MPPT Based Solar Sun Tracker Using IOT

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Abstract - *Photovoltaic modules provide a workable answer to the issue of power generation in remote regions by directly and cleanly converting sunshine into electricity. When there is a relatively low demand for electrical power, they are extremely helpful. Rather than installing additional panels, we can utilize a tracking system, which increases power, to maximize the amount of electricity extracted according to demand. By ensuring that PV modules are always facing the sun during the day, the solar tracker built and designed for this project maximizes the power production of the modules. Any scenario where solar modules are utilized could employ the tracker. This would prove particularly efficacious in scenarios where minimal modules are needed and optimal efficiency is paramount.*

Key Words: Photovolatic Modules, Sun Tracking, Electricity Generation

1. INTRODUCTION

Solar energy is one of the most promising renewable energy sources because of its enormous potential for conversion into electrical power. The Photo-Voltaic (PV) effect, which converts solar radiation into electrical energy, is a very promising technology that has no ecological impact and is quiet, clean, and dependable. It also requires very little maintenance. Sales in this market segment have grown exponentially over the last several years, indicating a significant demand for photovoltaic conversion systems in the next decades. The European Photovoltaic Industry Association (EPIA) recently released market research estimates stating that the installed power of PV conversion equipment climbed from approximately 1 GW in 2001 to nearly 23 GW in 2009.

Although PV panel conversion efficiency has steadily increased due to technology advancements, the majority of commercial panels still have efficiencies of little more than 20%. The technological community that works with solar energy harnessing technology is always looking for new ways to improve the conversion efficiency of PV panels. Solutions for increasing PV efficiency include solar tracking, optimizing the geometry of the solar cells, increasing their capacity to capture light, using new materials, etc. The amount of light radiation that enters the PV panels determines how much power they can produce.

A static PV panel's incident radiation changes continuously due to the ongoing variation of the sun-earth relative location. When the direction of solar radiation on the panel surface is perpendicular, the point of maximum received energy is obtained. Installing a photovoltaic panel on a solar tracking device that tracks the sun's path can therefore boost the panel's output energy. The PV conversion efficiency of the system is increased because, in contrast to traditional fixed PV panels, mobile PV panels powered by solar trackers are maintained at optimal insolation throughout the Sun's cycle. PV panels with solar trackers installed may see tens of percent increases in output energy, particularly in the summer when solar energy is more valuable. Solar cells, also referred to as photo-voltaic or PV cells, transform solar radiation into DC electricity. Compared to other renewable energy sources, photovoltaics (PVs) have the extra benefit of being noiseless and requiring little upkeep. A tracking system needs to be able to track during cloud cover, return the collector to its starting position at the end of the day, and track the sun with a particular degree of accuracy.

Growing in popularity quickly, solar energy is a significant way to increase the amount of renewable energy available. Therefore, it is essential that those working in engineering professions are familiar with the technology related to this field. The design and development of a microcontroller-based solar panel tracking system is presented in this study. Because solar tracking keeps the solar array pointed toward the sun, more energy may be generated. Eventually, a functional system will be shown to verify the design. Issues and potential fixes will also be discussed.

1.1 LITERATURE REVIEW

Design and construction of a microcontroller based single axis solar tracker. S. Zubair1, A. Suleiman2, H. T. Abdulazzez2, B. A. Salihu1

Solar energy is rapidly gaining popularity as an important means of expanding renewable energy resources. As such, it is vital that those in engineering fields understand the technologies associated with this area. This paper presents the design and construction of a microcontroller-based solar panel tracking system. Solar tracking allows more energy to be produced because the solar array is able to remain aligned to the sun. A working system will ultimately be demonstrated to validate the design. Problems and possible improvements will also be presented.

Design of two axes sun tracking controller with analytically solar radiation calculations ARTICLE in RENEWABLE AND SUSTAINABLE ENERGY REVIEWS MARCH 2015 Saban Yilmaz, Oguzhan Akgol, Muharrem Karaaslan

Photovoltaic systems have gained a great deal of interest in the world and these studies performed on this subject have been gaining more and more importance. In order to design new PV systems that will be installed to operate in more efficient and more feasible way, it is necessary to analyze parameters like solar radiation values, the angle of incidence of the genus, temperature etc. Therefore, in this study, theoretical works have been performed for solar radiation and angle of incidence values of any location, plus an experimental study was carried out on a system tracking the sun in two axes and in a fixed system. The performed prototype is also adapted into a PV system with 4.6 kW power. Theoretical data are consistent with the data obtained from the PV system with 4.6 kW power. This study will be an important guide for the future PV power stations.

Time operated solar tracking for optimum power generation Asst. Prof. K. Sambasiva rao, P. Harish, V. N. V. Ramana, M. V. S. Krishna teja

The growth or energy demand in response to industrialization, urbanization and social affluence has led to an extremely uneven global distribution of primary energy consumption. The Sun, Wind, Waves and geothermal heat are renewable energy sources that will never run out. They are perpetual or self renewing. The rate of consumption does not exceed rate of renewability. The cost of generating electricity from wind and solar power has decreased by 90% over the past 20 years. Maximizing power output from a solar system is desirable to increase the efficiency of a solar tracing system. To maximize the power output from solar panels, we need to keep the panels aligned with the sun. In this paper, the design of an efficient solar tracking system based on Real Time Clock (RTC) using microcontroller is described. The proposed tracking system is a low cost, high accurate, more efficient with low power consumption.

Two Ways of Rotating Freedom Solar Tracker by Using ADC of Microcontroller By Sobuj Kumar Ray, Md. Abul Bashar, Maruf Ahmad & Fahad Bin Sayed

Solar trackers are used to improve electric power radically of photovoltaic panel by using different sensor. The sensors retrieve the solar radiation. This paper presents a simple method, low cost microcontroller based solar tracker of two ways of rotating freedom in order to achieve the right positioning of photovoltaic solar cell to get the much sunlight during the day light session and as a result produce more electricity. This tracking system is developed with two direct current motor operated by a PIC16F72 microcontroller which processes the sensors (LDR) information by its internal ADCanalog to digital converter with Fuzzy logic and send correct information to motor controller IC-LM392D by which motor is operated. The motor is so operated that the panel can rotates two ways such as horizontally and vertically of its direction. A comparison has been made on a conventional solar follower plant and trucking system.

Design and Implementation of a Sun Tracker with a Dual-Axis Single Motor for an Optical Sensor-Based Photovoltaic System Jing-Min Wang and Chia-Liang Lu

The dual threats of energy depletion and global warming place the development of methods for harnessing renewable energy resources at the center of public interest. Solar energy is one of the most promising renewable energy resources. Sun trackers can substantially improve the electricity production of a photovoltaic (PV) system. This paper proposes a novel design of a dual-axis solar tracking PV system which utilizes the feedback control theory along with a four-quadrant light dependent resistor (LDR) sensor and simple electronic circuits to provide robust system performance. The proposed system uses a unique dual-axis AC motor and a stand-alone PV inverter to accomplish solar tracking. The control implementation is a technical innovation that is a simple and effective design. In addition, a scaled-down laboratory prototype is constructed to verify the feasibility of the scheme. The effectiveness of the Sun tracker is confirmed experimentally. To conclude, the results of this study may serve as valuable references for future solar energy applications.

Solar Tracking System Using Stepper Motor Ankit Anuraj and Rahul Gandhi

Solar energy is rapidly advancing as an important means of renewable energy resource. Solar tracking enables more solar energy to be generated because the solar panel is able to maintain a perpendicular profile to the sun's rays. Though initial cost of setting up a solar tracking system is high, this paper proposes a cheaper solution. Design and construction of a prototype for solar tracking system with single degree of freedom, which detects the sunlight using Light Dependent Resistors (LDR), is discussed in this paper. The control circuit for the solar tracker is based on an ATMega16 microcontroller. This is programmed to detect the sunlight through the LDRs and then actuate the stepper motor to position the solar panel where it can receive maximum sunlight. Compared with any other type of motor, the stepper motor is more controllable, more energy efficient, more steady and has high tracking accuracy and suffers little environmental effect.

Theoretical analysis and research results have been shown in this paper to advocate that the designed system realized precise automatic tracking of the sun and can greatly improve the utilization of solar energy.

Design of an Automatic Solar Tracking System to Maximize Energy Extraction Mostefa Ghassoul

This paper presents the design of a solar tracking system driven by a mnicrochip PIC 18F452 micro controller. The system is based on two mechanisms. The first one is the search mechanism (PILOT) which locates the position of the sun. The second mechanism(intelligent PANELS) aligns itself with the PILOT only if maximum energy possible could be extracted. On top of that the main advantage of the technique is that the rotation only takes place, if the energy obtained in the new position is higher then that consumed by the panels during the transition. So there are two mechanisms, one for the search which is mounted on a miniature motor and consumes only small amount of energy. Its role is to locate the best position for maximum energy extraction. The second one is the panels mechanism which rotates to the position when energy extraction is optimal.

AUTOMATIC SOLAR TRACKER SYSTEM. Nikesh. D. Watane Rakesh. A. Dafde

This paper presents the hardware design and implementation of a system that ensures a perpendicular profile of the solar panel with the sun in order to extract maximum energy falling on it renewable energy is rapidly gaining importance as an energy resource as fossil fuel prices fluctuate. The unique feature of the proposed system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensor constantly monitors the sunlight and rotates the panel towards the direction where the intensity of sunlight is maximum. The light dependent resistor's do the job of sensing the change in the position of the sun which is dealt by the respective change in the solar panel's position by switching on and off the geared motor the control circuit does the job of fetching the input from the sensor and gives command to the motor to run in order to tackle the change in the position of the sun. With the implementation the proposed system the additional energy generated is around 25% to 30% with very less consumption by the system itself. In this paper, an improvement in the hardware design of the existing solar energy collector system has been implemented in order to provide higher efficiency at lower cost.

1.2 SYSTEM DESIGN

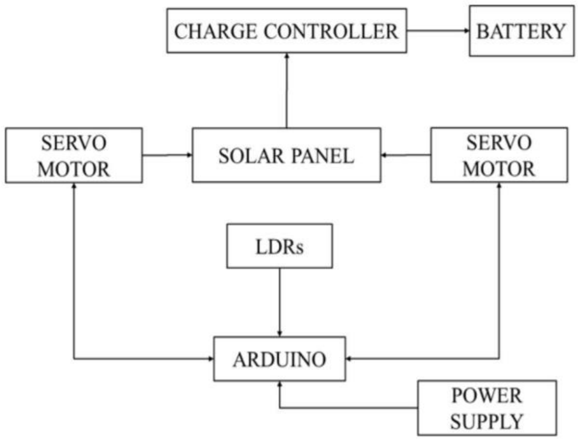

Figure No. 01 Block Diagram

The Sun tracking solar panel consists of two LDRs, solar panel and a servo motor and ATmega328 Micro controller. Two light dependent resistors are arranged on the edges of the solar panel. Light dependent resistors produce low resistance when light falls on them. The servo motor connected to the panel rotates the panel in the direction of Sun. Panel is arranged in such a way that light on two LDRs is compared and panel is rotated towards LDR which have high intensity. When the intensity of the light falling on right LDR is more, panel slowly moves towards right and if intensity on the left LDR is more, panel slowly moves towards left. In the noon time, Sun is ahead and intensity of light on both the panels is same. In such cases, panel is constant and there is no rotation.

The following figure shows the circuit diagram of the system:

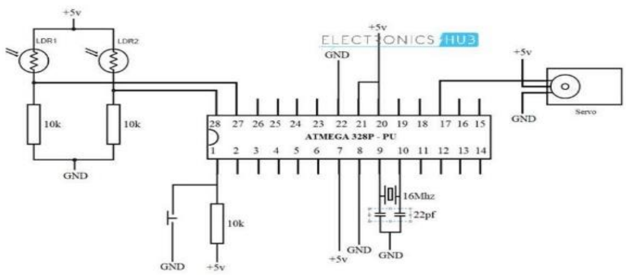

Figure No. 02 Circuit Diagram

2. PROPOSED SYSTEM

Solar trackers are essentially devices with solar panels installed on them that follow the sun's path across the sky to make sure the panels receive the most sunlight possible throughout the day. Following its discovery of sunlight, the tracker will attempt to navigate along the trail in order to identify the best sunlight. Numerous components are needed for the Solar Tracker's design. The Solar Tracker's design and construction may be broken down into six basic components, each of which has a primary role and must cooperate harmoniously with the others to accomplish a smooth operation.

Methods of Tracker Mount

1. **Single axis solar trackers**
   A horizontal axle or a vertical axle can be found on single axis solar trackers. In tropical climates with short days and a high noon sun, the horizontal type is utilized. In high latitudes when the sun does not rise very high yet summer days can be very lengthy, the vertical type is employed. The most popular and straightforward method is the single axis tracking system.

2. **Double axis solar trackers**
   Double axis solar trackers are able to track the apparent motion of the sun precisely anywhere in the world because they have both a horizontal and a vertical axle. Since astronomical telescopes use this kind of technology for control, a plethora of software is available to automatically predict and track the sun's journey across the sky. Solar panel efficiency can be raised by 30–40% by tracking the sun. A solar reflector is also focused toward the concentrator on heliostat systems using the dual axis tracking mechanism.

   Methods of Drive

   1. **Active Trackers**
      Active trackers are controlled by a controller that reacts to the direction of the sun using motors and gear trains. Two photo sensors, like as photodiodes, are usually arranged differently in light-sensing trackers such that they each produce a null when exposed to the same amount of light. They should be 90 degrees apart and omnidirectional mechanically. This will result in maximal sensitivity since the steepest portion of their cosine transfer functions will balance at that point.

   2. **Passive Trackers**
      In order for a passive tracker to move in response to an imbalance, a low boiling point compressed gas fluid is driven to one side or the other by solar heat producing gas pressure.

3. RESULT AND DISCUSSIONS

It was important to compare the experiment findings for the fixed panel with the smart solar tracker system in order to validate the proposed modeling. A few easy experiments were run to get this data. Figure shows the experiment setup for both the fixed and tracking systems. The sets were mounted three meters above the ground on a metal frame. A multimeter that was attached to the solar cells was used to record the readings for the open-circuit voltage and current. Throughout the whole test time, sunny weather was taken into consideration for the experiment. During the tests, a local wind speed of approximately 0.8 m/s (1.6 knots) was reported, while an average temperature of approximately 30˚C was recorded.

First, a solar panel mounted to the surface was used for the test. Next, a tilting mechanism with a DC motor, as seen above, was used.

The observations that were made are displayed below.

Time In Hour (24 Hr Format)	Power For Fixed Panel Mount (In Volts)	Power For Single Axis Tilting Mechanism (In Volts)
08.00	6.38	8.35
09.00	7.50	9.15
10.00	8.66	9.36
11.00	9.88	10.44
12.001	10.12	11.14
13.00	11.40	11.80
14.00	11.18	11.38
15.00	10.70	10.90
16.00	9.65	10.15
17.00	8.23	9.30
18.00	7.66	8.72

Table No. 01 Observation

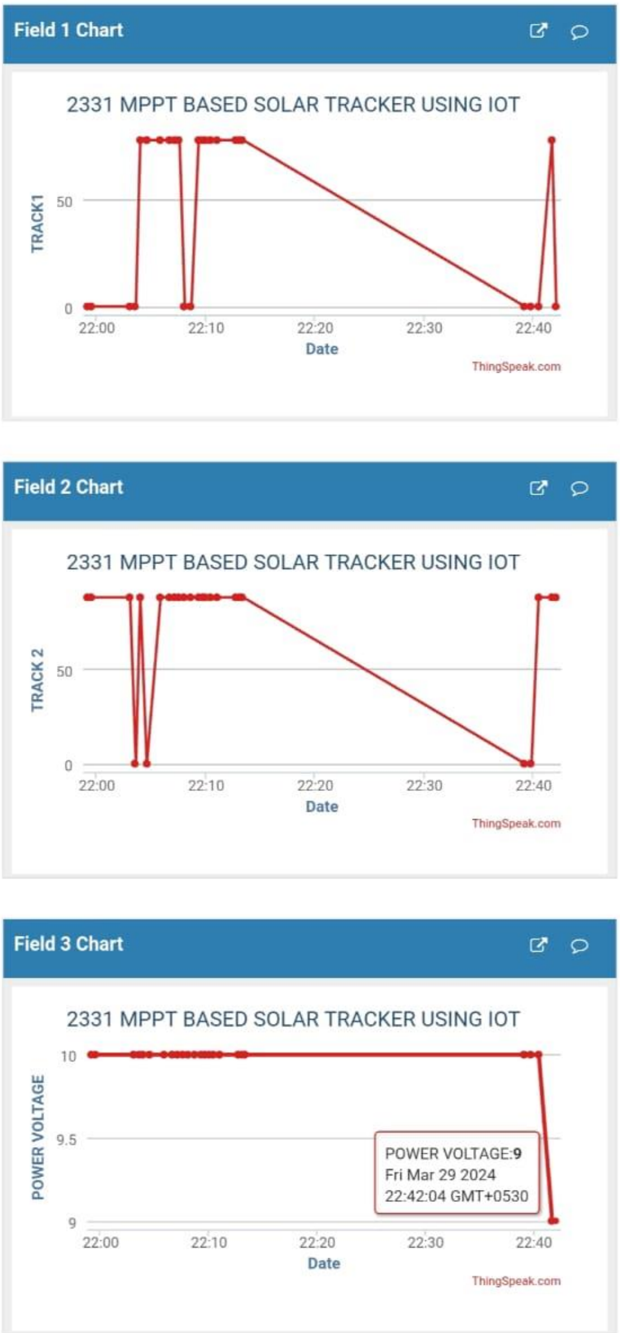

Figure No. 01 Thing Speak Result

4. CONCLUSION

Starting with the solar tracking system design for the experimental setup using a micro controller. All of the components of the experimental setup are producing good results, and when we compare tracking using LDR with Fixed Solar Panel System, we find that the efficiency of Micro Controller Based Solar Tracking System is improved by 30- 45%. By employing Step-Down T/F and 220V AC, the necessary power is employed to run the motor. In addition, the sun is continuously tracked by this tracking device. In the long run, this system proves to be more economical and efficient. According to the data, there is a 30% boost in efficiency with an autonomous tracking system as compared to a non-tracking system. Future work can still be done to improve the solar tracker's additional characteristics, such as wind and weather protection.

5. REFERENCES

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