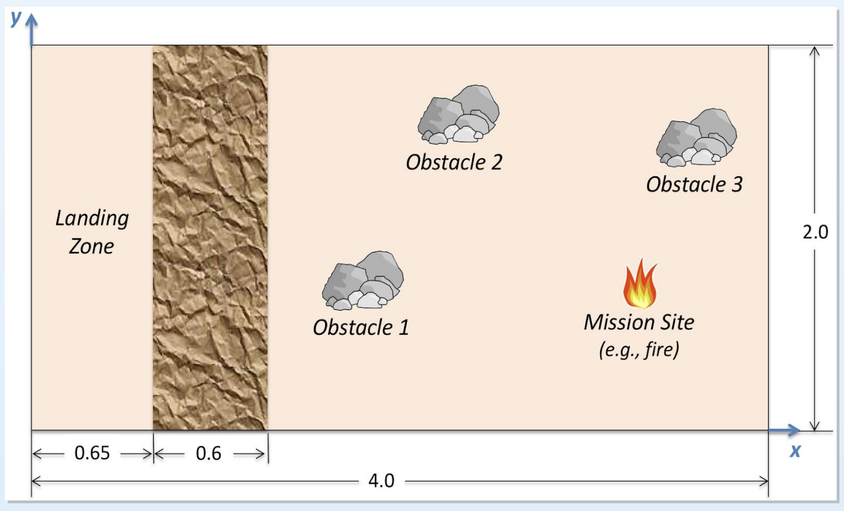
Team Hydration Nation

Water Mission Over Sand Vehicle
ENES100 (Professor Jackelyn Lopez Roshwalb)
Kalen Camacho, Anthony Ferrara, Zach Kasica, Imran Khawaja,
Alyssa McKinney, Brian Speicher, Ashley Williams, Yuchen Zhou

A. James Clark School of Engineering

Mission Objectives

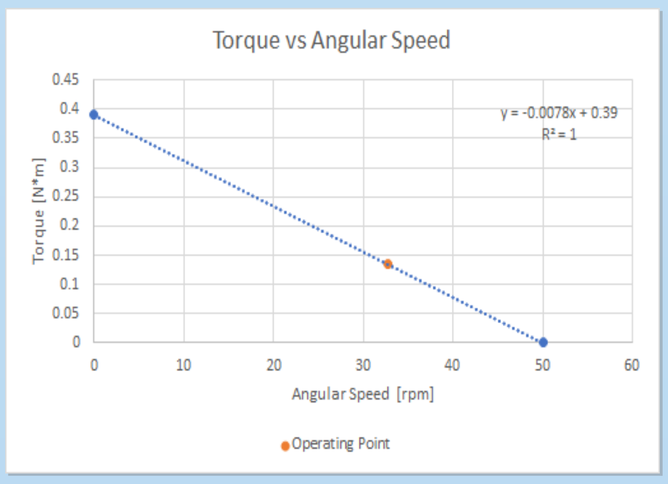
- Navigate to within 250 mm of the edge of the water pool
- Measure and transmit the correct water type
- Measure and transmit the depth of the water
- Cannot exceed 3 kg
- Footprint must be less than 350 mm x 350 mm



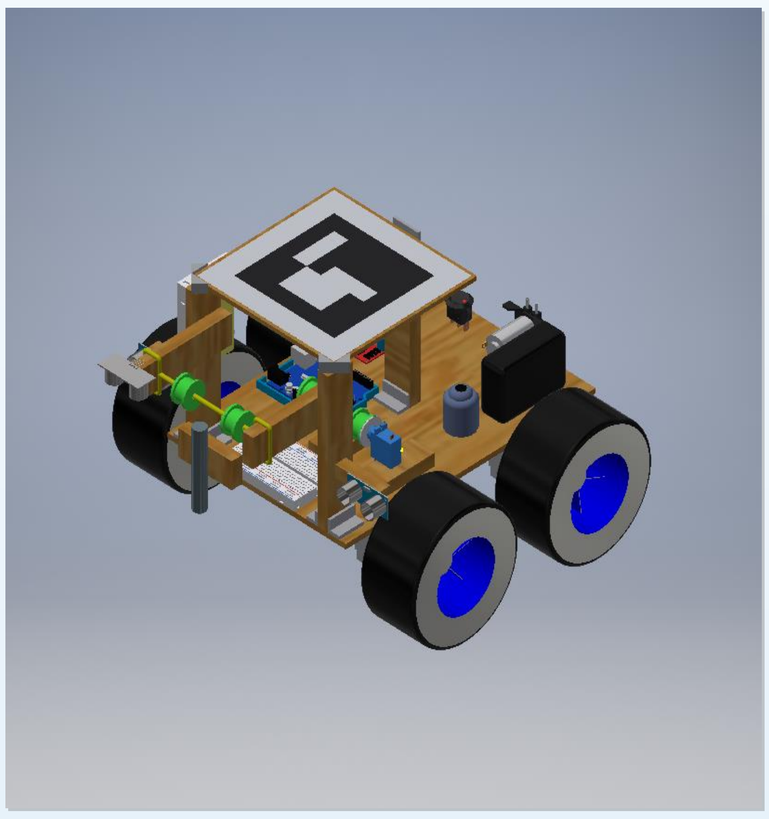
Top view of the arena

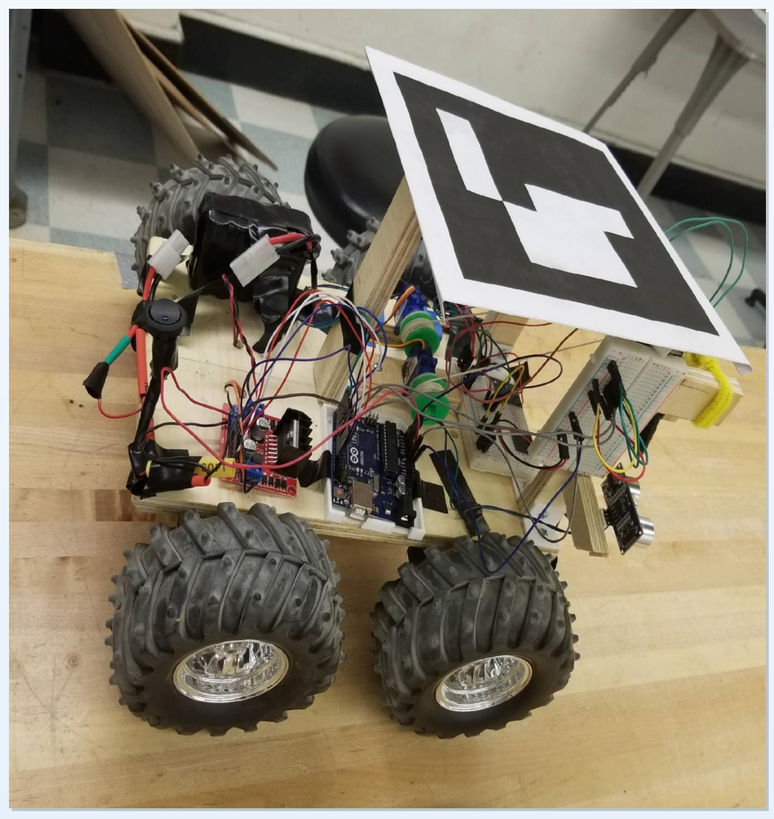
Design Details (Structure & Propulsion)

- Chassis (plywood) :
  200 mm (width) x 280 mm (length)
- Glue used to attach motor houses to the bottom of chassis and fasten 4 motors inside respective housing
- 4 wheels attached to each motor using hex adapter
- Parts (eg battery, breadboards, Arduino, ultrasonic sensors) which need to be easily removed in the case of an emergency are taped on
- Other parts (eg servos, tracker's pillars, pulley arms) which need to be sturdy are screwed into place
- The pulley is powered with two servos that has spindles attached
- The pulley strings extends out of the pulley arms, which are built off the tracker's pillars, where it hangs on the spindles around pipe cleaners for support
- Graph below shows data used to choose appropriate drive motors



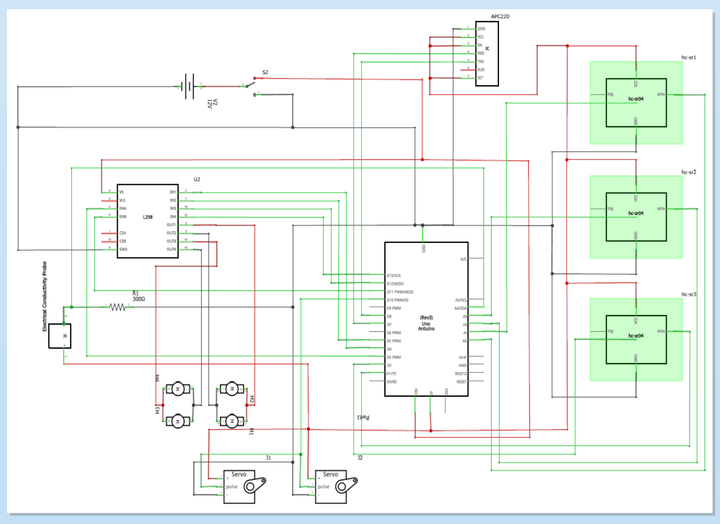
- Operating point is at 34.1 rpm





Power & Electronics

- Arduino UNO Rev3 and L298N H-bridge module are powered simultaneously by a 12V battery
- Driving wheels are powered and controlled by L298N
- Power for the rest of the components is supplied by the 5V output pin on the Arduino
- The Arduino controls the following components: one APC220 RF transceiver, two FS90R servos, three HC-SR04 ultrasonic sensors, and an analog pin that returns electrical conductivity of water sample.



Navigation & Control Algorithm

- Uses two ultrasonic sensors to detect obstacles in the path of the OSV, placed on the front corners of the vehicle.
- Navigates towards the objective while moving around any object detected by the sensors.
- Control Algorithm commands servo to drop the pulley with mission sensors when navigation was completed.

Shortcomings & Modifications

- Pulley replaced forklift- less complicated; more clearance
- Conductivity sensor replaced pH sensor- cheap to construct
- Ultrasonic sensor replaced water level sensor- more precise, consistent
- Conflicts with OSV caused removal of water pump- more important to have operating OSV

Lessons Learned

- Communication- everyone is dependent on each other doing their job
- Organization- we should have planned out the construction more prior to putting the OSV together
- Do not let one conflict stand in the way- we were able to overcome our OSV breaking down within 2 weeks of the competition by being flexible and quickly changing our design to adapt to the setback

Competition Performance

First Run:

- Result: Failed (0 point)
- Reason: Front right and back left wheels were stuck, and did not move

Second Run:

- Result: 20 points for getting to the mission site
- Modification: Removed the servo code from our final code
- Reason: Servo code was removed, so the pulley couldn't lower the EC sensor