

Smart emergency battery operated LED street lights

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Highlights:

- Making of battery-operated emergency street light.
- Converting of AC supply to DC and storing it.
- Making of model with the help of PCB circuit.
- Comparison between previous and purposed model.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mentioning of the people whose constant guidance and encouragement made it possible. We take pleasure in presenting before you, our project, which is result of studied blend of both research and knowledge.

We express our earnest gratitude to our Department of ME for the constant support, encouragement and guidance. We are grateful for the cooperation and the valuable suggestions.

Finally, we express our gratitude to all other members who are involved either directly or indirectly for the completion of this project.

ABSTRACT:

This report describes the design and fabrication of Smart emergency battery operated LED street lights that switches on automatically when main power fails. Power to the LED is supplied by a battery that keeps charging when the main power is present. The circuit of the automatic LED light is designed and built with hardware. Complete circuit diagram, which is tested successfully, is given.

The project model is designed and made on the PCB(printed circuit board).

1.1INTRODUCTION

It is supported the principle of providing lightweight once the ability is interrupt. this is often accomplished by the employment of automatic charger that gets charged once power provide exists. once the battery is totally charged it stops charging. just in case of breakdown, the diode glows mechanically with the availability provided by the charged battery.

This project is functioning on 2 major processes:

1. It activates mechanically once the mains power fail, thus you would like not search it within the dark.
2. Its battery starts charging as before long as mains resumes.

This Emergency lightweight is employed largely in village as a result of there is the shortage of electricity that is very needed. In industries and additionally as in family applications an emergency lightweight is employed wherever there's frequent non uniform voltage distribution happens. many varieties of emergency lights from reversible torches to systems like generators area unit obtainable in market. All of them need a switch to work them once frequent breakdown happens.

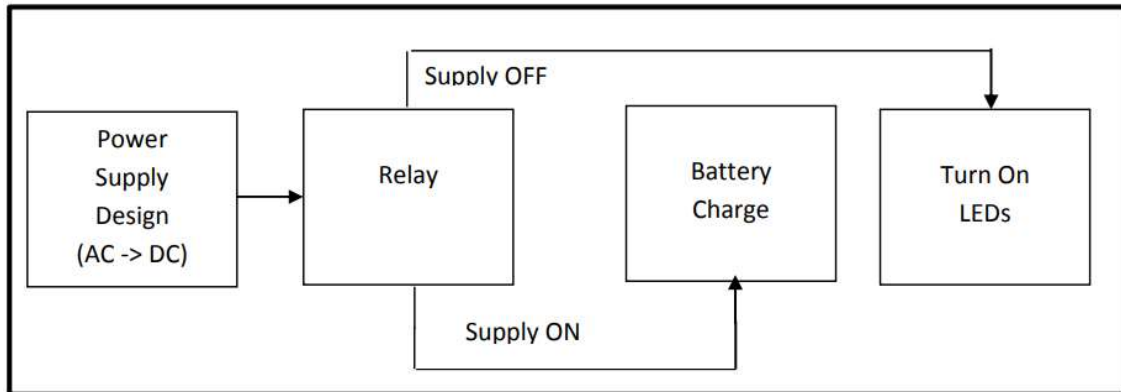
The present one deals with a model that senses the mains additionally as daylight to change on the emergency lightweight. there's no have to be compelled to search the switch within the dark because it switches on/off automatically. This gift one has one on/off switch on operative that the emergency lightweight glows. In most of the emergency lightweight there exists a disadvantage. The discharge level of the battery isn't being controlled to a secure level. The batteries get discharged utterly and lose their life quickly. this is often a awfully serious facet so as to beat this cut-off is provided and there exists a minimum discharge level that ensures the long lifetime of battery.

1.2 Block Diagram

Functional block diagram and flow diagram are explained below:

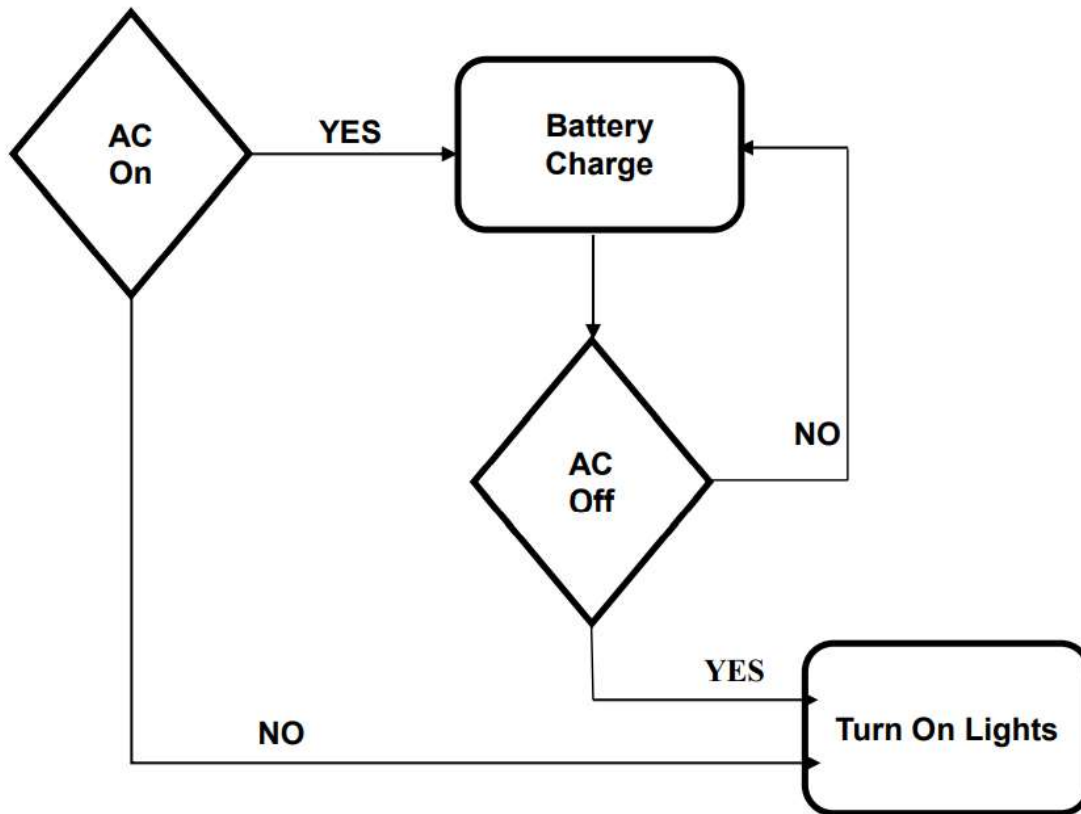
1.2.1 Functional Block Diagram

Power supply block is connected with relay and if the supply is off it will turn of LEDs. When supply is on it charge the battery continuously. Functional Block diagram describe as below.



1.2.2 Flow Diagram:

When AC is on the flow shows that battery will be charge. When AC is off it turn on the LEDs as shown in the flow diagram.



1.3 Explanation Of Each Block:

1.3.1 Power Supply:

For converting 230V AC to 12V AC, 12-0-12V Transformer is used. It steps down the voltage from 230V to 12V AC. Now, to convert 12V AC to 12V DC we use Bridge Circuit. There are four 1N4007 Diode is used to get 12V DC output. This is the function of Power Supply to convert AC to DC.

1.3.2 Relay:

Relay is working as a Switch. There are three terminal NC (Normally Close) and NO (Normally Open) and Common. Here we connect. NC terminal to the rechargeable battery and Common terminal is Connects with the LEDs. Now if Power supply is on it connects with NO terminal and charge the battery and when there is no power supply NC terminal is connected with the battery and LEDs will be ON.

1.3.3 Rechargeable Battery:

Li-ION battery is used to give 3.7V as Output and Maximum Voltage of the battery is 4.7 voltage Zener Diode of 4.5V is used to get 4.5V as an input. So that it can be measured how much time it will take to charge battery.

1.3.4 LEDs:

10 LEDs are connected in parallel to get charge from rechargeable battery when power supply is cut off. It is on automatically when power supply is off.

2 Design Details

2.1 Transformer:

Transformers convert AC electricity from one voltage to a different with a bit loss of power. increase transformers increase voltage, decrease transformers cut back voltage. Most power provides use a transformer to cut back the hazardously high voltage to a safer low voltage.

The input coil is termed the first and therefore the output coil is termed the secondary. there's no electrical affiliation between the 2 coils; instead they're coupled by associate alternating flux created within the soft-iron core of the electrical device. the 2 lines within the middle of the circuit image represent the core. Transformers waste little or no power that the power out is (almost) up to the facility in. Note that as voltage is stepped down and current is stepped up. The quantitative relation of the amount of activates every coil, known as the turn's quantitative relation, determines the quantitative relation of the voltages. A transformer includes a sizable amount of activates its primary (input) coil that is connected to the high voltage mains offer, and alittle range of activates its secondary (output) coil to allow an occasional output voltage.

TURNS quantitative relation = $(V_p / V_s) = (N_p / N_s)$

Where,

V_p = primary (input) voltage.

V_s = secondary (output) voltage

N_p = range of activates primary winding

N_s = range of activates secondary winding

I_p = primary (input) current

I_s = secondary (output) current.

In this circuit the electrical device used is of step down kind that consumes 230 volts as input (primary side) and produces output of 12volts. this could be termed as 230votls primary, 12v secondary step down electrical device.

VOLTAGE REGULATOR 7805

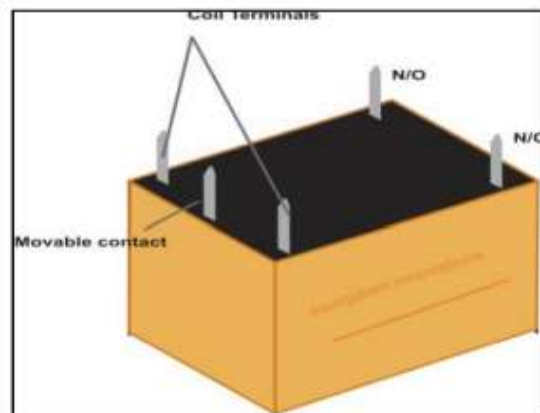
Features

- Output Current up to 1A.
- Output Voltages of five, 6, 8, 9, 10, 12, 15, 18, 24V.
- Thermal Overload Protection.
- tangency Protection.

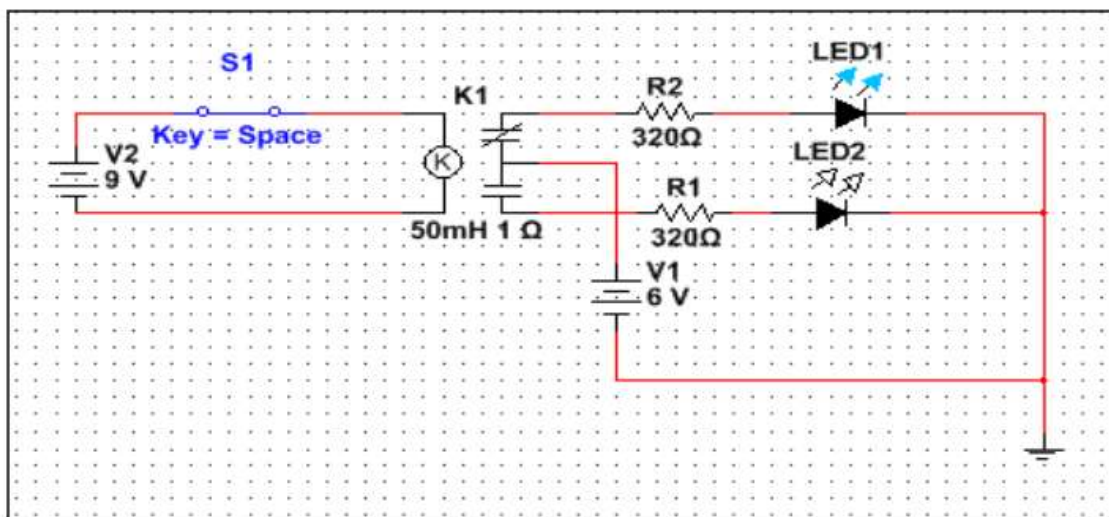
- Output semiconductor device Safe operative space Protection

2.2 Relay circuit:

Relay is functioning as a Switch. within the input of Relay 9V DC offer is given and at the output if we tend to connect bulb thus relay is functioning as switch and bulb can flip On/Off thus, we are able to verify the operating of Relay.

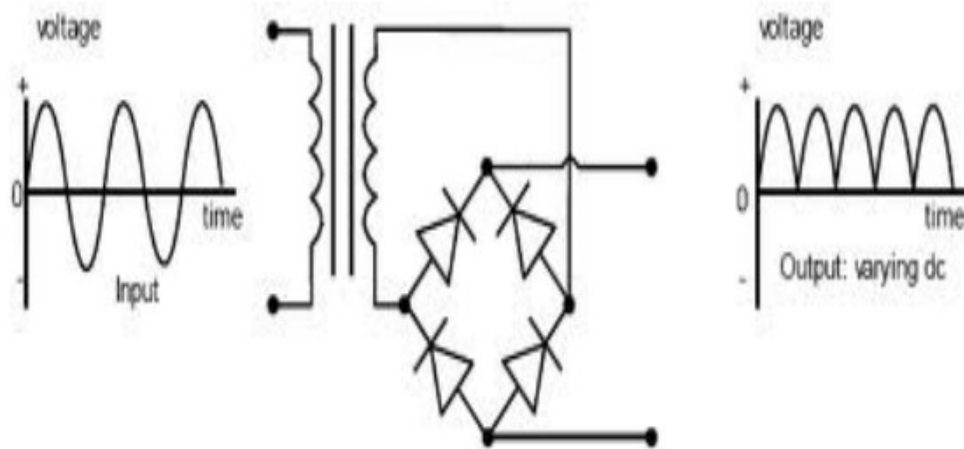


Simulated circuit for relay as shown below:



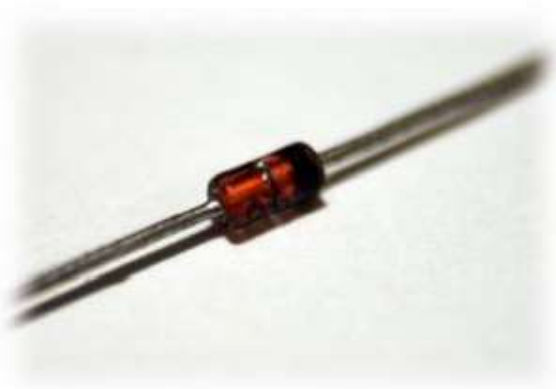
2.3 Rectifier :

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification. In positive half cycle only two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.



2.4 Zener Diode:

It permits current to flow within the forward direction as traditional, however will enable it to flow within the reverse direction once the voltage is on top of a particular price - the breakdown voltage called the Zener voltage. The Zener diode specially created to possess a reverse voltage breakdown at a particular voltage. for instance, a diode with a Zener breakdown voltage of four.2 V exhibits a fall of terribly nearly four.2 V across a large vary of reverse currents.



2.5 Capacitors

A electrical device or condenser may be a passive electronic element consisting of a combine of conductors separated by a stuff. once a voltage voltage exists between the conductors, an electrical field is gift within the stuff. This field stores fourteen energy and produces a mechanical force between the plates. The impact is greatest between wide, flat, parallel, narrowly separated conductors.



An ideal electrical device is characterised by one constant price, capacitance, that is measured in farads. this can be the quantitative relation of the electrical charge on every conductor to the voltage between them. In follow, the stuff between the plates passes alittle quantity of outflow current. The conductors and leads introduce constant series resistance and also the stuff has an electrical intensity limit leading to a breakdown voltage. The properties of capacitors in an exceedingly circuit might confirm the resonant frequency and quality issue of a electrical circuit, power dissipation and operational frequency in an exceedingly digital logic circuit, energy capability in an exceedingly dynamic system, and plenty of different vital aspects. A electrical device (formerly called condenser) may be a device for storing electrical phenomenon. The varieties of sensible capacitors vary wide, however all contain a minimum of 2 conductors separated by a non-conductor. Capacitors

used as elements of electrical systems, for instance, include metal foils separated by a layer of insulating film. Capacitors square measure wide employed in electronic circuits for obstruction electrical energy whereas permitting electricity to pass, in filter networks, for smoothing the output of power provides, within the resonant circuits that tune radios to specific frequencies and for several different functions.¹⁵ A electrical device may be a passive electronic element consisting of a combine of conductors separated by a stuff (insulator). once there's a possible distinction (voltage) across the conductors, a static field develops within the stuff that stores energy and produces a mechanical force between the conductors. a perfect electrical device is characterised by one constant price, capacitance, measured in farads. this can be the quantitative relation of the electrical charge on every conductor to the voltage between them. The capacitance is greatest once there's a slim separation between giant areas of conductor, thus electrical device conductors square measure typically referred to as "plates", touching on AN early means that of construction. In follow the stuff between the plates passes a little quantity of outflow current and conjointly has an electrical intensity limit, leading to a breakdown voltage, whereas the conductors and leads introduce an unsought inductance and resistance.

2.6 Diode:

Diodes square measure accustomed convert AC into DC these square measure used as [*fr1] wave rectifier or full wave rectifier. 3 points should he unbroken in mind whereas exploitation any sort of diode. most forward current capability most reverse voltage capability most forward voltage capability



The range and voltage capability of a number of the vital diodes out there within the market square measure as follows: Diodes of number IN4001, IN4002, IN4003, IN4004, IN4005, IN4006 and IN4007 have most reverse bias voltage capability of 50V and most forward current capability of one Amp. Diode of same capacities may be employed in place of 1 another. Besides this diode of additional capability may be employed in place of diode of low capability however diode of low capability can't be employed in place of diode of high capability. for instance, in situ of IN4002; IN4001 or IN4007 may be used however IN4001 or IN4002 can't be employed in place of IN4007. The diode BY125 made by company BEL is equivalent of diode from IN4001 to IN4003. BY 126 is like diodes IN4004 to 4006 and BY 127 is like diode IN4007

PN JUNCTION OPERATION

Now that you just square measure conversant in P- and N-type materials, however these materials square measure joined along to create a diode, and also the perform of the diode, allow us to continue our discussion with the operation of the PN junction. however before we are able to perceive however the PN junction works, we have a tendency to should initial think about current flow within the materials that conjure the junction and what happens at first inside the junction once these 2 materials square measure joined along.

Current Flow within the N-Type Material

Conduction within the semiconductor, or crystal, is comparable to physical phenomenon in an exceedingly copper wire. That is, with voltage applied across the fabric, electrons can move through the crystal even as current would flow in an exceedingly copper wire. The positive potential of the battery can attract the free electrons within the crystal. These electrons can leave the crystal and flow into the positive terminal of the battery. As AN negatron leaves the crystal, AN negatron from the negative terminal of the battery can enter the crystal, therefore finishing the present path. Therefore, the bulk current carriers within the N-type material (electrons) square measure repelled by the nine negative aspect of the battery and move through the crystal toward the positive aspect of the battery.

Current Flow within the P-Type Material

Current flow through the P-type material is illustrated. physical phenomenon within the P material is by positive holes, rather than negative electrons. A hole moves from the positive terminal of the P material to the negative terminal. Electrons from the external circuit enter the negative terminal of the fabric and fill holes within the neck of the woods of this terminal. At the positive terminal, electrons square measure far away from the valency bonds, therefore making new holes. This method continues because the steady stream of holes (hole current) moves toward the negative terminal.

2.7 LED

LEDs square measure semiconductor devices. Like transistors, and different diodes, LEDs square measure created out of element. What makes AN junction rectifier offer off lightweight square measure the tiny amounts of chemical impurities that square measure further to the element, like atomic number 31, arsenide, indium, and chemical compound. once current passes through the junction rectifier, it emits photons as a by product. traditional lightweight bulbs manufacture lightweight by heating a metal filament till it's white hot. LEDs manufacture photons directly and not via heat, they're much more economical than incandescent bulbs.

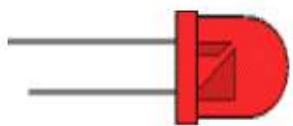


Fig: typical led

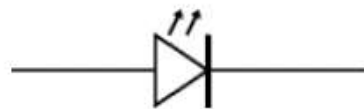


fig: circuit symbol

Not long ago LEDs were solely bright enough to be used as indicators on dashboards or equipment. However, recent advances have created LEDs bright enough to rival ancient lighting technologies. Trendy LEDs will replace incandescent bulbs in nearly any application.

Types of LED'S

LEDs are made in an associated array of shapes and sizes. The five millimetre cylindrical package is that the most typical, calculable at eightieth of world production. The color of the plastic lens is commonly a similar because the actual colour of sunshine emitted, however not continually. For example, purple plastic is commonly used for infrared LEDs, and most blue devices have clear housings. There are LEDs in extraordinarily little packages, like those found on blinkers and on telephone keypads. The most kinds of LEDs are miniature, high power devices and custom styles like alphanumeric or multi-colour

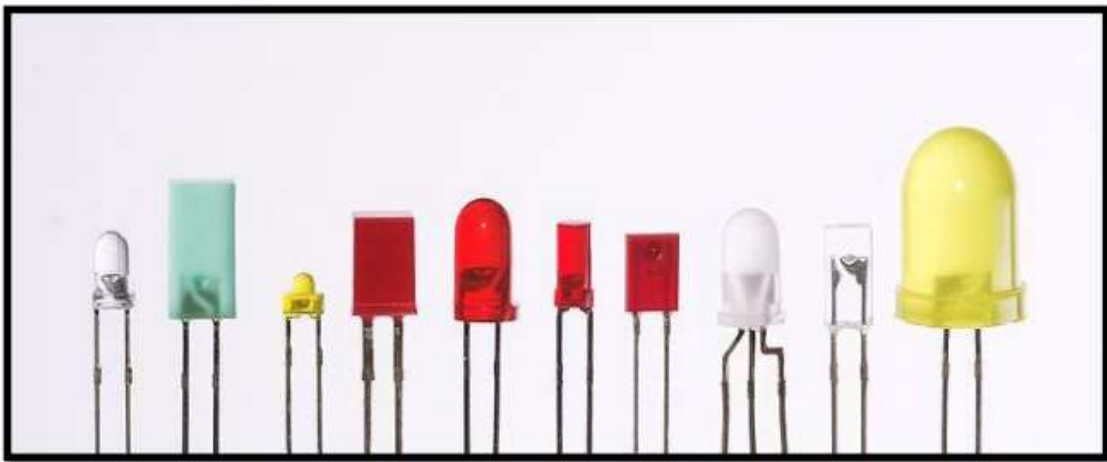


Fig: different types of LED's

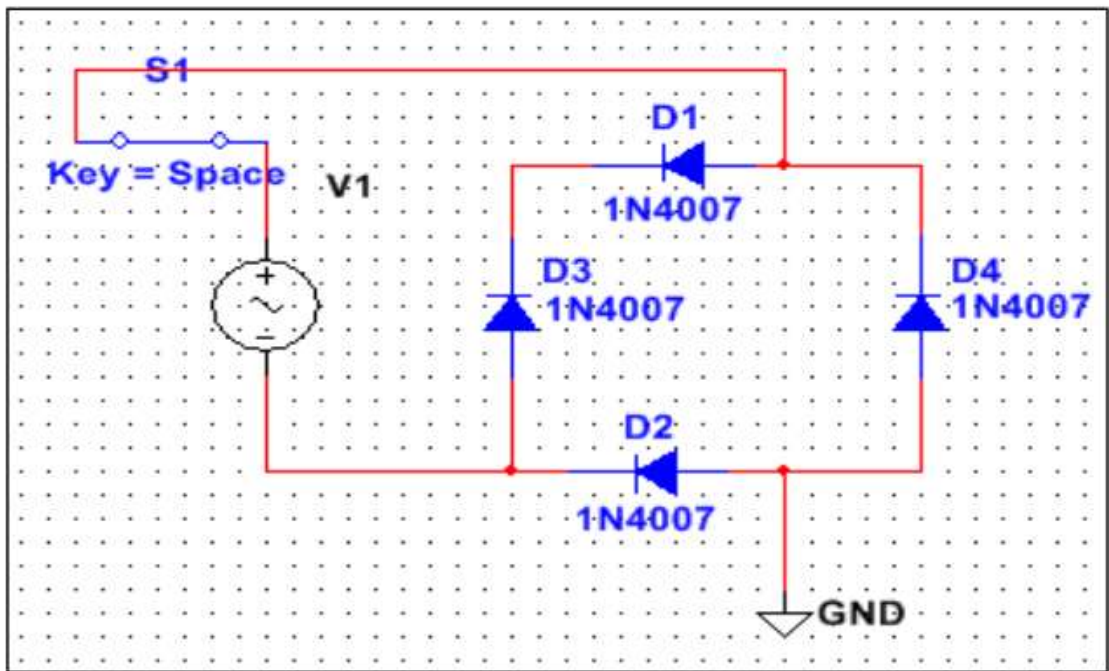
2.8 Rechargeable Battery:

Li-ION battery is employed to administer three.7V as Output and most Voltage of the battery is four.7 voltages. Zener Diode of four.5V is employed to urge four.5V as AN input. so it may be measured what quantity time it'll desire charge battery.

2.9 Bridge Circuit:

A electrical circuit may be a style of electric circuit within which 2 circuit branches (usually in parallel with every other) are unit "bridged" by a 3rd branch connected between the primary 2 branches at some intermediate purpose on them. within the circuit of automatic emergency light-weight the electrical circuit is employed for convert 12VAC to 12VDC

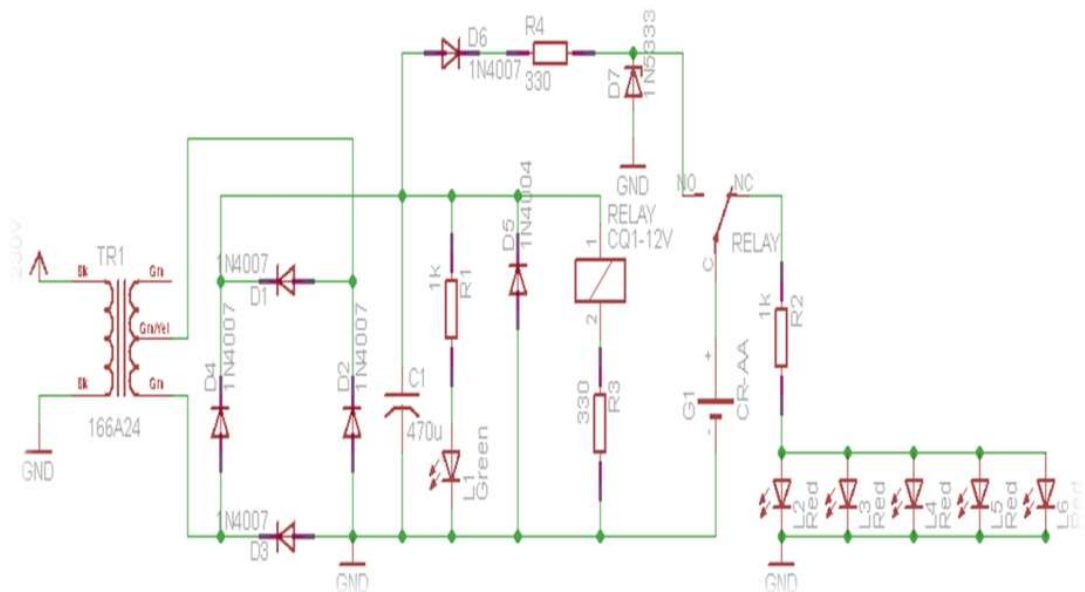
voltage.



3 Circuit Diagram with Explanation of Each Block

3.1 CIRCUIT DIAGRAM

Circuit diagram of battery operated smart street LED Emergency light is as below:



3.2 Operation of circuit Diagram

- The step down electrical device and also the diode bridge rectifier steps down and convert the high AC (in the vary of 110V or 230V) voltage to low (12V) DC voltage.
- The diode D5 prevents the battery charge from flowing back, it acts as a freewheeling diode too.
- within the presence of electricity, the relay contact connects the NO (Normally Open) terminal to battery. So battery charges throughout this point.
- Use inexperienced semiconductor diode because the charging indicator that glows once the emergency light-weight battery is charging.
- once offer failure happens, relay connects the North Carolina (Normally Closed) terminal to the battery.
- The semiconductor diode arrays are connected to North Carolina terminal, so they glow by mistreatment the charge hold on within the battery.

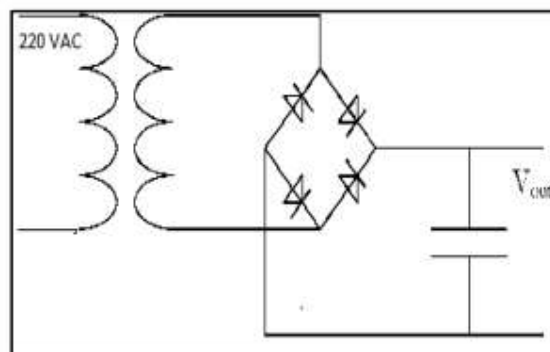
3.3 Working details of components:

3.3.1 Transformer:

For Converting High AC voltage to Low AC voltage we used 12-0-12V Transformer.

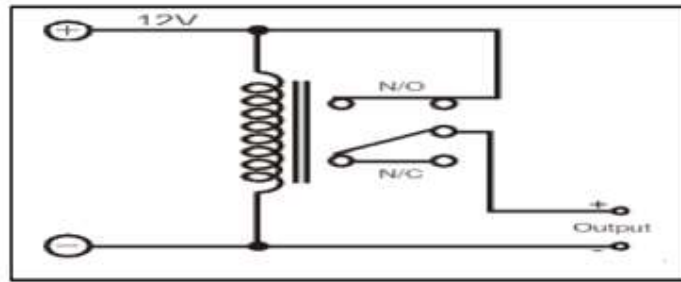
3.3.2 Bridge Circuit:

To convert 12V AC to 12 V DC, we use 4 Diode 1N4007. It has High Current Capability and Low Forward Voltage Drop. The value of capacitor is 470 μ F. So we get rectified output.



3.3.3 Relay:

Relay is working as a Switch. To operate relay we needs 12V DC supply so that we are using 12V Transformer.



3.3.4 Rechargeable Battery:

For Rechargeable battery, Nominal Voltage of Li-Ion battery is 3.7 Voltage. Standard capacity is 1950mAh. Charging voltage is 4.2V. Constant current 0.2C5A.

4 PCB designing:

4.1 Five steps to PCB creating

Draw the schematic of the circuit on a laptop exploitation the specified software system. style the PCB on the pc exploitation the specified software system. Print the PCB style through a electrostatic printer. Take the impression of the circuit on a copper-clad board. take away the surplus copper by etching.

Drawing the schematic

There are several software systems out there on the web to assist you draw the schematic of the circuit. Eagle software system may be an excellent choice however it's not a free ware. thus here we'll use categorical SCH for drawing the schematic. categorical PCB (which includes categorical SCH) is accessible on the web without charge.

Circuit description

Let us assemble an easy buffer IC. we'll place a faucet switch at one input Associate in Nursingd see that we have a tendency to get an equivalent output because the input by putt Associate in Nursinging crystal rectifier light-weight at the input by putt an crystal rectifier light-weight at the output pin. thus once we push the switch to 'on' position the crystal rectifier can glow, and once we push it to 'of' position the crystal rectifier can shut down.

Screenshot description:

Icons marked one through twenty four permit you to perform varied tasks as follows:

- Rotate the element also because the text by ninety. It also can be wont to rotate solely the text
- Rotate solely the element by 90° it's the element and image manager. All the component may be found here
- Options. you'll be able to amendment the color and dimensions of the

screen also because the grid spacing and alternative choices

- Previous zoom. It resumes the previous screen form
- Zoom to suit
- Zoom out
- Zoom in
- Undo
- Save
- Open
- General- purpose pointer, choose and moving tool
- Zoom into elect space
- Place a element. it'll not open the library window
- Place {a signal|a sign|a image|a symptom|a proof|an indication} or symbol level, just like the symbols of power

supply and ground

- Place a wire. All the connections are created exploitation this icon
- Place a corner within the wire, i.e., break a nonstop lines into 2
- Disconnect a wire from a element and connect it to the other
- Make a parallelogram for a brand new custom-built element. You can create any element that isn't gift within the library
- Add a line into a custom-built element
- Add a circle or arc in an exceedingly new element
- Place a brand new pin in an exceedingly element
- Place text
- Snap to grid. By keeping this selection 'on,' the wires can move and create angles at specific gap.
- This makes it simple to draw straight lines and styles.
- By keeping this selection 'off,' you may be able to create high precision angles within the circuit.

Designing the PCB:

whereas coming up with a PCB, try and create it as compact as doable. designed in Express PCB. Yellow lines show the silkscreen layer (component layout), red lines show the highest copper layer and green portion is that the bottom copper layer.

Screenshot description: Icons one to thirty one permit you to perform following tasks:

- Rotate the element also because the text by ninety
- Rotate solely the element by ninetyeth
- Move a particular item to very cheap copper layer
- Move a particular item to the highest copper layer
- Component manager (opens the library window)

- Options (can amend the color codes also as all the scale and measurements)
- Zoom to previous state
- Zoom to suit the screen
- zoom out to centre
- Undo
- Save file
- Open file
- General-purpose pointer, choose and moving tool
- Zoom into elect space
- Place a pad (either through-hole or surface-mount pad). it's useful in making multilayer PCBs
- Place a element.
- It won't open the library window
- Place a trace or wire
- Put a corner in an exceedingly trace
- Disconnect a trace
- Place text within the layout
- Place a parallelogram
- Place a stuffed power or ground plane
- Place a circle or Associate in Nursing arc
- Insert a grip phase within the board perimeter
- Pad info
- Highlight web connections.
- For exploitation this tool, you wish to link the schematic of the circuit to the present PCB.
- Toggle show of the highest silkscreen layer
- Toggle show of the highest copper layer
- Toggle show of very cheap copper layer
- Toggle snapping to grid

PCB description: The circuit's PCB is represented below, with the actual names of the parts as within the library given inside brackets.

At the centre may be a 20- pin base (20 dip). The 3-pin IC at the highest is 7805 (semiconductor TO-220 while not mounting hole, i.e., 7805 vreg). On the left of 7805 may be a one thousand F electrical condenser base (cap-lead spacing 4.5 mm (0.1 inch). On the proper of 7805 may be a zero.1f capacitor base (cap-lead spacing two.5 mm(0.1inch). The three holes on the left ar for the DC feminine input jach; in it 12V power provide are connected. On the proper of the 20-pin base is the base for a 1-kilo-ohm electrical device (0.25-watt electrical device with lead spacing of zero.35 inch). slightly below the 1-kilo-ohm electrical device base is the crystal rectifier base (LED-T1)

Rules of PCB making: There ought to be no ninetyeth connections of wires within the PCB. All connections ought to otherwise be created at 45%. The likeness of the PCB layout can always be imprinted on the copper facet (the solder side of the copper-clad board) of the particular PCB. Thus for any text to be written on the copper facet, the text ought to be reflected throughout layout style in order that the text seems traditional on the facet of the PCB. continually print from an electrostatic printer. output from inkjet or any other printer won't work because it might not be sharp enough. You can print on each high and bottom components of the board, but here we'll print text solely on the highest copper layer. There are standards for exploitation traces of various thicknesses for different purposes:

- (a) 0.6mm (0.025-inch) trace for single tracks
- (b) 1.3mm (0.050-inch) trace for power and ground tracks
- (c) 0.2mm to 0.4mm (0.010-to 0.015- inch) traces for going between IC and element pads.

Tracking from massive to tiny so back to massive is thought as 'necking-ing' or 'necking down'. you'll be able to additionally let remainder of the house remain coated by copper, feat clearance beside every line. we'll not use it as this type of stuffed circuit is best for industrial- level machine etching. The standards for clearances for electrical conductors are listed here within the table. for skinny tracks (<0.6mm traces), it's sensible to add chamfer to 'T' junction, therefore eliminating ninetyeth angles.

4.2 Printing the PCB layout

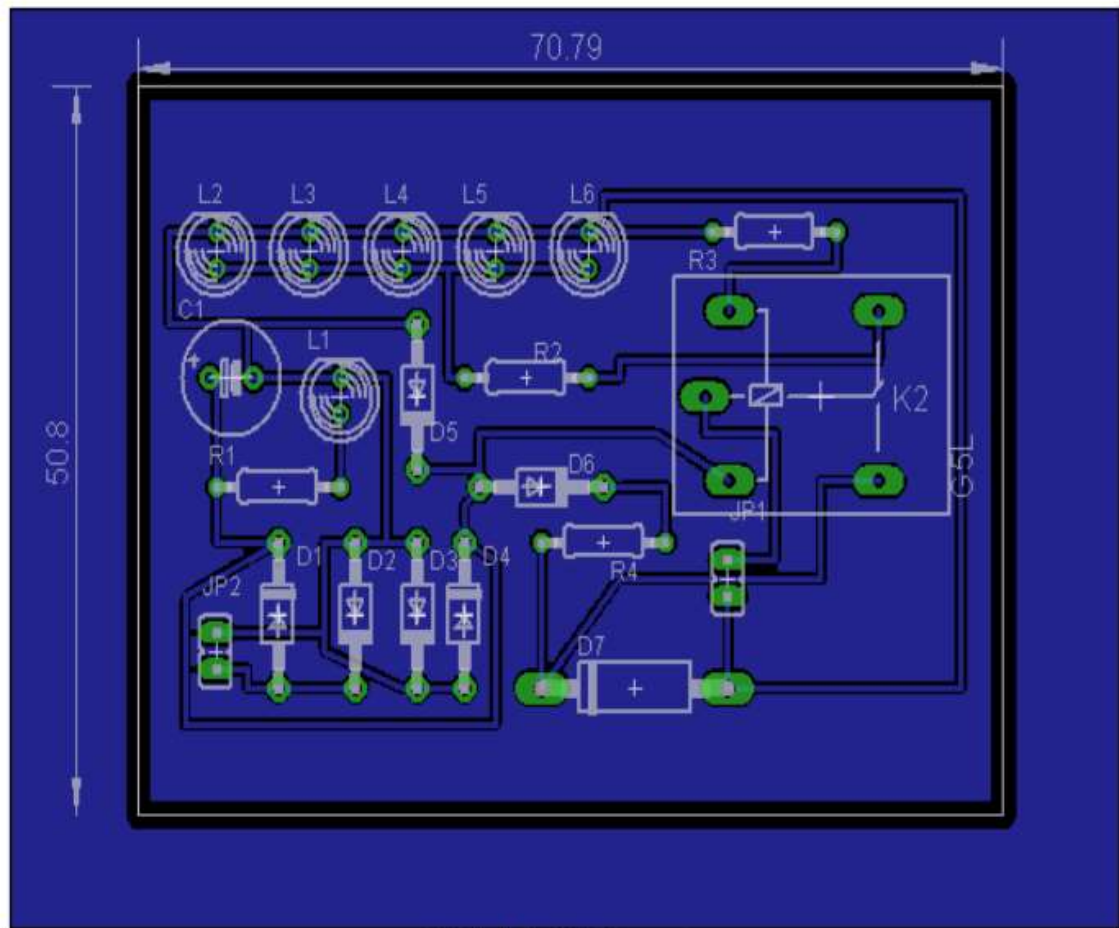
Go to File- Print. A window can open. Select 'Layers to Print.' Keep 'Enlarge to suit Page' choice uncurbed as it won't offer the precise layout of the parts. Print the PCB layout from an electrostatic printer. If you don't have an electrostatic printer at home, convert the file into a PDF file (using PDF995 software system) so print it elsewhere.

4.3 Etching

Cut the copper-clad board to a size of the PCB style output. You can additionally use a glass epoxy board however it's costlier than a copper-clad board. place the paper output on the board with the printed facet facing the copper facet. Affix the paper to the board using cello tape in order that the paper doesn't move whereas ironing. Now take your unit electric iron and set its temperature to the utmost. Press the new iron on the

paper for regarding four minutes. whereas doing thus, check for impressions, Continue ironing till the whole impression of the circuit comes on the copper facet. Complete the blanks, if any, with an honest permanent marker. If any line isn't dark enough, redraw it on the board exploitation the permanent marker. Wash the board in traditional water. Drill IC holes employing a 1mm hand PCB drill . Redraw the lines exploitation the permanent marker if they need been damaged by the drill. Now mix some FeCl (ferric chloride) powder in plight. The reaction is vigorous, thus take safety precaution. place the copperclad board within the answer and perpetually tilt the instrumentation from side to facet while not spilling its contents. this is often done to speed up the reaction. It takes 5 to 6 minutes to scrub away all the surplus copper. In between, keep checking the board. Ensure that the marker or carbon of the impression doesn't wash away. Take the board out and wash it below water to remove the permanent marker ink. take away carbon by exploitation enamel remover. Use a scrubber to carefully scrub the copper surface until it shines. Your PCB is ready!

4.4 PCB layout:



5.Features

- straightforward: Simple circuit. elements area unit simply obtainable and low price.
- Automatic: mechanically switches ON once the mains fails and turns OFF once mains power resumes. conjointly has its own device that once totally charged stops charging mechanically.
- Convenient : Makes our lives easier, convenient to use.
- Economical: Energy consumption is incredibly less, proves to be additional economic for the consumer.

5.1 Scope

Scopes of the good emergency battery operated junction rectifier street light-weight are:

- Longer Lasting battery that works approx. 8 hours
- Power is available; it senses and switches off the LEDs (lamp) instantly.

- straightforward to use.

5.2 Advantages

The advantages are; it's straightforward to use, terribly low price, save energy additional and straightforward to put in anyplace.

- Efficiency: additional light-weight per watt than incandescent bulbs.
- Color: will emit of Associate in Nursing meant color while not use of color filters.
- Size: terribly little.
- On/off time: illuminate terribly quickly.
- Life time: long helpful life time.

5.3 Disadvantages

- Cost: presently dearer.
- Health hazard: cool white LEDs will cause issues to eyes.

5.4 Application

- Used as another supply at the time of power outage.
- it's appropriate for domestic applications.
- utilized in remote residential areas.

6. Result, Future-Scope, References

6.1 Result :

The output of the LEDs is measured and tested battery backup is approx. 8 Hours. At the input of the battery the measured voltage is 4.5V through Zener Diode. Across Capacitor measured voltage is 12.15V DC and from calculated current is 12.15mA. Across Diode D2 voltage is 13.7V. This circuit can also be extended to a higher output voltage for which the charging voltage and the load are to be chosen accordingly. All the other components involved in the circuit are of same value.



Fig : model of major project

6.2 Future Scope

The emergency light which uses IC is a reliable one comparing to other on IC emergency lights and there is an automatic feature by which itself get glows. This project can be adopted for mass production as cheap and efficient method.

6.3 Conclusion

- The project was all over to be innovative for the development of day these days life.
- Device additionally adds a brand new look to the normal street light-weight.

- the price of implementing this circuit is additionally terribly less - an extra advantage in mistreatment this circuit.
- Therefore the implementation of good emergency battery operated junction rectifier street light-weight proves to be a price effective and compact application in today's world of technological miniaturisation. As of there has been a rise within the use of LEDs for the event of recent applications, its promotion would cause the improvement of future innovations!

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