Solar Energy Based LED Powered Light and Inverter Circuit with Different Types of Sensors

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Abstract. In this article we have designed and constructed a simple yet effective Solar Energy Based LED Powered Light and Inverter Circuit with Different Types of Sensors. The Solar Energy Based LED Powered Light and Inverter Circuit with Different Types of Sensors are constructed using simple electronic components and the voltage vs time graph during the sunny, cloudy, and rainy days are analyzed. The observed values are plotted in graph and the constructed device is found to be working perfectly which shows that the device can be used for various domestic and commercial solar applications.

1. Introduction

Every single living thing on earth relies on lot of power paced in our sun. plants utilize this energy for photosynthesis, giving new oxygen and cleaning air. This energy additionally gives light and warmth giving fundamental portion of nutrient D for well evolved creatures. The sun additionally impacts water cycle and earth’s climate. People convert this energy for many other applications such as cooking, heating and controlling regular machines.

Solar power systems have greater efficiency and thus affordable for residential and commercial customers particularly taking into account late oil spill in Gulf, more people look for alternative source of energy that will save both money and environment. By harnessing energy from natural renewable resources like sun, we are ecologically ensured by diminishing the use of other hurtful assets, for example, oil and coal.

A portion of the significant uses of sun powered vitality incorporates, solar powered buildings, distillations, water heater, power generation, pumps, cooker, solar furnaces, sun based animal products drier, thermal power production and green houses.

A material which discharges light energy when power or electric flow is gone through it is known as electroluminescence. In 21st century, the greatest discoveries include luminescence, incandescence, chemiluminescence, cathodoluminescence, triboluminescence, and photoluminescence.

Most commonly, semiconducting materials were made up of organic, inorganic or with metal dopants. This is the most common principles of all Light Emitting Diodes (LED). These light emitting diodes are p-n junction diodes which emits light in forward bias condition.

2. System Design and Description

Requirements

Solar panel

A 30 watts solar panel is used which is made up of polycrystalline material. The output obtained from this 30-watt solar panel is 15 volts, but in general we get 10-15 Volts. In case of peak hours i.e. from
morning 10 o’clock to evening 4 o’clock it would-be equal to the efficiency level, where as it would be low during the cloudy days.

Solar energy based powered LED circuit

**Batteries**

Ordinary lead acid batteries are used to overcome the disadvantages such as low life time, high toxicity, low discharge, low efficiency and non-recyclability. In our case we used 12-volt Li-ion battery fixed under the solar panel to store D.C output.

**Charge controller**

Since the solar panel doesn’t give a constant output, it can be achieved using Charge controller. The power cannot be directly sent to the battery as it is stabilized by means of charge controller. It is also used to prevent the overload of the battery and to extend the battery life time.

**LED**

The LED works behind the principle of electroluminescence. It states that in radioactive recombination of electron and pores produces photons. In this circuit a 12V LED is used.

**Construction and Working**

A 30 watts solar panel is constructed by using 30 individual poly crystalline silicon solar cells these individual solar cells are associated arrangement to get the voltage output in case of the current output we connect solar cells in parallel the solar cells produce a output of 10 to 15V this output is connected to a 12V lead acid battery which acts as a storage device. And also, a charge controller is fixed intermediately to control the output DC power and the battery is connected with variable resistor-controlled LED circuit. By using the regulator, we adjust the resistance value and the LED input is controlled here after the brightness level of the LED light increases or reduces which is depending upon the adjustable value of the resistance.
Fig 1. Constructed Solar energy based powered LED circuit

Solar energy-based inverter circuit with different types of sensor

Fig 2. Circuit Diagram of Solar energy-based inverter circuit with different types of sensors
Fig 3. Square Diagram of Solar energy-based inverter circuit with different types of sensor

Fig 4. Circuit constructed Solar energy-based inverter circuit with different types of sensor
Components required

LM7085

In order to give uniform voltage, a popular voltage controller 7805 IC is used. The IC 7805 is placed in 78xx arrangement where xx represents the voltage yield providing +5 volts-controlled force supply with heat sink arrangement.

PIC16F877A

![PIC16F877A Chip Diagram](image)

Fig 5. Chip diagram of PIC16F877A

PIC16F877A is a 8 piece microcontroller with compactable PIC16CS5X containing an EEPROM memory with self-programming capacity. The sequential port of PIC16F877A can be modified as Serial Peripheral Interface (SPI™), 2-wire Inter-Integrated Circuit (I²C™) and as Universal Asynchronous Receiver Transmitter (USART).
Fig 6. Pin Diagram of PIC16F877A

IC LM35

The IC LM35 is a temperature detector which converts the voltage to its relative centigrade temperature. By using this gadget, the user can also sense the temperature in Kelvin instead of °C which has a huge benefit. This device doesn’t involve any exterior calibration or trimming with workable temperature range of -55°C to 150°C.

BC547 Transistor

The NPN transistor BC547 is forward bias when the signal is connected to base and reverse biased on grounded base. It has an increase estimation of enhancement limits ranging from 110 to 800.
A base current of 5mA has to be supplied since 100mA is the most extreme measure of collector current that can be utilized in this transistor.

**Photo resistor**

A photo resistor is a segment which are sensitive to light, changing its resistance when exposed to sunlight. These values for resistance may change over numerous sets based on the wavelength and intensity of the light.

In order to increase their light sensitive properties, photo resistors are made using semiconductors like cadmium.
CT COIL

In order to quantify the exchanging current, a Current transformer coil (CT) is used which creates current in the secondary coil relative to the current in the primary coil.

Construction and working

Solar panel is the primary energy source. The 3 watts solar panel is constructed using polycrystalline silicon solar cells and the output is connected to the DC battery. A DC battery of 12V is placed to store the electricity energy by the solar panel and the electrical energy is stored in the DC battery now the DC current is converted in AC by using the inverter circuit here the sample inverter circuit is constructed using the n channel MOSFET, diode, capacitor and inductor coil. The relay unit is fixed with the circuit with the circuit to control the progression of the DC current, after the inverter changes over the DC to AC current (the 12V of DC is changed over into 220V of AC by utilizing the inverter) it directly given to the lead, where the AC light is associated.

The other part of the circuit comprises of LDR sensor which used to recognize the presence of the sun light once the light does not fall on the sensor the circuit gets initiated and the light associated with the circuit will glow.

The current transformer coil is connected to the AC current to find the amount of the current that used by the load connects to the circuit, which acts as the current sensor. LM35 integrated with the temperature sensor and it is used to find the amount of temperature in the circuit. In addition to that, the pulse with modulation is added in the pica microcontroller to save power and its used other for some applications.

These sensors are associated with the control unit where the programmed pica micro controller is connected, the PIC16F877A is programmed with the pulse modulation to increase the battery time and the temperature readings, voltage readings and the amount of energy that utilized by the AC lights are displayed in the LCD display and the thereafter the graph is plotted between

3. Result and Discussion

i. The solar power LED lights circuit with regulator. In this project we constructed the solar LED light with help of solar panel, charge controller, LED driver and regulator circuit. The 30W solar panel is constructed for the power source with a charge regulator to control the output power connected to the batteries. The LED driver is used to provide the constant current source for the LED’s and the regulator circuit for adjustment of the brightness of the LED with the help of six adjustable resistance connected to control the brightness of the LED’s its similar to the motion sensor. The six ways adjustable brightness will be useful for the time we need low brightness and we need high brightness we can adjust the regulator for the maximum brightness.

ii. The observed different voltage readings from the solar panel is plotted as graph with respect to the time, the voltage reading are noted for the several days which includes the sunny days, cloudy days and some days without proper sun light, there are three different graphs are plotted for sunny, cloudy and rainy days and we observed the different types of output values with respect to the time the output is high sunny days and moderate in cloudy and very low in extreme cloudy days.
Voltage and Time

The graph plotted between the voltage and time, as the voltage differs based on the temperature obtained on various intervals on time.

Graph plotted for Sunny day

1st Day

This graph shows the output of the solar panel during the sunny days and we get the different values which includes peak values and maximum output voltages, the peak value obtained during 12 PM - 1 PM where the sun is exactly at the center and the peak value reaches 14V and after the output reduces gradually when the sun starts to set in evening.

Voltage Vs Time graph

Graph 1. Voltage Vs Time graph plotted for Sunny day

Graph plotted for Cloudy day

2nd Day

The readings are noted for the cloudy day where the direct rays from the sun fall on the clouds and it gets scattered, thus the scattered rays fall on the solar panel and thus the voltage is not high as the energy we get in sunny day but it is moderate as the peak value reaches 5V during the cloudy days.
**Voltage Vs Time graph**

![Graph 2](image2)

**Graph 2. Voltage Vs Time graph plotted for Cloudy day**

**Graph plotted for the Cloudiest day or Rainy day**

**3rd Day**

During the cloudy day or rainy day, the temperature will be very low is the solar panel produced electricity but it very low as compare to the sunny days.

**Voltage Vs Time Period**

![Graph 3](image3)

**Graph 3. Voltage Vs Time graph plotted for the Cloudiest day or Rainy day**
Fig 9. Off condition of Solar energy-based inverter circuit with different types of sensor

Fig 10. Display showing the readings during on condition of Solar energy-based inverter circuit with different types of sensor
1. In this project we constructed the solar LED light which resembles the ordinary solar street light but there are some potential advantages in these lights compared the ordinary street lights. The main advantage of the LED driver circuit, which guarantee the security of LED light, the driver circuit control the progression of current to the light and it resist the damage when the usual flow of current to the system and therefore the life time of the LED’s will be high. Other advantage will be regulator circuit, by using their regulator circuit we can adjust the brightness of the LED in 6 ways its same like the motion sensor. The 6 ways adjustable brightness will be useful for the time we need low brightness and we need high brightness we can adjust the regulator for the maximum brightness. And other some advantages are low cost easily replaceable and low maintenance required for this LED light.

2. In this project we have constructed an inverter with different types of sensors including wireless sensor networks which can be used for data aggregation and multicast authenticated schemes.[41]. The solar panel produces a DC output and this DC is converted to AC by means of an inverter. This AC current is thus measured by CT coil which is connected to the inverter circuit. As the DC undergoes a transformation of AC by means of an inverter which is the basic principle behind it. One of the significant components of this project is the 7805-voltage regulator which manages the yield voltage at steady value. In addition to this we have fixed 2 sensors, one is LM35 that is the temperature sensor and a voltage sensor. These both sensors are fixed to measure the temperature and voltage at various intervals of time. As it varies based on climatic conditions as it reaches the peak value on sunny days and reaches lowest value on cloudy days and moderate when the intensity of sunlight is less.

Fig 11. On condition of Solar energy-based inverter circuit with different types of sensor

4. Conclusion
5. Reference

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