SOLAR TRACKING SYSTEM FOR OPTIMAL POWER GENERATION EMBEDDED SYSTEM

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Abstract:
Because the solar panel is dependent on the sun, solar energy with solar tracking will make it **possible to generate more energy. Even though the initial cost of setting up the tracking system is significant, there have been cheaper alternatives proposed over time. Light Dependent Resistors (LDRs) are used to detect sunlight. ATMega 328P microcontroller is used in the control circuit. The solar panel is placed where it will receive the most light. When compared to other motors, servo motors can maintain torque at high speeds.**

Keywords:
Solar Tracking System, Power Generation, Embedded System, Light Dependent Resistors, Renewable Energy, staticsolar panel.

Introduction:
In the current situation, everyone is dealing with power outages, which are causing a lot of problems for the people. So, to solve this problem, we have a solution in the form of the sun. Yes, we can get power from the sun's radiation, which is the solar energy that we use to generate power. Despite the fact that there are numerous energy sources such as wind, geothermal, and solar. Among these options, solar energy is the most accessible and cost-effective. Which can meet all of the requirements of the house? We will improve the efficiency of the solar system by using this project.

Many people all over the world use electric solar systems as backup power at their homes. This is because solar energy is a limitless energy source that is expected to become increasingly important in the long run for supplying electricity and heat energy to users. Solar energy has the potential to be a major source of energy in the future. A solar tracker is a solar panel that automatically follows the Sun to increase power.

As the price of fossil fuels fluctuates, renewable energy is rapidly gaining importance as an energy resource. At the educational level, it is therefore critical for engineering and technology students to understand and appreciate renewable energy technologies. Solar energy is one of the most widely used renewable energy sources. Furthermore, of all renewable energy sources available, solar energy has the least negative environmental impact. Photovoltaic cell electricity does not pollute the air or water, deplete natural resources, or endanger animal or human health. A solar tracker is a device that is used to direct a solar photovoltaic panel towards the sun and measure its output power. The surface of the module in solar tracking systems automatically tracks the sun throughout the day. The tracking system significantly improves system efficiency by lowering the cost per unit of output energy. The discovered voltage and current are transmitted via Wi-Fi to the user's mobile application. [1-3]

Applications

1. To manage renewable energy sources.
2. For domestic purposes.
3. For industrial purposes.

Review of Literature:
Solar panels are light-to-electricity converters. They are named after the sun or "Sol" because the sun is the most powerful source of light available. They are also referred to as photovoltaic, which means "light-electricity" in some cases. Solar cells, also known as PV cells, use the photovoltaic effect to absorb solar energy and cause current to flow between two oppositely charged layers. A solar panel is made up of solar cells. Although each solar cell

produces a small amount of power, a large number of solar cells spread across a large area can produce enough power to be useful. Solar panels must be pointed directly at the Sun to produce the most power. The development of solar cell technology begins with Antoine-Cesar Becquerel's 1839 research. While experimenting with a solid electrode in an electrolyte solution, he noticed the photovoltaic effect. When light fell on the electrode, he noticed a voltage develop. According to Encyclopaedia Britannica, Charles Fritts built the first genuine solar panel around 1883. He created junctions by coating selenium (a semiconductor) with a very thin layer of gold. Crystalline silicon and gallium arsenide are common materials used in solar panelsGallium arsenide crystals are grown specifically for photovoltaic applications, whereas silicon crystals are available in less expensive standard ingots, which are primarily used in the microelectronics industry. The Renewable Energy Corporation (REC) of Norway has confirmed that it will construct the world's largest solar manufacturing plant in Singapore by 2010. This plant will be capable of producing products capable of generating up to 1.5 gigatonnes (GW) of energy per year. That is enough to power several million homes at once. Last year, the entire world produced products with a total capacity of only 2 GW.It was built using a dc motor and a dc motor controller. An array of solar panels, a step up chopper, a single phase inverter, an alternating current power source, and a microcontroller-based control unit comprised the solar energy conversion unit. [4-5]

Objectives:

- The primary goal of the research is to detect and compare light intensity and to move the motor accordingly.
- A motor was used to power the solar project. The fact that the motor is fast, can sustain high torque, and has precise rotation within a limited angle influenced the decision. Because of the use of a dual axis tracking system, the design is limited to single axis tracking.

Research Methodology:

The solar tracker system's circuit is divided into three sections. There is an input stage made up of sensors. A programme in embedded software in the microcontroller, and finally the motor driving circuit. When the sun shines on the solar panel, it collects and stores the radiation. It will send a message to the microcontroller containing the stored power differences. The microcontroller will receive this information and send it to the dc motor drive. The panel rotates with the help of a motor as time passes.

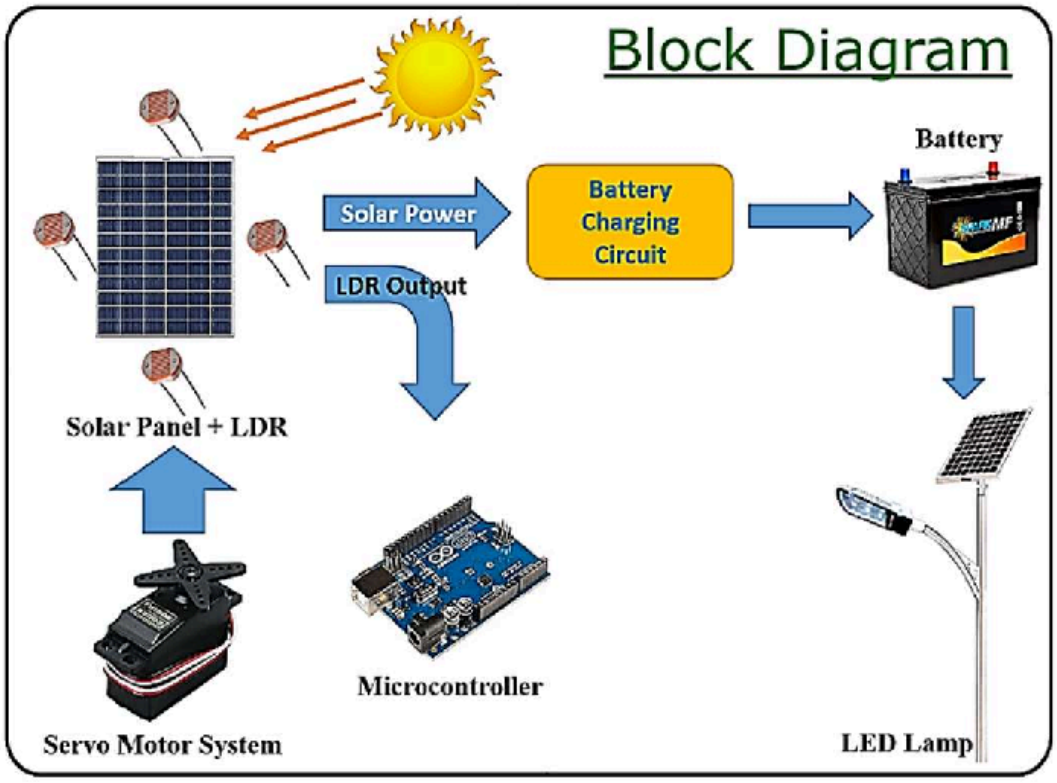

Figure 1. Block diagram for Solar tracking for optimal power generation

Light intensity sensors are installed on solar panels in this proposed methodology. In this system, we use two sensors to measure light intensity as it varies with angle. The motors and gears attached to the solar panel frame rotate the solar panel in the direction where the intensity is detected.

The motor is controlled by a microcontroller, which collects and processes data on light intensity from the two sensors via analogue channels. [6]

When the sensor detects a higher intensity of light, the microcontroller sends a signal to the motor, which rotates the panel via a gear mechanism. The system's secondary operation is to rotate in the direction of the sun.

The system's primary function is to collect solar power from the panel and store it on the battery charge controllers and microcontroller.

The microcontroller measures the input current from the solar panel and sends the information to the android app via the wi-fi module in this operation. This data will be received and displayed on the LCD. The solar panel is then transferred to solar charge converter modules, which convert the unregulated voltages to regulated voltages from which the battery is charged.

Result and Discussion:

Because LDR, or light dependent resistor, is commonly used in sun tracking systems, it was chosen as the sensor. This is due to the fact that LDR is light sensitive. LDR resistance decreases as incident light intensity increases. PIC16F866A had been chosen as the controller. This PIC programming will send a pulse to the driver, causing it to move the motor. Bidirectional DC motor control via relay was used for the driver. The motor controller was chosen because it is simple to control the motor to rotate clockwise and anticlockwise. The DC geared motor was also chosen because it has a hold torque of up to 4 kg.cm and a low rpm of 3rpm. Finally, the LM7805 is used to convert the input voltage from the source to 5 V output because the integrated circuit requires only 5 V to operate. [7-9]

Table 1 displays the voltage, current, and power received from a static solar panel and a solar tracker over the course of a day. The maximum voltage, current, and power for a static solar panel are 21.1 V, 5.94 mA, and 125.334 mW, respectively. Meanwhile, the maximum voltage, current, and power for a solar tracker are 21.6 V, 6.35 mA, and 137.160 mW, respectively. Figure 2 compares the power characteristic curves of a static solar panel and a solar tracker. It demonstrates that a solar tracker can receive more sunlight and, as a result, generate more power than a static solar panel.

Table 1: Reading data from solar panel

Hour	Using solar tracker Static solar panel			Using solar tracker Static solar panel		
	Voltage (V)	Current (mA)	Power (mW)	Voltage (V)	Current (mA)	Power (mW)
0800	16.8	1.23	20.664	18.3	3.41	62.403
0900	17.0	2.34	39.780	18.9	3.57	67.473
1000	17.6	2.51	44.176	19.4	3.98	77.212
1100	19.4	3.64	70.616	19.7	4.76	93.772
1200	19.8	4.45	88.110	20.4	5.40	110.430
1300	20.5	5.12	104.960	21.6	6.35	137.160
1400	21.1	5.94	125.334	21.4	6.11	130.754
1500	19.4	5.43	105.342	20.5	5.87	120.335
1600	17.2	5.01	86.172	19.6	5.26	103.096
1700	16.5	4.28	70.620	18.5	4.86	89.910
1800	16.2	2.87	46.494	17.5	3.75	65.625

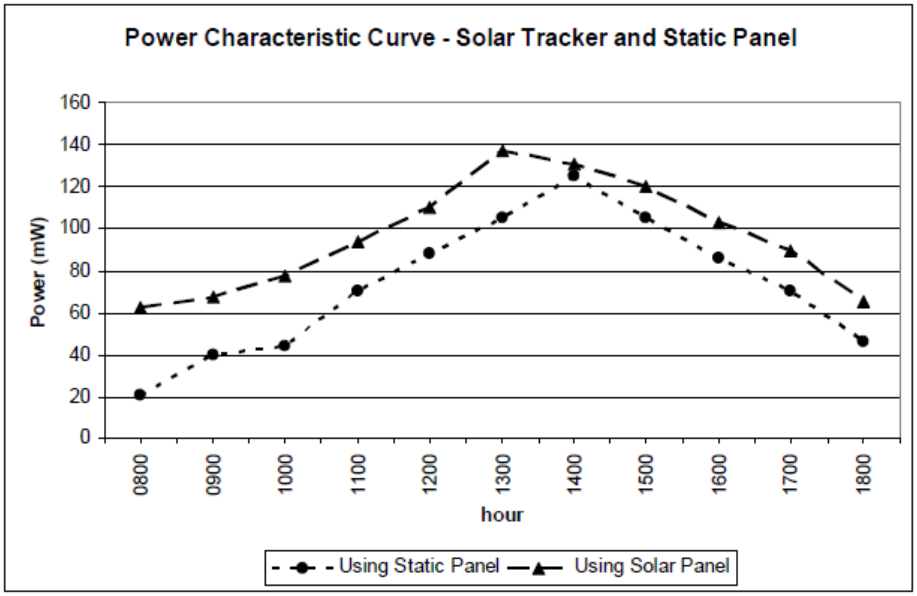

Figure 2: Power characteristic curve comparison of staticsolar panel and solar tracker. [10-12]

Outcome Of this paper

- The app will display the power and data generated by the solar panel.
- Power consumption details for the output.
- Data on the intensity of ultraviolet light in the app.
- The app's battery status.
- Details on the app's ambient light source.
- On-app analytics graph for power generated and consumed.

Conclusion:

The proposed sun tracking solar system is a more practical and efficient way of maximising energy received from the sun's radiation. The hardware was carefully designed to use the fewest number of components for implementation. The development and description of a microcontroller-based efficient solar tracking system with real-time clock. By comparing predefined measured readings, the proposed system provides variable indication of their relative angle to the sun. Using this method, the solar tracker successfully maintained a solar array at a gain of more than 40% over a fixed horizontal array. The proposed design is low in power consumption, high in accuracy, and low in cost.

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