5839B's Notebook

Table of Contents

Entries

Appendix

Post Season Build Analysis

For the building of our previous robot even though it unfortunately did not make worlds there were a lot of aspects executed properly and poorly to be identified. This is important as it allows the team to know what works and to keep doing as well as what to change in order to improve for the next season.

Drive Train The Drive Train is the base of any robot. The previous seasons drive train used 6 11w motors with the blue cartidge and a 48:60 gear ratio giving an RPM of 480. This spun 3 omni wheels with the middle one on each side being locked.

Pros	Cons
• speed • Pushing power • Strong Wedge	• Turning • Reliability • Over Heating • Field Traversal

-> Drive Train

Intake The intake was pwoered by 1 5.5w motor spining a series of 2in 45A flexwheels to interact with the game objects. It was a later addition and made use of many buildign techniques learned over the cource of the season.

Pros	Cons
• Picke	• Turning • Reliability • Over Heating • Field Traversal

-> Drive Train

What to do now?

- With the biggest problem being the drive a variety of drives should be modeled and tested in order to have a better idea of what works for the next season
- Work to create new odometry module desings that are stronger and more compact
- Take inventory of the parts available to our team so that when designing we know what parts we can use and how many of them are available
- Put together an order list of parts that the team wants to asses the needed funds
- See what funding is available to the team and what amount should be allocated to new parts
- Look into making a functional PTO (power take off) as they can allow for more powerful drives while still having all the desired mechanisms to manipulate game objects
- Look for or model our own paddels for the controller that suite the needs of our driver

3d design software

2024/03/10

Before any models for possible drive trains or new odometry sensors can be made a decision on what software to use is necessary. In the previous season we adpoted Autodesk inventor. There were a variety of reasons for this the primary one being familiarity. At Eastern Technical Highschool their is an Engineerign Magnet program which teaches Autodesk inventor. This not only means over half the team who is in this program know the software, but also there is 3 teachers who can assist us with any issues. Also with Inventor being used by the school the county provides a VDI or Virtual Desktop Interface where you can log in remotley to a desktop with Inventor. This allows the team who does not all have access to a high qaulity laptop to access the model on the shcool issued chromebooks. Due to these reasons we find it impractical to switch design softwares. Not only would we have to remake some of our premade assemblies such as for flex wheels, but we woudl have to spend time learnign new software which outweighs any of the other softwares advantages.

Designed by: Davis Bodami
Witnessed by: Praful Adiga

To effectivley use any software wether for coding or modeling file organization is key. To share these files the team makes use of Microsoft Onedrive since it works best with windows device which the majority of the team has.

For the Inventor the main robot assembly is made from a variety of sub assemblies. These sub assemblies are each for a key system such as the drive train or intake. There can exist further sub aseemblies within these as well such as that for the odometry sensors within the assembly they are attachetd to. To organize the many file for this a variety of naming conventions are used based off of the guide lines from Perdu Sig Robotics.

- Robots are marked with a folder labeled “! Robot Name”

-Within in that folder is the main assembly of the same name

-Assemblies or cut parts used throughout the model are stored in this high level folder

-There are also folders with each of the sub-assemblies labeled “Assembly Name”

-Within the sub-assembly folders are all the special cut parts and sub-assemblies of that Assembly.

-All other parts are stored in a default parts folder with every vex part organized by type

This system comes with a variety of advantages for the team. Indivudal axels or mechanisms be edited without opening the whole robot which allows team members to interact with the models without a powerful computer. It also allows for big changes to be made easier as the major sub-assemblies can be removed or changed without having to edit a bunch of indivudal parts. This also helps during the build process as we can divide the many sub-assemblies between any teammembers without other work to do. This has proven in the past to allow us to build full redesigns in just a week and half such as what we did after dulaney last year.

Drivetrain	1/29/2024 7:22 AM	File folder	
Flywheel	1/29/2024 7:22 AM	File folder	
Inner Frame	1/29/2024 7:22 AM	File folder	
Intake	2/6/2024 10:24 PM	File folder	
OldVersions	2/20/2024 3:05 PM	File folder	
PolyCarbonate Flat Pattern	11/25/2023 1:53 AM	File folder	
!FlyWheel Robot	2/20/2024 3:05 PM	Autodesk Inventor ...	26,660 KB
Odometry Poly bearing	11/4/2023 10:38 PM	DWG File	34 KB
Polycarbonate Bearing	11/15/2023 7:18 PM	Autodesk Inventor ...	134 KB
Polycarbonate Bearing_MIR	11/7/2023 8:39 PM	Autodesk Inventor ...	105 KB
Polycarbonate Bearing_MIR1	11/5/2023 7:57 PM	Autodesk Inventor ...	105 KB
Polycarbonate Bearing_MIR2	11/15/2023 7:18 PM	Autodesk Inventor ...	103 KB

Inventor Files from the Over Under Season

Designed by: Davis Bodami
Witnessed by: Praful Adiga

Before any designing can take place it is key to know the constraints one is placed under. For vex a key way of doing this other then reading the rules is too see what parts are available to your team. You may have the best idea for a design but without hte parts to build that idea is jsut waisted time.In order to see what parts we had an excel spread sheet was created with all Vex Parts that were in our Inventor parts library as well as newer ones found the Vex website. Additionally Tools and other accesories from the Robosource website were included that we deemed may prove useful.

5839 Vex Parts inventory										Key	
Hardware		Structure		Motion		Electronics		Tools			More needed
Part	Amount	Type	Amount	Type	Amount	Type	Amount	Type	Amount		None possessed but none needed
0.25" torx screw		2-wide aluminum c-channel		LS Bearing Flat		Brain		Hex Drivers		"	inch
0.25" hex screw		3-wide aluminum c-channel		Pillow Bearing		Controller		Wrenches		HS	High Strength
0.375" torx screw		5-wide aluminum c-channel		LS Shaft Collars		Battery		T-15 Drivers		LS	Low Strength
0.375" hex screw		2-wide steel c-channel		LS Shafts		11w Motor		T-7 Drivers	1	w	watt
0.5" torx screw		5-wide steel c-channel		4" Traction Wheels		Blue cartrige		Hex Ball Drivers		A	Durometer
0.5" hex screw		2x2x2 c-channel		3.25" Traction Wheels	0	Red cartrige		T-15 Ball Drivers	1		
0.625" torx screw		Lexan		2.75" Traction Wheels	0	Green cartrige		T-15 Alan Keys	1		
0.625" hex screw		Acetal	0	4" Left Mecanum Wheels	2	5.5w Motor		Hex Alan Keys	1		
0.75" torx screw		Aluminum Plates		4" Right Mecanum Wheels	2	Radio Reciver		Bit Magnetizer	1		
0.75" hex screw		Steel Plates		2" Left Mecanum Wheels	0	Optical Shaft Encoder		T-15 Power Bit	2		
0.875" torx screw		30 degree flat gussets		2" Right Mecanum Wheels	0	Vex Cables		Hex Power Bit	2		
0.875" hex screw		45 degree flat gussets		4" Omni Wheels		3 wire extenders		Needle Nose Pliers	4		
1" torx screw		60 degree flat gussets		3.25" Omni Wheels	11	3 wire expanders	0	Bolt Cutters	2		
1" hex screw		90 degree flat gussets		2.75" Omni Wheels	0	Solenoid 3 wire cables		Flush Cutters	4		
1.25" torx screw		30 degree bent gussets		2" Omni Wheels	0	Solenoids		Hammers	2		
1.25" hex screw		45 degree bent gussets		8T sprockets		Battery Cables		Saftey Glasses			
1.5" torx screw		60 degree bent gussets		16T sprockets		Inertial Sensor	3	Drill	3		
1.5" hex screw		90 degree bent gussets		24T sprockets		Vision Sensor	0	Air Compressors	1		
1.75" torx screw		Bevel Gearbox		32T Sprockets		Bumper Switch		Tool bags	0		
1.75" hex screw		Rack Gearbox		40T sprockets		Limit Switch		Tool Boxes	3		
2" torx screw		Worm Gearbox		HS Chain		Battery Chargers		Robot Boxes	0		
2" hex screw				8T HS Gear		Micro Usb Cables		Portable Battery Storage	0		
2.25" torx screw				36T HS Gear		Potentiometer	0	Cable Tester	0		
2.25" hex screw				48T Hs Gear		AI Vision Sensor	0	Portable Vise	0		
2.5" torx screw				60T HS Gear		GPS sensor		3 Wire Crimper	0		
2.5" hex screw				72T HS Gear		Spiral Wire Wrap (Large)	0				
0.5" Shoulder Screws				84T Hs Gear		3 Wire Cable Stock	0				
Lock Nut				HS Shaft		3 Wire Cable Connectors	0				
Thin Lock Nuts				HS Bearing Flat							
Keps Nuts				HS Shaft Collar							
0.25" Standoff				HS Insert							
0.5" Standoff				1/8" Versa Hex Adapters							
1" Standoff				1/4" Versa Hex Adapters							
1.5" Standoff				VersaHub Adapters	4						

Top half of the Inventory Spread Sheet

2" Standoff				30A 1.625" Flexwheel	0
3" Standoff				30A 2" Flexwheel	
4" Standoff				30A 3" Flexwheel	
6" Standoff				30A 4" Flexwheel	0
Zip Ties				45A 1.625" Flexwheel	0
Rubber Bands				45A 2" Flexwheel	
.5" Hex Set Screw				45A 3" Flexwheel	0
1" Hex Set Screw				45A 4" Flexwheel	
.125" Hex Set Screw				60A 1.625" Flexwheel	0
				60A 2" Flexwheel	0
				60A 3" Flexwheel	0
				60A 4" Flexwheel	0
				Flywheel Wieght Plate	0
				Universal Joints	0
				Intake Rollers	
				Shaft Couplers	
				High strenght Ball Bearing	20
				High strenght Ball Bearing Frame	20
				High strenght Ball Bearing Square Insert	
				High strenght Ball Bearing Round Insert	
				LS lock bar	
				Double Acting Piston	
				Reservoirs	
				Pneumatic Tubing	
				24" HS Axels	0
				Hinges	
				Bevel Gears	
				Worm Gears	
				Inner Slide Trucks	
				Outer Slide Trucks	
				Pulley	

Bottom half of the Inventory Spread Sheet

The Spreadsheet will take a while to fill out, but for now parts with known quanitities such as zero have been filled out. Those were marked with yellow to indicate more were needed. These were then taken

Designed by: Davis Bodami
Witnessed by: Praful Adiga

to a second spreadsheet. This lays out all the parts and tools we want, their price, quanity, link to purchase, and priority. The priority is key as it allows us to make decisions on what to get within our budget.

5839 Order List

Part	Amount Wanted	Price per Unit	Link	Cost	Priority
test	4	$ 41.79		$ 167.16	1
test2	2	$ 17.89		$ 35.78	2
test3	5	$ 2.49		$ 12.45	3
Test					
				Total	$ 215.39
				Budget	$0.00
				Funds Needed	$ 215.39

Order Spread Sheet with a calculation test

Note

Currently the budget is at zero as dues are yet to be collected and no fund raisers have been planned. It also improt to consider that a small percentage of the school's 15,000 dollar engineerign budget is randomly allocated to us so we will have that to work with.

After a week of work we were able to complete all rows of the spread sheet and figure out what parts the team was in need of. A variety of methods were used to measure the various parts. Large parts like Wheels and Motors were counted but other parts required a different aporach. String wires, and tubing were measured in feet, and metal strcuture by its weight. For parts like screws and nuts a single unit was weighed as well as the container and the total amount we had. The weight of the container was then subtracted from the total and then divided by the unit to find the total quanity.

Note

We found our time managment to be extremely poor during this endevor which greatly increased its length. To adress this we may work to change how the team meets to allow for not only more time, but better uses of that time.

New Drive Models

There exists a variety of drive models both practicle and impracticle that can be made with the VRC legal parts. It is important to judge where each one can shine to see which is the most practical when the next game releases. A decision can not be made yet for which drive is best, but the strenghts and weakness of each one can be assesed as well as models for the more practical ones generated. These models can give us a head start on the next seasons bot if they prove adequate for the next game as well as allow the team to test various ideas.

Tank Drive

A large variety of what can be considered a tank drive or differential drives exist within vex. These work by having two sides where each sides wheels all spin together. This allows for linear motion(Both sides spin the same direction), turning (Both sides spin opposite), and arcing (One side spins slower then the other in the same direction). These drives are often the simpilist and provide a wide range of motion while remaining able to push back against other robots. These drives can also be achieved in a variety of ways with varying numbers and sizes of wheels that augment their performance.

4in wheels provide greater speed as per each rotation the robot moves farther, however they give the robot less torque. Additonally since less of them can fit onto a dirve with the 18*18*18 size limit there is also less points of contact. Additionaly with the older 4in wheels the team currently own the traction versions are .125in smaller then the omni versions

3.25in wheels provide slower speeds, but are able to give the robot more pushing power as they have more torque and points of contact. These wheels are also easier to work with as the traction and omni versions are the same size unlike with the older 4in wheels

Omni wheels have rollers that allow the wheel to move side to side as well as forward and back. This makes them great for turning, but poor for traction.

Traction wheels wheels are all rubber and provide exceptional ground adherence for any robot, however they greatly limit turning making them impractical unless used as the middle wheel where there effects on truning are midigated.

From our teams expirence a 3.25in drive with 2 traction wheels in the middle and 2 omni wheels on either end appears to be the optimal way to execute this drive. Our previous drive with 3 4in omniwheels failed to push back agaisnt other robots that were using 3.25 in tank drives with the same amount of motors. These robots also were just as fast and maneuverable as ours showing little trade off for this design.

Pros	Cons
• Simplicity • Versatility • Easier to Control	• Limited Mobility • Wheel incompatabilities

-> Tank Drives

H/X Drives

These use either 4 or 5 omni wheels to achieve a robot that has the same range of motion as a Tank Drive, but with the additon of diagnol and horizantal movements. They either use in the case of an X drive 4 indivudally powered omni wheels in each corner at 90 degress from one another or 4 indivudallty powered onmi wheels in a traditional tank drive setup with one horizantal omni wheel for the H drive. These drives can however, prove dificult to control and in the case of the H drive impractical as the horizantal wheel rarley makes contact. They are also very easy to push around since all the wheels are omni. X drives can prove highly practical given the right game and design but in games such as over under the middle bar limits their use.

Pros	Cons
• Maneuberability • Complex Autonmous • Strafing	• Mechanical Complexity • Motor Usage • Practicality • Low Traction/Easy to push

-> X/H Drives

Mecanum Drives

Mecanum drives are likley the most special as they use specialized mecanum wheels. These like omni wheels have roller attached, but at an angle to provide unqiuley augmented movment. When set up correctly 4 indvidually powered mechnum wheels can provide the same movment as a X drive. However, since to go in any direction it directly turns the mecanum wheels they are harder to push as the motors resist the pushing directly. This along with other issues can also lead to faster overheating with mecanum drives. The vex edr 4in mecanum wheels are very bulky putting more strain on the motor additonally, the vex mecanum wheels unlike msot desings have limited contact with the ground due to the iregular design of their rollers. It is also important to note it easier to gear and build a frame for a mecnum drive over and X drive as it does not require the 45 degree angels to achieve its unique motion. Though also possible with an X drive an additional powered omni wheel could be put into the middle to provide more drive power. Since this wheel isnt needed at all times if a succesful PTO can be developed it could allow for a very versatile robot and drive.

Pros	Cons
• Maneuberability • Complex Autonmous • Strafing	• Mechanical Complexity • Motor Usage • Practicality • Requires balanced weight

-> Mecanum Drives

Swerve Drives

Previously considered impractical for vex swerve drives invlove either 3 or 4 independently steered and powered wheels. These focus around modules that can both rotate the oreintation of and spin the wheels. This allows for the robot to turn rapidly as well as turn while moving. The wheels can positioned

Designed by: Davis Bodami
Witnessed by: Praful Adiga

in the manner of a tradtional tank drive for linear movement and then turned to go the desired driection. However until the addition of the 5.5w motors these would either use 6 or all 8 of the robots availble motors. The 5.5w motors now allow for this drive to be possibly practical as a 3 wheel swerve drive could be made from 3 11w motors and 3 5.5w motors allowing for 38.5w of motors to be allocated to the robots mechanisms and manipulators. The advantages of swerve drives can be seen from other competitions like frc where they are often used to great success to create highly maneuverable bots. The use of one within vex would be highyl dependent on the game as one that with limtied room to move such as over under takes away many of a swerve drives advantages. It is worth creating a model for a swerve drive module incase the next game is one that priortizes movement. It would also provide practice using more complex gearing which the team has yet to expirment with.

Pros

- Maneuberability
- Complex Autonmous

Cons

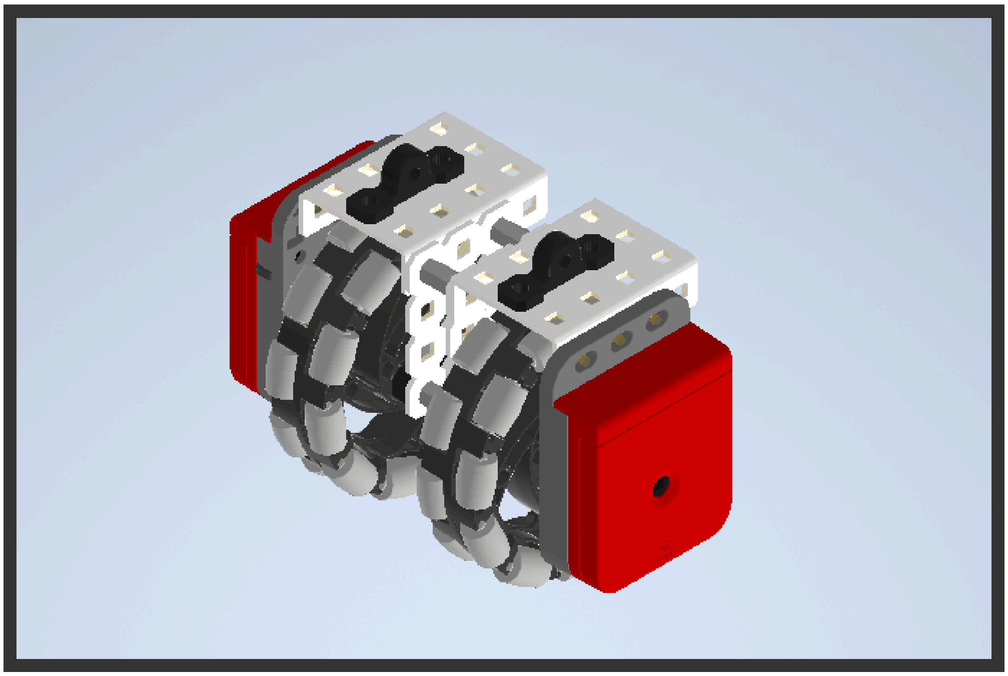
- Mechanical Complexity
- Motor Usage
- Practicality

-> Swerve Drives

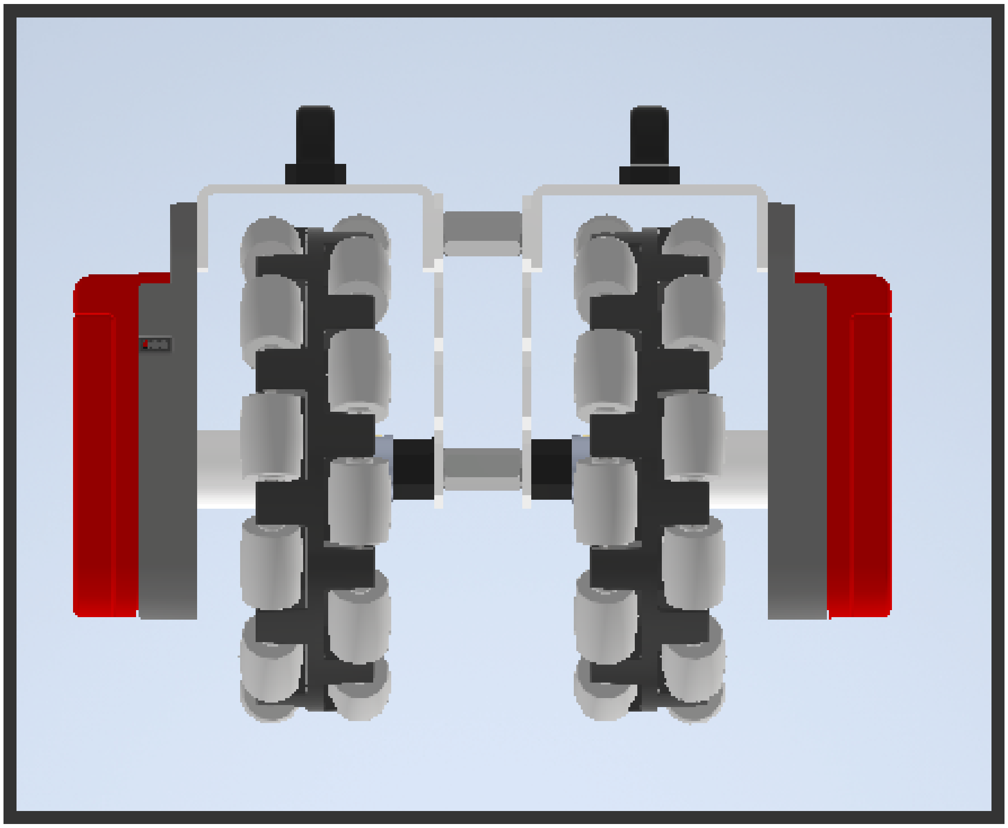
Odometry is a position tracking algorithim used by the coder to implement complex autons. It relies on three sensors 2 vertical and 1 horizantal. The failures of the previous design were compactness and resilliance and the new designs makes a few imrpovments to this area. It is important to complete this first as any protoype drives made must be designed to fit the sensors. This along with a basic mecnum drive which can act as a tank drive when need be will allow the coder to begin making some basic frameworks for next year.

New Design:

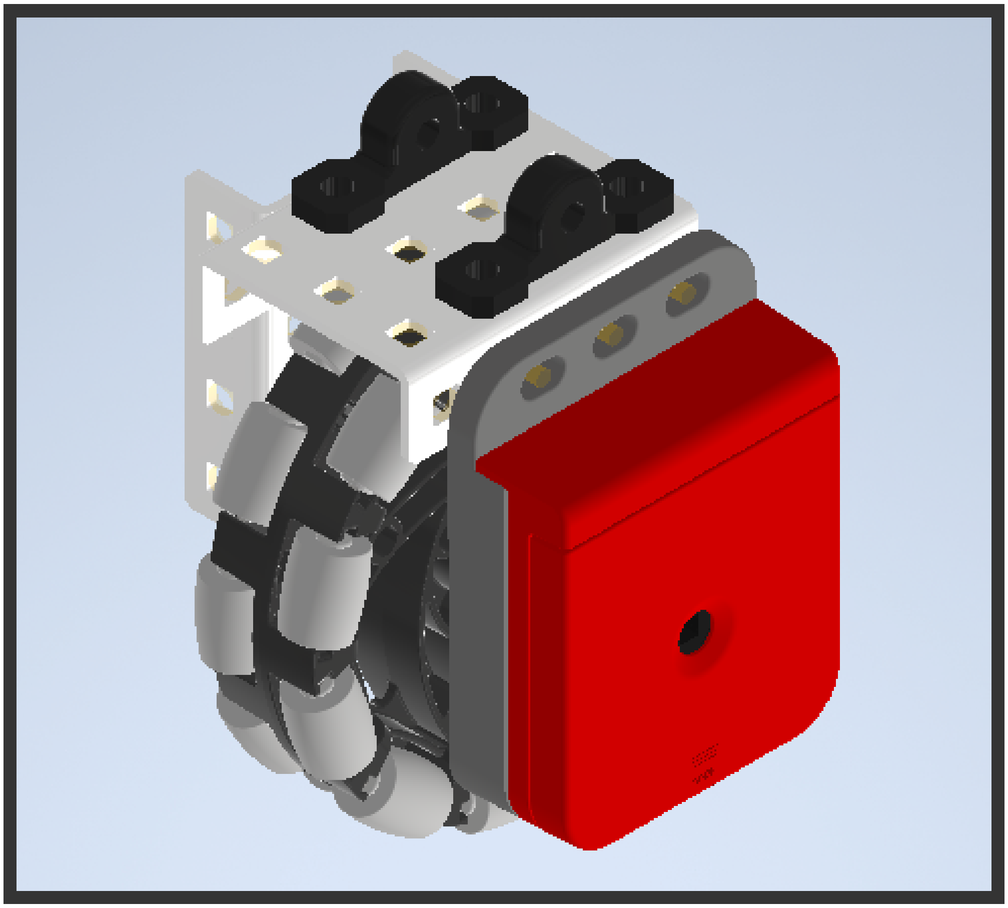
- Verical Wheels save space by being in the same module
- No plate is used without being reinforced
- Pillow bearings used to simplfy mounting
- Newer 3.25in wheels used for better traction



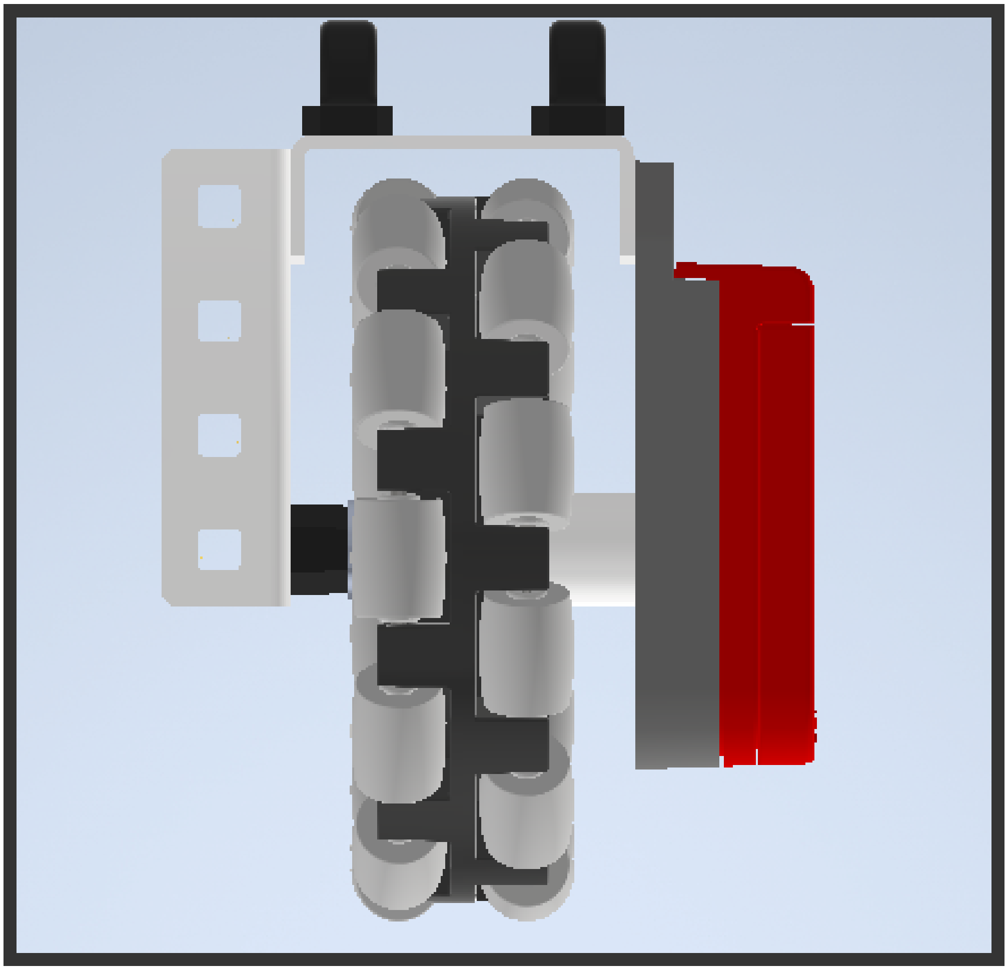
Isometric View of the New Vertical Odometry Sensor



Front View of the New Vertical Odometry Sensor



Isometric View of the New Horizantal Odometry Sensor

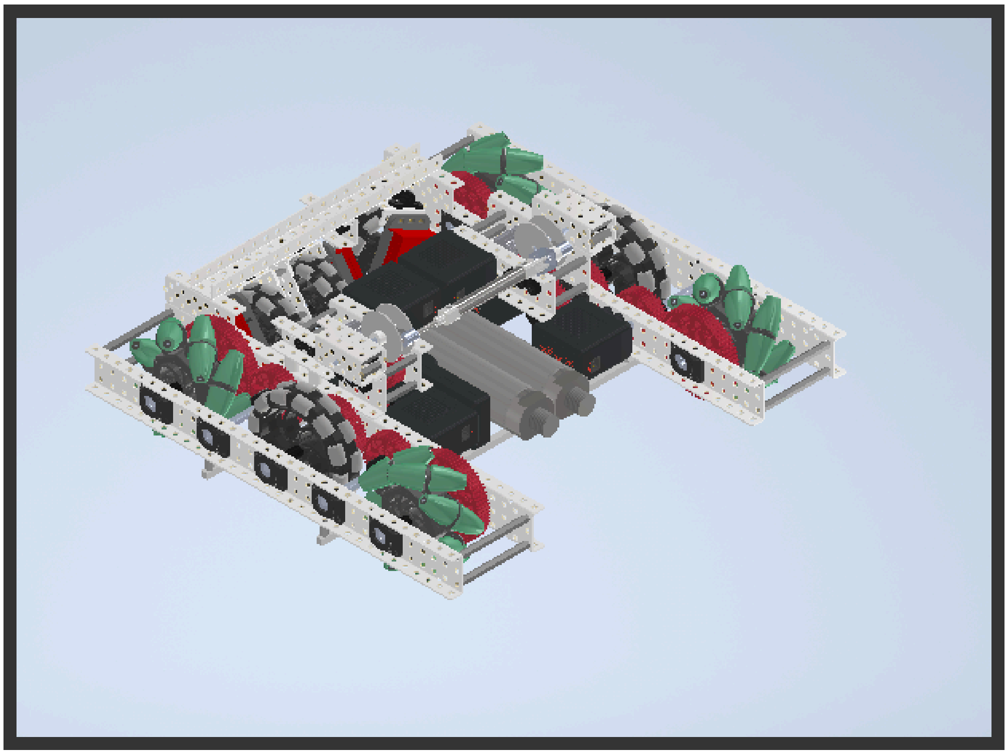


Front View of the New Horizantal Odometry Sensor

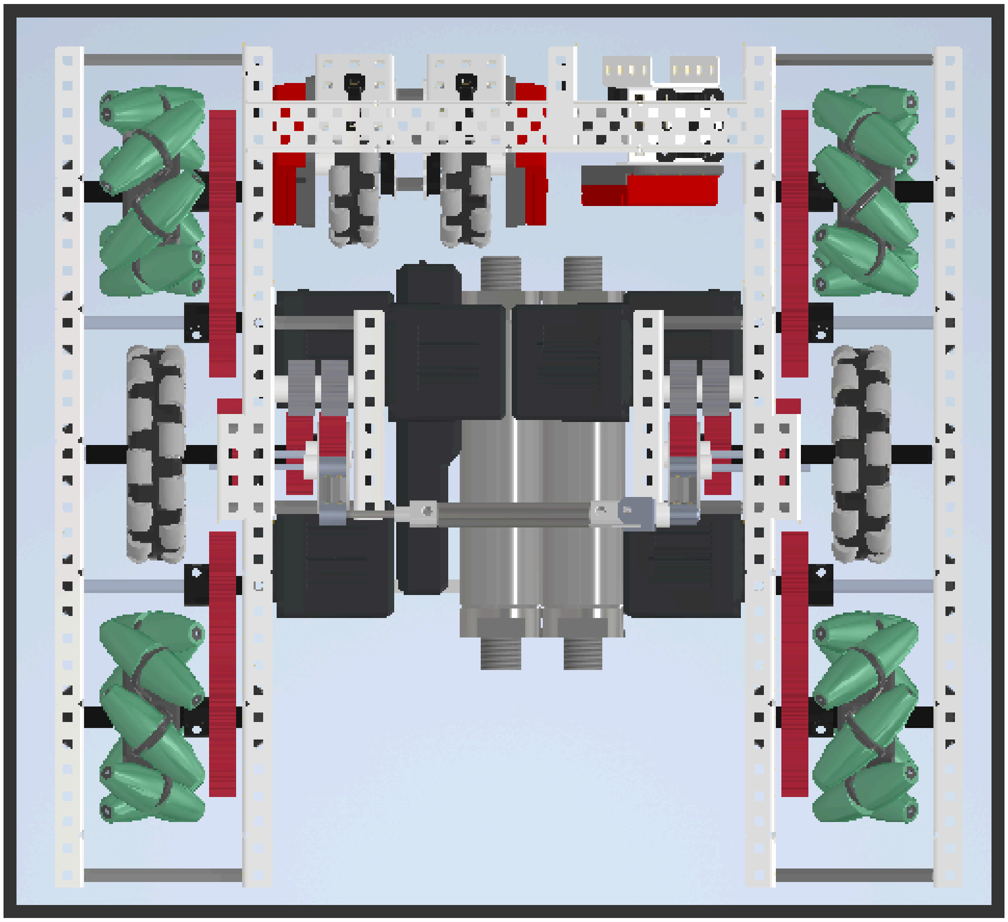
With inventory taken we can now begin to make some designs. To expirment with more complex Drives a Mechnum drive and a Swerve Drive module were completed. These should provide good practice for designing before the next season as well possibly giving us a head start if we choose to use these drives.

The first model made was that of a Mecanum Drive:

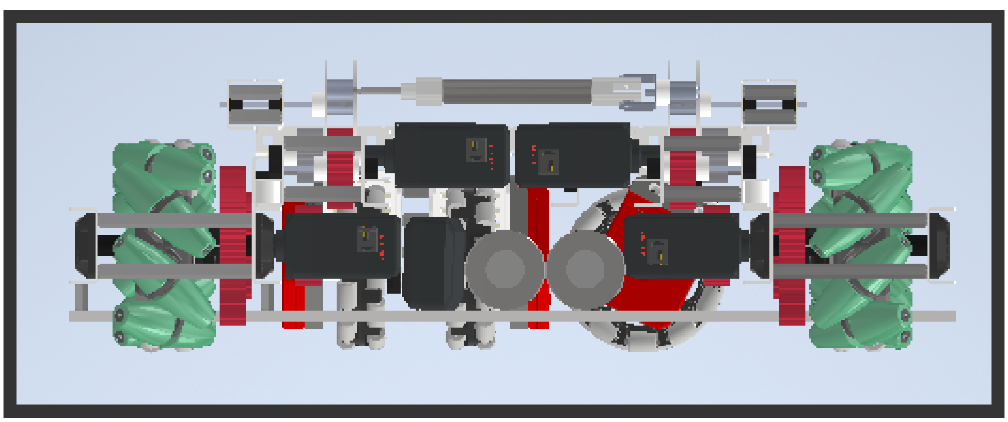
- 4 Mecanum wheels geared to 300 RPM with a 72:48 ratio driven by an 11w motor with the 600rpm cartrige.
- 24in HS axels with holes drilled in them as the main frame to ensure it was stronger then our previous drive trains.
- Center Omni Wheel for additional power
- PTO to allow for the cneter omni wheel to power other system while not in use
- Battery and Air Tanks kept low to ensure a proper center of gravity
- New Odometry Sensor fitted in the rear



Isometric View of the Prototype Mecanum Drive

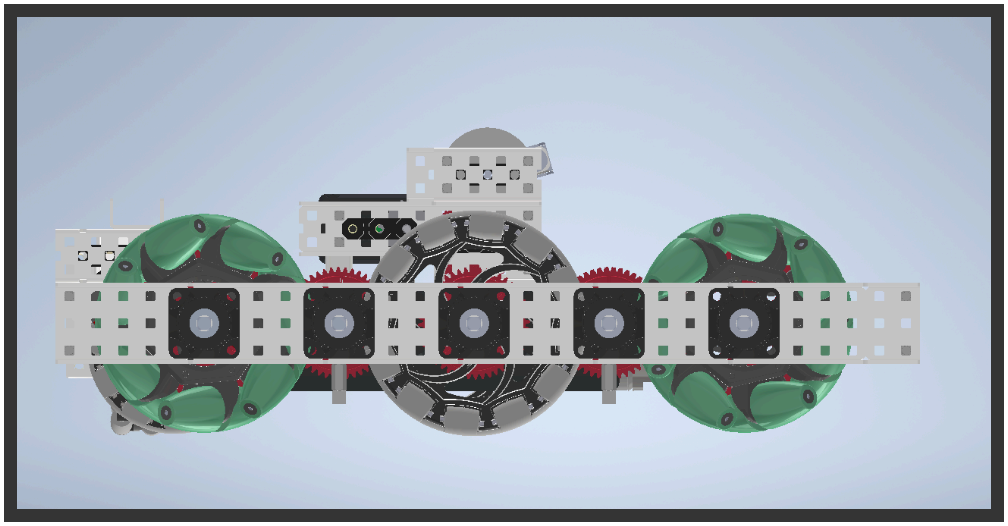


Top View of the Prototype Mecanum Drive



Front View of the Prototype Mecanum Drive

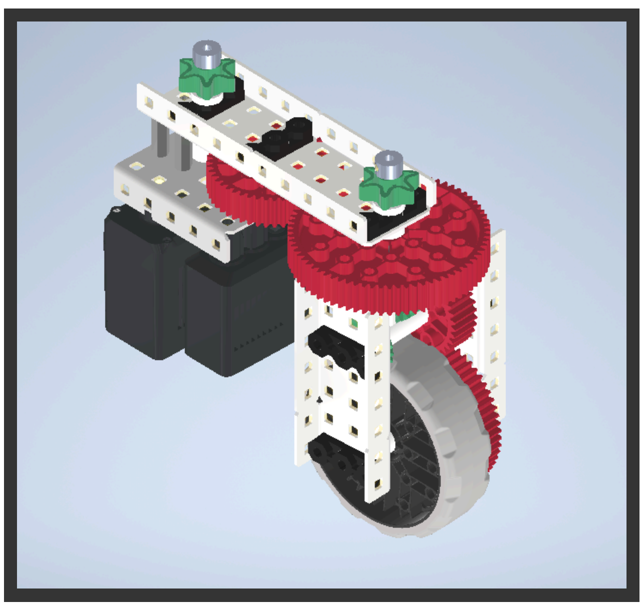
Designed by: Davis Bodami
Witnessed by: Praful Adiga



Side View of the Prototype Mecanum Drive

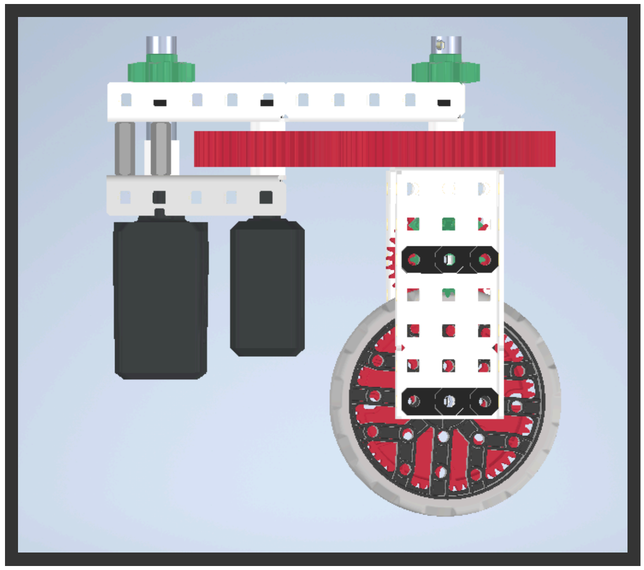
Before we could enter school to test this I created a Model for a Swerve Drive module:

- Keeps design compact with motors below the frame
- 72 tooth gear is screwed to the frame so they spin together
- Circular insert within the gear to allow the drive shaft to turn
- Chain runs to connect the Drive Shaft to the 11w motor
- 5.5w motor used to turn module

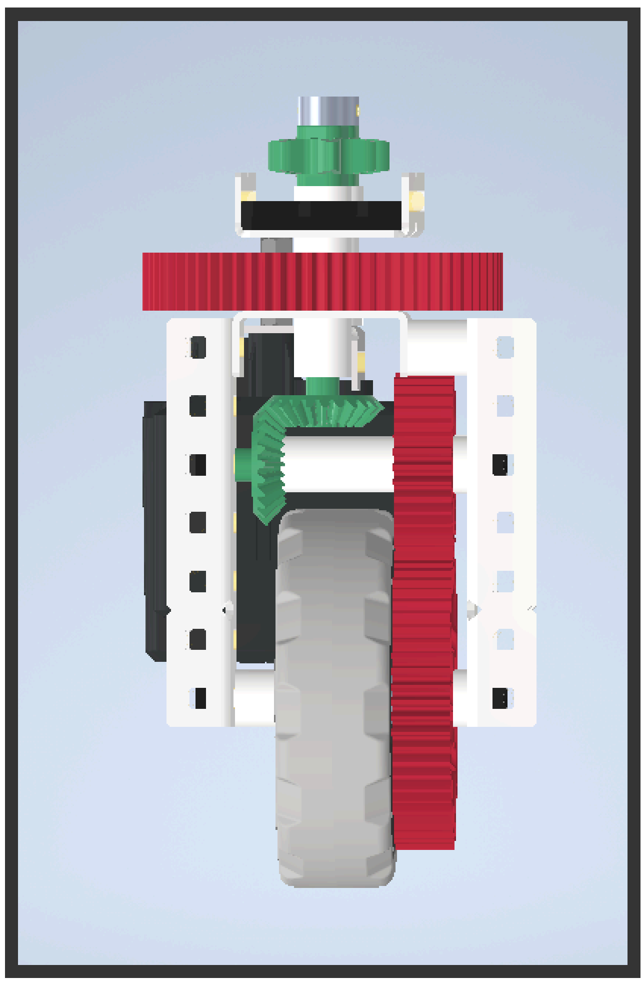


Isometric View of the Prototype Swerve Drive Module

Designed by: Davis Bodami
Witnessed by: Praful Adiga



Side View of the Prototype Swerve Drive Module

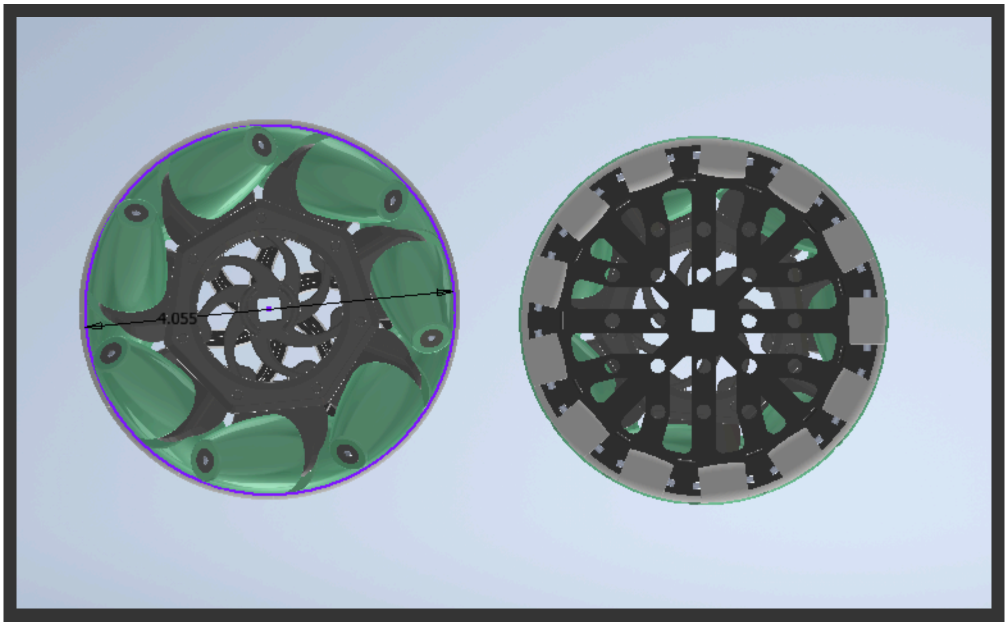


Front View of the Prototype Swerve Drive Module

Note

It is unlikley any of these drives will be used as tank drives have proved superior for many games in a row. They simply serve as a way to practice building and design techniques and mechanisms before the next season. However, cataloging them is still important as the ideas learned from them could proove very important.

While Building the Mecanum Drive a large oversight was made. Vex wheels may be advertised in standard sizes like 4in but that is seldom the case. For the wheels various forum posts and the perdu vex sig robotic website placed both the older 4 in omni wheels and 4in mecanum wheels as having a 4.125in diameter. However once we built the drive we found the omni wheel to be slightly bigger. Going into inventor confirmed these as the Mecanum wheels measured .0625in smallers then the omni Wheels.



Comparison of Mecanum Wheels and both the new (right) and old (left) omni wheel diameters

This means that for now until we can get the newer omni Wheels whish should be compatible with the mecanum wheels them alogn with the pto attached to them will be left out of the build. The older Wheels can not be used as they cause only one of the mecanum wheels to be in contact with the groudn which defeats the purpose of the drive.