ROBOCOP: Delivering an Autonomous Robot

Tanner Sones, Adam Boatner, Devin Jackson, Benicia Gabell, and Peter Park

Abstract

Robocop is an autonomous robot designed to traverse a Mars-like environment based on specific criteria. The project required a working drive system with suspension, wheels, and motors powered by lithium batteries connected to an Arduino-based control system. Code was implemented to utilize sensors with the driving system for navigation and obstacle avoidance. Designing and building such a project as a part of a team was a unique experience.

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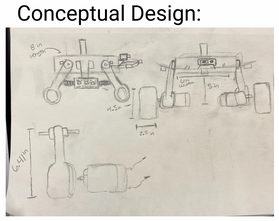
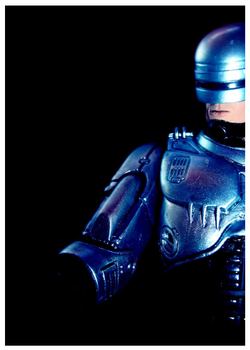


Most important features of our robot from the start:
Lift from the ground
Main housing unit
4 legs housing motors
Wide base
Front sensor



Design/Build

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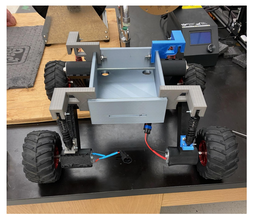

We started with computer aided 3D design (using Autodesk Fusion 360 software) trying to develop a model we could then print and build off of. 3D printers we used were Ender 3 Pro, Anycubic Viper, and Creality CR10.

Sensors

Infrared sensor provided long-range detection, but after testing realized they were unreliable in specific conditions

Ultrasonic provided accurate distance reading from up to 50 cm and were reliable in all settings.

Suspension

Utilizes compression and stabilizes structure. Found vertical positioning to be optimal for specific use. Designed suspension brackets.

Team Roles

Tanner Sones (Team Lead) - Operations, Design, Building, Programming, and Testing
Adam Boatner (Program Lead) - Building, Programming, and Testing
Devin Jackson (Build Lead) - Builder, Logistics, and Tester
Benicia Gabell - Management and Builder
Peter Park - Author of Abstract and Builder

Testing/Results

We are looking to see results from tests we ran, the process of testing sensor and motors initially as subsystems, and then integrating how they worked together in the different terrains we tested them on. It took a lot of trial and error to figure out the right amount of ultrasonic sensors, positioning of sensors, and code for sensors.

Before Dunes

Upon initial testing of our robot, we had an issue with the shaft coupling staying connected. This resulted in our wheels tearing from the shaft of our motors. Even though it was not ideal, Robocop performed exceedingly well even on 3 wheels. We were able to improve, with the use of more acceptable adapters

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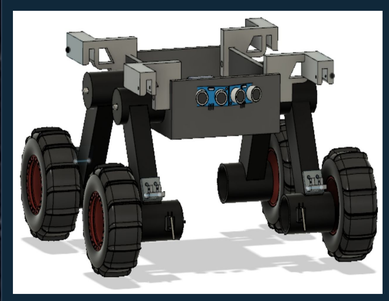
I will get pictures of robot suspension in action and another picture for testing before dunes portion

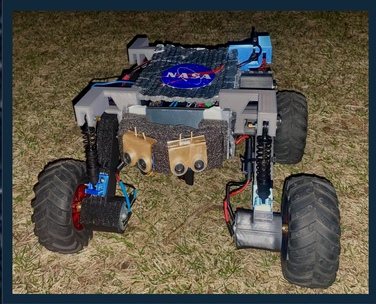
Dunes Results

Materials

- PLA Filament (chassis, and suspension brackets)
- Arduino Mega
- Sparkfun Monster Motor Shield
- Sparkfun ProtoShield
- 12v 200 rpm DC Motors (4)
- 14.8v lithium battery (motors)
- 9v alkaline battery (logic)
- Ultrasonic Sensors (2)
- RC Suspension
- RC Monster Truck Wheels (4)

➔ Final weight of build: 3.146 kg
➔ Final Price of build :





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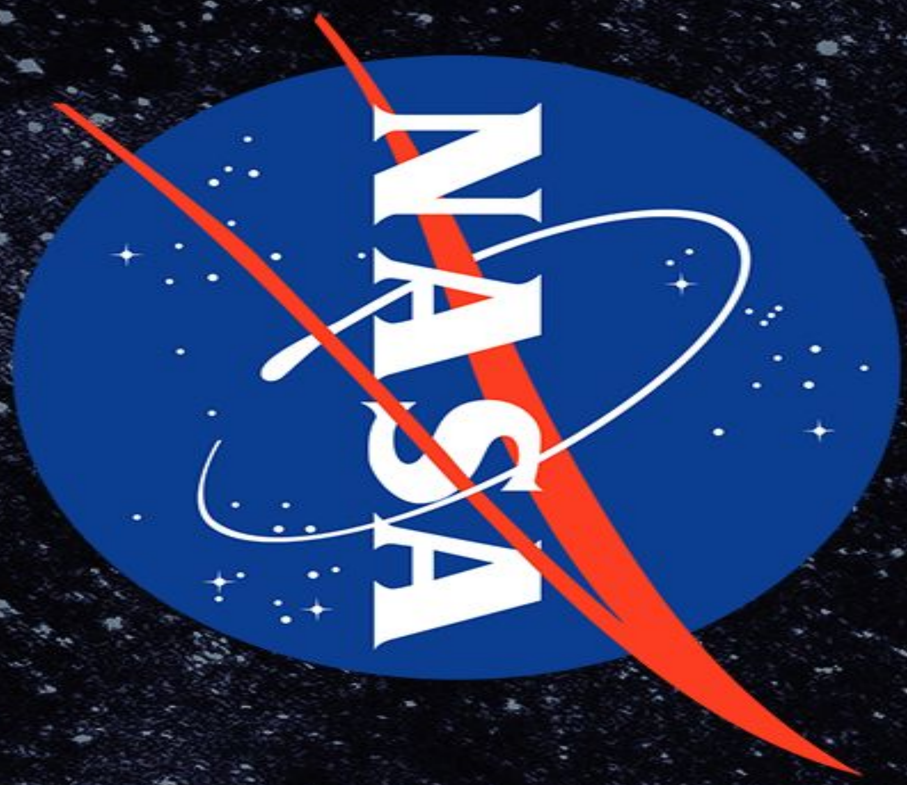
Conclusion

With much trial, error, and ingenuity our team was able to take inspiration from previous iterations of robot models, add our own design with improvements, with hopes of a successful autonomous robot.
We were able to take design cues for the chassis and legs to give us the building blocks to implement a suspension.
Based on challenge requirements, time of project, and results we as a group are satisfied with how far we have come. With the diligent support from our support staff, we have been able to make our ideas a reality and see the actual representation of months of planning and critiquing.
For future events we would like to add infrared sensors to provide additional failsafes.

Acknowledgements

Tom Dillon, Kieran Lawrence, Dr.Kathy Giese, COSGC, NASA



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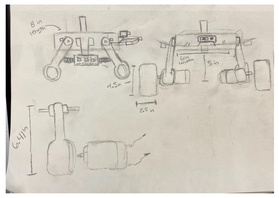

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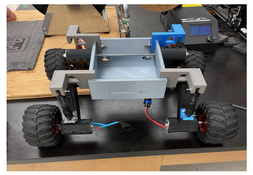

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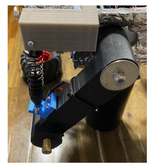

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Here is an extra text box to use that is fitted with the shape

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Dunes Results

Materials

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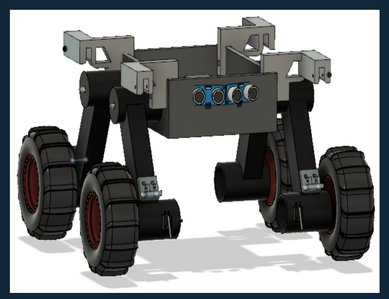
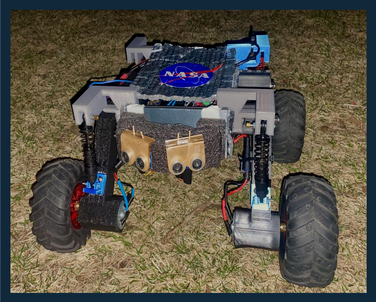
- Arduino Mega
- Sparkfun Monster Motor Shield
- Sparkfun ProtoShield
- 12v 50 rpm DC Motors (4)
- 14.8v lithium battery (motors)
- 9v alkaline battery (logic)
- Ultrasonic Sensors (2)
- Bump Switches (2)
- RC Suspension
- RC Monster Truck Wheels (4)

Part Name	Amount of parts	Weight of 1 (Kg)	Weight (Kg)
3D printed Housing Unit	1	0.247	0.247
3D printed Legs	4	0.127	0.508
12v DC Motors	4	0.249	0.996
Wheels	4	0.131	0.524
Arduino	1	0.037	0.037
Ardumoto	1	0.015	0.015
Lithium Battery	1	0.2344	0.234
9v Battery	1	0.034	0.034
Dowels	2	0.0525	0.105
Ultrasonic Sensors	2	0.0087	0.017
Bump Switches	3	0.01	0.030
Shaft Coupling	4	0.0678	0.271
Suspension	4	0.0468	0.187
Current Weight of Robot:			3.205 kg

Margin:	Budget:	$500.00	Last Update:	3/12/2023
		COSGC 2023		
Item	Cost	Amount	Total Cost	Notes
Ultrasonic Sensor	$16.00	4	$32.00	2 Planned
Bump Switch	$14.85	3	$59.40	3 Planned
Arduino Mega	$48.40	1	$48.40	
Ardumoto (Monster)	$24.95	1	$24.95	
Wiring Assortment	$3.00	1	$3.00	
Gearrisan 12v DC Motors	$14.99	4	$59.96	50 rpm, 7.2 kg *cm
Suspension + Brackets	$22.80	4	$11.99	
Lithium Batteries	$24.99	1	$24.99	2200 mAh
Battery Connectors	$0.99	1	$0.99	
Wheels	$5.00	4	$20.00	
Motor/Wheel Adapters	$4.00	1	$4.00	
3D Printed Housing Unit	$10.00	1	$10.00	Filament
3D Printed Legs	$21.00	4	$21.00	Filament
ON/OFF Switch	$1.54	1	$1.54	
Waterproof Connectors	$6.99	1	$6.99	
Misc. Components				
			Total (no margin):	$319.08





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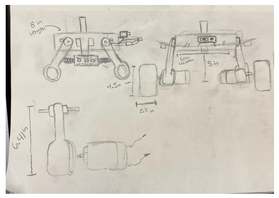

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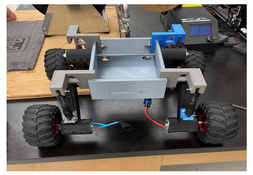

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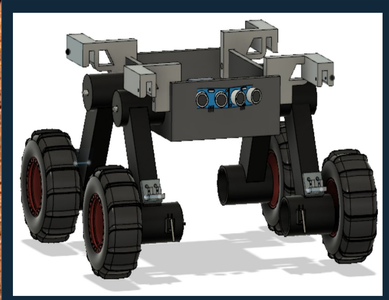

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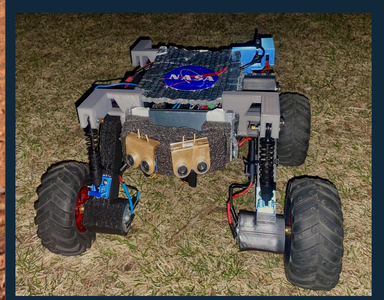

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