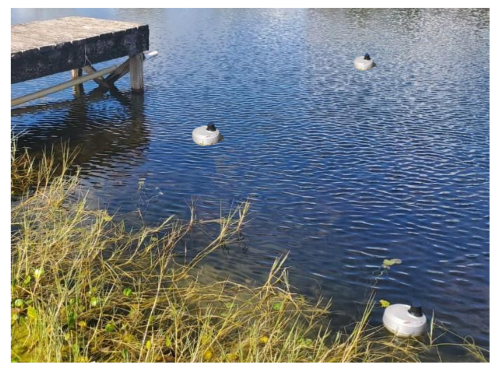
GatorByte – A Low-Cost, Real-time Water Resource Monitoring Buoy

Piyush Agade [a], Eban Bean, PhD, PE [a]

[a] Department of Agricultural and Biological Engineering, University of Florida, Gainesville, FL

Introduction

Commercially available water-quality monitoring systems are often cost-prohibitive for water resource professionals. The goal of this project is to develop a low-cost, compact, and mobile water-quality monitoring platform for short or long-term deployments in water bodies.



What is GatorByte?

GatorByte is a **low-cost mobile** water-quality monitoring and assessment platform with capability to **geo-tag** measurements and report in **real-time** actionable & accessible information in a time-effective manner.

Primary Goal

Develop **a low-cost, real-time, high-resolution** water resource monitoring and assessment tool to capture **temporal and spatial variations** in parameters using widely available, off-the-shelf or fabricated components**.**

Objectives

Specific research objectives are:

- Develop a **prototype** buoy with basic indicator parameters- pH, temp, dissolved Oxygen, Electroconductivity.
- Design 3D enclosure **CAD model** and **circuit board layout**
- Develop real-time web-based **visualization tools** with spatiotemporal visualization and bi-directional updates to device configuration.
- Add H/W and S/W compatibility for **more sensors and electronics modules.**

Salient Features

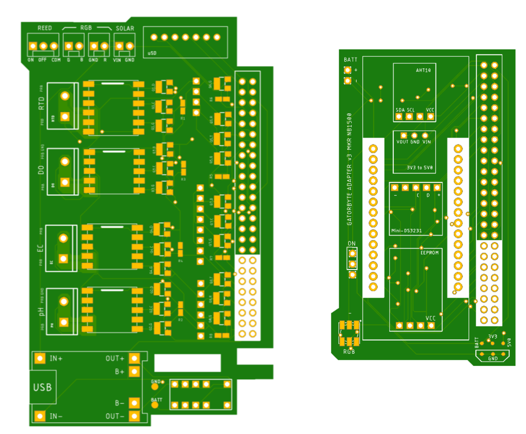
Commercially available alternatives are few to choose from, **expensive**, **large**, and have **proprietary hardware and software**.

In contrast, the proposed platform is/has:

- **Open-source** hardware and software
- **Inexpensive,** has **off-the shelf** components
- **Compact** design (5 in. X 4.5 in. Ø)
- **Modular** design; **expandable** sensors support
- **Less that $1500 per unit**
- Multiple configurations

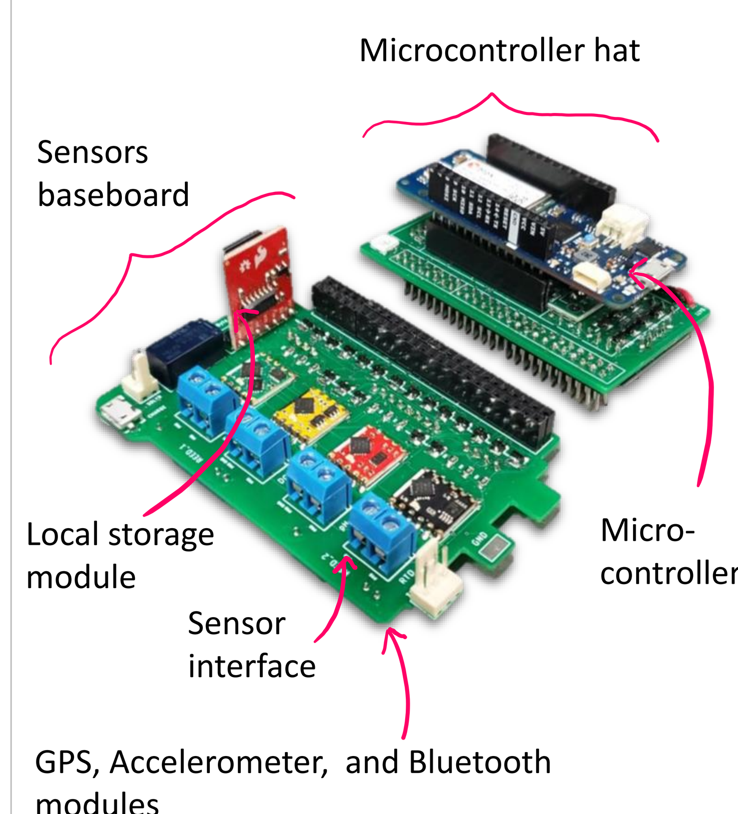
Hardware Components and Housing

- Buoy, station, lab benchtop configurations
- Realtime updates using NB-IoT communication
- On-board data storage
- GPS for location tracking
- Web-based visualization tool
- Custom PCB, 3D-printed housing



a. Open-source PCB design

b. Open-source CAD design



c. GatorByte PCB

d. Assembled housing

Figure 1 GatorByte's **small form-factor**, **open-source** and **inexpensive** 3D CAD and circuit designs, and on-board electronic components.

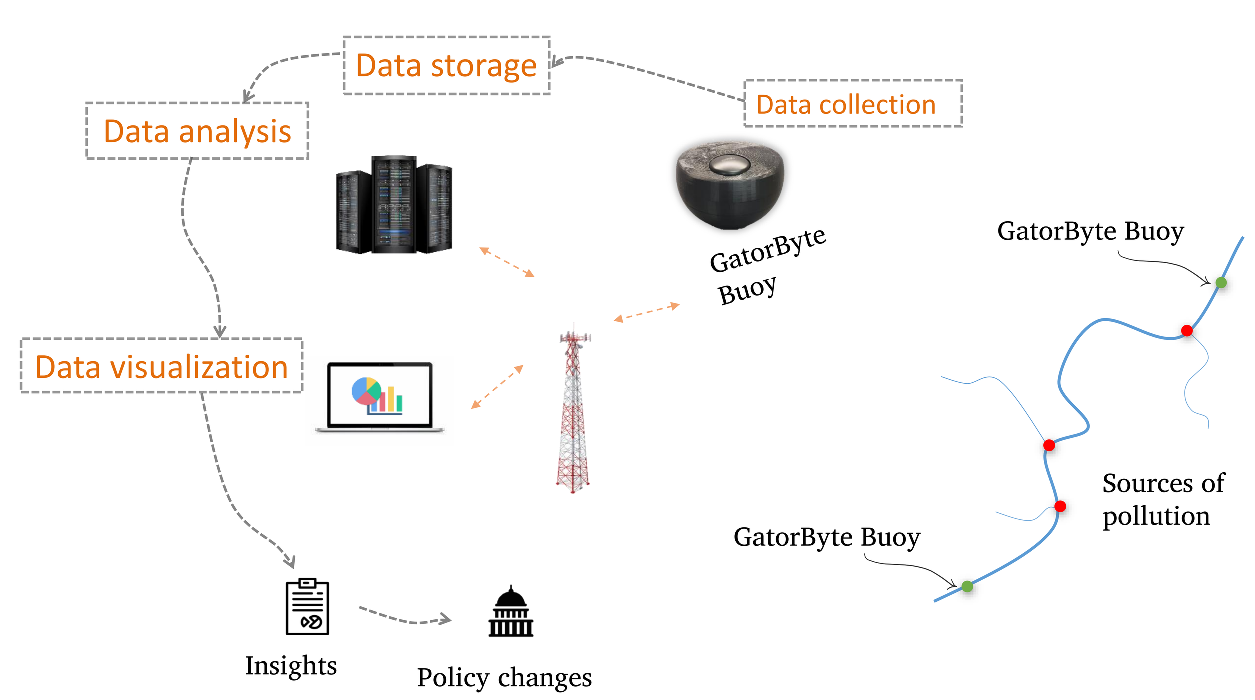


Figure 2 GatorByte platform designed to enable quick short-term mitigative actions and help with long-term policymaking.

Results

Figures 3 A prototype **web-application** that visualizes **the temporal and spatial** dimensions of the **water-quality data** collected during **a float survey**. The tools allow visualizing the geo-temporal water-quality data side-by-side to help users **better understand the relationship between a location and the variation of water-quality data**.

Future Work

Early 2022

- Survey urban storm water systems.
- Set up a swarm of GatorByte buoys and stations.
- Add support for Long-Range radio communication

Late 2022

- Add turbidity, spectroscopy, and nitrate sensor
- Develop map-based visualization applications

Early 2023

- Data processing and analysis.
- Make software and hardware designs open-source

Expected results

Early 2022

- Data collection and system testing
- Improve temporal and spatial resolution of data
- Make nodes more power efficient, and reduce data transfer costs

Late 2022

- Added capabilities to monitor more water quality parameters.
- Show data variation & allow users to derive insights using a map-based tool

Early 2023

- Parameter selection and optimization
- Enable other researchers to collaborate on the project, improve the system, or tailor the system for other monitoring applications.

Acknowledgments

This work is supported by the USDA National Institute of Food and Agriculture, AFRI project number 2017-08795

References

[1] Syahidah Nurani Zulkiflia et al. (2017), Detection of contaminants in water supply: A review on state-of-the-art monitoring technologies and their applications.

[2] Patricia A. Beddows et al. (2018), Cave Pearl Data Logger: A Flexible Arduino-Based Logging Platform for Long-Term Monitoring in Harsh Environments

[3] S. Ullo et al. (2020), Advances in Smart Environment Monitoring Systems Using IoT and Sensors

[4] Tzai-Hung Wen et al. (2013), Monitoring Street-Level Spatial-Temporal Variations of CO in Urban Settings Using a Sensor Network