Abstract

This project’s objective was to create an environmental monitoring system for a data center, to serve as an alternative to current proprietary systems. Companies like ITWatchDogs and Raritan offer monitoring systems that have some degree of customization, but cost hundreds to thousands of dollars, and lock a system administrator into using only that particular company’s hardware. In our case, our system consists of Raspberry Pi board(s) (motion sensor, camera, RF module, and Wi-Fi dongle attached), communicating and polling data from Arduino board(s) (humidity/temperature sensor, smoke sensor, water sensor, and RF module attached). Compared to the current proprietary options, our system’s implementation is very affordable and scalable.

Architecture

- Raspberry Pi Model 2 B Board
- Infrared Motion Sensor
- 5MP Camera
- Wi-Fi Nano USB Dongle
- RF Communication Module
- Arduino Uno R3 Board
  - DHT11 Humidity/Temperature Sensor
  - MQ135 Smoke Sensor
  - Water Sensor
  - RF Communication Module

Software: We wrote the Arduino software in C and the Raspberry Pi software in Python, both working in conjunction by sending the Arduino data over RF to the Raspberry Pi, which then processes and displays all the data, sending out alerts if appropriate.

Impact

Our project will have a benefit our sponsor, specifically the UTD Computer Science Data Center by offering another option for monitoring environmental conditions, at a significantly lower cost than products with similar functionality from large companies like ITWatchDogs and Raritan. If desired, it will be possible to adapt our system and scale it to a larger monitoring area, with more Raspberry Pis and Arduinos working in conjunction. Our code will be posted to GitHub, so that it might benefit others in the community who may not be able to afford an expensive commercial system. For instance, a small business or smaller school could possibly implement this system in its data center, at a fraction of the cost of a commercial system, all while having similar functionality to it. The benefit of this hardware is analogous to that of open source software. The cost is not zero, given the parts required, but the impact is similar in principle.

Summary

The value of this project is derived from the absence of an affordable, non-proprietary environmental monitoring system on the market. All the options that are currently available are expensive and not very adaptable. Given that our system consists solely of off the shelf parts and open source software, the cost is relatively low and the versatility/scalability is high. Our system is scalable and adaptable to data centers of various sizes and geometries, and thus feasible whether the budget is small or large. We initially tested Bluetooth for Raspberry Pi/Arduino communication, but changed to RF transmission due to automation issues that arose from having to manually pair the Bluetooth modules at setup. RF range is the limiting factor in regard to how large the system can scale, yet that can be worked around by deploying Raspberry Pis and Arduinos in clusters, and using Ethernet/Wi-Fi to allow clusters to communicate to others outside of RF range or allowing the clusters to operate independently.