The abstract must include:

- Note if submission is a project or research

  project

- Author’s name, major, faculty advisor’s name, and university

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- Author’s education level (undergraduate or graduate student, must be a current student)

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Dual-Axis Photovoltaic Solar Tracker with *MPPT* Battery Charging, Diversion Load Handling, and Data Acquisition/Transmission

To address the increasing demand for more efficient, reliable, and economical standalone renewable energy systems for remote power generation and atmospheric data collection, we have designed and tested a prototype dual axis motor controlled solar tracking photovoltaic *PV* system. The system design utilizes an Arduino microcontroller that facilitates dual axis motor controlled solar tracking to optimize the orientation of a 50 watt *PV* panel. The algorithm uses an array of four photo-resistors to initialize adjustments to the tilt of the *PV* panel, with a linear actuator, and to the azimuth with a gear motor. A simple relay charge controller charges a 12 Volt 21 Amp-hour battery bank. Current transducers and voltage dividers provide measurements of power into and out of the battery bank.

During summer 2015 the charging efficiency will be improved by implementing a maximum power point tracking *MPPT* charge controller. A limitation of battery-based systems is that when the battery-bank is fully charged, the available energy is shunted and lost. We will integrate the software and circuitry for diversion-load handling that operates only when this excess energy is available. This will provide data with a more complete representation of the total energy harnessable by the *PV* system. For environments that have both solar and wind resources, the prospect of hybrid *PV* /wind turbine power generation will also be explored. To minimize power dissipation, a MOSFET reverse polarity protection circuit will be installed instead of the series rectifier diode currently used. Software solutions for the *MPPT* controller

and the linear actuator control will be developed. Atmospheric data will be gathered including: absolute humidity, air temperature, solar irradiance, ground wind speed, and ground wind direction. The wind data will also be fit to the power curves of small (< 500 W) wind turbines for the consideration of potential upgrades to the system. Tracking optimization will occur through testing of phototransistors, photo diodes, and photo cell sensors in the system feedback array. The absolute orientation of the *PV* array will be monitored externally for calibration purposes and tracking efficiency analyzed in comparison to fixed solar tracking systems. Methods for high resolution monitoring of power generated and consumed will be developed through onboard self-sensing. Acquired data will be transmitted wirelessly via radio transmission, cellphone network and/or broadband network to a data storage receiver. Data analysis and comparison to fixed array systems will be on going. Results will be summarized for the poster presentation and a manuscript draft will be produced for eventual journal submission.

References:

1. Stamatescu, Iulia, et al. "Design and Implementation of a Solar-tracking Algorithm." *Procedia Engineering* 69 (2014): 500-507.
2. Ribeiro, S. C., et al. "Design and development of a low-cost solar tracker."*Australian Journal of Mechanical Engineering* 11.2 (2013): 139.
3. Koutroulis, Eftichios, Kostas Kalaitzakis, and Nicholas C. Voulgaris. "Development of a microcontroller-based, photovoltaic maximum power point tracking control system." *Power Electronics, IEEE Transactions on* 16.1 (2001): 46-54.
4. Gules, Roger, et al. "A maximum power point tracking system with parallel connection for PV stand-alone applications." *Industrial Electronics, IEEE Transactions on* 55.7 (2008): 2674-2683.