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Automatic Solar Tracking System using MPPT with Mirror Booster

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ABSTRACT: This paper is to design and develop a new microcontroller based solar tracking system with a mirror booster based on MPPT. Solar energy is rapidly becoming an alternative means of electrical source all over the world and the solar energy becomes profitable when the solar rays are tracked with its maximum efficiency. The best to get the maximum power output of solar array is by sun tracking. This paper deals with the design and construction of solar tracking system by using LDR, arduino A, Johnson motor, gear motor and mirror. Mirror is used as booster to maximize the efficiency. The panel and mirror will travel from south to north and vice-versa. The prototype is considered around a programmed arduino which controls the system by communicating with sensors and motor driver based on movement of the sun. The performance and characteristics of the solar tracker are experimentally analyzed.

KEYWORDS: LDR, Solar Panel, Mirror Booster, Gear Motor, Tracking Mechanism.

I. INTRODUCTION

We need energy in various forms like heat, light, sound etc. The development of new technology made it possible to convert electrical energy into any form of energy. This gives electrical energy an important position in the world. The running of the modern industrial structure depends on the low cost and the uninterrupted supply of electricity. Our reliance on fossil fuels for energy is one of the most hotly debated issues of our generation. Since the extraction of these fuels it requires fuel, the returns have to be greater than the amount of energy invested. As oil wells reach their peak, oil no longer freely spouts out of the ground. It becomes increasingly difficult and expensive to pull to the surface. The extensive use of fossil fuels has resulted in the global problem of greenhouse emissions. Moreover, as the supplies of fossil fuels are depleted in the future, they will become increasingly expensive. Also they have resulted in huge pollution, solar energy is becoming more important since it produces less pollution and the cost of fossil fuel energy is rising, while the cost of solar arrays is decreasing. In particular, small- capacity distributed power generation systems using solar energy may be widely used in residential applications in the near future.

Solar tracker is an automated solar panel that actually follows the sun to increase the power. Solar panels are mainly made by semiconductor materials, which increase efficiency. Unless high efficient solar panels are used, the only way to enhance the performance is by increasing intensity of light falling on it. Solar trackers are the most appropriate and proven technology that increases the efficiency of the solar panel by keeping the panels always aligned with the sun. Even though technology for trapping solar energy is already in existence, the process proposes disused to increase the overall efficiency of the system. In this paper, we are introducing a new solar tracking mechanism with a mirror booster. Mirror increases the efficiency. Light Dependent Resistors are used as sensors of the solar tracker. The designed tracker has a precise control mechanism. The design and implementation methodology of a small prototype of single axis solar tracking system with a mirror booster is presented.

The power conversion interface is important to solar power generation systems because it converts the dc power generated by a solar cell array into ac power and feeds this ac power into the utility grid. An inverter is necessary in the power conversion interface to convert the dc power to ac power. Since the output voltage of a solar cell array is low, a dc power converter is used in a small-capacity solar power generation system to boost the output voltage, so it

can match the dc bus voltage of the inverter. The proposed work proposes a new solar power generation system is composed of solar tracking with mirror booster, a dc/dc power converter, battery storage system, and inverter. Maximum Power Point Tracking (MPPT) is a technique that Grid Tie Inverters (GTI), solar battery chargers and similar devices use to get the maximum possible power from one or more photovoltaic devices, typically solar panels. It is the purposes of the MPPT system to sample the output of the cells and apply the proper resistance (load) to obtain maximum power for any given environmental conditions. In this study, a prototype is developed and tested to verify the performance of the proposed solar power generation system.

II. BLOCK DIAGRAM

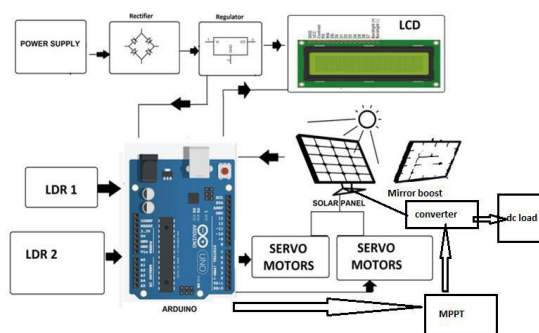


Fig : Block Diagram

III. WORKING PRINCIPLE

In the proposed technique we implemented a solar-based road cleaning robot to sweep the dust and unwanted waste in the roadways. In the project, design, and development of road cleaner robot which works on both automatic and manual mode. This robot is controlled by an Arduino controller. The multipurpose road cleaning machine has a wide range of applications. It can be used on all kinds of roads in rural as well as urban. Working on the basic principle of science, the project is a collaboration of mechanical, electrical, and electronic devices. To overcome the rising issues of cleanliness lines and manholes, removal of metal particles from road and also obstacles. The machine is an assembly of various rigid components, a chassis, some motors, microcontrollers, and various electromechanical devices whose working takes place on the various laws of physics and simple science. In this paper, our motive is to present a detailed qualitative study of cleaning system using the cleaner. One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform. Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

A. PV Module

Usually, several PV modules are arranged in series and parallel to meet the energy requirements. PV modules of different sizes are commercially available (generally sized from 60W to 170W). For example, a typical small-scale desalination plant requires a few thousand watts of power. A PV array consists of several photovoltaic cells in series and parallel connections.



Fig : 2. PV Module



Series connections are responsible for increasing the voltage of the module whereas the parallel connection is responsible for increasing the current in the array the most important component that affects the accuracy of the simulation is the PV cell model. Modeling of PV cell involves the estimation of the I-V and P-V characteristics curves to emulate the real cell under various environmental conditions. An ideal solar cell is modeled by a current source in parallel with a diode. However, no solar cell is ideal, and thereby shunt and series resistances are added to the model.

Typically a solar cell can be modeled by a current source and an inverted diode connected in parallel to it. It has its series and parallel resistance. Series resistance is due to hindrance in the path of flow of electrons from n to p junction and parallel resistance is due to the leakage current. When irradiance hits the surface of the solar PV cell, an electrical field is generated inside the cell. As seen in Fig.3 this process separates positive and negative charge carriers in an absorbing material (joining p-type and n-type).

In the presence of an electric field, these charges can produce a current that can be used in an external circuit. This generated current depends on the intensity of the incident radiation. Level of light intensity, the more electrons can be unleashed from the surface, the more current is generated.

B. Lead Acid Battery

The lead-acid battery was developed in 1859 by French Physicist Gaston planet and is the most established kind of Rechargeable battery. Despite having a low vitality to weight Proportion and a low vitality to-volume proportion, its capacity to supply high surge streams implies that the Cells have a moderately extensive energy-to-weight Proportion. This element, alongside their minimal effort, makes it appealing for use in engine vehicles to give the High current required via car starter engines. As they are cheap contrasted with more up-to-date advancements, lead-acid batteries are generally utilized not withstanding not vital and different plan utilized for capacity as a part of reinforcement force supplies in mobile phone towers, high accessibility settings like healing facilities, and stand-alone power frame works. For these parts, altered variants of the standard cell might be utilized to enhance stockpiling times and lessen support prerequisites. Gel-cells and consumed glass-mat batteries are basic in these parts, all in all, known as VRLA (valve-directed lead-acid) batteries.

Charging Sealed Lead Acid (SLA) batteries do not appear an especially troublesome procedure, but rather the critical step in charging a SLA battery is boosting the battery life. Basic consistent current/steady voltage chargers will carry out the occupation for some time, yet the battery future cited by the producer will be enormously decreased by utilizing non-clever chargers like this. Amplifying the life of your SLA battery by utilizing an insightful charger is not just practical, it is likewise better for the earth. Before taking a gander at the distinctive charging strategies it is vital to comprehend the battery science and what happens amid typical charge and release cycles. Normally the positive plates in a SLA battery are produced using lead dioxide and the negative plates from a wipe lead. The electrolyte is generally sulphuric corrosive blended with a gelling operator and is to a great extent consumed and held by protecting separators between the plates. When an SLA battery is being discharged; the lead (Pb) on the negative plate and the lead dioxide (PbO₂) on the positive plate are converted to lead sulfate (PbSO₄). At the same time, the sulphuric acid (H₂SO₄) is converted to water (H₂O). In a normal charge, the chemical reaction is reversed. The lead sulfate and water are electro-chemically converted to lead, lead dioxide, and sulphuric acid. During a full charge cycle any gasses produced need to be recombined in a so-called 'oxygen cycle'. Oxygen is generated at the positive plates during the latter stages of the charge cycle, this reacts with and partial discharges in the spongy lead of the negative plates. As charging continues, the oxygen produced also re-combines with the hydrogen being produced on the negative plate forming water. With correct and accurate cell voltage control all gasses produced during the charge cycle will be re-combined completely into the negative plates and returned to the water in the electrolyte.

C. ARDUINO UNO

The microcontroller is a computer on a chip. Micro suggests that the device is small, and the controller tells you that the device' might be used to control objects, processes, or events. Another term to describe a microcontroller is embedded controller, because the microcontroller and its support circuits are often built into, or embedded in, the devices they control. It is a temporary storage unit. Arduino is an open-source microcontroller that can be easily programmed, erased, and reprogrammed at any instant of time. Arduino uses hardware known as Arduino development board and software for developing code known as IDE. The microcontroller board used in our design is Arduino Uno actuators like motors, here we did not require any dumper kit to dump the program into the board Coming to the specification of Arduino Uno microcontroller board, it uses Atmega328p-pu as the main microcontroller, the operating

voltage of the board is 5v, the recommended input voltage and limit input voltage is 7v-12v and 6v-20v. It consists of 14 digital input/output pins, 6 PWM digital input/output pins, and 6 analog input pins, the dc current obtained from input/output pins is 20ma, and from 3.3v pin is 50ma. The case of the Arduino programming environment it containing a text editor for writing code. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function because the microprocessor is a natural way to implement many products.

IV. HARDWARE IMPLEMENTATION



Fig:3. Hardware Setup

In this project renewable energy has been used as the source for wireless power transmission. As the output from the renewable energy sources is low, we have to use a suitable step-up converter. By operating at resonant frequency and by achieving good coupling between the transmitter and receiver coil setup, the electrical energy gets transferred from transmitter coil to the receiver coil due to magnetic resonance between them.

V. CONCLUSION

This project has introduced the transmission of power wirelessly using the input from the solar panel. The proposed wireless power transmission using a high step-up dc-dc converter for PV cells has been built based on the simulation performed on MATLAB/ SIMULINK. The model uses the input from the solar panel and by using a high step-up dc-dc converter, the input of 12V has been stepped up to 70V which is then given as the input to the class E transmitter. The secondary or the receiver of the proposed model receives a DC output of 110V and the power delivered to the load is nearly 28W.

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