2018-19

FTC 9773

ROBOCRACY

ENGINEERING NOTEBOOK

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Our Team Story

“Resilience through Innovation & Simplicity”

We are a fourth year 4-H team with 3 new members. We are a diverse group of 11 boys and girls, in grades 8 to 12 from 6 different school districts, and while we may speak up to 6 different languages, we are united by a common passion for STEM.

Our theme this year is resilience through innovation and simplicity. Last year, after finishing first place at our Hudson Valley Regionals, we came back dead last from Eastern SuperRegionals. We took this opportunity to take a hard look at our process. After last year's season, where we strove for innovation for the sake of having a cool cutting-edge design, we have learned from our mistakes and are now striving for resilience through innovation and simplicity.

For the first time, we kick-started our season with the "build a robot in 36 hours" challenge. During this time, we were able to efficiently flush out a design and develop an intuition for the game. Because of this, we were able to break down our process and make sure to have deliberate design decisions that focus on resilience and efficient simplicity, in addition to innovation. Our process emphasizes analysis of competing ideas, developed by competing design groups, which are considered head to head until the stronger idea wins.

We maintain our process for sustainability which we cultivated last year, to become a more efficient and sustainable team. We each strive to learn two new skills during the season and we have a strong culture of mentoring each other. This protects the team from losing skills when someone graduates from the team.

An important part of being a member of Team Robocracy is making time for our robust outreach in the community. We seek to empower other kids to develop skills that they can use for the rest of their lives, thereby building their own resilience. We also share our expertise and skills where we can have a positive impact in the lives of others. We run multiple afterschool enrichment programs targeting underserved communities, run robotics camps, 3D print prosthetics, and recycle computers to donate to third world schools.

We are very grateful for our membership in 4H. 4H provides for us an excellent platform for our outreach and has enabled us to reach many communities that would otherwise not be exposed to STEM and robotics. 4H also gives us access to important resources such as advertisement, Lego Mindstorm kits, and their liability insurance for our workshops! Our Off The Streets and Amazing Afternoons programs in Mt. Vernon Elementary Schools are both conducted through 4H. As the only STEM-based 4H club in our area, we also take seriously our role of promoting and inspiring interest in STEM at fairs and all of the outreach we do.

Meet the team

Mitsiky
Member since 2015

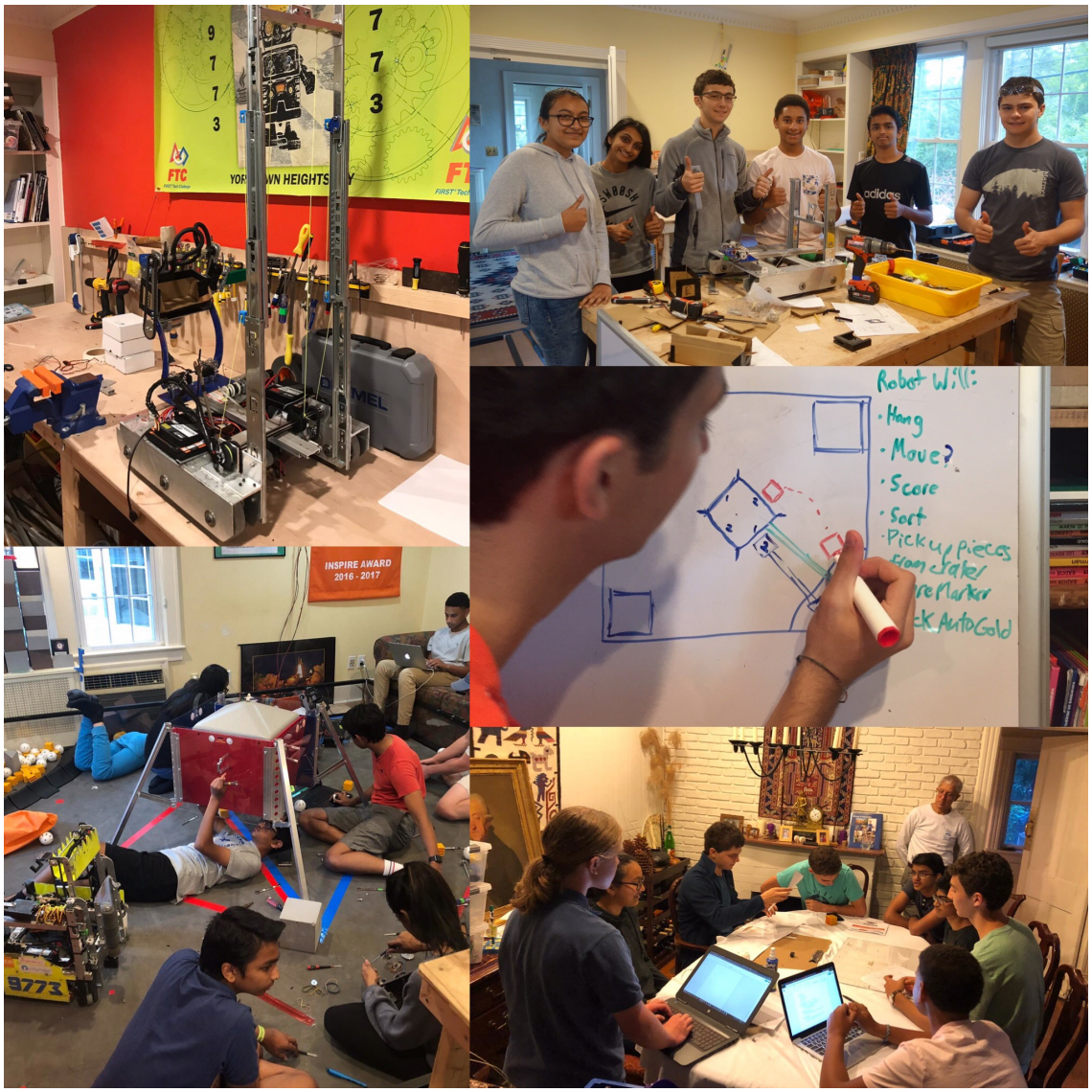
Role: Team Mascot

Outreach: Hoping to become a Therapy Dog so I can participate in the team's outreach, too!

I am a 4 1/2 year old Coton de Tulear and have been team mascot for two years. I am a wonderful distraction. I take seriously my job, doing my best to make everyone smile. In fact, my name, Mitsiky, means "My Smile" in Malagasy. My favorite hobbies are visiting chipmunk holes, playing tug-of-war with my toy bunny, and just being cute.

My goal this year is to earn my credential as a Therapy Dog so that I can participate in the team's outreach and make everyone feel good by flashing my warm smile. Also, I hope to finally catch a squirrel.

August


9773
FTC
INSPIRE AWARD
2016 - 2017
Robot Will:
• Hang
• Move?
• Score
• Sort
• Pick up Pieces
adidas

Preseason - August 19-25.

Programming Chassis Suitable to Test Localization.

Time: 20 Hours.
Meeting Participants: Nicolas, Zachary.

	Task:	Goals and Reflections:
1.	**First Iteration Mecanum Drive Module**	First attempt at lightweight chassis, worked well but could be made more compact.
2.	**Second Iteration Mecanum Drive and Integration into Chassis**	Second attempt is more compact and stronger.

Meeting Summary

The goal of this week is to develop new technology for the season. We focus on Mecanum wheels, which we have not used for a long time. Our immediate goal is design a platform to learn to program encoder wheels. We also want to gain experience in using bear motors, namely motors without internal gear boxes.

Task 1: First Iteration Mecanum Drive Module.					
Strategy	**Design**	**Build**	Math/Physics	Software	Team

1.1: Goals

- Design a mecanum chassis to use for testing localization and autonomous driving.
- Use the chassis to validate (or invalidate) new design ideas (bare motor drivetrain).
- Low cost.

1.2: Design Process

First, we plan components to use for the drive train. We do so by first considering our design goals for this robot in order of importance, then assessing how we can best accomplish these goals. Often, one design choice can satisfy many factors simultaneously.

Table 2: Design goals for the programming chassis.

Factors	Solutions
Testing New Designs	• Incorporate odometry wheels (for position tracking) • Prototype use of motors without gearboxes (With external reduction) • Test mecanum wheels
Low Cost	• Use motors without gearboxes: this will allow us to use our classic Neverest 20 motors (which we decommissioned due to their fragile gearboxes). • Design with mostly plywood, EuroBoard, and 3d printed parts. • Use Nexus mecanum wheels (already on hand). • Use EMS22Q Bourns encoder for odometry wheels (least expensive compatible encoder that satisfies the design constraints).
Analogous to Typical Competition Robots	• Make the robot lightweight, so we can add weight to match any future robot?s weight for testing • Use Mecanum wheels (we already have test tank chassis, and are looking to experiment with mecanum)

1.3: CAD and Build

A complete chassis requires 4 identical wheel modules, which contain a mecanum wheel and its motor. The CAD model is shown in Figure 1 on page 6. We CNCed the parts as well as 3D printed the large pulley. The result is shown in Figure 2 on page 7.

- Nexus mecanum wheel
- Single belt reduction from bare motor to wheel
- Adjustable tensioner pulley
- EuroBoard side plates
- Churro standoffs
- Extremely compact

Figure 1: CAD model of mecanum wheel module (first iteration).

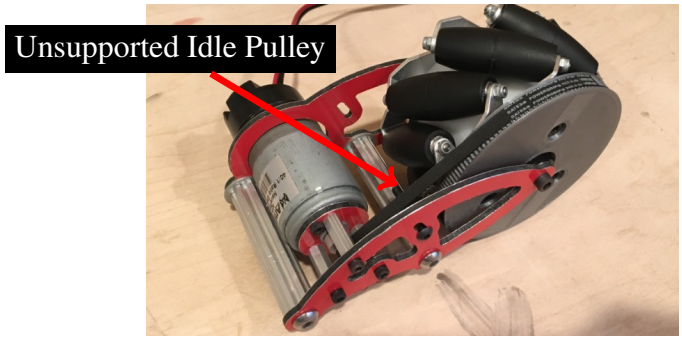


Figure 2: Prototype of mecanum wheel module (first iteration).

Table 3: Conclusion after first build.

Works	Need Improvement
• Wheel runs smoothly • Press fit bearings in wheel work flawlessly • Motor standoffs work well • EuroBoard is a fantastic prototyping material - cuts easily on the CNC	• Cantilevered idler bearing deforms the EuroBoard under load - needs support from both sides • EuroBoard is not very strong - not suitable for competition robot drivetrain, but works for light

1.4: Conclusion

The module looks promising, and has already successfully demonstrated the effectiveness of using EuroBoard as a prototyping material, though we should avoid using it structurally on a competition robot. The idler pulley needs to be redesigned with support on either side, and we can likely make the entire module even more compact by using a slightly shorter belt!

With these small modifications, the module is ready to be used on the programming chassis. We now need to design the chassis itself, as well as mounting points for all the sensors.

Task 2: Second Iteration Mecanum Drive and Integration into Chassis.

Continuing from:Task 1 on page 5

Strategy	**Design**	**Build**	Math/Physics	Software	Team

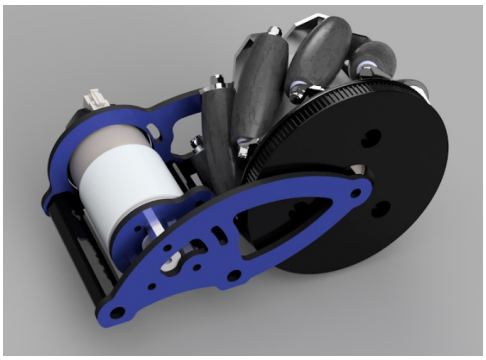
2.1: Goals

- Suggested improvements from Task 1 on page 5.
- Design odometry wheel modules.
- Design complete chassis.

2.2: Design

Using the feedback from Task 1 on page 5, we redesigned the CAD model for the wheel module, shown in Figure 3 on page 8. We reused an odometry design, shown in Figure 4 on page 8. The full chassis consists of 4 wheel modules and 3 odometry modules. The Chassis CAD is shown in Figure 5 on page 8.

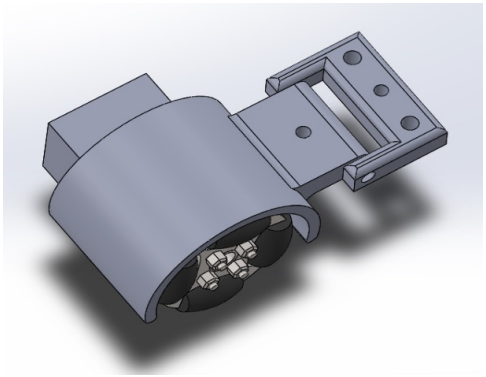
We CNCed the parts as well as 3D printed the large pulley. The result is shown in Figure 2 on page 7.



Improvements:

- Idler Bearing supported from both sides
- Shorter plate layout
- Slightly smaller pulley on the wheel to avoid scraping on the mat

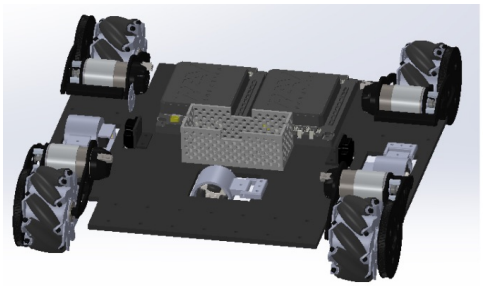
Figure 3: CAD model of mecanum wheel module (second iteration).



Features:

- 38mm omniwheel
- 1024 ppr direct mounted encoder
- Shielding to protect encoder
- Spring-loaded against the mat for improved reliability
- Accurate mounting holes

Figure 4: CAD model of odometry wheel.



Features:

- Lightweight simple chassis
- Fast Mecanum wheel base
- 3 odometry omniwheels
- 2 light sensors facing the mat
- Plywood base - easy to manufacture

Figure 5: CAD of entire Chassis.

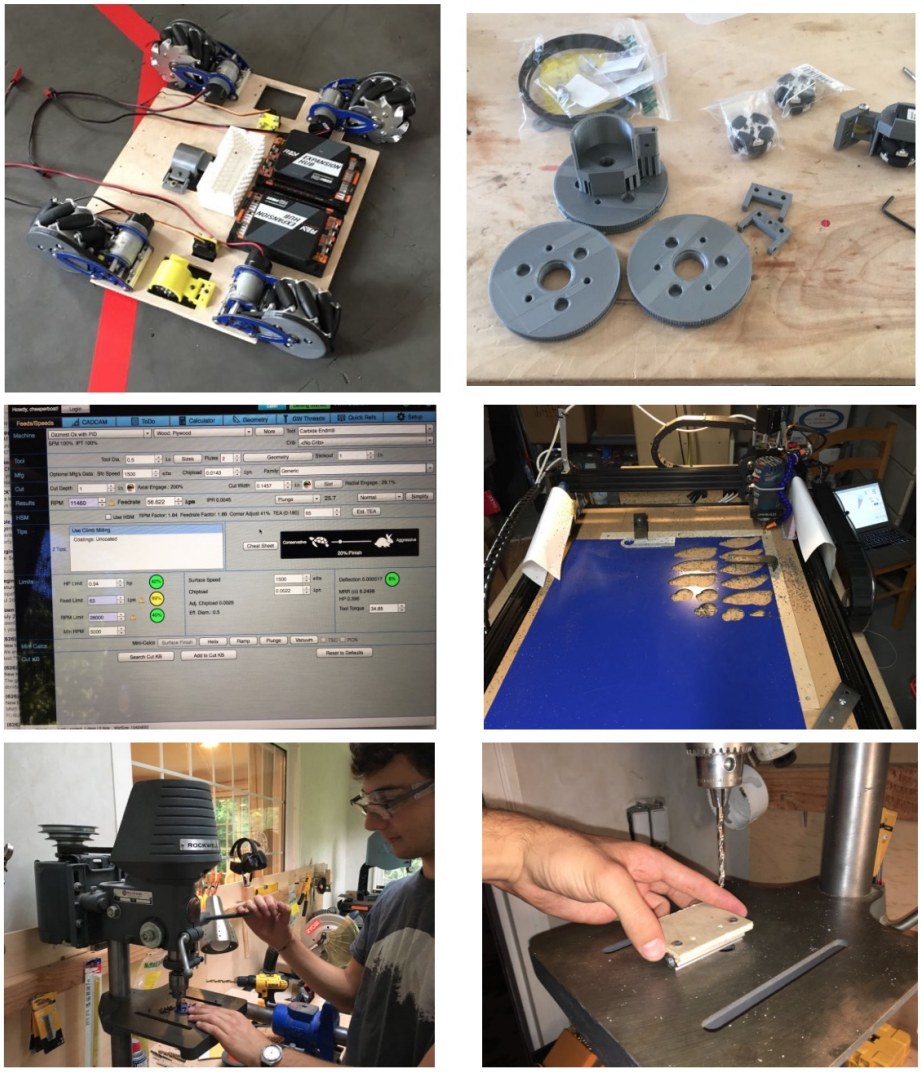


Figure 6: Building of full chassis (second iteration).

Signed by:	Nicolas Zachary.	**Date:**
		August 19-25