Smart Hive

Project Website: pwestman.github.io

Proposal

Proposal for the development of Smart Hive

Prepared by Roberto Loja, Yurii Sentsiv, Paul Westman
Computer Engineering Technology Students

January 20, 2017

Table of Contents

Executive Summary

As students 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 sensors and actuators for tracking and recording the movement of bees in and out of the hive. The database will store the population of bees inside the hive as well as temperature and humidity readings. The mobile device functionality will include requesting the most recent readings of population of bees in the hive, temperature and humidity and will be further detailed in the mobile application proposal. We will be collaborating with the following company/department: Humber Honey Bees.

Background

The problem solved by the project is finding a non-invasive way of tracking bee populations in the hive with varying temperature and humidity. With the depleted population of Honey bees recently, accurate data in this area is crucial. Up to date data can be requested and viewed from a mobile application that will be developed and integrated with the hardware component over the next two semesters.

The Humber Honey Bees are an initiative undertaken by Humber in June 2015 in an attempt to rebuild the local population of Honey bees in the area around Humber College. Honey bees are an essential part of our world as they are responsible for pollinating many of the plants that we eat. Due to their declining populations, studying and tracking them has never been more important. Therefore, this project will attempt to compile crucial data on Honey bee movement and population in the hive in varying temperatures and humidity.

We have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content" and have found and read articles that provide technical background information:

The first article provides insight into a smart bee hive that measures population, honey production, and temperature/humidity. (Wallich, 2011)

The next article introduces the use of strain gauges and instrumentation amplifiers. (Ştefănescu, 2011)

The last article demonstrates a method for estimating the population of a bee hive by measuring the hive's capacitance. (Perrault & Teachman, 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 us to build the subsystems and integrate them together as our 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 and winter semesters. Our 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 was completed in the fall term. It 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 was allowed to be used was 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC. Maximum power consumption was to be no more than 20 Watts.

Phase 2 System integration

The system integration will be completed in the winter term.

Phase 3 Demonstration to future employers

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

The tables below provide rough effort and non-labour estimates respectively for each phase.

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 Model B	$80.00	Creatron Inc.
Peripherals with cables	$5.00	
Digital Bathroom Scale	$25.00	
Resistors	$2.00	
Infrared Optical Interrupter Module	$80.80	
DHT11	$17.00	
Phase 1 Total	**$209.80**	
Phase 2		
Materials to improve functionality, fit, and finish of project.		
Phase 2 Total	**TBD**	
Phase 3		
Off campus colocation	<$100.00	
Shipping	*TBD*	
Tax	*TBD*	
Duty	*TBD*	
Phase 3 Total	**TBD**	

Concluding remarks

This proposal presents a plan for providing an IoT solution for bee tracking at Humber College. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project demonstrating our ability to learn how to support projects. We request approval of this project.

References

Perrault, P., & Teachman, M. (2016). Bee counters: Measuring a nest's occupation by its capacitance [resources_Hands on]. *IEEE Spectrum*, *53*(2), 20–21. https://doi.org/10.1109/MSPEC.2016.7419791

Ştefănescu, D. M. (2011). Strain gauges and wheatstone bridges #x2014; basic instrumentation and new applications for electrical measurement of non-electrical quantities. In *Eighth international multi-*

conference on systems, signals devices (pp. 1–5). https://doi.org/10.1109/SSD.2011.5767428

Wallich, P. (2011). Beehackers [hands on]. *IEEE Spectrum*, *48*(5), 20–21. https://doi.org/10.1109/MSPEC.2011.5753235