CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J0207

Project Title
Urban Solar, Year Two: Dual-Axis Panel Tracking Tests

Abstract

Objectives/Goals
Last year, a single-axis photovoltaic panel steering system was built, which demonstrated large power output advantages compared to fixed panels for any given day. That led to a proposed new rooftop tracker product concept, for which, a dual-axis system would be better; so that similar improved output efficiencies can be gotten all year as the sun elevation changes. This year, the objective was to test the accuracy of a new design for a dual-axis tracking system which uses the calculated positions of the sun to know where to steer; so that the cost of such a product could be reduced by eliminating the need for any sun angle sensors.

Methods/Materials
A new dual-axis steering system was designed and constructed using Lego pieces and programmed using the Lego MindStorms NXT controller. To be able to measure how well the tracking worked during each test, a special panel was built with four small solar cells positioned around a center shadow column; so whenever the panel was not pointing perfectly at the sun, a shadow reduced the voltage produced on at least one of the solar cells. The voltages were recorded with a 4-channel data acquisition system to provide graphs of the accuracy of the steering system.

Results
The test setup had several design and construction problems including: cracking of fragile solar cells, too little programming memory, too low recording resolution, and too much drive gear backlash. After serious accuracy problems in the initial testing led to extensive redesigns and rebuilds of several system components, the last 2 of the 10 test days produced good results.

Conclusions/Discussion
The final graphs document the excellent accuracy of the astronomically positioned, dual-axis, solar panel tracking system and the feasibility of reducing the cost of higher-output rooftop solar trackers.

Summary Statement
In order to get last years high output advantages over an entire year, a new dual-axis solar panel tracking system was created using Lego components; and then proven during tests to steer accurately using calculated sun positions.

Help Received
Father helped with panel design/building, algorithm calculations, calibration procedures, photos, and display board; Engineer friend, Selena Forman provided some LabView/NXT software language instruction; Engineer friend, Conrad Lindberg created schematic for power amplifier.