NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

A LIGHT/DARK ACTIVATED ALARM

Graduation Project
EE 400

Student: Shady Asqalan (20011008)

Supervisor: Assoc. Prof. Dr. Adnan Khashman

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ABSTRACT

As the life is getting more complicated, many people try to make their environment more safe and more comfortable, that leads to design some protection and luxury systems such as alarm systems. One of these alarm systems is light/dark activated alarm which considered as an "intelligent" alarm can make our life more easy and safety.

Light/dark activated alarm system depends on a sensitive element acts as the input of the alarm which is the photocell, photocell designed to act as high resistance under dark condition and as low resistance when brightly illuminated, this photocell and the rest of the circuit connected to it activate a relay when the light detected by the photocell, otherwise the relay is not active.

This project presents the design, test and building of a working alarm that is activated by light or darkness. When the switch is operated it controls an external device that is simulated here using a dynamo.

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INTRODUCTION

Generally, electronic security alarm systems are recognized in the entire world as an important contributor to the securing of life, property and possessions. A security system is an effective tool when used in conjunction with other sensible, overall crime prevention measures. Independent studies clearly show that premises with alarm systems are less likely to be broken into. As illustrated by these studies, electronic alarm systems, without question, contribute to a safer environment for you and your family. An alarm system is installed to deter and detect intruders. A basic security system will consist of both perimeter and space protection to secure your premise. The first stage secures vulnerable perimeter access points such as doors and windows; the second stage consists of space detection such as interior motion detectors which monitor movement inside the premise.

The aim of this project is to gain hands-on experience in designing and building electronic devices, and in solving problems encountered through out the project. Additionally, my objectives include building a working light/dark activated switch/alarm that operates an external device via a relay.

Chapter one will present the components which will be used in building the circuits in general, their characteristics, properties and functions will also be discussed. Also safety guidelines, which must be kept in mind when working on electronic projects, will be described.

Chapter two will give a brief description about light, what is light, how to produce a photon, frequencies, colors and behavior of light when it hits an object supported with many figures.

Chapter three of the project which is most important one will present detailed technical information about this light/dark activated alarm, and modifications made to it. Also it will include the components of this project and explanation of most important ones, in addition to some applications of this kind of alarms in general.

CHAPTER ONE
ELECTRONIC COMPONENTS

1.1 Overview

In this chapter a description about the electronics components used in general hardware projects will be described briefly in addition to safety guidelines.

1.2 Components

In this section i will generally explain each of the components structures and uses in the electronics circuits.

1.2.1 Resistors

Resistors are the most commonly used component in electronics and their purpose is to create specified values of current and voltage in a circuit by reducing the flow of electric current . The unit for measuring resistance is the OHM. (the Greek letter Ω). Higher resistance values are represented by "k" (kilo-ohms) and M (meg ohms). For example, 120 000 Ω is represented as 120k, while 1 200 000 Ω is represented as 1M2. Resistors are components that resist the flow of electrical current. The higher the value of resistance (measured in ohms) the lower the current will be. In order to know the resistor value manufacturers indicates its value by four colored bands around its body. The symbol for a resistor is shown in the following diagram (upper: American symbol, lower: European symbol.)

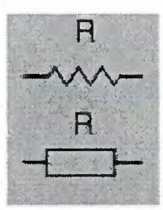


Figure 1.1 Resistor symbols

Resistance value is marked on the resistor body. The first three bands provide the value of the resistor in ohms and the fourth band indicates the tolerance. Tolerance values of 5%, 2%, and 1% are most commonly available. The following table shows the colors used to identify resistor values.

Table 1.1: Resistor color code.

COLOR	DIGIT	MULTIPLIER	TOLERANCE	TC
Silver		x 0.01 Ω	±10%	
Gold		x 0.1 Ω	±5%	
Black	0	x 1 Ω		
Brown	1	x 10Ω	±1%	$\pm100*10^{-6}/K$
Red	2	x 100Ω	±2%	$\pm50*10^{-6}/K$
Orange	3	x 1 kΩ		$\pm15*10^{-6}/K$
Yellow	4	x 10 kΩ		$\pm25*10^{-6}/K$
Green	5	x 100 kΩ	±0.5%	
Blue	6	x 1 MΩ	±0.25%	$\pm10*10^{-6}/K$
Violet	7	x 10 MΩ	±0.1%	$\pm5*10^{-6}/K$
Grey	8	x 100 MΩ		
White	9	x 1 GΩ		$\pm1*10^{-6}/K$

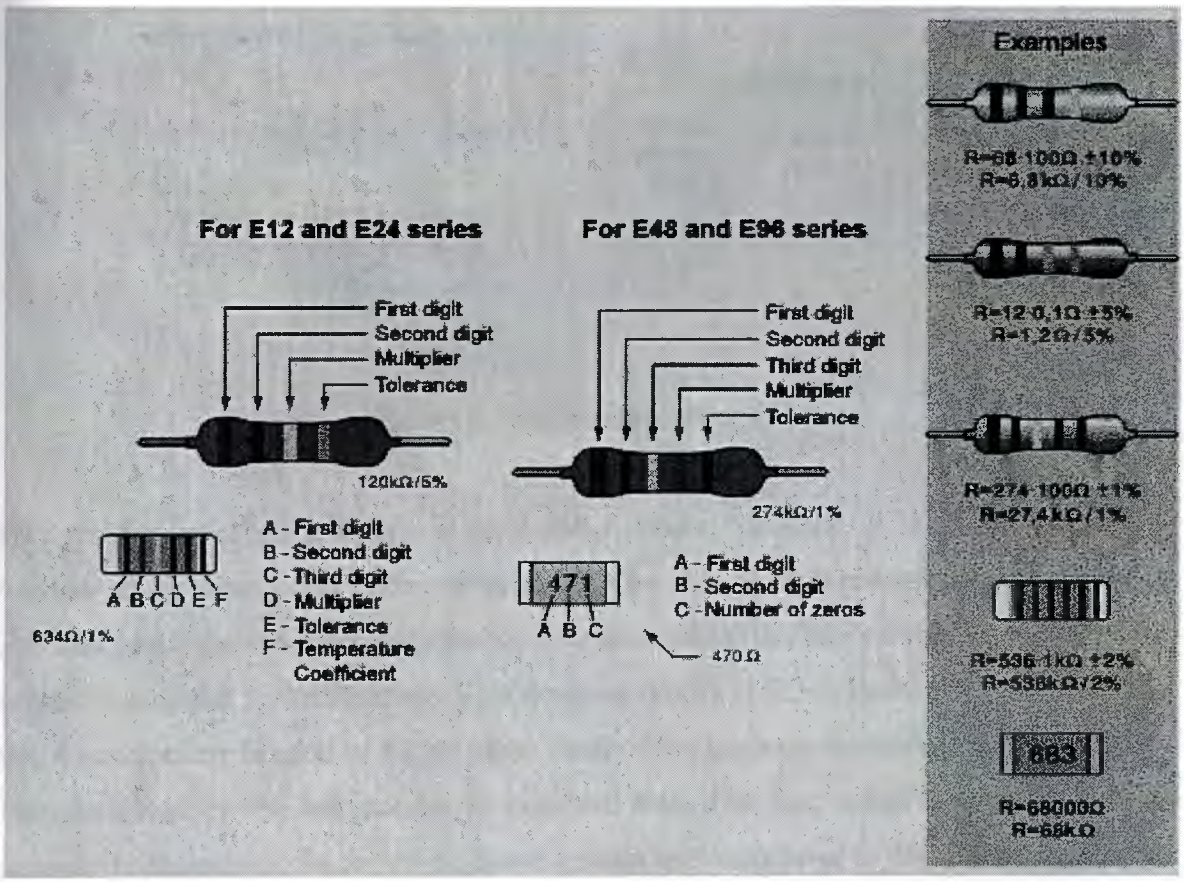
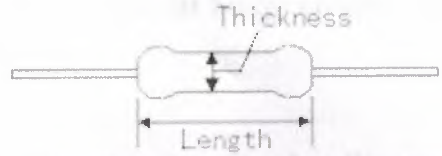


Figure 1.2 Four-band resistor, Five-band resistor, Cylindrical SMD resistor, Flat SMD resistor.[3]

1.2.1.1 Types of resistors

Carbon film resistors: This is the most general purpose, cheap resistor. Usually the tolerance of the resistance value is ±5%. Power ratings of 1/8W, 1/4W and 1/2W are frequently used. Carbon film resistors have a disadvantage; they tend to be electrically noisy. Metal film resistors are recommended for use in analog circuits.

From the top of the photograph
1/8W
1/4W
1/2W



Rough size

Rating power (W)	**Thickness (mm)**	**Length (mm)**
1/8	2	3
1/4	2	6
1/2	3	9

Figure 1.3 carbon film resistors.

This resistor is called a Single-In-Line (SIL) resistor network. It is made with many resistors of the same value, all in one package. One side of each resistor is connected with one side of all the other resistors inside. One example of its use would be to control the current in a circuit powering many light emitting diodes (LEDs). In the photograph on the left, 8 resistors are housed in the package. Each of the leads on the package is one resistor. The ninth lead on the left side is the common lead. The face value of the resistance is printed. (It depends on the supplier.) Some resistor networks have a "4S" printed on the top of the resistor network. The 4S indicates that the package contains 4 independent resistors that are not wired together inside. The housing has eight leads instead of nine. The internal wiring of these typical resistor networks has been illustrated below. The size (black part) of the resistor network which I have is as follows: For the type with 9 leads, the thickness is 1.8 mm, the height 5mm, and the width 23 mm. For the types with 8 component leads, the thickness is 1.8 mm, the height 5 mm, and the width 20 mm.

Metal film resistors: metal film resistors are used when a higher tolerance (more accurate value) is needed. They are much more accurate in value than carbon film resistors. They have good temperature stability, good long time stability, cannot handle overloads well. They have about ±0.05% tolerance. They have about ±0.05% tolerance. Resistors that are about ±1% are more than sufficient. Ni-Cr (Nichrome) seems to be used for the material of resistor. The metal film resistor is used for bridge circuits, filter circuits, and low-noise analog signal circuits.

Thick film resistor: similar properties as metal film resistor but can handle surges better, and withstand high temperatures,

Thin film resistor: good long time stability, good temperature stability, good voltage dependently rating, low noise, not good for RF, low surge handling capacity

Metal oxide resistor: mostly similar features as metal film resistor but better surge handling capacity, higher temperature rating them metal film resistor, low voltage dependently, low noise, better for RF than wire wound resistor but usually worse temperature stability

Variable resistors: there are two general ways in which variable resistors are used. One is the variable resistor which value is easily changed, like the volume adjustment of radio. The other is semi-fixed resistor that is not meant to be adjusted by anyone but a technician. It is used to adjust the operating condition of the circuit by the technician. Semi-fixed resistors are used to compensate for the inaccuracies of the resistors, and to fine-tune a circuit. The rotation angle of the variable resistor is usually about 300 degrees. Some variable resistors must be turned many times to use the whole range of resistance they offer. This allows for very precise adjustments of their value. These are called "Potentiometers" or "Trimmer Potentiometers." The symbol is used to indicate a variable resistor in a circuit diagram is shown below.

Figure 1.4 Variable resistors symbol.

There are three ways in which a variable resistor's value can change according to the rotation angle of its axis. When type "A" rotates clockwise, at first, the resistance value changes slowly and then in the second half of its axis, it changes very quickly.

The "A" type variable resistor is typically used for the volume control of a radio, for example. It is well suited to adjust a low sound subtly. It suits the characteristics of the ear. The ear hears low sound changes well, but isn't as sensitive to small changes in loud sounds. A larger change is needed as the volume is increased. These "A" type variable resistors are sometimes called "audio taper" potentiometers. As for type "B", the rotation of the axis and the change of the resistance value are directly related. The rate of change is the same, or linear, throughout the sweep of the axis. This type suits a resistance value adjustment in a circuit, a balance circuit and so on. They are sometimes called "linear taper" potentiometers. Type "C" changes exactly the opposite way to type "A". In the early stages of the rotation of the axis, the resistance value changes rapidly, and in the second half, the change occurs more slowly. This type isn't too much used. It is a special use. As for the variable resistor, most are type "A" or type "B".

Figure 1.5 Variable resistors. [3]

Wire wound resistors: There is another type of resistor other than the carbon-film type and the metal film resistors. It is the wire wound resistor. A wire wound resistor is made of metal resistance wire, and because of this, they can be manufactured to precise values. Also, high-wattage resistors can be made by using a thick wire material. Wire wound resistors cannot be used for high-frequency circuits. Coils are used in high frequency circuits. Since a wire wound resistor is a wire wrapped around an insulator, it is also a coil, in a manner of speaking. Using one could change the behavior of the circuit. Still another type of resistor is the Ceramic resistor. These are wire wound resistors in a ceramic case, strengthened with special cement. They have very high power ratings, from 1 or 2 watts to dozens of watts. These resistors can become extremely hot when used for high power applications, and this must be taken into account when designing the circuit. These devices can easily get hot enough to burn you if you touch one.

Composite resistor: usually some medium power resistors are built in this way. Has low inductance, large capacitance, poor temperature stability, noisy and not very good long time stability. Composite resistor can handle well short overload surges.

1.2.2 Capacitors

In 1745 a new physics and mathematics professor at the University of Leyden (spelled Leiden in modern Dutch), Pieter van Musschenbroek (1692 - 1791) and his assistants Allmand and Cunaeus from the Netherlands invented the 'capacitor' (electro-static charge or capacitance actually) but did not know it at first. His condenser was called the 'Leyden Jar' (pronounced: LY'duhn) and named so by Abbe Nollet. This Leyden jar consisted of a narrow-necked glass jar coated over part of its inner and outer surfaces with a conductive metallic substance; a conducting rod or wire passes through as insulating stopper (cork) in the neck of the jar and contacts the inner foil layer, which is separated from the outer layer by the glass wall. The Leyden jar was one of the first devices used to store an electric charge. If the inner layers of foil and outer layers of foil are then connected by a conductor, their opposite charges will cause a spark that discharges the jar. Actually, van Musschenbroek's very first 'condenser' was nothing more than a beer glass! [1]

A capacitor is an electronic device which consists of two plates (electrically conductive material) separated by an insulator. The capacitor's value (its 'capacitance') is largely determined by the total surface area of the plates and the distance between the plates (determined by the insulator's thickness). A capacitor's value is commonly referred to in microfarads, one millionth of a farad. It is expressed in micro farads because the farad is such a large amount of capacitance that it would be impractical to use in most situations. Capacitors store electric charge. They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge. They are used to smooth varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC (changing) signals but they block DC (constant) signals.

1.2.2.1 Capacitance

This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, symbol F. However 1F is very large, so prefixes are used to show the smaller values. Three prefixes (multipliers) are used, μ (micro), n (nano) and p (pico): μ means 10^{-6} (millionth), so 1000000μF = 1F, n means 10^{-9} (thousand-millionth), so 1000nF = 1μF, p means 10^{-12} (million-millionth), so 1000pF = 1nF. Capacitor values can be very difficult to find because there are many types of capacitor with different labeling systems!

1.2.2.2 Types of capacitors

There are many types of capacitor but they can be split into two groups, polarized and unpolarized each group has its own circuit symbol.

1. Polarized capacitors

Figure 1.6 Circuit symbol & examples of the polarized capacitor. [1]

Electrolytic Capacitors: Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering. There are two designs of electrolytic capacitors; axial where the leads are attached to each end (220μF in picture) and radial where both leads are at the same end (10μF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board. It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. It the project parts list does not specify a voltage; choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

Figure 1.7 Electrolytic capacitor. [2]

Tantalum Bead Capacitors: Tantalum bead capacitors are polarized and have low voltage ratings like electrolytic capacitors. They are expensive but very small, so they are used where a large capacitance is needed in a small size. Modern tantalum bead capacitors are printed with their capacitance and voltage in full. However older ones use a color-code system which has two stripes (for the two digits) and a spot of colors for the number of zeros to give the value in µF. The standard color code is used, but for the spot, grey is used to mean × 0.01 and white means × 0.1 so that values of less than 10µF can be shown. A third colors stripe near the leads shows the voltage (yellow 6.3V, black 10V, green 16V, blue 20V, grey 25V, white 30V, pink 35V).

For example: blue, grey, black spot means 68µF , blue, grey, white spot means 6.8µF , blue, grey, grey spot means 0.68µF .

2. Unpolarized capacitor

Small value capacitors are unpolarised and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems! Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be! For example 0.1 means 0.1µF = 100nF. Sometimes the multiplier is used in place of the decimal point. For example: 4n7 means 4.7nF.

Capacitor Number Code: A number code is often used on small capacitors where printing is difficult: The 1st number is the 1st digit, the 2nd number is the 2nd digit, and the 3rd number is the number of zeros to give the capacitance in pF. Ignore any letters - they just indicate tolerance and voltage rating. For example: 102 means 1000pF = 1nF (not 102pF!), 472J means 4700pF = 4.7nF (J means 5% tolerance).

Capacitor Color Code: A color code was used on polyester capacitors for many years. It is now obsolete, but of course there are many still around. The colors should be read like the resistor code, the top three colors bands giving the value in pF. Ignore the 4th band (tolerance) and 5th band (voltage rating). For example: brown, black, orange means 10000pF = 10nF = 0.01μF.

Note that there are no gaps between the colors bands, so 2 identical bands actually appear as a wide band. For example: wide red, yellow means 220nF = 0.22μF.

Figure 1.8 Circuit symbol & examples of the unpolarized capacitor. [2]

Polystyrene Capacitors: This type is rarely used now. Their value (in pF) is normally printed without units. Polystyrene capacitors can be damaged by heat when soldering (it melts the polystyrene!) so you should use a heat sink (such as a crocodile clip). Clip the heat sink to the lead between the capacitor and the joint. Real capacitor values (the E3 and E6 series) you may have noticed that capacitors are not available with every possible value, for example 22μF and 47μF are readily available, but 25μF and 50μF are not! Why is this? Imagine that you decided to make capacitors every 10μF giving 10, 20, 30, 40, 50 and so on. That seems fine, but what happens when you reach 1000? It would be pointless to make 1000, 1010, 1020, 1030 and so on because for these values 10 is a very small difference, too small to be noticeable in most circuits and capacitors cannot be made with that accuracy. To produce a sensible range of capacitor values you need to increase the size of the 'step' as the value increases. The standard capacitor values are based on this idea and they form a series which follows the same pattern for every multiple of ten. The E3 series (3 values for each multiple of ten) 10, 22, 47, then it continues 100, 220, 470, 1000, 2200, 4700, 10000 etc. Notice how the step size increases as the value increases (values roughly double each time).The E6 series (6 values for each multiple of ten) 10, 15, 22, 33, 47, 68, then it continues 100, 150, 220, 330, 470, 680, 1000 etc. Notice how this is the E3 series with an extra value in the gaps. The E3 series is the one most frequently used for capacitors because many types cannot be made with very accurate values.

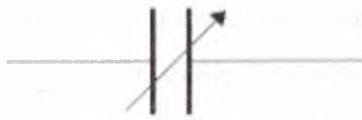
Figure 1.9 Polystyrene capacitor

3. Variable capacitor

Variable capacitors are mostly used in radio tuning circuits and they are sometimes called 'tuning capacitors'. They have very small capacitance values, typically between 100pF and 500pF (100pF = 0.0001μF). The type illustrated usually has trimmers built in (for making small adjustments - see below) as well as the main variable capacitor. Many variable capacitors have very short spindles which are not suitable for the standard knobs used for variable resistors and rotary switches. It would be wise to check that a suitable knob is available before ordering a variable capacitor. Variable capacitors are not normally used in timing circuits because their capacitance is too small to be practical and the range of values available is very limited. Instead timing circuits use a fixed capacitor and a variable resistor if it is necessary to vary the time period.

Trimmer capacitors: Trimmer capacitors (trimmers) are miniature variable capacitors. They are designed to be mounted directly onto the circuit board and adjusted only when the circuit is built. A small screwdriver or similar tool is required to adjust trimmers. The process of adjusting them requires patience because the presence of your hand and the tool will slightly change the capacitance of the circuit in the region of the trimmer!

Trimmer capacitors are only available with very small capacitances, normally less than 100pF. It is impossible to reduce their capacitance to zero, so they are usually specified by their minimum and maximum values, for example 2-10pF.
Trimmers are the capacitor equivalent of presents which are miniature variable resistors.



Variable Capacitor Symbol

Variable Capacitor

Figure 1.10 Variable capacitors symbol & a variable capacitor. [2]

1.2.3 Semiconductors

Semiconductors have a large amount of types. Transistors have three lead-out wires are called the base, emitter and conductor. It is essential that these are connected correctly, as there is no chance of project working if they are not. Fortunately modern transistors are not easily damaged, and incorrect connection is not likely to damage a device (or other components in the circuit) only one type is used in this project. One extremely important area of semiconductor technology is the field of telecommunications. The new "Information Super Highway" requires technology which can transmit and receive information at high rates. One approach which is already being applied to this area is optoelectronics or the use of light to transmit information. Electrons are used to transfer information within computers, but most information sent over long distances uses light pulses traveling through fiber optic cables. The laser diodes which create these pulses and semiconductor receivers that detect the pulses are areas of intensive research.

1.2.3.1 Diodes

Diodes are non-linear circuit elements. It is made of two different types of semiconductors right next to each other. Qualitatively we can just think of an ideal diode has having two regions: a conduction region of zero resistance and an infinite resistance non-conduction region. For many circuit applications, the behavior of a (junction) diode depends on its polarity in the circuit. If the diode is reverse biased (positive potential on N-type material) the current through the diode is very small. The following figure is shown the characteristic of diode.

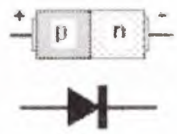


Figure 1.11 Diode. [5]

Forward Biased P-N Junction: forward biasing the p-n junction drives holes to the junction from the p-type material and electrons to the junction from the n-type material. At the junction the electrons and holes combine so that a continuous current can be maintained.

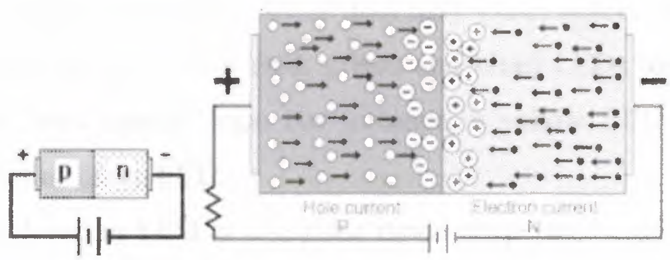


Figure 1.12 Forward Biased P-N Junction. [5]

Reverse Biased P-N Junction: the application of a reverse voltage to the p-n junction will cause a transient current to flow as both electrons and holes are pulled away from the junction. When the potential formed by the widened depletion layer equals the applied voltage, the current will cease except for the small thermal current [5]

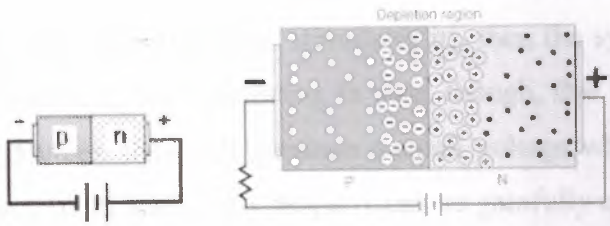


Figure 1.13 Reverse Biased P-N Junction [5]

1.2.3.1.1 Light emitting diode

Some semiconductor junctions, composed of special chemical combinations, emit radiant energy within the spectrum of visible light as the electrons transition in energy levels. Simply put, these junctions glow when forward biased. A diode intentionally designed to glow like a lamp is called a light-emitting diode, or LED.

Diodes made from a combination of the elements gallium, arsenic, and phosphorus (called gallium-arsenide-phosphate) glow bright red, and are some of the most common LEDs manufactured. By altering the chemical constituency of the PN junction, different colors may be obtained. Some of the currently available colors other than red are green, blue, and infra-red (invisible light at a frequency lower than red). Other colors may be obtained by combining two or more primary-color (red, green, and blue) LEDs together in the same package, sharing the same optical lens. For instance, a yellow LED may be made by merging a red LED with a green LED.

The schematic symbol for an LED is a regular diode shape inside of a circle, with two small arrows pointing away (indicating emitted light):

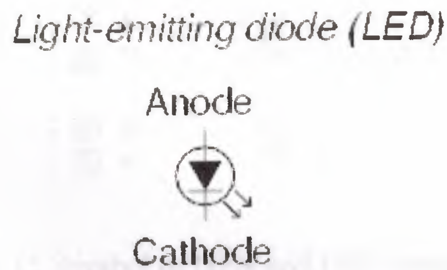


Figure 1.14 Symbol of LED

This notation of having two small arrows pointing away from the device is common to the schematic symbols of all light-emitting semiconductor devices. Conversely, if a device is light-activated (meaning that incoming light stimulates it), then the symbol will have two small arrows pointing toward it. It is interesting to note, though, that LEDs are capable of acting as light-sensing devices: they will generate a small voltage when exposed to light, much like a solar cell on a small scale. This property can be gainfully applied in a variety of light-sensing circuits.

Because LEDs are made of different chemical substances than normal rectifying diodes, their forward voltage drops will be different. Typically, LEDs have much larger forward voltage drops than rectifying diodes, anywhere from about 1.6 volts to over 3 volts, depending on the color. Typical operating current for a standard-sized LED is around 20 mA. When operating an LED from a DC voltage source greater than the LED's forward voltage, a series-connected "dropping" resistor must be included to prevent full source voltage from damaging the LED. [2]

1.2.3.2 Transistors

A Bipolar Transistor essentially consists of a pair of PN Junction Diodes that are joined back-to-back. This forms a sort of a sandwich where one kind of semiconductor is placed in-between two others. There are therefore two kinds of bipolar sandwich, the NPN and PNP varieties. The three layers of the sandwich are conventionally called the Collector, Base, and Emitter. The reasons for these names will become clear later once we see how the transistor works. As shown in the figure 1.7 there are two symbol of type of bipolar transistors.

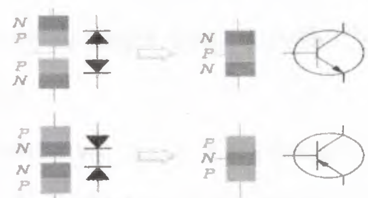


Figure 1.15 Symbol of NPN and PNP transistors. [5]

Some of the basic properties exhibited by a Bipolar Transistor are immediately recognizable as being diode-like. However, when the 'filling' of the sandwich is fairly thin some interesting effects become possible that allow us to use the Transistor as an amplifier or a switch. To see how the Bipolar Transistor works we can concentrate on the NPN variety. The figure 1.8 shows the energy levels in an NPN transistor.

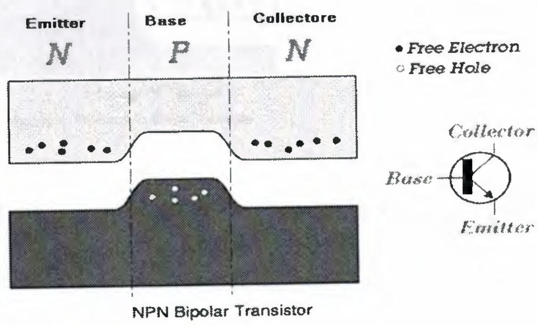


Figure 1.16 The energy levels in an NPN transistor. [5]

Figure 1.16 shows the energy levels in an NPN transistor when we aren't externally applying any voltages. We can see that the arrangement looks like a back-to-back pair of PN Diode junctions with a thin P-type filling between two N-type slices of 'bread'. In each of the N-type layers conduction can take place by the free movement of electrons in the conduction band. In the P-type (filling) layer conduction can take place by the movement of the free holes in the valence band. However, in the absence of any externally applied electric field, we find that depletion zones form at both PN-Junctions, so no charge wants to move from one layer to another.

Consider now what happens when we apply a moderate voltage between the Collector and Base parts of the transistor. The polarity of the applied voltage is chosen to increase the force pulling the N-type electrons and P-type holes apart. (I.e. we make the Collector positive with respect to the Base.) This widens the depletion zone between the Collector and base and so no current will flow. In effect we have reverse-biased the Base-Collector diode junction. The precise value of the Base-Collector voltage we choose doesn't really matter to what happens provided we don't make it too big and blow up the transistor! So for

For the sake of example we can imagine applying a 10 Volt Base-Collector voltage. As shown in the figure 1.9 the applying collector-base voltage. [5]

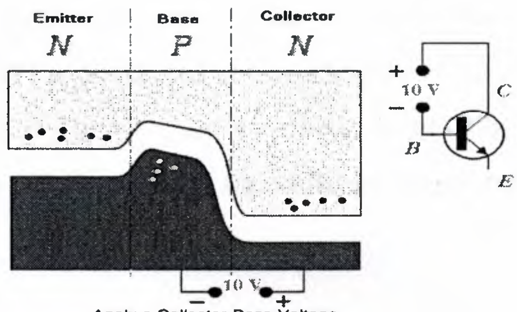


Figure 1.17 The applying collector-base voltage. [6]

1.2.4 Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round.

Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil. The relay's switch connections are usually labeled COM, NC and NO:

COM = Common, always connect to this; it is the moving part of the switch.

NC = Normally Closed, COM is connected to this when the relay coil is off.

NO = Normally Open, COM is connected to this when the relay coil is on.

Connect to COM and NO if you want the switched circuit to be on when the relay coil is on. Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

Disadvantages of relays:

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch many times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many chips can provide, so a low power transistor may be needed to switch the current for the relay's coil. [3]

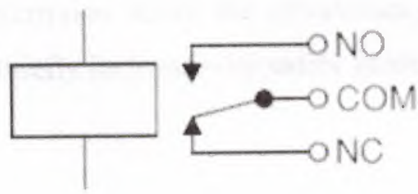


Figure 1.18 Circuit symbol for a relay.

1.3 Safety

In this project, low voltage applications are used. Thus, safety guidelines are not in concern of human safety but in components safety, although we cannot avoid the technical mistakes witch can occur during connecting parts and soldering them to the circuit, so we have to be careful from current and heat.

- One of the components which are used in this circuit is the chemical capacitor, this element has two poles and when connected to the circuit we have to care about its polarity so as to avoid damaging it.

- While connecting the circuit components to the power supply we have to be aware of misconnecting its polarity to assure the safety of used components.

- While the circuit is on, avoid touching the sensitive components like the transistor, and diodes and to avoid interfering with the out put signal.

- While soldering the parts to the circuit we have to be careful so as not to burn the parts which are sensitive and can be harmed by heat.

1.4 Summary

In this chapter a description about the electronics components used in general hardware projects described briefly inclosed with safety guidelines.

CHAPTER TWO

TECHNICAL ON LIGHT

2.1 Overview

In this chapter a discription about light,what is light,how to produce a photon, frequinces, colors, making of colors and behavior of the light when it hits an object will be discribed briefly.

2.2 Introduction

We see things every day, from the moment we get up in the morning until we go to sleep at night. We look at everything around us using light. We appreciate kids' crayon drawings, fine oil paintings, swirling computer graphics, gorgeous sunsets, a blue sky, shooting stars and rainbows. We rely on mirrors to make ourselves presentable, and sparkling gemstones to show affection. But did you ever stop to think that when we see any of these things, we are not directly connected to it? We are, in fact, seeing light -- light that somehow left objects far or near and reached our eyes. Light is all our eyes can really see.

The other way that we encounter light is in devices that produce light –incandescent bulbs, fluorescent bulbs, laser, lightning bugs, the sun. Each one uses a different technique to generate photons.

In this article, we will look at light from many different angles to show you exactly how it works!

2.3 Ways of thinking about light

You have probably heard two different ways of talking about light:

There is the "particle" theory, expressed in part by the word photon.

There is the "wave" theory, expressed by the term light wave.

From the time of the ancient Greeks, people have thought of light as a stream of tiny particles. After all, light travels in straight lines and bounces off a mirror much like a ball bouncing off a wall. No one had actually seen particles of light, but even now it's easy to explain why that might be. The particles could be too small, or moving too fast, to be seen, or perhaps our eyes see right through them.

The idea of the light wave came from Christian Huygens, who proposed in the late 1600s that light acted like a wave instead of a stream of particles. In 1807, Thomas Young backed up Huygens' theory by showing that when light passes through a very narrow opening, it can spread out, and interfere with light passing through another opening. Young shined a light through a very narrow slit. What he saw was a bright bar of light that corresponded to the slit. But that was not all he saw. Young also perceived additional light, not as bright, in the areas around the bar. If light were a stream of particles, this additional light would not have been there. This experiment suggested that light spread out like a wave. In fact, a beam of light radiates outward at all times.

Albert Einstein advanced the theory of light further in 1905. Einstein considered the photoelectric effect, in which ultraviolet light hits a surface and causes electrons to be emitted from the surface. Einstein's explanation for this was that light was made up of a stream of energy packets called photons.

Modern physicists believe that light can behave as both a particle and a wave, but they also recognize that either view is a simple explanation for something more complex. In this article, we will talk about light as waves, because this provides the best explanation for most of the phenomena our eyes can see.

2.4 What is Light?

Why is it that a beam of light radiates outward, as Young proved? What is really going on? To understand light waves, it helps to start by discussing a more familiar kind of wave -- the one we see in the water. One key point to keep in mind about the water wave is that it is not made up of water: The wave is made up of energy traveling through the water. If a wave moves across a pool from left to right, this does not mean that the water on the left side of the pool is moving to the right side of the pool. The water has actually stayed about where it was. It is the wave that has moved. When you move your hand through a filled bathtub, you make a wave, because you are putting your energy into the water. The energy travels through the water in the form of the wave. All waves are traveling energy, and they are usually moving through some medium, such as water. You can see a diagram of a water wave in Figure 1. A water wave consists of water molecules that vibrate up and down at right angles to the direction of motion of the wave. This type of wave is called a transverse wave.

Light waves are a little more complicated, and they do not need a medium to travel through. They can travel through a vacuum. A light wave consists of energy in the form of electric and magnetic fields. The fields vibrate at right angles to the direction of movement of the wave, and at right angles to each other. Because light has both electric and magnetic fields, it is also referred to as electromagnetic radiation

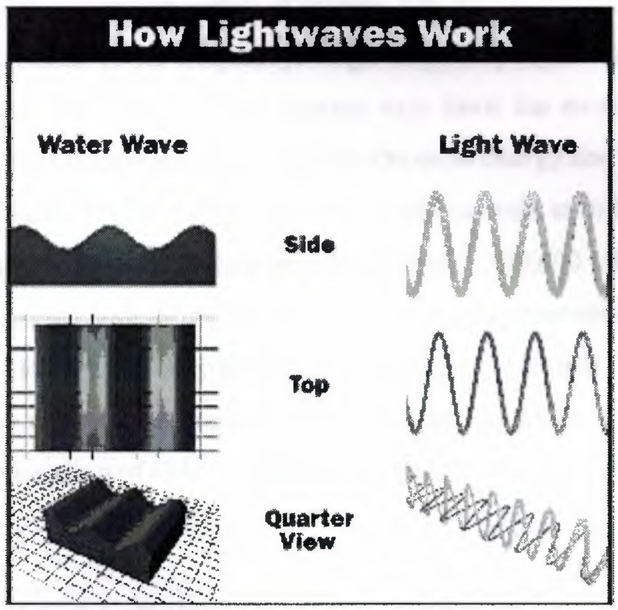


Figure 2.1 How lightwavwes work.[4]

Light waves come in many sizes. The size of a wave is measured as its wavelength, which is the distance between any two corresponding points on successive waves, usually peak-to-peak or trough-to-trough (Figure 2.1). The wavelengths of the light we can see range from 400 to 700 billionths of a meter. But the full range of wavelengths included in the definition of electromagnetic radiation extends from one billionth of a meter, as in gamma rays, to centimeters and meters, as in radio waves. Light is one small part of the spectrum.

2.5 Frequencies

Light waves also come in many frequencies. The frequency is the number of waves that pass a point in space during any time interval, usually one second. It is measured in units of cycles (waves) per second, or Hertz (Hz). The frequency of visible light is referred to as color, and ranges from 430 trillion Hz, seen as red, to 750 trillion Hz, seen as violet. Again, the full range of frequencies extends beyond the visible spectrum, from less than one billion Hz, as in radio waves, to greater than 3 billion billion Hz, as in gamma rays.

As noted above, light waves are waves of energy. The amount of energy in a light wave is proportionally related to its frequency: High frequency light has high energy; low frequency light has low energy. Thus gamma rays have the most energy, and radio waves have the least. Of visible light, violet has the most energy and red the least.

Light not only vibrates at different frequencies, it also travels at different speeds. Light waves move through a vacuum at their maximum speed, 300,000 kilometers per second or 186,000 miles per second, which makes light the fastest phenomenon in the universe. Light waves slow down when they travel inside substances, such as air, water, glass or a diamond. The way different substances affect the speed at which light travels is key to understanding the bending of light, or refraction, which we will discuss later.

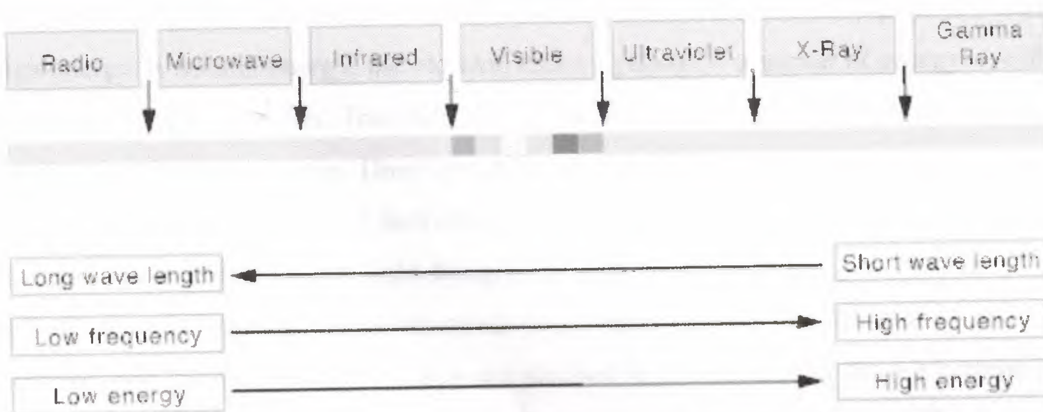


Figure 2.2 Electromagnatic spectrum.[1]

So light waves come in a continuous variety of sizes, frequencies and energies. We refer to this continuum as the electromagnetic spectrum (Figure 2.2). Figure 2.2 is not drawn to scale, in that visible light occupies only one-thousandth of a percent of the spectrum.

2.6 Producing a photon

Any light that you see is made up of a collection of one or more photons propagating through space as electromagnetic waves. In total darkness, our eyes are actually able to sense single photons, but generally what we see in our daily lives comes to us in the form of zillions of photons produced by light sources and reflected off objects. If you look around you right now, there is probably a light source in the room producing photons, and objects in the room that reflect those photons. Your eyes absorb some of the photons flowing through the room, and that is how you see.

There are many different ways to produce photons, but all of them use the same mechanism inside an atom to do it. This mechanism involves the energizing of electrons orbiting each atom's nucleus. How nuclear radiatio works describes protons, neutrons and electrons in some detail. For example, hydrogen atoms have one electron orbiting the nucleus. Helium atoms have two electrons orbiting the nucleus. Aluminum atoms have 13 electrons orbiting the nucleus. Each atom has a preferred number of electrons orbiting its nucleus. Electrons circle the nucleus in fixed orbits -- a simplified way to think about it is to imagine how satellites orbit the Earth. There's a huge amount of theory around electron orbitals, but to understand light there is just one key fact to understand: An electron has a natural orbit that it occupies, but if you energize an atom you can move its electrons to higher orbitals. A photon of light is produced whenever an electron in a higher-than-normal orbit falls back to its normal orbit. During the fall from high-energy to normal-energy, the electron emits a photon -- a packet of energy -- with very specific characteristics. The photon has a frequency, or color, that exactly matches the distance the electron falls. There are cases where you can see this phenomenon quite clearly. For example, in lots of factories and parking lots you see sodium vapor lights. You can tell a sodium vapor light because it is very yellow when you look at it. A sodium vapor light energizes sodium atoms to generate photons. A sodium atom has 11 electrons, and because of the way they are stacked in orbitals one of those electrons is most likely to accept and emit energy (this electron is called the 3s electron) The energy packets that this electron is most likely to emit fall right around a wavelength of 590 nanometers. This wavelength corresponds to yellow light. If you run sodium light through a prism, you do not see a rainbow -- you see a pair of yellow lines.[6]

2.7 Bring on the heat

Probably the most common way to energize atoms is with heat, and this is the basis of incandescence. If you heat up a horseshoe with a blowtorch, it will eventually get red hot, and if you heat it enough it gets white hot. Red is the lowest-energy visible light, so in a red-hot object the atoms are just getting enough energy to begin emitting light that we can see. Once you apply enough heat to cause white light, you are energizing so many different electrons in so many different ways that all of the colors are being generated, they all mix together to look white, as explained in one of the sections below.

Heat is the most common way we see light being generated, a normal 75-watt incandescent bulb is generating light by using electricity to create heat. However, there are lots of other ways to generate light, some of which are listed below:

Halogen lamps - Halogen lamps use electricity to generate heat, but benefit from a technique that lets the filament run hotter.

Gas lanterns :- Uses as fuel like natural gas or kerosene as the source of heat.

Fluorescent lights :- Use electricity to directly energize atoms rather than requiring heat.

Lasers :- Use energy to "pump" a lasing medium, and all of the energized atoms are made to dump their energy at the exact same wavelength and phase.

Glow-in-the-dark toys - In a Glow-in-the-dark toys, the electrons are energized but fall back to lower-energy orbitals over a long period of time, so the toy can glow for half an hour.

Indiglo watches - In Indiglo watches, voltage energizes phosphor atoms.

Chemical light sticks - A chemical light stick and, for that matter, fireflies, use a chemical reaction to energize atoms.

The thing to note from this list is that anything that produces light does it by energizing atoms in some way.

2.8 Making colors

Visible light is light that can be perceived by the human eye. When you look at the visible light of the sun, it appears to be colorless, which we call white. And although we can see this light, white is not considered to be part of the visible spectrum (Figure 2.2). This is because white light is not the light of a single color, or frequency. Instead, it is made up of many color frequencies. When sunlight passes through a glass of water to land on a wall, we see a rainbow on the wall. This would not happen unless white light were a mixture of all of the colors of the visible spectrum. Isaac Newton was the first person to demonstrate this. Newton passed sunlight through a glass prism to separate the colors into a rainbow spectrum. He then passed sunlight through a second glass prism and combined the two rainbows. The combination produced white light. This proved conclusively that white light is a mixture of colors, or a mixture of light of different frequencies. The combination of every color in the visible spectrum produces a light that is colorless, or white.

Colors by Addition - You can do a similar experiment with three flashlights and three different colors of cellophane -- red, green and blue (commonly referred to as RGB). Cover one flashlight with one to two layers of red cellophane and fasten the cellophane with a rubber band (do not use too many layers or you will block the light from the flashlight). Cover another flashlight with blue cellophane and a third flashlight with green cellophane. Go into a darkened room, turn the flashlights on and shine them against a wall so that the beams overlap, as shown in Figure 2.3. Where red and blue light overlap, you will see magenta. Where red and green light overlap, you will see yellow. Where green and blue light overlap, you will see cyan. You will notice that white light can be made by various combinations, such as yellow with blue, magenta with green, cyan with red, and by mixing all of the colors together.

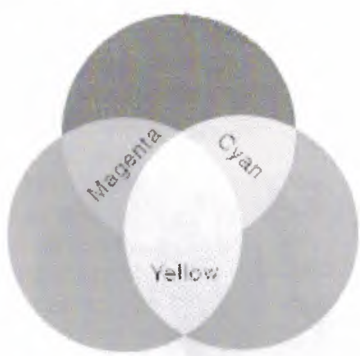


Figure 2.3 Mixing red,green and blue colors.[4]

By adding various combinations of red, green and blue light, you can make all the colors of the visible spectrum. This is how computer monitors (RGB monitors) produce colors.

Colors by Subtraction :- Another way to make colors is to absorb some of the frequencies of light, and thus remove them from the white light combination. The absorbed colors are the ones you will not see, you see only the colors that come bouncing back to your eye. This is what happens with paints and dyes. The paint or dye molecules absorb specific frequencies and bounce back, or reflect, other frequencies to your eye. The reflected frequency (or frequencies) are what you see as the color of the object. For example, the leaves of green plants contain a pigment called chlorophyll, which absorbs the blue and red colors of the spectrum and reflects the green.

Here is an absorption experiment that any one can try at home: Taking a banana and the blue cellophane-covered flashlight made earlier. Going into a dark room, and shine the blue light on the banana. What color do you think it should be? What color is it? If you shine blue light on a yellow banana, the yellow should absorb the blue frequency; and, because the room is dark, there is no yellow light reflected back to your eye. Therefore, the banana appears black.

So, if you had three paints or pigments in magenta, cyan and yellow and you drew three overlapping circles with those colors, as shown in Figure 2.4, you would see that where you have combined magenta with yellow, the result is red. Mixing cyan with yellow produces green and mixing cyan with magenta creates blue. Black is the special case in which all of the colors are absorbed. You can make black by combining yellow with blue, cyan with red or magenta with green. These particular combinations ensure that no frequencies of visible light can bounce back to your eyes.

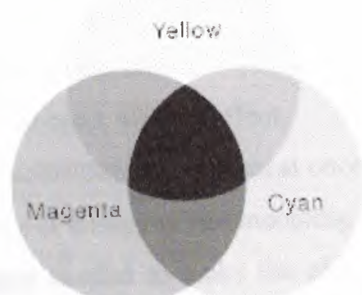


Fig. 2.4 Mixing magenta,cyan and yellow colors.[4]

But the color scheme demonstrated in Figure 2.4 appears to go against what your art teacher told you about mixing colors, right? If you mix yellow and blue crayons, you get green, not black. This is because artificial pigments, such as crayons, are not perfect absorbers -- they do not absorb all colors except one. A "yellow" crayon can absorb blue and violet while reflecting red, orange and green. A "blue" crayon can absorb red, orange and yellow while reflecting blue, violet and green. So when you combine the two crayons, all of the colors are absorbed except for green. Therefore, you see the mixture as green, instead of the black demonstrated in Figure 2.4.

So there are two basic ways by which we can see colors. Either an object can directly emit light waves in the frequency of the observed color, or an object can absorb all other frequencies, reflecting back to your eye only the light wave, or combination of light waves, that appears as the observed color. For example, to see a yellow object, either the object is directly emitting light waves in the yellow frequency, or it is absorbing the blue part of the spectrum and reflecting the red and green parts back to your eye, which perceives the combined frequencies as yellow.

2.9 When light hits an object

When a light wave hits an object, what happens to it depends on the energy of the light wave, the natural frequency at which electrons vibrate in the material and the strength with which the atoms in the material hold on to their electrons. Based on these three factors, four different things can happen when light hits an object:

The waves can be reflected or scattered off the object.

The waves can be absorbed by the object.

The waves can be refracted through the object.

The waves can pass through the object with no effect.

And more than one of these possibilities can happen at once.

Transmission - If the frequency or energy of the incoming light wave is much higher or much lower than the frequency needed to make the electrons in the material vibrate, then the electrons will not capture the energy of the light, and the wave will pass through the material unchanged. As a result, the material will be transparent to that frequency of light.

Most materials are transparent to some frequencies, but not to others. For example, high frequency light, such as gamma rays and X-rays, will pass through ordinary glass, but lower frequency ultraviolet and infrared light will not.

Figure 2.5 The waves pass through the object with no effect.

2.9.1 Absorption

In absorption, the frequency of the incoming light wave is at or near the vibration frequency of the electrons in the material. The electrons take in the energy of the light wave and start to vibrate. What happens next depends upon how tightly the atoms hold on to their electrons. Absorption occurs when the electrons are held tightly, and they pass the vibrations along to the nuclei of the atoms. This makes the atoms speed up, collide with other atoms in the material, and then give up as heat the energy they acquired from the vibrations. The absorption of light makes an object dark or opaque to the frequency of the incoming wave. Wood is opaque to visible light. Some materials are opaque to some frequencies of light, but transparent to others. Glass is opaque to ultraviolet light, but transparent to visible light.

Figure 2.6 The waves absorbed by the object.

2.9.2 Reflection

The atoms in some materials hold on to their electrons loosely. In other words, the materials contain many free electrons that can jump readily from one atom to another within the material. When the electrons in this type of material absorb energy from an incoming light wave, they do not pass that energy on to other atoms. The energized electrons merely vibrate and then send the energy back out of the object as a light wave with the same frequency as the incoming wave. The overall effect is that the light wave does not penetrate deeply into the material.

In most metals, electrons are held loosely, and are free to move around, so these metals reflect visible light and appear to be shiny. The electrons in glass have some freedom, though not as much as in metals. To a lesser degree, glass reflects light and appears to be shiny, as well. A reflected wave always comes off the surface of a material at an angle equal to the angle at which the incoming wave hit the surface. In physics, this is called the Law of Reflectance. You have probably heard the Law of Reflectance stated as "the angle of incidence equals the angle of reflection."

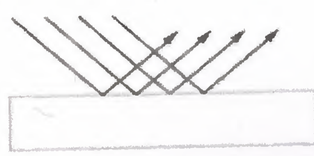


Figure 2.7 The waves reflected by the object.

You can see for yourself that reflected light has the same frequency as the incoming wave. Just look at yourself in a mirror. The colors you see in the mirror's image are the same as those you see when you look down at yourself. The colors of your shirt and hair are the same as reflected in the mirror as they are on you. If this were not true, we would have to rely entirely on other people to tell us what we look like!

2.9.3 Scattering

Scattering is merely reflection off a rough surface. Incoming light waves get reflected at all sorts of angles, because the surface is uneven. The surface of paper is a good example. You can see just how rough it is if you look at it under a microscope. When light hits paper, the waves are reflected in all directions. This is what makes paper so incredibly useful -- you can read the words on a printed page regardless of the angle at which your eyes view the surface.

Another interesting rough surface is Earth's atmosphere. You probably don't think of the atmosphere as a surface, but it nonetheless is "rough" to incoming white light. The atmosphere contains molecules of many different sizes, including nitrogen, oxygen, water vapor and various pollutants. This assortment scatters the higher energy light waves, the ones we see as blue light. This is why the sky looks blue.

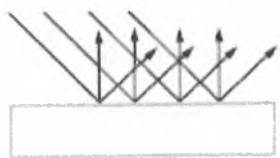


Figure 2.8 The waves can be scattered off the object.

2.9.4 Refraction

Refraction occurs when the energy of an incoming light wave matches the natural vibration frequency of the electrons in a material. The light wave penetrates deeply into the material, and causes small vibrations in the electrons. The electrons pass these vibrations on to the atoms in the material, and they send out light waves of the same frequency as the incoming wave. But this all takes time. The part of the wave inside the material slows down, while the part of the wave outside the object maintains its original frequency. This has the effect of bending the portion of the wave inside the object toward what is called the normal line, an imaginary straight line that runs perpendicular to the surface of the object. The deviation from the normal line of the light inside the object will be less than the deviation of the light before it entered the object. The amount of bending, or angle of refraction, of the light wave depends on how much the material slows down the light. Diamonds would not be so glittery if they did not slow down incoming light much more than, say, water does. Diamonds have a higher index of refraction than water, which is to say that they slow down light to a greater degree.

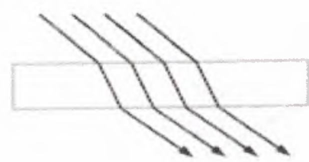


Figure 2.9 The waves refracted through the object.

One interesting note about refraction is that light of different frequencies, or energies, will bend at slightly different angles. Let's compare violet light and red light when they enter a glass prism. Because violet light has more energy, it takes longer to interact with the glass. As such, it is slowed down to a greater extent than a wave of red light, and will be bent to a greater degree. This accounts for the order of the colors that we see in a rainbow. It is also what gives a diamond the rainbow fringes that make it so pleasing to the eye.

When two incoming light waves of the same frequency strike a thin film of soap, as seen in Figure below, parts of the light waves are reflected from the top surface, while other parts of the light pass through the film and are reflected from the bottom surface. Because the parts of the waves that penetrate the film interact with the film longer, they get knocked out of sync with the parts of the waves reflected by the top surface. Physicists refer to this state as being out of phase. When the two sets of waves strike the photoreceptors in your eyes, they interfere with each other; interference occurs when waves add together or subtract from each other and so form a new wave of a different frequency, or color.

Basically, when white light, which is a mixture of different colors, shines on a film with two reflective surfaces, the various reflected waves interfere with each other to form rainbow fringes. The fringes change colors when you change the angle at which you look at the film, because you are changing the path by which the light must travel to reach your eye. If you decrease the angle at which you look at the film, you increase the amount of film the light must travel through for you to see it. This causes greater interference.

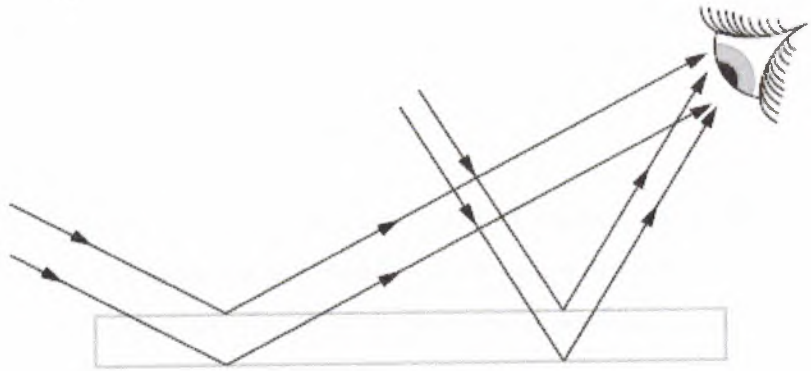


Figure 2.10 The angle of looking to an object change the color.[4]

Everything we see is a product of, and is affected by, the nature of light. Light is a form of energy that travels in waves. Our eyes are attuned only to those wave frequencies that we call visible light. Intricacies in the wave nature of light explain the origin of color, how light travels, and what happens to light when it encounters different kinds of materials.

2.10 Summary

In this chapter a discription about light,what is light,how to produce a photon, frequinces, colors, making of colors and behavior of the light when it hits an object discribed briefly.

CHAPTER THREE
HARDWARE APPROACH

3.1 Overview

This chapter will present detailed technical information about this light/dark activated alarm, and modifications made to it. Also it will include the components of this project and explanation of most important ones, in addition to some applications of this kind of alarms in general.

3.2 Components of project (light activated alarm)

In chapter one, a description of the components used in general hardware projects and the practical use of each one were given, but in this section, the value and type of each component used in this circuit listed below

- R 1 10K Ω
- VR 1 100K Ω
- PCC Photocell
- RL Relay
- Tr 1 Transistor (BC109c)
- D1 Diode (1N4148)
- B1 Battery (9 V)
- S1 Miniature toggle type (SPST)

3.3 Light activated alarm Circuit

This section shows the original circuit and description of most important components of it.

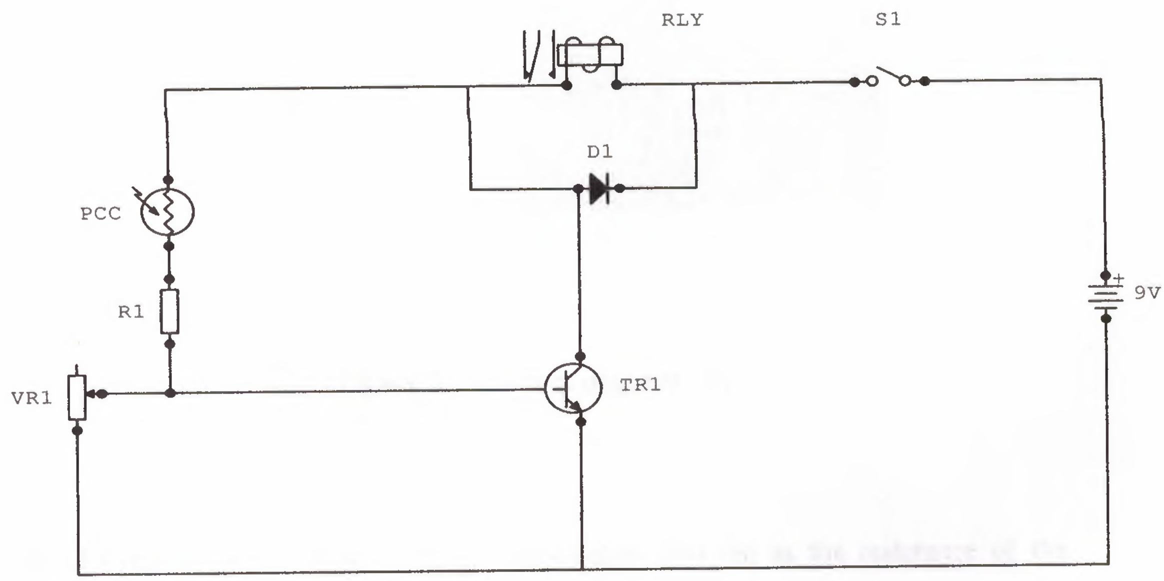


Figure 3.1 Circuit of light activated Alarm

The circuit shown above has two important components one of them is the photocell which is the input device of the circuit that receive the light and the other one is the relay which is the output of the circuit that may used to switch a second circuit which can be completely separate from the first.

• Photocell

A photocell is a type of resistor. When light strikes the cell, it allows current to flow more freely. When dark, its resistance increases dramatically. Photocells need some calibration to be responsive in the exact lighting scenario you have. They can be used to detect large or small fluctuations in light levels to distinguish between one light bulb and two, direct sunlight and total darkness, or anything in between. Each scenario requires a slightly different voltage divider setup, which we'll get into below.

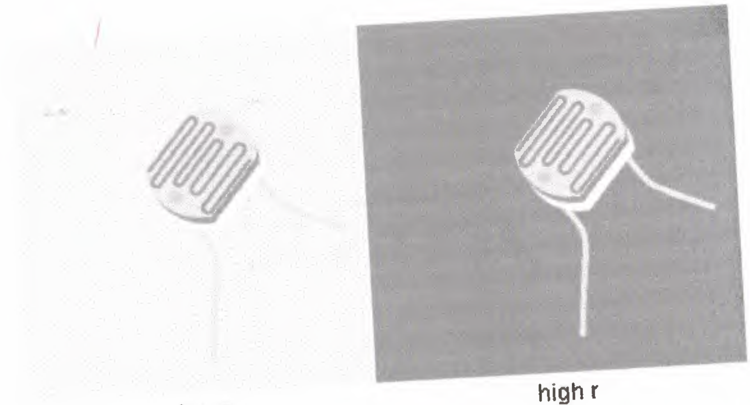


Figure 3.2 Concept diagram. [4]

Circuit diagram: You can see in the circuit below that the as the resistance of the photocell reduces (as a result of more light reaching it) the voltage on Ain will go up towards 5V. If the resistance of the photocell increases (as a result of less light reaching it) the voltage on Ain will fall towards Gnd (0V).

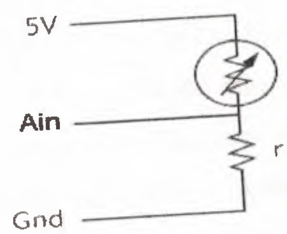


Figure 3.3 Circuit diagram

• Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first.

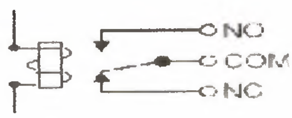


Figure 3.4 Circuit symbol for a relay.

3.4 Working principle of this circuit

This circuit works in the following manner: - The relay coil is driven from the collector of TR1, and relay will be activated if TR1 is switched on by a suitable current and voltage. The voltage and current available at base of TR1 is dependent on two main factor, the resistant provided by PCC1, and the setting of VR1. If VR1 is set on maximum value PCC1 needs to have resistance of at most 100k or less in order to bias TR1 into conduction and act the relay. In total darkness PCC1 has a resistance of 100 kΩ, but only a very low light level is sufficient to reduce resistance sufficiently to switch on TR1 and the relay. If VR1 is set for a lower resistance level, PCC1 needs exhibit a lower resistance in order to bias TR1 into conduct and the sensitivity of the circuit is reduced since PCC1 must subjected to higher light level in order to produce this 100 kΩ resistance. If VR1 is steadily adjusted lower in resistance sensitivity of the circuit is progressively reduced. With VR1 virtually minimum resistance even an extremely high level light will be insufficient to operate the circuit. Thus VR1 as sensitivity control, and enables the light-threshold level be varied over extremely wide limits.

D1 might at first appear to be superfluous, but it must borne in the mind that the relay coil is a highly inductive component and this can result in a high reverse voltage being generated across the relay coil as it is de-energized. The purpose of D1 to suppress this voltage pulse and prevent it from damaging.

A pair of normally-open relay contacts is used to coil some ancillary item of equipment, and this equipment with switch on and off sympathy with the relay. [7]

3.5 Results

The circuit shown in figure 3.1 is actually for a switch of type that activates a relay when the light level received by light sensor rises above certain threshold level, and switch off again when the light level falls back below the threshold level.

3.6 Modification

Many modifications can be added to the circuit of figure 3.1; one of these modifications is to connect an inverter to the circuit so that it will work as a dark activated circuit, another component which is the LED can be put to give a light to active parts in the circuit.

3.6.1 Components of modified circuit

The components added to modify the previous circuit (figure 3.1) to obtain the modified circuit (figure 3.8) is as following:-

- 2 LEDs Red and green
- Dynamo
- B 2 Battery (9 V)
- Switch Miniature toggle type (SPDT)

- LED

LED is an abbreviation of Light Emitting Diode, from its name it is understood that it is a diode that emit light when an electric current passes through it.

There are various ways used to show which LED lead-out wire is the anode (+) and which is the cathode (-), one of the most common being to have one lead-out wire shorter than the other, usually the shorter lead-out wire is cathode one (-).

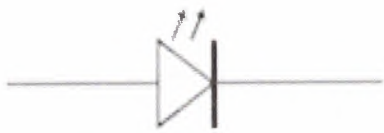


Figure 3.7 A circuit symbol of a light emitting diode

3.6.2 Light/dark activated alarm Circuit

This section presents the modified circuit used in this project.

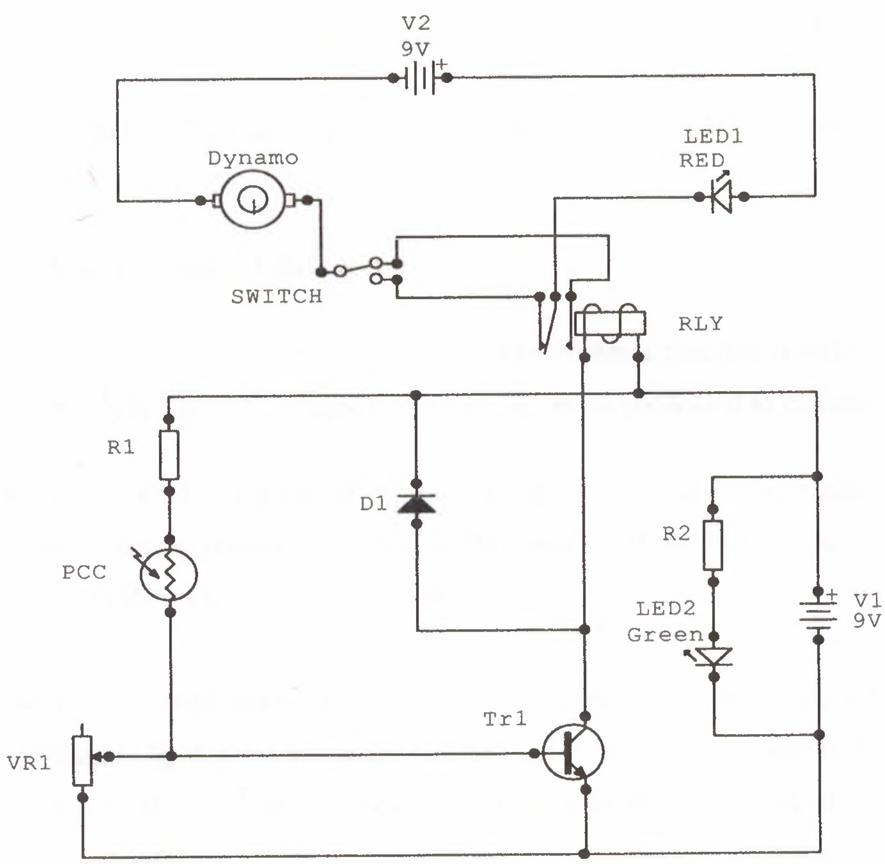


Figure 3.8 Circuit of light/dark activated alarm in dark situation.

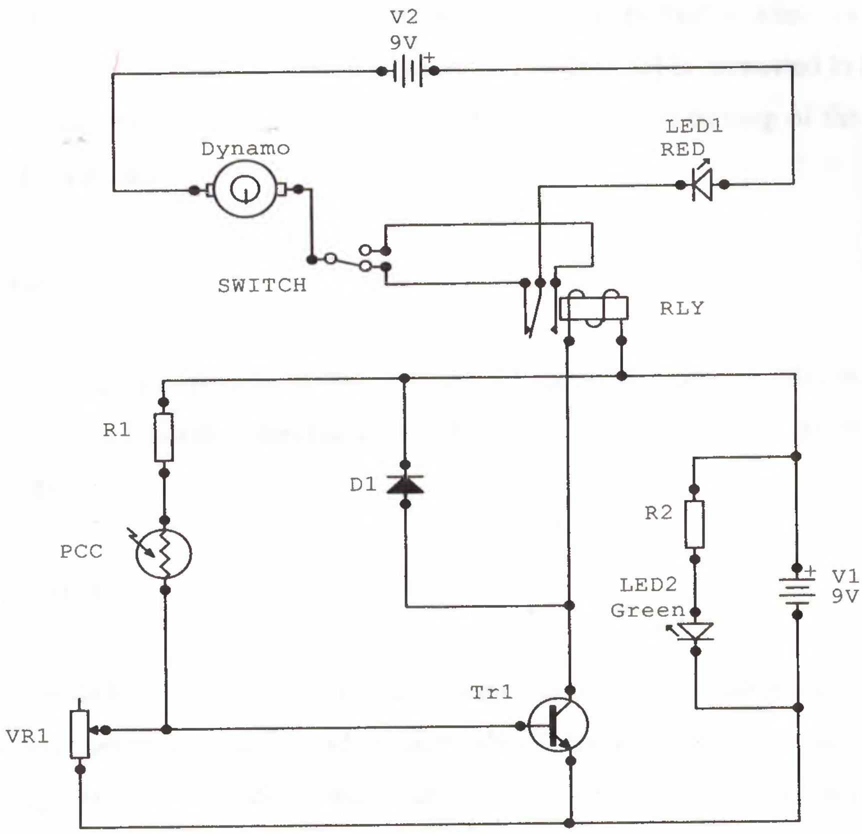


Figure 3.9 Circuit of light/dark activated alarm in light situation.

3.6.3 Working principle of this circuit

The working principle of this circuit is not different than the working principle of circuit shown in figure 3.1 except that there is a circuit connected to its output.

The circuit connected to the output of the first circuit is a simple circuit can be turned ON in light or dark conditions depending on the situation of the double side switch. The green LED shows that our system is working.

In figure 3.8 the small circuit is working in the dark that is when the relay is not working (because light is not exist), depending on the way that is connected to the relay and we can see that from emitted light from the red diode and turning of the dynamo when there is no light.

While in figure 3.9 the small circuit is working in the light that is when the relay is working (because light is detected), depending on the way that is connected to the relay and we can see that from emitted light from the red diode and turning of the dynamo when the light exists.

3.6.4 Results

The circuit added to the circuit in figure 3.1 can work when the relay is active or not active in other words, when the light exist or not controlled by the position of the double switch.

3.7 Applications

Light/dark activated switches have many applications in many fields such as burglar-alarm systems in home and industry also it can be used in automatic control systems especially in industries. One of applications we can see it every day which is illumination of streets, also it can be used to sound an alarm when light enters a normally dark area, such as the inside of a safe or strong-room, or they can be used to sound an alarm if an intruder or object breaks a projected light beam.

3.8 Summary

This chapter presented detailed technical information about this light/dark activated alarm, and modifications made to it. Also it has included the components of this project and explanation of most important ones, in addition to some applications of this kind of alarms in general.

CONCLUSION

As the electronic fields are considered as a real revolution in the world, it is obviously seen in these project chapters, that useful alarm can be created, to be practical and useful to the people life.

Light/dark activated alarm is actually circuit acting as a switch depends on existence of the light can control many devices, but since this project is intended for undergraduate electrical and electronic engineering level, the electronic device that will be controlled via this switch is a simple device, as a simulation for a more complicated system or device. Here a dynamo is driven by a relay at the output of the circuit and depends on the user's choice for light-activation or dark-activation, the device may be operated.

After a great deal of working over this experiment of preparing this project theoretically and practically; it has been found-out that too much knowledge gained and too much techniques learned by using simple components were to have a simple and cute light/dark activated alarm.

Two important aims accomplished were:-

- To modify the original circuit where possible.

  This aim is accomplished by simple circuit connected to the output of the basic circuit to show a kind of applications to the system. Four LEDs are added to make the use of the device easier, a green diode to show that our system is active and ready to detect the light or darkness as user's choice, and a red diode to show that the alarm is turned ON.

- To investigate areas of applications.

  This aim is accomplished by referring to many references and consulting many people who have technical knowledge about real-life applications to this light/dark activated switch.

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