1.0 Introduction

With our project we aim to construct and develop a greenhouse monitoring system. Systems like this are already available to consumers and industry professionals yet most lack certain features that many people would like to see incorporated. With our project we aim to achieve a device that has all the features and specifications to benefit everyone. Users will also be able to have up to date information for key variables inside of a greenhouse environment. Some of these key values that will be interpreted; current temperature, current humidity, gas and air quality, and soil moisture levels. These values will then be added to a database hosted by Amazons' Firestore, which we will then pick up inside of an Android mobile application that we are currently developing, were users will be able to view and interact with the greenhouse in real time. Things like watering the plants, opening vents, turning on fans, and lowering curtains will be some of the features that we also plan to incorporate into the finished project to allow remote management for the greenhouse. According to our project schedule, we have currently completed the first half of our project requirements by successfully completing our previous semester which has allowed us to move on to our current semester where we will continue working and later finish up with our project. This project is in collaboration with the Humber Arboretum, who is in need of an updated system to better closely monitor the environment and habitat of their plants.

1.1 Scope and Requirements

We are creating an Internet of Things (IoT) capstone project that uses a distributed computing model and is documented by an OACETT certification acceptable technical report. This project will consist of a Broadcom (Raspberry Pi 4) development platform

with a custom PCB for connecting sensors, which will be encased in a custom enclosure. The Broadcom development platform will connect to the internet through enterprise wireless (capable of storing certificates). This device will be responsible for picking up/processing readings from the sensors and storing them within a database. The device will be capable of reading temperature from the DS18B20, air quality/humidity from the BME680, and soil moisture from the EK1940. The maximum dimensions for this project are 12 13/16" x 6" x 2 7/8" = 32.5cm x 15.25cm x 7.25cm. We will be adhering to CSA Z462, the highest AC voltage that will be used is 16Vrms from a wall adapter from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will not exceed 20 Watts.

This database will be hosted through Google's Firebase and will be used to store the temperature, air quality/humidity, and soil moisture readings. These stored readings will be accessible for retrieval and display. It will also store login credentials of employees using the mobile application.

The mobile application will be an Android application designed for phones running Marshmallow 6.0 or higher. It will consist of a login screen for greenhouse employee authentication, and a guest login for all others. The application will be able to retrieve/display sensor data in real time, as well as have a refresh button to update readings. It will also have a weather widget displaying the outside weather local to the greenhouse. This application will be programmed in Java using Android Studio.

This project will be able to auto-maintain greenhouse conditions by comparing sensor readings to given parameters, and using built-in algorithms to determine which parts of the environment need adjusted.

This project will not measure certain readings such as sunlight and plant nutrient level. It will not feature its own outdoor weather station, but as stated above, it will rely on local weather data. This device is a prototype and therefore is not CSA approved.

Raspberry Pi 4

- CPU – Broadcom BCM2711, Quad core Cortex-A72 64-bit SoC @ 1.5GHz
- RAM – 4GB LPDDR4-2400 SDRAM
- WiFI – 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Ethernet – Gigabit
- USB – 2 USB 3.0 ports; 2 USB 2.0 ports
- GPIO header – Raspberry Pi standard 40 pin
- HDMI – 2 × micro-HDMI ports
- Storage – Micro-SD card slot for loading operating system and data storage
- OS – Raspbian Buster (Debian Linux based)

DS18B20

- Measures Temperatures from -55°C to +125°C (-67°F to +257°F)
- ±0.5°C Accuracy from -10°C to +85°C
- Programmable Resolution from 9 Bits to 12 Bits

BME 680

- Interface I²C and SPI
- Pressure: 300 - 1100 hPa

- Humidity: 0 - 100%
- Temperature: -40 - 85°C

EK1940

- Interface PH2.54-3P
- Capacitive sensor
- Analog out

Custom PCB

- 2 layers
- 1.6mm thick
- lead-free soldering
- 1oz copper weight
- FR4 standard
- 16 mil min. trace spacing

Custom Enclosure

- 3D printed using PLA filament
- laser cut 3mm acrylic

Database

- Firebase Cloud Firestore
- NoSQL cloud based

- flexible, hierarchical data storage (documents and collections)
- persists data on device for offline use

Mobile Application

- native Android application
- minimum Marshmallow 6.0 (API 23) or higher
- phones and tablets (portrait mode)
- secure login for staff

Report

/1 Hardware present?

/1 Introduction (500 words)

/1 Scope and Requirements

/1 Background (500 words)

/1 References

6.0 References

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Humber Arboretum. (2020). Retrieved from Humber Arboretum and centre for urban ecology: https://humber.ca/arboretum/

Raspberry Pi. (2020). Retrieved from Raspberry Pi 4 Tech Specs: https://www.raspberrypi.org/products/raspberry-pi-4-model-b/specifications/