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A Research Paper On Sun Tracking Solar Panel

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***Abstract*—Solar energy is one of the most important renewable energy sources used for electricity generation. Conventional**

Fixed solar panels cannot utilize maximum sunlight throughout the day because the position of the sun continuously changes. To overcome this limitation,a Sun tracking Solar Panel system was designed and implemented .The system automatically tracks the movement of the sun and adjust the solar panel positon for maximum sunlight absorption.

The proposed system uses Light Dependent Resistors(LDRs),Arduino UNO microcontroller ,servo/DC motor, and a motor driver circuit for automatic tracking. The LDR sensors detect sunlight intensity from different directions ,and the Arduino controls the motor movement according to sensor output .The motor rotates the panels towards the direction of maximum sunlight.

Experimental results showed that the tracking system generated higher electrical output compared to fixed solar panels. The average output voltage of the fixed panel was 8.62 while the tracking system generated approximately 10.02 V.Achieving nearly 15-20% higher efficiency. The system proved to be effective reliable ,low-cost ,and suitable for renewable energy application.

***Index Terms*—Solar Energy, Sun Tracking System, Arduino UNO,LDR Sensor, Renewable Energy ,Solar Panel.**

I. INTRODUCTION

Renewable energy technologies are becoming increasingly important because of rising demand of rising demand and depletion of coventioanl energy resources. Solar energy is one of the cleanest and most widely available renewable energy sources.Solar panels cannot continuously face the sun throughout the day, reducing overall efficiency. A Sun Tracking Solar Panel system solves this problem by automatically adjusting the panel position according to sunlight direction .The propsed system used LDR sensors and ardunino-based automation to continuously align the solar panel towards maximum sunlight.This increases energy absorption and improves power generation efficiency.

The project aims to design and implement a low-cost and efficient solar tracking mechanism suitable for small-scale renewable energy applications.

II. OBJECTIVE

The objective of the project is to study existing solar panel systems identify their limitations,to design and develop an automatic sun tracking mechanism,to maximize solar energy absorption throughout the day,to improve solar power generation efficiency, to reduce loss caused by fixed orientation,to develop a low-cost renewable energy solution.By tracking the sun's direction, the system helps in maximizing solar energy absorption and improving the overall efficiency of power generation.Another objective of the project is to reduce the energy loss that occurs due to fixed panel orientation and increase the output performance of the solar panel system. The project also focuses on developing a simple,efficient,and low-cost renewable energy solution that can be easily implemented for practical applications.

III. METHODOLOGY

The methodology used in the sun tracking solar panel project is based on an automatic light sensing and tracking mechanism.The system mainly conists of LDR(Light Dependent Resistor),an Arduino UNO microcontroller,a motor driver,and a DC/servo motor connected to the solar panel.The LDR sensors are placed on opposite sides of the panel to continuously detect the intensity of sunlight falling on each side.

The Arduino UNO continuously reads and compares the values obtained from both sensors.If one sensor recives more sunlight more sunlight that the other, the controller identifies the direction of maximun sunlight and sends signals to the motot driver,The motor then rotates the solar panel towards the brighter side until both sensors recive nearly equal of the sun frm morning to evening.

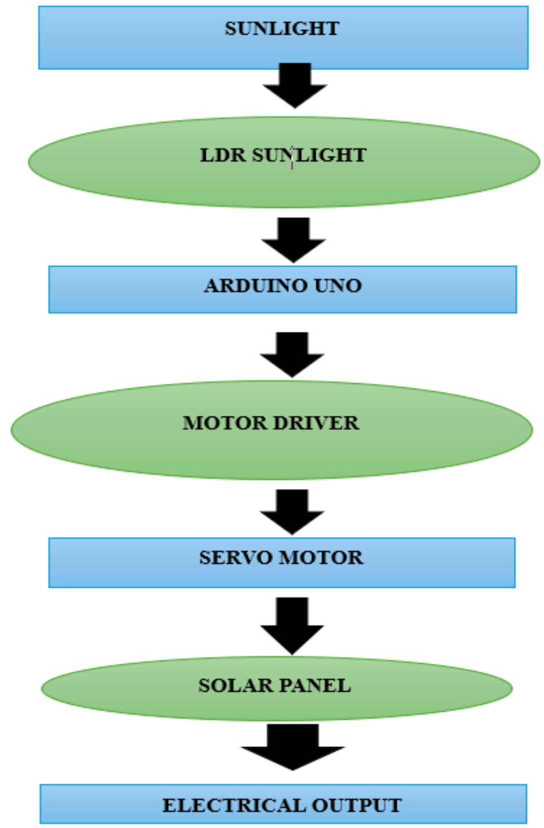
By continuously adjusting the position of the solar panel, the system helps in maximizing solar energy absorption and improving the overall efficiency of power generation.The methododlogy also reduces energy loss caused by fixed panel orientation and provides a simple,efficient,and low-cost renewable energy solution.

IV. HARDWARE AND SOFTWARE

The Sun Tracking Solar Panel system consists of both hardware and software componenets that work together to automatically track the movement of the sun.The main hardware cocmponenets is the solar panel,which converts sunlight into electrical energy using photovoltaic cells.LDR(Light Dependengt Resistor)sensors are used to detect the intensity of sunlight and provide analog input signals to the Arduino UNO.The Arduino UNO acts as the main controller of the system by processing the sensor data and controlling the movement of the motor.Amotor driver is used to control the direction and operation of the motor according to the signals recived from the Arduino.The servo/DC motor rortates the solar panel toward the direction of maximum sunlight to improve energy absorption.

The software part of the project is developed using the Ardunio IDE and Embedded C programming language.The algorithm of the system begins with staring and initializing the Arduino boards and sensors.The Arduino continuously reads the values form the LDR sensors and compares the light intensity detected on both sides of the panel.If one sensor receives higher sunlight intensity,the controller activates the motor and rotates the panel towards the brigher side,When botj sensors values become nearly equal,the motor stops.This process is repeated continuously throughout the day,allowing the solar panel to automatically follow the sun and generate maximun power.

V. BLOCK DIAGRAM



VI. EXPERIMENTAL RESULTS

The experimental analysis of the Sun Tracking Solar Panel system was carried out by comparing its output voltage with a fixed solar panel at different times of the day.The observations showed that at 9:00AM,the fixed solar panel produced 8.1V while the sun tracking panel generated 9.3V.At 11:00AM, the output of the fixed panel was 9.0V,whereas the tracking system produced 10.5V.Similarly,at 1:00PM,the fixed panel generated 9.8V and the tracking panel produced 11.2V.At 3:00PM,the fixed solar panel output was 8.7 while the tracking system generated 10.1V.Suring the evening at 5:00PM,the fixed panel produced 7.5Vand the tracking panel generated 8.9V.

The overall efficiency comparison showed that the fixed solar panel system had an average output voltage of 8.62V with an efficiency of 100%,while the Sun Tracking Solar Panel system produced an average output voltage of 10.02V with an efficiency of 116%,These experimental results clearly indicate that the sun tracking system generated higher output voltage throughout the day compared to the fixed panel system.The tracking mechanism continuously aligned the panel toward maximun sunlight,which improved solar energy absorption,increased power generation efficenecy,and reduced energy loss caused fixed panel orientation.

VII. CONCLUSION

The Sun Tracking Solar Panel project successfully demonstrated the improvement in solar energy generation efficiency through automatic sunlight tracking.The systems used LDR sensors,anArduino UNO,and a motor-based mechanism to Continuosuly adjust the position of the solar panel according to the direction of maximum sunlight.By automatically tracking the sun throughout the day,the system increased solar energy absorption and reduced energy loss caused by fixed panel orientation.

The experimental results showed that the sun tracking system produced approximately 15-20%higher efficieny compared to conventional fixed solar panles.The project proved to be simple,reliable,and cost-effective for renewable energy applications.The developed system can be effectively used in street lighting systems,residential solar power systems,agriculture application application,and smart energy management systems to improve overall power generation efficiency and support sustainable energy development.

VIII. FUTURE SCOPE

The future scope of the Sun Tracking Solar Panel project includes several improvements and advanced developments to enhance system performance and efficiency.The project can be further upgraded by implementing a dual-axis solar tracking mechanism,which will allow the panel to track sunlight in both horizontal and vertical directions for maximun energy absorption.Integration with IoT-based monitoring systems can enable real-time data monitoring and remoted control of the solar panel system.AL-based tracking optimization techniques can also be used to improve the accuracy and efficiency of sunlight tracking under different environmental conditions.In the future,the system can be developed for industrial-scale solar power power applicatins to increase large-scale energy generation.The project can also be integrated with battery management systems for efficient energy storage and power utilization.Additionally,smart grid integration and wireless communication technologies can make the system more intelligent,automated,and suitable for modern renewable energy applications.

REFERENCES

[1] Rizk,J.,and Chaiko,Y.,”Solar tracking Systems:More Efficient Use of Solar Panles”,World Academy of Science,Engineering and Technology,Vol.41,2008.

[2] Barsoum,N.,”Fabrication of Dual-Axis Solar tracking Controller Project,”Intelligent Control and Automation,Vol.2,No2,2011.

[3] Clifford,M.J.and Eastwood,D.,”Design of a Novel Passive Solar tracker,”Solar Energy,Vol.77,No.3,2004.

[4] Sidek,M.H.M.,Azis,N.,Hasan,W.Z.W.,Ab Kadir,M.Z.A.,Shafie,S.,and Radzi,M.A.M.,”Automated Positioning Dual-AxisSolar Tracking Syatem with Precision Astronomical Algorithm,”Renewable Energy,Vol.99,2017.

[5] Alexandru,C.,”The Design and Optimization of a PhotovoltaticTracking Mechanism,”Mechanism and Machine Theory,Vol.49,2012.

[6] Kalogirou,S.A.,Solar Enegry Engineering:Processes and Systems,2ndEdition,Academic Press,2014.

[7] Abdallah,S.,and Nijmeh,S.,”Two-Axes Sun Tracking System with PLC Control,”Energy Conversion and Management,Vol.45,N0.11-12,2004.

[8] Al-Mohamad,A.,:Efficiency Improvement of Photo-Voltaic Panels Using a Sun-Tracking Systems,”Applied Energy,Vol.79,No.3,2004.

[9] Hafez,A.Z.,Soliman,A.,EI-Metwally,K.A.,and Ismail,I.M.,”Solar tracking Systems:Technologiesand trackers Drive types-A Review,”Renewable and Sustainable Energy Reviews,Vol.91,2018.

[10] Chong,K.K.,and Wong,C.W.,”General Formula for On-Axis Sun-tracking System and Its Application in Improving Tracking Accuracy,”Solar Energy,Vol.83,No.3,2009.

[11] Mousazadeh,H.,Keyhani,A.,Javadi,A.,Mobli,H., Abrinia,K.,and Sharifi,A.,”A Reviewof Principal

and Sun-Tracking Methods for Maximing Solar Systems Output,"Renewable and Susbtainable Energy Reviews,Vol.13,No.8,2009.

[12] Rubio,F.R.,Ortega,M.G.,Gordillo,F.,and Lopez-Martinez,M.,"Application of New Control Strategy for Sun Tracking,"Energy Conversion and Managemnet,Vol.48,No.7,2007.

[13] Poulek,V.,and Libra,M.,"New Solar Tracker,"Solar Energy materials and Solar Cells,Vol.51,No.2,1998.

[14] Bakos,G.C.,"Design and Construction of a Two-Axis Sun Tracking System for Parabolic Trough Collectirs,"Renewable Energy,Vol.31,No.15,2006.

[15] Kelly,N.A.,and Gibson,T.L.,"Improved Photovoltaic Energy Ouput for Cloudy Conditions with a Solar Tracking Syatems,"Solar Energy,Vol.83,No.11,2009,

[16] FAthabadi,H.,"Novel High Efficient Offline Sensorless Dual-Axis Solar Tracker for Using in Photovoltaic systems and Solar Concentrators,"Renewable Energy,Vol.95,2016.

[17] Vieria,R.G.,Guerra,F.K.O.M.,Vale,M.R.B.G.,and Araujo,M.M.,"Comparative Performance Analysis Between Static Solar Panels and Single-Axis Tracking Syatems,"Journal of Solar Energy Engineering,Vol.138,No.1,2016.

[18] Eke,R.,and Senturk,A.,"Performance Comparison of a Double-Axis Sun Tracking Versus Fixed PV System,"Solar Energy,Vol.86,No.9,2012.

[19] Huang,B.J.,Ding,W.L.,and Huang,Y.C.,"Long-Term Field Test of Solar PV Power Generation Using One-Axis 3-Position Sun Tracker,"Solar Energy,Vol.85,No.9,2011.

[20] Saxena,A.K.,and Dutta,V.,"A Versatile Microprocessor based Controller Solar Tracking,"Proceedings of the IEEE,1990.