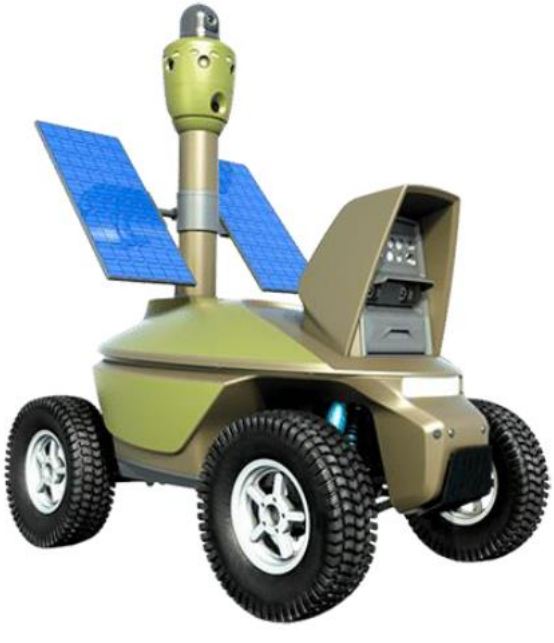
Final Project Initial Specification
Engineering 100-420
Win 2021
Solar Tracker

Solar energy provides power from a renewable source for both grid-connected and off-grid applications. Solar energy collection can be dramatically improved when solar cells are directly facing, and tracking the movement of, the sun. A solar tracking system can increase total power collection by up to 50% in comparison to a fixed flat-plate solar energy installation, depending on geographic location and system configuration. Maximizing power conversion can be critical in meeting power requirements and meeting demands for size, scale, and cost of the system. A means of monitoring sunlight and related environmental conditions are critical for the control of a solar energy installation using solar tracking. It is also desirable for these monitors to be stand-alone, mobile, and network-connected.

Design challenge: Build a self-powered solar power system with active tracking that will wirelessly report data on environmental conditions and position of the sun over time. The concept is that your power system would be used to power other devices as part of a remote sensing system. The concept scenario for this system is that the power system is on a relatively slow moving mobile vehicle (such as the Mars Pathfinder or the SMP Robotics product below). Over the course of the project, you will have several assignments, with details to follow throughout the semester.



- Design Concept Discussion
- Final Presentation and Product Demonstration
- Final Report

Product Requirements

Your solar tracker will need to meet the following requirements.

Technical Requirements

- Self-powered by solar cell (with battery storage)
- Active tracking across the full sky. The system must be able to find the sun even if initially pointed directly away.
- Wirelessly report data (ambient temperature, sun position, and irradiance) via Bluetooth at regular time intervals
- The device/instrument should be portable and freestanding.
- It should occupy the minimum require height and width necessary to achieve the other goals.
- The weight should be minimized.
- Optional challenge: The average power used for tracking should be minimized.

Materials

- Solar cell
- Li-ion battery
- Maximum Power Point Tracker (MPPT)/Li Charging Controller
- Microcontroller (Redboard)
- Bluetooth Serial module (HC-05)
- Timer Circuit
- Optical sensors
- Servos
- Resistors, switches, LEDs
- Breadboard, wire, soldering equipment
- Materials for mechanical assembly

While you may be able to quickly develop a simple solar tracker, you are highly encouraged ***to design/build/test the BEST possible product***. Think carefully about the structural design, tracking capabilities, sensitivity, and power requirements of your product. ***You will be asked to characterize (measure, provide data, and discuss) each of the following***, and devote significant effort into the optimization of one or more of these aspects:

- Sensitivity of light detection and temperature
- Accuracy in tracking position of sun
- Providing the most power possible for running loads external to your system
- Minimizing power requirements for your tracking/reporting system
- Size, weight and mechanical stability
- Quality and neatness of construction

Suggested Timetable and Milestone

	Week 1 (2/22)	Week 2 (3/1)	Week 3 (3/8)	Week 4 (3/15)	Week 5 (3/22)	Week 6 (3/29)	Week 7 (4/5)	Week 8 (4/12)
Single axis tracking								
Design and build the physical system								
Full sky tracking								
Optimize the tracking system								
Bluetooth & optional challenge								
Back-up labs								

Tips for success:

1. Before building the entire structure attach the solar panels to the servos and move them through the servos entire range to gauge clearances needed
2. Do not mount the photo sensors permanently (sometimes they fail and need to be replaced)
3. Get the device working with a power supply first, then get it functioning with a fully charged battery and then add in the solar cell
4. Use color coded wires and try to organize them; it will make your trouble shooting of your circuits a lot easier.
5. Use clear and detailed comments in your code to help with debugging.
6. Remember to take photos and videos over the course of your project to document progress. You will need them for your final presentation and report.