Progress Report for an Advanced Function Maximum Power Point Tracking Battery Charger for 12 Volt Lead-Acid and 16 Volt Ni-Cad Batteries

ENSC 440: Capstone Project, ENSC 305: Project Documentation

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Introduction and Background

The content of this document is to solely outline the schedule, the progress, and the remediation of the ongoing development of Helios Mk-I (HM1). HM1 is a solar panel battery charger that implements a maximum power point tracking (MPPT) algorithm to optimize power transfer from solar panels to a load. The specification for this particular project were given to Solar Solutions by Analytic System as per request from BC Hydro. Essentially, HM1 will be a standalone product that will be able to charge 12V PbA and 16V NiCd batteries. Solar Solutions strives to provide energy for the future that is renewable, innovative, and sustainable.

Schedule

The schedule for the HM1 project has been modified accordingly to reflect our focus on hardware issues. Since the firmware is easier to modify than the hardware, we have spent greater time than originally planned making sure our company has the proper foundation to build upon. With regards to the original schedule, Solar Solutions underestimated the design process by approximately a month and a half. To accommodate extra time in the hardware process, the firmware will only demonstrate general operation. Specifics to the modification are discussed in the remediation section of the paper. Table 1 outlines the schedules before the demonstration for the project on April 16, 2014.

Table 1 Expected Deadlines for HM1

Item #	Tentative Deadline
PCB layout complete and order placed	March 27th, 2014
PCB received	April 1st, 2014
Soldering of all 300 components per board, for all five boards, with ongoing functional verification	April 4th, 2014
Preliminary firmware demonstration	April 8th, 2014
Maximum Power Point Tracking demonstration	After April 16th, 2014
Final demo preparation and post-mortem complete	April 16th, 2014s

Financial

Solar Solutions have been contracted by Analytic Systems to design HM1. Thus, funding of approximately $2500 for the project will be provided by Analytic Systems. Budget is summarized in Table 2 below.

Table 2 Budget for Solar Solutions

Item #	Cost
Components for prototype	$245.05
Printed circuit board prototype	$200 (for rapid prototyping)
Chassis	N/A, borrowed
Total	$445.05

Evidently, Solar Solutions still has ~$250 of funds remaining. This is since we decided to only go with a single PCB revision, which was a choice, approved by Analytic Systems. s

The cost for each PCB is excessive due to the robustness and flexibility of the design. There are two goals for Solar Solutions: provide a piece of demonstrable hardware to SFU for our Capstone project, but to also provide a battery charger design to Analytic Systems. To ensure our product would be demonstrable we put emphasis on redundant circuit blocks and optional parts and added the ability to bypass non-critical parts of our product (such as reverse battery protections) to rapidly provide a demonstrable product as opposed to a polished, finished product.

Progress

Solar Solutions has completed the schematics for the different circuits required for the project, and 50% of the layout is complete. The schematics are extremely detailed, and are to industry level standards, which is why they required a reasonable time to complete. Additionally, the schematics were simulated extensively using LT-Spice with some circuits tested on breadboards. The remaining 50% of the layout is presently underway.

The firmware is presently being developed so that once the first microcontroller is soldered, debugging can immediately begin. The design of the firmware had already been previously discussed, and is presently being written. Now that the schematics are complete, the firmware can be written specifically for our PCB.

The simulator within MPLAB, our IDE, has been utilized to ensure all the clocks and timers are operating as anticipated to ensure a rapid transition to the PCB when it is ready.

PCB layout for a switching power supply is one of the most complicated tasks required of Solar Solutions. After beginning the PCB layout time was taken to consult with two engineers at Analytic Systems to ensure the layout made sense. After confirmation (no changes suggested) layout began in earnest. Presently most of the analog circuitry has been laid out and digital circuitry will soon follow.

Remediation

Solar Solutions has reprioritized the original project to omit advanced firmware, and focus on advanced hardware. Firmware design have been reduced to demonstration purposes only and the RS-232 code and Visual Basic program for supporting communication between the microcontroller and a computer have been omitted.

Conclusion

Solar Solutions is on progress for our revised goal of producing an industry standard hardware platform upon which Analytic Systems can run their own firmware, and developing enough of our own firmware to demonstrate the basic functionality of the solar charger. Big steps remaining in our project are the final completion of the layout, soldering all 300 components for each of the five PCB's, and testing the firmware we have written. The project has been a strong learning tool, and is anticipated to be very successful.