Dual Axis Automatic Solar Tracking System

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ABSTRACT

Due to the continues increase the cost of fuel, pollution and global warming, the need arises for the use of solar energy (which is available freely and non-polluting source of energy).In order to make full use of solar energy the solar irradiance at a particular place must be estimated   This is a project in which the efficiency of the solar panel is improved using rotational mechanism. In this project solar panel is being rotated at certain angles by using two self driven motors the different geometrical angles of the sun like azimuth and elevation are controlled by the two motors respectively. The obtained energy is stored in a battery using charge controller. By observing overall researches the product is designed in such a way that maximum efficiency is gained using solar tracking mechanism without any external power source.
Keywords— Raspberry pi, solar panel, azimuth angle, elevation angle, motor.

ARTICLE INFO

I.   INTRODUCTION

In the world, the top three energy sources of electricity are coal at (37%), natural gas at (30%), and nuclear at (19%). These forms of energy are non-renewable meaning they will eventually be depleted. For this reason it is important to seek renewable sources of energy as they are cleaner, easier to use, require less maintenance, and will always be available. This project focuses on solar energy, which is a renewable form of energy. On average the earth surface receives about 600 W/m2 of solar energy.

This value depends on several factors such as the time of the day and the atmospheric conditions. In 2012, only 0.11% of solar energy was used to generate electricity. It is estimated that solar energy will become the largest source of electricity by the year 2050. For this reason there should be a larger investment in harnessing solar energy.

The basic idea behind this project is to utilize maximum amount of renewable sources (Solar energy).The Sun releases an estimated 384.6 yotta watts (3.846×10^26 watts) of energy in the form of light and other forms of radiation. At the Earth's surface, the energy we receive is approximately 1,000 W/m2 for a surface perpendicular to the Sun's rays at sea level on a clear day. If we are able to convert this energy to electricity we can easily fulfil energy requirement of world. Solar energy is the energy of the sun's rays into useful forms of energy such as electricity and heat. Solar cell or Photovoltaic cell (PV) is the device used to convert solar energy to electrical power.

Solar tracking decreases the angle of incidence of sun's rays on the panel. This maximises the output power from a fixed amount of installed power generator.

Tracking can be classified into two types: Dual axes and Single Axis. In Single axis solar tracker, solar panel moves in one direction (using single motor) where as in dual axes solar tracking panel moves in two directions (using two motors). The single axes tracker is very useful when the sun's path is stationary but as the sun's path changes with season, the Dual axes tracker, which follows the sun irrespective of its path, is very efficient.

Dual axis trackers have two degrees of freedom that act as axes of rotation.

II. PROBLEM STATEMENT

In today's world non renewable sources are available at degraded level. So it is necessary to utilize the renewable resources effectively. In case of solar energy the main question emerges is, how to increase efficiency and use the solar energy effectively?

III. OJECTIVE

1. To increase the efficiency of the device

2. To improve the performance of the solar panel

3. To maximize the solar energy utilization

4. To improve the solar panel installation technique

IV. LITRATURE SURVEY

The following are the review paper on the different tracking system.

Jeng-Nan, juang and R.Radharamanan [1] reviewed on Design of a Solar tracking system for renewable energy .To effectively harness solar energy and convert the energy in a useful form for common domestic appliances and devices.

Divya Mereddy and Vijaya Rama,Raju.v. [2] reviewed on Smart dual axes solar tracking .To move the panel such that it is always perpendicular to sunrays. The efficiency of the system is improved significantly by using dual axes LDR sensors.

Anita Khanna. [3] reviewed on Efficient vertical dual axis solar tracking system. This work aims at designing dual-axis solar tracking system based on Astronomical data of sun's position.

Tung-sheng zhan. [4] reviewed on Design and implementation of the Dual-axis solar tracking system. To design an automatic dual-axis solar tracking system with a new designed sun-position tracker mechanism. The proposed automatic solar tracking system has an overall energy increases of about 17%-25% more than the fix angle PV systems

V. PROPOSEDWORK

BLOCK DIAGRAM
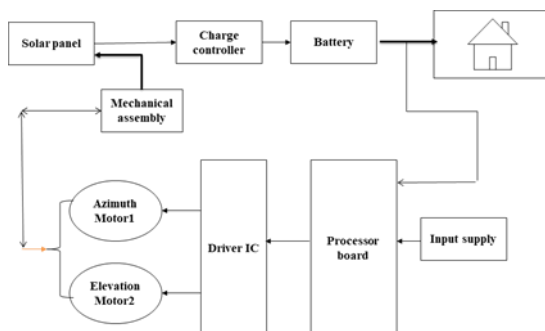
Working of system

The system basically works on a close loop mechanism. The solar panel is rotated in two axes using two motors. The first motor is used to rotate the elevation axis of the panel and another motor is used for tracing the azimuth angle of the panel. Using this mechanism the panel will be perpendicular to the sun from the time of sunrise till the sunset time. This will increase the amount of time of contact of the sun and the solar panel resulting in increase in efficiency of the panel. The received energy is stored in a battery followed by a charge controller. The charge controller (MPPT) works on buck boost principal which is also a protective circuitry for battery.

The motor used to rotate the axes consumes the power stored in the battery itself. Hence this mechanism also can be called as self driving mechanism without any external power source requirement.

A. Hardware Design

1. Raspberry Pi

The Raspberry Pi is small pocket size computer used to do small computing and networking operations. It is the main element in the field of internet of things. It provides access to the internet and hence the connection of automation system with remote location controlling device becomes possible.

Figure 2: Raspberrypi

Specification:-
The raspberry pi 3B model is the earliest model of the third generation of raspberry pi. It replaced raspberry pi 2B model.

- Quad core 1.2GHz Broadcom BCM2837 64bit cpu
- 1GB RAM
- BCM43438 wireless LAN and Bluetooth low energy
- 100 base Ethernet
- 40 pin extended GPIO
- 4 USB(2 port)
- 5V/2.5A DC via micro USB connector
- Full size SDMI

2. **Charge controller:-**

There are two types :-
1. MPPT- Maximum power point tracking
2. PWM- Pulse width modulation
It prevents battery discharge at night through the solar modules. We can increase amp but not voltage. It converts the high to low voltage. Used as a buck and boost converter.
A charge controller or charge regulator is basically a voltage and/or current regulator to keep batteries from overcharging. It regulates the voltage and current coming from the solar panels going to the battery.
Solar panel voltage- 16to 20 volt
Battery needs around – 12 or 14 to 14.5 volts to get fully charge
 So if there is no regulation the batteries will be damaged from overcharging.

3. **Motor Driver(L293D):**

    L293D is a dual H-bridge motor driver integrated circuit   (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.L293DcontainstwoinbuiltH-bridgedrivercircuits.

    In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 7 and 10 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.
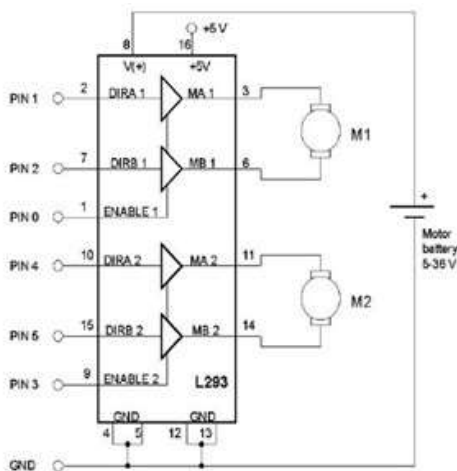

Figure 3: Motor Driver(L293D)

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input   is high, the associated driver gets enabled. As a result, the outputs become active and working phase with the inputs.

    Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

4. Python:

    Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, and a syntax that allows programmers to express concepts in fewer lines of code, notably using significant whitespace.

    It provides constructs that enable clear programming on both small and large scales.

VI. CONCLUSION

Hence by precisely following the sun's path with the help of dual axis tracker based on azimuth and elevation throughout the day we can obtain maximum efficiency and thus generate more amount of electricity compared to the single axis tracker.

VII. RESULT

1. Increase the efficiency effectively
2. Increase the performance of Solar panel.
3. Effectively utilization of solar energy

VIII. FUTURE SCOPE

- We can store more energy by using dual axis automatic solar tracking system.
- Other renewable energies are very expensive so we can reduce the cost of energy here we can provide one time installation process .
- In future we will be used hydraulic and pneumatic system for cleaning the solar panels and we can remove the dust particalon that

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