

University of North Dakota

Engineering an Autonomous Robot for Regolith Collection on Mars

Alec Redmann, Austin Cote, Jacob Berry



Presentation Overview

- Introduction
- NASA Robotic Mining Competition
- Final Design
- Outreach
- Conclusion
- Questions

Introduction

UND Robotics Team

- 6th Year in Competition
- 11 Team Members
- All undergraduates– ME & EE

Faculty Advisors:

Dr. Jeremiah Neubert
Dr. Surojit Gupta
Dr. Naima Kaabouch

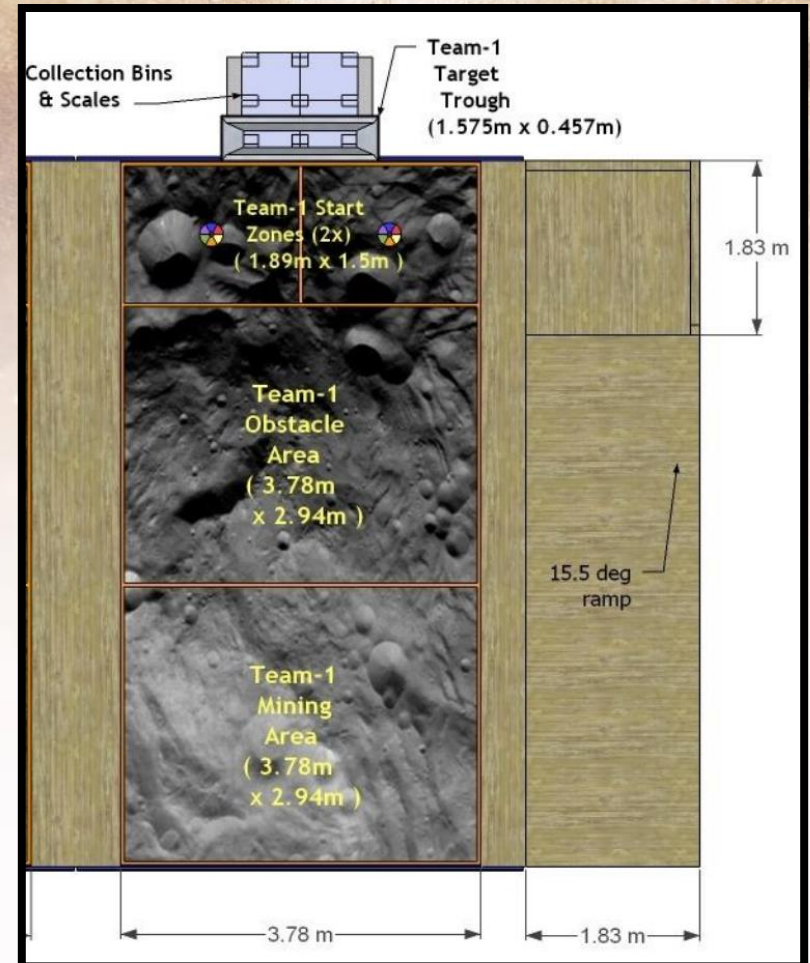
Team Members:

Nick Allen, Jacob Berry,
Austin Cote,
Pushkara Jayasekera,
Kyle Kunkel, Anne Mayer,
Tate Messmer, Alec
Redmann, Dustin Rudnick,
Jordan Senff, Luke Spray



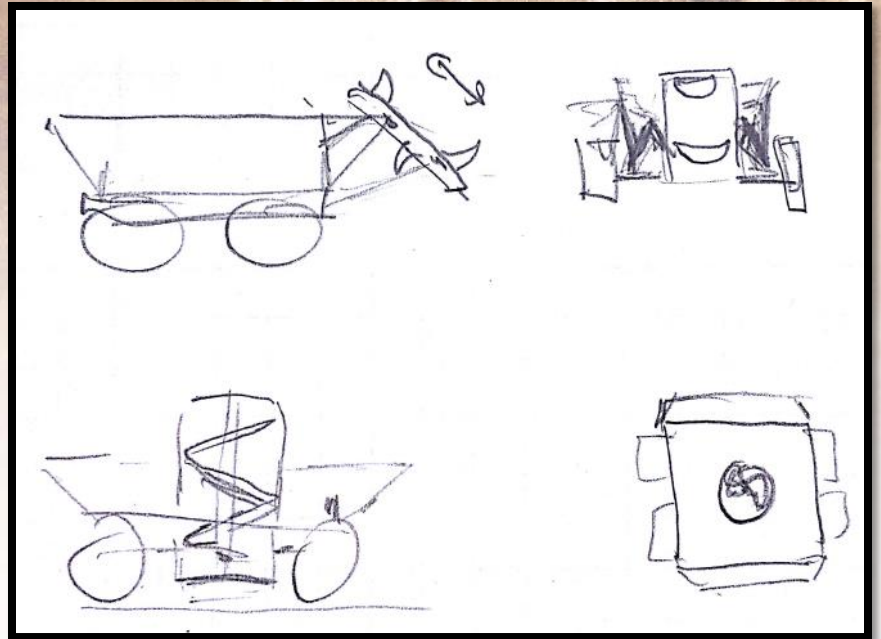
NASA Robotic Mining Competition

- 6th Annual Competition held at Kennedy Space Center, Florida
- On-site Mining Competition
- Scoring:
 - Regolith: 3 pts / kg
 - Ice Simulant: 6 pts / kg
 - Robot Mass: -8 pts / kg
 - Autonomy: Up to 500 pts
- Constraints:
 - Max Mass: 176 lbs
 - Max Dimensions: 60 x 30 x 30 in



Design Goals

- Mine to a Depth of 20 inches
- Mine minimum of 200 lbs. of Regolith in 10 Minutes
- Utilize Lightweight Materials





FINAL DESIGN

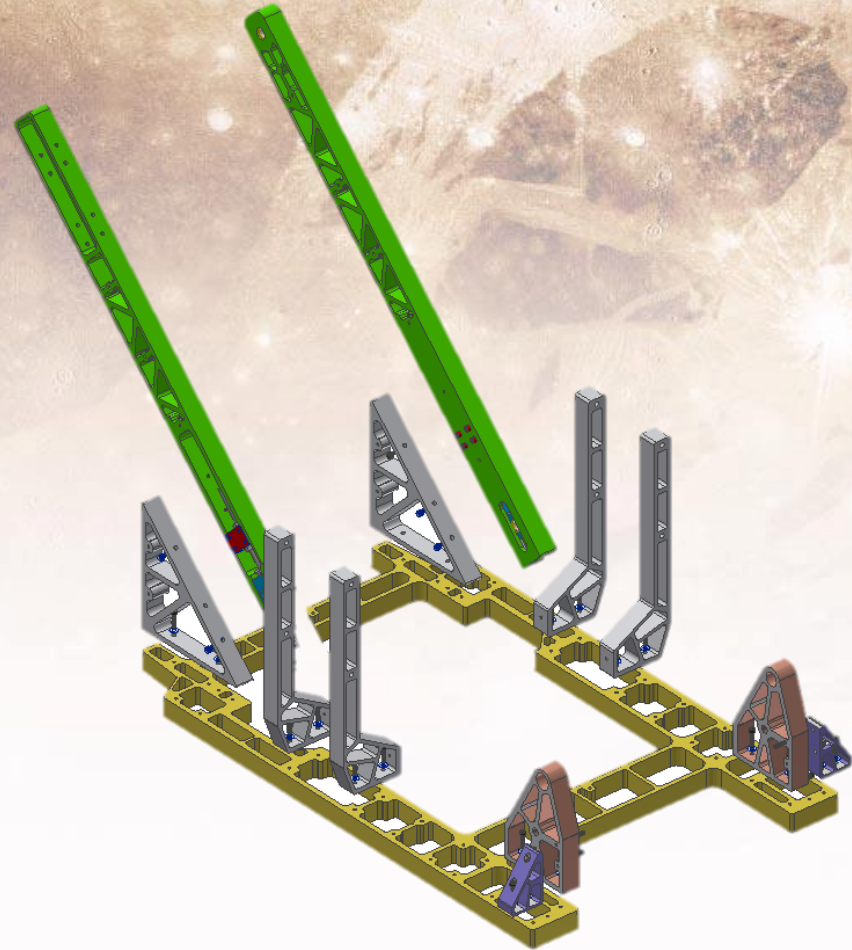
DAIR: Deep Acquisition of Icy Regolith

Complete System



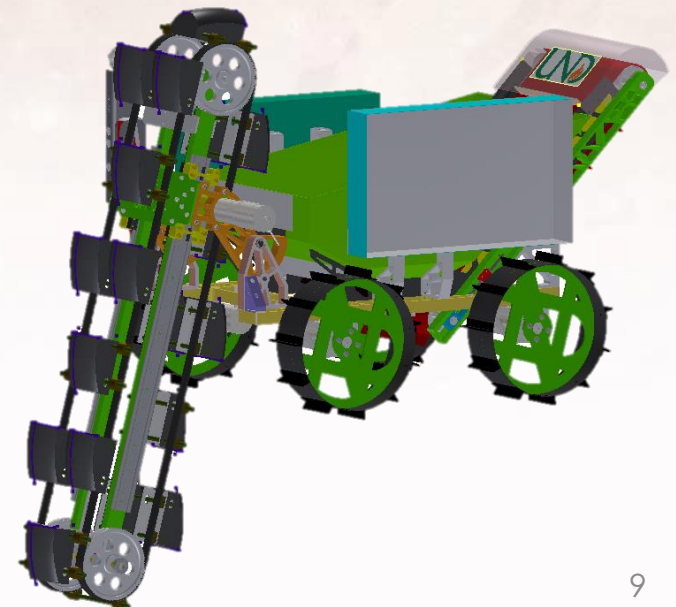
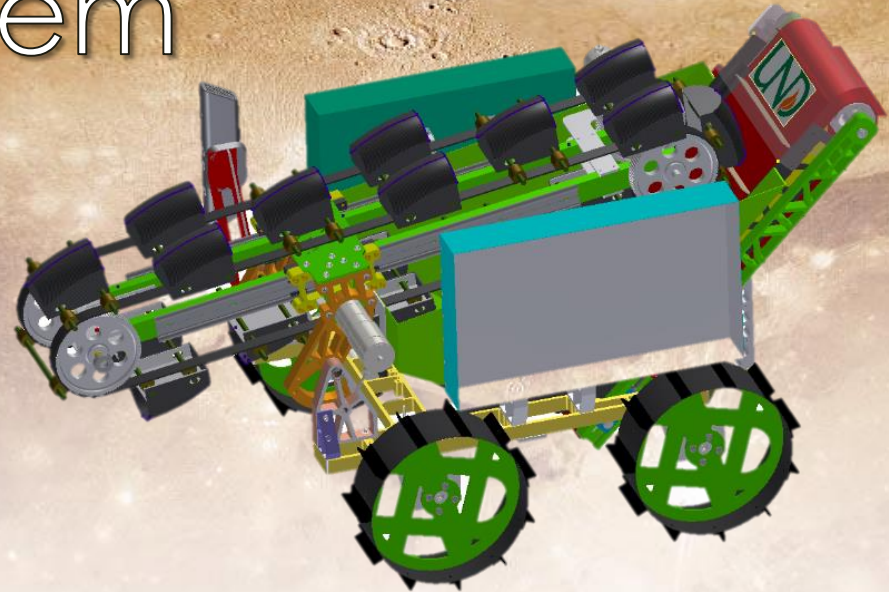
Structural System

- Magnesium Alloy
 - 30% lighter than Aluminum
 - Waterjet cut
 - Protected by TAGNITE
- Modular Design



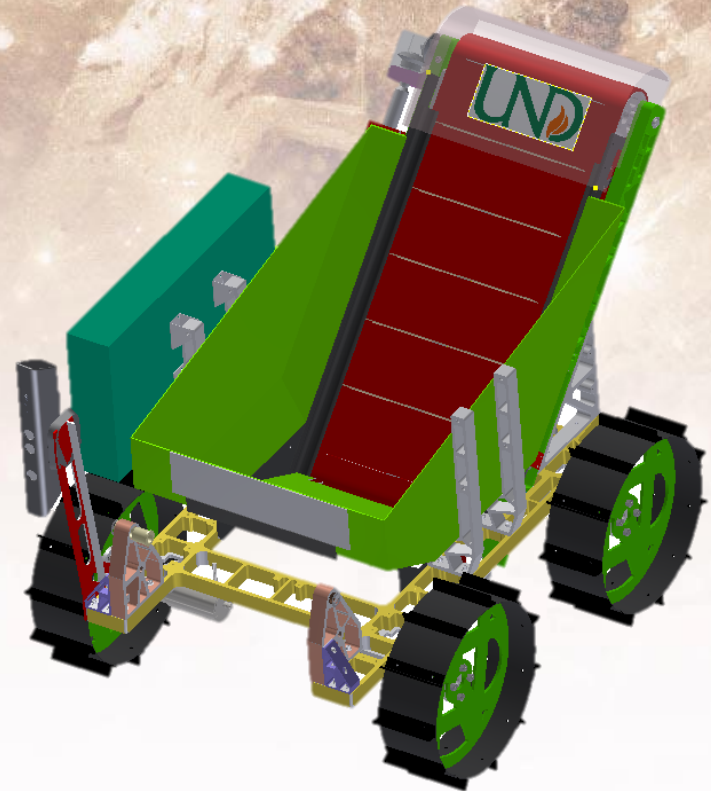
Excavation System

- Spring Release System
- Controlled Lowering & Raising
- Mining Depth of 20 in.
- Carbon Fiber Scoops



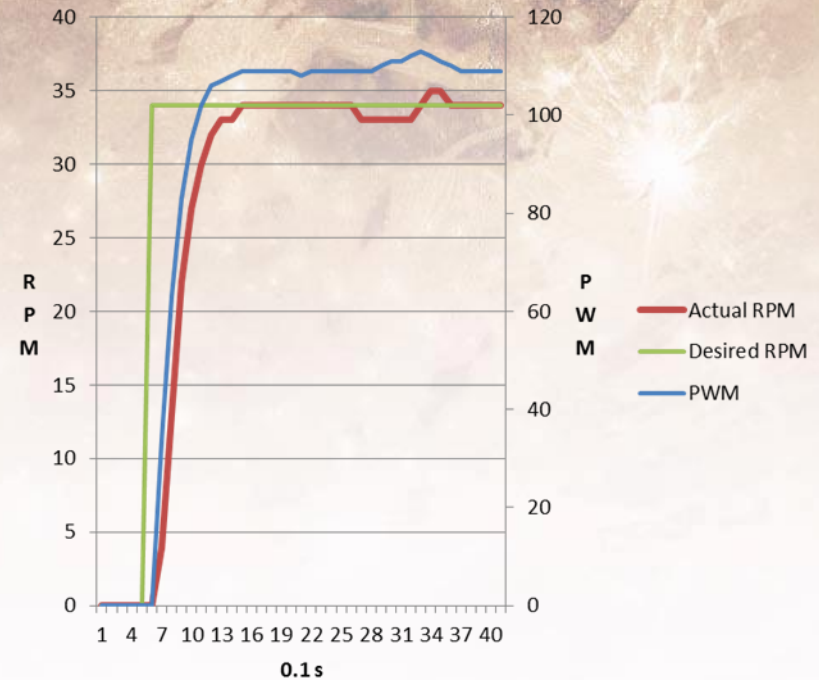
Delivery System

- Conveyer Dumping System
 - Urethane paddles
- Magnesium Hopper



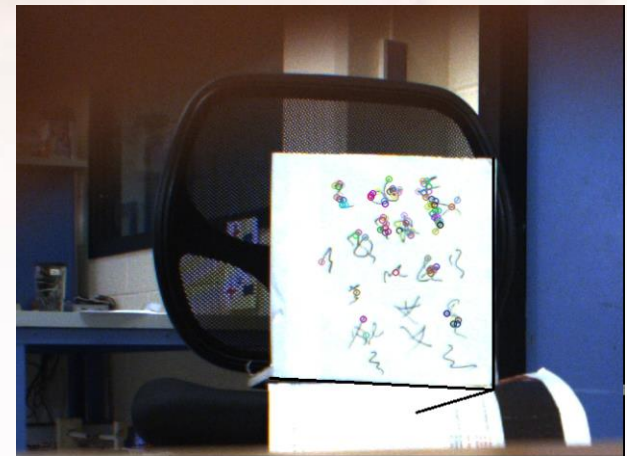
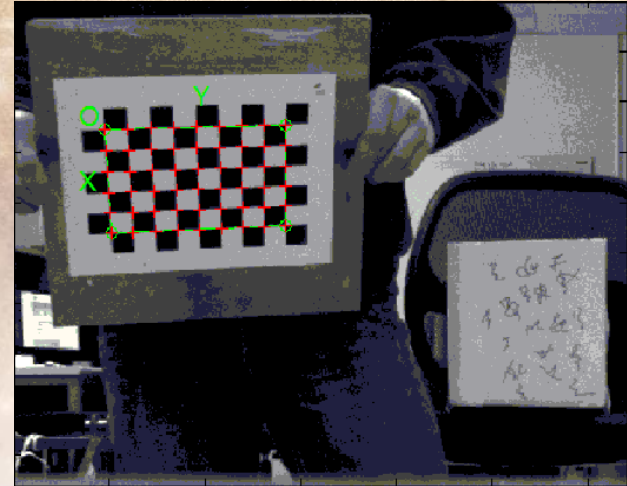
Traction Control

- Traction issues previous years
- Use encoder data
 - If the motor is spinning slower than desired add power
 - If the motor is spinning faster than desired reduce power to the wheels

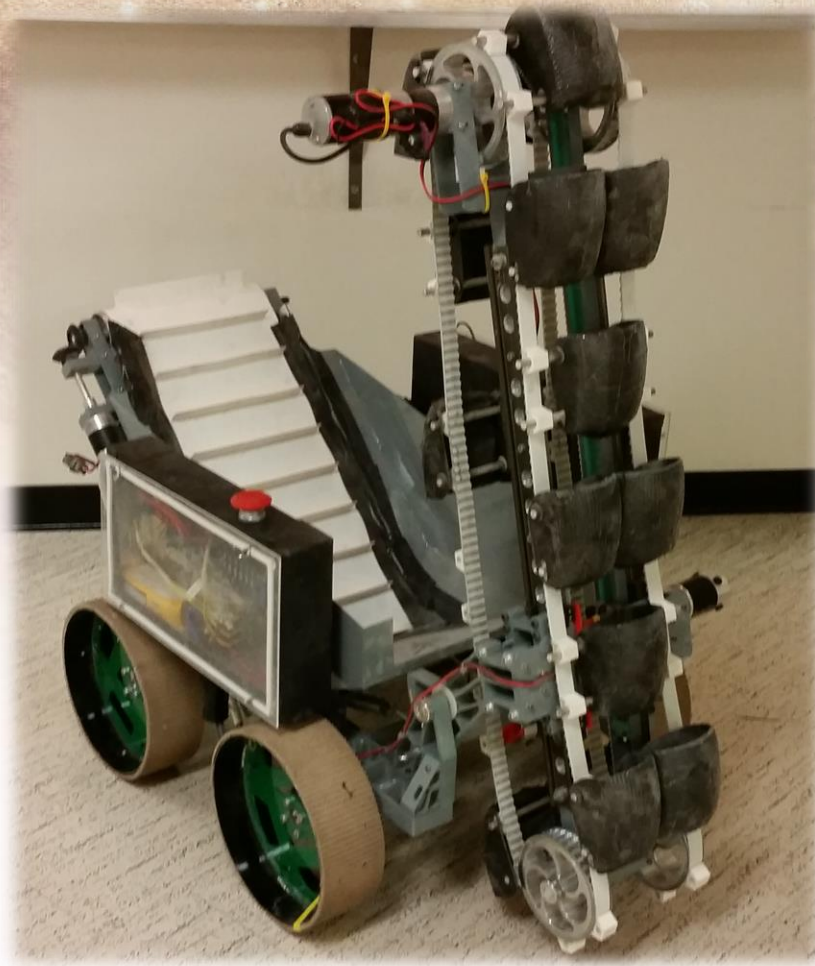


3D Model Based Localization

- Camera Calibration
- One Frame Needed for Detection
- Detection Phase
- Pose Estimation



Completed Robot

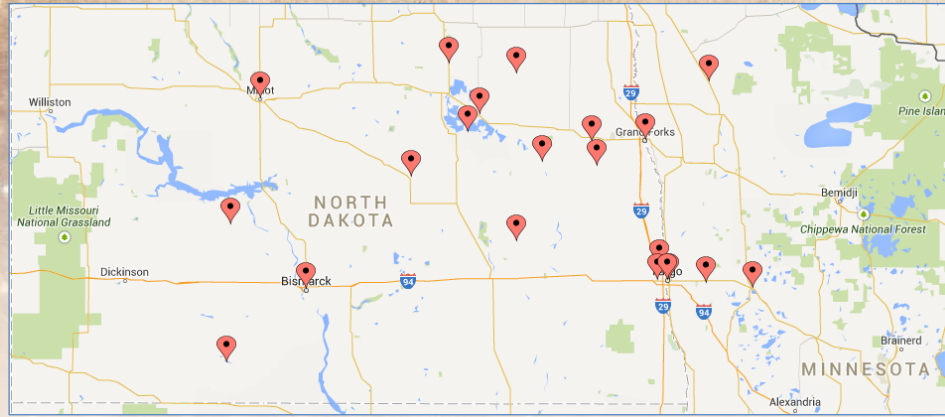




OUTREACH

Inspiring the Next Generation

Outreach



(Image courtesy of Google Maps)



4/24/2019



UND Lunabotics

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Outreach





CONCLUSION

Conclusions

- Complete re-design
- Attained Mining Depth of 20 in.
- Increased Regolith Storage
- Autonomy Capable System

Credits

Thanks to Our Advisors:

- Dr. Jeremiah Neubert
- Dr. Surojit Gupta
- Dr. Naima Kaabouch

Thanks to Our Sponsors:



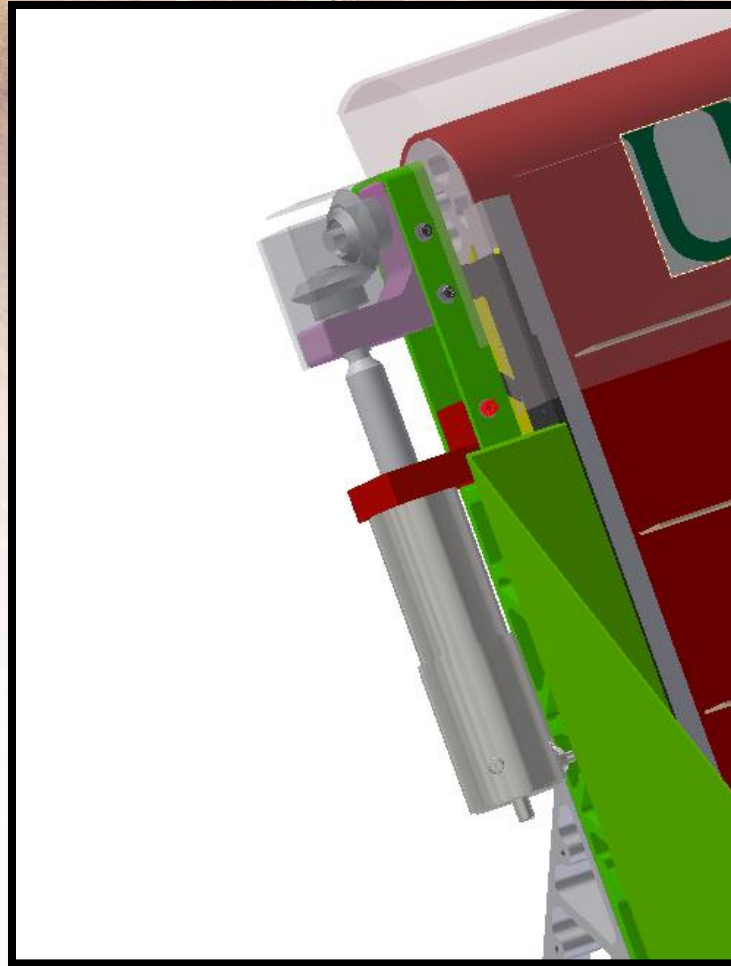


QUESTIONS?

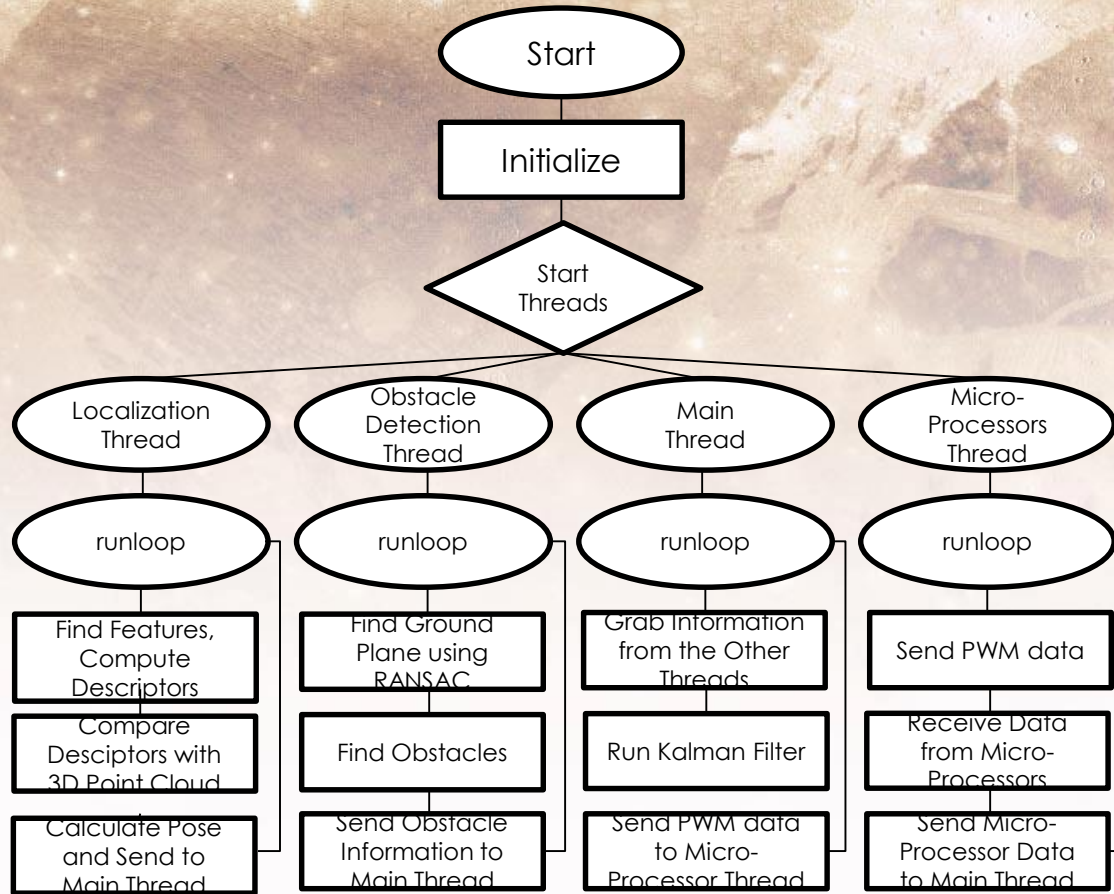


Supplementary Information

Right Angle Gear Box



System Architecture



Project Schedule

