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NIGERIAN BUILDING AND ROAD RESEARCH INSTITUTE

(Ministry of Science, Technology and Innovations)

BUILDING RESEARCH DEPARTMENT

RESEARCH PROPOSAL

ON

DESIGN AND CONSTRUCTION OF FOUR SENSORED BURGLAR ALERT SYSTEM

JULY, 2022

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ABSTRACT

The project “Design and Construction of a Four-Sensored Burglar Alert System” involves the use of the NE556 dual timer integrated circuit as a triggering device, light dependent resistors, door switches in conjunction with a touch point configured as a sensing devices coupled together as a system, the system is used for security purpose in order to reduce the rate of burglary in our homes, industries and society in general. The system can detect the presence of a burglar in four different ways using the different sensing units which are LDR1, LDR2, Door switches and a touch point. The system triggers an alarm when light falls on LDR1 at the entry of premises, when light falling on LDR2 is obstructed, when door switches are opened or a wire is broken and when a handle as a touch point is touched.

1.0 General Introduction

1.1 Introduction

Through the expansion of the social order and the standard living it has driven the high level of crimes, particularly home raid and business premises robberies which happens daily. Definitely fencing, burglar bars on the doors and windows are now distant from the necessity of home security, other than that these systems should be switched with well modernized and brainy alarm system.

Why security is important? Home or business premises security is undeniably important in the current world. Whether you are away or inside your property the common question is, is your property safe? The security matter is not regulated to homeowners; it is widely emphasis in order to protect your property against potential break-in.

Security has been defined as safety from harm. Considering the current global Security environment, the importance of good physical security is difficult to ignore. Physical security services are becoming private rather than public service i.e. individuals and organizations tend to hire private security firms and install security equipment and use the police as the backup [1]. Physical security has seen less attention and it is primarily an applied field, it has no dedicated line of research. Instead, it is scattered through fields like engineering, computer science, chemistry and physics as well as social sciences such as criminology, sociology and psychology [2]. Providing security relies on two main elements; i.e. equipment or technology and People: Security is an important aspect of all our lives. A secure environment tends to give individuals rest of mind. However, Theft rates have increased causing disharmony in the areas where such events occur. This sometimes leads to unpleasant occurrences such as fights and sometimes injuries.

Burglary is defined as the unlawful entry into almost any structure (not just a home or business) with the intent to commit any crime inside (not just theft). No physical breaking and entering is required; the offender may simply trespass through an open door. Unlike robbery, which involves used of force or fear to obtain another person's property, there is usually no victim present during a burglary [3].

This project "Four-sensored Burglar alert System" would be designed to be constructed in order to reduce the rate of burglary in our society and hence improve security. The project when completed will be cheaper as it can be afforded with a low cost, durable and reliable. The idea of designing and constructing of a Four- sensored Burglar alert system is to find electronics means of detecting a Burglar in four different sensing ways which are; when light falls on LDR, when light falling on LDR is obstructed, when door switches are opened or a wire is broken and when a handle is touched [4].

1.2 Aim and Objectives

1.2.1 AIMS

The aim of this project is to design and construct a simple, cheaper and reliable burglar alarming system that detects the presence of a burglar in four different ways in order to minimize the high rate of criminal activities in our homes, offices and firms.

1.2.2 Objectives

The objectives of this project are:

i- To configure NE556 timer integrated circuit as a triggering device

ii- To use Light Dependent Resistors (LDRs) as a burglar sensing device, i.e. to develop reliable means that can be used to realized alarm security system.

iii- To construct a complete burglar alarm circuit using the sensing device, available ring device and other different electronics components, i.e. developing an electronics circuit for causing automatic alerting in the form of an alarm.

iv- To test different electronic components and to identify their specification from the data sheet

v- Designing and build the burglar alarm system and test its functionality and the system to contain audible only.

1.3 PROJECT MOTIVATION

The electronics technology is the bedrock of the development and economics growth of any developed country, it is a well-established fact that the rate of development of a society or a' country is often measured in terms of the level of engineering practices carried out within that society or country. Also, the major objective of engineering is to utilize the available resources of nature to restore the dignity of man by improving the comfort timeliness of operations as well as removing the drudgery usually associated with the performance of labour intensive, time-consuming activities of mankind.

There is need to undertake project that may have positive impact on the technology of a country. This project is embarked upon to undertake research work that would come out with design of Four-sensored Burglar alert System which will play an important role in the security of our homes, companies, schools, etc., in order to save properties against burglary.

1.3 PROJECT SCOPE

The scope of this project is geared towards designing and constructing of a Four-sensored Burglar Alert System that can be used to detect any burglar or intruder by alarming in order to stop him from unauthorized access to our premises or properties.

Therefore, the scope of this project is limited to rooms with only one entrance and exit. Such rooms include stores, living room, or house main entrance. Such rooms ensure that all individuals accessing the room can only access the room and leave the room via one door. Also, the project can be able to detect an intruder when one of the sensors was activated only, i.e. by obstructing or blocking the light falling on one of the LDR sensor or flashing of light to the other LDR sensor, touching a point of high potential or by cutting a wire loop in form of switch.

2.0 Literature of Related Literature

This chapter recalls the past projects which use the idea of using sensing devices for the implementation of an electronic security system that are related to this project. It also reviews the principle of the electronics components used in the project and how they are used to the design process. The components that make the circuit are also fully discussed. These include Buzzer, Capacitor, Diode, Resistor, Transistor, Switch, Light Dependent Resistor, Voltage regulator and Relay.

2.1 Previous Works

The idea of using sensing devices for convenience, safety, security and quality of service purpose is not new, but the application cost, design method and reliability of the system varies. “Burglar Alarm” by Rana Sampson, United State Development of Justice. The burglar alarm is made from complete electronic circuit loop where by the loop is closed with a bell at the output or a siren so as to alert the owner of what so ever is secured [5]. A central control box monitors several motions detectors and perimeters guards and sound an alarm when any of them are triggered. Some burglars' alarms work on the concept of magnetic contacts and others on sensitivity. For those that works on sensors, the sensors are normally placed in the entrance of any building or restricted entrance of the rooms, in which if the sensor receive a signal above the threshold value set for it, it activate an alarm. Nowadays, closed circuit televisions are incorporated to burglar alarm to detect the presence of unauthorized persons.

Another similar project related to the Four-Sensored Burglar Alarm System is a project titled " Development of a Simple Sound Activated Burglar Alarm System" by Mahmud Shehu and Abubakar Sadiq, Department Of Electrical and computer Engineering, Federal University of Technology, Minna. The operation of this burglar alarm is simple, when the intensity of sound exceeds certain intensity, the alarm is triggered and the siren begins to operate. The speaker beeps and the flasher (light) flashes, these actions thus alert the owner of the residence and or security personnel of the presence of an intruder [6].

A Simple and Reliable Touch Sensitive Security System" by Adamu Murtala, School of Electrical and Electronic Engineering, University of Nottingham, Malaysia, the system is divided into three units, the power supply unit which employs the use of both DC battery and mains supply to ensure constant power supply to the circuit, the trigger unit which is responsible for activating the alarm unit and designed to have much time and period and more sensitivity in order to reduce the rate of false alarm, and the alarm amplitude unit which main function is to produce amplitude alarm sound when triggered by the trigger unit with the main the aim of producing a large audible sound that can alert the entire neighborhood or scare an intruder away[7].

Another project titled “Design and Construction of Motion Intruder Detector” by Jubril Olalekan Yakubu, Department of Electrical Engineering, Bayero University, Kano. The system uses an infrared sensor {IRTSOP sensor} and infrared ray {IR} receiver to detects the presence of an intruder when the infrared rays are intercepted, but the only problems associated with the system is that the system detects the presence of an intruder in only one way and the cost of the sensor and receiver are high. Also reliability of the system is somehow low [8].

A similar project titled “Design and Construction of an Automatic Triggered Bell Ringer Circuit” by Adamu Murtala Zungeru and Ijemaru Gerald Kelechi, Department of Electrical and computer Engineering, Federal University of Technology, Minna. This introduces the use of two sensors, sensors that depict the concepts of pressure and light resistivity and conductivity respectively, and a laser beam directly projected permanently on the light sensors surface. A force exerted on the force sensor triggers a buzzer alarm and likewise, an obstruction in the path of the laser triggers the buzzer alarm. Once there is pressure exerted on the force sensor, the resistance tends to infinity and voltage dropped across it biases the diode and transistor and the voltage reaching the buzzer trigger it [9].

However, a similar project titled “Design and Construction of a Light Sensitive Security System” by Salako Murtala Adetunji, Department of Electrical and Computer Engineering, Federal University of Technology, Minna. The sensor pad which is light dependent in this system is mounted at the presence of persons and set on the necessary alarm to alert the occupant of the house. The main parts of the security alarm system are the power supply unit, the light sensor unit, transistor switch unit, the monostable multivibrator and alarm unit. This system is capable of raising an alarm when someone is at the entrance into the building. As a person comes to the entrance of the building, the sensor pad placed at the door detects that particular person as he blocks the rays of light falling on it, the signal from the sensor pad is pad is fed to the monostable multivibrator and it will be set to a high and once it is set, the transistor will be switched on and subsequently activates the relay whose output is fed to the buzzer [10].

The “Four-Sensored Burglar Alert System” is designed to be constructed in order to reduce the rate of burglary in our society and hence improve security. The system is divided into five stages or units (figure 1). The units are: Power supply unit; Sensing unit; Triggering unit, Switching unit and Sounding unit (Buzzer)

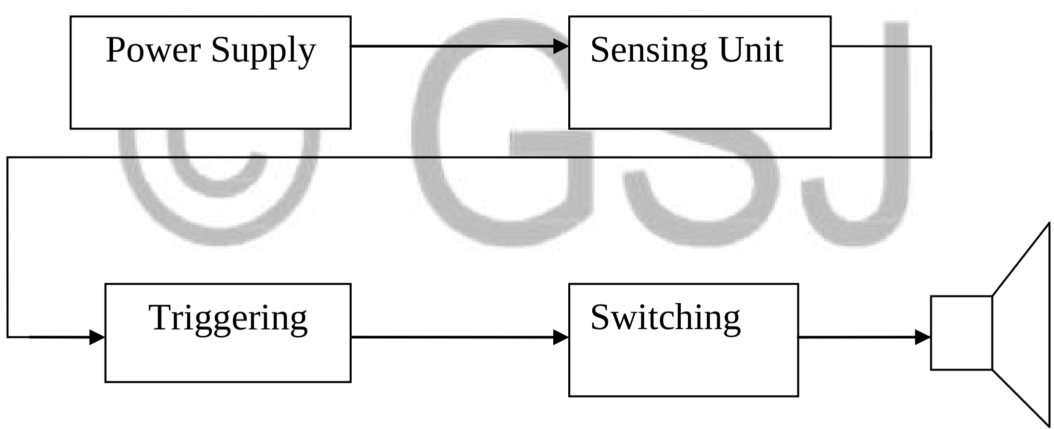

Figure 2.1 Block diagram of the system

2.2 Basic Components

2.2.1 Voltage Regulator

The voltage regulator used in this project is a fixed linear voltage regulator. There are many IC regulators available that produces a fixed positive output voltage. The

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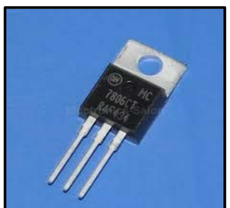
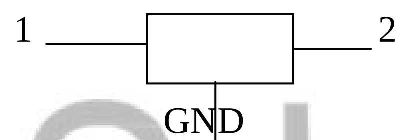
78XX series is representative of three terminals device with several fixed positive output voltage which make them useful in a wide range of applications [12].

The change in voltage from no load to full load condition is called voltage regulation. A voltage regulator is an electric circuit that is aimed to reduce these variations to zero or at least to minimum possible value. For the purpose of this project, integrated circuit regulator 7806 is used to provide a constant 6V D.C to the circuit. The figure below shows a standard configuration symbol of a 7806 fixed positive voltage regulator [12].





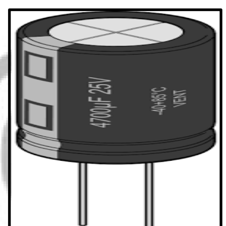
(a) Physical appearance (b) Symbol

Figure 2.2 Voltage regulator

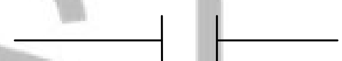
2.2.2 Capacitor

A capacitor essentially consists of two conducting surface separated by layer of an isolating medium called “dielectric” the conducting surfaces may be of either circular plates or be of spherical or cylindrical shape. However, the purpose of capacitor is to store electrical energy by characteristic stress in the dielectric. Also the property of a capacitor is to store electricity called its capacitance. Hence the capacitance of a capacitor is defined as the amount of charge required to create a unit potential difference between its plates.

A capacitor is a passive two terminal electrical component used to store energy in an electrical field. Capacitors are widely used to filter or remove AC signals from variety of circuit. In a DC circuit, they can be used to block the flow of direct current while allowing AC signals to pass. A capacitor's capacitance C is measured in farad. It can have any value ranging from Farad (F), millifarad (mF), microfarad (μF), nanofarad (nf), and picofarad (pF) [13]. The basic construction of all capacitors involves two metal plates separated by an insulator; electric current cannot flow through the insulator, so more electrons pile up on one plate than the other. The result is a difference in voltage level from one plate to the other. Two types of capacitors are used in constructing this circuit; they are polarized and non-polarized capacitors. When the capacitor Is polarized, it means that it has one way to be inserted into a circuit and non-polarized capacitor can be inserted without considering the polarity of the terminals [13].



(a) Capacitor



(b) Symbol

Figure 2.3: Capacitor and its symbol

2.2.3 Resistor

A resistor is an electronic component that resists the flow of electric current. It has two terminals across which electricity must pass and it is designed to drop the voltage of the current as it flows from one terminal to another. Resistors are primarily used to create and maintain known safe currents within electrical components. Resistances have specific values of resistances which range from a few ohms to thousands or millions ohms. The unit of resistance is ohms (Ω) [14].

A variable resistor allows more control over current flow by changing the amount of resistance. When resistance increases in a variable resistor, the amount of current that is allowed to flow in a circuit decreases. Two basic components make up variable resistors. The resistive material is the first component and is called the element. The second component, called the wiper or brush, is used to set the resistance, and is often controlled with a knob or sliding switch.

Figure 2: Variable Resistor and Resistor

2.3.3.1 Colour Coding

Colour coding are colours that are used to find or indicate the value of resistor based on the colours the resistor has, it has 4 bands as shown below in the table.The first band indicates the first digit value of resistance while the second band indicates the second digit of the resistance value but the third shows the number of zeros following the second digit or the multiplier and lastly the fourth band indicates the percentage tolerance and if there is no fourth band the tolerance is 20%. Consider the table below.

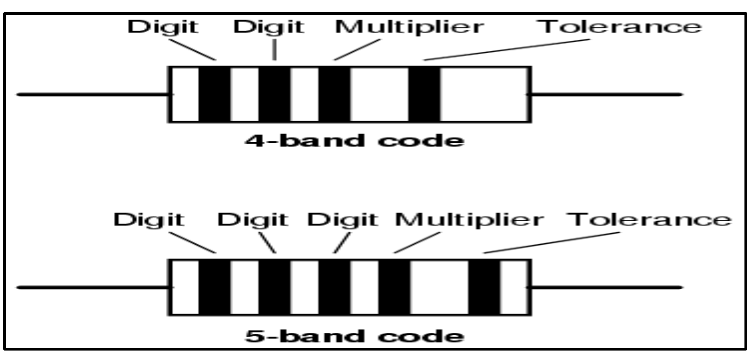


Figure 2.:

Table 2.1: Resistor colour coding

COLOUR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
BLACK	0	0	0	1	
BROWN	1	1	1	10	
RED	2	2	2	100	
ORANGE	3	3	3	1000	
YELLOW	4	4	4	10000	
GREEN	5	5	5	100000	
BLUE	6	6	6	1000000	
VIOLET	7	7	7	10000000	
GREY	8	8	8		
WHITE	9	9	9		
GOLD	-	-	-	0.1Ω	±5%
SILVER	-	-	-	0.01Ω	±10%
NO BAND	-	-	-	-	±20%

2.3.3.2 Calculating Resistance Value

The Resistor Colour Code system is all well and good but we need to understand how to apply it in order to get the correct value of the resistor. The "left-hand" or the most significant coloured band is the band which is nearest to a connecting lead with the colour coded bands being read from left-to-right as follows:

Digit, Digit, Multiplier = Colour, Colour x 10^{colour} in Ohm's (Ω's)

For example, a resistor has the following coloured markings;

Yellow Violet Red = 4 7 2 = 4 7 x 10^2 = 4700Ω or 4k7.

The fourth and fifth bands are used to determine the percentage tolerance of the resistor. Resistor tolerance is a measure of the resistors variation from the specified resistive value and is a consequence of the manufacturing process and is expressed as a percentage of its “nominal” or preferred value.

2.2.4 Integrated Circuit

The integrated circuit used as a triggering unit is NE556 timer, the NE556 dual timing circuit is a highly stable controller capable of producing accurate time delays of oscillation. The 556 is a dual version of 555 timer I.C. Timing is provided by an external and capacitor for each timing function. The two timers operate independently of each other sharing only Vcc and Ground. The circuits may be triggered and reset on falling wave forms [7, 9]. It may be used in many applications such as precision timing, sequential timing, time delay generation, pulse width modulation, linear ramp generator. In this circuit the IC is used as pulse generation device [9].

The NE556 is a dual timing circuit uses as its timing elements an external resistor/capacitor network. It can be used in both monostable and astable modes with frequency and duty cycle, controlled by the capacitor and resistor values. While the timing is dependent upon the external passive components, the monolithic circuit provides the starting circuit, voltage comparison and other functions needed for a complete timing circuit. Internal to the integrated circuit are two comparators, one for the input signal and the other for capacitor voltage; also flip-flop and digital output are included. The comparator reference voltages are always fixed ratio of supply voltage thus providing output independent of supply voltage.

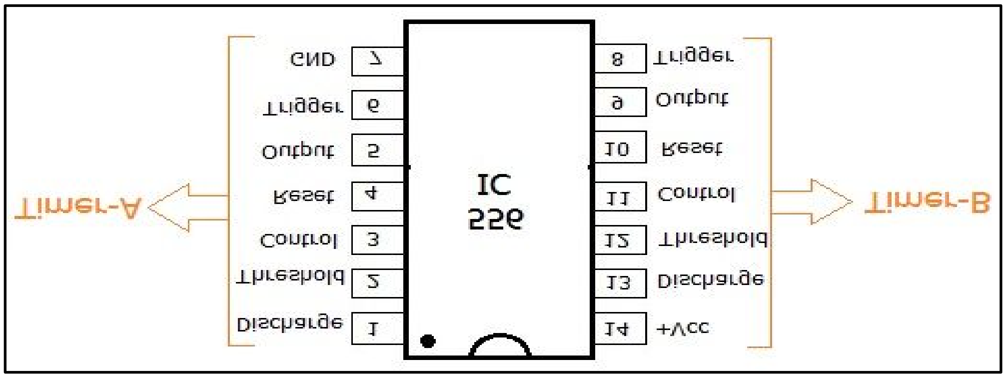


Figure 3: Pins configuration of NE556 Dual timer

2.2.5 Switches

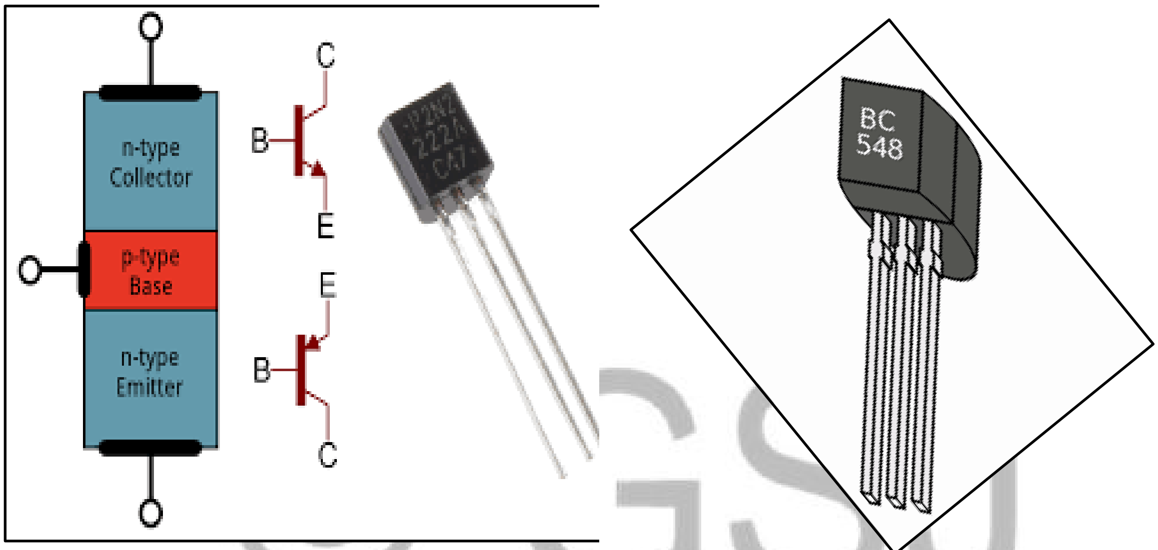
Switches are used for opening and closing contacts of a circuit from the supply, sometimes switches are used for setting and resetting. Two types of switches used in constructing this project are single-Pole Single-Throw (SPST) and Push-To-On switches. The Push-To-On switch is used for resetting the NE556 IC after it is triggered; this is achieved by utilizing pin 4 and pin 10 of the IC. The symbols for SPST and Push-To-On (Figure 2.6)

(a) (b)

Figure 2.6: Single-Pole single-Throw switch and Push-to-On

2.2.6 Transistor

Transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals (Figure 2.7). Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits [14].



(a) Transistor

Figure 2.7: Transistor

2.2.7 Light Dependent Resistor

Photo resistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to 1MΩ, but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the light applied and are nonlinear devices. They are used in many applications but are sometimes made obsolete by other devices such as photodiodes and phototransistors. Some countries have banned LDRs made of lead or cadmium over environmental safety concerns.

Photo resistors are most often used as light sensors. They are often utilized when it is required to detect the presence and absence of light or measure the light intensity. Examples are night lights and photography light meters. An interesting hobbyist application for light dependent resistors is the line following robot, which uses a light source and two or more LDRs to determine the needed change of course. Sometimes, they are used outside sensing applications, for example in audio compressors, because their reaction to light is not instantaneous, and so the function of LDR is to introduce a delayed response.

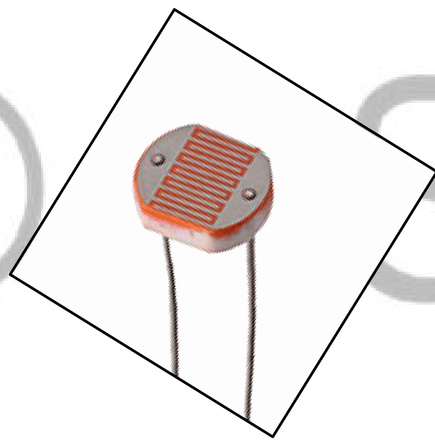
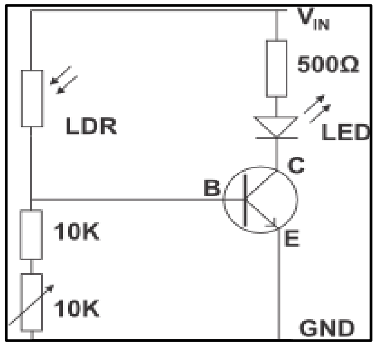


Figure 2.8: Light Dependent Resistor

2.3.6.1 Light Sensor

If a basic light sensor is needed, an LDR circuit such as the one in the figure can be used. The LED lights up when the intensity of the light reaching the LDR resistor is sufficient. The 10K variable resistor is used to set the threshold at which the LED will turn on. If the LDR light is below the threshold intensity, the LED will remain in the off state. In real-world applications, the LED would be replaced with a relay or the output could be wired to a microcontroller or some other device. If a darkness sensor was needed, where the LED would light in the absence of light, the LDR and the two 10K resistors should be swapped.



3.0 Material and Methods

3.1 Method

The methodology employed in the design and construction of this project is outlined below:

i- Design and development the circuit diagram using different software such as PROTEUS ISIS version 7.7.

ii- Carrying out literature review and components identification

This involves proper gathering of information from textbooks, obtaining relevant through previous reports, technical papers, internet, data sheets, etc., pertaining the components needed for constructing of this project, the construction itself and the principle of operation of the constructed circuit. The components needed for constructing of this project, the construction itself and the principle of operation of the constructed circuit.

iii- Design and Analysis to come up with components values

This involves proper selection of components to be used during construction like resistors, transistors, capacitors, integrated circuits, etc., the analysis also involves knowing why a particular value of a components is being used that can be arrived by using appropriate formulas and equations.

iv- Purchasing of individual components

v- Testing of individual components purchased using appropriate testing and measuring instrument.

vi- Implementing the design circuit on Bread-board for testing the workability of the circuit before permanent construction.

vii- Construction of the circuit using Vero board and soldering materials; This involves assembling, mounting, soldering and evaluating of the components on a Vero board after which the circuit will be tested and cased.

viii- Testing of the constructed project and Casing Here, the project is tested after soldering in order to confirm its required function. Also, a suitable plastic casing is provided for the constructed system.

3.2 Software Description

It is a software suite containing schematic, simulation as well as PCB designing.

- PROTEUS ISIS VERSION 7.**7** is the software used to draw schematics and simulate the circuits in real time. The simulation allows human access during run time, thus providing real time simulation.
- ARES is used for PCB designing. It has the feature of viewing output in 3D view of the designed PCB along with components.
- The designer can also develop 2D drawings for the product.

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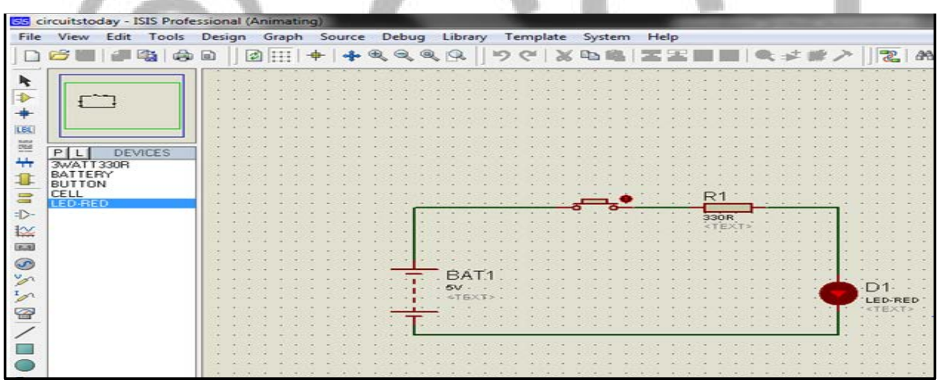
3.2.1 Features

Proteus ISIS Version 7.7 has wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc., probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors etc.

ARES offers PCB designing up to 14 inner layers, with surface mount and through hole packages. It is embedded with the foot prints of different category of components like ICs, transistors, headers, connectors and other discrete components. It offers Auto routing and manual routing options to the PCB



3.3 Power Supply Design

In this project, a regulated DC voltage supply unit will be used as supply to the circuit after construction. 7806 is a voltage regulator integrated circuit; it is a member of 78XX series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output; the voltage regulator IC maintains the output voltage at constant value. The XX in 78XX indicates the fixed output voltage it is designed to provide, 7806 provide

+6V regulated power supply. Capacitors of suitable values will be connected at input and output pins depending upon the respective voltage levels.

3.3.1 Pin Description

This shall be describe according to table (2)

Table 2: pin description

Pin Number	Function	Name
1	Input voltage (5V-18V)	Input
2	Ground (0V)	Ground
3	Regulated output (6V)	Output

3.3.2 Diode Selection

A diode will be used at the positive input of the 12V DC power supply from the regulated power supply. This will be used for the purpose of blocking the discharge from the capacitor and allowing the current flow only in one direction from the supply due to P-N junction of the diode.

From the maximum voltage relationship:

$$V_{MAX} = Vs \times \sqrt{2}$$

$$\text{V\_MAX} = 12 \times \sqrt{2}$$

$$\text{max} = 16.97V$$

Vs is the supply voltage from the regulated voltage supply which is 12V.

Peak – Inverse Voltage (PIV) is found by using the relation:

$$PIV = 2 \times Vmax$$

$$PIV = 2 \times 16.97$$

$$PIV = 33.94V$$

Also, the diode must withstand a current of 1000mA, 33.94V

Therefore, IN 4001 (50V), 1A is selected.

3.3.3 Filtration

The ripples factor of any filter is the ratio of AC signal to the ratio of DC signal in present and it should never exceed 1%. In fact, 0.2% or less is a good value, the smaller the percentage of ripples, the better the smoothing of the pulse setting. Hence, for this project, the ripple factor is assumed to be 0.0000033% in order to have a perfect smoothing (since the power is obtained from regulated power supply in the laboratory).

The value of the smoothing capacitor is found using the relation;

$$C = \frac{1}{4\sqrt{3} \times F \times \beta \times R_L}$$

F = frequency = 50Hz, β = ripple factor = 0.0000033 and R_L = Load resistance

RL is a resistance connected across the capacitor for the discharge action which is the resistance connected to a thin but long wire to the metallic handle of the door which assumed to be 1MΩ in order to drop small voltage and the high the value of resistance, the better the sensitivity.

$$C_1 = \frac{1}{4\sqrt{3} \times 50 \times 0.000003 \times 1 \times 1O^6} \quad := 874.77 \times 10^{-6}$$

C1 = 874.44µF

Therefore a standard value of 1000µF will be chosen.

The capacitor voltage V_c will be obtained from the relation;

$$V_C \geq 2 \times V_{max}$$

$$V_{max} = \sqrt{2} \times (6 - 0.7 - 0.7) = \sqrt{2} \times 4.6V$$

$$V_c = 2 \times \sqrt{2} \times 4.6 = 13.01V$$

Hence a standard value of $V_C = 25$V is selected.

Therefore, for the smoothing a capacitor of $1000\mu F$, 25V rating is chosen which is C_1 as used in the circuit.

3.3.4 Regulation

The regulator used in this circuit is 7806. Because the circuit requires a 6V positive regulator for the operation, hence 78XX is used for positive regulation, where XX represent the required voltage, which is 6V for this project.

3.4 Base Resistor Design

A base resistor provides the necessary resistance to bias the base junction of a bipolar junction transistor (BJT). The resistor R1 controls the amount of current flowing into the base, which controls the amount of current flowing through the collector. Usually an NPN transistor controls a load such as a relay or motor; it is required to behave as a switch and conduct fully known as saturation. A proper value of base resistance is required for conduction in the saturation region. The value of this resistance is different for different input voltages.

A high power 2N2222 NPN silicon type bipolar junction transistor and BC 158 PNP silicon type bipolar junction transistor will be used in the design of this project. The 2N2222 NPN silicon type bipolar junction transistor is connected to the output terminals of the dual timers of the IC1 via diodes and the base resistor (R1).

The transistor T2 has the following specifications:

Table: Specification of transistor

Polarity	NPN
Frequency	250MHz
$\boldsymbol{I_C}$ **(max)**	800mA
$\boldsymbol{V_{CE}}$	30V
$\boldsymbol{\beta(H_{fe})}$	100 – 300
Power dissipation	0.5W
$\boldsymbol{V_{BE}}$	0.7V

The LDR is a light sensitive variable resistor made from cadmium sulphide which is high with little or no illumination and vice-versa.

Table: Technical specification of the LDR:

$Peak\ spectral\ response$	$610nm$
$cell\ resistance\ at\ 50lux\ (0.25mW/cm^2)$	$2.4K\Omega$
$Cell\ resistance\ at\ 1000lux\ (5mW/cm^2)$	130Ω
$Dark\ resistance\ (minimum)$	$10M\Omega$
$Maximum\ power\ dissipation\ at\ 25^0C$	$200mW$
$Resistance\ rise\ time$	$70mS$
$Resistance\ fall\ time$	$350mS$

From the circuit;

$$V_{CC} - V_{LDR2} - V_{D3} - I_B R_1 - V_{BE} = 0 \quad \dots\dots\dots\dots\dots\dots\dots \quad (1)$$

V_{LDR2} Is negligible because LDR2 is located on a light source of high luminous intensity and for equation (1) to be satisfied, the light source must be blocked (i.e by a burglar) which increases the resistance of the LDR2, which result in very negligible voltage drop.

$$Therefore, V_{CC} - V_{D3} - I_{BR1} - V_{BE} = 0 \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where V_{CC}= 6V, V_{D3}= 0.7V (silicon diode), V_{BE} = 0.7V (for silicon transistor)

Hence, R1 can be found from the relation;

$I_B = \frac{I_{C\,(MAX\,)}}{\beta}$; β is chosen to be 250 from the data sheet

$I_B = \frac{800mA}{250} = 3.2\text{mA},$

Therefore; R1 = $\frac{V_{CC} - V_{D3} - V_{BE}}{I_B}$

R1 = $\frac{6-0.7-0.7}{3.2\times10^{-3}} = \frac{4.6}{0.0032} = 1437.5\Omega$

R1 =1.4375KΩ

R1 is chosen to be 2.2KΩ to conform to standard.

Power dissipated by R1 is found using the relation;

$$P = I^2R_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$P = (3.2 \times 10^{-3})^2 \times 2.2 \times 10^3$$

$$P = 0.022528W$$

Also a $\frac{1}{4}W$ power dissipated resistor will be chosen.

The resistor T1, which is BC 158 PNP silicon type bipolar junction transistor, is used as a switch for the touch point (P), which is connected to trigger input of the first timer.

The transistor has the following specifications;

Table:

$Polarity$	PNP
$Frequency$	100MHz
I_C (max)	100mA
V_{CE}	25V
$\beta(H_{fe})$	70 (mins)
$Power\ dissipation$	0.3W
V_{BE}	0.7V

Capacitor C2 of $0.01\mu F$ value will be connected between and ground to prevent the transistor from false switching due to variation of the resistance of VR3 or any other external condition. Generally, the capacitor is used to protect the Trigger pin of the first timer from disturbance. Capacitor C3 of $0.1\mu F$ value is chosen to improve the regulation inside the IC for low noise operation.

The practical value of C3 range is $0 \leq C3 \leq 0.1\mu F$. This is because to ensure stable closed loop operation, all the devices are frequently compensated internally or externally. The compensation can easily be upset by unwanted stray circuit capacitance and inductance, resulting in spurious oscillations; that's why the circuit lead lengths will be short and then layout as tight as possible.

VR1 and VR2 will be used for adjusting the sensitivity of LDR1 and LDR2 respectively, for be sensitivity, the VR1 and VR2 have a selected value of 100KΩ each.

3.5 Construction, Testing and casting

This describes the steps taken in the verification of calculated results through real-time implementation and measurements. The construction of the system is in two stages: the soldering of the components and the coupling of the entire system into the casing. This chapter is very essential for the project under discussion. Unless special precautions are taken, a large number of components may have been destroyed by overheating, resulting in a setback for the entire project. Thus, damaging the components completely or reducing the components' reliability increases the system's failure rate.

3.3.1 Construction

The first stage is the soldering of the NE556 dual timer socket at the center of the Vero-board, and then the remaining components that make up the circuit. The circuit will be soldered in a number of patterns; each stage will be tested using the multimeter to make sure it is working properly before the next stage is done. This helps to detect mistakes and faults easily. The soldering circuit will be on Vero-board. The second stage of the system construction is the casing of the soldered circuit. For this system, the material used for the casing is a PVC box. Proper locations of the sensing units and switches will be selected property. The polarity of the components shall be placed with respect to each other. Extreme care shall be taken during soldering in order to safeguard the components from being damaged against heat from soldering iron. The right components with their appropriate values will be used. Extra care will be taken in mounting the components on the

Vero-board. Active components like NE556 IC will be provided with sockets in order to avoid excessive heat that may lead to the likely damage of the components. The system will be constructed on a single Vero-board.

3.2 Principle of Operation

At the instant when power is first supplied to the circuit, the system will activate itself making it ready for operation. The alarm will be switched on under the following four different conditions: 1. when light falls on LDR1 (at the entry to the premises). 2. When light falling on LDR2 is obstructed. 3. When door switches are opened or a wire is broken. 4. When a handle is touched. The light dependent resistor LDR1 should be placed in darkness near the door lock or handle etc. If an intruder flashes his touch, its light will fall on LDR1, reducing the voltage drop across it and also the voltage applied to trigger 1 (pin 6) of IC1. Thus, Transistor T2 will get forward biased and relay RL1 energize and operate the alarm. Sensitivity of LDR1 can be adjusted by varying preset VR1. LDR2 may be placed on one side of a corridor such that the beam of light source always falls on it. When an intruder passes through the corridor, his shadow falls on LDR2. As a result voltage drop across LDR2 increases and pin 8 of IC1 goes low while output pin 9 of IC1 goes high. Transistor T2 gets switched on and the relay operates to set the alarm. The sensitivity of LDR2 can be adjusted by varying potentiometer VR2. A long but very thin wire may be connected between the points A and B or C and D across a window or a door. This long wire may even be used to lock or tie something. If anyone cuts or breaks this wire, the alarm will be switched on as pin 8 or 6 will go low. In place of the wire between point A and B or C and D door switches can be connected.

These switches should be fixed on the door in such a way that when the door is closed the switch gets closed and when the door is open the switch remains open. If the switches or wire, are not used between these points, the points should be shorted. With the help of a wire, connect the touch point (P) with the handle of a door or some other suitable object made of conducting material. When one touches this handle or the other connected object, pin 6 of IC1 goes low. So the alarm and relay get switched on. Remember that the object connected to this touch point should be well insulated from ground. For good touch action, potentiometer VR3 should be properly adjusted. If potentiometer VR3 tapping is held more towards ground, the alarm will get switched on even without touching. In such a situation, the tapping should be raised. But tapping point should not be raised too much action would then vanish. When you vary potentiometer VR1, re-adjust the sensitivity of the touch point with the help of potentiometer VR3 properly.

The circuit diagram for the project is as shown below:

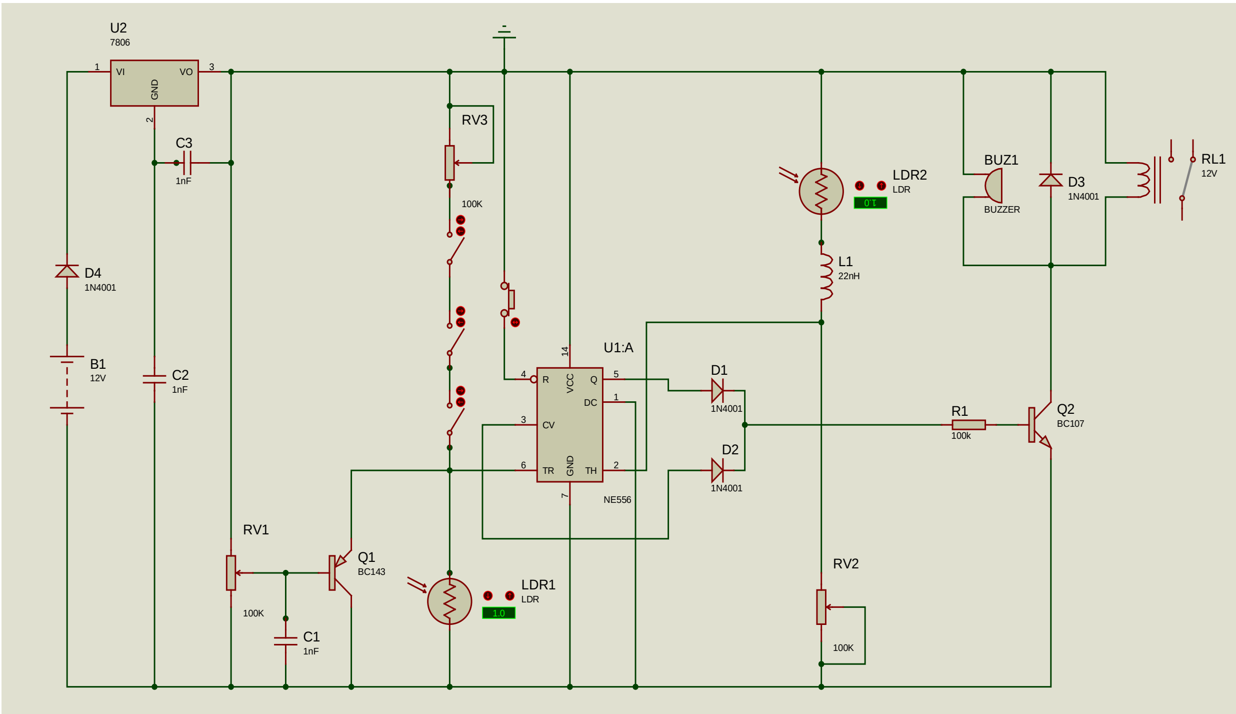


Fig 4.1: Circuit Diagram of Four-Sensored burglar Alert system

3.3.3 Testing

The testing of the burglar alert system, four steps are listed below;

Step 1: To ensure that all the components to be used are functionally operating, they should be first tested with Multi-meter and failed ones will be replaced before finally soldering them on the Vero-board.

Step 2: The circuit will be simulated using Proteus ISIS version 7.7 software. The result obtained from the simulation closely corresponds to the desired result, with only some negligible slight variations.

Step 3: To ensure that there is no breakage (i.e. there is continuity) in the circuit path on the Vero-board, the circuit path will be tested immediately after soldering on the Vero-board using a digital Multi-meter.

Step 4: During the functionality testing, LDR1 will be located in a dark place and a light source of high intensity will be brought near it, the transistor (T2) will be switched on and the contact relay (RL1) shall be closed; hence the alarm will turn on and the sound shall be heard through the buzzer. LDR2 will be located near a light source of the intensity, the light source will be blocked, and this also results in the closure of the relay (RL1) and the sound will be heard through the buzzer. The touched point (P) shall be connected to a metal handle of a wooden door and the handle will be touched, the contacts relay (RL1) as closed and sound will be heard through the buzzer. Lastly; the door switches (S2, S3, and S4) will be set closed and when they are opened, the contact of the relay (RL1) will be closed and sound will be heard through the buzzer.

4.0 Expected Outcome/Results

The main reason for testing all components before finally soldering them on a Vero-board is to avoid the time-wasting effort it will take to disassemble faulty components at the end of the day. The continuity test which will be carried out on a Vero-board is to check the circuit path if the circuit is working in normal conditions and to ensure the continuity of the system. The manual simulation of the circuit design using a breadboard will also be observed; the sole objective of the simulation is to compare the design results with the practical results that will be carried out from the simulation. The two results will be compared to observe the expected result.

The various problems that shall be encounter during the implementation stage are highlighted as:

1. Some of the basic components that will be used won't be available on the market because our shop doesn't supply them. The only alternative is to make an order available on the internet.

5.0 Work Plan

This work shall be plan into three (3) stages:

Stage I

- Desk studies
- Market Survey
- Purchase of Electric items

Stage II

- Experimentation
- Design
- Construction and
- Testing

Stage III

- Report writing
- Publications

6.0 Budget/Cost

The total sum of one million Two hundred and two thousand naira only (#1,202,000.00) shall be spent for this research work (Table 3.1)

Table 4: Estimate cost for the propose research work

S/NO	COMPONENTS	QUANTITY	AMOUNT	TOTAL
1	Voltage Regulator	2	20,000	40,000
2	Capacitor	10	15,000	150,000
3	Resistor	6	4,000	24,000
4	Integrated Circuit	2	18,000	36,000
5	Switches	8	5,000	40,000
6	Transistor	6	7,500	45,000
7	LDR	8	15,000	120,000
8	Casing	1	35,000	35,000
9	Testing Board	1	50,000	50,000
10	Vero Board	1	16,000	16,000
11	Power Supply	2	30,000	60,000
12	DTA for Market Survey	6 Research Officers	12,000	72,000
13	Fuel for the experiment	7days	12,000	84,000
14	Computer System	1	320,000	320,000
15	Software	1	55,000	55,000
16	Stationeries	-	30,000	30,000
17	Transportation and logistics	-	25,000	25,000
Grand Total Amount				**1,202,000.00**

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