Baguette

Team 5940

2018 Technical Binder

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Scoring Objectives

Action	Criteria	MATCH Points		Ranking Points
		AUTO	TELEOP	
AUTO-RUN	For each ROBOT that breaks the vertical plane of the AUTO LINE with its BUMPER at any point in the AUTO stage	5	-	-
OWNERSHIP	SCALE	2 + 2/sec	1 + 1/sec	-
	ALLIANCE'S SWITCH	2 + 2/sec	1 + 1/sec	-
VAULT	For each POWER CUBE placed in the VAULT	-	5	-
PARKING	For each ROBOT fully supported by the SCALE (either directly or transitively), not at all in the opponent's PLATFORM ZONE, and has not CLIMBED	-	5	-
CLIMBING	For each ROBOT fully supported by the SCALE (either directly or transitively) with BUMPERS fully above the BRICKS at T=0, not in direct contact with their PLATFORM, and not at all in the opponent's PLATFORM ZONE	-	30	-
FACE THE BOSS	All three (3) ALLIANCE ROBOTS have CLIMBED or two (2) ROBOTS have CLIMBED and the ALLIANCE has played the LEVITATE POWER UP	-	-	1
AUTO QUEST	ALLIANCE completes three (3) AUTO-RUNS and has OWNERSHIP of their SWITCH at T=0 of the AUTO stage	-	-	1
Win	ALLIANCE's final MATCH score exceeds their opponents'	-	-	2
Tie	ALLIANCE's final MATCH score equals their opponents'	-	-	1

We began the season with a basic analysis of the 2018 game, FIRST® POWER UP. There are several scoring objectives we considered viable for our team:

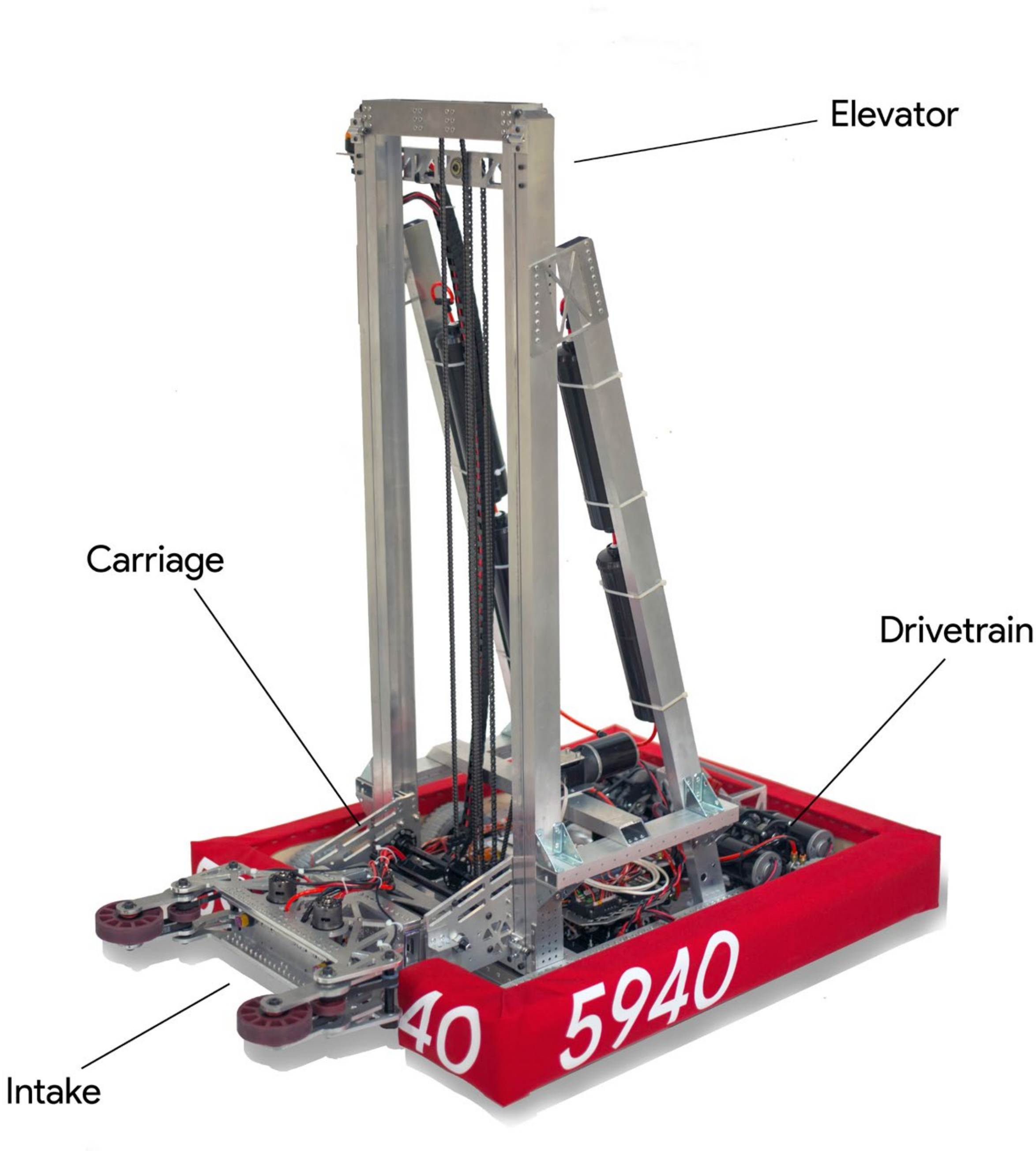
- Switch & Vault Only
  - A small agile robot can shuttle power cubes across the field quickly, filling our switch.
  - Filling the vault in a timely manner allows us to apply Power Ups when we want, granting us the ability to control the match better
  - Requires significantly less resources to design and build, allowing for more time to test
- Scale-capable Robot
  - Can compete with other alliance for scale ownership
  - Scale robots may be more scarce, allowing for us to potentially own the scale the entire match
  - Allows us to gain experience with a more mechanically complex mechanism
  - Could put a power cube on the scale in auto, thus allowing us to own it sooner
  - Contains many of the "Switch & Vault" benefits

Considering the following and our team capabilities, we decided on our "Scale-capable Robot" concept. We then set to define the various characteristics our robot needed to have to be successful.

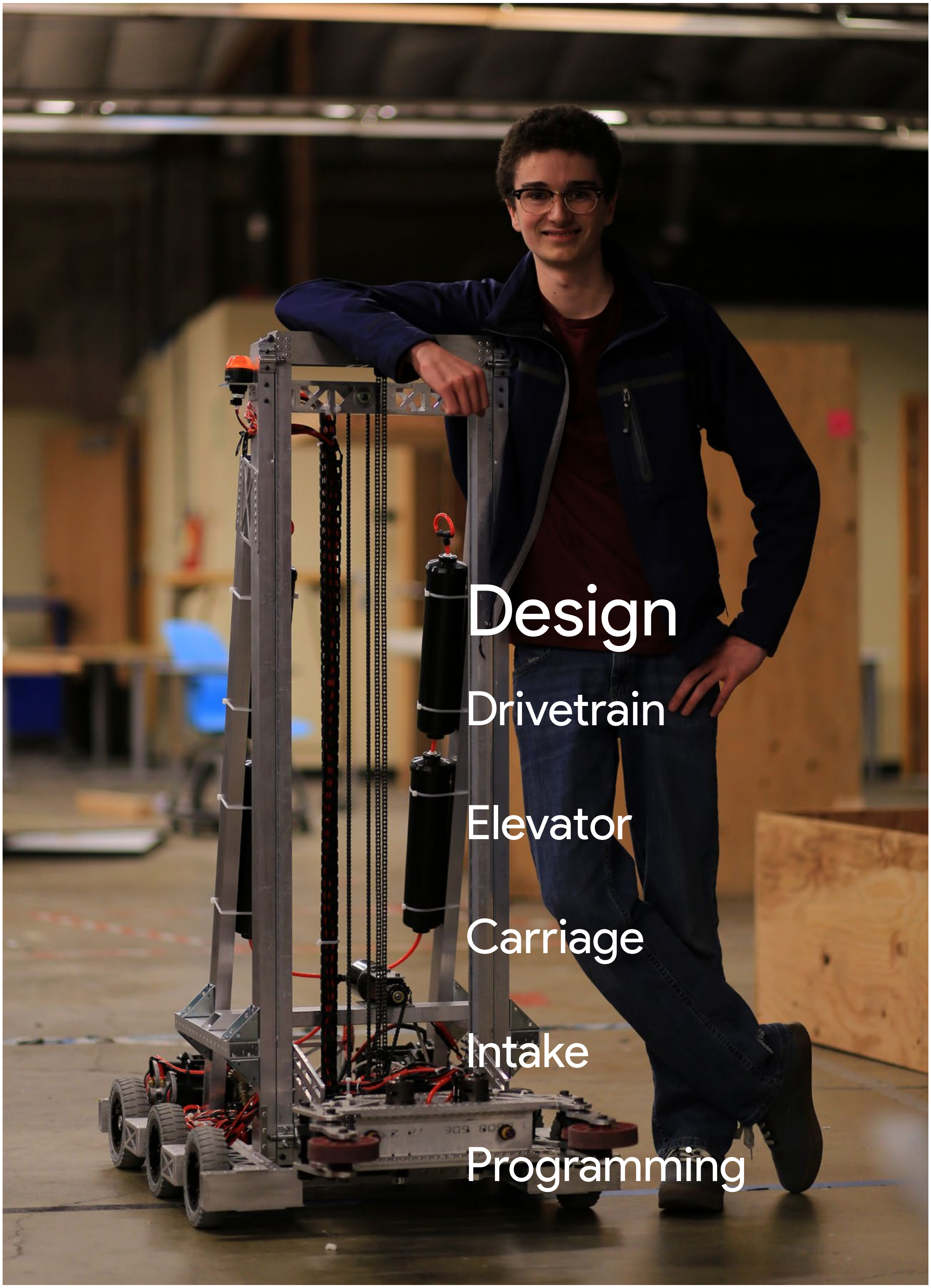
Design Requirements

Before beginning the prototyping process, we defined what we wanted our final robot to be capable of:

- Score a Power Cube in the Switch during autonomous
- Be able to effectively and efficiently intake Power Cubes and deliver the with a high degree of accuracy
- Reach both the Scale and the Switch
- Place a Power Cube above at least one Cube already in the Switch or Scale
- Navigate the obstacles of both the cable protector and the Scale Platform
- Put Power Cubes through the Exchange
- Minimize the risk of robot falling or tipping
- Following these ideals, we began to prototype and design Baguette.



Baguette


Design
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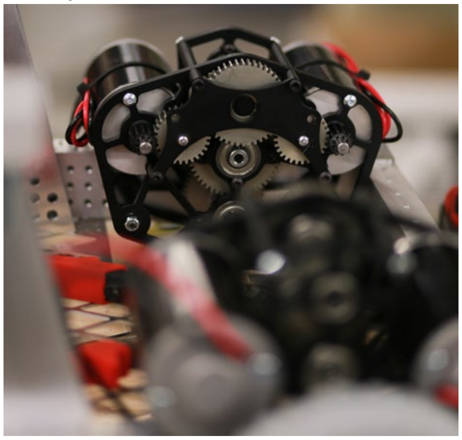
Drivetrain

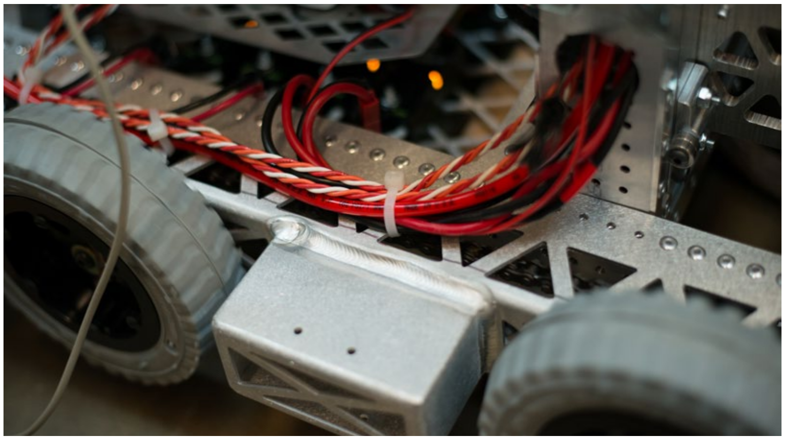
Design Goals & Criteria:

- Mechanically simple for less modifications and tuning
- Uses two-speed WCP Flipped-DS gearboxes
- Can both quickly traverse field while also maintaining good mobility
- Clears the on-field cable covers as well as the Scale Platform

Prototyping & Design Discussion

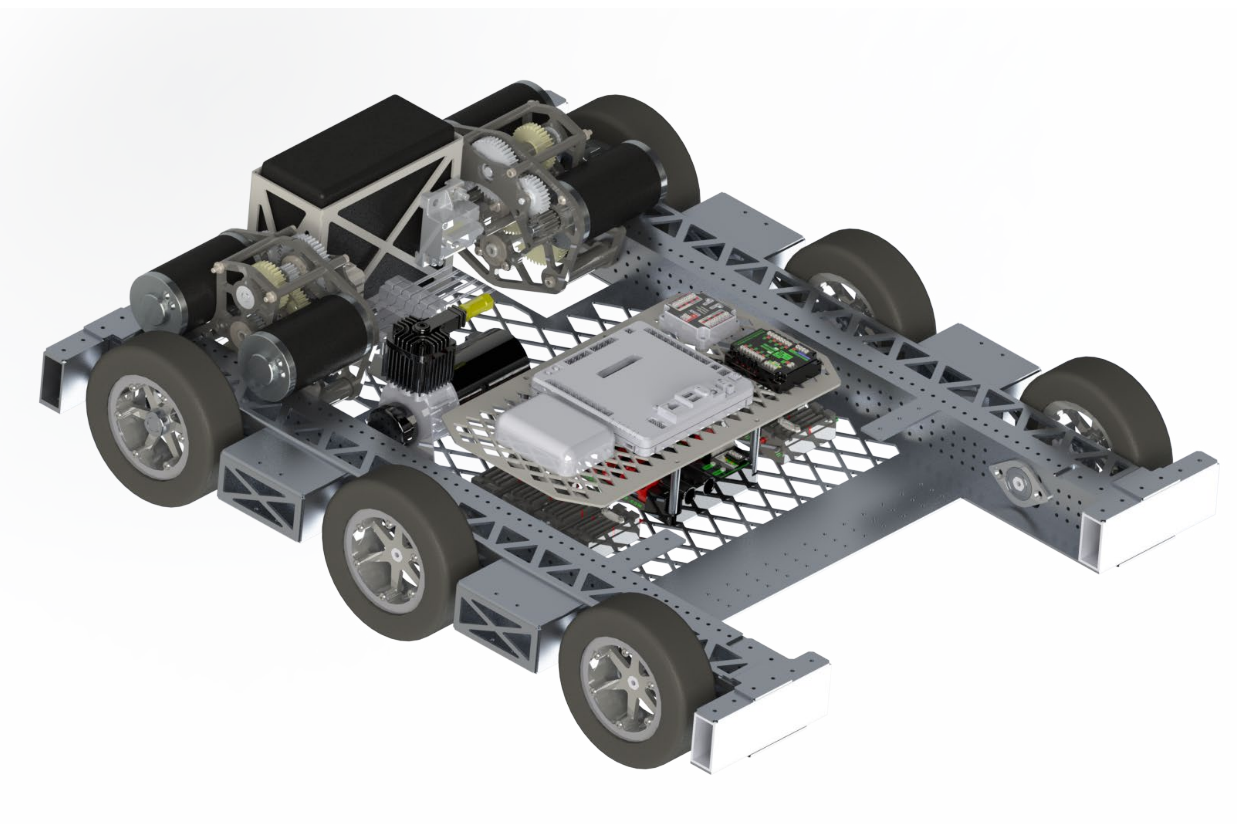
- We chose to reuse the general WCD concept, as we used it in the 2017 season with great success
- For easier forwards mechanism placement we opted to locate gearboxes in the rear of robot
- Various wheel options were considered:
  - 4" Colson Performa
    - Good wear resistance and traction
    - Have hex hub already molded to wheel
    - Concerns about ground clearance with the Scale Platform
  - 6" Colson Perfoma
    - Similar wear & traction characteristics stated above
    - Less maintenance compared to pneumatic wheels of similar size
    - Hard to acquire (size we needed has been discontinued)
    - Requires the pressing in of a custom or COTS hub
    - No resistance to bumps or added cushioning
  - 6" West Coast Products Pneumatic Wheels
    - Great cushioning and dampening
    - Strong CNC-machined hubs
    - More parts to fail (tubes, tires, and wheel)
    - Requires constant attention and inflation
- Had to run chain on the exterior of drivetrain for electronics packaging purposes
- To support wheels/bumpers, we designed a sheet metal chainguard that has welded bumper attachments





Drivetrain Overview

- West Coast Drive overall design concept
  - 2”x1”x1/8” tubes attached with custom gussets, .1” lasered bellypan with CNC bent & welded battery box
  - Bumper mounting facilitated through angle aluminum brackets and Rivnuts
- Wheel layout/spacing
  - 1/8” center drop (11.25” wheelbase)
  - 6” WCP Pneumatic Wheels with 2” of ground clearance
- Custom chainguard/bumper mounts
  - CNC bent from one piece of .1” aluminum
  - Has triangle pattern for lightening and inspection purposes
  - Supports wheel cantilever with bearing pockets
  - Laterally stiffens chassis with integrated rivet holes and gussets
  - Has CNC bent/welded bumper mounts with Rivnuts
- Gearing and Powertrain
  - Rear-mount West Coast Products Flipped DS gearboxes
  - 2 CIMs per side, two speeds
    - 19.2 (6 fps) - Low Gear
    - 8.9 (13 fps) - High Gear
  - Live Thunderhex with 12t sprockets
  - Sliding bearing blocks for maintaining chain tension



Elevator

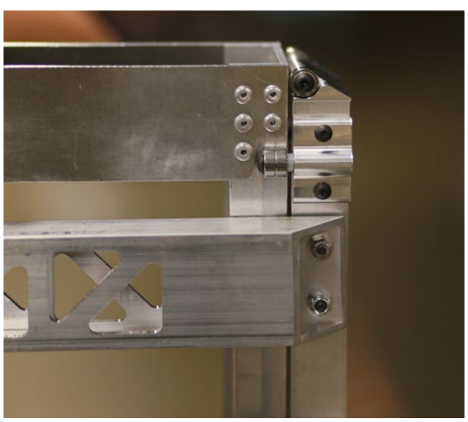
Design Goals & Criteria:

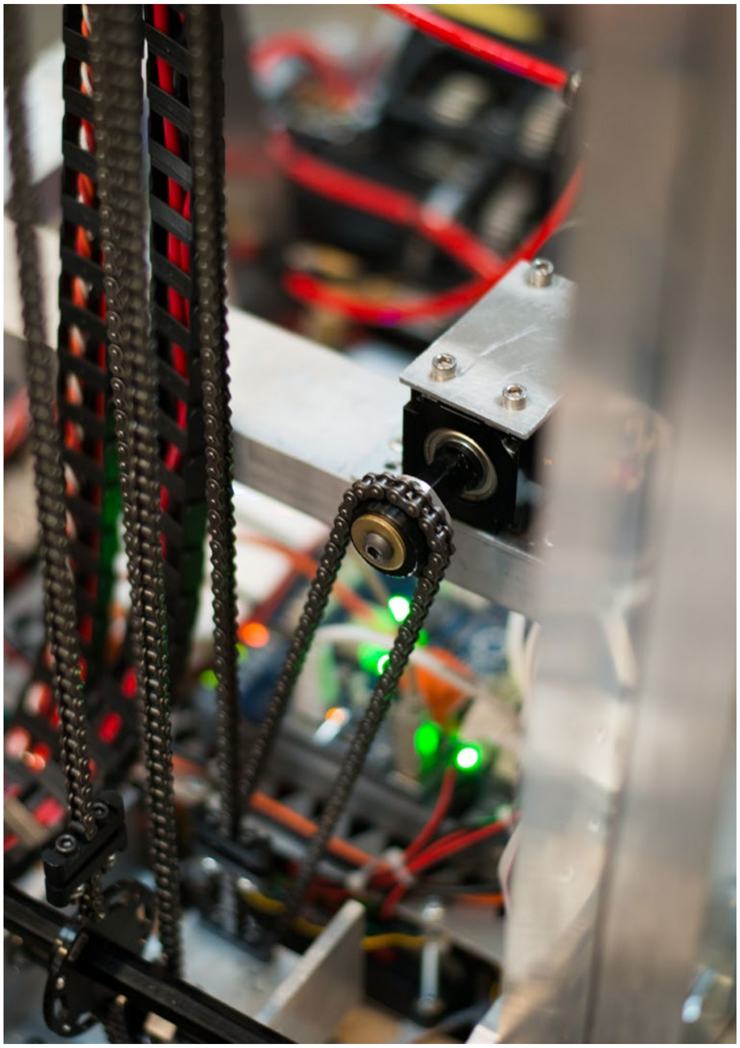
- Can reach both the Scale and Switch
- Quickly and accurately can raise to an inputted height
- Tall enough to place a Power Cube on the top of another that has already been scored
- Fits within the sizing constraints at the beginning of the match

Prototyping

- We had already decided that an elevator was the easiest lifting device to package and simplistic to build (as we had never done so)
- Two general concepts emerged
  - The "Adrian Elevator" - inspired by 1678 in 2016
  - The "Cheesy Elevator" - inspired by 254 in 2011
- Adrian Elevator (Cascade Lift):
  - Pros -
    - Uses loops of chain to raise and lower
    - No cables to deal with
    - Method of actuation is comparatively stronger
  - Cons -
    - More complex
    - Contains more failure modes
    - Less experience in the FIRST community to learn from
- Cheesy Elevator (Continuous Lift):
  - Pros -
    - Less complex actuation system
  - Cons -
    - Cable spool and assorted devices would have to be designed
    - Takes up more space on robot interior

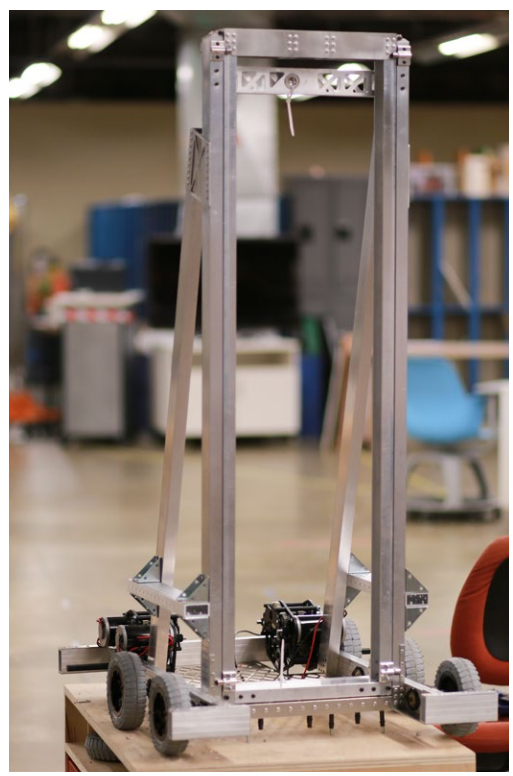
We decided on a hybrid of the two designs, using a tube and bearing block solution found on 254's various lifting robots in 2011, 2008, and 2007, but with a highly similar cascading actuation system to 1678's robot in 2016.

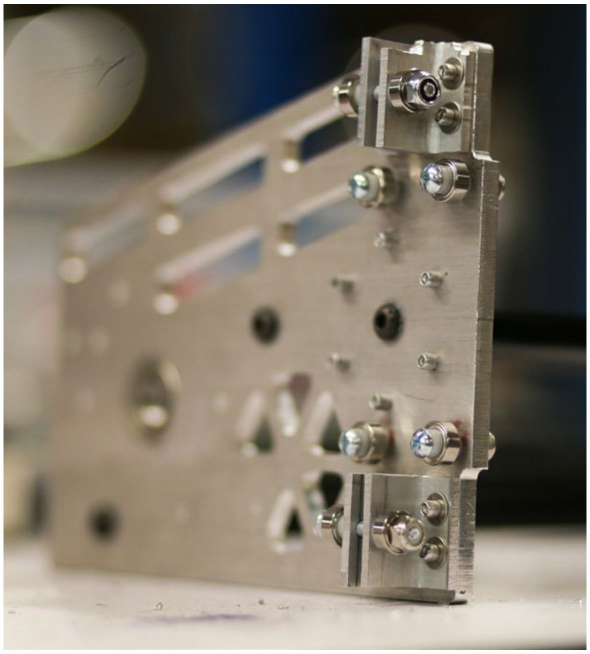



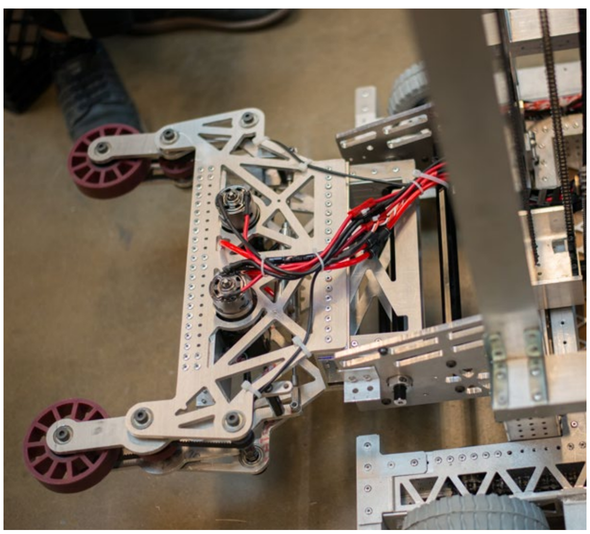
Elevator Overview

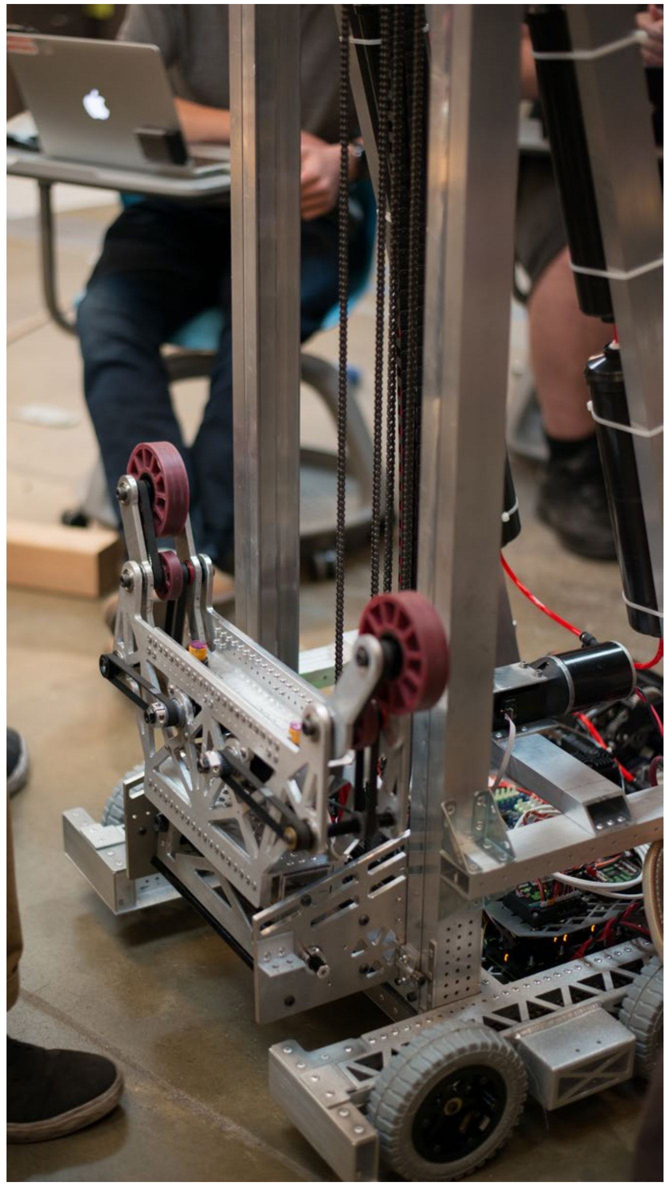
- Custom bearing rollers end caps and blocks
  - Allows smooth, reliable, and frictionless motion
  - Grants accurate programmatic control of elevator
  - Holds elevator frame together in critical areas
- Cascading chain lift system
  - Powered by a single 775pro attached to a VexPro VersaPlanatary with 25:1 reduction
  - Two loops of chain move the inner frame and carriage
  - Contains PID loop and CTRE Mag Encoder for consistent control and positioning
  - Can reach ~8 feet, above a level of cubes already stacked on Scale



Carriage



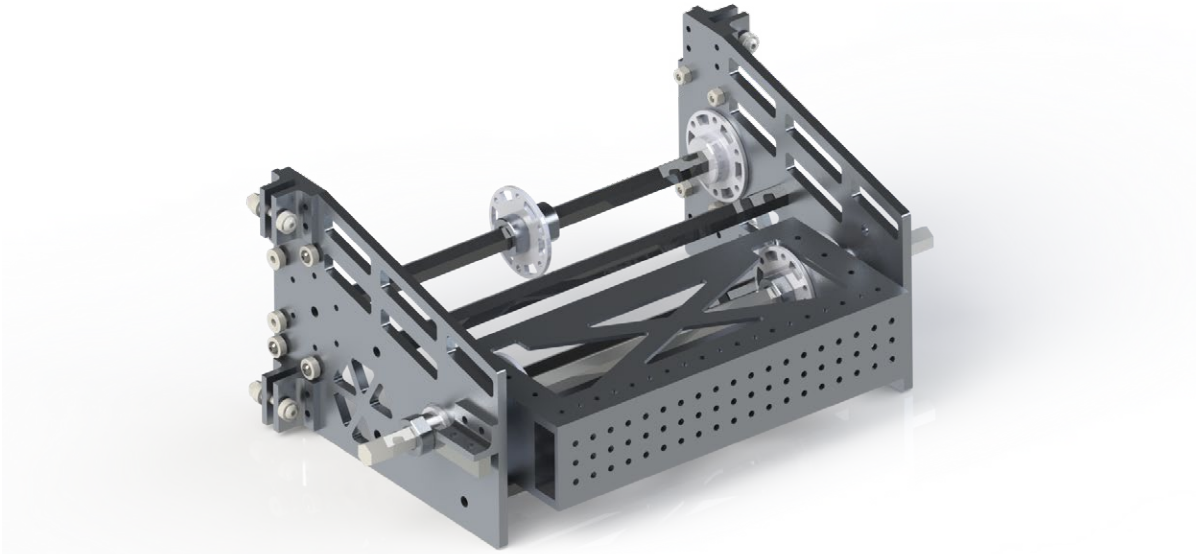




Design Goals & Criteria

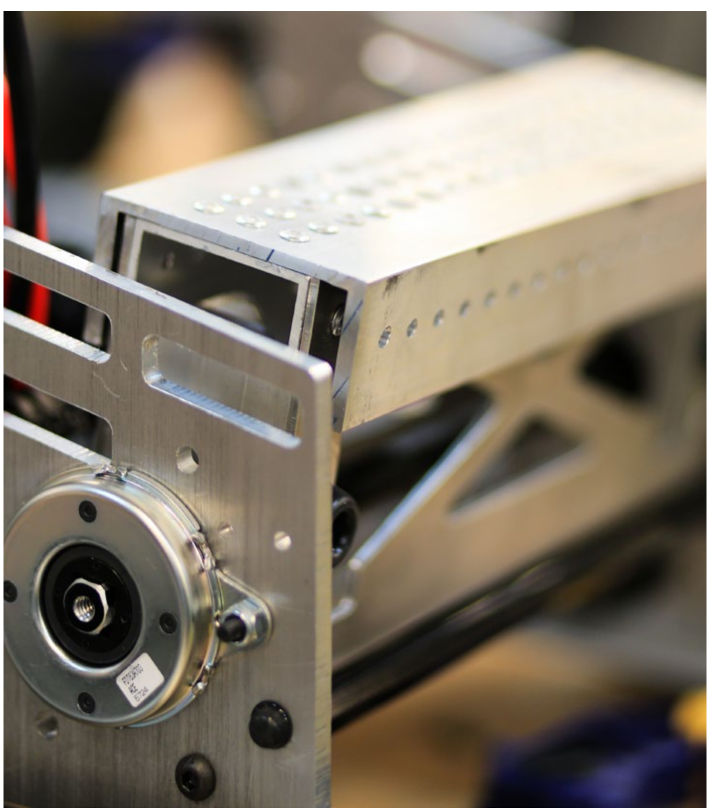
- Slides smoothly and is frictionless through entire range of travel
- Tightly constrained inside inner frame
- Has area for mounting intake
- Integrates a method for pivoting the intake downwards at the beginning of the match

Minimal prototyping was needed once the elevator mechanism and structure was defined.



Carriage Overview

- 1/4” Aluminum Plate construction attached with ThunderHex standoffs
  - Stiff with excellent ridgity in multiple dimensions
  - Has multiple attachment points for different mechanisms
- Integrated bearing roller solutions
  - Has multiple bearings in each dimension
  - Keeps the carriage from racking side-to-side and front-to-back
- Uses a rotational force dampener to rotate intake mechanism down at match start
  - Less complexity by using gravity to actuate intake lowering



Intake

Design Goals & Criteria:

- Quickly and efficiently intake Power Cubes
- Place cubes accurately and reliably on the scale & switch
- Needs to be reliable and serviceable

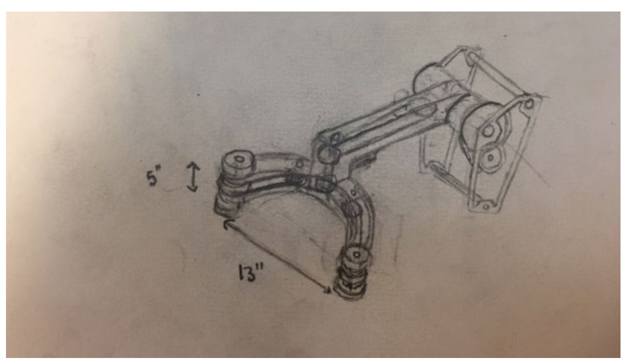
Prototyping

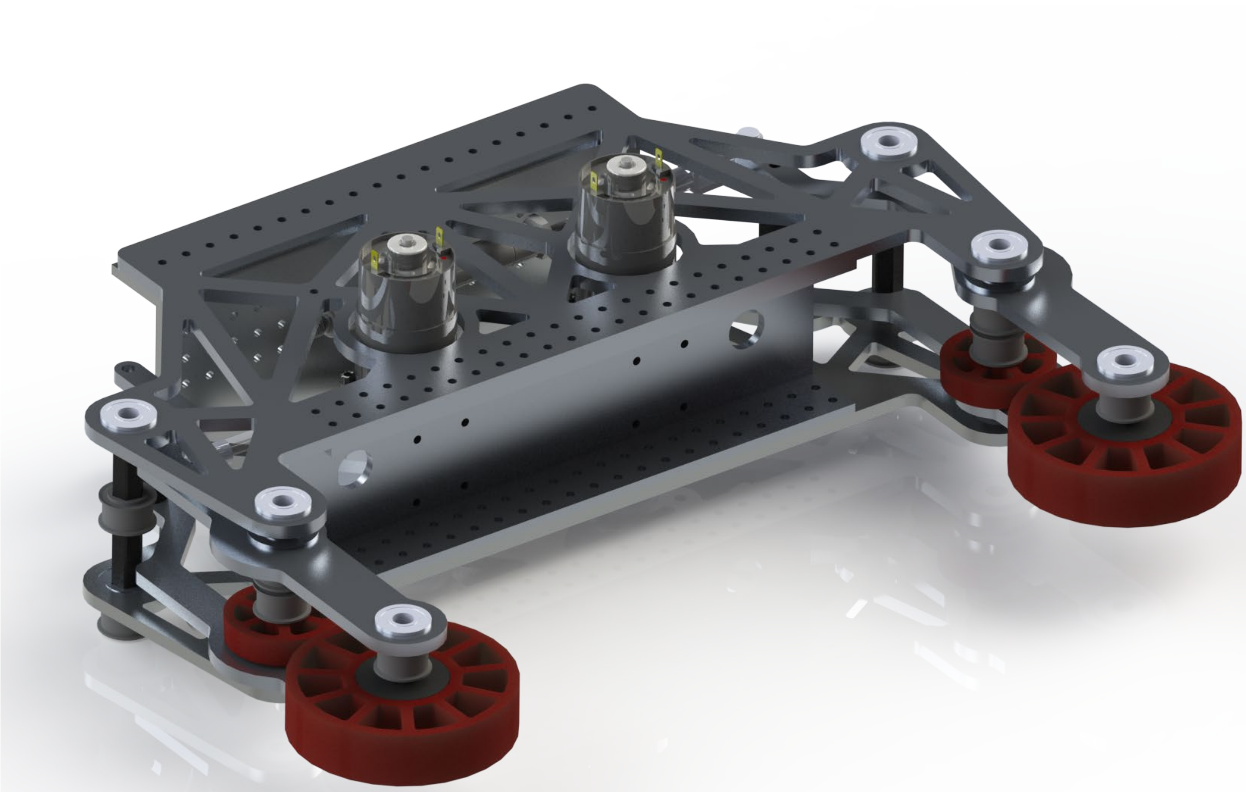
- We knew we wanted to go with an active roller system
  - "Touch it, own it"
- Needed to package into elevator carriage
- Strong and bend resistant
  - Being held outside bumpers

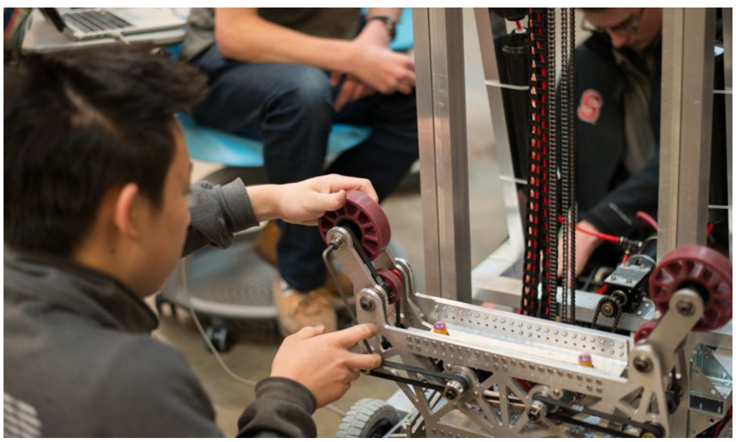
Two general prototypes were considered and manufactured:

- Prototype 1: "Pincher"
  - Pros -
    - Relatively simplistic
    - Less moving parts
    - Increased servicablity
  - Cons -
    - Compliant arms were difficult due to geometry of intake
    - Significant amount of the intake has to "stick out" through the elevator frame into the robot
- Prototype 2: "Sideswipe"
  - Name and inspiration from Team 1114's 2015 robot
  - Pros -
    - More flexible in different orientations
    - Could pick up in more orientations than "pincher" could
    - Packages compactly for elevator usage
  - Cons -
    - Due to smaller size more mechanisms are stacked inside
    - Heavier due to the nature of the design

Considering the various characteristics of each device, we decided to go with a modified "Sideswipe" variant.







Intake Overview

- Dual intake arms
  - Actuates with pneumatic cylinders
  - Can either spin to outtake cube or simply open arms and drop cube on plate
  - Each contains two AndyMark 4” Compliant Wheels (35A)
  - Can center and align cube for intaking
- 1/4” Plate CNC route major plates
  - Houses two VexPro VersaPlanatary gearboxes at 35:1 using one 775pro each
  - Conveys power to intake wheels and arms using GT2 belting from WestCoast Products
  - Attaches to pivoting carriage
  - Contains two IR distance sensors for cube detection and automatic centering

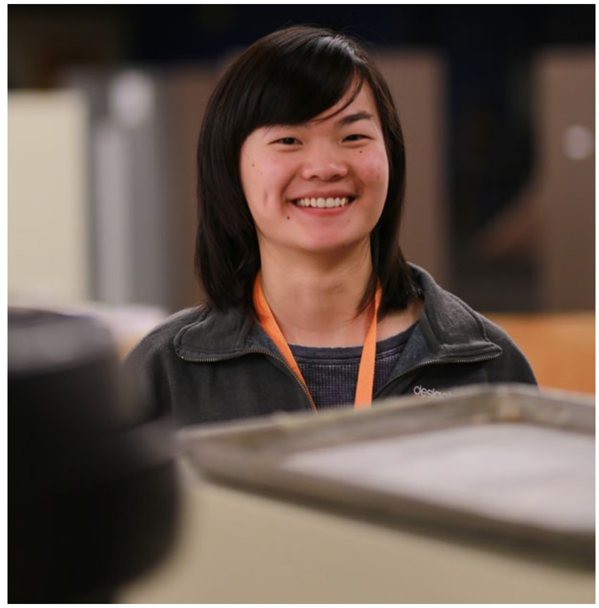
Programming

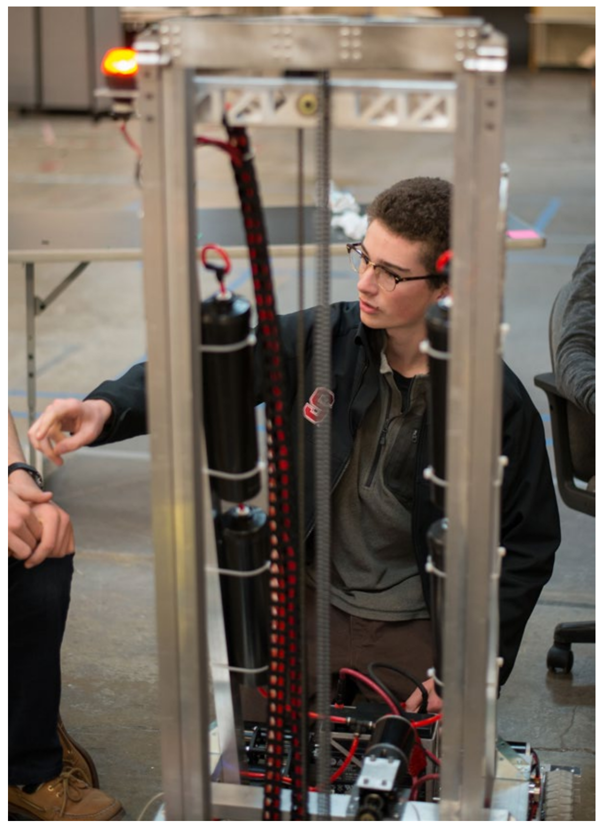
General Information & Overview
- Custom Node Framework designed entirely by Team 5940 students
- Over 500 commits to master across all our various Git repositories
- Uses Gradle for build and deploy to RoboRio
- Travis CI for automatic doc building
- Students have freedom to use many different develop environments

Node Framework
- Uses Nodes to do actions
- Is in the form of a directed asyclic graph
- Nodes are updated every update cycle and either update their stored value or perform an action based on other Node's values

Autonomous Path Planning
- An ordered list actions the robot will do during auto
- Actions can be moving forward, turning, outtaking a cube, or raising the elevator
- Uses PID control to move a specified distance
- Selects the proper list of actions based on the starting position of the robot, and the randomized switch and scale positions

Elevator Control
- Uses PID to move the elevator to a set position
- Sets the elevator height based on how far the joystick is moved.





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