Dual-Axis Solar Tracker

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Abstract:
Solar energy is becoming a popular technique to develop sustainable energy sources. Engineering professionals must understand the technologies involved. Solar panel tracking system design and construction are covered in this project. Solar tracking orients the solar array toward the sun, increasing energy output. This system expands on course topics.
Solar energy feasibility requires solar array system efficiency optimization. Solar array systems can be improved by sun tracking. This method keeps a solar array facing the sun at all times. Solar modules cleanly turn sunshine into energy in remote areas, solving the power generating problem. The solar tracker designed for this project is reliable and affordable for aligning a solar module with the sun to maximize energy output.
Hardware/software hybrid prototype Automatic Sun Tracking System improves solar panel alignment with the sun to maximize energy production and inspire design. Problems and solutions will be discussed.

Keywords: solar tracking; single axis; dual axis; light depending on resistor (LDR), servo motor, Arduino, altitude, azimuth, charge controller.

1. INTRODUCTION

The world population grows daily, increasing energy demand. Oil and coal, the world's main energy sources, are expected to disappear in the next century, raising concerns about humanity's capacity to get inexpensive, reliable energy. Renewable energy with minimal operational costs is urgently needed. Solar energy is a major source in warm places. For roughly 10 months, India has longer bright days and two months of largely cloudy sky.
This makes our nation solar-rich, especially in western deserts like Rajasthan, Gujarat, Madhya Pradesh, etc. Most studies on photovoltaic cell collection and conversion of solar radiation into electrical energy have ignored variations in sun angle of incidence by installing the panels in a fixed orientation, which reduces the solar energy they can collect. We know that the angle of inclination is 0 degrees at midday and -90 degrees after dawn and +90 degrees before sunset. Thus, solar radiation is zero at sunrise and sunset and 100% at midday.
A larger part of solar energy is lost within the world. It is sparkling and absolve to the entire and that we can never face the insufficiency of solar energy like more than a few different energy. During this work dual axis, solar tracker is the main focus to talk about .This paper also demonstrates the renewable energy state of dealings, entirely special light sensors, some expected value of solar tracker etc. We are going to end with the premeditated tricks which might be functional for upward solar energy.

2. SOLAR ENERGY

Solar Energy Circumstances of India

In July 2009, India pledged US$19 billion to develop 20 GW (20,000MW) of solar energy by 2020. The proposal mandates solar-powered equipment and apps in government buildings, hotels, and hospitals. India planned to launch its National Solar Mission on November 18, 2009, to generate 1,000 MW of power by 2013 as part of the National Action Plan on Climate Change. India receives 1500–2000 sunshine hours per year (depending on area), therefore the daily average solar energy incidence is 4–7 kWh/m2, far greater than its present energy demand. Even a 10% PV module efficiency would be a thousand times greater than the predicted 2015 home power needs. The Gujarati government and Clinton Foundation signed an MOU to build the world's largest solar power facility. The William J. Clinton Foundation's renewable energy initiative would develop four facilities, including a 3,000-megawatt facility near Pakistan-India. Australia, South Africa, and California are additional options.

3. SOLAR TRACKER

Solar trackers track the sun's daily rotation from east to west. All tracking systems allow one or two degrees of movement freedom. Trackers align solar collectors/panels with the sun as it passes around the sky daily. sun trackers boost sun energy received by the solar energy collector and heat/electricity production. Solar trackers boost solar panel production by 20-30%, improving project economics. The cosine of the angle between the incoming light and the panel reduces direct beam energy. The sun traverses 360 degrees east-west a day, yet any stationary point may see 180 degrees for half a day. Local horizon effects restrict this to 150 degrees of effective motion. According to the table above, a solar panel oriented between dawn and sunset will lose 75% of its energy in the morning and evening due to 75-degree motion on either side. Rotating panels east and west can recover these losses. Single-axis trackers rotate east-west. Over a year, the sun travels

46 degrees north-south. The identical set of panels at halfway between the two local extremes will lose 8.3% as the sun moves 23 degrees on either side. Dual-axis trackers track daily and seasonal movements. .*"Fig. 1,"* shows the position of the sun over the year.

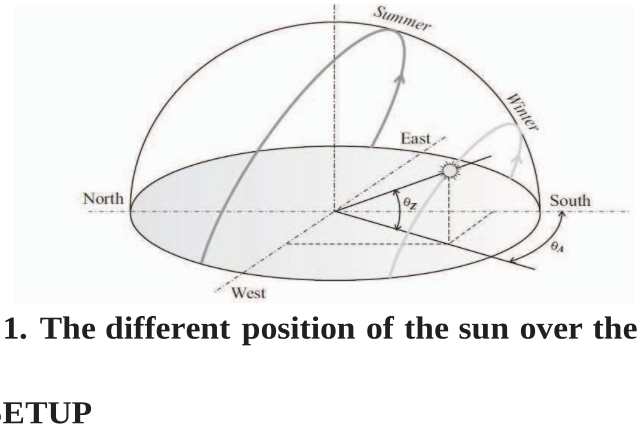

Fig. 1. The different position of the sun over the year

4. EXPERIMENTAL SETUP

By rotating PV panels in different axes, the suggested tracking system can track a lot of daylight. Dual-axis systems watch the sun in four directions, maximizing solar panel output. We can capture more solar beams during this emerge. "Fig. 2" explains the rear dual-axis tracking

Fig. 2. Dual axis tracker

The dual-axis tracker, depicted in "Fig 3", absorbs solar energy more efficiently by spinning in both horizontal and vertical axis. A system using 4 LDR sensors, 2 servo motor, and Arduino. The sensors and one motor tilt the tracker in the sun's east-west direction, while the base motor along with sensors tilt in in north-south direction.

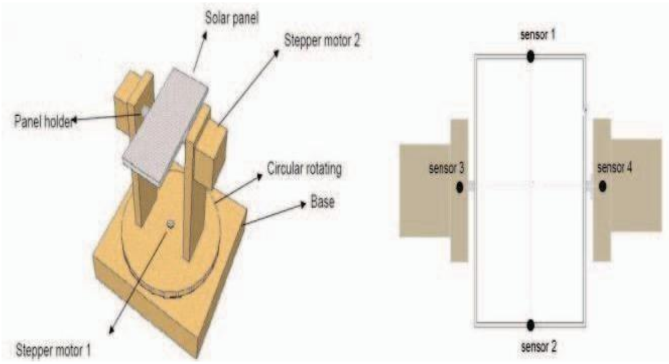

Fig. 3. Proposed model

The servo motor follows the sun. This microcontroller plans servo motors based on sensor input from two servo motors and four LDR sensors. LDR sensors notify Arduino microcontroller about sunlight. The microprocessor adjusted servo motor rotation based on LDR sensor readings. Dual Axis sun tracking system explained with block diagram in "Fig. 4".

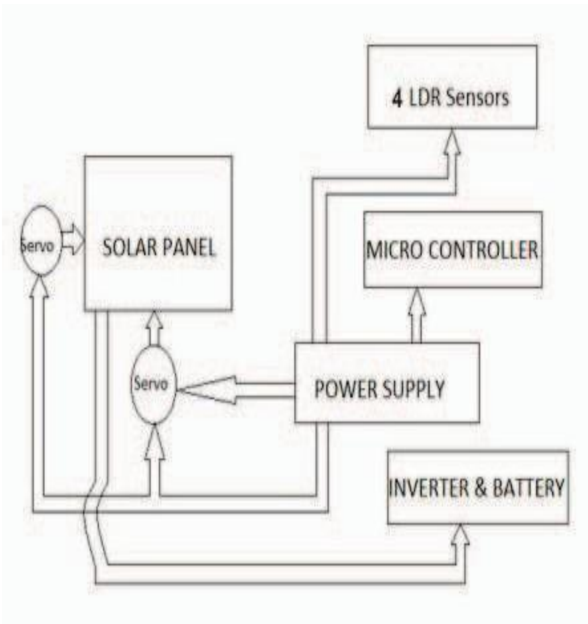

Fig. 4. Block diagram of overall system

LDR sensors signal the microcontroller when they detect sunlight, as shown in the circuit diagram. The microcontroller is a logic unit that controls sensor input and motor driver track. Assume the sun moves from east to west, causing light absorption to fluctuate on one sensor compared to another. The controller activates driving circuits and adjusts servo motors to new places when sensor pairs have the same light intensity. Same procedure may be used if sun's location changes in the sky. Since this model captures extra sun rays, its solar energy conversion potential is much higher. In "Fig. 5," the control algorithm's gesture appraisal is the important decision factor. The primary process begins when LDR sensors provide data. Sensor productivity is analog and digitally stimulated. Analogue to digital converters (ADCs) do this useful duty. Arduino microcontroller receives digitized signals. It determines servo motor direction and steep angle from digital inputs. Arduino microcontroller runs servo motors if sensor light detecting and signals are equal. It starts the algorithm. This process continues until detector pairs get equal light and PV panel is adjusted for maximum power. Solar panel voltage varies and needs synchronization. Solar panels frequently employ a regulator to manage their output voltage. This principle uses solar energy. No one wants to supply electricity from the outside, making our solution cost-effective. Battery storage and storage system supervision can make the model unbiased. The idea of produced voltage controls battery storage. Generation of voltage is used for storage charging and discharging.

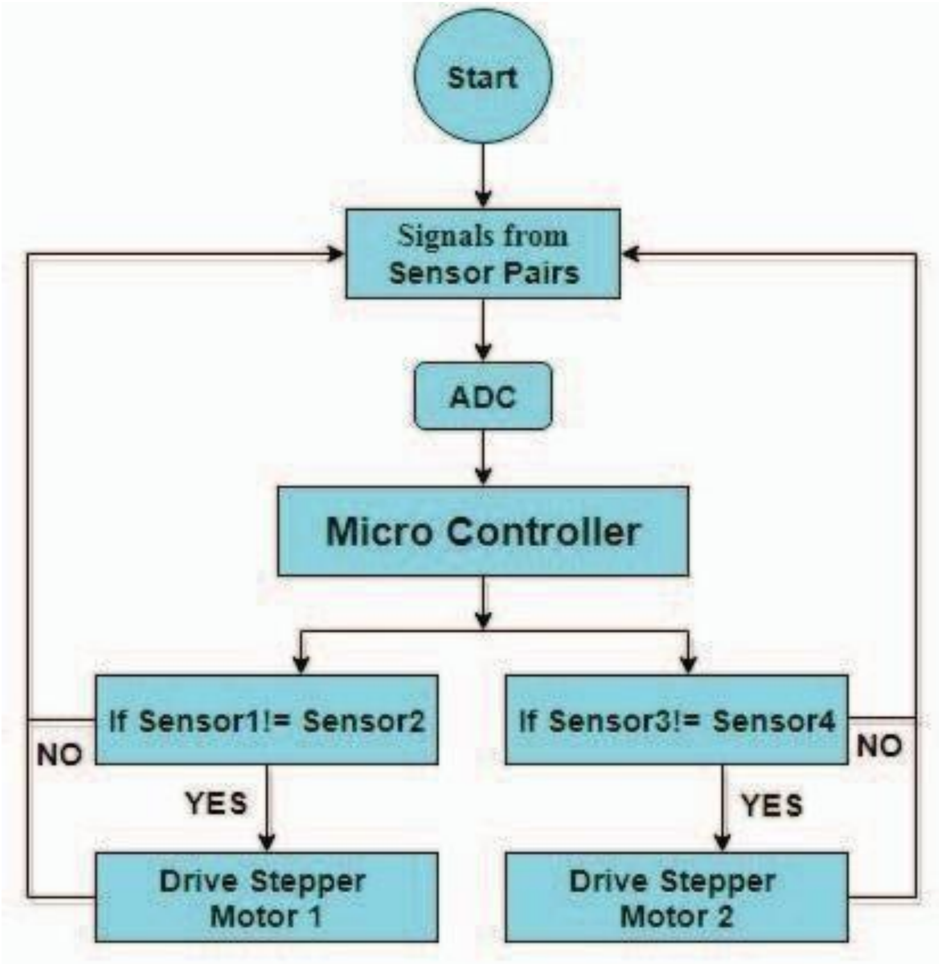

Fig. 5. Control algorithm

5. HARDWARE IMPLEMENTAT ION

All previous sections detailed the control formula and dual-axis block diagram. We tend to resort to hardware implementation of the proposed model." The support model is 2 feet tall. Increase panel altitude and set it in open air for better tracker control.

Hardware accomplishment uses a 36-watt monocrystalline PV panel. Two static magnet servo motors are employed. Servo motors are ideal for position control since they move in stages. PIC microcontrollers are easier to utilize than ATMEL microcontrollers for controlling. Table I lists PV Panel, LDR sensor, and servo motor ratings for our hardware design.

TABLE I. COMPONENT RATINGS

Component Name	Component Ratings
PV Panel Dimension	16×16 inches square
PV Panel Rating	35 Watts
PV Panel Material	Mono crystalline
Servo Motor	5v, 0.6 A, 9gr Servo HXT 900
Controller	Arduino Uno
LDR	GM 9516

6. CHARGE CONTROLLER

A charge controller or regulator regulates voltage and current to prevent battery overcharging. It controls solar panel-to-battery voltage and current. It protects against overcharging and overvoltage, which can reduce battery performance and safety. It will also prevent deep discharging or execute regulated discharges, depending on battery technology, to preserve battery life. The charge controller is between the solar battery's output and the battery holder's input. Solar batteries produce more power when sunshine is intense and less when daylight is low.

Charge controllers stabilize battery input. It also prevents overcharging, extending battery life. Stopping reverse current flow, especially at night, is a pointless charge controller feature.

7. FUTURE WORK

Even in nations with a large solar energy output, dual-axis solar tracking is rare commercially since single-axis tracking is performing the job. However, dual-axis tracking boosts potency. We used a sporadic PV panel for our investigation. Business- level cost-effectiveness and system potency can be found.

This study employed monocrystalline PV. This variant may also employ poly crystalline PV panels. LDR was utilized for this model, however dust makes it a poor sensor. We can utilize the more efficient sensor later. Adding a solar panel instead of a tracking structure is cheaper since a trustworthy structure is costly.

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