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Weather Condition based Solar tracking system with Automatic PV Cell Washer

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ABSTRACT:As population is increasing globally; we are very concerned for Electricity. There are various ways of electricity generation like Hydro power plant, Nuclear power plant, Windmill plants and also solar power plants. The former two are Non Renewable source of energy; hence we cannot depend only on such technology. Also Harnessing Energy from Hydro and Nuclear is equally difficult. The latter two are Renewable source of Energy; nowadays we have lots of power plants established on Solar and Wind Technology. Our project aims at Dual axis or Dual direction tracker. The Solar panel used in this system can adjust its direction both in X-Y co-ordinates. This helps better directivity with Sun rays, thus increasing the efficiency of the solar system.

KEYWORDS: Solar, Tracking, Wind technology.

I. INTRODUCTION

Solar-directed energy is perhaps the main environmentally friendly power source that has been acquired recently and is being considered more. Solar energy is the most accessible and abundant fraction of fuel sources. The amount of energy the sun provides in a day is enough to cover the world's energy needs for a year. Sunlight-based energy is pollution-free, so there are no unsafe consequences for the climate. Converting solar energy into electrical energy has many applications. Recently, there has been an increment in the innovative work of minimal expense level collectors, thin film devices, concentrator frameworks and numerous imaginative concepts. Son the expenses of little unit of sun-based force modules and sun-oriented force plants for the huge scope creation and utilization of sun-based force. In this article, we have introduced the usefulness of the sunlight based photovoltaic modules. The most ideal approach to build the productivity of a sun-oriented module is to utilize a maximum power point tracker, a force electronic gadget that incredibly increment effectiveness of framework. As, an outcome the framework works the greatest force point. Thus, a MPPPT amplifies network productivity in this way lessening in general framework costs. Furthermore, we are attempting to plan the MPPT with calculations of a choose MPPT technique which is, and notice carry out it with DC-DC converter. We found several types of DC converters. Among them, the most appropriate converter was selected. Our scheme is a buck converter. PV creation framework ordinarily utilizes a microcontroller-based charge regulator that is associated with battery and a heap. The charge controller is used to maintain the correct charge voltage battery. A decent strong and solid PV charge regulator is in this way a vital piece of any PV battery charging framework to accomplish most extreme proficiency. Solar-directed energy is perhaps the main environmentally friendly power source that has been acquired recently and is being considered more. Solar energy is the most accessible and abundant fraction of fuel sources. The amount of energy the sun provides in a day is enough to cover the world's energy needs for a year. Sunlight-based energy is pollution-free, so there are no unsafe consequences for the climate. Converting solar energy into electrical energy has many applications. Recently, there has been an increment in the innovative work of minimal expense level collectors, thin film devices, concentrator frameworks and numerous imaginative concepts. Son the expenses of little unit of sun-based force modules and sun-oriented force plants for the huge scope creation and utilization of sun-based force. In this article, we have introduced the usefulness of the sunlight based photovoltaic modules. The most ideal approach to build the productivity of a sun-oriented module is to utilize a maximum power point tracker, a force electronic gadget that incredibly increment effectiveness of framework. As, an outcome the framework works the greatest force point. Thus, a MPPPT amplifies network productivity in this way lessening in general framework costs. Furthermore, we are attempting to plan the MPPT with calculations of a choose MPPT technique which is, and notice carry out it with DC-DC converter. We found several types of DC converters. Among



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II. LITERATURE REVIEW

Huynh D.C & et. Al. [1], This article recommends a high-level aggravation and perception calculation to follow the greatest force point of a protective sun-based board. PV sun powered cells have a non-straight V-I gonalities with an Articulated MPP that depends non ecological factors like temperature and illumination. To consistently collect the greatest yield, form the photovoltaic sun-based board, it should consistently be worked on its MPP. The proposed P and O calculation can lessen the primary inconvenience as a role related with the P and O calculation. This is accomplished by deciding the short out current before each unsettling influence and perception step. The reproduction results got are contrasted and the MPPs are acquired with the customary P and O calculation under various environmental condition. Likewise, it is straight forward and can be hardly carried out in a computerized signal processor.

Grzexsaik [2], The paper concerns a PV charge regulator for cutting edge CdTe modules with a yield voltage much progressed than current upsides of the significantly degree of 12-24V. Since most of the ostensible voltage of remain solitary PV establishment ordinary stay at the level bit 12 or 24V because of accommodation, specialized article and battery properties, the voltage of this high DC module output to be DC changed into an appropriate lower extreme with alternatively high proficiency. Another uncommonly evolved 50-12V “Dual Axis Solar Tracking System Using MPPT Controller with Self Cleaning Mechanism” Department Of Electrical Engineering, JCEP, KM. Gad Page 4 charge regulator arrangements is introduced. The excellent of MPPT. Very acceptable recycling results indicate that resolution is interesting for the new market of high voltage modules.

Petchjatuporn. P and et. al. [3], This article offering development of a greatest force point following methodology utilizing fake organization for a sun-oriented energy framework. By utilizing a three-layer organization and a couple of basic beginnings capacities, the greatest force point of a sun-based module can be professionally followed. The following calculation incorporated into sunlight based monetized battery charging framework has been effectively figured it out. On a minimal expense of RISC PIC 16F876 microcontroller without the need of outer sensor unit. Test grades of productive sun orient board show.

Longxi. Chang & et. Al. [4], A fully integrated solar charger controller with input MPPT regulation protection for 10V to 28V solar-powered panel. IEEE June 2013. A completely controlled sun powered charge regulator highlighted in this article. This charger had a wide information voltage. Contribution of around 10 v to 28 v. For the sun-oriented board. Information circle controls is utilized here as MPPT insurance. This charger offers jumpers sorts of battery voltage. From around 4 v to 12 v. The regulatory framework utilizes signal blunder amplifier, and no outside reward system are required

III. PROBLEM STATEMENT, OBJECTIVE AND METHODOLOGY

Problem Statement

- The dual-axis solar tracker tracks the position of the sun in addition to following the suns movement.
- The dual-axis works similar to single axis but it captures the solar energy more effectively by rotating its axis along vertical and horizontal axis.
- Dual axis solar tracking system can be an effective way to increase the efficiency of solar cells.

Objective

- To design a dual axis PV system that tracks the sun path with MPPT controller.
- Design a cleaning mechanism that runs across the length of the panel.
- To Improve overall efficiency of the solar PV system

Methodology:

To understand the maximum power point tracking which helps to understand maximum solar power absorption concept?

- With mechanical technique we studied the dual axis solar tracker with electrical technique using MPPT controller.
- The Solar Photo Voltaic system gives non-linear output because of changes occurs in weather intermittence. So, to optimize the PV system output MPPT technique is used.



➤ To absorb maximum solar energy with the help of PV panels cleaning PV panels are also important. So, cleaning of solar panels is done with the help of stepper motor. This cleaning concept helps to absorb maximum amount solar energy.

IV. CONSTRUCTION AND MANUFACTURING

The complete assembly of parts is in frame structure. So, as to align the bearings properly while assembling, 12V lead acid battery is used for the energy storing purpose. Presence of sun i.e., in daytime battery is charged and used when it is necessary. PV panels absorb sunlight, and it generates electricity. For cleaning the solar panels DC motor used. According to Fleming’s left hand rule it generates electric current. And this electric current is converted to mechanical work. Pump is used to supply water required for cleaning. The converter normally used in PV system is a DC-DC converter. Make sure it delivers maximum power to the load. It depends on the structure of the converter provided. Solar panels convert 30-40% of solar radiation into electrical energy. Maximum power point tracking technique is absorbing maximum light intensity or solar radiation. It maximizes energy and increases overall productivity of the solar panel. In this proposed system perturb and observe (P&O) system is used for MPPT. This algorithm adjusted voltage by a small range then it measures energy using controller. Due to easy to implement and cost effectiveness, MPPT is mostly used. Servo Motor 2 Arduino Uno ATmega 328p-pu Solar Panel 12volt Servo Motor 1 DC-DC Converter (MPPT) LDR -1 LDR Load (Batt LCD 16 x 2 Relay Water Pump “Dual Axis Solar Tracking System Using MPPT Controller with Self Cleaning Mechanism” Department Of Electrical Engineering, JCEP, KM. Gad Page 13 AT MEGA 328P-PU gives low power controller and high performance from microchip. AT MEGA 328PPU is most popular 8-bit microcontroller used in Arduino board. Voltage divider circuit is used here which produces output voltage which is with-in of input voltage. By using ohms law current sensor measure the drop in voltage when current is sensed.

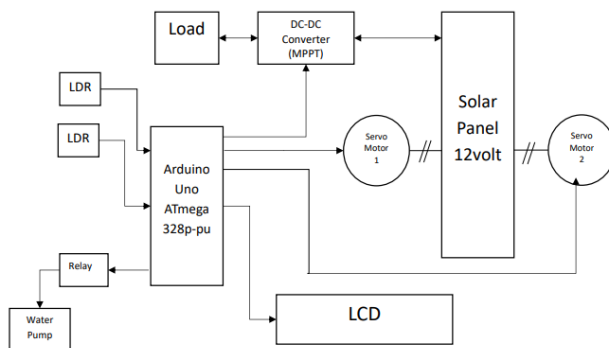


Figure 1- Concept diagram

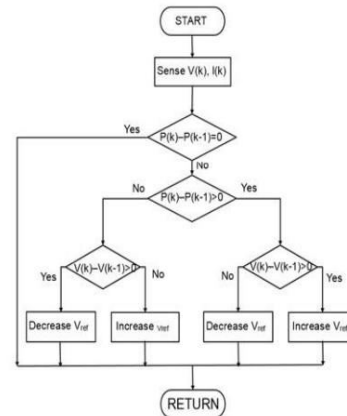


Figure 2- Block diagram

AT MEGA 328P-PU gives low power controller and high performance from microchip. AT MEGA 328PPU is most popular 8-bit microcontroller used in Arduino board. Voltage divider circuit is used here which produces output voltage which is with-in of input voltage. By using ohms law current sensor measure the drop in voltage when current is sensed. In this fig.2, first PV current and voltage are recorded. Power comes from the voltage and current of the solar panel. As the PV current increases, the output power increases. So, the reference current also increases, otherwise the reference current decreases. When the output power decreases as the solar panel current increases, the reference current decreases by one level. Otherwise, the reference current is increased by one level. If the power is increased, the disturbance is in the forward direction, otherwise the direction is reversed. Through this continuous process, PV modules can achieve maximum performance in all environmental conditions

Components used in System are:

Solar PV Panel: Solar energy is one of the most common renewable energy sources. It is critical to predicting and optimizing the performance and accuracy of solar energy system. Solar energy is clean and does not produce any pollutants. As we know the solar radiation changes over time of day, geographic location then the weather conditions. Therefore, the best way to increase the efficiency of solar panels is to use a maximum power point tracking system and a dual axis solar tracking system. Solar panels are made up of many solar cells. These cells are like a semiconductor



which is made by silicon. There are two layers in PV cells, one is positive layer and another one is negative layer. When sun rays falls down to the solar panel, particles of energy called photons is there. Those photons loose their energy that is electrons. As one knows there are two layers one is positive and one is negative and it forms an electrical circuit. The electrons flows into that circuit are nothing but electrical energy. This energy can be used to power a load. A load may be a light. PV cell generate the DC type electricity. The electricity generated by PV cells used for charging the batteries or power supply to the devices, which is operated on DC current. In transmission and distribution system electricity is in the AC form that is alternating current for this purpose inverters are used for conversion of DC power into AC power

Arduino UNO: Arduino UNO showing in fig.3. In this project ATmega328p-PU microcontroller is used. It is also called as Microchip. It consists of various digital input/output and analog input/output pins. Supply can be given to the Arduino by using USB cable. It is same as Arduino Nano and Leonardo. It can be supplied by using 5V adopter and also by using regulator ranging between 7 to 20V. It is very easy for using in hardware and software. It is used in automation system developing, in different circuit design. It is flexible and has a low cost, size is small. Language used for coding is C++.

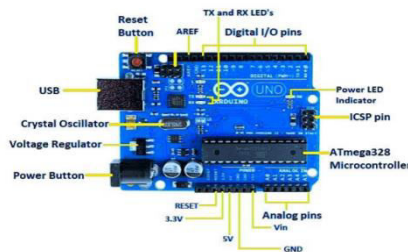


Figure 3- Arduino UNO

DC Servo Motor: The below fig. 4 is geared servo motor. A DC motor through closed loop control system. DC servo motor is mainly used as an automatic converter, serves as the servomotor. Due to its precise closed-loop control, it can be used in a varied variation of productions. The definition of in servo systems motor is used as a DC servo motor. A servo system is a closed loop system in which the response signal (acceleration, position, speed, etc.) energies the motor. These signal performances as an error and use the control to indicate the exact position or speed that has been reached. The motors are attached to a load shaft via a gear train designed for power adjustment. The servo motor performances as a mechanical transducer as it converts an electrical signal into a speed or angular position.



Figure 4- DC Servo Motor

Light Dependent Resistor (LDR) The fig.5 shows Light dependent Resistor LDR. It also called as photo resistor and photo-conductive cell. It is a passive device. Its main function is sensing the light intensity and it is electronic component. When the light intensity changes there is change in resistance. LDR is made by semiconductor materials which has high resistance. Resistance and sensitivity of LDR is dependent upon semiconductor material. LDR's are used in Night lighting, streetlamps, Alarms, etc., The understanding of light-dependent resistors or photo resistors also differs with the wavelength of the occurrence light.



Figure 5- Light Dependent Resistor (LDR)



Resistors: A resistor is nothing but the passive device. It is a two-terminal device. Its function is opposing the flow of current. If any component operates on less voltage, if there is a high voltage in this circuit, the resistor will create a voltage drop in this circuit. and ensures the component uses its required voltage. It is used for many applications such as minimizing the current, for adjusting the signal levels also for dividing the voltage. It is used for making the voltage divider circuit. Combination of Resistor and diode is used for voltage divider.

Capacitors: Capacitors have conductive plates separated by insulators or dielectrics. Capacitor is a device which stores the electrical energy. It is a manual device. There are 2 terminals. Capacitor consists of two plates that two plates is nothing, but the conductors and they are separated by isolator. It does not spend energy; it stores between its two plates. It is used in many electronic and electrical circuits. There are many applications such as; it is used for smoothing the output power. It is also used for stabilization of voltage and power, in this project polyester type capacitor is used of 0.1μ. The main purpose of using this capacitor is for harmonic reduction

Relay: The fig.2.17 shows the Relay. In this project the main purpose of relay is to ON-OFF the pump, which is used for cleaning mechanism. Working of relay is based on electromagnetic induction principle. Relay is nothing but the one type of switch, which is used for close and open the circuits electronically and by electromechanically. When there is need for controlling the more than one circuit then relay is used. Another use of relay is isolation purpose. You can isolate low voltage circuits from high voltage circuits. The application of relays is low-power circuits, which are used for the control of high-power and high-voltage circuits. The relay consists of number of contact and combination, and it consists normally close, normally open, control coil etc., Microprocessor used a relay for controlling the high load.

16x2 LCD Display: It is most used port in electronic based projects. The advantages of LCD display are its cost is very less and it is user friendly component. It has 16 columns and 2 rows hence it is called as 16X2 LCD display. In market there are other LCD displays are available such as 8 x 1, 8 x 2, 10 x 2, 16 x 1, etc. The 32 characters are shown by the 16X2 LCD display. The 16 x 2 screen has a total of 1280 pixels. This LCD displays the information by using MCU. This is happening by using CS817 interface, which is mounted back of the LCD display.

MPPT IMPLEMENTATION

The MPPT Program. MPPT continuously makes incremental variations in the voltage and monitor the changes in power. If the voltage changes increase output of the solar panel, disturbance follows in same direction. If the change in voltage the output of the solar panel is reduced, the next perturbation in the opposite direction. With this technology, the duty cycle of boost converter specifies voltage regulation of intermediate circuit between the photovoltaic generator and the converter. The algorithm associates the voltage of power and estimate the time (k) to use the sample at a specific point in time (k-1) and how long it will take to compute the maximum power point.

HARDWARE IMPLEMENTATION

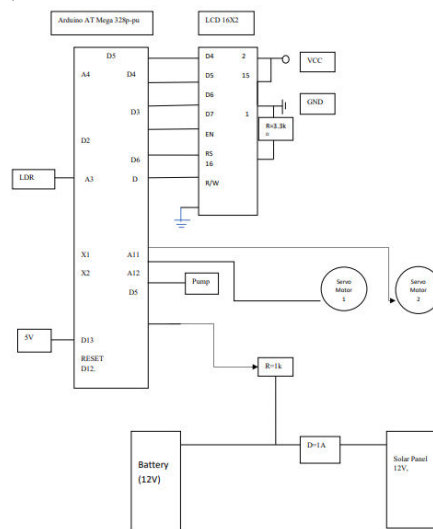


Figure 6: Circuit Diagram



WORKING: The fig. 6, showing the circuit illustration of Dual axis solar tracking system using MPPT controller with self-cleaning mechanism. The components used are a photovoltaic solar panel, a motor driver, an Arduino, a DC servomotor, a 16 × 2 display; Photovoltaic cells have two layers of semiconductor material with differing charges. When sunlight enters the cell, its energy hits electrons that exit through the two layers due to the reverse charge of the layers, electron should move from N shell to P shell, but the PN intersection makes an electric field. Any way an outside circuit associated with PV cell permits electrons to head out N to P. This electron streaming in the circuit give direct current. A normal sunlight-based board changes simply 30 over to 40 level of occurrence sun powered radiation into electrical energy. Greatest force point following strategy is utilized to work on the proficiency of sun-oriented board. As per MPPT innovation the yield force of circuit is greatest When the impedance of the source is coordinated with the impedance of the heap. On the supply side, boost converter relates to a sun powered board to work on the yield voltage. By suitably adjusting the obligation pattern of converter with a solitary PWM the impedance of source is received to stack impedance there are a few procedures of MPPT, however bother and notice calculations are utilized in this task. In this technique, regulator changes the voltage marginally by requesting that the organization measure the forces and if the force increments, further changes are endeavoured the beating until the force quits expanding. This P&O technique. The cell's voltage expands first, a breakdown power is created, and the voltage continues to expand until the breakdown power decreases. When the produce power starts to diminish voltage across a unit is decreased till it arrives at greatest force. This interaction proceeds until MPPT is gotten. If the force has expanded, it is expected that it has purchased the working place of MPP closer. In this way another voltage unsettling influence a similar way should move the working point to MPP. At the point of decreasing force, the working point moves away from the MPP, and the heading bit must rotate to return to the MPP. Keeping your solar panels clean is important to get the maximum amount of solar energy. Then clean the solar panel.

V. HARDWARE IMPLEMENTATION AND RESULTS

The figure shows the implemented hardware with all components is connected. The solar panel is connected on dual axis for sun tracking. Arduino Uno is connected is in circuit. LDR sensors are connected to Arduino uno as input to the Arduino. Two servo motors are connected on dual axis for movement of solar panel.



Figure 7- Hardware implementation

Table 1: Results

Lumens (lux)	Voltage (V)	Current (A)	Power (W)
342	9.78	0.11	1.08
476	10.22	0.15	1.53
543	11.11	0.21	2.33
643	11.54	0.27	3.12

VI. ADVANTAGES, LIMITATIONS AND APPLICATIONS

Advantages

1. Maximizing the solar system energy production and consequential up to 45% more energy.
2. The solar tracker delivers a rational solution in circumstances of limited power capacity of the assembly to the grid.



3. This is efficient and energy saving

Disadvantages

1. Dual axis solar tracker has technical complexity.
2. Lower performance in cloudy weather.

VII. CONCLUSION

1. Dual axis solar tracking system is additional effective than the single axis solar tracking system.
2. Mechanical system along with electrical system that is MPPT controller is provided in the design of DC-DC boost converter.
3. It is providing with self-cleaning technique which is insured cleaning on solar panel at consistent intervals.
4. It is also maximizing the energy generation, so it improves the overall efficiency of system
5. Problems facing for the hardware the DC motor we are using for pump is producing a back EMF and it stop working of all the components in project.

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