ANNQUEST NOVEMBER 2016
ISSN: 2321-3043
www.stannsannquest.com

OPTIMIZED SOLAR STREET LIGHT CONTROL

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Abstract

Solar energy is a vital renewable energy source. A passive solar street light is designed to let in as much sunlight as possible. Solar panel can be used to generate the electricity. Photo voltaic cell is one of the low cost modules useful for automatic solar street light control system. The other solar systems are highly costly and they are controlled manually. Many times losses of energy due to manually control. To control the solar street light automatically, we can use switching transistor, low cost PIC microcontroller IC-16F877A, and current control charger circuit and control the solar street light system automatically. This system has low cost, reliable and flexible compared to manual control system. The system does not require man power maintenance and it is not time consuming.

Keywords: Solar panel, Battery (12volt), Power LED's, photo voltaic cell, PIC 16F877A, Mechanical pole, stepper Motor.

Introduction

This project is about how to develop and fabricate the solar street panel which is charge the lead acid 12 volt battery during the day time by using sun as the source. To control the circuit of the charging, we used the charging circuit that is display the conditions of the charging whether it's in charging condition or in discharge condition. When it's in charging condition, green light Led will turn on until the battery fully charges. When battery is fully charge, red light Led will turn on automatically through the PIC Microcontroller IC-PIC16F877A, (refer Fig 3.0) and then battery polarity switching to the load, we used IC-PIC16F877A to turn on the lamp at night time by using the photocell sensor (refer Fig 2.0) and PNP power transistor, The PIC16F877A will determine whether it is daylight or night by using photo cell, and its output given to the in build ADC of Microcontroller PIC16F877A. To determine the intensity of the light we set up the coding of the PIC. When PIC gets the input from ADC output, PIC16F877A gives the output to the PNP power transistor to turn off the light otherwise PIC16F877A will automatically turn on the light. By using these conditions, we can save the battery energy at day time and photocell sensor (refer Fig 2.0) detect the light ray from the sun, and output give to the in build ADC of PIC16F877A and it will turn off the lamp. Then charging circuit will continue to charge the battery for day time.

Project Aim

The solar street light system is designed specifically for portable use at the rural areas and energy backup if disaster happens. It's the new way to save the energy, and use it more efficiently. The total system in practical as shown in Fig 1.0.

Objective

The main objective of this project is to develop the portable solar street light with the DC voltage as the source. There are two secondary objectives to be achieved in order to achieve the main objective stated above. The two secondary objectives are discussed in the following paragraph. The first objective is to develop the charging circuit that can charge 12V lead acid battery by using the solar panel as the DC source. This charging circuit can implement the charging condition. (As we know we have several charging condition like charging condition and floating condition). The second objective is to design and program for the controlling the system by using the Microcontroller IC-PIC16F877A. Control the solar street light to turn on and to turn off. When the time changes like day to night and night to day. This system also used for measure the intensity of light by measuring highest intensity point set the solar panel by moving it by stepper motor angle set with time. It will improve the efficiency of the DC energy.

Scope of the Project

The scope of the project includes construct the circuit in order to charge the 12V lead acid battery. The acid battery will supply power to turn on the lamp when there is no light at night time. Integration between photo voltaic sensors was also Concentrated in development of this system. In order to control the circuit for Switching the PIC16F8727A.

World History of Solar Energy

Solar energy is the light and radiant heat from the Sun that influences Earth's climate and weather and sustains life. Solar power sometimes used as a synonym for solar energy or more specifically to refer to electricity generated from solar radiation. Solar radiation is one of the primary resources, like wave power, hydroelectricity and biomass account for most of the available flow of renewable energy on Earth. Solar energy refers primarily to the use of solar radiation for practical ends. All other renewable energy sources other than geothermal derive their energy from energy received from the sun.

Street Lamp

Before we had incandescent lamps, gas lighting was in use in cities. The earliest of such street lamps were built in the Arab Empire, especially in Cordoba, Spain. The first electric street lighting employed arc lamps, initially the 'Electric candle', 'Jablochoff candle' or ‘Yablochkov candle’ developed by the Russian Pavel Yablochkov in 1875. This was a carbon arc lamp employing alternating current, which ensured that the electrodes burnt down at the same rate. Yablochkov candles were first used to light the Grand’s Magasins du Louvre, Paris where 80 were deployed. Soon after, experimental arrays of arc lamps were used to light Holborn Viaduct and the Thames Embankment in London - the first electric street lighting in Britain. More than 4,000 were in use by 1881, though by then an improved. Differential arc lamp had been developed by Friederich von Hefner-Alteneck of Siemens & Halske.

Fig 1.0. Old and new style solar street lamp

PHOTOVOLTAIC CELL

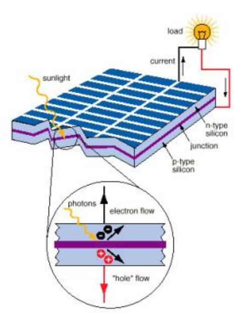

Fig 2.0 Photovoltaic Cell

Photovoltaic energy is the conversion of sunlight into electricity. A photovoltaic cell, commonly called as solar cell or PV, is the technology used to convert solar energy directly inters electrical power. Sunlight is composed of photons, or particles of solar energy. These photons contain various amounts of energy corresponding to the different wavelengths of the solar spectrum. When photons strike a photovoltaic cell, they may be reflected, pass right through, or be absorbed. Only the absorbed photons provide energy to generate electricity. When enough sunlight energy is absorbed by the material that is a semiconductor, electrons come out from the material atoms. Special treatment of the material surface during manufacturing makes the front surface of the cell more receptive to free electrons, so the electrons naturally migrate to the surface. When the electrons leave their position, holes are formed. When many electrons, each carrying a negative charge, travel toward the front surface of the cell, the resulting imbalance of charge between the cell's front and back surfaces creates a voltage potential like the negative and positive terminals of a battery.

Advantages of photovoltaic systems

1. Conversion from sunlight to electricity is direct, so that bulky mechanical generator systems are unnecessary.
2. PV arrays can be installed quickly and in any size required or allowed (refer Fig 2.0).
3. The environmental impact is minimal, requiring no water for system cooling (refer Fig 1.0).

Battery Charger

A battery charger is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. The charge current depends upon the technology and capacity of the battery being charged. For example, the current that should be applied to recharge a 12 V battery will be very different from the current for a mobile phone battery. A simple charger works by connecting a constant DC power source to the battery being charged. The simple charger does not modify its output based on time or the charge on the battery. This simplicity means that a simple charger is inexpensive, but there is a trade-off in quality. Typically, a simple charger takes longer to charge a battery to prevent severe over-charging. Even so, a battery left in a simple charger for too long will be weakened or destroyed due to over-charging. These chargers can supply either a constant voltage or a constant current to the battery.

BLOCK DIAGRAM

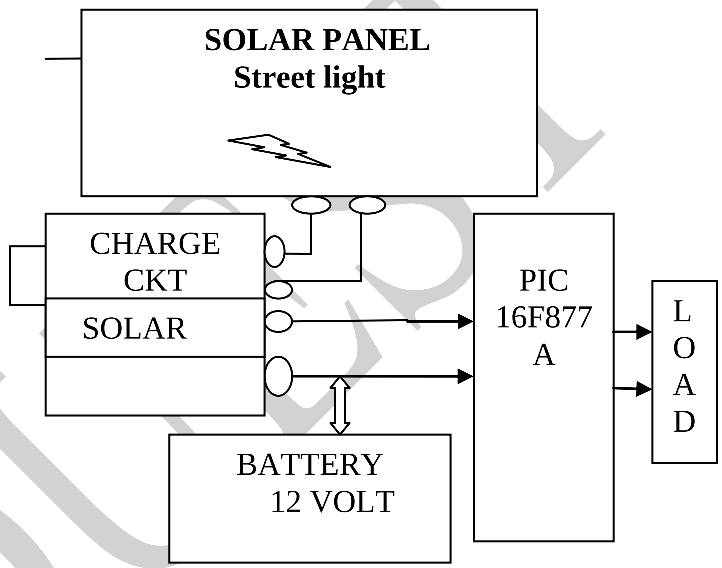

Fig 3.0: Block Diagram of Solar Street Lamp

This block diagram above is about the combination of the charging circuit, Microcontroller PIC16f877A, load and DC voltage source. That is 12-volt battery, during day time solar panel will get the energy from the sun and the charging circuit will control the charging rate supply to the 12-volt battery. The charging circuit will require to charge the 12-volt battery once battery fully charge it will turn of the solar to 12-volt battery connection and connect to the load by using relay, it is a component in the charging circuit. The 12-volt battery charging only at day time and it will discharge through load that is solar street light at night time. The diode 20L15T is used to eliminate current drawn from the battery.

Conclusion

By using this system, we can optimize the cost of the solar street light. It is better compared to other systems because it is automatically controlled.

Charging Operation

The power control circuit can operate current from the solar panel input through Q3 and IC3. When the solar panel voltage exceeds 12V, zener diode ZD1 conducts and turns on Q3, providing power to IC3. IC3 produces a regulated 5 Volt power source. The 5V is used to power the circuit's logic and as a reference voltage for comparing to the battery float voltage. The float voltage comparator IC1a compares the battery voltage (divided by R1/VR1 and R3) to a reference voltage (divided by R5 and R6). The comparison point is offset by the thermistor TM1 for temperature compensation. The comparison point is also modified by Equalize switch, S1 and R2. The output of IC1a goes high (+5V) when the battery voltage is below the float voltage setting. The output goes low when the battery voltage is above the float voltage setting. This provides the charge/idle signal that controls the rest of the circuit. Fuse F1 prevents excessive battery current from flowing in the event of a short circuit. The experimental setup of charging operation is as shown in the Fig 3.0.

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