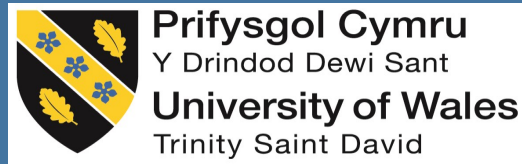


Investigation into Solar Panel technology and optimization of their efficiency.

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1. Abstract

The ever-increasing use of renewable energy technology now accounts for the largest growth in new energy production worldwide and renewable technologies, such as solar and wind, are now cheaper than fossil fuel technologies in the production of electricity. This trend indicates public acceptance that renewable energy technologies are going to be the energy sources of the future.

Solar Photovoltaic (PV) is now the fastest growing renewable power source worldwide. Solar PV panels work by absorbing sunlight via their photovoltaic cells and generating direct current (DC). Most solar panels are not working at their optimum efficiency as they are positioned at a fixed angle to the sun. The efficiency can be increased by moving the panel throughout the day so that it is aligned to face the sun. To prove that Solar PV panels can be more efficient when better aligned to face the sun, this project develops an automatic solar tracking system to keep solar panels aligned with the sun to maximise power. The automatic solar tracking system can sense where the highest light intensity is and align the Solar PV panel via an electric motor. The highest light intensity is detected via the difference in resistance levels of two Light Dependant Resistors (LDRs) that are placed apart on a solar panel.

2. Aims

Design and build a working Solar Photovoltaic (PV) sun tracking system that is controlled by a microcontroller.

Collect, analyse, and evaluate the performance of photovoltaic cells with and without solar tracking.

Research various sun tracking technologies

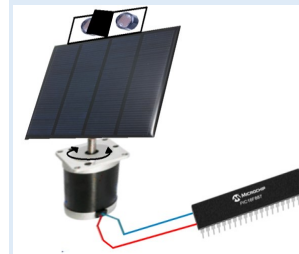
3. Objectives

Design and build a single axis automated solar tracking that is controlled by a microprocessor.

Prove with data generated from the tracking system that the tracking PV systems can be more efficient



4. Conceptual Design to Functional Prototype

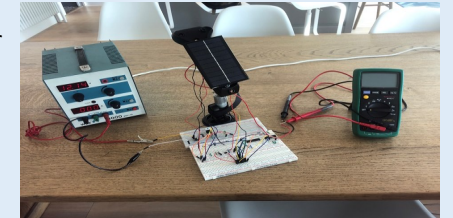
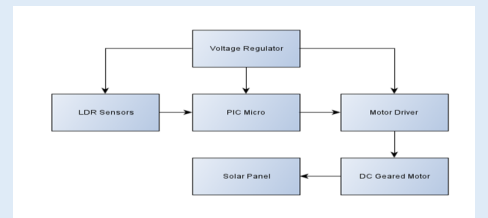
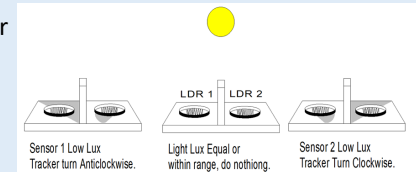


The solar tracker system that has been designed for this project is a single axis tracker that consists of a small solar panel mounted onto the shaft of a bidirectional geared motor at a fixed azimuth angle best suited for the regional area condition. The direction the motor turns is controlled by a PIC microcontroller that determines the direction from the difference in resistance between two Light Dependent Resistor (LDR) sensors situated above the solar panel that are situated either side of a divider. The design offers a reliable and economical way to align a solar panel with the sun.

The operation of the sun tracker is based around two elements, which are the hardware and the software that have been designed so that the microcontroller can determine the direction the solar panel needs to move so it can always be perpendicular to the sun. The input signals are obtained from two LDRs that can sense light strength. The microcontroller receives the light readings from the LDRs and processes the readings using software code written to determine which LDR is receiving the strongest amount of light. The microcontroller will send out an input signal to one of two pins in the motor driver if the calculated difference between the LDR signals are greater than a set value, it will turn motor in one of two directions. The hardware requires two supply voltages, 12 and 5 volts. The LDRs and PIC microcontroller require 5 volts and the motor drive requires 12 volts.

Proteus simulates the design to prove that the real-world implementation will function as intended. It also works with the microcontroller compiler CCS which means it can be used to write program code and compile it to create a Hex file for programming the PIC.

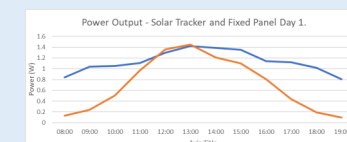
The project made sure to produce a working solar tracker that was functional and did not use expensive components. The main components were affordable priced but good quality.



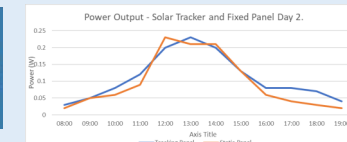
5. Experiment and Findings

The solar Tracker system was placed next to a identical but fixed solar system outside in an open area that had no shade. Starting at 8am until 7pm output power was recorded over three days.

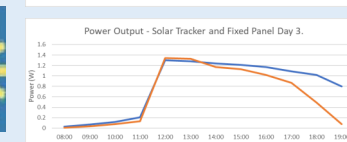
Day 1 Sunny conditions



Day 2 Overcast



Day 3 Cloudy start then clear



Average Daily Power calculated.

Weather Conditions	Fixed System (Wh)	Tracking System (Wh)	Increase in Power (%)
Sunny Clear Sky	7.8	12.45	59
Overcast	1.05	1.2	15
Cloudy with Sunny Intervals	7.05	8.75	20
Total	15.9	22.4	40

6. Conclusion

A solar tracking system was designed and constructed. Its performance has been experimentally compared to a reference system. This single axis solar tracker can follow the sun's azimuth but not its elevation. Using a geared motor with a low speed and high torque reduces program complexity by eliminating the need to control the motor's speed in software. LDR sensors can accurately position the system. The objective of constructing a single axis solar tracker that increases the power output relative to a static solar panel has been achieved but the experimental results - although limited - show that, at locations where there is likely to be significant cloud cover for much of the time, the improvement is minimal.

7. Recommendations

The prototype could be much improved by further development. Only one method and one mode of solar tracking was evaluated. Alternatives that should be investigated before any commitment to the current design is made, include tracking of the sun's elevation in addition to its azimuth and so-called "maximum power point" tracking.