NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

LIGHT / DARK ACTIVATED SWITCH

Graduation Project
EE – 400

Student: Mohammed Al Dairi (20000922)

Supervisor: Assoc. Prof. Dr. Adnan Khashman

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ACKNOWLEDGMENTS

IN THE NAME OF ALLAH, MOST GRACIOUS, MOST MERCIFUL.

I wish to express my deep appreciation to my god how stood beside me all the time and how supported me in all my achievements and who has given me the power and patience to finish my college studies successfully.

I am vary grateful to my teachers from in school and my lecturers who have brightened my mind with knowledge that i will need to have the finest life.

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Last but not least i dedicate my work and my success to my great parents, my whole family and my friends who provided me the encouragement and assistance that have made the completion of this work possible and I hope them success and happiness in life.

Here I would like to thank Omar Daban and Hazem Baz with their kind help, Also I will never forget my wonderful times that I spent in Cyprus and Near East University with my good friends who helped my incorporeally during my studying in college and I like individualize my best friend Rami Alia with my gratitude for his standing beside me all the time.

ABSTRACT

As the light is an important apparent in our life and it is used in a wide range of application, we are going to design and explain a light and dark activated switch circuit by using an LDR sensor.

So by this project we can control many different real life applications such as: alarm system, out door illumination, drying machine and so on. In this project we are going to make a circuit that is controlling an alarm and some LEDs by giving a signal (light or dark) to the LDR sensor, assuming the system was chosen as a light activate and the room's state was dark, if the despoiler comes and turned the light switch ON or aspect a light bulb to the LDR sensor in this room, the alarm and the red lamp will be ON, because he will give a signal to the LDR sensor which will affect to the system to work and even he turned the switch OFF, the yellow lamp will tell that, there is some one came and turned the light switch ON.

Or if we assumed this system as alarm found in refrigerator and the parents don't want their child open the refrigerator and play on it, so when the child opens it, the light which is inside the refrigerator will affect to the system to work (the alarm and the red lamp will be ON) and even he closed it, the yellow lamp will tell the parents that, the refrigerator has been opened.

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INTRODUCTION

The inquiry into the nature of light has lead us to recognize light as a small part of the Electro-magnetic spectrum on one hand and as the beam of photons on the other, forcing us to accept wave particle duality as the fundamental tenet of nature.

In this project we are going to design, build and test light and dark activated switches. How to turn the switches on and off, using them for alarm and LEDs will be presented. Suggestion into where these switches can be used will be made.

The first chapter of this project is the background chapter, which include electronic component especially the components were used in this project (light and dark activated switches) with some explanation and the characteristic of them. And Safety guideline when doing electronic project because of any electric component it has a guideline safety, if you do not know what is it you will burn, or break the component so that before doing any electric project you have to be care about this chapter.

Chapter two is about switches, with some information about types of switches, how they work? How we can use them? And the contact material used for making switches.

The third chapter is the most important chapter, which explains the hardware project in details, how we built it, How it work, what its input and output? With the circuit diagrams of light activated switches, dark activated switch and both of them after combining them together.

The aims of this project are:

- To design and build a light / dark activated switch.
- To gain hands-on experience in electronic hardware project.
- To modify the original circuit where possible.
- To suggest potential real-life use of switches.

CHAPTER ONE
BACKGROUND

1.1 Overview

This chapter will contain information about the electronic components with some explanation about their types, characteristic, polarity and the way of measuring them (i.e. the way of measuring a resistor by reading its colors). Also it will shows a figures for some components spicily which are used in this project.

This chapter will also explain the safety guideline when doing electronic circuits, with brief explanation about light activated switch circuit, how it works.

1.2 Electronic Components

The first task problem for someone starting electronics hardware projects is that of identifying the various components used in projects. Before proceeding to the project a brief description of the used components will be given so that even a complete beginner should have no difficulty in sorting out which component is which, and connecting each component into circuit correctly.

1.2.1 Resistors

These are small cylindrical component having a lead out protruding from each end. The value is not marked in numbers and letters, but is indicated by four colored bands around the body of the component. The value is in units called "ohms", and resistors often have values of many thousands of ohms, or even a few million ohms. In order to avoid constantly using very large number it is common for resistance to be specified in kilo ohms (K) and mega ohms (M). These are equal to a thousands ohms and a million ohms respectively. Thus a resistor having a value of 25,000 ohms would normally be said to have a value of 25 k, and a resistor having a value of 3,100,000 ohms would normally have its value given as 3.1 M. It is common these days for the units symbol to be used to indicate the decimal point as well. This sometimes further shortens a value in its written form, and there is no danger of a decimal point being overlooked due to poor quality printing or something of this nature. In our two examples given above the value of 25 k would not be altered since the "K" already indicates the position of the decimal point, but 3.1 M would be altered to 3M1.

The resistor color code is detailed below [1].

Table 1.1: Resistor color code

Color	1/2nd Band	3rd Band	4th Band
Gold	Not used	0.1	5%
Black	0	0	Not used
Brown	1	10	1%
Red	2	100	2%
Orange	3	1,000	Not used
Yellow	4	10,000	Not used
Green	5	100,000	Not used
Blue	6	1,000,000	Not used
Violet	7	Not used	Not used
Grey	8	Not used	Not used
White	9	Not used	Not used
Silver	Not used	0.01	10%
No Band	Not used	Not used	20%

In the example shown in figure 3 the first two digits of the value are 1 (brown) and 0 (black); giving 10 which must be multiplied by 100 (red), giving a value of 1000 ohms. This would normally be written at 1.0 k or 1k0. The fourth band is gold which indicates that the value of the components is within 5% of this marked value. Note that it is perfectly all right to use a component having a closer tolerance than is specified in a components list (a 2% type can be used in place of a 5% type for example), but a component having a higher tolerance than that specified (such as a 10% type instead of a 5% type) is not acceptable.

Figure 1.1: 10 * 100 = 1000 ohms, 1.0 k, 1k0.

Tolerance is 5%

Figure1.1 resistors have their value marked using a colour code.
The resistor colour code is very straightforward, with the first two bands giving the first two digits of the value, the third band giving a multiplier (i.e. the first two digits are multiplied by this third figure in order to give the value of the component in ohms), and the fourth band showing the tolerance of the component.

Resistance determines how much current will flow through a component. Resistors are used to control voltage and current levels. A very high resistance allows a small amount of current to flow. A very low resistance allows a large amount of current to flow. Resistance is measured in ohms.

The resistor is probably the most common and well known of all electrical components. Their uses are many, they are used to drop voltage, limit current, attenuate signals, act as heaters, act as fuses, furnish electrical loads and divide voltages.

These uses are basic, for example, the voltage divider use is used in a variety of networks to divide voltages in specified increments of the applied voltage such as for analog to digital converters and digital to analog converters. They are used as matched pairs with relative accuracy much greater than their absolute accuracy. Matching is used in building voltage dividers and Whetstone & Kelvin Bridges with extremely precision accuracy over a wide range of temperatures. Matching the absolute value and the temperature coefficient of Resistance (TCR) does this. This accuracy is limited only by the ability to accurately measure them and their stability.

Resistors also have a power rating, Power Wire wound Resistors are used when it is necessary to handle a lot of power. They will handle more power per unit volume than any other resistor. Some of these resistors are free wound similar to heater elements. These require some form of cooling in order to handle any appreciable amount of power. Fans cool some and others are immersed in various types of liquid ranging from mineral oil to high-density silicone liquids. Most are wound on some type of winding form. These winding forms vary. Some examples are ceramic tubes, ceramic rods, heavily anodized aluminum, fiberglass mandrels, etc. And this is not usually marked on the component (except in the case of high power types where the value and wattage may both be written on the component, no color codes being used). For the circuit in this book ordinary miniature 1/8, 1/ 4, or 1/3 watt resistors are satisfactory since the power levels involved are very low. Higher power resistors are not really suitable, and this is due to their physical rather than electrical characteristics. Higher wattage resistors are physically quite large and would be difficult to fit into the available space, and some have very thick lead out wires, which will not fit easily into solder less breadboards.

1.2.2 Diodes

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common type of diode in modern circuit design is the semiconductor diode, although other diode technologies exist. Semiconductor diodes are symbolized in schematic diagrams as such:

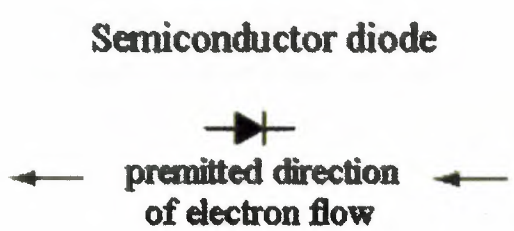


Figure 1.2: Semiconductor diode

When placed in a simple battery-lamp circuit, the diode will either allow or prevent current through the lamp, depending on the polarity of the applied voltage:

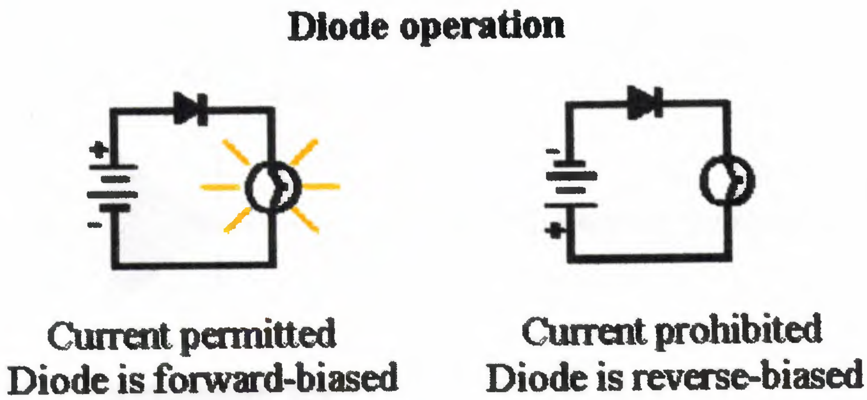


Figure 1.3: Diode operation

When the polarity of the battery is such that electrons are allowed to flow through the diode, the diode is said to be *forward-biased.* Conversely, when the battery is "backward" and the diode blocks current, the diode is said to be *reverse-biased.* A diode may be thought of as a kind of switch: "closed" when forward-biased and "open" when reverse-biased.

This forward-bias voltage drop exhibited by the diode is due to the action of the depletion region formed by the P-N junction under the influence of an applied voltage. When there is no voltage applied across a semiconductor diode, a thin depletion region exists around the region of the P-N junction, preventing current through it. The depletion region is for the most part devoid of available charge carriers and so acts as an insulator:

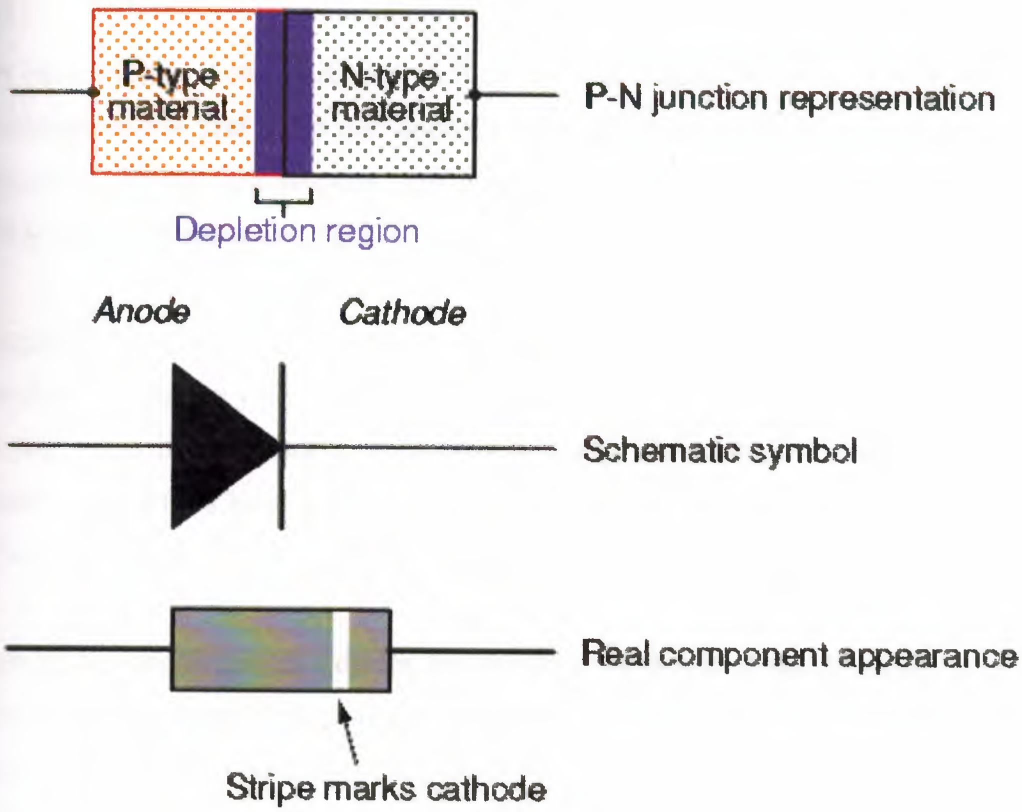


Figure 1.4: Shows how diode appears and how it work inside

If a reverse-biasing voltage is applied across the P-N junction, this depletion region expands, further resisting any current through it:

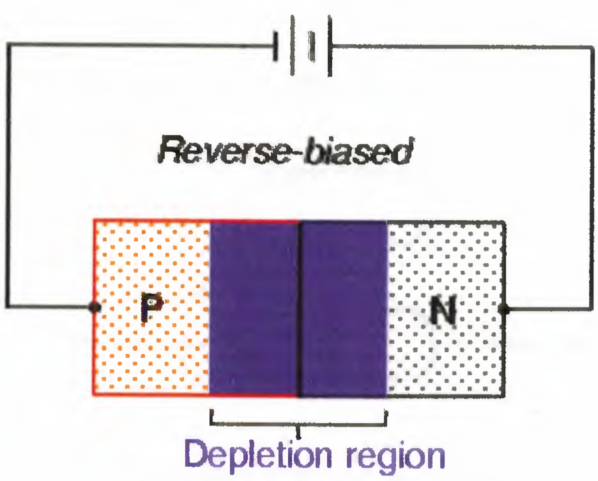


Figure 1.5: diode when connect to battery

There are different types of diodes such as Germanium diode (Ge), Silicon diode (Si). Germanium diodes find some use since Ge has much smaller band gap energy than Si, producing lower forward voltages. However, this smaller band gap also makes Ge less useful at higher temperatures due to a higher leakage current.

One type of diode is used in the project, the 1N4 001 silicon type. The main point to note about diodes is that they are polarized components and must be connected into circuit the right way round if the circuit is to function properly. The cathode (+) lead of a diode is normally marked by a band around the appropriate end of the component's body, and this band is shown on the component layout diagrams in order to indicate diode polarity.

Therefore, if a circuit that uses diodes fails to work we should check the diodes with some sort of component tester if this is possible. Another minor complication is that some diodes have a number of bands marked around their body, and in such cases the manufacturer uses these bands to indicate the diode type number rather than simply marking the type number on the component. In such cases the bands are normally offset towards the end of the component from which the cathode (+) lead out wire emanates.

Figure 1.6 should help to clarity this point [1].

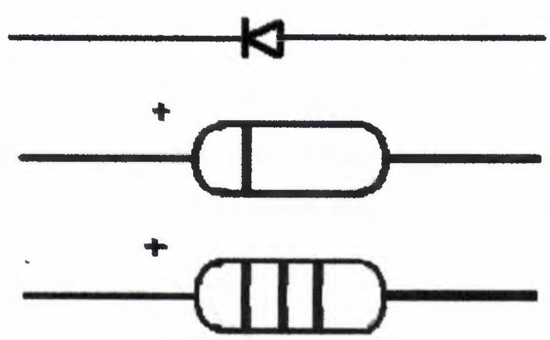


Figure 1.6: Diode shapes

Figure 1.6 Diode polarities is shown by a hand (or bands)

One light-emitting diode (LED) is used in this project. 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 shorter than the other as shown in fig (1.3). Usually the shorter lead out wire is the cathode one [1].

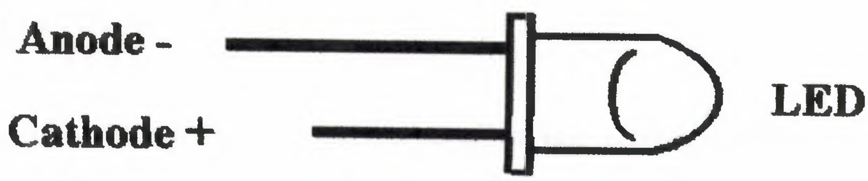


Figure 1.7: LED polarity

REVIEW:

An ohmmeter may be used to qualitatively check diode function. There should be low resistance measured one way and very high resistance measured the other way. When using an ohmmeter for this purpose, be sure you know which test lead is positive and which is negative! The actual polarity may not follow the colors of the leads as you might expect, depending on the particular design of meter.

Some multimeters provide a "diode check" function that displays the actual forward voltage of the diode when it's conducting current. Such meters typically indicate a slightly lower forward voltage than what is "nominal" for a diode, due to the very small amount of current used during the check.

1.2.3 Transistor

The transistor is an arrangement of semiconductors materials that share common physical boundaries. Materials most commonly used are silicon, gallium arsenide, and germanium, into which a process called "doping" has introduced impurities. In *n*-type semiconductors the impurities or dopants result in an excess of electrons, or negative charges; in *p*-type semiconductors the dopants lead to a deficiency of electrons and therefore an excess of positive charge carriers or holes.

The *n-p-n* junction transistor, which is used in this project, consists of two *n*-type semiconductors (called the emitter and collector) separated by a thin layer of *p*-type semiconductor (called the base). The transistor action is such that if the electric potentials on the segments are properly determined, a small current between the base and emitter connections results in a large current between the emitter and collector connections, thus producing current amplification. Some circuits are designed to use the transistor as a switching device; current in the base-emitter junction creates a low- resistance path between the collector and emitter.

The *p-n-p* junction transistor, consisting of a thin layer of *n*-type semiconductor lying between two *p*-type semiconductors, works in the same manner, except that all polarities are reversed [1].

1.2.4 Photocell

The photocell used in this project (light / dark activated switches) is an RPY5SA which is a small cadmium sulphide photo-resistor, and physically is flat, about *5* mm square, and has the two lead out wires coming from one edge. It looks very much like a small ceramic plate capacitor.

Like an ordinary resistor, a cadmium sulphide photocell is not a polarized component and can be connected into circuit either way round. The light sensitive surface of the component is the one having a gold patterned surface, and not the one to which the two lead out wires.

1.2.4.1 Sensors

A Sensor is a device, which converts a physical phenomenon into an electrical signal. As such, sensors represent part of the interface between the physical world and the world of electrical devices, such as computers. The other part of this interface is represented by Actuators, which convert electrical signals into physical phenomena.

Any light sensor will operate differently in different amounts of ambient (e.g., room) lighting. For best results when using light sensors, they should be physically shielded from room lighting as much as possible, but this is not usually perfect. Given that room lighting will affect nearly all light sensors to some degree, software should be designed to compensate for room lighting.

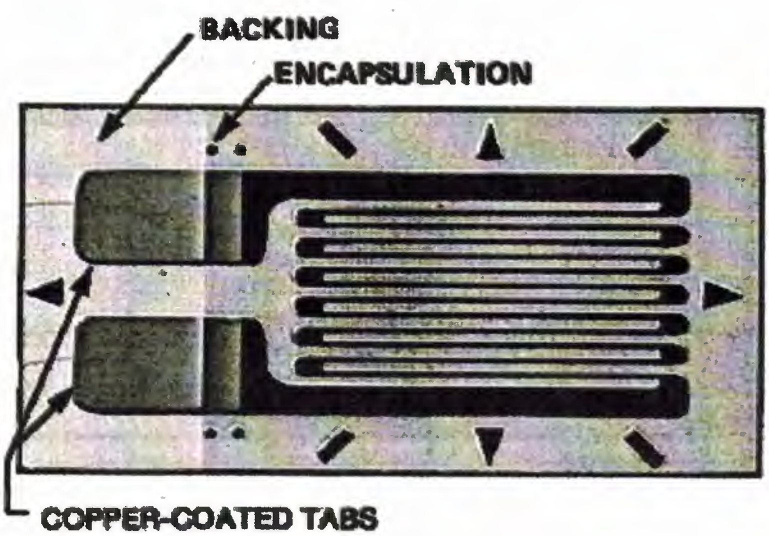


Figure 1.8: Sensor

When using reflectance-type or break-beam light sensing, controlling the sensor's own illumination source is a good strategy. If a sensor reading is taken with the sensor's own illumination off, the reading due to ambient light is measured. If a reading is then taken with the illumination on, a value combining ambient light plus the sensor's own illumination results. By subtracting these two values, the sensor reading due to its illumination alone can be obtained.

The illumination source control method will not wholly eliminate the influence of ambient light. Further calibration in an actual performance environment will probably be necessary.

1.2.5 Switches

There are many different types of switch available to the designer. Which type of switch is used depends largely on what they control. To set something in the *on* or *off* position a normal *on/off* switch is used. An *on/off* switch stays in the *off* position until it is switched *on* will also stay in the *on* position until it is switched *off*.

A switch, which stays in the set position until it is reset, is called a latched switch. A simple *on/off* switch is called a single-pole, single-throw switch (SPST). The poles are the number of circuits that the switch makes or breaks. The throws are the number of positions to which each pole is switched. There is other type of switches which is not operating manually as (SPST), it is operate via an electromagnet; which called (RELAY). There are many types of RELAY, one of these is used in this project, which is having an operating coil with a resistance of 185 ohm or more, and 12 volt operating supply. There make sure that the voltage and current rating of the RELAY are sufficient to control th e equipment concerned. Relays do not have lead out wires.

1.2.6 Basic Gate

Before we can start developing design methods for digital circuits we need to become acquainted with the theorems of Boolean algebra. First we will look at a few basic gate circuits.

There are a number of basic gate circuits found in digital circuits. The most important of these are shown in Figure 1. The AND gate has the property that the output of the gate will be high only if both inputs are high. The output of the OR gate will be high if either or both inputs are high. The exclusive OR circuit labeled ExOR (XOR is also frequently used) has an output that is high if either but not both inputs are high together. The output of the NOT (or inverter) circuit provides the inverse of the signal on its input. The NAND and NOR circuits are the same as the AND and OR circuits but with an inverter on their outputs.

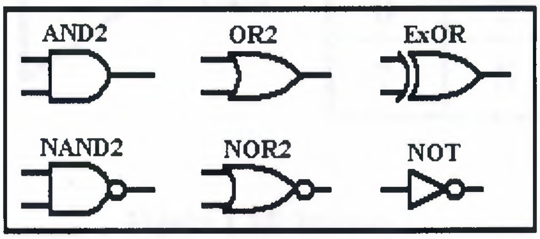


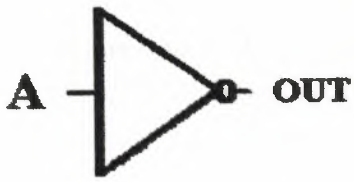
Figure 1.9: Some basic gate circuits and an inverter.

1.2.6.1 Inverter

The symbol shape of an INVERTER can be referred to as a triangle with a small circle or bubble on its output side. This circle or bubble symbol is called a NOT circle. It will cause the output signal to be inverted from the original input signal. If a high level signal is applied to the input side of this inverter it will be transformed into a low level output. The opposite will be true when a low level input signal is applied to the inverter a high level output signal will appear.

Inverters are only 1 input and 1 output type of devices. The truth table in Figure 1.10 will demonstrate the logic of this device. Like other symbols, the inverters input is on the left and the output is on the right, but may appear on schematic drawings in various directions. Again, you putter with this inverter with simulated LEDs.

A good example can be used on a single tank operation with an attached alarm system. If the tank fluid level goes low, that is below a predetermined set point, a float connected to a switch would send a low level input signal to the inverter and in turn cause a high level output from the inverter and an alarm to give an audible signal.



A	OUT
0	1
1	0

Figure 1.10: Inverter

1.3 Safety

1-We have taken care about chip pins when we plant it in the board to not be broken.

2-Be aware while soldering to not heat up the chip by hold the soldering iron long time on the pins.

3-While soldering be aware not be let to pins to be soldered together and check after soldering the pins in between space.

4-Be aware of the soldering iron position while stand by.

5-Be aware when turns up side down the board after the chip plant that the pins arrangement will be different.

1.4 Summary

In this chapter we have seen different types of electronic components and the safety way of using them in any electric circuit, also we learned how to measure them without expecting an error, the operation of the circuit (LIGHT / DARK ACTIVATED SWITCH) was described.

In second chapter we will talk about different types of switches, the materials are used for making switches, with some figures showing the operation of them.

CHAPTER TWO

SWITCHES

2.1 Overview

This chapter will present information about switches, what they mean? Where we can use them? And the types of switches, contact materials, applying switches in hostile environment, and switch terminology have all been included, with some circuit parameters that affect the switch life-time. In addition, this chapter will explain the effect of acceleration (shock and vibration).

2.2 Introduction to Switches

Switches are devices used to allow electric current to flow when closed, and when opened, they prevent current flow. This is a generic high-level search form that includes options for all switch types. There are many different types of switch available to the designer. Which type of switch is used depends largely on what you are trying to control.

These days, using a computer to do just about anything is easy - providing you can manipulate a keyboard and a mouse. For many young learners with complex physical and/or communication disabilities, the whole experience of education through the use of technology can be a closed book. However, the use of alternative access devices like switches can often transform “I can’t do” into “I can do”. With switches, we can control anything from a simple toy to a sophisticated speech output device, record school work and have access to recreational software. This article gives an overview of what can be possible through the use of switches, and how to facilitate that possibility. However, at the outset it is vital to remember that the successful use of switch access to technology is dependent on the careful undertaking of assessment and trial, monitoring and progression.

Switches come m all shapes, sizes and types and must be carefully matched to the needs of the user. The process of switch selection cannot be separated from the needs of individual students. The following suggestions are offered to help us begin our switch assessment planning. We will need to choose switches using the following criteria.

(a) Switch type

Button, wobble, string, platform, tongue, finger, sound, grip, suck, blow, head there are many types of switch available, and the one(s) chosen should be dependent on a combination of the factors discussed in this resource.

(b) Target area

How big does the surface area of the switch need to be for the user to operate it successfully? For example, the Able Net Big Red switch (13cm diameter) provides a large target to hit, but also increases the risk of being knocked accidentally. A small switch, for example the Able Net Specs switch (3.5cm diameter), may be too small a target for a child with only gross arm movements.

(c) Feedback

Does the user need to hear a click to help them understand that they have activated the switch? Does this click draw attention away from the activity being accessed?

(d) Sensitivity

How much pressure is the user able to use to activate the switch? Some switches need a greater amount of pressure than others. The Tash Micro light and Able Net String switches, for example, are very sensitive, while the QED Platform switch requires greater pressure. Some switches, like the Able Net Large Adjustable Pressure Switch, can be adjusted to operate at various levels of pressure from light to heavy.

(e) Travel

How much active movement does the user have? Some switches are designed for large sweeping movements (e.g. the Able Net Handy Switch) while others will activate with a very small movement (e.g. the Able Net Jellybean switch)

(f) Design

Most switches are made of hard material such as plastic. Some users hit their switches with some force and may appreciate a softer surface, for example the Tash Soft Switch[9]

2.3 Switch Types

1. Normally open and normally closed
2. Rocker switches
3. Pushbutton switches
4. Tact switches
5. DIP switches (Dual In-Line Package)
6. Snap-Action switches
7. Slide switches
8. Rotary switches
9. Key lock switches
10. Leaf switch
11. Detector switches
12. Toggle switches

2.4 Switch Terminology

All switches, regardless of how they look or the size or what part of the body is used to control it, operate in the same manner. A switch is a mechanical device used to open and close a circuit. Opening a circuit (usually turns a device OFF) is achieved by breaking a connection in the circuit. This stops current flow in the circuit. Closing the circuit (usually turns a device ON) allows the current to flow again. These are some terminologies associated with switches.

Normally Open (N.O.): Without activating the switch, the contact is open.

Normally Closed (N.C.): Without activating the switch, the contact is closed.

Single Pole Single Throw (SPST): Activating the switch opens/closes one circuit.

Single Pole Double Throw (SPDT): Activating the switch opens/closes the connection of one circuit to one of two.

Double Pole Single Throw (DPST): Activating the switch opens/closes the connection of two circuits to one.

Double Pole Double Throw (DPDT): Activating the switch opens/closes two circuits.

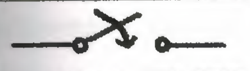
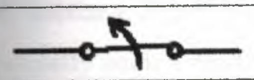
Momentary: The switch is closed/open only when the switch is activated.

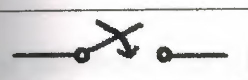
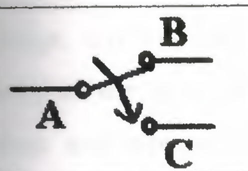
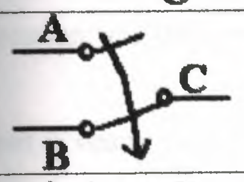
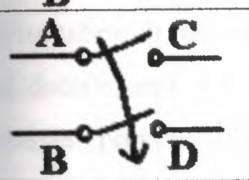
Latch: The switch remains closed/open until the switch is activated again.

Feedback: The switch indicates that it has been activated.

For example: visual (light), audio (click) [9].

Table 2.1: Contact forms

	Normally Open (N.O.)	Without activating the switch, the contact is open.
	Normally Closed (N.C.)	Without activating the switch, the contact is closed.

	Single Pole Single Throw (SPST)	Activating the switch opens/closes one circuit.
	Single Pole Double Throw (SPDT)	Activating the switch opens/closes the connection of one circuit **(A)** to one of two **(B or C)**.
	Double Pole Single Throw (DPST)	Activating the switch opens/closes the connection of two circuits **(A and B)** to one **(C)**.
	Double pole Double Throw (DPDT)	Activating the switch opens/closes two circuits **(A to C) and (B to D)**.

2.5 Contact Materials

The most universal contact material is silver. It combines the chemical, electrical, thermal, and mechanical properties that usually are needed for best contact performance in a wide range of applications. If silver contacts are clean, there is no lower limit to the voltage and current that they will control reliably.

This applies, for example, to a switch that is sealed sufficiently to keep out contaminates. Silver has definite drawback and that is its tendency to tarnish in the presence of H2S and moisture. This characteristic encourages the use of gold contacts in some applications. If silver contacts are exposed to sulfides and moisture for a long enough time and in sufficient concentration, the contacts will tarnish. This seldom affects performance of the switch.

Nearly always, the combination of mechanical force and movement of the contacts, and the circuit voltage, rupture the tarnish film and reestablish good electrical continuity. Occasionally, however, small amounts of silver sulfide may collect at the contact interface and increase the resistance of- the closed switch enough to constitute an open circuit. Generally such a malfunction clears up on the next switch closure, but it may not.

The likelihood that silver contacts will experience this kind of problem depends upon the voltage, current, inductive characteristic of the circuit, the temperature, humidity, and purity of the environment; the degree of sealing of the switch enclosure; the mechanical forces and movement of the switch contacts; the exposure time and number of switch operation; and the amount of switch resistance that constitutes an effectively open circuit.

Gold is nearly inert chemically and does not form sulfides of oxides in normal switching environment. It has some important limitations as a contacts material. It expensive, it is soft and ductile, and it is usefulness is very limited where an electric arc is present. It does, however, prevent sulfide tarnishing if properly applied. To reduce cost and to make the contacts more nearly universal, silver contacts are sometimes plated with gold. Accordingly, the theory goes, if the voltage and current are low enough to make gold contacts desirable, they are low enough that they will not disturb the gold plate. If voltage and current are too high for gold contacts, they will burn the plate off and expose the silver, which is suitable for higher loads. However, there are some practical limitations. If gold is plate directly on silver contacts, sulfur atoms in the presence of moisture can penetrate the pores in the gold plate and react with the silver base metal, forming silver sulfide. The sulfide then migrates rapidly over the surface of the gold plate as a spongy deposit that can cause more trouble than would sulfide tarnish on an unprotected silver contact. The usual procedure is to use a nickel barrier plate between the silver base metal and the gold plate. This stops the sulfide problem but adds to the cost and sometimes is incompatible with some of the switch manufacturer's production processes.

Cost aside, the answer would seem to be a solid gold contact, but gold is very ductile and may experience plastic flow under the influence of contact force on closure. This can be remedied by alloying other elements with the gold to harden it. Sometimes it is possible to alloy a high enough percentage of other elements with the gold that the cost of the contact can be significantly reduced. But this introduces other considerations, for example, polymer formation. Gold and gold alloy contacts can generate polymers at the contact interface when organic contaminants are present in the atmosphere. Silver does not form polymers.

The type of polymer usually formed on pure gold contacts does not increase switch resistance, but the same is not always true for gold alloys. If the atmosphere around gold or gold alloy contacts is clean, no polymer will be formed, but then under such conditions silver contacts will not form sulfides and are considerably less expensive. In short, the choice of contact material involves a number of consideration and often a trade-off decision.

Other contact materials sometimes are used for applications of this kind, the most common materials are platinum, palladium, and their alloys. Although these materials are sometimes used as pure metal, they tend to have poor wear properties and are very soft hence the use of alloys, which preserve some of the desirable properties of the elemental materials and improve hardness and wear resistance. The ruthenium, osmium, and rhodium. Others are silver, copper, and nickel. Most of the platinum and palladium alloys can form polymers that increase switch resistance.

In summary, although no universal rules can be laid down, the following practices usually are followed:

• If the switch is sealed, sulfides cannot enter and silver contacts can be used.

• If the switch *is* not sealed, the electrical load should be considered if there is an arc, silver contacts can be used.

• If there is no arc, the environment is a controlling factor. if panicle contamination is likely to reach the contacts, gold is no help. Use a sealed switch or bifurcated constants.

• If a completely alien film contaminant such as paint spray or oil mist can reach the constants, gold does not help, so choose a sealed switch.

• If the environment of an unsealed switch contains significant amounts of moisture and

H2S (from sources such as decaying organic matter or vulcanized rubber), gold contacts can be a real help [11].

2.6 Applying Switches in Hostile Environment

In their simplest forms, electromechanical, electromagnetic, and solid-state control devices are designed for environments which may be called friendly, i.e., clean factory areas, offices, and other surroundings that are typical of room conditions. However, these devices often are needed for use in the presence of dust, dirt, metal particles, oil, corrosive agents, or very high or low temperatures.

For extreme environment such components usually are made from special materials, provide with protective enclosures, or changed in other ways to alter the immediate area of control enable the device to survive and perform satisfactory.

Switches control circuit safely and reliably in millions of applications. As the link between the mechanical and electrical parts of a system, a switch must perform well, both mechanically and electrically. It usually does, despite the complication effects temperature, humidity, and other environmental factors. Still, there are environments that reduce the reliability of switches and can even cause premature failure. High temperature can reduce contact life; a partial vacuum can encourage electrical breakdown to ground; oil can deteriorate plastic can disable the switch; ice can jam the actuating mechanism; the electric arc in an unsealed switch can detonate an explosive atmosphere.

The effects of environments on switches are not always obvious, and it is possible for a system design to be well advanced before a potential switch problem is recognized. Familiarity with the effects of environment on switch performance often can improve the design and save considerable time. This section discusses the factors to consider when applying switches in hostile environments.

Any specific environment consists of a unique combination of temperature, pressure, humidity, contamination, and the like, and these conditions sometimes conspire to cause switch problems. The environment in which a switch must operate is determined not only by the geographical location but also by the equipment and circumstances in which it is to be used. The table (2.2) illustrates some types of hostile envy. To which some switches may exposed. The switch should be tested by exposing it to simulated condition of end use (electrical, mechanical, and environmental) and evaluating it to be sure it performs as required [4].

2.7 Effects of Acceleration, Shock and Vibration

When the switch is accelerating any direction, the common contact experiences an apparent force in the opposite direction. This may act to keep closed contacts closed and open contacts open, in which case there is no problem. The force may be directed perpendicular to the line of movement of the common contact, and have no significant effect. However, if the force acts to separate closed contact or to closed open contacts, there is the possibility that the switch may experience a malfunction. During the launching of a high-velocity missile, switches on the missile are subjected to high linear acceleration. Switches used in the hub of the propeller of in a spinning projectile have a component of acceleration toward the center of rotation. The movable contact, as a passenger in the switch, may be forced in an unfavorable direction [5].

A Partial List of Typical Hostile Environments Encountered by Switches [4].

High temperature: Industrial and household furnaces, pasteurizing equipment, steam Cleaning of food processing machinery, foundries, rolling mills, surfaces high performance aircraft, jet engine afterburners, missile launchers.

Low temperature: Commercial refrigeration, military and commercial equipment in arctic regions, Aircraft flying above 35,000 ft, cryosurgical, liquid oxygen, and ot her cryogenic equipment.

Temperature shock: Transfer of equipment to and from heated shelters in arctic regions, airdrops of military supplies, spacecraft reentry.

Vacuum: Aircraft and spacecraft, aerial cameras and weather instruments, industrial Vacuum processes.

High pressure: Undersea equipment, oil drilling instrumentation.

Humidity: Laundry machinery, dairy and meat packing equipment, textile plants, hothouses, carrier-based aircraft, pharmaceutical manufacture.

Liquid splash or shallow immersio n: Sump pumps, aircraft landing gear, shipboard deck mounted equipment, gasoline pumps, and hydraulic production machinery

.

Ice: Snow removal machinery, ski lifts, refrigeration control, aircraft, and arctic installations.

Corrosion: Marine and seaboard applications, plating departments, battery manufacture.

Sand or dust: Earth moving machinery, desert vehicles, air conditioners, foundries, cement mills, concrete block manufacture, textile manufacture and flour mills.

Fungus: Tropical military gear, geological and metrological instrument.

Explosion: Starch packaging, coalmines, petroleum refining, grain elevators, flour mills, coke manufacture, surgical operating rooms, machining operations producing aluminum or magnesium dust.

2.7.1 Shock

When a device containing a switch is struck, dropped, or otherwise subjected to a disturbance, it under-goes a pulse of acceleration known as a shock. In its simplest form, this transient acceleration is all in one direction, but its magnitude varies with time. A grap h of the acceleration versus time may be a simple half-sine wave, or it may have any of wide variety of shapes and dimensions. Although ordinarily mechanical shock has little or no effect upon switch performance, a shock pulse having high acceleration and relatively long duration can cause a closed switch to open momentarily or an open switch to close momentarily. If acceleration is very high, in the thousands of gravity units, some switches may be permanently damaged by the shock.

To judge the effect of most mechanical shocks on switches. The common contact of a switch experience similar forces when the switch is subjected to a mechanical shock, and the effect can be judged by considering the position of the contacts and the direction of the shock. If a shock pulse has a fairly simple waveform (such as half-sine). It is usually specified in terms of acceleration versus time. If the shock wave is complex and cannot readily be expressed in this way, it is sometimes specified in terms of acceleration versus frequency, and resulting graph is called a shock spectrum. If the duration of the shock pulse is of the same order of magnitude as half natural period of some part of the switch mechanism, its effects on the switch may be amplified or attenuated. Thus a shock pulse having 50g peak acceleration may separate the closed contacts of a switch, while a steady acceleration of 50g in the same direction would not [5].

2.7.2 Vibration

Vibration is an oscillating movement which may have a consistent, repetitive patte rn or may be irregular. Thus the acceleration may vary regular or irregular. Most laboratory vibration test provide simple harmonic motion, which is a sine wave. The acceleration then follows a negative sine wave and specified in terms of frequency and maximum acceleration. In application where the vibration does not follow a simple waveform, conditions may be more difficult to specify in some instance, the vibration is not periodic and the acceleration varies erratically.

In vibration, as with other forms of acceleration, the common contact is a passenger in the switch and experiences an apparent force in the direction opposite to that of the acceleration. With vibration, the acceleration is along an axis, first in one direction, then in the opposite direction. The magnitude and direction of acceleration are reversed rapidly, and the rate of change affects the response of the switch to the vibration. The closed contacts of a vibration switch may remain closed at l0g, 50 Hz, but may separate momentarily at l0g, 50 Hz.

In summary, acceleration is any change of the velocity's magnitude or direction. Shock and vibration are forms of acceleration in which acceleration varies with time. The common contact, as a passenger in the switch, behaves as though it were forced in the direction opposite that of the acceleration. With this in mind, one can judge whether a given acceleration, shock, or vibration will act to cause closed contacts to open or open contacts to closed [5].

2.8 Effect of Circuit Parameters on Swit ch Life

2.8.1 Current Rating of a Switch

The published current rating of a switch at a given voltage represents the maximum electrical load the switch is designed to control. As a rule it is based on connection of the circuit to either the normally open normally closed throw of the switch, and does not necessarily apply where both throws of one pole are connected simultaneously. If the switch has more than one pole, the electrical rating usually applies with one throw of each pole connected. The current rating generally assumes that, in the case of pushbutton and snap-action-type switches, the plunger of the switch is driven to full over travel and lull release during actuation. The switch can close the circuit, carry the steady -state current indefinitely, and open the circuit during each cycle of operation through life. The ability of the switch to close and open the circuit reliably is affected by the current versus time characteristics of the circuit.

Occasionally, the suggestion is made that switches b e provided with minimum voltage and current ratings, i.e., values of voltage and current below which they should not be used. This derives from the erroneous impression that a given switch will develop performance problems below specific levels of voltage and current. In practice, this is not the case. A clean switch usually can control micro volt- microampere circuits without difficulty. There is no particular voltage or current level at which problem begin, and there is no technically valid way by which to set minimum electrical ratings. It is possible to establish minimum ratings on the basis of arbitrary resistance levels [6].

2.8.2 Closing the Circuit

In a dc resistive circuit such as an electrical heater, the steady-state current is present at the instant of switch closure. As the switch contacts strike and then bounce apart, each rebound draws an electric arc. This melts metal on the surfaces of the contacts, and some of the metal is evaporated. There may be some general erosion of material from both contacts, and a net transfer of material from one to other. The contacts then re-close on molten metal, sometimes forming a weld when the metal solidifies. The higher the current the stronger the weld is likely to be, and the higher the force that the switch mechanism will have to provide to open the circuit. The strongest weld occurs when the load is characterized by a high inrush current. If the inrush current persists during part or all of the contact bounce time, conditions are conducive to severe arci ng and strong welds. Capacitive circuits often have high current at switch closer, encouraging contact welding. The highest current of all occurs when the switch is closed on a short circuit. Unless the switch is specially designed to with-stand closure on a short circuit, life under this condition can be predicted as zero.

In a dc inductive circuit there is a time delay as the magnetic filed builds up in the coil before current reaches its steady-state level. Since most of the contact bouncing occurs during the low-current part of the transient, there is little contact deterioration and almost no tendency to weld during closure.

In ac circuits the current transients combine with the alternation of the current, and the switch closes at random points on the current wave, including current peaks and zero current.

Ac inductive circuits, such as those containing solenoid coils, almost always involve moving iron and consequent inrush current. Switches are designed to resist contact deterioration and the effects of contact welding throughout life, but in all circuits, the lower the current on switch closure the longer will be the life of the switch [6].

2.8.3 Carrying the Steady- State Current

Once the contacts have closed and stabilized, the switch carries the steady-state current of the circuit. This is simply a matter of controlling the (1A2 R) heating, and seldom presents a problem. 1 A ac has the same heating effect as I A dc, since the equivalence of the two is based on heating. Control bodies may impose limitations on temperature rise at rated current. Except for very unusual overloads or short-circuit conditions. However, switch life is unaffected by the current the closed switch carries [6].

2.8.4 Opening the Circuit

Before the contacts can separate, any welds holding them together must be fractured by the switch mechanism. Many switches are designed to do this. In a dc resistive circuit the steady-state current is present at the instant of switch opining. When the contacts of the switch separate far enough to extinguish the arc, nothing further happens. Arc time in a dc resistive circuit usually is very short and energy is low. There is some erosion and migration of contact material.

In a dc inductive circuit arcing is more severe, because the energy stored in the magnetic field of the coil is partially dissipated in the arc as the field collapses. The arc often persists after the contacts are fully separated, and contact erosion and migration continue as long as the arc lasts. During the life of the switch, migration gradually narrows the space between the open contacts and eventually may draw and sustain an arc, destroying the switch. Normal arcing melts and evaporates contact material, some of which may condense on surfaces of adjacent insulators. The intense heat of the arc itself may gradually deteriorate insulators that are near it. The general effect is to reduce their insulation resistance and dielectric strength. This is encouraged in a dc inductive circuit by the voltage transient that occurs just as the arc goes out. The current drops suddenly to zero, producing a voltage proportional to its rate of change. There is a little effect on the switch life because of the short duration of the high-voltage transient. Switches are designed to withstand these conditions during life, but at the end of switch life, one possible mode of failure is electrical breakdown of an insulator. The higher the source voltage the more prevalent is this mode of switch failure [6].

2.9 Summary

In this chapter we have discussed switches, the types of switches we have seen 12 types of switches, the effect of the circuit parameter on the life-time of switches, and the effects of the acceleration (shock and vibration). Also the contact material, terminology of switches, and the use of the switches in the hostile environment were been discussed.

CHAPTER THREE
LIGHT / DARK ACTIVATED SWITCH

3.1 Overview

In this chapter we will explain and design *a light / dark activated switch* circuit, what is the input and the output of the circuit? How does it work? What the problems are after building this circuit? The diagram of the circuit will show how we can connect the circuit, also the components that are used in the circuit will be presented. And in this chapter we will combine the light activated switch circuit with the dark activated switch circuit in one circuit, with the diagrams of the modified circuit.

3.2 Introduction

There is a wide range of applications for light / dark activated switch such as: staircase light timers, outdoor illumination, automatic door openers by a light beam, alarm system, solar tracking system and so on. Many of applications are familiar with the single transistor opto-switch where a photo sensor is placed between the base and either grounded depending whether a normally on or normally off function is required. This simple circuit is testing how is the photo sensor is affect on the switch.

3.3 Light Activated Switch

3.3.1 How Does It Operate?

The circuit diagram shown in figure (3.1) is for a switch of the type that activates a relay when the light level received by the light sensor rises above a certain threshold level, and switched off again when the light level falls back below the threshold level.
The relay coil is driven from the collector of Tr1, and the relay will be activated if Tr1 is switched on by a suitable base current and voltage. The voltage and current available at the base of Tr1 is dependent on two main factors, the resistance provided by PCC1, and the setting of VR1. If VR1 is set at maximum value PCC 1 needs to have a

resistance of about 100 kilo ohm or less in order to bias Tr1 into conduction and activate the relay. In total darkness PCCI has resistance of 200-kilo ohm or more, but only a very low light level is sufficient to reduce its resistance sufficiently to switch on Tr1 and the relay.

If VR1 is set for a lower resistance level, PCCI needs to exhibit a lower resistance in order to bias Tr1 into conduction, and the sensitivity of the circuit is reduced since PCC1 must be subjected to a higher light level in order to produce this lower resistance. If VR1 is steady adjusted lower in resistance, the sensitivity of the circuit is progressively reduced. With VRI at virtually minimum resistance even an extremely high level of light will be insufficient to operate the circuit. Thus VR1 acts as a sensitivity control, and enables the light threshold level to be varied over extremely wide limits.

Dl might at first appear to be superfluous, but it most be borne in mind that a 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-energised. The purpose of Dl is to suppress this voltage pulse and prevent it from damaging Tr1

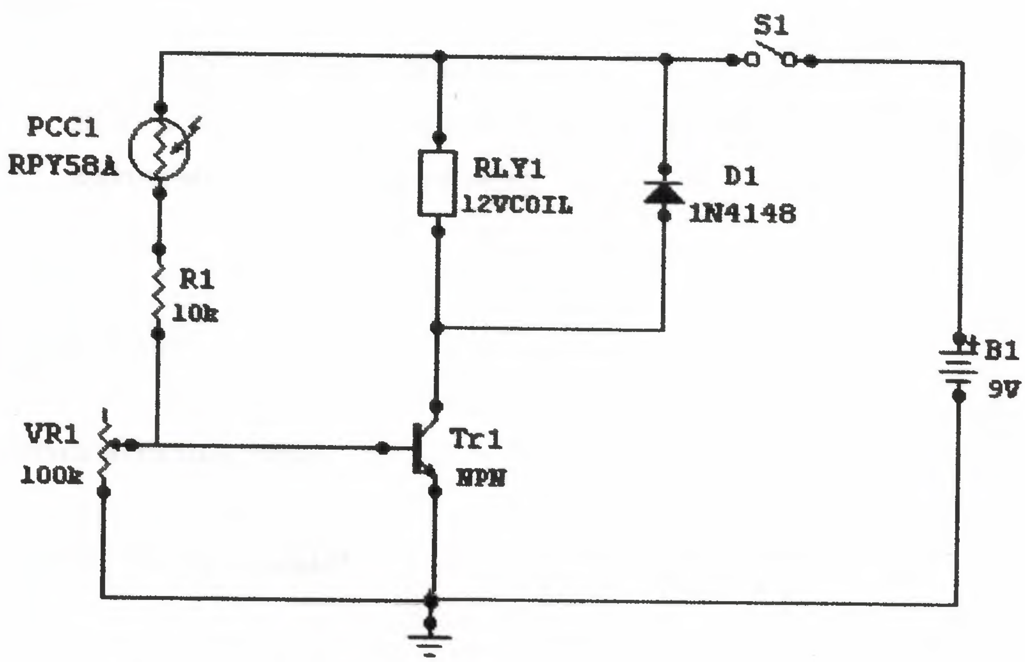


Figure 3.1 The circuit diagram of the light activated switch

3.3.2 The Components

The following component have been used in this circuit:

1) Resistors of 1/3 watt 5%:

- R1 10 k ohm (brown, black, red, gold)
- VRl 100 k ohm

2) Semiconductors:

- Tr1 BC1O9C
- Dl IN4148
- LED red for the power and green for the output

3) Photocell:

PCC1 RPY58A

4) Switch:

- S1 SPST miniature toggle type
- RLY 6/12-volt coil having a resistance of 185 ohms or more, and contacts of appropriate type and adequate rating.

5) Battery:

B1 size 9-volt

3.4 Dark Activated Switch

3.4.1 How Does It Operate?

The circuit diagram of the Dark-Activated Switch is given in Figure 3.2.

This circuit is a modified version of the previous one, and basically VR1 and PCC1 have been swopped over. Thus, in this circuit a base current is allowed to flow into Tr1 and switch the device on when PCC1 is in darkness and has a high resistance. Under bright conditions PCC1 has a low resistance and effectively short-circuits the base of Tr1 to earth and cuts it off. With VR1 at maximum resistance PCC1 will cut off Tr1 unless a very low level of light is present, but with VR1 at minimum resistance the light threshold is raised considerably, and VR1 acts as a sensitivity control much as it did in the circuit of Figure 3.1. Also in common with the previous circuit, R1 is included to ensure that an excessive base current cannot flow into the base of Tr1.

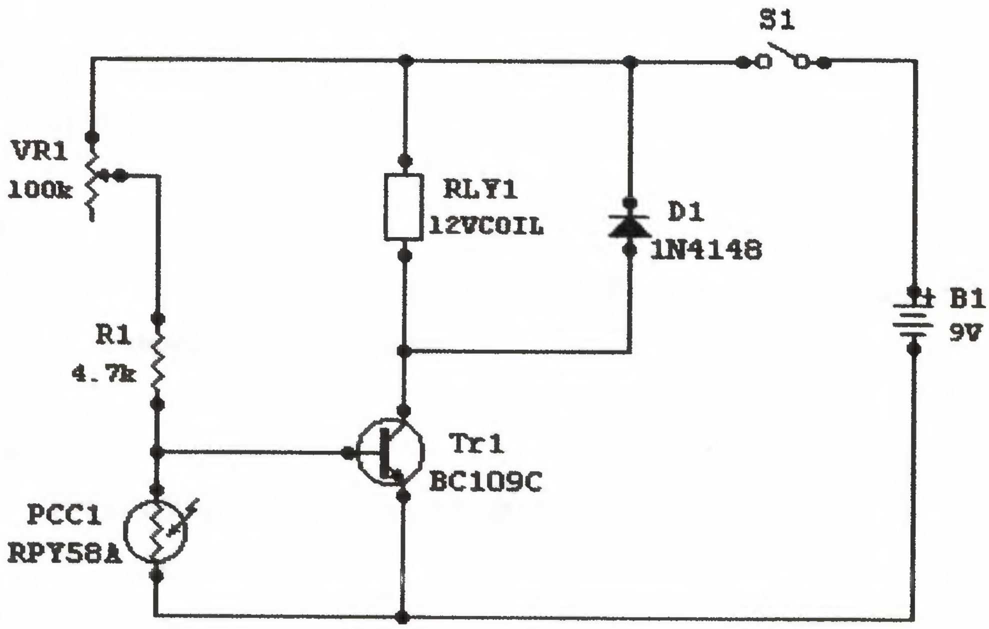


Figure 3.2 The circuit Diagram of the Dark Activated Switch

Of course, if any of the light-sensitive circuits described in this book are constructed as permanent cased projects, the photocell must either be fitted on the exterior of the case, or it must be mounted inside the case behind a hole drilled in the case so that it can respond to the ambient light level.

3.4.2 The Components

1) Resistors of 1/3 watt 5%:

- Rl 4.7 k ohm (yellow, violet, red, gold)
- VR1 100k lin. Carbon

2) Semiconductors:

- Trl BCLO9C
- Dl 1N4148

3) Photocell:

PCC1 RPY58A

4) Switch:

S1 SPST miniature toggle type

5) Relay:

RLA 6/12-volt coil having a resistance of 185 ohms or more, and contacts of appropriate type and rating.

6) Battery:

B1 PP6 size 9 volt and connector to suit

7) Miscellaneous:

- Verobloc
- Control knob
- Wire

3.5 The Circuits Problems

Photo sensor is very sensitive to infrared light; that causes this circuit cannot be useful for some applications that are dealing with infrared sources. To avoid this problem special infrared shield is used for the photo sensor. And the Photo sensor is sensitive to light level also, so that for each level of light we have to adjust the variable resistance.

3.6 Light and Dark Activated Switch

3.6.1 How Does It Operate?

Inverter Gate

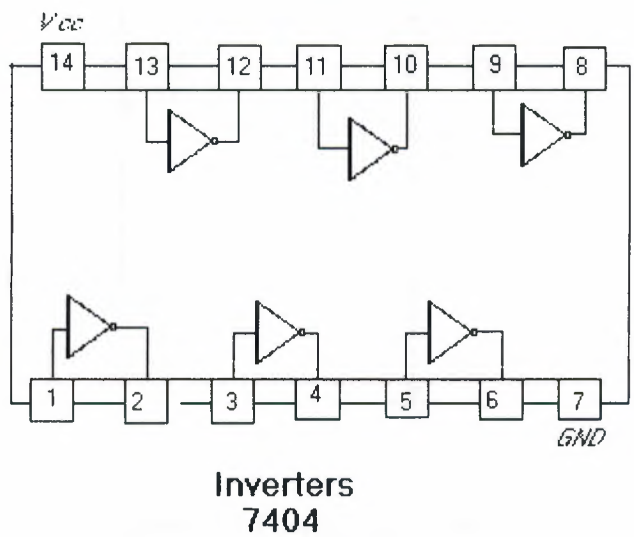


Figure 3.3 Inverter Gate

The chip (IC) 7404 is an inverter gate, and the principle of its is, when the gate input is not connected assumed as high (1) input so, the output is low (0), and we can measure nearly Vcc voltage at the input so, we used the input of first gate at pin 1 as positive source at the collector of the transistor.

Power Supply Circuit

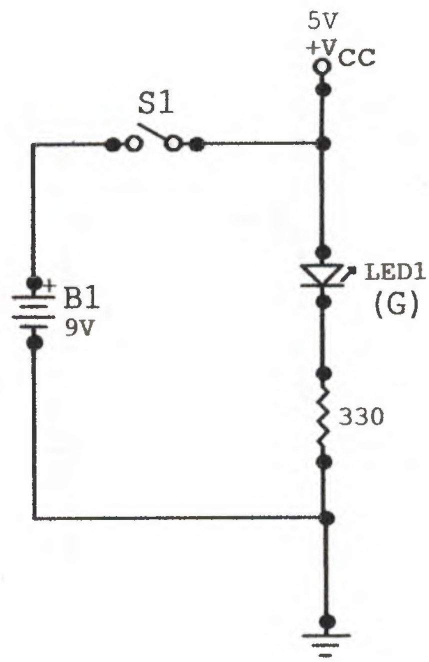


Figure 3.4 Power supply circuit

This circuit is used to supply the circuit by the power of the buttery, the LED is used to indicate the power connection when the switch is pressed and the 330-ohm resistor is used as a voltage divider with the LED.

Sensor Circuit

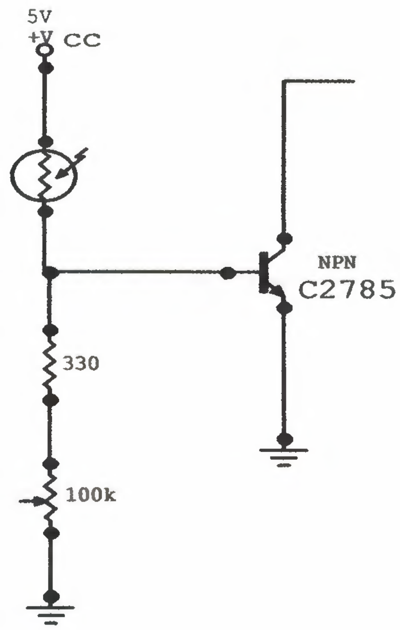


Figure 3.5 Sensor Circuit

The photo resistor with the variable resistor and the 330-ohm resistor are making biasing for the base of transistor.

When its light the resistive of the photo resistor decreasing so, more current passing the base of the transistor and so, a high current will pass the collector through the emitter that connected to the ground, that will drop the voltage on the collector that is connected to the input of the inverter to change it to low level (0), The variable resistor to adjust the accuracy of the changing of the photo resistor. The 330-ohm resistor is used to ensure the minimum resistive between the base and ground.

__Light and Dark Detection__

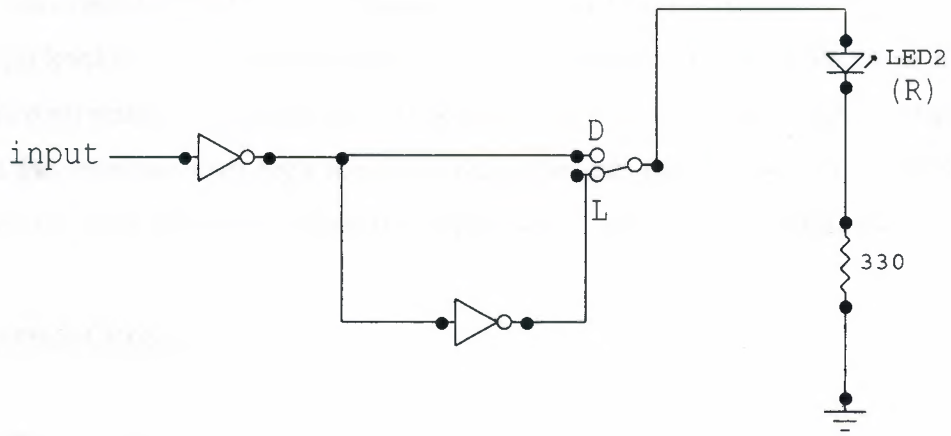


Figure 3.6 Lights and Dark Detection

When the input of the circuit is high (1) the node 2 is low (0) and node 3 is high (1), the red light will be ON.

The 330-ohm resistor is used as a voltage divider for the LED so, the LED will blow when the activating switch light activates.

__Loop Circuit__

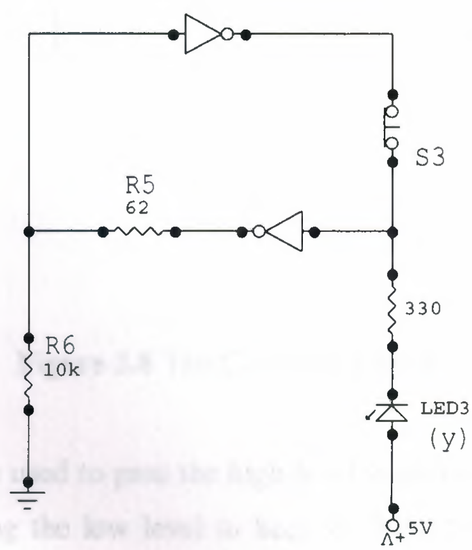


Figure 3.7 Loop Circuit

Initially, this circuit at node 13 is 0 because of the 10-kilo ohm resistor.

When high level (1) is connected to node 13,node 12 will be (0) and node 10 will be (1) and so,62 ohm resistor will pass the high level to node 13 to hold the high level at node 13 when the external level high source is disconnected, the yellow LED will be ON. And when the push button is pressed the circuit will be return to the initially state.

The Complete Circuit

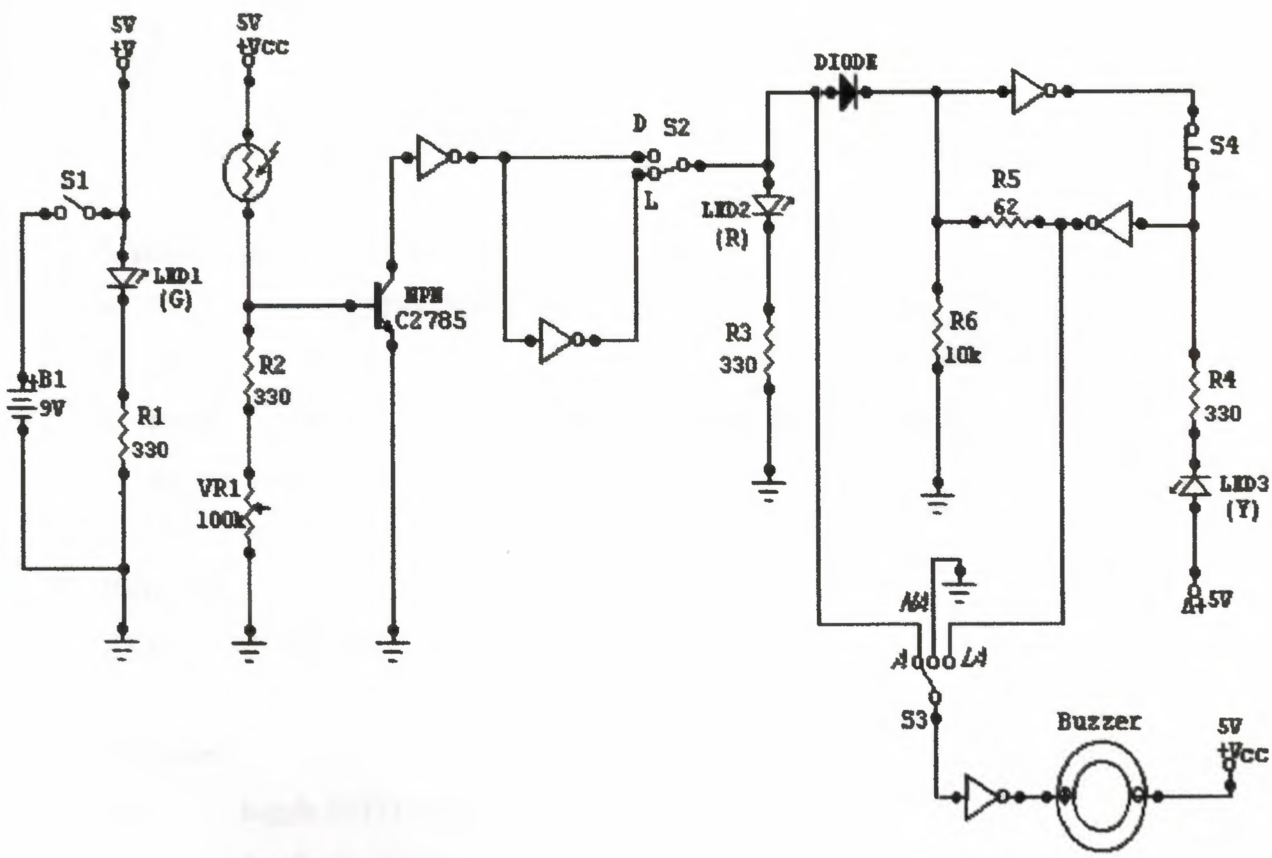


Figure 3.8 The Complete Circuit

The diode in the circuit is used to pass the high level from the light and dark detection circuit and prevent passing the low level to keep the high level detection in the loop circuit.

The selector switch light or dark activator is used to select the input of the loop circuit and the buzzer circuit from the light LED node or the dark LED node.
The selector switch of the buzzer circuit is used to select the input of the circuit (light or dark) or the loop detection or low (0) no alarm.

3.7 The Components

1) Resistors 1/3 watt 5%:
   - R1, R2, R3, R4   330 ohm
   - R5   62 ohm
   - R6   10 k ohm
   - VR1   100 k ohm

2) Semiconductors:
   - Tr1   C2785 (NPN)
   - D1   1N4148
   - LED   Green for the light activate, Red for the dark activate and Yellow for the loop

3) Photocell:
   PCC1   RPY58A

4) Switches:
- S1   toggle SPDT type
- S2   3-selections type
- S3   push putton normally close

5) Gate:
   Inverter gate   7404

6) Buttery:
   B1   size 9-volt

7) Buzzer

8) Miscellaneous:
   - Verobloc
   - Control knob
   - Wire

3.8 Using Instructions

1- Turn ON the power switch.

2- Activating the circuit by turning the activation switch to the desired state (light, dark).

3- Adjust the sensitivity-actuating key.

4- Choosing the alarm state (loop, non or alarm).

5- when resetting the circuit press the reset button to reset the loop alarm.

3.9 Results

The circuit worked well without any fault as showing in the figure 3.8. The problem in this circuit is as we mentioned before the sensitivity of an LDR sensor, but in this circuit this problem occur more than the first and second, while we are converting the effective light in dark or in light and we could detect the at least one time activation by using loop alarm.

And the complete circuit was installed inside a box to make it friendlier; In addition a push button was added to reset the switch indicator (yellow LED). (e.g. as an alarm system, it indicates intrusion).

The entire alarm system is shown in figures 3.9, 3.10, 3.11, and 3.12.

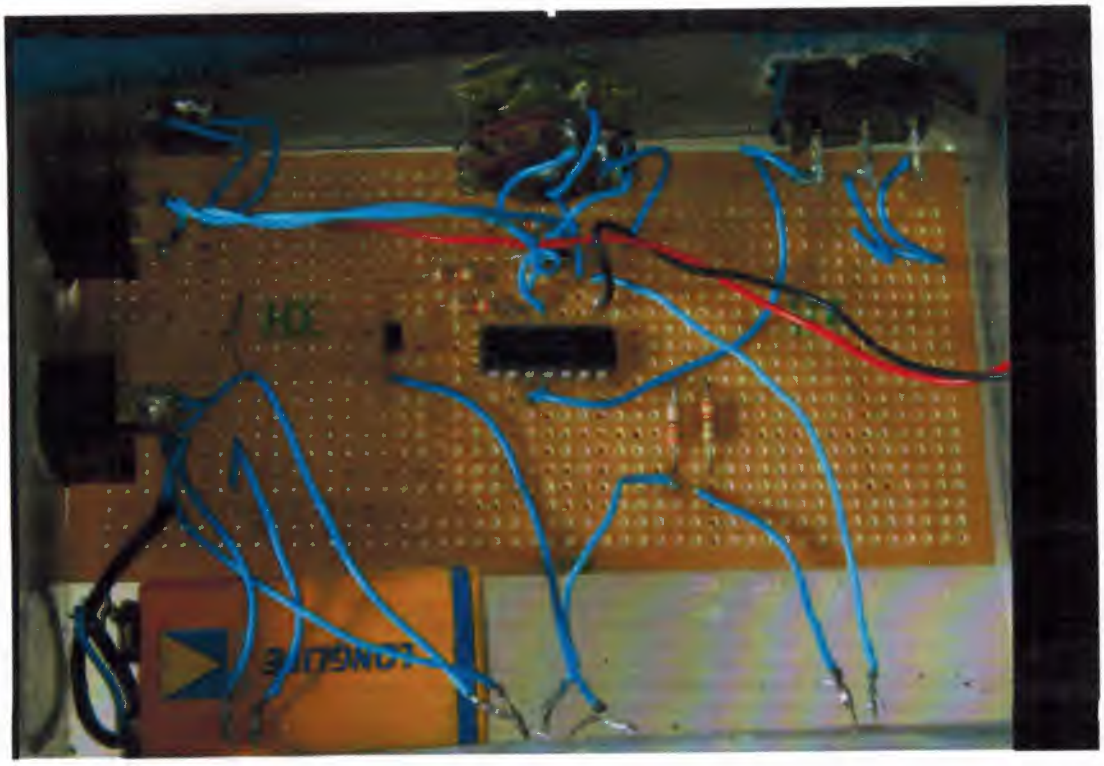


Figure 3.9 Third Circuit on the Board

Figure 3.10 Third Circuit Shows the LEDs and Sensor at the Front

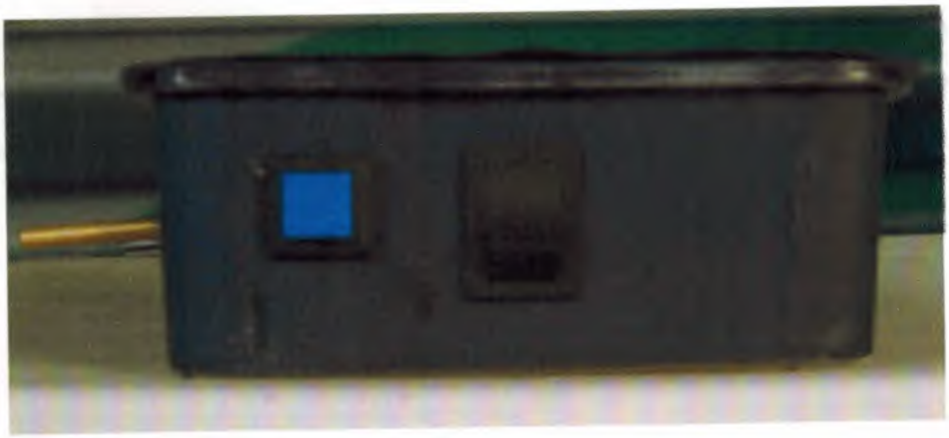


Figure 3.11 Third Circuit Shows the Power Switch and Push Button Switch.

Figure 3.12 Third Circuit Shows Activation Switch, Alarm States Switch and Sensitivity Actuating.

3.10 Summary

In this chapter the light and dark activated switch circuits were presented. Also in this chapter we have explained three circuits using photo sensor (LDR), the diagram of the first, second and third circuits also showed. And the components for all of them were listed.

CONCLUSIONS

So far from this project we have accomplished our aims that were:

- To design and build a light / dark activated switch.
- To gain hands-on experience in electronic hardware project.
- To modify the original circuit where possible.
- To suggest potential real-life use of switches.
- To benefit how to build and use alarm system in our houses to protect our belongings and ourselves by using LDR sensor.

In the first chapter we have seen different types of electronic components and the safety way of using them in any electric circuit, also we learned how to measure them without expecting an error.

In the second chapter we have discussed switches, the types of switches we have seen 12 types of switches, the effect of the circuit parameter on the life-time of switches, and the effects of the acceleration (shock and vibration). Also the contact material, terminology of switches, and the use of the switches in the hostile environment were been discussed.

The third chapter was an introduction about light and dark activated switch, where we can use it. Also in this chapter we have explained three circuits using an LDR sensor, the third circuit was a combination between the light and the dark activation switch, the diagram of the first, second and the third circuit.

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