TEAM 9717 ROBOT-A

St. Catharine Comets
Coach: Sheree Petrignani
St. Catharine Academy
Meet the team!

MEET THE TEAM 9717-A

TEAM 9717 ST. CATHARINE COMETS

Team members:

- Mahnoor Sultan: Captain, Lead Mechanical
- Nayeli Acevedo: Co-Captain, Lead Mechanical
- Olivia Chadwick: Lead Mechanical, lead driver
- Antonella Qetaj: Lead programmer, special skills, electronics, engineering notebooks
- Laura Ngoyen: mechanical
- Samia Rivera: mechanical, driver
- E'Manna Evans: mechanical, driver
- Marcelle Cooper: mechanical, driver
- Amaya Rojas: mechanical, driver
- Jasmine Carrion: programmer, special skills driver
- Brianna Rios: programmer, special skills driver
- Alyssa Montes: Driver, powerpoint
- AutoDesk CAD/CAM: Kristina Pereira, Yudelis Mateo- Moronta, Miraclelynn Breban

SEASON 9

- 1/29 Kennedy High School, LI (canceled)
- 2/5 Freeport High School, LI
- 2/12 Vaughn College, Queens, NY
- 2/19 Harvey School, Katonah, NY
- 2/26 Adelphi University, LI
- 3/5 Kennedy High School, LI
- 3/12 States, Queens, NY

INSPECTION CHECKLIST

VEX ROBOTICS COMPETITION STARSTRUCK

Robot Inspection Checklist

Team Number_______________

REC Foundation

Size Inspection

☐	Robot fits within starting size restrictions (18" x 18" x 18") does not touch walls or ceiling of the sizing box! *Robot should be measured WITH Team ID # Plates installed.*	R4

Overall Inspection

☐	Team is only competing with ONE robot - they have no spare or replacement robots.	R1
☐	Robot displays colored VEX Team Identification plates on at least (2) opposing sides.	R19
☐	Robot does NOT contain any components which will be intentionally detached on the playing-field.	G11
☐	Robot does NOT contain any components that could entangle or damage the playing-field or other robots.	R3
☐	Robot does NOT contain any sharp edges or corners.	R3
☐	Robot on/off switch is accessible & Microcontroller lights are visible without moving or lifting the robot.	R16

VEX Parts Inspection

☐	ALL Robot components are (or are IDENTICAL to) OFFICIAL VEX Products as sold on VEXrobotics.com (No 3D printed functional parts are allowed)	R5 R6 R7
☐	Robot does not use VEX products not intended for use as a robot component or any VEX packaging.	R5b
☐	ALL Components on the Robot NOT meeting VRC Inspection Criteria are NON-FUNCTIONAL decorations	R7d
☐	Any grease is used only in moderation on components that do not contact the field, objects, or other robots.	R7e
☐	Any non shattering plastic on the robot was cut from a single sheet up to 0.070" material not larger than 12"x24".	R7f
☐	Robot has only (1) VEX EDR Microcontroller.	R9
☐	Robot utilizes the VEXnet wireless communication system.	R10
☐	None of the *electronics* are from the VEXplorer, VEXpro, VEX-RCR, VEX IQ, or VEX Robotics by Hexbug.	R10b
☐	Total number of Servos and Motors is not more than twelve (12) without use of pneumatics or ten (10) with use of pneumatics.	R11
☐	Each 2-wire motor is plugged into its own 2-wire port or into a Model 29 motor controller	R11-2a
☐	A motor may only be controlled by a single controller port	R11-2b
☐	Robot uses a maximum of (1) Y-Cable per each 3-wire Motor Port (cannot "Y" off a 2-wire Motor Port)	R12
☐	Robot uses (1) VEX 7.2V (Robot) Power Pack as the primary power source.	R13
☐	If the Robot has a Power Expander, it has a 2nd 7.2V (Robot) Power Pack	R13
☐	Robot uses a maximum of (1) VEX Power Expander	R13b
☐	Robot has a charged 9V Backup Battery connected	R13c
☐	Team only utilize VEX Battery Chargers for charging VEX 7.2V Battery Packs	R13e
☐	Robot is not controlled by more than (2) VEX hand-held transmitters.	R14
☐	NO VEX electrical components have been modified from their original state.	R15a
☐	NO Method of attachment NOT provided by the VEX Design System is used. (Welding, Gluing, etc.)	R15b
☐	Robot uses a maximum of two (2) VEX pneumatic air reservoirs. (Maximum 100 psi per air reservoir)	R18

Field Control Check

☐	Robot successfully completes the "Field Control Check" Procedure. See Inspection Guidelines.	R21
☐	Robot enters Autonomous mode when prompted with no driver control for duration of Autonomous.	R20
☐	The Hand-held Controller(s) ONLY control the robot when robot is in Driver mode.	R20

PTC Verification Testing

Failure to pass this test will result in immediate Event Disqualification	**Pass / Fail:** __________	**Tested By:** __________________	R15 R21

Final Inspection Pass / Fail: ________ **Inspector Signature:** ________________ **Team Initials:** _______________

DESIGN CONCEPT: NATURE (HEARING, SIGHT, AND SMELL)

NATURE IN ENGINEERING

- Biomimicry: the imitation of the models, systems, and elements of nature for the purpose of solving complex human problems.
- Nature is one of the most fundamental sources of inspiration for many Engineering projects, just look at a mouse on any computer!
- Nature is a self-sustaining system that has individual parts that work in unison. Similarly, the different components of our robot work in unison to be an efficient system.
- Looking into nature for design inspiration helps us fine tune our design to work more precisely and efficiently.
- Nature also has patterns that engineers can use to better predict behavior in their own projects.
- By using an animal for our design, we supply ourselves with a structural idea, movements, and functions. This solid foundation helps us progress much faster in building.

EXAMPLES OF BIOMIMICRY

Some basic examples are:

- **Wright Brothers: observed turkey-vultures to design the first airplane.**
- **Japanese Bullet Train: kingfisher bill gliding through water.**
- **Velcro: observed burrs sticking to the fur of animals.**
- **Submarines: modeled after the shape/movement of whales.**

ROBOTS INSPIRED BY REAL CREATURES

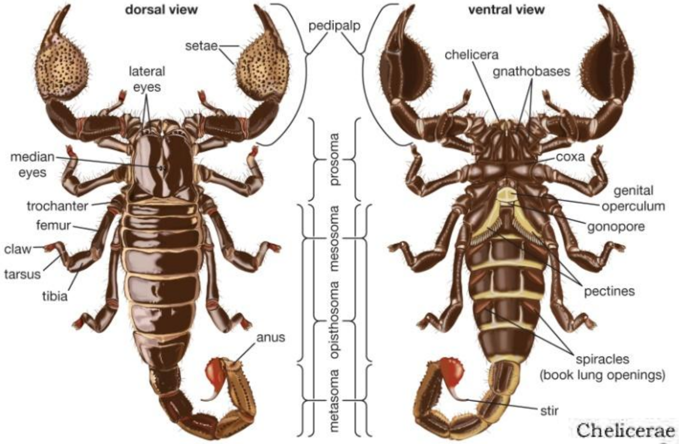
Octopus Robot - Modeled after the octopus. The robot has a squishy body with no rigid parts on it. It was tested successfully in the Mediterranean Sea and uses its 8 legs to swim.

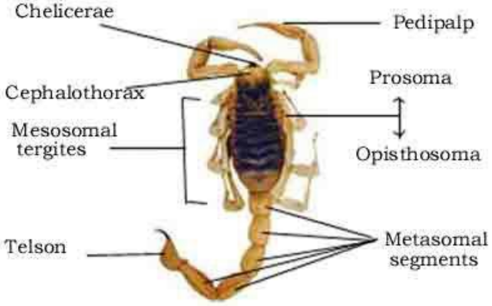
Dog Robot - The BigDog and Spot robots are modeled after a dog. These robots are capable of running at very high speeds and have the ability to transport heavy things around.

Snake Robot - The Guardian S is a waterproof robot modeled after a snake. It is capable of moving on any kind of terrain and even climbing up stairs.

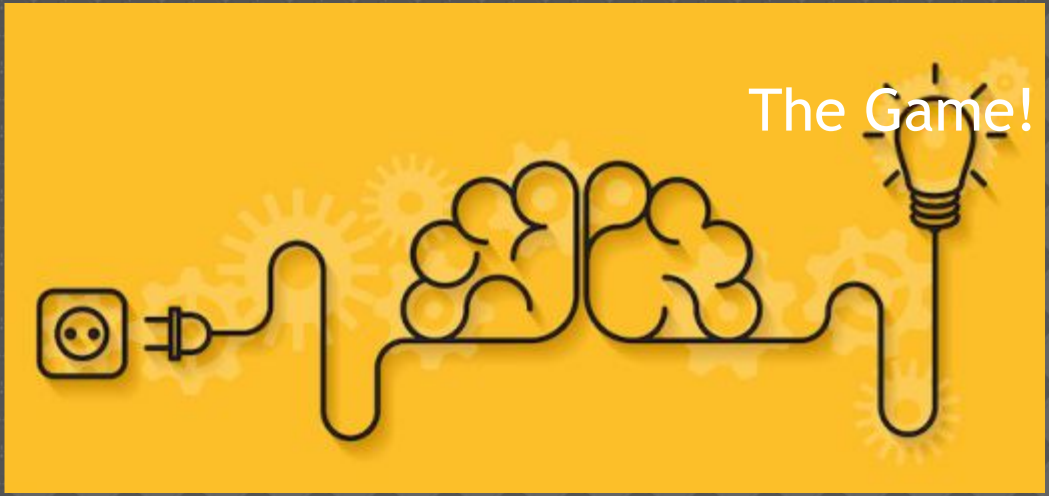
OVERVIEW OF A SCORPION

- Fun Fact: Scorpions are an exoskeleton. They are made of chitin which is a tough, protective molecule made of polysaccharide and nitrogen. This is a model of a scorpion:

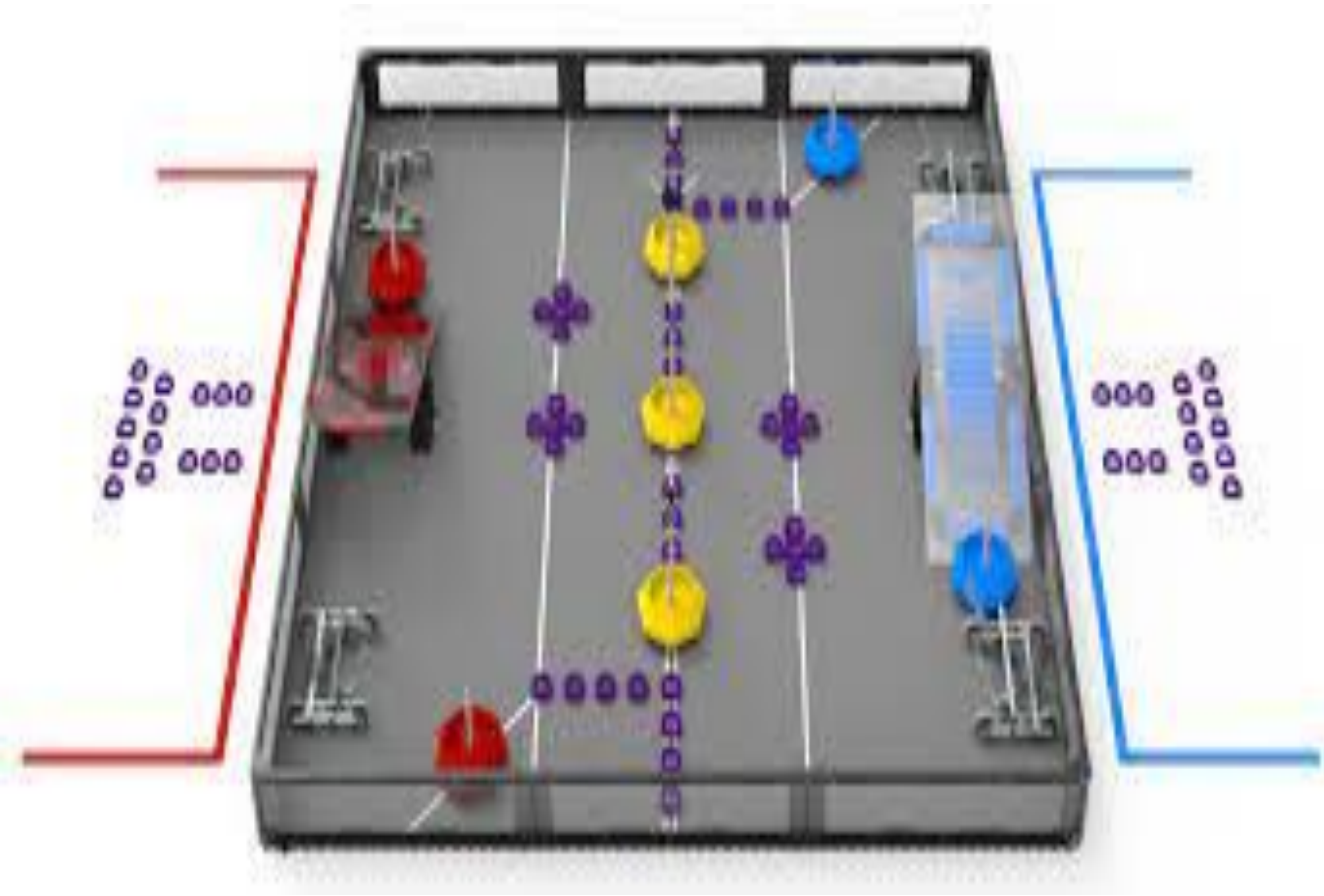




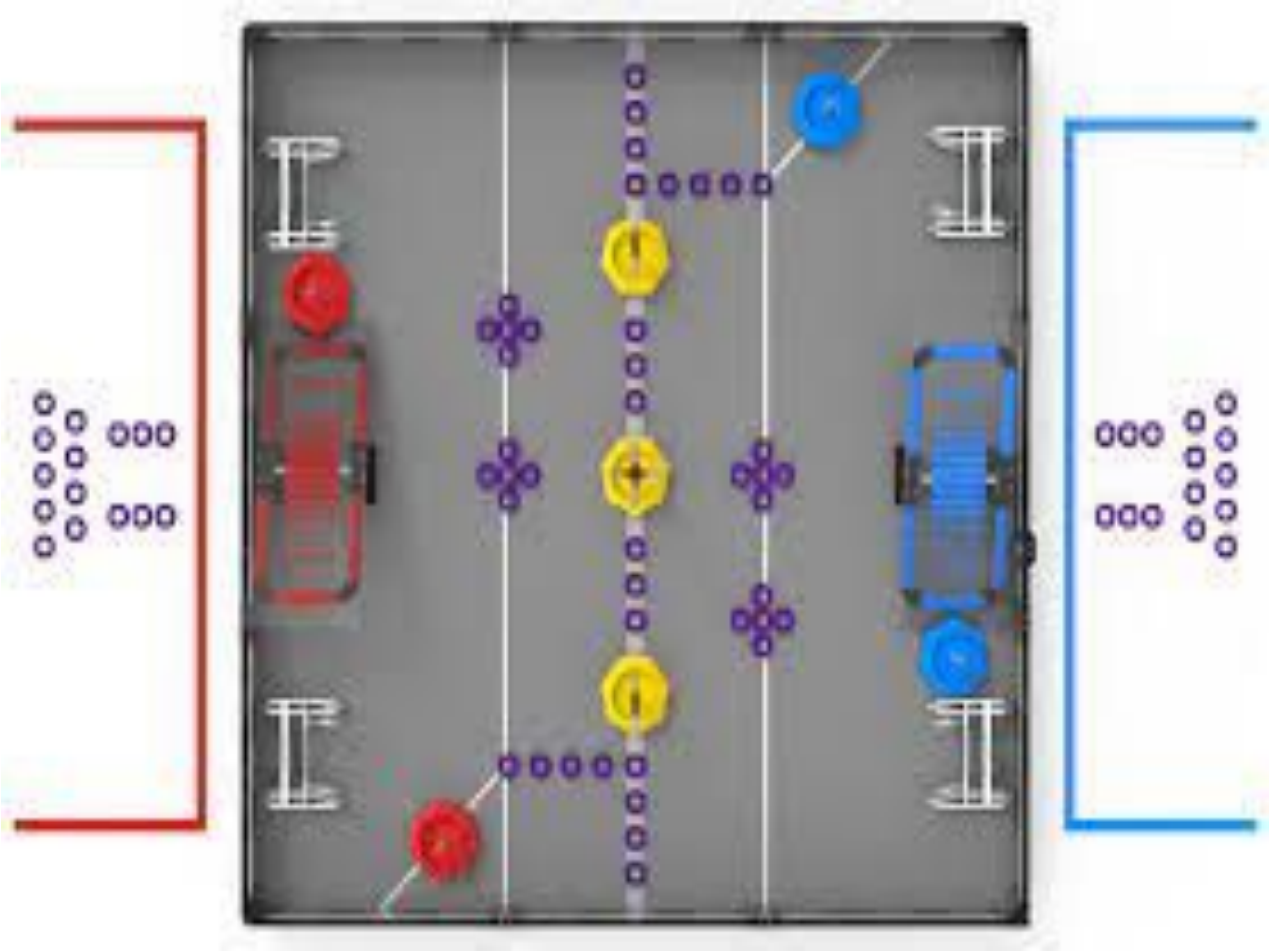
GAME OVERVIEW: INITIAL THOUGHTS



GAME DETAILS:

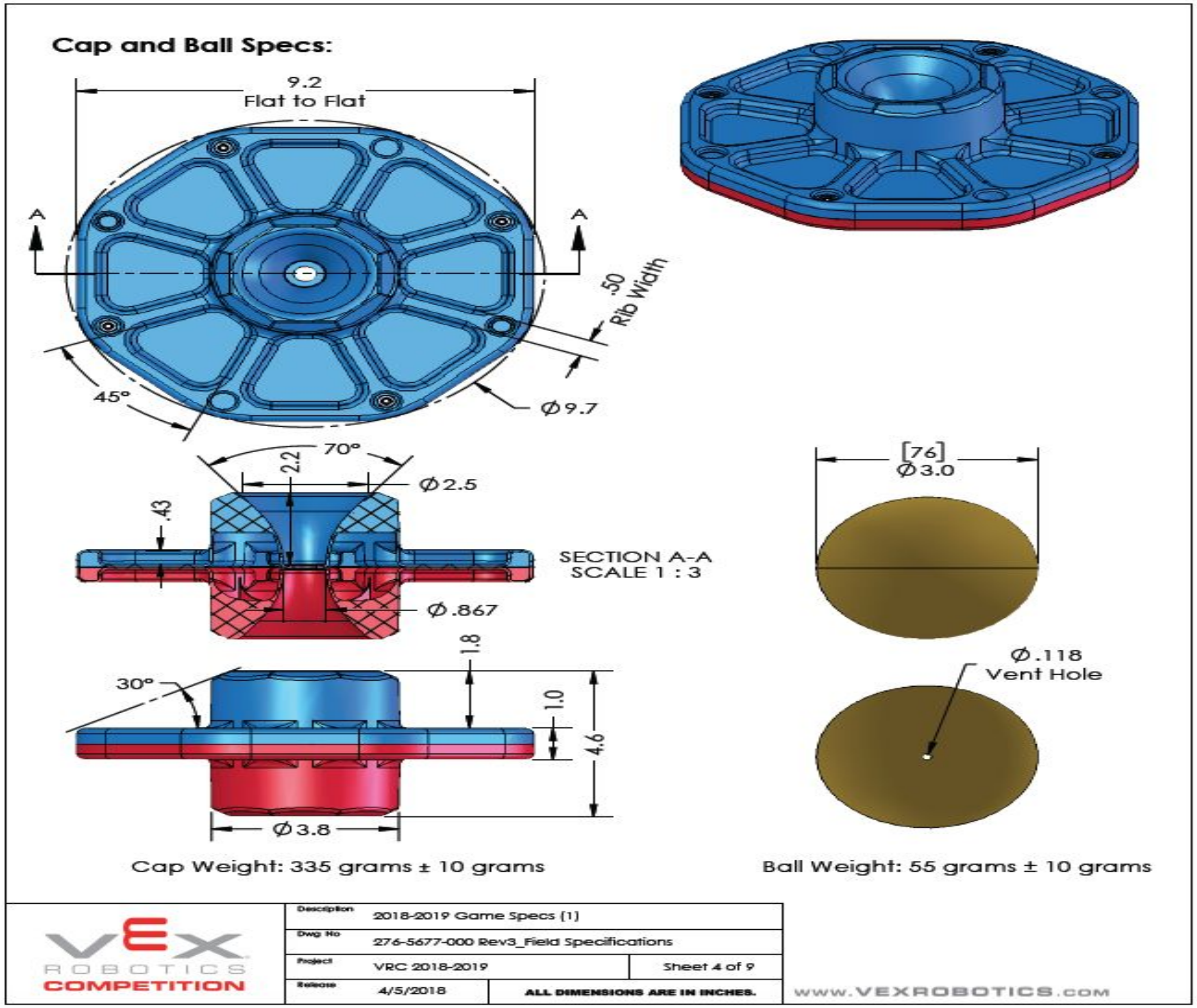


GAME OBJECT MANIPULATION:

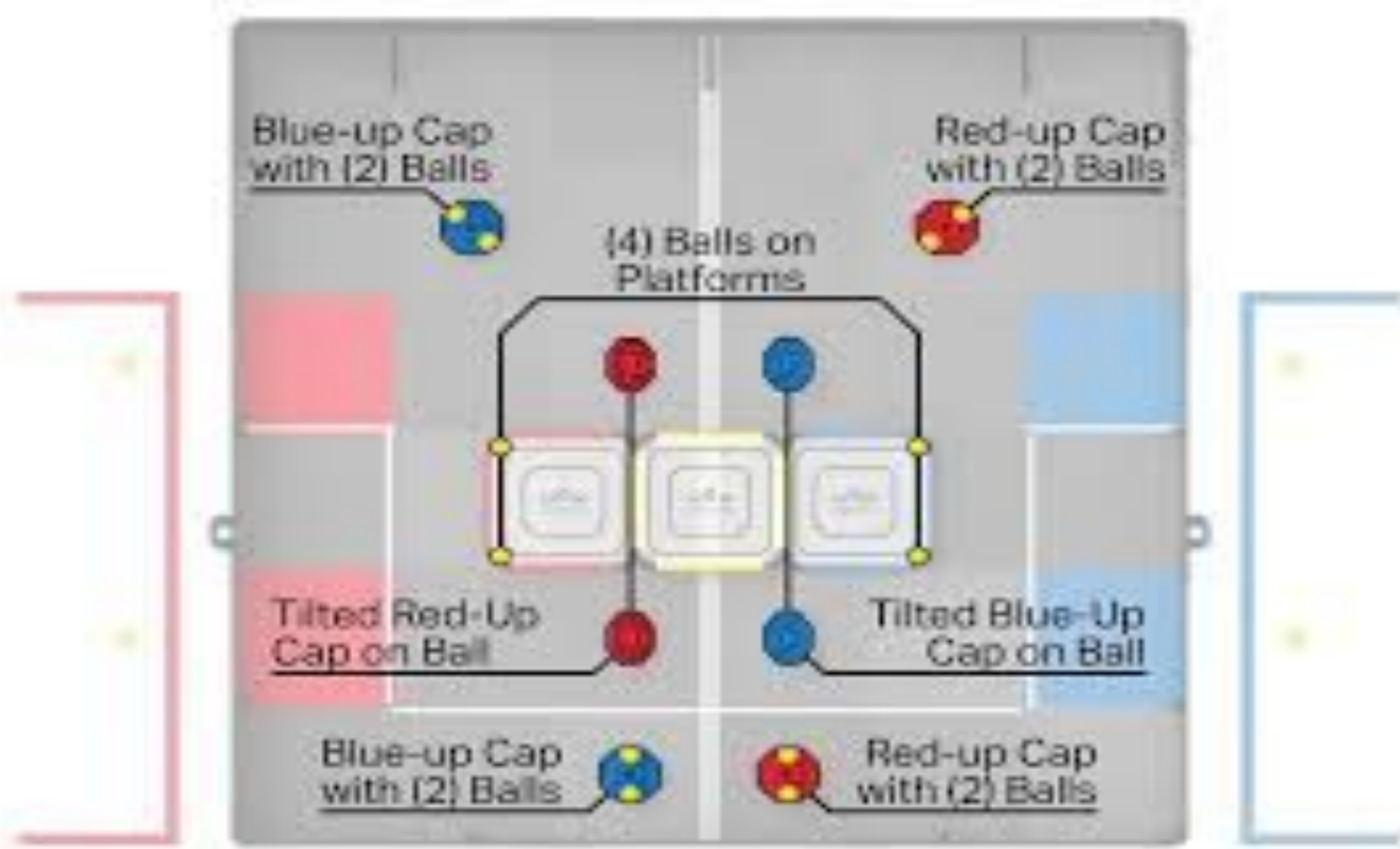


FIELD OVERVIEW AND POINT SYSTEM:

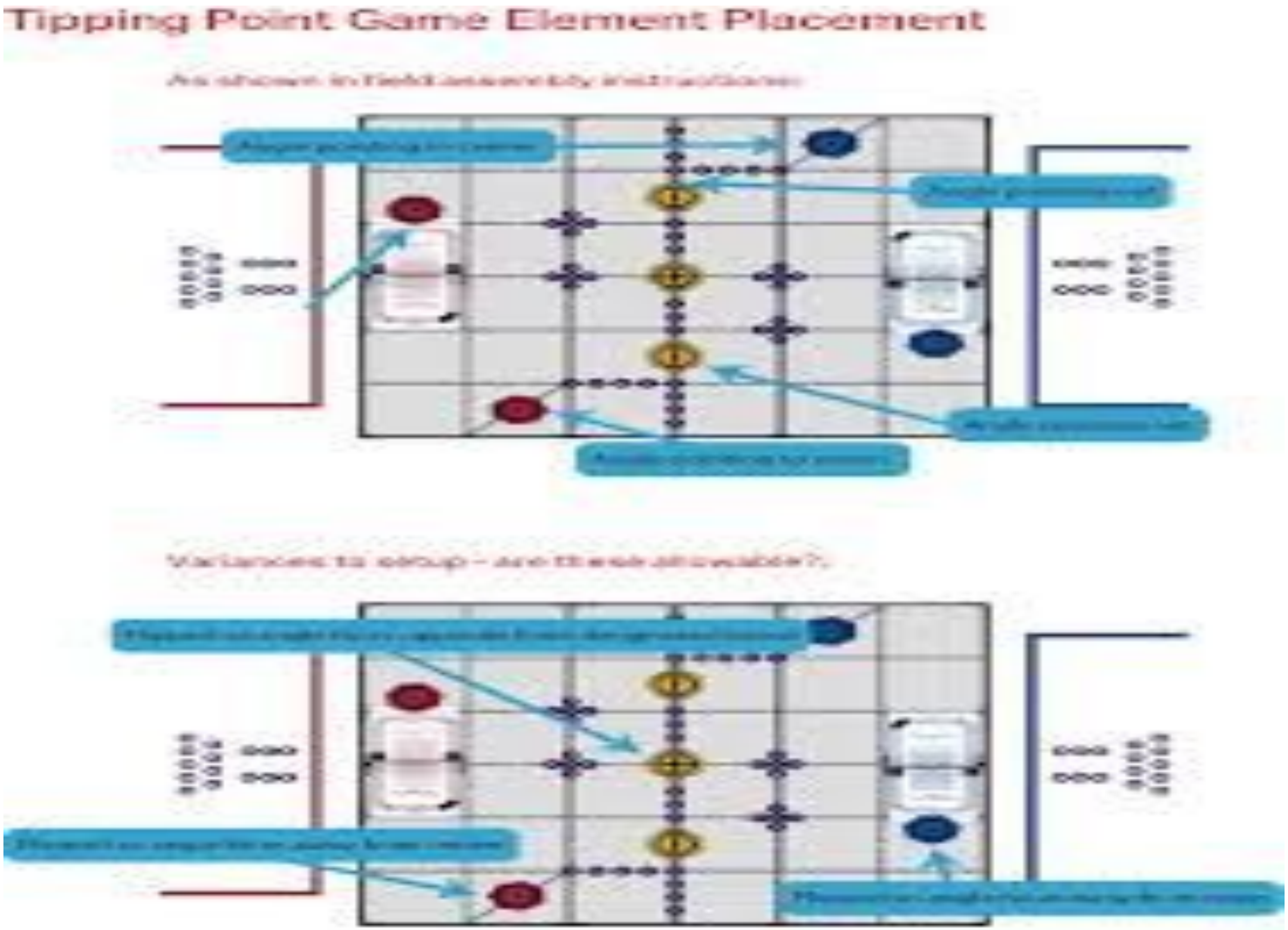
INITIAL THOUGHTS



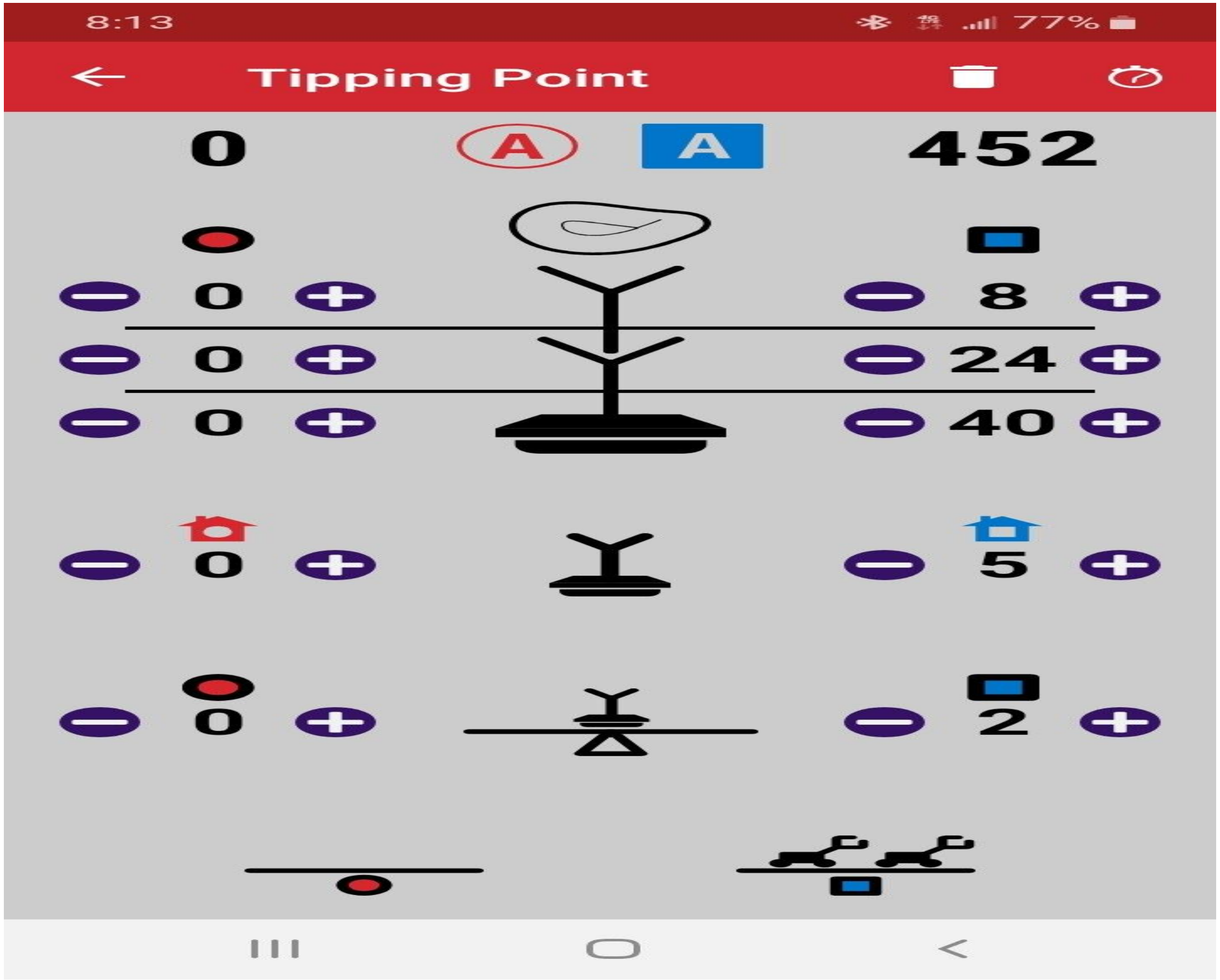
STRATEGY PLANS: OFFENSE AND DEFENSE



STRATEGY PLAN FOR AUTONOMOUS:



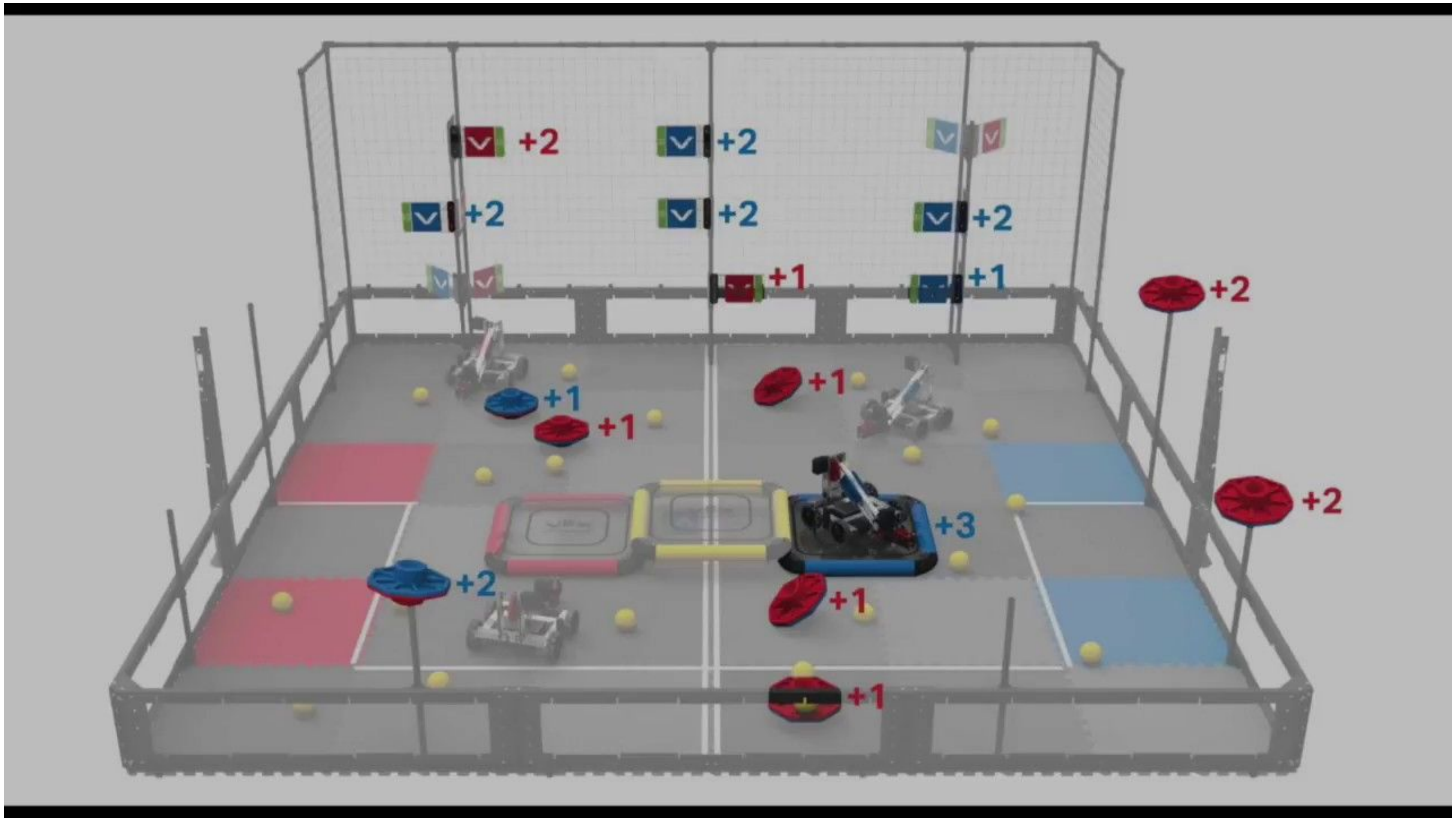
SCORING TABLE



SCORING STRATEGY:

Red Score:	280		Blue Score:	252
Red robots on platform:	2		Blue robots on platform:	2
Goals on red platform:	5		Goals on blue platform:	2
Goals in red zone:	0		Goals in blue zone:	0
Rings in goal base:	0		Rings in goal base:	52
Rings in goal branch:	0		Rings in goal branch:	20
Rings in high branch:	0		Rings in high branch:	0
Points from auton:	20		Points from auton:	0
Rings scored:	72	out of 72		
Goals Scored:	7	out of 7		

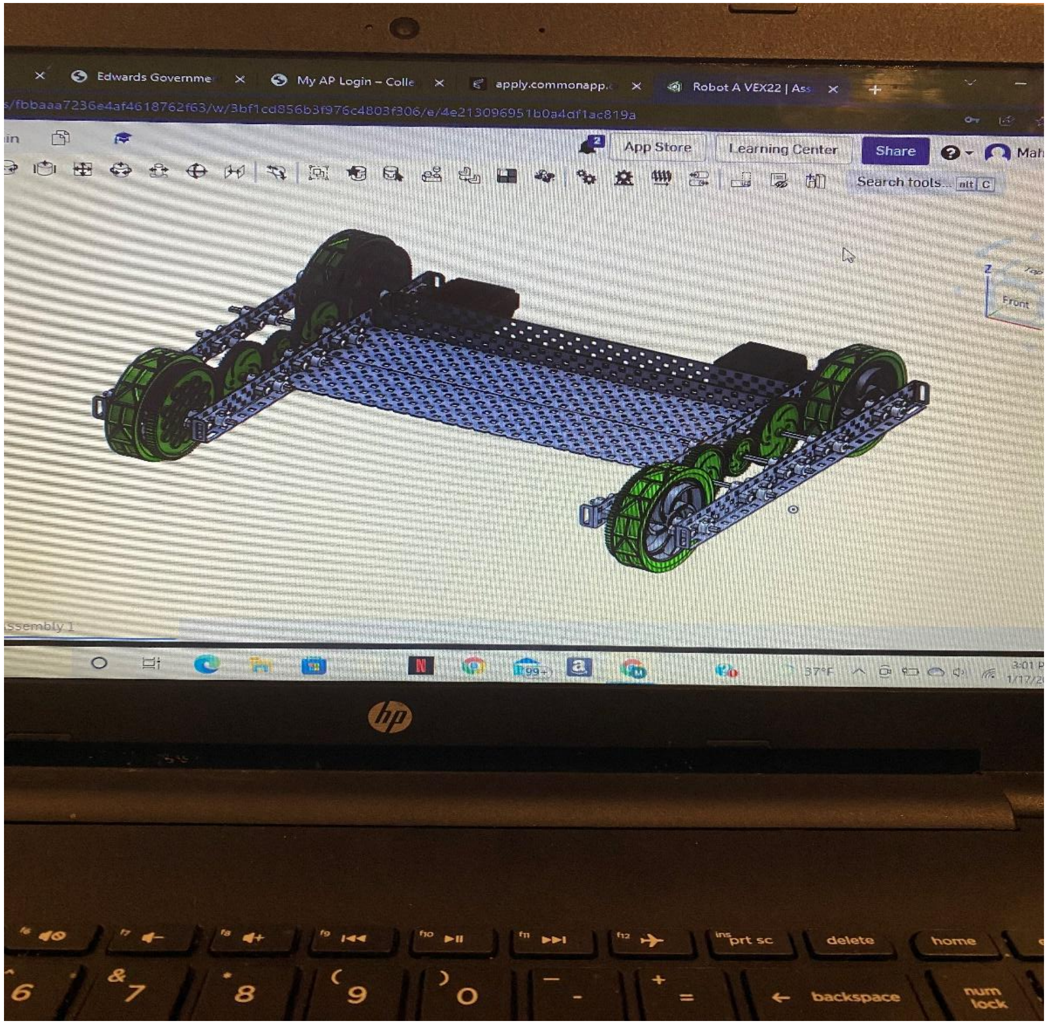
SCORING STRATEGY:



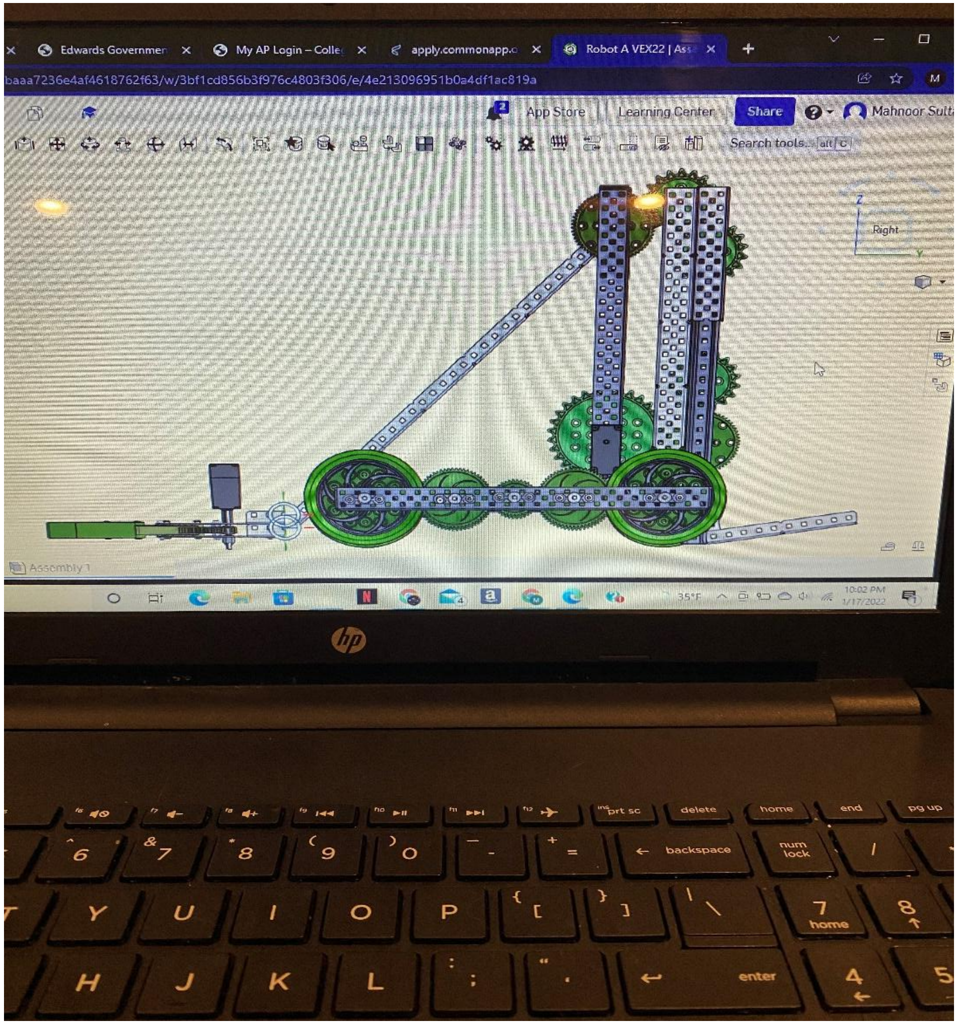
CAD BUILDING PROGRESS:

- While thinking of a design, we decided to start building on software such as Tinker CAD, Robot Mesh Studio & OnShape. It helped us to brainstorm and made sure that the performance of the robot is optimal.

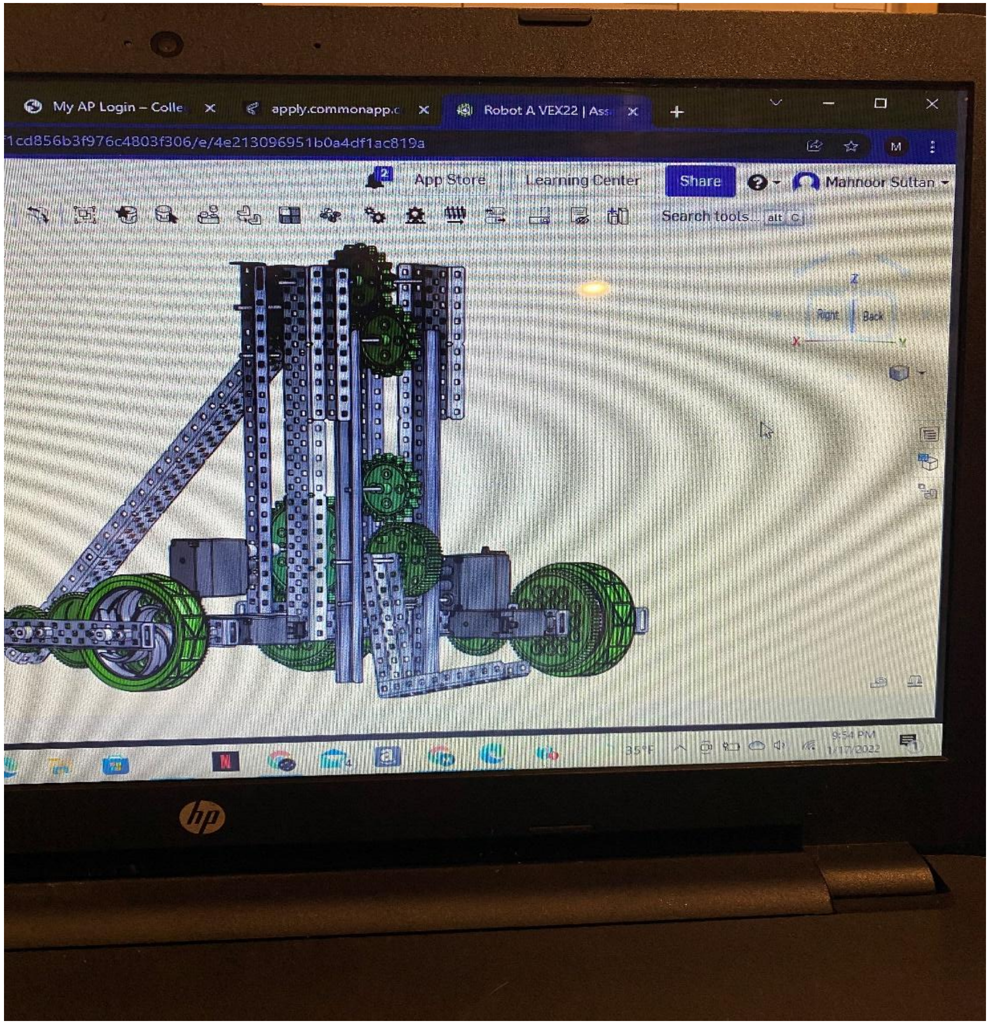
CAD/CAM PROCESS (VIRTUAL BUILDING PROCESS)



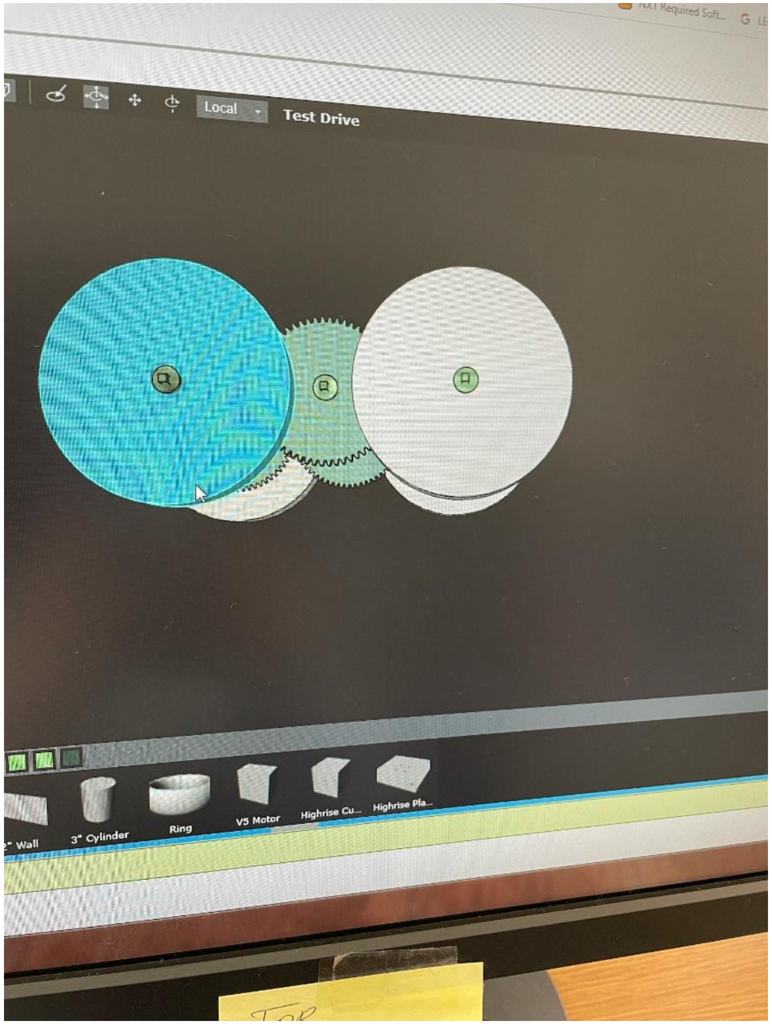
ONSHAPE CAD/CAM



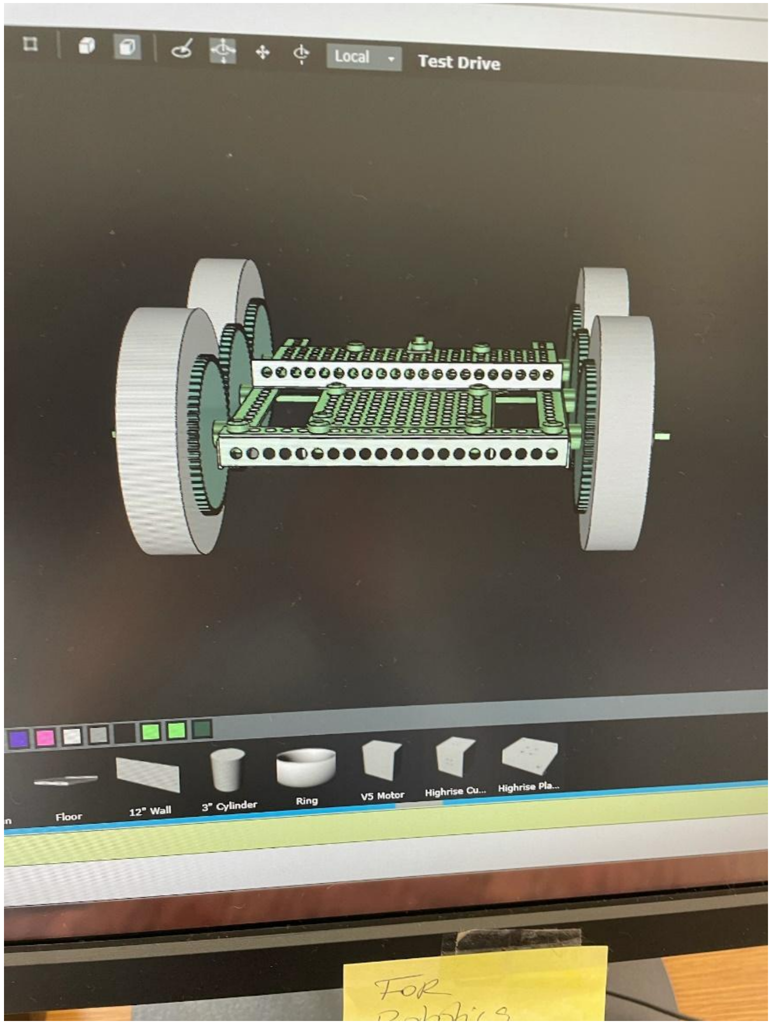
ONSHAPE CAD/CAM



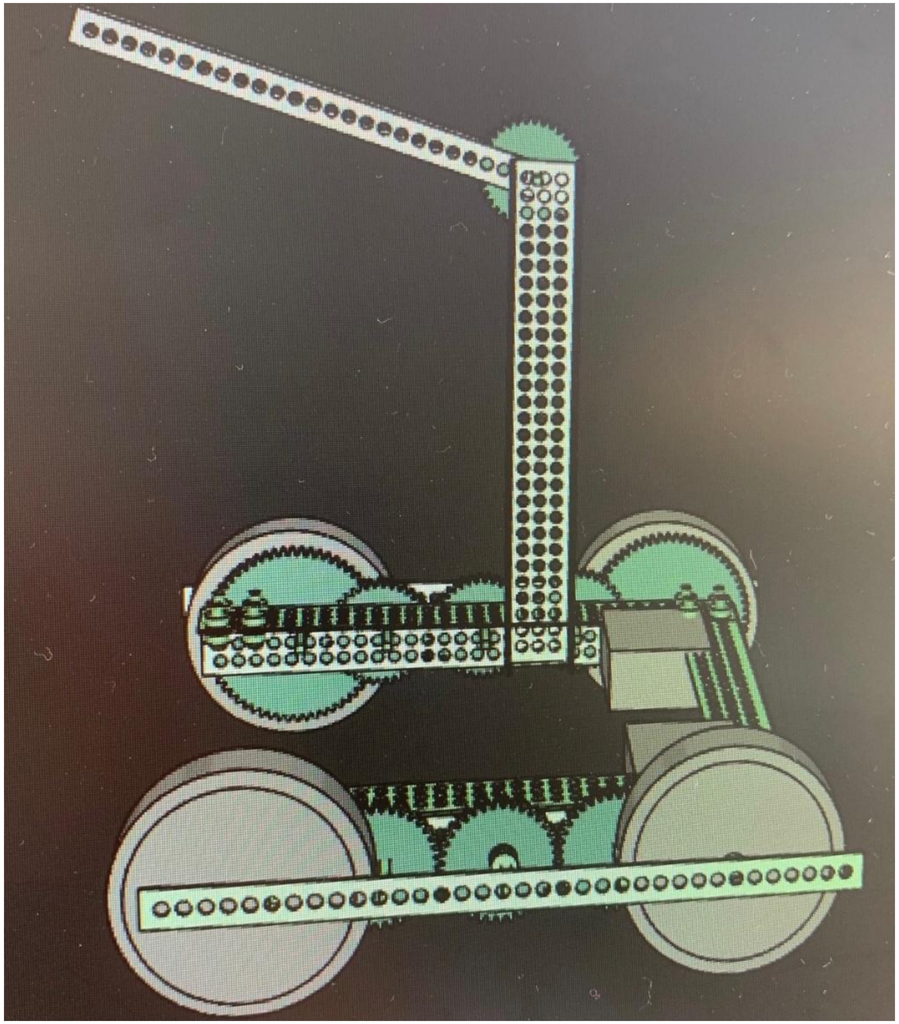
CAD/CAM AUTODESK GEARTRAIN



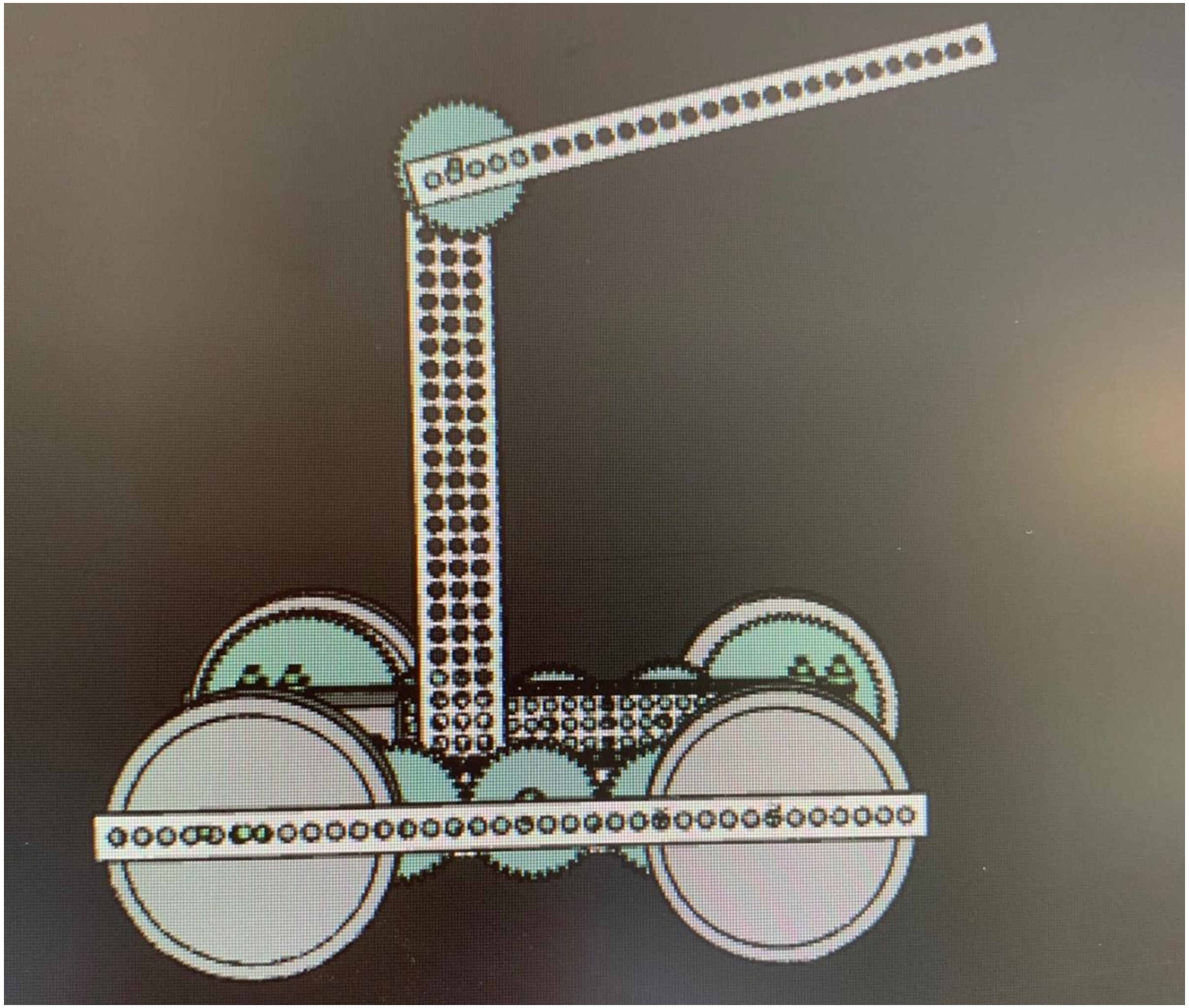
CAD/CAM AUTODESK GEARTRAIN



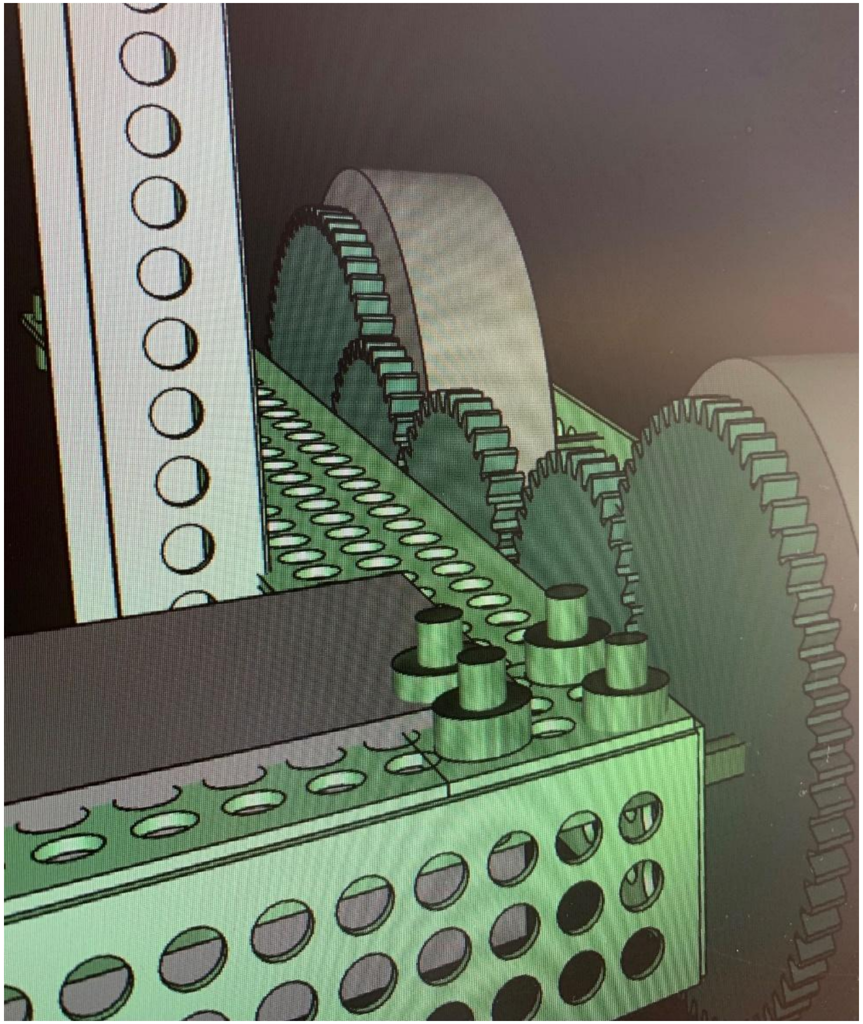
GEARTRAIN WITH CLAWLIFT



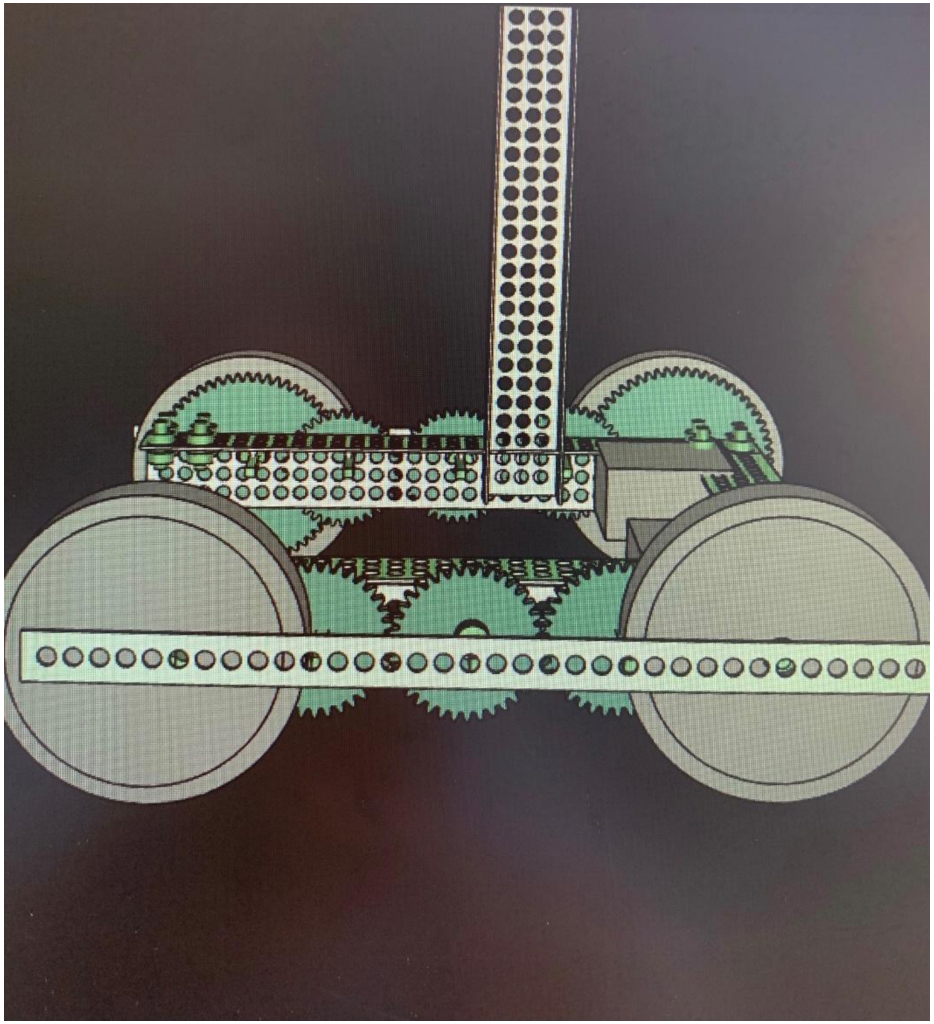
GEARTRAIN WITH CLAWLIFT



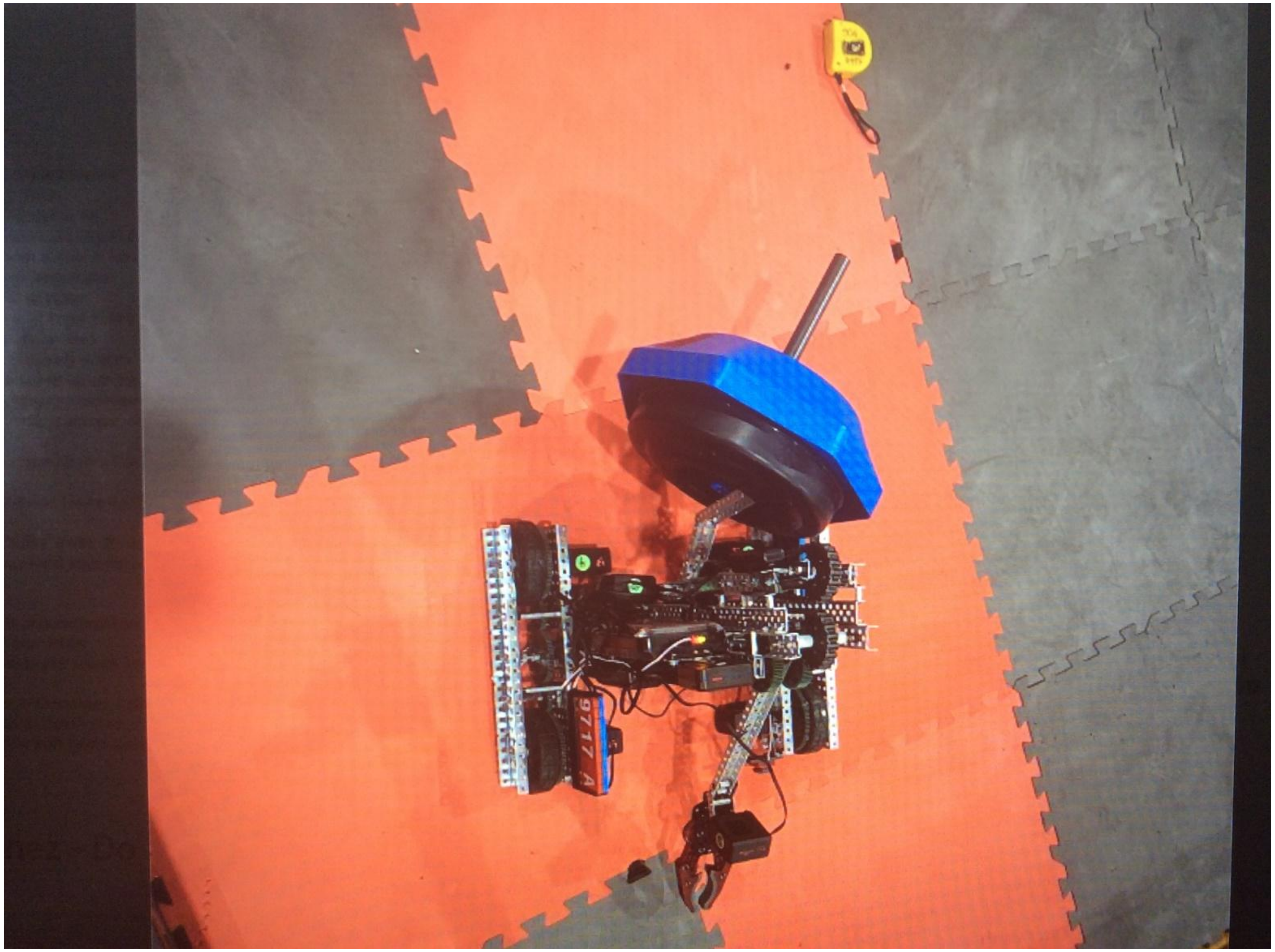
GEARTRAIN 2-WHEEL DRIVE



GEARTRAIN 2-WHEEL DRIVE



ROBOT A- HOOKS GOALIE



PERFORMANCE ROBOT A-SKILLS AUTONOMOUS
CLICK THE QR CODE, WATCH IN MOTION, ENJOY!

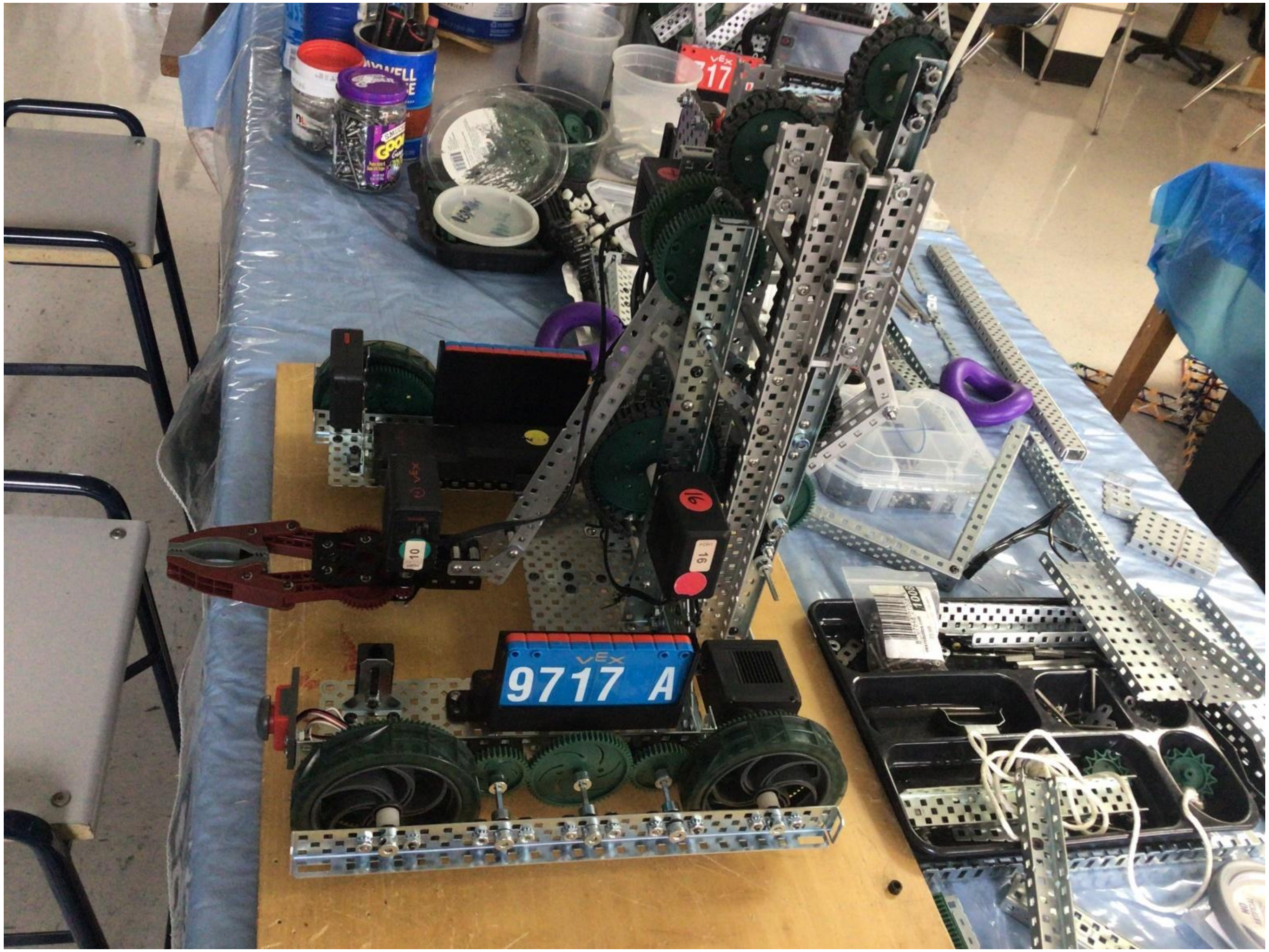
PERFORMANCE OF ROBOT A-SKILLS DRIVE
CLICK THE QR CODE, WATCH IN MOTION, ENJOY!

PERFORMANCE OF ROBOT A-SKILLS DRIVE/SPIN
CLICK THE QR CODE, WATCH IN MOTION, ENJOY!

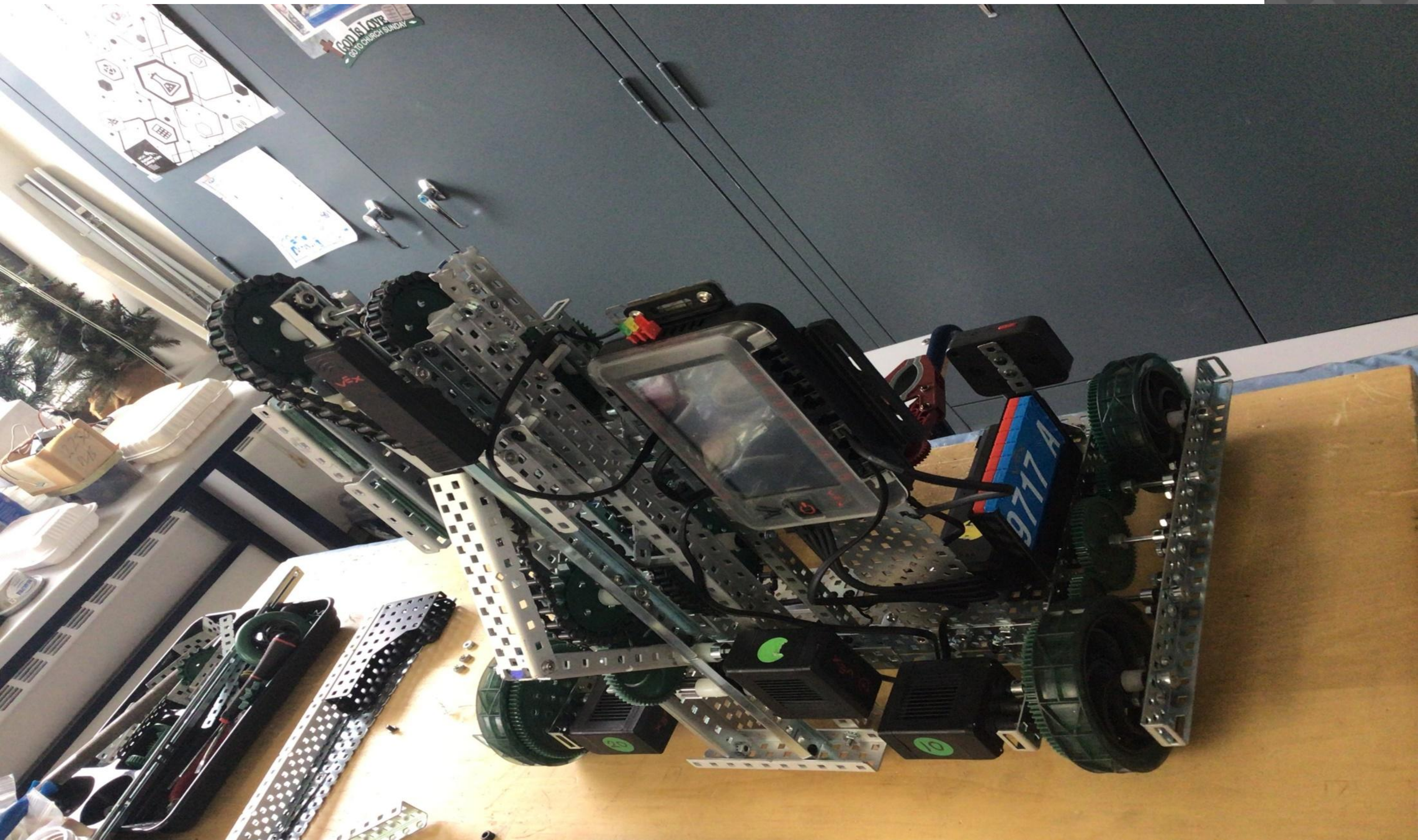
BUILDING LOG (IN-PERSON)

- On the next slides, we will be showing the building progress since our school allowed all students to go in person and we were able to build in the lab.

BUILD LOG ROBOT A



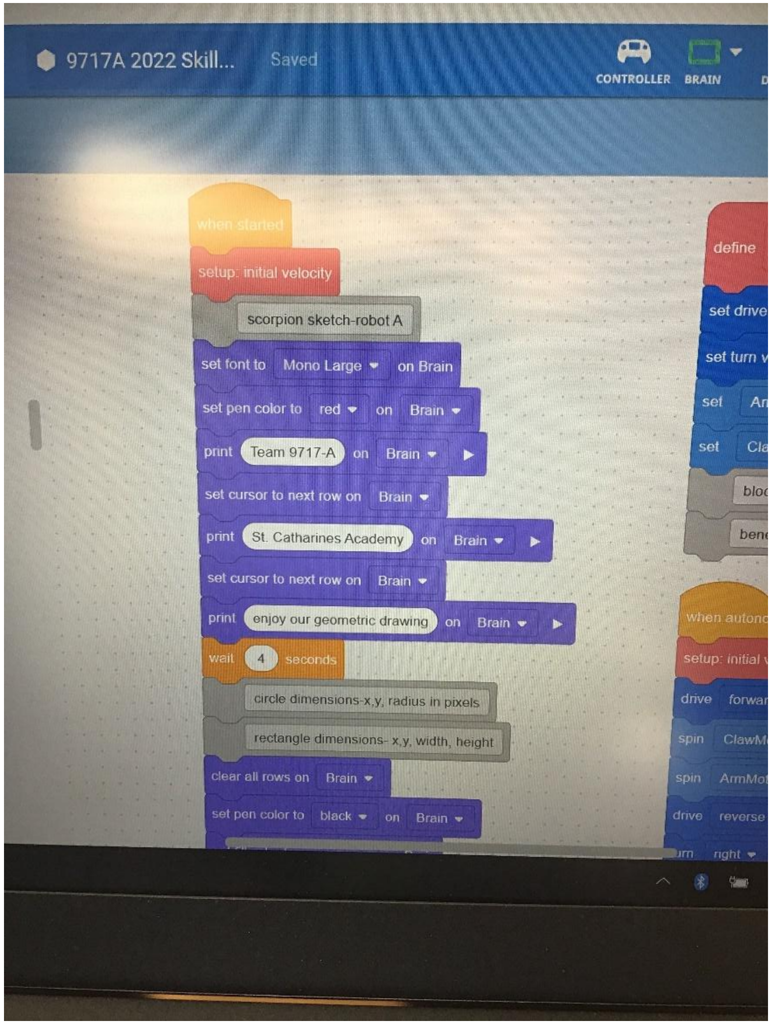
ROBOT A



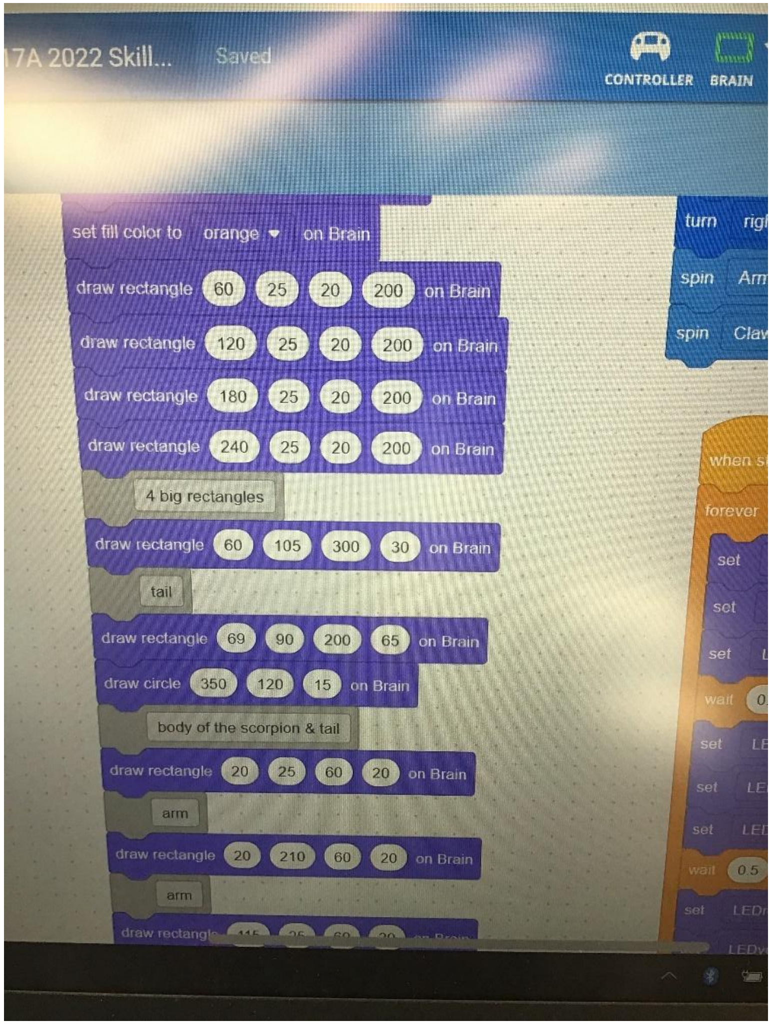
BUILDING REVISIONS

PROGRAMMING: AUTONOMOUS, TEST/TRIALS

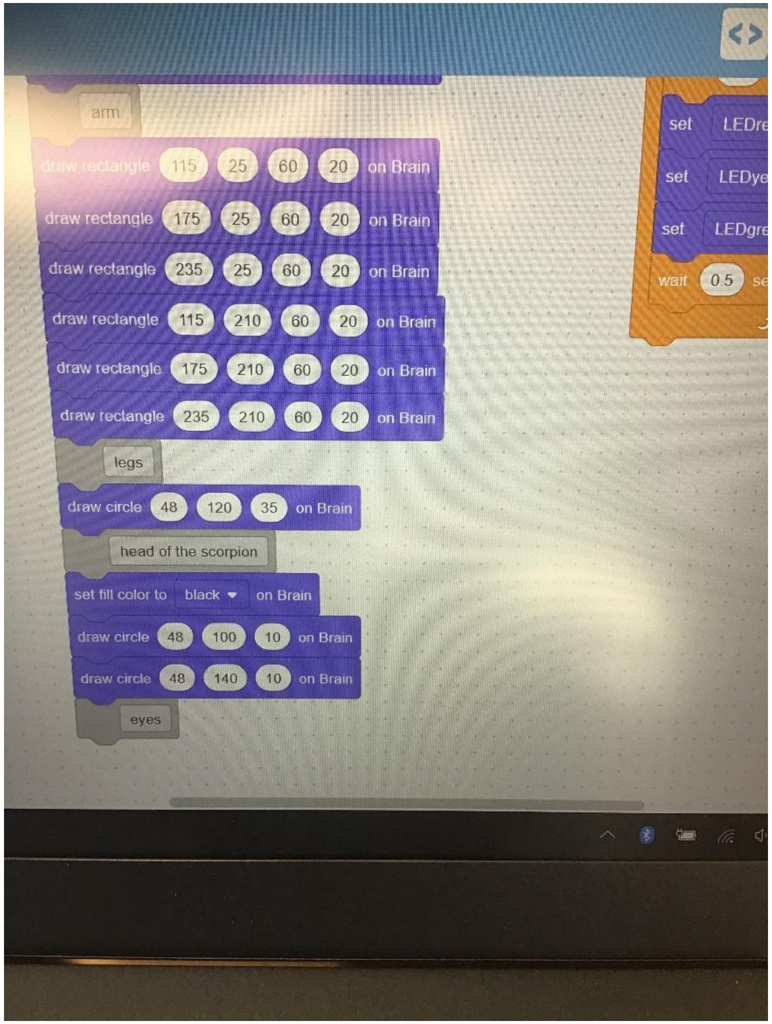
CODE FOR SPECIAL SKILLS



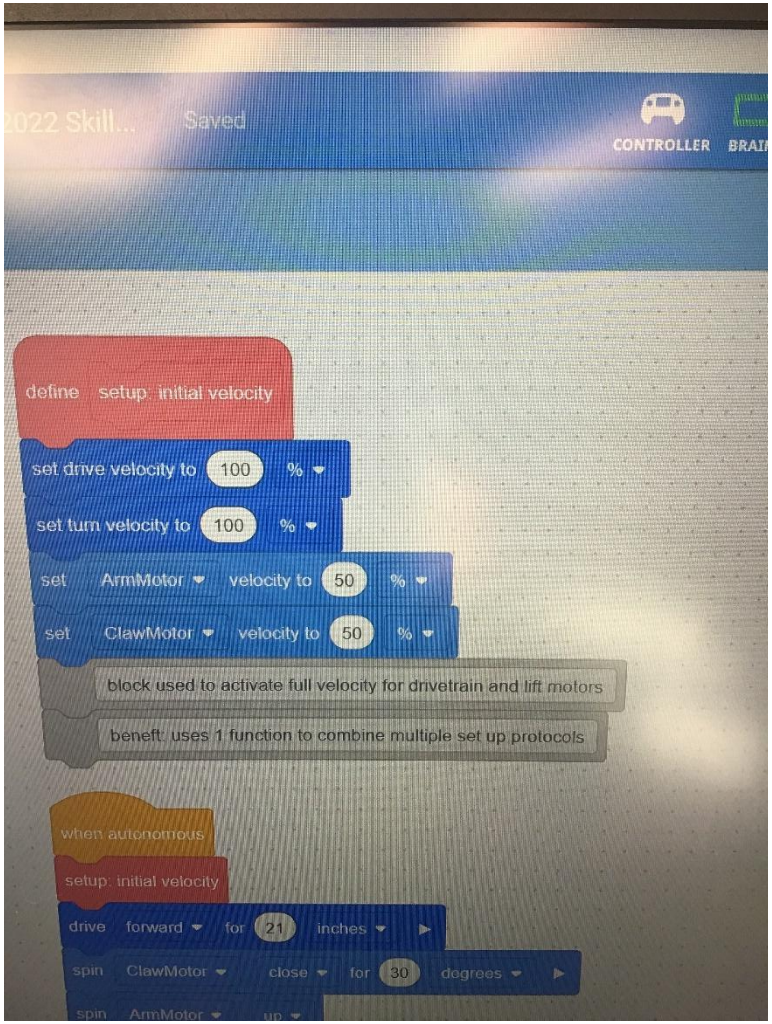
CODE FOR SPECIAL SKILLS



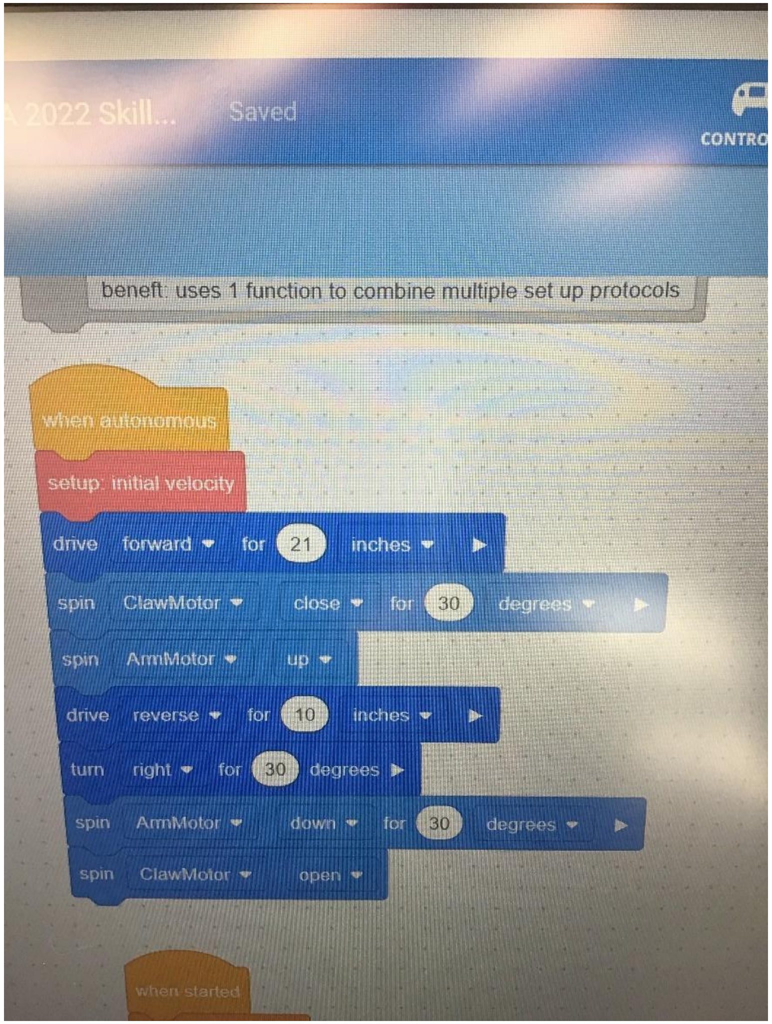
CODE FOR SPECIAL SKILLS



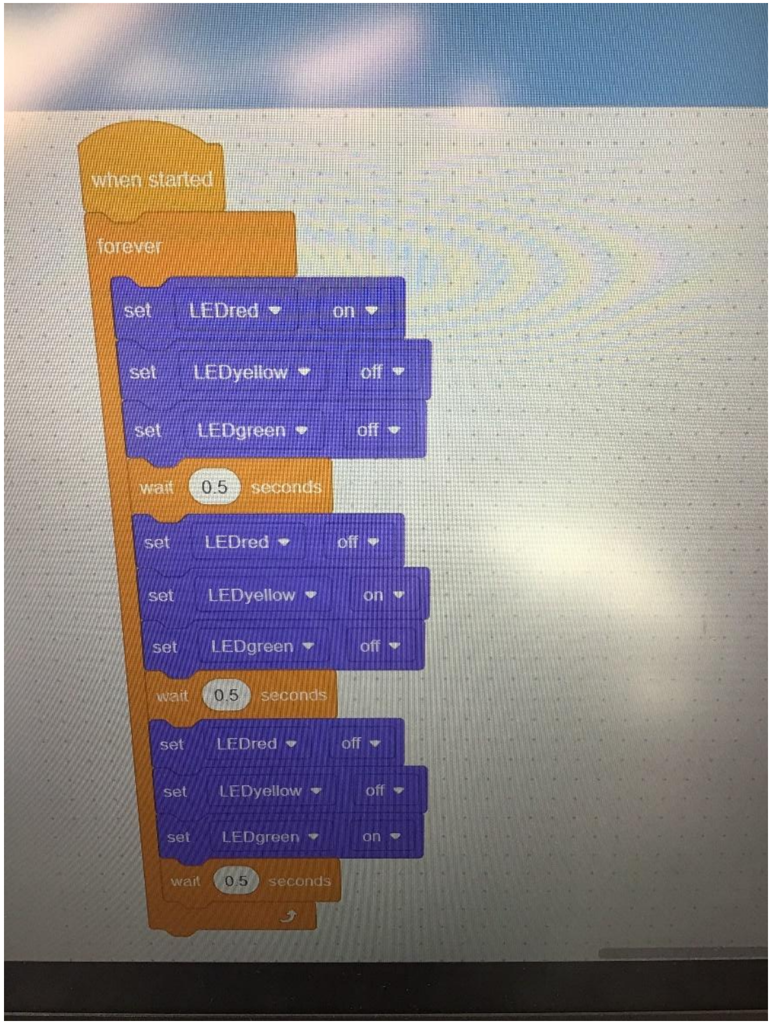
CODE FOR SPECIAL SKILLS



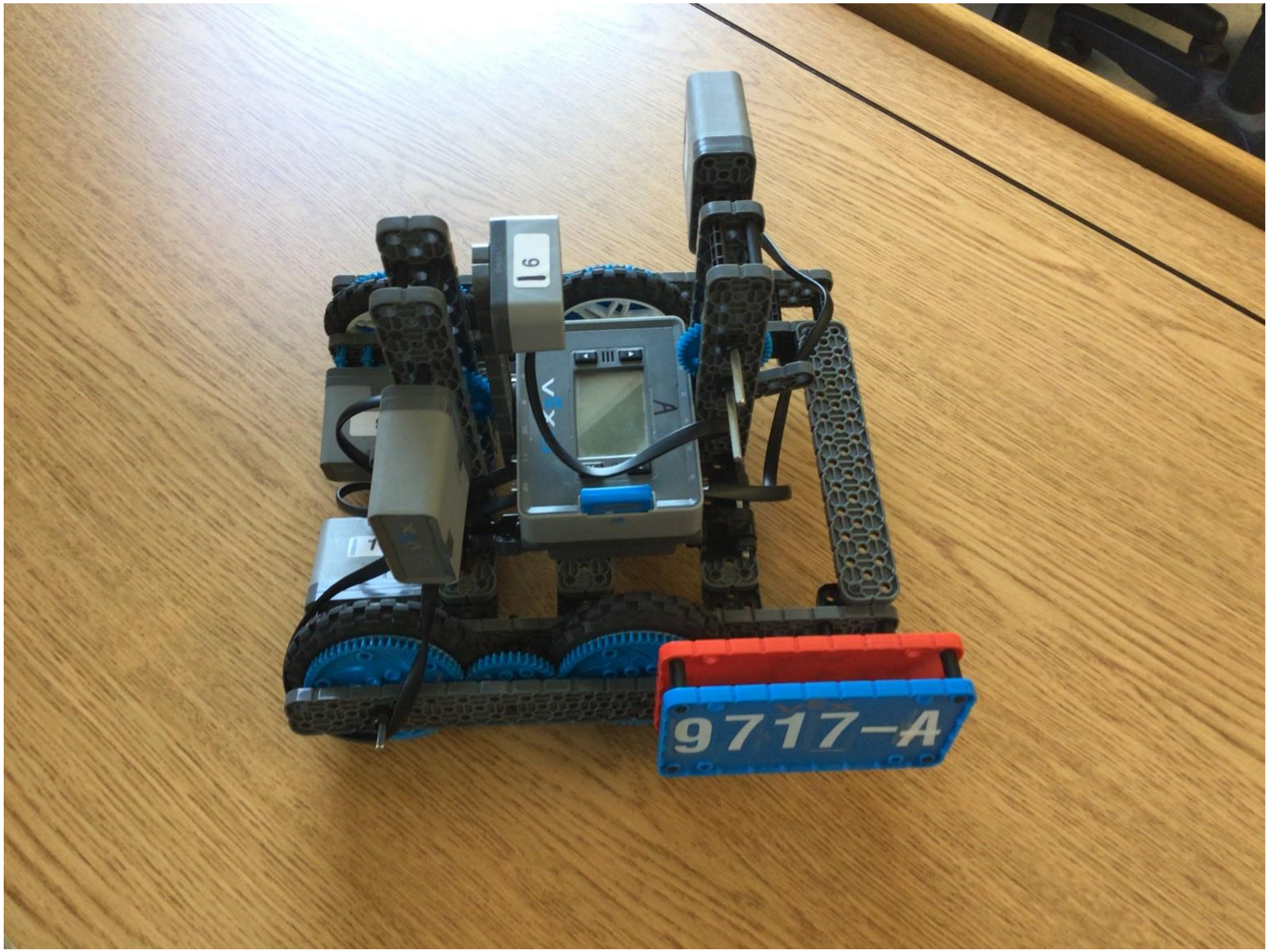
CODE FOR SPECIAL SKILLS



CODE FOR SPECIAL SKILLS

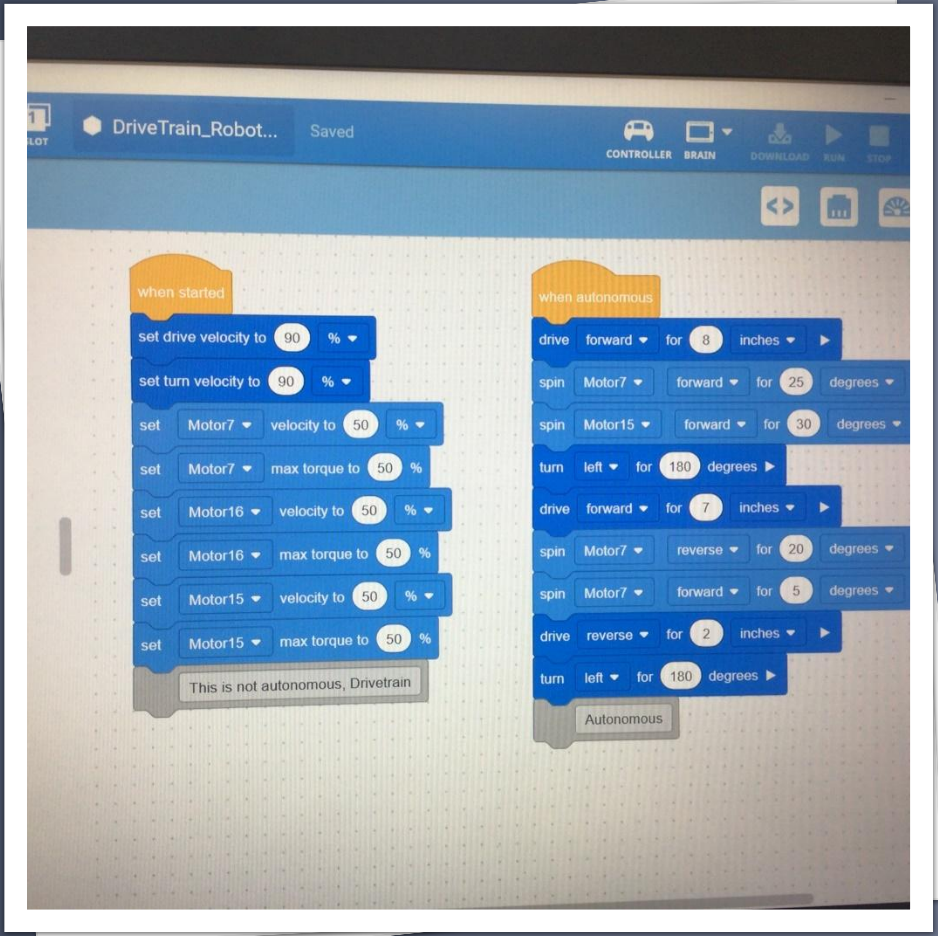


PROTOTYPE A

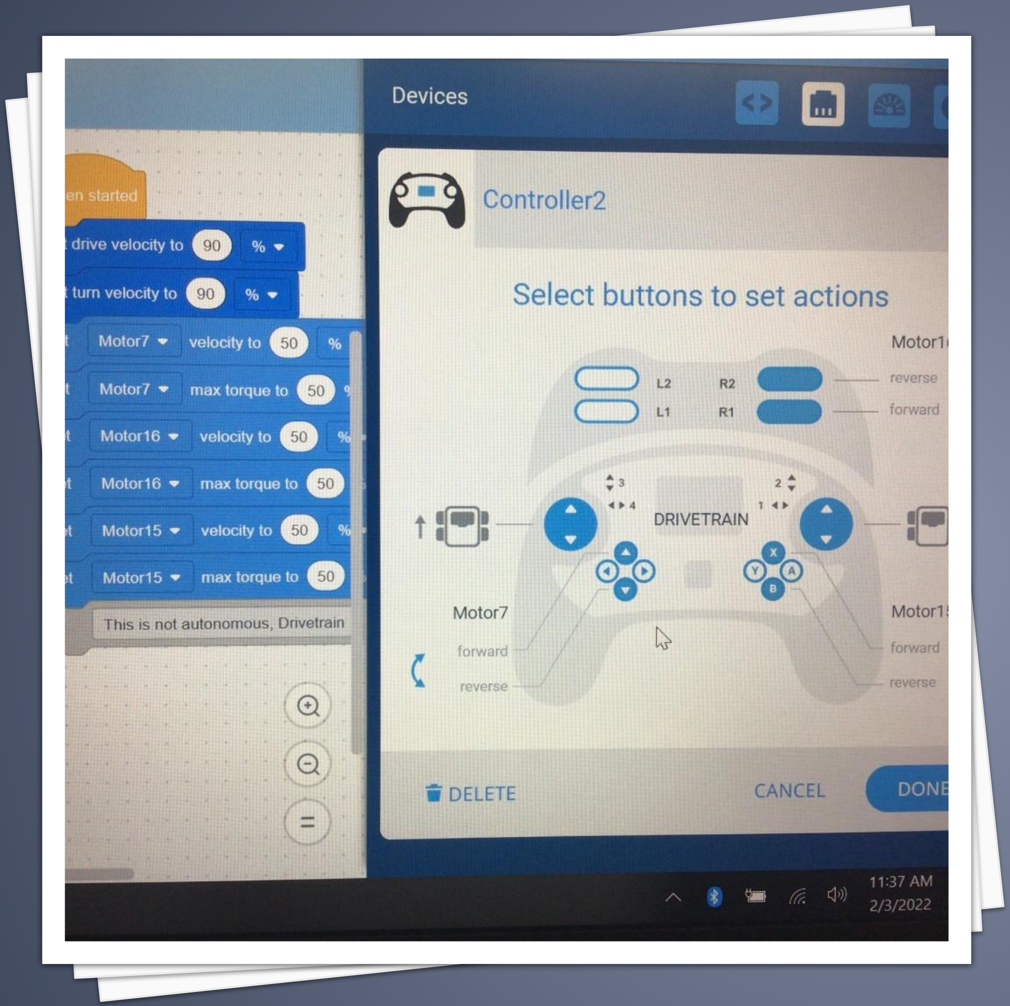


PURPOSE OF THE PROTOTYPE

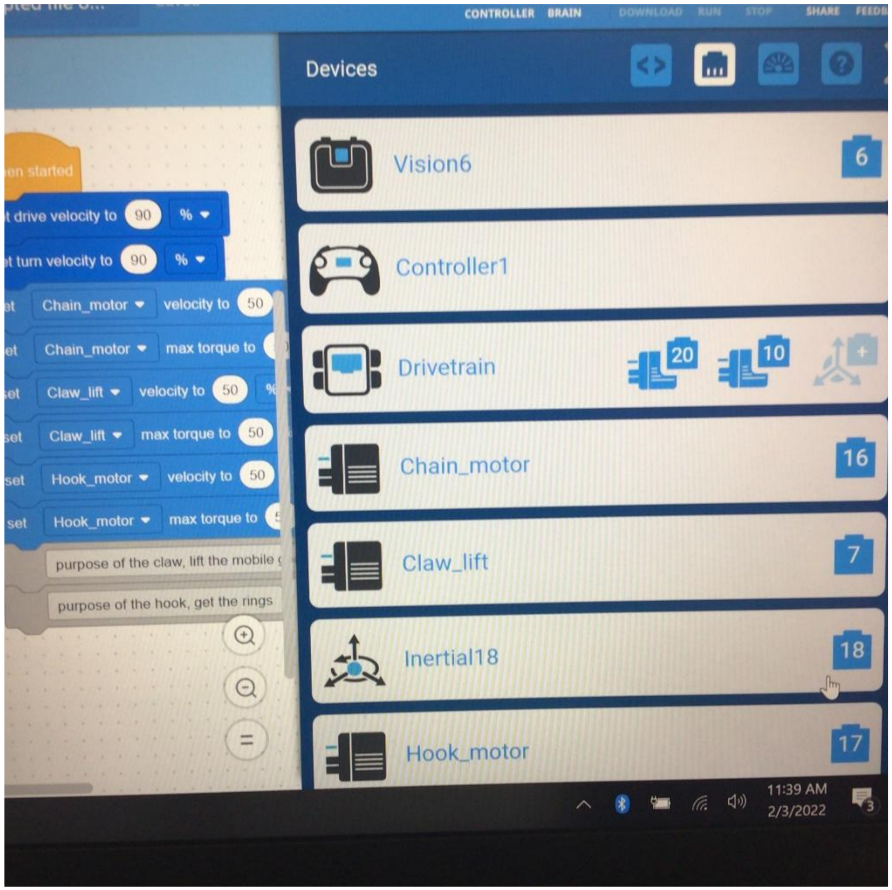
- The prototype is essentially our initial tester robot where we can experiment with different design ideas and function.
- We can test different gear trains and see how our motors will operate with each mechanism.
- We can also quickly edit and change our design on the prototype before we build the final version.
- Programming: we can program different autonomous programs and test the basic movements of our program before transferring to the official bot.
- Overall: gives a gauge of performance and efficiency of our robots



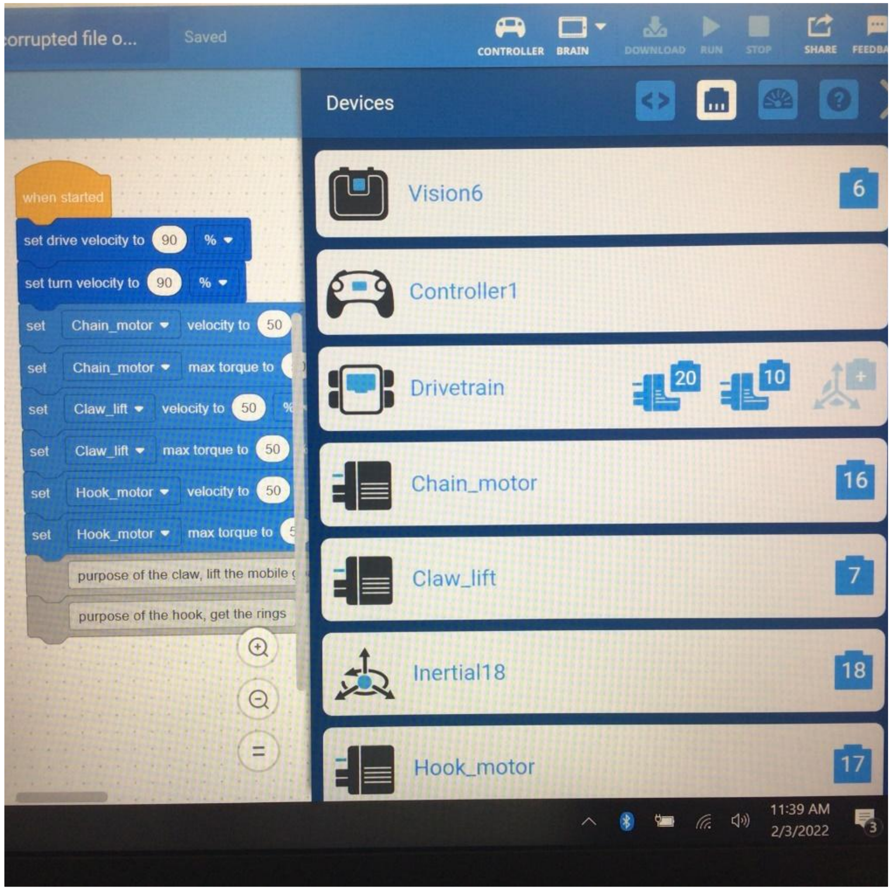
CODING DRIVETRAIN



CODE JOYSTICK



CODE ROBOT'S DEVICES



CONTROLS, MOTORS, JOYSTICK

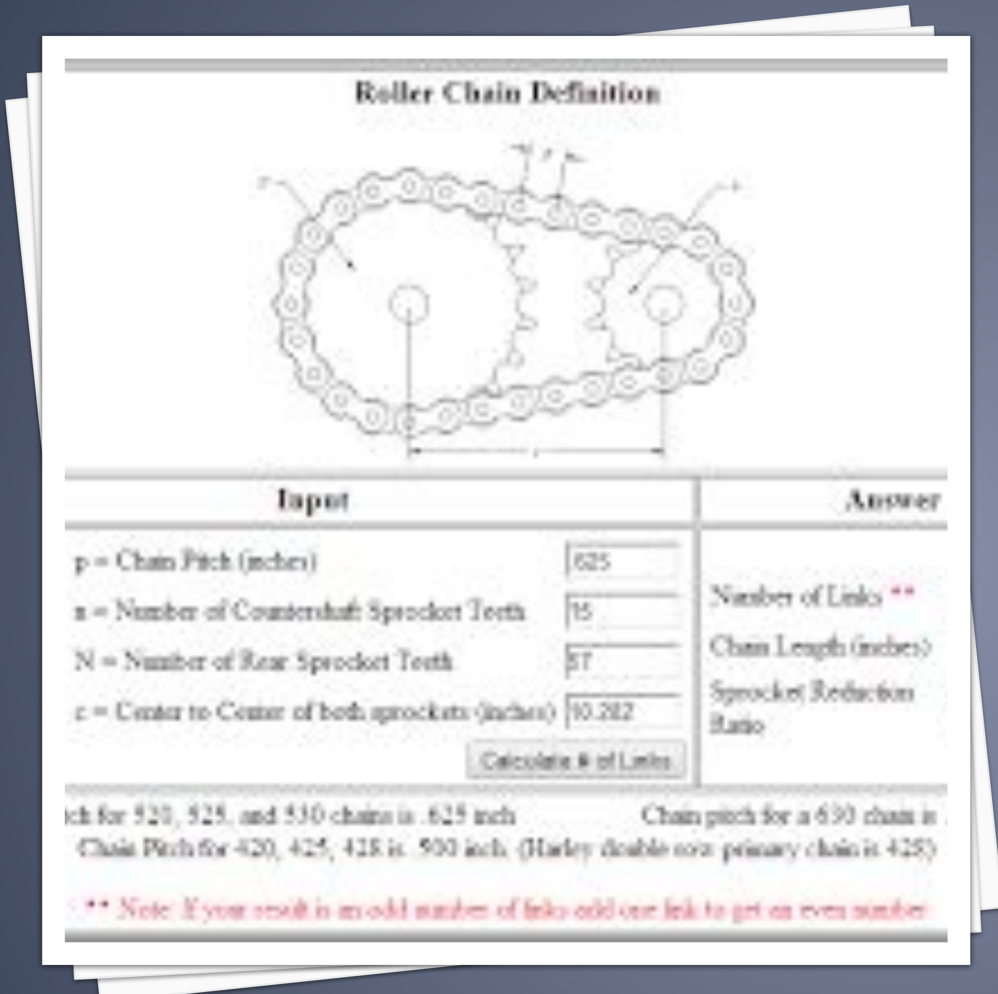
Vision sensor, interial, distance, bumper

SPECIAL SKILLS- SCORPION

SPECIAL SKILLS- SCORPION

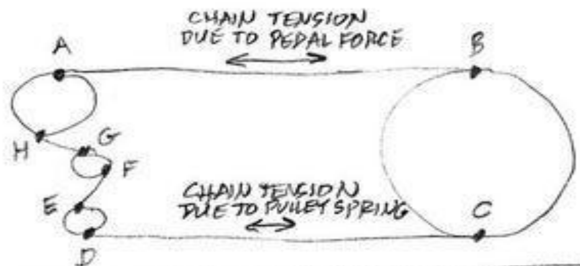
SENSORS: 4 USED IN AUTONOMOUS

- Vision- to see colors of rings & goalies on playing field
- Distance- to count how many inches to drive in autonomous & skills
- Inertia- Newton’s 1st law, when detects motion drive train will drive in Newton’s 2nd Law, hopefully pure kinetic energy in Newton's 3rd Law of coefficient of friction
- Bumper- if hit object robot bounces away from it



CALCULATIONS: RPM TO MPH CONVERSIONS.

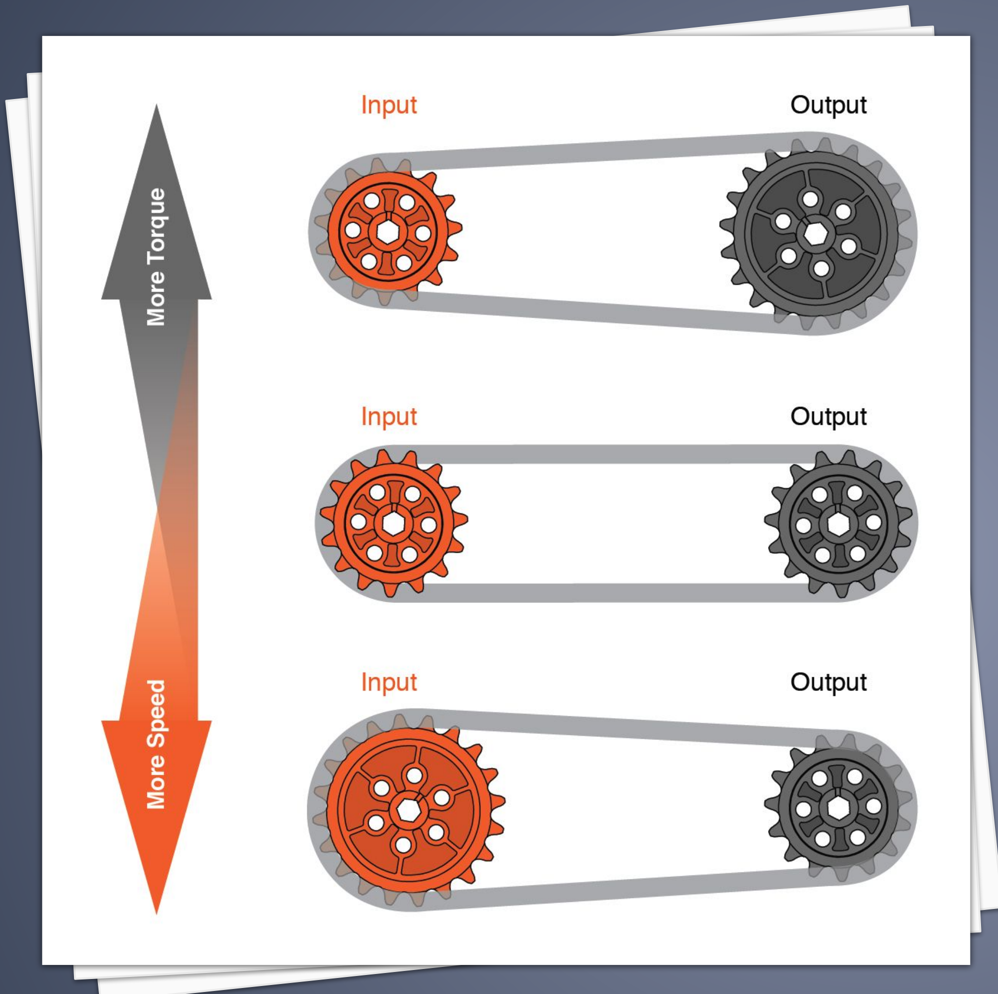
CALCULATIONS: VELOCITY AND ACCELERATION

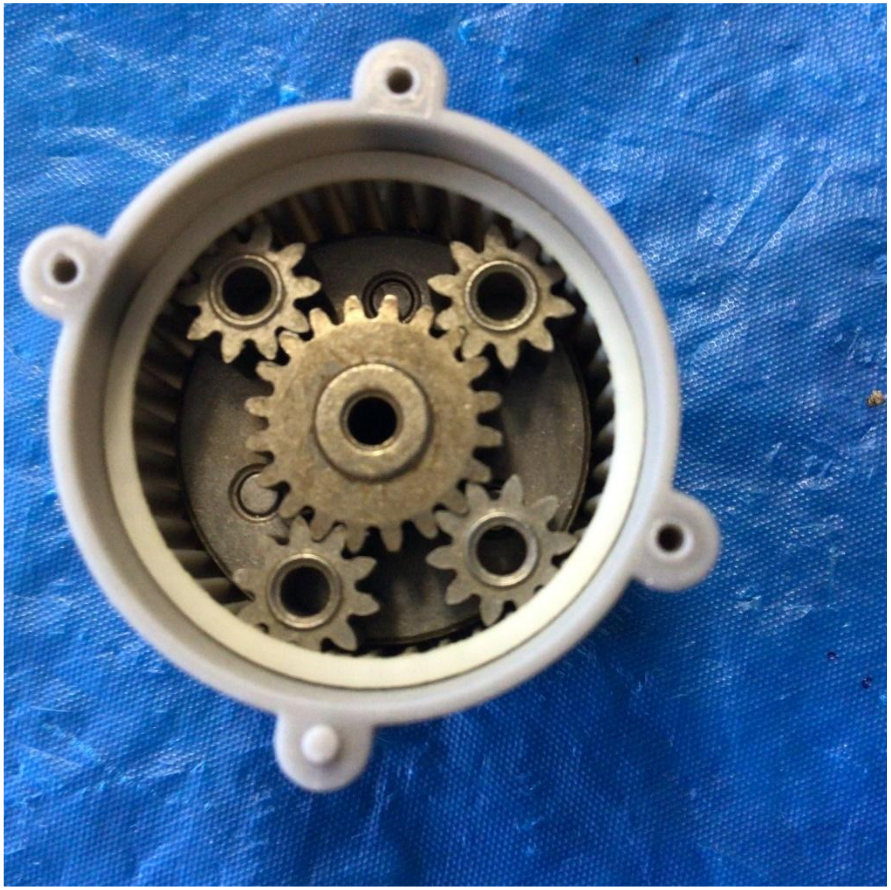


VELOCITY = 20 MPH						POWER = 260 WATT				CADENCE = 126 RPM
	GEAR: 52 RING / 26 COG					GEAR: 26 RING / 13 COG				
	# LINKS PER PEDAL REVOLUTION	LINK BEND ANGLE °	CHAIN TENSION lbF	LINKS × ANGLE × TENSION	% OF TOTAL	# LINKS PER PEDAL REVOLUTION	LINK BEND ANGLE °	CHAIN TENSION lbF	LINKS × ANGLE × TENSION	% OF TOTAL
A	52	360/26	85	61,414	34.5	26	360/13	[illegible]	[illegible]	[illegible]
B	52	360/52	85	30,707	17.3	26	360/26	[illegible]	[illegible]	[illegible]
C	52	360/52	10	3600	2.0	26	360/26	[illegible]	[illegible]	1.5
D	52	360/10	10	18,720	10.5	26	360/10	10	9,360	4.0
E	52	360/10	10	18,720	10.5	26	360/10	10	9,360	4.0
F	52	360/10	10	18,720	10.5	26	360/10	10	9,360	4.0
G	52	360/10	10	18,720	10.5	26	360/10	10	9,360	[illegible]
H	52	360/26	10	7,200	4.0	26	360/13	10	7,200	3.1
			TOTAL	177,802				TOTAL	232,483 (1.31×)	

- Design Strategies
- Speed, Power, Torque & DC Motors
- Mechanical Power Transmission
- Drivetrain Design
- Lifting Mechanisms
- Systems Integration
- Testing & the Iteration Process

CALCULATIONS: MAXIMUM ACCELERATION /VELOCITY



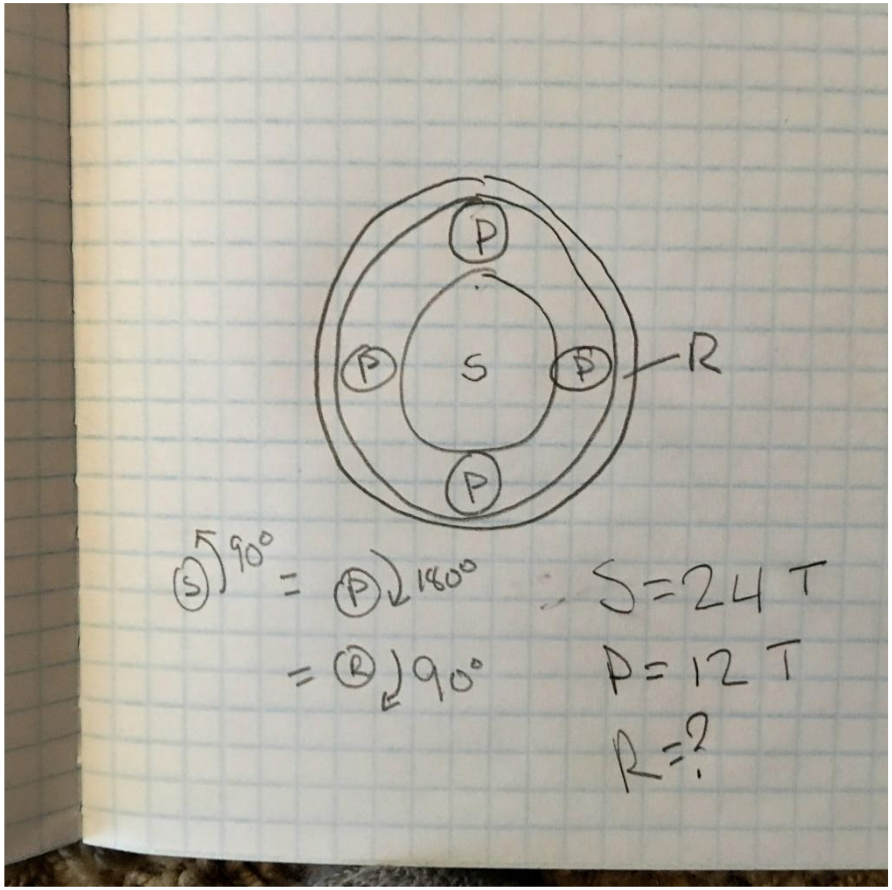


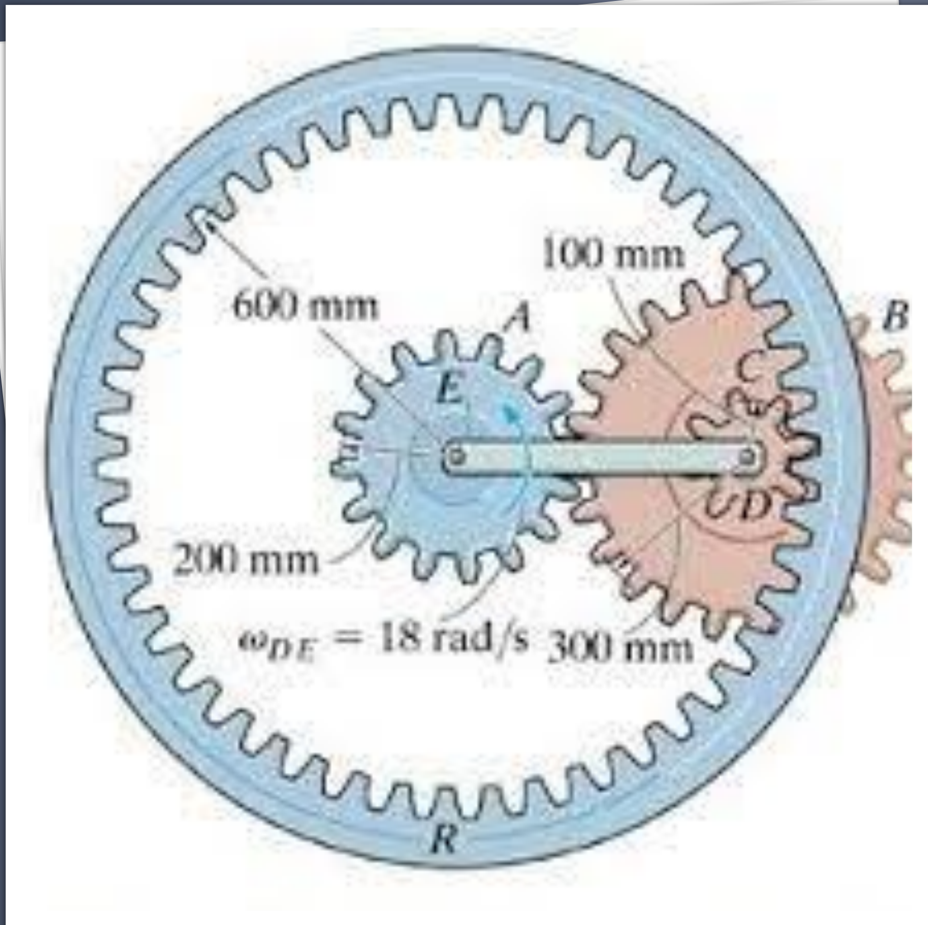
CALCULATION: GEAR TRAINS

Planetary/Epicyclic gear train for motors running 2-wheel drive at 200 rpms
Claw lift is 100 rpms

CALCULATION: GEAR TRAINS-INTAKE ARMS

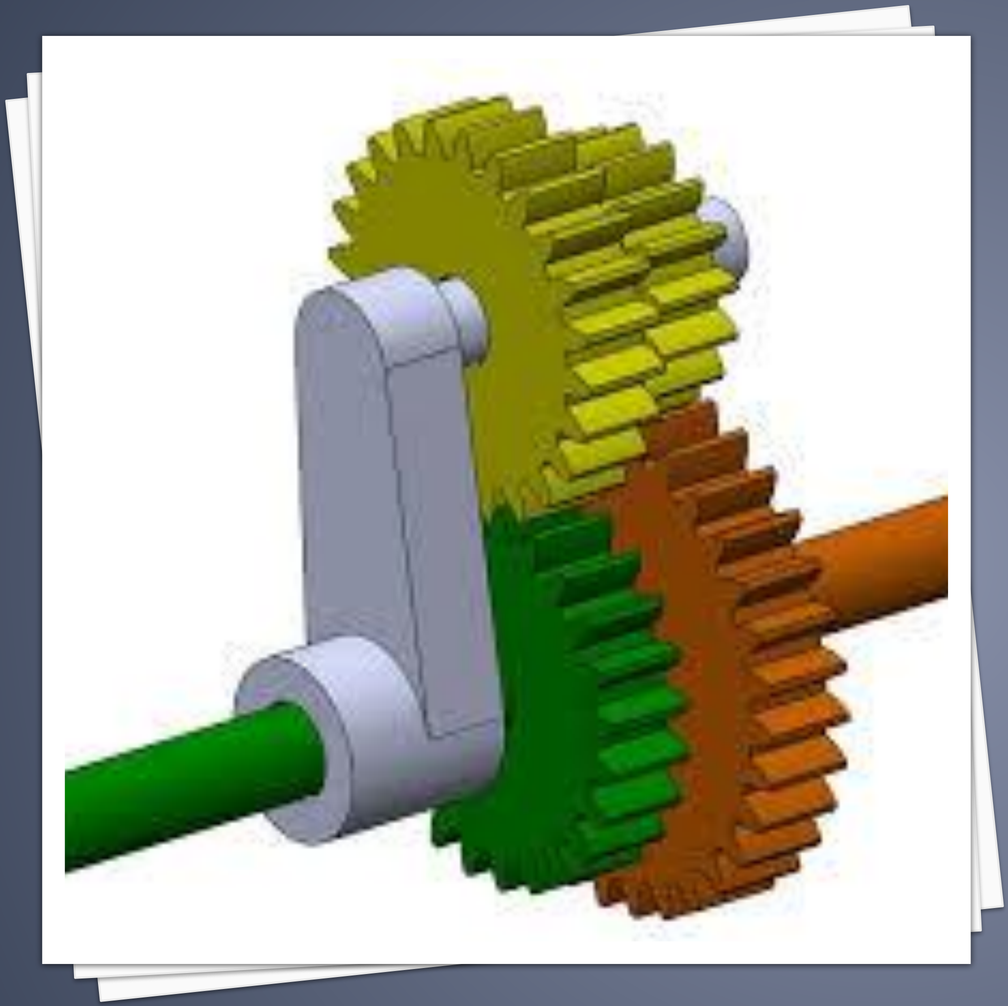
Planetary calculation





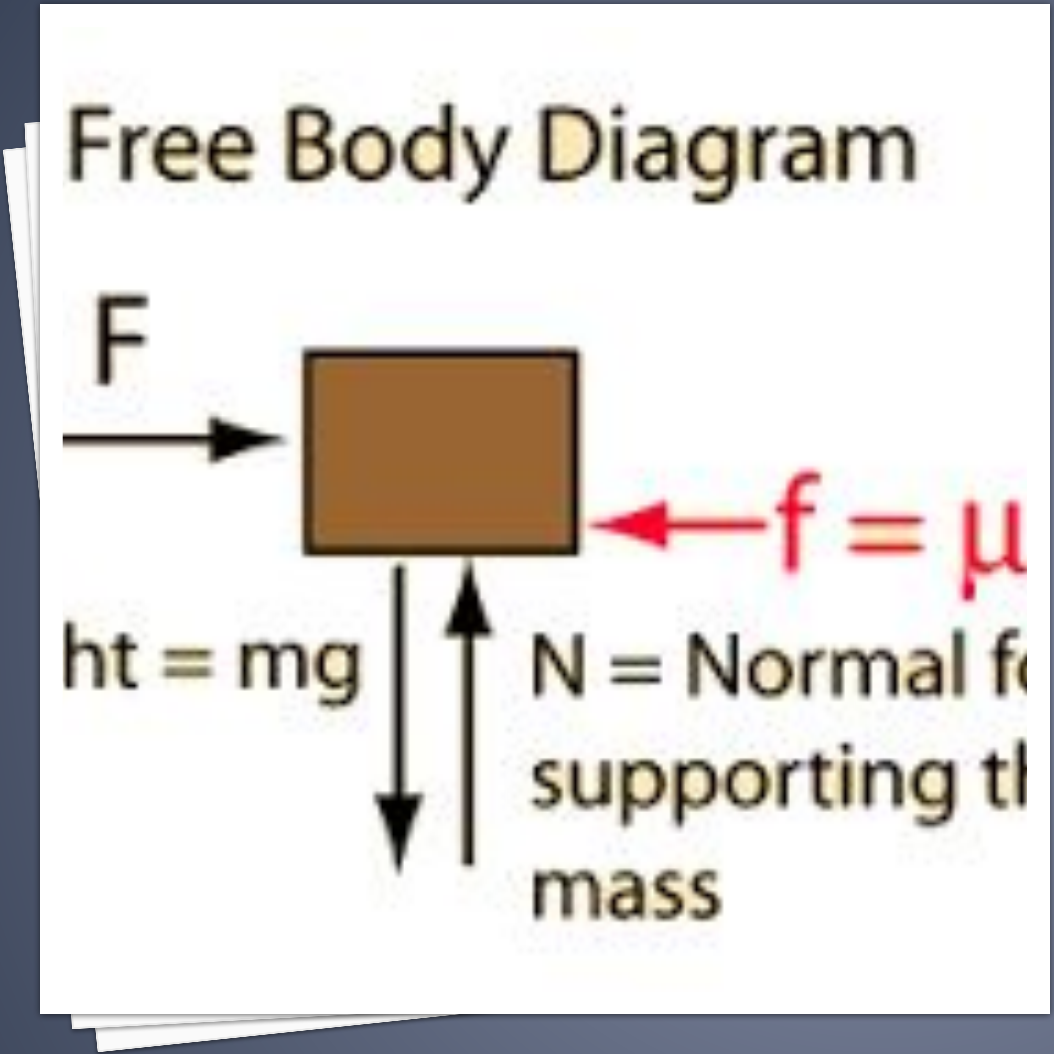
EPICYCLIC GEAR TRAIN WITH ARM

Motion synchs with planetary gear train



CALCULATIONS: REVISED INTAKE ARM GEAR TRAIN

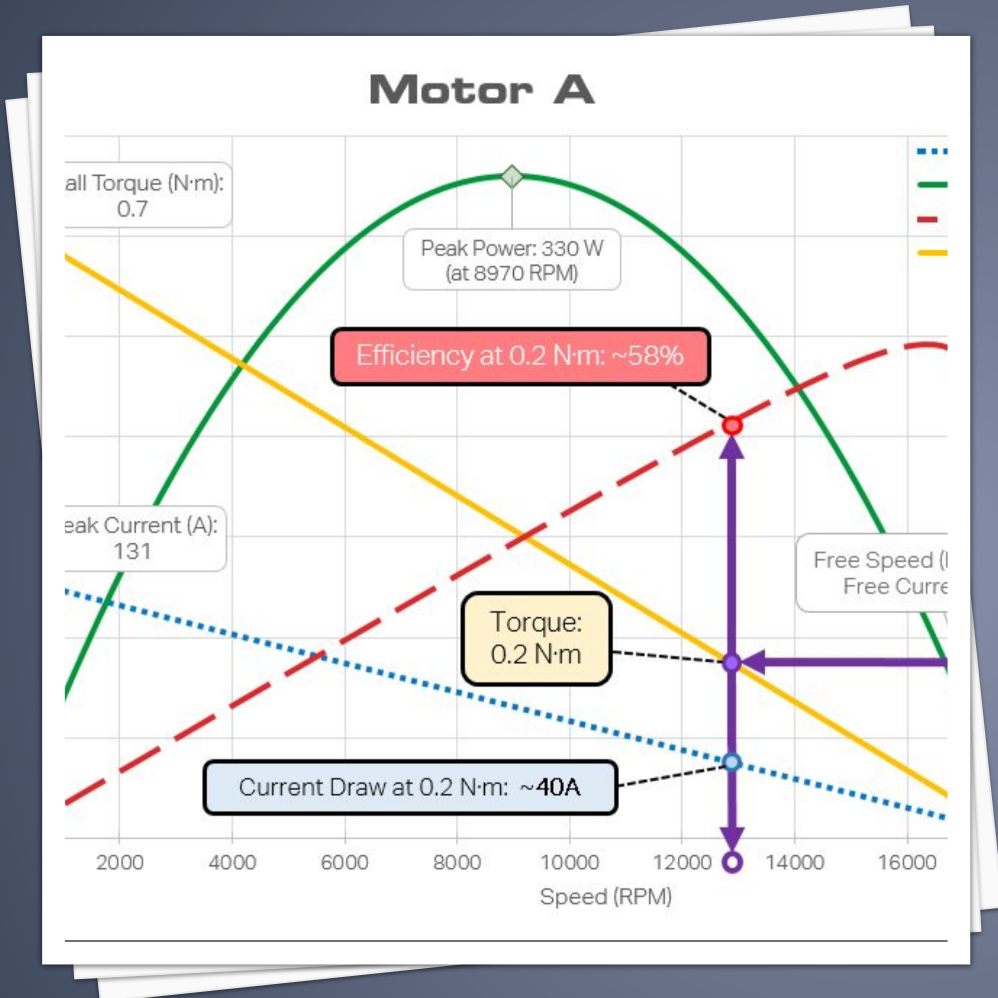
Vertical angle of geartrain

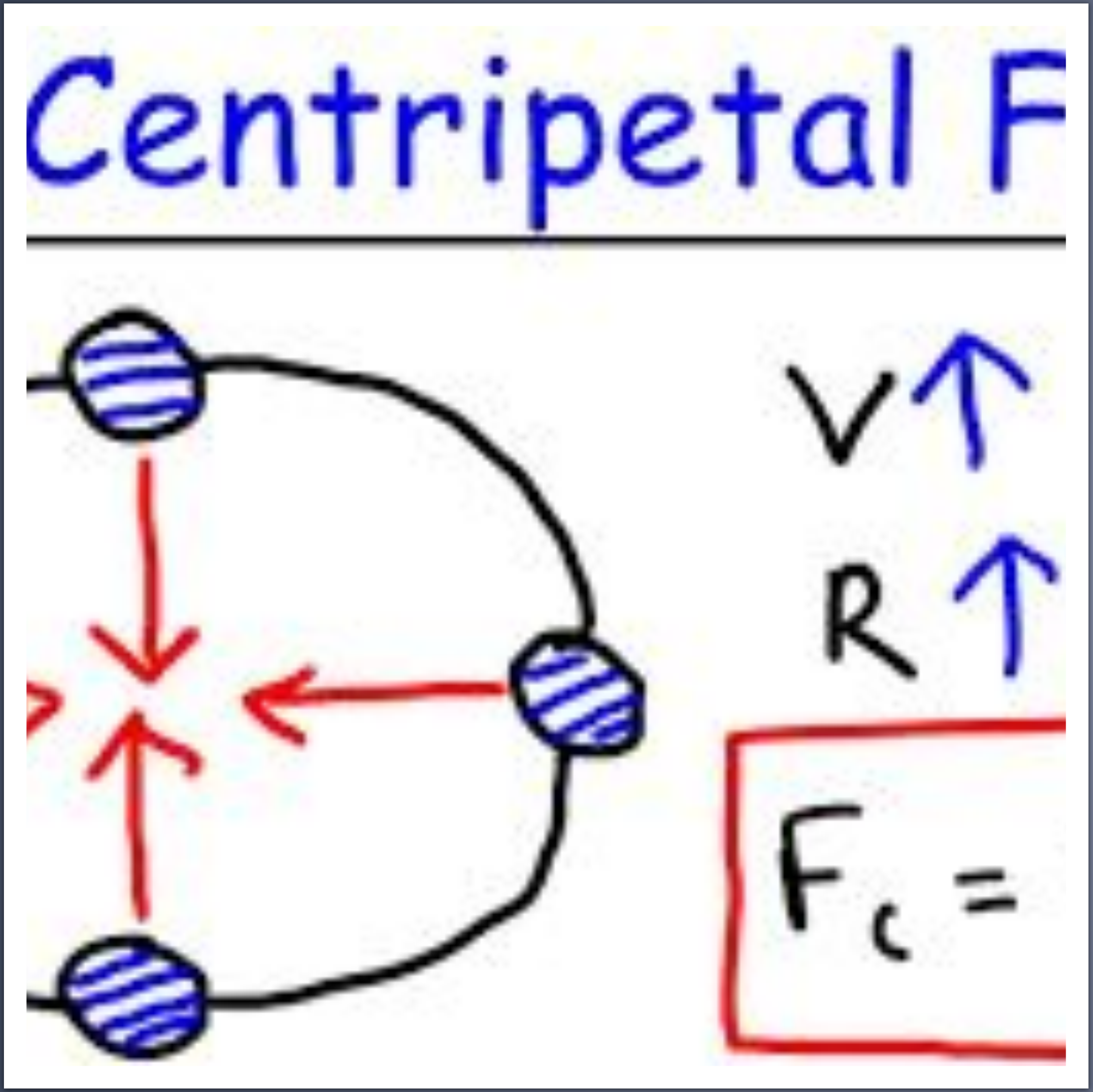


CALCULATIONS: NEWTON'S 3 LAWS OF MOTION

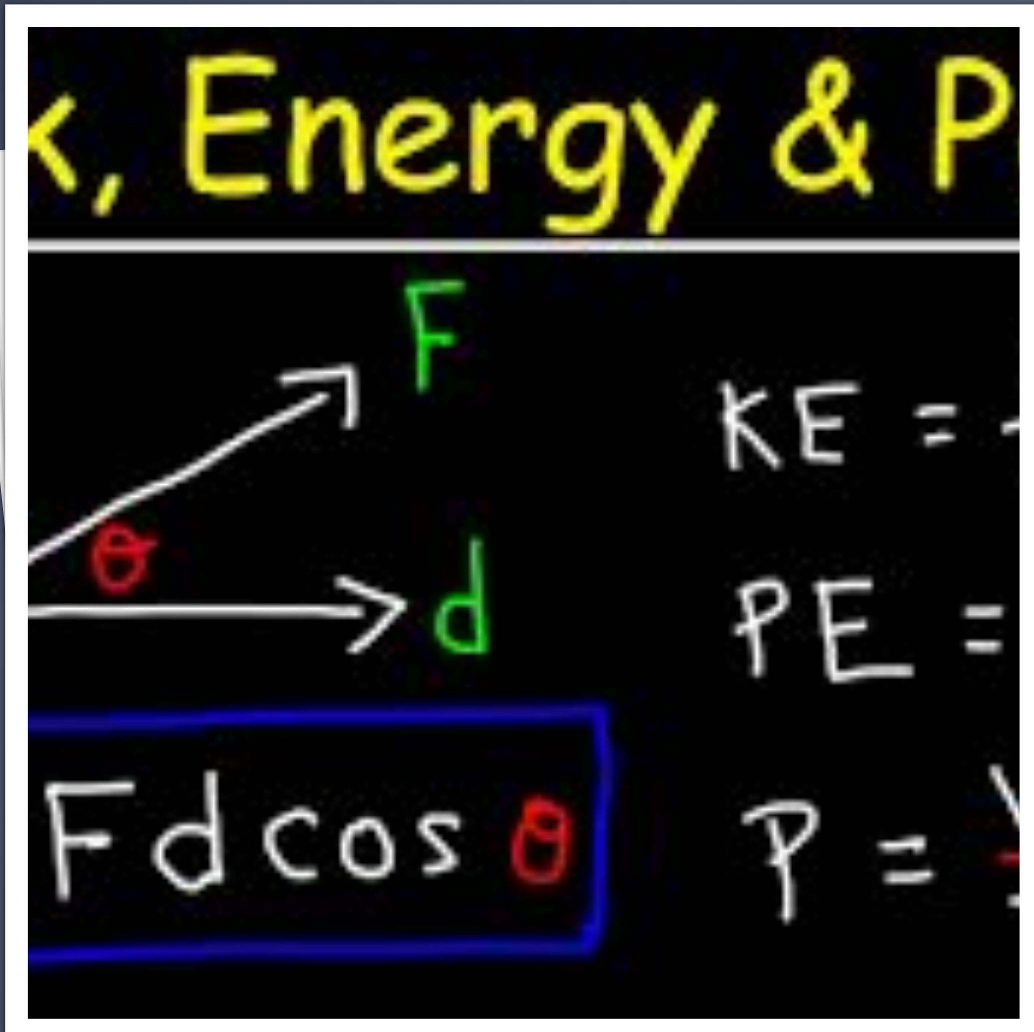
Center Gravity, distribution of Forces

CALCULATION: PROJECTILE MOTION



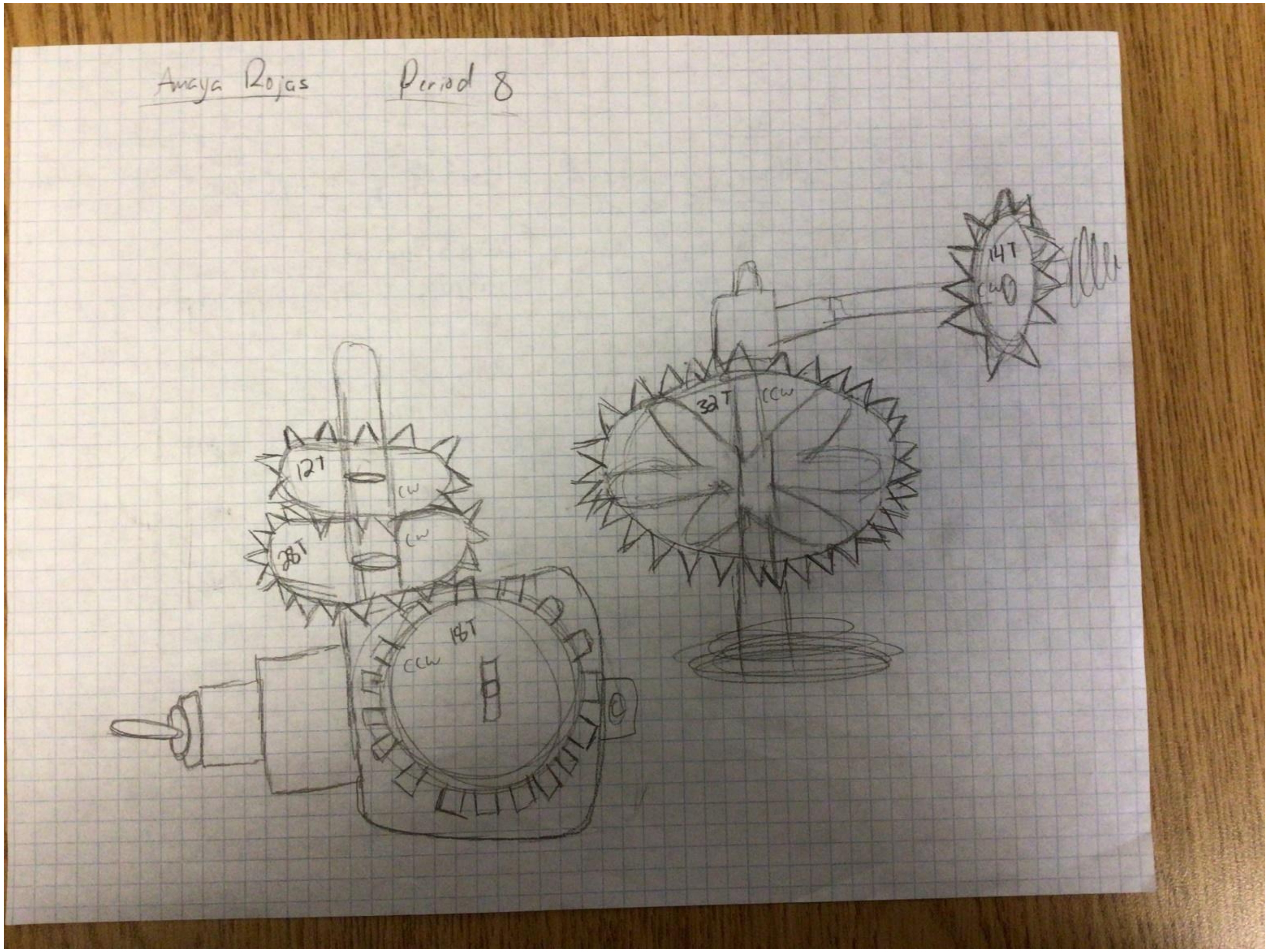


CALCULATION: CENTRIPETAL FORCE (WHEELS)



CALCULATIONS: WORK, POWER, ENERGY.

COMPLEX COMPOUND GEAR TRAIN



GEAR RATIOS, RPMS, TORQUE

directions | Math

Small yellow pinion = $\boxed{12T}$ → ccw
large yellow pinion = $\boxed{24T}$ → cw
green gear = $\boxed{16T}$ → ccw
Small red gear = $\boxed{14T}$ → side-side
large red gear = $\boxed{32T}$ → ccw
Small orange rack = $\boxed{11T}$ → ccw
large blue rack = $\boxed{21T}$ → side-side

Motor Rpm = 30

Gear Ratio $\left(\frac{\text{driver}}{\text{driven}}\right)$

Gears 1+2: $\frac{14}{32}$ = 7:16 → gearing up
Gears 4+5: $\frac{12}{11}$ → 12:11 → gearing up
Gears 6+7: $\frac{21}{24}$ = 7:8 → gearing up
Gears 3+6: $\frac{44}{16}$ = 3:2 → gearing down

$\boxed{\text{Torque} = 0}$

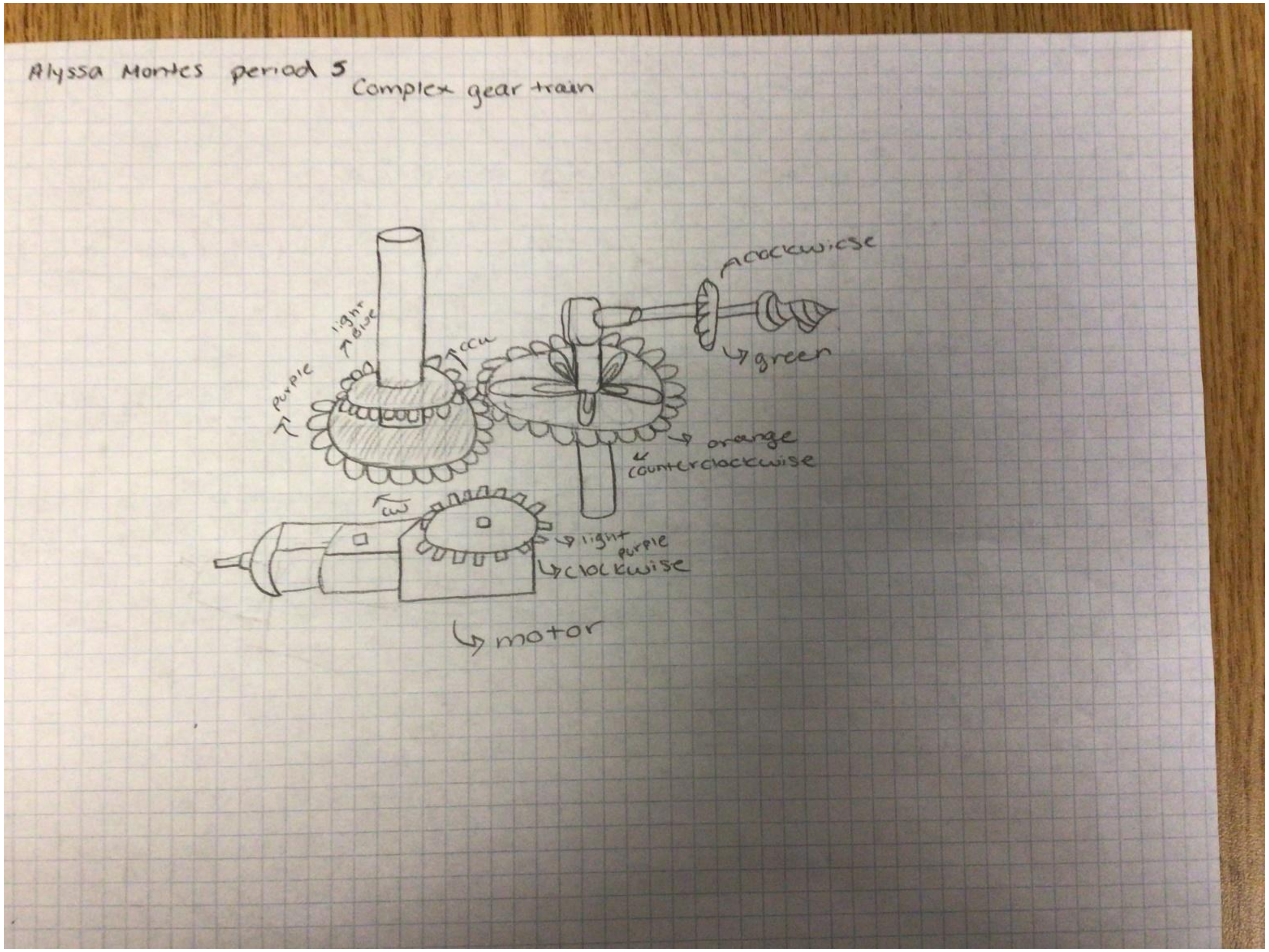
RPM
G1 = 30 rpm
G2 = 69 rpm
G3 = 30 rpm
G4 = 30 rpm
G5 = 75 rpm
G6 = 36 rpm
G7 = 60 rpm

$t = (54)(0.2)(\text{sine } 180)$
$t = 1.08(\text{sine } 180)$
$t = 0$

54 (Force)
.02 (Radius)
Sine 180

Small yellow pinion = driver
large yellow pinion = driver
green gear = idler
Small red gear = driven
large red gear = driver
Small orange rack = driven
large blue rack = driven

GEAR IDLER ON COMPOUND GEARTRAIN



VELOCITY RATIO, RPMS, TORQUE

Math

orange = 32 T
Green = 14 T
Dark purple = 28 T
light purple = 18 T
light bleu = 12 T

Gear ratio: Math

$\frac{28T}{18T} \overset{\div 2}{=} \frac{14T}{9T} = \boxed{14:9 \text{ (gearing down)}}$

$\frac{32T}{12T} \overset{\div 3}{=} \frac{8T}{3T} = \boxed{8:3 \text{ (gearing down)}}$

$\frac{14T}{32T} \overset{\div 2}{=} \frac{7T}{16T} = \boxed{7:16 \text{ (gearing up)}}$

RPM

Gears:

G A: $\boxed{45 \text{ rpm}}$ (18T)
G B: $\boxed{29 \text{ rpm}}$ (28T)

> $\boxed{29 \text{ rpm}}$

G C: $\boxed{29 \text{ rpm}}$ (12T)
G D: $\boxed{11 \text{ rpm}}$ (32T)

> $\boxed{11 \text{ rpm}}$

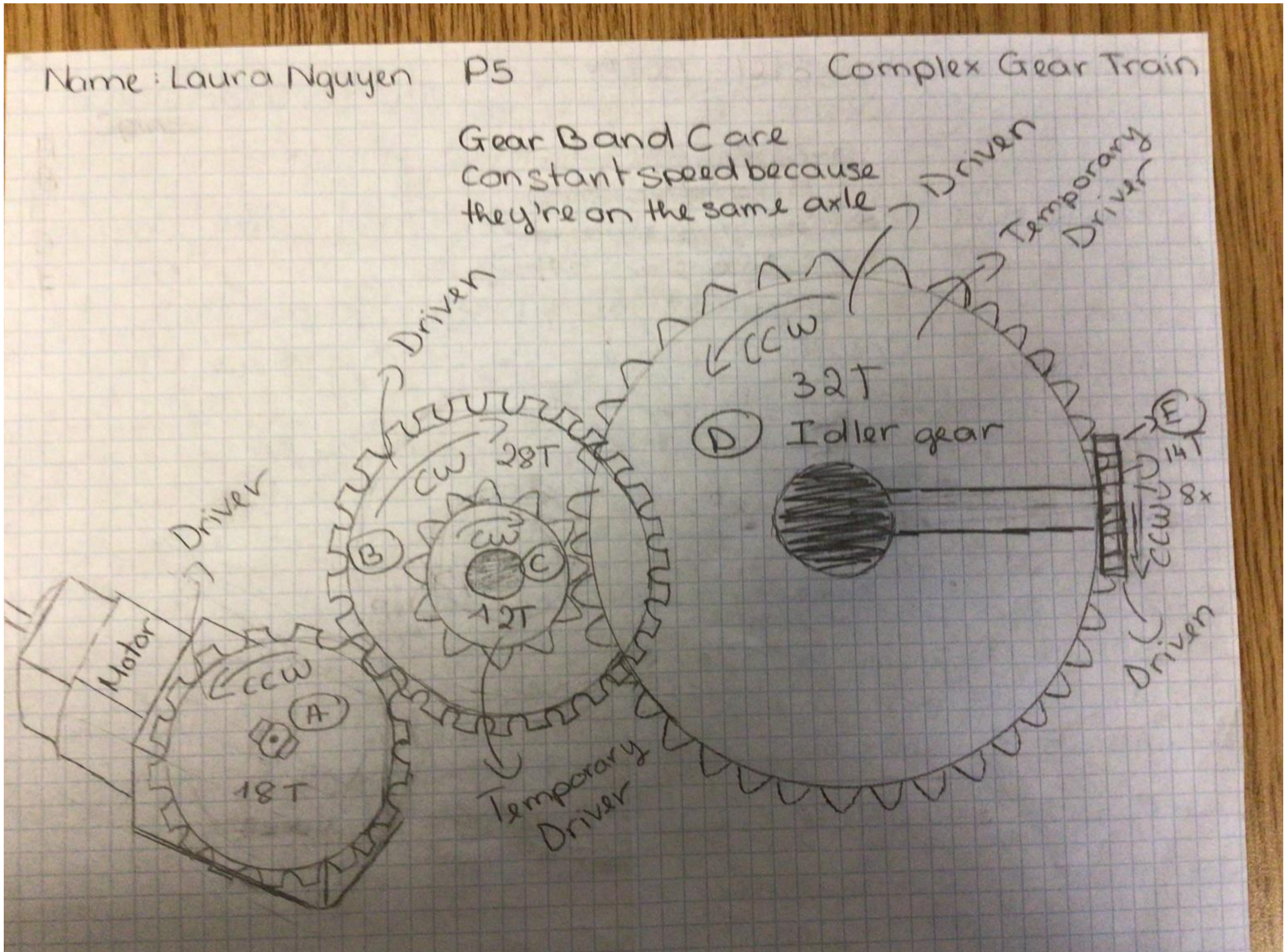
G E: $\boxed{25 \text{ rpm}}$ (14T)

> $\boxed{25 \text{ rpm}}$

$\frac{28}{18} = \boxed{1.56}$ $\frac{32}{14} = \boxed{2.28}$

$\frac{32}{12} = \boxed{2.67}$

GEAR TRAIN LAYOUT TO MESH



GEARING UP & GEARING DOWN

Gear Ratio: $\frac{\text{Driven}}{\text{Driver}} = \frac{B}{A} = \frac{28 \div 2}{18 \div 2} = \frac{14}{9}$ $\boxed{14:9}$ Gear Down

A spins 14 times B spins 9 times

Gear Ratio: $\frac{\text{Driven}}{\text{Driver}} = \frac{D}{C} = \frac{32 \div 4}{12 \div 4} = \frac{8}{3} = \boxed{8:3}$ Gear Down

C spins 8 times D spins 3 times

Gear Ratio: $\frac{\text{Driven}}{\text{Driver}} = \frac{E}{D} = \frac{14 \div 2}{32 \div 2} = \frac{7}{16}$ $\boxed{7:16}$ Gear Up

D spins 7 times E spins 16 times

RPM

original RPM

A = 18T = 45 rpm

B = 28T = 28.8 rpm

C = 12T = 28.8 rpm

Same rpm because they're on the same axle

D = 32T = 10.786 rpm

E = 14T = 24.59 rpm

Gear A and B = $\frac{28}{18}$ = 1.56 gear down

Gear C and D = $\frac{32}{12}$ = 2.67 gear down

Gear D and E = $\frac{32}{14}$ = 2.28 gear up

$B = \frac{45}{1.56} = 28.8$

$D = \frac{28.8}{2.67} = 10.786$

$E = 10.786 \times 2.28$

$= 24.59$

Torque

Equation: $\tau = r \cdot F \cdot \text{sine}\ \theta$

Sin 15

Force = 54N

Radius = 3.5m

Solve:

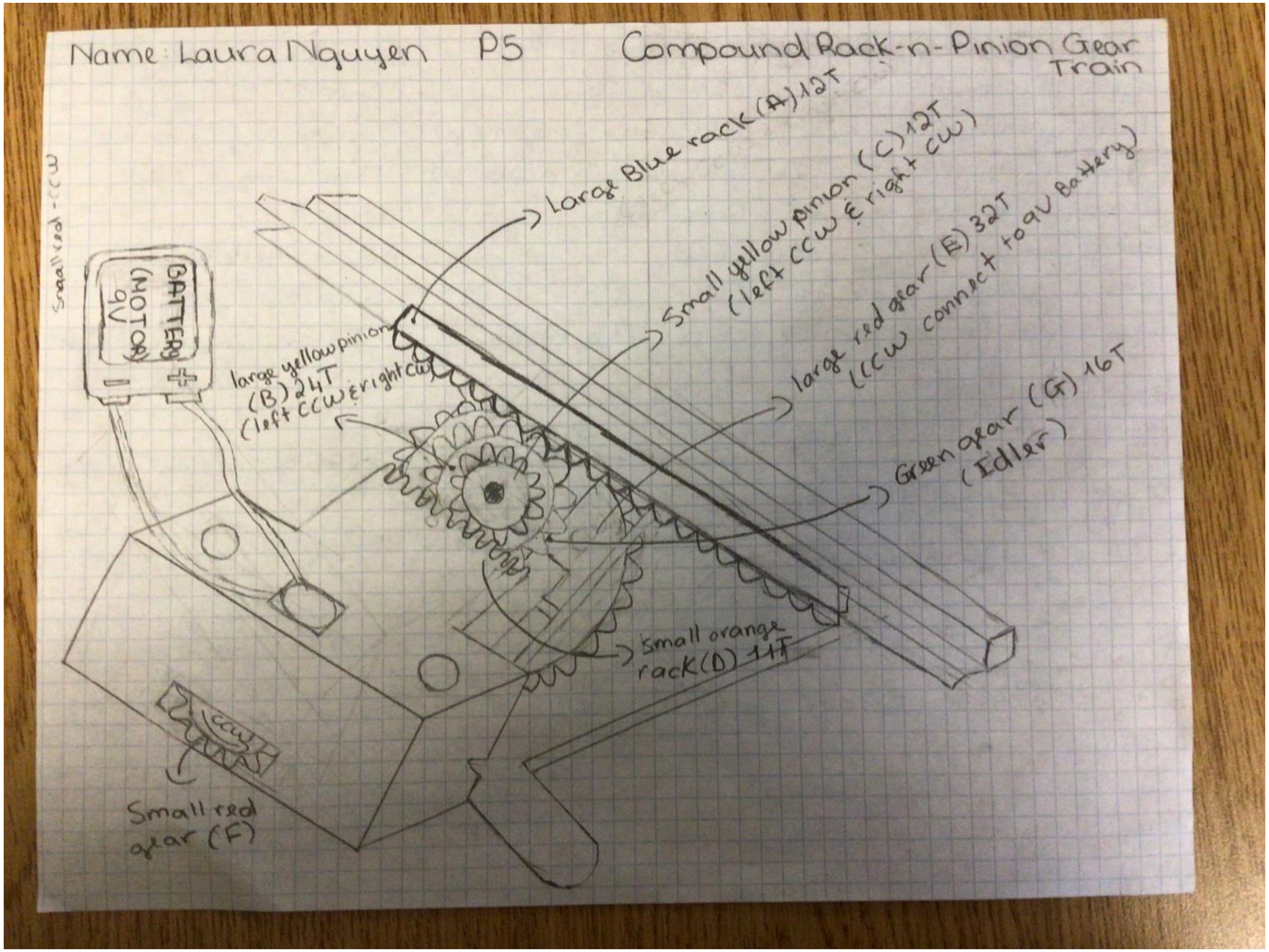
$\tau = rF(\sin\theta)$

$\tau = 3.5(54)(\sin 15^\circ)$

$\tau = 48.9167995244$

$\boxed{\tau = 49\ \text{Nm}}$

RACK -N- PINION GEAR TRAIN



DIRECTION CCW OR CW

Color		# Teeth	Direction	Driven or Driver
Large blue rack	A	21T	left or right	Driven
Large yellow pinion	B	24T	left CCW & right CW	Temporary Driver Driven
Small yellow pinion	C	12T	left CCW & right CW	Temporary Driver
Small orange rack	D	11T	Constant	Driven
Large red gear	E	32T	CCW	Driver (9V Battery)
Small red gear	F	14T	CW	Driven
Green gear (Idler)	G	16T	left CCW & right CW	Idler (Temporary Driver

Gear Ratio: $\frac{\text{Driven}}{\text{Driver}}$

$\frac{A}{B} = \frac{21}{24} = \frac{7}{8}$ $\boxed{7:8}$ Gear Up

$\frac{D}{C} = \frac{11}{12} =$ $\boxed{11:12}$ Gear up

$\frac{F}{E} = \frac{14}{32} = \frac{7}{16}$ $\boxed{7:16}$ Gear up

$\frac{C}{G} = \frac{24}{16} = \frac{3}{2}$ $\boxed{3:2}$ Gear down

RPM CALCULATION:

E & F: $\frac{32}{14} = 2.29$; $30 \times 2.29 = 68.57$

G = 68.7 RPM

C & G = $\frac{24}{16} = 1.5$; $68.57 \div 1.5 = 45.71\bar{3}$

A & B = $\frac{24}{21} = 1.14$; $30 \times 1.14 = 34.2$

rack = $34.2 \times 1.14 = 38.988$

RPM

Gear E = 30 RPM
Gear F = 68.57 RPM
Gear G = 68.57 RPM
Same RPM because they're on the same axle
Gear C = 45.713 RPM
Gear B = 34.2 RPM
Rack A (Blue) = 38.988 RPM

Torque Equation: $\tau = r \cdot F \cdot \text{sine}\ \theta$

Force = 54 N
Radius = .02 m
Sin = 180°

Solve: $\tau = rF(\sin\theta)$

$\tau = .02m(54)(180°)$

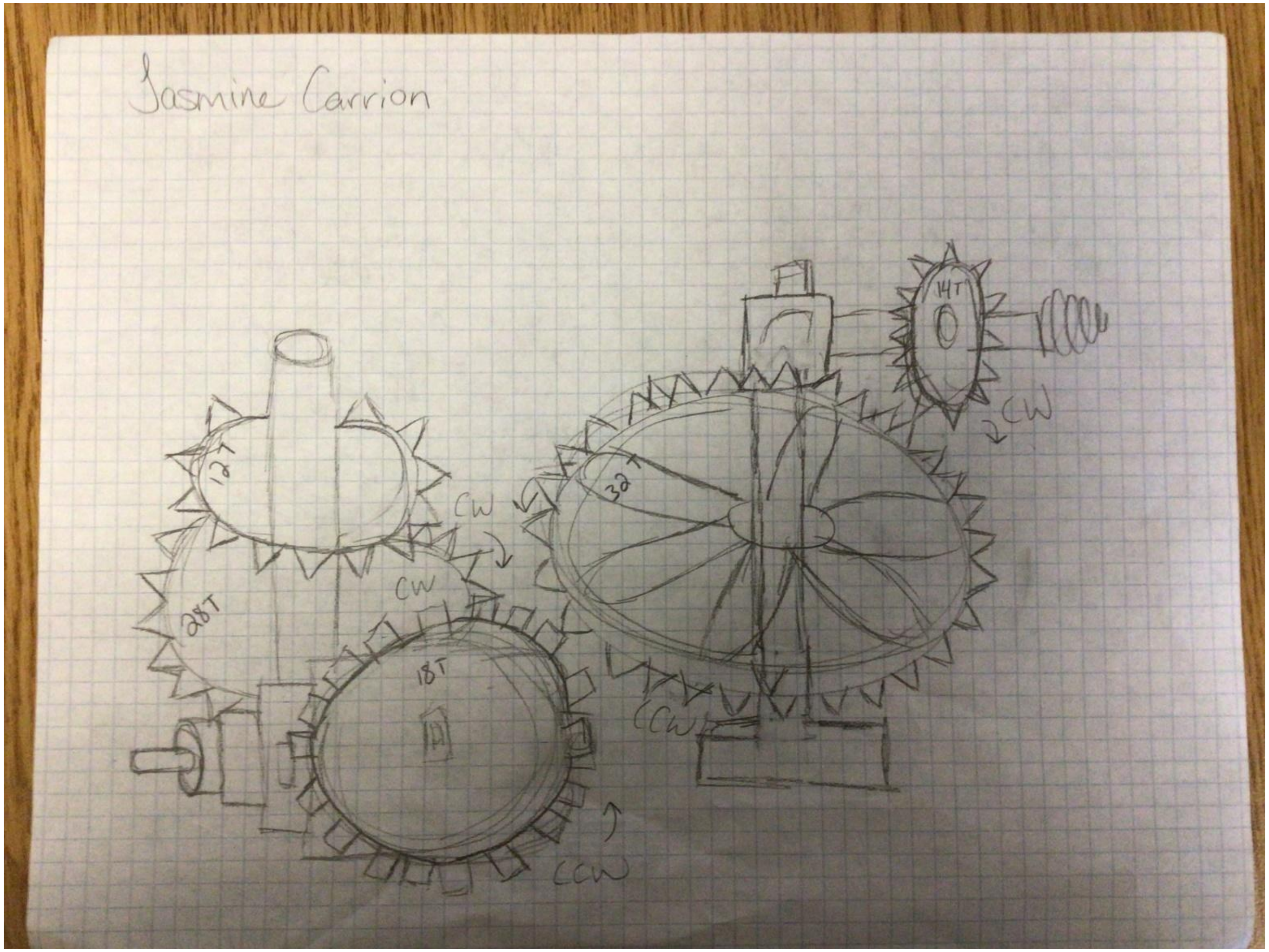
$\boxed{\tau = 0 Nm}$

hence

COS 180 = −1 (moving left)
COS −180 = +1 (moving right)

Because it is perpendicular motion

COMPLEX GEAR TRAIN



VELOCITY RATIO, RPMS, TORQUE

Jasmine Carrion Period 8

Complex Gear Train

Gear Ratios:

Dark Purple & Light Purple:

$\frac{\text{Driven}}{\text{Driver}} = \frac{DP}{LP} = \frac{28}{18} = \frac{14}{9}$, $\boxed{14:9}$ gearing down

Blue & orange:

$\frac{\text{Driven}}{\text{Driver}} = \frac{32}{12} = \frac{8}{3}$ $\boxed{8:3}$ gearing down

Orange & Green:

$\frac{\text{Driven}}{\text{Driver}} = \frac{14}{32} = \frac{7}{16}$ $\boxed{7:16}$ gearing up

Light blue, orange, green:

$\frac{\text{Driven}}{\text{Driver}} = \frac{B}{A} = \frac{32}{12} = \frac{8}{3}$ $\boxed{8:3}$ gearing down

$\frac{\text{Driven}}{\text{Driver}} = \frac{C}{B} = \frac{14}{32} = \boxed{7:16}$ gearing up

Light purple, Purple, Light blue:

$\frac{\text{Driven}}{\text{Driver}} = \frac{12}{8} = \frac{2}{3}$ $\boxed{2:3}$ gearing up

RPM(s):

190 rpm

Dark Purple & Light purple

$190 \div \frac{14}{9} =$ Light purple: 190, Purple: 298 rpm

Blue and orange:

$122.14 \div \frac{8}{3} =$ Light Blue: 296 rpm, orange: 790

orange and green:

$45.80 \times \frac{16}{7} =$ Orange: 790 Rpm, green: 1805.7 rpm

Light ble, orange, green:

$104.69 \times \frac{16}{7} =$ Light Blue: 296 rpm, orange: 296 rpm, green: 1805.7 rpm

Light purple, Light blue:

$239.29 \times \frac{3}{2} =$ Light purple: 190 rpm, Light Blue: 296 rpm

Torque:

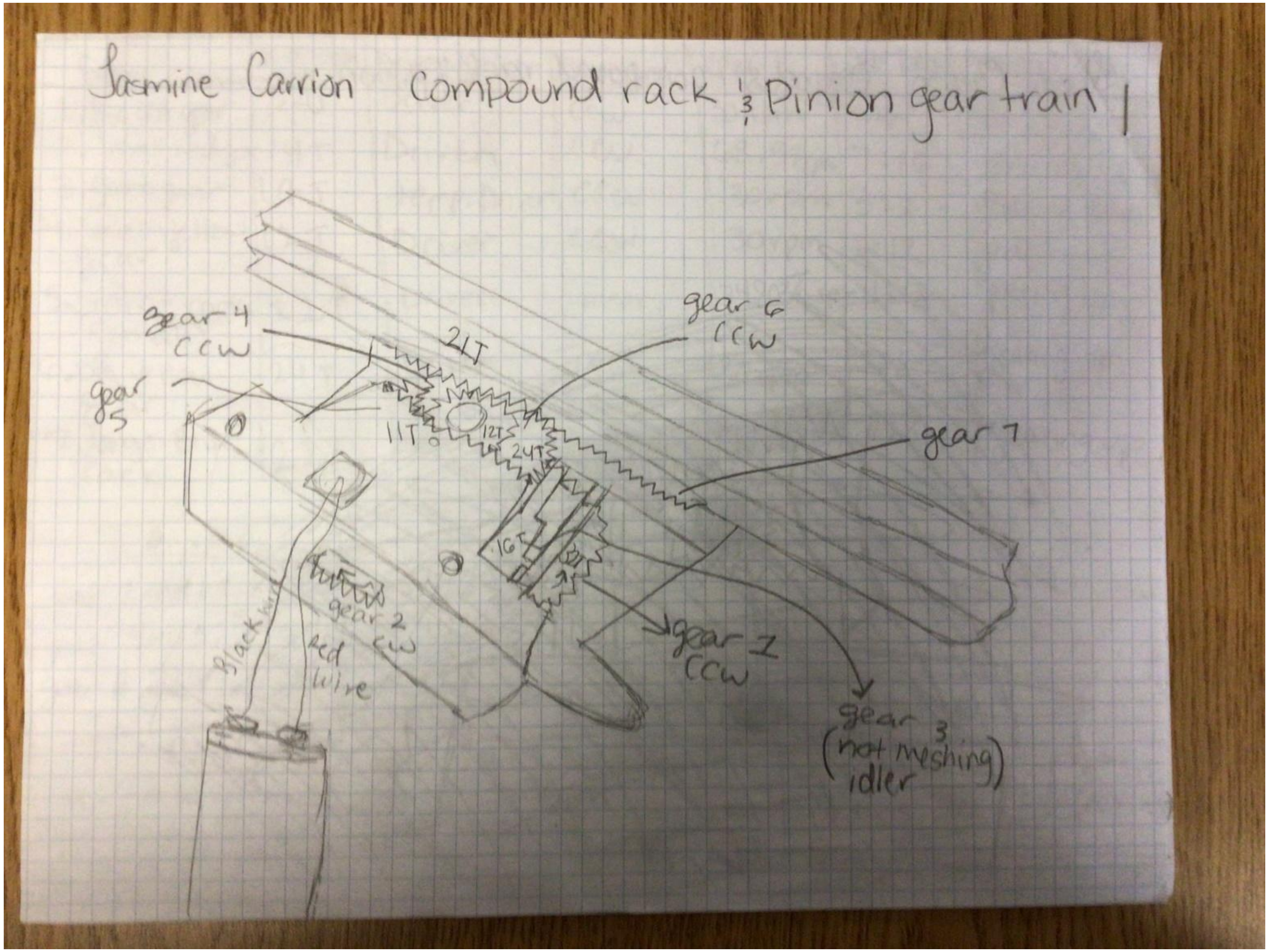
$T = rF(\sin\theta)$

$T = 54m\,(.035)(\sin x^{\theta})$

$T = 1.89(\sin 330)$

$T = -0.25$

RACK -N- PINION RE-DESIGN



GEARING UP & GEARING DOWN

Gears	# Of Teeth	Driven/Driver	Direction	RPM	Gear Ratio	gearing ↑ or ↓
1. big red gear	32T	Driver	CCW	30 rpm	7:16	gearing up
2. Small red gear	14T	Driven	CCW	68.57 rpm	7:16	gearing up
3. green gear	16T	temp. Driver	CCW	30 rpm	3:2	gearing down
4. Small yellow gear	12T	Driver	CCW	30 rpm	11:12	gearing up
5. orange rack (small)	11T	Driven	Linear	$74.80\overline{36}$ rpm	11:12	gearing up
6. big yellow gear	24T	Driver	CCW	30 rpm	7:8	gearing up
7. large Blue rack	21T	Driven	Linear	78.37 rpm	7:8	gearing up

Gear Ratios

gear 1 and 2: $2/1 = \frac{14}{32} \rightarrow$ 7:16

gear 4 and 5: $5/4 \rightarrow 11/12 \Rightarrow$ 11:12

gear 6 and 7: $7/6 \rightarrow \frac{21}{24} \rightarrow$ 7:8

RPMS

gear 1 → 30 rpm
gear 2 → 68.57 rpm
gear 3 → 30 rpm
gear 4 → 30 rpm
gear 5 → $74.80\overline{36}$ rpm
gear 6 → 30 rpm
gear 7 → 88.37 rpm

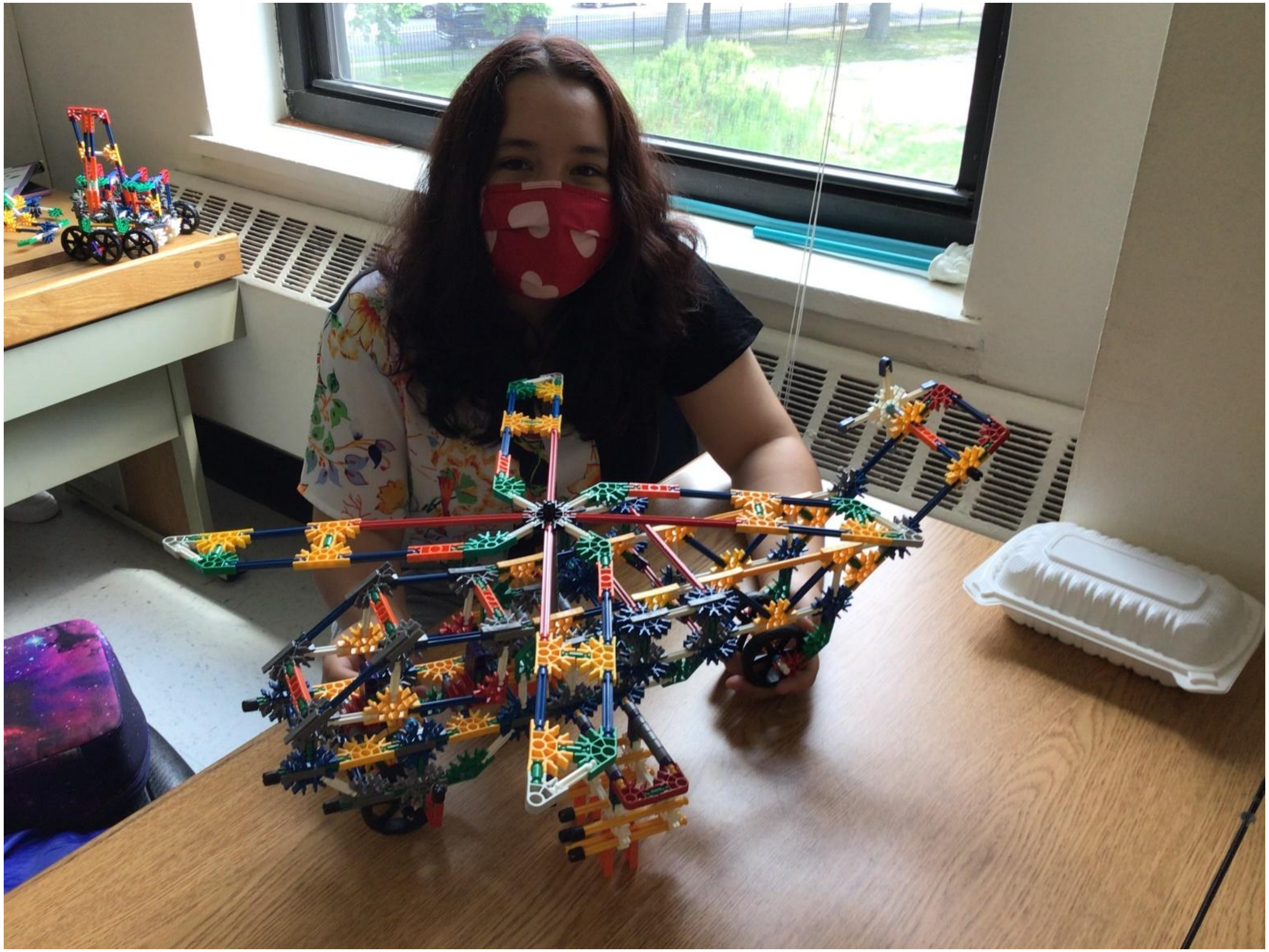
Torque:

54N = force
radius = .02
Sine 180

t = F * r * sin
t = (54)(.02)(Sine 180)
$\boxed{t = 0}$

Torque is zero b/c the rotation makes it perpendicular

COMMUNITY SERVICE-SPEND A DAY IN ENGINEERING MIDDLE SCHOOLS



BUILDING IN OUR STEM LAB

FREEPORT HS TOURNAMENT

- Revision problems:
- Drivetrain on left side not running right, friction
- Claw not opening 30/60 degrees in autonomous
- Tough driving on Vex mat on field
- Changed side chassis pieces for 18 inch^3 inspection
- Changed the chain lift, smooth uplift
- Redesigned the claw
- Inverted the motors on 2-wheel drive
- Changed coding for drivetrain & lift
- Added another sensor (now have distance, inertial, Vision)

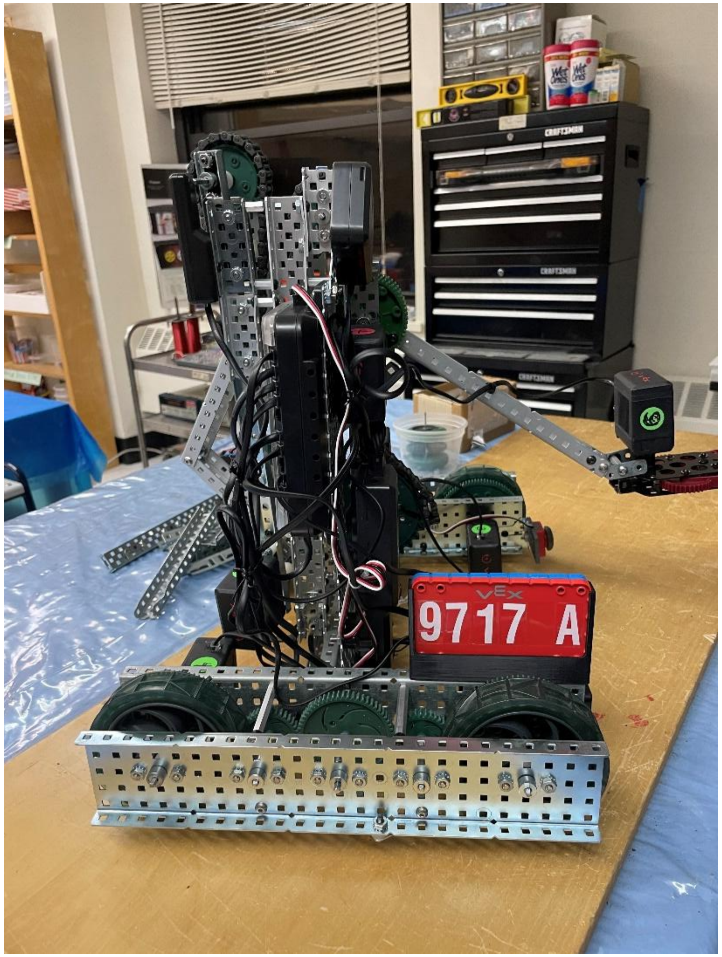
VAUGHN COLLEGE TOURNAMENT

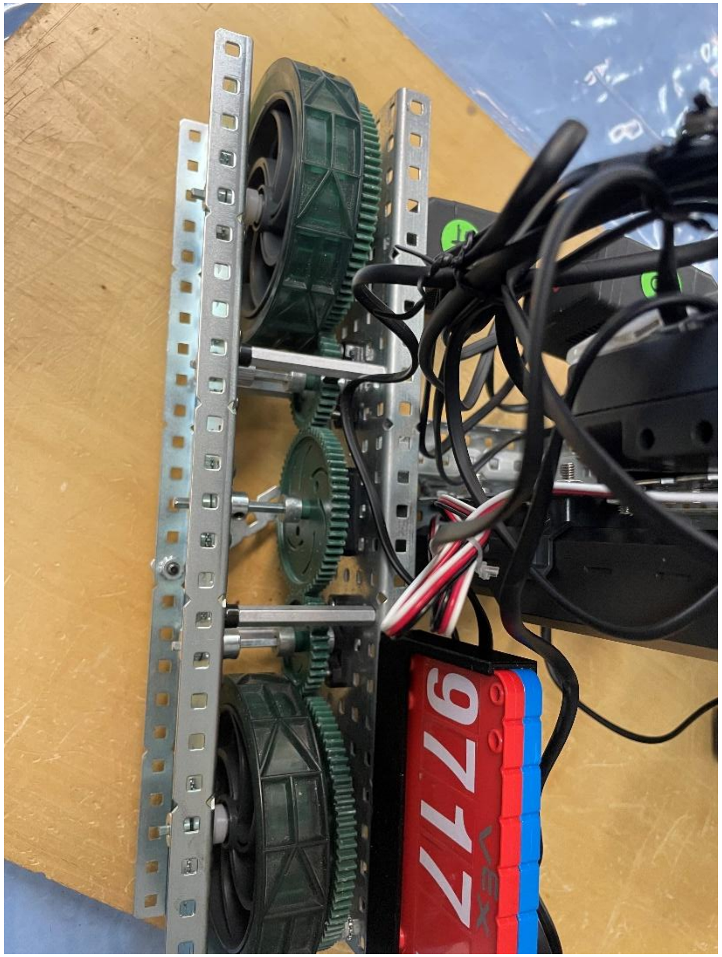
- Revisions:
- Claw was damaged, cut chassis piece and attach differently so stronger & stable
- Left & right side 2-wheel drive train alternately not turning
- Fix the claw
- Motors on 2-wheel drive train over heating
- Next match will drive Robot A onto the teeter seesaw pulling the mobile goalie

HARVEY SCHOOL TOURNAMENT

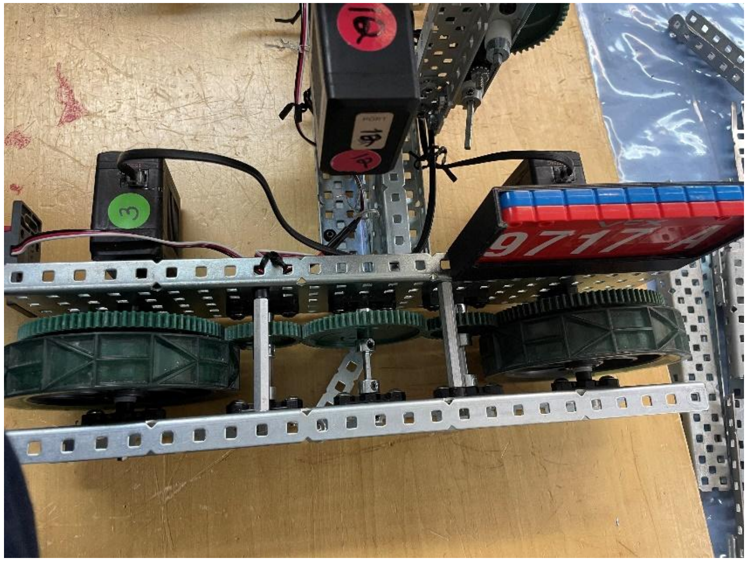
- Revisions:
- Re-attached and lifted claw
- Change the U-hook intake
- Added 2 more motors, now 4-wheel drive
- Tweaked speed of chain lift
- Changed all wheels to omni wheels
- Tried U-intake then went back to claw lift

ROBOT A-EPICYCLIC GEARTRAIN

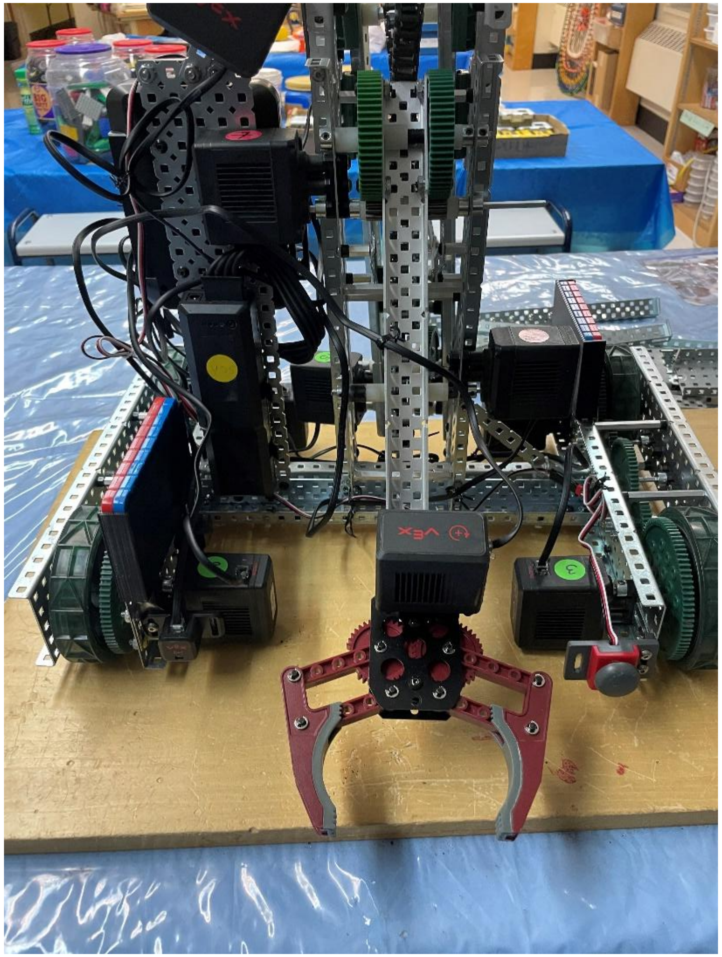


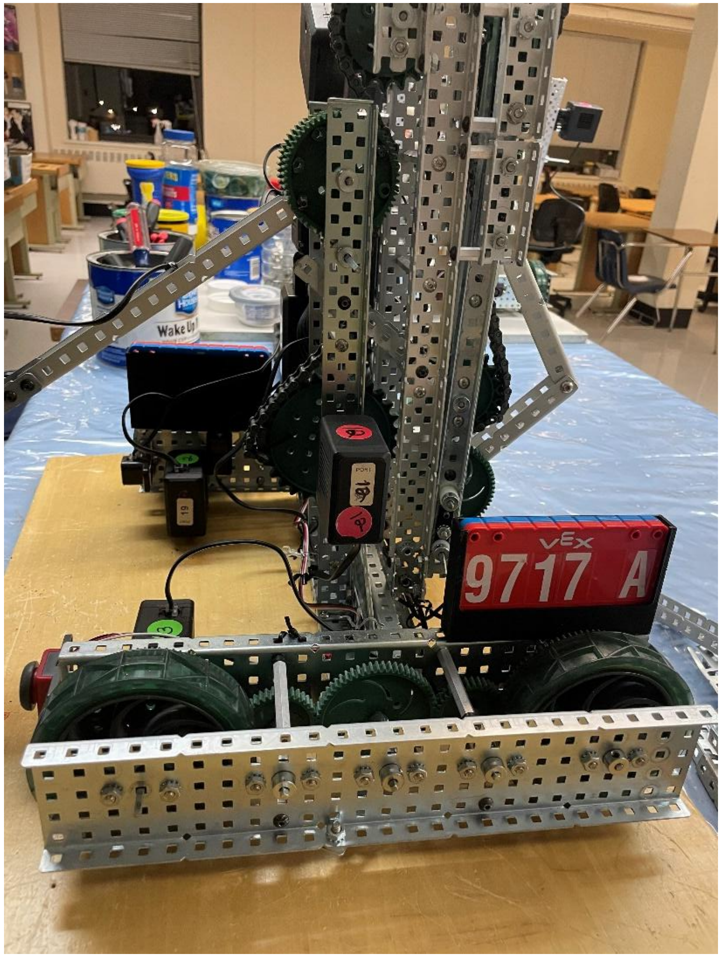


ROBOT A- CLAW LIFT HEIGHT

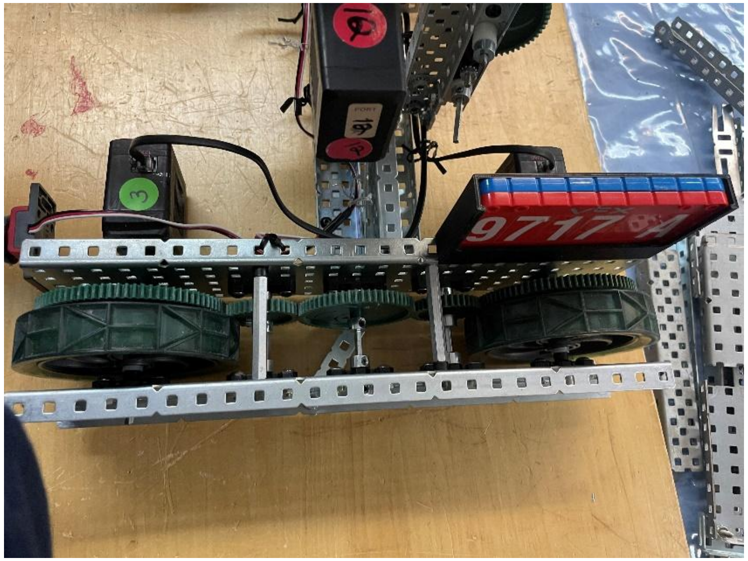


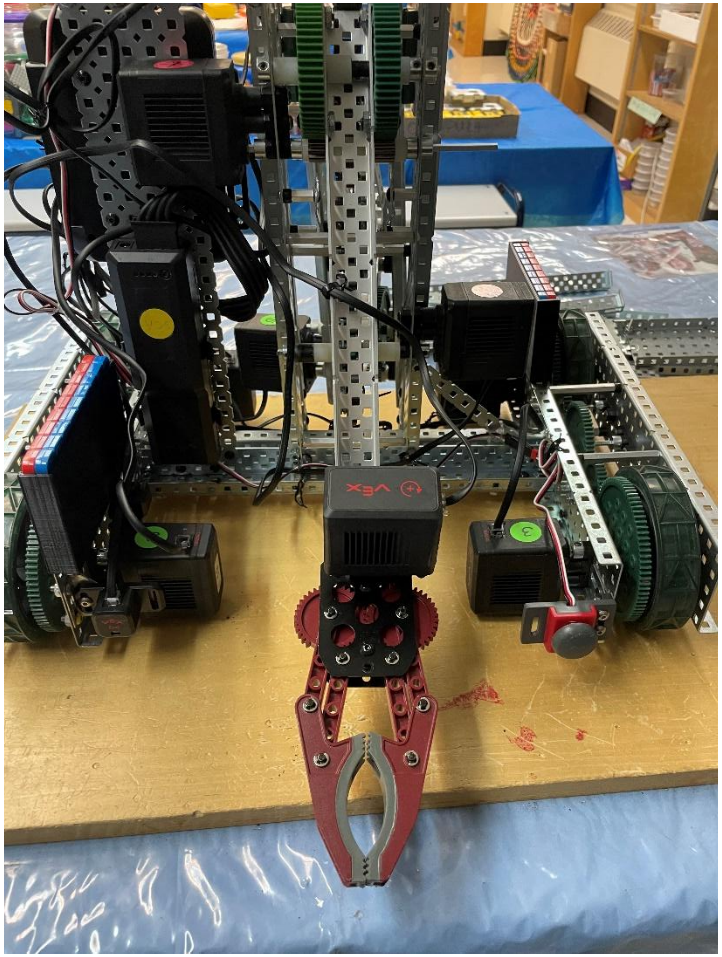
ROBOT A- CLAW GRAB



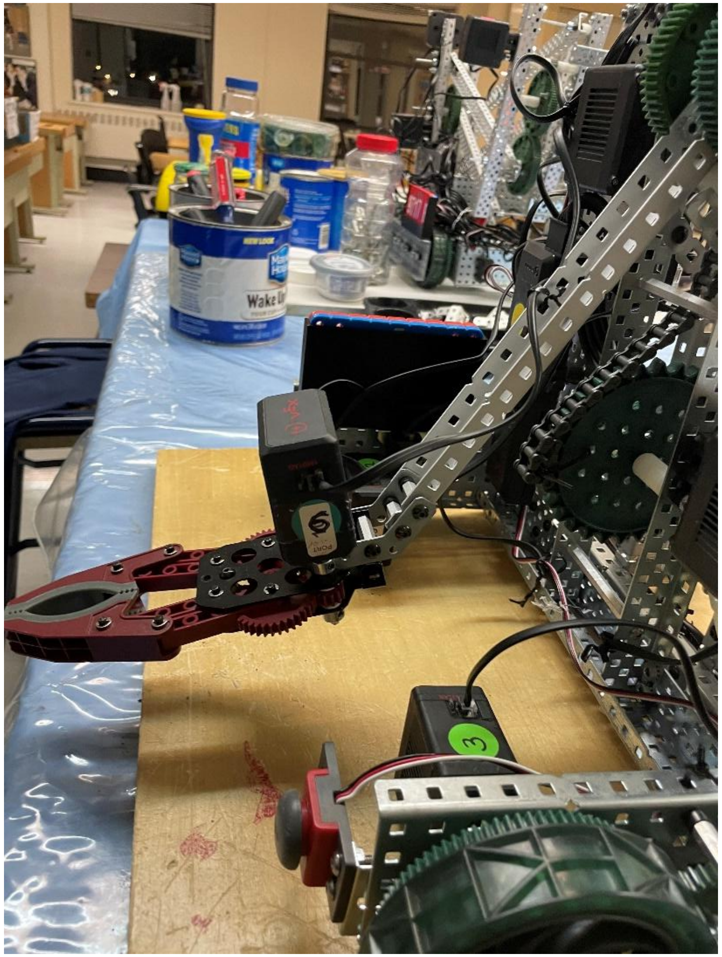


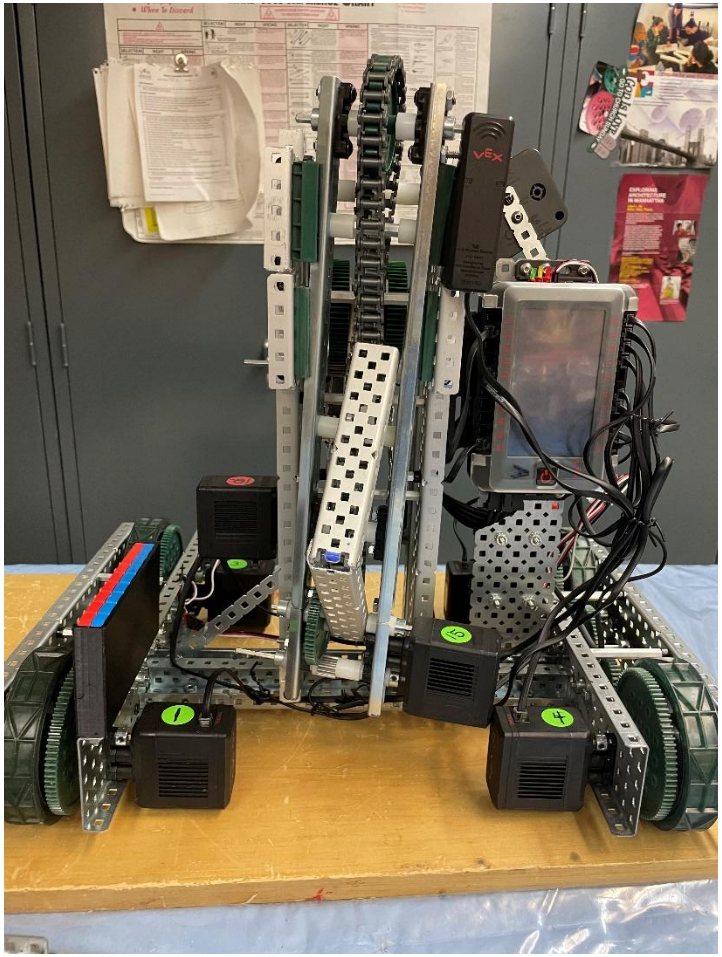
ROBOT A- GEARTRAIN & 4 SENSORS



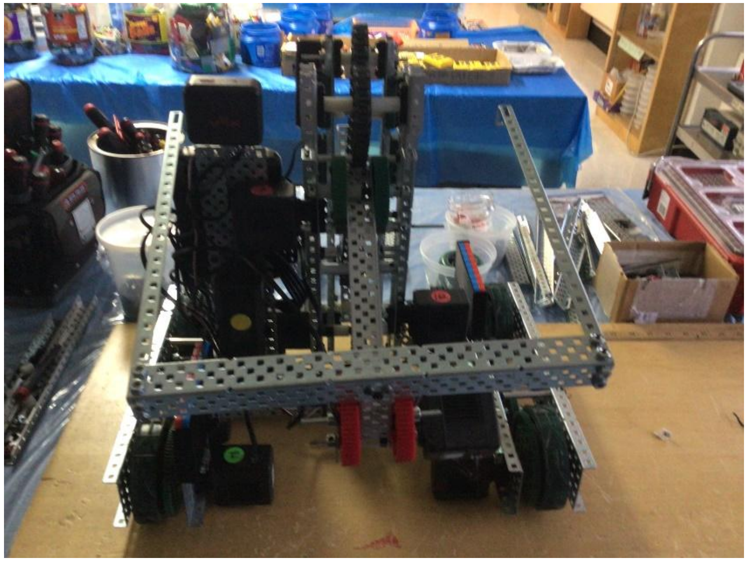


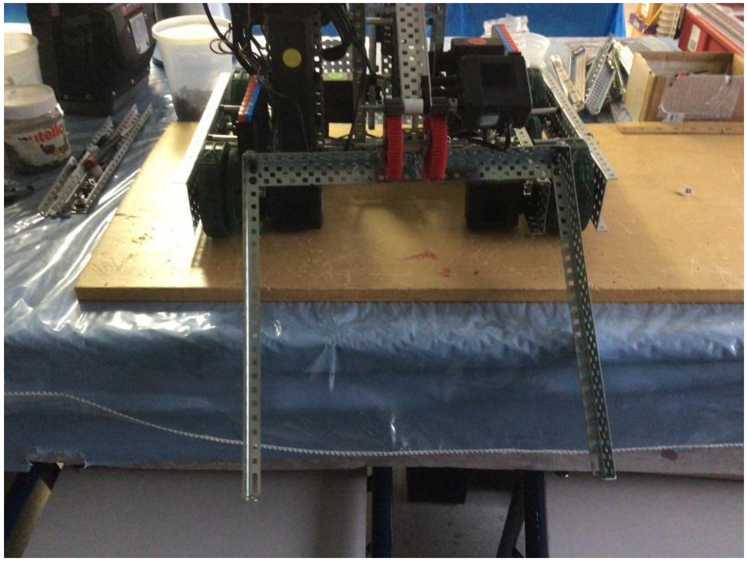
ROBOT A- CLAW LIFT





ROBOT A- TRIED U-INTAKE





ROBOT A- U HAUL & CHAIN LIFT