CARITAS UNIVERSITY AMORJI-NIKE, EMENE, ENUGU STATE

Caritas Journal of Engineering Technology

Article History: Received: 22nd March, 2022 Revised: 7th April, 2022 Accepted: 14th May, 2022 CJET, Volume 1, Issue 1 (2022)

Design and Construction of Security Dark Activated Switch

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ABSTRACT

The burglar alarm system is based on the principles of the photo resistive detector (LDR) whose electrical resistance is usually very high up to 1mΩ or more when dark and falls below to as little as a few hundred ohms when the detector is illuminated. When there is an intruder, due to his/ her shadow, the detector's surface is dark or not illuminated causing the electrical resistance of the detector to become very high making the voltage of the voltage comparator (IC) to be higher than the reference voltage terminal causing its output to be high this then causes the alarm actuate/activate the alarm which then sounds to alert the household of an intruder. The whole process continues as long as there is constant power supply.

Keywords: burglar system, photo resistive detector, security alert, voltage comparator

INTRODUCTION

The circuit works basically on the principle of the photo resistive detector(LDR) whose electrical resistance is usually very high up to 1mΩ or more dark but falls below to as little as a few hundred ohms when the detector is illuminated. In our homes, this circuit can be used to alert the household of an intruder or an unwanted guest. As earlier said, this circuit works basically on the principle of the LDR (Light Dependant Resistor) whose electrical resistance is usually very high up to 1mΩ or more dark and falls bellow to as little as a few hundred ohms when dark an falls below when the detector is illuminated. When there is an intruder or an unwanted guest, due to his/her shadow the light dependant resistor (detector) surface is dark or not illuminated their by causing the electrical resistance of the detector to be very high therefore making the voltage of the voltage comparator (IC) to be very higher than the reference voltage terminal causing its output to be higher this then cause the alarm actuator to alert the household of an intruder. The circuit is disabled if not needed or if the owner is not around. The whole process continues as long as there is constant power supply from the battery.

LITERATURE REVIEW

ELECTRONIC COMPONENTS AND CIRCUIT RELEVANCE

Electronic circuits are made up of electronic components. Electronic components are categorized as discrete or integrated circuits are further subdivided into small scale integration (SSI), medium scale integration (SLSI) which is popularly known as microprocessors. For effective circuitry design, adequate knowledge of electronic component is necessary consequently, this section of the project text is concerned with reviewing the electronic components used in this Project design. Brief description, configuration as well as their functions are presented here under.

RESISTOR

A resistor is an electric component that limits the flow of electron (current carriers) in an electronic circuit. Various types as well as size are available commercially. The values could either be inscribed on its or a system of color code could be used. This system uses four color bands. Three of the bands are closely spaced while the fourth ((4th) band is often gold or silver (though other exists like red, brown, and blacks) is the tolerance.

The S.I unit resistance is ohms (Ω) figure 2.1a and figure 2.1b shows sketches of some of the resistors used in this project and their symbols.

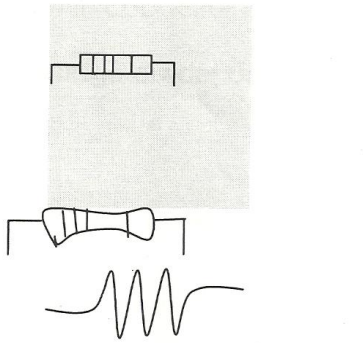


FIG 2.1 a resistor types (fixed resistors) and symbols

Resistors are manufactured in different forms. The fixed value resistor, as shown above and the variable resistors are shown below in figure 2.1b

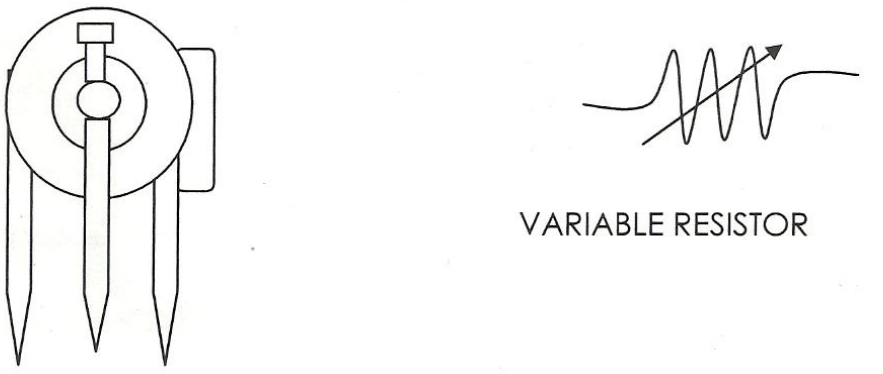


FIG 2.1b variable resistor and symbol

Resistor play a great role in electronic circuit, they are used with active device like in amplifiers, with capacitor to establish time constant also in voltage divider and so on.

RESISTORS IN SERIES AND PARARELL

Resistors can either be arranged in series or in parallel depending on the circuit in which it is being used.

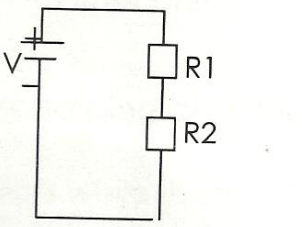


Fig 2.1c Resistors In series

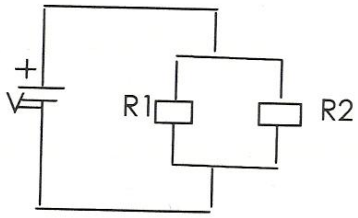


fig 2.1d Resistors in

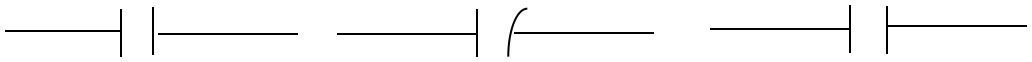
Fig 2.1c Resistors in series, Fig2.1d Resistor in parallel

For resistance in series, current flowing through is the same R_{total} = RI +R2

For resistors in parallel, the voltage the same R $_{total}$=$\frac{R_1 X R_1}{R_1+R_1}$

CAPACITORS

These are electronic components that have the ability of storing energy in form of electric field. Their ability to store and absorb electricity is called capacitance and is measured in farads (F) with other units as microfarads (NF) nanofarad (nf), etc. The discharging and charging of characteristic was used in the building oscillators while its smoothening ability was explored in filtering ripples from the rectified A.C in the power supply unit.Various types of capacitors are available they are ceramic, polyester, mica, polystyrene and electrolytic. While the others are



Non-polarized. Polarity must be b served while using polarized capacitors such as electrolytic capacitors fig 2.2a shows the symbol used by capacitors in circuits.

Non- polarized polarized non-polarised

Fig 2.2a capacitors symbol

The formula to calculate the amount of capacitance is Q= CV

Where Q= charge in coulombs (c)

C= capacitance in farad (f)

V = voltage in volts (v)

When a charged is stored, the amount of energy is thus

W = ½ Cv^2

Where

W = energy

CAPACITOR CODE

Except for the electrolytic and large types of capacitor, which usually have the value printed on them, like 470µf, 24V, so to say, most the smaller capacitors have two or three number printed on them, some with one or two letter added to that value.

Examples are 105, 47 4j, etc

For 105,it means 10 100,000 in pica farad (pf) that is

106 pf = 1µf

For 474j, it means 47 10,000 = 470nf = 0.47 µf and j = 5 % tolerance value.

CAPACITORS IN PARALLEL AND SERIES

For capacitors in series, as shown in fig 2.

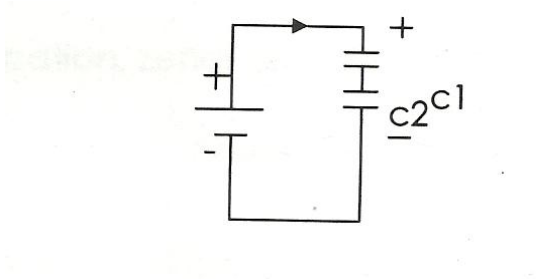


Fig 2.2b capacitor in series

C_{eq} = c 1 + c2

C_{eq} = c 1.c2/c1 +c2

C_{eq} is the equivalent capacitors

For capacitance in parallel as shown in fig 2.2c

Equivalent capacitance c_{eq} = c1 + c2

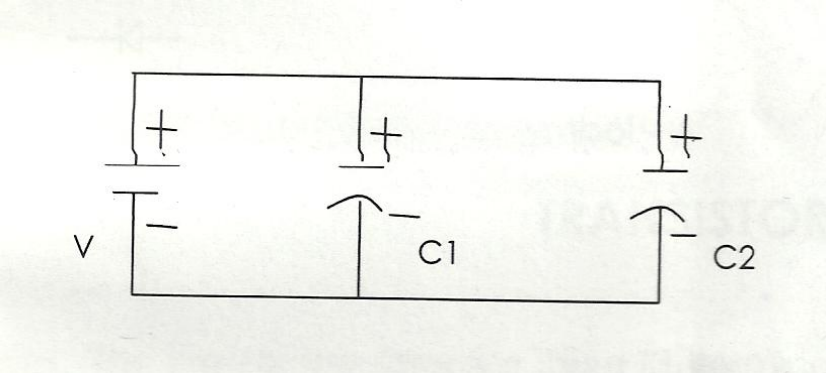


FIG 2.2C capacitor in parallel

DIODE

The diode is an electronic value that allows the flow of current in only one direction. They are made from both n-type and p-types.

Semiconductor materials depending on the semi-conductor materials used. The diodes can be classified as silicon or germanium diodes, diodes types include power diode, used mainly for rectification, zener diode used for voltage stabilization, fast switching or signal diode for signal channeling.

Other types of diode have the ability of emitting light when current flow through them. These are used in assembling all the seven segment display pictorial sketch of power, zener and LEDs as well as

their symbol are shown in fig 2.3

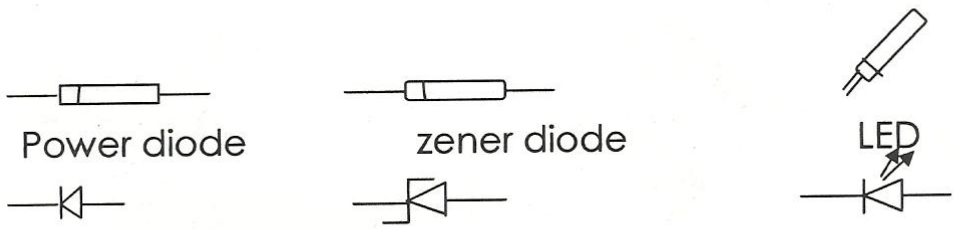


Fig 2.3 Diode types and symbol

TRANSISTOR

The bipolar transistor is a three (3) terminal device. The terminals are called emitter (E), base (B) and collector (C) they are active device since they can deliver power to a load.

There are two basic types – NPN and PNP

Transistors are generally used in circuit for amplification of signal, and to switch on/off various circuits.

There are two basic types of transistors- BJT and FET transistors.

TRANSISTORS AS AN AMPLIFIER

As an amplifier it can be connected in common-emmiter (CE) common based (CB) and common- collector (CC) configurations. Generally, the CE- configurations is used.

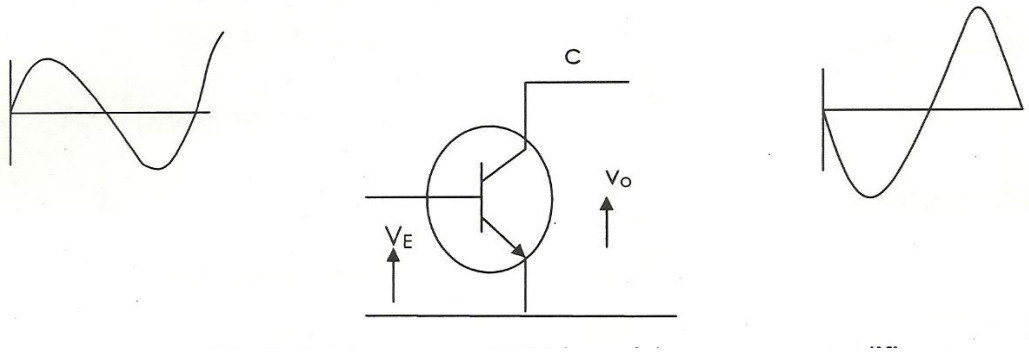


Fig 2.4a shows an NPN transistor as an amplifier.

TRANSITORS AS SWITCH

Transitors can be used as an electronic switching a circuit based on its operation in cur-off and saturation modes.

Fig 2.4b shows the transistors action as an electronic switch with sufficient based biasing.

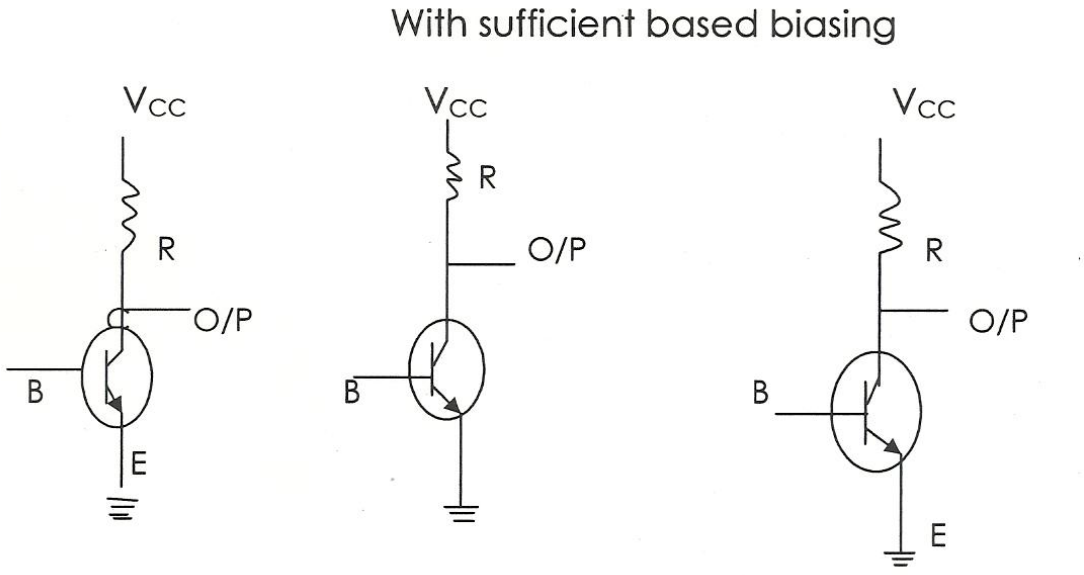


Fig 2.4b transistors as a switch

The selection of transistors is based on the following parameters.

1. (Max) PT Power dissipation

2. Collector current Maximum D.C

3. Hfe (B) gain

4. VC_{eo} = collector to emitter breakdown voltage with based open

5. V_{cbo} = collector to based breakdown with emitter open

6. Frequency (FT) gains bandwidth freq at which small signal gain becomes unity.

BASIC OP-AMPS APPLICATION

OP-amps can be used to realize the following circuits-adder –subs tractor. Integrating circuit, differentiating circuit sign changes scale changer phase- shifter, D.C followers, delay equalizer etc.

OP-AMPS USED AS A COMPARATOR

Comparator is a circuit that compares signal voltage in one input with a reference in voltage in other input, or a circuit that compares two voltage levels it is also one that voltage cross a predetermined level. The reference voltage could be + ve or - ve or 0.

The simplest op-amp comparator circuit is that shown below in

Fig 2.8(b)

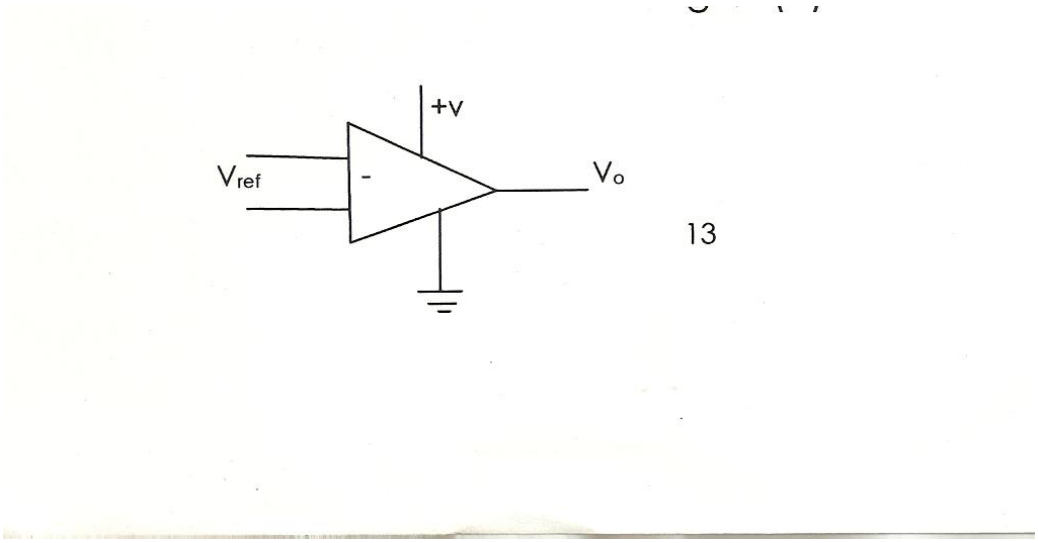


Fig 2.8 op-amp comparator circuit if V2>Vref then the op-amp will be driven to + Vsat, then is V_o=

=vsat. This is because of the high internal gain of the op-amp that will multiply (V_2-V_1) to give a high

= ve voltage at the output if v2 < Vref, then, V_o= - Vsat

BLOG DIAGRAM OF THE BUGLAR ALARM SYSTEM

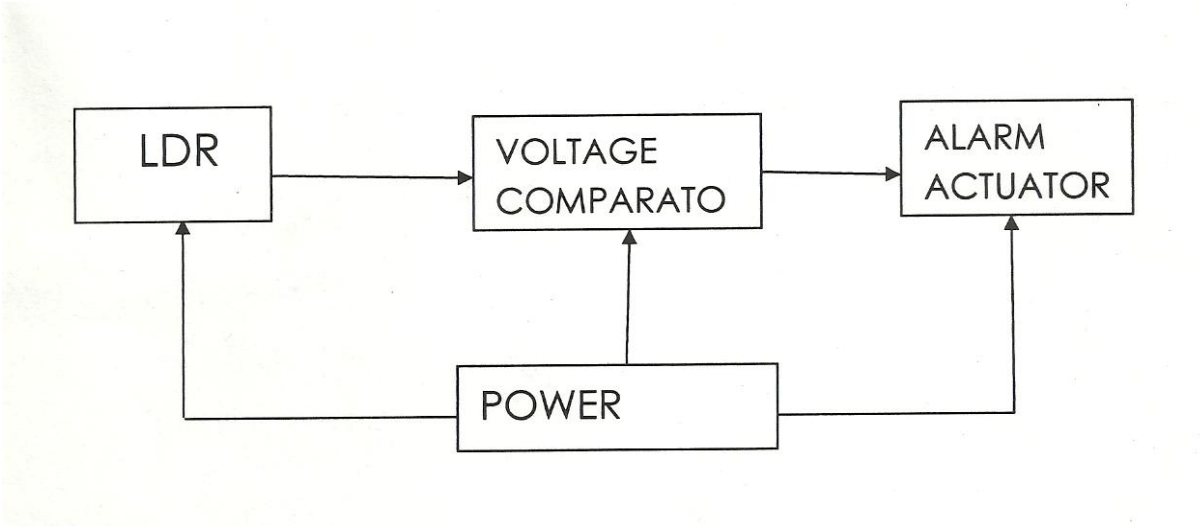


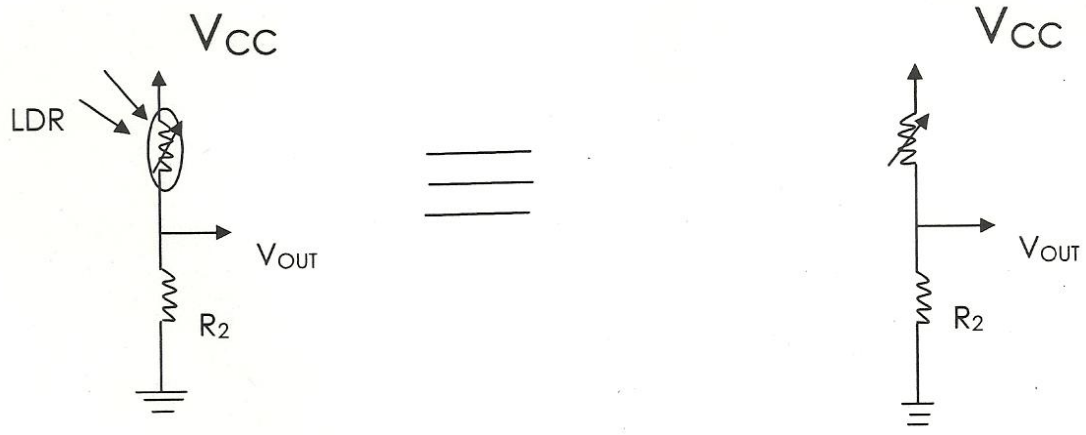
FIG 2.6 Block diagram of the Buglar alarm system

CONSTRUCTION

The block diagram of the alarm system has been shown in fig 2.6 of chapter two. The design analyses of each block are now shown hereunder.

PHOTODETECTOR RESISTOR (LDR)

LDR which means light dependent resistor are photo resistive detectors, they are often substituted for fixed or variable resistor to make an existing circuit sensitive to light. The variable resistance of a photo resistor can be changed to a variable by means of simple voltage divider circuit.



Now V_{out} = (R2/R-R2) o V_{oc}

Now with R2 = 100k

With light R1 = 50k and V_{cc} =9v

V_o = 100 o 9v ÷ 150 = 30 ÷ 5 6v v_{out} = 6v

Without light or illumination R1 = 800k

So V_{out} = (100 ÷ 800 + 100) o 9 =1v

VOLTAGE COMPARATOR CIRCUIT

This was realized by a general purpose op-amp and voltage divider network of two resistor (R2 and R3). The two input voltage (variable and reference inputs) of the N4741 op- amp IC were measured in the presence and absence of light with a multimeter and the voltage obtained at the output of the IC were within the expected values.

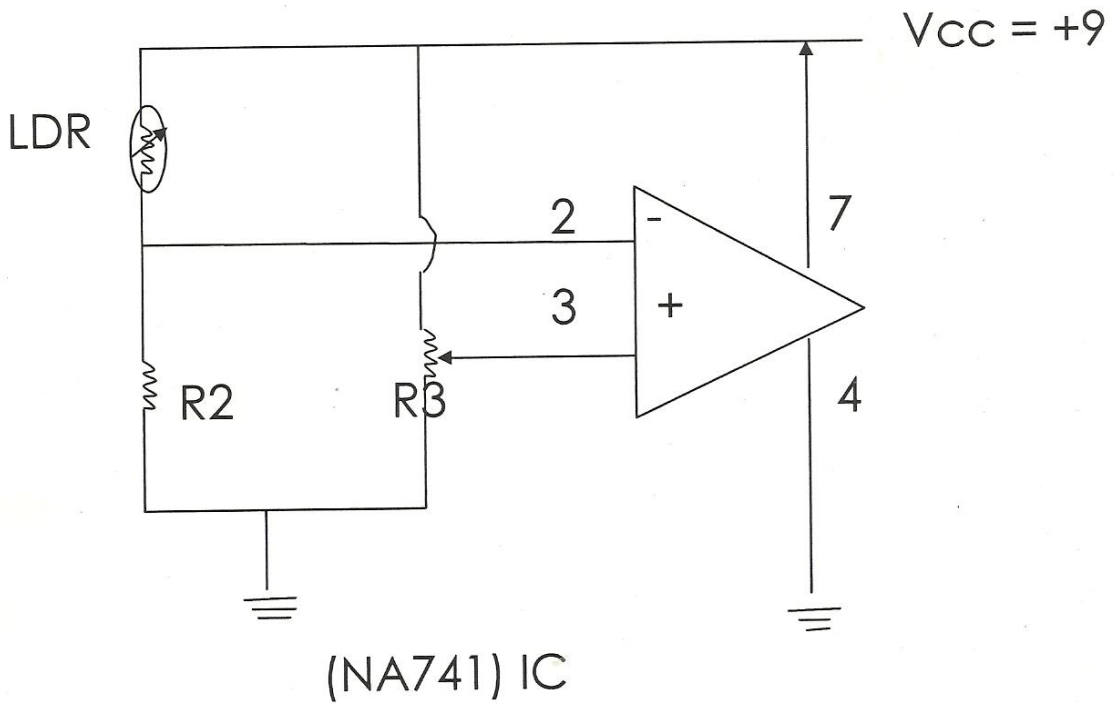


FIG 3.2 VOLTAGE COMPARATOR CIRCUIT

As seen above, R3 provides the reference voltage (V_{ref}) to pin 3 of

the IC .

Now with v_{cc} =9v and R3 = 100k with light, voltage at pin 2 = 6v

(as already calculated)

Voltage at pin 3 = Va 9v (if the pointed of the variable resistor is at the

middle, I e) 50kQ = 4.5v

Now since voltage at pin 2 is higher than that at pin 3 the output voltage of the comparator 1C (NA741) changes from high to low.

Without light

Voltage at pin 2 = 1 v (already calculated)

Voltage at pin 3 = 4.5v (constant or fixed)

Now since voltage at pin 3 is higher than that at pin 2, the output voltage of the 1C changes from low to high.

ALARM ACTAUTOR OR DRIVER CIRCUIT

This circuit was realized by a voltage divider network of two resistors (R4 and R5) and a transistor (2N2222). The voltage at the collector of the NPN transistor was measured by a multimeter in the absence and in the presence of light respectively and expected result was obtained.

Also the 6v relay coupled to the collector of the transistor was tested and it was found to enable the alarm in the absence of light and disable the alarm in the presence of light

The circuit diagram is as shown below.

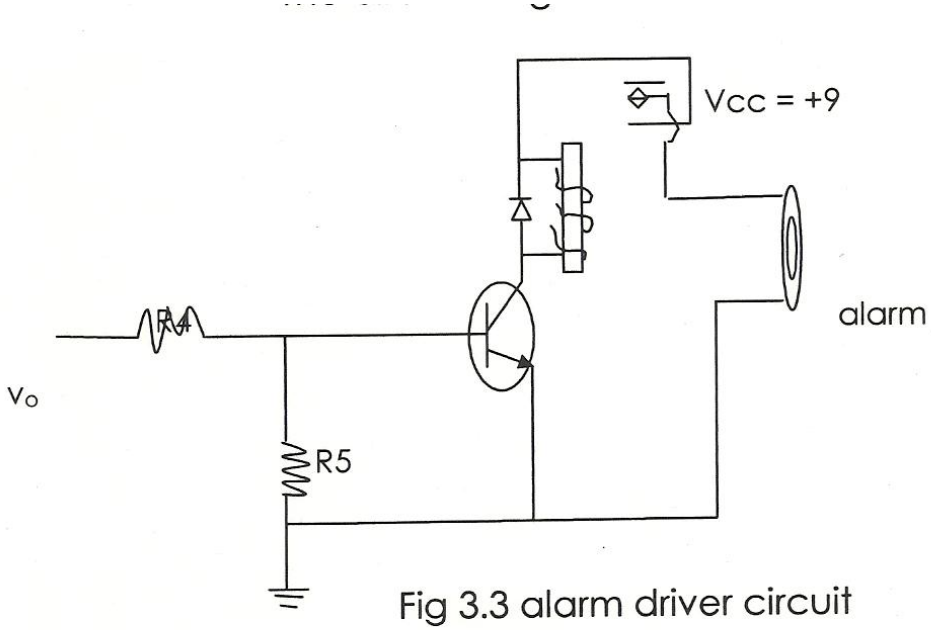


Fig 3.3 alarm driver circuit

R4 and R5 from the voltage divider network Q is an NPN transistor (2N2222).

R4 and R5 also biases the transistor Q

Without light or illumination v_0 = 9v

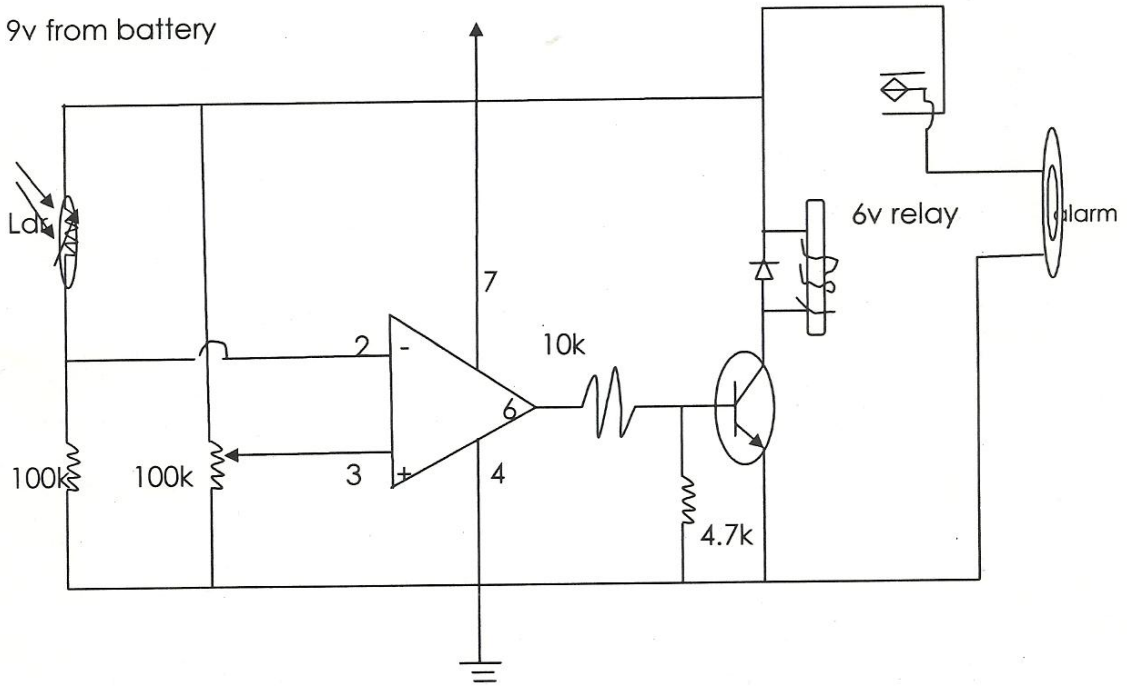
Then voltage at the base of the transistor Q is Vb = (R5 -HR4+R5) v

WithR4 = 10kandR5=5k

Vbase=5-f- 15D9 = 3V

Hence, 3v will be just enough to bias the transistor Q without destroying it.

COMPLETE CIRCUIT DIAGRAM OF THE BUGLAR ALARM SYSTEM



DESIGN AND IMPLEMENTATION

The components used for this project are 9v battery and jack for the power supply, light dependent Resistors, op-amp (NA741), transistors, relay (6v) and alarm.

FABRICATION AND ASSEMBLY

As already seen, the system was splinted into blocks in the design of this project and each block was fabricated, assembled and finally tested to ensure that the desired result were met at each block. Thus, with the entire blocks copied together the whole system was tested to ensure that it agreed with the objectives designed for

PACKAGING

The Vero board in which component were soldered to, were packaged in a (18 by 9.5 by 7) cm cast acrylic plastic box.

BILL OF QUANTITY

The prices or bill of quantity shown in table 1 gives the component used in the construction as at July 2009.

TABLET: BILL OF QUANTITY

COMPONENTS	QUANTITY	UNITS #	AMOUNT #
1 LDR	1	200	200
2 200kO_ VARIABLE RESISTOR	1	30	30
3 50KQ VARIABLE RESISTOR	1	30	30
4 100 KQ VARIABLE RESISTOR	1	20	20
5 10 KP_ VARIABLE RESISTOR	1	20	20
6 4.7KQ VARIABLE RESISTOR	1	20	20
7 NA741 OP-AMP(IC) AND SOCKET	1	100	100
8 2N2222 TRANSISTOR(NPN)	1	40	40
9 6V RELAY DC	1	120	120
10 5V-24V DC ALARM	1	180	180
11 9V BATTERY AND JACK/CLIP	1	150	150
12 JUMPER WIRE (6-IN- 1)	3 YARDS	80	240
13 DIODE 1N4148	1	30	30
14 PACKAGING/BREAD BOARD AND VEROBOARBJCAST ACRYLIC PLASTIC MATERIAL)	1	1800	1800
15 POWER SWITCH	1	50	50
GRAND TOTAL			3030

A system of this type was not found around locally to compare the price with that it cost me to assemble this unit. However, considering the worth of the finished system the cost in terms of value for the most is cheap. However, the cost can be further reduced if the system is produced on a large scale.

TESTING

LIGHT DEPENDENT RESISTOR

Since its electrical resistance is usually very high up to 1 mQ or more when dark and falls below to as little as a few hundred ohms when its surface is illuminated it was tested by a multi-meter to ascertain its functionality.

VOLTAGE COMPARATOR

The two input voltage (variable and reference inputs) of the NA741 op-amp 1C were measured in the presence and absence of light with a multi-meter and the voltage obtained at the output of the 1C were within the expected values.

ALARM ACTAUTOR UNIT.

This circuit was realized by a voltage divider network of two resistors (R4 and R5) and a transistor (2N2222). The voltage at the collector of the NPN transistor was measured by a multi-meter in the absence and in the presence of light respectively and expected result was obtained.

Also the 6v relay coupled to the collector of the transistor was tested and it was found to enable the alarm in the absence of light and disable the alarm in the presence of light

CONCLUSION AND RECOMMENDATION

Although the design and construction of the burglar alarm system was somehow tasking especially in the achieving of its sensitivity, it was further broadened my knowledge on the theory of basic electronic components, device etc. As earlier explained, when there is an intruder due to his/her shadows the LDR (light dependent resistor) surface is dark or not illuminated causing the electrical resistance of the detector to become very high making the voltage of the voltage comparator (1C) to be higher than the reference voltage at the IC's terminal. This tend causes it's to be high making the alarm Actuator to enable/activate the alarm which the sounds to alert the household of an intruder. The whole process continues as long as there is constant power supply. Though there were difficulties encountered during the design and construction stages. The study was a real success

RECOMEMMEDATION

All the discrete components used in the project could be built into a single 1C chip to further reduce the circuitry and increase sensitivity of the circuit could be further increase if more specialized 1C was in place of the NA741 1C.

REFERENCES

McNair, J.B (1992) AM. Jesus name Electronics 19 and 255 Opdyke, D.L (1976), Electronics vol.A supplements, p. 695 and 932 Utah Construction Trades Licensing Act Burglar Alarm Licensing Rules, R 156-55d, Utah Division of Occupational and Professional Licensing, P.O. Box 146741, Salt Lake City, UT84114, (1982) www.dopl.utah.gov.

Utah Construction Trades Licensing Act, Title 58, Chapter 55, Utah Division of Occupational and Professional Licensing, P.O. Box 146741, Salt Lake City, UT 84114, www.dopl.utah.Rov. Electrical codex (1980), 3rd edition national academy of sciences. Washington DC.