Introduction

AquaSol Solutions is collaborating with the Department of Fisheries and Oceans (DFO) to design a solar powered battery charger for an offshore hydrophone system. This hydrophone will be installed on a buoy off the coast of British Columbia to monitor the migration patterns of endangered resident killer whales.

Solar panels will be mounted on the buoy to charge lithium polymer batteries, which in turn will supply power to the hydrophone. The hydrophone will operate for 24 hours a day throughout the summer, and intermittently throughout the winter. Data collected by the hydrophone will be transmitted to a base station via an ISM (Industrial, Scientific, and Medical) band transmitter.

The progress report will outline the original proposed schedule, the current state of team finances, the project progress and planned remediation steps.

Schedule

In reference to the schedule outlined in the project proposal [1], the team is behind schedule on the following items: the order of the printed circuit board (PCB), the hardware assembly, the programming of the microcontroller (MCU), and the integration of the hardware and software. Ordering the PCB was scheduled for February 18th and was delayed until March 24th. The programming of the MCU was scheduled to be completed by March 10th, but is still ongoing. The integration of the hardware and software was scheduled to commence on March 10th; integration will begin as soon as the PCB and MCU programming are completed.

Reasons for falling behind schedule include changing requirements from the DFO, late arrival of parts, and decisions to add reliability features into the system. In particular, the charge controller and circuit breakers have not arrived yet despite being ordered more than a month ago. Hardware and software integration cannot commence before the arrival of the charge controller. Communication delays with third-party collaborators have also occurred.

Every other originally scheduled item has been completed; see the "Progress" section for a detailed discussion.

Finances

The DFO has paid for parts of the final product that will be installed on the buoy. In terms of the parts needed for the proof -of-concept stage and for the project demo, AquaSol Solutions is over budget by $509.22. A breakdown of the costs incurred is shown in Table 1.

Table 1: Breakdown of project costs

Items	Price
Rosin flux pen	8.51
SO8 PC boards	7.31
Notebooks	41.05
MCU eval board, 32 V buck converter, relay	305.13
MCU eval board, 24 V buck converter	190.26
MCU eval board refund	-80.00
Shipping for load switch demo board	23.82
Protoboard for SOT-363	22.49
Interface module connectors	31.60
MC4 connectors	27.72
Superwick	3.39
2 X 3.7V backup Li-ion batteries	24.64
Jumper wire kit, DC power cable, load resistor	18.21
RJ45 jack, protoboard, 9 pin D-sub female	14.27
PCB passive components and ICs	200.82
PCB connectors	30.00
PCB manufacturing	300.00
Duty	90.00
Total Cost	1259.22
ESSEF Funding	750.00
Remaining Funding	-509.22

The initial budget was underestimated because of the changing requirements, and the need for high quality, robust components in harsh marine environments. The team plans on applying for extra funding from the Wighton Fund. The DFO will cover any additional costs if they find the project satisfactory.

Progress

The circuits have been simulated and functionally verified. An evaluation board mock-up of the hardware portion of the power management unit (PMU) has been built and tested. A passive Ethernet hub has been tested and functionally verified as well. Additional safeguards (fuses and a low-voltage disconnect for the backup battery) have been added to the system design. Schematic capture of the circuitry is in its final stages, and PCB design is imminent. The PCB design files will be sent out for manufacturing within the week.

FreeRTOS has been successfully installed on the MCU. Interrupts and general-purpose input-outputs (GPIOs) are functional and have been tested. I2C and CAN drivers are currently being developed. The I2C drivers will be tested by communicating with the humidity sensor. The CAN drivers will be tested by communicating with the battery management system (BMS). A web server has been set-up to test the communication between the desktop application and the hydrophone.

All documentation up to this point has been completed.

Remediation

Despite falling behind schedule on the hardware assembly, the programming of the MCU, and the integration of the hardware and software, the team has scheduled a large amount of time for integrated system testing. Testing of the hardware has already commenced, and the team remains confident that they can catch up.

AquaSol Solutions is prepared for potential PCB failure before the project demo. Two PCBs will be purchased, and even if both fail, the hardware functionality can be demonstrated using the mock-up evaluation boards. If the evaluation boards fail, circuits can be built on protoboards.

Certain aspects of the software have been assigned lower priority in case the software remains unfinished. In particular, low-power mode and the desktop application are not critical to system functionality. In case the desktop application is not completed, a console-based interface will be used to verify the communication between the application and the hydrophone.

Conclusion

AquaSol Solutions is slightly behind schedule and over budget. The progress report outlined alternative sources of funding to cover the additional costs. The progress report also outlined remediation for unforeseen PCB component failure and an unfinished desktop application.

References

[1] AquaSol Solutions, "Solar Powered Battery Charger for Offshore Applications: Project Proposal," AquaSol Solutions, Burnaby, BC, Canada, Rev. 4, 2014.