Rocket City Space Pioneers

Lunar Rover Prototype

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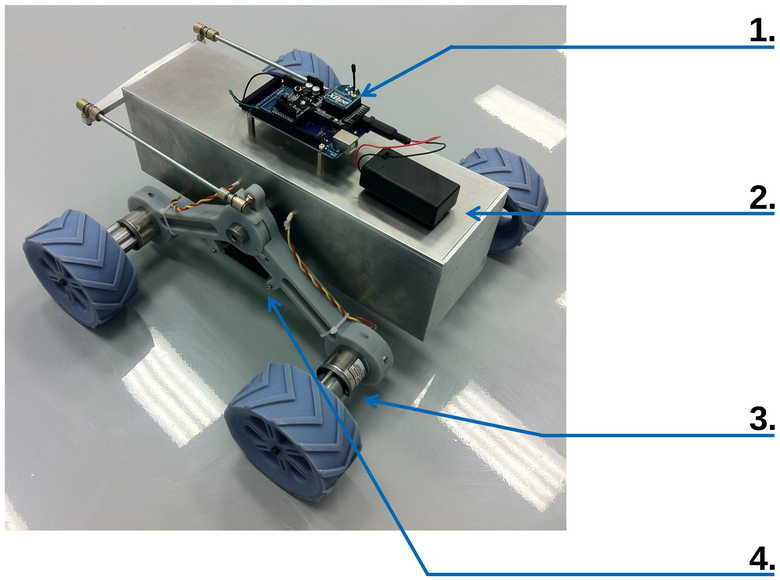
Abstract

The Rocket City Space Pioneers (RCSP) is a team of companies formed in order to compete for the Google Lunar X Prize. The RCSP team has the goal of sending a robotic lunar lander to the moon and deploying a rover to traverse the lunar surface. We designed, built, and tested an Earth-based rover prototype that mimics the size and capabilities of a lunar rover. Focusing on the suspension and drive system, we built the rover around a 4-wheeled rocker system with a collapsible suspension system to provide RCSP with crucial data required to advance the design of the lunar rover.

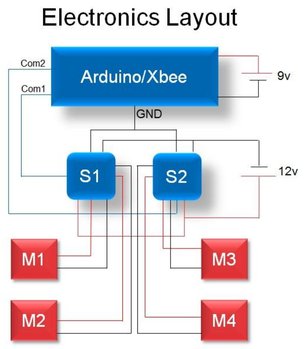


Requirements

- Ability to test suspension and drive system
- Ability to operate effectively in simulated lunar terrain
- Ability to fully deploy from stored state
- Mimic capabilities of an actual lunar rover
- Design prototype around a 3u CubeSat
- Provide long duration testing

1. Control

- Arduino Mega 2560
- Xbee transceiver module
- Two Sabertooth motor-controllers
- Two 2800mAh Ni-MH battery packs
- Power switch
- Remotely operated by laptop



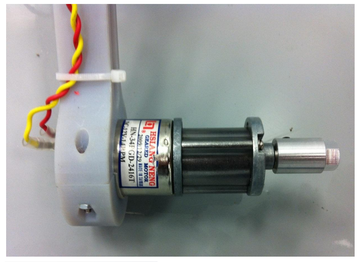
2. Chassis

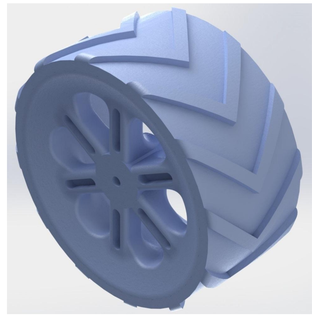
- Mimics a 3u CubeSat in size (10 x 10 x 34 cm)
- Welded 1/8” aluminum structure
- External extension to support the rear differential linkage
- Provides mounting points for the electronic components and suspension
- Removable lid for easy internal access

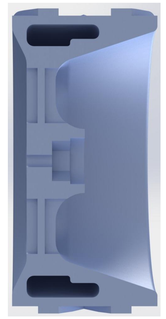
3. Drive System

- Motor cuffs to mount motors to suspension arms
- Adhesive rubber on motor cuffs to prevent motor rotation
- Motors apply 3.53 N-m (500 oz.-in.) torque at 14rpm
- Universal hub used to mount the wheel to the motor
- Custom 3D printed wheels

- Motor hub integration
- Slanted wheel well for debris reduction
- Hollow wheel for weight reduction
- Chevron style tread

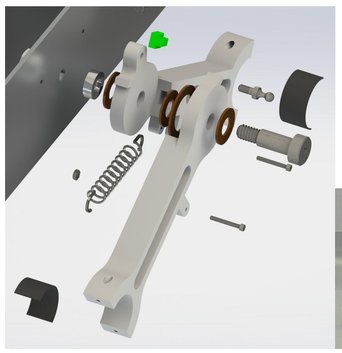




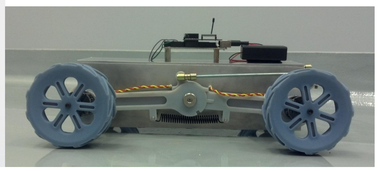


4. Suspension

- Light weight rocker system with rear differential linkage
- Collapsible for slim profile stowage
- Deployable using drive wheels and tension springs
- Locking mechanism integrated to secure fully deployed state
- Deployed ground clearance of 7.5cm
- Longitudinally stable up to a 54 degree slope
- Laterally stable up to a 60 degree slope



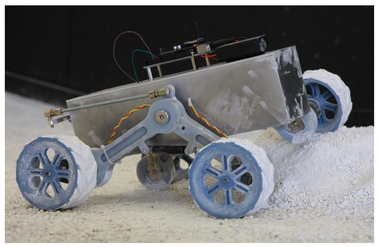
- Shoulder screw for rotation
- Thumb latch
- Collapsible for a 6.85cm reduction in height



Conclusions & Results

The prototype provides sufficient capability to test deployment, suspension, speed, torque, and control in a simulated lunar environment.

Total rover mass		5.36 kg (11.82 lbs)
Overall rover dimensions	Deployed	34x30x17.5 cm (13.37x11.81x6.89 in)
	Stowed	40x30x11 cm (15.75x11.81x4.33 in)
Overall system cost	Materials	$1,593.75
	Labor	$3785.00
	Total	$5378.75
Top speed		9.4 cm/s
Minimum turning radius		0 m
Battery life		~1 hour 23 minutes
Wireless range		120 m (393.7 ft)
Maximum climbable slope		45 degrees
Maximum traversable deflection		10 cm



- Terrain testing
- Created mound obstacle course with deflections up to 10cm in height

- Turn testing
- Zero degree turning radius
- Measured by comparing ground impression diameter to the rover’s wheel spacing

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