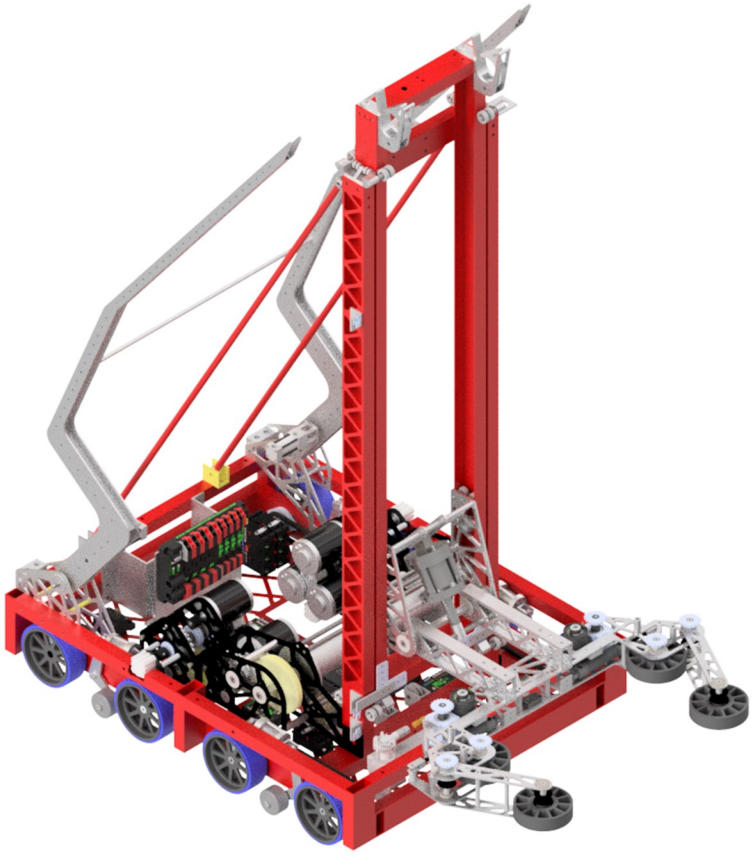
FIRST Team 1987
The Broncobots

2019 Technical Book



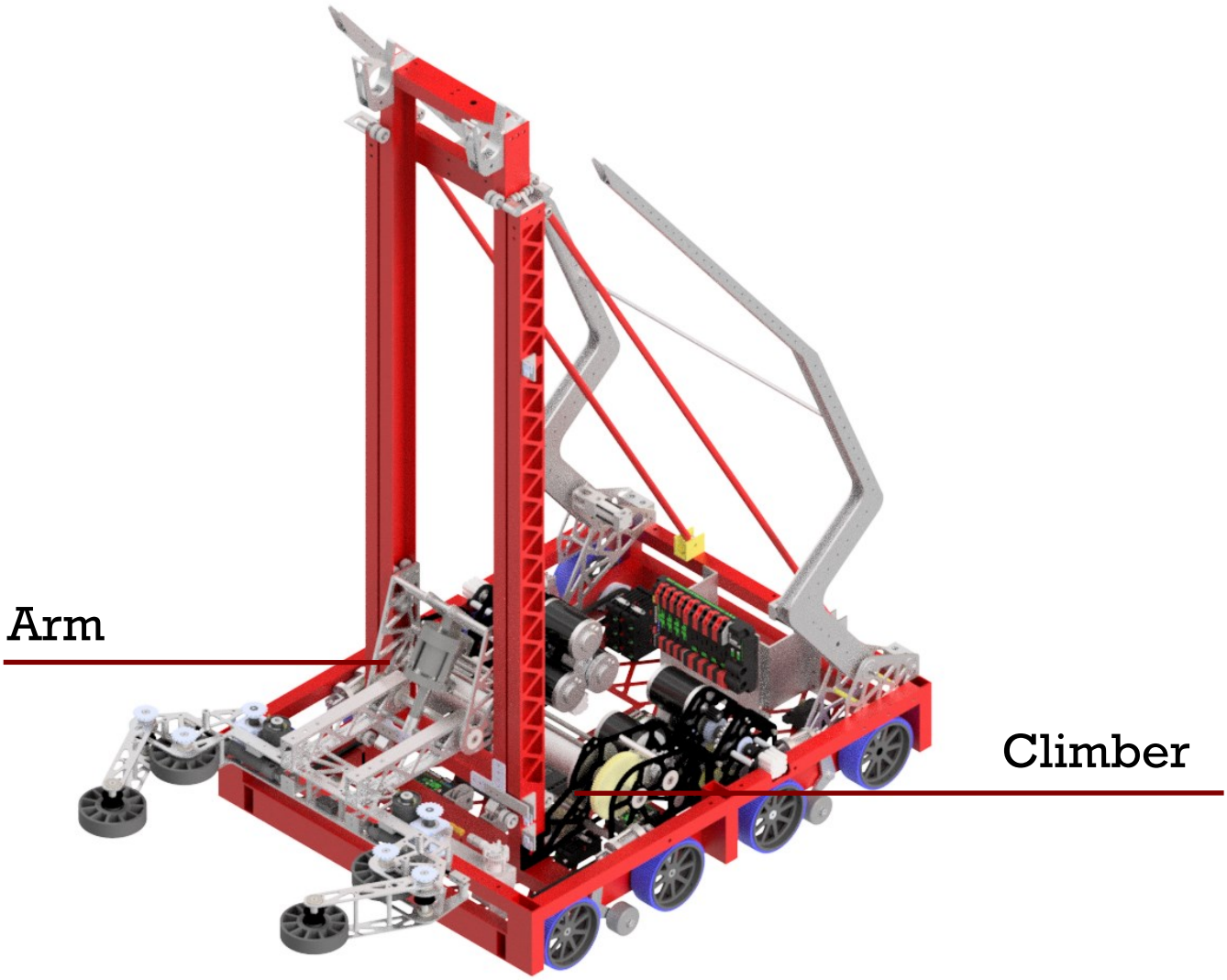
5,425 Student Hours

30 Students | 6 weeks

This student led team designed, built, and programmed this robot. Students designed the robot in Fusion 360 and programmed in Java. Mentors stood back, only stepping in when needed.

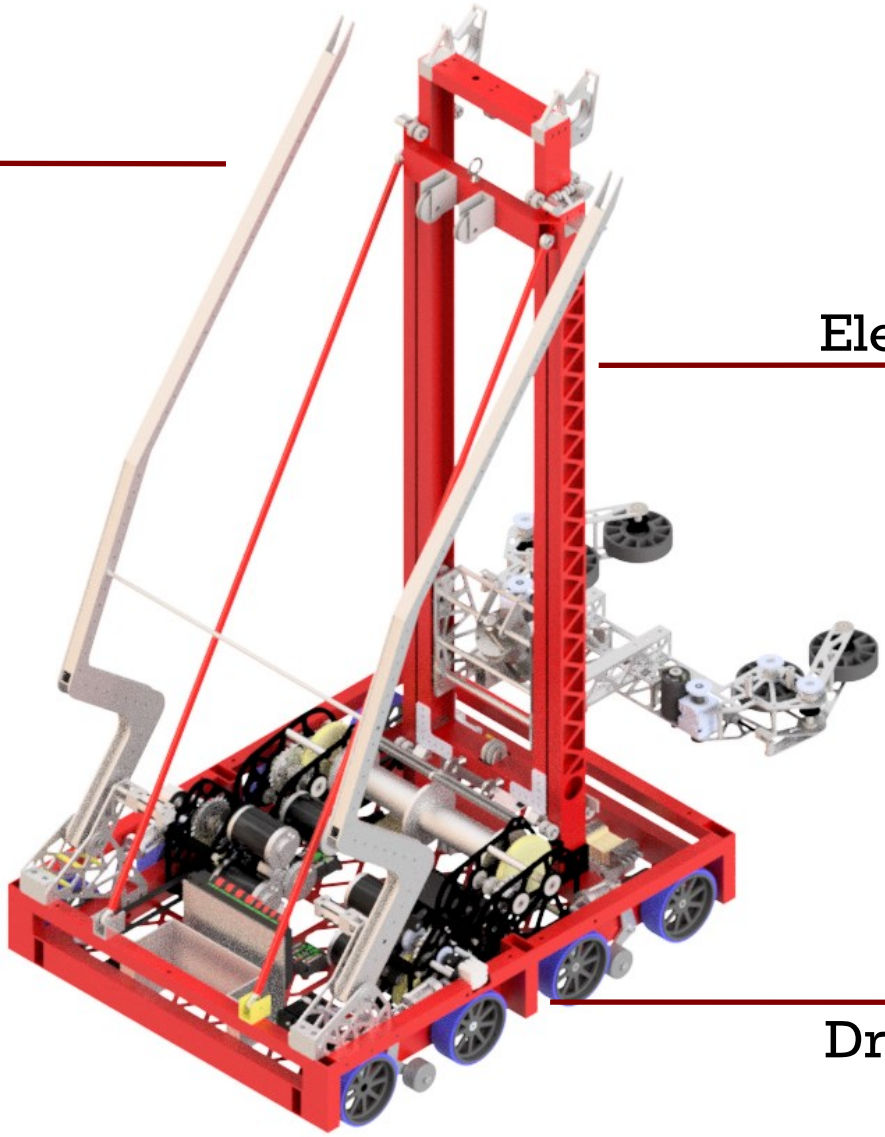
TABLE OF CONTENTS

ORION



Cargo Collect

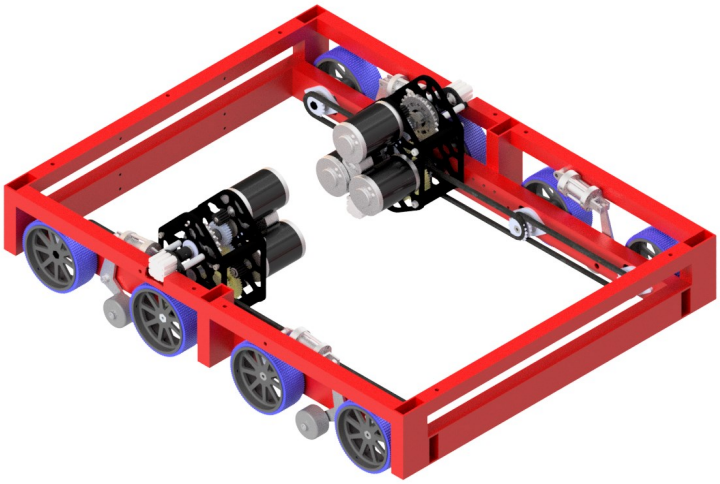
Elevator



Drive Train

DRIVE TRAIN

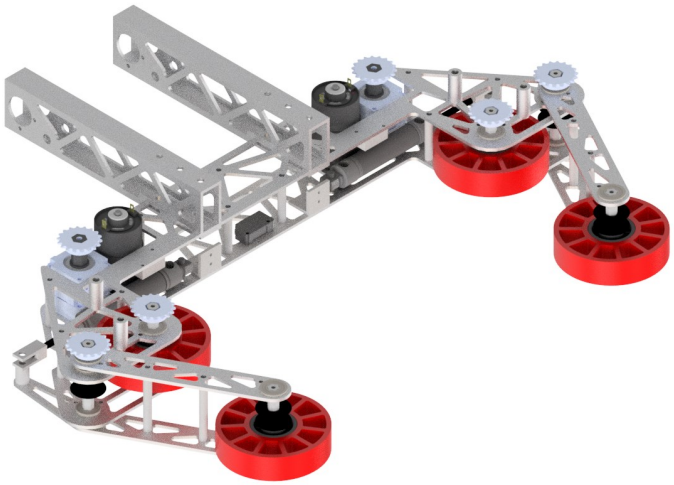
Mechanism



- 8 Custom Made 4.5” Wheels with 1/8” drop centers
- West Coast Drive 3 Mini CIM dual speed base kit with PTO
- Calculated “Real” speed:
  - High: 18.42 ft/sec
  - Low: 6.30 ft/sec

CARGO/HATCH MANIPULATOR

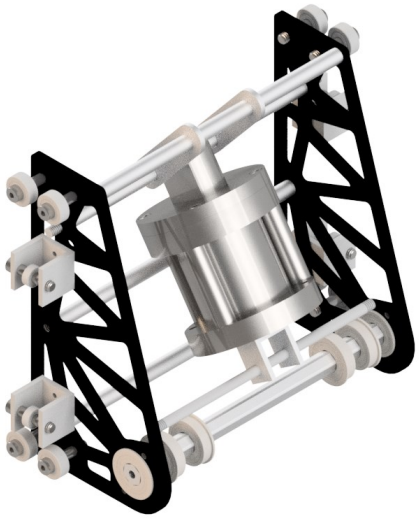
MECHANISM



- Intake Wheels driven by two 775 Pro motors with 5:1 reduction
- Pneumatic Cylinders act as a spring for collecting, and are stiff for holding and shooting
- Limit Switches detect when a cube is in the manipulator

ARM

MECHANISM



- Pneumatic Cylinder to raise and lower cube manipulator
- Passive latch to extend to shooting angle once match begins

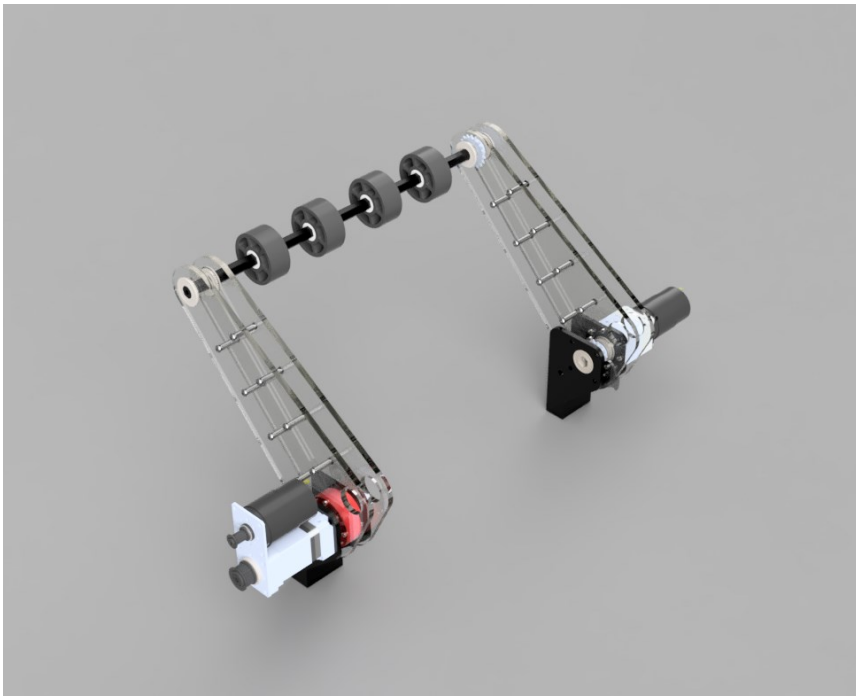
ELEVATOR

Mechanism

- Cascading elevator
- Lifts cube manipulator into the air
- Hooks at the top for climbing
- Utilizes amsteel Blue rope for a light-weight, non-stretch cable.

CARGO COLLECTOR

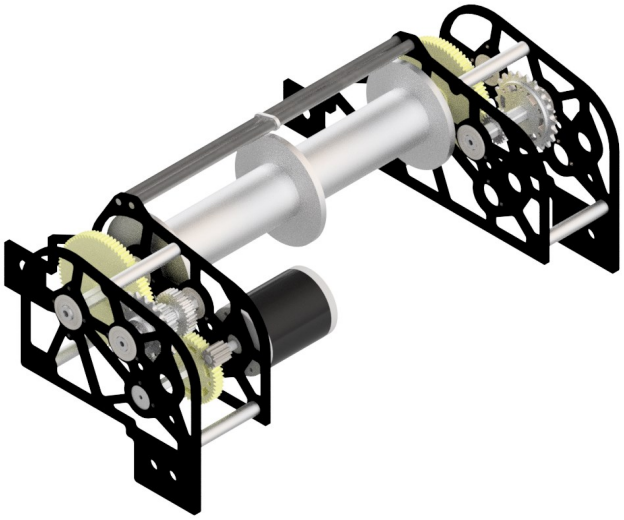
Mechanism



- Intake wheels driven by a 10:1 versa planetary powered by a 775 pro motor.
- Pivots up and down by a 300:1 180 degree versa planetary
- Efficiently collects cargo off of the floor.

CLIMBER

Mechanism



- Swing down arm mechanism with an 11” suction cup designed to grip rough surfaces specifically
- Once unattached from the robot it is guided by an on-board winch system made specifically for this task
- The winch features a standard ratchet to keep the rope from unspooling
- Cables are made from _____

PROGRAMMING

QR Code

Scan to see our code

Robot Code

Organization: FRCTeam1987

PROGRAMMING

Software

Drive:

- One SRX Mag Encoder on each side of the drive to leverage position control.
- A NAVX IMU to leverage heading control.

Autonomous (contains three main drive commands):

- Trajectory path driving
  - Spline driving paths are generated via a set of points from the open source library, Pathfinder.
  - The robot's max acceleration, velocity, wheel base width, and wheel diameter are parameters for the command which drives the path.
  - Two open loop PIDs are used. One leverages the NAVX for heading control. The other leverages the two drive encoders for position control.
- Drive straight for a distance
  - Leverages both Mag Encoders on the drivetrain for closed loop PID position control.
- Pivoting for an angle
  - Leverages the NAVX for open loop PID control.
- 12 different auto routines
  - The main command takes two different parameters to decide which auto to choose. The first is the starting position of the robot on the field (left, middle, right). The second parameter is the "autonomous mode" (whether we want to go to the scale, switch, both, or both on just our starting side of the field.

PROGRAMMING

Software

Elevator:

- One SRX Mag Encoder leveraging closed loop PID control to set elevator heights.
- Three Hall Effect sensors.
  - One sensor two inches below physical maximum of elevator to act as a soft stop.
  - One sensor one inch above physical minimum of the elevator to act as a soft stop.
  - One sensor at the "home" position. This is the height which the Mag Encoder considers 0 inches. This is also the height which the elevator is most commonly at during a match.

Cube Manipulator:

- A Proximity Sensor located in the center of the cube manipulator to detect a cube a few inches away.
- Two limit switches, one on each inside corner of the cube manipulator. They are individually triggered when a part of the cube is positioned in the back of the cube manipulator.
- These three sensors are used in coordination in our collect commands.
  - If the Proximity Sensor is tripped then the claw closes.
  - If one of the limit switches is pressed and the other is not, the wheels on the opposite side of the cube manipulator rotate the opposite direction to reposition the cube.
  - If the Proximity Sensor and both limit switches are pressed, while leveraging a debouncer, then the collect command ends.

PROGRAMMING

Software

Tele-operated:

- Co-driver and driver buttons
  - Co-driver has the ability to set the potential height for the elevator when placing and collecting cubes. When the driver presses either the collect or place buttons, the elevator will automatically move to the height the co-driver had set before collecting or placing.
  - When all three sensors for the cube manipulator have been pressed (a cube has been successfully collected) then the driver's controller rumbles.