International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 11 | Nov 2020 www.irjet.net p-ISSN: 2395-0072

Solar GPS Tracker Renewable Energy on IoT

K.C.Rajavenkatesswaran

[1]Assistant Professor, Nandha College of Technology, Erode.

Abstract - *The inhabitants of the world is receiving augmented quickly step by step and the insist for energy is growing suitably. IoT (Internet of Things) for manipulation and remote monitoring the orientation of the solar panel from anywhere. The entire people in the globe now need the renewable power resources which have economical costs. Solar energy is appraised as one of the main power resources in humid countries. The desert areas in the west of India like Rajasthan, Gujarat, Himachal Pradesh, etc. are highly rich in solar energy resource. This paper presents the development of dual axis solar tracker using Arduino and Raspberry Pi. Using the astronomical estimates of the sun from GPS vision-sensor, Walnut Innovations and IoT process outcomes, a system is projected to locate the sun's position to obtain the maximum solar energy. Based on the outcomes, the solar tracking system decides whether to use IoT outcomes or astronomical estimates to accomplish the maximum competence of the solar panel. It also makes monitoring the solar tracker position from anywhere at any time*

***Key Words*: Dual axis solar tracker, Arduino board, LDR Sensors, Raspberry Pi, Walnut Innovations, Photosensitive Resistor Sensor, Dusk sensor board, PS**

1. INTRODUCTION

Solar energy is rapidly gaining extra significance in growing the renewable energy resources. This energy has the large risk of adaptation into power. This proposed paper is initiated to conquer the loss in power generation on the solar battery. This may be done by succeeding the high intensity of the sunshine created by the sun rays. Solar battery is machine-controlled to follow the purpose of high intensity of the daylight victimization LDR (light dependent resistor) sensors. This sensing element helps to sense the extreme temperature created by the sun lightweight on the panel surface and it is sent to the microcontroller. This device sends the feedback to the servo motor that permits the servo motor to rotate the panel to receive the high intensity of the daylight.

For this, we have to locate the exact position of the sun. This can be done using the Astronomical estimates from the GPS. Furthermore, we also use the vision sensor image the overcome the inefficiencies of the GPS estimates. By this overall strategy, it is doable to conserve full quantity of power created by the solar battery by receiving the high intensity sun light. Fig.1 represents the various types of solar trackers.

Fig.1. Various Types of Solar Trackers

II. EXISTING WORK

On one side we can see the world energy resources depletion to be a major problem. On the other hand global warming is increasingly developed, which is a major concern. In order to search for other power generation process, the best and easy way of power generation is done by using photo voltaic cells. This is done by using solar panels. In the existing system, all the solar panels are stagnant. They are not able to locate the position of the sun and they cannot discriminate between the presence and nonexistence of sunlight. This method of implementation doesn't produce constant output from the solar panel which leads to loss in power generation.

III. CONCEPTUAL MODEL OF THE SOLAR TRACKER

To overcome the above losses we have to build a system which works according to the environment bases. Since the solar panel generates the power according to the intensity produced by any source of light, we have to design the system to track the high intensity by itself without any agent bases. This is done by implementing the system with sensors which senses the amount of intensity produced by the light source. The system is capable of rotating to 360 degrees (NORTH – SOUTH 180 degrees && EAST – WEST 180 degrees).The rotation is achieved using pair of servo motor.

In previous tracking methods, the sun has been tracked from east to west (0-180 Degrees) only. Even though sun rises in east and sets in west, it has slight variation in angles on north and south direction throughout the year. The angle variation in north and south direction changes every month. This variation is not tracked in existing systems. This leads to loss in power generated by the solar panel and the proposed work overcomes this loss of energy.

IV. WORKING METHODOLOGY

A. Solar Trackers

Solar tracker may be a device that follows the movement of the sun because it rotates from the east to the west on a daily routine. Prior to everything, all systems need to supply one or 2 degrees of freedom in movement. Trackers square measure keeps solar panels orienting directly towards the sun because it moves through the sky each day. These solar trackers will increase the number of solar power that is received by the solar power collector and improves the energy output of the heat/electricity that is generated. Solar trackers will increase the output of solar arrays by 20-30% that improves the political economy of the solar panel applications. The two basic types of solar trackers are single-axis and double-axis. Here we are using Dual axis tracking system. Dual axis tracker as shown in the Fig.2 have two degrees of freedom that act as axes of rotation.

Fig.2. Dual axis tracker

B. Working of the Solar Tracker

The electrical system consists of LDR sensors which provide feedback to a micro controller. This micro controller processes the sensor input and provides two PWM signals for the movement of servo motors. This servo motor moves the solar panel towards the higher density of solar light. The entire electrical system is powered by a 12volt source power supply. Initially five different analog values are obtained from LDR's, and then they are feed to microcontroller. Micro controller gives two different PWM signal for the movement of solar panel through servo motor. The current time, as well as the latitude and longitude positions of the solar tracking system, can be acquired by GPS. Using that information, the current azimuth and altitude angles of the sun can be estimated by an astronomical formula. However, the current heading angle of the solar tracking system may not be correct, and it cannot be updated from the GPS measurement. Therefore, in our study the camera sensor is used to more accurately determine the position of the sun. The center position of the sun is computed by image processing; the solar panel is maneuvered to locate the center position of the sun on the image center.

V. SOLAR TRACKING METHODS

The current time, as well as the latitude and longitude positions of the solar tracking system, can be acquired by GPS. Using that information, the current azimuth and altitude angles of the sun can be estimated by an astronomical formula. However, the current heading angle of the solar tracking system may not be correct, and it cannot be updated from the GPS measurement. Therefore, in our study the camera sensor is used to more accurately determine the position of the sun. The center position of the sun is computed by image processing; the solar panel is maneuvered to locate the center position of the sun on the image center

$$\varepsilon = 23.4393 - (3.563 \times 10^{-7} d) \quad (7)$$

The x and y rectangular coordinates for elliptic Coordinates are obtained using (8) and (9). True anomaly (v) is obtained using (10). Celestial longitude (l) and distance (r) for calculating celestial longitude are obtained using (11) and (12) [5], [6] and [7].

$$x = \cos(E) - e \quad (8)$$

$$y = \sin(E) \cdot \sqrt{1 - e^2} \quad (9)$$

$$v = \tan^{-1} \frac{y}{x} \quad (10)$$

$$r = \sqrt{x^2 + y^2} \quad (11)$$

$$l = v + w \quad (12)$$

The perpendicular ecliptic coordinates are transformed to an equator coordinate system using (13), [8].

$$x_{equat} = r \cdot \cos(l) \quad (13)$$

$$y_{equat} = (r \cdot \cos(l)) \cdot \cos(\varepsilon)$$

$$z_{equat} = (r \cdot \cos(l)) \cdot \sin(\varepsilon)$$

Greenwich Mean Sidereal Time (GMST) and sidereal time (SIDTIME) are defined by (14) and (15). The hour angle (ha) is obtained using (16).

$$GMST = L/15 + 12 \quad (14)$$

$$SIDTIME = GMST + UT + LON/15 \quad (15)$$

$$ha = SIDTIME - RA \quad (16)$$

The z-axis transformation in the direction of the zenith is defined by (17), (18), and (19).

$$x_{hor} = (\cos(ha) \times \cos(De) \times \sin(lat)) - (\sin(De) \times \cos(lat)) \quad (17)$$

$$y_{hor} = \sin(ha) \times \cos(De) \quad (18)$$

$$z_{hor} = (\cos(ha) \times \cos(De) \times \cos(lat)) + (\sin(De) \times \sin(lat)) \quad (19)$$

A.Solar Image Tracking

The conventional solar image tracking method using an optical sensor is inefficient because it often mistakes the sun for light scattered by clouds or other obstacles. Therefore, it is desirable to find the widest range for the location of the sun through pixels separated by color.

Although astronomical estimates from the celestial formula are expected to provide an accurate position of the sun, the actual solar panel could be facing away from the normal direction of the sun because of the tracking system's current heading-angle measurement error.

Therefore, we propose a more precise tracking method using an image sensor. The objective of tracking is then to locate the sun at the center of the image.

Consider the x and y coordinates represent horizontal and vertical distances, respectively. And also, A and L represent the distance to the center and the image sensor focal length, respectively. The lateral angle correction using the image sensor is defined as (24). The longitudinal angle correction is also calculated in the same way.

$$\theta = \tan^{-1}\frac{h}{L} \quad (20)$$

VI. EXPERIMENTAL RESULTS

Using the tracking method that fuses astronomical estimates and the solar image, the solar tracker panel can maintain its position facing the normal direction of sunlight.

However, when the weather is cloudy, controlling the tracker by solar image is not desirable because it is difficult to locate the sun using the solar image. In such a case, it is better to employ only astronomical estimates instead of their fusion with image processing.

SUN POSITIONS- SUNNY DAY | SUN POSITIONS- CLOUDY DAY

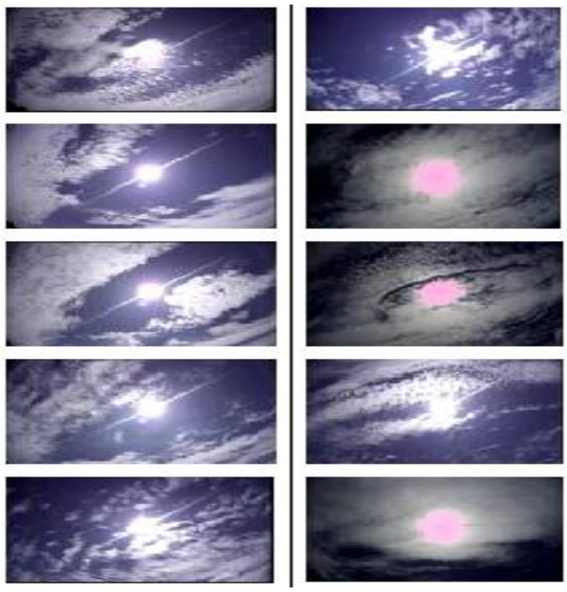

Fig. 3: Examples of sun positions during regularTime intervals in sunny and cloudy days

As shown in Fig.3, the developed solar tracker demonstrates good performance in tracking the sun because the sun in the camera image remains in the center of the image as the tracker moves over time.

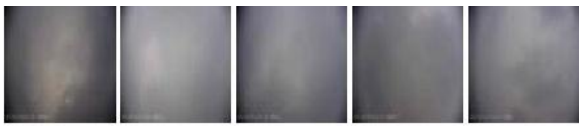

Fig. 4: Movement of sun during cloudy day

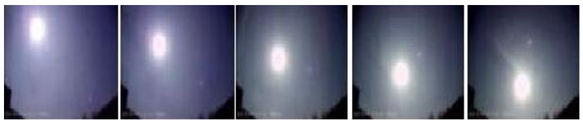

Fig. 5: Solar movement during sunny day

Fig. 4 and Fig. 5represents images of the solar tracker tracing the sun and images of the sun taken by a camera attached to the tracker. The images in this figure are presented in chronological order from the upper left to lower right.

VII. CONCLUSION

In this paper, we have anticipated a solar GPS tracker system and an algorithm that uses astronomical estimates of solar position and simple in design, concentrated in cost and precise in tracking. The solar tracker will be reliable and accurate throughout the operation and yields maximum output power. A variety of technologies for the solar energy are available on the market. But this tracking technology which is based on dual axis has higher energy gain comparing with both fixed solar panel and single axis solar tracking technologies and it is also very efficient. We expect that the proposed method will improve acceleration of the local spread of the solar cell module due to the high precision and robustness of the system in all weather conditions.

REFERENCES

[1] Roth P. et al: Energy Convers. Manage., 2005, 46, 1179-1192.

[2] Plesz B., Pánczél S., Timár -Horváth V. and Mizsei J.: 3rd International Workshop on Teaching in Photovoltaics, Proceedings 2006, Prague, 97-101.

[3] Homepage: http://www.solar-trackers.com

[4] M. Blanco-Muriel, D. C. Alarcon-Padilla, T. Lopez-Moratalla, and M. Lara-Coira, "Computing the solar vector," Solar Energy, vol. 70, no. 5, pp. 431-441, 2001.

[5] Y. K. Choi, N. H. Lee, K. J. Kim, and Y. Cho, "A Study on the influence to solar radiation by changing the azimuth and tilt of a photovoltaic array," The Transaction of the Korean Institute ofElectrical Engineers, vol. 62, no. 5, pp. 712-716, 2013.

[6] V. Poulek and M. Lbra, "New solar tracker," Solar EnergyMaterials and Solar Cells, vol. 51, pp. 113-120, 1998.

[7] V. Poulke and M. Libra, "A very simple solar tracker for space and terrestrial spplications," Solar Energy Materials and Solar Cell, vol. 60, pp. 99-103, 2000.

[8] R. Grena, "An algorithm for the computation of the solar position," Solar Energy, vol. 82, pp. 462, 2008.

[9] J. J. Michalsky, "Astronomical algorithm for approximate solar position," Solar Energy, vol. 40, no. 3, pp. 227-235.

[10] M. J. Clifford and D. Eastwood, "Design of a novel passive solar tracker," Solar Energy, vol. 77, pp. 269-280, 2004.

[11] Soham Adhya, Dipak Saha, Abhijit Das, Joydip Jana and Hiranmay Saha 2016 An IoT based smart solar photovoltaic remote monitoring and control unit International Conference on Control, Instrumentation, Energy & Communication IEEE.

[12] Tanvir Arafat Khan Md., S.M.Shahrear Tanzil, RifatRahman, SMShafiul Alam, "Design and Construction of an Automatic Solar Tracking System", presented at 6th International Conference on Electrical and Computer Engineering ICECE2010,18-20 December 2010, Dhaka, Bangladesh.

[13] Masoumeh Abdollahpour, Mahmood Reza Golzarian, Abbas Rohani and Hossein Abootorabi Zarchi 2018 Development of a machine vision dual-axis solar tracking system solar energy 169 136-143

[14] Subhasri G and Dr.Jeyalakshmi C 2018 A study of IoT based solar panel tracking system Advances in Computational Sciences and Technology 11 537-545

[15] Vikas Reddy.B,Sai Preetham Sata,2016, "Solar energy analytics using Internet of Things", International Journal of Applied Engineering Research ISSN 0973-4562, Vol 11, number 7(2016)pp4803-4806.