Marlboro Community Garden Compost Sensors

Introduction

The Marlboro Community Garden has 16 compost bins, split evenly among four bin locations. At each location, each of the four bins serves a specific purpose. The open bin is used to store fresh garden waste, the browns bin is used to store brown materials such as dried leaves, which are meant to be mixed with the garden waste, the closed bin is used to store materials that are being actively composted, and the finished bin stores finalized and sifted compost.

Within the closed bin, different microorganisms drive the composting process through chemical reactions. These organisms operate best under specific conditions. Maintaining optimal temperature and moisture levels helps to keep the organisms working efficiently and accelerates the process. The optimal range for temperature is 140-160 degrees Fahrenheit, while the optimal range for moisture is 50-60%. Temperature and moisture can be regulated by aerating or watering the compost, respectively.

In order to monitor the temperature within the bins, the gardeners used to travel to the garden and use a handheld instrument to physically take measurements. Moisture within the bins was not measured. I sought a method to track these conditions that would not require an extra trip to the garden, and that would obtain data more consistently.

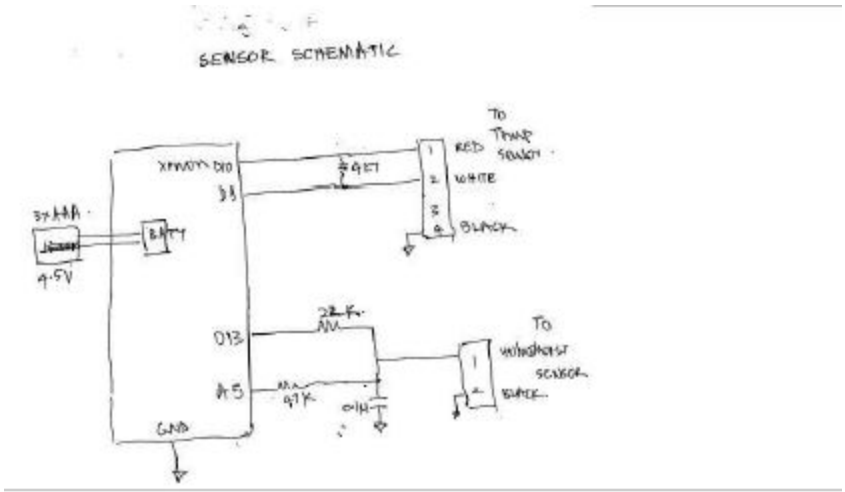
For this project, I used Particle Argon and Particle Xenon IoT modules.(https://www.particle.io/)

Project Overview

The sensing system involves five devices that work together in a mesh network. Four devices are each placed in one of four closed bins located around the garden. These devices are based around Xenon modules, and collect data directly from the compost. A fifth, gateway device is mounted on the fence on the east side of the garden. The gateway device collects data from the other devices and publishes it to a website by connecting to wi-fi from the Morganville Firehouse, using the Argon module as a base.

All of the devices were programmed using C++ and stored inside of waterproof enclosures.

Sensor Devices

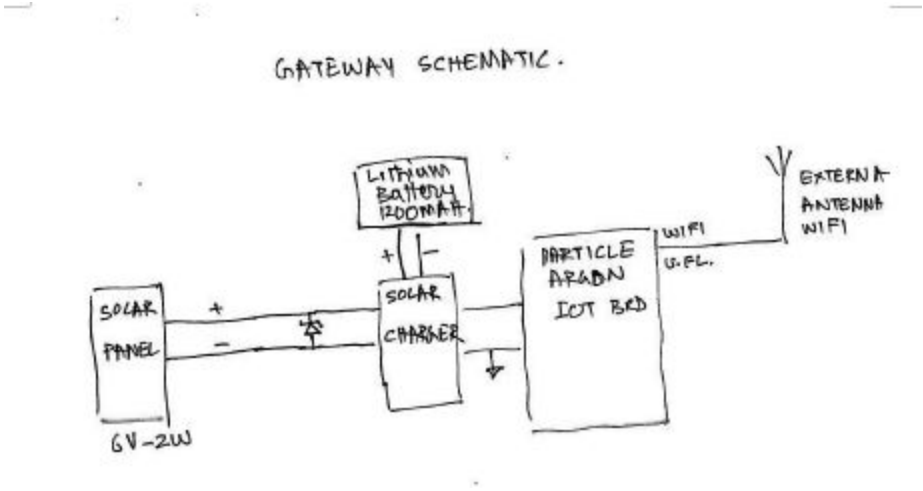


The sensor devices use a Particle Xenon module interfacing to temperature sensor SEN-11050 and a moisture sensor. The moisture sensor is an analog to digital converter measuring the resistance between two metal screws. As the moisture in the compost increases, the resistance between the screws decreases.

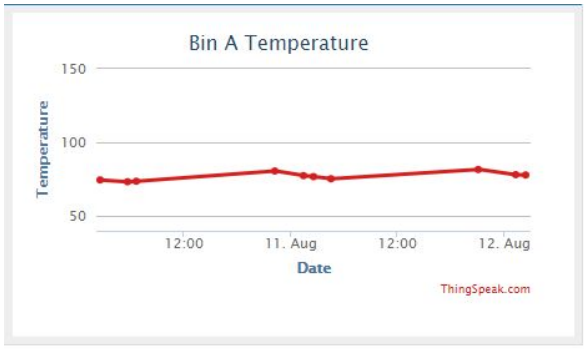
The Xenon module reads the temperature and moisture levels and sends them to the gateway, along with its current battery voltage.

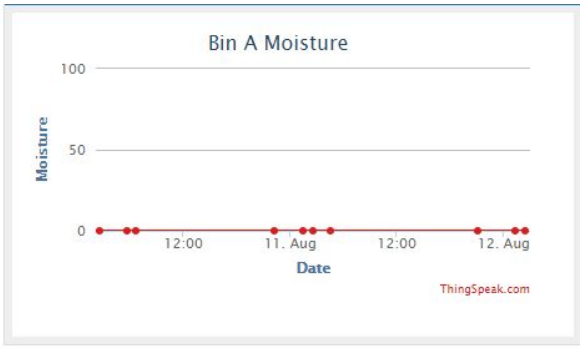
The sensor devices are powered by three AA lithium batteries. Because of their low power requirements, these sensors will run for about 7.4 years before needing a battery replacement.

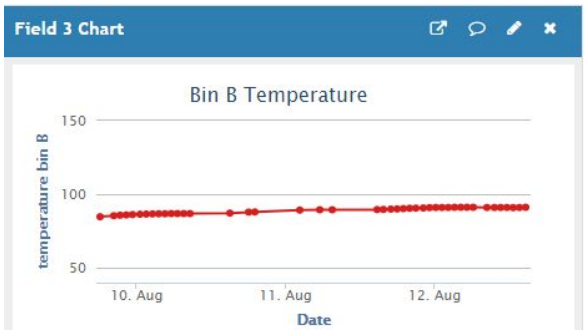
Gateway Device

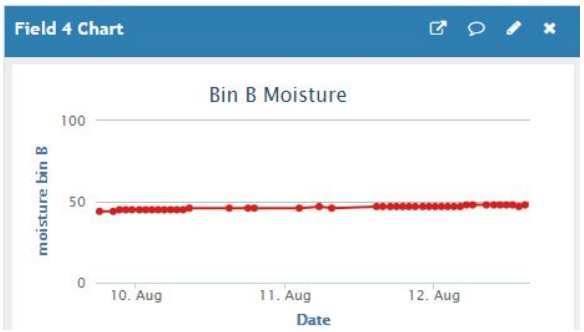


The gateway device receives data messages from the other devices and compiles them in a string before publishing the data in a private channel on Thingspeak, an IoT data collection website. The data is displayed on time graphs and is accessible to all the gardeners.









The gateway device is powered by a rechargeable 1200 mAh lithium-polymer battery which is charged using a six watt solar panel. It communicates with the internet when publishing data by connecting to WiFi from the nearby Morganville Firehouse.