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Team 507: Southeast Con
VDR 2

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11/14/2024

Sponsors and Advisors

Dr. Oscar Chuy

Dr. Johnathan Clark

Dr. Bruce Harvey

FAMU-FSU College of Engineering

Meet the Team

Kelsey Gross

Ian Lemler

Luiz Santos

Eric Strawn

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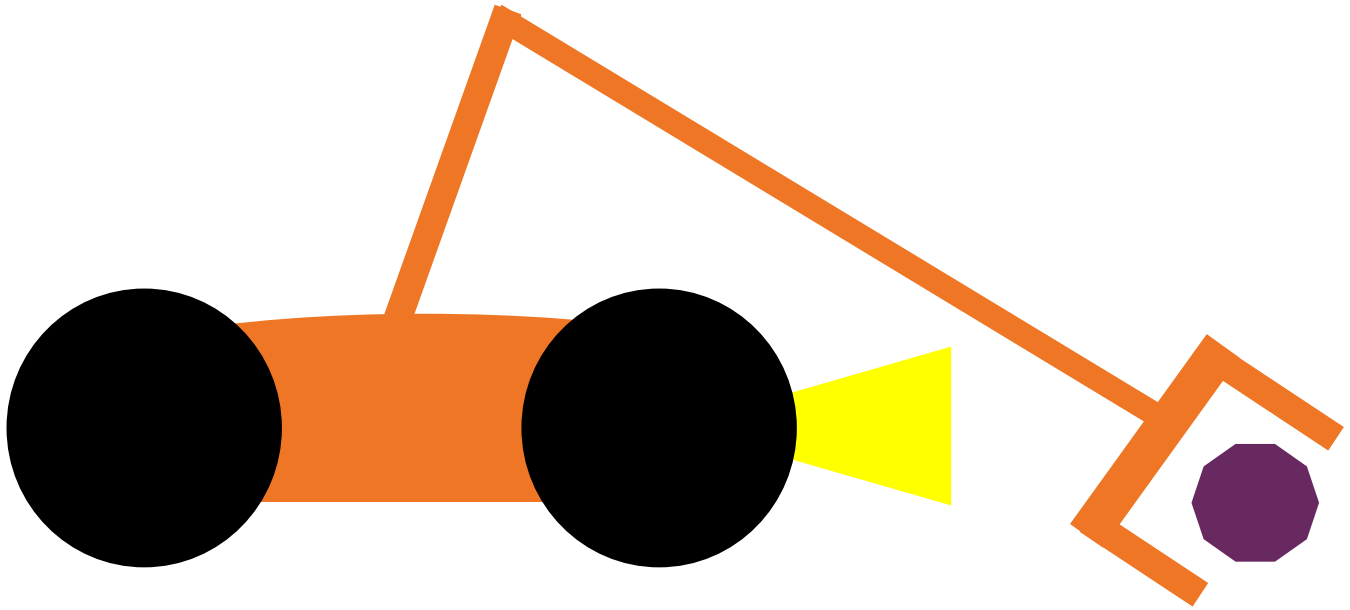
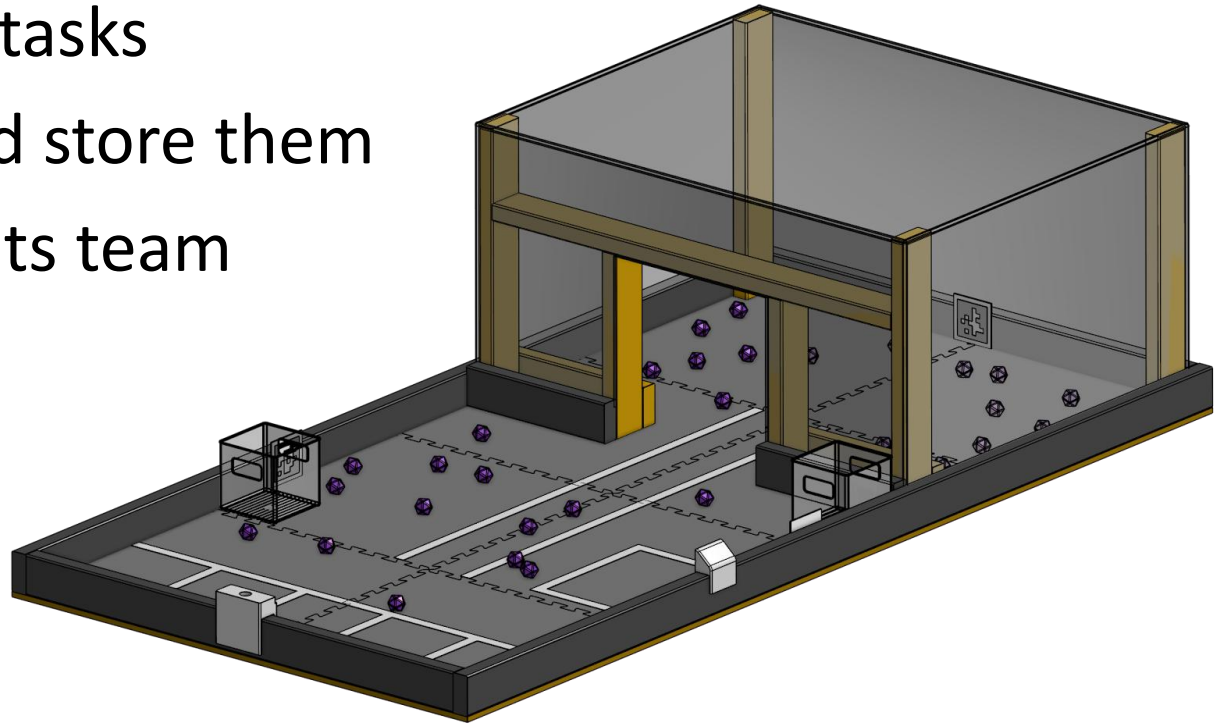
Objective

- The objective of this project is to design, develop, and compete with a working robot that allows for the collection of different types of astral materials and optimizes point scoring.

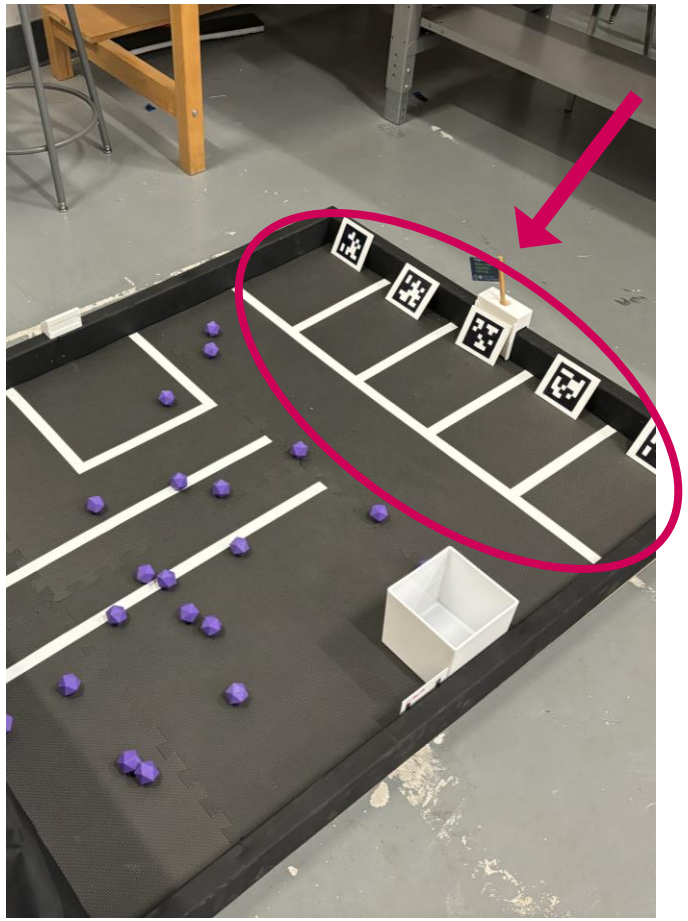


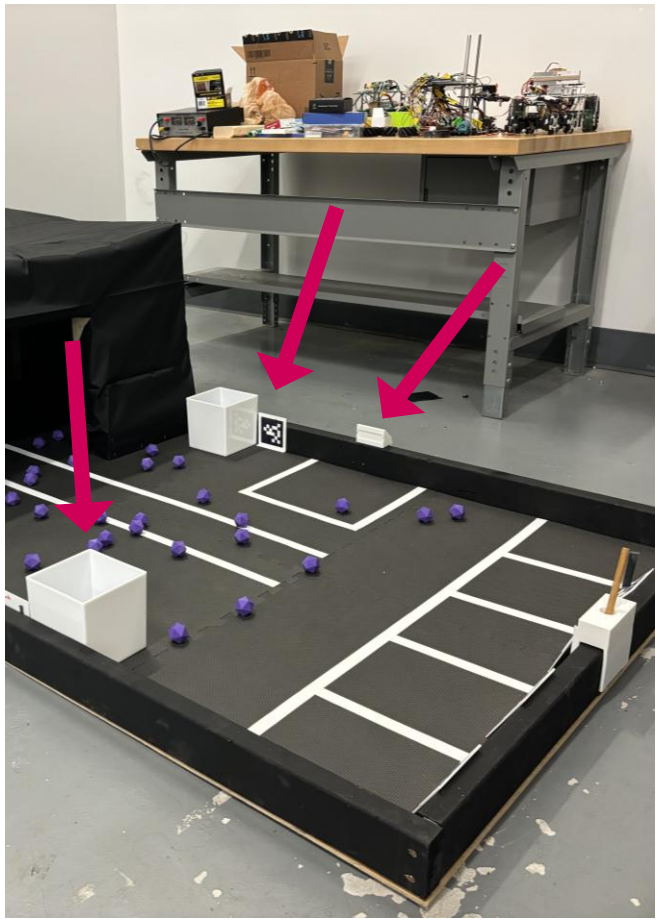
Project Description

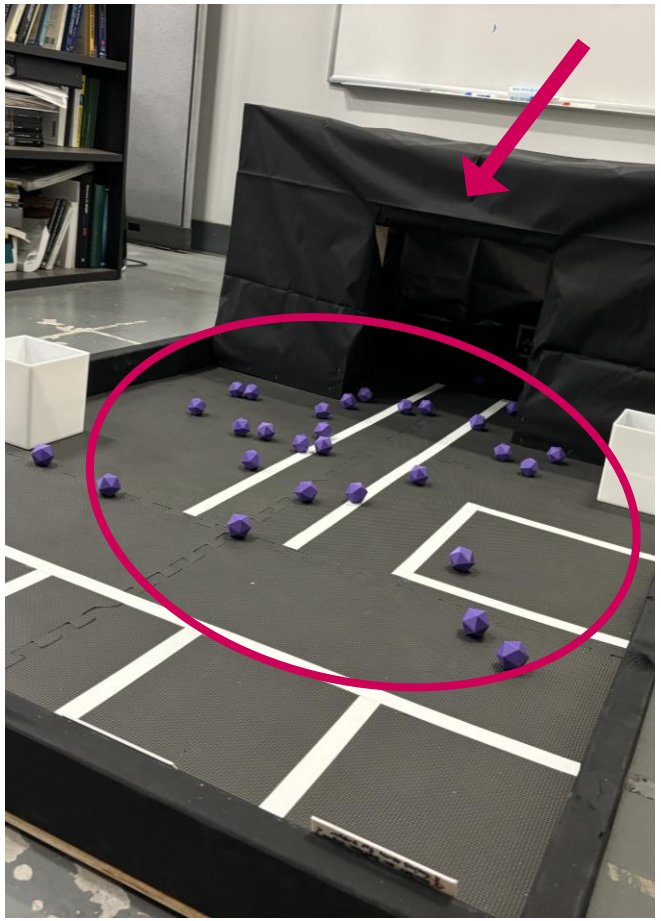
- Regional Competition for the Southeast States
- Design, build, test, and program a fully autonomous robot
- 3 Minutes to complete all tasks
- Collect astral materials and store them
- Work with ECE departments team



The Game Field







Targets and Metrics

Targets – Collection Mechanism

Function	Target	Metric
Detect Objects	Materials are detected within a 20 cm radius with 95% accuracy	% of materials detected
Grip Objects	90% collection success rate	% of materials supported
Detection and Collection Integration	Less than 2 seconds between material detection and collection start	Tested in software portion of robot (time between code portions)

Targets – Sorting Mechanism

Function	Target	Metric
Differentiate Materials	Able to differentiate between materials with a 90% accuracy	Field test to determine accuracy (percentage)
Separation	Separates different materials with 75% accuracy	Field test to determine accuracy (percentage)

Targets –Navigation

Function	Target	Metric
Work in Cave	Operate at 85% efficiency of robot outside the cave	Compare to all targets outside of the cave
Autonomous	Operate autonomously for 3 minutes before being turned off	Timer to measure operation time (minutes)
Detect LED	Robot moves within 2 seconds of LED light being turned on	Timer to measure start time after LED (seconds)

Targets – Structure, Power, and User Interaction

Ian Lemler

Function	Target	Metric
Meets Weight Requirement	Less than 12 kg	Weight scale
Emergency Stop capabilities	Power to 0V	Voltmeter
Support Weight	Support up to 15 kg and operate normally	Weight scale
Generate Power	5-24V for at least 4 minutes	Timer to measure how long the battery can support all functions of the robot

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Critical Targets

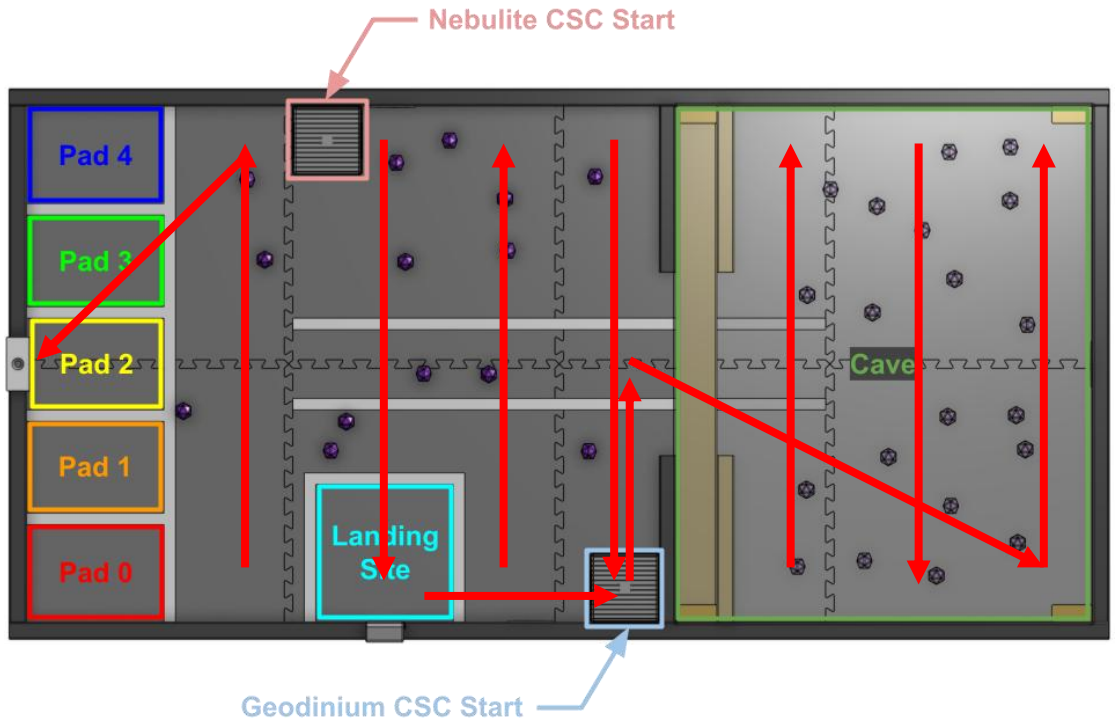
- Weigh less than 12 kg and support up to 15 kg
- All power goes to 0V upon activation of emergency stop
- Battery generates enough power to support necessary systems for the duration of the game (3-4 minutes)
- Robot collects and supports objects with a 90% success rate
- Robot detects LED light within 2 seconds to ensure optimal start speed

Point Potential

Task	Points
Out of the Landing Site	5
Out of the Landing Site within 3 Seconds	5
In the Cave (First Time)	15
Cosmic Shipping Container in Non-Telemetry Rendezvous Pad	15
Cosmic Shipping Container in Telemetry Rendezvous Pad	30
Astral Material supported by the Robot Unit (each)	1
Astral Material in wrong Shipping Container (each)	2
Nebulite in Nebulite Cosmic Shipping Container	5
Geodinium in the Geodinium Cosmic Shipping Container	6
Team Beacon has at least some portion in the Beacon Mast	40

Point Optimization

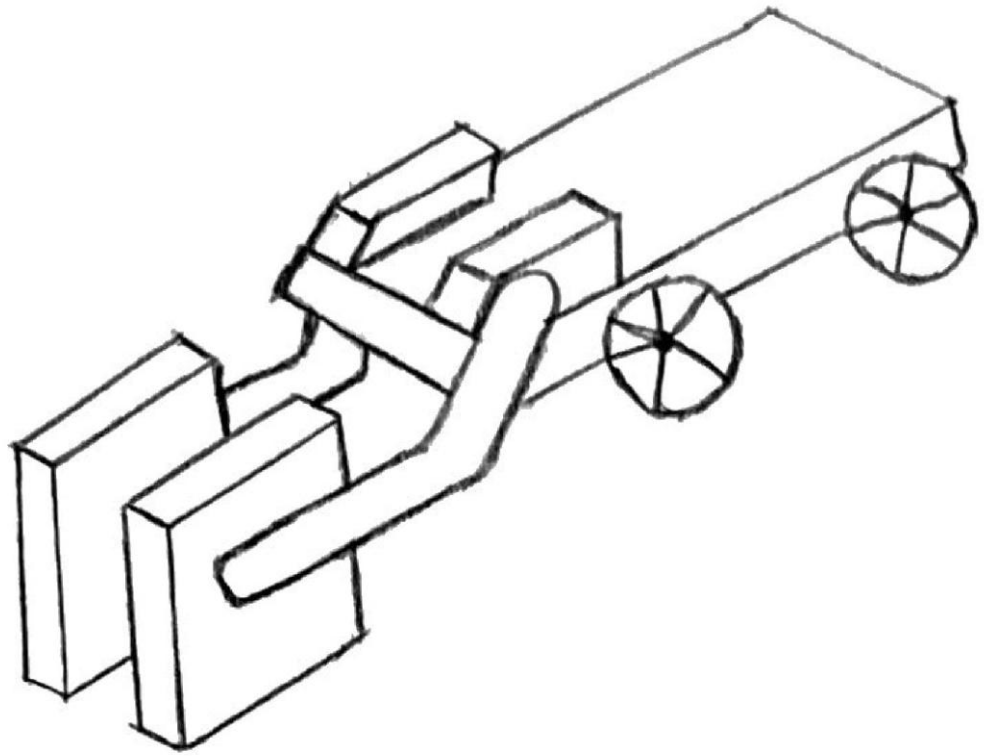
Ideal Plan	Points
Out of the Landing Site	5
Out of the Landing Site within 3 Seconds	5
In the Cave (First Time)	15
Cosmic Shipping Container in Telemetry Rendezvous Pad	30
Geodinium in the Geodinium Cosmic Shipping Container	
Team Beacon has at least some portion in the Beacon Mast	40
In the Cave Points Gained	52
Out of the Cave Points Gained	88
Total:	235



Concept Generation

Kelsey Gross

Compactor



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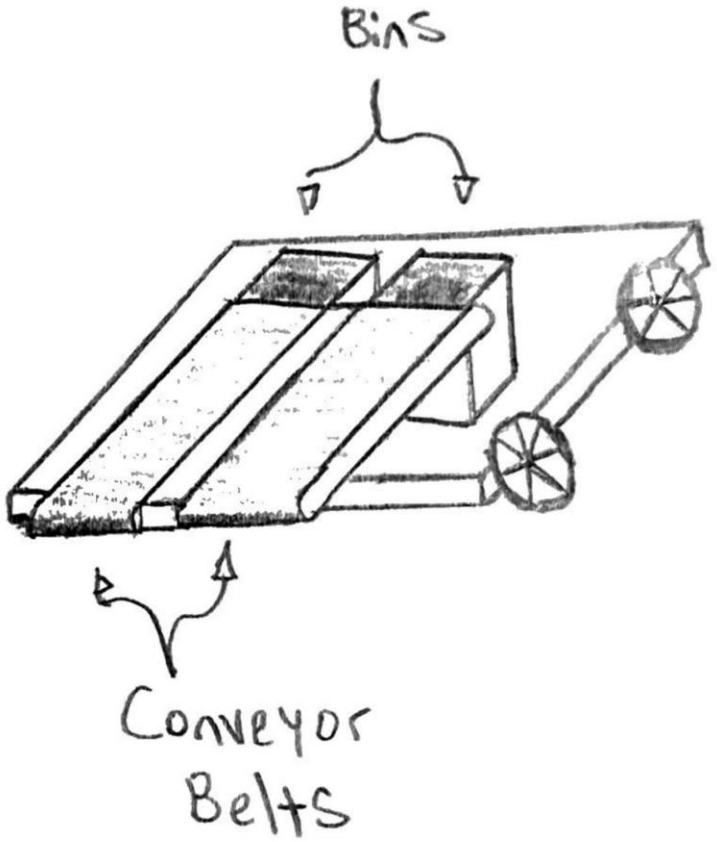
Kelsey Gross

Multi Conveyer



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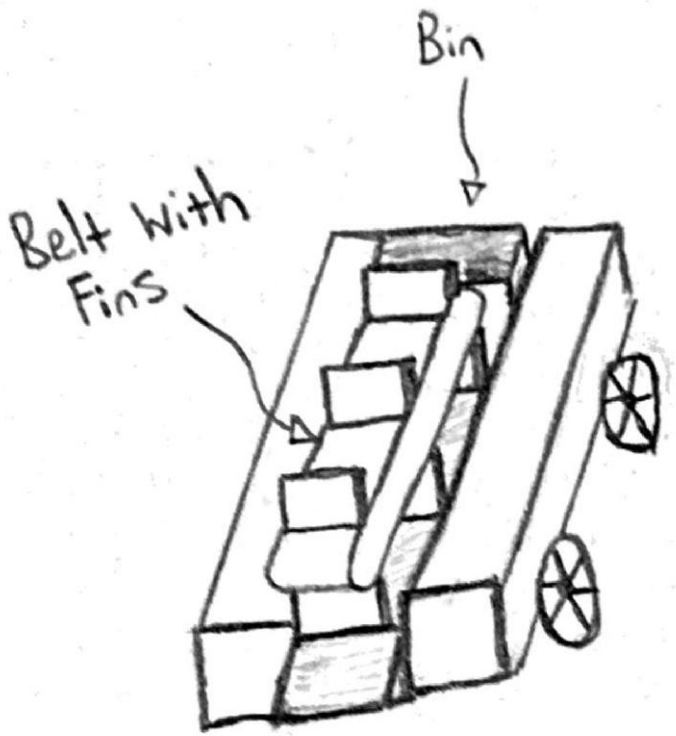
Kelsey Gross

Lazy Hercules



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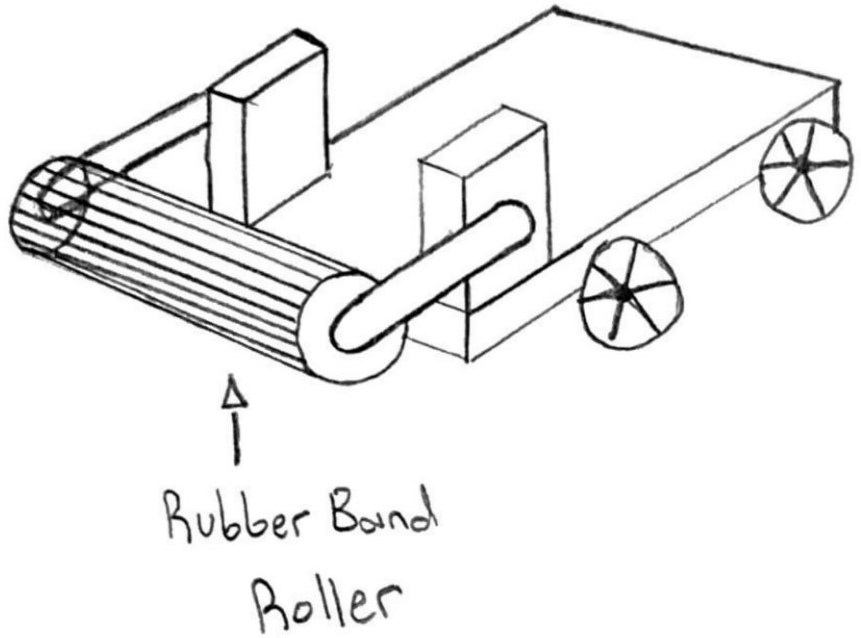
Band Box Bot



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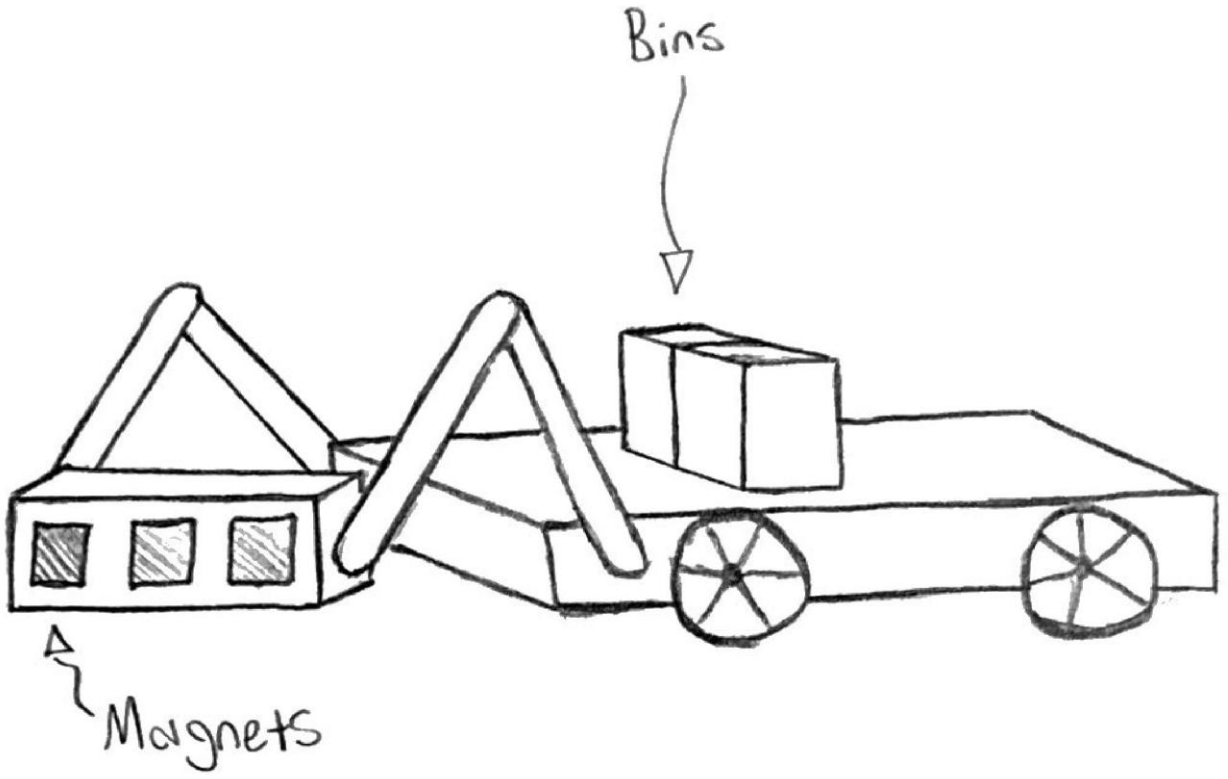
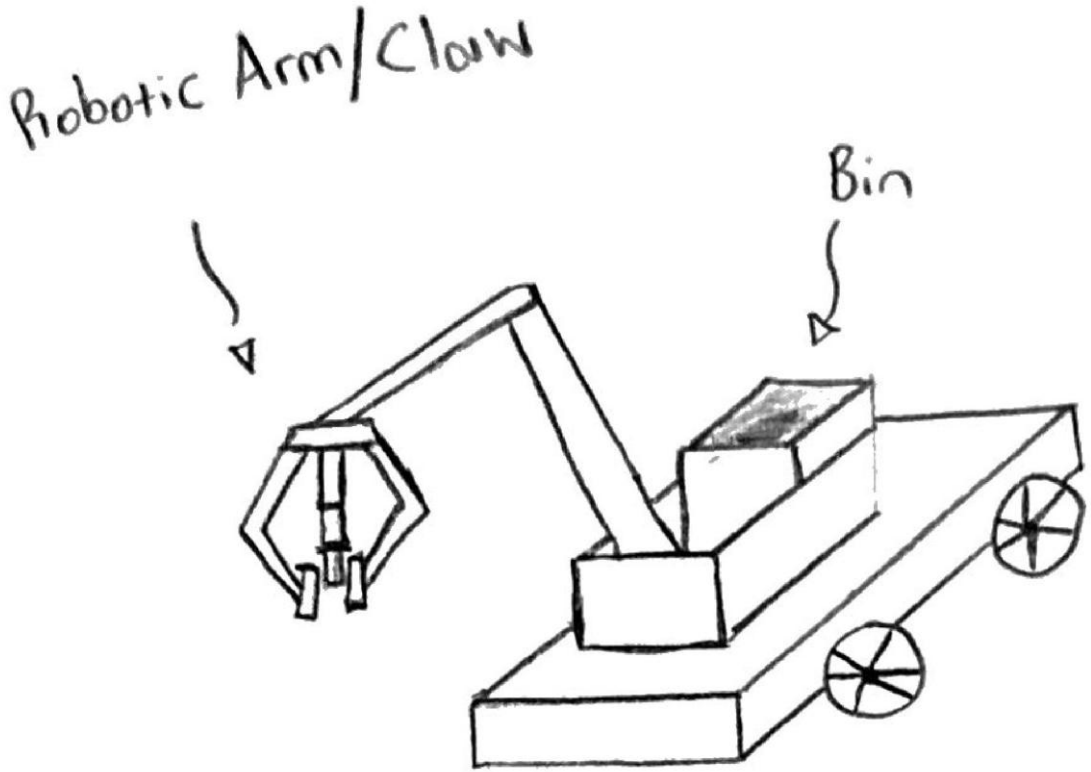
Magnetic Bulldozer



Kelsey Gross

Robotic Claw



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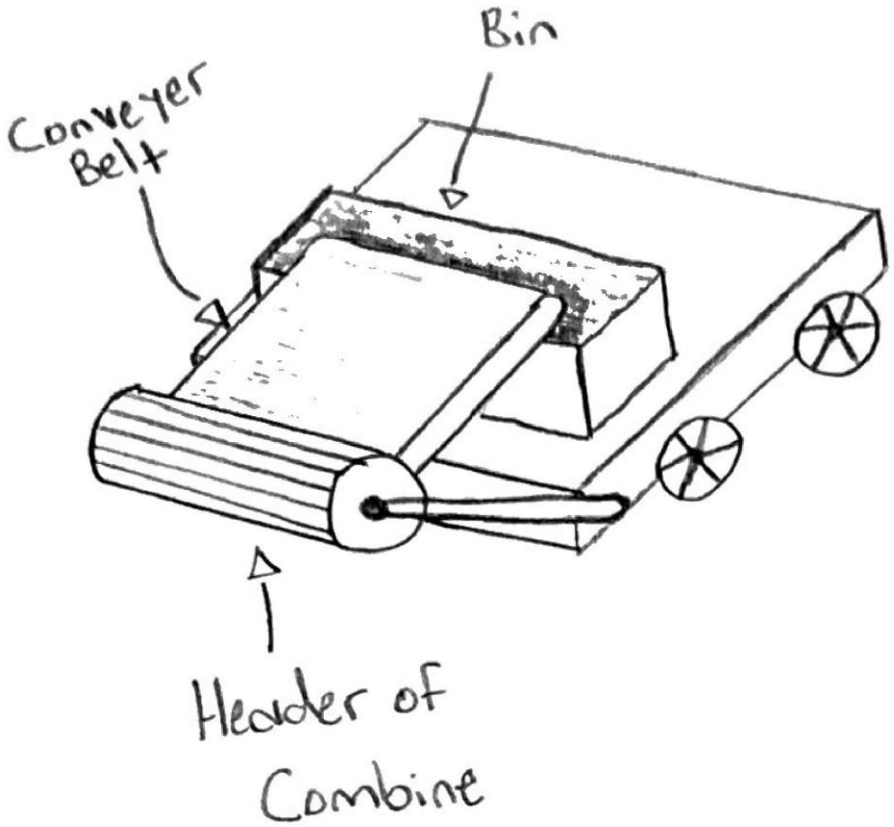
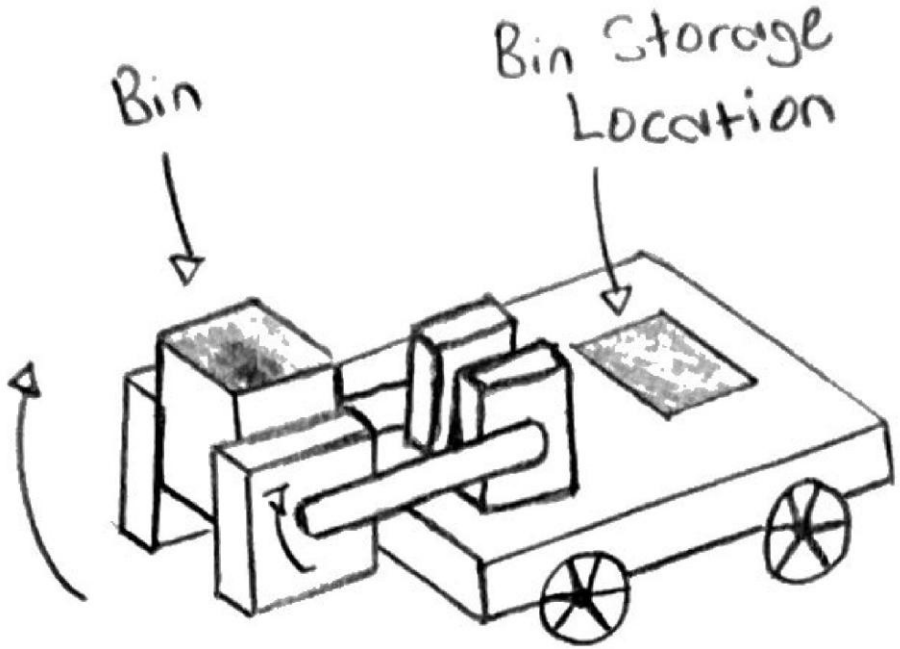
Frank



Kelsey Gross

Clamp and Lift



Concept Selection

Binary Pairwise Comparison

Customer Requirement	IWF
Under 12 kg	4
Starts with LED	7
Size Constraint Followed	4
Battery Powers Robot	8
IR Camera works in Cave	1
Intakes Material	7
Reads April Tag	4
Feedback System	6
Autonomous	9
Detect Materials	4
Sort Materials	1

House of Quality

Engineering Characteristic	Raw Score	Rank Order
Weight	72	7
Voltage From Power Supply	722	7
Stability	59	10
Time to Move	63	9
Time to Complete Collection	76	6
Volume	126	3
Time to Place Beacon	160	2
Time to Place Bins	55	11
Sensors	201	1
Speed of Shutoff	54	12
Mobility	94	4
Wheel Torque	93	5

Ian Lemler

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Pugh Charts

		Concepts							
Engineering Characteristics	Datum	1	2	3	4	5	6	7	8
Weight		+	S	+	+	S	+	S	S
Voltage from Power Supply		S	-	S	S	-	-	-	S
Stability		+	S	+	+	-	-	+	+
Time to Move		+	+	+	-	-	-	S	S
Time to Complete Collection		-	+	+	-	-	-	S	-
Volume		+	S	+	S	S	S	-	+
Time to Place Beacon		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time Place Bins		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sensors		S	S	S	S	-	-	+	S
Speed of Shutoff		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mobility		+	S	+	+	-	-	-	S
Wheel Torque		+	+	+	+	-	S	-	S
# of pluses		6	3	7	3	0	1	2	2
# of minuses		1	1	0	2	7	6	4	1

1	Compactor	☑
2	Multi-Conveyor	☑
3	Lazy Hercules	☑
4	The Band Box Bot	☑
5	Magnetic Bulldozer	
6	Robotic Claw	
7	Frank	
8	Clamp and Lift	☑

High Fidelity
Medium Fidelity
Datum: Nothing But Net Robot
Eliminated

		Concepts			
Engineering Characteristics	4	1	2	3	8
Weight		-	-	S	S
Voltage from Power Supply		-	+	+	S
Stability		-	+	+	+
Time to Move		+	+	+	+
Time to Complete Collection		-	+	+	+
Volume		S	-	S	S
Time to Place Beacon		+	+	+	+
Time Place Bins		+	+	+	-
Sensors		-	+	S	S
Speed of Shutoff		S	S	S	S
Mobility		+	S	S	-
Wheel Torque		-	S	S	S
# of pluses		4	7	6	4
# of minuses		6	2	0	2

1	Compactor	
2	Multi-Conveyor	☑
3	Lazy Hercules	☑
8	Clamp and Lift	☑

4	The Band Box Bot	DATUM

Selected:	
1	3
2	2
3	8

Pugh Chart 1 - Results

1	Compactor	☑
2	Multi-Conveyor	☑
3	Lazy Hercules	☑
4	The Band Box Bot	☑
5	Magnetic Bulldozer	
6	Robotic Claw	
7	Frank	
8	Clamp and Lift	☑

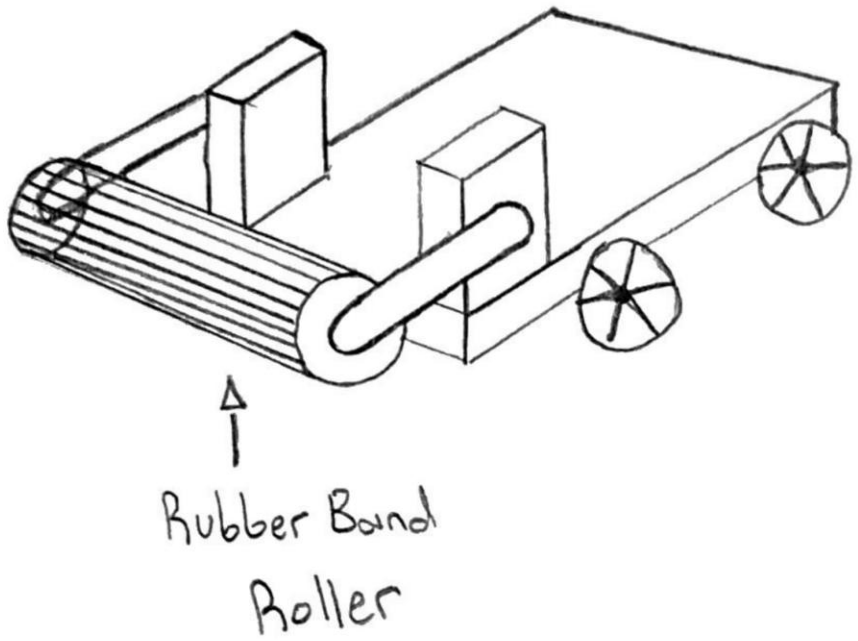
High Fidelity
Medium Fidelity
Datum: Nothing But Net Robot
Eliminated

Pugh Chart 2 - Results

1	Compactor	
2	Multi-Conveyor	☑
3	Lazy Hercules	☑
8	Clamp and Lift	☑

4	The Band Box Bot	DATUM

Selected:	
1	3
2	2
3	8



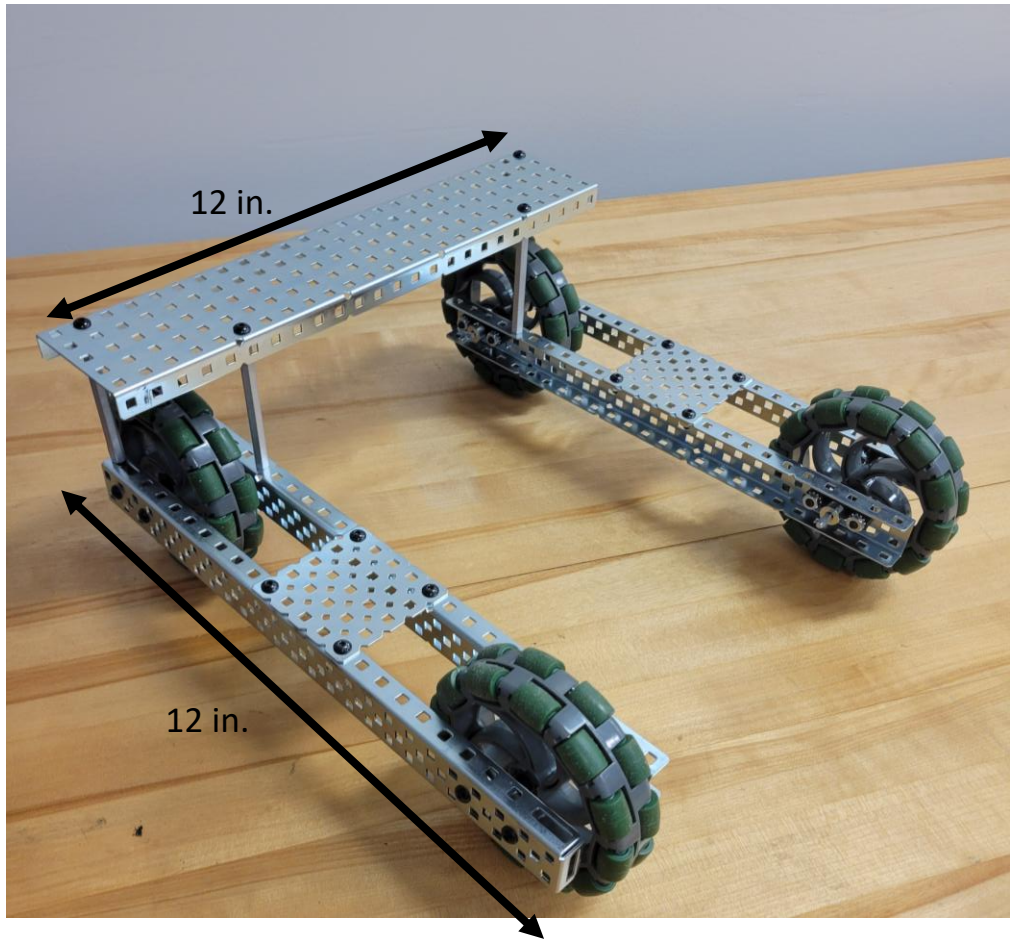
AHP

Criteria	Sum	Normalized
Weight	60.03	0.215
Voltage from power supply	60.53	0.159
Stability	45.68	0.111
Time to move	5.03	0.019
Time to complete collection	24.34	0.060
Volume	58.00	0.194
Time to place beacon	7.30	0.021
Time to place bins	9.70	0.026
Sensors	30.77	0.073
Speed of shutoff	15.58	0.038
Mobility	16.42	0.040
Wheel torque	18.42	0.044

Testing

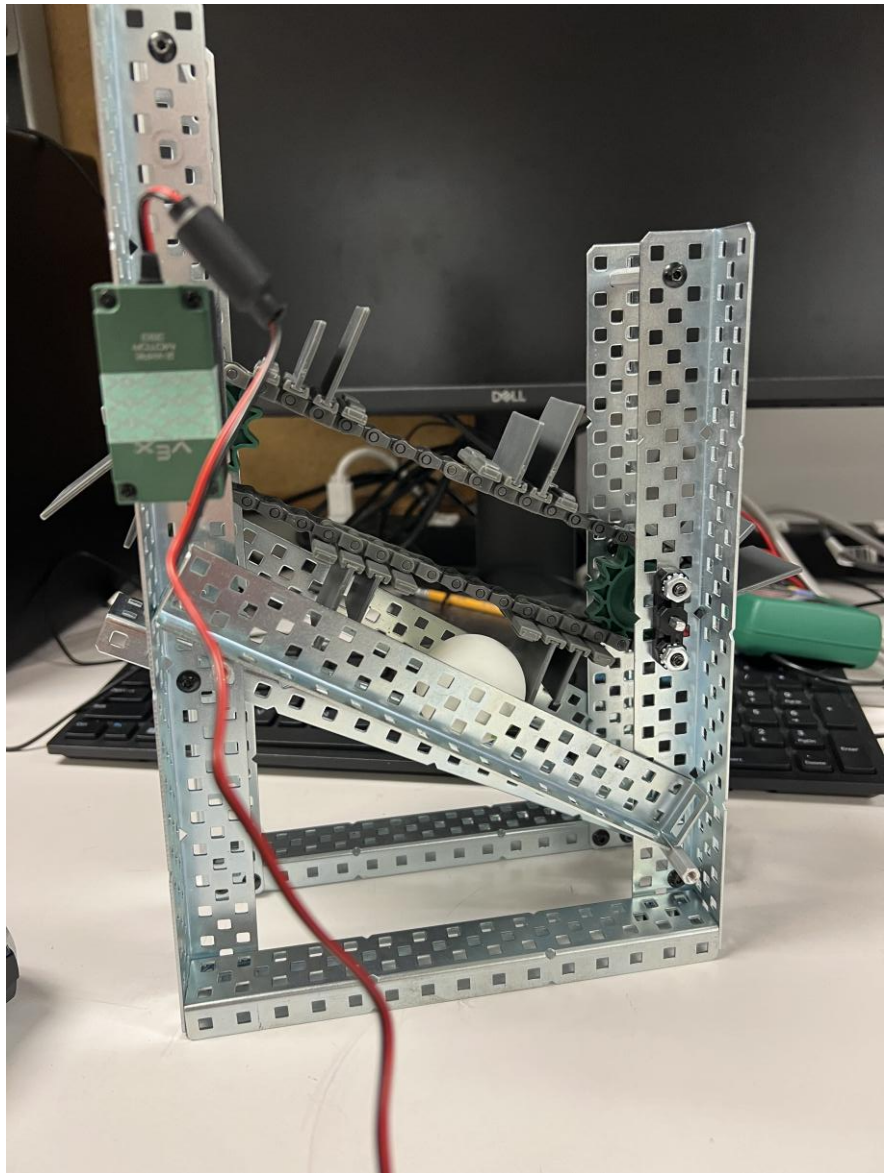
Concept 1

- Proof of drive train concept
- Give a visual representation of start size constraint in the X and Y axis

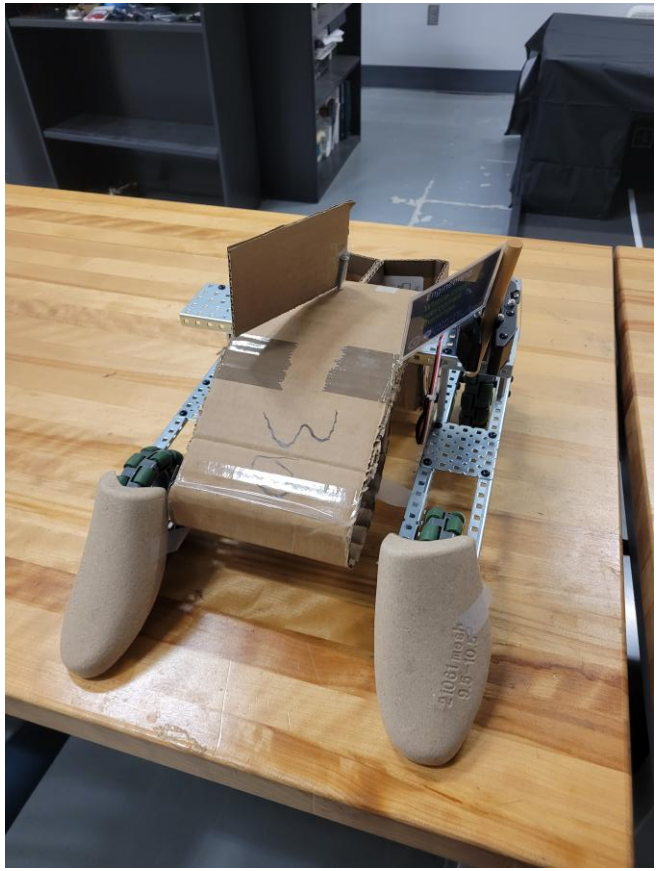


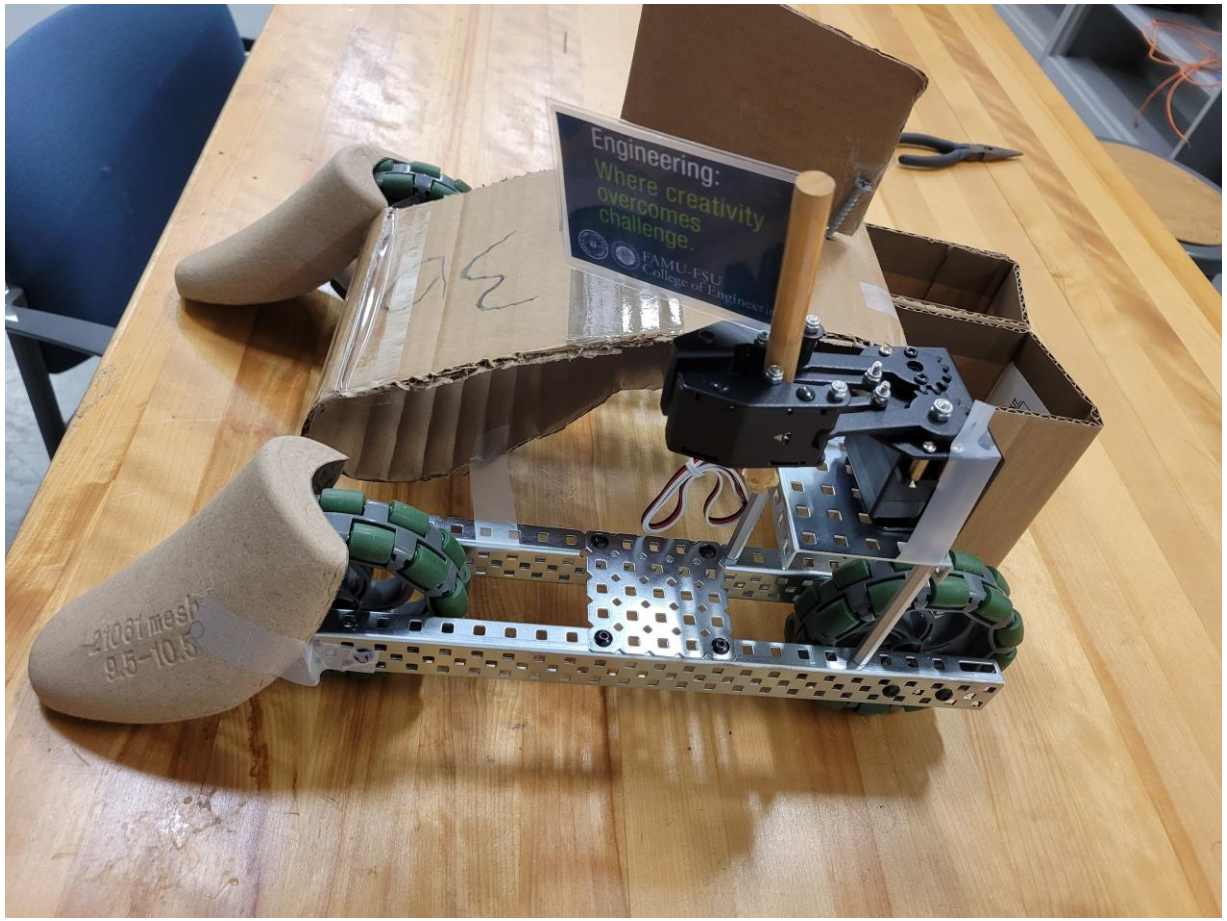
Concept 2

- Validate Lazy Hercules intake methodology
- Test whether the magnets in the Geodinium was strong enough to stick to steel
- Allow for spec-ing of motors for the conveyor belt to be done and validated



Prototype 1

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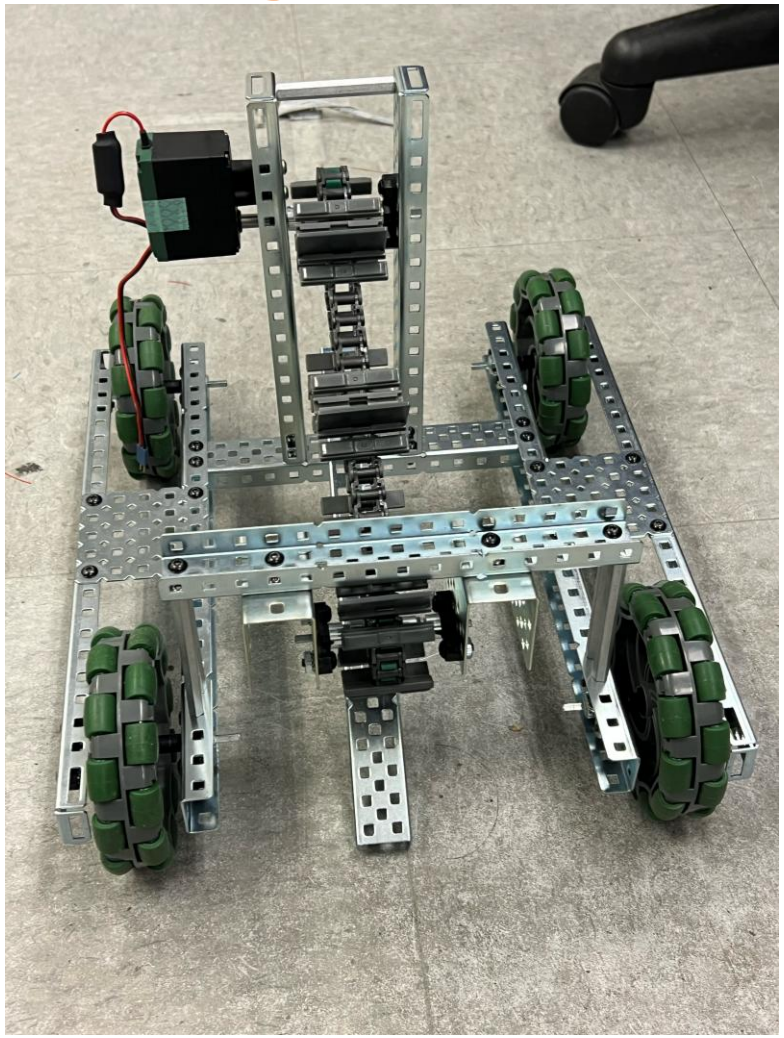
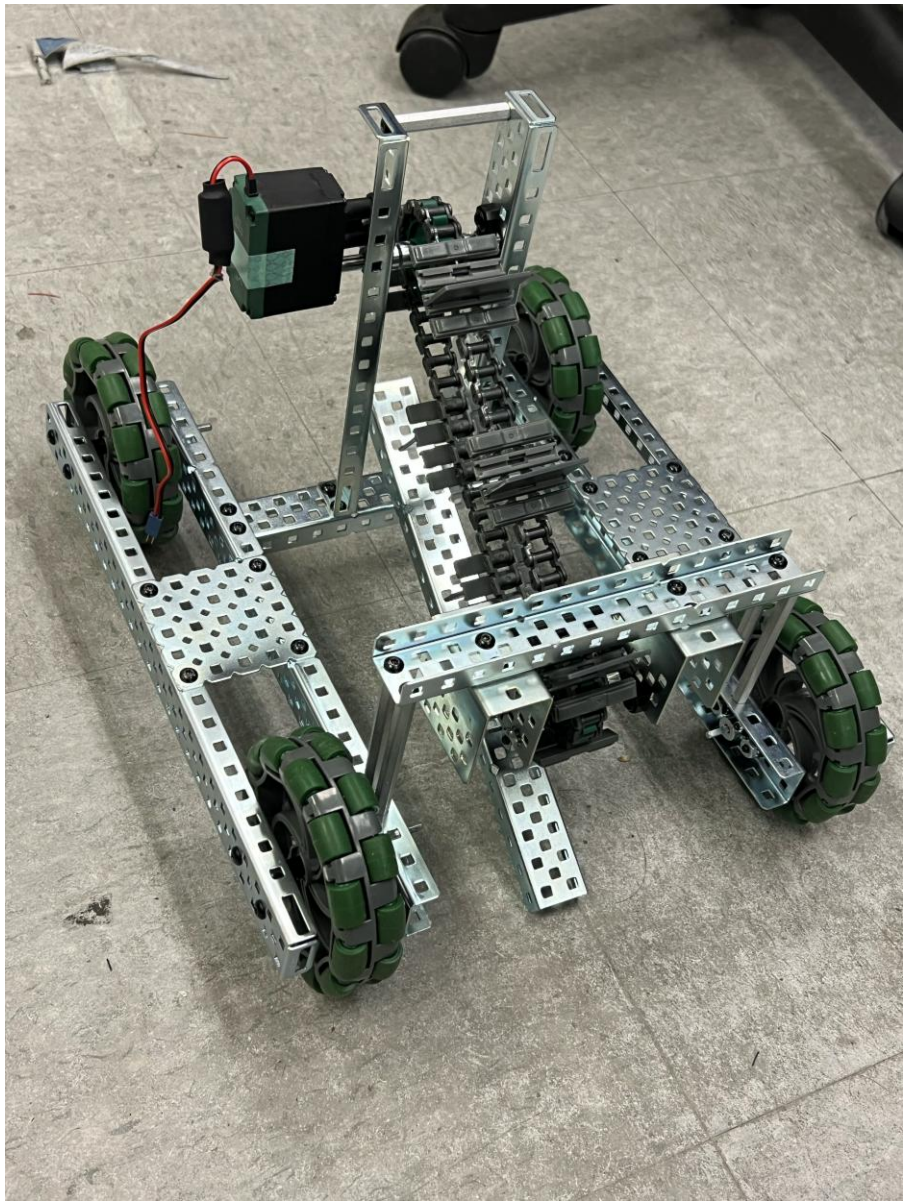
Prototype 2





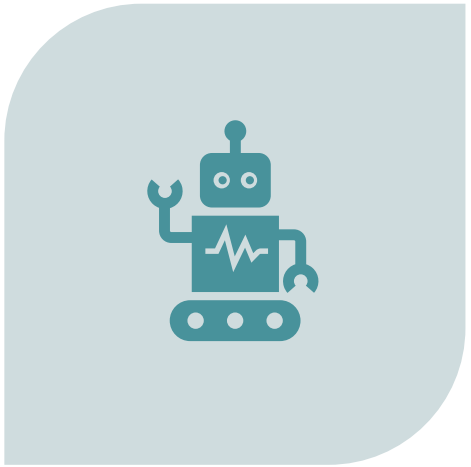
Completed Work

RESEARCH PAST DESIGNS THAT WORKED FOR OTHER TEAMS

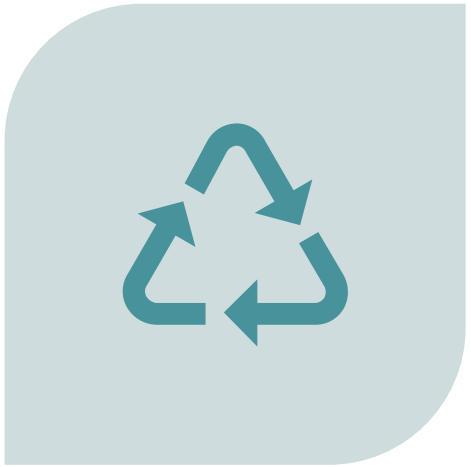
FINISH CONCEPT GENERATION AND SELECTION

BUILD FIRST PROTOTYPE WITH CARDBOARD

Future Work



CREATE FULLY FUNCTIONAL PROTOTYPE BY END OF SEMESTER



ITERATE ON FUNCTIONAL PROTOTYPE