(S.T.A.R.) Capstone Group

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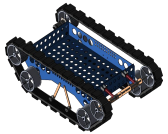
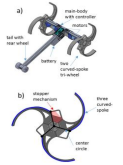
Objective

Design and build an autonomous stair climbing robot which can balance a carried item while traversing the stairs.

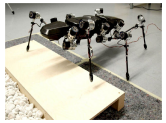
Alternative Designs



Tank tracks
Tri-Wheel Legged



Tri-wheel curved spoke



Walking Robot

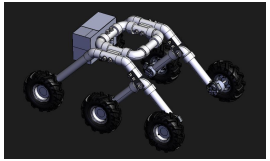
Constraints

Constraints
Must Autonomously Traverse Stairs
Dimensions Must Meet .609m Wide, .762 m Long, and .914m Tall
Must Be No More Than 6.8 kg
Must Balance an Object Overhead
Must Complete Each Stair in 3 Seconds
Must Not Exceed $1,500 for 1 Robot
Must be Aesthetically Pleasing

Decision Matrix

Evalution Metrics	Weight	Benchmark	Design 1		Design 2		Design 3		Design 4	
			Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Speed	25	≥3 second/stair	5	125	2	50	1	25	4	100
Aesthetics	30	Client Criteria	2	60	3	90	3	90	5	150
Size	15	≥ 1x1x1 ft^3	5	75	3	45	2	30	4	60
Weight	15	≥10lbs	5	75	2	30	1	15	4	60
Flat Surface Movement	15	Ratio	1	15	3	45	2	30	5	75
Total:	100			350		260		190		445

Selected Design



-Extremely Versatile over multiple terrains
-Excellent mix of speed, carrying capacity, simplicity, aesthetics and robustness
-Lightweight yet rigid design
-Better opportunity to incorporate balancing

Budget

Part Number	Description	Vendor	Link	Amount	Justification	Cost per Item	Shipping	Total
A58SW31ZY	12V Motors	BRINGSMART	Amazon	6	6 per bot	$29.99	$0.00	$179.94
AMAT0008	Microcontroller	Arduino	Portenta H7	1	1 per robot	$104.00	$3.60	$107.60
ASX00031	Expansion Board	Arduino	Portenta Expansion Board	1	1 per robot	$45.99	$3.60	$49.59
HC-SR04	Arduino ultra sonic sensor	Digikey	Ultra sonic sensor	2	2 per	$5.95	$6.50	$18.40
TA-45C-1300-3S-XT60	Battery (12V LiPo)	Amazon	Tattu Lipo1300 mAh	1	1 per robot	$33.99	$0.00	$33.99
RB-Dim-23	Motor Controller	RobotShop	Sabertooth 12V	1	1 per robot	$119.99	$16.17	$136.16
PVC023001200HD	PVC fittings/Pipe	HomeDepot	PVC	3	1 per robot	$16.11	$5.99	$54.32
300DL	3" wheels	Dubro	Wheels	6	6 per robot	$9.80	$0.00	$58.80
B07TGJGJGD	Wire	Amazon	20 gauge wire	1	Various	$14.88	$0.00	$14.88
B07PGZNM34	Filament	Amazon	Filament	1	Various	$19.49	$0.00	$19.49
101020532	Distance Sensor	Seed Studio	ToF Sensor	4	4 per robot	$14.20	$5.10	$61.90
RO-902-0087-000	Servo Motors	Trossen Robotics	Servo	2	Balancing	$23.90	$16.40	$64.20
4554	Accelerometer	Adafruit	ICM 20948	3	3 per robot	$14.95		$44.85
9657K225	Compression Springs	McMaster Carr	McMasterCarr	3	3 per robot			
Total						$453.24	$57.36	$844.12

Balancing

Mechanical Balancing Design

Electronic Balancing System

Conclusion

The completed product will implement these design decisions and constraints to achieve the expressed objective.

Note: Final product will be demonstrated during the poster presentation.