

DEMONSTRATION OF AUTOMATIC FENCE LIGHT POWERED BY AC DURING COVID-19 ERA

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Abstract

Automatic fence light is the light where by the light on the fence is automatically switched ON by night and switched OFF by day without the help of anybody or by manual means. The lamp remains ON till morning and then turns OFF during the day time. This eliminates the need of switching the fence light daily and it also helps to lighting the premises when the occupants are out of station. The system makes use of light sensor to operate and sense ambient intensity of light. In an automatic fence light many components are involve in the construction of the circuit. The components includes: transformer, relay, Light Emitting Diode (LED), diode, resistor, capacitor, switch, Vero board and Light Dependent Resistor (LDR). Its working principle is as follows neither the time is day or night, then by night the light switches ON with the help of the Light Dependent Resistor (LDR) and switches OFF by day automatically.

Keywords: LDR, LED, AC, Sensor Unit.

INTRODUCTION

In this modern age, there is easy solution to a lot of problems encountered by man taken introduction of computer as an instance. Unlike the olden days, when every job are being done manually stand by applicants has increase in recent years with increasing system. This work "Automatic fence light" is a standby source of light that switches light ON by night and OFF by day. It was developed because of the danger of life, over stressed and when nobody is around by night to switch ON the light (Mehta & Mehta, 2010).

Automatic fence light is an automatic switching device that switches ON automatically when there is a power supply. Automatic fence light are standard on new commercial and high occupancy residential building such as colleges, dormitories, etc. It incorporate a transformer, diode, capacitor, resistor, light, relay, switch and lamp. It is divided into three units, the rectification unit, the sensor unit and the main circuit unit, the

main circuit unit comprises of relay, LED, resistor, switch, integrated circuit (IC), diode and lamp. (Mehta & Mehta, 2010)

The rectification unit comprises of transformer, diode and capacitor. The sensor unit comprises of the light dependent resistor. The three unit are interconnected to give light each of the basic electrical and electronics components used in the research work is very vital for instance a relay is a component that finds application in many electrical and electronics devices. (Mehta & Mehta, 2010)

A relay is an electromagnetic switch under the principle of electromagnetism and light dependent resistor (LDR) which also work as a sensor that senses the dark and light. Another component that plays a vital role in this work is the full wave bridge rectifier.

The purpose of using the rectifier is to convert alternative current (AC) to direct current (DC) that circuit will use in its action. (Nwagalaku, 2012)

Transformer, one of the essential components that find application in this research work is transformer. The transformer is used to step down the 220V AC to supply to 12V DC rectified and used as 12V DC to the circuit or system. Man has received many benefits through automatic fence light.

If par venture the current is not on the circuit it means that the partial contact on the transformer input terminal is bad when the current is not connected on the circuit and the soldering base of the input relay & the reverse positive voltage need to be checked to

avoid damage on the component. The component that plays a vital role in this research is the full wave bridge rectifier. Automatic fence light is a device that is highly needed at home, hospital, companies, churches and office surrounding. The aim of this research will be to ON light automatically when there is power supply to the building and surrounding.

Modern automatic fence light is installed in virtually every commercial and high occupancy residential building. The light consist of high intensity lighting bulb or light emitting diode (LED).

As there are strict requirement to provide an environment with light. (Kosap, 2002).

In recent years automatic fence light has made less use of the traditional one or two head lamp unit with manufacture stretching the concept of lighting to accommodate and integrate fence lighting into the architecture for large commercial or industrial facilities to have light to the environment for those that do not or do continue operation during the night shift, especially when work cooperates from the day till night comes and there is no chance for running for switching ON or OFF of light or to avoid unnecessary risk of accident of electrocution or injuries then they automatic fence light comes in.



HISTORICAL BACKGROUND

By the nature of the device on automatic fence light is design to become ON when the LDR detect that there is darkness (night) and off when the day (light) comes. This is an electromagnetism to triggered a relay to operate an AC lamp at set. These happen when there is A.C power supply switches ON and OFF the fence light device automatically switches the light with the help of the sensor light dependent resistor (LDR) with the circuit that will cause the relay to automatically switches. It provide an ease, convenience switching of the fence light instead of going by the manual old method that sometimes being endangered of electro-cution and other accident. Automatic fence light needs no manual to operate. It switches ON and OFF automatically. (Nkamuo, 2013). The lamp remains on till morning and the turns OFF immediately by day, This eliminates the need of switching the fence lamp daily also helps to light the premises of the house when the occupants are out of station (Nwokoye, 2011).

In this research, we use light detecting resistor as a light sensor for detection of high level or low level of voltage to energies the relay coil which is used to interface the control circuit with the external light source. The power is wasted in the system so it is very much economic to have this arrangement so that power is not wasted during day time manual operation is not possible. Though, we can use it in our daily life for the betterment of our system.

Simple resistor or relay technology was used to switch on light with light dependent resistor (LDR) as the sensor that senses darkness or light when there is power supply (Mehta & Mehta, 2010).

"Transformer is a static piece of apparatus by means of which (Electric power in the corresponding decrease or increase in the (current. (Gaur *et al.*, 2011).

A resistor is a component which provides resistance in an electrical amount of current flowing in a circuit (Nwagalaku, 2012).

A relay is an electromagnetic device that is activated the flow of current. A small current flowing through a coil in relay magnetic field which pulls on switch contact.

A transformer is apparatus that work under the principle of primary coil to the secondary without being electrically connected (Nwokoye, 2011)

A diode is a semiconductor device which allows a current to flow through it one direction only. Diodes are made from germanium or silicon (Nwagalaku, 2012).

Light emitting diode (LEDs) gives off light when a current passes through them in the forward direction. A LED is a transducer which is used to change electrical energy into light energy from the semiconductor gallium arsenide phosphate (Theraja, 2008).

Capacitance is a component with store electric charge. It consists of two metal plate separation by an insulator called the dielectric (Nwagalaku, 2013).

A transformer is an electrical device constricted with colis of wire electrically coupled to each other so that there is inductance for the transfer of power from one winding to other.

A resistor is a passive two terminal electrical component that implements electrical resistance as a circuit element. A resistor had to reduce current flow and the same time, it act to lower voltage levels within circuit. A resistor may have fixed resistance or variably resistance such as those find in thermistors, varistors, timmers, photo resistors and potentiometers.

MATERIAL AND METHOD

Transformer

A transformer is a static piece of apparatus by means of which electric power in one circuit is transformed into the electric of the same frequency in another circuit (Nwokoye , 2011).

Moreover, a transformer is an electrical device constructed with coils of wire (windings) electrically coupled to each other so there is mutual induction for the transfer of power from one winding to the other.

A transformer can be used to step up or down the voltage in a circuit with a corresponding increases or decrease in the current circuit.

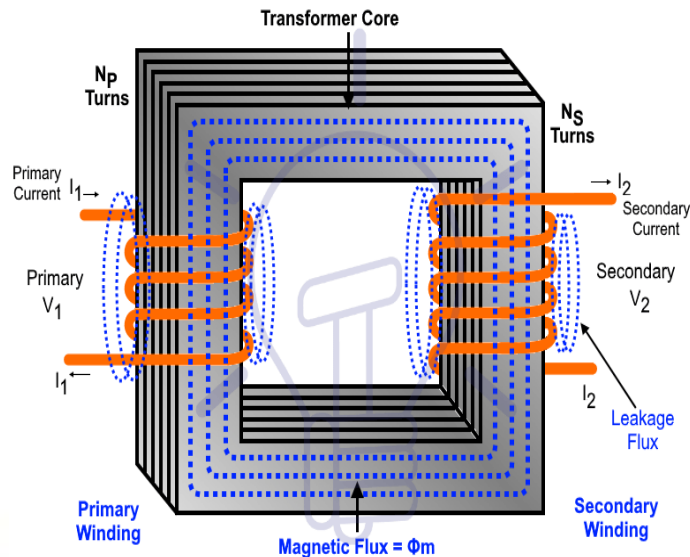


Figure 1: The diagram of a transformer

Step-up transformer

It is a transformer in which the secondary voltage is greater than the primary voltage. Also, the secondary winding is then the primary winding. A transformer that increases the voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a step-up transformer. As a step-down unit, this transformer converts high-voltage, low-current power into low-voltage, high-current power.

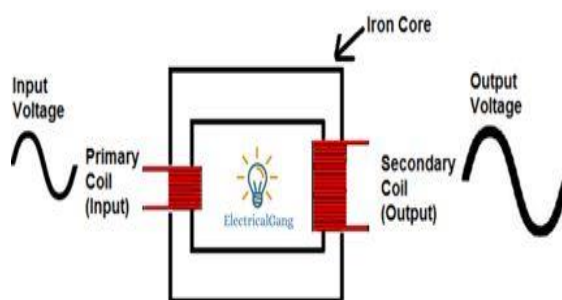


Figure 2: The Basic diagram of a step up transformer.

Step-down transformer

This is a transformer in which the secondary voltage is less than the primary voltage. Again, the primary winding is greater than the secondary winding. A Step down Transformer is a device which converts high primary voltage to a low secondary voltage. In a Step down Transformer, the primary winding of a coil has more turns than the secondary winding.

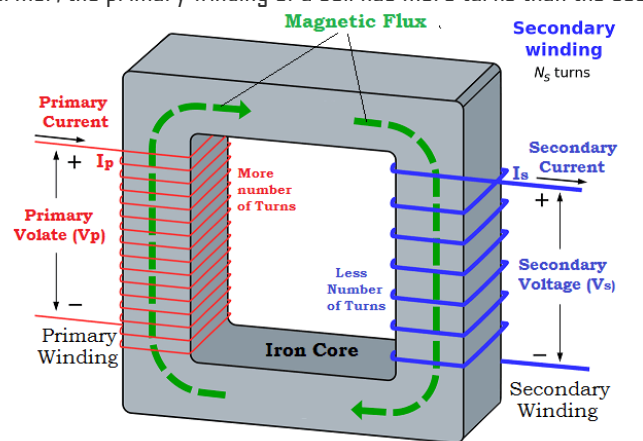


Figure 3: The basic diagram of a step down transformer

The physical basis of a transformer mutual inductance between circuits linked by a common magnetic flux.

Diode (semi-conductor)

A diode is a semiconductor device which allows a current to flow through it in one direction only (Nwagalaku, 2012).

A diode allows electricity to pass or flow in one direction only and diodes are made from germanium (Ge) or silicon (Si) and are commonly referred to as junction diodes due to the fact that they are made so the one half of the material has a predominance of positive charge carriers, whilst the other half has a predominance of negative charge carriers. The junction between these two regions is called a P-N junction. The connection to the p-side of the n-side, the cathode. In most diodes the cathode end is identified by a black band. A diode which is connected with its anode positive and its cathode negative is said to be forward-biased. If connection so that its anode negative and its cathode positive, the diode is said to be reverse-biased.

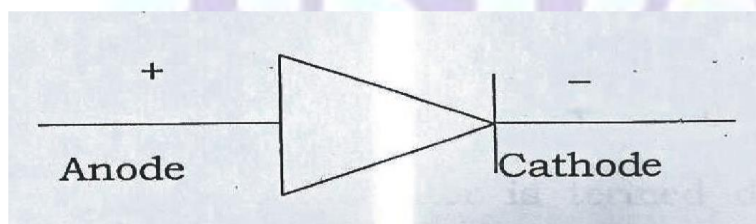


Figure 4: The diagram of a diode

A diode has low resistance to electric current when forward biased. These properties make a diode useful as a rectifier which can convert alternating current (A.C) to direct current (D.C)

Capacitor

A capacitor is a component which stores electric charge (Nwagalaku, 2012). It consists of two metal plates separated by an insulator called dielectric. The fixed capacitors are made of dielectric on each side of which it is connected to one of the leads of the capacitor.

When choosing a capacitor it is important to consider the value, tolerance, working voltage and leakage current. It consists of two metal plate separations by an insulator.

A capacitor consists of two metal plate separations by an insulator. The insulator is termed dielectric. The conducting surface may be in the form of either circuit plates or be of spherical or cylindrical shape.

Fixed Capacitor

This capacitor are made of dielectric on each side which it is connected to one of the capacitor.

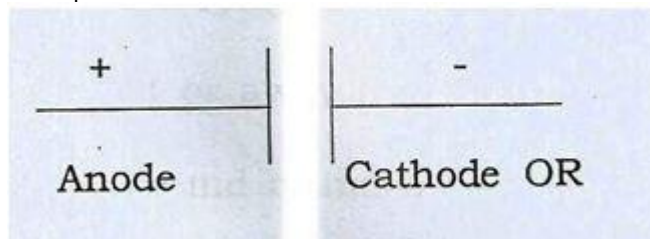


Figure 5: The circuit of Fixed capacitor

Variable capacitor

A **Variable Capacitor** is a [capacitor](#) whose capacitance may be intentionally and repeatedly changed mechanically or electronically. Variable capacitors are often used in [L/C circuits](#) to set the resonance frequency, e.g. to tune a radio (therefore it is sometimes called a Tuning Capacitor or Tuning Condenser), or as a variable [reactance](#), e.g. for [impedance matching](#) in [antenna tuners](#).

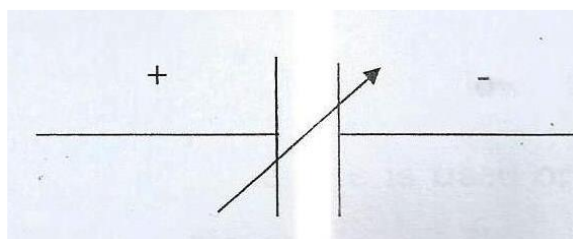


Figure 6: The circuit Variable capacitor

A relay is an electromagnetic device that is activated by flow of electric circuit. A small current flowing through a coil in relay creates magnetic field that pulls on switch contact against or away from another. A relay consists of a coil wire that move round a soft iron core. Taking for instance the relay used in this research is a 12V relay with five outlets (terminal) normally open and normally close. When the coil is energized by the current flow, the hinged armature (the common) is attracted to the electromagnet (normally open) and presses two contacts together. When there is interruption to the current flow, the normal open switch was demagnetized and applied in place that is easy to make contact of human effort and also to break the contact of human effort.

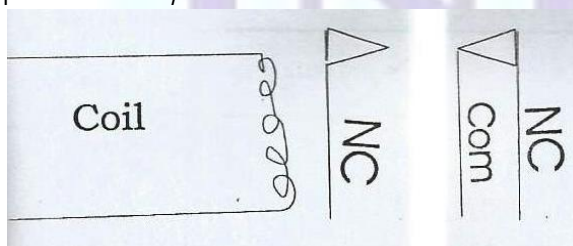


Figure 7: A symbol of relay

Resistor is a passive two terminal electrical component that implements electrical resistance as a circuit element.

Resistor act to reduce current flow and act the same time to lower voltage levels within circuit. The electrical function of the resistor is specified by its resistance. (Paul & Wilfred, 2003).

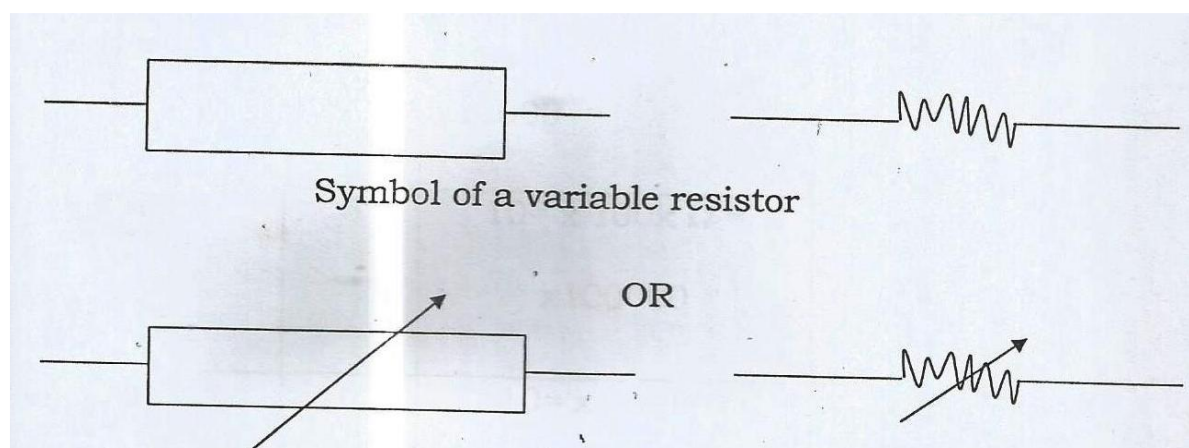


Figure 8: The Symbol of fixed resistor

The resistor colour code is shown in table below

Showing the resistor colour code (Theraja 2008)

Table 1: Shows different colours of LED and their Bands

Color	Color	1st Band	3rd Band Multiplier	4th Band Tolerance
Black		0	x1 Ω	
Brown		1	x10 Ω	$\pm 1\%$
Red		2	x100 Ω	$\pm 2\%$
Orange		3	x1k Ω	
Yellow		4	x10k Ω	
Green		5	x100k Ω	$\pm 0.5\%$
Blue		6	x1M Ω	$\pm 0.25\%$
Violet		7	x10M Ω	$\pm 0.10\%$
Grey		8	x100M Ω	$\pm 0.05\%$
White		9	x1G Ω	
Gold			x0.1 Ω	$\pm 5\%$
Silver			x0.01 Ω	$\pm 10\%$

Light Emitting Diodes (LEDs)

Light emitting diodes (LEDs) when a current passes through them in the forward direction. (Theraja, 2008). A LED is a transducer which is used to change electrical energy into light energy and is made from the semiconductor gallium arsenide phosphide. The LED must be connected in a circuit the correct way round if it is to work. Its anode must be positive and its cathode must be negative. The anode is

usually the longer of the two terminals. LEDs are used as indicator in lamps and in seven segment displays. They are small, reliable, having life and operating speed.

Methodology

Automatic fence light circuit into two parts, first part was power supply unit which was used to drop down the 220V A.C voltage into 2V regulate D.C with the help of transformer and bridge rectifier. And second part consists of sensor and relay (switch), which was used to switch ON the light when there is power supply.

The resistor helps to reduce the amount of current that flows through the LED. Switch unit is where we make and break the contact. The relay is originally connected to its "normally open" contact when the current flows through the coil of the relay, when there is open and close contact, the A.C power supply fails on the common contact of the relay.

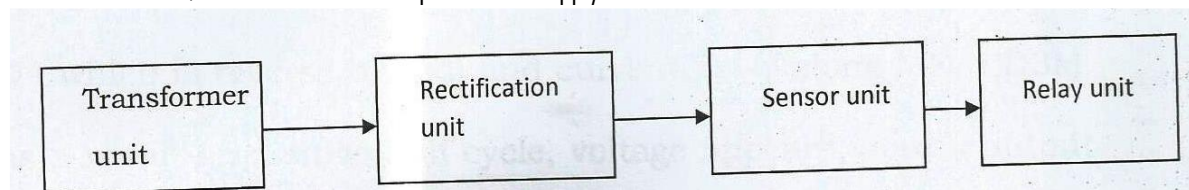


Figure 9: The block diagram of electric fence light

An A.C voltage is being converted to D.C voltage by the rectification. It consists of a step down transformer connected to the A.C mains, four diodes that make up the full wave. Rectification bridge and capacitor for smoothing. This is how the rectification unit converts the supplied A.C voltage. When input A.C. supply was switched ON and the transformer became positive and negative automatically. During the positive half cycle of the A.C. input terminal M is being forward biased diode D1 and D3 conducts (but not D2 and D4 which is reverse biased) and current flows along MD, CD3M. As a result of positive half cycle, voltage appears across output (O/P).

During the negative half cycles when terminal N becomes positive and terminal M negative then D2 and D4 conduct (but not D1 and D3). And current keeps on flowing along MD4, CD2M. It means that both half cycle of input A.C supply are utilized. This means the voltage waveform at the output after rectification to be unidirectional and later smoothed with a capacitor (C) connects to the circuit. This charges up during the positive half cycle.

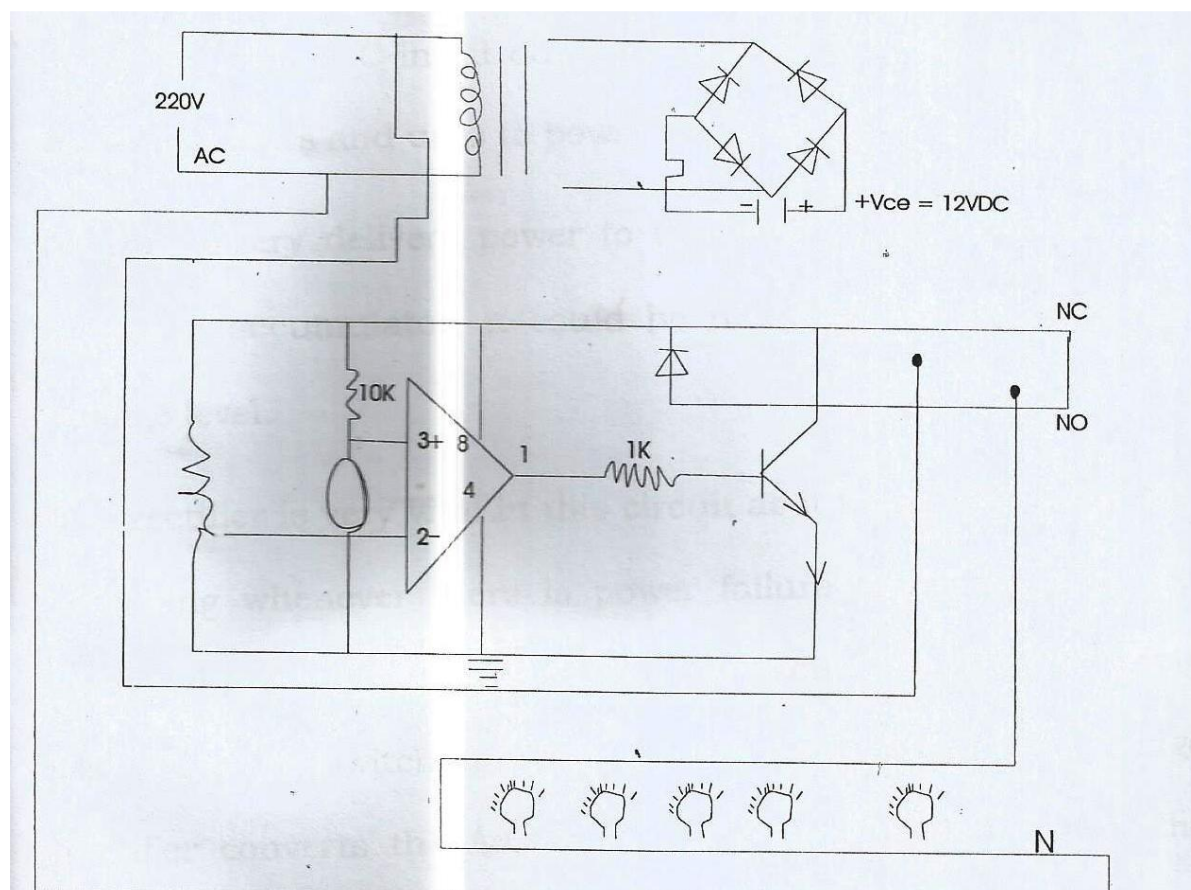


Figure 10: The general circuit diagram of automatic fence light.

Principle of operation

The current operates to give light automatically by night and fails OFF by day with the help of an LDR. The transformer is step down transformer which steps down the 220V A.C input down to 12V D.C. it is rectified by the bridge rectifiers and uses to power the circuit.

As the battery delivers power to the circuit, it discharges, but being an accumulator, it could be recharged to maintain the voltage level.

The rectifier is very vital in this circuit as it helps which is liable to falling whenever there is power failure to convert the A.C supplied to the bridge to D.C that the circuit uses in performing its action or switching. When power is restored, the bridge rectifier converts the A.C to D.C which is used to power the circuit automatic switching. The function of the capacitor is to remove the ripple in the waveform at the output after rectification i.e. the output after rectification is unidirectional and later smoothened with a capacitor charges up during the positive half cycle and discharge during the negative half cycle.

The light emitting diode (LED) indicates when there is power supply to the circuit i.e it lights where there is A.C supply. A resistor is connected in series with LED to reduce the current passing through the relay which is the chief component that switches and LDR which senses when there is darkness or light that controls the circuit.

The relay coil became energized and magnetic to make and brake contact. A switch was introduced to put off the fence light when it is not needed while there is any emergency to put off the light by night or may not been needed by them so it can be put off using switch to avoid wasting time or disconnection on already connected.

The diode is connected along the positive terminal to prevent the positive voltage from reversing.

Materials used

The component that makes up the circuit were first mounted and connected on a Vero board for testing. Then when it was confirmed to be working as the principle of operation disclosed earlier, it was then transformed to the work board and soldered neatly according to layout of the circuit diagram.

1. Soldering iron: this was used with combination of soldering lead to solder the component to veroboard.

2. Pliers: this did a lot of job in construction of the research work casing, like cutting the jumpers or cable used for the connection and also the long terminal of components.

3. Screw driver: this was used to lose and tight nuts and bates.

4. Punch: this was used for piecing or to make hole on the metal casing.

5. Cutter: this is used for cutting small pieces of iron after soldering any component to veroboard.

Power Supply Unit

This is a stand by voltage that is generated by a smaller power supply inside the unit. In older (p.s.u) design, it was used to supply the voltage regulator, located on the low voltage side of the transformer, allowing the regulator to measure output switching supply sharing components of the main unit due to cost and energy saving requirements.

Rectifier

These are electrical device that converts alternating current A.C which periodically reverses direct to direct current (D.C) which flows in only one direction. The process is known as rectification.

Relay

This is an electrical operated switch. Many relay use an electromagnet to mechanically operate a switch, but operating principle are also used as solid state relay. Sufficient strength to enable the equipment to perform as intended. The casing is 50mm and 130mm respectively. The construction of the class is involves operation such as metal, cutting, drilling and bending (folding finally, when the - shaped cases were fitted with screws, the classes formed are pointed. The necessary holes were made using driver at the size of the outlet and the bulbs filled on top of the fence.

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Table 2: The values of resistor using color code.

Resistor	Rating	Band				Value
		1 st	2 nd	3 rd	Coded	Measured
1	0.25w	Brown 1	Black 0	Red 102	1k	1998
2	0.25w	Brown 1	Black 0	Orange 103	10k	10.2k
3	0.25w	Yellow 4	Purple 7	Red 102	4.7k	4.5k
4	0.25w	Red 2	Black 0	Orange 103	20kn	19.7

DISCUSSION

The early development of automatic fence light, automatic fence light is a lighting device that switches ON automatically when a building experiences a power supply by night with the help of a sensor light dependent resistor (LDR). However the development of automatic fence light are standard in new commercial and high occupancy residential buildings, such as college dormitories etc. by the nature of the device, an automatic fence light designed to come on when the sensor sense darkness around the environment. When there is a power supply every model, therefore, requires some sort of technologies to make everything possible and automatically light electricity to the environment during the night without manual control.

The diodes were manual lighting an area during night and perhaps provide enough light to solve the power problem in our environment.

Recommendations

To introduction of uninterruptable power supply device (U.P.S). Government should help the youth financially thereby improving the creating and productivity of our youths.

Government should provide construction site and a venue where youths can produce their designs, this will encourage the youth to be hardworking in other to perform very well.

Government should help youths of engineering, technology and other science discipline with scientific equipment from them to be industrious and also put in what they are taught in practice to enable them to achieve their set goals.

Conclusion

An automatic fence lighting system switched ON by night and switched OFF by day without the help of anybody. It remain ON till morning and then turned OFF during the day time. The researcher will contribute to the realization of the dream of lighting system. The system mske use of sensor to operate and to sense the intensity of light automatic fence without any manual switching of any kind.

References

- Kosap S.O (2002), *Principles of Electronic Materials and Devices*, Tata MC Graw-Hill (ed), New Delhi. vol 2: PP 5-11
- Malvino A. & Bates D. (2006), *Electronic Principles*. Tata McGraw- Hill. New Dell. vol 1; pp 10-30
- Mehta V. & Rohit M. (2010), *Principles of Electronics*, S Chond Company Ltd VOL 8(4): pp 2-5
- Nkamuo C. (2013); *Fundamental of Electronics (1st edition) Nigeria*: Base Press Ltd.
- Nwagalaku F. N (2012) *Maintenance and Repair*. Unique Press and publishers.
- Nwokoye A.O (2011), *Basics Electric Circuit and Electronics*, Nnamdi Azikiwe University Awka vol 1 (2): pp 1-10
- Paul H. & Wilfred H. (2003). *The Art of Electronics*. Cambridge University press, Cambridge low price edition. vol 3 pp 1-10
- Thereja B.L (2008), *Fundaments Of Electrical Engineering And Electronics* S. chand and company ltd. New dell vol 1 (2): pp 10-20

