

Proposal for the development of Greenhouse Health Monitor

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<https://github.com/DBoo92/317Hardware>

Executive Summary

As a student in the Computer Engineering Technology program, I will be integrating the knowledge and skills I 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 the following sensors and actuators BME280 - for temperature and humidity

STEMMA Soil Sensor - for soil moisture level

Solenoid Valve - for dispensing water. The database will store Temperature, humidity, and soil moisture levels from the device. As well as the date/time of each reading and the location of the device (different result sets for different plants/areas).. The mobile device functionality will include The app will allow employees to login, select a desired plant/area, and view those measurements online. It will display the current readings, along with recent min/max readings (all readings time stamped). The user will be able to monitor the health of the greenhouse and even share these results online or through social media. There will be an option to press a button to water the plant if the soil moisture is low. As an added feature, the user will be able to take a picture from the app and share it on social media. and will be further detailed in the mobile application proposal. I will be collaborating with the following company/department I will be collaborating with the Humber Arboretum/nurseries and prof. Kristian Medri on this project.. In the winter semester I plan to form a group with the following students, who are also building similar hardware this term and working on the mobile application with me Daniel Bujold, Ryan McAdie, Aiden Waadallah. The hardware will be completed in CENG 317 Hardware Production Techniques independently and the application will be completed in CENG 319 Software Project. These will be integrated together in the subsequent term in CENG 355 Computer Systems Project as a member of a 2 or 3 student group.

Background

The problem solved by this project is The Humber Arboretum and various other nurseries are lacking a system to monitor temperature, humidity, and soil moisture levels. A system like this would be vital in ensuring the optimal health of the plants. This would allow employees to view and monitor greenhouse conditions in real-time. Data acquisition will help with adjusting the environment and future planning. This system should theoretically improve plant health, increase yield, decrease resource use, and minimize human error. A bit of background about this topic is This project solves the need for a measurement/monitoring system in the Humber Arboretum. Such a system will help monitor the health of the plants. Theoretically, this system has the potential to make the greenhouse more efficient. Existing products on the market include Monnit Greenhouse Monitoring, Sensaphone Greenhouse Remote Monitoring, and Growtronix. I searched through Humber's IEEE subscription and read various articles relating to this topic. The research paper listed below proved to be the most insightful. Having gone through 4 semesters of the Computer Engineering Technology program, I have learned:

- Java programming from CENG 212
- C programming from CENG 252 and CENG 153
- circuit design from CENG 215
- application development process in CENG 216
- SQL and database from CENG 254 and CENG 256
- wireless and connectivity from CENG 253 and CENG 152

These skills sets will enable me to design and build the system required for this project..

Existing products on the market include [1]. I have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content"[2] and have found and read [3] which provides insight into similar efforts.

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 brief description below provides 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.

We will need to purchase a Raspberry Pi, BME 280 sensor, STEMMA capacitive soil moisture sensor, solenoid valve (rated for liquid), and materials for a device enclosure (for waterproofing/protection).

Concluding remarks

This proposal presents a plan for providing an IoT solution for The solution consists of a Broadcom development platform (Raspberry Pi) connected to various sensors/actuators for monitoring. A BME280 for temperature/humidity, a STEMMA soil moisture sensor, and a solenoid valve for dispensing water. This system can be placed in a specific plant or area in order to take measurements. The device will connect to enterprise WiFi in order to send/receive data. It will store these measurements in a database for analysis. These measurements will be able to be viewed from an app to assist nursery employees. If the soil moisture reading is low, the app will allow the employees to dispense a controlled stream of water into the soil.. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project demonstrating my ability to learn how to support projects such as the initiative described by [3]. I request approval of this project.

References

[1] Monnit Corporation. (n.d.). Greenhouse monitoring. Retrieved from <https://www.monnit.com/solutions/greenhouse-monitoring>

[2] Institute of Electrical and Electronics Engineers. (2015, August 28). IEEE Xplore Digital Library [Online]. Available: <https://ieeexplore.ieee.org/search/advsearch.jsp>

[3] Kumar, A., & Hancke, G. P. (2014). Energy efficient environment monitoring system based on the IEEE 802.15.4 Standard for low cost requirements. IEEE Sensors Journal, 14(8), 2557 - 2566. doi: 10.1109/JSEN.2014.2313348