

RIT Space Exploration Rover Feasibility Study

Thomas Hall*

RIT Space Exploration, Rochester Institute of Technology
Rochester, N.Y.

Email: *tjh2822@g.rit.edu

Abstract—Begin the design and construction of a mock rover. A rover would be an area of space exploration completely new to SPEX, because of this there are a lot of unknowns that need to be answered before starting this project. Because of this the project will require a large amount of prototyping and testing. The team would look at the talent and skills of RIT Space Exploration and answer the question: what caliber of rover are we able to make. It would employ a multidisciplinary team to cover for construction and development. The project would be slated to run for two semesters. The rover would be extremely promotable and would look great at Imagine RIT.

I. INTRODUCTION

Robotics and by extension rovers are a tremendously important part of space exploration. This is also an area that RIT Space Exploration has very little experience with project-wise. The purpose of this project is to assess and assert the capability of RIT SPEX in regard to the construction and fabrication of a mock-rover and then begin construction. As this is a new area to RIT SPEX, prototyping and experimenting is necessary to most effectively accomplish this goal. This project will look at the unknowns, technical challenges, project management, and member skills of RIT Space Exploration in regards to a University Rover Competition (URC) capable rover. The project is intended to last 2 semesters with the deliverable of a basic rover and a technical report. The project is also intended to lead into a future rover project with expanded capabilities.

II. PRIMARY OBJECTIVE

The goal of this project is deliver a functioning mock rover. The rover will allow the team to develop skills and knowledge to build a more feature complete rover in the future. The details are defined in the minimum viable product section.

III. SECONDARY OBJECTIVES

The study will also investigate the University Rover Competition (URC) as hosted by the Mars Society as a potential long term goal. The competition is held annually and features 4 very intense competitions. Such a rover would need to be fully self navigating, perform scientific analysis on soil samples, and having a robotic arm capable of fine motor control. Such a project would be among the most ambitious SPEX has ever attempted. The skills learned from this project should be applicable to such a future project.

IV. MINIMUM VIABLE PRODUCT

The minimum viable product (MVP) is defined by the following features:

- Rocker-bogie-like suspension
- Ability to control remotely (such as a gamepad)
- Ability to traverse terrain such as gravel, cement, and asphalt
- Technical report and rover kit as deliverable
- Physical rover demo present at Imagine RIT

The MVP is intended to be flexible in implementation depending on funding. The size and materials are not defined because of this. Should the funding allow for it there are many improvements that can be made beyond the MVP and quality materials.

- Lidar based CV for autonomous or partially autonomous navigation
- Improved navigation with use of GPS system
- Robotic arm with 3+ degrees of freedom
- Optional drill or grasper attachment
- Soil sample analysis with archimedes screw
- Larger / faster rover
- Solar cells for additional long-term navigation
- better control interface

V. BENEFIT TO SPEX

Rovers are a huge part of space exploration. It is also an area that SPEX is not currently involved with. It would be beneficial to our members to get some experience in this area. A rover would look super good for SPEX at Imagine RIT. The rover would be rather large and would attract many eyes. We could even demo it outside if there is sufficient space. A rover would be very easy to get video and photos of for SPEX promotions. Having a rover is also another opportunity for SPEX to fundraise. There is plenty of space to place company logos on the body of the rover. It would also allow for SPEX to reach out to robotics companies. The self driving component would be the heaviest computer science project SPEX would have attempted, this would help with retention of CS and SE majors. Machine learning and artificial intelligence are at the forefront of computer science right now. They are heavily desired in industry including space exploration.

A. Mindset

The purpose of this project is to investigate and implement a mock rover. Because of this the team members must be in

the mindset to analyze each part of the project and identify as many problem areas that need answers as possible. This means being specific on how we are going to accomplish our goals. What material, what algorithm, with what method will we be accomplishing this. It is very easy to over estimate the team's ability especially when the project is so new to the team.

B. Traceability

It is important that the team members document the sources they use to gather information. There will be a Google Drive folder that will hold notes with links to any books, articles, media or their sources that are relevant to the rover project.

C. Assessing Technical Skills

Building a rover, especially one built to URC specifications requires a large team with a diverse set of technical skills. This study will look at RIT SPEX and asses what areas are sufficient and what areas need to be developed in order to build a rover. It will also let us know to what spec we are currently capable of building such a rover.

D. Accessibility

The study would require a handful (4-5) members each with different areas of expertise. The members would need that knowledge as well as \LaTeX , notetaking, and good research practices.

VI. IMPLEMENTATION

This project would involve divvying out the different project areas to the different team members and each week meeting to discuss progress. The team would take this information, refine it and put it into the PDD draft. Approx. 10 weeks into the semester the mechanical team should be able to build a rough CAD model and do any prototyping. The PDD would be finished by the end of the semester (or earlier) and the project would be free to shift to second semester work.

A. Deliverables

The primary deliverable of this study will be a PDD for the spring. It is also noted that the materials that the team will come across or notes should also be saved in an Google Drive folder for future reference. The team will also present at SPEX design reviews and the weekly checkups at general meetings with the areas the team members are studying that week. The should have a rough CAD model for the PDD showing the spacing and layout of the potential rover. The team may decide to use said CAD model to prototype.

B. Milestones

The largest milestones would be PDD draft and completion. This can also be expanded to include the CAD models and any prototypes.

VII. EXTERNALITIES

A. Prerequisite Skills

The study is going to require members that are knowledgeable in mechanical design and manufacturing, software engineering, machine learning, electrical engineering, and project management. These members will also need to be experienced in research and design document work. Though this seems simple, finding SPEX members to do this well

B. Funding Requirements

The cost of this study is relatively minimal as it is a study. There may be physical prototype costs but these should again be very small. Physical prototyping can be done with cheap materials like cardboard or foam core.

C. Faculty Support

Support from faculty could greatly advance this study and what RIT SPEX is capable robotics wise. The team should reach out to professors for advice and help.

D. Long-Term Vision

The long-term vision of this project is to open RIT Space Exploration up to a new area of projects and development. Robotics and rovers are at the core of deep space exploration and most science missions. The University Rover challenge is also a worthy long term goal.

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