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# MOTION INTRUSION DETECTING SYSTEM WITH LIGHT AND ALARM

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***ABSTRACT***

*This research work deals with the design and construction of an automatic triggered bell ringer circuit with LED lighting system to light up on the intruder. The light resistivity is internally configured infrared beam directly and projected permanently outward from the motion sensor module. The movement detected on the motion sensor module triggers a buzzer alarm and once this happens, the resistance tends to infinity and voltage dropped across the internally base diode why the transistor are sensed at the output of the motion sensor module. The major components used are the comparator (LM358), timer (NE555) and voltage monitor (LM3914) etc.*

***Keywords: Alarm, Beam, lighting, motion, module, sensor, security, vicinity.***

## INTRODUCTION

Security of lives and property is a major challenge globally and Nigeria is not an exception. Security is one of the important concepts of the world and every country is always security conscious of her domain.

### Background of the study

In most developing countries, the demand for increased security measures is on the rise on a daily basis, making security one of the highest basic necessities. In Nigeria, there is rather an increase in crime rate ostensibly due to its huge population size, poverty, poor governance, and corruption. Hence, the need to have strong security architecture in both domestic and commercial vicinities is of paramount necessity. In reacting to these challenges which has become a national issue, the idea of the construction of an automatic triggered alarm ringer circuit (which could also be regarded as a motion detector or an intruder successful in a reasonable and agreeable extent. As it is crucial to have a security system which would not only secure the premises but also increases the chances to capture criminals due to initial ignorance of the devices presence. Unlike false alarms, normal motion detectors are capable of distinguishing the presence of both human and animal, hence avoid false alarms. Most security systems implement this approach to overcome false alarm problems without involving high costs. Additionally, it is also significant to have a simple alarm base that will be difficult to be hacked into as it lacks any programming features, and can be conveniently operated without the requirement of wireless internet connections. Bin Wa, and Zhongring tc (2001) categorized security systems as hardwired, wireless and hybrid systems it is stated that most alarm systems are hardwired.

### Problem Statement

There are some needs that lead to the development of this research and constructed project work. Also in the invention of intrusion detecting system with motion detection security light and alarm. Among others, they are as follows: -

1. The question to live more secure in the rising insecurity issues that is wide spread across Nigeria.
2. The need to have an unnoticeable criminal presence detector and alert system which can be used in the silent mode to just switch on the LED light on the intruder.
3. To achieve a fast and false alarm free security system.
4. To have a rechargeable security system without 100% dependence on public power supply, as the public power supply in Nigeria is unreliable.

**Aim and Objective of the study**

The aim of this project is to design an intruder alert system that will trigger an alarm when human presence is sensed (movement) and also activate a bright light towards the direction where movement is sensed to make the intruder visible and identifiable.

The objectives of the project are;

1. To understand the user needs for security light and alarm system through research and to design a practical security light motion and alarm.
2. To build a reliable light source at night for the users as the power supply in the country is insufficient to the user.
3. To implement all the basic features that, one would normally expect to find on a standard security light and alarm.

**Scope of the study**

The scope of the study is to design and construct an invincible beam breaker security alarm system that can be used everywhere, including home, offices, airports, showrooms, industries, etc where preopr security is to be ensured.

1. It covers the range of 50-meters radial from the point where is been positon.
2. It senses the movement of human being within the range or radius where is been mounted.
3. It has the resistivity of light that is configured from internally infrared beam.

**Significance of the project**

This device functions as an electronics watch dog. This device also functions as a major security alarms used in residential, commercial industrial and military properties for protection against burglary (theft) or property damage, as well as personal protection against intruders.

**Materials**

During the past 15years, there has been a substantial amount of research into the development of new condition monitoring techniques.

In 1972, 'Mark donason' (Dutch scientist), made the first discovery of intruder sensor with a mechanism using a natural intruder. He invented the intruder sensor as early as 1970, but his design was not built before his death.

In 1980, some group of scientist known as Jeorge and James carried out an experimentation to know how the intruder sensor detects the presence of human. This experiment was concluded as when human draw-close to it and makes a move on it will then detect and send a signal. During the year 1983, there was a research work that was done in England by some scientist called Jonathan and Mori, carried out a research work that led to the conclusion of intruder alarm and how it triggered. As things went on, later in 1991, in US, Kelvin don set a panel for further investigation and research on how the sensor detect human presence. This draw to a concluded research work towards human presence to the sensor. Nelson at (1997) in British, introduced intruder motion detectors as its main sensors instead of the intruder having to match an underground switch before alarm is sounded. Bin Wa, and Zhongring tc (2001) presented the simulation of a three phase monitor of systems (at three different positions) using LEDs as its detection indicators. This system worked in such a way that when an intruder passes an unauthorized area, he mistakenly matches some implanted underground switches which will help On the LEDs to indicate an intruder. Hamid negarin et al (2000) presented a methodology by which some limitation of Bin Wa and Zhongring tc work will be improved upon by introducing buzzers to intruder alarm systems for alerting the owners even if they are not looking at the indicator LEDs as at the time of the intention. Nakanurqa of at (2006) later proposed a new motion of intruder alarm system using motion detectors as its main sensors so instead of the intruder having to match an underground switch before alarm is sounded, only the presence of the intruder is able to trigger the intruder alarm. This was a very big breakthrough for Nakanura.

In later years, Nakanura's intruder alarm system was later improved upon and enhances to be more stable by making use of batteries as it was formally used on public power supply which may fail at some point. And the system was later made to be a rechargeable type so that the user does not need to buy batteries on intervals anymore. They achieved this by using a transformer and rectifier to convert A.C into D.C and using the resultant power to change the lead acid rechargeable battery, before this, the used transformer to step down the high volts 220VA.C to 120V.

The motion sensor based intruder alarm was actually achieved in such a way that when motion is detected by the motion sensor module, it sounds a high signal to the comparator (LM358) in its non-inverting terminal. The signal is now being powered by the LM358 comparator to activate transistors and relays and then alarm is sounded for some time and automatically steps because of the present of NE555 mono-stable multi-vibrator circuit by making our own intruder alarm to be interfaced with lighting system (Bright LED lights) and buzzer in such a way that immediately the intruder is sensed by the motion detector module, not only will the alarm be activated but a very bright light is shown on the intruder so that his/her location is easily identified and necessary security measures is taken.

In our own project, we can switch off the alarm part of the design so that the said intruder will not even know that he/she has been caught. This will allow the user enough time to alert necessary security personnel

## METHODOLOGY

### Block diagram description

The block diagram for the proposed design is given in fig 3.1below. it consists of a transformer, diodes for rectification, capacitor for filtering the motion sensor module, a comparator unit to interpret messages from the motion sensor module! Two mono-stable multi-vibrator (MMV) circuits for initiating delay, switching circuit that virtually controls all activities in the system, the alarm unit and LED unit. The block diagram is below.

### Circuit diagram description

The operation circuit comprises of two monitoring stages, (the Alarm stage and lighting stage). The alarm stages start to bring up sound automatically when the pin sensor senses that someone is moving around its perimeter (according to the present sensitivity) and at the same time, the LED lights also comes up. After 5minutes, if the movement is no longer sensed by the motion sensor module, then the alarm will twin off but the light continues to be On for 10minutes before it finally goes OFF. The transistor Q1being BC547 (NPN transistor), whenever the motion sensor output is high, it then triggers the base of Q1 and the collector of Q1 becomes low. It is connected to the inverting input of a comparator whose non-inventing terminal is being fizzed to 5volt which uses a variable resistor. It makes the non-inventing terminal of the comparator (LM 358) to be higher in voltage than the inventing terminal, then the comparator output is set high. This high output of LM358 is now being sent to transistor Q2 and Q3 to activate the mono-stable multi-vibrator (MMV1) and (MMV2). Mono-stable multi-vibrator goes high in its output when it is triggered and automatically goes back low after 10 seconds if the triggering signal is absent. MMV1 controls the alarm through a mosfet (metal oxide semiconductor field effect transistor) and MMV2 controls the light through another mosfet. The mosfet used is transistor (INF3205) for both of them and MMV1 was configured to last for 5seconds while the MMV2 is configured to last for 10 seconds.

### Principle of operation

The circuit utilizes an operational amplifier (OP amp) whose name is LM358 configured as a comparator to monitor changes in the output voltage level for the pin sensor since the motion sensor module changes its output from low (0) to high (5V) when motion is sensed and changes

from high (1) to low (O). When no motion is not sensed, the output of the motion sensor was connected to the base of the transistor Q1 being BC547 (NPN transistor. Therefore, whenever the motion sensor output is high, it triggers the base of Q1 and the collector of Q1 becomes low but this collector is connected to the inverting input of a comparator, whose non inverting terminal is being fizzed to 5V using a variable resistor.

This makes the non-inverting terminal of the comparator (LM358) to be higher in voltage than the inverting terminal, and then the comparator output is set high. This high output of LM358 is now being sent to transistor Q2 and Q3 to activate mono-stable multi-vibrator (MMV)1 and the (MMV)2 respectively. As already known, mono-stable multi-vibrator goes high in its output when it is triggered and automatically goes back low after a while if the triggering singed is absent. This feature of an MMV was absolutely utilized in this project in the sense that MMV1 controls the alarm through a MOSFET (Metal oxide semiconductor field effect transistor) and MMV2 controls the light through another MOSFET. The MOSFET used is transistor (INF3205) for both MOSFET 1 and 2. The MMV1 was configured to last for 5 seconds while the MMV2 is configured to last for 10 seconds, this is why on activation of the alarm (being controlled by MMV1) will deactivate first before the light (connected to MMV2). The formula for calculating the delay timing of an MMV, is

$T_{(s)} = R\propto x\ C_{(f)} x\ 0.693$.....1

The parameters in equation 1

Where "t" is the total time taken for the mono-stable multi-vibrator (MMV)

"C" is the capacitor in farads

"R" is the resistance on Ohms

"$\alpha$" is the alpha

**Segments/components of the system**

These are the components used in the construction of intruder motion detecting system.

i. **Transformer**

A transformer is a device that is made up of the cause of elimination (laminations) and a former tow house delaminating basically a transformer is used to step up and step down AC voltage (alternating-circuit). It can be used as a single device to step up small AC voltage say 12volts to 220volts or to step down larger AC voltage of about 220volts down to 12volts and so on in this project we used the step down transformer to supply 12volts to a circuit because we design the circuit to work on 12volts. The battery uses the light and other components like buzzer is rated to 12volts as well as below is the specification of the transformer used for this project.

Input Voltage = 220-240v (AC)

Output Voltage = 12v (AC)

Output Current = 500ma (AC

ii. **Rectification/Filtration**

A rectifier is a circuit basically made up of diodes which allows current to flow only in one direction but AC voltage outputted from the transformer although 12 volts is still AC and because of the above property of a diode it is now used to build a full bridge rectifier so cute to convert AC (moving into direction) to DC (moving in only one direction) the filtration section on the other hand is made up of capacitors both polarized and non-polarized capacitors are used to store charges and because of this characteristics of theirs, they help in filtering ripples that may escape from the rectifier unit. This help to ensure pure DC output voltage of the capacitors used in this project for filtering is 4700 microfarads by 50volts. Polarized capacitor and 0.1microfarad ($10^4$) ceramic capacitors.

iii. **Rechargeable battery unit**

A battery has already known as a device that has the ability to store charges for later use of the batteries general store DC voltages and rechargeable batteries are those types that can be

recycled after use in this project will use rechargeable battery for the powering. This is to make our system not to depend 100% on public power supply of the specification of the battery used in this project is below.
Battery Voltage rated at 12V
Battery ah rated at 2ah

iv. **Charge controller**

Since a battery needs to be charged then charging rate and charging level needs to be checked this is why we build a charge controller circuit to monitor the battery voltage at all times this charge controller circuit is actually made up of comparators and MOSFET inn order to control the battery charge so we set this battery change controller to stop charging the battery whenever the battery is as high as 13.5volts, this will help the battery to last longer.

**V. The Alarm**

The alarm section consists of a buzzer which will give a very loud beep sound when an intruder is detected this boxer can be regulated in such a way that the sound which doesn't give sound even if intruder is detected but only light comes up, these controls features are located in the switching circuit so there is a specific switch to silent the alarm of this device, the buzzer used for this device is a 12 volts' buzzer.

**vi. Comparator unit**

A motion sensor is a device that senses motion, it achieve this with the use of infrared light and infrared receiver that the motion sensor used in this device is the SB 612/V1.4 motion sensor module. This model is powered by 5volts fixed power supply and when it senses movement is sent out high voltage (5V) at its output this 5V is now latter being used by the circuit (comparator) to control two mono-stable multi-vibrator of the comparator unit is wired thus. The non-inverting input of the comparator what's connected to the output of motion sensor module with this configuration that the comparator is triggered whenever motion sensor sent out high signal.

**vii. Mono-stable multi-vibrator**

A Mono-table Multi-vibrator is a circuit that is table only in one portion that is the off position it works in such a way that when it is triggered, the output is set to be high even after the triggering signal is removed but this high output will only take a time to determine by the designer of the circuit and then it switches off again NE555IC was used to achieved a Mono-stable Multi-vibrator circuit in our project being very versatility and stable NE555IC was used and is controlled by the formula below.

$t = 0.693 \times RC$.....2

Where t = time in seconds
r = resistor on ohms
c = capacitor in farads

The R1 and C1 controls the time of the Mono-stable Multi-vibrator of two of these kinds of circuit which was used in this project. The first one is to control the alarm and the second one is to control the light we made first.

**viii. The switches unit-**The switching circuit is basically consisting of transistors and MOSFET and resistance which are responsible for receiving signals from the different unit of the system and sending out and light respectively. This unit is also responsible for our indicators which are several indicators in this device, one of them shows when a battery is charging and the other shows when the battery is full there is also an indicator connected with the alarm so that as long as the alarm is blowing the LED is on and switching un it controls them all.

**ix. The LED light**

The LED light section consist of 12volts LED that is very bright. This lighting system will come up and stay longer than the buzzer so that everywhere will still be visible even some seconds after the intruder is sensed.

## Construction testing and packaging

### Components for the Construction

The various components used in the constitution of intruder motion detector sensor light and alarm are listed in the table below.

**Material/components and requirements value (Researchers, 2019)**

**Table 1**

| Components | Values | Quantity |
|---|---|---|
| Transformer | 12V,1.5A | 1 |
| Diode | IN4007 | 5 |
| Capacitor | 1000nf | 1 |
| Mosfet | Inf3205 | 2 |
| Resistor | 10k | 7 |
| OP-amp | Lm358 | 1 |
| Spinic socket | 8pin | 2 |
| Zener Diode | 5V | 1 |
| Variable Resistor | 10k | 2 |
| PIR module | PIR | 1 |
| Transistor | BC547 | 3 |
| Voltage Regulator | L7805 | 1 |
| Battery | 12V | 2 |
| NE555 | NE555 | 1 |
| LED light | 12V | 1 |
| Buzzer | 12V | 1 |
| Adaptable | 6 by 9 | 1 |
| Soldering led | 0.5mm | 4yards |

### Construction

This was with reference to the circuit diagram following each unit in the block diagram and the steps involved in the construction process.

**Step 1:** After providing the rechargeable battery that was used to power the system, next was fixing each component in the comparator unit.

**Step 2:** The components were carefully and firmly placed from points to every unit before soldering take place.

**Step 3:** The polarity of each component were observed from the positive to the negative charge before fixing it right and soldering them in order to avoid ineffective efficient in the circuit.

### Tools for the Construction

1. **Multi-meter**: A multi-meter is a meter for measuring multiple parameters like voltage, resistance and current etc used for testing the connectivity to clear any problem of short circuiting.
2. **Plier**: It is used for holding and bending the components to be soldered has been soldered as well as removing of insulation.
3. **Soldering Iron:** It is used for melting the soldering lead for soldering components to the circuit board.
4. **De-soldering pump (sucker**): It is used to remove soldering lead from the circuit board after melting.

5. **Cutter**: It is used for cutting wires.
6. **Razor Blade**: It is used to peal connecting wires and for cutting the circuit board.
7. **Brush**: It is used to clear the surface of the circuit board

**Testing**

**Table2:** Shows the testing results of the construction.

| **Component under test** | **Rated value** | **Tested real life value** |
|---|---|---|
| Resistors | 10K, 1K | 9.87K, 0.972K |
| Battery | 12V | 12.5V |
| Capacitors | 100μf | 99μf |
| Transistors | 520 gain | 610gain |
| LED bulb | 12V | 12V |
| Buzzer | 12V | 12V |

On the completion of the circuit construction, it was inspected and tested severally using PROTEUS to simulate the circuit, and was found to be working satisfactorily. The component were tested each by using the multi-meter to find out if they are okay by setting the multi-meter to the continuity, the wires are connected in the major circuit before the final soldering of the circuit to a very board.

Finally, testing the power supply output as the multi-meter was set to a DC voltage output through a regulator that is given to circuit and the output gave 12VDC.

**Packaging**

This is the process of housing the circuit. They include the following choice made:

a. The effectiveness of the sensor to detect movement.
b. The cost of materials in the market.
c. The beauty of the physical outlook of our system after finish.

**Specification in the packaging**

1. The packaging use was 6 by 9-inch adaptable box.
2. The height of the box is 10 square meter.
3. The LED light was placed on top of the box as well as the sensor module.

Therefore, these reasons or consideration brought us into giving the system this type of casing which is the plastic casing, although there are many other materials like wood and metal etc that could be used but due to the low conductivity of plastic and the beautiful look after finishing this plastic casing was used.

**Result obtained**

**Analysis**

This project construction and design of automatic trigger bell ringer circuit that deals with the motion detector system with LED lighting up on the introducer when it detect human presence.

This movement which detected on the motion sensor module triggers a buzzer alarm and once this happens, it resistance tends to infinity the voltage which dropped across the internally based diode. Therefore, the light is configured from the infrared beam which is directly projected and permanently outward from the motion sensor module.

It covers the area of two meters' inch from the place which it detects or receive signal from human presence.

**Observation**

1. It was noticed that immediately the system was powered ON, the alarm keep blaring, and the LED light ON with great intensity. This indicates the detection of a movement around it.

2. It was observed that after about 5 seconds, the alarm stopped blaring, the LED light was still ON, but within 15seconds from the time the alarm stopped blaring, the bright LED light automatically switched OFF.

## SUMMARY

This device is an electronic device that is designed and installed in a house or building not in a clearly visible area but with an invisible radius where movement by the intruder is to be detected, the LED bright light to illuminate the area increases the security condition of a house. The circuit designed system is equipped with an alarm system which senses to detect movement from a human. It then sends a signal to a comparator where the non-inverting input, and the output is sent as a high logic to the switching circuit. This has the ability to score intruders always and notify the owner so that necessary security measures can be taken.

## CONCLUSION

The realization of this work is a technical breakthrough in a right direction. As a result, the design met its desired output as a motion detector with security light, and alarm system.

However, dispute the difficulties encountered in the construction process, the motion detecting system work was an interesting exercise. In the course of carrying out this work, a lot of knowledge in the operation of this system was proper connecting of components and effective soldering techniques were acquired.

The workability and effectiveness of this project can provide a lot of help to various students who are into constructions that uses this type of motion sensor for further more research.

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