Mario Kart Robot

* Goal: design and build a fully autonomous robot from scratch to race around in a mario kart themed competition
* Split into teams of 4
* Built over the span of 6 weeks
* Many aspects of the course, black tape outlining a path, rainbow road, zipline, IR beacon for shortcut, and rocky sections
* Competition was formatted such that you get points for competing laps, collecting item boxes (3D printed cubes), and collecting coins (only on the zip line)
* Points were deducted for collecting bombs (item boxes with a red top and a magnet inside)
* Two robots were racing against each other at the same time, also had to design for collisions and robustness against them
* Combined mechanical, electrical and software design
* We called our robot the name R.O.B.erto
* All mechanical systems were designed in CAD using OnShape and then 3D printed, laser cut, or water jet cut and other machine tools
* Mechanical systems included the robot chassis which I personally designed and built, a mechanism we called the Elasti-Grab which collected objects, and a scissor lift and a hook which we used to take the zipline
* We were the only team out of 17 to successfully take the zipline and collect coins during the competition
* The Elasti-Grab works like a combine harvester, with a spinning ring of elastic bands that scoop up the item boxes into our collection area
* To avoid bombs, we used computer vision to detect the red colouring using a camera and a raspberry pi
* All electrical components were built from scratch as well
* All circuits were constructed using basic parts like MOSFETs and resistors and capacitors and were all soldered together
* We also designed a couple PCBs for specific circuits
* The brain of the robot was an stm 32 microcontroller called a blue pill and was programmed in c++
* Learned a lot in this project about rapid prototyping – designed something say in CAD, quickly building it, then testing to see if it works, and repeating until satisfaction
* Also learned about debugging, specifically with the electrical circuits
* Also about noise reduction as had multiple DC motors along with sensitive signals
* The car drove using PID control with an array of infared LED and phototransistor pairs under the car at the front to detect the black tape, along with a differential rear drive

Mechanical systems:

* Chassis or body of the robot was built and designed by me in CAD (onshape)
* Was designed to be press fit into place, so minimal glue
* Also designed to be sturdy to withstand collisions between other robots
* Was designed to efficiently house all required components – motors, object storage, electrical circuits, and all other mechanical systems (elasti-grab, scissor lift)
* some stands were 3D printed to secure the circuit boards vertically, being efficient of space
* A stand was also 3D printed
* The Elasti-Grab was inspired by a combine harvester and using a spinning ring of elastic bands to collect the objects
* The motor used for this was connected via a gears (which were 3D printed) to an encoder, this allowed us to prevent objects from getting stuck, which happened occasionally
* We used a rotatory encoder to tell us if the elasti-grab stopped spinning, then quickly spun the elasti grab in the opposite direction and then in the direction to collect objects again
* The scissor lift in the back went up and down via its own motor as well
* The motor was also geared to an encoder to allow for precision and control of the height of the scissor lift to correctly grab onto the zipline
* For fun, we also engraved “sponsors” on the sides of the car, mimicking what we see in NASCAR