Applications for Low Cost Sensors and Computing Platforms

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Overview
Some of the biggest limiting factors of environmental research are the limitations of high quality lab equipment. Such equipment is often expensive, prioritizes data quality over data density, and has low mobility. In recent years there has been and unprecedented emergence of low cost sensors and computing platforms that use common communication protocols. The goal of this project was to determine if these sensors could be used as a viable supplement to the limitations of lab equipment.

Equipment and Procedures

• This project tested the Sparkfun Spectral Triad as7265x, an 18 channel spectroscopy sensor that measures light in the 410nm-940nm range. It was connected to a Raspberry Pi model 2 B+ through an I2C connection.

• An application was developed in Python that allows a user to control the sensor, collect spectral data, and graph the results.

• Indoor measurements were taken under a halogen bulb lamp and outdoor measurements were taken on a sunny day. All measurements were taken away from shadows and normalized against the spectral signature of a white reference.

Key Findings

• A significant difference was found between the spectra of healthy and unhealthy vegetation in the Near Infra-Red range.

• The sensor was able to measure a significant overall difference in spectral responsivity between wet and dry soil.

• The collected spectral data was used to train a Random Forest Classifier. The classifier was able to identify different types of vegetation and soil with an average accuracy of 95%.

Impact and Conclusions

When compared to high quality lab spectroscopy equipment that is often priced at thousands of dollars, the Spectral Triad priced at $65 is much more affordable. The test findings have shown that this inexpensive sensor is practical for supplementing the limitations of lab equipment. This sensor could have a large impact on agriculture when integrated into irrigation systems. The ability to monitor crop health and soil moisture would allow farmers to optimize crop irrigation and maximize output. Work is being done to test if the sensor is able to identify water contaminated with algae. Depending on the results, this sensor could possibly be used to measure water purity and provide advanced warning for algae blooms.

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