WiNTR: Wi-Fi Network Tracking Robot

Tinu Vanapamula, Kevin Sisk, Saron Shimels

Under the Mentorship of Thomas Dignan, Rob Rosenberry, Evan Bolt

Abstract

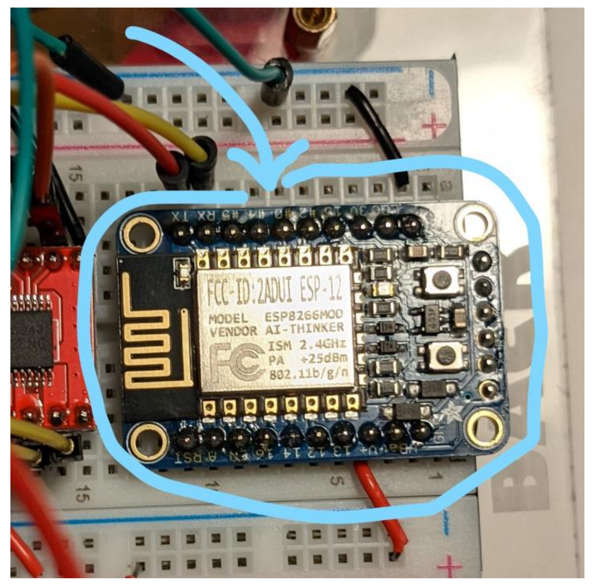
Autonomous vehicles are used to reduce human work and assign certain tasks to capable robots that can do a better job than us. WiNTR tracks Wi-Fi access points to locate the signal origin. WiNTR determines which direction to go using a continuous data stream to track where a signal is strongest: playing hot & cold with Wi-Fi. The rapid data sampling provides accurate readings and reduces error.

WiNTR also helps identify rogue access points. In order to remove unwanted Wi-Fi access points, you have to identify them first: that's where WiNTR comes in.

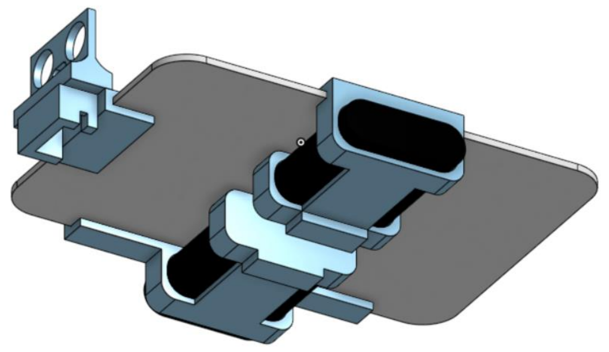
Objective

We were tasked to build an Over Terrain Vehicle (OTV) that tracks Wi-Fi signals autonomously with the following requirements:

- Powered by rechargeable Li-on batteries and run for 10 continuous minutes with a mechanical kill switch.
- Able to transmit and receive Wi-Fi communications using an ESP Communication Module.
- Controlled by an Arduino compatible microcontroller.
- Establish a command set of protocols to communicate between client device, ESP module, and microcontroller.
- Able to autonomously navigate and track a Wi-Fi access point.



Design Process



1. Research

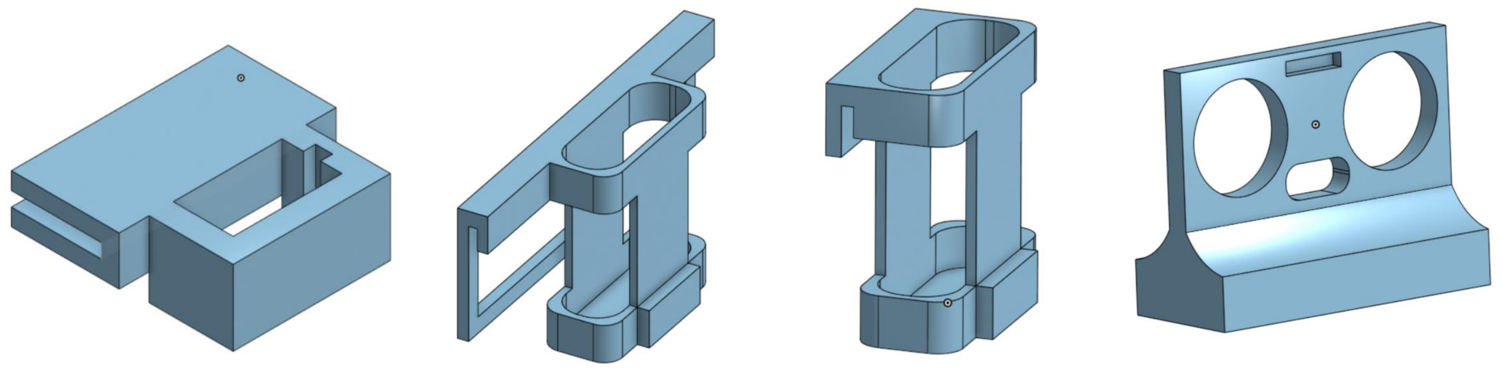
- Identified components needed to create a capable robot.
- Researched datasheets, specifications, and pinouts of each component for wiring and schematics.

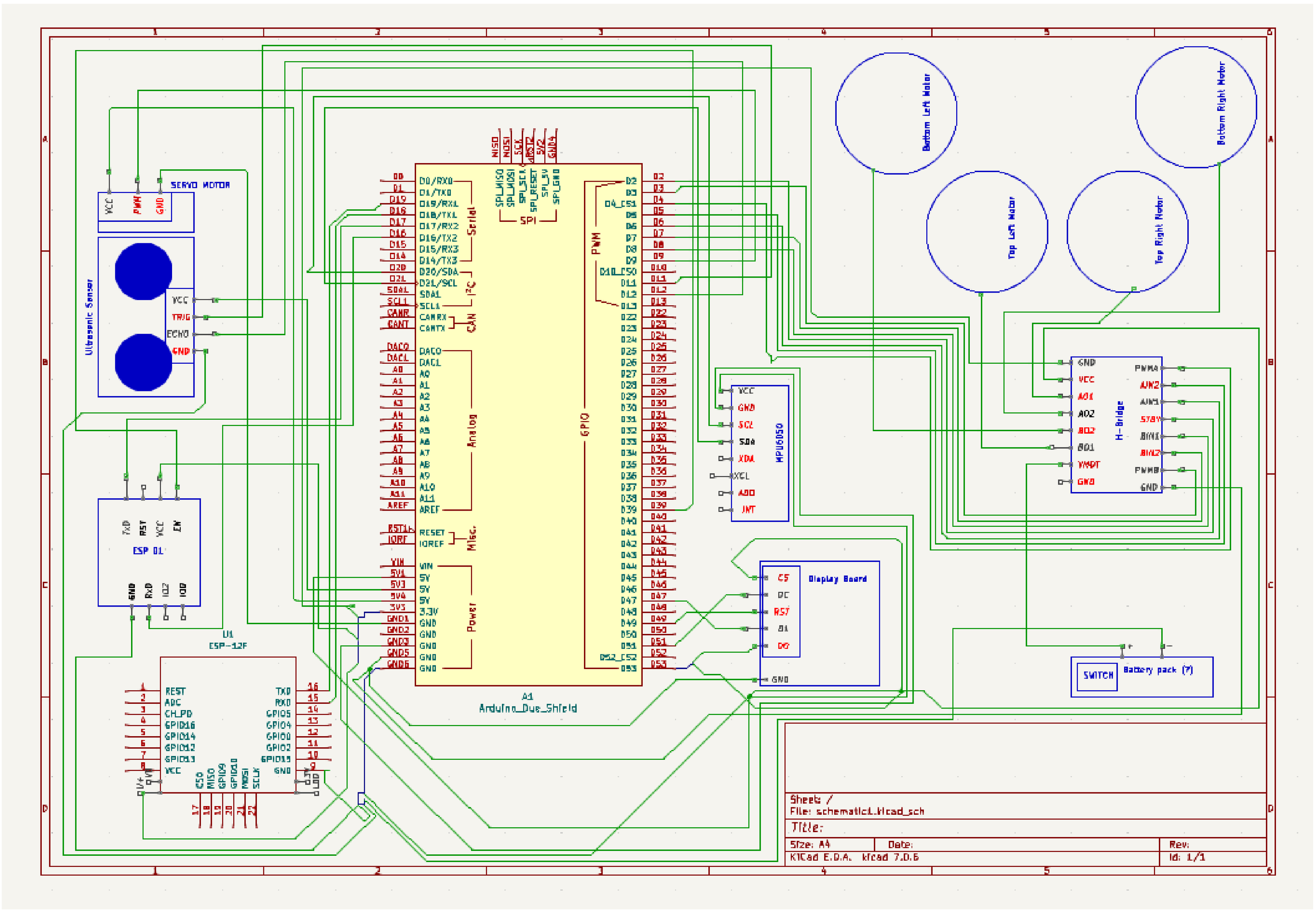
2. Prototype

- Created a prototype and tested each component individually before integrating the components/sensors with our robot and codebase.
- Used Computer Aided Design (CAD) to model and test parts for our robot.

3. Test and Debug

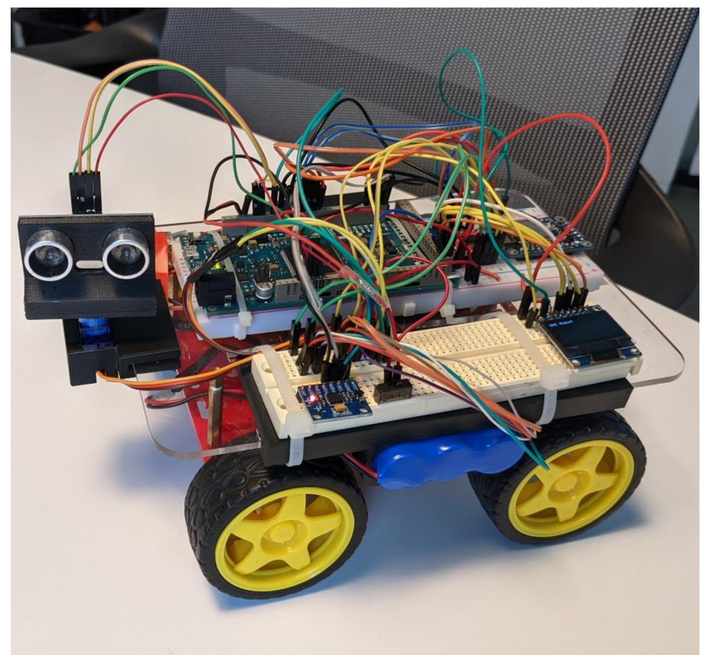
- Tested our robot using various metrics including speed, positional accuracy, and sensor values.

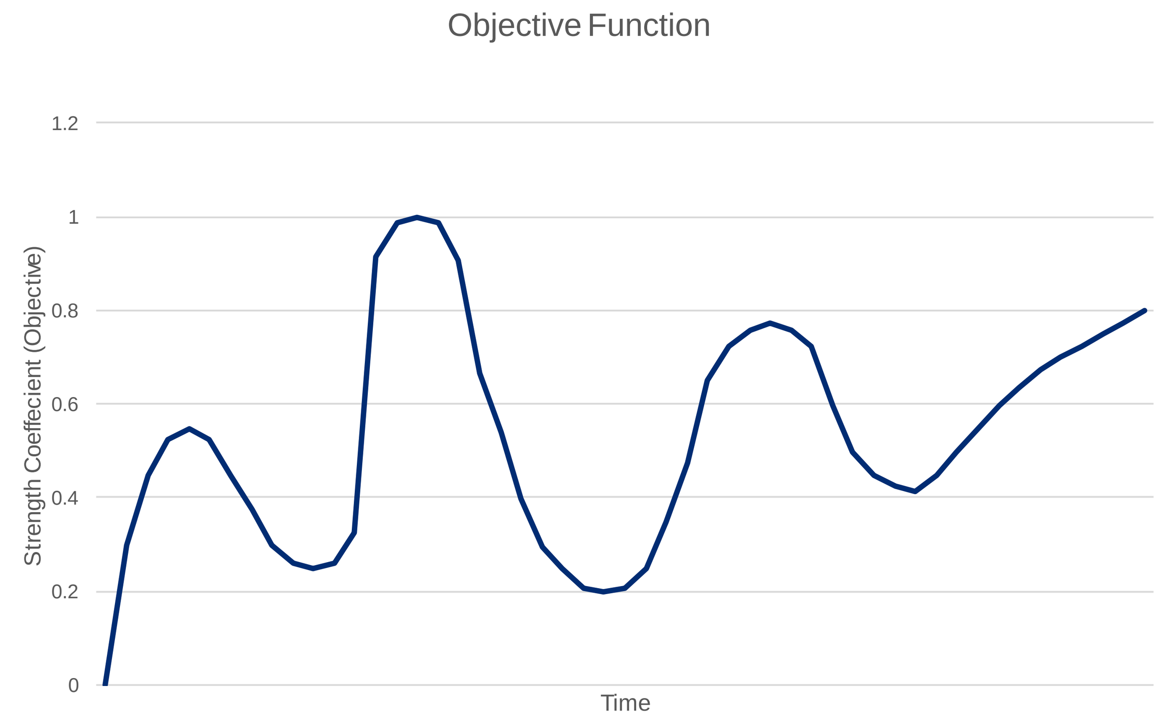




Results

- The robot was able to successfully navigate and locate the strongest access points.
- The autonomy of the robot can be modeled after the machine learning concept of gradient descent where we're attempting to optimize the objective function of network signal strength.





Future Work

- Achieve more precision by using a more accurate Wi-Fi module than a commercially available ESP8266
- More security including SSL protected API routes and storing the password outside of the firmware.
- Optimize the objective function for the absolute maximum instead of staying at a local maximum to navigate the robot closer to the access point.