Team 307

Concept Selection

Binary Pairwise Comparison

	Autonomous	Obstacle Avoidance	Read QR Codes	Limit Speed	Fit in a 2ft. Box	Weight Limit	Multiple Terrain	Cut Off	Light Sensor	Total
Autonomous	-	1	1	1	1	1	1	1	1	8
Obstacle Avoidance	0	-	1	1	1	1	1	1	1	7
Read QR Codes	0	0	-	1	1	1	1	1	1	6
Limit Speed	0	0	0	-	1	1	1	1	1	5
Fit in a 2ft. Box	0	0	0	0	-	1	1	1	1	4
Weight Limit	0	0	0	0	0	-	1	1	1	3
Multiple Terrain	0	0	0	0	0	0	-	1	1	2
Cut Off	0	0	0	0	0	0	0	-	1	1
Light on/off	0	0	0	0	0	0	0	0	-	0
Total	0	1	2	3	4	5	6	7	8	-

House of Quality

↑↓

Customer Needs	Engineering Requirements								
	Weight Factor	Autonomous	External Volume	Total Weight	Maximum Operating Speed	Torque at Wheels	Low Light Sensors	On-Board Camera	Cut-Off Switch
Autonomous	8	↑↑			↓↓	↓			↑
Small System	4		↑↑	↑	↑	↑			

Lightweight	3		↑	↑↑	↑	↑		↑	
Human Walking Speed	5	↑	↓	↑	↑↑				↑
Traverse Office Terrain	2	↑↑		↑	↑	↑↑			
Obstacle Avoidance	7	↑↑	↑		↑↑	↑			
Scans QR Code	6						↑↑	↑↑	
Easy On/Off	1	↑							↑
Varied Light Conditions	0						↑↑	↑	
Targets		No External Input	≤ 2 ft^3	≤ 20 lbs.	≤ 4 mph	≥ 0.3 Nm	Lidar Sensor	Raspberry Pi Camera Module v2	On/Off

Pugh Chart

The concepts being compared in the Pugh Chart below come from the concept generation.

Concepts:

Concept 1:
- Power: Lithium Polymer Batteries
- Reasoning Hardware: Arduino
- Sensor Suite: LIDAR, RGBD Camera, IMU
- Locomotion: Caterpillar Track, DC Motors
- Frame: Aluminum

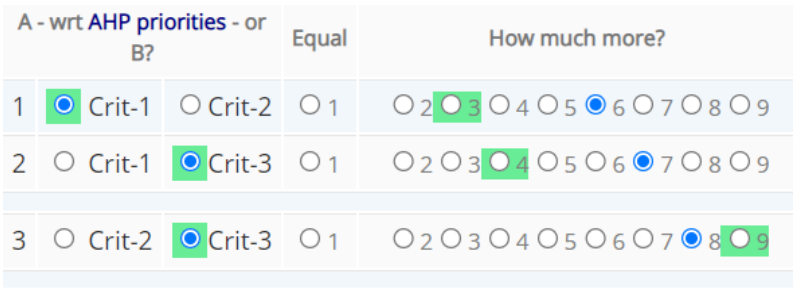
Concept 2:
- Power: Lithium Polymer Batteries
- Reasoning Hardware: Raspberry Pi 4
- Sensor Suite: LIDAR, sonar Sensor, Raspberry Pi Camera Module, IMU, light sensor
- Locomotion: Mecanum Wheels, DC Motors
- Frame: Plastic

Concept 3:
- Power: Lithium-Ion Cells
- Reasoning Hardware: BeagleBone
- Sensor Suite: LIDAR, RGBD Camera, IMU
- Locomotion: Linear Actuators, Omni wheels, DC Motors

- Frame: Plexiglass

Concepts			
Selection Criteria	**Concept 1**	**Concept 2**	**Concept 3**
Accurate	-1	+1	+1
Ease of Use	0	+1	+1
Power	-1	0	-1
Cost	-1	0	0
Smooth Integration	-1	+1	-1
Durability	+1	0	0
Score	-3	3	0
Continue?	No	Yes	No

Analytic Hierarchy Process (AHP)



Priorities

These are the resulting weights for the criteria based on your pairwise comparisons:

Cat		Priority	Rank	(+)	(-)
1	Crit-1	18.8%	2	10.0%	10.0%
2	Crit-2	5.4%	3	2.9%	2.9%
3	Crit-3	75.7%	1	40.4%	40.4%

Decision Matrix

The resulting weights are based on the principal eigenvector of the decision matrix:

	1	2	3
1	1	6.00	0.14
2	0.17	1	0.12
3	7.00	8.00	1

Reasoning Hardware		Raspberry Pi 4	Arduino Mega	BeagleBone
Ease of use	0.188	6	8	7
Cost	0.54	5	7	6
Compatibility	0.757	9	4	6
Score		10.641	8.312	9.098

Movement/ Direction Manipulation		Mecanum Wheels	Omni	Caster Wheels
Ease of use	0.188	7	6	1
Cost	0.54	5	5	7
Compatibility	0.757	8	7	3
Score		10.072	9.127	6.239

QR Code Scanner		Zed Mini	Raspberry Pi Camera Module v2	MakerFocus Pi 4B Camera with Holder	Adafruit Pixy2
Ease of use	0.188	3	8	7	7
Cost	0.54	2	7	7	3
Compatibility	0.757	1	8	8	7
Score		2.401	11.34	11.152	8.235

Sensors		LIDAR	Ultrasonic	IMU
Ease of use	0.188	5	8	7
Cost	0.54	6	8	9
Compatibility	0.757	7	9	8
Score		9.479	12.637	12.232

Power Allocation		LiPo Batteries	Lithium-Ion Cells
Ease of use	0.188	8	5
Cost	0.54	6	8
Compatibility	0.757	7	6
Score		10.043	9.802

Robot Frame		Aluminum	Plexiglass	Plastic
Ease of use	0.188	5	3	7
Cost	0.54	5	6	8
Compatibility	0.757	5	4	8
Score		7.425	6.832	11.692

Final Selection

- Power: Lithium Polymer Batteries
- Reasoning Hardware: Raspberry Pi 4
- Sensor Suite: LIDAR, sonar Sensor, Raspberry Pi Camera Module, IMU, light sensor
- Locomotion: Mecanum Wheels, DC Motors
- Frame: Plastic

We used the binary comparison table, house of quality, pugh chart, and analytical hierarchy process to come up with the best solution to our concept selection. This final choice will be able to meet all of the customer's needs while simultaneously being able to efficiently meet all of the engineering requirements. Our final product should be able to autonomously traverse an office environment without collision with objects and people, while taking into account cost, power efficiency, and time complexity.