DESIGN AND CONSTRUCTION OF EMERGENCY LIGHTING SYSTEM USING LIGHT EMITTING DIODE (LED)

BY

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(2005/21994EE)

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR DEGREE, IN ENGINEERING (B.ENG) FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

NOVEMBER, 2010.

DECLARATION

I, ADETORO Saheed Ayodeji, declare that this project was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

ADETORO Saheed Ayodeji
(Name of Student)

------------------------------ 06/03/2011
Signature and Date

CERTIFICATION

This is to certify that this project titled "Design and Construction of an Emergency Lighting System using LEDs" was carried out by ADETORO Saheed Ayodeji with matriculation number, 2005/21994EE and submitted to the Department of Electrical and Computer Engineering, Federal University of Technology, Minna in partial fulfillment of the requirements for the Bachelor degree in Engineering (B.Eng.).

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Signature and Date
7/5/2011

DEDICATION

This project is dedicated to Almighty God and my beloved parents.

ACKNOWLEDGEMENT

First and foremost, all praises, adorations and glorifications are ascribed to Almighty God who has been taking care of me and for the successful completion of this programme. I I am also grateful to my parents, Surv. S.A. Adetoro and Mrs. R.F. Adetoro for their moral and financial support.

My profound gratitude goes to my supervisor Engr. Dr. M.N. Nwohu for his relentless effort and advice in putting me through in this work and all the staff in the Department of Electrical Engineering.

My appreciation goes to my siblings Halimat, Zainab, Gbolagade and Damilola whose concerns, prayers and love have been immeasurable to me.

I am also indebted to my friends, Williams, Gift, Temi, Mariam and to my entire course mates, for all your effort to encourage me.

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LIST OF NOTATIONS

I Current

V Voltage

AC Alternating current

V_P Primary voltage

V_S Secondary voltage

$V_{r.m.s.}$ Root Mean Square voltage

N_p Number of primary turn

N_s Number of secondary turn

I_P Primary current

I_S Secondary current

V_+ Positive input voltage

V_{ref} Reference voltage

P Solar power

A Effective area

H Irradiance

R_0 Responsivity

I_{ph} Photon current

R_{LDR} LDR resistance

V_{CC} Source voltage

V_{Coil} Voltage across relay coil

R_{Coil} Relay coil resistance

I_{coil} Current through relay coil

I_C Collector current

V_C Collector voltage

R_C Collector resistor

I_B Base current

V_B Base voltage

R_B Base resistor

V_{BE} Base-emitter voltage

β Gain of transistor

t Time

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CHAPTER ONE

1.1 INTRODUCTION

In the past, switching and control had often been carried out manually to obtain the desired result. With advancement in technology and increase in modern civilization, the use of manual operated switches is gradually getting phased-out thus paving way for the use of automatic switching devices in electrical installation works which has increased tremendously over the years. The yearn for automation by human race in all areas of life is only calling for ease, comfort and efficient accomplishment of tasks that might be susceptible to inefficiency and unpredictable failures if manually done.

The use of automatic switching controllers has become more essential for domestic and industrial switching related appliances. Automatic switching control is achieved by using controller operated based on the principle of the light dependent resistor (LDR) otherwise known as photocell. Thus the use of LDR that is sensitive to solar energy has greatly reduced the involvement of mankind in the field of power switching. Consequently, man made errors have been considerable reduced if not totally eliminated.

Lighting systems can be controlled automatically by use of an electrical circuit incorporated with a contactor or relay. This enables the switching of the light by the day and night as long as the public power supply is out. Even as the government needs to ensure the security of live and properties of her citizens, street lighting at night becomes very important. More so, some individuals would want lighting system at night for the illumination of their premises.

Thus, this project is aimed at designing and constructing of an Emergency Lighting System, which provides constant illumination for domestic use in times of public power failure.

1.2 AIM AND OBJECTIVE

- To enable the switching off of domestic light during the day and switching it on at night when public power supply goes out.
- The primary objective of this project is to provide constant illumination in homes at the event of power failure.

1.3 MOTIVATION

The need to have illumination in homes at all times to prevent obscurity thereby maximizing the comfort of the user brought an idea of working on this project. Furthermore, the high consumption rate of energy that attract high cost with the use of tungsten bulbs can now be reduced with the use of low power consuming LED.

1.4 PROJECT OUTLINE

Chapter one is composed of the introduction, objective and motivations of this project, while Chapter two discussed the literature review which comprised a brief historical background and theoretical background of the project work. Chapter three dealt with how the project design and construction was accomplished. In chapter four, the testing of the circuit, results obtained and discussion of the results were highlighted. The conclusion and recommendation on the project work were contained in chapter five. Finally, consulted materials were cited in the references.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

Engineering like human, has gone through series of evolution and transformation. As early as 18th century, British Government required home owners to place a burning stick or fagot outside their homes in the night as a measure to protect crime and later, oil lamp were used and gas lamp to brighten roads and pathways. Later in 19th century an American technologist Charles Brush developed arc lamp. Today houses and streets are illuminated with electricity, the switching method in many places particularly African countries are manual which consists of a breaker with a bypass fuse, a conductor and some miniature circuit breakers (MCB) [3].

Engineering as a field of study is all about making the entire life more meaningful and easier through the application of science and technology. An attempt to achieve this, various researches and workshop were embarked upon in order to understand phenomena around us. Though engineers predict that technology will improve as life remains. The above mechanical switching described is manual bulk and grossly inefficient [2].

Human being requires light to carry out many functions particularly at night. There arises a need for a control system, which will be automated and reduce human effect on electronic switching system developed by all standard to be more reliable and effective. An example is Emergency Lighting System, which is the main aim of this project.

2.2 THEORETICAL BACKGROUND

This section discussed the theoretical background of discrete electronic components whose electrical characteristics have been put into use in various modules of this project work.

2.2.1 TRANSFORMER

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled wires. A changing current in the primary circuit creates a changing magnetic field. In turn, this magnetic field induces a changing voltage in the secondary circuit. By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other [3].

The secondary induced voltage V_s is scaled from the primary V_p by a factor ideally equal to the ratio of the number of turns of wire in their respective windings.

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

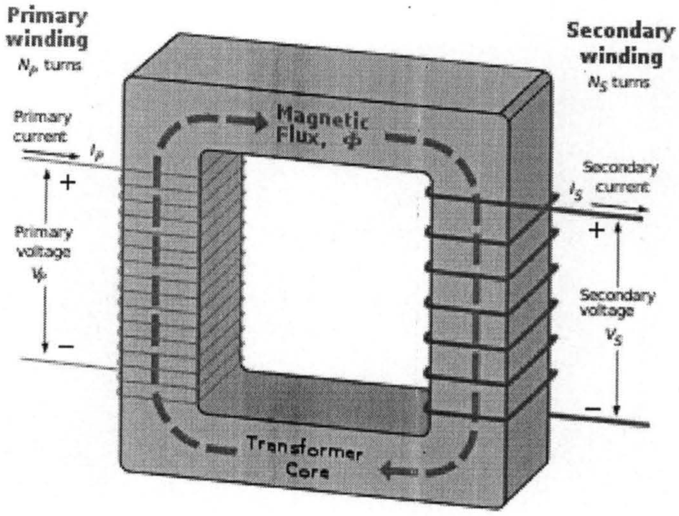

Plate I: Transformer

By appropriate selection of the number of turns, a transformer thus allows an alternating voltage to be stepped up by making N_s more than N_p or stepped down, by making N_p more than N_s. A key application of transformers is to reduce the current before transmitting electrical energy over long distances through wires. A transformer is also a major class of coil having two or more windings usually wrapped around a common core made from laminated soft iron sheet, which help in the reduction of eddy current. The rating of the transformer used in construction is 220/12V 500mA [5].

2.2.2 RECTIFIER

A rectifier is an electrical device that converts alternating current to direct current, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals [2]. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. A device which performs the opposite function (converting DC to AC) is known as an inverter [7].

2.2.3 FULL BRIDGE RECTIFIER

The bridge rectifier is a network of four diodes connected in a bridge configuration. It is also a full wave rectifier circuit in which each half cycle of AC input is rectified by a pair of diodes in opposite quarters of the bridge and in series with each other. A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to DC (direct current), and is more efficient. However, in a circuit with a non-center tapped transformer, four diodes are required instead.

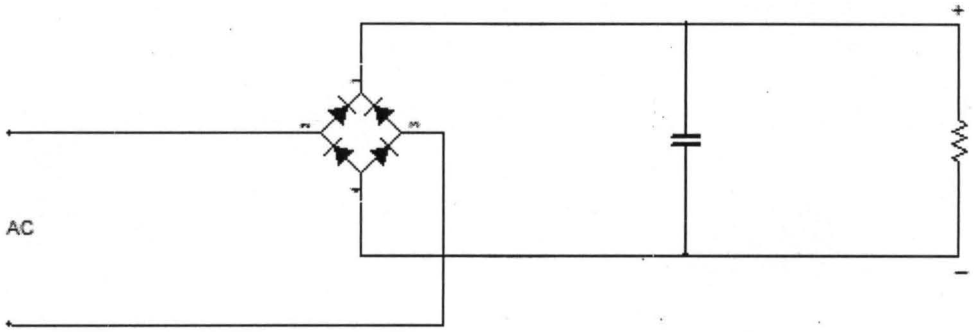

Figure 1: Full Wave Rectifier using four diodes

2.2.4 PHOTO-DETECTOR

Photo-detector is semi-conductor devices that can detect or sense optical signal through electronic processes. They convert the optical signals variation in to electrical variation that are subsequently amplified and further processed [8]. The photo-detector used in this project is a photo resistor, it is also known as Light Dependent Resistor (LDR) [8].

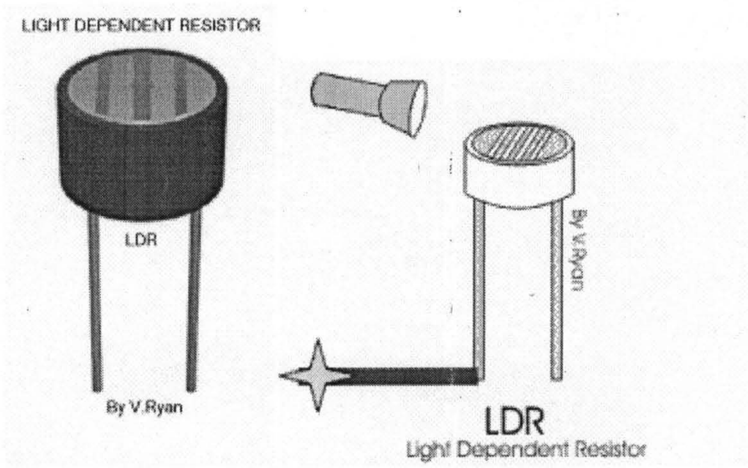

Plate II: Light Dependent Resistor

2.2.5 TRANSISTOR

In electronics, a transistor is a semiconductor device commonly used to amplify or switch electronic signals. A transistor is composed of three terminals, a base, a collector and an emitter. By sending varies levels of current to the base, the amount of current flowing through the emitter from the collector can be regulated. In this way, a small amount of current may be used to control a large amount of current, as in an amplifier. A voltage or current applied to one terminal of the transistor changes the current flowing through the other pair of terminals. Because the controlled current can be much larger than the controlling current, the transistor provides amplification of a signal. The transistor is the fundamental building block of modern electronic devices, and is used in radio, telephone, computer and other electronic systems. Some transistors are packaged individually but most are found in integrated circuits [5].

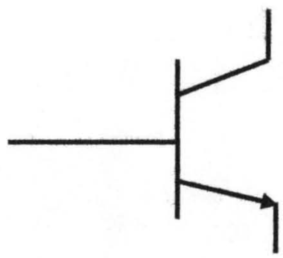

Figure 2: Symbol of a transistor

Transistors can be used as a switch or an amplifier depending on it is connected

(a) Switches: Transistors are commonly used as electronic switches. When the input bais voltage is low the transistor does not conduct thus it is at the cutoff region. By increasing the input voltage, the transistor can be brought to a saturation region where the transistor will be conducting well.

(b) Amplifiers: By sending small amount of current to the base, a large amount of current flows through the emitter from the collector. Since a small amount of current can be used to control a large amount of current, it therefore functions as an amplifier [3].

2.2.6 CAPACITOR

It consists of two conducting surfaces separated by a layer of an insulating medium called a dielectric. The conducting surface could be with the form of a circular, rectangular or spherical shape while the dielectric medium may be with the form of oil, air, paper ceramic or electrolytic. It is used to store electrical energy by electrostatic stress in the dielectric. The capacitance of a capacitor is the defined as the amount of change required to create a unit potential difference between the conducting surfaces.

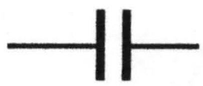

Figure 3: Electric symbol of a capacitor

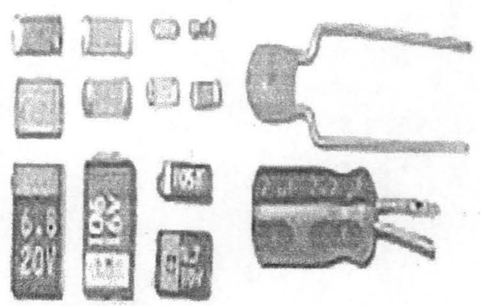

Plate III: Types of Capacitor

2.2.7 RELAY

A relay is an electromechanical device that opens or closes contacts to effect the operation of another device in the same circuit or different circuit. Thus, relays are used as protective and control devices for switching and for transmission of signals. However, in this project work, relay is being used as a switching device.

A switch is used to describe any mechanical device by which two or more electrical conductors may be conveniently connected or disconnected. The simplest form which consists of two strips metal on which are mounted electrical conductors [5].

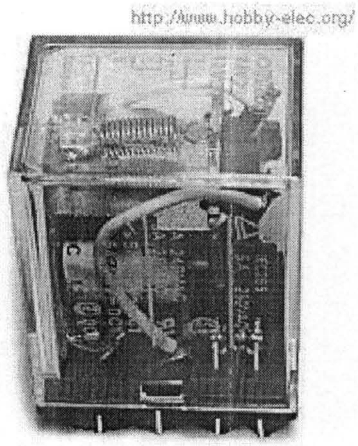

Plate IV: RELAY

2.2.8 OPERATIONAL AMPLIFIER

Basically there are different types of operational amplifier circuits. The common ones are inverting amplifier, non-inverting amplifier, summer, integrator and differentiator and comparator circuits. In this project work the operational amplifier is used as a comparator [9].

2.2.9 VOLTAGE COMPARATOR

Comparators are special types of an operational amplifier circuit without feedback used to compare a signal voltage on one of the input terminals with reference voltage on the other input terminals. When the signal voltage differs from the reference voltage, the output of the comparator becomes low or high. The signal input is connected to the non-inverting input, when the signal voltage is greater than reference voltage the output voltage goes high, but when signal voltage is less than reference voltage the output goes low. The comparator can drive a relay connected to it via a transistor to control a variety of devices such as lamps and motors [9].

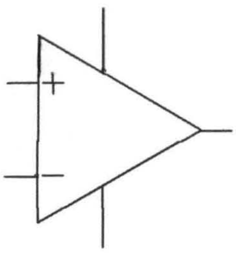

Figure 4: Symbol of Operational amplifier

2.2.10 LIGHT EMITTING DIODE

This type of diode emits light when current flows through it in the forward direction (Forward biased). When a small voltage is applied to the diode in the forward direction, current flows easily. Because the diode has a certain amount of resistance, the voltage will drop slightly as current flows through the diode. A typical diode causes a voltage drop of about 0.6 to 1V. This voltage drop is called forward bias voltage, in the case of silicon diode it is almost 0.7V. The voltage drop needs to be taken into consideration in a circuit which uses many diodes in series. Also, the amount of current passing through the diodes must be considered.

When voltage is applied in the reverse direction through a diode, the diode will have a great resistance to current flow. Different diodes have different characteristics when reverse-biased. Selection of a diode depends on how it will be used in the circuit. The current that will flow through a diode biased in the reverse direction will vary from several mA to just μA, which is very small. The limiting voltages and currents permissible must be considered on a case by case basis. For example, when using diodes for rectification, they are required to withstand a reverse voltage. If the diodes are not chosen carefully, they will break down [7].

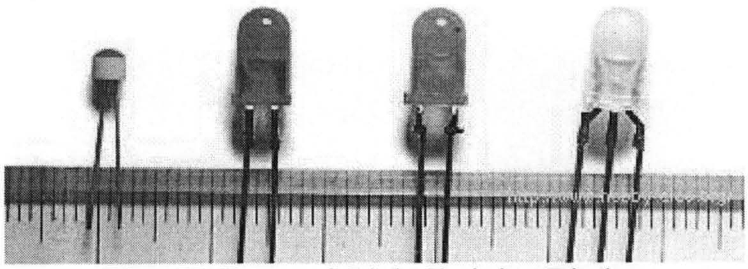

Plate V: Types of Light Emitting Diodes

Light emitting diodes must be chosen according to how they will be used, because there are various kinds. The diodes are available in several colors. The most common colors are red and green, but there are even blue ones. The device on the far right in the photograph combines a red LED and green LED in one package. The component lead in the middle is common to both LEDs. As for the reaming two leads, one side is for the green, the other for the red LED. When both are turned on simultaneously, it becomes orange. When an LED is new out of the package, the polarity of the device can be determined by looking at the leads. The longer lead is the anode side, and the short one is the cathode side. The polarity of an LED can also be determined using a resistance meter, or even a 1.5 battery [8].

CHAPTER THREE

DESIGN AND CONSTRUCTION

This project, Emergency Lighting System consists of the following basic units.

- The power supply unit
- The control unit
- The switching unit
- The charging unit
- The output unit

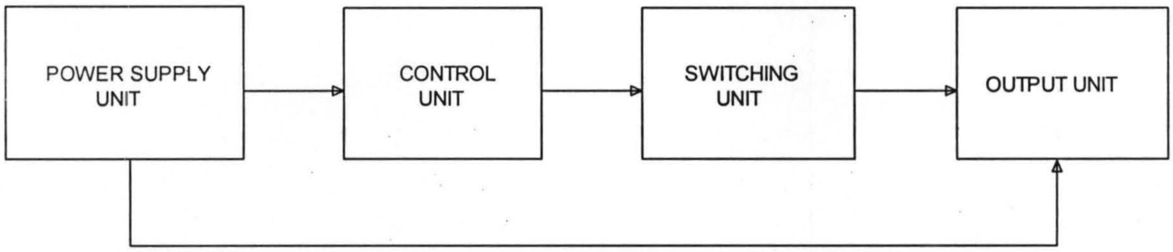

Figure 5: Circuit block diagram

3.1 Power Supply Unit

The power supply charges the 6V rechargeable battery which supplies the entire circuit with the required voltage to operate, it also activates the relay that disconnects the battery supply from the output once the AC power supply is on. The power supply uses an AC source which was converted to DC for normal operation. The power supply is subdivided into four sections.

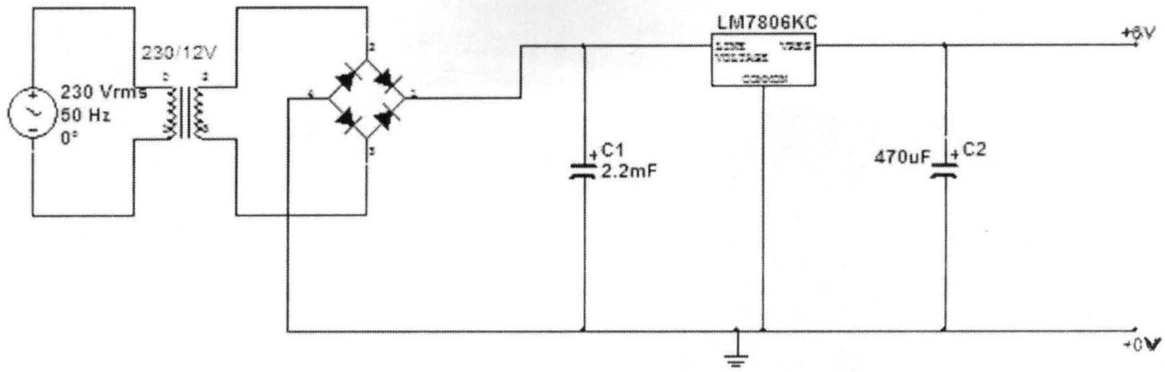

Figure 6: Power Supply Circuit.

The power supply is subdivided into four sections.

- Voltage transformation.
- Rectification.
- Voltage filtration.
- Voltage regulation.

3.1.1 Voltage Transformation.

Voltage transformation was achieved with the use of a step down transformer. The transformer which serves two functions, to provide isolation from the supply, and also to step down the value of the input voltage.

Primary Voltage $V_p = 230V_{r.m.s}$.

Secondary Voltage $V_s = 12V_{r.m.s}$.

Secondary Current $I_s = 500mA$.

The schematic diagram and equation definitions of a transformer are shown below.

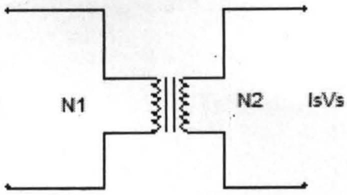

Figure 7: Transformer Symbol

Where N is the ratio of primary turns to the secondary turns, and V_p, V_s, I_p, and I_s are the primary and secondary voltages and currents. N_1 and N_2 are the number of turns of windings on the primary and secondary coils respectively.

But power input is equal to power output.

$$V_pI_p = V_sI_s$$

$$I_p = V_s \times \frac{Is}{Vp}$$

$$I_p = \frac{12 \times 500 \times 10^{-3}}{230}$$

$$I_p = 26mA$$

3.1.2: Voltage Rectification.

A full wave bridge was used to convert the AC voltage into pulsating DC voltage. It uses four diodes, as shown below.

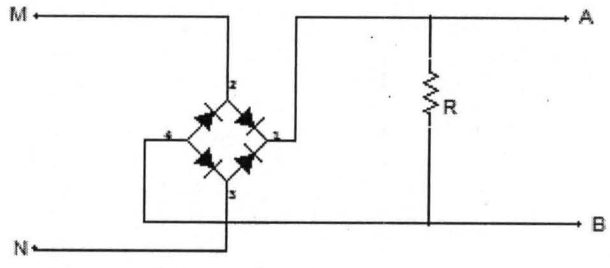

Figure 8: Bridge Rectifier

The diodes consume 1.4V at a time, because each diode uses 0.7V when conducting and there are only two diodes conducting. During the positive input-half cycle, terminal M of the transformer is positive and N is negative, as shown above, diode D_1 and D_3 becomes forward biased (ON) where as D_2 and D_4 are reverse biased (OFF).

During the negative input-half cycle, terminal M of the transformer is negative and N is positive, diodes D_1 and D_3 are reverse biased (OFF) while D_2 and D_4 are forward biased (ON). So we discover that current keeps on flowing through the load resistor in the same direction i.e. from A to B in the both half cycle of the input AC. It means that both half cycle of the input AC supply is utilized. The frequency of the rectified output voltage is twice the supply frequency. This rectified output consists of a DC component and many AC components or ripples [5].

The relationship obtained is as shown below.

$V_{dc} = [V_{r.m.s.}\sqrt{2} - 1.4]V$

where $V_{r.m.s.}$ = The r.m.s. value of the transformer secondary voltage.

$\sqrt{2}$ = r.m.s. for peak value conversion factor.

1.4 = Voltage drop in the two adjacent diodes in the bridge rectifier.

For 12V AC output.

$V_{dc} = 12\sqrt{2} - 1.4 = 15.6V$

3.1.3 Voltage Filtration.

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply, to act as a reservoir which supplies current to the output when the varying

DC voltage from the rectifier is falling. The capacitor charges quickly near the peak of the varying DC and discharges as it supplies current to the output.

The filter capacitor used in this project is 2200μF, because capacitor has the basic property of opposing changes in voltage, hence a bigger capacitor would tend to reduce the ripple magnitude. It is found that increasing the capacitor size increase V_{dc} towards the limiting value V_{ip}, thereby reducing the magnitude of ripple voltage, the time flow of current pulse through the diode and increasing the peak current in the diode [7]. The 2200μF capacitor at the output of the regulator is to make sure all ripple contents are removed from the output of the voltage regulator.

3.1.4 Voltage Regulation

Many voltage regulators are available in IC form, the main function of which is to keep the DC supply constant even when AC input voltage of the transformer varies or when the load varies [2]. The voltage regulator used in this project is LM7806, which is a 6V voltage regulator. The LM7806, in value shows that it is a positive voltage regulator (+6V).

3.2 CONTROL AND SWITCHING UNIT

This unit is concerned with detailed analysis and operation of the component that make up the control unit. It comprises series combination of photo-detector and operational amplifier acting as a voltage comparator that compares the voltage of two input signals. The photo-detector in this arrangement provides a signal corresponding to the light intensity changes.

3.2.1 COMPARATOR CIRCUIT

Comparators are special types of an operational amplifier circuit without feedback used to compare a signal voltage on one of the input terminals with reference voltage on the other input terminals. When the signal voltage differs from the reference voltage, the output of the comparator is either low or high as the case may be [5].

The signal input (V_+) is connected to the non-inverting input, when V_+ is greater than V_{ref} the output voltage goes high, but when V_+ is less than V_{ref} the output goes low. The comparator can drive a relay connected to it via a transistor to a relay.

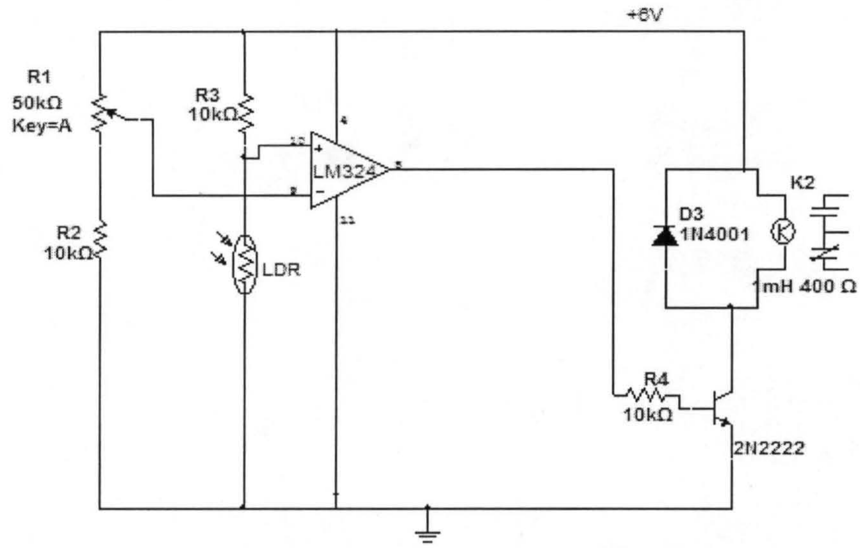

Figure 9: Control and switching unit

Three sun ray power intensity was selected as shown below for calculation of the photon current that passes through the LDR at a particular light intensity.

0.4mW, 0.35mW, 0.15mW.

Active surface area = $0.081cm^2$

I_p (Photon Current) = P (Power) × R_0 (Responsivity)

R_o (Responsivity) = 0.35 for the chosen LDR

I_P is the photon current that goes through the LDR at a particular light intensity.

At P = 0.4mW

I_{p1}= 0.4mW × 0.35 = 0.00014A

$$I_{p1} = \frac{6V}{10k + R_{LDR}}$$

$$R_{LDR} = \frac{6V - 10k\, I_{p1}}{I_{p1}}$$

$$R_{LDR} = \frac{(6V-(10k \times 0.14mA))}{0.14mA}$$

R_{LDR} = 32857

At P = 0.35mW

$I_{p2} = 0.35\text{mW} \times 0.35 = 0.0001225\text{A}$

$$R_{LDR} = \frac{6\text{V} - 10\text{k}\, I_{p2}}{I_{p2}}$$

$$R_{LDR} = \frac{(6\text{V} - (10\text{k} \times 0.1225\text{mA}))}{0.1225\text{mA}}$$

$R_{LDR} = 38979.6\Omega$

At P = 0.15mW

$I_{p3} = 0.15\text{mW} \times 0.35 = 0.0000525\text{A}$

$$R_{LDR} = \frac{6\text{V} - 10\text{k}\, I_{p3}}{I_{p3}}$$

$$R_{LDR} = \frac{(6\text{V} - (10\text{k} \times 0.0525\text{mA}))}{0.0525\text{mA}}$$

$R_{LDR} = 104285.7\Omega$

Assuming the variable resistor on the voltage divider circuit is set to a ratio 1:4.

$$V_{ref} = \frac{6\text{V} \times 50\text{k}}{10\text{k} + 50\text{k}} = 5\text{V (Voltage Divider Theory)}$$

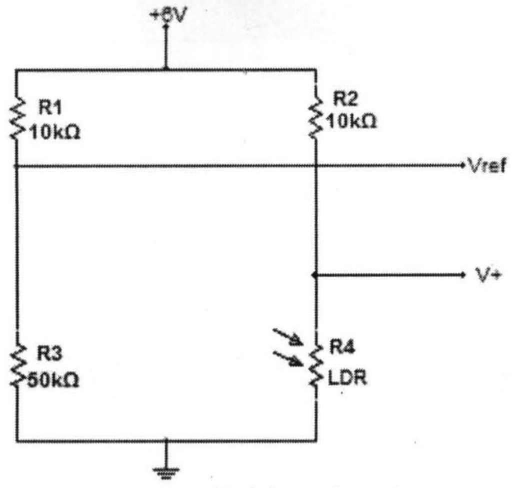

Figure 10: Voltage divider circuit

At I_{p1}, $R_{LDR} = 32.856k\Omega$

$$V_+ = \frac{6V \times 32856}{10k + 32856} = 4.6V$$

At I_{p2}, $R_{LDR} = 38.979k\Omega$

$$V_+ = \frac{6V \times 38979}{10k + 38979} = 4.76V$$

At I_{p3}, $R_{LDR} = 104.286k\Omega$

$$V_+ = \frac{6V \times 104286}{10k + 104286} = 5.472V$$

At the input of the comparator when V_{ref} is compared with V_+

(a) When $V_+ = 4.6V$; $4.6V - 5V = -0.4V$

An error voltage of -0.4V will be at the input of the op-amp hence the output of the op-amp is low, therefore the relay remains open because the transistor senses a low voltage.

(b) likewise at $V_+ = 4.76V$; $4.76V - 5V = -0.24V$

The output of operational amplifier remains low, and the relay still remains open.

(c) But when $V_+ = 5.47V$; $5.47V - 5V = 0.47V$.

An error voltage of 0.47V will be at the input of the operational amplifier hence the output of the operational amplifier will be high. The transistor will now be triggered and the relay switched to ground, hence the relay is closed.

3.3 CHARGING OF THE BATTERY

The transformer current rating is 500mA and a voltage of 6V is used to charge a battery of rating 4.5Ah, 6V.

3.3.1 CHARGING TIME

Charging power rating = $500mA \times 6V = 3watt$.

Battery energy rating = $4.5Ah \times 3V = 13.5watt$ in one hour (presuming the battery is down to 3V).

Energy = IVt

$13.5Wh = 3Watt \times t$

$$\text{Time} = \frac{13.5}{3} = 4.5\text{hours}$$

Therefore it takes about 4.5hours before the battery is completely charged.

3.4 OUTPUT UNIT

The output of this project work is a parallel connection of 20-Light Emitting Diodes (LED).

3.4.1 LED POWER CONSUMPTION

Rating for white LED used.

Forward bias voltage = 2.2V

Forward bias current = 30mA

Current taken by 20-White LEDs

$30mA \times 20 = 0.6A$

Power consumed by 20- white LEDs

$0.6 \times 2.2V = 1.32Watt.$

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.1 CONSTRUCTION

In the process of realizing this project, the connection of the circuit was initially done on a computer software application (MULTISIM) before constructed on a breadboard to allow for testing and to ascertain that it is functioning effectively. All irregularities were checked and then tested and found to have a satisfactory output. The components were subsequently removed and transferred to a Vero board.

4.2 TEST AND RESULT

With the knowledge of the system operation, the system was tested step by step to the relay output. The load was connected across its normally open terminal and its common terminal. The wave form of each module was obtained as shown below.

Table 1: Measured voltage for each module

MODULE	VALUE (DC VOLTS)
VOLTAGE SUPPLY UNIT	6
CONTROL UNIT	4.87
OUTPUT UNIT	6

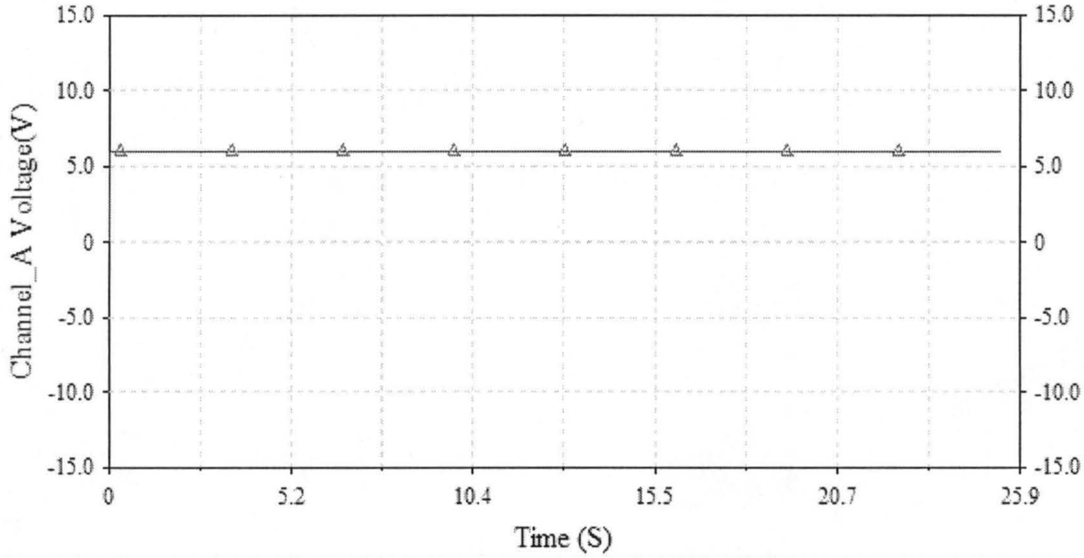

Figure 11: Wave form of the voltage supply unit.

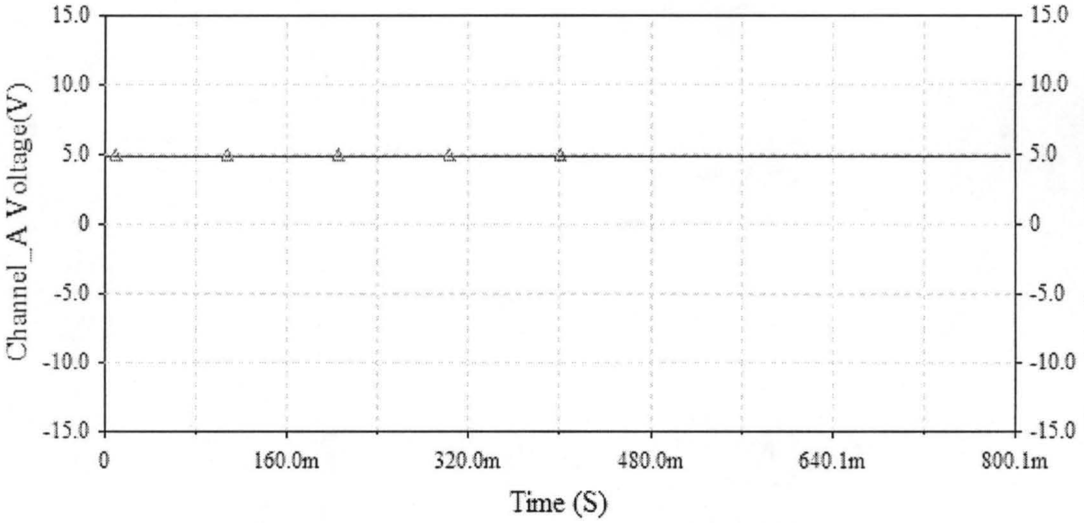

Figure 12: Wave form of the control unit output.

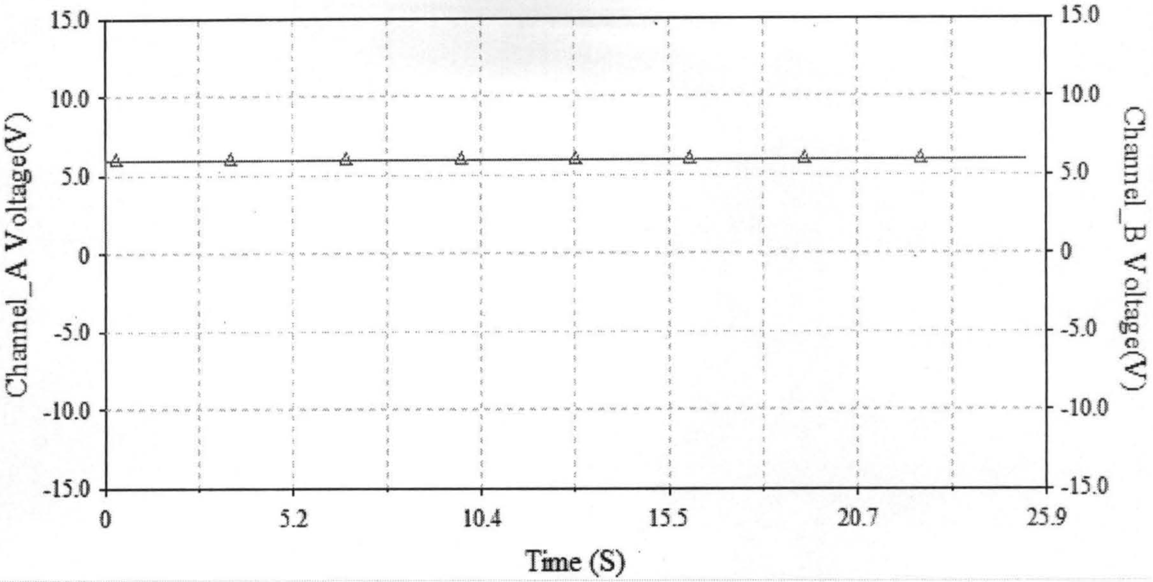

Figure 13: Wave form of the output unit.

The wave forms above are noticeably, a straight line on a constant voltage level, this is because they are DC voltage.

4.3 SYSTEM OPERATION

The light intensity on the LDR was reduced by covering the top of the LDR with an opaque material indicating a dark situation. The relay thus gets energized and closes the contact, thereby switching ON the load. Immediately the material used in covering the LDR is removed, light rays fall on the LDR which consequently de-energize the relay and switch off the load. The complete circuit diagram is shown in Fig. 14 below.

But once there is AC power supply in the circuit the first relay cuts out the output (LED) from battery supply thereby switching it off and charging the 6V battery.

The load constitutes 1.32watts LED and testing was carried out at dusk and dawn without covering the top of the LDR to ensure that it is functioning effectively. The effectiveness of the controller circuit had been tested for several times and was found to be effective and reliable.

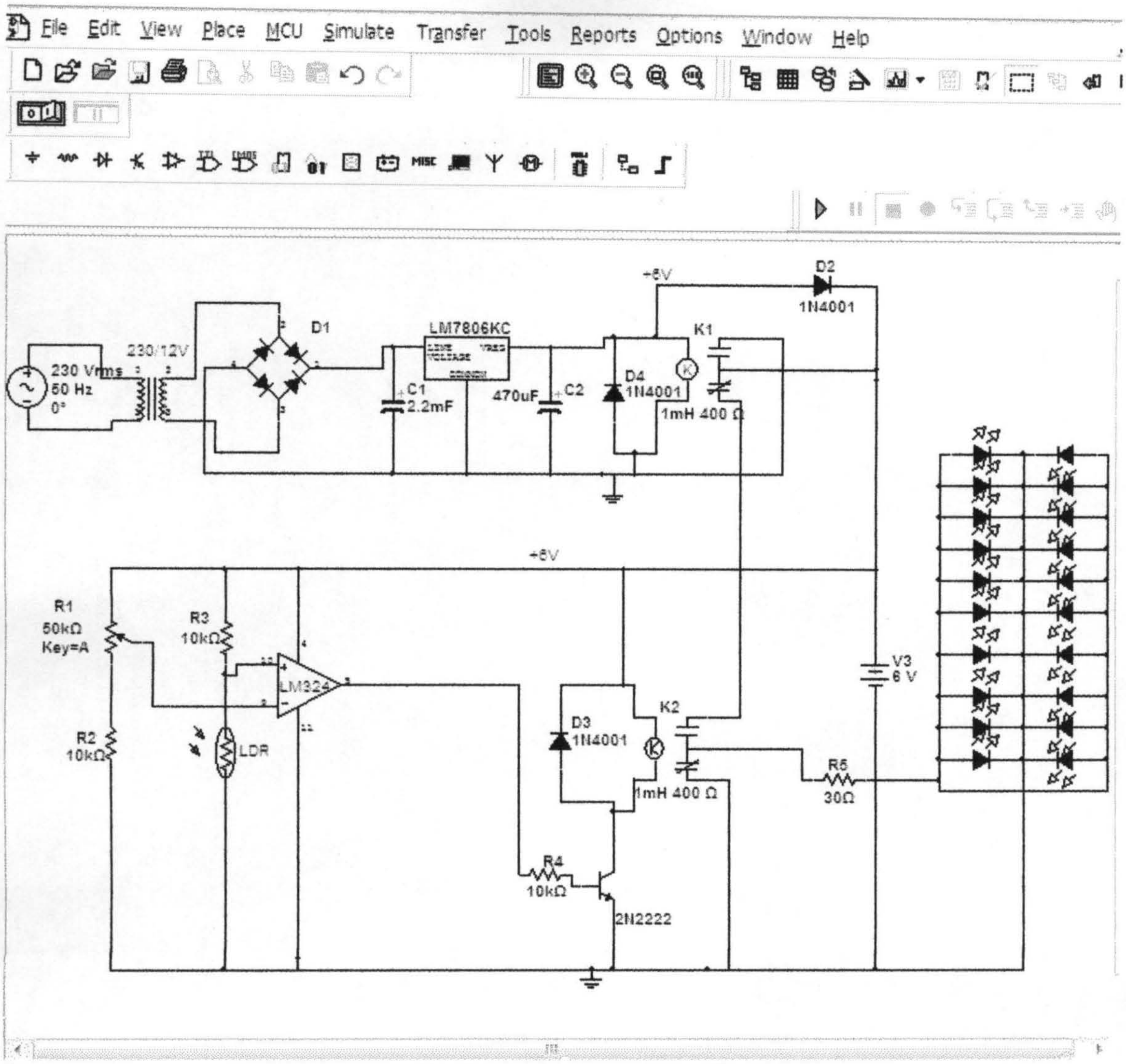

Figure 14: Complete circuit diagram

4.4 ASSEMBLING

The components were placed on a Vero board and soldered and all the connecting positive and negative terminals were cut out to avoid short-circuiting. The whole system was assembled in a metal casing and provision was made for the LDR to sense light from the outside. Also, LED indicators which glow Red and Green were mounted with the red indicating that there is power in the circuit, while the green indicates that the load or the Light Emitting Diode as applicable in this project is ON.

4.5 COST ANALYSIS

The cost estimation of the Emergency Lighting System Using LDR is shown in the table below.

TABLE 2: Cost of electrical components used

S/N	ITEMS	QUANTITY	COST(N)
1	240/12 TRANSFORMER	1	300.00
2	BLOCK RECTIFIER DIODE	1	150.00
3	LM324 OP-AMPLIFIER	1	120.00
4	CAPACITOR	2	160.00
5	VOLTAGE REGULATOR IC	1	100.00
6	LIGHT DEPENDENT RESISTOR	1	200.00
7	RESISTORS	5	200.00
8	LIGHT EMITTING DIODES	25	300.00
9	TRANSISTOR	1	100.00
10	RELAY	2	200.00
11	FLEXIBLE WIRE	1	100.00
12	VERO BOARD	1	180.00
13	METAL CASING	1	3000.00
14	LEAD	1	200.00
15	DIODE	2	20.00
16	RECHARGABLE BATTERY(6V)	1	1000
	TOTAL COST		6330.00

CHAPTER FIVE

5.1 CONCLUSION

The emergency lighting system has been designed to a high degree of sensitivity and efficiency using simple available components. The objective of this project was achieved, as soon as the ac power source goes out, the LEDs come on if the LDR senses a dark environment. The project was also tested and the wave form of each module was obtained.

5.2 RECOMMENDATION

This project construction has only one light sensor (LDR), hence it could easily be triggered falsely if a shadow accidentally is cast on the sensor. I would therefore recommend that about three sensors connected together by an AND gate be placed strategically at different places to reduce the chances of false triggering.

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