Figure 1:

apa	bibliography
apa.csl	SpringCitations.bib

Solar Panel Project

Project Website: https://steve-spiteri.github.io/

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Proposal

Proposal for the development of a solar panel project

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Executive Summary

As student's in the Computer Engineering Technology program, we will be integrating the knowledge and skills we have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build the hardware portion that will connect to a database as well as to a mobile device application. The internet connected hardware will include a custom PCB with various sensors. The database will store historical production and weather data. The mobile device functionality will include the ability to view the system status, DC output power overview, weather factors, past power production data and will be further detailed in the mobile application proposal. This semester I plan to continue working with Richard Burak and Salvatore Angilletta, who also built similar hardware last term and have worked on the mobile application. The hardware has been completed in CENG 317 Hardware Production Techniques independently and the application has been completed in CENG 319 Software Project. These will be integrated together this term in CENG 355 Computer Systems Project as a member of a 3 student group.

Background

The problem solved by project is how to track a solar panel system. With the purposed hardware and companion mobile application it will allow solar panel owner the ability to easily monitor their system status, track their power production, view historical production data, and view weather data from a web interface and simple mobile application.

The hardware, powered by a Raspberry Pi 3, will operate in series with a solar panel system. Information will be gathered to indicate if all is well with the system and power production overview. Multiple sensors such as temperature, humidity, barometric sensors will be used to gather weather data. Weather data will be available to view at a glance and historically. With this data you understand performance variations day to day.

I have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content"[1] and have found and read three which provide insight into similar efforts.

The first journal discusses how shade can reduce power generation up to 10-20% annually.(Hanson, Deline, MacAlpine, Stauth, & Sullivan, 2014)

The second journal discusses low cost options for measuring solar panel defects. (Ranhotigamage & Mukhopadhyay, 2011)

The third and final journal we found provides information about how extreme high temperature can affect solar panel degradation. (Kim, Seo, Cho, & Krein, 2016)

In the Computer Engineering Technology program we have learned about the following topics from the respective relevant courses:

- Java Docs from CENG 212 Programming Techniques In Java,
- Construction of circuits from CENG 215 Digital And Interfacing Systems,
- Rapid application development and Gantt charts from CENG 216 Intro to Software Engineering,
- Micro computing from CENG 252 Embedded Systems,
- SQL from CENG 254 Database With Java,
- Web access of databases from CENG 256 Internet Scripting; and,
- Wireless protocols such as 802.11 from TECH152 Telecom Networks.

This knowledge and skill set will enable me to build the subsystems and integrate them together as my capstone project.

Methodology

This proposal is assigned in the first week of class and is due at the beginning of class in the second week of the fall semester. My coursework will focus on the first two of the 3 phases of this project:
Phase 1 Hardware build.
Phase 2 System integration.
Phase 3 Demonstration to future employers.

Phase 1 Hardware build

The hardware build will be completed in the fall term. It will fit within the CENG Project maximum dimensions of 12 13/16" x 6" x 2 7/8" (32.5cm x 15.25cm x 7.25cm) which represents the space below the tray in the parts kit. The highest AC voltage that will be used is 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will be 20 Watts.

Phase 2 System integration

The system integration will be completed in the fall term.

Phase 3 Demonstration to future employers

This project will showcase the knowledge and skills that I have learned to potential employers.

The tables below provide rough effort and non-labour estimates respectively for each phase. A Gantt chart will be added by week 3 to provide more project schedule details and a more complete budget will be added by week 4. It is important to start tasks as soon as possible to be able to meet deadlines.

Labour Estimates	**Hrs**	**Notes**
Phase 1		
Writing proposal.	9	Tech identification quiz.
Creating project schedule. Initial project team meeting.	9	Proposal due.
Creating budget. Status Meeting.	9	Project Schedule due.
Acquiring components and writing progress report.	9	Budget due.

Mechanical assembly and writing progress report. Status Meeting.	9	Progress Report due (components acquired milestone).
PCB fabrication.	9	Progress Report due (Mechanical Assembly milestone).
Interface wiring, Placard design, Status Meeting.	9	PCB Due (power up milestone).
Preparing for demonstration.	9	Placard due.
Writing progress report and demonstrating project.	9	Progress Report due (Demonstrations at Open House Saturday, November 7, 2015 from 10 a.m. - 2 p.m.).
Editing build video.	9	Peer grading of demonstrations due.
Incorporation of feedback from demonstration and writing progress report. Status Meeting.	9	30 second build video due.
Practice presentations	9	Progress Report due.
1st round of Presentations, Collaborators present.	9	Presentation PowerPoint file due.
2nd round of Presentations	9	Build instructions up due.
Project videos, Status Meeting.	9	30 second script due.
Phase 1 Total	**135**	
Phase 2		
Meet with collaborators	9	Status Meeting
Initial integration.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Meet with collaborators	9	Status Meeting
Incorporation of feedback.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Prepare for demonstration.	9	Progress Report
Complete presentation.	9	Demonstration at Open House Saturday, April 9, 2016 10 a.m. to 2 p.m.
Complete final report. 1st round of Presentations.	9	Presentation PowerPoint file due.
Write video script. 2nd round of Presentations, delivery of project.	9	Final written report including final budget and record of expenditures, covering both this semester and the previous semester.
Project videos.	9	Video script due
Phase 2 Total	**135**	
Phase 3		
Interviews	TBD	
Phase 3 Total	**TBD**	
Material Estimates	**Cost**	**Notes**
Phase 1		
Raspberry Pi 3 Kit	$119.99	CanaKit
Barmetric Pressure Sensor	$8.33	RobotShop
DHT-11 Sensor Breakout	$4.04	RobotShop
6V Solar Cell	$5.95	Sayal
Safety Glasses	$5.04	Pyramex
Lead Free Solder (10g)	$4.49	RobotShop
Soldering Iron (25W)	$6.80	RobotShop
Soldering Iron Holder	$4.56	RobotShop
5-pin PCB Header (female)	$0.89	Digi-Key
2x20 GPIO Header	$9.99	Adafruit

Humber PCB Components Kit	~$40.00	Humber College - Prototype Lab
Custom PCB	Unknown	Humber College - Prototype Lab
Laser-cut Acrylic Box	Unknown	Humber College - Prototype Lab
Digital Multimeter	$14.59	RobotShop
M2.5 Screws/Standoffs	$11.99 (Bulk)	HVAZI
Phase 1 Total	**$267.43**	
Phase 2		
Materials to improve functionality, fit, and finish of project.		
Phase 2 Total	**TBD**	
Phase 3		
Off campus colocation	<$100.00	An example: [4].
Shipping	*TBD*	
Tax	*TBD*	
Duty	*TBD*	
Phase 3 Total	**TBD**	

Concluding remarks

This proposal presents a plan for providing an IoT solution for solar panel interactive display. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project. I request approval of this project.

References

Hanson, A. J., Deline, C. A., MacAlpine, S. M., Stauth, J. T., & Sullivan, C. R. (2014). Partial-shading assessment of photovoltaic installations via module-level monitoring. *IEEE Journal of Photovoltaics*, *4*(6), 1618–1624. https://doi.org/10.1109/JPHOTOV.2014.2351623

Kim, K. A., Seo, G. S., Cho, B. H., & Krein, P. T. (2016). Photovoltaic hot-spot detection for solar panel substrings using ac parameter characterization. *IEEE Transactions on Power Electronics*, *31*(2), 1121–1130. https://doi.org/10.1109/TPEL.2015.2417548

Ranhotigamage, C., & Mukhopadhyay, S. C. (2011). Field trials and performance monitoring of distributed solar panels using a low-cost wireless sensors network for domestic applications. *IEEE Sensors Journal*, *11*(10), 2583–2590. https://doi.org/10.1109/JSEN.2011.2150214