TECHNICAL SPECIFICATIONS

Final Mechanical Design

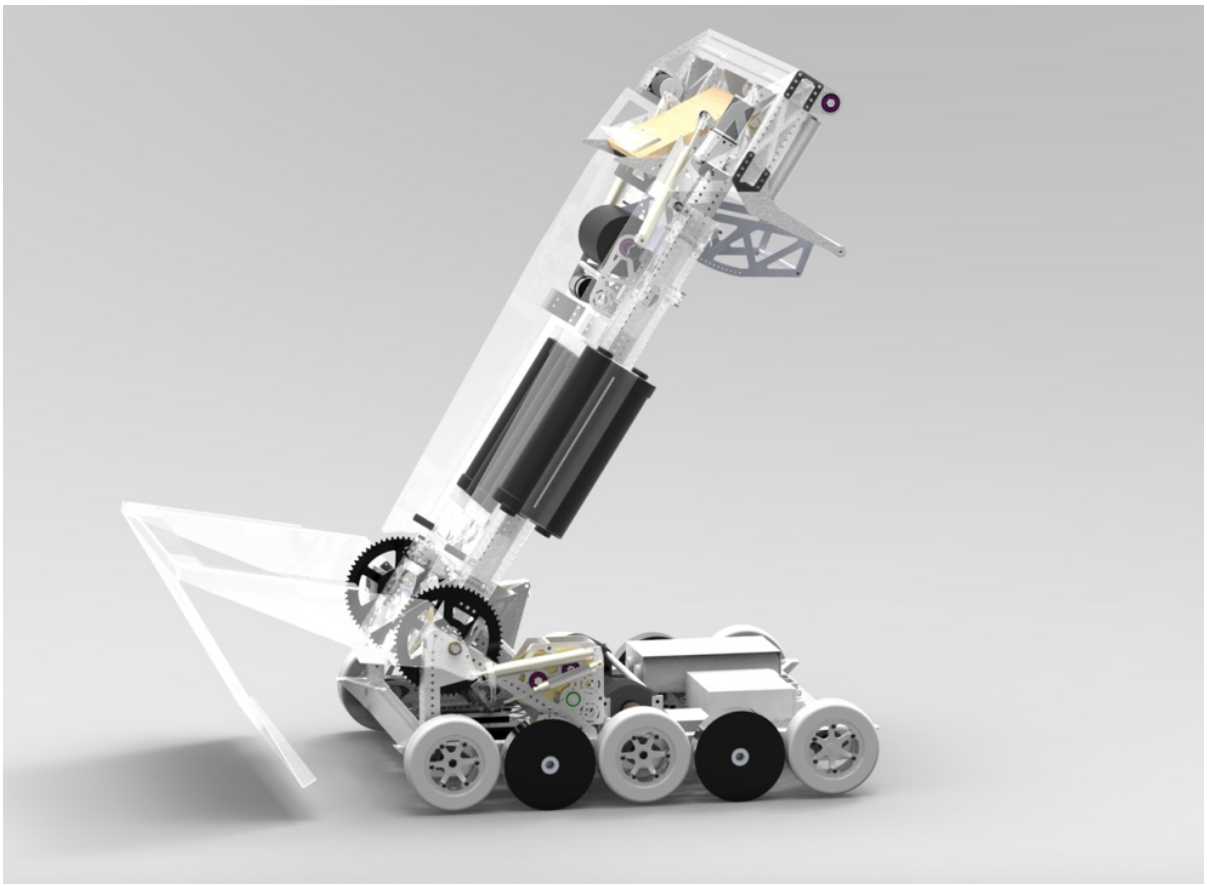
Subsystems Overview

The 2016 robot, Adrian, features a robust West Coast Drivetrain supporting a utility arm that includes an elevator, shooter, and intake. The design gives 1678 infinite variability in movement, shot angle, and low bar ability.

Drive Chassis

The shape of the chassis was designed to maximize wheel base width while keeping space for 5 wheels on each side spaced as closely together as possible. Wheel placement ensures that that the robot can glide over defenses.

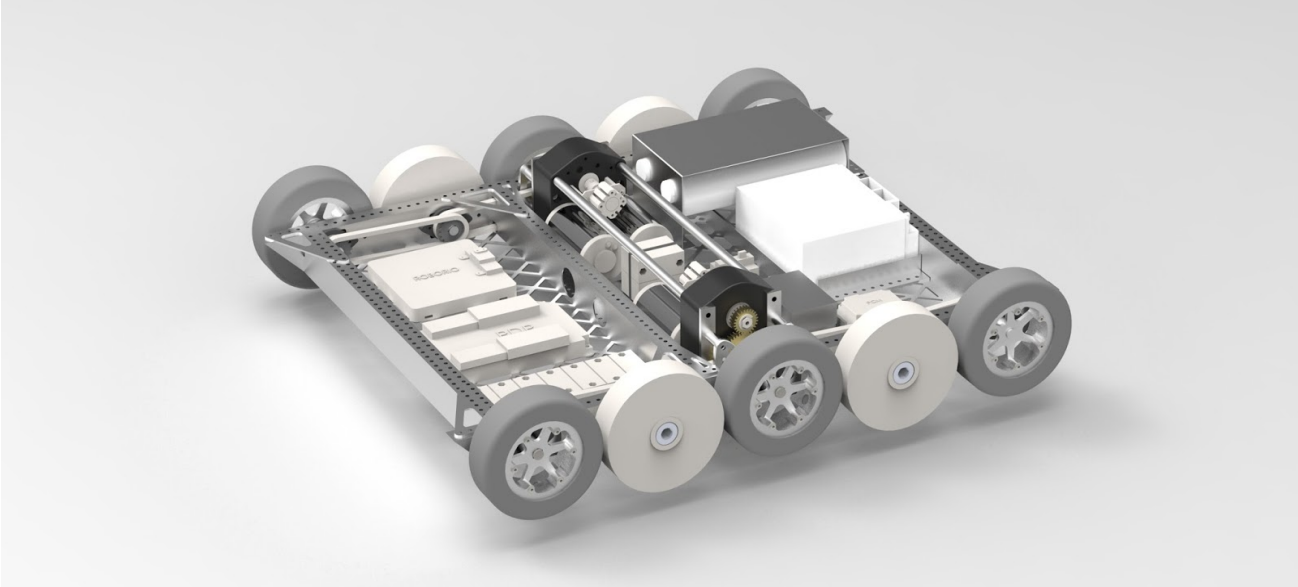
- 23.5” Wide
- 32.00” Long
- Side rails are 2”x2”x1/8” Al 6061 Rectangular tube
- Cross bars are 2”x2”x1/16” Al 6061 Rectangular tube
- .090” thick laser cut belly pan features clearance holes for rivet nuts, enabling secure fixtures for electronics
- The middle cross rail provides a mounting point for the pivot arm mechanism as well as torsional support for the rough gameplay



Drivebase

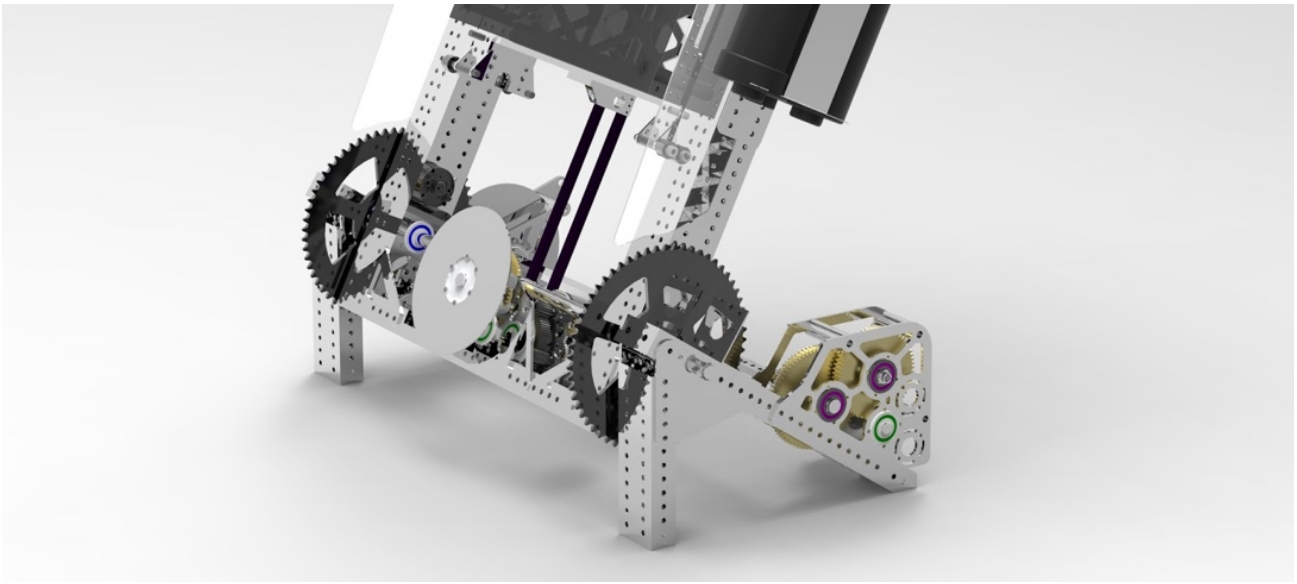
After one week of drivetrain prototyping, we were able to adapt our traditional drive base design to conquer the Defenses

- 10 Wheel, “West Coast Drive”
- 6 6” pneumatic wheels take the brunt of the impact from traversing the Defenses as well as keep us from beaching on the Moat
- 4 6” Colson wheel are dropped by .25” to create a stable wheelbase for shooting
- #25 Chain transfers power from the gearbox to the outer wheels through 18t sprockets
- Bearing blocks and tensioning cams allows us to adjust chain tension throughout the season
- ThunderHex bearings and shafts in the drive train improve efficiency with better bearing concentricity and less backlash
- We use VexPro 2 Speed Ball shifters at 9.167:1 High Gear and 20.833:1 Low Gear ratios to give us good speed as well as strong pushing power



Drivetrain

While 1678 does not usually prototype a drivetrain, the dynamic field forced us to modify our usual design. By building a complete prototype base, we were able to choose an appropriate wheel diameter, gearbox ratio, and wheel C-C distance. In addition, we found that the Moat was a unique challenge, often causing our prototype base to beach. Lastly, we discovered the robustness required of our final base to withstand random impacts from game play.



Pivot Arm

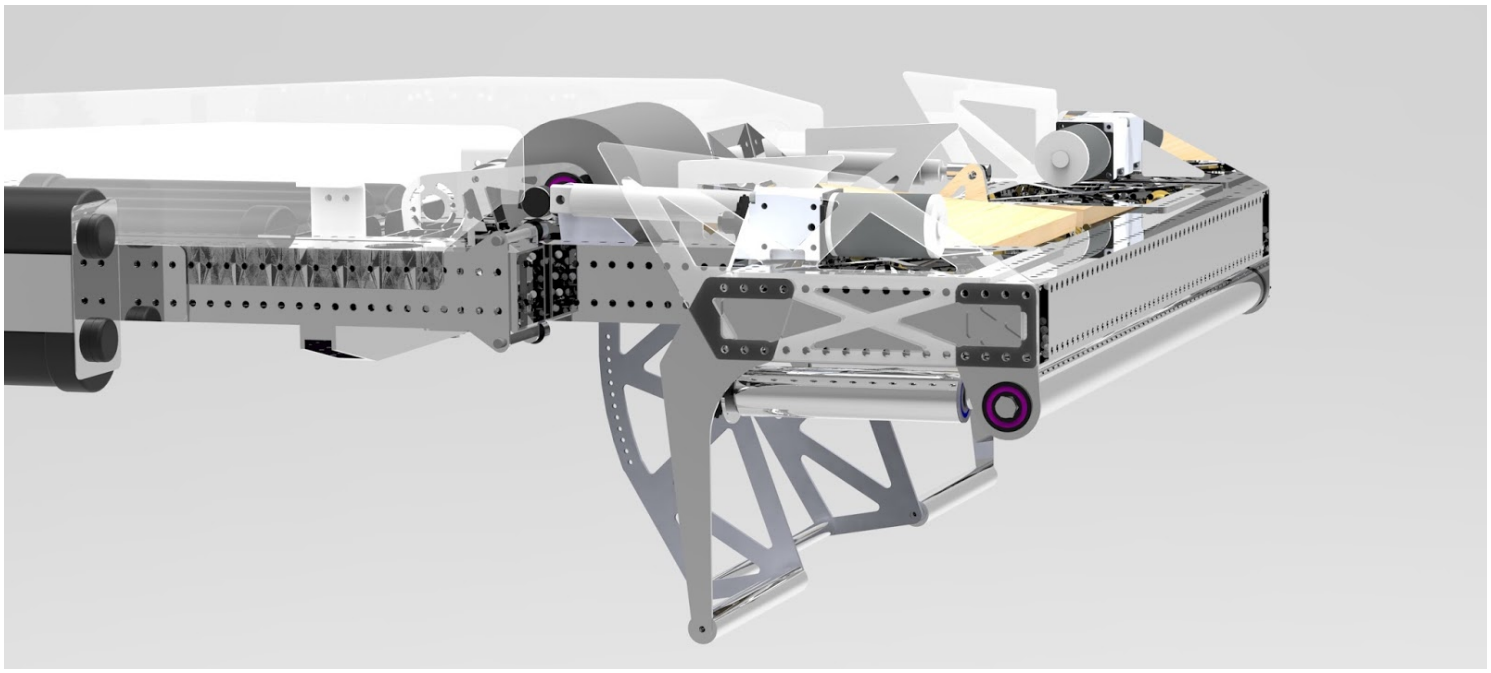
- The pivot arm supports our intake, shooter, and elevator mechanisms
- Powered by two 775 pros in a custom gearbox with a 610:1 ratio through three spur gear stages and a final #35 chain sprocket stage
- Arm held by a 140mm disc brake to maintain arm positions
- Theoretical top rotational velocity of 124.9 deG/s

Elevator

- The elevator contains the shooter and intake and extends during shooting to make an undefendable shot
- Powered by two 775 pros in a custom gearbox with a 30:1 ratio through two spur gear stages
- Elevator inner stage powered by #25 chain
- Elevator held in position by 140mm disc brake
- Theoretical top linear velocity of 34.1 in/s

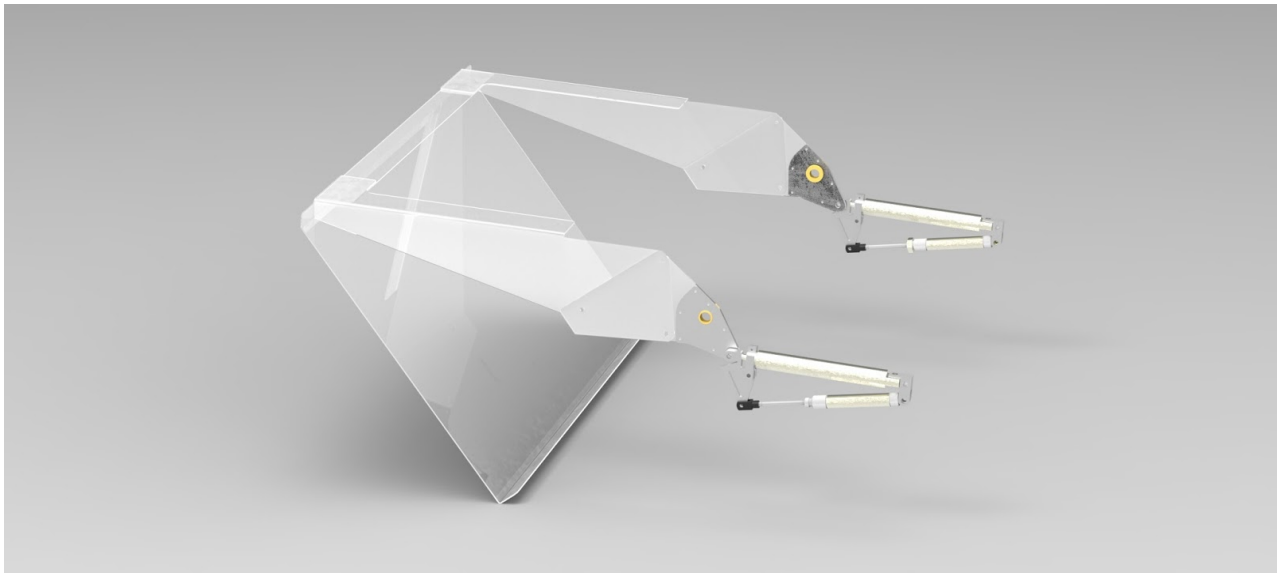
Shooter

- The shooter delivers a fast, power shot that enables us to make shots from the outer works and batter
- Powered by two 775 pros through a single 2.5:1 belt reduction
- Drives three 2” wide, 4” diameter 35A urethane wheels
- Theoretical surface speed of 260 in./s
- Plywood shooter hood directs shot angle



Intakes

- The intake mechanism is able to retrieve Boulders through its wide acquisition zone
- Front and side rollers are powered independently by one 775pro each through a 7:1 VersaPlanetary gearbox
- Urethane belting provides high grip on Boulders
- Passive side rollers prevent the robot from driving over Boulders unintentionally



Class A Defense Mechanism

- The Class A Defense mechanism comes in two configurations for the Portcullis and Cheval de Frise
- Actuated with a 3/4” bore, 3” stroke pneumatic cylinder

Prototyping

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Electrical

For *Stronghold* 1678 changed few aspects of the robot's electrical and pneumatic systems over previous years, although one major choice was relying on an off-board compressor this year. The choice was made to ease electrical load on the battery during matches and to save weight. In terms of wiring, Stronghold has required the most time and work to date for 1678. Many devices such as lights, motors, and sensors all reside at the end of the robot's elevator, which is further articulated on a pivot. The location of these sensors and actuators means that every cable must be managed through 180 degrees of pivot movement, then through two feet of linear movement. Further adding to the difficulty of wiring, cables had to be run through the structural tubing of the robot in several places. Fortunately, these obstacles were easily overcome with a little work, and all the cabling has been functioning reliably. A few custom circuits were also used this year, including the control for our status light strip and adapters for 12 V sensors.

Robot Programming

Autonomous

The above photo is a picture of one of our autonomous routines. With the help of one of our mentors, we created a scripting language called Lemonscript. For Lemonscript, we write .auto files with simple commands as seen above. The .auto file is then parsed and a set of C commands are run that correlate to the Lemonscript commands. The .auto files don't need to be compiled and can just been changed directly on the roboRIO. This makes it easy to have quick iterations in testing and to make new autonomous routines on the fly at competition if needed. The Lemonscript commands are also straightforward to read, making them easy to understand. Simply by reading the file, we know exactly what the robot is going to do. Then, if something goes awry, the issues can be isolated faster by looking at what the routine was, and what the robot actually executed.

20 lines (15 sloc) | 278 Bytes

```
1  SetWedge: false
2  CheckArmCalibration
3  SetArmPosition: TUCK: 1
4
5  DriveStraight: 16.5
6
7  SetArmPosition: AUTO: 3
8  PointTurn: angle: -55.0
9  Wait: seconds: 1.5
10 Align
11 Wait: seconds: 0.4
12 Align
13 Shoot
14
15 Wait: 0.6
16
17 AbsolutePointTurn: 0.0
18 SetArmPosition: TUCK: 1
19 DriveStraightAtAngle: -16.5, 0.0
```

Control Systems

Within our codebase this year, there are many different mechanisms that we need to precisely control. Our shooter is comprised of a shooter wheel that spins at a very high speed. We use a bang bang controller to consistently maintain the shooter's speed. This allows our shot to remain consistent from all of our shooting positions. The shooter is placed the end of an arm, which is composed of an elevator and a pivot. The pivot rotates the whole arm, and the elevator extends to raise the shooter to different heights. These two actions need to be repeatable and accurate. For the pivot and the elevator, we use PID loops to move the mechanisms to their positions. Encoders are mounted to the pivot and elevator gearboxes, allowing us to measure their current positions and calculate how far the mechanisms still need to travel. By fine tuning our PID loops, we allow the pivot and elevator to quickly move to their positions and keep our shot consistent and accurate.