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Dual Axis Solar Tracker with Power Level Monitor

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ABSTRACT: The design and implementation of a dual axis solar tracker with a power level monitor are presented in this work. The suggested dual axis solar tracker system uses LDRs to follow the sun's movement, and a gear motor to provide the solar panel with two-axis adjustability. It keeps the efficiency of solar energy gathering at its highest level. In order to manage power consumption and maintain the system's desired level of power, the system also has a power level monitoring system. The system's temperature is monitored by a temperature sensor, and if it rises over a particular threshold, the pump motor will turn on to cool the solar panel. While the IOT is used to interface with other systems, the LCD is utilized to display system information. The energy generated by the solar panel is stored and used for home appliances with the help of the battery and inverter. The system is made to be effective, dependable, and economical.

KEYWORDS: 1.Power level 2. Solar tracker 3. Dual-axis 4. Cooling 5. Sensors 6. Sunlight 7. Efficiency 8. Solar energy 9. Sustainable 10. Eco-Friendly 11. IOT 12. Home appliances 13. Motors

I. INTRODUCTION

For many years, solar energy has been a rising source of power, and with to advances in solar technology, it is now among the most effective and economical energy sources available. Solar tracking is a method that can be used to make solar panels more effective by ensuring that they are always facing the sun and are utilizing as much sunlight as possible. To do this, a technology called the Dual Axis Sun Tracker with Power Level Monitor was created. It tracks the sun and modifies the direction of the solar panel using a combination of electronic parts and sensors.

The Dual Axis Solar Tracker with Power Level Monitor system consists of a solar panel, a DC to DC converter, a battery, an inverter, a DC load and an AC load, a PIC16F887A controller, a Pulse Width Modulation (PWM) circuit, a temperature sensor, four Light Dependent Resistors (LDRs), three relays, a pump motor, two gear motors, a Liquid Crystal Display (LCD) and an Internet of Things (IoT) module.

The solar panel is used to harness solar energy and transform it into electrical power. Following that, the battery is charged and the DC and AC loads are powered by this electricity. The solar panel's DC electricity is transformed into an useful DC voltage using a DC to DC converter. The PWM circuit is used to manage the system's power output and the current that flows through the DC and AC loads. The LDR and temperature sensors output readings are read by the pic 16f887a controller. The temperature sensor keeps track of the system's temperature to prevent overheating of the components. If the solar panel overheats, the pump motor and relay prevent it from burning up. The four LDRs are used to sense the position of the sun and decide how to tilt the solar panel in accordance. The two gear motors are utilized to change the solar panel's orientation that are controlled by the two relays. The IoT module is used to remotely monitor the system while the LCD is utilized to show the system's status.

The Dual Axis Solar Tracker with Power Level Monitor system is made to offer users a reliable, affordable method of tracking the sun and increasing the amount of electricity produced by solar energy. It is a trustworthy and simple-to-use technology that may be applied in a number of circumstances and environments. The system has the ability to supply electricity to remote areas and can be used to power a range of DC and AC loads, such as pumps and motors. The system can also be used to monitor the system's power level and notify users when it drops below a predetermined



level. The system can also give users to access the stored data that can be retrieved from a distance using the IoT module, as well as real-time data on the system's state.

II. LITERATURE SURVEY

EXISTING SYSTEM

Sagar Swami, Rahul Kumar, Neethesh Kumar [1], In "Dual Axis Solar Tracking System Using Arduino" describes that solar energy is a cutting-edge technology that can provide enormous long-term benefits. Solar energy is converted to electric power via solar cells. The most efficient method for raising output and performance is a solar tracing device, which maximizes sun energy utilizing a solar cell. LDRs are used as photosensors in the hardware development, and two servomotors are used to direct the position of the solar panel. The Arduino Mini uses "C language" programming for its software component.

According to Krishnashree Achuthan, Joshua David Freeman, Prema Nedungadi [2] "Remote Triggered Dual Axis Solar Irradiance Measurement System", understanding the quantity and quality of solar energy that can be captured at a location is essential for estimating and optimizing the cost of energy production for the majority of developing and developed countries, This article describes the development of a dual-axis tracking, irradiation sensor, and solar position tracking algorithm-based efficient, low-cost solar irradiance measurement system. The sensed data is collected using a data acquisition system, which offers user-friendly remote access utilizing a collaborative platform to monitor and control real-time data with the ability to adjust parameters and graphically show the data and broadcast live. Without investing expensive equipment, a suitable location for a solar energy installation could be evaluated. The effectiveness of the system devised is demonstrated by the study's successful capture of perceptions of utility, general adaptability, and ease of learning underlying scientific concepts and their retention for beginner users.

Adven Maish, Murodbek Safaraliev, Karomatullo Mukhmudov [3], In "Application of Dual Axis Solar Tracking System in Qurghontepa, Tajikistan," explained how solar energy development has rapidly accelerated throughout the world. Fortunately, Tajikistan has access to solar energy resources on scale with other renewable energy sources like hydro and wind. The region in Tajikistan known as "Bokhtar, Qurghontepa" is the subject of the study. By collecting data on the daily average solar irradiance collected over the course of a year, the experiment was carried out to investigate the solar potential of the area. The effectiveness of the Dual Axis Solar Tracker (DAST) and Static Solar System (SSS) was evaluated and compared for this investigation. In addition to calculating seasonal and annual energy gains and efficiency, DAST and SSS were used to measure daily and monthly average sun intensity data. According to the results, DAST can attain an efficiency as high as 80.57% just during the fall season, with a 44.02% overall efficiency advantage over a one-year period.

Muhammad Maidugu Aji, Bawa Garshima Gamiya, Aisha Temitope Olomowewe [4], In "Design and Simulation of Dual-Axis Solar Tracking Systems" discusses the rising global deployment of photovoltaic (PV) devices. However in installations, a fixed PV module is typically employed, using pre-specified angles derived by geographical location. As a result, when the day and the seasons of the year change, the variation in solar radiation causes a sharp decline in the power generated by PV systems. In order to maximize the production of solar energy, this study proposes the design and simulation of a dual-axis solar tracker, which allows the solar module to be readily moved along two (2) rotational axes. The tracking system is set up as an adaptive tracking system based on closed-loop monitoring, using servo motors as module adjusters, Light Dependent Resistor (LDR) sensors as device inputs, and an Arduino Uno as the system's brain. Readings of the voltage, current, and power taken by the dual-axis Solar Tracker at different times of the day were compared with readings taken by a stationary solar module at the same time as the reading from the other module. The outcomes demonstrated how precise and efficient the automated sun tracking technology is.

III. PROPOSED SYSTEM

An innovative system called the Dual Axis Solar Tracker with Power Level Monitor can be used to improve the energy efficiency of solar panels. The Dual Axis Solar Tracker tracks the sun using both the horizontal and vertical axes of rotation to maximize the solar panel's total output energy. The system has a Power Level Monitor that can be used to measure how much energy is being generated. The power level is collected and made available for accessing via IOT from any location. Also, this method has a water cooling system, if the temperature rises above a certain point, it can



cool the solar panel. Because of this, the system is able to generate more energy even when the sun is at its lowest point of the day, increasing efficiency.

Solar panel, DC to DC converter, battery, inverter, DC load, AC load, PIC16F887A controller, PWM, temperature sensor, LDR 1, LDR 2, LDR 3, LDR 4, relay and pump motor, relay and gear motor, relay and gear motor 2, LCD, and IOT are some of the components that contribute to the Dual Axis Solar Tracker.

The system's central component, the solar panel, uses LDRs to collect solar energy from the sun and transform it into electrical energy. The solar energy is transformed into DC electricity using a DC to DC converter. A battery is used to store this power, which can later be used to power the device or supply electricity to both DC and AC loads. The PIC16F887A controller is in the role of controlling the PWM, temperature sensor, LDRs, relays, pump motor and gear motors among other system components.

The PWM is used to control how much power is sent to the system's different parts. The temperature sensor measures the system's temperature and cools the solar panel if it becomes too hot. Based on the intensity of the light, the LDRs are used to determine the position of the sun. Higher intensity will result in less resistance, which will cause the solar panel to move in that direction. The pic microcontroller reads the LDR output values and then instructs the relays and gear motors to rotate the solar panel in the required axis. Finally, the system's power level is displayed on the LCD and the data is sent to the cloud using IOT.

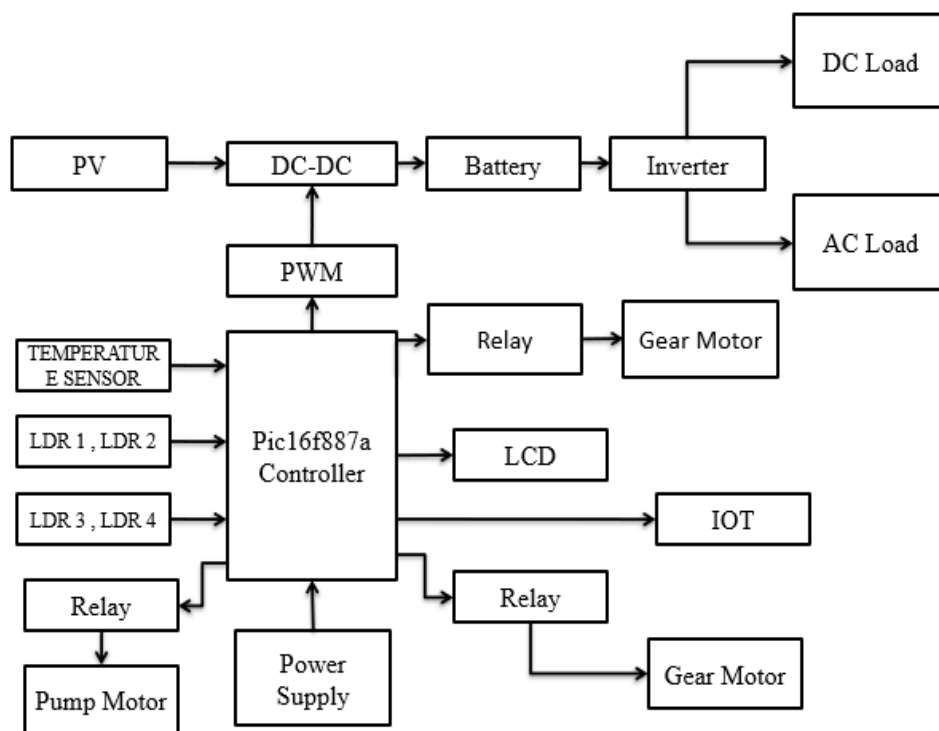


Figure 1. block diagram of proposed system

When compared to static solar systems, the Dual Axis Solar Tracker with Power Level Monitor is much more efficient. By locating the solar panel directly towards the sun, it can generate more power. The system can measure the amount of energy being generated, and the power level is stored and made available for accessing via IOT from any location. Due to its dual axes, this device can generate more energy even when the sun is at its lowest point of the day. Additionally, the system has an LCD that shows the system's power level and an IOT that sends data to the cloud. A

innovative technology, the Dual Axis Solar Tracker with Power Level Monitor has a water cooling system that can improve the energy efficiency of solar panels. Therefore, we can produce a lot of electricity using this technique.

IV. METHODOLOGY

In order to increase the efficiency of solar energy production, this project aims to develop a dual axis solar tracker with a power level monitor. A solar panel, DC to DC converter, battery, inverter, DC load, AC load, PIC16F887A controller, PWM, temperature sensor, LDR 1, LDR 2, relay, pump motor, relay 1, relay 2, gear motor 1, LCD, and IoT are the various components that have to be integrated into the project. The following steps present the project's methodology:

Component selection: The first step is to select the components that will be used in the project. This includes selecting components that are compatible with the project requirements and are of high quality. The components should be chosen based on their cost, performance, and compatibility with the project.

System design: The next step is to design the system. This includes designing the circuitry, the control logic, and the overall system architecture. The design should be such that it meets the project requirements and is efficient in terms of power consumption.

Software development: The next step is to develop the software that will be used to control the system. This includes the development of the software for the PIC16F887A controller, the PWM, the temperature sensor, the LDR 1 and LDR 2, the relay, the pump motor, the relay 1 and gear motor 1, the relay 2 and gear motor 2, the LCD, and the IoT.

System testing: Once the system has been designed and the software has been developed, the system needs to be tested to ensure that it meets the project requirements. This involves conducting tests to check the functionality of the system, the accuracy of the measurements, and the robustness of the system.

Deployment: Once the system has been tested, it needs to be deployed in the field. This includes ensuring that the system is correctly installed and that it is connected to the power grid.

Monitoring: The last step is to monitor the system to ensure that it is performing as expected. This involves monitoring the power output, the temperature, and the current and voltage levels.

These are the steps that are involved in developing and deploying a dual axis solar tracker with power level monitor. This project aims to maximize the efficiency of solar power production, and thus, the selection of high-quality components and the design of a reliable and efficient system are crucial. Additionally, the system should be tested and monitored to ensure that it is performing as expected.

V. SYSTEM ARCHITECTURE

System architecture is the design of the system that defines the system components, their interaction and their interconnectivity. The system architecture of the dual axis solar tracker with power level monitoring includes the following components:

Solar Panel: The solar panel is responsible for collecting the energy from the sun and converting it into electrical energy. The solar panel is connected to the main power system through the DC to DC converter.



Figure 2. solar panel



DC to DC Converter: The DC to DC converter converts the solar energy from the solar panel into a usable form for the rest of the system. This component is also responsible for providing the correct voltage and current for the other components in the system.



Figure 3. DC to DC converter

Battery: The battery is responsible for storing the energy generated from the solar panel for later use. It is connected to the main power system via the DC to DC converter.



Figure 4. power storing battery

Inverter: The role of converting DC electricity from the solar panel into AC power for usage by the rest of the system belongs to the inverter.



Figure 5. inverter

PIC16F887A Controller: The PIC16F887A controller is responsible for controlling the other components in the system. This component is responsible for switching on and off the various loads, as well as controlling the direction of the solar tracker.



Figure 6. PIC16F887A controller

Temperature Sensor: The temperature sensor is responsible for monitoring the temperature of the system. This component is connected to the PIC16F887A controller and is used to ensure that the system does not overheat due to excessive sunlight.



Figure 7. temperature sensor

LDRs(4): The light dependent resistors (LDRs) are responsible for detecting the high intensity of sunlight available in the environment. These components are connected to the PIC16F887A controller and are used to control the speed of the solar tracker.



Figure 8. LDR sensor

Relay and Pump Motor: The relay and pump motor are responsible for controlling the heat of the solar tracker. The relay is connected to the PIC16F887A controller and is used as a switch, while the pump motor is responsible for cooling the solar tracker using water if PV panel get overheated.



Figure 9. pump motor

Relay (2) and Gear Motor (2): The relays and gear motors are responsible for controlling the speed of the solar tracker. The relay is connected to the PIC16F887A controller and is used to switch the speed of the solar tracker, while the gear motor is responsible for moving the solar tracker at the correct speed.



Figure 10. gear motor

LCD: The LCD (Liquid Crystal Display) is responsible for displaying the status of the system. This component is connected to the PIC16F887A controller and is used to display the amount of voltage available, the current generated in the solar tracker, and the power level of the system.



Figure 11. LCD

PWM: The PWM (pulse width modulation) is responsible for controlling the speed of the solar tracker. It is connected to the PIC16F887A controller and is responsible for controlling the speed of the solar tracker according to the intensity of sunlight available.

DC Load and AC Load: The DC load and AC load are responsible for consuming the electrical energy generated from the solar panel and battery. These components can be anything that requires electrical energy, such as lights, fans, or pumps.

IOT: The IOT (Internet of Things) is responsible for connecting the system to the internet. This component is connected to the PIC16F887A controller and is used to monitor the system remotely via the internet.

The system architecture of the dual axis solar tracker with power level monitoring requires a lot of components for it to work properly. By understanding this system architecture, it is possible to design and build a reliable and efficient system that is capable of harvesting energy from the sun and storing it for later use.

VI. ADVANTAGES

1. Increased efficiency: Dual axis solar trackers can increase solar cell efficiency by up to 35% compared to fixed solar panels. This means more electricity is generated with less solar cells, saving money on installation and maintenance costs.
2. Reduced cost: By tracking the sun and generating more electricity, solar cell costs can be reduced with the use of fewer solar cells.
3. Extended life: Dual axis solar trackers can extend the life of solar cells by providing more consistent exposure to sunlight, reducing the wear and tear caused by extreme temperatures and prolonged exposure to direct sunlight.
4. Increased safety: By minimizing the risk of any part of the solar cell being burned or damaged due to over exposure to direct sunlight, dual axis solar trackers can help reduce the risk of fire and other hazards.
5. Power level monitoring: Dual axis solar trackers can be equipped with power level monitoring devices, which can help optimize the performance of the solar cell system, as well as alerting users to any problems or maintenance that needs to be done.

VII. RESULT AND DISCUSSION

The LDR senses the light rays and instructed the gear motor to move the solar panel according to the light rays. If a light ray present in east side the panel move towards east , if the light ray present in west side the panel move towards west. The power generated from the solar panel is stored in a battery and by using inverter, the stored power is given to the different home appliances. The power level is monitored by LCD and IOT. Additionally, cooling system is used for the overheated solar panel which is reduced using water. By this method we can generate large or high amount of electricity than other methodologies.

The Dual Axis Solar Tracker with Power Level Monitor was found to be effective in tracking the sun and accurately monitoring the power level of the solar panel. The tracker was able to accurately adjust the solar panel to the correct position in order to maximize the amount of sunlight received and the power level of the solar panel. Additionally, the



power level monitor was able to accurately measure and track the power level of the solar panel in order to ensure that the solar panel was operating at its maximum efficiency.

These features make the Dual Axis Solar Tracker with Power Level Monitor an effective tool for tracking the sun and maximizing the efficiency of the solar panel. Additionally, the power level monitor is an important feature, as it can help to prevent system overloads and ensure that the solar panel is operating at its maximum efficiency.

VIII. FUTURE SCOPE

Dual Axis Solar Tracker with Power Level Monitor and Cooling System has a huge future potential. It has the potential to revolutionize the solar energy sector. It can be used to lower energy production costs, monitor performance, and boost the efficiency of solar panel systems. Additionally, it can be used to create innovative cooling systems that lengthen solar panels' useful lives and save maintenance costs. In the long-term, this idea might result in a more effective and affordable approach to generate solar power.

IX. CONCLUSION

The dual axis solar tracker with power level monitor is an innovative way to maximize the efficiency of solar energy. By tracking the exact location of the sun and adjusting the orientation of the solar panels accordingly, the tracker can significantly increase the amount of energy produced. Additionally, the power level monitor ensures that the solar panel is always operating at its peak efficiency and the cooling system ensures the solar panel to not get overheat. This concept is an effective way to reduce both energy costs and carbon emissions. So by this method we can generate large amount of electricity.

REFERENCES

- [1] Sagar Swami, Rahul Kumar, Neethesh Kumar [December 2020] "Dual Axis Solar Tracking System using Arduino", International Information and Engineering Technology Association (IETA), vol.4, No.1.
- [2] Krishnashree Achuthan, Joshua David Freeman, Prema Nedungadi [April 2020] "Remote Triggered Dual-Axis Solar Irradiance Measurement System", IEEE Transactions on Industry Applications, Vol.56, No.2.
- [3] Adven Maish, Murodbek Safaraliev, Karomatullo Mukhmudov [2019] "Application of Dual Axis Solar Tracking System in Qurghonteppa, Tajikistan", 7th International Conference on Smart Energy Grid Engineering
- [4] Muhammad Maidugu Aji, Bawa Garshima Gamiya, Aisha Temitope Olomowewe [Feb 2022] "Design and Simulation of Dual-Axis Solar Tracking Systems", International Conference on Multidisciplinary Engineering and Applied Science (ICMEAS).
- [5] A Mohamad, MTA Rahman, K Phasinam, [October 2021] "Analysis of an Arduino based Solar tracking system", Journal of physics conference series.
- [6] Yousif R. Al-Saadi, Monaf S. Tapou, Areej A. Badi, [July 2022] "Developing Smart Self Orienting Solar Tracker for Mobile PV Power Generation Systems", IEEE Transactions on Power Delivery, Vol.10.
- [7] H. N. Shashank and C. Hithashree [2021], "Efficient Dual Axis Solar Tracking System", in Lecture Notes in Electrical Engineering, vol. 698, pp. 883–889.
- [8] S. Obukhov, A. Ibrahim, A. A. Zaki Diab, A. S. Al-Sumaiti, and R. Aboelsaud [2020], "Optimal Performance of Dynamic Particle Swarm Optimization Based Maximum Power Trackers for Stand-Alone PV System under Partial Shading Conditions," IEEE Access, vol. 8, pp. 20770–20785.
- [9] X. Zhang, D. Gamage, B. Wang, and A. Ukil [Jan 2021], "Hybrid maximum power point tracking method based on iterative learning control and perturb & observe method," IEEE Trans. Sustain. Energy, vol. 12, no. 1, pp. 659–670.
- [10] R. Lopez-Erauskin, A. Gonzalez, G. Petrone, G. Spagnuolo, and J. Gyselinck [Jan 2021], "Multi-variable perturb and observe algorithm for gridtied PV systems with joint central and distributed MPPT configuration," IEEE Trans. Sustain. Energy, vol. 12, no. 1, pp. 360–367.
- [11] J. P. Ram, D. S. Pillai, N. Rajasekar, and S. M. Strachan [Jun 2020], "Detection and Identification of Global Maximum Power Point Operation in Solar PV Applications Using a Hybrid ELPSO-PO Tracking Technique," IEEE J. Emerg. Sel. Top. Power Electron., vol. 8, no. 2, pp. 1361–1374.
- [12] N. Priyadarshi, S. Padmanaban, J. B. Holm-Nielsen, F. Blaabjerg, and M. S. Bhaskar [Mar 2020], "An Experimental Estimation of Hybrid ANFISPSO-Based MPPT for PV Grid Integration under Fluctuating Sun Irradiance," IEEE Syst. J., vol. 14, no. 1, pp. 1218–1229.



- [13] R. B. Bollipo, S. Mikkili, and P. K. Bonthagorla [Jan 2021], “Hybrid, optimal, intelligent and classical PV MPPT techniques: A review,” CSEE Journal of Power and Energy Systems, vol. 7, no. 1. Institute of Electrical and Electronics Engineers Inc., pp. 9–33.
- [14] K. Y. Yap, C. R. Sarimuthu, and J. M. Y. Lim [Nov 2020], “Artificial Intelligence Based MPPT Techniques for Solar Power System: A review,” J. Mod. Power Syst. Clean Energy, vol. 8, no. 6, pp. 1043– 1059.
- [15] S. H. Hanzaei, S. A. Gorji, and M. Ektesabi [Oct 2020], “A Scheme-Based Review of MPPT Techniques With Respect to Input Variables Including Solar Irradiance and PV Arrays’ Temperature,” IEEE Access, vol. 8, pp. 182229–182239.
- [16] L. M. Fernández-Ahumada, J. Ramírez-Faz, R. López-Luque, M. Varo-Martínez, I. M. Moreno-García, and F. Casares de la Torre [Jan 2020], “A novel backtracking approach for two-axis solar PV tracking plants,” Renew. Energy, vol. 145, pp. 1214–1221.
- [17] Y. Zhu, J. Liu, and X. Yang [Apr 2020], “Design and performance analysis of a solar tracking system with a novel single-axis tracking structure to maximize energy collection,” Appl. Energy, vol. 264, p. 114647.
- [18] A. Awasthi et al. [Nov 2020], “Review on sun tracking technology in solar PV system,” Energy Reports, vol. 6. Elsevier Ltd, pp. 392–405.
- [19] C. F. Abe, J. B. Dias, G. Notton, and P. Poggi [Mar 2020], “Computing Solar Irradiance and Average Temperature of Photovoltaic Modules from the Maximum Power Point Coordinates,” IEEE J. Photovoltaics, vol. 10, no. 2, pp. 655–663.
- [20] M. Kermadi, Z. Salam, J. Ahmed, and E. M. Berkouk [Sep 2019], “An Effective Hybrid Maximum Power Point Tracker of Photovoltaic Arrays for Complex Partial Shading Conditions,” IEEE Trans. Ind. Electron., vol. 66, no. 9, pp. 6990–7000.
- [21] A. Diaz, R. Garrido, and J. J. Soto-Bernal [Feb 2019], “A Filtered Sun Sensor for Solar Tracking in HCPV and CSP Systems,” IEEE Sens. J., vol. 19, no. 3, pp. 917–925.



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