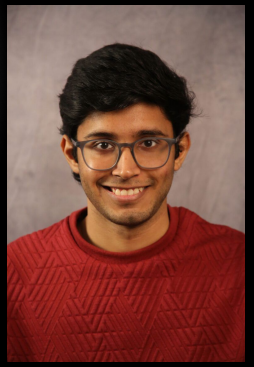
Lunar ROADSTER

(Robotic Operator for Autonomous Development of Surface Trails and Exploration Routes)

"Starting with a foothold on the Moon, we pave the way to the cosmos"

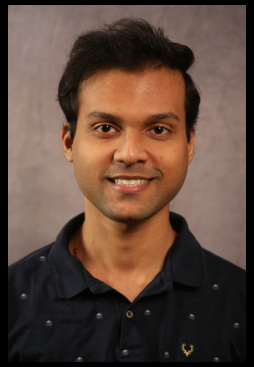
The Team

Ankit Aggarwal



Deepam Ameria

Bhaswanth Ayapilla



Simson D'Souza

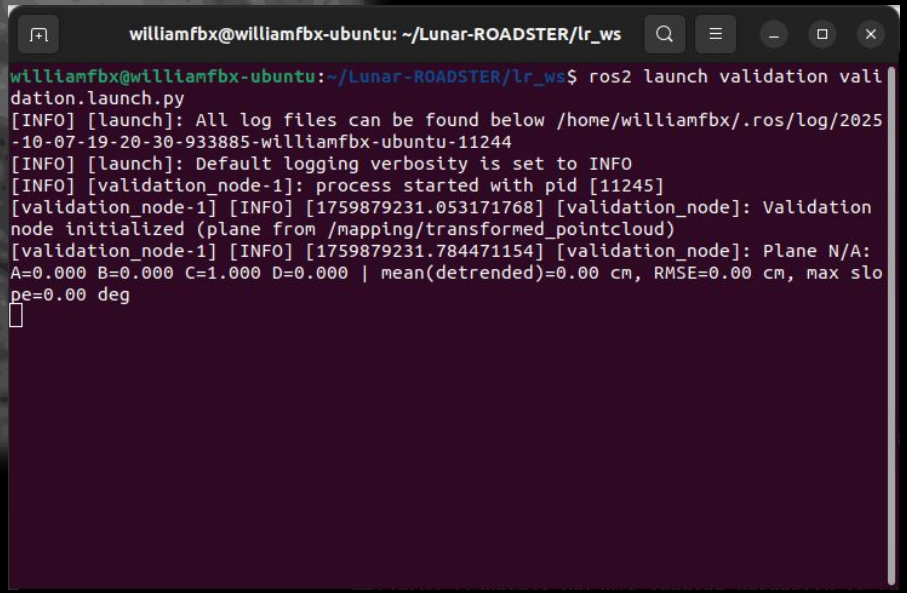
Boxiang (William) Fu

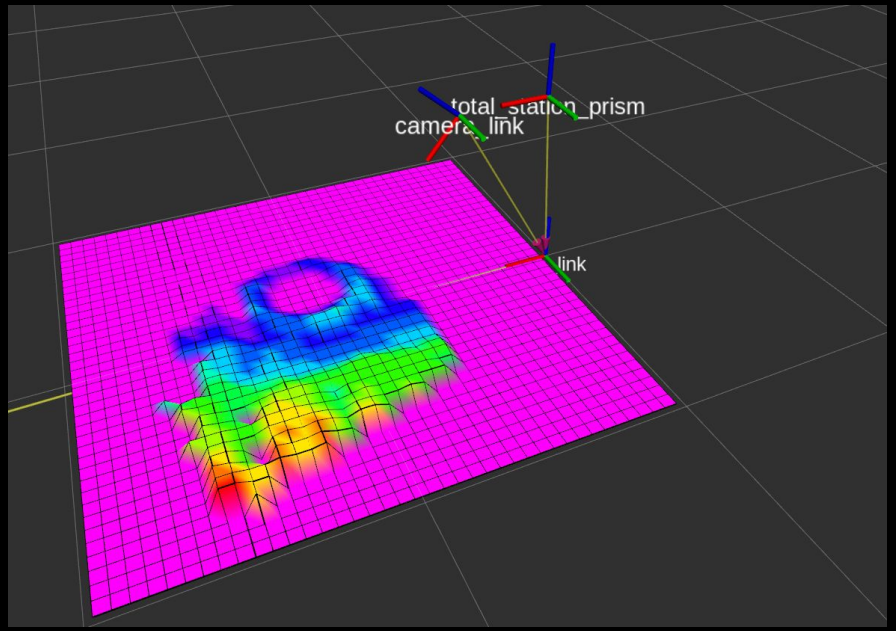
Dr. William "Red" Whittaker

Agenda

1. Validation subsystem
2. Perception subsystem
3. Navigation subsystem
4. Mechatronic subsystem
5. Integration
6. Risks and Issues

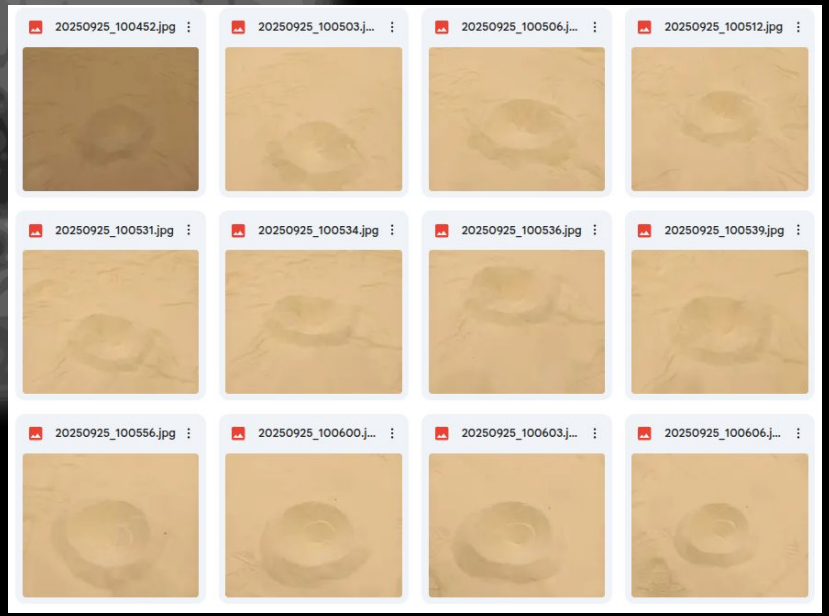
Goal: Validation Stack



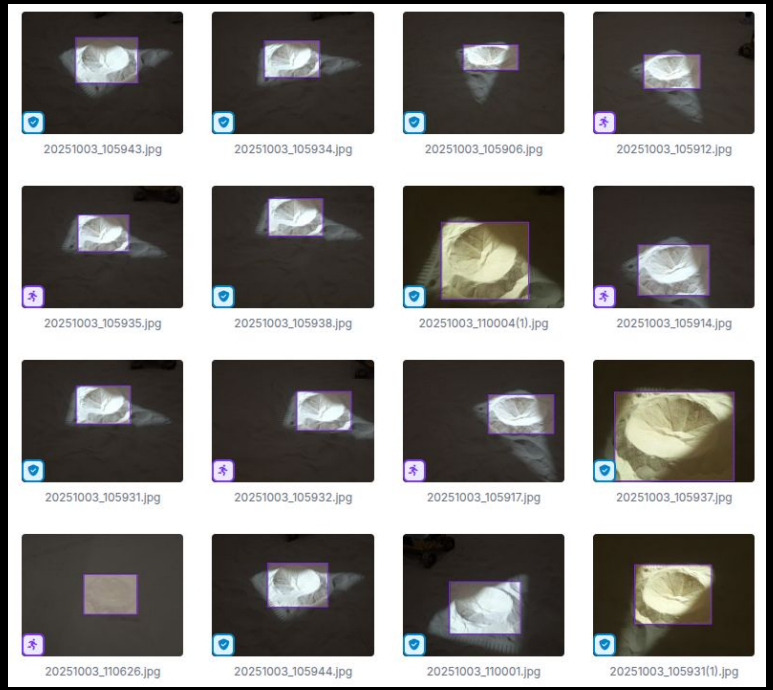


Experiments: Tried different gradient operators (finite difference, Sobel, Scharr), grid cell sizes (2cm, 5cm, 10cm), wall height thresholding, max slope thresholding

Goal: Implement Perception Stack

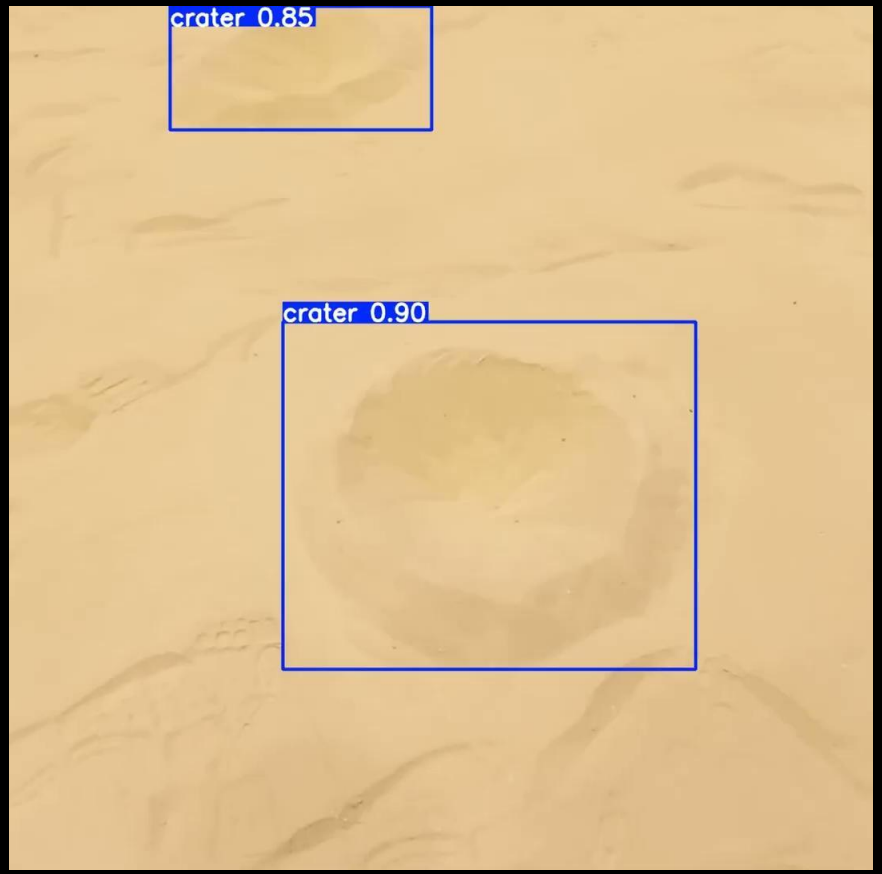


Collected Data



Annotated Data on Roboflow

Goal: Implement Perception Stack



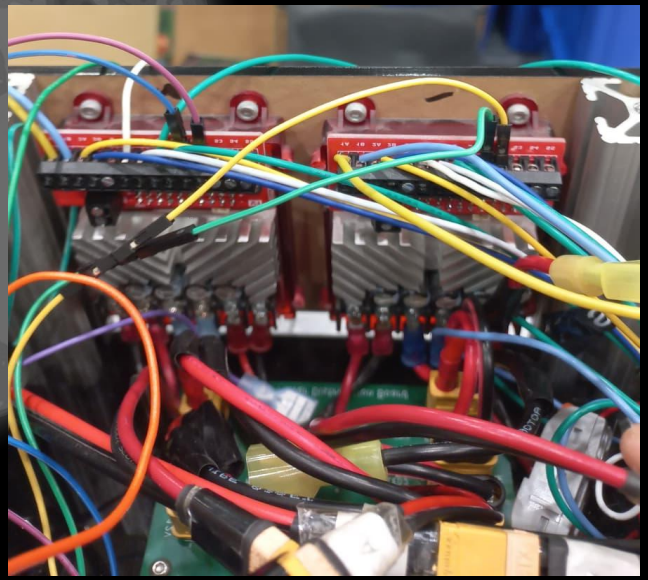
Goal: Navigation stack tested and tuned

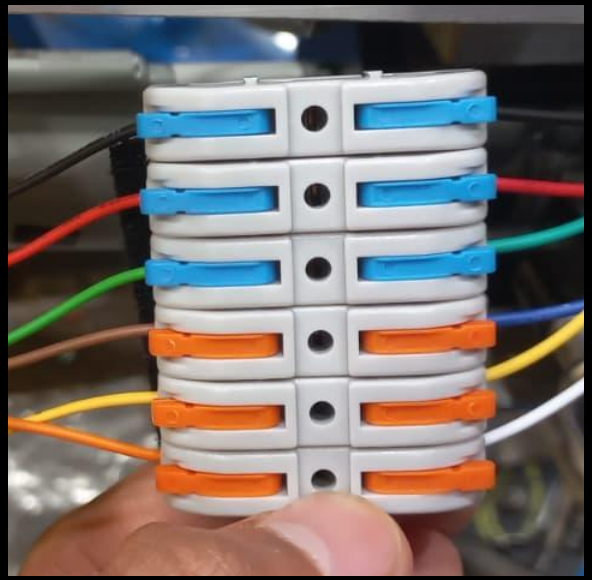
- Code: Global Planner and Pure Pursuit Controller (DONE)
- Testing: Pending (Blocker : Hardware)

Goal: Local Navigation Controller Ready

- Code: MPC Controller (IN PROGRESS)
- Testing: Pending (Blocker: Hardware and Perception Stack)

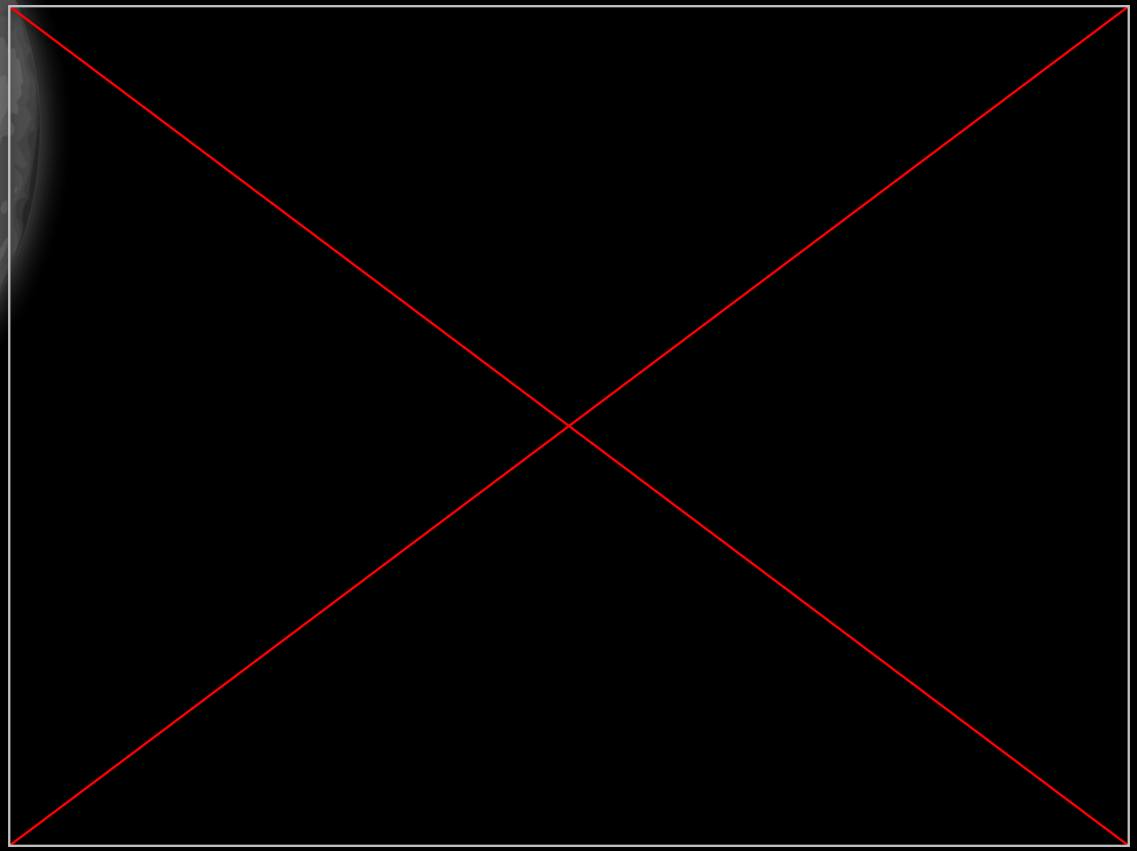
Goal: Hardware Finalized





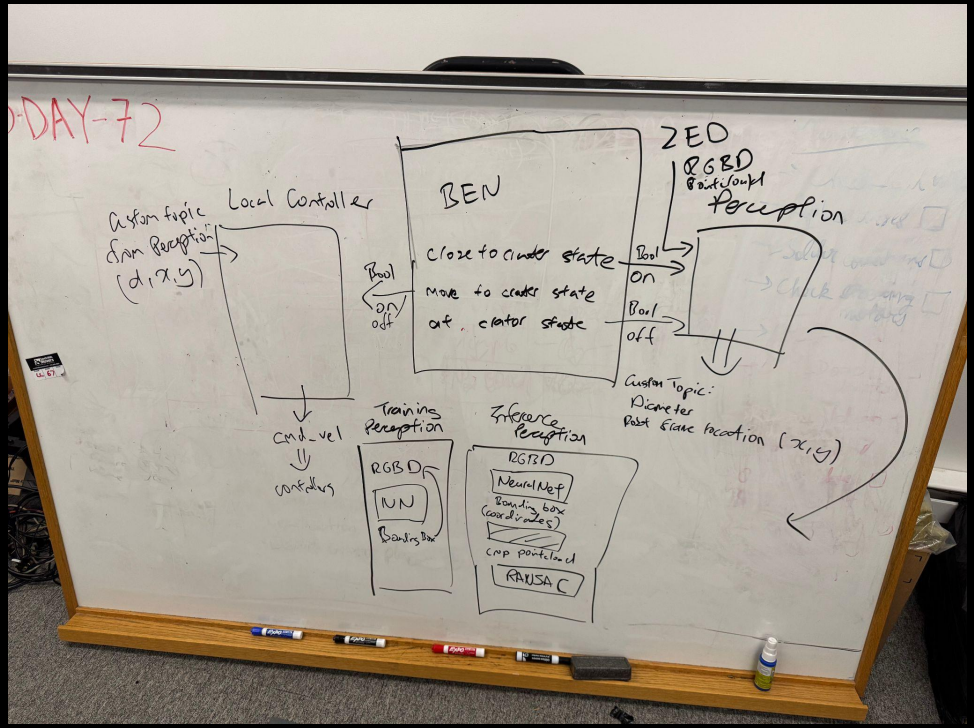
New components have arrived and are assembled. These are much more reliable connections.

Goal: Hardware Finalized



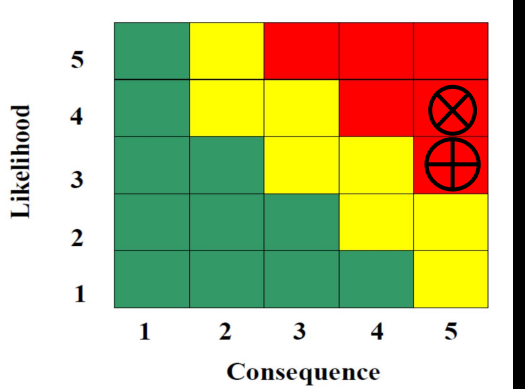
Goal: Initial Methodology for Integration

- Initial team discussion on how the Behaviour Executive Node (BEN) will interact with subsystems and units
- Settled topic gateways for communication between packages
- Settled dependencies between packages



Risk Management

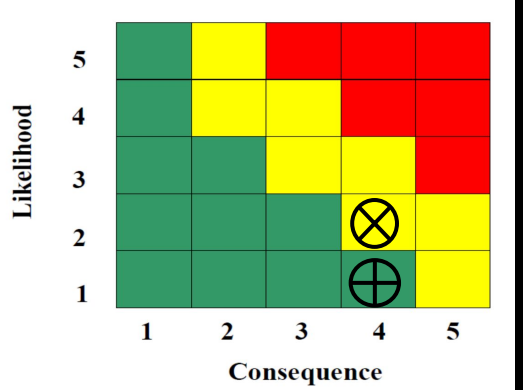
Risk ID	Risk Title	Risk Owner	Risk Type:	Logistics
R30	No spares available	Team		
Description		**Date Added**		
Discontinued model, spare parts unavailable		3/4/2025		
		Date Updated		
		8/30/2025		
Consequence				
The whole project falling through, or redo almost all subsystems on a different rover.				



Action/Milestone	Success Criteria	Date Planned	Date Implemented
Check out eBay and other similar platforms for spares	Successfully find exact spares on these platforms	3/6/2025	9/22/2025
Check out and stock similar parts if not same	Successfully find and stock similar parts	3/6/2025	9/22/2025
Find a twin rover that was used by a previous team on campus	Successfully find the twin rover and scavenge parts	3/6/2025	3/7/2025
Find similar parts - a slightly smaller pinion and motor set	Spares problem will be solved	9/10/2025	9/22/2025

Risk Management

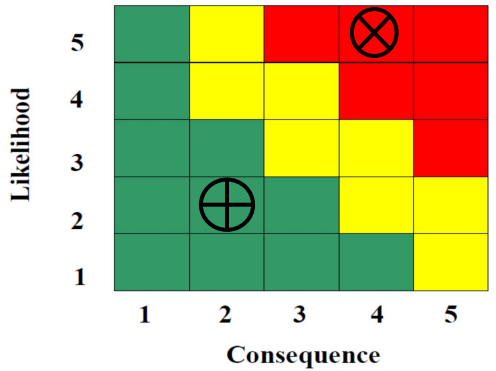
Risk ID	Risk Title	Risk Owner	Risk Type:	Logistics
R36	PRL Moonyard Access	William		
Description		**Date Added**		
Securing Moonyard access for testing/demos will be restricted and challenging		8/29/2025		
		Date Updated		
		8/29/2025		
Consequence				
No testbed available for testing and/or FVD				



Action/Milestone	Success Criteria	Date Planned	Date Implemented
Devise and discuss a testing and demo plan with Prof. Red and Prof. David Wettergreen beforehand and reserve slots	Successfully meet and discuss the schedule of high priority projects	9/11/2025	9/11/2025
Complete Medical Evaluation to get unrestricted but controlled access	Successfully complete the Medical Evaluation and get unrestricted access to the Moonyard	9/5/2025	9/11/2025
Respirator Training	Complete training and get custom masks	9/30/2025	

Risk Management

Risk ID	Risk Title	Risk Owner	Risk Type:	Technical
R34	Arduino requires reset before operation	Bhaswanth		
Description		**Date Added**		
Arduino needs to be manually reset each time before starting autonomy or switching between autonomy and teleoperation modes.		3/4/2025		
		Date Updated		
		4/10/2025		
Consequence				
Slows down setup time and impacts operational readiness, delaying mission start and mode transitions.				



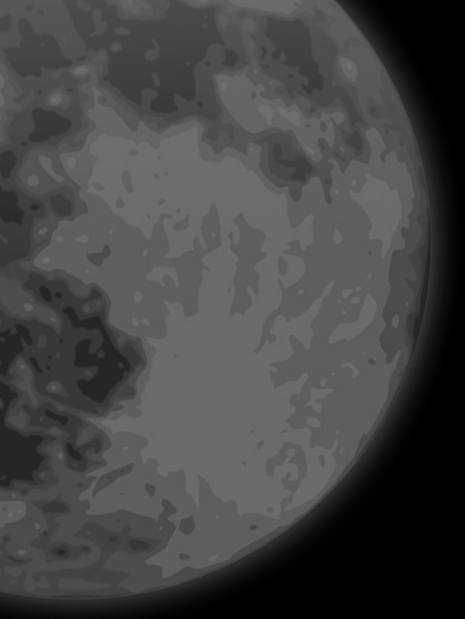
Action/Milestone	Success Criteria	Date Planned	Date Implemented
Check USB port permissions and drivers issues on Jetson	Successfully establish consistent serial connection without reset	4/26/2025	9/5/2025
Verify that Arduino is connected via USB 3.0 instead of USB 2.0 port	Ensure stable high-speed communication	4/26/2025	9/5/2025
Check for ROS node frequency mismatches causing packet loss to Arduino	Match ROS publish/subscribe rates	4/26/2025	9/5/2025
Implement a software reset trigger	Reset can be called from the operations terminal	9/7/2025	

Issues Log

I14	09/14/2025		**Team**	Steer pinion tooth chipped and worn-out due to wear-and-tear. Unable to find exact replacement for the pinion	1. Replace with similar pinion that has different tooth count 2. Switch to using another chassis		
I15	09/14/2025	10/07/2025	**Ankit Aggarwal** **Deepam Ameria** **Simson D'Souza**	Wires keep on coming loose during operations due to bad soldering	1. Re-solder every wire 2. Switch to plug connectors and buy adaptors for the RoboClaws and motors	Switched wiring to use plug connectors	This allows us to stop worrying about loose wiring due to bad soldering
I16	10/04/2025		**Team**	Unable to obtain rear steer motor encoder feedback	1. Recheck wiring permutations to see which one is correct 2. Retrace wiring to make sure everything is wired correctly		
I17	10/04/2025		**Team**	Front steer has power issue	1. Recheck front steer power connections with the RoboClaw connectors 2. Check how the rear steer power connections are connected and try to copy		

Future Work

- Perception: Geometric Feature Extraction.
- Validation: Tuning, testing and integration.
- Localization: Explore and implement SkyCam methodology.
- Navigation: Test and tune the local and global planners and controllers on the rover.



THANKS!

Team Lunar ROADSTER