

Aerojet Payload: RC Rover

Group 28

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Project Narrative

One of the goals of space exploration is the investigation of terrestrial surfaces on celestial bodies, such as moons, planets, and asteroids. As these surfaces are hostile to human life, a safe and efficient method of exploration is needed. Using a remotely-controlled vehicle, like the Curiosity Rover, presents an effective way to explore a different planet. The goal of this project is to make a lightweight, remotely controlled rover that can serve as a payload on a rocket.

The goal of this project is the design and development of a rocket payload system that deploys a small, lightweight, radio-controlled rover capable of video surveillance of the landing site. As this payload system will be housed in and released from a rocket, weight and durability concerns are paramount. The payload must be able to survive the G-forces and vibrational forces of launch, deployment, and eventual touchdown while remaining operational. Further, as we don't have perfect control over the landing, we must ensure that our payload system can release the rover under a broad range of conditions, and that the rover can operate properly in those conditions. Finally, unknown factors and stochastic effects may damage our system in unpredictable ways before our rover gets a chance to work, so redundancy will be an important design principle. Ideally, our system should have sufficient redundancy to allow the bypass of any malfunctioning components while still completing the mission.

The rover will be housed in a payload canister. A release sensor will be triggered when the canister lands on the ground, triggering the canister to open. The rover must be successfully deployed from the canister and be able to drive freely in a desert environment. The rover will start transmitting a live video feed after deployment. Ground control will be able to send commands to the rover to remotely control it.

This is an interdisciplinary project that will involve collaboration with several teams of engineers. We will closely collaborate with the mechanical and aerospace teams building the rocket and ensure that our rover meets their payload specifications. As a result, our design may be subject to change to ensure a successful rocket launch and deployment.

Requirements and Constraints

Requirements

Trace #	Requirement	Value (if applicable)
1.0	Mass and Dimensions	
1.1	Payload assembly max weight (sled, canister, and payload combined)	4.31kg
1.2	Payload minimum weight	1kg
1.3	Payload Canister dimensions	12.7cm diameter 40.64cm length
1.4	Payload Sled Dimensions	Maximum 1.27cm depth on either side of payload
2.0	Payload Sled	
2.1	Payload Sled will release Payload Canister at deployment phase via force generated by parachute.	-1.0 G
3.0	Payload Canister	
3.1	Payload Canister will contain the Payload during launch, deployment, descent, and landing phases.	N/A
3.2	Canister will provide power-on signal to Payload during deployment phase.	N/A
3.3	Canister will act as RC signal relay for payload after landing.	N/A
3.4	Canister will open under its own power on command.	N/A
4.0	Payload (Rover)	
4.1	Rover will travel the specified distance from the Payload Canister landing site under its own power.	10ft
4.2	Rover will transmit live video feed back to the Ground Station.	

Constraints

Environmental:

- Landing site will be in the California Mojave Desert, which means sand, dust, and windy conditions. Will require environment-proofing.
- Sandy, irregular terrain will require greater motor torque, clearance, and other “all-terrain” considerations.

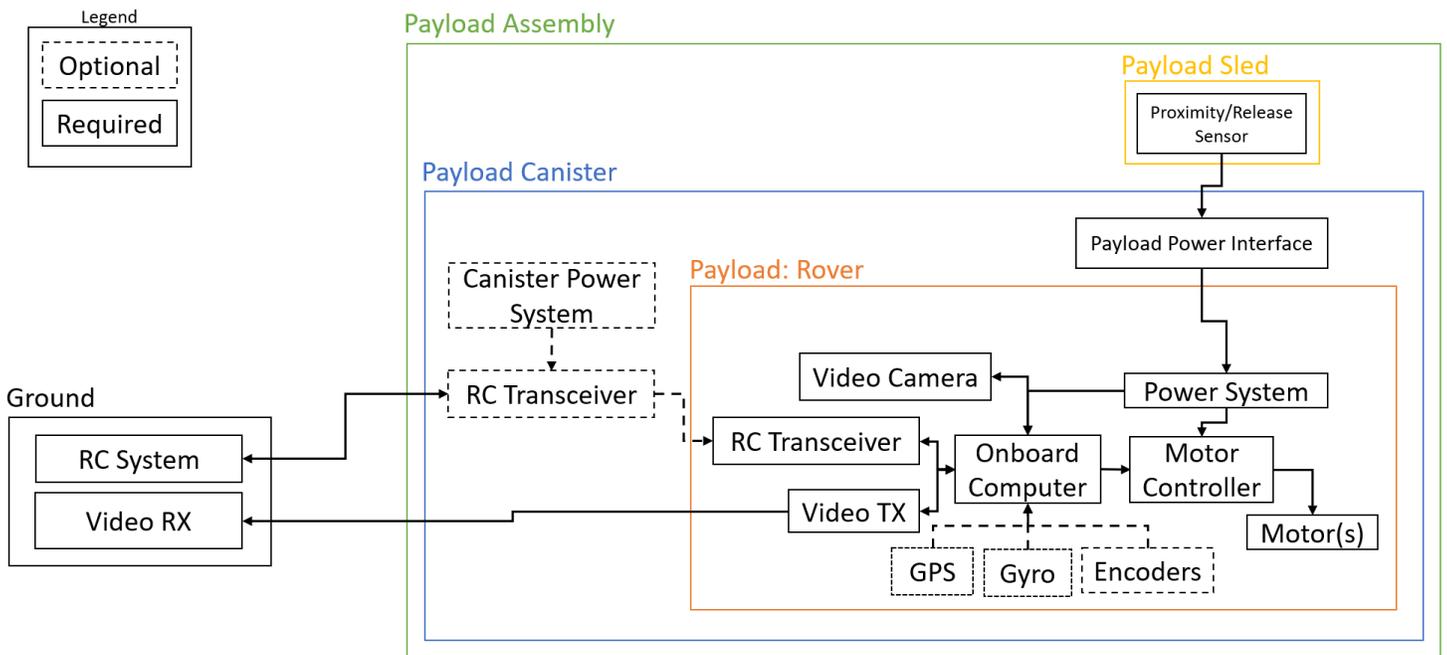
Durability:

- Payload assembly will be subjected to rocket launch, deployment, descent, and landing conditions: will need to be capable of withstanding these and remaining operational.

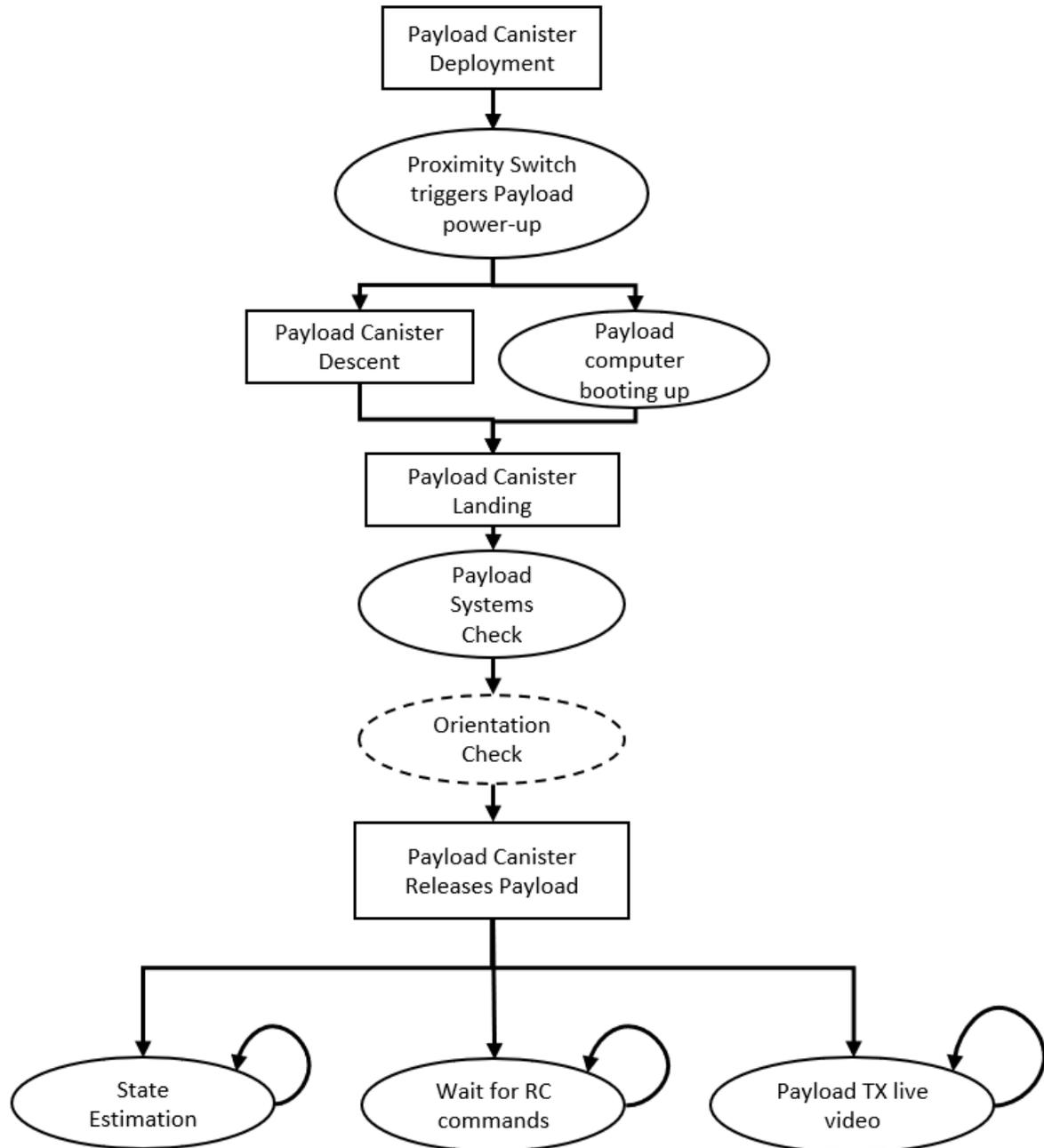
Misc.:

- Landing orientation will be difficult to control, the payload canister must be capable of opening in a broad range of conditions.

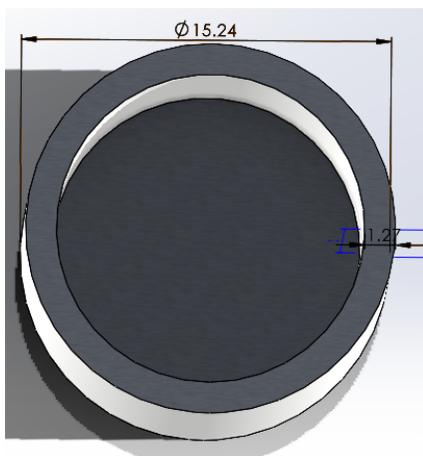
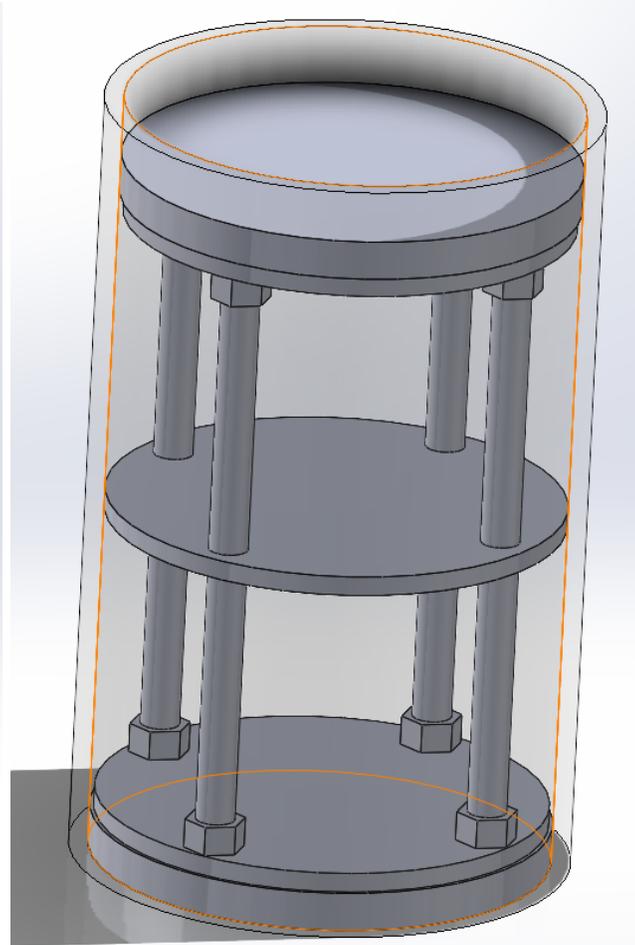
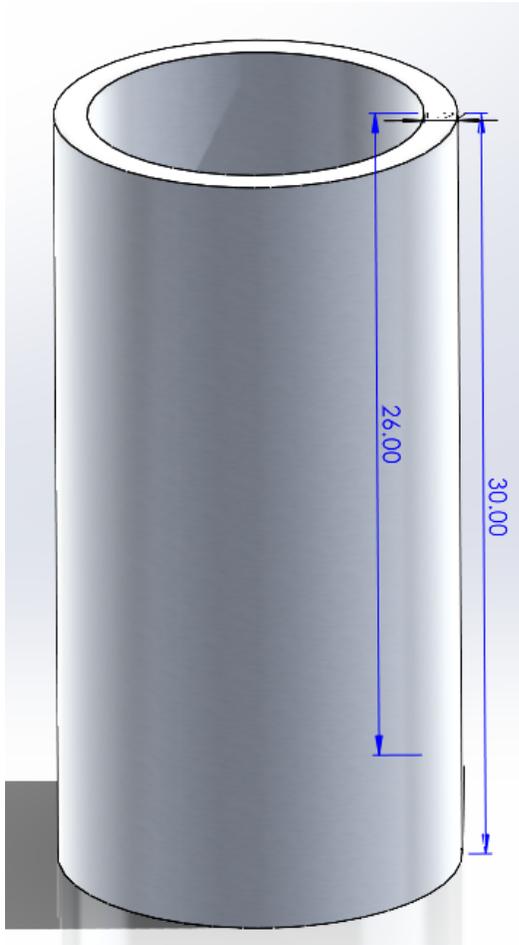
Block Diagram



Sequence Diagram



Sled/Canister Design



Estimated Budget and Financing

Part	Quantity	Price Estimate
FPV Camera Module TX RX	1	\$20
Single Board Computer	1	\$100
Microcontroller(s)	3	\$20
Stepper Motor with driver board	2	\$15
Battery Management System	1	TBD
Lithium ion cell	4	\$40
DC/DC converter	2	\$15
Brushless DC motor	4	\$80
Rover frame	1	\$20
Payload canister	1	\$20
Payload sled	1	\$20
PCB	3	TBD
All terrain wheels	4	\$25

This is a tentative, early estimate of project costs. As the design reaches maturation, there will likely be adjustments made to the parts list and the budget may be subject to change. As this is an interdisciplinary project, further consultation with the mechanical and aerospace teams will be needed throughout the semester to refine the design and ensure that the overall Arcturus project is successful.

Initial Project Milestones

SENIOR DESIGN I	Group/ Team Member	Start	Finish	Status
Familiarize ourselves with the project	Group 28	9/17/21	9/24/21	Completed
Role assignments	Group 28			In Progress
Identify parts	Group 28			In Progress
Project Reports				
Initial Documents	Group 28			Completed
Updated Initial Documents	Group 28	TBD	TBD	Incomplete
First Draft	Group 28			Completed
Final Draft	Group 28	TBD	TBD	
Final Document	Group 28	TBD	12/7/21	
Research, Documentation, and Design				
FPV Camera Module TX RX	Justice	TBD	TBD	
Single Board Computer		TBD	TBD	
microcontroller(s)		TBD	TBD	
Battery Management System	Justice	TBD	TBD	
DC/DC converter	Justice	TBD	TBD	
Brushless DC motor		TBD	TBD	
Rover frame		TBD	TBD	
Payload canister		TBD	TBD	
Payload sled		TBD	TBD	
PCB	Justice	TBD	TBD	
All terrain wheels		TBD	TBD	
Order and Test PARTS	Group 28			

SENIOR DESIGN II				
Build Prototype	Group 28	TBD	TBD	
Testing and Redesign	Group 28	TBD	TBD	
Finalize Prototype	Group 28	TBD	TBD	
Peer Presentation	Group 28	TBD	TBD	
Final Report	Group 28	TBD	TBD	
Final Presentation	Group 28	TBD	TBD	

House of Quality

Correlations	
Positive	+
Negative	-
No Correlation	

Relationships	
Strong	●
Moderate	○
Weak	▽

Direction of Improvement	
Maximize	▲
Target	◇
Minimize	▼

