Abstract

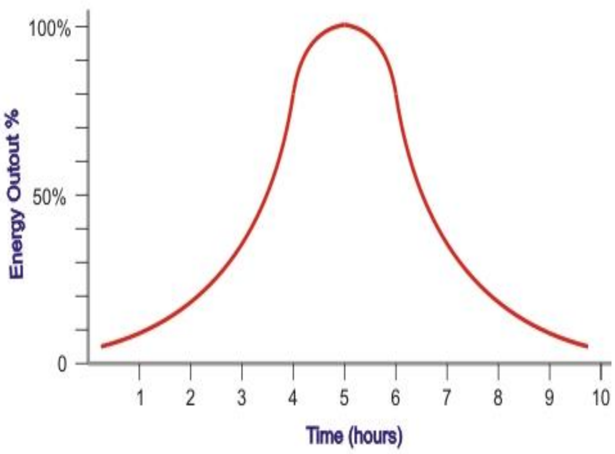
Solar energy is rapidly gaining notoriety as an important means of expanding renewable energy resources. As such, it is vital that those in engineering fields understand the technologies associated with this area. Our project will include the design and construction of a microcontroller-based solar panel tracking system. Solar tracking allows more energy to be produced because the solar array is able to remain aligned to the sun. This system builds upon topics learned in this course.

Introduction

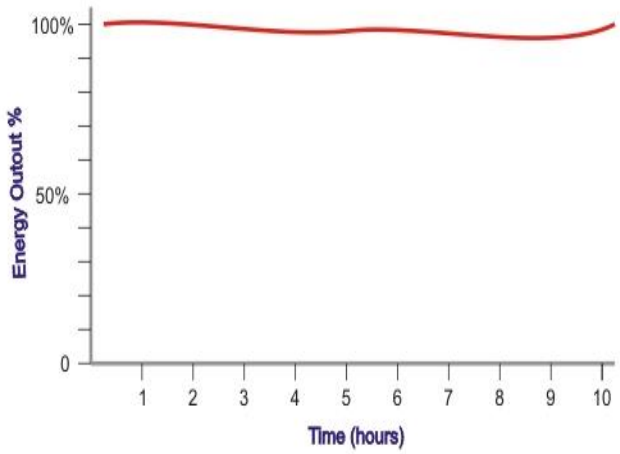
Renewable energy solutions are becoming increasingly popular. Photovoltaic (solar) systems are but one example. Maximizing power output from a solar system is desirable to increase efficiency. In order to maximize power output from the solar panels, one needs to keep the panels aligned with the sun. As such, a means of tracking the sun is required. This is a far more cost effective solution than purchasing additional solar panels. It has been estimated that the yield from solar panels can be increased by 30 to 40 percent by utilizing a tracking system instead of a stationary array . This project develops an automatic tracking system which will keep the solar panels aligned with the sun in order to maximize efficiency.

This report begins with presenting background theory in light sensors and servo motors as they apply to the project. The paper continues with specific design methodologies pertaining to LDRs, servo motors, microcontroller selection physical construction, and a software/system operation explanation. The report concludes with a discussion of design results and future work.

Percentage of Energy Absorbed at each time of the day



Without Solar Tracker



With Solar Tracker

Advantages of a Dual Axis Tracker

While the single axis solar tracker takes into account only the daily changes in the movement of the sun, the dual axis system also accounts for the annual seasonal changes.

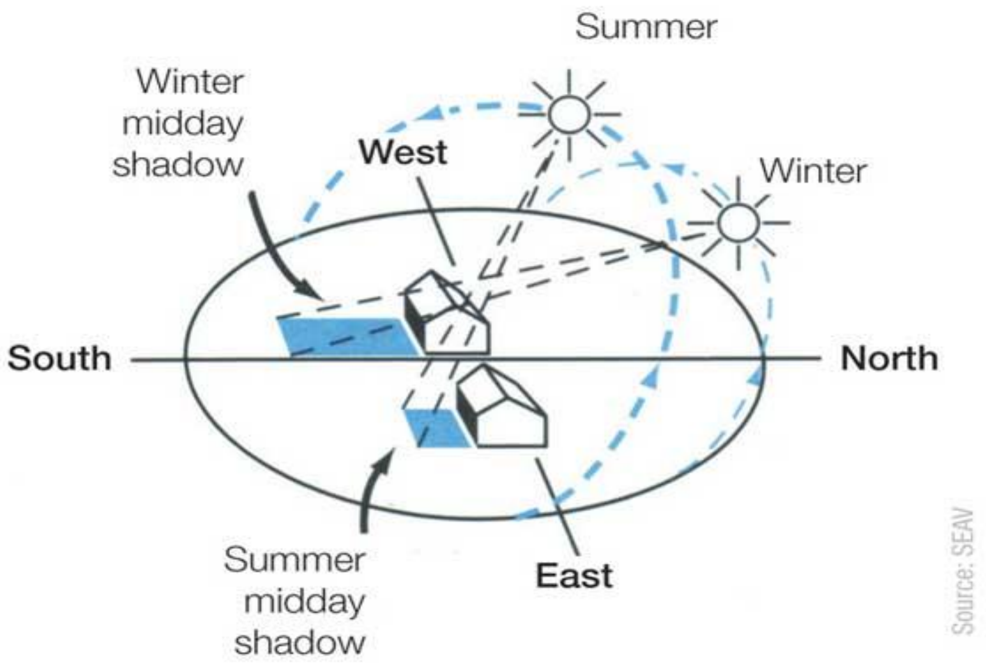


Image Credit : econews.org

LDR/Photocell as the Light Sensor

The sun tracker uses a cadmium sulfide (CdS) photocell for light sensing. This is the least expensive and least complex type of light sensor [2]. The CdS photocell is a passive component whose resistance in inversely proportional to the amount of light intensity directed toward it. To utilize the photocell, it is placed in series with a resistor. A voltage divider is thus formed and the output at the junction is determined by the two resistances. Figure 1 illustrates the photocell circuit. In this project, it was desired for the output voltage to increase as the light intensity increases, so the photocell was placed in the top position.

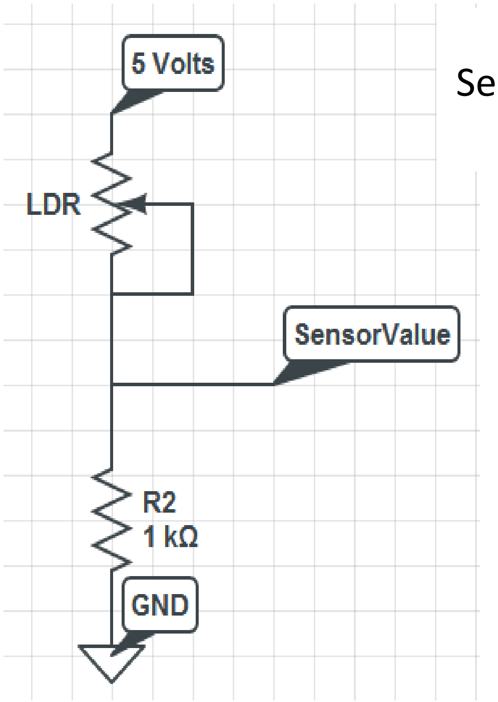
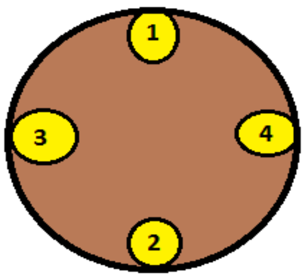


Image produced at circuitlab.com

SensorValue = (5 x R2)/(LDR + R2) V



Sensor(1) > Sensor(2) : Rotate down

Sensor(1) < Sensor(2) : Rotate up

 >Sensor(4) : Rotate left

Sensor(3) < Sensor(4) : Rotate right

Sensor(1) = Sensor(2) or/and

Servo Motor Theory

Servos are controlled by sending them a pulse of variable width. The control wire is used to send this pulse. The parameters for this pulse are that it has a minimum pulse, a maximum pulse, and a repetition rate. Given the rotation constraints of the servo, neutral is defined to be the position where the servo has exactly the same amount of potential rotation in the clockwise direction as it does in the counter clockwise direction. It is important to note that different servos will have different constraints on their rotation but they all have a neutral position, and that position is always around 1.4 milliseconds (ms).

The angle is determined by the duration of a pulse that is applied to the control wire. This is called Pulse width Modulation. The servo expects to see a pulse every 10 ms. The length of the pulse will determine how far the motor turns. For example, a 1.4 ms pulse will make the motor turn to the 90 degree position (neutral position).

The Nex NRS-585 Servo motor that we used has built in motor, gearbox, position feedback mechanism and motor controller. It can be controlled to move to any position just by using simple pulse controller. This motor has three wire interface for control and power supply.

Brown cable ---- Gnd
Red cable ---- 5V Supply Voltage
Orange cable ---- PWM Signal.

SPECIFICATIONS :

Operating speed: 0.15sec/60 degree

0.6 ms for 0 degree Rotation

2.2 ms for 180 degree Rotation

Dimension: 40mm x 20mm x38mm

Torque: 4kg-cm at 6V

Operating voltage: 4.8V to 6V

Motor weight: 50gms