2019 FLYSET FTC
Workshop Proceedings

24 August 2019

9:00am – 4:00pm

Rice Middle School, Plano ISD

8500 Gifford Dr., Plano, TX 75025

Acknowledgements

We would like to acknowledge the teams that hosted this workshop:

technicbots 8565

RAVENCLAW ROBOTICS 11472

Thank you to all of the following teams that took part in our 2019 joint Summer FTC Robot Study Project and presented their study results at the workshop:

CIRCUIT BREAKERS

TECHNICAL DIFFICULTIES 7172

9010

VIBOTS VIKING ROBOTICS VINES HIGH SCHOOL FTC 11341

technicbots 8565

RAVENCLAW ROBOTICS 11472

FTC #15536 bit.ly/ftc15536 LIBERTY CYBERHAWKS

WATTEVER 16296

Thank you to our sponsors:

美中专业人士协会 (ACP)

Team **11472** is the recipient of the 2019 FLYSET & ACP FTC grant which provides a brand new set of Tetrix FIRST Tech Challenge Competition Set (Value of $532) to support a budget tight FTC team.

Winners of the raffle drawings:

goBILDA DREAM • MAKE • REPEAT

SERVOCITY.com

1. $25.00 store credits for www.gobilda.com from ServoCity - **Team 12430**
2. GoBilda 3212-0001-0001 – Linear Actuator Kit from ServoCity - **Team 16296**

Abstract

This summer of 2019, FTC team 8565 (Technicbots) collaborated with six other FTC teams in North Texas to conduct a joint FTC Summer Robot Study. Each participating team chose various topics relating to different aspects of the robot. They researched, set up and ran tests, collected and analyzed data, and presented their results at the annual FLYSET FTC workshop, which was co-hosted by FTC team 8565 (Technicbots) and FTC team 11472 (Ravenclaw Robotics).

While each team worked on their summer projects, every month we organized meetings with all the participating teams at various locations around North Texas. During these meetings, all teams presented their project thus far and interacted with one another to provide feedback, discuss ideas, and more.

The summer program culminated with an FTC workshop which was kicked off by Dr. Patrick Michaud, the Affiliate Partner for the FTC program in North Texas, explaining this year's tournament format and was attended by a wide audience of coaches, mentors and fellow team members. Each of the seven teams presented their project ideas, test results and conclusions, whereby participants got to learn more about all aspects of FIRST, and even how FIRST skills can be applied in designing and building a product in the real world to help those in need.

Additionally, the afternoon tracks of the workshop offered hands-on, guided experiences led by various FTC teams on different topics to interested participants. Coaches from rookie FTC teams were also able to participate in a panel discussion with experienced team coaches (6832, 11341, 12764, 15152, 15536) on how to form and maintain a successful team and collaborate with others.

Schedule

2019 FLYSET FTC Workshop

Time: 8/24/2019 9am-4pm
Location: Rice Middle School, 8500 Gifford Dr., Plano, TX 75025
Hosting teams: 8565, 11472

Time Slot	Session title	location	Team
Morning Sessions			
9:00am-9:05am	Introduce hosting teams and all study participant teams	cafeteria	coaches from 6566/7172/8565/11341/11472/15536/16296
9:05am-9:20am	Tournament Format for the 2019-2020 season	cafeteria	Dr. Patrick Michaud
9:20am-9:30am	Engineering Design Workshop Experience - Burt Bot	cafeteria	8565
9:30am-9:40am	Chassis - V Frame 8 Wheel Chassis	cafeteria	8565
9:40am-9:45am	Havester System - Ball Intake	cafeteria	8565
9:45am-9:55am	Extension System - Linear Slide Configurarions and Materials	cafeteria	8565
9:55am-10:10am	Extension System - Rack pinion and Four bar linkage	cafeteria	11472
10:10am-10:25am	Extension System - Fishing pole and Elevator	cafeteria	7172
10:25am-10:35am	Extension System - Rack pinion and TinkerCAD	cafeteria	15536
10:35m-10:45am	break	cafeteria	
10:45am-10:50am	FLYSET ACP Joint Grant Distribution	cafeteria	FLYSET/ACP
10:50am-11:00am	Robot Build Transitioning from FLL to FTC	cafeteria	16296
11:00am-11:10am	Control Hub (North Texas Pilot Region)	cafeteria	16296
11:10am-11:20am	Mecanum Chassis with Odometry Wheels	cafeteria	8565
11:20am-11:30am	CAD Integration with Unity	cafeteria	8565
11:30am-11:40am	CAD with Autodesk Inventor	cafeteria	11472
11:40am-11:50am	Engineering Notebook	cafeteria	11472
11:50am-12:00am	Fundraising Ideas	cafeteria	6566
Lunch			
Afternoon Sessions			
Time Slot	**Session title**	**location**	**Team**
1:00pm-3:00pm	Blocks programming 101 for general public	classroom # 1	8565, 11341, 11472, 16296
1:00pm-3:00pm	OnBot Java Refresher	classroom # 2	15536
1:30 PM	product/certificate giveaway drawing #1	cafeteria	8565
1:30pm-2:30pm	Fusion 360 Quick Intro and Deep Dive panel discussion	classroom # 3	8565 and 9010
1:30pm-2:30pm	FTC panel discussion for Rookie Teams	cafeteria	11341
2:30 PM	product/certificate giveaway drawing #2	cafeteria	8565
1:00pm-3:00pm	Discussion and interaction with morning sessiosn presenters	cafeteria	all
	Thanks to Joint FTC Summer Study project participating teams: **6566, 7172, 8565, 11341, 11472, 15536, 16296**		
Presentations	http://flyset.org/2019-flyset-ftc-workshop/		

Part 1
Morning Sessions

2019 FLYSET FTC Workshop

V-Frame 8 Wheel Chassis

(8/24/2019)

Presenters

Austin Liu - FTC 8565

- 9th year in FIRST
  - 3 years in Jr. FLL
  - 3 years in FLL
  - 2 years in FTC
- Main Builder with Programming and CAD experience
- Enjoys Tennis and Video Games

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Audrey He - FTC 8565

- 9th year in FIRST
  - 3 years in Jr. FLL
  - 3 years in FLL
  - 2 years in FTC
- Builder and notebook manager on the team
- Enjoys art and dance

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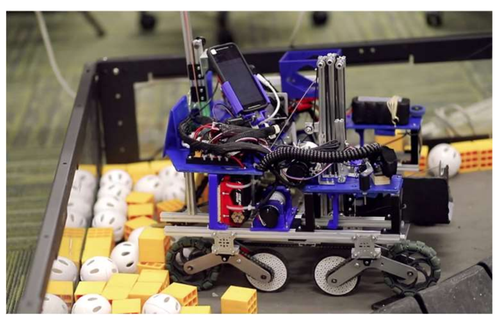
Project Background

V-Frame 8 Wheel Chassis



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Chassis Design

Goals

- Build a similar chassis that can cross the crater efficiently
- Compare the chassis with other chassis in normal driving
  - Going straight
  - Turning
- Evaluate the chassis in crossing crater

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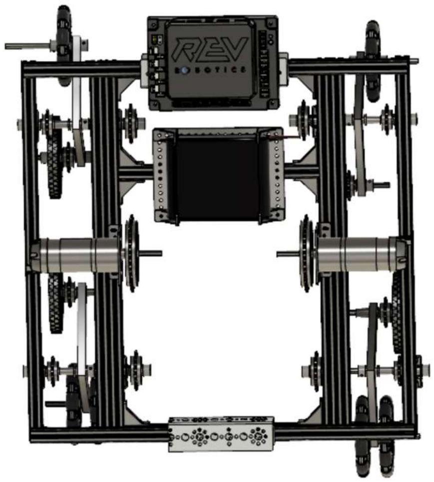
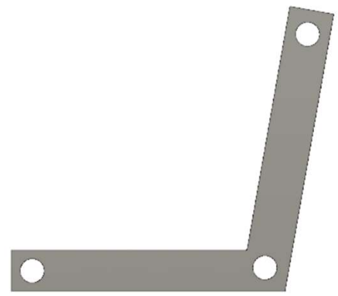
Design





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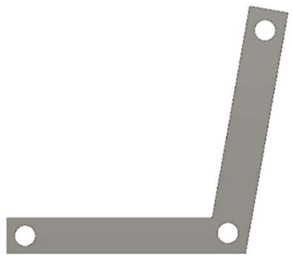
Chassis Build

Build Decision

For easy adjustment, I chose to 3D print my parts for fast prototyping.



V - Wheel Hole Sizing

- Problem
  - Holes vary based on the 3D printer
  - Axles wobbled in place
- Solution
  - Make it considerably smaller and adjust by filing

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V - Wheel Length Requirements

- Problem
  - Length was in between chain link size
- Solution
  - Adjust hole distance in the model to the perfect chain size

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V - Wheel Strength

- Problem
  - V - Wheel breaks under pressure
- Solution
  - Slowly increase the infill of the V - Wheel
    - 20%
    - 30%
    - 50%
    - 70%

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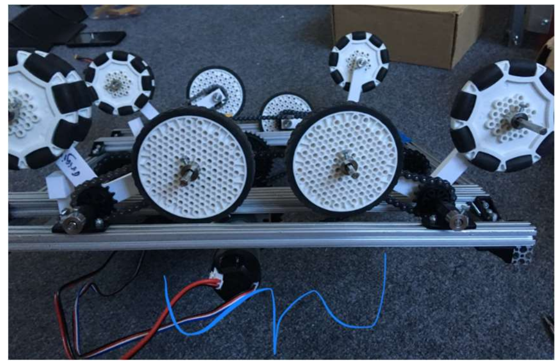
V - Wheel Pair Spacing

- Problem
  - Inner drive wheels weren't sync
  - Front frame was already over before back frame came into contact with the crater
- Solution
  - Find the best distance between the inner wheels



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V - Wheel Pair Spacing

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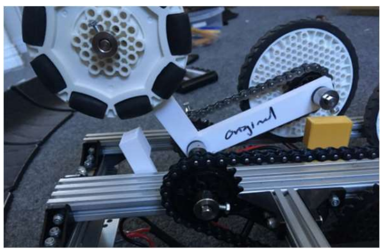
V - Wheel Rotational Limit

- Problem
  - V-Frame rotates too much
    - Affects the crossing efficiency
- Solution
  - Custom printed block part

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Project Results

Forward Speed Test Spec

- Drive forward for 5 seconds at full power (100%) (Sensitive to voltage)
- Measure distance traveled in meters

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Forward Speed Test Code

```
// Run the robot forward for 5000 ms
while (runtime.milliseconds() < 5000 && opModeIsActive()) {
    // robot.leftFrontMotor.setPower(1);
    robot.leftBackMotor.setPower(0.97);
    // robot.rightFrontMotor.setPower(1);
    robot.rightBackMotor.setPower(1);
}
// Stop the robot
robot.stopRobot();
```

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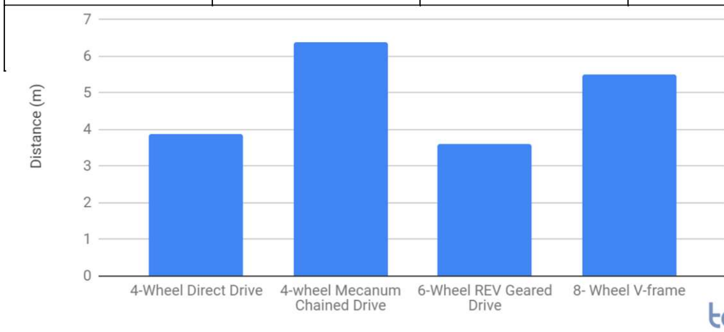
Forward Speed Test Results

	4-Wheel Direct Drive	4-wheel Mecanum Chained Drive	6-Wheel REV Geared Drive	**8- Wheel V-frame REV**
				5.50m



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3 Second Turn Test Spec

- Turn for 3 seconds at full power (one side 100% power forward, other side 100% power backward) (Sensitive to voltage)
- Record: can it turn freely? (Yes) Does it get stuck? (No)
- If it can turn freely, record how far it turned in degrees using IMU sensor
- Rotate more than 1 rotation, so need to add 360 degrees to the reading on the driver station which stays on the phone for 6 seconds after robot stops

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3 Second Turn Test Code

```
waitForStart();
runtime.reset();// Turn the robot for 3000 ms
while (runtime.milliseconds() < 3000 && opModeIsActive()) {
 //  robot.leftFrontMotor.setPower(-1);
    robot.leftBackMotor.setPower(-1);
//   robot.rightFrontMotor.setPower(1);
    robot.rightBackMotor.setPower(1);
```

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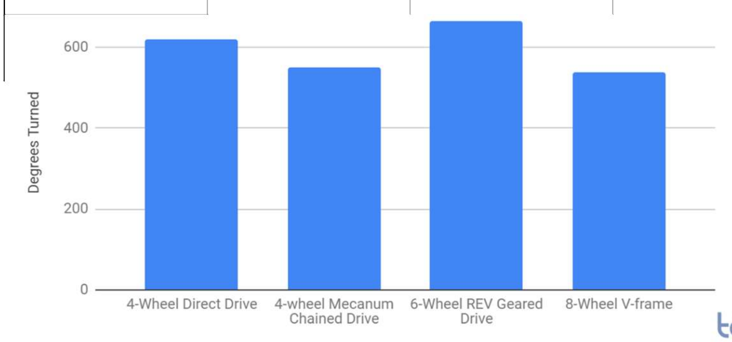
3 Second Turn Test Results

	4-Wheel Direct Drive	4-wheel Mecanum Chained Drive	6-Wheel REV Geared Drive	**8-Wheel V-frame REV**
				536°



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Crater Crossing Test Spec

- Robot will start at one side of the crater
- Drive forward for 3 seconds at full power
- Check log on phone to see Gyro Sensor reading
- Record every other value

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Crater Crossing Test Code

```
robot.leftBackMotor.setPower(0.9);
robot.rightBackMotor.setPower(1);
runtime.reset();
while (opModeIsActive() && (runtime.seconds() < 3.0)) {
    Log.i( tag: "angle:",  msg: ""+getHeading());
    if(Math.abs(getHeading()) > memes) memes = Math.abs(getHeading());
    telemetry.addData( caption: "Highest Angle: ", memes);
    telemetry.update();
```

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Crater Crossing Test Video

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Crater Crossing Test Comparison

- Not completed yet because the chassis has not been tuned to go through the crater entirely

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Conclusions

Next Steps

- Thicken the V-Frames and finalize hole distance
- Raise the motors up higher on the chassis
- Two points of connection on the blockers

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2019 FLYSET FTC Workshop

Ball Intake

(8/24/2019)

Presenter

Derek - FTC 8565

Derek is a 9th grader at Jasper High School. This will be his 9th year in the FIRST program and 3nd in FTC. His role on the team is with the hardware side and being a builder. Outside of robotics, Derek likes playing cello, soccer, and gaming.

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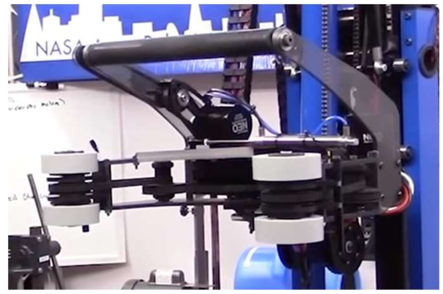
Project Background

Ball Intake

- Different intake mechanisms for different materials
- Inspiration from FRC team 254 Cheesy Poofs
- Intake worked very effectively in the FRC 2019 season



FIRST ROBOTICS COMPETITION

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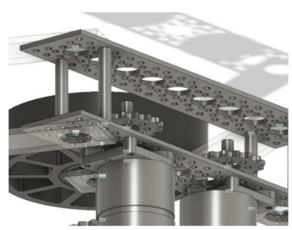
Project Design

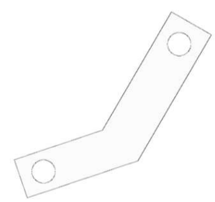
Goals

- See how effective intake was with balls
- How efficient and how much potential could it have

CAD

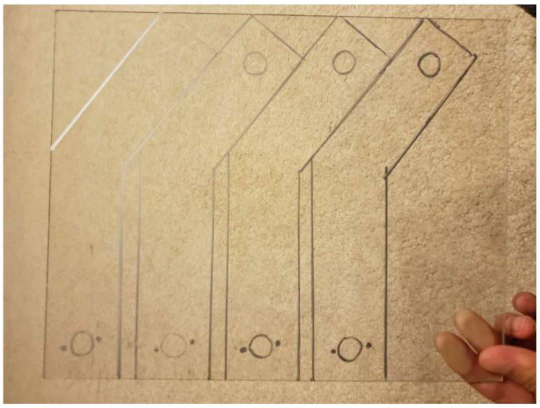
- Pre-building stage, planning out parts and design

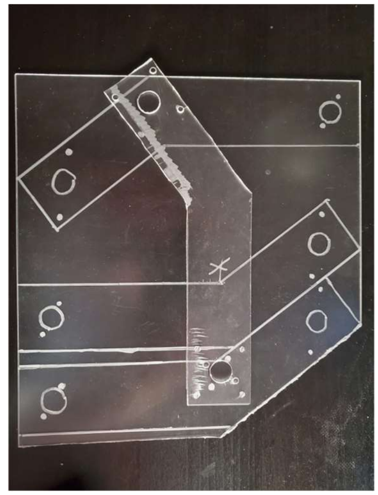




Build Stages

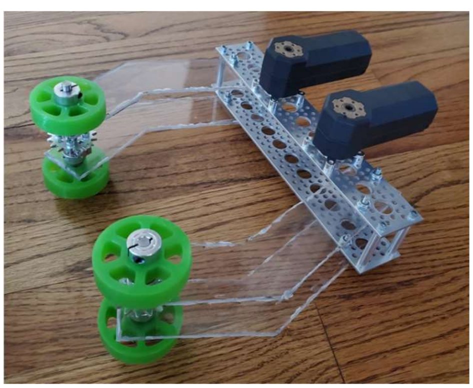
- Designed the right custom part





Build Stages

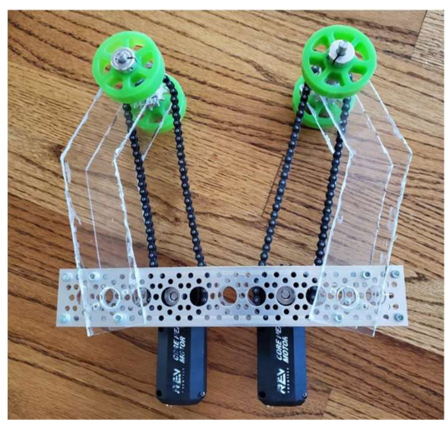
- Change in motors
- Positioning of custom parts



Project Results

Faults with design

- Custom parts too weak
- Chains aren't aligned
- Chains blocking room



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Conclusions

Lessons learned

- Be as precise as possible when using custom parts (use CAD)
- Use the right tools to cut and shape it out (such as CNC)
- Think about spacing during design stage
- Taking shortcuts, not thinking design fully results in the long way in the end
    - More prototyping before full production

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2019 FLYSET FTC Workshop

Linear Slide Design and Configuration

(8/24/2019)

Presenter

Champers Fu - FTC 8565

- Joined FTC this year
- Hobbies include building circuits and swimming

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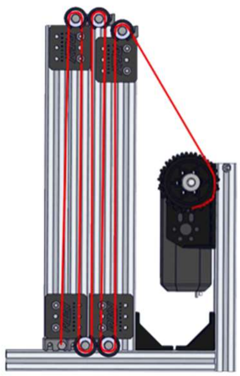
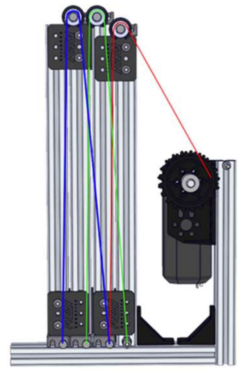
Project Background

Background



Continuo
us



Cascade

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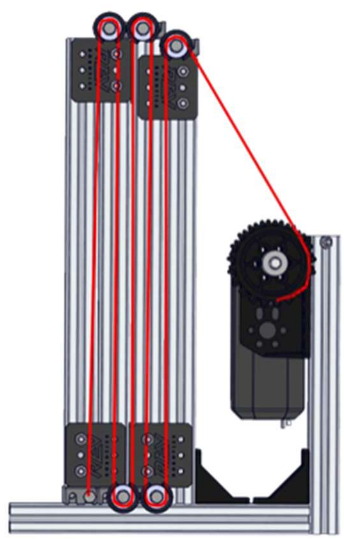
Continuous

Pros: Less tension on string, less power required, lift more weight

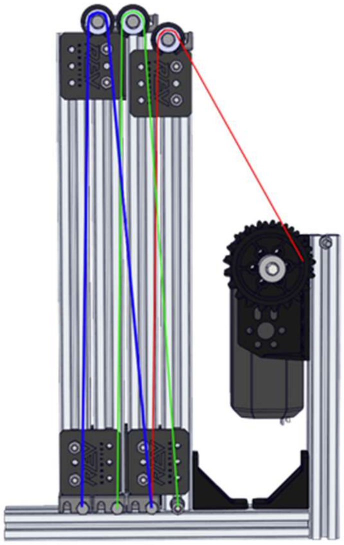
Cons: Slower



Cascade

Pros: Significantly faster

Cons: More power and torque required, able to lift less weight



Project Design

Goals

- Compare continuous and cascade linear slides
- Compare the Rev linear slide with Misumi
- Measure characteristics during testing

Top: Misumi
Cost: About $25 per segment

Bottom: Rev
Cost: $14 per segment

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Goals

Top: Misumi

Bottom: Rev

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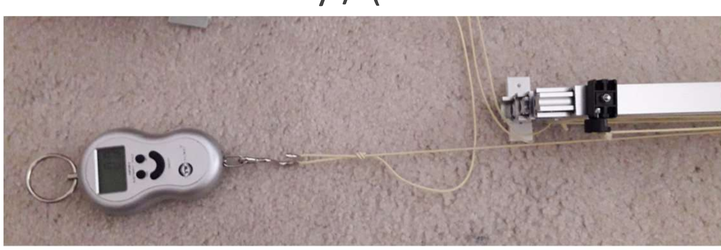
Characteristics to Measure

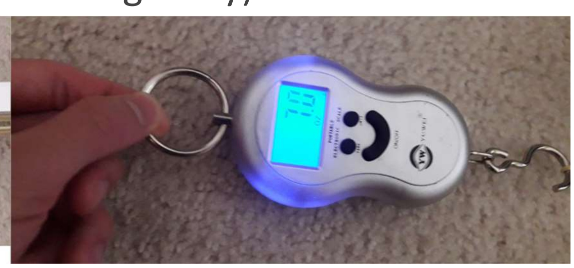
- Time
- Motor speed
- Power Usage (Energy = Volts x Amps x Time)
- Torque (T = Frictional Force x motor shaft radius)

  Frictional Force = Friction Coefficient x Mass of load and slides x acceleration due to gravity

Friction Coefficient Estimate

Friction Coefficient = force required for constant velocity / (mass*acceleration due to gravity)





Measuring force

Friction Coefficient Estimate

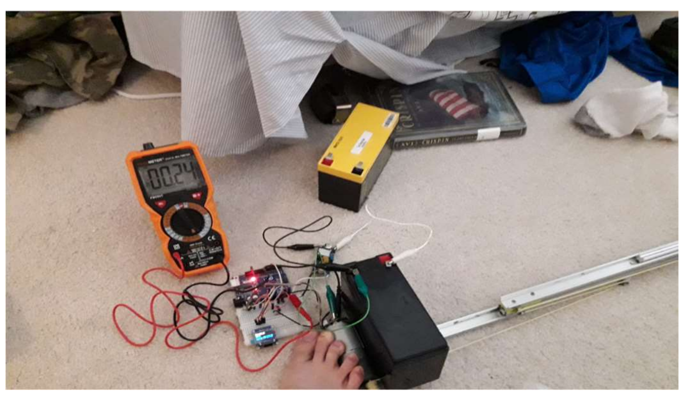
	Rev Continuous	Rev Cascade	Misumi Continuous	Misumi Cascade
Frictional Force (N)	.89	2.1	1.1	2.2
Friction Coefficient	.39	.85	.19	.38

Mass of Rev slide = 115g per slide

Mass of Misumi slide = 292g per slide

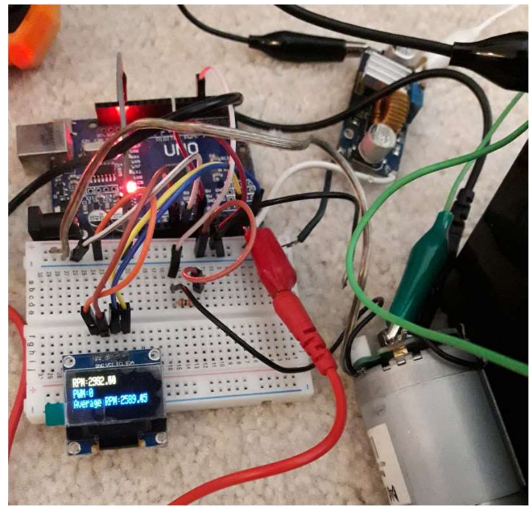
Setup

- Motor run at 5v instead of 12v for higher accuracy
- Each linear slide had 3 stages
- Length of fully extended Rev slide is 1.14 m
- Length of fully extended Misumi slide is 1.53m

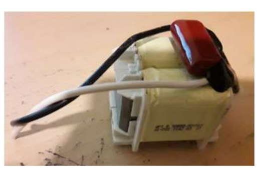


Setup

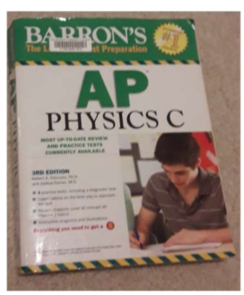
- RPM measured using hall effect sensors
- Hall effect sensor output was detected using the Arduino pulseln() function which was converted into rpm
- Average rpm was calculated in real time using and approximation of the mean value theorem
- Current measured using a multimeter
- Constant voltage of 5v



Various Loads



Small Inductor (282g)



Textbook (1083g)

Microwave Transformer (4058g)

Lead Acid Battery (2508g)

Project Results

Rev Continuous Slide

	RPM	Time (sec)	Current (a)	Power (w)	Energy (j)	Tension (N)	Torque (N*m)
No load	2540	29	.22	1.1	31.9	.89	.003
Small Inductor (282g)	2379	34	.27	1.35	45.9	1.96	.007
Textbook (1083g)	2121	40	.40	2	80	5.02	.018
Lead Acid Battery (2508g)	1801	52	.77	3.85	200.2	10.48	.037
Microwave Transformer (4058g)	1242	68	1.26	6.3	428.4	16.41	.057

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Rev Cascade Slide

	RPM	Time (sec)	Current (a)	Power (w)	Energy (j)	Tension (N)	Torque (N*m)
No load	2322	15	.22	1.1	16.5	2.08	.007
Small Inductor (282g)	1964	17	.31	1.55	26.35	4.44	.016
Textbook (1083g)	1801	21	.45	2.25	47.25	11.12	.039
Lead Acid Battery (2508g)	1684	29 -Stopped 2 inches from finish	.81	4.05	117.45	23	.08
Microwave Transformer (4058g)	Not tested						

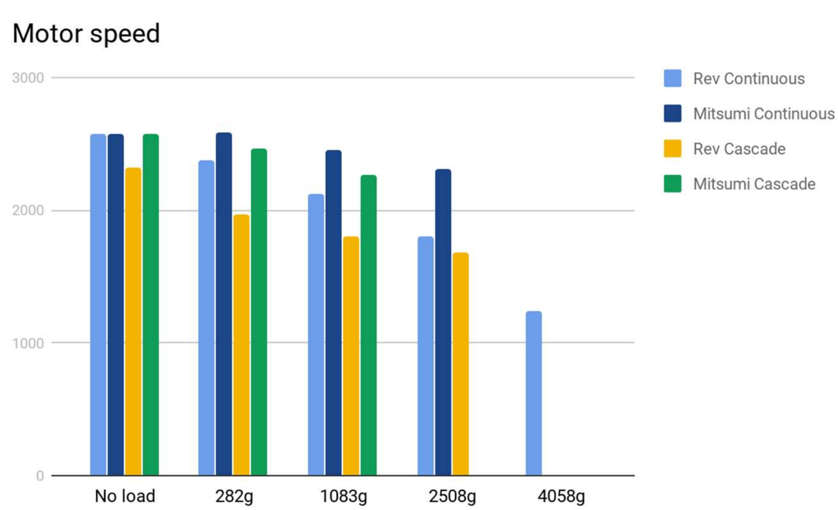
Misumi Continuous Slide

	RPM	Time (sec)	Current (a)	Power (w)	Energy (j)	Tension (N)	Torque (N*m)
No load	2576	33	.19	.95	31.35	1.36	.0048
Small Inductor (282g)	2588	34	.20	1	34	1.89	.0066
Textbook (1083g)	2451	38	.25	1.25	47.5	3.38	.0118
Lead Acid Battery (2508g)	2310	47* Only extended 2 slides	.48	2.4	112.8	6.04	.0211
Microwave Transformer (4058g)	Not tested						

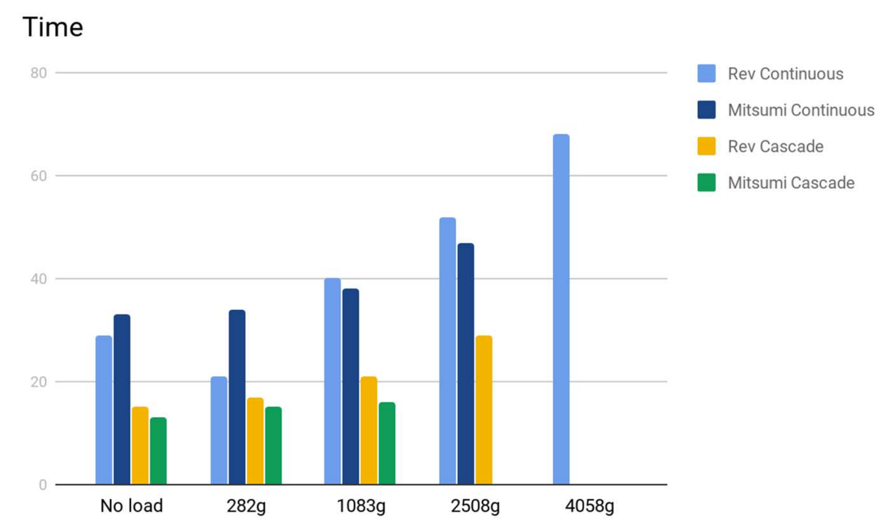
Misumi Cascade Slide

	RPM	Time (sec)	Current (a)	Power (w)	Energy (j)	Tension (N)	Torque (N*m)
No load	2572	13	.18	.9	11.7	2.72	.0095
Small Inductor (282g)	2468	15	.21	1.05	15.75	3.77	.0132
Textbook (1083g)	2269	16	.31	1.55	24.8	6.76	.0237
Lead Acid Battery (2508g)	Not tested						
Microwave Transformer (4058g)	Not tested						

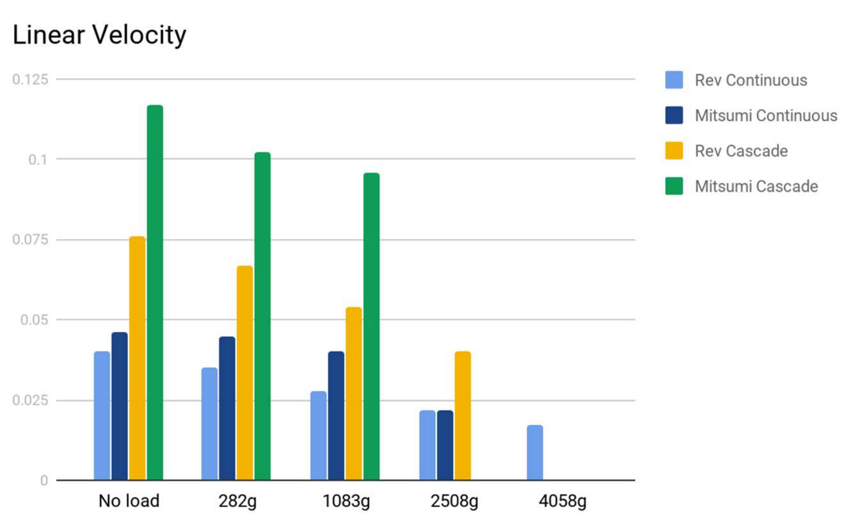
Angular Velocity (RPM)



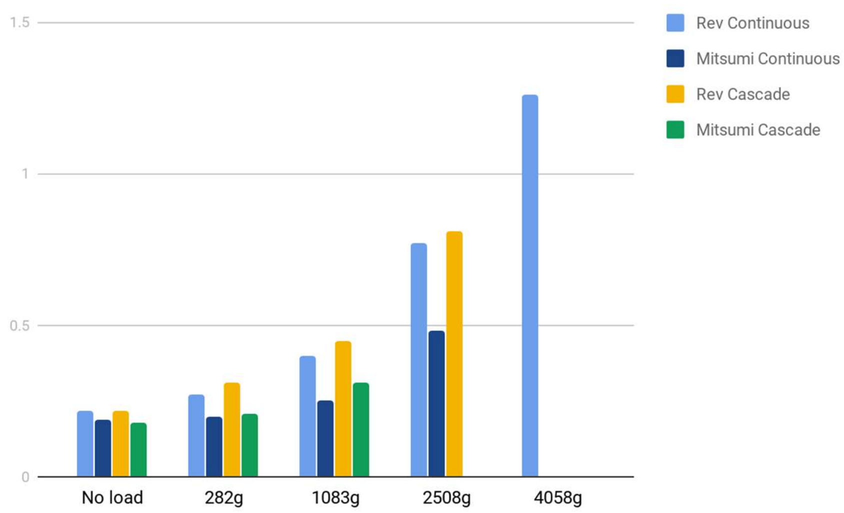
Time (sec)



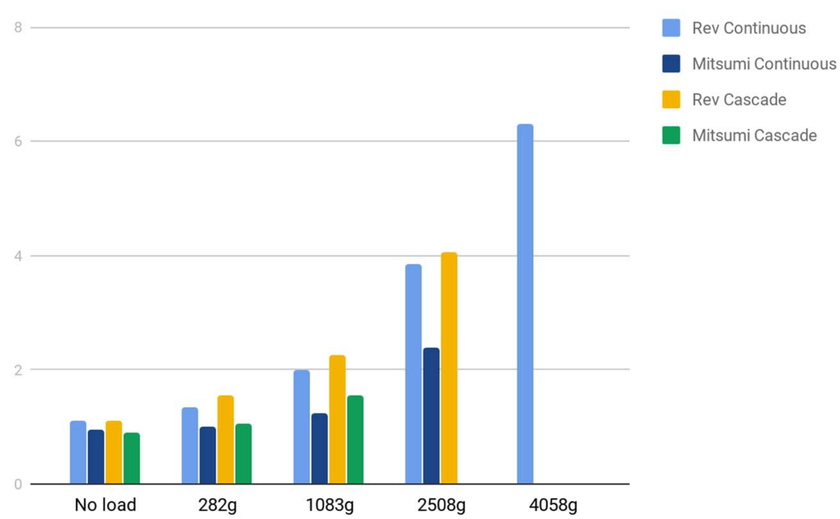
Velocity (m/s)



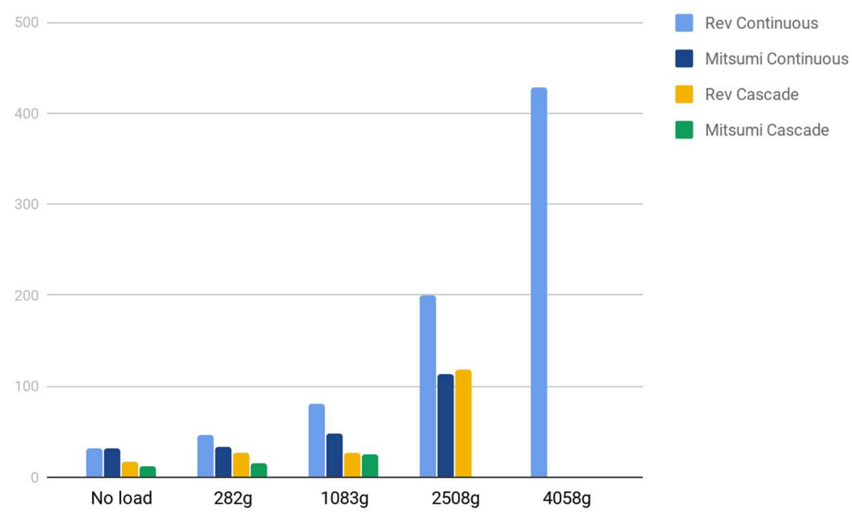
Current (amps)



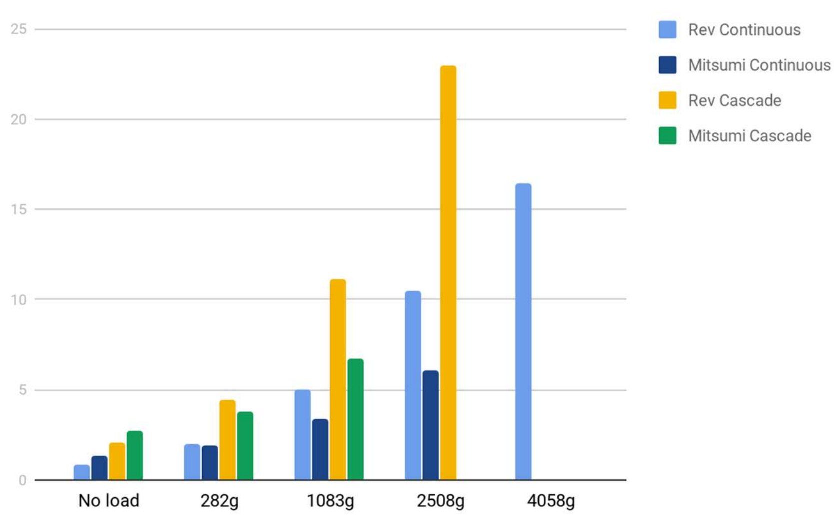
Power (watts)



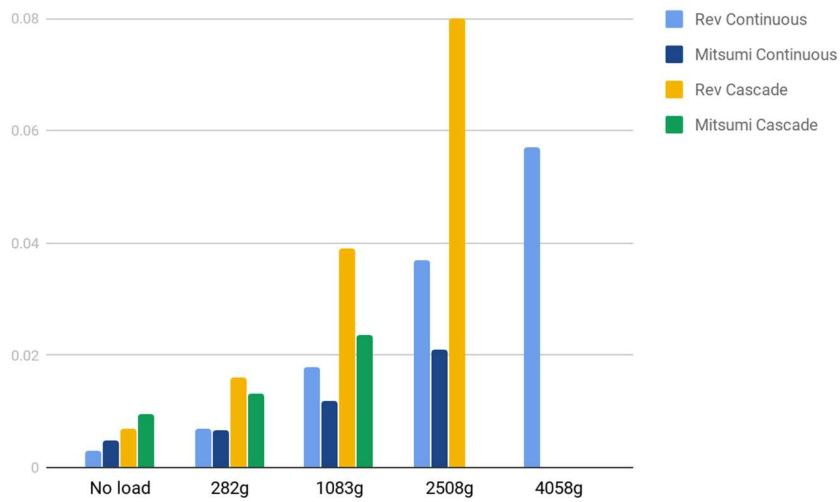
Energy Used (joules)



Tension (Newtons)



Torque (Newton Meters)



Conclusions

Conclusions

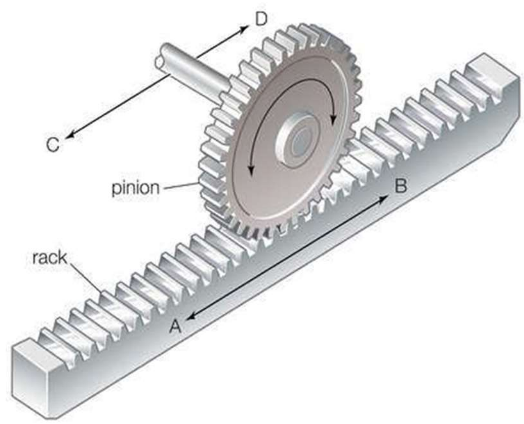
- 7172 mentioned a 4 stage cascade slide (as required in most FTC games) quadruple torque – I only tested 3 stage here with given materials
- Cascade slide would be ideal for applications with a small load and high motor power
- Continuous slide would be better for heavy lifting
- Misumi slides have much less friction, but are not as structurally strong
- REV slides are stronger but have much higher friction
- REV slides also have an issue where the plastic pieces that hold the slide together have imperfections that cause even more friction

Morning Session - 11472
Rack Pinion and four Bar linkage

(15 minutes)

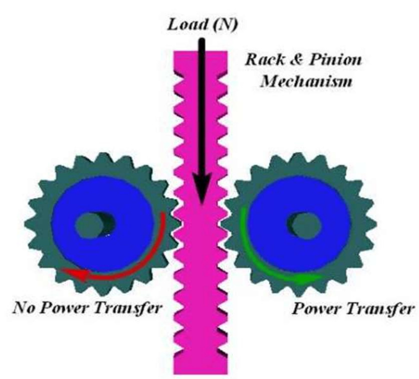
Extension Mechanism – 11472
Rack and Pinion Linear Slide

-Uses rotary motion to translate to linear motion
-pinion gear is typically small to provide necessary torque



Extension Mechanism – 11472
Rack and Pinion Linear Slide

- For added stability, rack can be built with pinion gears on each side
- Only one pinion gear should be powered by a motor



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Extension Mechanism – 11472
Rack and Pinion Linear Slide

Tetrix Basic Parts

Threaded plastic allows slide blocks and rack to be mounted to C-Channels using 6-32, 5/15 socket head cap screws

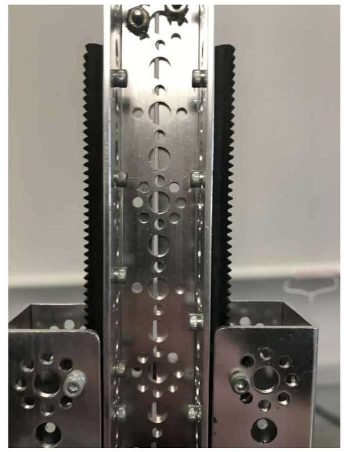
Extension Mechanism – 11472
Rack and Pinion Linear Slide

- **Advantages**
- Diversity of Tetrix parts allows for numerous variations of linear slide mechanism that can be tailored to each team's needs.

Extension Mechanism – 11472
Rack and Pinion Linear Slide

11472

- <u>**Advantages**</u>
- Two points of contact on the rack gear will support heavier loads than single rack and pinion system.
- Less likely to pinch or bind during motion



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Extension Mechanism – 11472
Rack and Pinion Linear Slide

11472

- <u>Disadvantages</u>
- Plastic teeth have been know to wear down under heavy loads.

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Extension Mechanism – 11472
Rack and Pinion Linear Slide

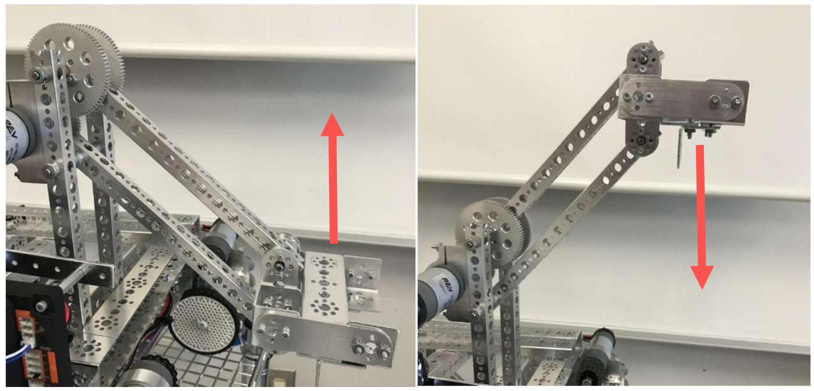
- <u>Disadvantages</u>
- Tetrix materials are often heavier, bulkier, and take up more space than other cascading linear slides
- Set screw in pinion gear can loosen or strip and needs to be tightened regularly

Extension Mechanism – 11472
Rack and Pinion Linear Slide

Questions?

Extension Mechanism – 11472
Parallel Four Bar Linkage

- The simplest movable closed-chain linkage
- Consists of four bars connected in a loop by four joints
- Generally joints are configured so the bars move in parallel planes



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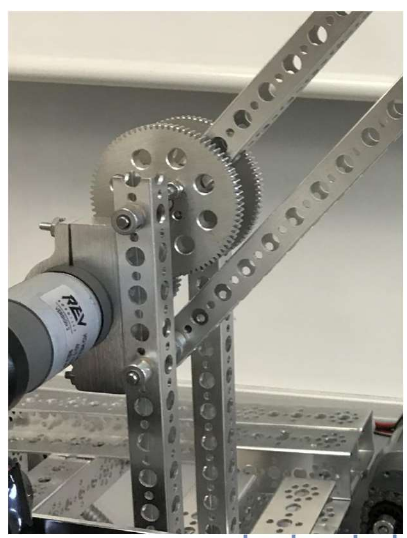
Extension Mechanism – 11472
Parallel Four Bar Linkage

- Most often powered by sprocket or gear attached to arm rotating around either pivot point
- Springs or rubber bands can be used to reduce strain on motor from being front-heavy



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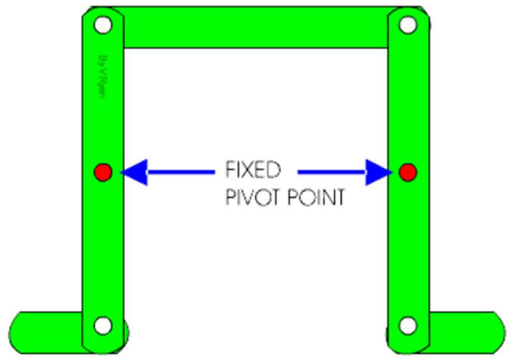
Extension Mechanism – 11472
Parallel Four Bar Linkage

Advantages

- Stable in all directions of force
- Maintains level Carriage
- Simple to build



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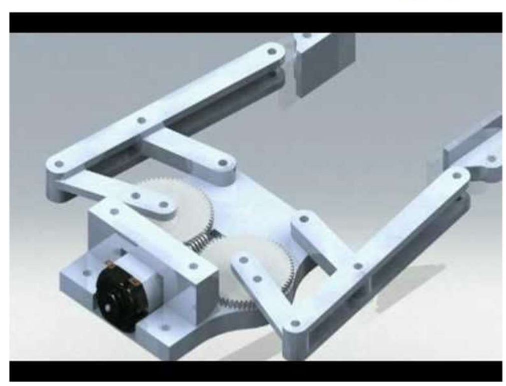
Extension Mechanism – 11472
Parallel Four Bar Linkage

Disadvantages

•Occupies up significant amount of space on the robot

•Limited degrees of rotation 130-180 degrees (depending on distance between joints type of materials used, and build method)

Becomes less stable when wider range of motion is attempted



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2019 FLYSET FTC Workshop

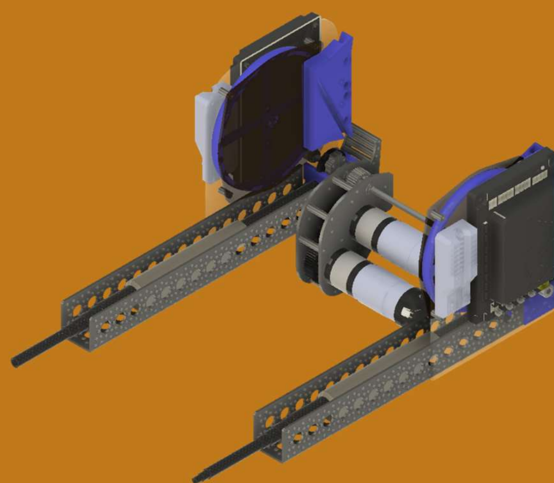
7172 - telescoping linear extension, elevator, omniwheel encoder

(8/24/2019)

Presented by 7172

Matthew Thomas
Sophie Guerin
Abinav Damera

Telescoping extension



Goals for linear extensions

Length - sufficient reach to score points

Fast - extend fully in less than 1 second

Strong / reliable

Background

Used in Rover Ruckus season

Based on concept used by i2c Robotics in Res-Q season

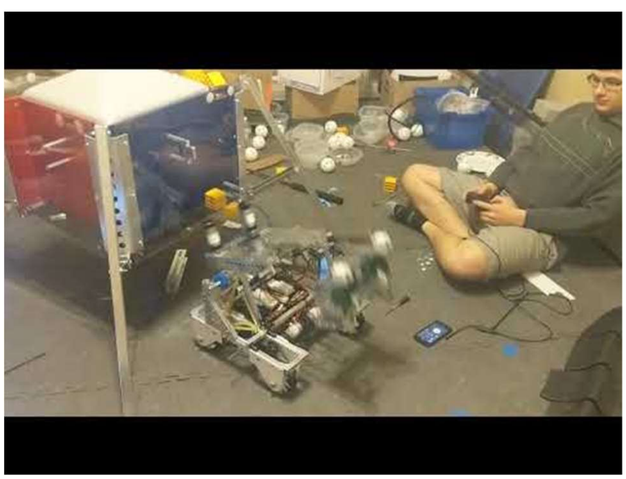
Telescoping components

- Telescoping fishing pole
  - Carbon fiber - light and strong
  - Excellent reach
- Flexible rack gear (KHKGears.us)
- Driving gear
- 3D-printed gear guide
- Gear storage system

Challenges

- Fit inside of 18"
  - Tight bend required at insertion point
- Gear rack storage
  - Avoid kinking or breaking rack gears
- Motor synchronization when using two poles
  - Stinger: unsynchronized, sometimes binds
  - Chariot: 2 motors drive common axle

Video demonstration

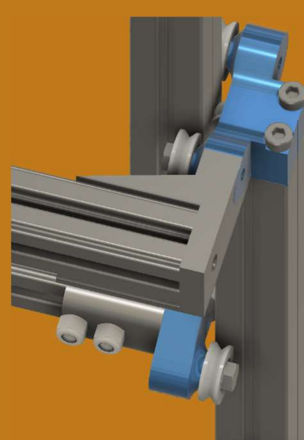


https://youtu.be/fF23CUXN4XI

Results

- Length: Excellent
  - Extend 48+ inches
  - Limited primarily by length of rack gear (2M)
- Speed: Excellent
  - Unloaded - full extension in 0.5 seconds
  - Loaded - good extension in ~1 second
- Reliability: Fair
  - Pro: Cord / pulleys not needed, less entanglement
  - Con: Rack gears can break easily if not managed
  - Telescoping poles increase friction with use
- Cost: high ($35 per rack gear, $30 per pole)

Elevator Lift



Goals for elevator lift

- Strong / reliable
  - Able to lift robot weight if needed
  - Won't bind, kink, break, snap
- Length
  - Achieve at least 40 inches of extension
  - As far as possible with 2 stages
- Fast
  - Full extension in under 1 second
  - Ideally around 0.5 second

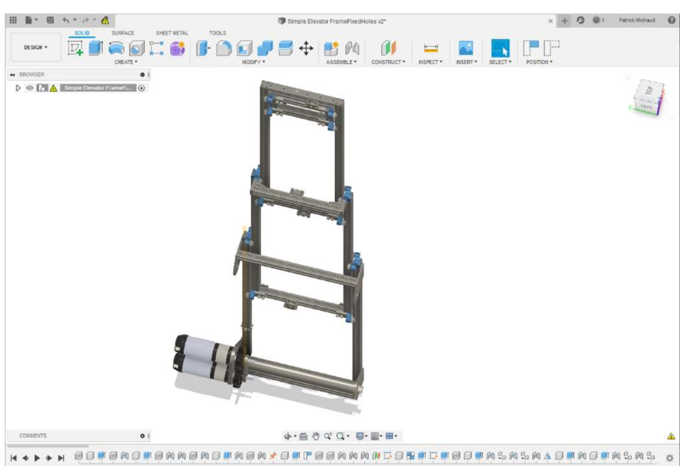
Background

Based on frame-based elevators used by top FRC teams

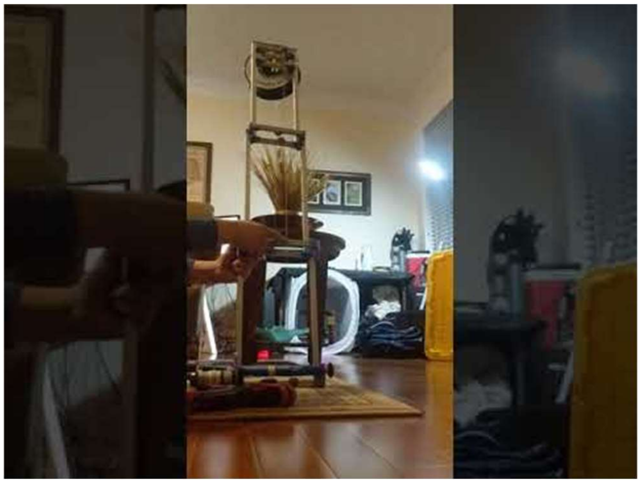
Telescoping components

- REV punch tubes and extrusion
- Pulley bearings
  - Lots of pulley bearings
- 3D printed parts
- Motors, gears, axles, etc.
- Spring assist
  - May not be FTC legal as purchased

CAD Model



Video demonstration



https://youtu.be/5oV5_snbVPo

Results

- Length: Good
  - Extend 40+ inches, more with articulated arm
  - Limited primarily by 18" size constraint
- Speed: Excellent
  - Unloaded - full extension in 0.5 seconds
  - Loaded - good extension in ~1 second with 4 pound payload
  - Spring balancer makes a big difference
- Reliability: Good so far
  - Needs testing on field and on robot
- Cost: average

Encoder navigation

Goals for encoder navigation

- Enable robot to know its position on the field to within 1"
- Program autonomous modes using waypoints
- Repeatedly return to the same spot

Background

Based on encoder-based navigation

used by Gluten Free in Relic Recovery and Rover Ruckus seasons

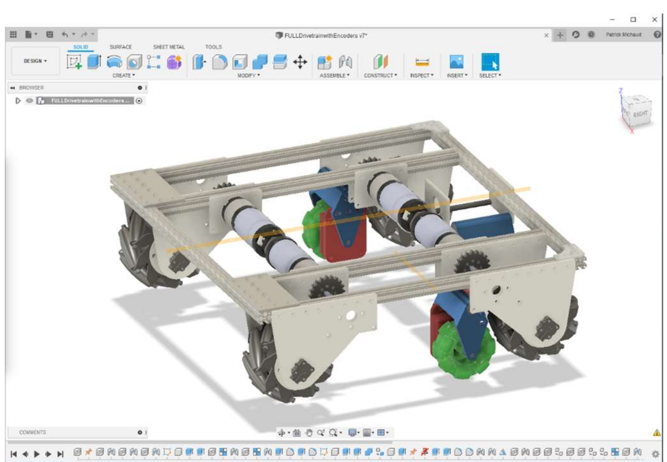
Components for study

- VEX shaft encoders
  - Inexpensive, easy to wire to REV hubs
- VEX omniwheels
  - Easy to connect to VEX shaft encoders
- 7172 standard drive chassis
- 3D printed mounting components

Key observations

- VEX encoders have varying levels of quality
  - Some reliably give 360 ticks/rotation
  - Others seem to "miss" ticks
- Omni wheels need to be tensioned to surface
- Three wheels needed to keep track of orientation and distance

CAD Model



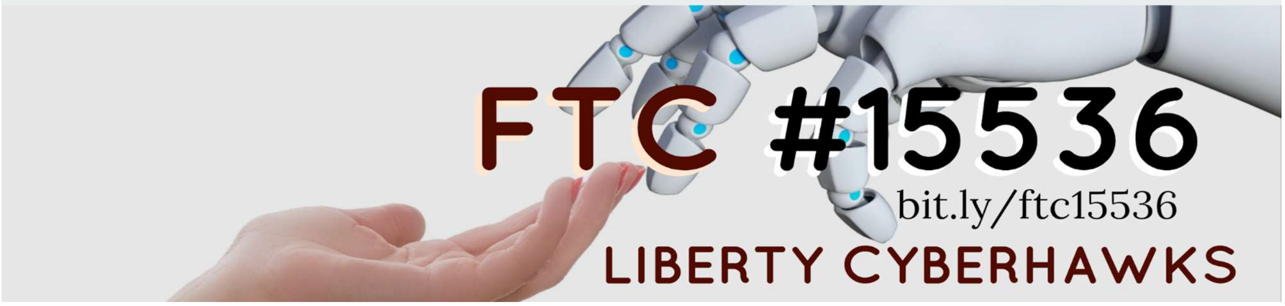
Video demonstration

https://youtu.be/Ozm6f5Uy
-X8

Results

- Still early in development
- Implementation only does positioning in one orientation;
  rotation being worked on next
- Some VEX encoders are inconsistent
  - Still determining why
  - Will likely switch to other encoders
- Very reasonable results
  - Can generally navigate to within 2 inches of target point, even with flaky encoders

Tinkercad



A Simple Introduction

- 3D printing software
- Web app
- STL file format

Types Of Shapes

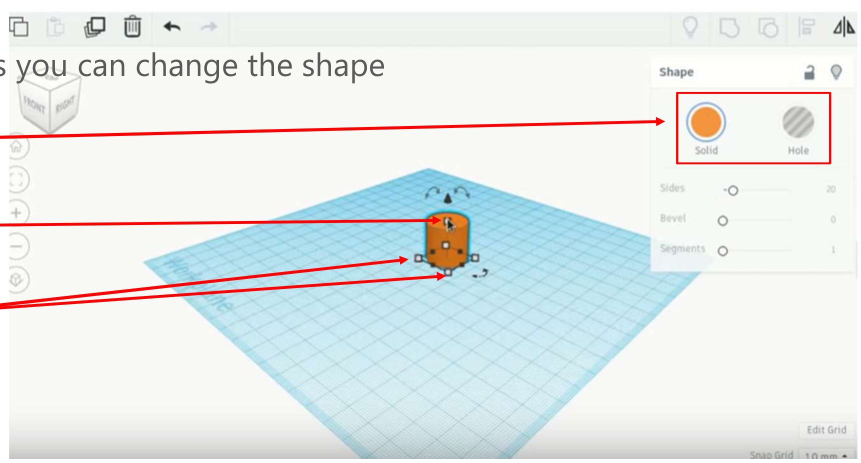
There are 5 types of shapes

- Basic Shapes
- Text
- Symbols
- Connectors
- Extras

Adjusting A Shape

There are 3 main ways you can change the shape

- Solid or Hole
- Height
- Width/Length



Pros and Cons

Pros:

- Simple
- Easy to use
- Perfect for quick fixes
- Works with almost all 3D printers

Cons:

- Might not be able to make certain objects
- Relies entirely upon Internet

Personal Experience

Ta-Da!

Conclusion

- Simple, easy-to-use software
- Good option for small pieces, not efficient for complex pieces
- Perfect for rookie teams

Robot Building Transition

From FLL to FTC

FIRST LEGO LEAGUE

FIRST TECH CHALLENGE

WATTEVER (#16296)

Control Hub

WATTEVER (#16296)

What is a Control Hub

The Control Hub is the new hub released by REV for the 2019-2020 season.

- It’s unique feature is that, it is a Expansion hub and robot controller in one unit. So when using Control Hub, you only need 1 phone as the driver controller.
- It works with all programing clients that FIRST has provided us.
- On Android Studio, it will only work with SDK 5.0 or above;
- We can’t test DC motors and servos using the REV interface app, but with the expansion hub you can do that.

Comparing of Expansion Hub and Control Hub

1. Th hub has over don’t need RC phone which gives more space on your robot.
2. There is no hassle of pairing the RC phone with the Control hub

Comparing of Expansion Hub and Control Hub

3. The USB connection on the expansion hub is currently most vulnerable connection as compared to Control hub.

Other than that, the amount of pins and sockets are the same; as well as the design and size of the hub. Bottom line, there is no technical advantage of using Control hub over the Expansion hub.

North Texas Pilot Program

Teams in North Texas can apply to a pilot program in which they can get a Control Hub for a discounted price ($175.00), and it will be legal for the team that has the Control hub. Outside the pilot program, you can still buy the Control hub but you need to pay the full price ($300.00). Contact Patrick R. Michaud (patrick.michaud@utdallas.edu) for additional information.

How to enroll in the pilot program

1. Go to the Submittable web site using the below link to apply for the pilot program (https://usfirst.submittable.com/submit/69f974f8-05f7-4a31-9d3f-51787e71bb53/2019-2020-first-tech-challenge-control-hub-pilot)

2. You will get a reply mail, mentioning that the application is under review, as mentioned below

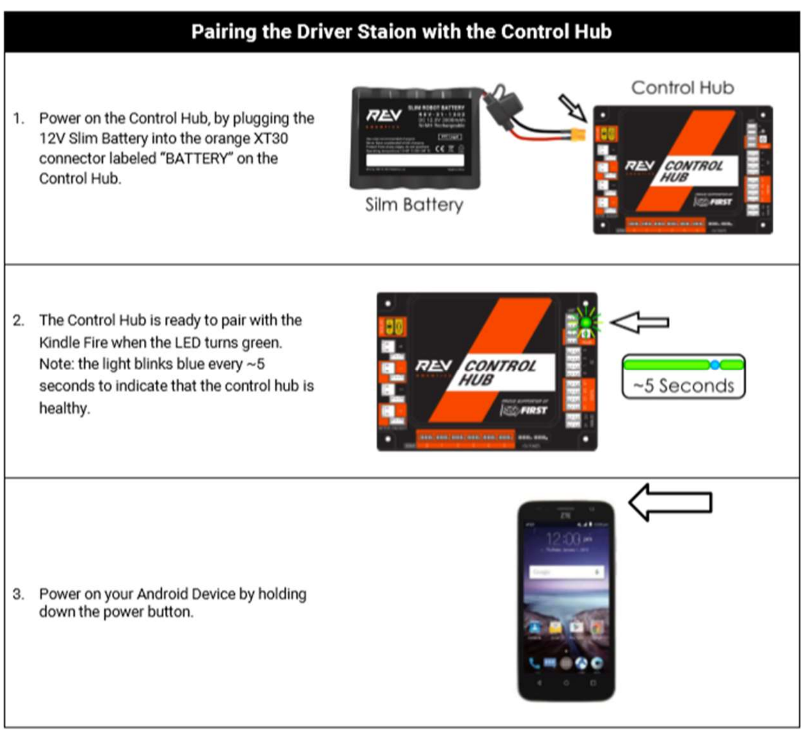
Thank you for submitting your application to participate in the 2019-2020 FIRST Tech Challenge Control Hub pilot.
If your application meets the eligibility criteria, you will receive an email with the coupon code that is necessary to receive the discounted price. Instructions on how to use the coupon code will be included in the email. Please allow 48 hours to receive a response.

3. Once you are approved, you will get a confirmation mail with a coupon code and detail steps on how to purchase the Control Hub at reduced price.

How to Connect the Driver station to the Control hub

Since Control hub acts like a robot control phone, the connecting process is roughly the same. The detail steps of connection the Control hub can be found at

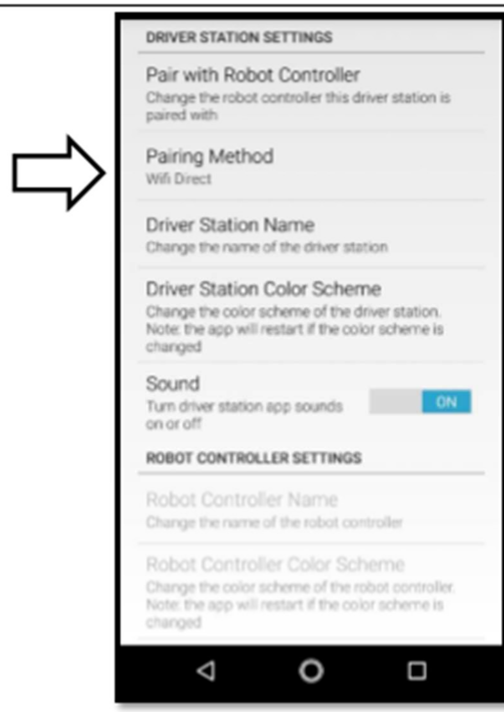
http://www.revrobotics.com/content/docs/REV-31-1595-GS.pdf



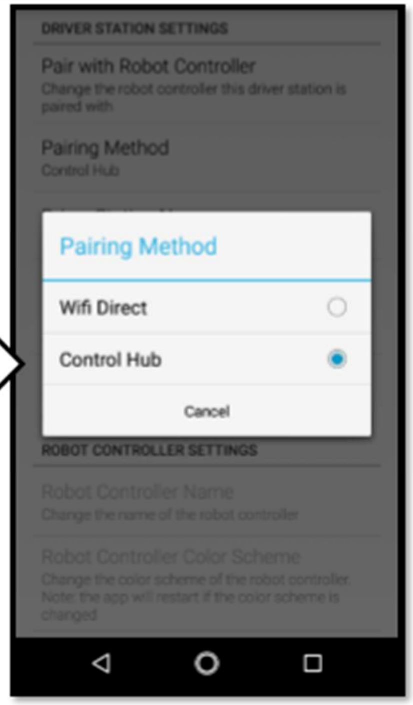
4. Open the Driver Station application from the HOME Screen.

5. On the Driver Station page, open the menu from the top right corner, then select "Settings".

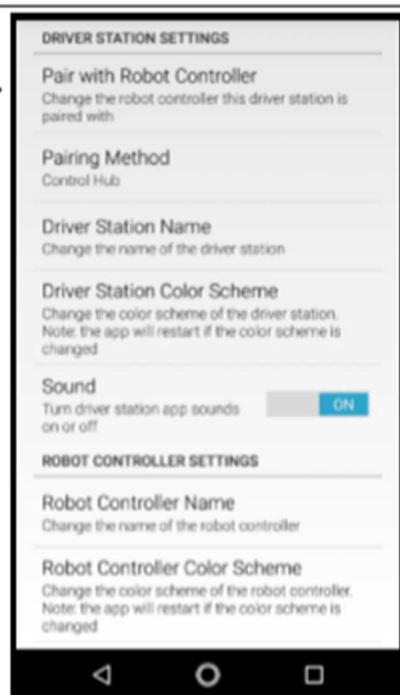
6. Select, "Pairing Method"



7. Select, “Control Hub”

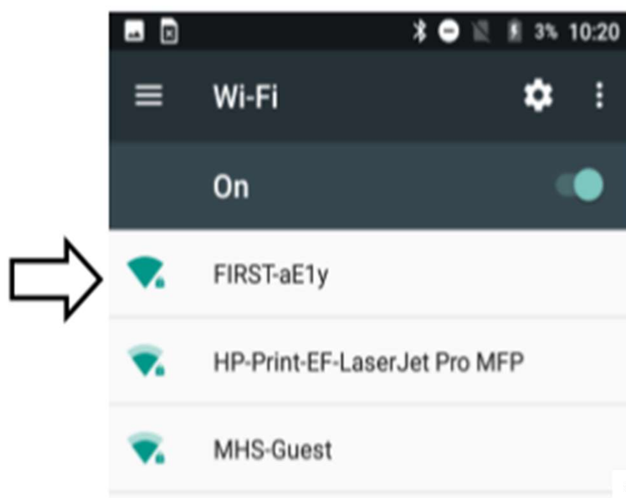


8. Select, “Pair with Robot Controller”.

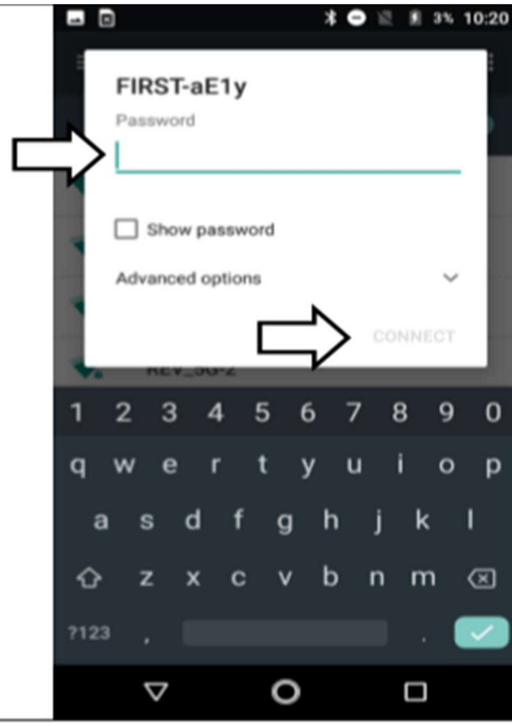


9. Select "Wifi Settings"

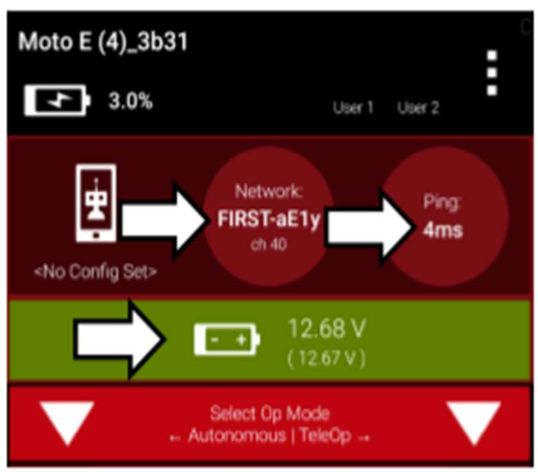
10. Select the name of the Wifi network that matches the name of the network printed on your control hub. This should start with "FIRST-".



11. Enter the password to the Wifi network in the password field. This defaults to "password". Press "CONNECT".
12. After pressing connect, press the back arrow at the bottom of the display until you return to the main driver station screen.



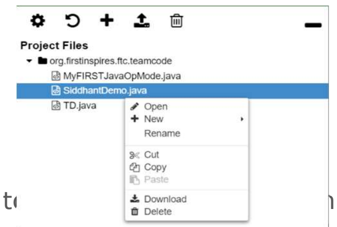
13. After a couple of seconds, the Driver Station page will indicate the network name, a ping time, and battery voltage.



Your Driver Station is now paired with your Control Hub!

Porting Code from Expansion Hub to Control Hub

Step 1: On the expansion hub left click on the code you want to send over. It should look like this:



Then click on download, next you will be asked t… …n your computer. Complete that and then disconnect from the expansion hub and connect to the control hub. (Note these same steps are applicable to folders inside of the java program.)

Porting Code from Expansion Hub to Control Hub

Step 2: Now that you are on the control hub, there should be a button in the top left that looks like this

click it and it should look like this

It should show the name of… , and end with.java. Select the code file from your folders and it should be in the java… now.

2019 FLYSET FTC Workshop

Odometry Wheels

(8/24/2019)

Presenter

Anthony - FTC 8565

- 9th year in FIRST
  - 3 years in Jr. FLL
  - 3 years in FLL
  - 2 years in FTC
- Software Lead
- Enjoys Skiing and Video Games

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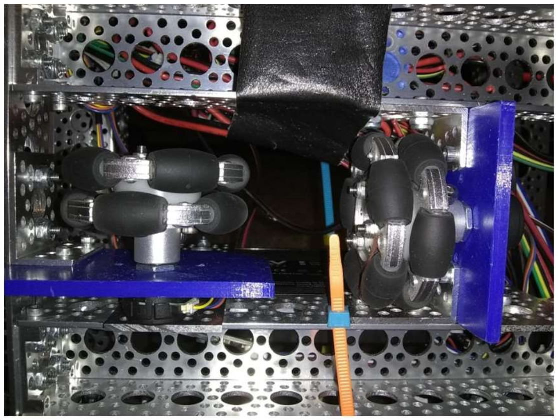
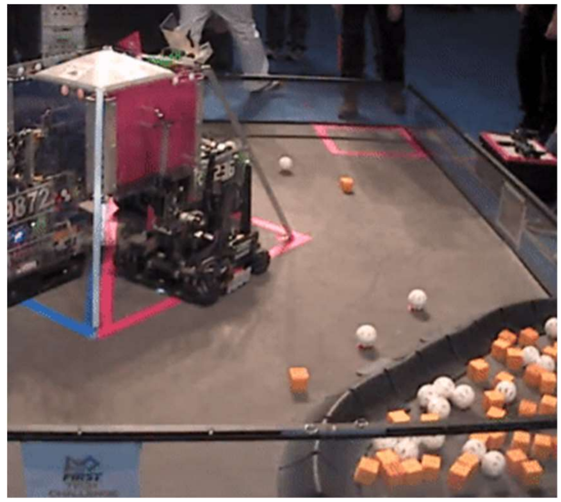
Project Background

Background





(Courtesy of FTC Team 8393, Detroit 2019 Ochoa F2)

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Project Design

Goals

- Learn how to construct an odometry wheel setup
- Compare odometry wheels to traditional motor mounted encoders

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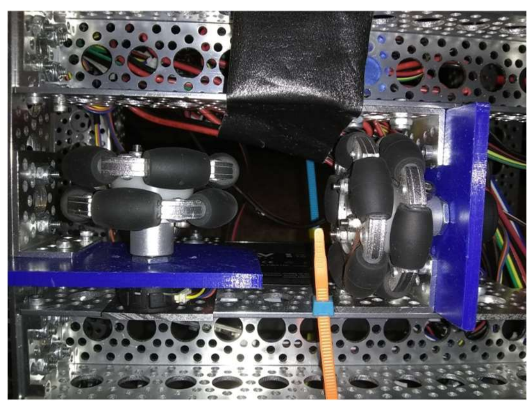
Robot Setup



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Setup

- 15 trial runs for each of the encoders for strafing - moving 112 cm
- 13v battery
- Shared PID controller
- No load or 15 pound load
- 100% speed or 50% speed
- Counts_per_inch found experimentally

Motor Encoder code

The code we used for the motor encoder:

```
public void mecanumSideDrive(double distance, double power) {
   distance *= COUNTS_PER_INCH;
   robot.defaultEncoderMode();

   int startDistance = robot.getEncoderPosition();
   float startHeading = robot.getHeading();
   timeoutTimer.reset();
   timeoutTimer.reset();

   while (Math.abs(robot.getEncoderPosition() - startDistance) < Math.abs(distance)) {
       double error_degrees = robot.getHeading() - startHeading;
       double correction = robot.gyroDriveController.findCorrection(error_degrees);
       robot.leftBackMotor.setPower(Range.clip(power + correction, -1, 1));
       robot.leftFrontMotor.setPower(Range.clip(power - correction, -1, 1));
       robot.rightBackMotor.setPower(Range.clip(-power - correction, -1, 1));
       robot.rightFrontMotor.setPower(Range.clip(-power + correction, -1, 1));
       dispEncoders();
   }
   robot.stopRobot();
   robot.defaultEncoderMode();

}
```

Dead Wheel Encoder code

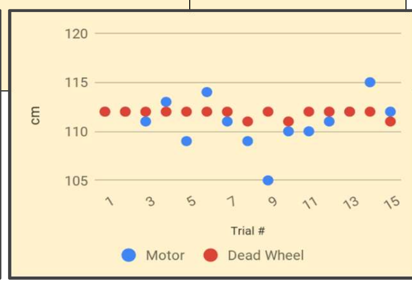
The code we used for the dead wheel encoder:

```
public void mecanumOdoSideDrive(double distance, double power) {
   distance *= Constants.S4T_COUNTS_PER_INCH;
   robot.defaultEncoderMode();

   int starty = robot.leftFrontMotor.getCurrentPosition();
   float startHeading = robot.getHeading();
   timeoutTimer.reset();
   timeoutTimer.reset();

   while (Math.abs(robot.leftFrontMotor.getCurrentPosition()-starty) < Math.abs(distance)) {
       double error_degrees = robot.getHeading() - startHeading;
       double correction = robot.gyroDriveController.findCorrection(error_degrees);
       robot.leftBackMotor.setPower(Range.clip(power + correction, -1, 1));
       robot.leftFrontMotor.setPower(Range.clip(power - correction, -1, 1));
       robot.rightBackMotor.setPower(Range.clip(-power - correction, -1, 1));
       robot.rightFrontMotor.setPower(Range.clip(-power + correction, -1, 1));
       dispEncoders();
   }
   robot.stopRobot();
   robot.defaultEncoderMode();

}
```

Project Results

Results

	100% Speed	100% Speed	50% Speed	50% Speed
	Motor	Dead Wheel	Motor	Dead Wheel
0 pound load	**3.1818**	**0.5936**	**1.8047**	**0.3399**



Conclusions

Conclusions/Observations

- Strafing with mecanum wheels has a significant amount of slippage. While strafing, **odometry wheels had 5.67 times smaller error than with traditional encoders**. Using motor encoders would have average error of 1.798 cm for every meter of strafing, and only 0.314 cm using odometry wheels.

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Lessons Learnt

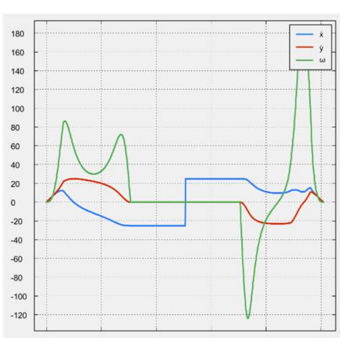
- Wheel height sensitivity- Sometimes the wheel can't touch the ground. We are going to spring load.
- Set screw hub coming loose
- Motor encoder port

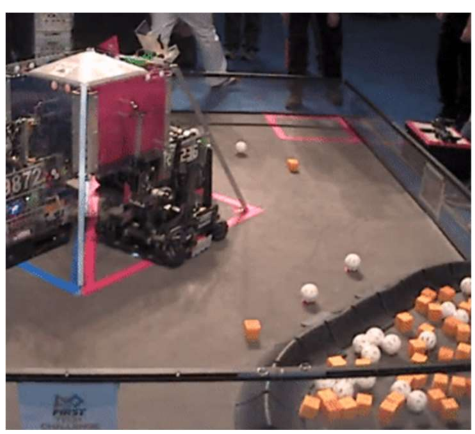
Sensor

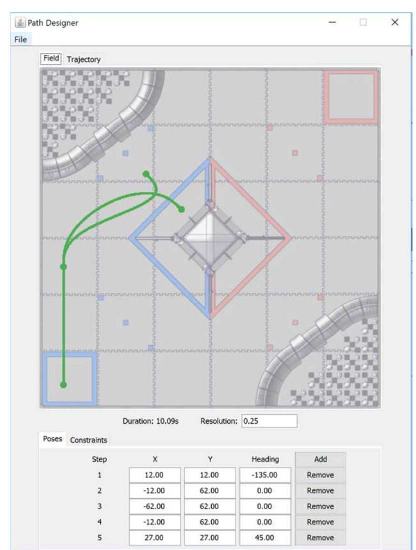
- Encoder damage- we had several encoders break from pressing against the ground too hard. This problem stopped once we switched from s4ts to e4ts though.
- S4t is generally better as it already comes with a shaft, so it is easier to put on and so it is harder for dust to get in and ruin the encoders.
- They are the basically the same thing, the only difference is the shaft

Next steps

- Roadrunner
- Spring loading







2019 FLYSET FTC Workshop

CAD Integration with Unity

(8/24/2019)

Presenter

Max Fan - FTC 8565

I have been in FIRST teams for 8 years.

- 3 years in Jr. FLL team
- 3 years in FLL team
- Currently my third year in FTC team

My role in the team is CAD lead. I have experience in PTC Creo and Fusion 360. Now I have experience in Unity.

My hobbies are reading, playing games, and watching movies.

FLY SET

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Project Background

FLY SET

For Fun and Learning New Cool Skills with Unity

FIRST CHAMPIONSHIP

FTC #6547

FLY SET

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Project Design

Goals

- Use gamepad to control robot mechanism movement in Unity Gaming Engine
  - Use C# script to detect gamepad key pressing and manipulate the imported CAD model

Process

1. Export CAD model into .obj file
2. Import CAD model obj file into Unity
3. Editing imported gaming objects with proper tags so they can be manipulated in script
4. Drag the gaming objects to turn make sure they have the pivot point set correctly
5. Attach C# script to the gaming object to confirm the rotation is on the same pivot point as manual drag
6. Write the gamepad controlling code in C# to move the intended gaming object (i.e., CAD model mechanism)

Project Results

Import CAD Models into Unity

- We chose to use our last season's robot as example (it was modeled in Fusion 360)
- At beginning of the summer:
  - Fusion 360 does not support export to .obj file
  - Two steps:
    - Fusion 360: exports to STEP file
    - PTC Creo: reads in STEP file and exports to .obj file
    - Unity: reads in .obj file
- With recent Fusion 360 update to support export to obj file
  - Single Step:
    - Fusion 360: exports to .obj file
    - Unity: reads in .obj file

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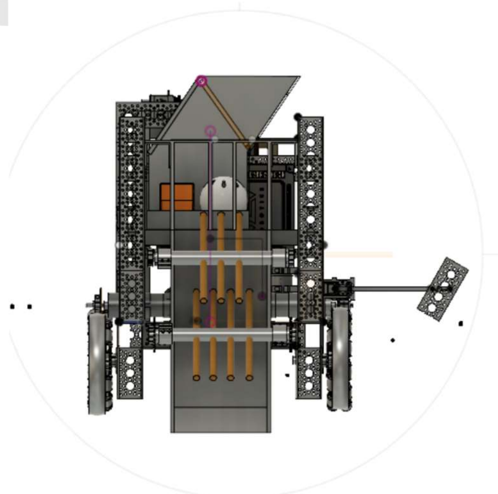
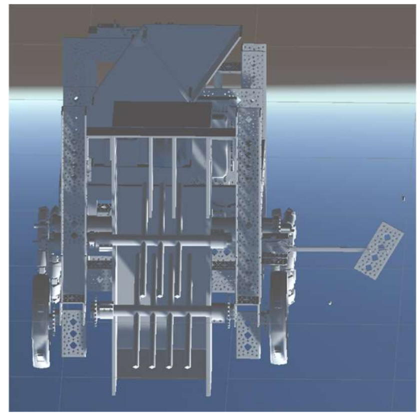
CAD Model vs. Gaming Objects in Unity





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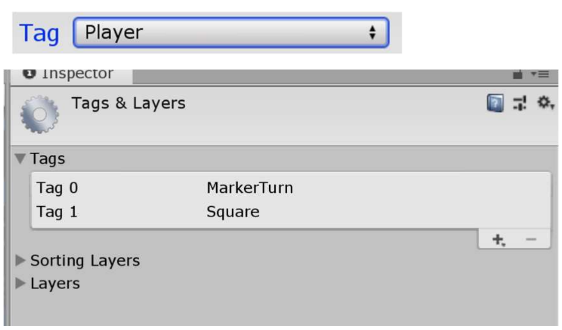
Editing Gaming Object for Tagging



- Tagging allows for identifying certain game objects (ie. Mechanism in CAD model)
- Tagged objects are looked up in code and controlled accordingly
  - Rotation
  - Sliding

```
public Transform objectToTurn = GameObject.FindWithTag("MarkerTurn").transform;

public Transform MarkTurn = GameObject.FindWithTag("Player").transform;
```

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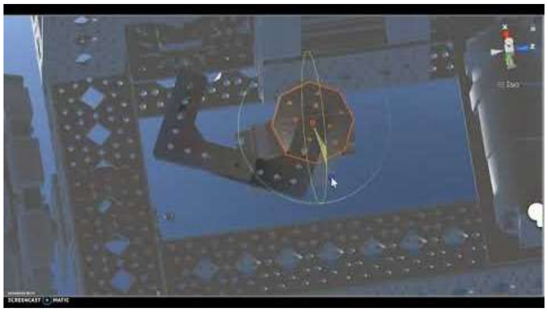
Dragging Gaming Object Manually



- The white cube in the middle of the circle is center of object
- Arrows control movement of the object manually
- Pivot point always stays the same no matter where dragged
- Rings turn the angle of the object

Using Script to Control Gaming Object

- Code lets us control the robot using arrow keys
  - Left arrow to rotate left
  - Right arrow to rotate right

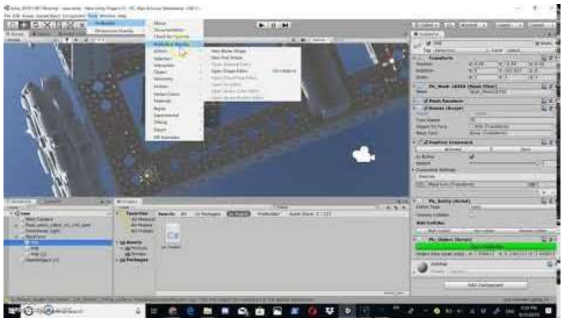
```
if (Input.GetKey(KeyCode.LeftArrow))
   objectToTurn.Rotate(new Vector3 (0, Time.deltaTime * -50, 0));
if (Input.GetKey(KeyCode.RightArrow))
   objectToTurn.Rotate(new Vector3 (0, Time.deltaTime * 50, 0));

Vector3 originPoint = new Vector3(1.08f, -1.25f, 2.96f);
```

Script Triggered Rotation Pivot Point Issue

Options to Resolve the issue

- **Option #1:** set the pivot point correctly in CAD before exporting
  - Confirmed in Fusion 360 that they are good (just after importing they changed locations)
- **Option #2:** attach the mechanism gaming object to an empty gaming object and manipulate the empty gaming object
  - Typical work around in Unity Community
  - For some reason didn't work, after attachment, manual drag works but not script triggered
- **Option #3:** Use ProBuilder to edit the pivot point of gaming object including the ones imported
  - ProBuilder is a free Unity asset even for the basic personal plan of Unity

Edit the Pivot Point Using ProBuilder



- Use the ProBuilder Window in Unity
- Select object from hierarchy to probuilderize
- Drag the object to the pivot point
- Click on "Freeze Transform" from the ProBuilder Window
- Drag the object back

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Script Triggered Rotation Pivot Point fixed

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Using Script to Detect Gamepad Keys

```
if (Input.GetKey(KeyCode.LeftArrow) || Input.GetButton("XButton"))
    objectToTurn.Rotate(new Vector3(0, Time.deltaTime * -50, 0));
if (Input.GetKey(KeyCode.RightArrow) || Input.GetButton("YButton"))
    objectToTurn.Rotate(new Vector3(0, Time.deltaTime * 50, 0));
```

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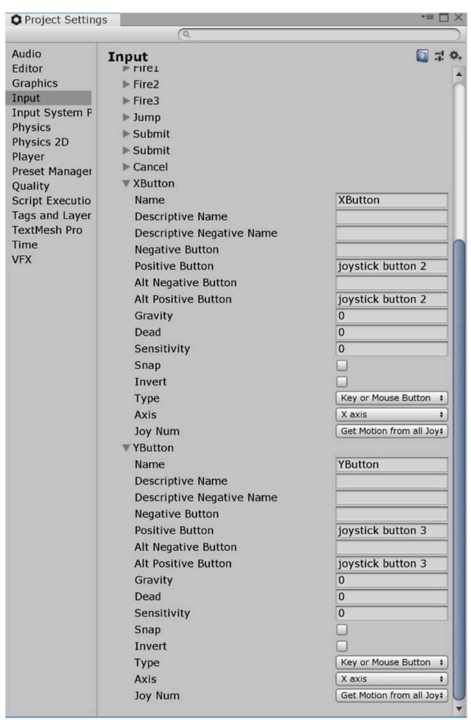

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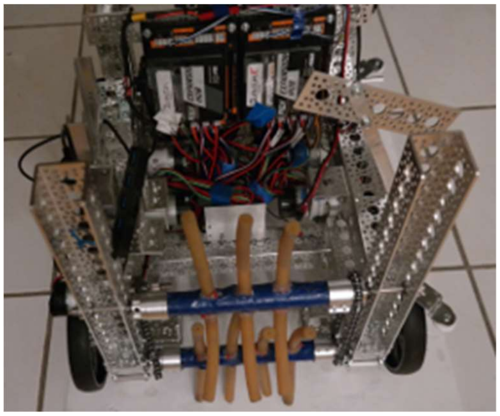
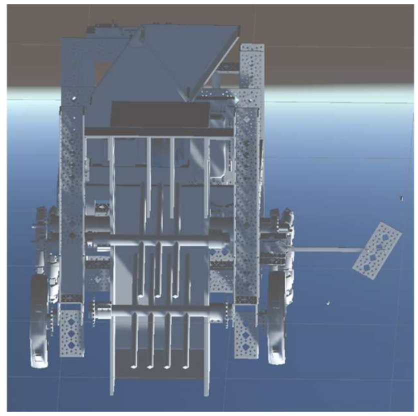
Live Demonstration





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Conclusions

Observations

- CAD model parts and Unity gaming objects correspond to one another
- Most challenging part is the pivot point change
  - Researching the solution to fix pivot points took about 60-70% project time
- Unity forums and Unity answers are VERY helpful

Tips

- Unity updates often, keep projects in one version
- Research for assets in the Unity Store, they will help
- Search in Unity Answers community for hints and solutions

Additional Info

Fusion 360 with REV Robotics Parts

Challenges:

- Transition to Fusion 360 last season with help from Team 9010

Goals:

- Model our 8 wheel suspension chassis (based on REV Kits of parts) in Fusion 360 to see how hard or how easy it might be

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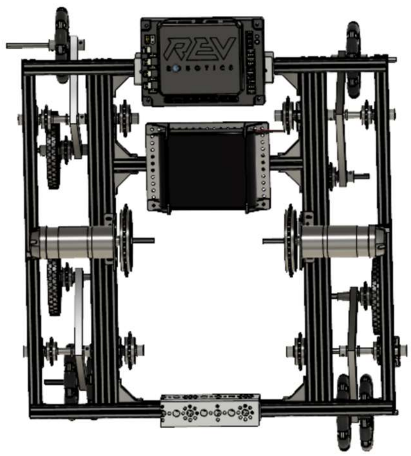
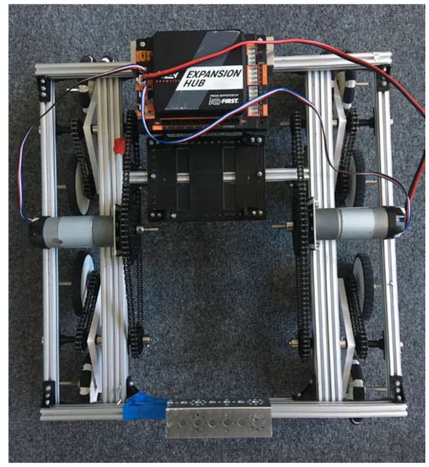
Fusion 360 vs Real Robot





Conclusions and Tips

- Successfully created the chassis model in Fusion 360
- Not hard, only difficult to select lines
  - Shouldn't be too hard, auto selects lines
  - Zoom in far enough to see all the lines cleary
- Can not do chains because then have to do one chain at a time
- REV pieces different than others

Morning Session - 11472
CAD with Autodesk Inventor
(10 minutes)

RAVENCLAW ROBOTICS 11472

CAD AUTODESK® INVENTOR® 11472

- Autodesk Inventor provides engineers and designers a professional grade solution:
  - -3D mechanical design
  - -Simulation
  - -Visualization
  - -Documentation

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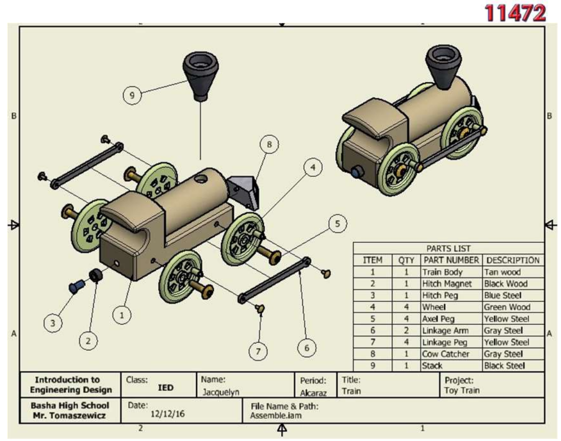
CAD AUTODESK® INVENTOR® 11472

- Autodesk Inventor allows engineers and designers to create:
  - -Drawings
  - -Parts Lists
  - -Presentations



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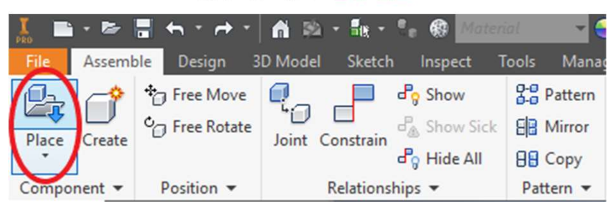
CAD AUTODESK® INVENTOR® 11472

<u>Advantages of Inventor</u>

- -Upload premade parts
- -Open source cad
  - Grabcad
  - 3D content central
- -Place parts in assembly

GRABCAD



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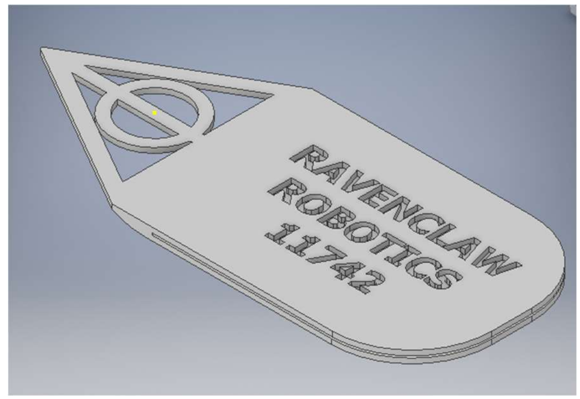
CAD AUTODESK INVENTOR 11472

11472

<u>Advantages of Inventor</u>

-Extensive options allow for precisely detailed builds with custom features

-Plano ISD engineering classes use Inventor



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CAD AUTODESK INVENTOR 11472

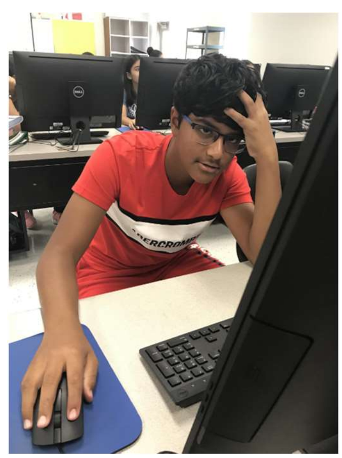
11472

<u>Disadvantages of Inventor</u>

-Complex software can be difficult to learn

-Expensive to purchase

-Some features are not needed for FTC



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CAD AUTODESK® INVENTOR® 11472

11472

Tips for using Autodesk

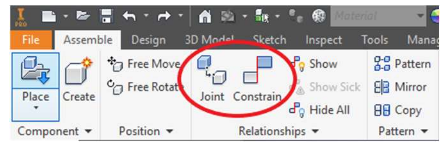
-Use Constraints and joints

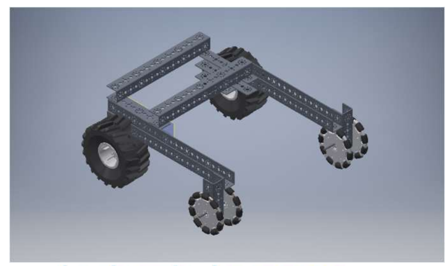
- Allow easy shifting of parts if needed

-Not all parts are required to be recreated in cad

- Only cad the main parts

-Make the robot in separate pieces.





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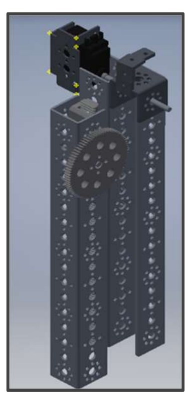
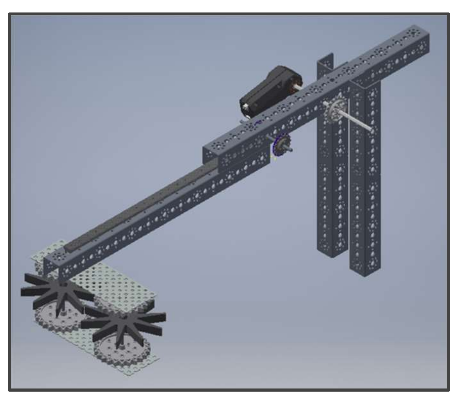
CAD AUTODESK® INVENTOR® 11472

11472

Presentation tips

-Use the snipping tool for a fast cropped screenshot





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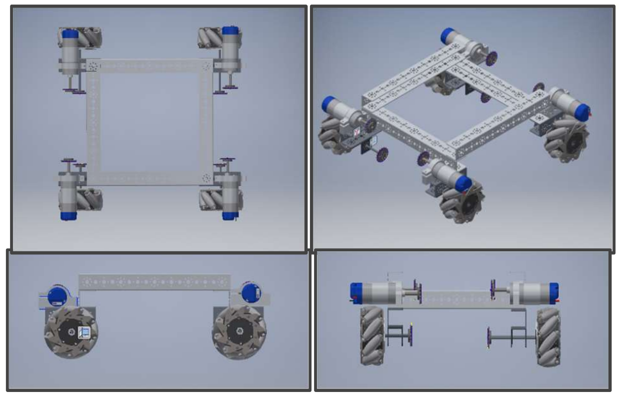
CAD AUTODESK INVENTOR 11472

11472

Presentation tips

- -Make multiple camera angles
- -Show multiple parts of your robot



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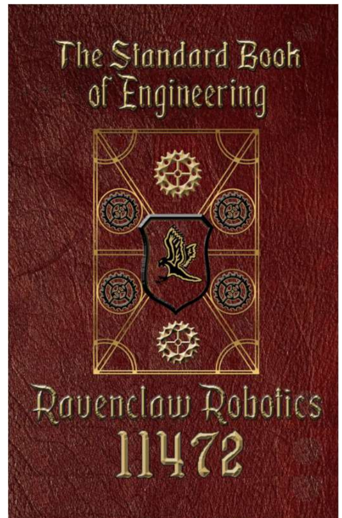
Morning Session - 11472
Engineering notebook

(10 minutes)

RAVENCLAW ROBOTICS 11472

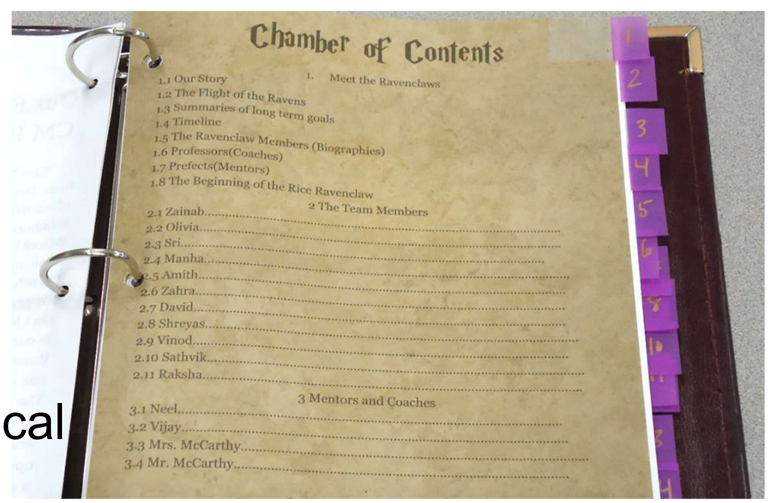
Engineering Notebook Topics - 11472

- Best Practices
- Content
- Organization
- Pitfalls
- Aesthetics,
- How to make your notebook stand out.



Engineering Notebook - 11472

Table of Contents
-Organized
-Well established
-Chronological



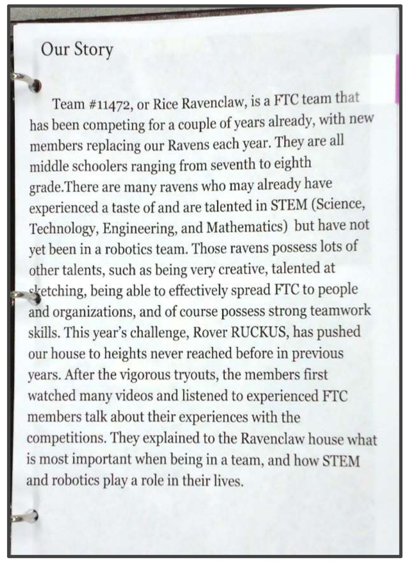
Engineering Notebook - 11472

Introduction
-Team Biographies
-Accomplishments
-Team History

Hi, my name is David Cui and I recently moved to Plano one year ago. I am a 7th grader and I have interests in physics, math, history, and engineering. I love fidgeting

My name is Shreyas Sailesh. I am a 7th grader at Rice middle school. This is my 3rd year of robotics. I love programming using robots and python. I have used a lot of digital coding and design challenges. I am a lover of robotics

Hi! My name is Amith Yedavalli and I am on the Rice First Tech Challenge Team. I've done robotics for a long time and I have mild experience in coding. I love hands-on learning and tinkering. One of my favorite parts



Our Story

Team #11472, or Rice Ravenclaw, is a FTC team that has been competing for a couple of years already, with new members replacing our Ravens each year. They are all middle schoolers ranging from seventh to eighth grade.There are many ravens who may already have experienced a taste of and are talented in STEM (Science, Technology, Engineering, and Mathematics) but have not yet been in a robotics team. Those ravens possess lots of other talents, such as being very creative, talented at sketching, being able to effectively spread FTC to people and organizations, and of course possess strong teamwork skills. This year's challenge, Rover RUCKUS, has pushed our house to heights never reached before in previous years. After the vigorous tryouts, the members first watched many videos and listened to experienced FTC members talk about their experiences with the competitions. They explained to the Ravenclaw house what is most important when being in a team, and how STEM and robotics play a role in their lives.

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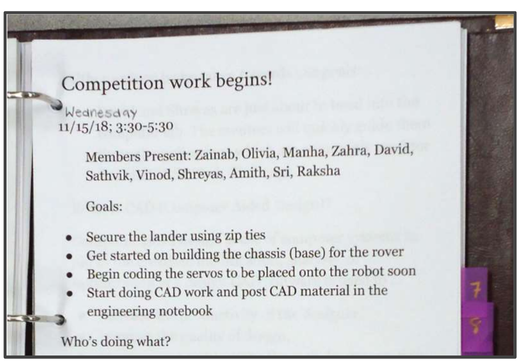
Engineering Notebook - 11472



Competition work begins!

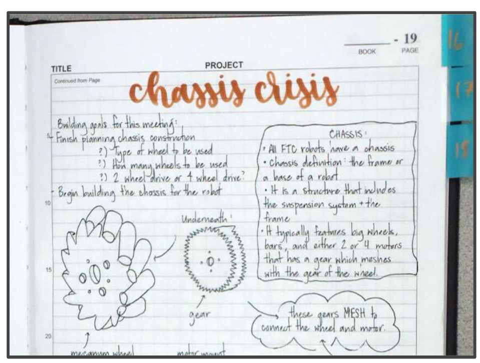
Wednesday
11/15/18; 3:30-5:30

Members Present: Zainab, Olivia, Manha, Zahra, David, Sathvik, Vinod, Shreyas, Amith, Sri, Raksha

Goals:

- Secure the lander using zip ties
- Get started on building the chassis (base) for the rover
- Begin coding the servos to be placed onto the robot soon
- Start doing CAD work and post CAD material in the engineering notebook

Who's doing what?



- 19
BOOK PAGE
TITLE PROJECT
Continued from Page
chassis crisis

Building goals for this meeting:
- Finish planning chassis construction
?) Type of wheel to be used
?) How many wheels to be used
?) 2 wheel drive or 4 wheel drive?
- Begin building the chassis for the robot

CHASSIS:
• All FTC robots have a chassis
• Chassis definition: the frame or a base of a robot
• It is a structure that includes the suspension system + the frame
• It typically features big wheels, bars, and either 2 or 4 motors that has a gear which meshes with the gear of the wheel.

Daily Log:
-Title, date, duration of meeting, and signatures
-Drawings and observations

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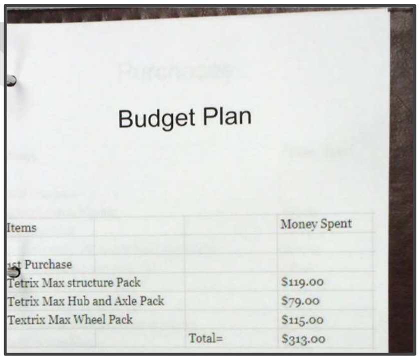
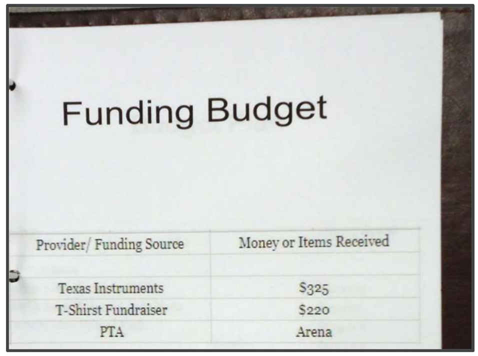
Engineering Notebook - 11472



Budget Plan

Items	Money Spent
1st Purchase	
Tetrix Max structure Pack	$119.00
Tetrix Max Hub and Axle Pack	$79.00
Textrix Max Wheel Pack	$115.00
Total=	$313.00



Funding Budget

Provider/ Funding Source	Money or Items Received
Texas Instruments	$325
T-Shirst Fundraiser	$220
PTA	Arena

<u>Business Plan:</u>

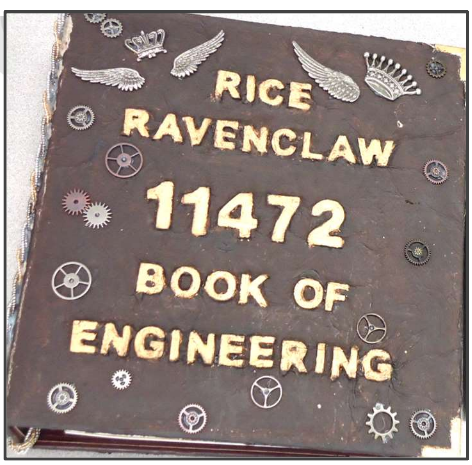
-Sponsors

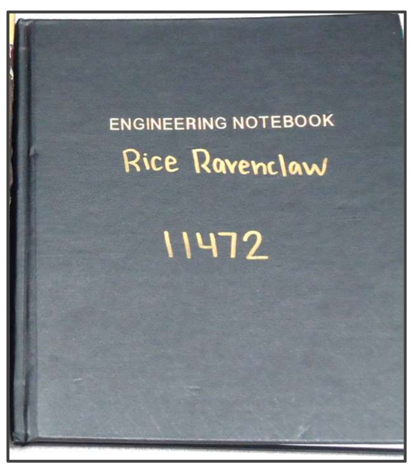
-Funding

-Team Spending

-Budget

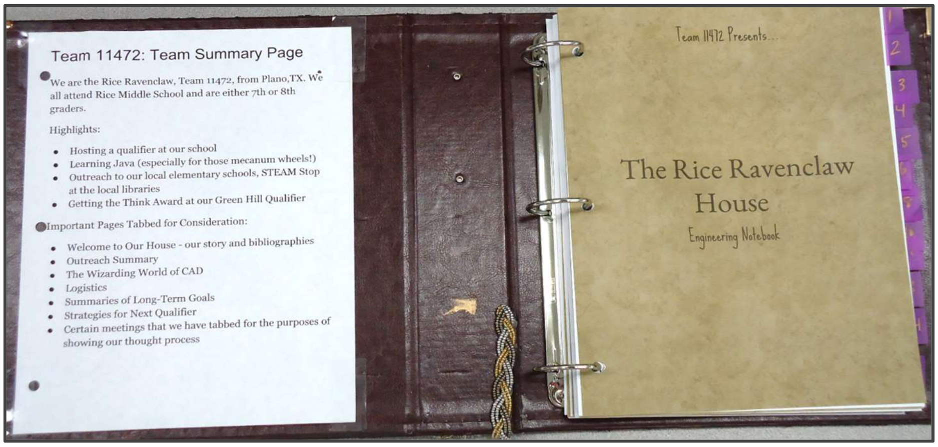
Engineering Notebook - 11472





Organization

Engineering Notebook - 11472



Organization

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Engineering Notebook - 11472

Organization

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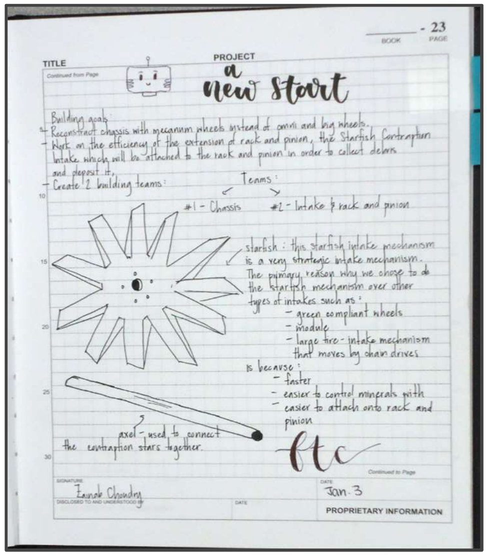
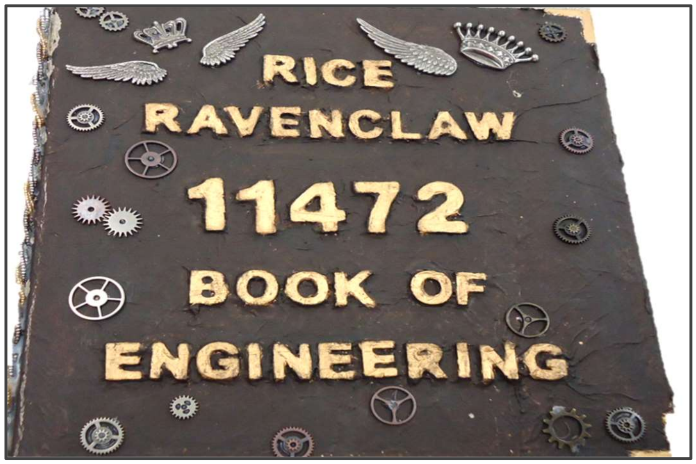
Engineering Notebook - 11472

Best Practices
-Avoid too much 1st person narrative
-Include specific details
-Keep entries and drawings technical



Engineering Notebook - 11472

Engineering Notebook - 11472



Aesthetics

Fundraising Ideas

FTC team 6566 Circuit Breakers

GOAL OF FUNDRAISING CAMPAIGN WILL BE TO MEET OR EXCEED ALL ANTICIPATED EXPENSES REQUIRED FOR ALL TEAMS TO PARTICIPATE IN FULL CAMPAIGN FOR THE 2019-2020 COMPETITION SEASON

HOW MUCH DOES IT COST FOR A TEAM TO COMPETE ALL THE WAY THROUGH "WORLDS"

- COST TO BUILD ROBOT
- TRAVEL
- FOOD
- ENTRY FEES
- UNIFORMS
- PIT

THERE ARE A VAST NUMBER BUSINESS' IN THE AREA (PARKER & TARRANT CO'S.) THAT ARE RELIANT ON STEM FACTORS FOR THEIR SUCCESS. THESE SHOULD BE YOUR MAIN TARGETS FOR $$$!!!

- MANUFACTURERS
- CIVIL DEFENSE
- TECHNOLOGY BASED
- SOFTWARE COMPANIES
- OIL & GAS
- CONSUMER GOODS
- LOGISTICS
- COMMUNICATIONS
- HEALTH CARE
- AND MANY, MANY, MORE!!!

THERE ARE ALSO A LOT OF BUSINESS’ THAT AREN'T INVOLVED IN STEM, BUT WILL STILL GIVE $$$. THESE SHOULD BE YOUR SECONDARY TARGETS:

- RESTAURANTS
- BANKS
- CAR DEALERSHIPS
- HOME BUILDERS
- NATIONAL RETAILERS
- LOCAL RETAILERS
- INSURANCE AGENTS
- REAL ESTATE COMPANIES
- RAW MATERIAL SUPPLIERS
- LAW FIRMS
- MEDICAL FIRMS
- PHARMACY’S
- GROCERY STORES
- AND MANY MORE!!!

YOU WILL DEVELOP A PLAN TO CONTACT A TARGETED LIST OF COMPANIES AND ASK FOR THEIR SUPPORT.

THE GOAL OF THIS EFFORT WILL BE A FULLY FUNDED TEAM WITH CORPORATE SPONSORSHIPS THAT ARE “SUSTAINABLE”

INITIAL “TWO PRONG” APPROACH

1. DIRECT, TARGETED MAILING: LETTER & FLYER INFO ON CLUB
2. DIRECT, TARGETED EMAILS: INTRO LETTER AND INFO ON CLUB

AS AN EXAMPLE OF SOME OF THE COMPANIES TO TARGET:

MANUFACTURERS

Alcon

General Motors

Ben Hogan Golf

Etc.

CIVIL DEFENSE

Lockheed Martin

Bell Helicopter

Textron

Etc.

OIL & GAS

Devon Energy

Oilfield Services Co's.

Drillers

Equipment/Tool Manufacturers

ONCE IDENTIFIED, COMPANIES WILL BE RESEARCHED TO DETERMINE WHO EXACTLY IS THE RIGHT PERSON TO REACH. MOST OF WHAT YOU NEED TO KNOW CAN BE FOUND ON THE TARGETED COMPANY'S WEBSITE. MANY OF YOUR TARGETS ALREADY HAVE FUNDS SET ASIDE, HOPING A GROUP LIKE YOURS WILL COME FORWARD AND ASK FOR THEIR MONEY!!!

"GIVING BACK"

https://www.chick-fil-a.com/About/Giving-Back

"GRANTS"

https://www.lockheedmartin.com/en-us/who-we-are/communities/applying-for-contributions.html

"DONATIONS"

https://www.alcon.com/about-us/corporate-social-responsibility#monetary-donation

SO NOW WHAT?

- Write a letter that explains:

1. Who you are
2. What you want
3. Why you want it
4. What you will use $$$ on
5. What's in it for them

- Create a "flyer piece" to provide in addition to the letter. This piece will:

1. List club accomplishments
2. Info on members
3. Explain what's "in it" for them
4. Provide clear instructions on how to donate: i.e. Links & contact info
5. Provide access to charitable donations docs.

ACTION ITEMS

- Director

1. Budget amount
2. Tax contribution docs
3. How to donate:

- Links
- Bank account
- Etc.

- Members

1. Identify Targets

- By category/type
- Divide and conquer

1. Letter
2. Create Flyer

- Club accomplishments
- Member bio's: class, position/job, hobbies, GPA, dream school, dream job.
- Sponsorship "Levels"

More $$$ = More Benefits

Example Flyer

James Madison High School Robotics Team is Seeking Corporate Sponsors

The JMHS Robotics Team 620 (www.jmhsrobotics.org) seeks support for the 2011-2012 season. Our team is proud to be affiliated with the US FIRST robotics competition. FIRST – For Inspiration and Recognition of Science and Technology – was founded in 1989 and is based in Manchester, New Hampshire. FIRST (www.usfirst.org) is a 501 (c) (3) not-for-profit public charity with the mission to inspire young people to become science and technology leaders by engaging them in exciting mentor-based programs that build science, engineering and technology skills that inspire innovation; and to foster well-rounded life skills including self-confidence, communication and leadership. The FIRST Robotics Competition (FRC) promotes exactly the kind of skills that high-tech companies require.

The FIRST Robotics Competition exposes thousands of high school students to engineering and technology in an exhilarating real world

parts provided by FIRST. The robot is designed to accomplish a variety of specific tasks that are changed each year. All of the design and construction must be completed during an intensive six week period prior to the regional competitions in Washington, D.C. and Pittsburgh, PA. In addition, the team participates in outreach activities, such as demonstrating the robot for community groups and local elementary students.

The budget for registration fees, building and shipping the robot, and the team's travel to the competitions is about $30,000, with the registration fees alone being $9,000. We are now looking for corporate sponsors to allow the team to compete again this year. Past sponsors have included SAIC, Alltech Corporation, BAE Systems, Booz Allen Hamilton, Dynalectric Corporation, NASA, ExxonMobil, The PTR Group, and the Vienna (VA) Optimist Club. Donations range from $500 to $10,000. Sponsors at the $500 level and higher have their corporate logos included on our t-shirt and team banner. *All gifts of any amount are appreciated!*

Please consider becoming one of our sponsors.

Booz Allen Hamilton, Dynalectric Corporation, NASA, ExxonMobil, The PTR Group, and the Vienna (VA) Optimist Club. Donations range from $500 to $10,000. Sponsors at the $500 level and higher have their corporate logos included on our t-shirt and team banner. *All gifts of any amount are appreciated!*

Please consider becoming one of our sponsors. **It is a great way to get positive name recognition and encourage the development of future engineers, scientists and technology experts**. Tax deductible checks can be made out to James Madison High School (Note: Robotics Club) Tax ID #54-080573 or to FIRST Robotics (Note: Team 620) EIN #22-2990908 and mailed to:

James Madison High School ***OR***
FIRST Finance - Team 620
2500 James Madison Dr 200
Bedford Street
Vienna, VA 22181 Manchester,
NH 03101

Please contact Mark Krikorian, Fundraising Chair (msk@cis.org, 703-938-4789) if you have any

Part 2
Afternoon Sessions

2.1 Blocks Programming

This session, open to the general public, was offered at the workshop for the first time this year, and was very well-received.
With Blocks Programming for FTC Robotics, led by the Technicbots, participants were paired up and guided through the entire process of getting a FTC robot moving, from setting up the phones and configuring to creating a real op mode and testing it. We would like to thank the various FTC teams (11341, 11472, 16296) who agreed to lend their robot and programmer to help with this session.

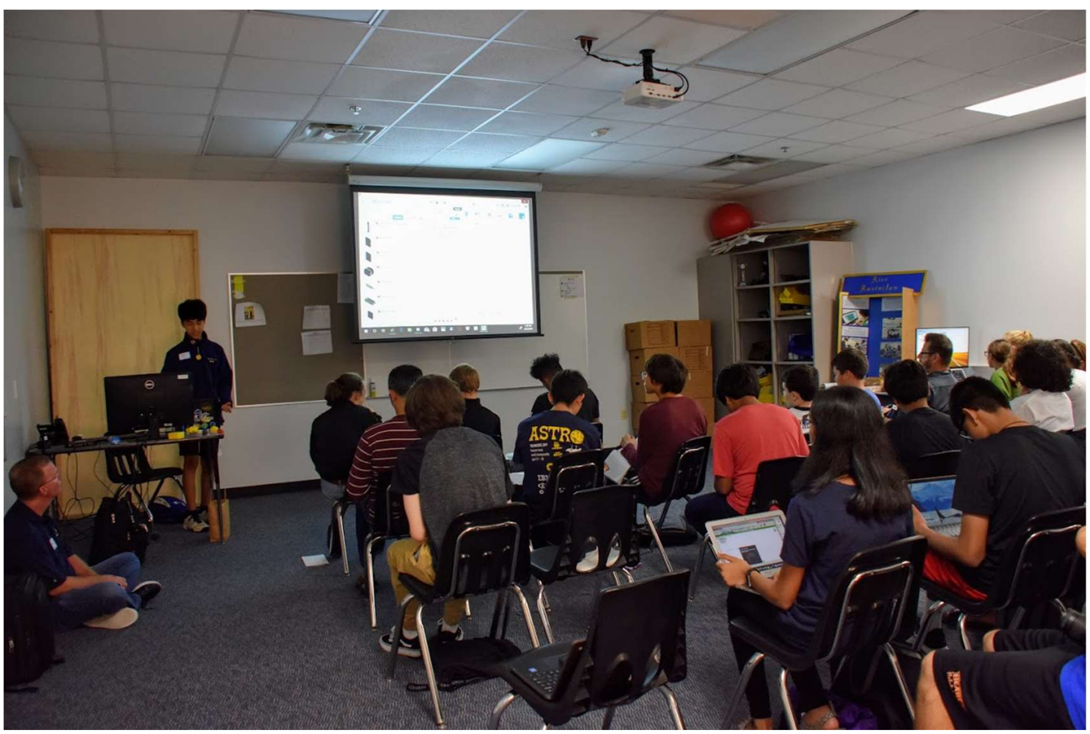
2.2 OnBot Java Refresher

The OnBot Java session was led by FTC team 15536 (Liberty Cyberhawks). Participants were taught how to use OnBot Java to program and download their op mode to a robot controller phone.

2.3 Fusion 360 Quick Intro and Deep Dive Discussion

This session was led by FTC team 8565 (Technicbots) and FTC team 9010 (Robotic Rangers) and provided participants with an introduction into the Fusion360 software as well as a tutorial on how to use it. Team 9010 provided hints and tips for some of the deep dive topics.

There was high interest in this topic, as the room was full before the session started. There was in-depth discussions during the session and even a prolonged session period.




Rice

2.4 FTC Rookie Team Panel Discussion

The Rookie Team Panel Discussion, led by team 11341 (ViBots), was an informal panel discussion between rookie teams, with the experienced coaches as panelists (6832, 11341, 12764, 15152, 15536). First-year FTC teams were able to meet and interact with each other and talk about all aspects of starting and making a successful FTC team.