

Portable Nutrient Data Collection System

Problem

Water data collection is not efficient enough such that the nutrients in the water can be measured quickly and with ease. Measuring the nutrients in water samples is important for environmental and agricultural studies.

Solution

Our system speeds up the process of measuring water samples by applying a voltage across the sample and measuring the light intensity with a spectrometer. We make this easy to use by packing our system into one box which is controlled by a phone application with a simple user interface.

Design Requirements

Functional

- Weather resistant
- Wireless connectivity
- Store data in a database
- Display data meaningfully

Non-Functional

- Simple interface
- System should be portable
- Reasonable wireless range
- Short runtime for scanning

Operating Environment

This system is intended to be used in the field by operators such as farmers, surveyors, or environmental agencies.

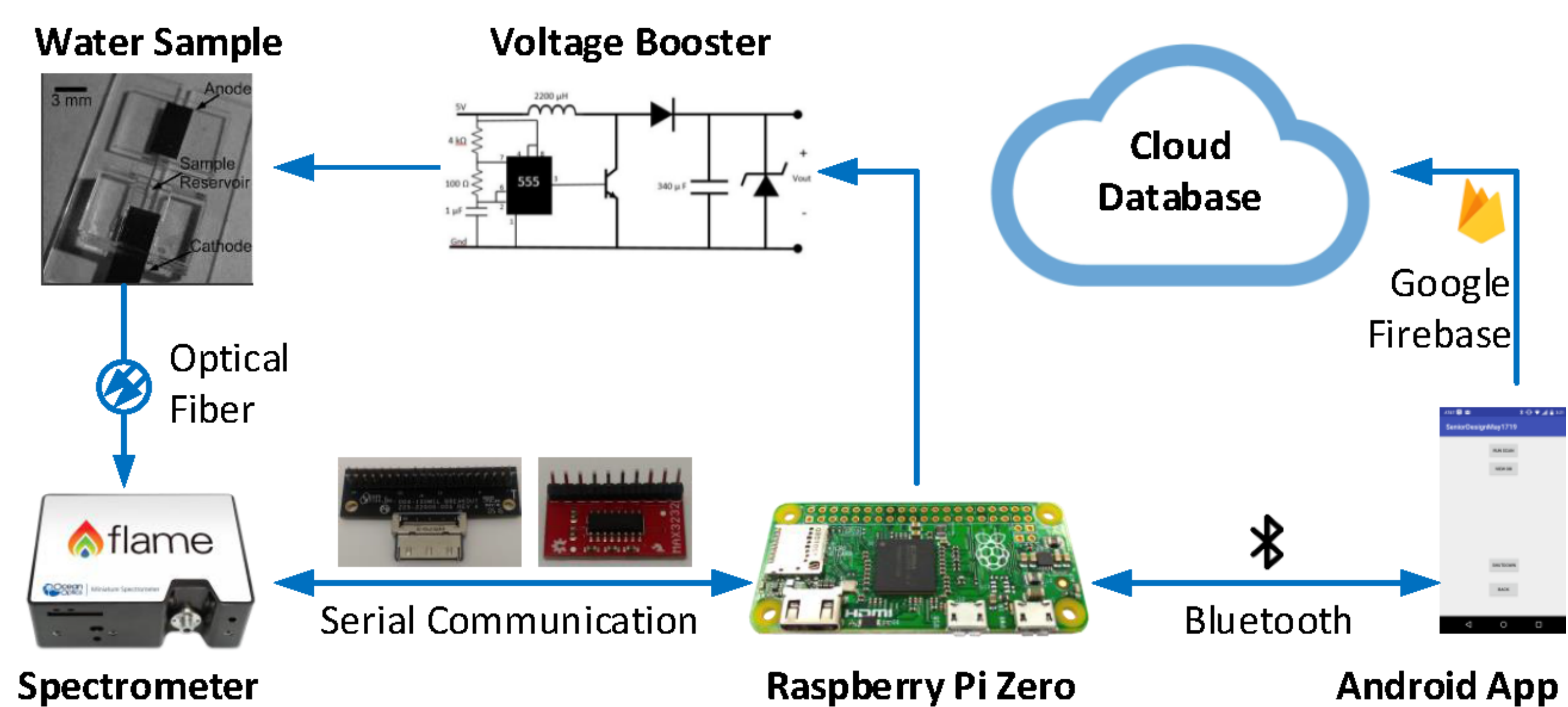
Software

Technology

- Android Studio
- Android Plot
- Java
- Firebase
- Python
- RPI.GPIO library
- C3.js
- Material showcase
- React



Concept Sketch



Module Explanation

Raspberry Pi

- Facilitates communication
- Utilizes serial ports and Bluetooth communication
- GPIO pins control the voltage booster and indicator lights

Android App

- User interface
- Controls the whole system
- Stores sample data
- Graphs data

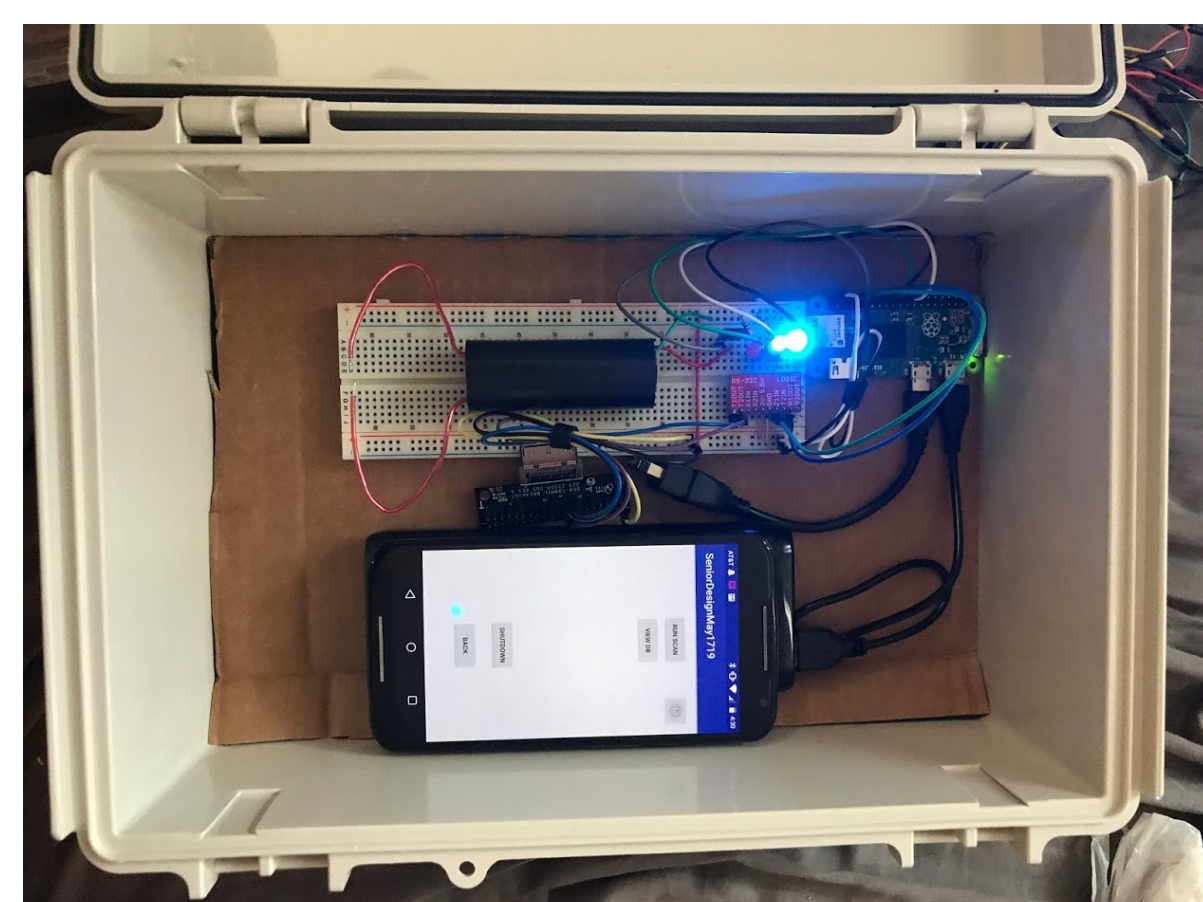
Voltage Booster

- Used to create a micro-discharge
- This converts the sample into data read in via fiber optic

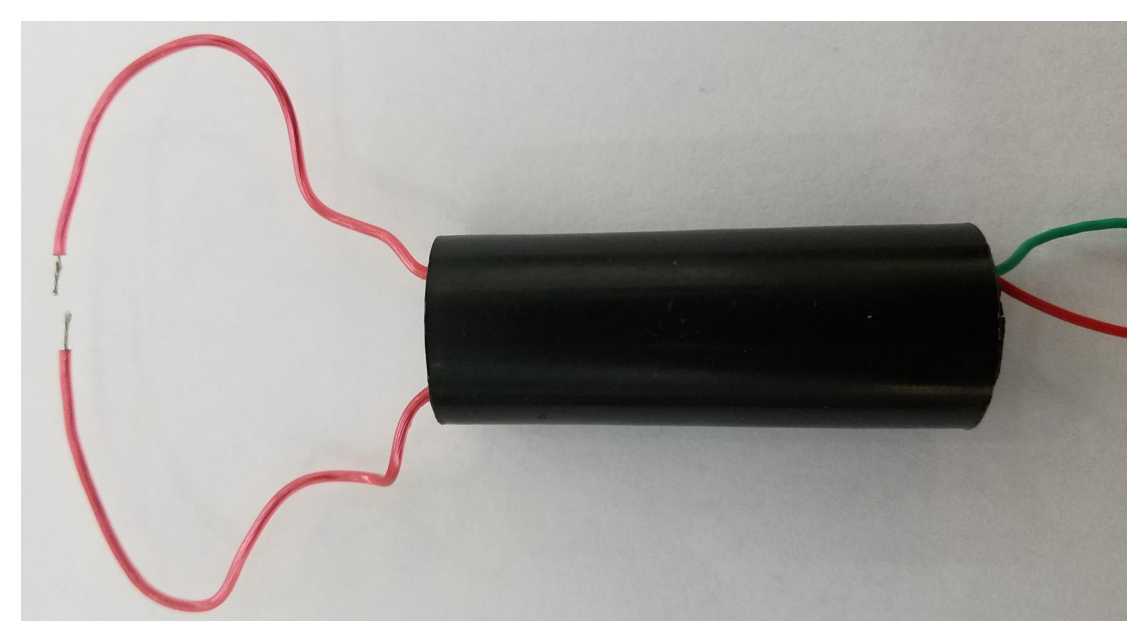
Web Viewer

- Displays sample data
- More readable graphs
- Provides database management

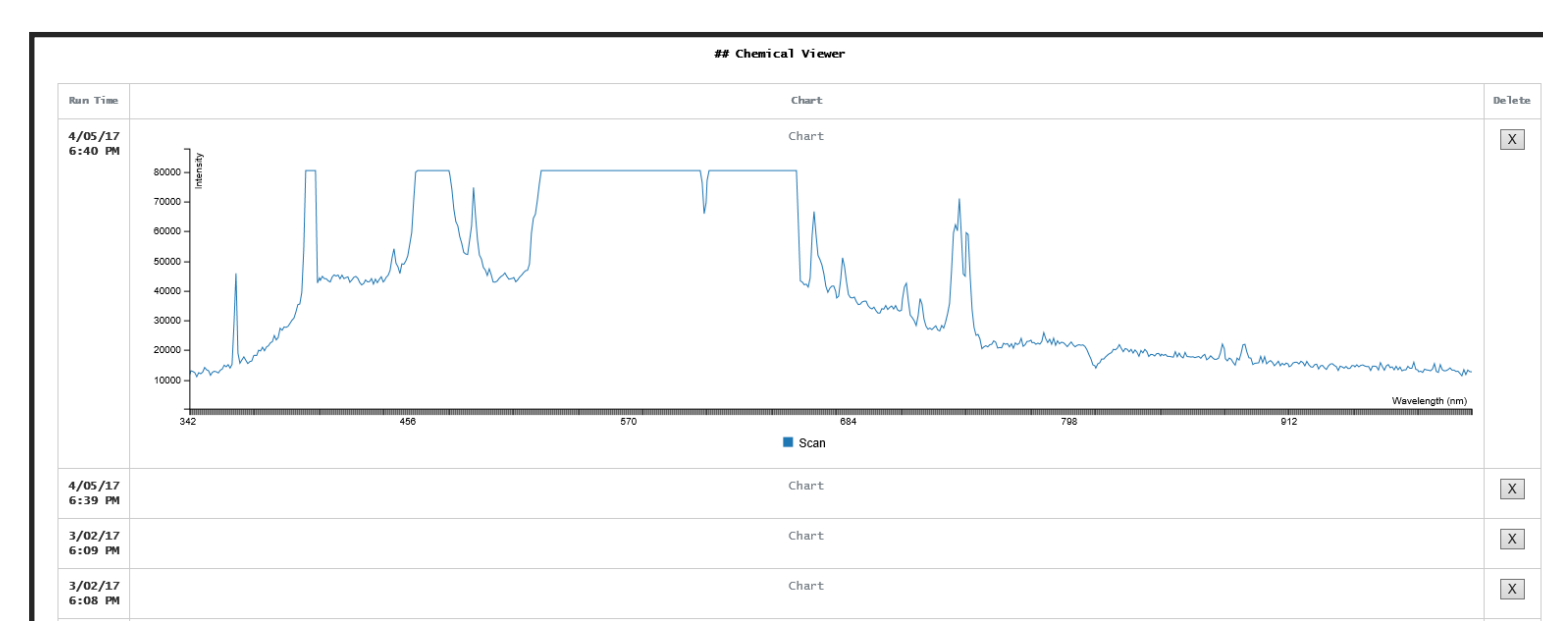
System Setup



Voltage Booster



Web-app View

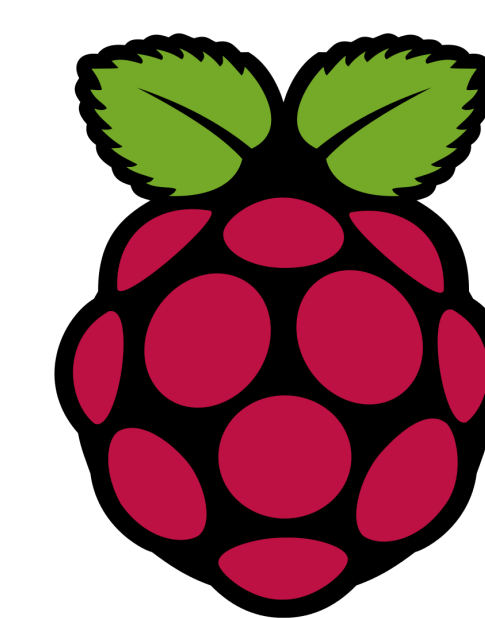


Testing Environments

- Android Studio
- Raspberry Pi

Testing Strategy

- Test each subsystem separately
- Once tested, integrate into main system
- Test integrated system



Raspberry Pi and Android App

- The Android app is the controller of the system
- Bluetooth communication from the app is received by server code on the Raspberry Pi
- Calibrated to time the arc from the voltage booster with the spectrometer scan

Voltage Booster

- Boosts 5 V DC input up to 400 kV DC
- Control output by length of air gap between positive lead and path to the negative lead
- Charges almost instantaneously
- Smaller than other options
- Contains transformer, capacitors, and oscillator components

Cloud Database and Viewer

As data is received from the device in the Android app, it is stored in a local database. If there is an active internet connection, it is also uploaded to Google's cloud database, Firebase.

Firebase allows us to remotely access our scan data, for the purposes of viewing it on the desktop. We've created a React web-app allowing us to do this.

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May1719

Client: Dr. Long Que, Advisor: Dr. Daji Qiao

Team Members:

Ben Theisen, Michael Rupert, Zakk Belloma, Ryan Young, Ben Engebrecht, Logan Boas

<http://may1719.sd.ece.iastate.edu>