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Single Axis Solar Tracking System For E-Vehicle Charging Station

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Abstract: Renewable energy is quickly gaining importance as an alternative energy resource since fossil fuel are limited and their prices are very costly. The sole feature of the proposed methodology is the use to charge the electric vehicles with the help of renewable energy sources by using the MPPT tracking Algorithm .This project observes the potential benefits of having a single axis tracking for the solar panels which ensures maximum power point tracking (MPPT) taking solar rays as the only reference outline. Tracking is implemented through the use of LDR's and DC motors. The simulation of the tracking system has been provided using schematic modeling in proteus software. Buck – boost converter is used to regulate the voltage level according to the charging level of the electric vehicles. For controlling operations of the hardware, arduinoIDE is programmed and installed. In this paper, the microcontroller named 'Arduino UNO (Atmega 328)' is utilized to give the signal to the motor that will move the solar panel along with the sun to gain maximum sunlight angle. With the implementation of the proposed system, the energy efficiency can be increased by 20% - 25% than the existing system with very less consumption of the system itself.

Keywords: Electric vehicles, Solar panel, Solar tracker

I. INTRODUCTION

With the depletion of non-renewable sources in the near future, the investigators and investors have changed the focus in the field of renewable energy sources. Among the different type of renewable energy sources, hydropower, bio-fuel, wind power, tidal power, sun power and power from the earth are the important power sources. Because of the perpetual property of renewable sources, they are encouraged for the replacement of fossil fuel sources. Among these energy sources, solar power is one of the most accessible mode of renewable energy. Due to the exploration and evolution growth, PV cell material with their better execution is improved and cost is also reduced. Therefore nowadays, this energy source has been widely used for housing and industrial purpose. Solar photovoltaic energy is very much predictable to become a main source of power in the future.

As discussed earlier that the output of PV module depends over the certain characteristics. Thus, to enhance the efficiency of Module or in order to harness the larger amount of electricity one has to deal with the characteristics on which the output depends. By providing solar tracking system to a PV module the respective output can be enhanced. The sunlight falls over the module can produce the maximum power at the times when the sun rays are perpendicular to the module surface. This will tend to maximize the amount of power radiated by the sun. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% - 60%.

A solar panel under an open circuit is able to supply a maximum voltage with no current, while under a short circuit is able to supply a maximum current with no voltage. In other case, the amount of power supplied by the solar panel is zero. The key is to develop a method whereby maximum power can be obtained from the voltage and current multiplied together. The point where the maximum power from the system can be obtained is called Maximum power point, to track that point during the sunshine hours is called as Maximum Power Point Tracking (MPPT).Nowadays E-vehicles have also becoming the fastest growing section in automobile industry, it needs a place to get re-charged. With this solar tracking concept, it can be easily interfaced with the charging station and it can be easily incorporated.

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II.WORKING DESCRIPTION

The system has various components present in it and it has two sections tracking and charging sections. The power output of the PV panel gets increased by implementing the tracking section and the energy gets stored and the E-vehicle gets charged by the charging section.

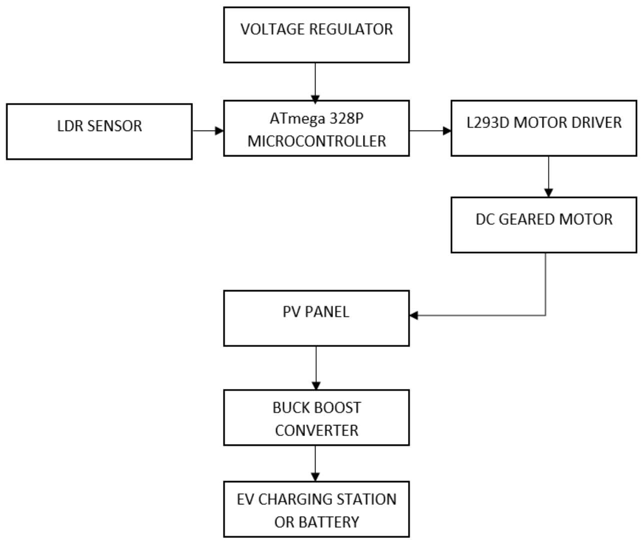

Figure 1: Block Diagram

A) LDR Sensor:

LDR is an active component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident light intensity; in other words, it exhibits photoconductivity.

Figure 2: LDR Sensor Module

B) Arduino UNO:

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE via a type B USB cable.

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Figure 3: Arduino uno

C) L293 Motor Driver:

L293D is a monolithic integrated, high voltage, high current, 4-channel driver. Basically, this means using this chip you can use DC motors and power supplies of up to 16 Volts, thats some pretty big motors and the chip can supply a maximum current of 600mA per channel, the L293D chip is also what's known as a type of H-Bridge. The H-Bridge is typically an electrical circuit that enables a voltage to be applied across a load in either direction to an output

Figure 4: l293 motor driver

D) DC Geared Motor:

Gear motor refers to a combination of a motor plus a reduction gear-train. These are often conveniently packaged together in one unit. The gear reduction reduces the speed of the motor, with a corresponding increase in torque. A small ratio can be accomplished with a single gear pair, while a large ratio requires a series of gear reduction steps and thus more gears.

E) PV Panel:

A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

F) Buck Boost converter:

A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

IV. PROGRAMMING

The programming for the Arduino to control the DC Geared motor through LDR module has been done in Arduino IDE (Integrated Development Environment) and the code for the program has been given below.

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```
void setup()
{
pinMode(10, OUTPUT);
pinMode(8, OUTPUT);
pinMode(9, OUTPUT);
pinMode(2, INPUT);
pinMode(3, INPUT);

Serial.begin(9600);
}
void loop()
{
if (digitalRead(2) == HIGH)
{
digitalWrite(10, 1);
digitalWrite(8, LOW);
digitalWrite(9, HIGH);
}
if (digitalRead(3) == HIGH)
{
digitalWrite(10, LOW);
digitalWrite(10, 1);
digitalWrite(8, HIGH);
digitalWrite(9, LOW);
}
if (digitalRead(2) == digitalRead(3))
{
digitalWrite(10, LOW);
}
delay (1000);
}
```

Step 1: Get the input from the LDR 1 and LDR 2.

Step 2: Send these two inputs to the digital pins 2 & 3 of Arduino uno.

Step 3: From the program the microcontroller will compare the two digital inputs.

Step 4: The microcontroller will act accordingly and send the output signals.

Step 5: The output signals will be sent through pins 8, 9 & 10 to the motor driver.

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Step 6: The DC geared motor is connected through the output pins of the motor driver.

Step 7: let output value of LDR 1 is V1 and value of LDR 2 is V2.

Step 8: If V1>V2 or V1<v2 motor will rotate until V1=V2

V. SIMULATION

The simulation has been done using the Proteus Design Suite and all the components has been included in it. A comparator is used for converting the analog signal of the LDR to a digital one. Libraries for Arduino uno has been put into the root of proteus program.

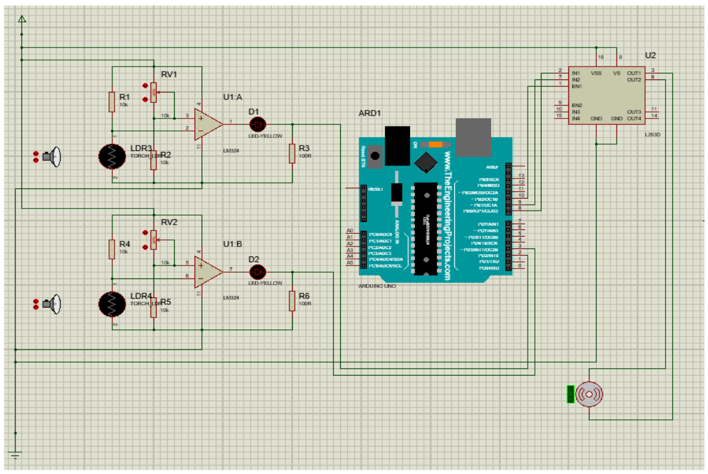

Figure 5: Simulation diagram

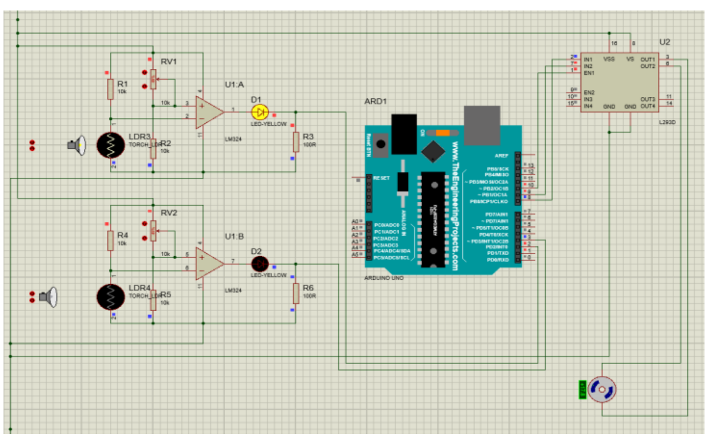

Figure 6: Simulation output 1

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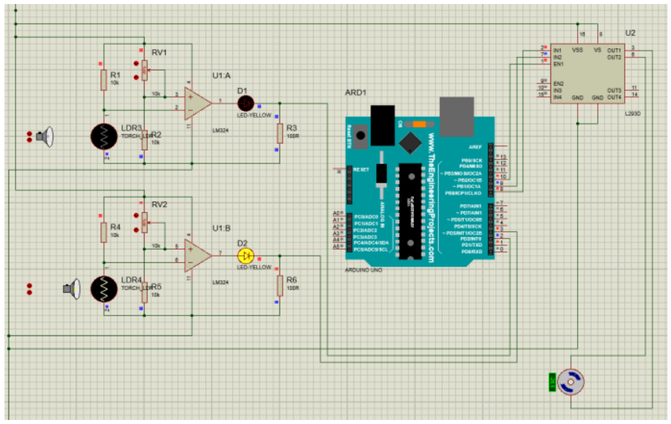

Figure 7: Simulation output 2

V. RESULT & CONCLUSIONS

Thus the design and simulation of single axis solar tracking device for EV charging station is designed and implemented. For tracking ability test of this prototype, we have used the movement of torch light. For light tracking, gear motor is also appropriately used, by which to provide a wide range of PV panel movement. The comparison between single axis tracking system and fixed mounting based PV systems

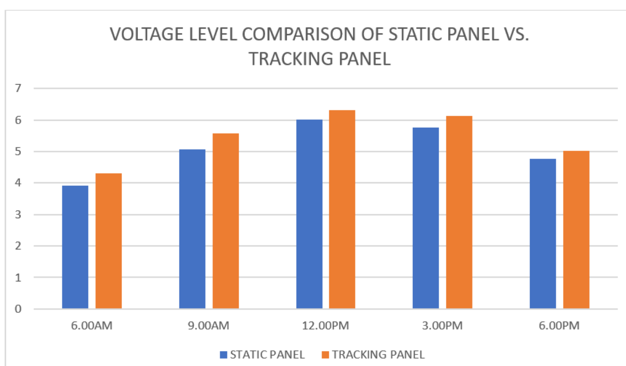

Figure: 8 voltage comparison

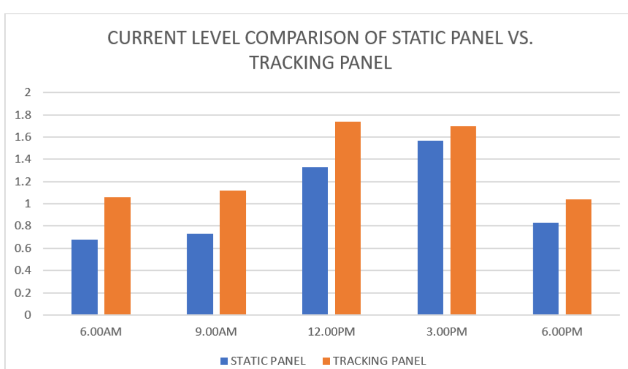

Figure : 9 current comparison

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For a single axis solar tracking system, an efficient method of tracking has been developed and applied to 10W, 12V solar panel implemented through a MPPT algorithm.

By the implementation of this method, the efficiency can be improved by 35-40% when compared to the existing system.

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