

## Citrus Circuits Fall Workshop Series

## Strategic Design

by Mike Corsetto

#### Who Am 1?

- 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 RI3D 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

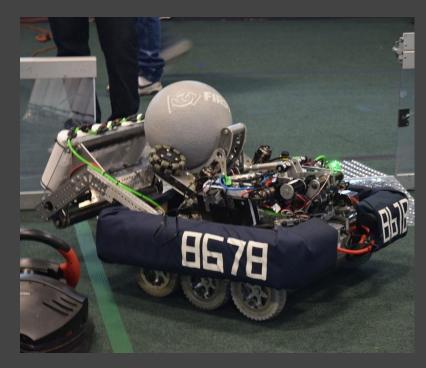






## Off-Season Project Ideas

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







## Drivetrain Design









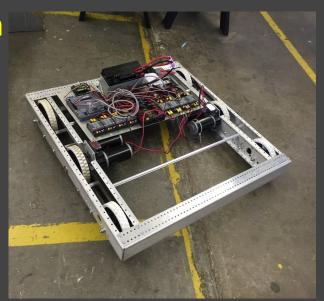




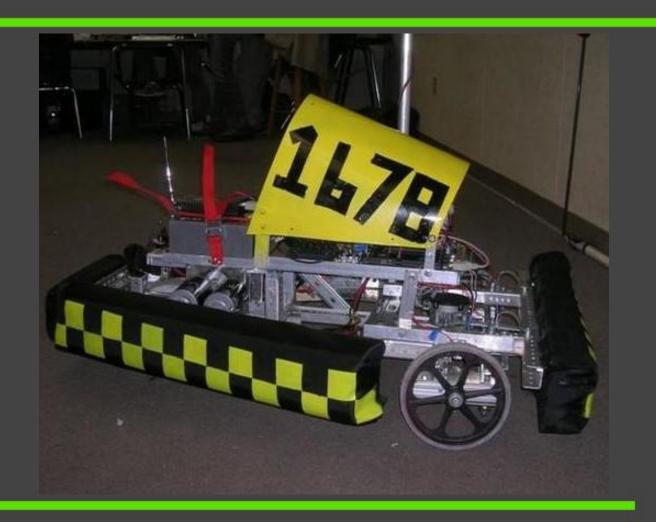


#### Golden Rule #3

- 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

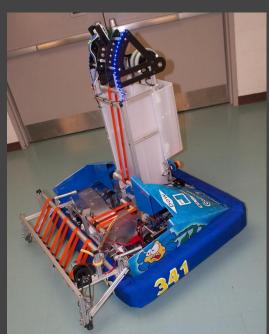






#### Acquisition Zone

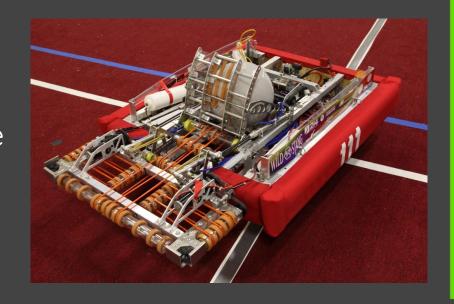
- Effective Intake Area
- Object/Intake Interaction
- Make the Driver's Job Easy
- Stress The Prototype





#### Golden Rule #4

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









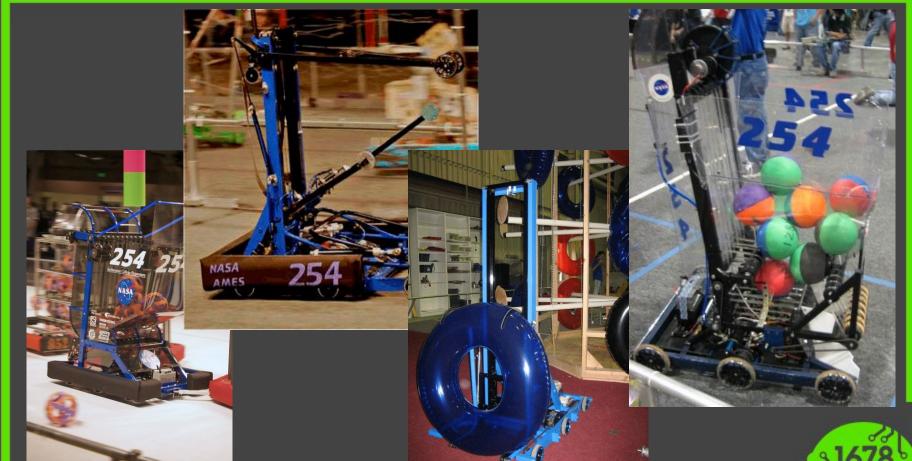








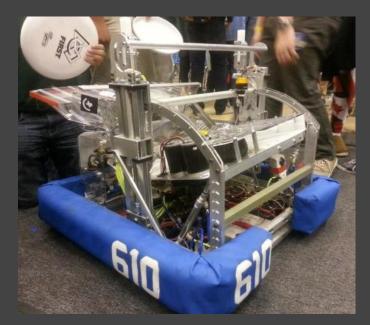






## Device/Robot Alignment

- 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

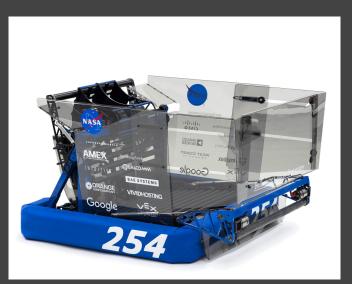
- So Much Can Go Wrong (Power, Signal, Radio, Leaks, etc)
- Spend time to do it right
- 1678 On Einstein in 2013





## 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
- STOP

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





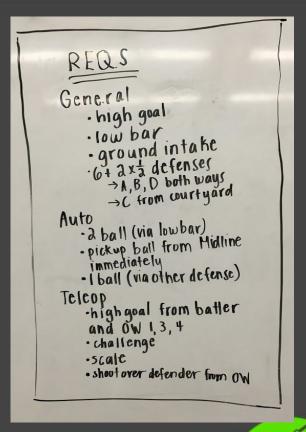
## Brainstorming

- 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

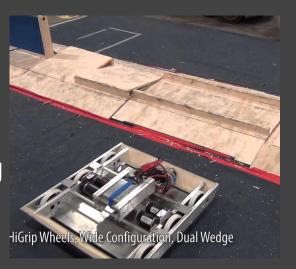


- Day 14
  - Finish Drivetrain
- Days 15-16
  - Wire up entire drive base, test functionality
- Days 8 21
  - Build Mechanisms
  - Program Mechanisms
- Days 22-28
  - Mechanism Integration/Wiring
  - Test code with assembled robot



#### 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



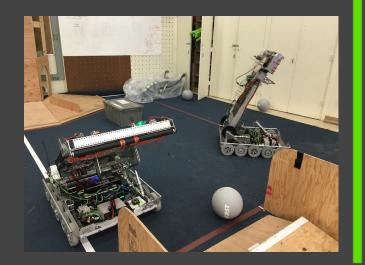
## Withholding Allowance

- 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
  - o 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 <u>chiefdelphi.com</u>
- TCA thecompassalliance.org





## Thank You! Questions?

Mike Corsetto

Email: corsetto@gmail.com

Instagram: @mcorsetto

## Questions?



Give us Feedback!

