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Research on Development and Analysis of Hybrid Solar Generating Module for High-Efficiency Solar Energy Station & Solar Tracking Using Arduino UNO

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Abstract - The increasing demand for permanent energy solutions has increased the requirement for more efficient solar technologies. This article presents the development and evaluation of a hybrid sun beat module that integrates advanced sun tracking and energy conversion when using an Arduino UNO microcontroller. The system uses a halogen light source to simulate solar movement, which facilitates accurate traction of solar panels through a specially designed gimbal mechanism and has a tilted mirror to increase the light catch. Integration of two 6V photovoltaic panels combined with voltage sensors enables real -time monitoring of energy production, which is shown through the 16 × 2 LCD screen. The proposed system improves solar energy efficiency by maximizing photon absorption and increasing total energy production by adjusting panel orientation. Experimental results indicate that the hybrid approach leads to a significant increase of 20 to 25 percent in the energy yield compared to the static solar panel configuration, which combines active tracking with increased light reflection. In addition, the efficiency of the system can be scaled to reduce the number of modules required for power generation, cost reduction and better system contributes to flexibility. This task demonstrates the ability to adapt energy catches and integrate cost-effective, accurate tracking and reflection techniques in solar systems to optimize and promote sustainable energy solutions.

Keywords- Renewable energy, hybrid model, solar energy.

INTRODUCTION

In the current scenario in a world economy, the demand for energy security is rising. All shareholders (countries) are seeking energy power to ensure their development. Developing nations like China, Brazil and India are developing at alarming speed, it will always augment the demand for oil, and as the oil supply will be voltage. With a fast decrease in oil and gas resources, and with the negative impacts of their consumption on the climate cycle, it has compelled us to explore other energy include sources, and also state that the consumer is only accountable for 2% of total energy consumption. Modified fuel budget, the use of mass transport systems as a means to work, carpooling, conservation of energy and energy consciousness are some indicators for lifestyle modification. With various repercussions of energy crisis surfacing in the form of rising inflation as well as climatic change, the governments in most nations are now increasingly more conscious of alternative energy benefits as well as fostering renewable energy technology.

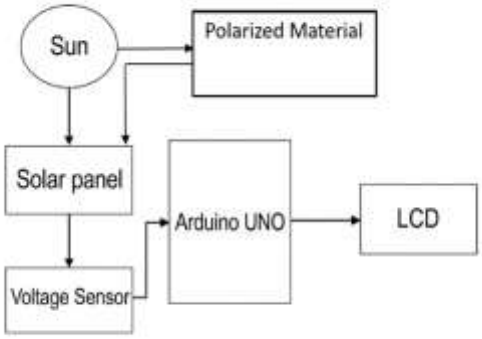
Renewable energy resources can fulfill today's world energy demand multiple times, so their potential is very strong. They may enhance energy supply market diversity, secure long-term energy supply, and decrease local and global atmospheric emissions. They can also provide commercially viable substitutes to fulfill particular needs for energy services (particularly in developing nations and rural regions), generating new job opportunities and offering prospects for local equipment fabrication. Although numerous renewable energy technologies are on the market to purchase, most of them are yet in the initial phases of development and aren't yet fully developed. They require ongoing R, D, and demonstration efforts. Our proposed system assists to utilize the solar panel's reflected light for another application.

METHODOLOGY

The proposed system works as follows: Arduino Uno Microcontroller acts as a central control unit, and orchestrates the operation of the entire layout. Originally, Halogen Light Display repeats the sun's speed, which provides a dynamic reference for sun tracking. The timber manufacturer, equipped with central locking, enables accurate adjustment of solar panels and mirror orientation. When the sunlight hits solar panels, photovoltaic cells

convert solar to electric power. The inclusion of a tilted mirror increases the photo capture, and controls more sunlight against solar panels for increased energy production. The voltage sensors located at the end of each solar panel measure the voltage generated, which is then displayed on the 16*2 LCD screen for surveillance and analysis of real -time. This systematic integration of components ensures optimal use of solar energy and effective tracking helps increase the general performance and stability of the system

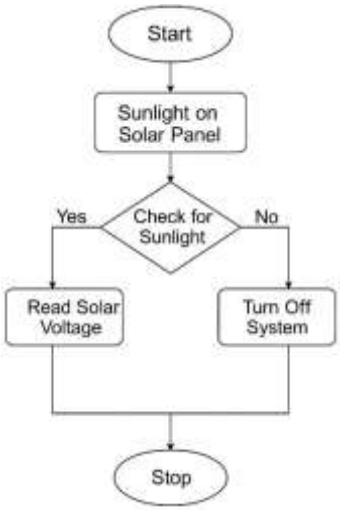
BLOCK DIAGRAM



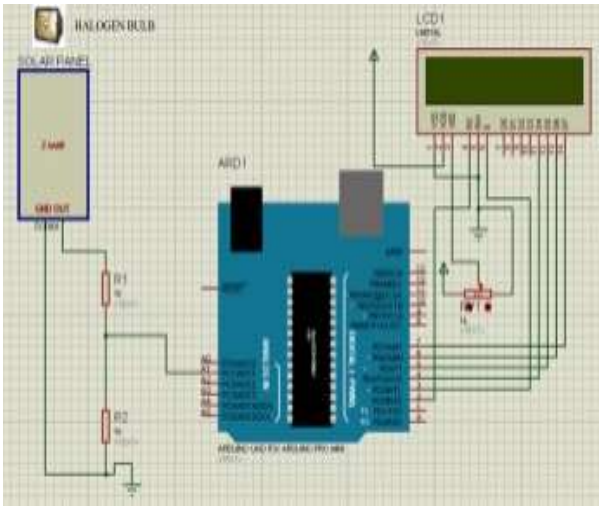
DESCRIPTION

In this proposed system we used The Arduino UNO as a microcontroller. The voltage sensor functions as an input device that provides voltage data to the microcontroller. The LCD is attached to them as an output device to the microcontroller.

FLOW CHART



CIRCUIT DIAGRAM



WORKING

In this paper, we are developing a hybrid solar generating module in association with solar tracking using an arduino uno microcontroller. The System Uses a Halogen Light Display to Simulate the Movement of the Sun, which Enables Accurate Solar Tracking. A timber manufacturer with central locking facilitates a tilted mirror for the exact position and increased photo -catching solar panels. The Voltage Sensors in the Ends of the Panels Monitor the Voltage Generated, which is displayed on an LCD Screen for Real -Time Analysis. By integrating these components, we aim to adapt the conversion of solar energy, maximize energy production and improve the general system efficiency, which contributes to permanent energy solutions.

SYSTEM REQUIREMENT

HARDWARE REQUIREMENT

1. Arduino
2. LCD
3. Voltage Sensor
4. Solar Panel
5. Halogen Bulb
6. AC

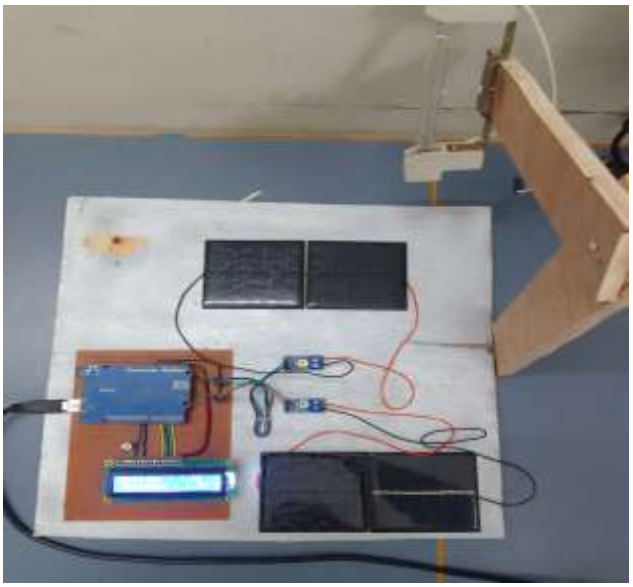
SOFTWARE REQUIREMENT

1. Arduino IDE
2. Proteus

EXPERIMENTAL SETUP AND RESULT

EXPERIMENTAL SETUP

Fig. (a) Shows Top View of the Experimental Setup



RESULT

The development and analysis of a hybrid solar module for a high efficiency solar station, combined with sun tracking using Arduino UNO, gets promising results. By taking advantage of an Arduino Uno microcontroller as a base, the system involves a halogen light screen to simulate the sun's movement. A timber manufacturer with central locking facilitates the exact position, while the halogen assembly ensures accurate representation of solar angles. Integration of two 6-volt solar panels, improved by a bent mirror for increased photo capture promotes total energy production. At the end of each solar panel, the voltage sensors enable real -time monitoring, with the data displayed on the 16*2 LCD screen. This extensive approach includes hardware and software elements to adapt the conversion of solar energy and track efficiency, marking significant progress toward permanent energy solutions.

Fig. Shows the Voltage Output of Solar Panel using Halogen Bulb

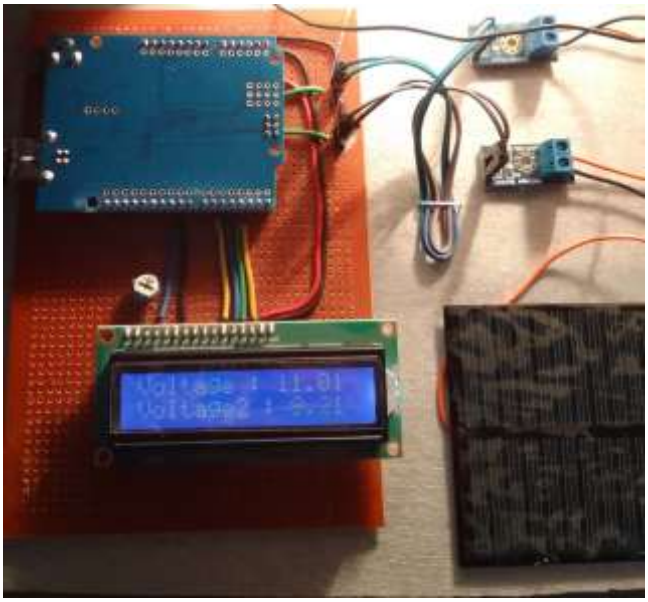
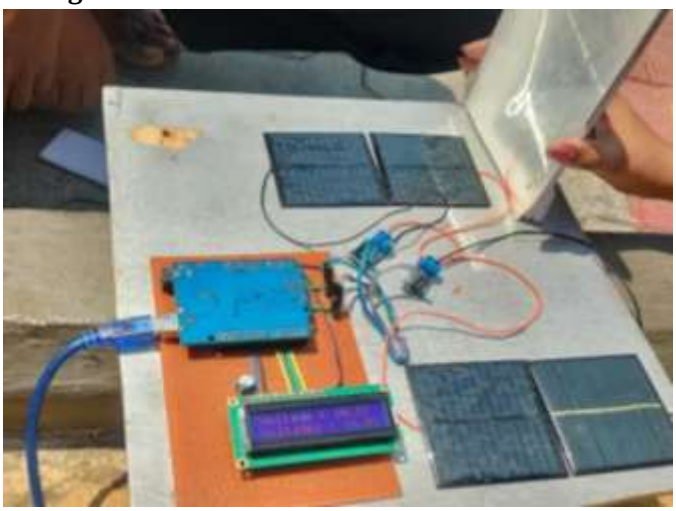
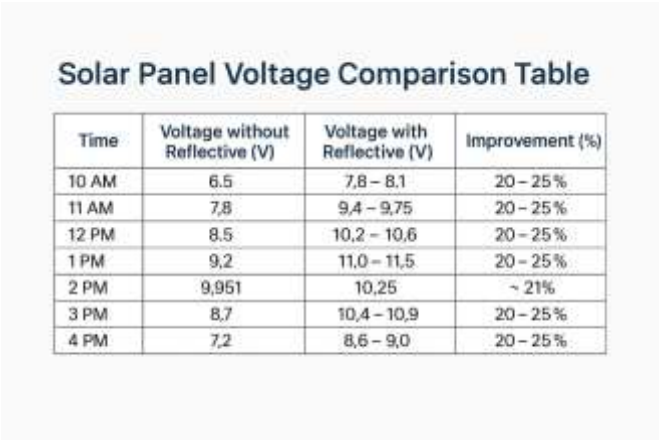


Fig. Shows the Voltage Output of Solar Panel using Sunlight





Solar Panel Voltage Comparison Table

Time	Voltage without Reflective (V)	Voltage with Reflective (V)	Improvement (%)
10 AM	6.5	7,8 – 8,1	20 – 25%
11 AM	7,8	9,4 – 9,75	20 – 25%
12 PM	8.5	10,2 – 10,6	20 – 25%
1 PM	9,2	11,0 – 11,5	20 – 25%
2 PM	9,951	10,25	~ 21%
3 PM	8,7	10,4 – 10,9	20 – 25%
4 PM	7,2	8,6 – 9,0	20 – 25%

Fig. Shows the Voltage Output of Solar Panel using Sunlight according to time

Comparative comparison of solar panel voltage provides a detailed, time -based analysis of the voltage output to the voltage comparison of the voltage. At 10 o'clock, the panel produces 6.5 V without reflection, which increases to the range of 7.8–8.1 V with the reflex layout, showing a noticeable improvement of 20-25%. At 11 AM, production is improved from 7.8 V to 9.4–9.75 V, and continues to grow continuously. At 12 o'clock, as the sunlight becomes more direct, the voltage increases from 8.5 V to 10.2–10.6 V, which maintains the same area of improvement. During the afternoon, the panel's voltage grows from 9.2 V, up to 11.0–11.5 V without reflection, shows again 20-25% efficiency gain. Interestingly, the voltage increases from 9.9 V to 10.25 V, reflecting a slightly less improvement of about 21%, which can be attributed to the sun near the extreme position, which reduces the relative effect of the reflector. The trend continues at 15.00, with an increase from 8.7 V to 10.4-10.9 V, and finally at.

I. CONCLUSION

Developing hybrid systems is one of the most practical and effective answers for power generation compared to non-renewable energy resources. This is not only cheaper, but it does not harm the environment. Another thing is that they are often used to generating electricity in hilly areas, where it is quite difficult to transfer electricity through traditional methods. Depending on the requirement, the layout is often resolved. All people in this world must be motivated to use non-traditional resources to supply electricity to some extent to make them self-evident. Long life and little maintenance are its many goals. This requires only a few high initial investments.

We can conclude by combining different electronic components with built -in codes for the following purposes that the use of reflective materials on solar panels at a particular angle will help to increase the solar panel force in simple methods as shown in two experimental layouts with the cover's reflective mirror and without coverage without covered mirror.

Our paper is based on hybrid -based energy, which is not very expensive and helps to reduce pollution caused by fuel. Therefore, it is beneficial for a natural point of view

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