Autonomous Hydrographic Survey Boat

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Introduction:

Hydrography is the science of surveying and charting bodies of water. Hydrographic surveying is important in the field of civil engineering, for groups must know the layout of a body of water before starting projects like dredging, diverting water sources, building docks, etc.

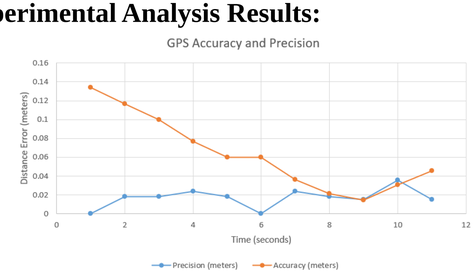
The team collaborated with the Tennessee Tech Water Center to create an autonomous hydrographic surveying boat that can measure and map the depth of bodies of water and send the acquired data to an on-site technician in real time. This type of survey is conducted by navigating the boat back and forth across the body of water. Performing this task manually is labor-intensive and prone to error. Autonomous control eases the role of the technician while accomplishing the task more efficiently and accurately.

Autonomous Boat Prototype

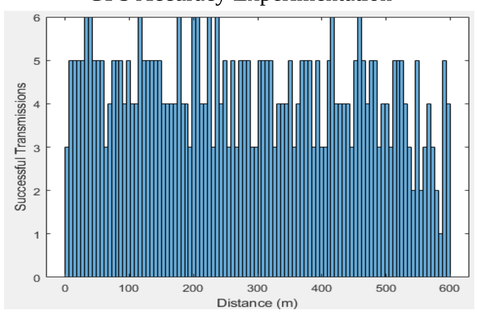
Specifications:

- Design should be easily replicable for any group interested in using this project to take their own hydrographic measurements
- Successfully measure the entirety of Cane Creek Lake (56 acres) in one test run
- Travel at a speed of 3-5 ft/s to ensure accurate sonar data measurements
- Transmit hydrographic measurements, GPS location, and battery voltage levels from the boat to a land base in real time
- Can switch between manual and autonomous control

Experimental Analysis Results:

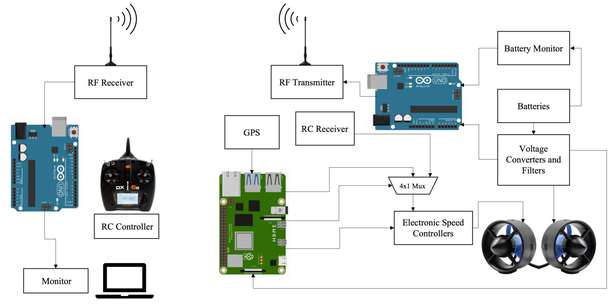


GPS Accuracy Experimentation



Data Transmission Samples vs Distance from Base Station

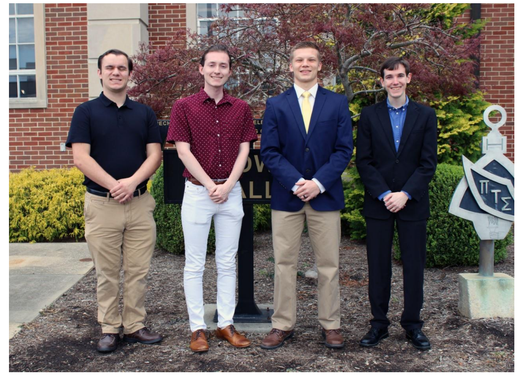
Final Product:



System Layout

- The autonomous navigation algorithm is executed by a Raspberry Pi 4B
- RTK GPS data is used by the autonomous algorithm
- Wireless transmissions of GPS data and battery status to the base station are accomplished with a pair of Arduino Uno's and RF modules over a maximum distance of 600 m
- The user can manually navigate the boat using a handheld RC and can switch control modes with a toggle switch
- LiPo batteries provide a lifetime of about 3 hours of continuous testing

GPS Points Implemented into the Raspberry Pi for Autonomous Control



From Left: Joshua Herrera, Andrew Alley, Levi Daniel, & Carter Ashby

Future Work:

We have designed the boat to travel to certain desired points whose coordinates are listed on the Raspberry Pi. This Python code can be used as a base for a program that can generate a set of equidistant parallel lines across a body of water for the autonomous boat to travel. Future teams can work to integrate the current systems with the Sontek M9 HydroSurveyor sonar system provided by the Water Center to transmit and map recorded hydrographic measurements.

Acknowledgements:

We would like to thank Mr. Roberts for his guidance throughout our time working on this project. Additionally, we would like to thank Dr. Kalyanapu of the Civil and Environmental Engineering Department and the Water Center for funding this project.