AUTONOMOUS ROBOTICS

Design Book

Milton Hinnant

Jan 18th

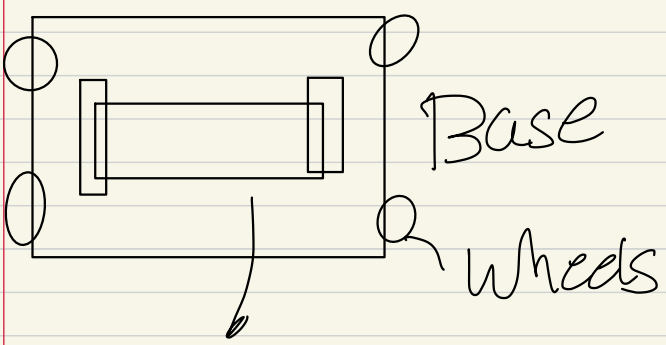
"Squar Bots"

Build guide

Parts

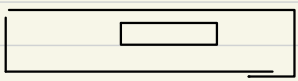
36-tooth gear
60-tooth gear
Metal Chassie

Code pre Loaded on micro-controller



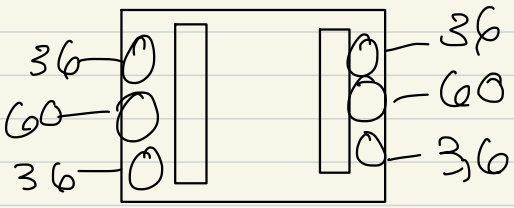
today we started with the the initial build of the squares

Following the design guide we got the metal chassis built.



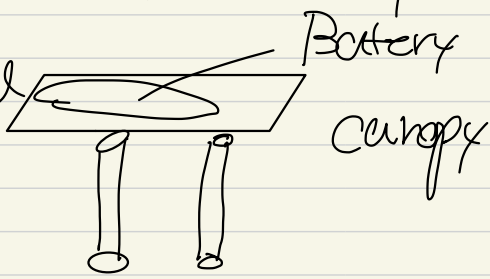
added the motors next put them in the middle of the metal chassis next metal Shafts. added collars & 60 tooth Gear. have a left & right

Side. Put everything to Getner



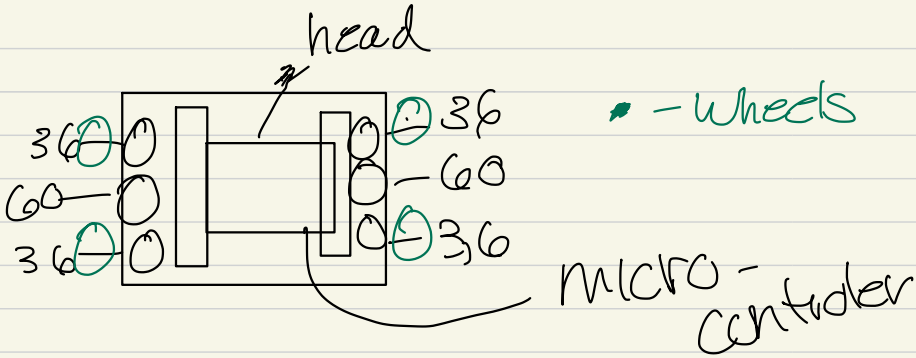
adding the battery canopy

We constructed the Canopy



added on top of Base

adding the Wheels to the outside now



Wheels add on the cogs adding micro controller. Put the micro controller the wrong way.

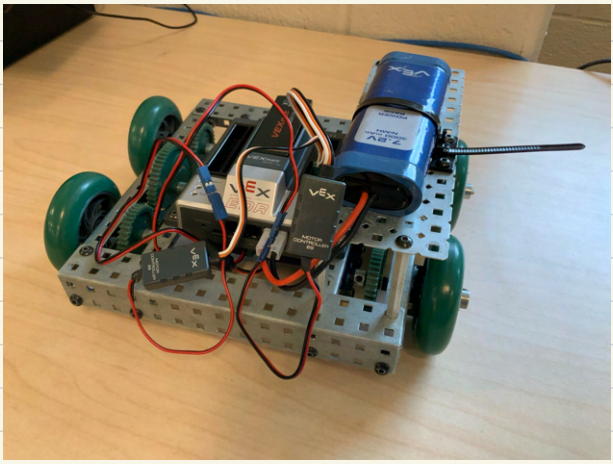
adding battery to canopy.

Installing battey canopy to base. time to wire every thing.

the motor wires need an adaptor. the direction matters!

wired the battery up.

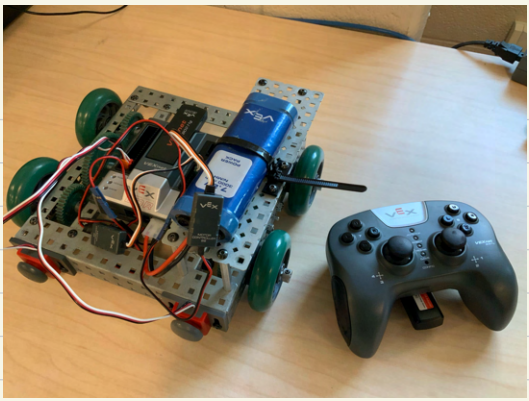
after switching the motor wires around we are done with the build.



Jan 20th

teleop

- joystick
- Bump sensors

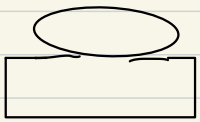


pairing the Micro controle with the controler. Issues Withe the pairing have to re try it again. Done

We can now move our robot around with the remote. tele-op done

Continue.....

Autonomos Mode

Bump sensors 

when pressed it does Something

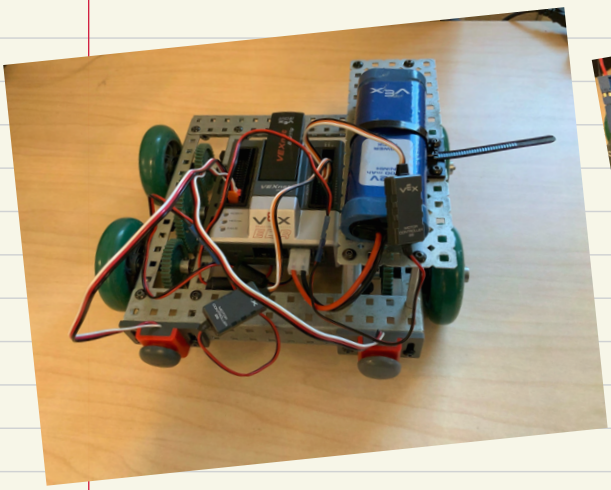
we add two to the font left and right of the base.

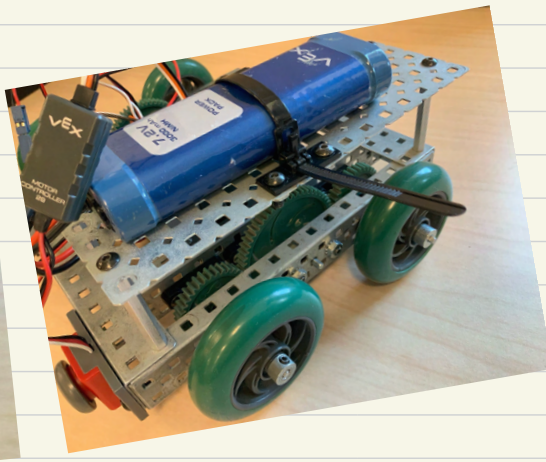
Wiring them to the micro controller. dg.10, 11. adding the jumper now done! we are having an issue with the the bompers.

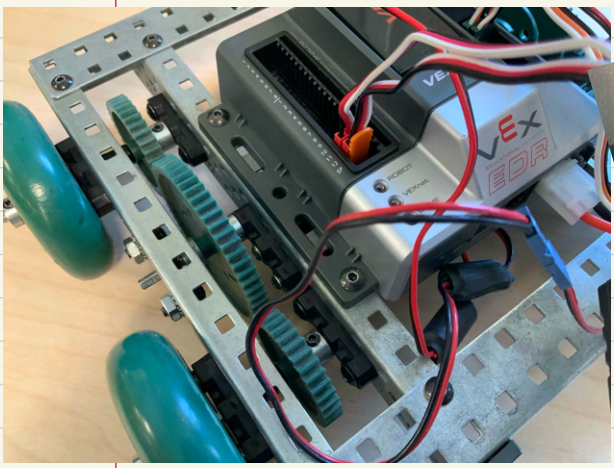
bumpers put in wrong spot

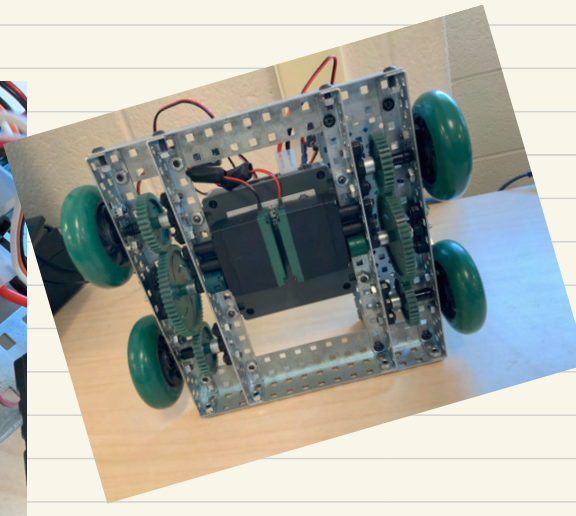
issue resolved

done









Jan 25th

Hailstone Numbers

$n_{i+1} = n_i / 2$	if n_i is even
$n_{i+1} = 3n_i + 1$	if n_i is odd

function return n/2
return 3*n+1

```
hailstone(int n){
    if(n%2==0){
        return n/2
    }return 3*n+1
}
```

Hailstone Sequence

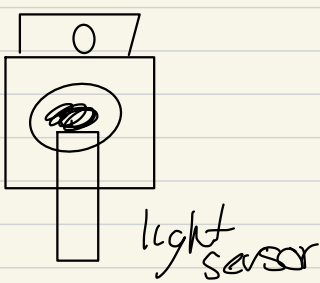
7, 22, 11, 34, 17, 52, 26, 13

"light controlled Motor"

Motor that speed up depending on the intensity of the light source.

light sensor needed

added a light sensor to the micro controler



Most of today is programing.

pseudo code

int sensval

int adjusted senssor value

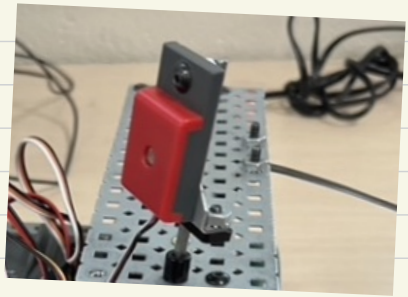
int motor speed

adjusted sensorValue()
sensorValue()

while(loop through
pull values for
between
-127 -127 light convert
invert values light number to
-1000 -1000 motor speed
s

our light is not working consistenly
we can not get our micro compute
to connet with the computer
consrstenly

got new batteries in flash light.
done with part two



jan 27th

Anticipatory Obstical Avoidance

- Ultra Sonic Sensor
- Micro Controller
- port 2

Back away for obstacls

Computer will not connect to Micro Controller been having this issue for 30 minutes

15 mins left got it working

Jan 28th

yesterday we mounted the Ultra sonic sensor then we had computer issues most of class.

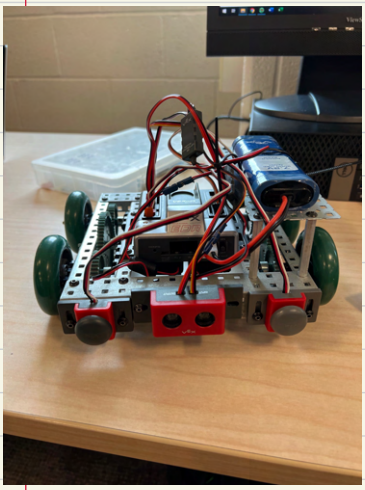
pseudo Code

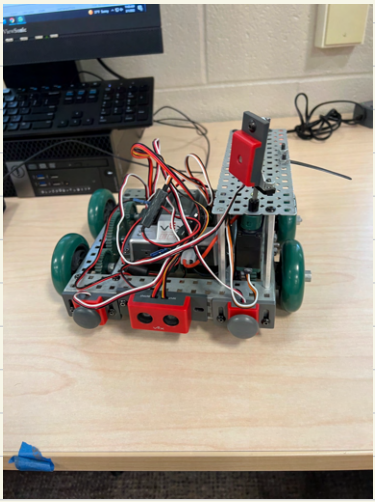
```
While(true)
    While{ get starting distance
        "do something when number is small"
            move motors
    }
    Bump Sensors Check for press
    }
```

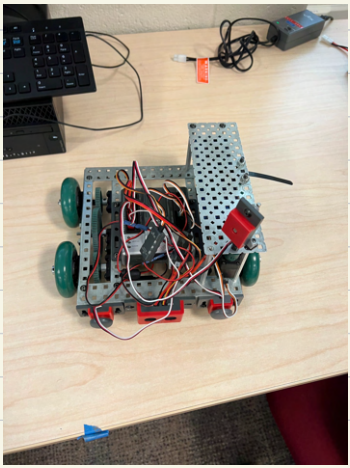
Between -1 & 50 while

Using Bump Sensors

done







move camera to tell depth.

Feb 1st — High & low freq - ultra chirps

lecture notes — modulate chirps

Part Build a light sensor that can figure out the direction

- flashlight higher # turn to direction

Part 2

- how accurate is the light sensor.
- which direction is the beam pointed by Statements

Part 3 photo axes

- Optical Shaft encoder
  - when wheels move so does it

Wondering Mode

Keep Bumpers

Part 4 - Optical Shaft encoder

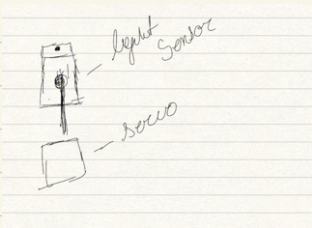
positive counter Clock wise

negative Clockwise

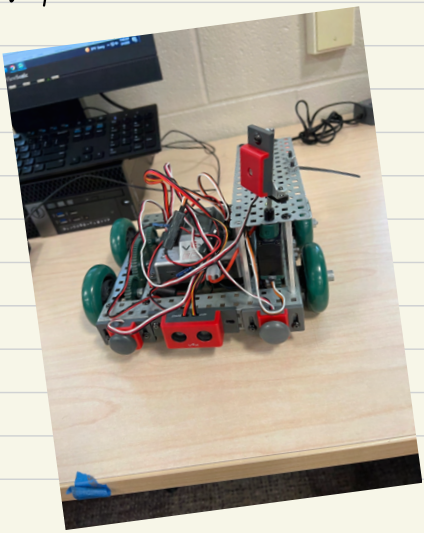
Feb 3 - 11

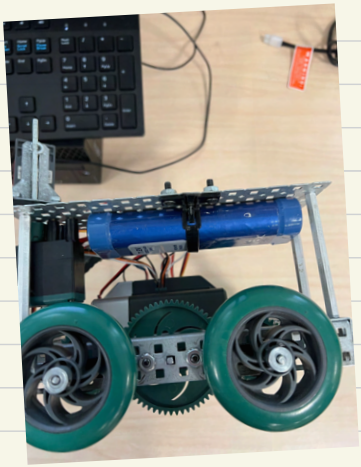
Active Directionality Sensing

we mounted a light sensor on top of a servo



we added this to the front of of our Robot and moved the battery to underneath the canopy.

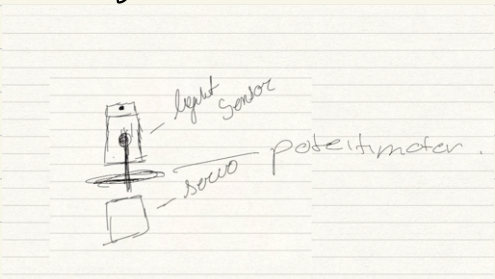




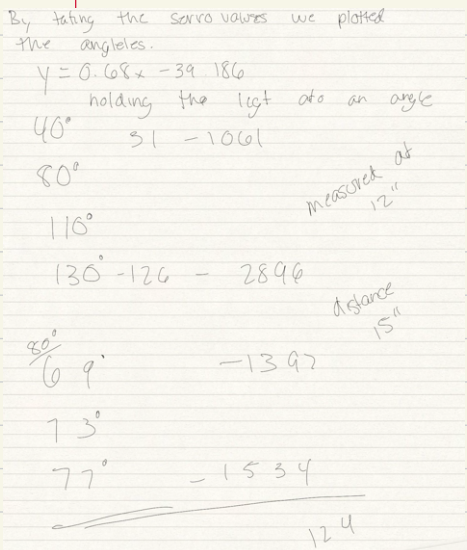
With the code we started with the initial position of the servo the made a while loop through all of the positions the servo can move between -127 ≤ 127 So we can find the position that finds the brighest light source and stoping once it finds the source.

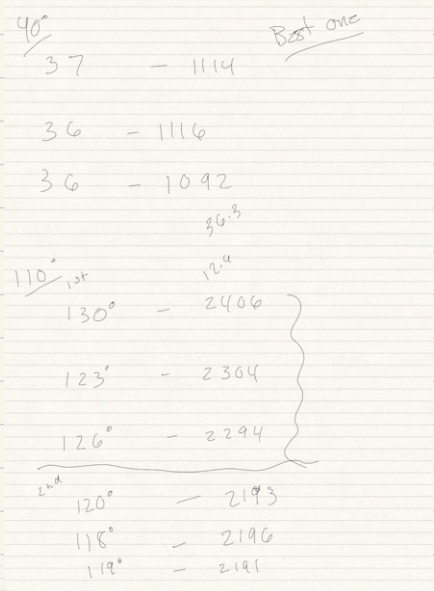
Part 2

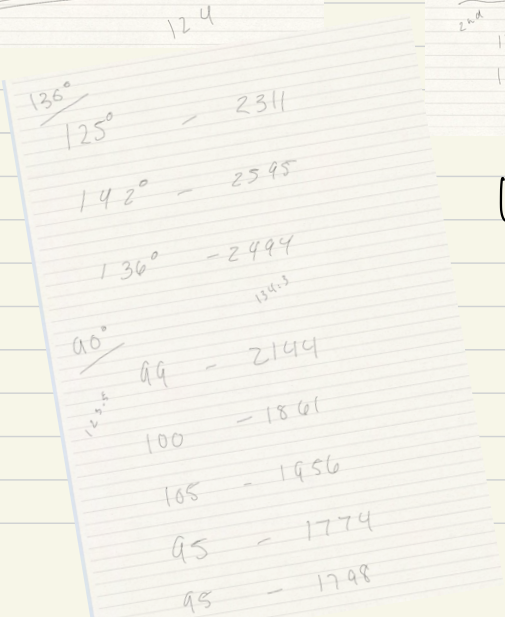
we add a potentiometer to the bottom of the light sensor servo combo



today we are gathering the angles from the potentiometers with the light source

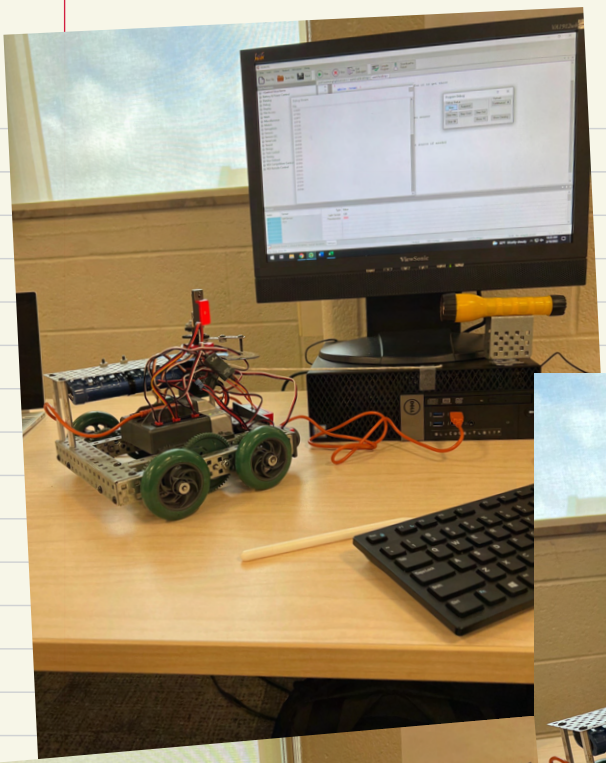

By taking the servo values we plotted the angleles.
$y = 0.68x - 39.186$
holding the light at an angle
40° 31 - 1061
80°
110°
130° -126 - 2896
measured at 12"
distance 15"
80°
69 -1397
73°
77° - 1534
124

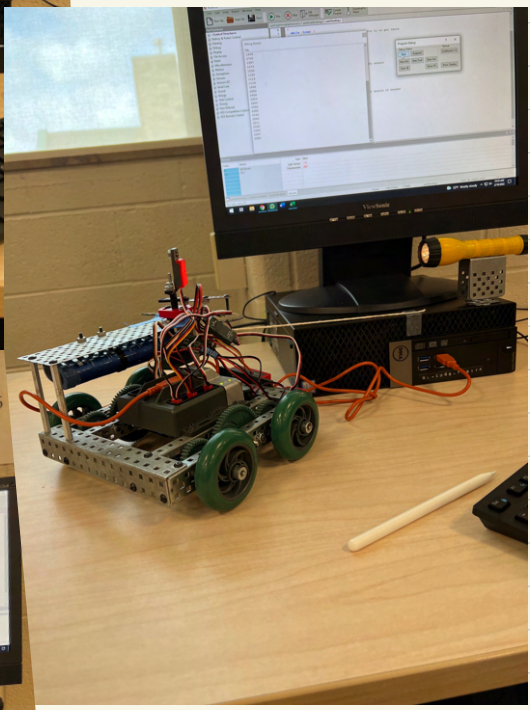

40°
37 - 1114
Best one
36 - 1116
36 - 1092
36.3
110° 1st 12"
130° - 2406
123° - 2304
126° - 2294
2nd
120° - 2193
118° - 2196
119° - 2191

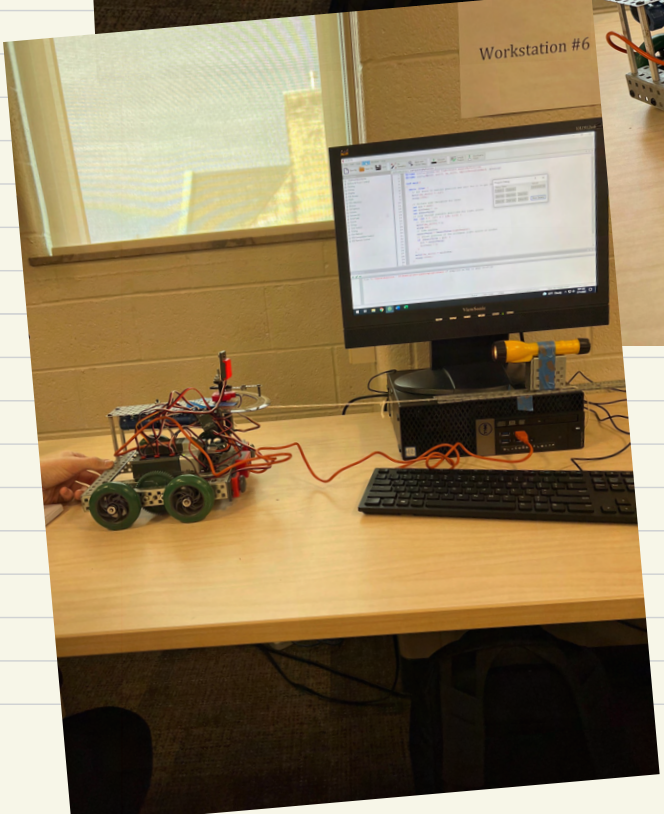

136°
125° - 2311
142° - 2595
136° - 2494
134.3
40°
1st 2nd
99 - 2144
100 - 1861
105 - 1956
95 - 1774
95 - 1798

We made a tool on the protractor to get the angles used

Screws & Brackets






Workstation #6

today we continued with the same caculations

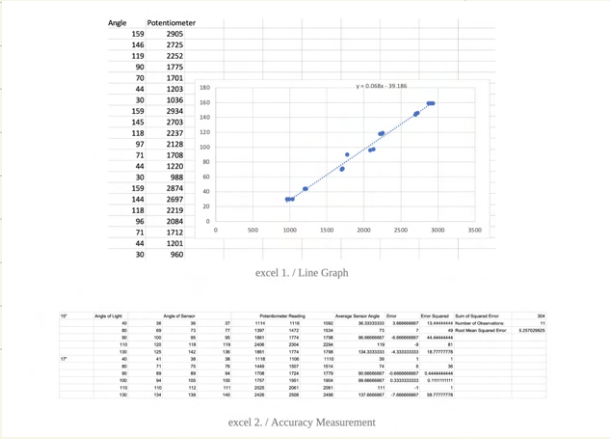
the start.

90°	
89	1708
89	1724
94	1779

80°	
89	1718
92	1766
72	1464
71	1449
75	1507
77	1514

dist 17.5

We tested the two enclosures and got better readings from the no enclosure. going that way.



Angle	Potentiometer
159	2905
146	2725
119	2252
90	1775
70	1701
44	1203
30	1036
159	2934
145	2703
118	2237
97	2128
71	1708
44	1220
30	988
159	2874
144	2697
118	2219
96	2084
71	1712
44	1201
30	960

excel 1. / Line Graph

15°	Angle of Light	Angle of Sensor		Potentiometer Reading		Average Sensor Angle	Error	Error Squared	Sum of Squared Error	SEM
	40	36	36	1114	1116	36.33333333	3.666666667	13.44444444	Number of Observations:	11
	80	69	73	1387	1472	73	7	49	Root Mean Squared Error:	5.257025825
	90	100	95	1801	1774	1798	98.66666667	8	44.44444444	
	110	120	118	2456	2394	2394	116	6	81	
	130	125	142	1861	1774	1798	134.3333333	-4.333333333	18.77777778	
17°	40	41	36	1118	1106	1110	36	4	1	
	80	71	75	1448	1507	1514	74	6	36	
	90	89	89	1708	1724	1779	90.66666667	0.666666667	0.444444444	
	100	94	105	1757	1901	1894	99.66666667	6.333333333	0.111111111	
	110	110	112	2025	2061	2061	111	1	1	
	130	134	139	2426	2508	2498	137.6666667	-7.666666667	58.77777778	

excel 2. / Accuracy Measurement

Photoaxis

have to re work the code we are having an issue with the sensor not finding the light

pusedocode

```
find light(){
  motor[my_servo]=-127
}
```

add print statements for debugging code.

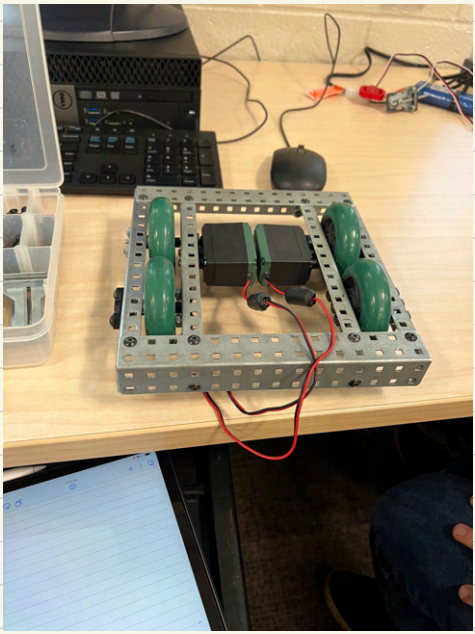
fixed

check github

Maze traversal

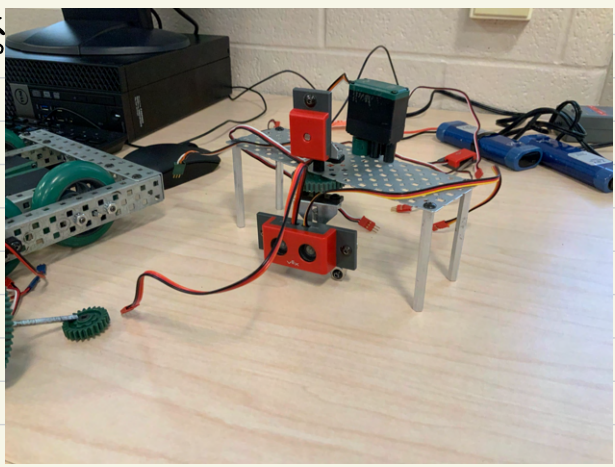
Quick lecture about the maze movement.

today we start from scratch we take everything down to the base and start from there

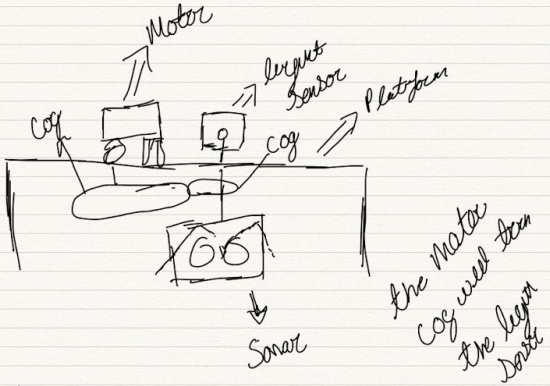


Building a platform for the light sersor and the Serve on top using a canopy

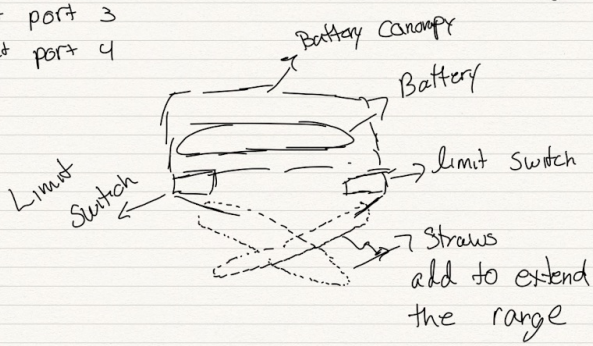
Servo gear turns the lightsensor

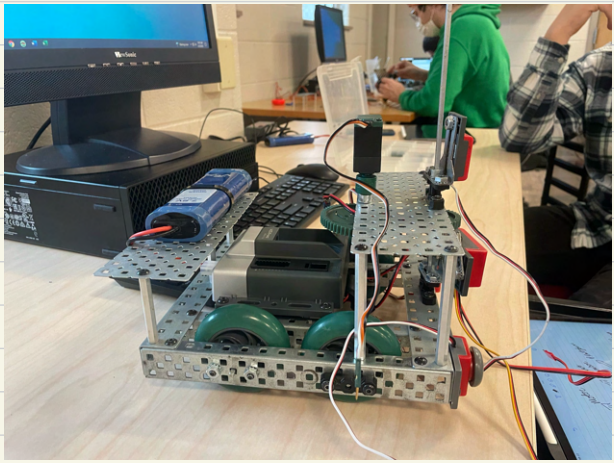


We add two cannopies for the Battery and the light sensor serve combo.

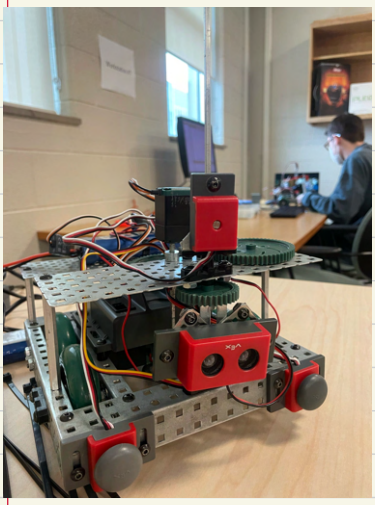


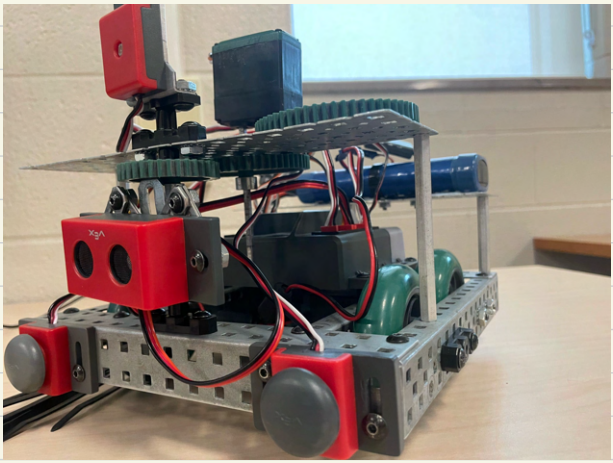
digital
Left port 3
Right port 4

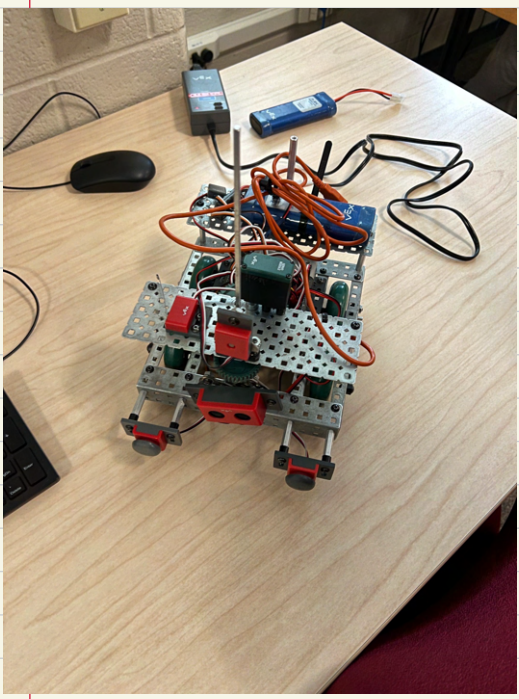




adding bump sensors to the font with the microcontroller in the middle of the base the ultra sonic is on the canapy also the servo turns it all







We have re worked our maze code ove 10 times we did not do well on the Contest

Maze Race

the design is to have the robot scan just before moving towards any direction

group 3

- no light sensor

Ultra Sonic Sensor

the Ultra Sonic Sensor doesn't move right only left hugs the walls.

Straw bump Sensor didnt make it stuck in 2nd turn

group 8 "mr Charles"

Super close got in the right spot when turned on.

group 11 minator

designed to hug the wall on the right side. using the ultra Sonic Sensor.

group 2 "geo"

limit switch - broke

- light Sensor

our group -

terrible

group 9 - Bumpee

group 5 - G won

March 22 - April

Robot Manipulation

- gears
- Pid Control
- Kinematics

Inverse Kinematics

two - Joints

Multiple Solutions

More degrees of freedom
you have to pick one

No Solutions
- design conditions

the Solution Space
- Configuration Space

7 - degrees of freedom in the human arm

How to Solve every Inverse Kenimatics

- the law of Sines
- the law of COSines

Solving for θ^2

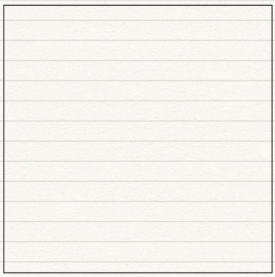
- Complete triangle
- label triangle
- find the law that works (Cosine)
- define right triangle
- Substitutions
- Math

Solving for θ_1

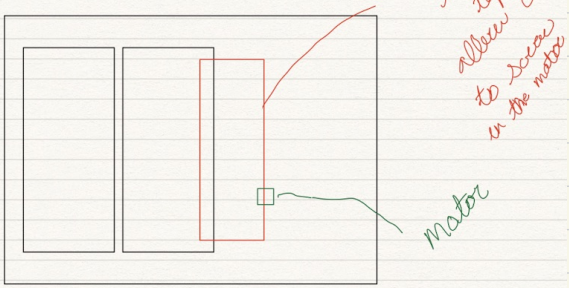
- $\frac{b}{\sin B} = \frac{c}{\sin C}$
- finish triangle
- Math

Build table
Impleads Solve the Problem.

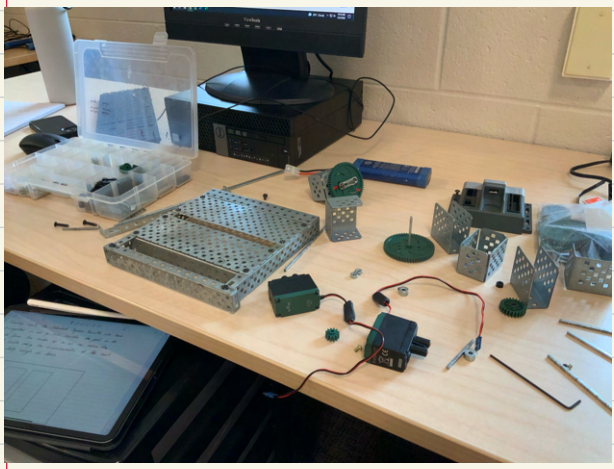
The Build



Starting with the Standard Spaxe Build we have incorporated in all of our builds. the goal is to Build from the middle up so we can balance the weight. With adding the microcontroller at the back to also help weigh it down

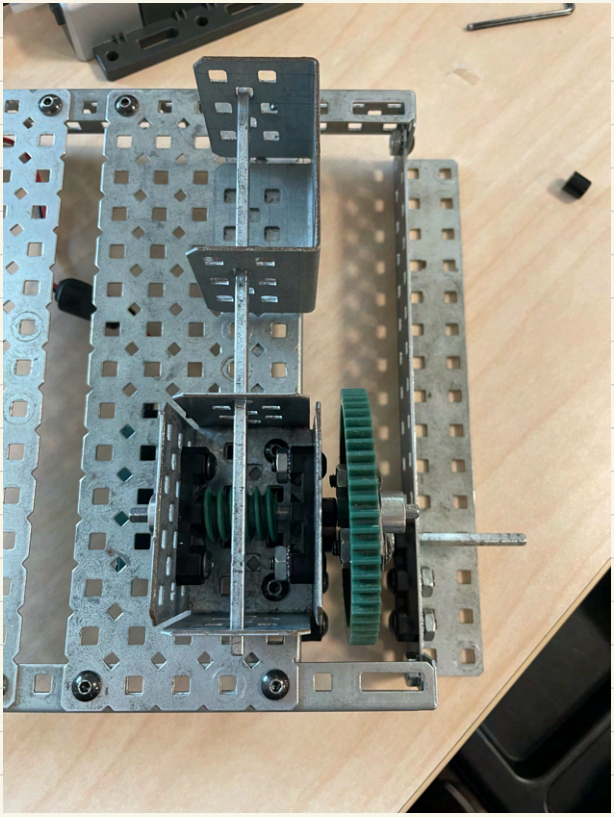


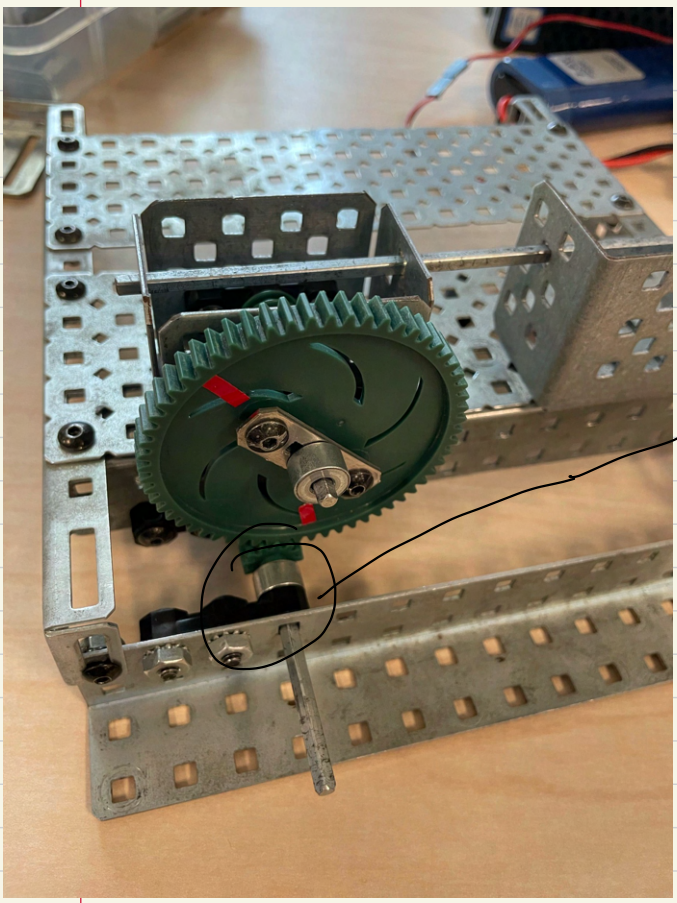
Next we moved to the gears we need more torque not Speed



Worked on a worm Gear

Using 1 motor to move the whole Base



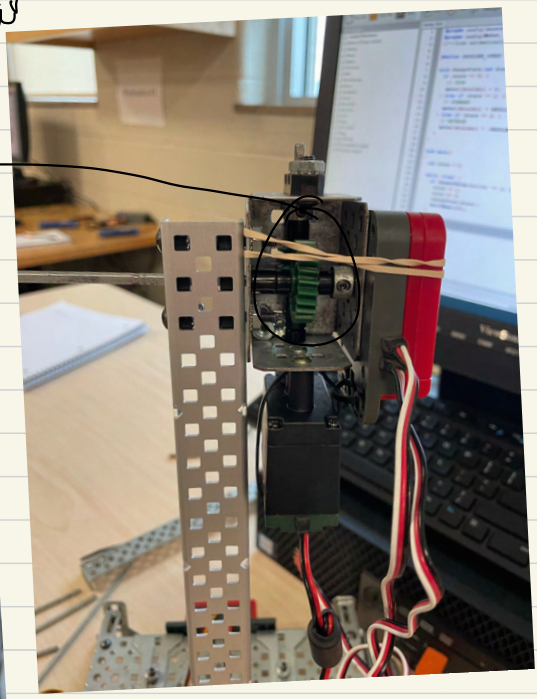


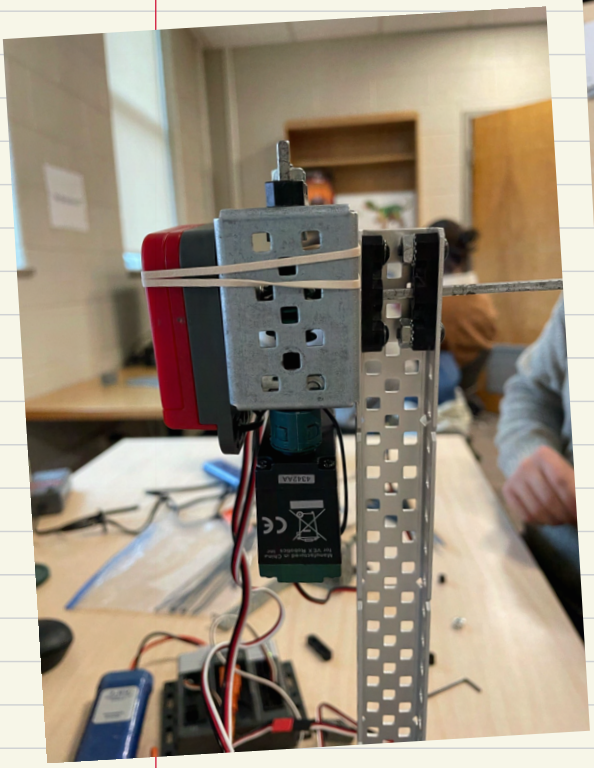
gear attached to motor

We are having issues with the worm gear slipping we added a rubberband to the gear to keep it secure.

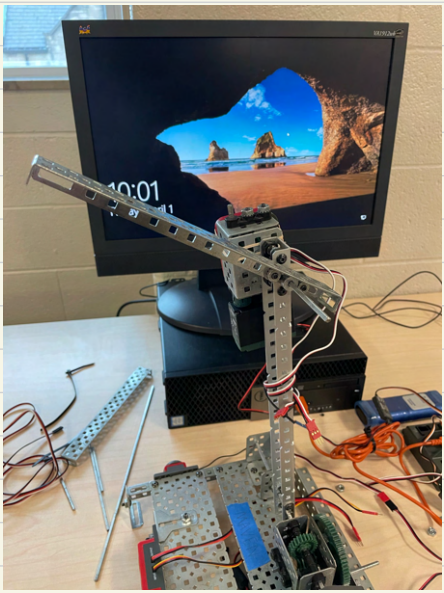
today we are working on the Shoulder Using the same setup we did for the bottom Shoulder

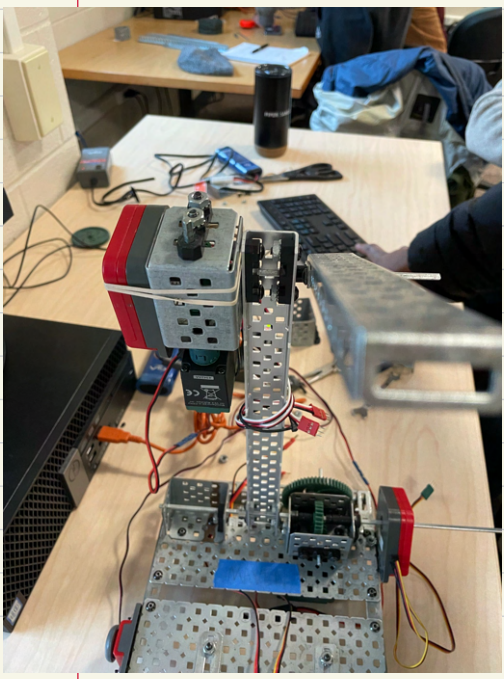
worm gear





now we are working on our arm



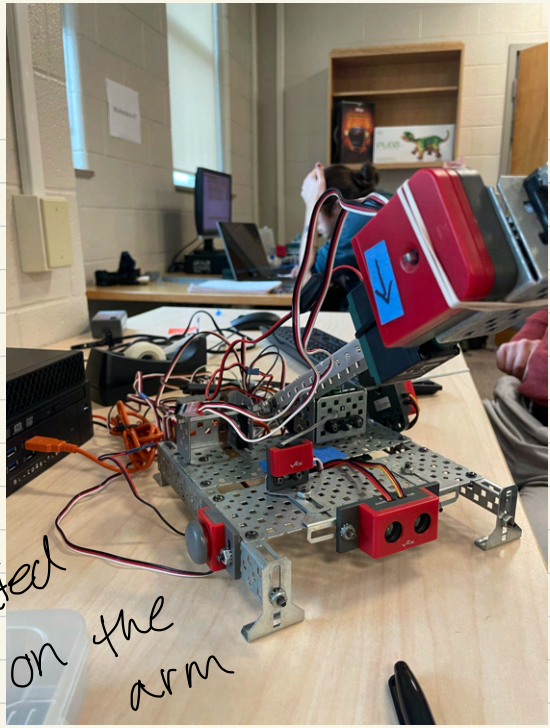


Pseudo code

go to e 3

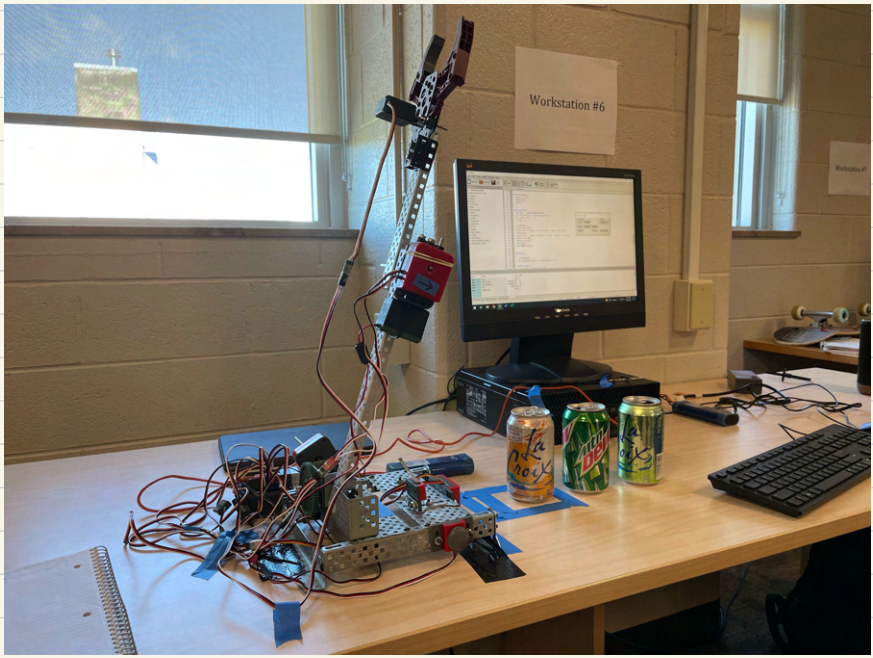
reset()
throwCan()
grabCan()

today we sat the claw we mounted it on the arm



we will test out the claw the next class

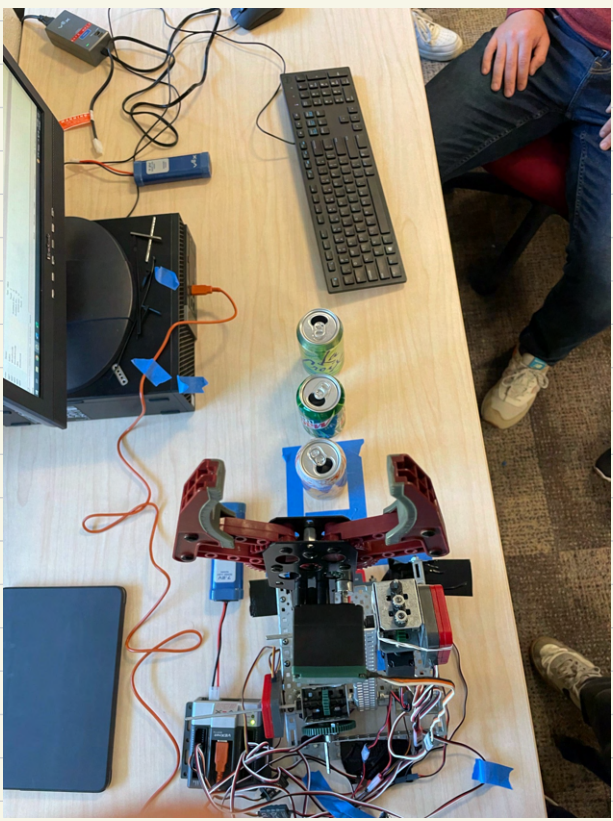
We got the claw to



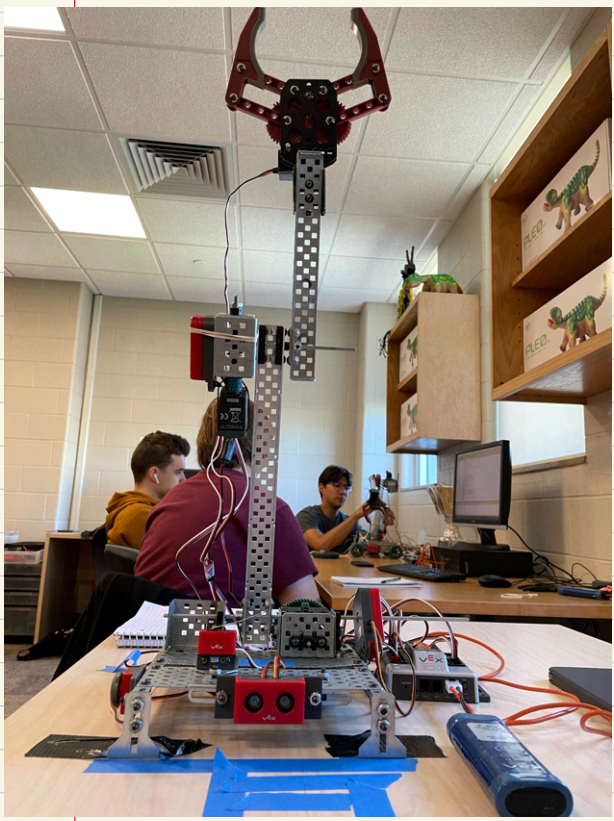
pick up 1 can trying on the second can it misses or when picking up the 1st can it hit the second one.

We are add to are grabcs function we will grab the can the automatically move it backwards towards the base to clear other cans

We taped down the allowed space for the cans



today we finished our manipulation



It's been a great semester I have enjoyed the course!

- milton