Name(s)

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Project Number

J1007

Project Title

Making Air Quality Monitoring More Accessible and Affordable through IOT Devices

Abstract

Objectives

My goal was to create a portable, accurate and affordable air quality sensor, that integrates with a fast loading web app, that runs on any device, in order to assist people in monitoring their air quality. Air quality sensors today are not necessarily designed for the general public, with most manufacturers intending that scientists are using the sensors, and with that, the sensors are complicated to use, expensive. My goal is to increase the role of citizen scientists in environmental monitoring and study. This approach is adaptable to other uses beyond air quality, where efficiency, offline local monitoring as well as public data sharing, and a comprehensible user interface are required.

Methods

I built an open source air quality sensor, using an Arduino Nano, that was modified to have a ch340 USB control chip, so that I could have more control over the Arduino Nano, and not have to use closed source drivers. A Shinyei ppd42ns measures PM10 & 2.5. I calibrated by running it next to a PurpleAir PA-II and modified the potentiometer until the data was within 0.02 points of each other. I used a DHT11 sensor for temperature & humidity. I developed my own software for collecting and comparing the data and published my app to the Google Play Store. I also developed the custom ch340 chip drivers, and developed my own Linux distribution for the raspberry pi that boots quickly, runs my data collection software, and provides advanced networking tools for interfacing with the app. For performance, I used the Google Lighthouse performance test tool, and ran it using my customized device configuration.

Results

The total price is $32.99, with the most expensive component being the $21.99 PM sensor. The application scores a 96 in performance on Lighthouse, and a 100 in accessibility, best practices, and SEO. It also works offline on most modern devices. The sensor is still too large for small pockets, but is certainly more portable than it s 7x6x5 inch predecessor and a smaller case could be printed. It is accurate within 2 data points of the PurpleAir (for PM 2.5).

Conclusions

The application functions well, but I plan to rewrite it, to move away from its legacy codebase, so that I can bump its 96% performance score to 100%. Along with rewriting the app, I would like to redesign the sensor case, so that is is more portable and ergonomic and upgrade the sensor module to a Plantower PMS 5003.

Summary Statement

I built a portable, accurate, and affordable air quality sensor, and an efficient web app, that runs on any device, in order to assist and connect people monitoring air quality.

Help Received

None. I assembled the sensor and developed the application by myself. I conducted all testing and compared the data by myself.