Efficient Power Generation Based on Solar Tracking System with Panel Cleaning Mechanism

Dr.B.Chandrasekaran[1] S.Naveen[2] S.Chaitanya Raghu[3] V.Sai Ganesh Sanghi[4]
[1]Assistant Professor [2,3,4]B.E. Student
[1,2,3,4]Department of Electronics and Communications Engineering
[1,2,3,4]Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, India

***Abstract*—** The aim of this paper is to give an innovative concept to handle energy demand around the world is increasing rapidly for many applications. Renewable sources of energy are solar, wind and geothermal which are inexhaustible. Solar energy is abundant in nature and is proving its existence for many applications like street lighting, house hold appliances, water heating, agricultural and industrial purpose. One of the way to harness solar energy is done by using solar panels. Limitation of solar energy is its efficiency for any application due to the factors like dust, humidity, temperature etc. Electrical parameters of solar panel are sensitive to accumulated dust density and will affect the transmittance of the solar panel thereby reduce its efficiency. In order to overcome this problem, it is necessary to clean the solar panels regularly. One of the method is to increase the efficiency of solar panel is by removing the dust accumulated on solar panel. Cleaning of solar panels is difficult task. The normal way to clean the solar panels is washing them manually but it is not reliable and economical. In this regard a work is taken up to design and implement the automatic dust cleaning mechanism for solar panel. The designed automatic cleaning mechanism consists of IR LED, Photo diode arrangement in order to sense the dust accumulated on solar panel. The efficiency of solar panel is determined by taking the readings of voltage and current of particular panel with and without dust for various days, weeks and months. By the recorded values efficiency comparison of solar panel with dust and without dust is made. The designed automatic cleaning system produces an effective, non-abrasive cleaning and avoids irregularities in the generation of power due to the deposition of dust on the solar panel. From the study it is proved that average efficiency of solar panel increases about 1.6% to 2.2% by regular cleaning. Thus developed model maximizes the efficiency.

Keywords: Arduino MEGA; LDR; Photovoltaic (PV) panel; Solar Tracking System; voltage and current Sensor; Humidity and Temperature (DHT 11) Sensor; NodeMCU(IoT)

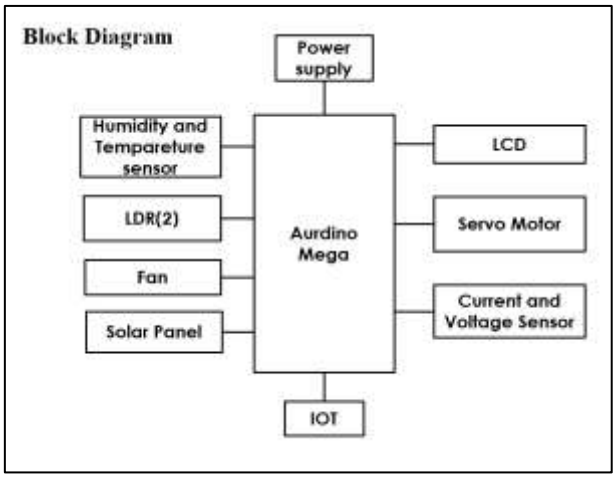
I. INTRODUCTION

Arduino based solar panel automatic cleaning system for those area where dust effect on solarpanel. By many reason the efficiency of solar energy can be decreased. Such that dust from environment, bird shit or any other small obstruction. The system will clean the solar panel asour preprogrammed schedule. The project designed by using ATmega 328 microcontroller with an Arduino MEGA, relay module to control the motor. The design and construction is reliable that it won't hamper for solar power consumption. The whole construction need a little place so it can be attached with solar panel very easily. As this project will operate by automatically so it is designed as user friendly.

As designed, the motor will convert electrical power into mechanical output which will rotatethe iron frame and coupling point. By rotating automatically it will clean the solar panel for a certain period of time. For the first step the wiper will move to forward side of the solar paneland after that it will reverse back to the solar panel. Then it will take a delay time of 24 seconds in our prototype project (which will take 24 hours in real implementation). After that the system will again clean the solar panel as follow the above methodology. User can changethe delay time of cleaning system after how much of time the system will run. The systemwill run with some Arduino software based code in which the delay time can be increased or decreased.

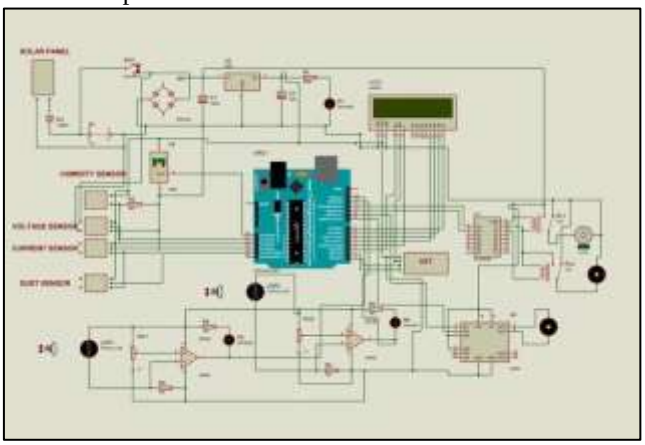
II. PROPOSED SYSTEMS

The maximum efficiency of a solar panel is extracted using two combined techniques. The first one we have to implement is a micro-controller based Solar-tracking system. The system checks the position of the sun and controls the movement of a solar panel so that radiation of the sun comes normally to the surface of the solar panel and the second is to install an MPPT charge controller which makes the Inverter to work at maximum power point. So that under any climatic conditions maximum power is extracted. This way we make efficient use of both solar panel and solar-energy from sun. There are different methods of tracking out the power form the panel as discussed above.



As mentioned in above topic we came to know that the project concept aims at extracting maximum power from solar panel by using light sensors (LDR'S).And by the status of LDR's the panel rotates with the help of 3.5V dc Motor in any direction and if the sunlight is more in any direction then it rotates to that direction. The output from panel is derived to an DC-DC Boost Converter which is used to increase the voltage without change in current rating their by increasing the battery charging condition. Where the output is given to Battery which is used to drive loads in failure of supply and

in day times from panel after boost converter. The panel is also provided with temperature and humidity (DHT 11) sensor, Voltage sensor and Current sensor. The sensors sense the respective parameters and data is sent to the monitoring unit as well as in shown on LCD screen. When the Temperature is high enough the microcontroller switch on the Fan by using the power derived from the solar Panel. The whole setup is provided by a dust sensor which sensor the dust on the panel. The dust sensor and LDR's helps in increasing the efficiency of the solar panel.



III. Problem Statement and Objective

Renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. At the educational level, it is therefore critical for engineering and technology students to have an understanding and appreciation of the technologies associated with renewable energy. One of the most popular renewable energy sources is solar energy. Many researches were conducted to develop some methods to increase the efficiency of Photo Voltaic systems (solar panels). One such method is to employ a solar panel tracking system. This system deals with a RTC based solar panel tracking system. Solar tracking enables more energy to be generated because the solar panel is always able to maintain a perpendicular profile to the sun's rays. Development of solar panel tracking systems has been ongoing for several years now. As the sun moves across the sky during the day, it is advantageous to have the solar pane track the location of the sun, such that the panels are always perpendicular to the solar energy radiated by the sun. This will tend to maximize the amount of power absorbed by PV systems. It has been estimated that the use of a tracking system, over a fixed system, can increase the power output by 30% -60%. The increase is significant enough to make tracking a viable preposition despite of the enhancement in system cost. It is possible to align the tracking heliostat normal to sun using electronic control by a micro controller.

Design requirements are:

1) During the time that the sun is up, the system must follow the sun's position in the sky.
2) This must be done with an active control, timed movements are useful. It should be totally automatic and simple to operate.

The operator interference should be minimal and restricted to only when it is actually required. The major components of this system are as follows.

1) Solar Panel
2) LDR'S
3) DC motor.
4) Temperature sensor
5) Humidity sensor
6) Aurdino MEGA
7) Current sensor
8) Voltage Sensor
9) Nodemcu

IV. Literature Survey

A. Technology of Solar Panel

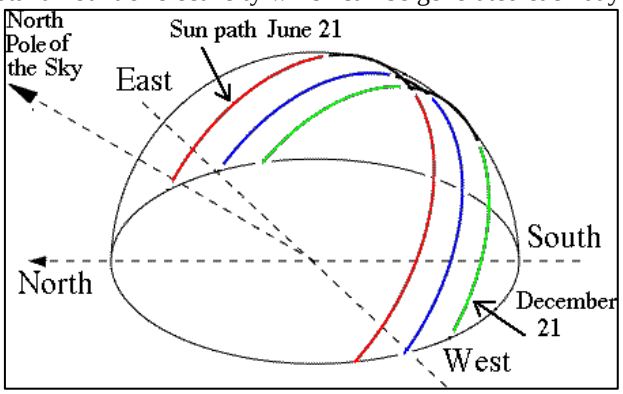
Solar panels are devices that convert light into electricity. They are called solar after the sun or "Sol" because the sun is the most powerful source of the light available for use. They are sometimes called photovoltaic which means "light-electricity". Solar cells or PV cells rely on the photovoltaic effect to absorb the energy of the sun and cause current to flow between two oppositely charge layers. A solar panel is a collection of solar cells. Although each solar cell provides a relatively small amount of power, many solar cells spread over a large area can provide enough power to be useful. To get the most power, solar panels have to be pointed directly at the Sun. The development of solar cell technology begins with 1839 research of French physicist Antoine-Cesar Becquerel. He observed the photovoltaic effect while experimenting with a solid electrode in an electrolyte solution. After that he saw a voltage developed when light fell upon the electrode. According to Encyclopedia Britannica the first genuine for solar panel was built around 1883 by Charles Fritts. He used junctions formed by coating selenium (a semiconductor) with an extremely thin layer of gold. Crystalline silicon and gallium arsenide are typical choices of materials for solar panels.

Gallium arsenide crystals are grown especially for photovoltaic use, but silicon crystals are available in less-expensive standard ingots, which are produced mainly for consumption in the microelectronics industry. Norway's Renewable Energy Corporation (REC) has confirmed that it will build a solar manufacturing plant in Singapore by 2010-the largest in the world. This plant will be able to produce products that can generate up to 1.5 gigawatts (GW) of energy every year. That is enough to power several million households at any one time. Last year, the world as a whole produced products that could generate just 2 GW in total.it was implemented with a dc motor and a dc motor controller. The solar energy conversion unit consisted of an array of solar panels, a step up chopper, a single phase inverter, an ac mains power source and a microcontroller based control unit.

B. Evolution of Solar Tracker

Since the sun moves across the sky throughout the day, in order to receive the best angle of exposure to sunlight for collection energy. A tracking mechanism is often incorporated into the solar arrays to keep the array pointed towards the sun. A solar tracker is a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. When compare to the price of the PV solar panels, the cost of a solar tracker is relatively low.

Most photovoltaic (PV) solar panels are fitted in a fixed location-for example on the sloping roof of a house, or on framework fixed to the ground. Since the sun moves across the sky though the day, this is far from an ideal solution. Solar panels are usually set up to be in full direct sunshine at the middle of the day facing South in the Northern Hemisphere, or North in the Southern Hemisphere. Therefore morning and evening sunlight hits the panels at an acute angle reducing the total amount of electricity which can be generated each day.



C. Suns Apparent Position

During the day the sun appears to move across the sky from left to right and up and down above the horizon from sunrise to noon to sunset. Figure 1 shows the schematic above of the Sun's apparent motion as seen from the Northern Hemisphere. To keep up with other green energies, the solar cell market has to be as efficient as possible in order not to lose market shares on the global energy marketplace. There are two main ways to make the solar cells more efficient, one is to develop the solar cell material and make the panels even more efficient and another way is to optimize the output by installing the solar panels on a tracking base that follows the sun. The end-user will prefer the tracking solution rather than a fixed ground system to increase their earnings because:

- The efficiency increases by 30-40%
- The space requirement for a solar park is reduced, and they keep the same output
- The return of the investment timeline is reduced
- The tracking system amortizes itself within 4 years (on average)

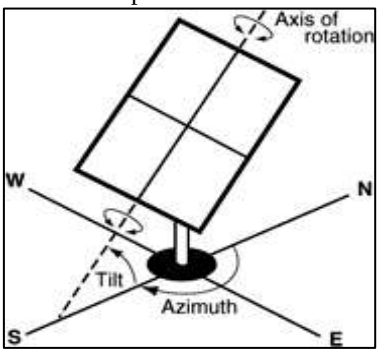
In terms of cost per Watt of the completed solar system, it is usually cheaper (for all but the smallest solar installations) to use a solar tracker and less solar panels where space and planning permit.

V. SOLAR TRACKERS

There are many different types of solar tracker which can be grouped into single axis and double axis models:

A. Single Axis Trackers:

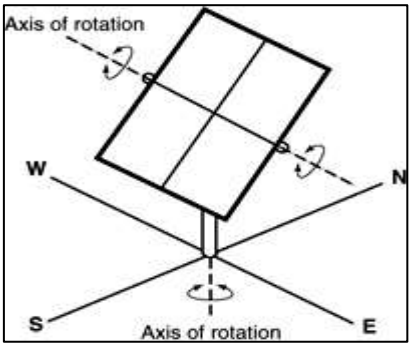
single axis solar trackers can either have a horizontal or a vertical axle. The horizontal type is used in tropical regions where the sun gets very high at noon, but the days are short. The vertical type is used in high latitudes (such as in UK) where the sun does not get very high, but summer days can be very long. These have a manually adjustable tilt angle of 0-45 degrees and automatic tracking of the sun from east to west. They use the PV modules to themselves as light sensor to avoid unnecessary tracking movement and for the reliability. At night the trackers take up a horizontal position. This kind of tracker is most effective at equatorial latitudes where the sun is more or less overhead at noon. Due to the annual motion of the earth the sun also moves in the north and south direction depending on the season and due to this the efficiency of single-axis is reduced since the single-axis tracker only tracks the movement of sun from east to west. During cloudy days the efficiency of the single axis tracker is almost close to the fixed panel.



One axis tracking PV array with axis oriented South

B. Dual Axis Trackers:

In dual-axis tracking system the sun rays are captured to the maximum by tracking the movement of the sun in four different directions. The dual-axis solar tracker follows the angular height position of the sun in the sky in addition to following the sun's east-west movement double axis trackers have both a horizontal and a vertical axle and so can track the sun's apparent motion exactly anywhere in the world. This type of system is used to control astronomical telescopes, and so there is plenty of software available to automatically predict and track the motion of sun across the sky. When the sun moves in the northern direction the tracker has to track the path of the sun in anti-clockwise direction along the horizontal axis (east to west). If the sun moves in the southern direction then the tracker has to track the path of the sun in clockwise



Dual axis solar trackers track the sun in both directions i.e. from east to west and north to south for added output power (approx. 40% gain) and convenience

VI. SOLAR TRACKER COMPONENTS

1) Sun tracking algorithm: This algorithm calculates the solar azimuth and zenith angles of the sun. These angles are then used to position the solar panel or reflector to point toward the sun. Some algorithms are purely

mathematical based on astronomical references while others utilize real- time light-intensity readings.

2) Control unit: The control unit executes the sun tracking algorithm and coordinates the movement of the positioning system.
3) Positioning system: The positioning system moves the panel or reflector to face the sun at the optimum angles. Some positioning systems are electrical and some are hydraulic.

Electrical systems utilize encoders and variable frequency drives or linear actuators to monitor the current position of the panel and move to desired positions.

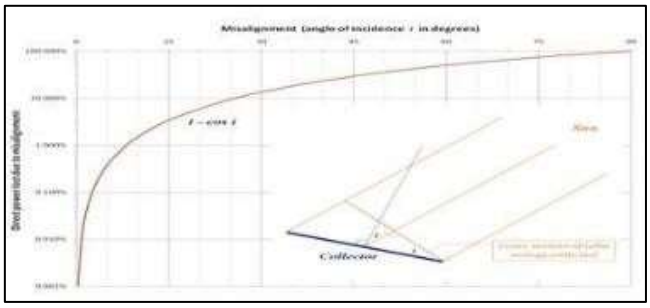


Fig. 6:

The effective collection area of a flat-panel solar collector varies with the cosine of the misalignment of the panel with the Sun.

VII. RESULTS

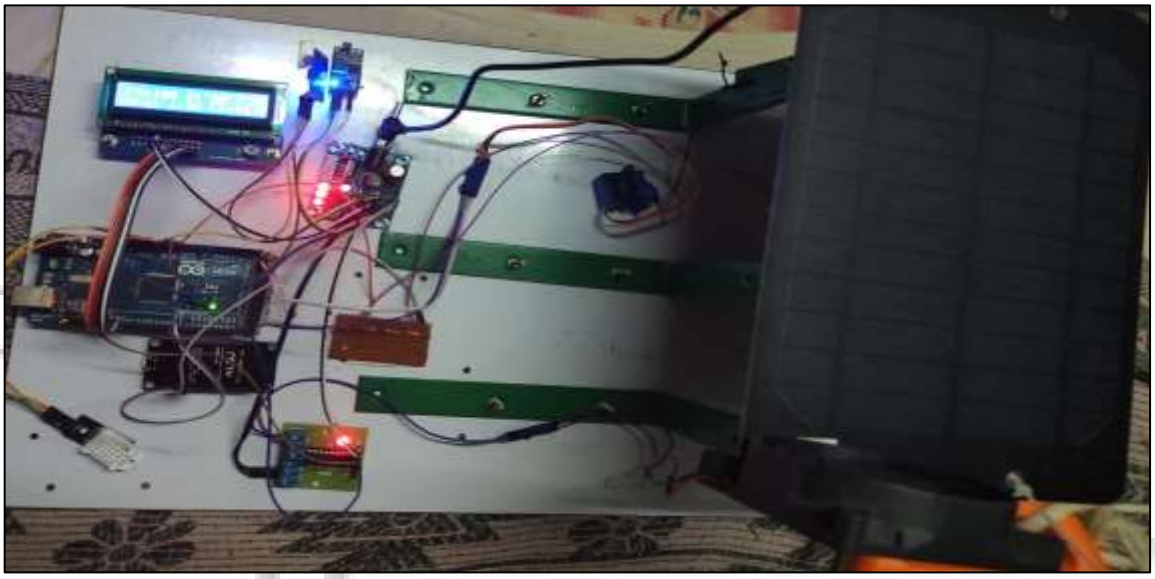


Fig. 7: Solar tracker

Fig. 8: LCD Display

Fig. 9: output readings on Mobile screen through WIFI

VIII. CONCLUSIONS

We were Comprehensive Successfully. It is perfect solution to cleaning a panel from dust. These project are capable to cleaning any types of dust from the panel. This is time based recognition system can shortly complete the work. This is hard ware based but logically they perform by controller

direction. This is a great project to increase our energy source from sun to panel. We use this system in our home, office, solar power plant etc.

This hardware project has performed forward cleaning & reverse Cleaning. We used Arduino-MEGA board but we can straightforwardly use any Arduino-MEGA or Nano well- suited board for this project. The main part to overcome in this project is to the Arduino-MEGA board with hardware components. We can easily enhance a few elements to improve our project more forward-thinking in future. This is very beneficial to use in sonar system project to get more power from sun. Cause if we us that it is more efficient. We use 2 channel relay module for controlling motor to forward & revers.

It is consistent. It 95% working.

ACKNOWLEDGEMENT

The researcher would like to exprss the profound sense of appreciation to Electronics Communication and Engineering Department /Sri Chandrasekharendra Saraswathi Vishwa Mahavidyalaya, Kanchipuram, Tamilnadu, India : for their valuble Support and constructive directions.

REFERENCES

[1] Zhan, T., Lin, W., Tsai, M. and Wang, G. Design and Implementation of the Dual-axis Solar Tracking System.IEEE.37th Annual Computer Software and Applications Conference. pp. 276-277 (20 II)
[2] Zolkapli, M., AI-Junid S. A., Othman Z., Manut, A., and Mohd Zulkifli A. High-efficiency dual-axis solar tracking development using Arduino .IEEE .International Conference on Technology, Informatics, Management, Engineering & Environment.pp.43-47 (2013)
[3] http://www.bluebuildenergy.com/products/solar-panel-cleaning/improve-solar-panel- efficiency.com
[4] https://www.energymaters.com.au/suntech-solar-panel-5watt-12volt- monocrystalline-p-41.html

