Team 4 – Final Project Presentation

MCHE 201: Introduction to Mechanical Design

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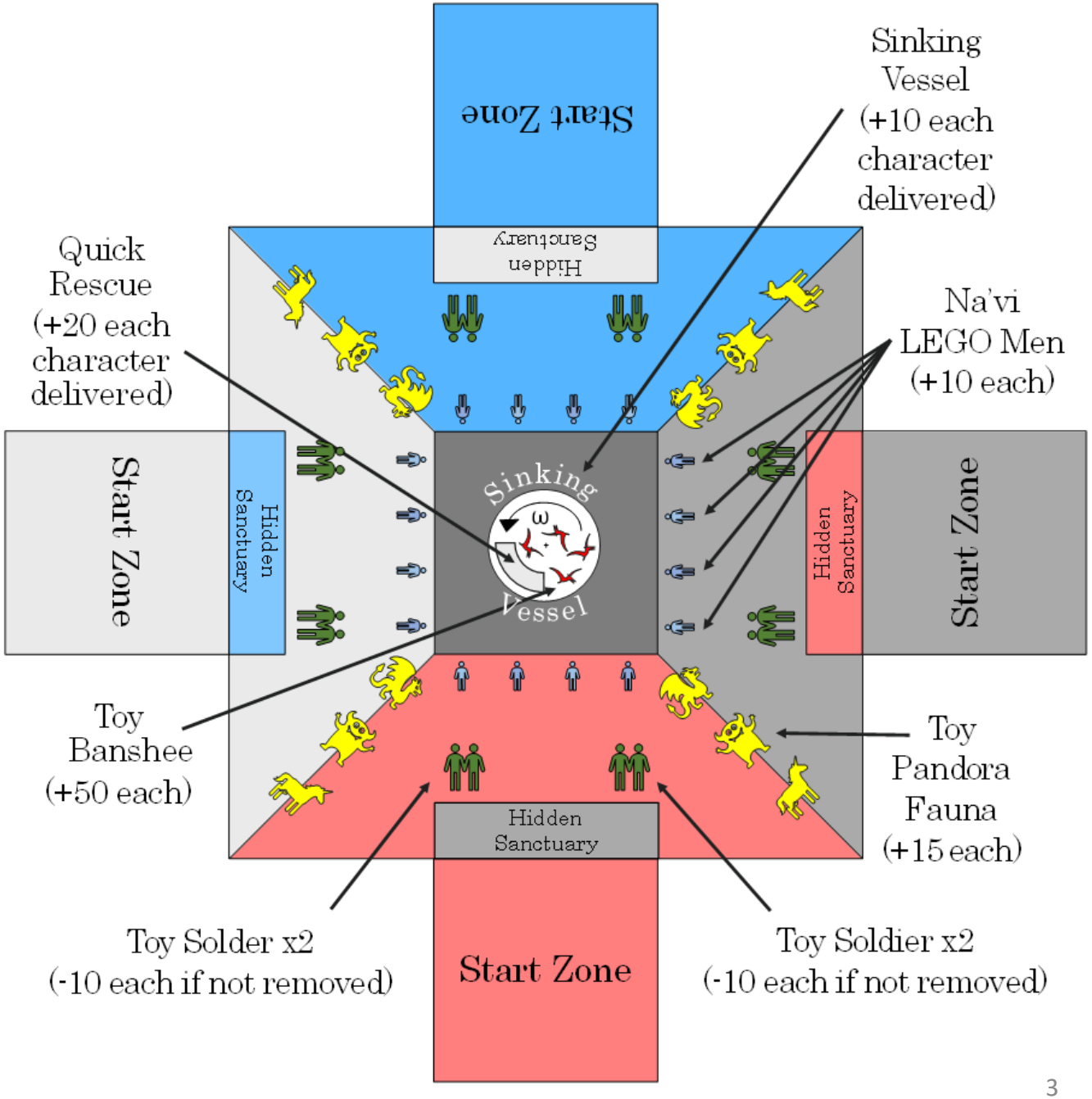
Agenda

- Objectives and Strategy
- Rulebook
- Final Design
- Problem Understanding & Design Tools
- Final Competition Results
- Conclusion

Competition Objectives

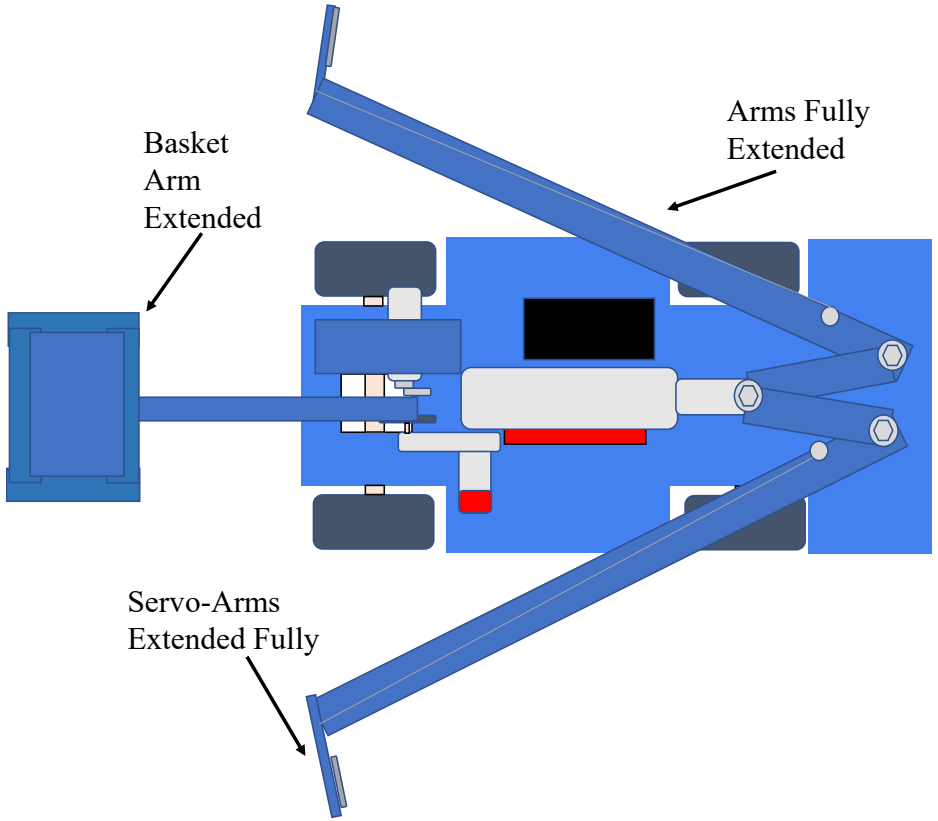
- Knock 4 Toy Soldiers off course
- Collect 4 Na’vi Lego Men
- Collect 6 Fauna
- Collect 3 Banshees
- Rescue Jake Sully & Neytiri



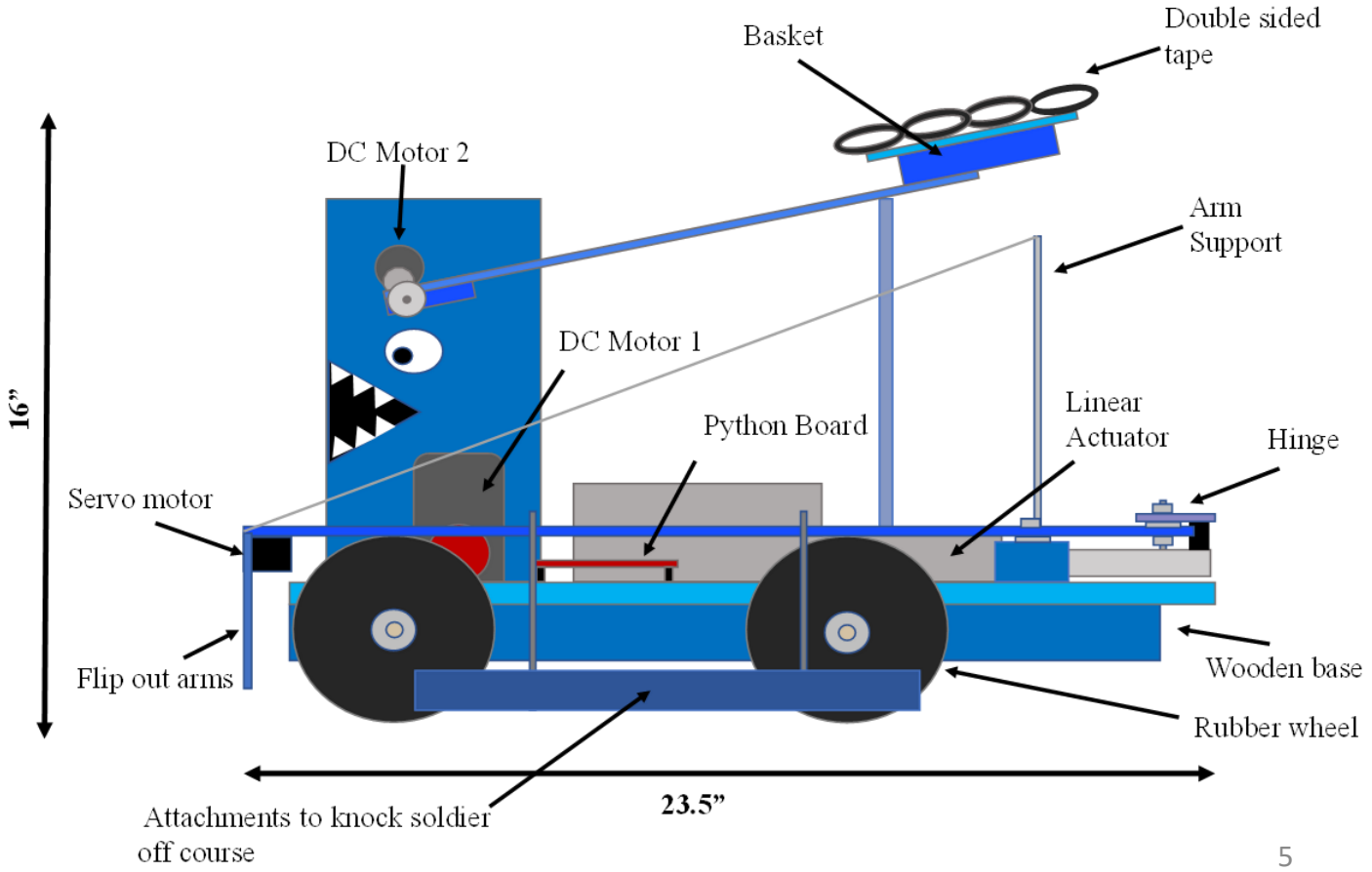
Rulebook

- Robot autonomous and controlled by Python Microcontroller Board
- Must move when button is pressed
- 30 seconds of run time
- 4 minutes of set-up time and 2.5 minutes of clean-up time per round
- Max 18” height, 12” x 24” base
- Must be boxed before each round
- Cannot damage track or other robots

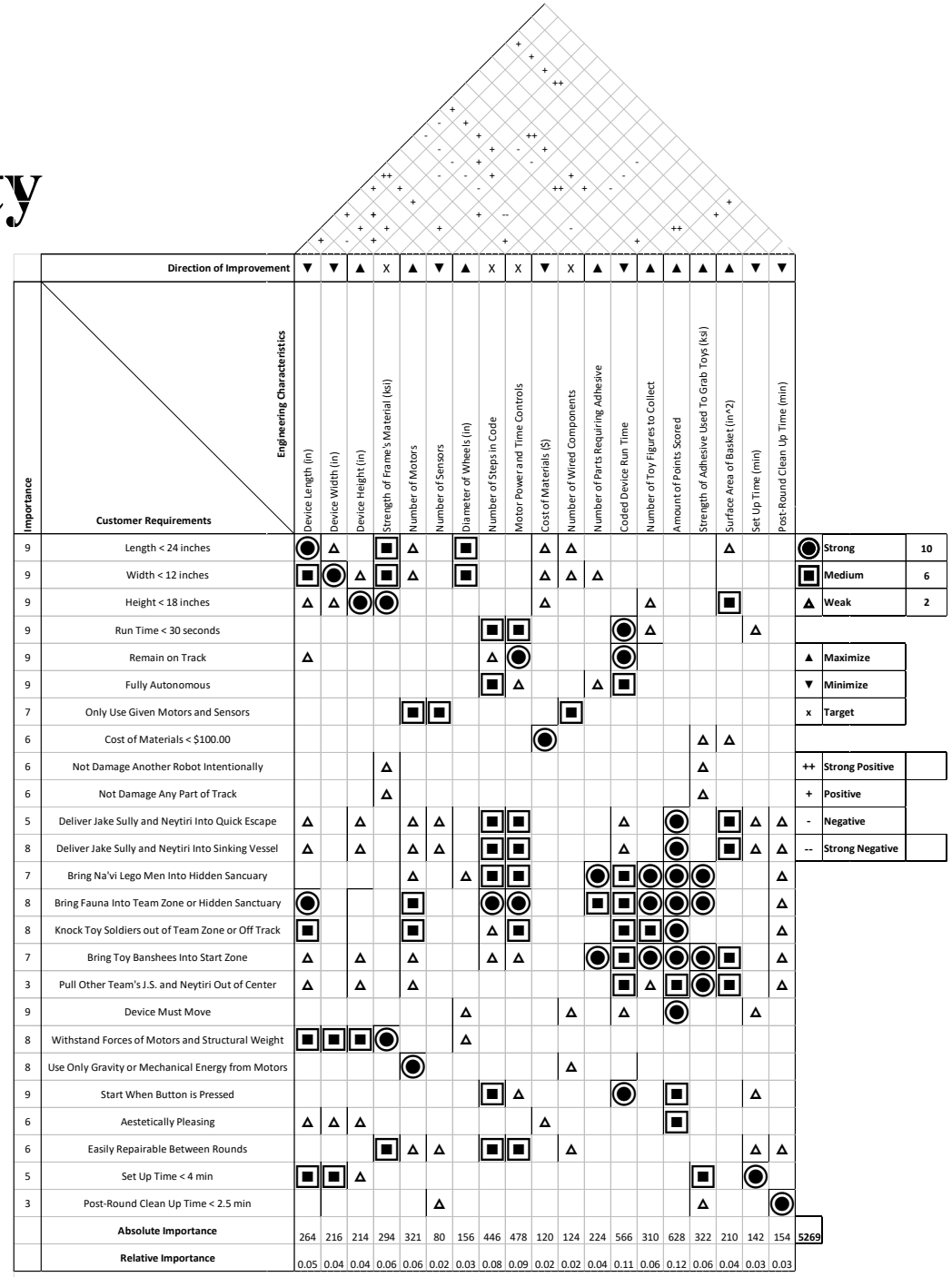
Final Design, “Ikran”



- Components Used:
  - 1 Pyboard
  - 2 DC Motors
  - 2 Servomotors
  - 1 Linear Actuator



House of Quality



	Direction of Improvement	▼	▼	▲	x	▲	▼	▲	x	x	▼	x	▲	▼	▲	▲	▲	▲	▼	▼
Importance	Customer Requirements \ Engineering Characteristics	Device Length (in)	Device Width (in)	Device Height (in)	Strength of Frame's Material (ksi)	Number of Motors	Number of Sensors	Diameter of Wheels (in)	Number of Steps in Code	Motor Power and Time Controls	Cost of Materials ($)	Number of Wired Components	Number of Parts Requiring Adhesive	Coded Device Run Time	Number of Toy Figures to Collect	Amount of Points Scored	Strength of Adhesive Used To Grab Toys (ksi)	Surface Area of Basket (in^2)	Set Up Time (min)	Post-Round Clean Up Time (min)
9	Length < 24 inches	◉	△		■	△		■			△	△						△		
9	Width < 12 inches	■	◉	△	■	△		■			△	△	△							
9	Height < 18 inches	△	△	◉	◉						△				△			■		
9	Run Time < 30 seconds								■	■				◉	△				△	
9	Remain on Track	△							△	◉				◉						
9	Fully Autonomous								■	△			△	■						
7	Only Use Given Motors and Sensors					■	■					■								
6	Cost of Materials < $100.00										◉						△	△		
6	Not Damage Another Robot Intentionally				△												△			
6	Not Damage Any Part of Track				△												△			
5	Deliver Jake Sully and Neytiri Into Quick Escape	△		△		△	△		■	■				△		◉		■	△	△
8	Deliver Jake Sully and Neytiri Into Sinking Vessel	△		△		△	△		■	■				△		◉		■	△	△
7	Bring Na'vi Lego Men Into Hidden Sancuary					△		△	■	■			◉	■	◉	◉	◉			△
8	Bring Fauna Into Team Zone or Hidden Sanctuary	◉				■			◉	◉			■	■	◉	◉	◉			△
8	Knock Toy Soldiers out of Team Zone or Off Track	■				■			△	■				■	■	◉				△
7	Bring Toy Banshees Into Start Zone	△		△		△			△	△			◉	■	◉	◉	◉	■		△
3	Pull Other Team's J.S. and Neytiri Out of Center	△		△		△								■	△	■	◉	■		△
9	Device Must Move							△				△		△		◉			△	
8	Withstand Forces of Motors and Structural Weight	■	■	■	◉			△												
8	Use Only Gravity or Mechanical Energy from Motors					◉						△								
9	Start When Button is Pressed								■	△				◉		■			△	
6	Aestetically Pleasing	△	△	△							△					■				
6	Easily Repairable Between Rounds				■	△	△		■	■		△							△	△
5	Set Up Time < 4 min	■	■	△													■		◉	
3	Post-Round Clean Up Time < 2.5 min						△										△			◉
	Absolute Importance	264	216	214	294	321	80	156	446	478	120	124	224	566	310	628	322	210	142	154
	Relative Importance	0.05	0.04	0.04	0.06	0.06	0.02	0.03	0.08	0.09	0.02	0.02	0.04	0.11	0.06	0.12	0.06	0.04	0.03	0.03

◉	Strong	10
■	Medium	6
△	Weak	2

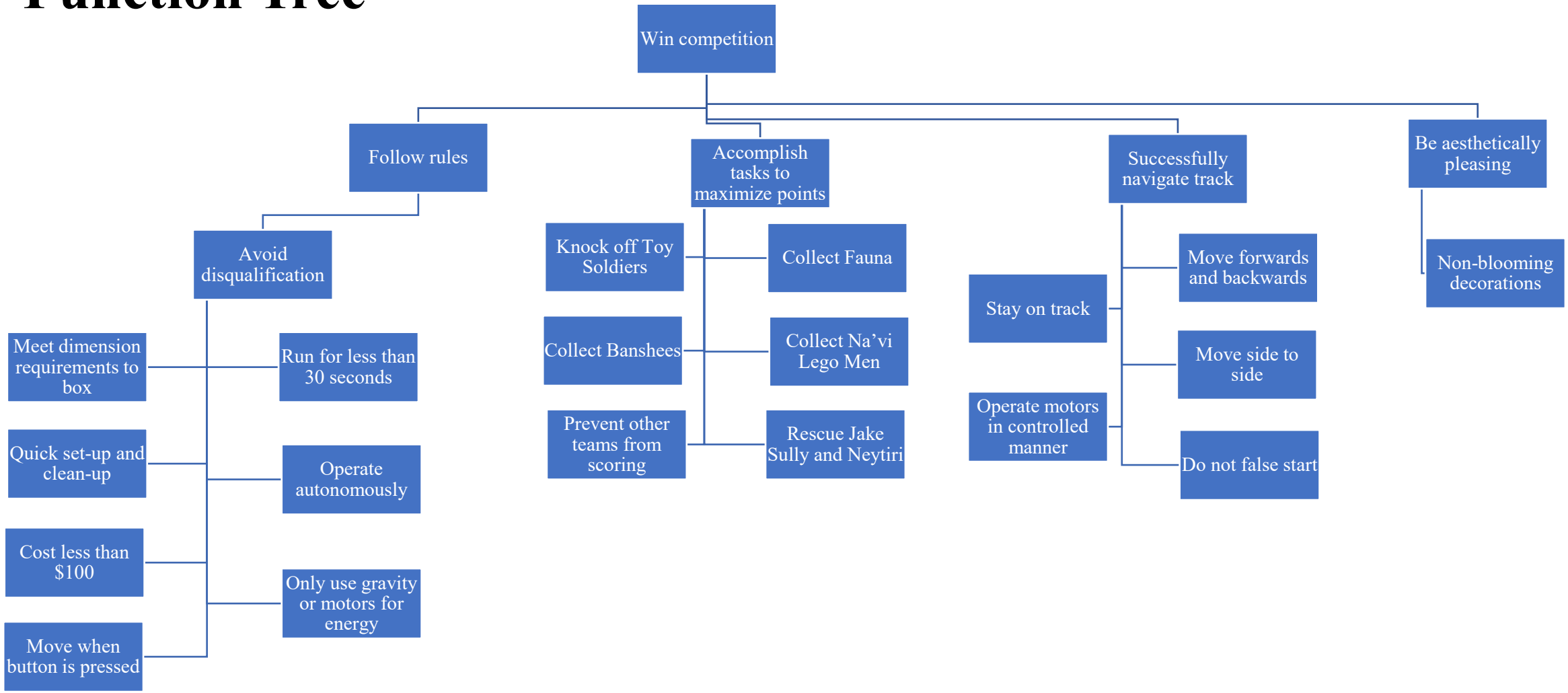
▲	Maximize
▼	Minimize
x	Target

++	Strong Positive	
+	Positive	
-	Negative	
--	Strong Negative	

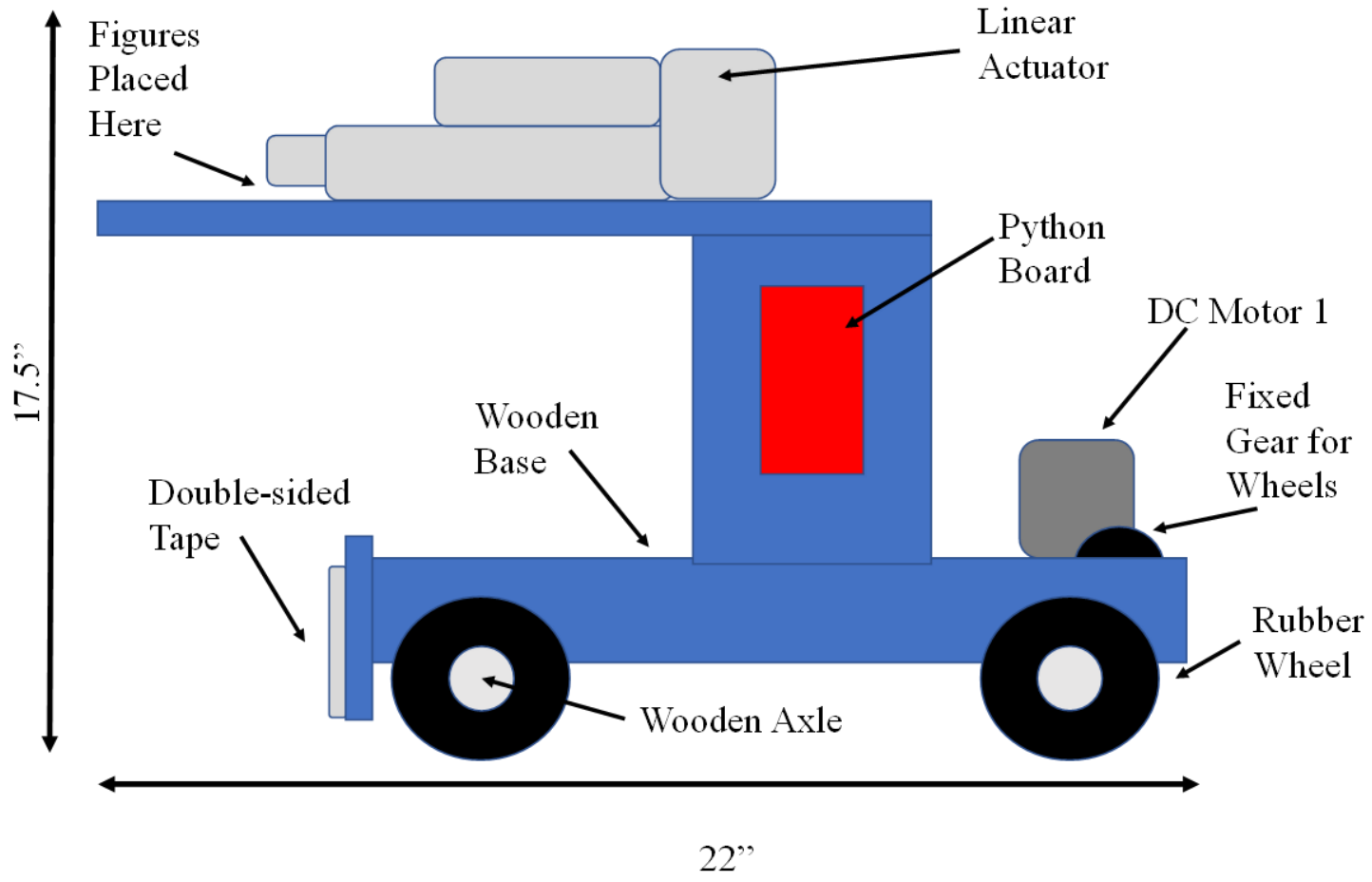
Specification Sheet

		Specification for:	Issued:	3/7/2023
		Avatar Robot Final Competition	Page # of N	
Changes	D/W	Requirements	Responsibility	Source
		Mechanically design an autonomous coded robot with multiple objectives		
		Geometry		
3/14/2023	D	Legnth less than 24 inches	Design Team	Contest Rules
4/5/2023	W	Legnth less than 23 inches	Design Team	Design Team
3/29/2023	D	Height less than 18 inches	Design Team	Contest Rules
4/5/2023	W	Height less than 17 inches	Design Team	Design Team
3/14/2023	D	Width less than 12 inches	Design Team	Contest Rules
4/5/2023	W	Width less than or equal to 11 inches	Design Team	Design Team
		Kinematics		
3/20/2023	W	Top Speed of 99 % for DC motors 1 and 2	Design Team	Design Team
4/1/2023	W	Reaches 4 Lego Navi men at the ocean within 2 seconds by use of gears via motor 1	Design Team	Design Team
4/1/2023	W	Reach Sinking Vessel with motor 2 swinging arm by 5 seconds	Design Team	Design Team
4/15/2023	D	Stop motors or any mechanical movment after 30 seconds	Design Team	Contest Rules
1/5/1904	W	Linear Actuator extending out 80 degrees 2 foot long arms	Design Team	Design Team
		Forces		
3/22/2023	W	Weight less than 20 lbs	Design Team	Design Team
3/20/2023	D	Must not cause damage to track	Design Team	Contest Rules
		Energy		
3/20/2023	W	Power consumption must be less than 12 V	Design Team	Design Team
3/20/2023	D	Power Supply = 12 V	Design Team	Contest Rules
		Materials		
3/20/2023	D	Use of 1 pyboard microcontroller	Design Team	Contest Rules
3/30/2023	W	Use of 1 Linear Actuator	Design Team	Contest Rules
3/20/2023	D	Contains no more than 3 servomotors	Design Team	Contest Rules
3/21/2023	D	Contains no more than 2 DC motors	Design Team	Contest Rules
		Signals		
3/20/2023	D	Robot begins at start signal	Design Team	Contest Rules
4/14/2023	W	Robot initiates sleep loop at 28 seconds	Design Team	Design Team
3/20/2023	W	Robot does not get a false before signal	Design Team	Design Team
		Safety		
3/29/2023	D	No intentional damage to the track or to surrounding competitors	Design Team	Contest Rules
3/29/2023	W	No entanglement with surrounding robots	Design Team	Design Team
		Quality Control		
4/6/2023	W	Ensure bolts on actuator arms arent loose	Design Team	Design Team
3/20/2023	D	Avoid damage to track	Design Team	Contest Rules
3/20/2023	D	Avoid damage to surrounding teams' device's	Design Team	Contest Rules
		Transport		
3/20/2023	D	Deliver Jake and Netiri into Sinking Vessel	Design Team	Contest Rules
4/13/2023	W	Launch Jake and Netiri over Sinking Vessel via swinging arm using motor 2	Design Team	Design Team
		Operation		
3/29/2023	D	Collect 4 Na'vi Lego Men		
3/29/2023	D	Complete tasks in less than 30s	Design Team	Contest Rules
4/5/2023	W	Complete task within at least 28 seconds	Design Team	Design Team
4/5/2023	W	Autonomously operate in correlation to prior code loop	Design Team	Design Team
3/29/2023	D	Remove Toy Soldiers from Team Zone	Design Team	Contest Rules
3/24/2023	W	Drag Toy Soldiers off track upon reversal	Design Team	Design Team
3/29/2023	D	Bring Banshees from rotating Sinking Vessel back into the Start Zone	Design Team	Contest Rules
4/2/2023	W	Stick at least 1 Banshee on basket arm after Jake and Neytiri rescue	Design Team	Design Team
		Maintenance		
4/4/2023	D	Boxed and ready to operate in less than 3.5 minutes	Design Team	Contest Rules
4/2/2023	W	Boxed and ready to operate in less than 1 minute	Design Team	Design Team
		Costs		
3/20/2023	D	Extra materials cost less than $100	Design Team	Contest Rules
4/2/2023	W	Extra materials cost less than $95	Design Team	Design Team
		Schedules		
3/23/2023	D	Ready for Preliminary Contest before March 23, 2023	Design Team	Contest Rules
4/6/2023	D	Ready for Qualifying Round before April 6 , 2023	Design Team	Contest Rules
4/20/2023	D	Ready for Final Contest before April 20, 2023	Design Team	Contest Rules

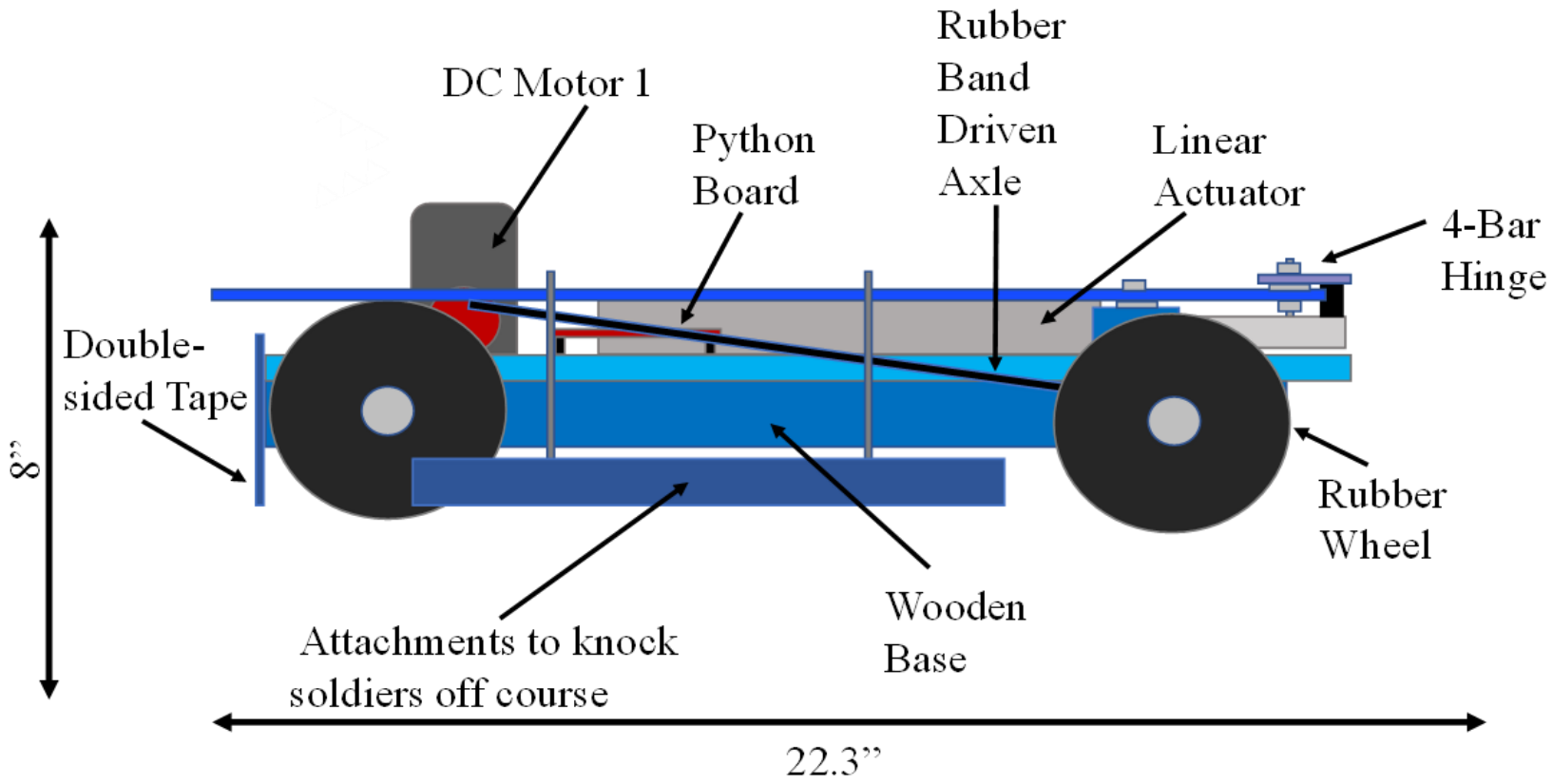
Function Tree



Alternate Design 1: The Pusher

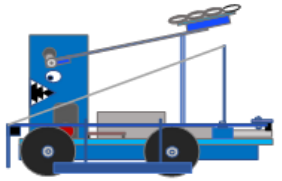
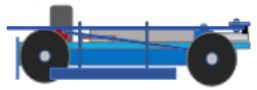


Alternate Design 2: The Spreader

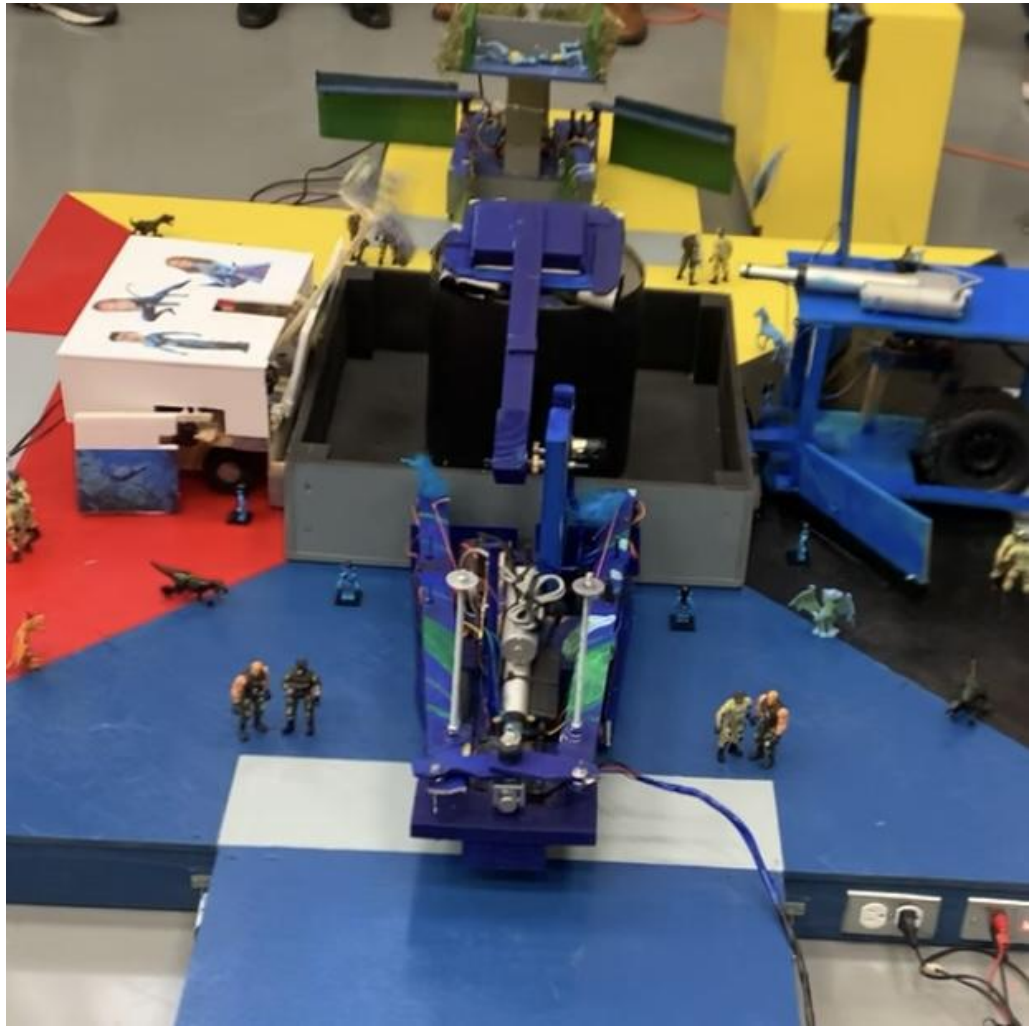


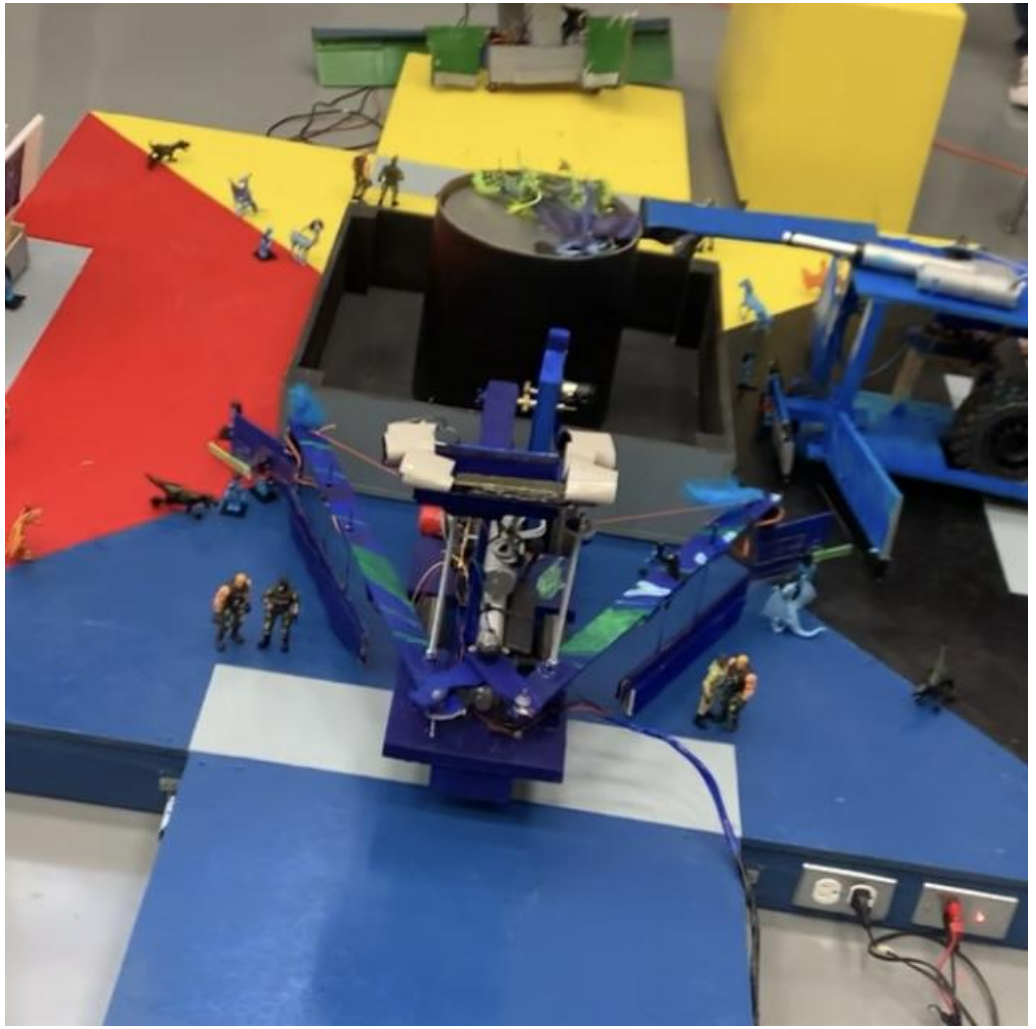
Evaluation Matrix

Pts.	Meaning
0	Unsatisfactory
1	Inadequate
2	Weak
3	Tolerable
4	Adequate
5	Satisfactory
6	Good, but drawbacks
7	Good
8	Very Good
9	Exceeds Req.
10	Ideal Solution

Importanace	Customer Requirements			
9	Length < 24 inches	8	8	8
9	Width < 12 inches	7	8	7
9	Height < 18 inches	7	7	9
9	Run time < 30 seconds	9	9	9
9	Remain on Track	9	9	9
9	Fully Autonompus	9	9	9
7	Only Use Given Motors and Sensors	9	9	9
6	Cost of Materials < $100.00	9	9	9
6	Not Damage Another Robot Intentionally	9	9	9
6	Not damage Any Part of Track	9	9	9
5	Deliver Jake Sully and Neytiri Into Quick Escape	9	5	1
8	Deliver Jake Sully and Neytiri into Sinking Vessel	9	9	1
7	Bring Na'vi Lego Men Into Hidden Sanctuary	9	4	8
8	Bring Fauna into team Zone or Hidden Sanctuary	9	1	3
8	Knock Toy soldiers out of Team Zone or Off Track	9	2	8
7	Bring Toy Banshee Into Start Zone	6	1	1
3	Pull Other Team's J.S. and Neytiri Out of Center	5	1	1
9	Device must move	9	9	9
8	Withstand Force of Motors and Structural Weight	7	6	7
8	Use Only Gravity or Mechanical Energy from Motors	8	8	8
9	Start When Button is Pressed	8	8	8
6	Aestetically Pleasing	8	5	7
6	Easily Repairable Between Rounds	4	7	6
5	Set up Time < 4 min	7	8	7
3	Post-Round Cleanup atime < 2.5 min	7	7	7
	Total	1448	1232	1258
	Relative Total = Total/Number of Criteria	0.58	0.49	0.50

Final Competition Results





Thank you