DESIGN AND CONSTRUCTION OF DARKNESS ACTIVATED SWITCH

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DECLARATION

I EMEDO OLUEBUBE JANE (AST/2372060592) hereby declare the originality of this work carried out by me, in the department of physical science laboratory technology, school of applied science and technology Auchi polytechnic, Auchi. Under the supervision of Mr. Babaiwa D. other work consulted and quoted are duly acknowledged.

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Mr. Babaiwa D. Date

CERTIFICATION

This is to certify that this project titled **"Design and Construction of Darkness Activated Switch"** was carried out by Emedo Oluebube Jane under the supervision of Mr. Babaiwa D. of the department of physical science laboratory technology. The project meets the regulations governing the award of Higher National Diploma in Federal polytechnic Auchi, and is approved for its literary presentation and contribution to science and knowledge.

_____ _____

Mr. Babaiwa D.
(supervisor)

Date

_____ _____

Mr Jafaru Braimah
(Head of Department)

Date

DEDICATION

This project is dedicated to God Almighty, the custodian of life, the epitome of great moral character and the architect of my destiny.

ACKNOWLEGMENT

Marcus Tullius Cicero once said, “A thankful heart is not only the greatest virtue but the parent of all virtues”. First of all, I would like to thank the supreme power, the almighty God for the successful completion of this work; it is only by his grace that all conceived ideas of men are possible and realizable.

Also, my sincere thanks goes to my project supervisor, Mr. Babaiwa D. for his guidance, support and methodology to complete this project.

Finally, I am eternally grateful to my beloved mother Mrs. Ajuonuma Emilia Chinyere, Mr. Ajuonuma Samuel Arinze, Mr. Ajuonuma Henry Nnaemaka, Miss Ajuonuma Doris Chidimma, the entire family of late Mr. Ajuonuma Emedo Paul and my friend Akawe Terver Daniel and the entire department of Physical Science Laboratory Technology (PSLT) class of 2022, acquaintance turned colleagues, friends and family. You all made my journey enlightening and successful. I appreciate you all for your believe, trust, confidence, care, willingness to listen, occasional drama, moral and emotional support. I pray almighty God guides us all right and make it easier for us all to get to the zenith of our respective life.

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ABSTRACT

This project presents the design and construction of Darkness activated switch. This is aimed at activating a switch or AC (Alternating Current) lamp at sunset and deactivate it at sunrise. The Darkness activated switch can trigger a relay to operate an AC lamp at sunset and sunrise. This eliminates the need of switching ON and OFF manually. The circuit utilizes the light sensing property of LDR (Light Dependent Resistor) to activate the circuit. The Light Dependent Resistor (LDR) changes or varies resistance with change in the resistance and intensity of light hitting its surface.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Light consists of discrete packets of energy called photons thus the energy contained in a photon depends on the frequency of light. Essentially, optical detectors are devices used to convert optical energy or light into electrical energy (Bolay *et al;* 2012).

Advancement in technology has made all aspects of life simpler and easier thereby making automated systems more preferred to manual systems (Nikhil, 2016). Automatic switch systems are designed to alert an individual or group of individuals at specified times (Busari *et al;* 2015). The automatic darkness activated switch refers to a circuit that employs a photo detector/Light Dependent Resistor that senses the amount of light intensity. It will automatically switch ON or OFF the lamps depending with the amount of light intensity (Thomas, 2004). The light sensor is a passive device that converts light energy into electrical signal that generates an output signal that is proportional to the intensity of the light (Mavrya *et al;* 2012).

Manual control of light is prone to errors and stressful. The introduction of automation and remote management solution for detecting dark illuminations is vital and can be achieved by the use of programmed micro-controller. The present power and economy crises has a negative effect on Nigerians coupled with the fact that there is power wastage as more appliances are left powered than are necessary with no plan for conservation (Adelakun *et al;* 2014). The reason for this design is to cut down these excesses by automating the switching. This will in turn save cost and power used over a period of time and more efficiency is achieved.

1.2 OBJECTIVE OF THE STUDY

The objective of this project is to design and construct a device that will trigger a switch when light or darkness fall on the sensor (Light Dependent Resistor).

1.3 SCOPE OF THE STUDY

The scope of this project took into consideration the hardware design and construction of an automatic darkness activated switch using a Light Dependent Resistor to control this regulation. The circuit is to switch ON the light when Darkness falls on the sensor. The Light Dependent Resistor will have high resistance in darkness and low resistance when illuminated.

1.4 SIGNIFICANCE OF THE STUDY

This device is very useful in that it helps to distinguish daylight and Dark hours. It eliminates the conventional use of light switches and also helps to switch ON and OFF the premises when the occupants are out of reach.

1.6 LIMITATION OF THE STUDY

One of the problems of this device is that any opaque material can trigger the device, such as human shadow, movement of animals across the sensor can trigger the system.

1.6 APPLICATION OF THE PROJECT

Darkness activated switch has become very important in our everyday activities because of its application in many useful devices that has been used to solve some societal problem. Some of the other areas in which darkness activated switch can be used are:

a. For automatic switching of street lights.
b. For automatic outdoor lighting or garden lighting at home.
c. For switching the hoardings ON/OFF automatically.

d. As light detector circuit when the pin of the IC (Integrated Circuit) is reconfigured.

e. As Darkness activated switch.

1.7 DEFINITION OF TERMS

- **LIGHT DEPENDENT RESISTOR (LDR):** It is a device whose sensitivity depends upon the intensity of light falling on it.
- **LIGHT EMITTING DIODE (LED):** It is a semiconductor device that emits light when an electric current flows through it.
- **SWITCH**: Is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.
- **ELECTRIC LAMP/BULB**: Is an electrical component that produces light.

CHAPTER TWO

LITERATURE REVIEW

2.1 OVERVIEW OF DARKNESS ACTIVATED SWITCH

Darkness activated switch is important in operating appliances and equipment in our environment today as opposed to the conventional switching ON and OFF appliances. This is because of a lot of power wastage caused by human errors and omission.

In FUNAAB (Federal University of Agriculture Abeokuta), a device was designed and constructed to power security light that automatically becomes activated and deactivated with the intensity of light hitting the light dependent resistor, which was aimed at reducing theft in the late hours of the night (Babalola, 2012).

Over the years, darkness activated switch has been improved upon as a lot of technologies have been put in place ranging from solar powered lamps which are from a renewable energy source to energy from power grid. Moreover, the major component of darkness activated switch is the light dependent resistor of photo-resistor and this component finds application in a lot of fields ranging from automatic light circuit, simple fire alarm circuit, and darkness activated switch, automatic led emergency light.

2.2 LIGHT DEPENDENT RESISTOR (LDR)

Light Sensor LDR (Light Dependent Resistor) is one type of resistor that can experience changes in resistance when experiencing changes in light reception (Tipsuwanporn *et al;* 2010). The amount of resistance value on the LDR Light Sensor (Light Dependent Resistor) depends on the size of the light received by the LDR itself. LDR is often called a device or sensor in the form of resistors that are sensitive to light (Aryza *et al;* 2017). Usually LDR is made of cadmium sulphide (CdS) which is a semiconductor material whose resistance varies

according to the amount of light (rays) that hit it. Like a conventional resistor, LDR mounting in a circuit is exactly the same as a regular resistor installation. The working principle of LDR Light sensor will change with the intensity of light that surrounds it or the surrounding. In a dark state the LDR resistance is about 10MΩ and in a light state of 1KΩ or less (Lubis e*t al;* 2015).

In the dark or dim light, the material from the disk produces free electrons with a relatively small amount. So there are few electrons to transport the electrical charge. This means that when the light is dim, LDR becomes a bad conductor, or LDR can also have a great resistance in the dark or dim light. At the bright light, there are more electrons out of the atom of the semiconductor material. So that will be more electrons to transport the electrical charge. This means that when the bright light, LDR into a good conductor, or LDR can also have a small resistance during bright light. When we will set the sensitivity of LDR (Light Dependent Resistor) in a circuit then we need to use potentiometer (Gain *et al;* 2013).

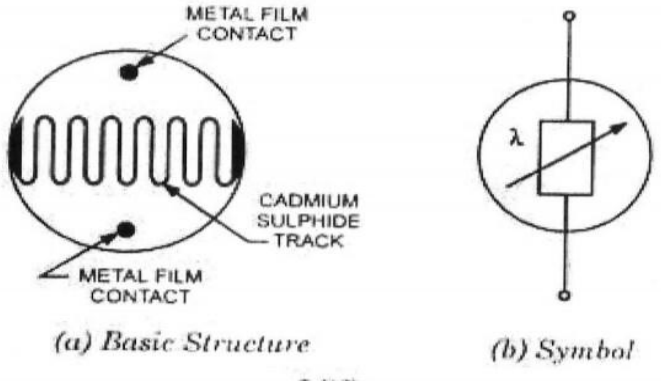

Figure 2.1: Light Dependent Resistor

2.3 LIGHT EMITTING DIODE (LED)

A LED consists of a junction made from the semiconducting compound gallium arsenide phosphide (GaAsP). It emits light when it is in a forward biased state, the color depending on the composition and impurity content of the compound. At present red, yellow, and green

LEDs are the most available. A modern retorting LED light "bulb" shape, complete with aluminum heat sink, light diffusing dome and E27 screw for using a built-in power supply working on phosphor coating to mix yellow down converted light with blue to produce light that appears white (Narasimha, 2011).

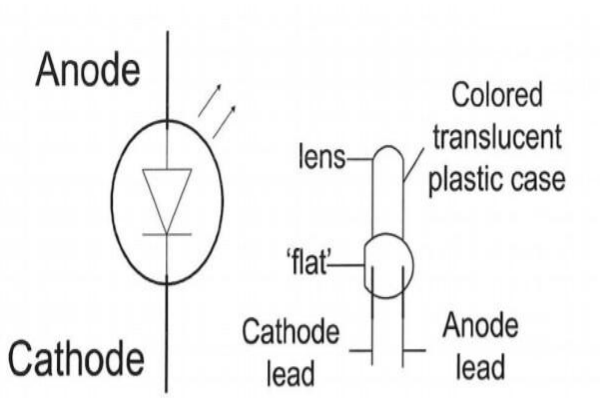

Figure 2.2: Light Emitting Diode

2.4 VERO BOARD

Vero board is a brand of strip board, a pre-formed circuit board material of copper strips on an insulating board which was originated and developed in the early 1960s by the Electronics Department of Vero Precision Engineering Ltd (VPE). It was introduced as a general-purpose material for use in constructing electronic circuits – differing from purpose-designed printed circuit boards (PCBs) in that a variety of electronic circuits may be constructed using a standard wiring board.

The first single-size Vero board product was the forerunner of the numerous types of prototype wiring board which, with world-wide use over five decades, have become known as Strip board. The generic terms 'Vero-board' and 'strip-board' are now taken to be synonymous. As with other strip boards, in using Vero-board, components are suitably positioned and soldered to the conductors to form the required circuit. Breaks can be made in

the tracks, usually around holes, to divide the strips into multiple electrical nodes enabling increased circuit complexity.

This type of wiring board may be utilized for initial electronic circuit development, to construct prototypes for bench testing or in the production of complete electronic units in small quantity. Vero-board was first used for prototype construction within Vero Electronics Department in 1961. The images of a binary decade counter sub-unit clearly show both the assembled components and the copper conductors with the required discontinuities.

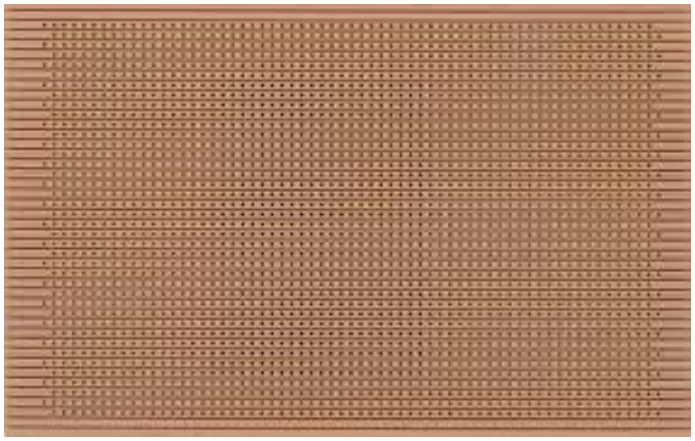

Figure 2.3: Vero board

2.5 A.C LOAD BULB

An incandescent light bulb, incandescent lamp or incandescent light globe is an electric light with a wire filament heated until it glows. The filament is enclosed in a glass bulb with a vacuum or inert gas to protect the filament from oxidation. Current is supplied to the filament by terminals or wires embedded in the glass. A bulb socket provides mechanical support and electrical connections.

Incandescent bulbs are manufactured in a wide range of sizes, light output, and voltage ratings, from 1.5 volts to about 300 volts. They require no external regulating equipment, have low manufacturing costs, and work equally well on either alternating current or direct current.

As a result, the incandescent bulb became widely used in household and commercial lighting, for portable lighting such as table lamps, car headlamps, and flashlights, and for decorative and advertising lighting.

Incandescent bulbs are much less efficient than other types of electric lighting, converting less than 5% of the energy they use into visible light (Keefe, 2007). The remaining energy is lost as heat. The luminous efficacy of a typical incandescent bulb for 120 V operation is 16 lumens per watt, compared with 60 lm/W for a compact fluorescent bulb or 150 lm/W for some white LED lamps (Balzani *et al;* 2015).

Figure 2.4: Electric light bulb

2.6 TRANSISTOR

Transistors are active components used basically as amplifiers and switches. The two main types of transistors are;

2.6.1 Bipolar transistors whose operation depends on the flow of both minority and majority carriers.

2.6.2 Unipolar transistors or Field Effect Transistors (FET) in which currents is due to majority carriers on (either electrons or holes). The transistor as a switch operates in class A

mode. In this mode of bias, the circuit is designed such that current flows without any signal present. The value of bias current is either increased or decreased about its mean value by the input signal (if operated as an amplifier) or ON and OFF by the input signal if operated as a switch.

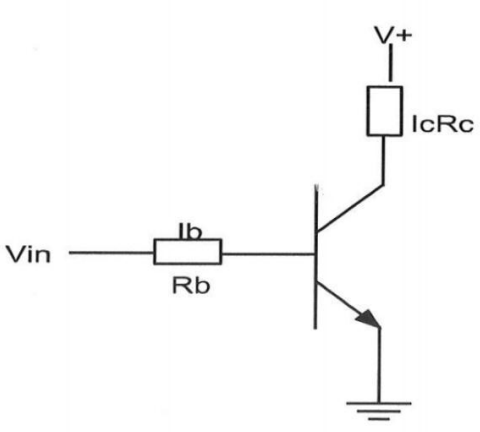

Figure 2.5: Circuit Diagram of a Transistor

2.7 RELAYS

A relay is a switch worked by an electromagnet. It is useful if we want a small current in one circuit to control another circuit containing a device such as a lamp or electric motor which requires large current, or if we wish several difference switch contacts to be operated simultaneously. The controlling current flows through the coil; the soft iron coil is magnetized and attracts the L-shaped soft iron armature. This rock on its pivot and opens closes or changes over as shown in figure 2.6, the current needed to operate a relay is called the *pull-in* current and the *drop-out* current is the current in the coil when the relay just stops working (Roon, 2006).

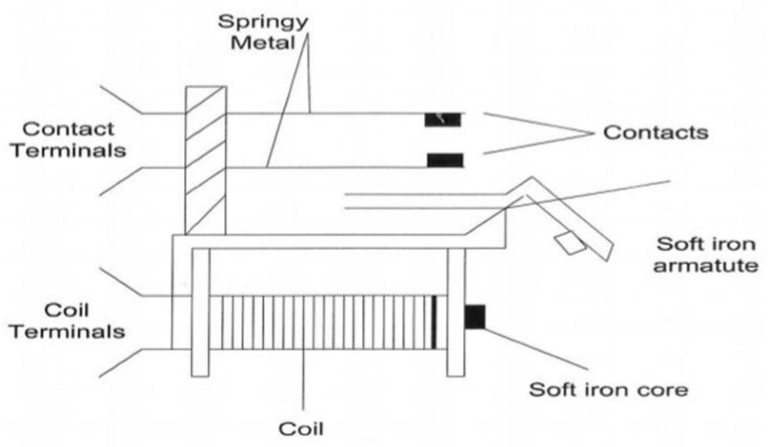

Figure 2.6: Schematic Diagram of a Relay

2.8 STEP DOWN TRANSFORMER

A transformer is a static machine that converts the high voltage (HV) and low current from the primary side of the transformer to the low voltage (LV) and high current value on the secondary side of the transformer. A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Commonly, transformers are used to increase or decrease the voltages of alternating current in electric power applications (Edward, 2001).

A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core and a varying magnetic field impinging on the transformer's secondary winding. This varying magnetic field at the secondary winding induces a varying electromotive force (EMF) or voltage in the secondary winding. Making use of Faraday's Law in conjunction with high magnetic permeability core properties, transformers can thus be designed to efficiently change AC voltages from one voltage level to another within power networks (Edward, 2001).

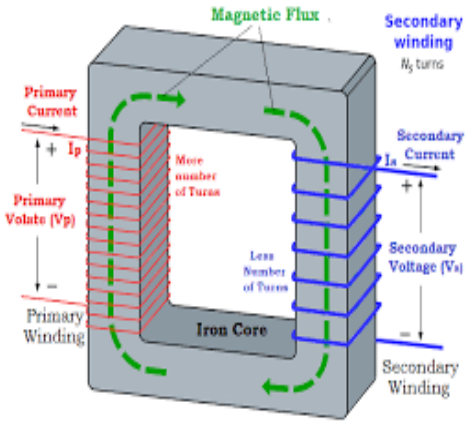

Figure 2.8: Step down transformer

2.9 CAPACITOR

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electro-statically in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors (plates) separated by a dielectric (i.e. insulator). The conductors can be thin films, foils or sintered beads of metal or conductive electrolytes. The non-conducting dielectric acts to increase the capacitor's charge capacity. A dielectric can be glass, ceramic, plastic film, air, vacuums, paper, mica, oxide layer etc. Unlike a resistor, an ideal capacitor does not dissipate energy. Instead, a capacitor stores energy in the form of an electrostatic field between its plates. There are different types of capacitors such as polarized capacitors, non-polarized capacitor and variable capacitors etc. It is also called a condenser polarized capacitors have polarity such as positive terminals and negative terminals. A capacitor is measured in voltage and micro-farad

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric. In simpler terms, the dielectric is just an electrical insulator. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field.

The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device. An ideal capacitor is wholly characterized by a constant capacitance *C*, defined as the ratio of charge ±*Q* on each conductor to the voltage *V* between them.

Because the conductors (or plates) are close together, the opposite charges on the conductors attract one another due to their electric fields, allowing the capacitor to store more charge for a given voltage than if the conductors were separated, giving the capacitor a large capacitance. Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary.

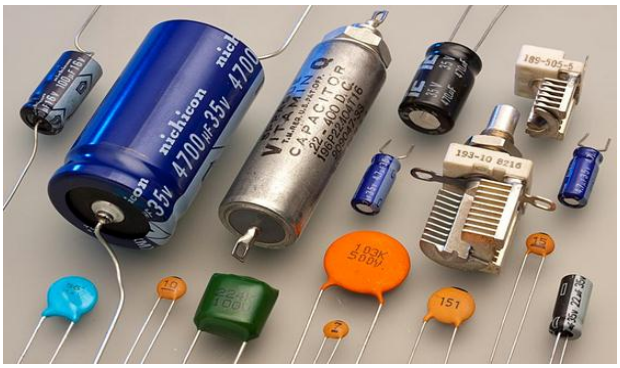

Figure 2.9: Capacitor

2.10 RESISTOR

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a

volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Figure 2.10: Resistor

2.11 DIODE

A diode is made up of two words i.e., “Di “means two, and “Ode “means Electrodes which means that a device or component has two electrodes. (i.e., cathode and anode). A diode is an electronic device having a two-terminal unidirectional power supply. A semiconductor diode is the first diode that forms in semiconductor electronic devices, after that there were lots of new innovations that takes place, but the most common diode used is a semiconductor diode.

A diode has two terminals that have a low resistance to the flow of the current in one direction; there is low resistance on one side and high resistance in the other, thus restricting the flow of current in one direction. Semiconductor diodes are two-terminal devices that consist of a p-n junction and metallic contacts at their two ends. Materials that are used to make diode are: Germanium, silicon and germanium arsenide etc.

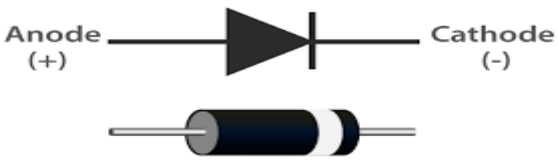

Figure 2.11: Diode

CHAPTER THREE

DESIGN METHODOLOGY

3.1 INTRODUCTION

In this chapter, we would be considering the hardware structure of the entire project which gives a detailed explanation of the function of the device and components used. This chapter would entail the block diagram, operation of the whole circuit.

3.2 SYSTEM BLOCK DIAGRAM

The block diagram of the circuit is a block of drawings that expresses different segments of the stages involved for the circuit to be functional. The various segments involved in this circuit includes; the power supply, light sensor segment, the logic control segment, switching timer segment, and the load.

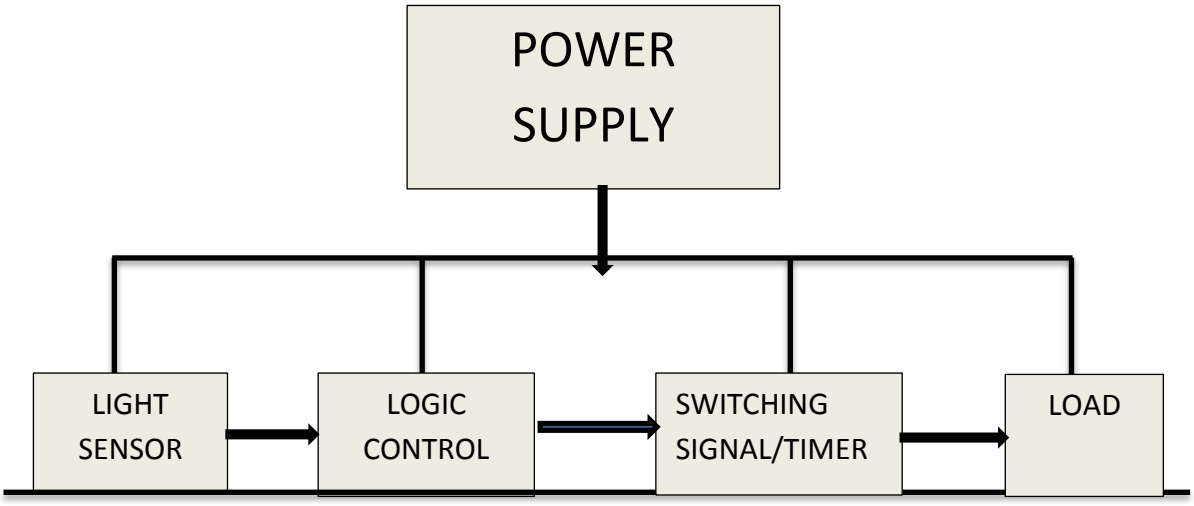

Figure 3.1: Generalized Block Diagram

3.3 CIRCUIT LAYOUT OF THE SYSTEM

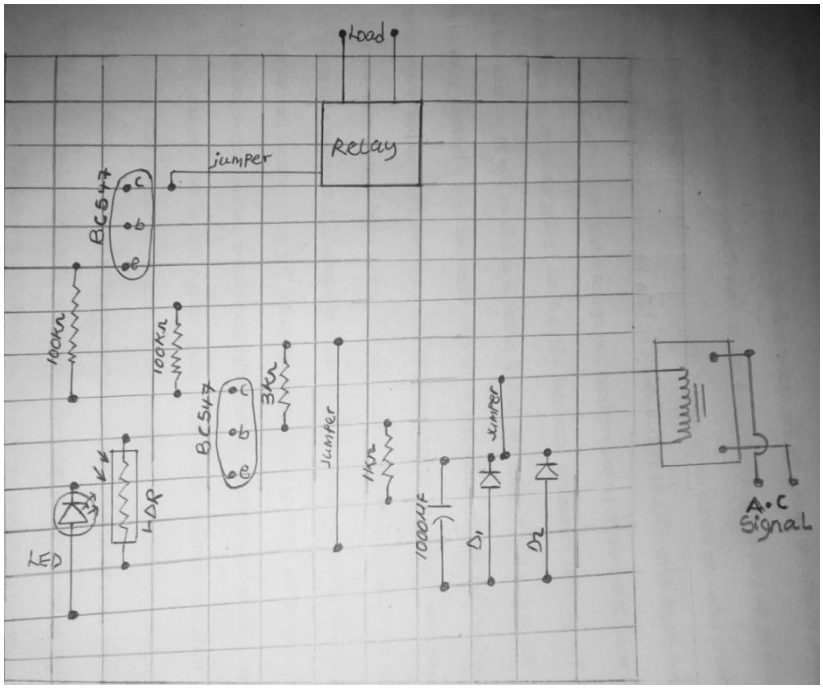

Figure 3.2: Circuit layout of darkness activated switch

3.4 PRINCIPLE OF DESIGN AND OPERATION

This project is about switching ON and OFF power supply using light intensity (rays from the sun) driving/powering a load.

The project has a power supply section that houses a transformer which steps down the input voltage and a rectifier which converts alternating current to direct current for use in the complete circuit. After noise must have been removed from the capacitors to convert voltages to 5V and 12V respectively. The circuit has a light dependent resistor (LDR)/photo-resistor whose resistivity increases or decreases with the intensity of light (sun rays) falling on it. The light dependent resistor is connected to a comparator which compares resistance and then to a timer which acts as a monostable multivibrator which determine the state of the circuit. This in turn is connected to a flip-flop which has a memory and keeps track of the past state of the circuit for changes. The circuit operates a load of not more than 1KW power.

3.5 OVERALL SPECIFICATION

- Input Voltage……240VAC
- Output Voltage……9-0-9VAC
- Supply Voltage……5VAC/12VAC
- Current…….500mA
- Frequency……..50Hz

However, a host of other resistors were used to oppose the flow of current, thereby protecting the circuit from getting damaged. Also, a capacitor was used to filter out the noise caused in the circuit by passing voltage over some components.

3.6 CONSTRUCTION

In implementing any electronic circuit, a circuit diagram is first obtained after which all components and material needed for the circuit project is made available. The components needed are then connected on a breadboard which provides a temporary platform to construct a circuit and make sure that the circuit is operational as desired before it is transferred and soldered on the permanent platform for the construction. The system layout that makes make this project is shown in figure 3.1 below.

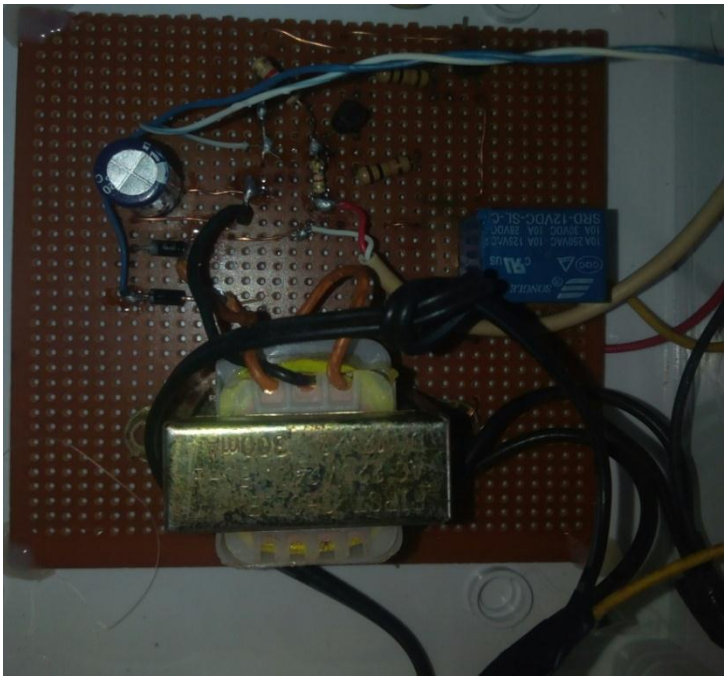

Figure 3.3: System layout

3.7 TESTING

The testing of the project was first done on a breadboard whereby all the components used for the project were affixed to the breadboard as it is on the circuit diagram. Usually it is expected not to work on the first attempt and so each connection terminal is checked carefully to make sure that they are all fitted in perfectly on the breadboard.

Also, another testing is done when the components have all been soldered on the permanent casing, at this point the working principle of the project can fully be tested and further corrections can be made if need be. The testing phase is shown in figure 3.2 below.

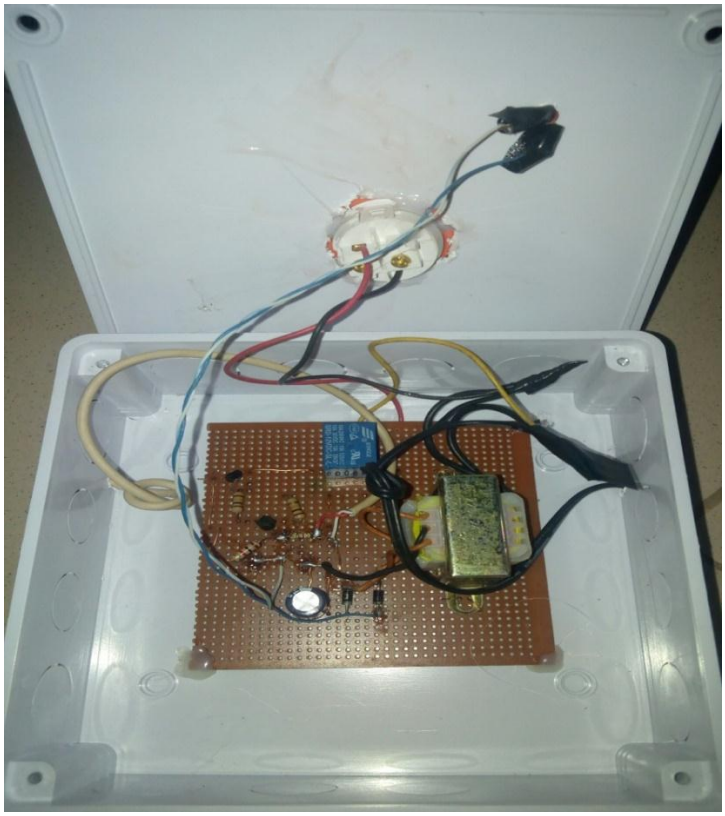

Figure 3.4: Testing of the project

3.8 CASING AND ASSEMBLING OF THE SYSTEM

Having provided the casing and having finished the construction of the sections of this system, the assembling into the casing followed. The sections were properly laid out and assembled into the casing where the general coupling and linkages into the peripheral devices took place.

Finally; the indicator, switches, and plug were carefully brought out from the internal part of the casing through the holes made on the body of the casing, the panel cable plug outlet mounted on the body of the casing where power source terminals will be connected to.

Figure 3.5: Casing and assembling of darkness activated switch

3.9 DESIGN STAGES AND PROCEDURES

The steps taken for this project are explained further below;

3.9.1 Stage One

In this stage, the circuit is thought out and designed using a simulator software, it is then tested for errors and corrections are made.

3.9.2 Stage Two

The components are then soldered on a Vero board (the power components, the logic control components and the switching components) following the circuit diagram simulated. At this stage the LED is added as well as the LDR connected to the main circuit. They are joined with a lot of care to avoid breaks or errors. Then, testing is carried out.

3.9.3 Stage three

Finally, the main circuit is then housed in a cubic containment as required tapping out the LED, LDR and power supply. The final testing is done at this stage to ascertain the work

done. After this the project is ready. At this stage, also an external load can be added to check the output description.

3.10 APPLICATIONS

The darkness activated switch is popular in street lighting systems. However, it can be programmed to achiever the following purpose;

- For automatic outdoor lighting or garden lighting at home.
- For automatic switching of street lights.
- For switching the hoardings ON and OFF automatically.
- For self-switching operation of displaying title hoardings of companies.
- As a light detector circuit.
- As Darkness activated switch.
- For controlling appliances in offices to avoid wastage.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Darkness activated switch is an electrical device which helps to distinguish daylight from dark hours. Thus, eliminating the conventional use of light switches and also helps to switch ON and OFF the premises when the occupants are out of reach.

The construction of this device with the aid of some components such as Light Dependent Resistor (LDR), capacitor, resistors, relay, diode etc. were arranged to make a complete circuit. From the circuit diagram, the main part which is responsible for the automatic switching, switching ON and OFF depending on the intensity of light falling on it, is the Light Dependent Resistor (LDR). Light Dependent Resistors, differs from other resistors in that there operation is dependent on the intensity of light falling on it.

The idea of automating switching ON and OFF electrical appliances using Darkness activated switch has been achieved. As the system is setup to be completely automated using a light dependent resistor. This in turn will reduce cost due to wastage as well as the need for security men leaving there place of primary assignment. Also, this will help cut down the likelihood of fire outbreak due to negligence on the part of some staff. The Darkness activated switch is a simple circuit that can be properly utilized and if possible made in bulk to cover large areas. The project works simply with the use of a renewable source of energy which is sunlight. Albeit, sunlight is a common source which makes the use of Darkness switch quite interesting. Therefore, the major objective of the undertaken project was achieved.

5.2 RECOMMENDATIONS

Although, the main objective of the project was thus achieved, it is subject to further improvement.

i. It will be a better equipment if a solar power supply could be incorporated to the overall design so as to make power available at all times and to complement one another.

ii. Sensors could also be provided to increase the credibility of the circuit since for now direct rays of light from bulb cold also trigger the switch. As such, the whole design could be improved soon.

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APPENDICES

APPENDIX I

IMAGE OF THE COMPLETE PROJECT

APPENDIX II

LIST OF ITEMS

S/NO	Component name	Value/details	Quantity
1	LDR	1KΩ -10MΩ	**1**
2	Capacitor	1000µf	**1**
3	Resistor	100kΩ	**2**
4	Resistor	1kΩ	**1**
5	Resistor	3kΩ	**1**
6	Relay	125VAC-250VAC/10A	**1**
7	Transistor	BC547	**2**
8	LED	Red	**1**
9	Transformer	12-220V/300mA	**1**
10	Diode	IN4007/50V	**2**
11	Electric bulb	White	**1**
13	Lamp holder	……	**1**