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Sun Tracking System with Automatic Cleaning of Solar Panels using Arduino Atmega

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Abstract: ***In this paper, we have combined the Sun tracking system and automatic cleaning of PV module for the solar panels. This tracking mechanism is based on the angle of rotation of earth around its own axis. The sun tracking system enables the panels to follow the sun direction with the use of LDR (Light Dependent Resistor) there is an automatic cleaning system that helps to reduce the risk of accidents as there is no involvement of humans in the cleaning of solar panels. The presented tracking-cum-cleaning system provides more energy output compared to the flat PV module. The cleaning system cleans the panels after a particular time of intervals by cleaning the dust and other particles accumulated on the panels. Due to this, the panels are able to trap most of the sunlight. This makes the solar panels more efficient. This system enhances clean and emission-free power production.***

Keywords: Photovoltaic (PV) panel, Sun Tracking System, dust accumulation; automatic cleaning. Pocket Friendly.

I. INTRODUCTION

Solar energy is the transferable form of heat energy, the energy that comes from the sun. Solar energy is the purest and occurring in a large number of renewable energy sources available. It has been used for years ago in many different ways by people all over the world. Solar energy could be converted into usable forms, it would be sufficient to supply the world‘s energy demand. However, this is not possible because of this kind of the conditions in the atmosphere such as the effect of clouds, dust, and temperature. Solar energy can be converted to more usable energy forms through the solar panel. Radiation comes from the sun are gathered on solar panel and actively convert that energy to electricity. Solar panels are made up of comprised of various individual solar cells. Solar PV Panels use solar energy from the Sun to generate electric power through the photovoltaic effect. Solar panels are the most promising source of method of extracting solar energy from the sun. In the steady solar panels, the solar cells in solar panels trap most of the sunlight in the afternoon time when the sun rays are directly incident on the panels. So there is a transformation of sunlight into electricity is maximum on noon time only.

A. Tracking System

So there is a need for a tracker to track the sun direction so that the more amount electricity will be generated whole day till evening when the sunsets. So this sun tracker tracks the sun direction using the LDRs (Light Dependent Resistor). This makes panels most of the time nearly perpendicular to the sun’s direction. Therefore, the sun tracker is good and efficient to traps the maximum amount of sunlight. The efficiency of the solar panels is reduced due to the accumulation of dust and other particles. These particles cover the solar panels so that the sun rays are not fully incident on the solar panels and hence the solar panels are not fully capable of capturing the sun rays. But in areas having sand and dusty reasons have more problem of accumulation of dust on the panels. So there is a need for cleaning solar panels after a regular time interval.

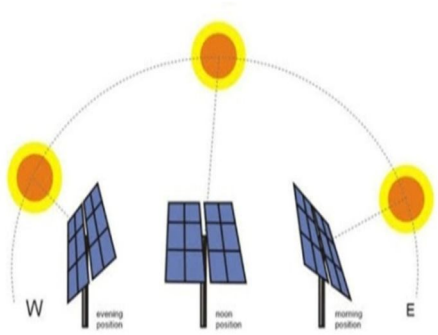

Fig.1.Illustration of Sun Tracking System [9]

B. Cleaning System

Traditionally, the cleaning of the solar panels done manually using human labor. Due to this, there is a risk of human lives, damage to panels, movement difficulties, etc. To overcome these difficulties arises due to traditional cleaning method and also to create a productive, non-comparable and to avoid the traditional manual cleaning system. This automatic cleaning system cleans the solar panels in such a way that there is no involvement of human labor and reduces the chances of accidents and risk of human life and damage of solar panels. This automatic cleaning system enhances the efficiency of the solar panels as the dust accumulated doesn't harm the panels and most of the sunlight gets trapped by the panels to produce a maximum amount of electric energy through solar energy.

The efficiency of the panels is checked when there is an accumulation of dust on the panels after 1 week or 2 weeks and the efficiency of panels is checked after cleaning the solar panels for some time intervals. After comparing both the efficiencies, we can show that the efficiency of the solar panels increases when the panels are cleaned after a regular interval of time in a day.

So, the main motive of this project is to traps the maximum amount of solar energy in a day by tracking the sun direction and to protect the panels and increase its efficiency by cleaning the panels without damaging the panels and avoiding the risk and accidents that occur during the traditional manual method.

Fig.No.2: Cleaning Arrangement

C. Need

Solar energy is abundant in nature and renewable forms of energy. So, there is a need for a maximum amount of energy that can be generated through the Sun's radiation. In recent days, solar power generation technologies have rapid growth and achieved a great height in power generation. For achieving the maximum amount of power generation from the solar panels there is a need for panels to be faced towards sun most of the time during day time. The energy conversion efficiency of the PV array is affected by the PV panel's orientation i.e. tilt angle, time of the sunshine, and dust accumulation. Likewise, there are some more of these drawbacks faced by the fixed solar panel system that leads to the acceptance of sun tracking-cum-cleaning system for better efficiency.

D. Problem Identification

1) Efficiency is low as the panel cannot be tilted according to change in sun direction.
2) Also, setting the solar panel fixed in a particular direction limits the catching of solar radiations to that particular time zone, which determines the amount of solar radiation received by the surface of a PV module.
3) Another major obstacle in the performance of solar panels is the dust accumulation on the panels.
4) The accumulation of dust on the surface of solar panels reduces the glass cover transmittance and hence decreases the amount of solar irradiation reaching the panel cells.

E. Objectives of this Project

1) To maximize the use of solar radiation for the production of solar power.
2) To avoid the risk created through manual cleaning.
3) To clean panels efficiently.
4) To avoid dust-related problems on the panels.
5) To track the Sun's direction throughout the day.
6) To make the system automated using the Arduino Atmega.

II. COMPONENTS USED

A. *Pin Configuration*

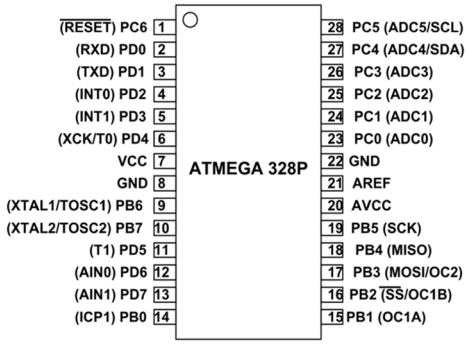

Fig.3: Pin configuration of Arduino Atmega[10]

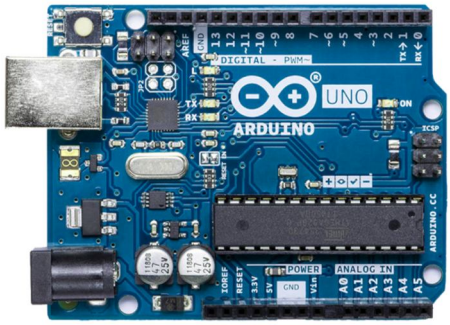

Fig.4: Arduino Atmega[11]

Arduino Atmega328 is 28 Pins and 8-bit AVR Microcontroller, which was manufactured by Microchip, follows RISC Architecture, and has a flash memory of 32KB. It consists of an EEPROM of 1KB and its SRAM is 2KB. It has 8 Pin for ADC operations, which all combine to form Port-A (PA0 - PA7). It has two 8 bit inbuilt timers and one 16 bit inbuilt timer. UNO is based on Atmega328 Microcontroller. It's UNO's heart. It operates on 3.3V to 5.5V but normally we use 5V as a standard. Its excellent features include low power dissipation, cost-efficiency, programming lock for security purposes, real timer counter with a separate oscillator. It uses Embedded Systems applications.

B. *Servo Motor*

The servo motor varies from the fraction of watts and the rotating power rating have low. The rotor of the motor is the low and high speed of response. The rotor of the motor smaller in dimension and the long length. It operates at low speed sometimes may zero speed. The gear connected to a mechanical shaft of the motor. It could be handled any industrial load. The gearbox acts as the mechanical transducer to convert the output of the motor in form of position based on applications. It senses the position of the rotor and then acts according to the rotor position.

Fig.5: Servo Motor Metal Gear [12]

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C. LDR Sensor

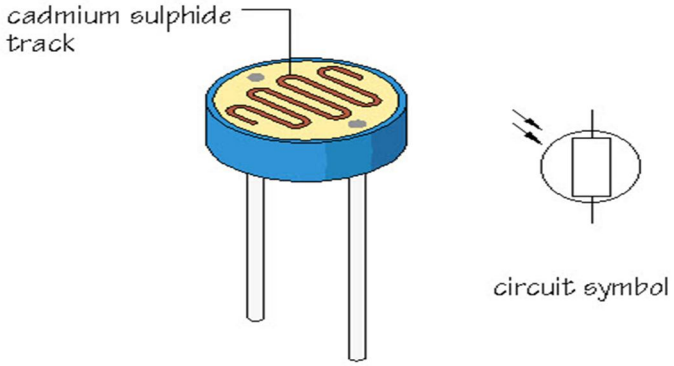

Fig.4: LDR Sensor[13]

Light dependent resistors, LDRs or photoresistors are used to detect the presence of light. Light dependent resistor or LDRs are also known as photoresistor, or even photo cell, photocell or photoconductor. The LDRs or photoresistors are used in various electronics device designs. LDR provides a larger change in resistance in change in the light. They have low cost, ease in production, and easy to use , LDRs are used for different kinds of applications. At one time LDRs are used in photography light meters, and today they are used in various applications where there is detection of light.

D. DC Geared Motor

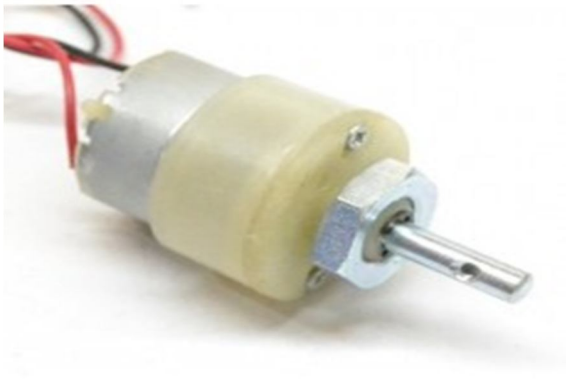

Fig.6: DC geared motor

1) RPM: 60
2) Operating Voltage: 12v
3) Gearbox: Attached Plastic Gearbox
4) Shaft diameter: 6mm with internal hole
5) Torque: 2 kg-cm
6) No-load current: 60 Ma
7) Load current: 300 mA

DC Motor – 60 RPM / 12 Volts geared motors are simple DC motors. Generally, they are attached with the gear. This can be used in all robots and a variety of mm threaded drill holes in the middle of the shaft, making it simple to connect it to the wheels or any other mechanical assembly. These motors are widely used for robot applications. these motors are very easy and available in different sizes. Also, these can be easily available in the market and easily replaceable. DC Geared motors with metal gearbox for heavy applications, available in the wide RPM range and it is suited for robotics and industrial applications which is easily adjustable in such kind of application. Nut and threads with proper arrangements are provided on the shaft to easily connect and internally threaded shaft for easily connecting it to the wheel.

III. APPLICATIONS

A. Photovoltaic power stations
B. Rooftop solar PV systems
C. Standalone PV system
D. Solar vehicles
E. Solar panels on spacecraft and space stations
F. Solar planes
G. Solar hybrid power systems
H. It is mostly used in desert areas where accommodation of dust is frequent on the solar panel.
I. In Solar power plants which are located near to mining area

IV. CONCLUSION

From this project, we have learned that the most important factors are the position of solar panel and the cleanness of the surface of the panel. If the panel facing the sun at an optimum angles the output power increases. But the surface of the panel accumulates dust over time the output decreases significantly. The condition of panel surface depends on the weather conditions. It has low price, making it very competitive for the world market.

In this project we tried to tackle this issue by automating the procedure of cleaning and adjusting the angle of solar panel. From, the observation we can conclude that the power output increased significantly without any human intervention. Also we can conclude that the implementation of this system is possible in practical.

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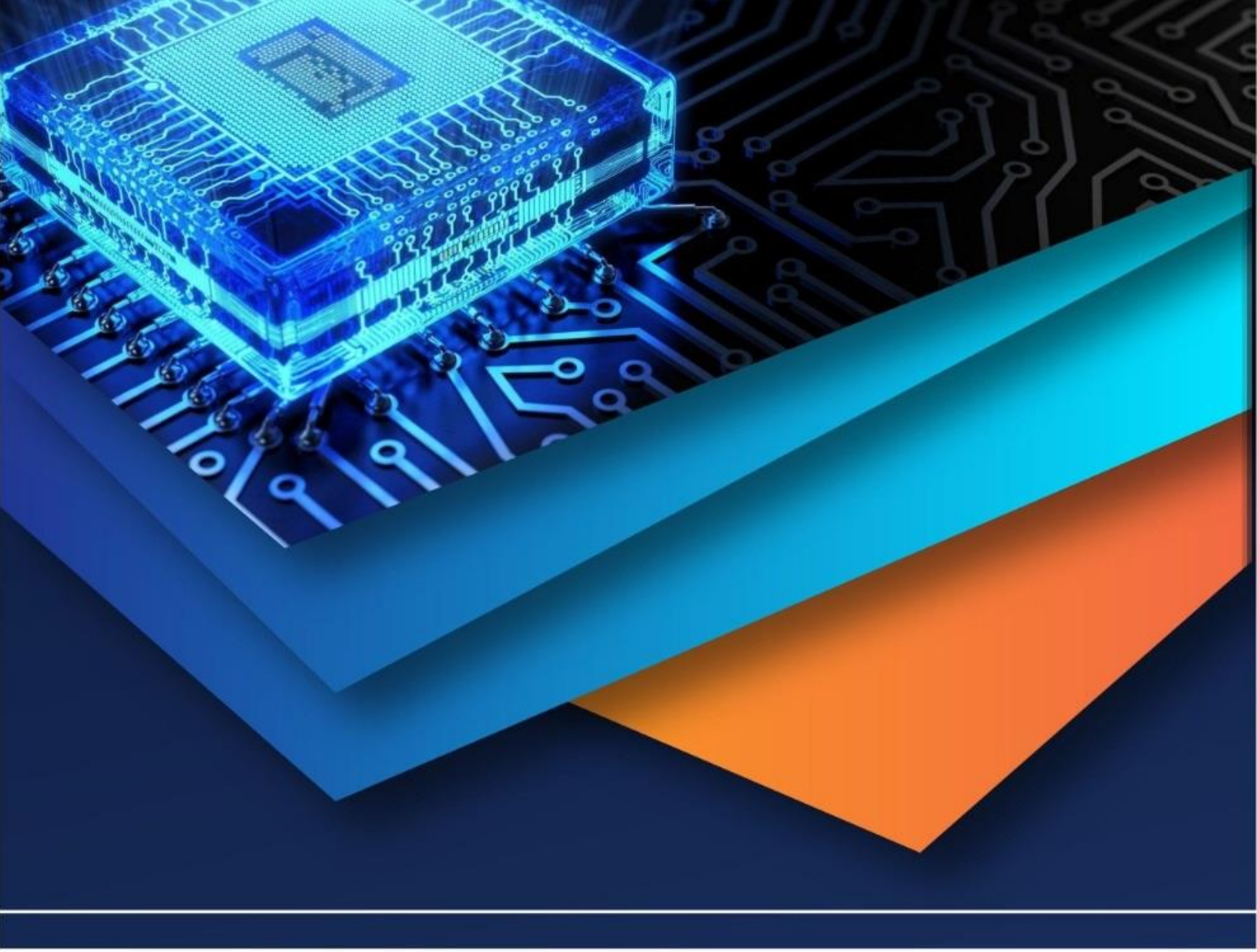

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