps the best test of the residents of this incredible country called Nigeria, and the world on the loose. All the above customary home security framework have neglected to productively check the delicate security circumstances of this country. Wrongdoing rate are rising and advanced methods are being developed to perpetrate violations. It has along these lines gotten inescapable to create security framework that can coordinate the advancing modern wrongdoing methods of the present day. Joyfully enough, the innovative advances, for example, power have in no little estimates made ready to modern home security. That is reasonable a viable for the cutting edge family. The improvement of the home electro-attractive alert framework was the start of the headway in home security frameworks. ABUS security tech, Germany reports that the principal electromagnetic alert framework on the planet was at that point protected on 21 June, 1853 for the sake of a man called Augustus Russed Pope, a designer from Sommerville Boston. This first security alert was in reality extremely straightforward, battery worked and ends up being compelling for protection from gatecrasher. It was an essential structure utilizing electronically charged magnets on entryways and windows to such an extent that if entryways or windows are opened while furnished, the caution sounds to drive off the gatecrasher [14]. Looks into have prompted the heaps of enhancement for this most established security caution framework that today we have then progressively refined home computerization and security framework that can end up being successful in forestalling the rising wrongdoing circumstances in Nigeria and to world on the loose.

In this day and age of innovative headway and computerization framework has made its imprint and is likewise getting one of the quickly creating division of utilization based innovation [10]. In building up this mechanized home security framework distinctive strategy can be adjusted one of such procedures has been portrayed by [10]. This development of a ''GSM based home security ready framework'', actualizes the [10] home security framework and [15] - GSM Based Intelligent Home Security System for Intrusion Detection.

This GSM based home security alert system will be construct using the underlisted hardware components.

- 8051 microcontrollers
- GSM module (SIM 800A).
- Passive Infrared (PIR) sensor module
- Serial cable
- Mobile phone

The inactive infrared (PIR) sensor is a three terminal electronic gadget used to detect or distinguish movement. It is additionally called a movement finder or sensor. At the point when an interloper goes into the field of inclusion of the sensor, it distinguishes the nearness of the gatecrasher. The premise of its activity is that each human emanates out infrared beams or warmth radiation. The PIR (Passive Infrared) sensor picks the infrared radiations and changes over it into electrical low voltage signal. The three terminals of PIR (uninvolved infrared) sensor are the yield terminals, the inventory voltage terminal (Vcc) and the ground. The low voltage yield is taken through the "out'' terminal. It likewise has in-fabricated potentiometers to alter its affectability. Plate 1.1 underneath is an image of the detached infrared (PIR) sensor.

A. Statement of problem: Security of both lives and properties has become a big challenge everywhere today because the rate of crimes is on the increase. There are reports of thefts, burglary, robbery, kidnapping, murder, rape, etc. everywhere you go. The ways to prevent or eliminate these crimes have been a very big problem of the society today and the GSM based (wireless) home security alert system is inevitable [29-34].

B. Aim and objectives of the study: The aim of this study is to construct a GSM based home security alert system using PIR (passive infrared) sensor, microcontroller, GSM module, buzzer alarm system and an android mobile phone. To study and analyze the existing research works on home security systems.To construct a GSM based home security system using the components /chips. To test-run the constructed home security system. To package the constructed device for effective presentation, good outlook, and safe handling. To draw a conclusion and make recommendations.

Figure 1 Picture of the PIR (Passive infrared) sensor

The sign produced by the PIR (Passive infrared) sensor should have been changed over into valuable signs, name a microcontroller is utilized for this reason. The microcontroller makes or empowers interface between two frameworks and oversees correspondence between them. It is a PC on-a-chip and contains every one of the components of PC [12].

There are different adaptations of microcontrollers. The microcontroller utilized in this work is the 8051 microcontrollers. They have a place with the Intel MCS-51 family [10]. The 8051 microcontrollers has in-fabricated capacities to limit the outer circuits and gadgets. The microcontroller is the core of the home security framework, where focal handling of information happens. The microcontroller is interfaced with the PIR (aloof infrared) sensor to such an extent that the PIR (detached infrared) sensor yield is associated with the microcontroller. Microcontroller is a multi-handling gadget that gathers information from different sensors like gas/smoke sensors, PIR (uninvolved infrared) sensors, temperature sensors, and so forth and with the fitting recommended limits. In this task work, the 8051 microcontroller has been utilized to gather information from the PIR (Passive infrared) sensor. By accepting the sensor signals, it goes in the relating direction by sending AT directions to the yield gadgets.

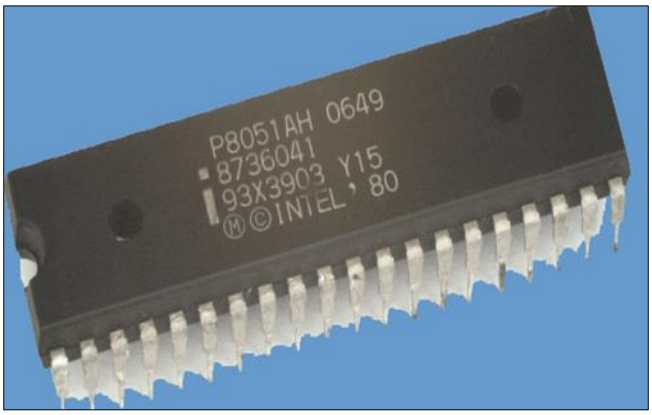

Figure 2 Picture of the 8051 microcontroller

For this development, two yield gadgets are associated with the microcontroller. They are the worldwide framework for versatile (GSM) correspondence and the ringer alert. The microcontroller in this way on getting signals from the PIR (aloof infrared) sensor, sends AT direction to the (GSM) module and bell; advising them regarding the threat, and to send SMS or sound by and large. In this undertaking, the (GSM) utilized is the GSM module SIM 800A. The alert framework is acknowledged by the bell sounded.

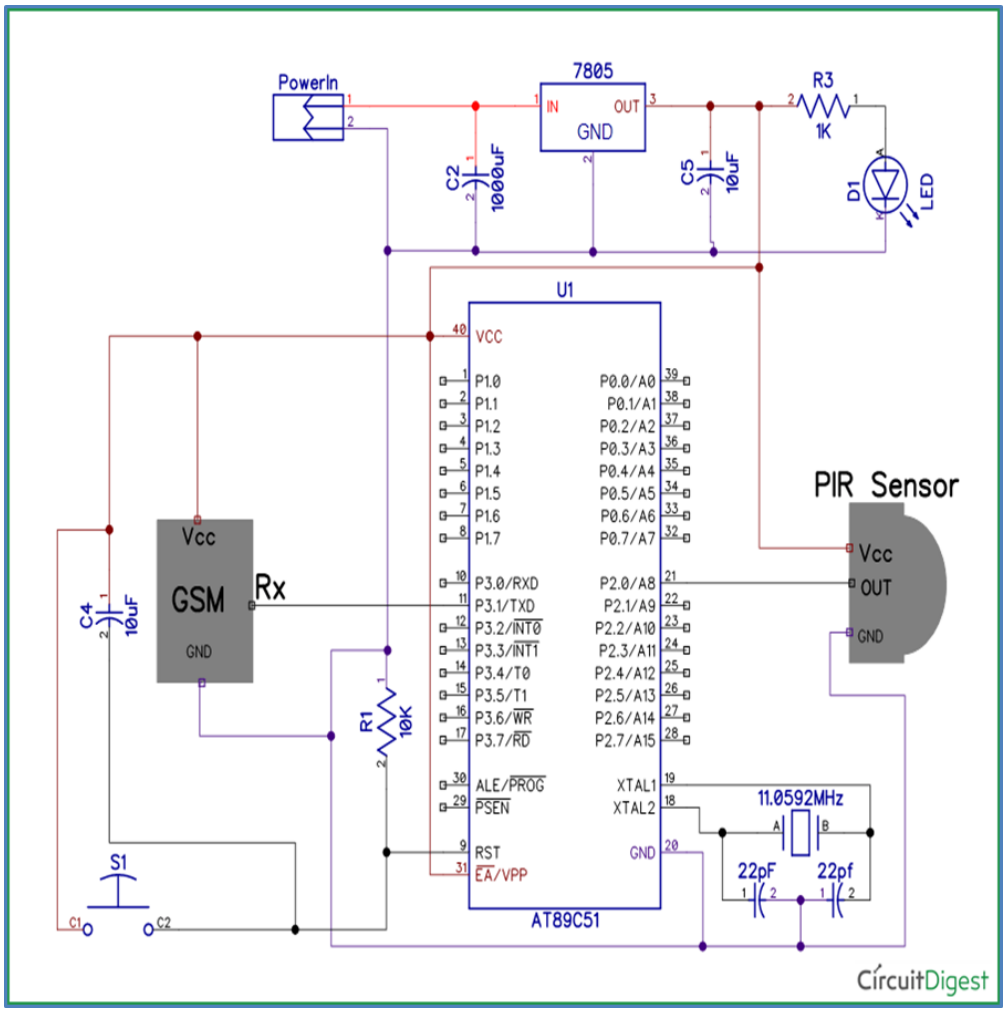

Figure 3 The microcontroller links with the (GSM) module (SIM 800A), and the buzzer alarm

The GSM module or modem enables the PC to impart over the versatile system through calls/SMS. It comprises of a SIM card and works over a membership through a portable system. It is a profoundly fitting and-play gadget fit for interfacing with a PC or any microcontroller's sequential port through MAX 232/IC. The IC is utilized to change over the TTL rationale levels of the microcontroller to a RS232 rationale levels for empowering sequential correspondence. The second control unit of the microcontroller used in this development is the caution controls. This control produces cautions of various types utilizing ringers. At the point when the ringer caution gets directions, it is enacted and sounds to report that there is an interloper.

2. Material and methods

The materials used for the implementation of the GSM based home security alert system are listed and described in this chapter. The chapter also presents step by step procedures taken to construct the security alert system.

2.1. The Passive Infrared (PIR) Sensor

The PIR sensor is a three-terminal motion detector that detects infrared radiations of living beings including humans. Every living being with body temperature above absolute zero, emits heat radiations [11]. Those heat radiations are emitted at infrared wavelength to human eyes, but visible to the passive infrared (PIR) sensor. When any living being comes within the range of coverage of the PIR sensor, it detects the infrared radiations from the living being and then converts the radiation into electrical signal voltages [18]. In this project construction, the passive Infrared (PIR) sensor detected infrared radiations of living being that was within its range of coverage. Using its inbuilt potentiometers, its sensitivity in terms of distance of coverage and ON-State duration on detecting living being (s) were adjusted appropriately. The PIR sensor's three terminals are the positive supply voltage (+Vcc), the signed output terminal (Out), and the ground (GND) terminal. The range of coverage, ON-State duration and the output voltage signal from the PIR sensor were then measured and recorded appropriately.

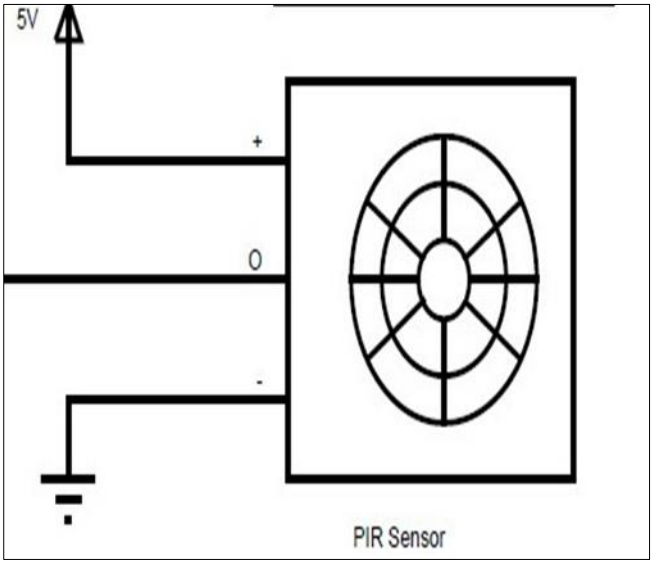

Figure 4 PIR Sensor Connection

2.2. The Arduino Uno Microcontroller

The microcontroller capacities to get the yield signal from the PIR sensor as its info. The microcontroller 1forms the sign and yield it by speaking with the venous yield gadgets including the GSM module, the Buzzer caution framework, and so forth. The Arduino Uno is a circuit board comprising of other info and yield gadgets including the microcontroller. Truth be told, the Arduino Uno is microcontroller board dependent on 8 – bit. At mega 328P, microcontroller, gem oscillator, sequential correspondence, voltage controller, and so forth, support the microcontroller. The highlights of the Arduino Uno used for this task development incorporate 14 computerized input/yield sticks out of which 6 can be utilized for beat without tweak (RWM) yields 6 simple, input pins (from A6 - A6) USB association, a force barrel jack an ICSP header and a reset catch.

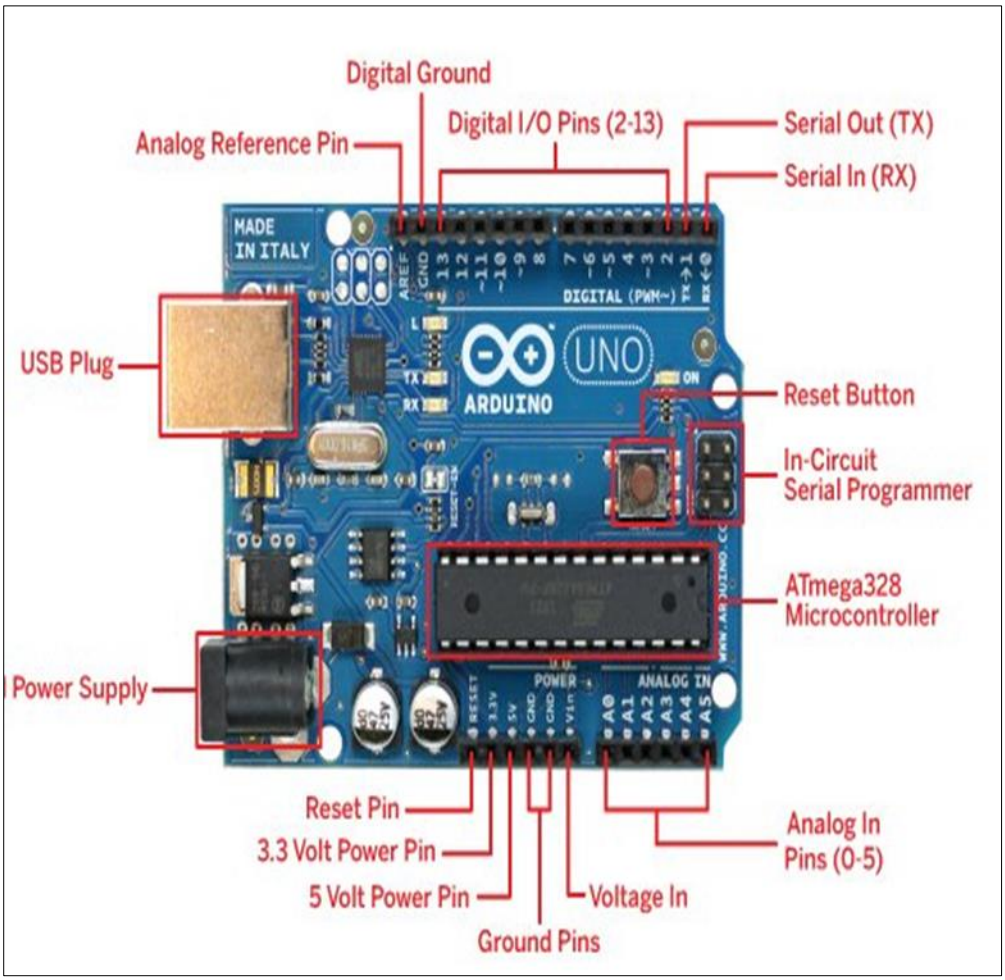

Figure 5 An Arduino Uno with pin outs and wiring

The microcontroller changes over the voltage signal from the PIR Sensor into helpful signs. It empowered interface between the PIR Sensor and the yield gadgets, the GSM module and the bell and oversees correspondence between them. It is the core of the developed GSM based security ready framework utilizing PIR Sensor. It is in the microcontroller that the focal preparing of the information happens. So the yield of the PIR Sensor was associated with the microcontroller. The Arduino Uno was then customized fittingly, underneath, in order to speak with the GSM module send instant messages and make considers when the PIR sensor recognized an interloper, just as initiate the bell to sound, to alarm close by people or neighbors about the nearness of a gatecrasher. The developed gadget was tried and it communicated something specific "there is an interloper" to a coded cell phone.

2.3. GSM Module

GSM modules generally, are fascinating to use, especially when there is need for remote access. They perform all actions that normal mobile phones do such as making/receiving calls, sending/receiving a SMS, connecting to internet using GPRS, etc. Normal microphones and speakers can also be connected to the GSM module. In this project constructed globalization for mobile network (GSM), SIM 900A modern has been used. Figure 3.3 below shows the GSM SIM 900A modem.

Figure 6 GSM Module used for the construction of GSM Based home security alert using PIR Sensor

The SIM 900A modem is worked with Dual Band GSM/GPRS based. The modem chips away at frequencies of 900/1800MHZ. SIM 900 inquiries the two groups naturally. It is additionally conceivable to set the recurrence groups being at plugs. SIM 900 is a Ultra reduced and solid remote module. For the viable use of the GSM module, the SIM card was embedded into the GSM module and very much bolted. The GSM was then fueled through a 5V power arrangement on the Arduino board and ground (cress). The radio wire was fittingly associated and after about I minute the status LED started to flicker. The module set up organizes and the LED flickers persistently in like clockwork. The GSM was then interfacing with the proper Arduino Pms (i.e GSM's 5VT to Arduino's D and GSM's 5VR to Arduino's D1) for sequential correspondence among Arduino and SIM 900A module. The signal was likewise appropriately interfaced with the microcontroller. The microcontroller had the option to send directions to the interfaced GSM module and the ringer to be enacted once there was a gatecrasher inside the activity scope of the PIR Sensor. This was tried by permitting human move into the activity scope of the PIR Sensor. The built gadget sent instant messages to the coded cell phone about an interloper. The ringer alert was additionally actuated at the same time.

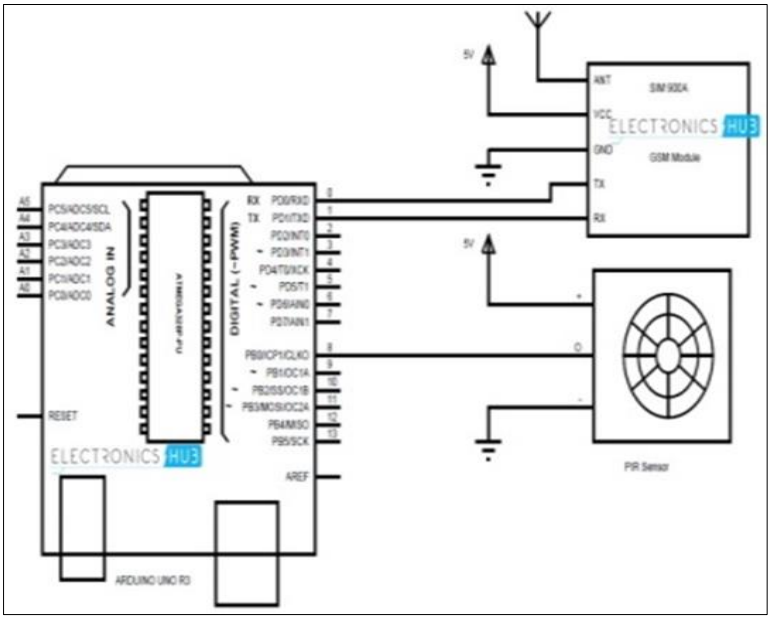

Figure 7 Complete Circuit diagram of the GSM based home security alert system using PIR Sensor, Arduino Uno (microcontroller), GSM Module and Buzzer alarm

3. Tests/Results, discussion and cost analysis

This chapter presents the various tests/measurements performed on the constructed GSM Based Home Security Alert System. In addition, it presents, and discusses the results of these tests/measurements. The chapter also presents the cost analysis of the materials used for the construction of this device.

3.1. Tests/Measurements

- The supply voltage (+Vcc) to the PIR sensor was measured and recorded.
- The PIR sensors output voltage was measured and recorded accordingly.
- The output voltage signal from the microcontroller to the buzzer and GSM modem were also determined and
- recorded.
- The range of coverage of the PIR sensor was measured and recorded by allowing a living being to approach it
- from a distance.
- The duration of the on-state of the device was also measured and recorded.
- The effective operations of the device in terms of communication was observed.

3.2. Results of tests/measurement

- (i) The supply voltage (+Vcc) = +5.0Vdc
- (ii) The PIR sensor's output voltage signal = 3.3Vdc
- (iii) The microcontroller's output voltages to the buzzer and GSM module = 9V and 5V
- (iv) The range of coverage of the PIR sensor = 5 meters
- (v) Duration of the on-state of the device = 43 seconds
- (vi) The device effectively sends text message to the coded mobile phone number "there is an intruder**".**

3.3. Discussion

In this project work, the construction of an efficient, low cost GSM based home security alert system was carried out. The device can detect the presence of an intruder and an alert the user or home owner through text message, and buzzer alarm system. These have been successfully achieved as the constructed device was able to detect the presence of an intruder at a distance of about 5 meters away and consequently sent an SMS to the home owner and also activated the buzzer alarm to sound simultaneously. This simple but very effective GSM based home security alert system has been constructed using common passive and active electronic components that are very readily available locally and cheap too. The design and construction was not complex and could be designed and constructed by most homes, offices and industries, to protect their lives and properties especially even when they are not at home. The device can immensely control crime rates because with the SMS and alarm systems, the home owners can always contact the appropriate security, out fits, even when far away from home in case of any intruding actions.

3.4. Costing

The cost analysis of the materials used for this project construction is summarized in Table 4.1 below.

Table 1 Cost analysis of the materials used for this project construction

S/N	Materials Description	Quantity	Unit cost (₦)	Total cost (₦)
1	PIR sensor	1	1,500	1,500
2	Arduino Uno microcontroller	1	3,500	3,500
3	GSM module (SIM 900A) modem	1	1,500	1,500
4	Buzzer	1	500	500
5	9V battery	1	100	100
6	Connecting wires	Lot	200	200
7	Casing	Lot	1,000	1,000
Total				₦8,300

The cost for the construction of the GSM base home security alert system is ₦8,300 while the market price of the same security alert system is between ₦18,000 and ₦25,000.00. It is therefore cost effective to construct it than to purchase it ready made.

4. Conclusion

A GSM based home security alert system has been successfully constructed with very cheap and locally available passive and active electronic components. This device is simple to build, easy to maintain and very portable. The device can go a long way to solving/reducing the crime rates as it can effectively contact the home owners, even when far away from home.

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