

Client/Company/Organization: D. Raj Raman (ISU faculty member, but this is a private project)

Submitter Name: D. Raj Raman

Email: rajraman@iastate.edu

Project Contact: _____

Email: _____

Project Title:

Hybrid solar/battery for electronic derailleur

Project Abstract:

Electronic shifting for bicycles became commercially available more than two decades ago, and in the past five years have exploded in popularity even among non-racing cyclists. As a lifetime cyclist, I welcome technological advances but have been frustrated by the requirement that commercially available shifting systems (e.g., Shimano Di2, SRAM eTap) be recharged, especially since the average power requirement for shifting is very low (ca. 0.5 W, conservatively). The goal of this project is to design and build a replacement for the battery pack used by a commercially available rear derailleur. This replacement will have a smaller (estimated 30% capacity of normal) battery, and a small photovoltaic "fin." The PV fin will allow harvesting of solar energy at any time the bike is exposed to light, and control circuitry will ensure the battery is charged but not overcharged.

Constraints for this project include:

- 1) System is plug-in replacement for existing battery
- 2) System can run for 10 h in the dark under normal shifting regimen
- 3) Fin is sufficiently large/efficient to completely recharge battery in 6 h of full sunlight
- 4) Charge control circuit avoids overcharging (depending on PV size, this may not be an issue, but we need to ensure it is not)
- 5) Mechanical design is sufficiently robust to handle vibration, temperature swings (-20 to 40 C), and moisture (hard rainfall).
- 6) System is mechanically robust (nothing hanging off that is easily broken during transport, or when leaning bike against object)
- 7) Others - I hope to engage the team early to identify phantom criteria that I may have missed here.

Approaches: In a sense this is a solar battery charger project at its heart, but one using a relatively small battery and PV array. It's not as small as the old Casio PV digital watch I had 30 years ago, but it's smaller than most of the "camping phone charger" type devices that are available. Identifying existing solutions and understanding how to adapt them to this specific problem will be important, as will thinking through the mechanical challenges of the design. It may be that integrating the PV into the body of the "battery" replacement is not realistic, and that a separately mounted PV and wire connection to the battery is better - team will have to do some preliminary work to make that determination.

Tools: Circuit design programs, battery modeling software???

Expected Deliverables:

A plug-in replacement for the battery on a commercially available rear derailleur (likely SRAM eTap) that never needs charging because of the built in PV array on the device.

Specialized Resources Provided by Client:

I will purchase the derailleur, mini PV array, and battery.

The materials I purchase will cost ~\$500. I will also provide team mentoring as needed.

Anticipated Cost: _____

Financial Resources Provided by Client: _____

Preferred Students for the Project:

- Electrical Engineering
- Computer Engineering
- Software Engineering
- Cyber Security Engineering
- Other:

Other Special Skills: Circuit fabrication, other mechanical fabrication skills a bonus

Anticipated Client Interaction (estimate):

- 1 meeting per week
 - In person, Over the phone, Web / video conferencing
- 1 meeting per month
 - In person, Over the phone, Web / video conferencing
- 2 or more meetings per month
 - In person, Over the phone, Web / video conferencing
- 1 meeting per semester
 - In person, Over the phone, Web / video conferencing

Meeting ABET Criteria

Please rate the following statements as they relate to your proposed project:

0 – Not at all 1 – A Little 2 – Somewhat 3 – A Lot 4 – Completely

On this project, students will need to apply knowledge of mathematics, science, and engineering	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project gives students an opportunity to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input checked="" type="checkbox"/> 3	<input type="checkbox"/> 4
This project involves students from a variety of programs, i.e., CprE, EE, and SE	<input type="checkbox"/> 0	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
This project requires students to identify, formulate, and solve engineering problems	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4
This project gives students an opportunity to use the techniques, skills, and modern engineering tools necessary for engineering practice	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> 4

Project Approval – for use by ECpE Senior Design Committee

- Approved: _____
 - Project Assigned: sdmay22-01
 - Advisor(s) Assigned: D. Raj Raman (rajraman@iastate.edu)
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