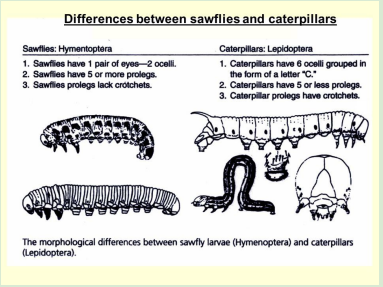
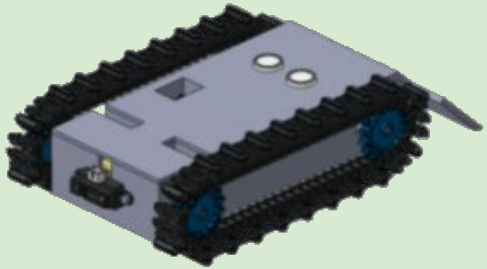
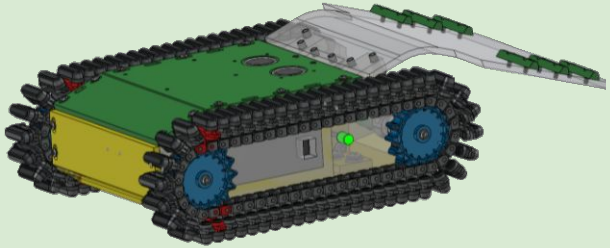


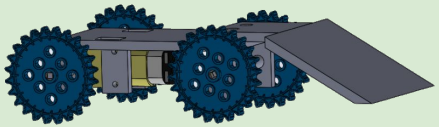
Sawfly Larva Insect Project

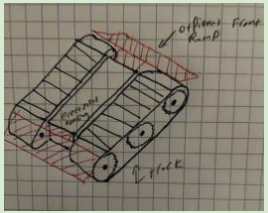
ME 397 : Senior Design II

Spring 2022









Team Information: Team #3 - Sawfly Larva Insect Project

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Research Strategy

Biomimicry

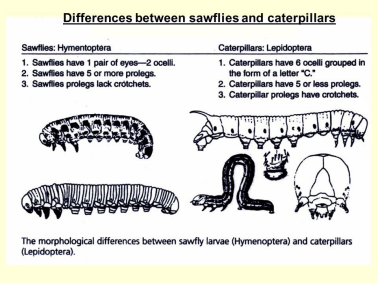
Swarm Robotics

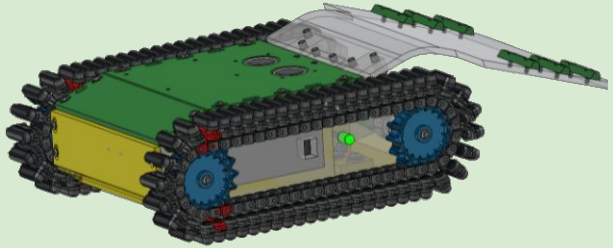
Spatial Organization

Navigation

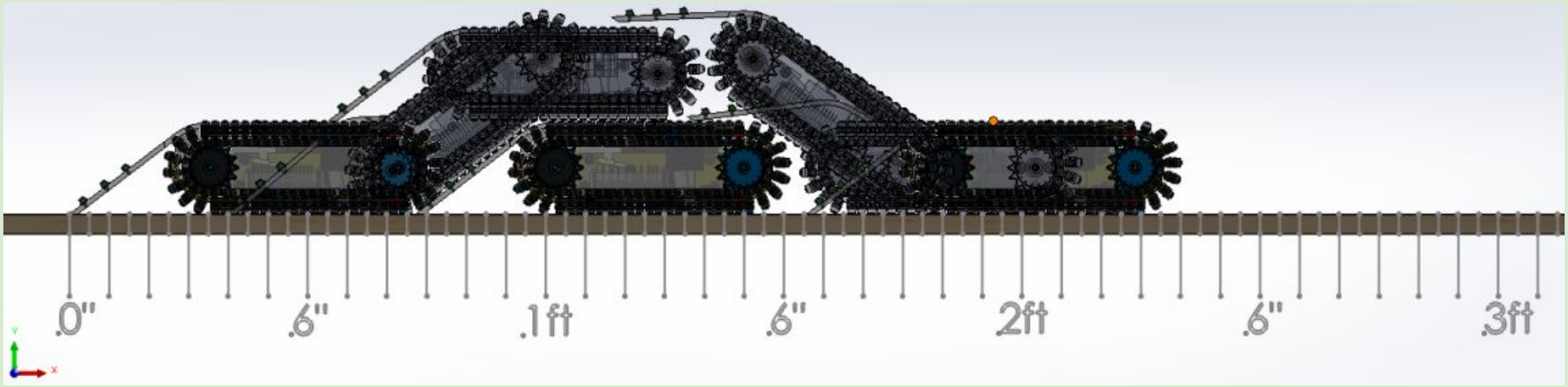
Decision Making

Design Ideas

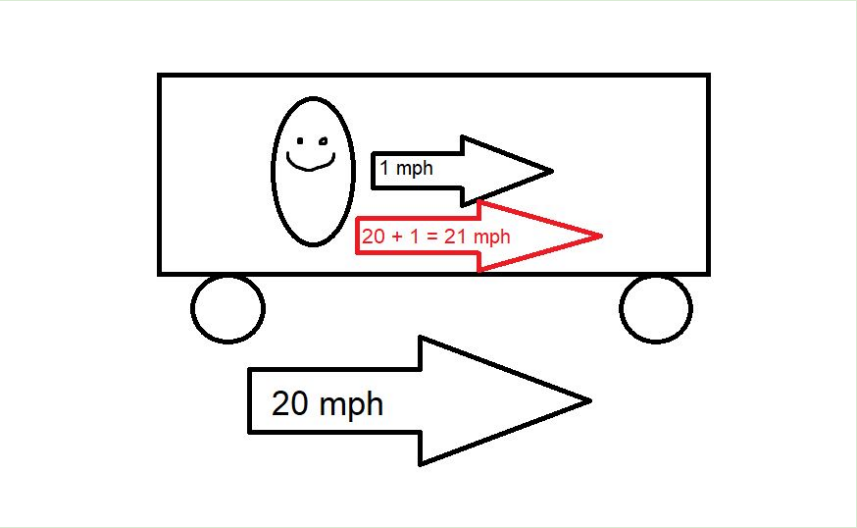


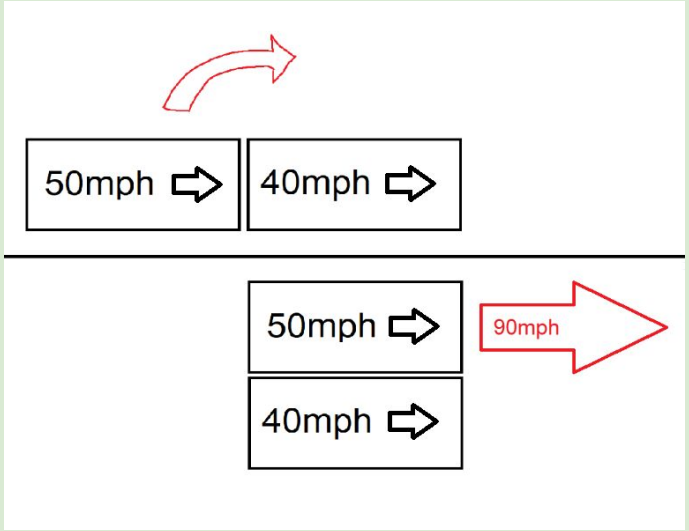


Research

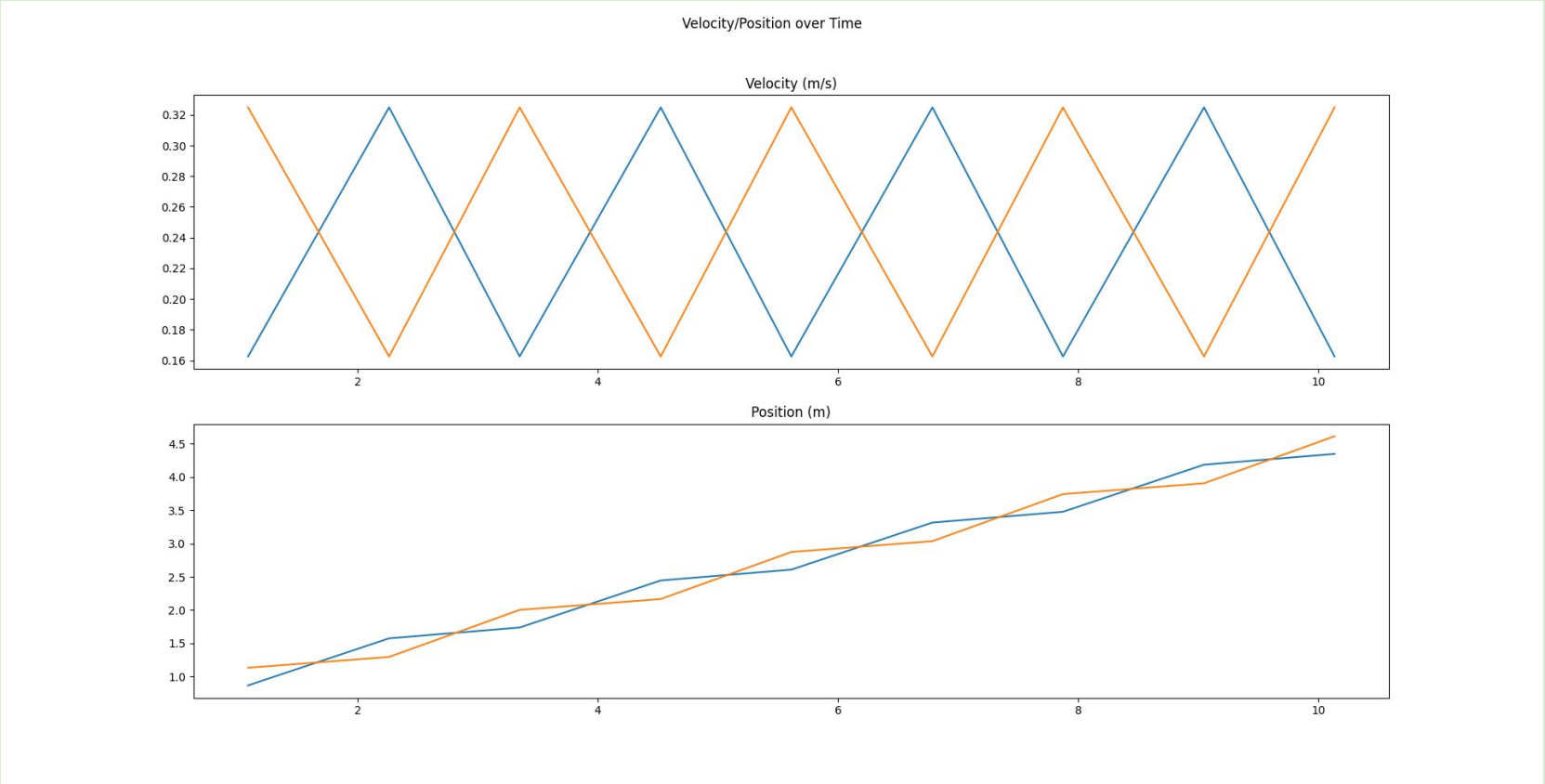


Principle of Relativity

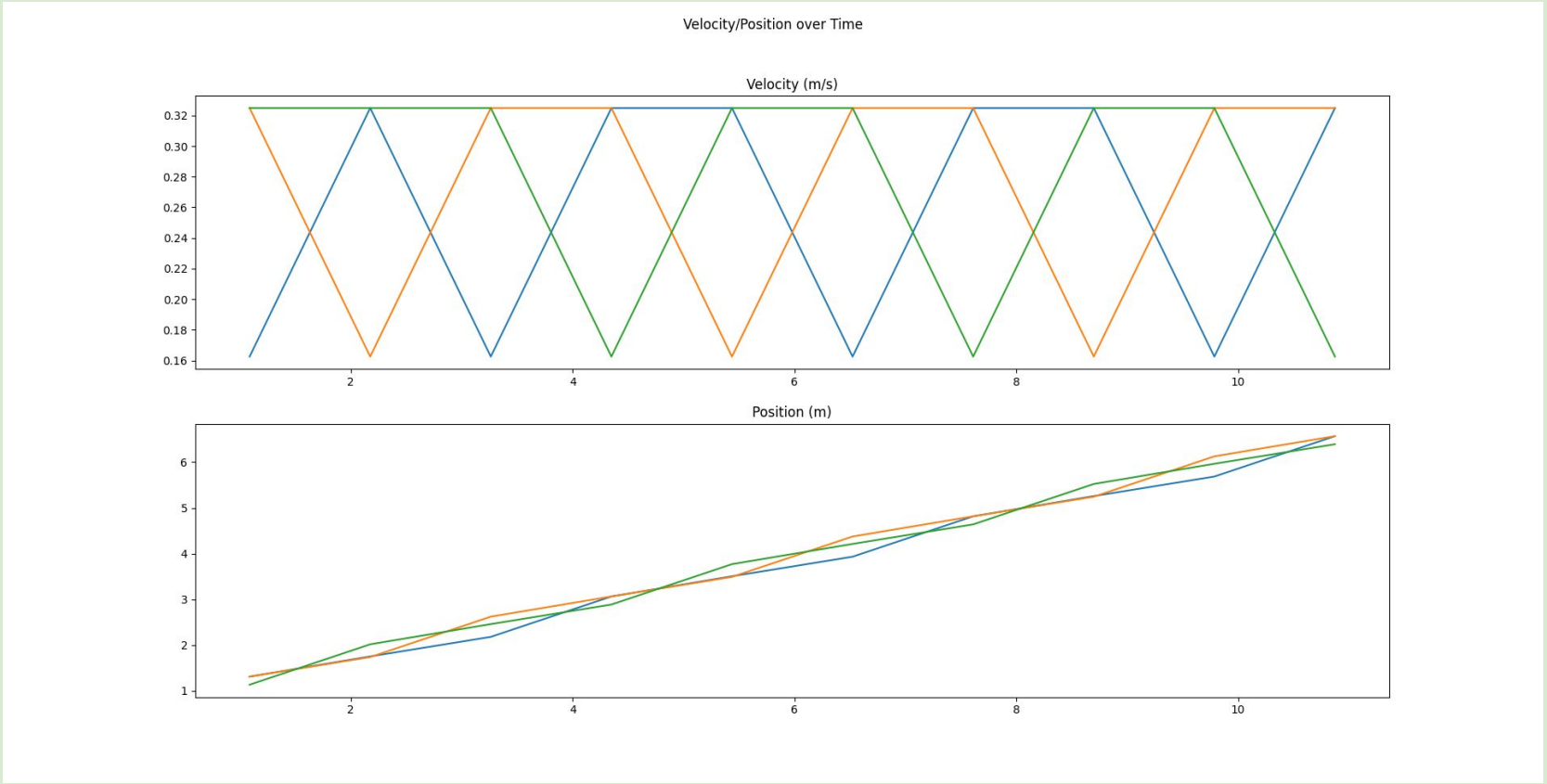




2 Robot - Velocity(m/s) vs Time(s) & Position(m) vs Time(s)



3 Robot - Velocity(m/s) vs Time(s) & Position(m) vs Time(s)

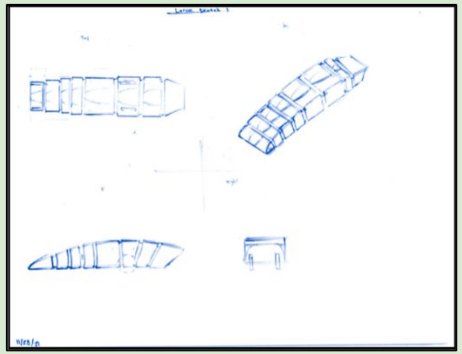


Percentage Speed Difference

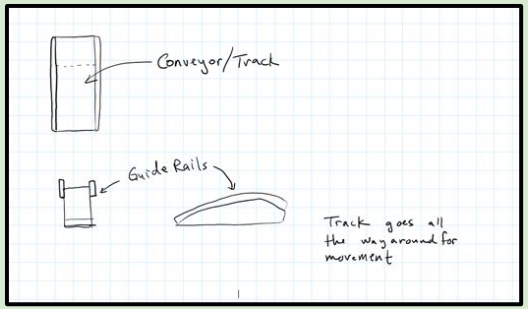
Distance (m)	Time (s)			Percent Time Difference (%)		Speed (m/s)	Percent Speed Difference (%)
3.13	9.62	MAX speed	1 Robot	0		0.35	0.00
					AVG	0.35	0.00
3.48	7.87	Alternating	2 Robots	20		0.44	30.45
3.74	7.87			20		0.48	37.58
					AVG	0.46	34.09
3.50	5.44	Alternating	3 Robots	55		0.64	65.93
3.49	5.44			55		0.64	65.60
3.77	5.44			55		0.69	72.38
					AVG	0.66	68.05

Design Alternatives

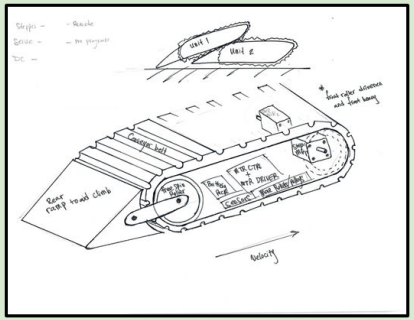
Design 1: “Wheel Bug”



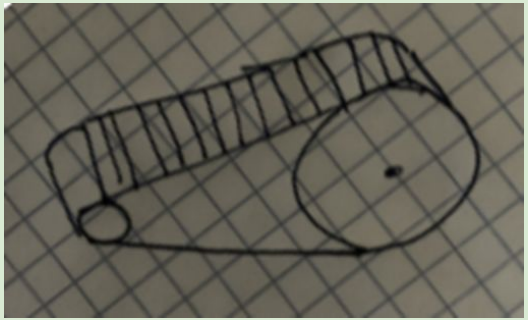
Design 2: “Track Bug”



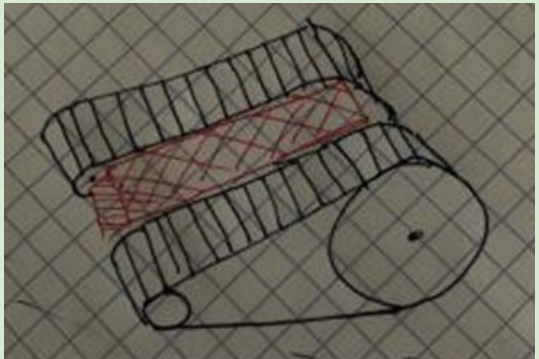
Design 3: “Single Track Bot without an Incline”



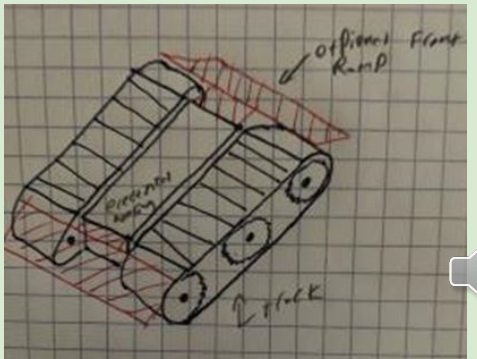
Design 4:(Single w/ incline)



Design 5:(double w/ INC)



Design 6:(double no INC)

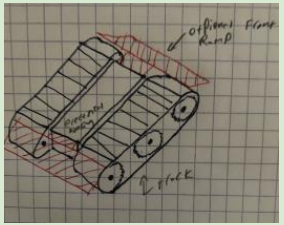


Decision Matrix

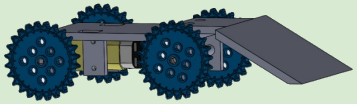
	Manufacturability		Aesthetic		Stability		Coordination		RANK
Weight Factor	0.25		0.10		0.30		0.35		1.00
Design 1 Wheel bug	6.00	1.50	6.00	0.60	3.00	0.90	1.00	0.35	3.35
Design 2 Track bug	1.00	0.25	5.00	0.50	6.00	1.80	4.00	1.40	3.95
Design 3 Single track No INC	5.00	1.25	1.00	0.10	4.00	1.20	3.00	1.05	3.60
Design 4 Single Track W/ INC	4.00	1.00	2.00	0.20	1.00	0.30	2.00	0.70	2.20
Design 5 Double Track W INC	2.00	0.50	4.00	0.40	2.00	0.60	5.00	1.75	3.25
Design 6 Double Track No INC	3.00	0.75	3.00	0.30	5.00	1.50	6.00	2.10	4.65

Design Progression

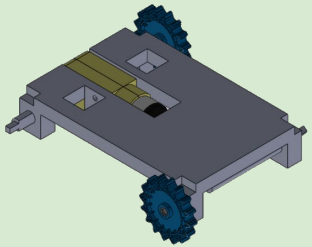
Preliminary sketch



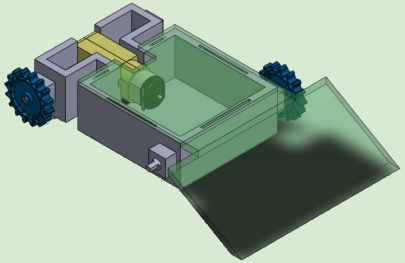
Prototype A



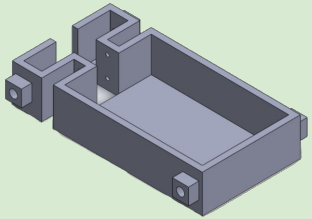
Prototype B



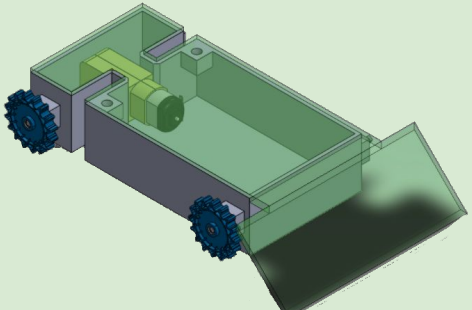
Prototype C



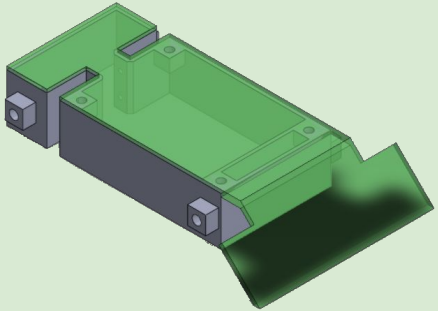
Prototype D



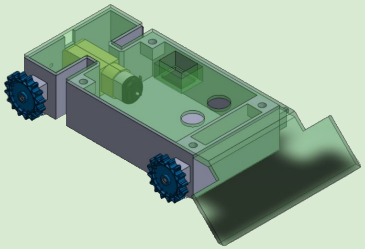
Prototype E



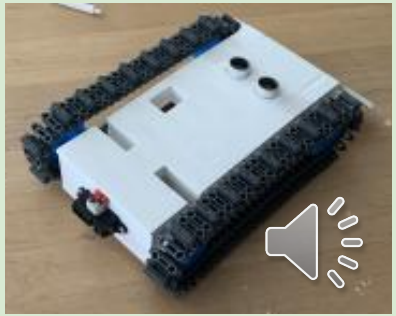
Prototype F



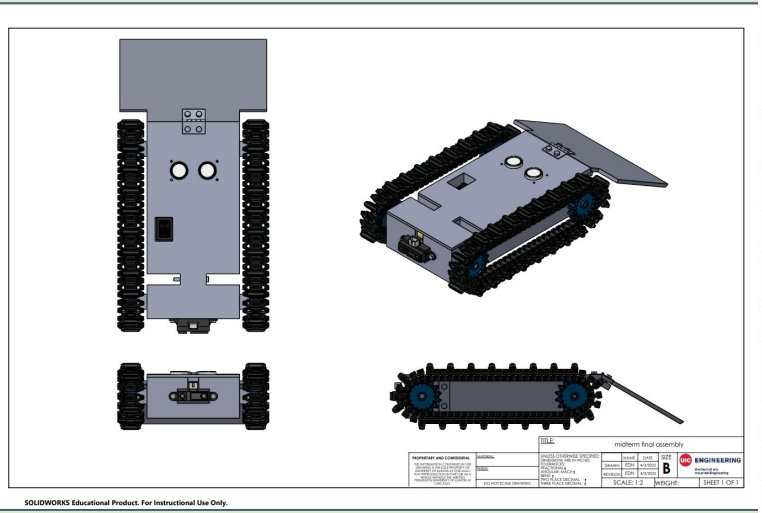
Prototype G

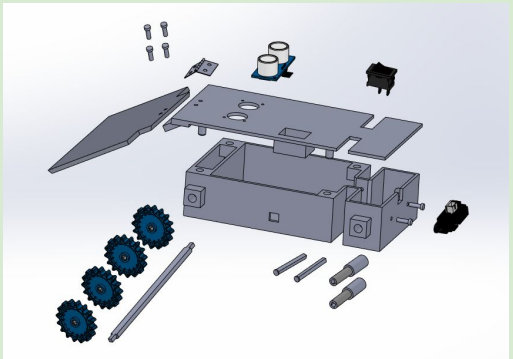


Final Design



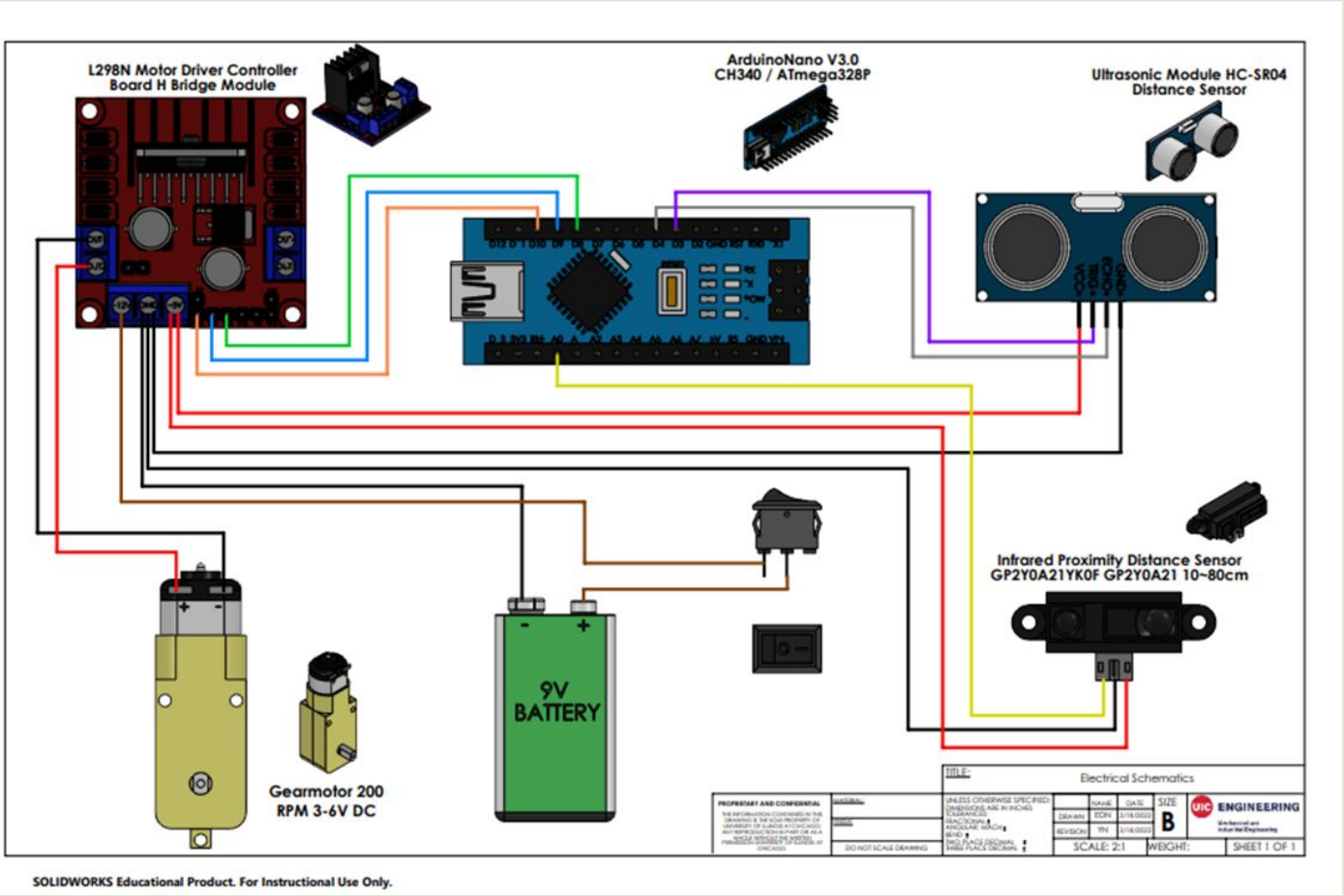
Final Design



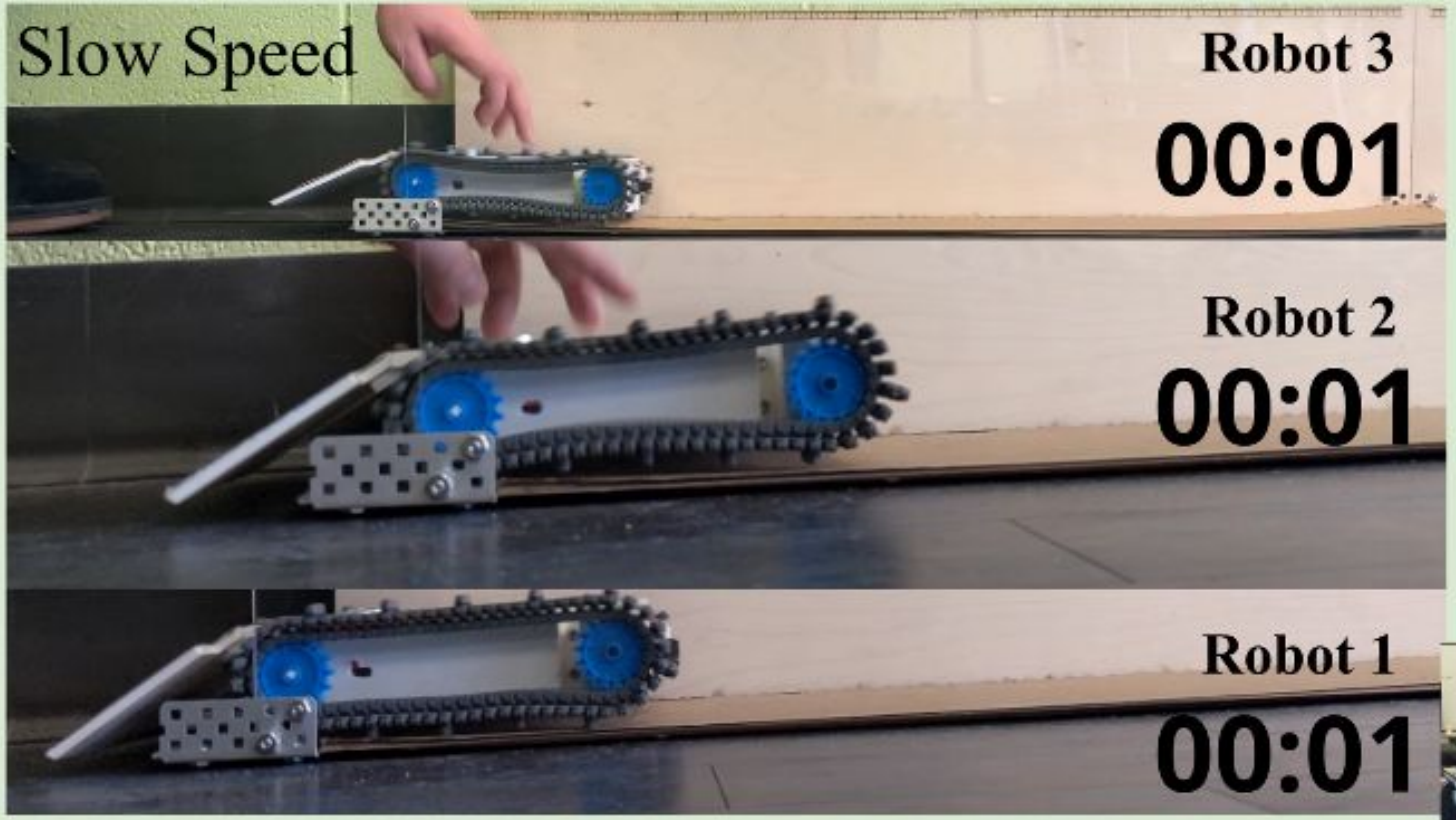


ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	Unit Price ($)	Extended Price ($)
1	Chasis	3D printed (100g)	1	$0.03/g	$3.00
2	DC Motor		1	$2.95	$2.95
3	M3x45mm		2	$0.10	$0.20
4	Gear to Gear G	3D printed (3g)	1	$0.03/g	$0.09
5	L298N Motor Driver		1	$2.50	$2.50
6	Rechargable 9V battery		1	$7.01	$7.01
7	ARDUINO NANO		1	$6.66	$6.66
8	MiniBreadboard		1	$0.45	$0.45
9	hc sr04 ultrasonic sensor		1	$1.30	$1.30
10	16 T Wheel		4	$0.25	$1.00
11	RA1113xxx1 (ON/OFF Switch)		1	$0.90	$0.90
12	Chain		120	$0.06	$7.20
14	Rubber Traction Link		18	$0.10	$1.80
15	Long Range SHARP IR Sensors - #GP2Y0A21YK0F		1	$7.00	$7.00
16	M3x5		10	$0.10	$1.00
17	0.1 m to g	3D printed (2g)	2	$0.03/g	$0.06
18	Lid Flap	3D printed (35g)	1	$0.03/g	$1.05
19	Lid	3D printed (40g)	1	$0.03/g	$1.20
20	Hinge		1	$0.50	$0.50
21	Vex Robot Connection		2	$0.10	$0.20
				Total Price	$45.07

Electronic Schematic using L298N H-Bridge



Data Collection



Ideal Speed Amplification

Ideal Speed Amplication						
Length of Track (in)	Conveyor Length (in)	Conveyor (%)	Cooperative Speed (in/s)	Individual Speed (in/s)	Percent Increase while on robots (%)	Overall Percent Increase (%)
128	24	18.75%	26.67	14.28	46%	8.63%

Ideal

Not Ideal

2 Robot vs. 3 Robot vs. No Cooperative Movement

2 and 3 Robot Speeds Compared

	2 Robot Robot 1	2 Robot Robot 2	3 Robot Robot 1	3 Robot Robot 2	3 Robot Robot 3
Individual Speed (in/s)	11.04	10.47	10.63	9.61	9.53
Cooperative Speed (in/s)	11.75	10.50	11.46	9.64	10.18
Percent Increase	6.39%	0.25%	7.84%	0.33%	6.76%

2 Robot

3 Robot


The End