



Citrus Circuits
Fall Workshop Series

Strategic Design

by Mike Corsetto

Who Am I?

- Lead Technical Mentor of Team 1678
- Mechanical Engineer at Sunpower
- Going into 16th season in FRC
- Started mentoring 1678 in 2008
- I'm not that smart (Credit to Karthik, 254 and others)



Overview

- Pre-Season Prep
- Drivetrain Design
- Mechanism Design
- Electrical and Pneumatics
- Build Season
- Competition Season





Pre-Season Prep

Golden Rule #1

- Keep It Simple Silly
- Build Within Your Team's Capabilities
- Simple = Robust
- Function over Form



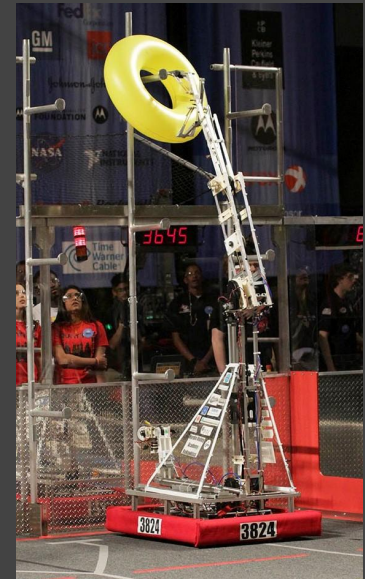
Golden Rule #2

- Steal From The Best, Invent the Rest
- Do Your Research
- Study R13D Teams in-season
- Look at 2056, 610, 973, 330
 - Simple, effective robots



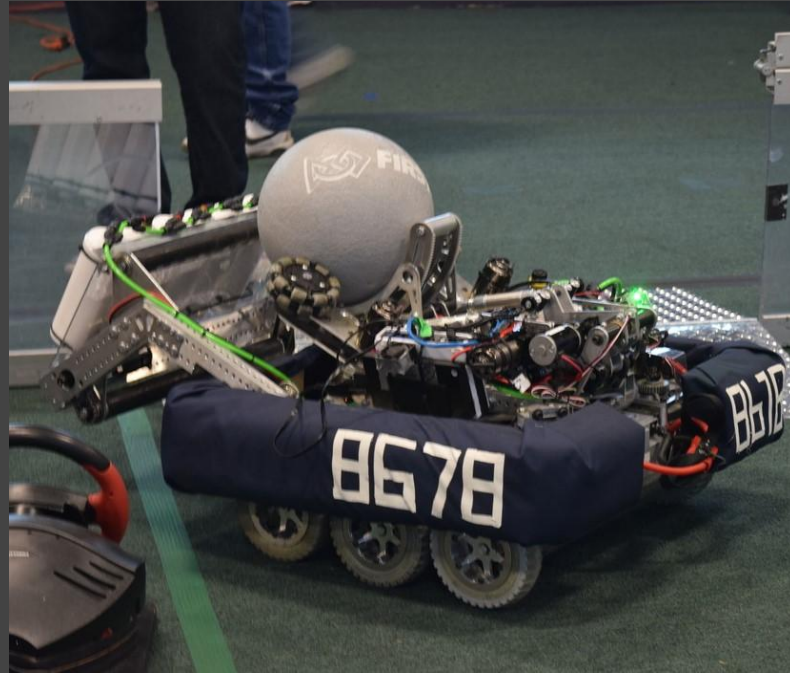
Learn Your Game History

- Games often have repetition
- Climbing in 2010, 2013, 2016
- Tubes in 2007, 2011
- Exercise Balls in 2008, 2014
- Foam Balls in 2006, 2012, 2016
- Flat discs in 2013, 2017



Off-Season Project Ideas

- Ball Shooters
- Ball Intakes
- Elevators
- Climbers
- Kit Bot
- Bumpers



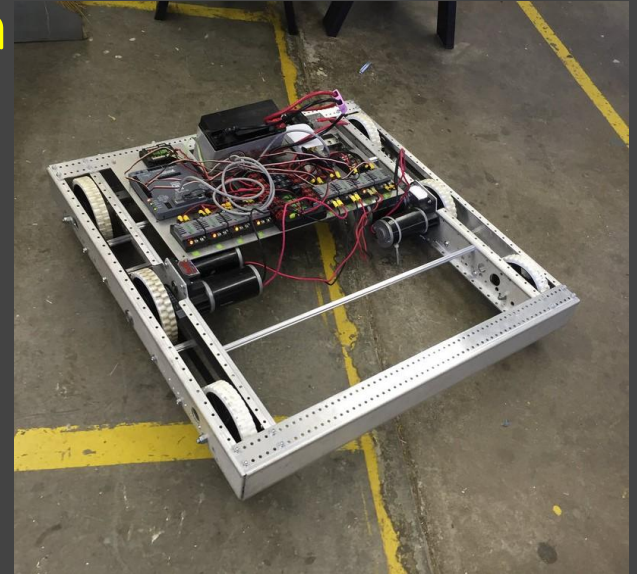


Drivetrain Design



Golden Rule #3

- Use A Proven (for you!) Drivetrain
- Basic 4, 6, or 8-Wheel Drive
- Kitbot
- Kitbot on Steroids (Team 1114)
- Spend Time on Mechanisms
- Story of Rarecab in 2008







Mechanism Design

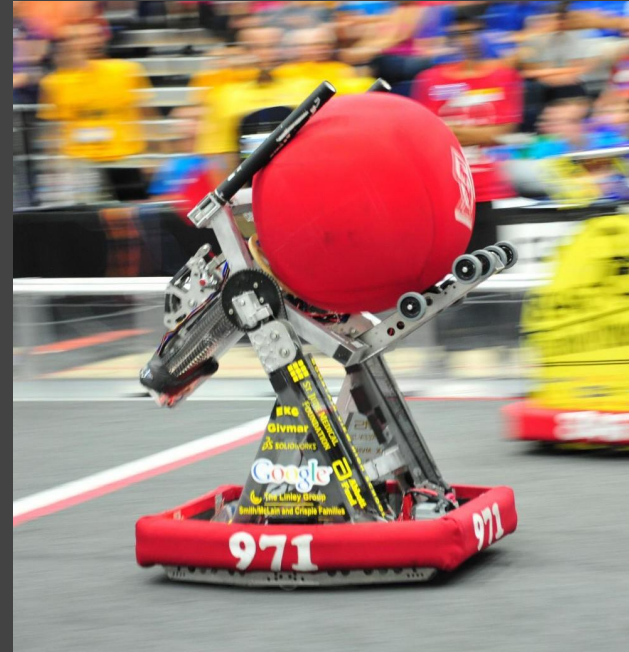
Mechanism Geometry

- K.I.S.S.
- Minimum Degrees of Freedom
- Low C.O.G. (Motors and Battery)
- Symmetry When Possible
- Inside Frame Perimeter If Possible
- Robust When Outside Frame Perimeter



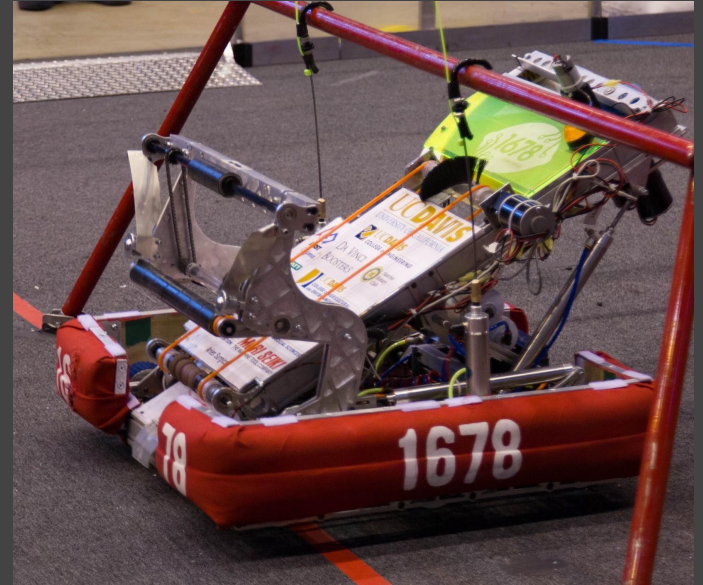
Movement - Motors

- Range of Motor Choices
- Single Speed or Shifting Gearboxes
- Allow Variable Movement
- Harder to Control (Need Sensors for precision motion)



Movement - Pneumatics

- Movement From Point A to Point B
- Very Repeatable and Precise
- Non-Variable
- Requires Compressor and/or Storage
- Usually lighter than motors
- Be careful, can run out of air!



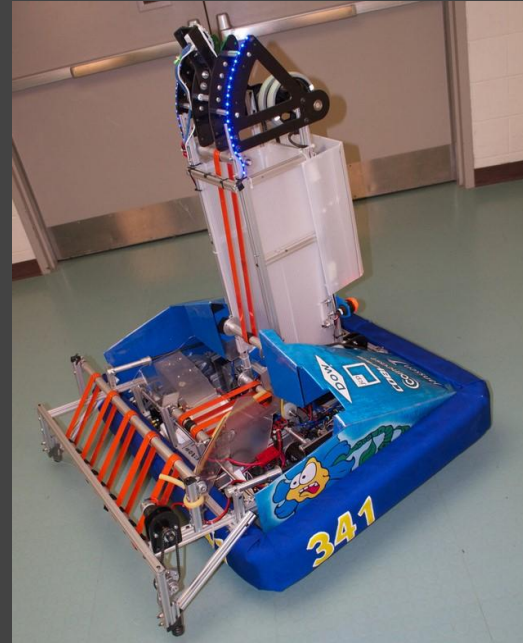
Game Object Processing

- Acquisition
- Manipulation
- Storage
- Elevation
- Positioning
- Release



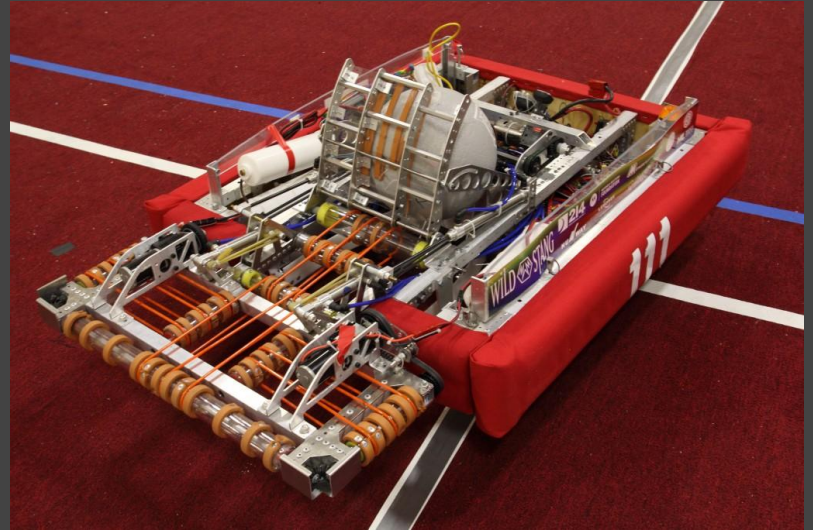
Acquisition Zone

- Effective Intake Area
- Object/Intake Interaction
- Make the Driver's Job Easy
- Stress The Prototype



Golden Rule #4

- Rolly-Grabbers
- Continuous Intake
- Increases Acquisition Zone
- Compare to Single Intake
(claw, hook, scoop)

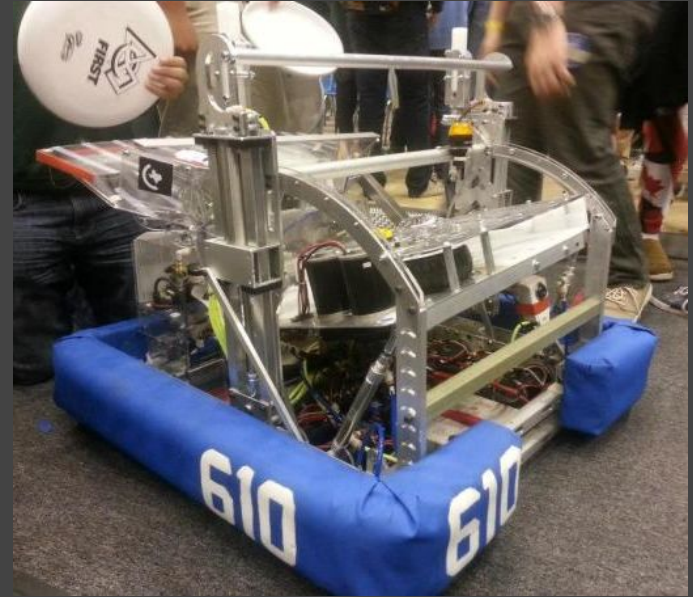






Device/Robot Alignment

- How can you guarantee proper placement?
- Are there physical objects for orient the robot?
- Quick Alignment = Efficient Scoring and Simpler Code



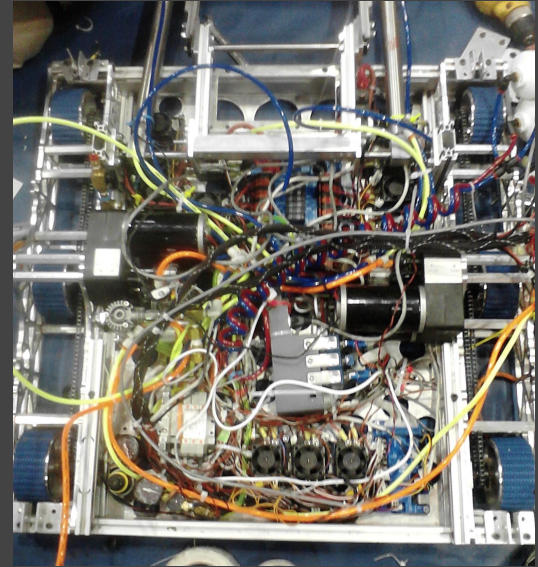




Electrical, Pneumatics and Programming

Electrical and Pneumatics

- So Much Can Go Wrong (Power, Signal, Radio, Leaks, etc)
- Spend time to do it right
- 1678 On Einstein in 2013



Programming “Toolkit”

- Precision Autonomous Driving
 - Using encoders + gyro
- Vision Alignment
 - Limelight
- PID for arms and elevators
 - Talon + Mag Encoder
- Bang Bang controller for Shooter
 - Talon + Mag Encoder





Build Season

Build Season Overview

- Accelerated Schedule is Important
- When setting schedule: “Aim for the Moon, Land among the Stars”
- Students ALWAYS assume there is more time than there is
- Often, Mentors do too!



Week 1

- Days 1 – 3
 - Brainstorming
- Day 3
 - Design Drivetrain
- Days 4 – 14
 - Prototyping Mechanisms
 - Drive-base electrical layout
 - Fabricate/Assemble Drivetrain
 - Begin writing code for expected mechanisms



Brainstorming

- Most important weekend of your entire season
- Three Steps (in this order!)
 1. Read the Rules
 2. Answer the “What” Questions
 - a. What is our strategy? What will the robot do?
 3. Answer the “How” Questions
 - a. How will the robot carry out this function?



Week 1

- Days 1 – 3
 - Brainstorming
- Day 3
 - Design Drivetrain
- Days 4 – 14
 - Prototyping Mechanisms
 - Drive-base electrical layout
 - Fabricate/Assemble Drivetrain
 - Begin writing code for expected mechanisms

REQS

General

- high goal
- low bar
- ground intake
- 6+ 2x $\frac{1}{2}$ defenses
 - A, B, D both ways
 - C from courtyard

Auto

- 2 ball (via lowbar)
- pickup ball from Midline immediately
- 1 ball (via other defense)

Teleop

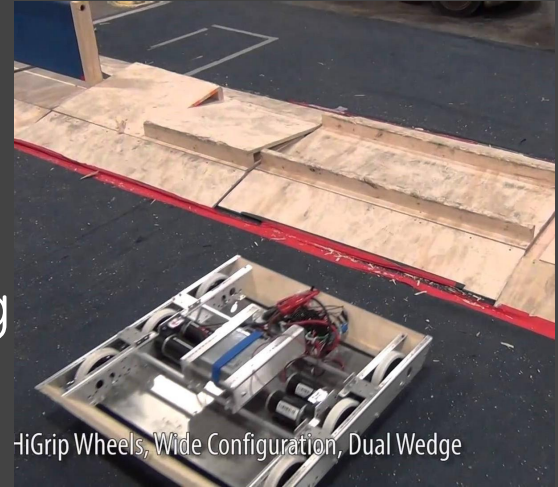
- high goal from batter and OW 1, 3, 4
- challenge
- scale
- shoot over defender from OW

- Day 14
 - Finish Drivetrain
- Days 15-16
 - Wire up entire drive base, test functionality
- Days 8 – 21
 - Build Mechanisms
 - Program Mechanisms
- Days 22-28
 - Mechanism Integration/Wiring
 - Test code with assembled robot



Golden Rule #5

- Day 29
 - Robot “finished”
- Days 29 – 45
 - Testing, BREAKING, fixing, iterating
 - **#5: Fail Faster!**
 - Driver Practice
 - A Good Driver Beats a Good Robot





Competition Season

The Biggest Lie in FRC

- Myth: Build Season is 6 weeks
- Reality: Build Season never ends



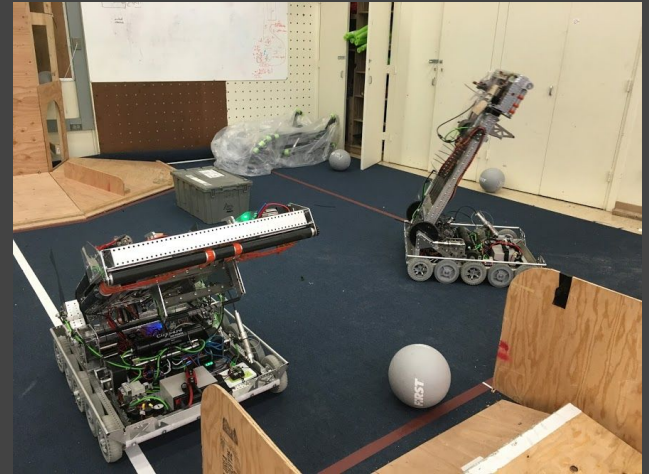
Withholding Allowance

- Allowed to bring < 30 lbs of parts to each event
- Keep parts to fine tune and bring to competition
 - Do not rely on this, but can be useful
 - Installation of new parts takes up precious time in the pits, so plan accordingly
- Allowed to Add Entire Components
 - ie. Stingers in 2012



Practice Robot

- Identical to competition robot
 - If not full robot, copy of drive-base
 - Buy AM Drive Base, transfer mechanism, instant practice robot! Just add water!
- Large investment, large reward



Watch Other Competitions

- Watch other regionals
- Webcast parties
- Read Chief Delphi
- Watch FUN and Gamesense
- Volunteer at events
- Look at other robots for ideas



Summary

- Pre-Season Prep – Golden Rules #1 and #2
- Drivetrain Design – Golden Rule #3
- Mechanism Design – Golden Rule #4
- Electrical and Pneumatics – Keep It Neat
- Build Season – Golden Rule #5
- Competition Season – Time to Improve



Resources

- Chief Delphi – chiefdelphi.com
- TCA – thecompassalliance.org





Thank You! Questions?

Mike Corsetto

Email: corsetto@gmail.com

Instagram: @mcorsetto

Questions?



Give us Feedback!

