UPS System Using Solar Power

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ABSTRACT-The main objective of the paper is to design and construct a solar tracker based UPS system that follows the sun direction for producing maximum output for solar powered applications. Here we propose a "UPS System Using Solar Power" project that uses solar energy to charge battery and then the DC battery is used to power an AC load using inverter. Our solar panel is used to constantly charge the 12V DC battery using charge controller circuitry. And once we turn on the load switch the battery charge is inverted and stepped up from 12V DC to around 220 – 230 V AC. This is now provided to the AC load. Thus our system successfully powers AC load using a solar panel and battery. Microcontroller based control system takes care of sensing sunlight and controlling the motorized mechanism for rotating the panel in the direction of sun. This system works continuously without any interruption. This achieves the goal of tracking sun in dual axis. The Microcontroller is programmed using powerful Embedded C language. The "UPS System using Solar Power", uses PIC16F72 Microcontroller. It is an exclusive project that can control the dual axis solar tracker towards the sun. It works based on LDR along with the help of motorized mechanism which is attached to the DC motors. This solar energy will charge the battery and convert this battery voltage DC into AC voltage with the help of inverter.

Keywords: Solar Tracker, PIC Microcontroller, DC Motor, Battery, Solar Charge Controller, Inverter.

I.INTRODUCTION

Achieving balance between power consumption and power production is a bigger challenge today. The best way to solve this imbalanced equation is to use solar energy as efficiently as possible. The problem in the usage of solar energy is with solar cell panel should be exposed maximum to the sun light. If the solar panel is fixed in a particular direction then the sun light intensity varies from morning to evening. Moving the solar cell panel in the direction of sun can increase the solar energy generated from the solar cell.

The main advantage of using solar power energy is it's a renewable energy and viable for long term, the maximum efficiency of solar power can be attained by proper orientation within right locations. The actual beauty of solar powered supply lies in its ability to capture light energy and generate electrical energy, that can be used both as online energy source (on-grid) in case of power failure and also as Independent/alternate energy source (off-grid). There is no pollution in atmosphere due to nitrogen oxide, carbon dioxide or any other pollutants. It is an unlimited source of power which is free, unlike deleterious fossil fuels which are expensive as well.

II. LITERATURE SURVEY

Rohith Madhuraj, Rohit Kumar Kamat, [1] "Solar Powered UPS System", the research and development of a solar powered UPS in India's market as an alternative source of energy. It consists of design which is done according to our research. The design of solar UPS consists of solar charge controller, inverter circuit and a solar panel. During this process many circuit simulation were done to fit the requirement of this project. It also shows that solar Ups can be highly efficient and successful in electrical UPS market. This project consists of solar panel which consist solar cell which convert solar energy into electrical energy. We also have charging circuit which will charge 12V DC (direct current) battery and inverter circuit will convert it AC (alternative current).

J.C. Osuwa, E.C. Igwiro, [2] "Uninterruptible Power Supply Using Solar Rechargeable Battery", Uninterruptible Power Supply is critical to many sectors of the economy such as operation of units in hospitals, banking operations, information technology systems, etc. and generally, a constant power supply is cardinal to rapid economic growth and sustainable development. In developing countries in particular, where power failure is a regular feature, there is great need for improved UPS systems. A power supply system that incorporates a renewable source of energy as contained in this work provides a viable option to overcome the problem of disruption of work in progress due to power failure.

P. Venkatesh, T. Swetha, [3] "Solar Powered UPS", sudden change in voltage may cause damage for the functioning of mission critical electrical loads. To avoid these damages and to provide a steady flow of power to these electrical loads we are using uninterruptible power supply UPS). It provides instantaneous solution to these power quality problems. It includes the design, analysis research methodology used and the findings the market study during the research. In the design of solar UPS there are mainly two parts they are solar panel and specially designed inverter circuit. The inverter circuit has been designed on the basis of solar panel. The paper provides study of possibilities of design and functionality of a solar

powered UPS. Main purpose of using solar UPS is having high efficiency and also a successful alternate to electrical UPSs in the market. There are two main components in the design: an outdoor solar panel comprising of solar cells. Which will convert solar energy into electrical energy and inverter that will convert that energy into alternating current.

E. Shiva Prasad, M. Aravind Goud, [4] "The Solar Powered Uninterrupted Power Supply System", solar powered UPS system in India's market as a main source of energy over the conventional AC grid. The design consists of a solar charge controller, inverter circuit, solar panel and 2-channel Relay module automatic switching between the Solar and the conventional grid. It also shows how beneficial the solar powered UPS system over the conventional UPS systems available in the market. It also shows the advantages of the Solar UPS system to the stand-alone system. In this project, the solar panel converts the solar energy to the electrical energy. The DC output of the solar panel is fed to the charge controller which helps in charging the 12V battery and connected parallel to the inverter circuit where the DC is converted to AC and a step-up transformer is used to increase the level of the voltage from 12V AC to 230V AC.

Haris Jawaid, Nadeem Ehsan, [5] "Solar Powered UPS", solar powered UPS in market to meet the alternate energy source requirements of homes and small offices. It includes the design, analysis, research methodology used and the findings of the market study during the research. The design of the solar UPS includes a specially designed inverter circuit and a solar panel. The inverter circuit has been designed according to the requirements and specifications of solar panel. Many sample circuits have been studied to optimize the existing circuit. Assistance has also been taken from design engineers of existing UPSs in the market to see possible alternatives in case of any components' failure or unavailability. The paper provides study of possibilities of design and functionality of a solar powered UPS. It suggests that solar UPS can be a highly efficient and successful alternative to electrical UPSs in the market. There are two main components in the design: An outdoor solar panel comprising of solar cells, which will convert solar energy into electrical energy and inverter circuit that will convert that energy into alternating current to be used for home appliances.

III. PROPOSED METHODOLOGY

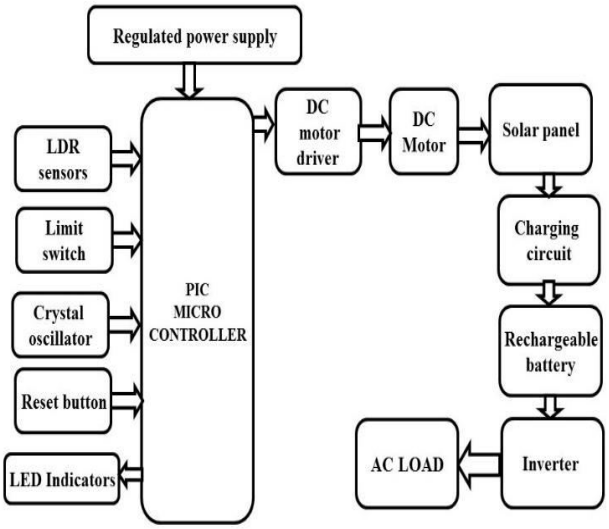

Figure 3.1: Block Diagram

In this project, the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig3.1

A. Regulated Power Supply:

Every embedded system requires DC voltage which is 5V. The supply we get in our houses is 230v, 50Hz. Here, RPS is used to ensure the condition that the output remains same even if the input changes as it converts AC to pulsating DC.

B. Transformer:

It is a device which transfers the AC current from one voltage to another by stepping up or stepping down the voltage. The input voltage 230v is given at primary side and the output of the transformer is 12v (AC) as shown in fig (3.2).

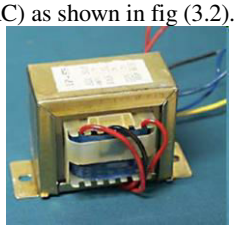

Figure 3.2: Transformer

C. Microcontroller:

Microcontrollers are "special purpose computers". The microcontroller includes a CPU, RAM, ROM, Input/Output ports, timers etc.., like a standard computer, but on a single silicon chip. Microcontroller based systems are designed to perform a specified task. The microcontroller used in the project is pic microcontroller developed by microchip incorporation.

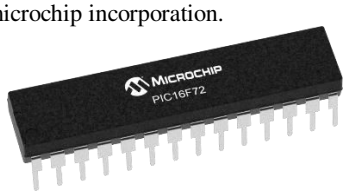

Figure 3.3: PIC Microcontroller

D. LDR (light Dependent Resistor)

A photo resistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referenced as a photoconductor.The light falling on the brown zigzag lines on the sensor, causes the resistance of the device to fall. This is known as a negative co-efficient.

Figure 3.4: light Dependent Resistor

E. LED (Light Emitting Diode)

A light-emitting diode (LED) is a semiconductor diode that radiates light (electro luminescence) when current passes through it in the forward direction. Infrared LED to work in our remote controls, and get other ones of different colors to make indicators or, in large arrays, displays - even color ones. The color of the emitted light depends on the composition and condition of the semi conducting material used, and can be infrared, visible, or near-ultraviolet.

Figure 3.5: LED

F. Limit Switch

A switch operated by the motion of a machine part or the presence of an object. A limit switch can be used for controlling machinery as part of a control system, as a safety interlock, or as a counter enumerating objects passing a point.

Figure 3.6: Limit Switch

G. Crystal Oscillator

Crystal oscillators are used mainly in digital integrated circuits for providing a stable clock signal and in specific applications which require high-frequency reference.

Figure 3.7: Crystal Oscillator

H. DC Motor

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The input of a DC motor is current/voltage and its output is torque (speed).

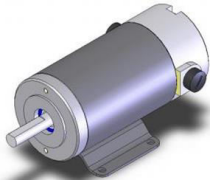

Figure 3.8: DC Motor

I. DC Motor Driver

The L293D are quadruple high-current half-H drivers. The L293D is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

Figure 3.9: DC Motor Driver

J. Solar Plate

A solar cell or photovoltaic cell is a device that converts solar energy into electricity by the photovoltaic effect. Sometimes the term solar cell is reserved for devices intended specifically to capture energy from sunlight, while the term photovoltaic cell is used when the source is unspecified.

Figure3.10: Solar Plate

K. Charging Circuit

Charging circuit which we can use to charge the battery which is coming from solar energy. The solar plate output will be connected to the rectifier. These spikes are removed with the help of capacitor is used. We can get 12V Steady DC at the output terminal which can be indicated if the LED glows. This 12V DC power is used to charge the battery.

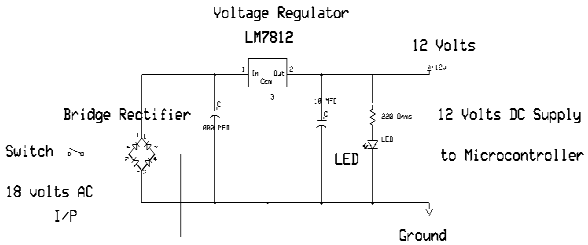

Figure 3.11: Charging Circuit

From the above circuit diagram, we can see that the 18v AC is being converted to 18V pulsating DC which is in turn converted to smooth DC with the help of the Capacitor. This 18V Smooth DC is converted to 12V DC by the Voltage Regulator 7812. At the output of the regulator, we get some spikes which are not desirable. These spikes are removed with the help of another capacitor used. We can get 12V Steady DC at the output terminal which can be indicated if the LED glows.

N. Battery

Battery is a device consisting of two or more electrochemical cells that convert chemical energy into electrical energy. In this we used 12v dry acid type battery for charging the solar energy.

Figure 3.12: Battery

M. Inverter

It's a device that converts direct current (DC) electricity, which is what a solar panel generates, to alternating current (AC) electricity, which the electrical grid uses.

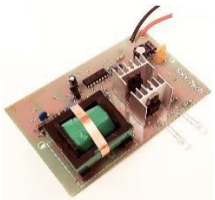

Figure 3.13: Inverter

N. LOADS

Simple house hold appliances can be used**.** In our project we are using a bulb and a USB connected charger as loads.

For the bulb: The input is 220-230VAC.

The output is 10w.

For the charge: The input is 220-230VAC.

The output is 5V, 2A.

IV. PROJECT DESCRIPTION

The schematic diagram and interfacing of PIC Microcontroller with each module is considered.

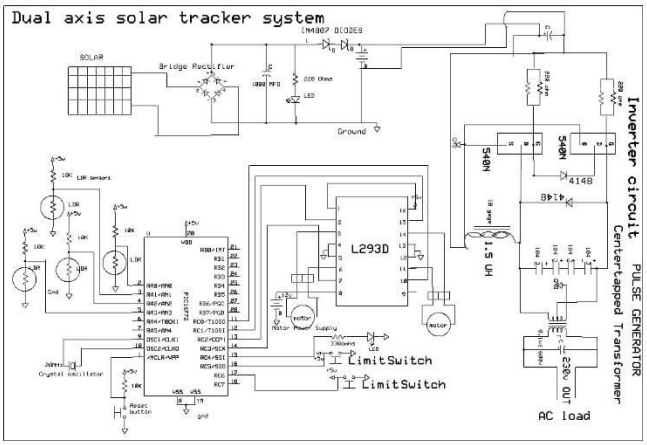

Figure 4.1: Schematic diagram of UPS System using Solar power

V. WORKING

The main controlling device of the project is PIC Microcontroller to which LDR's and geared DC motor with panel setup to its shaft are interfaced. The Microcontroller gets input from LDR sensors regarding the direction of sun and controller process this information and controls the movement of solar panel attached to DC motor. This achieves the goal of tracking sun in dual axis. Our solar panel is used to constantly charge the 12V DC battery using charge controller circuitry. And once we turn on the load switch the battery charge is inverted and stepped up from 12V DC to around 220 – 230 V AC. This is now provided to the AC load. Thus our system successfully powers AC load using a solar panel and battery. The Microcontroller is programmed using powerful Embedded C language.

VI. HARDWARE AND RESULTS

The project "**UPS System using Solar Power**" was designed as a dual axis solar tracker based UPS system to provide the maximum out for solar powered applications. This system store the solar energy into the battery with the help of charging circuit and convert this battery DC voltage into AC voltage with the help of inverter for AC appliances.

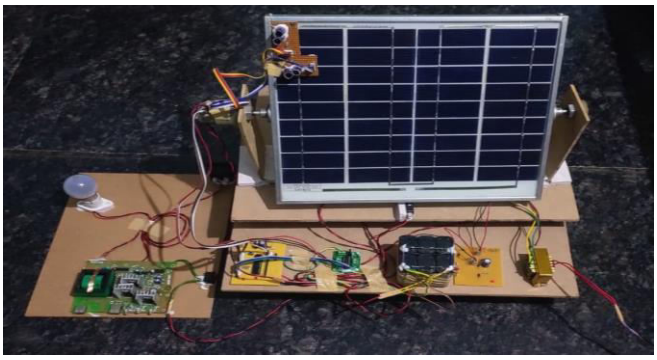

Figure 5.1: Hardware kit of UPS system using Solar Power.

Figure 5.2: Hardware Kit of UPS System using Solar Power for the Battery Charging.

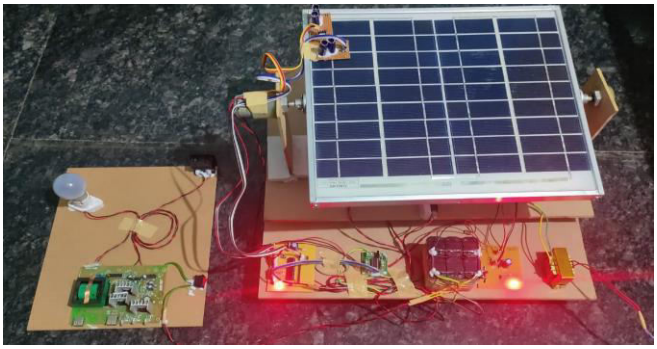

Figure5.3: Hardware Kit of UPS System using Solar Power for the LDR's on the Solar Panel which adjust to the sun direction.

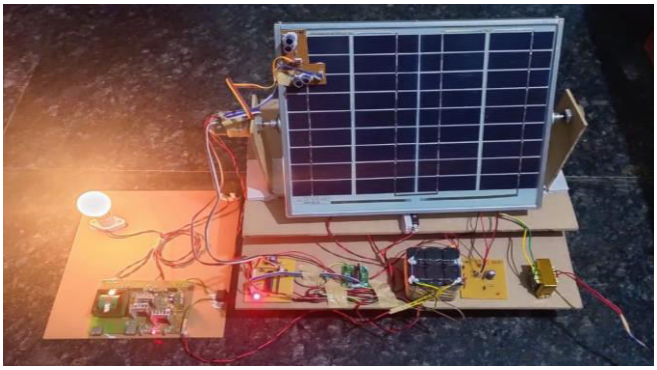

Figure5.4: Hardware Kit of UPS System using Solar Power for the supply is connected to Bulb (load), the bulb glows.

For the bulb: The input is 220-230VAC and the output is 10w.

Figure5.5: Hardware Kit of UPS System using Solar Power for the supply is connected to a USB (charger) connected to phone (load), the phone charges.

For the charge: The input is 220-230VAC and the output is 5V, 2A.

VII. CONCLUSION

The solar UPS system is designed with new technology i.e Dual Axis Solar Tracker and LDR based solar tracking system, constructed and tested in various conditions. Solar tracking method is the easiest method to increase the overall efficiency of the standalone solar panel. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

VIII. FUTURE SCOPE

Automatic solar tracking system offers a prototype for implementing a large array type solar tracker. This will be an expansion of mechanical as well as electronic system following additions can be made to the prototype to maximize the power conversion.

By connecting the solar panels in an array more energy can be extracted.

Using aluminium type of material for the assembly set up the weight upon the motors can be reduced which will automatically reduce the power consumption of the system.

With the monocrystalline PV panel in use, the efficiency of the project can be increased. Monocrystalline PV panels have also more lifetime than polycrystalline panels.

Improve the load carrying capacity.

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