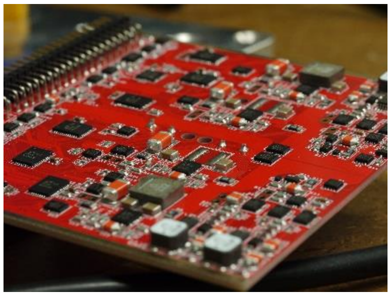

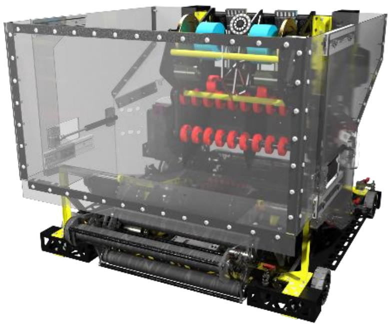

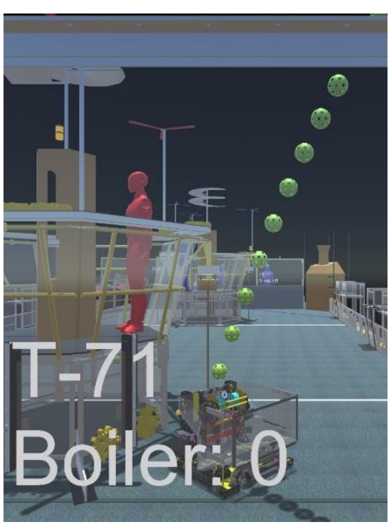

Bradley L. Davis

Design Portfolio

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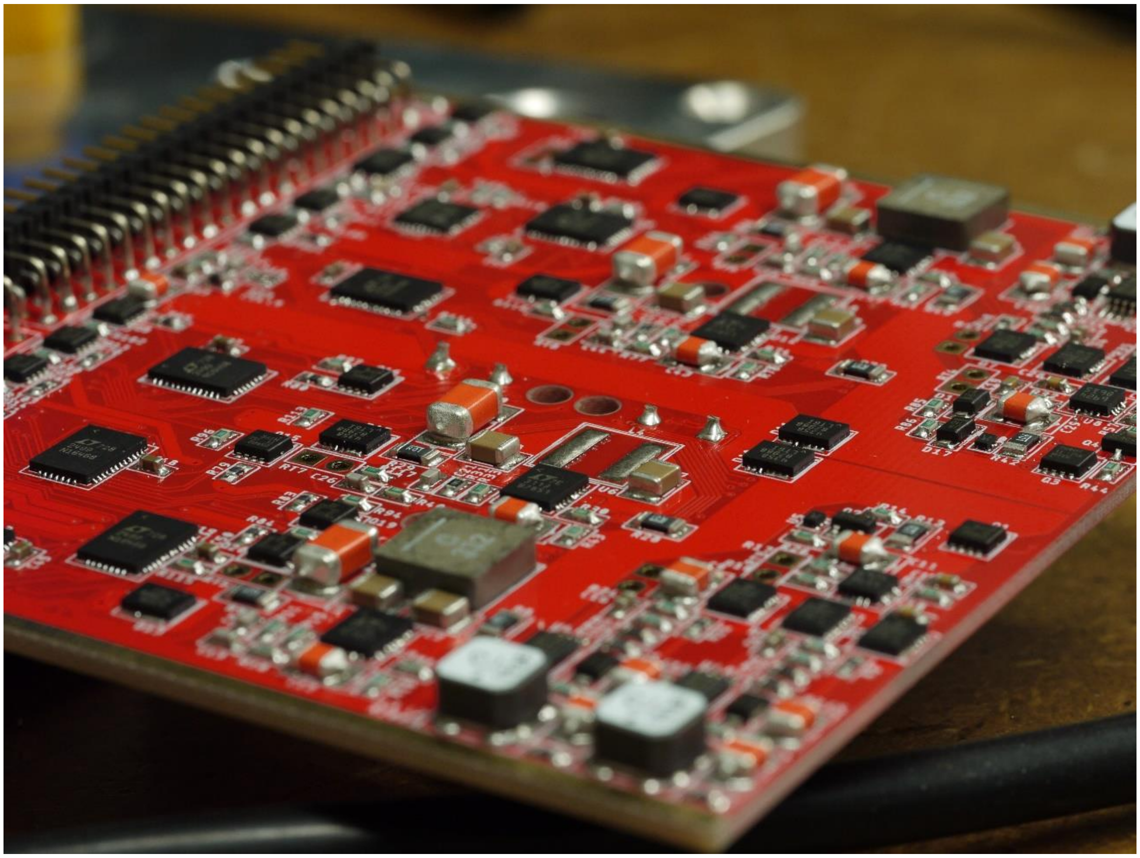
Bradley L. Davis

CougSat-1 EPS Fall 2017

Electrical Power System for Cougs in Space's Nanosatellite



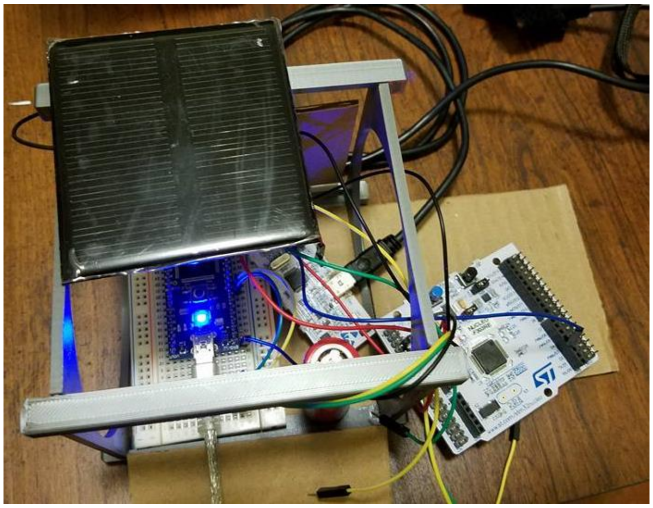
Cougs in Space is Washington State University's satellite club. The electrical power system (EPS Rev.A, pictured above) for CougSat-1 began development Fall 2017 to be launched in Spring 2020. Its function in the satellite is to generate, store, regulate, and manage electrical power.

Power is generated using triple junction photovoltaic cells. The cells are connected through a maximum power point tracking circuit which optimizes power extraction. The energy is stored in two lithium ion batteries for consumption during eclipse operation. The EPS regulates the energy to common voltage levels. There are 10 separate power rails on the backplane, each is current monitored and switchable; ideal for maintaining a low power state. These sensors and functions are controlled by the power management IC (PMIC). The PMIC also monitors and regulates the batteries' temperatures to preserve battery health. Furthermore, the PMIC communicates with the main satellite processor to process power commands and return status reports. The design features complete double redundancy for fault-tolerant operation.

My role on the power team is to create the printed circuit boards. I created the entire schematic and laid out all 260 surface-mount and 11 through-hole components. In November, every power team member collaborated in soldering the board using a reflow oven. Testing uncovered an issue with voltage spikes in the regulation section. The next iteration is in the circuit design phase and software is being developed on a prototype model.

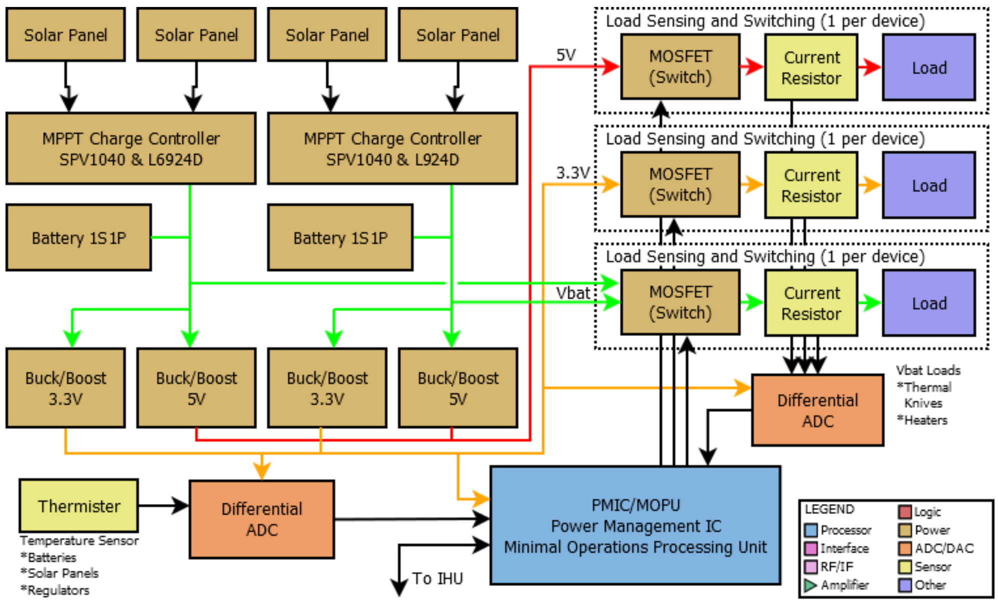
Cougs in Space Power Team Members: Reid Collins (Lead), Bradley Davis, Cameron Gott, Adithiya Vivekanandan, William Deleon

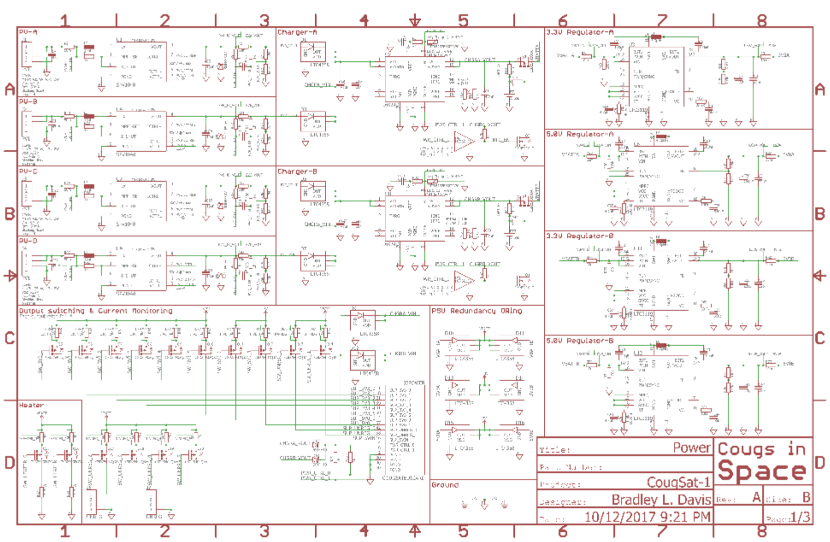
CougSat-1 EPS

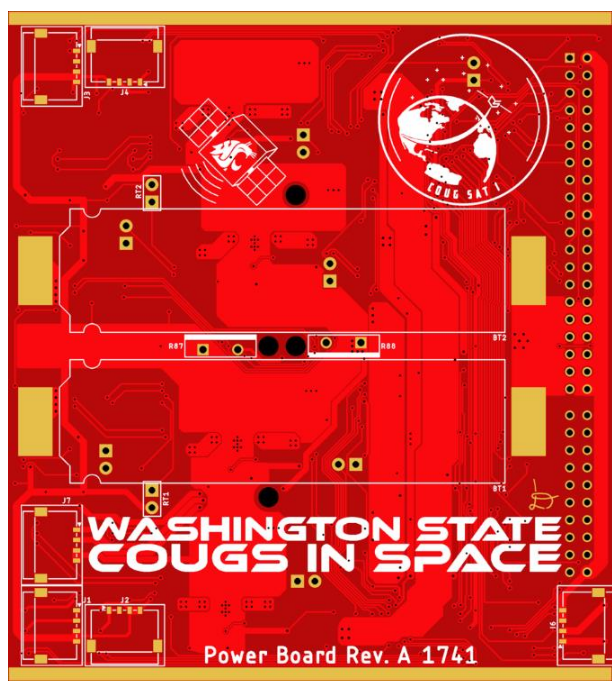


Prototype EPS including a photovoltaic cell and intra-satellite communication over I2C.

Functional block diagram of EPS illustrating power chain and doubling redundancy.





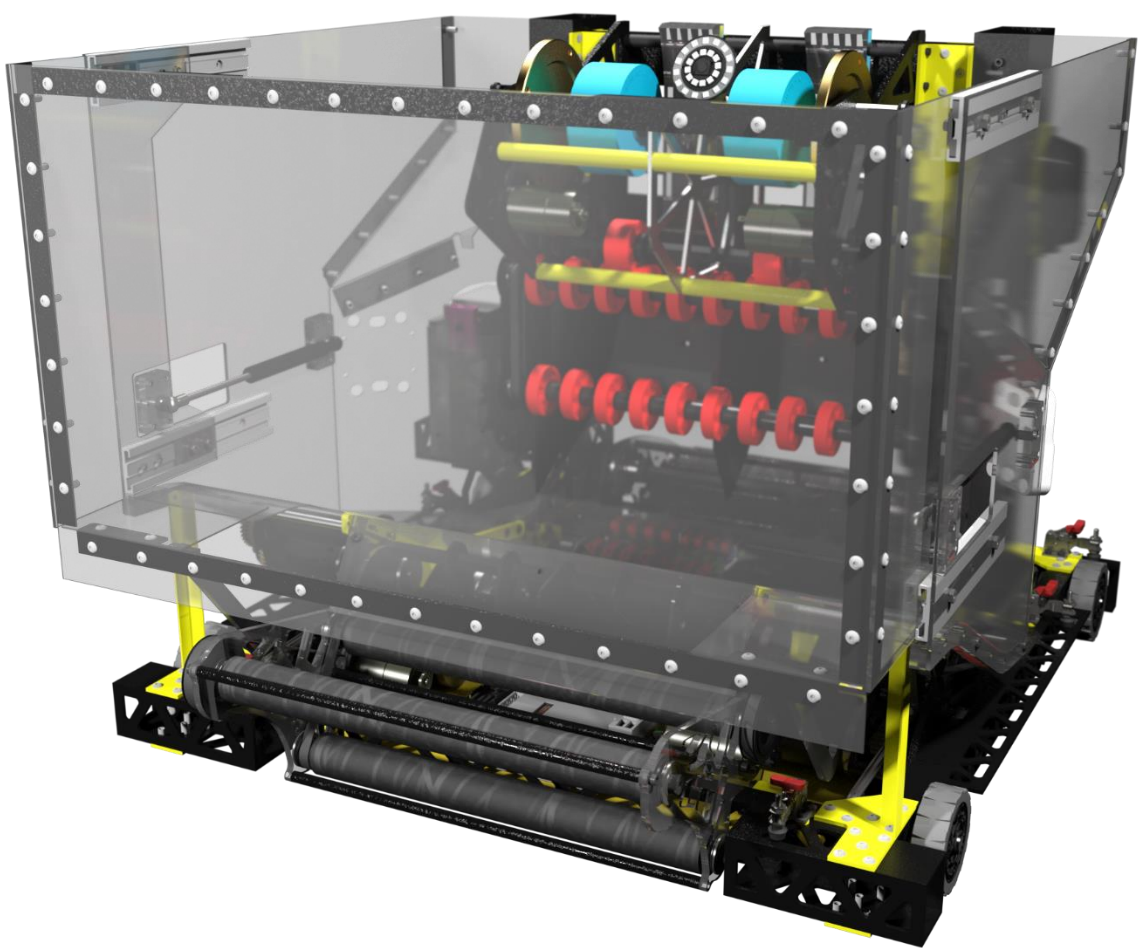


One sheet of EPS schematic (above) and bottom side of EPS board CAD (right).

Created in Autodesk EAGLE by Bradley Davis.

Hindenbearg January - May 2017

Bear Metal's Robot Competing in FRC's Steamworks



Tahoma High School's robotics club, Bear Metal, participated in FIRST Robotics Challenge's *Steamworks* in 2017. The robot designed, fabricated, assembled, wired, and programmed in six weeks was named *Hindenbearg*. The goal of the challenge was to shoot large wiffle balls to build steam pressure, connect an airship's propellers using gears, and climb a rope onto the airship.

Hindenbearg accomplished the first task by sucking wiffle balls off the ground using counter rotating rollers into a hopper. The hopper fed into a hooded-wheel shooter, duplicated for more throughput. Gears were maneuvered using an articulated box with a roller. A drum, covered in hook side Velcro, stuck to fibrous rope and rotated to hoist the 150 pounds of robot into the air.

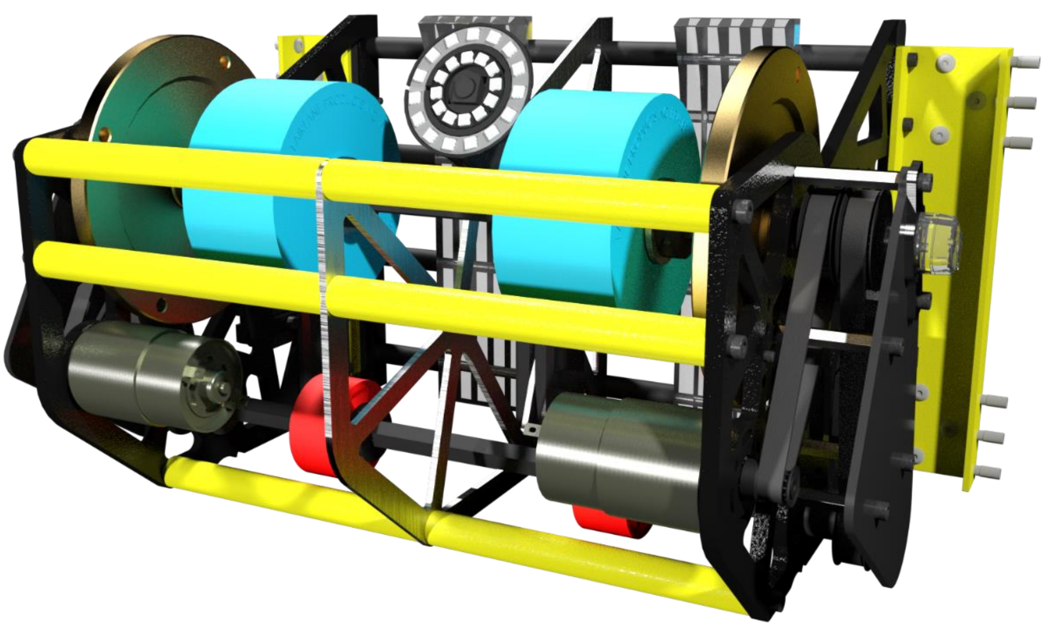
My role on the team was to lead the design sub team to design the mechanical components of the robot in Autodesk Inventor. I created 90% of the nearly 2,000 parts on Hindenbearg. The majority of design occurred during the first 18 days of the six-week build. Through testing, iterations were made to components and updated in the virtual model. I rendered the model using Autodesk 3ds Max after every major version. The resultant renders were 100 megapixels large and as photorealistic as I could get. Using the same program, I created a spherical video demonstrating the shooting capabilities to be viewed in a virtual reality headset.

Bear Metal Design Team Members: Bradley Davis (Lead), Conor Nickel, Noah Miller

Hindenbearg

Hindenbearg shooting wiffle balls into the boiler target (left). Hindenbearg climbing a blue rope showing off the Bear Metal logo on its underside (below).

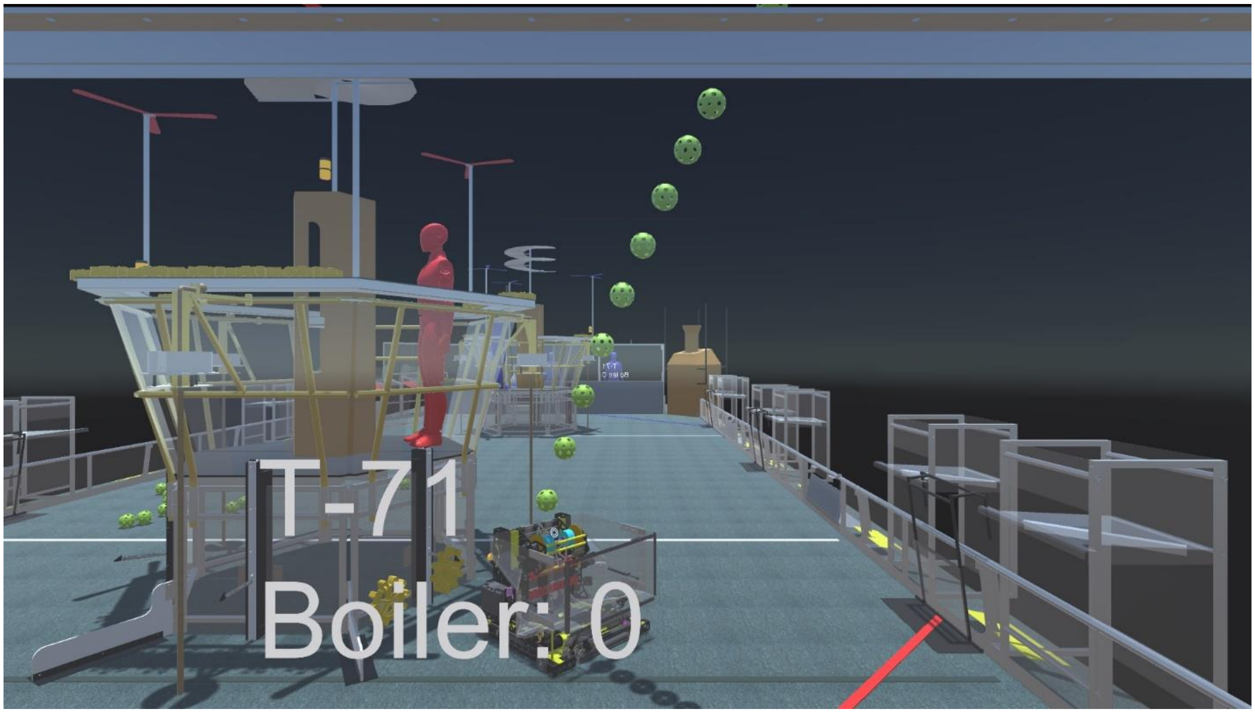
Photorealistic rendering of Hindenbearg's double hooded-wheel shooter. Including a camera for machine vision aiming (center). Note the inclusion of all fasteners.



FRC: The Game

April - May 2017

Virtual Reality Robot Simulator



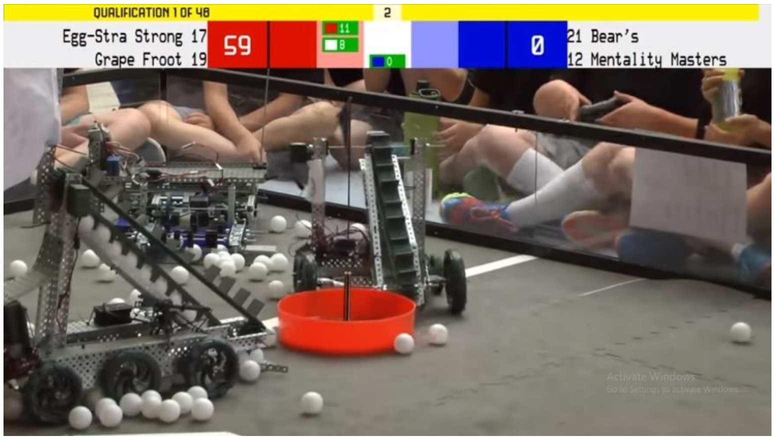
In less than a month, I created a multiplayer game that simulates FRC Steamworks using the Unity game engine. For details on Steamworks, see Hindenbearg. One player is immersed in a virtual reality headset and drives Hindenbearg with a controller. The other player uses a normal monitor and operates another team's robot. Each robot drives realistically based on its unique drivetrain. They can also collect and shoot wiffle balls, collect and place gears.

I am planning on updating the simulator for the next FRC game. This would allow current members of Bear Metal to use it early in the season to quickly identify and test strategies before any robot is made.

FRC: The Game available for anyone to try it out at competitions in virtual reality.

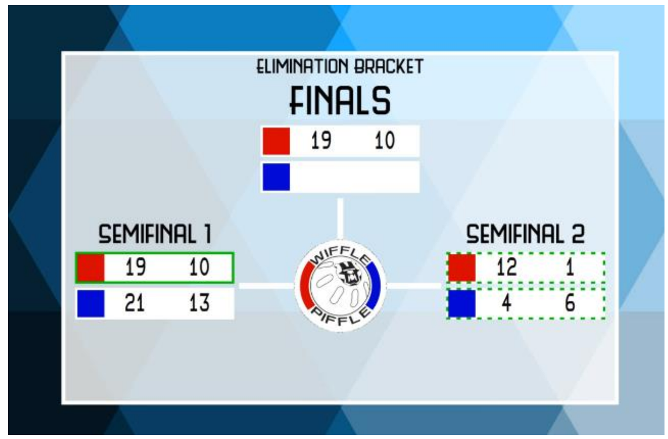
Wiffle Piffle & Flag Frenzy — June 2016 & 2017

Robotics Summer Camp Game & Tournament Software



For the annual summer camp hosted by Tahoma Robotics Club, I created the game the campers play. This includes all rules, game mechanics, animation, and testing out gameplay using prototype robots. I also wrote my own software that manages the competition tournement with a round-robin qualification round, alliance selection, and double elimination bracket (below).

The software automatically added tie-breaking matches. Friends and family of campers who were unable to attend the competition watched a livestream of the matches online (above).



Baja, Ogre, and Hot Bot — April 2017

Mini Robust Robots for Facebook Outreach Event

Facebook held an event for *Take Your Kid to Work Day* and the event planner asked Bear Metal to attend and bring robots to entertain the children and parents. I, along with a few others, built six robots in just a few weeks including spring break. The robots were designed as robustly as possible, so they could be used for hundreds of hours and many outreach events without fault. Each robot had its own specialty. Baja Bot (gold) had large knobby tires. Ogre Bot (green) had a ping pong ball shooter. Hot Bot (red and blue) was extra fast.