NASA RC ROVER CHALLENGE

Wesley Derry, Nate DeYoung, Aylee Rupert, Hannah Sibery, Shane Skinner, Owen Tong
Design Engineering Technology
Advisor: Dr. Timothy Jenkins

ABSTRACT

The team designed and built a NASA Remote Controlled (RC) Rover for the NASA Human Exploration Rover Challenge. The challenge tasked the team with designing an RC rover that fits in a 2.5 ft. x 2.5 ft. x 2.5 ft cube, complete terrain mapping and sample drilling tasks, and successfully traverse obstacles. Additionally, a cargo bay is needed to hold a sensor package which is the final task. Figure 1 displays an example of a current NASA Rover that was used for inspiration during the design phase. Figure 2 shows the layout of the course at the competition. At the competition, the team would be required to traverse the course which consists of 10 obstacles and various tasks. All the tasks and obstacles will earn the team points towards an overall score.

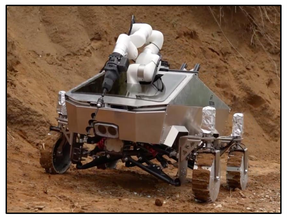

Figure 1: Lunar Robot Design Example

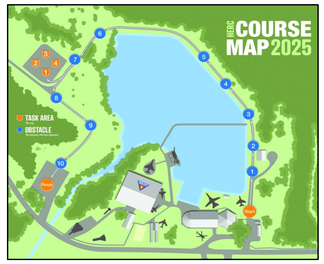

Figure 2: Course Map

CUSTOMER NEEDS/SPECS

Table 1 displays the needs and specifications determined by the team after evaluating the design problem and meeting with the project's sponsor.

Table 1: Needs and Specifications

Customer Needs	Target Specifications
Ability to connect with the pilots remotely	Volume Restriction of 2.5' x 2.5' x 2.5'
Must have a cargo space to hold a specific item	Cargo Space must be 6" x 4" x 2"
Ease of Maintenance	Torque Requirement of 90 lb·ft
Comprehensive user manual	Max. Turning Radius of 5'
Ability to accomplish the two tasks: sample drilling and terrain mapping	Suspension Travel of 12"
Long Battery Life	Battery Life ≥ 2 hours
Durability	Durability. Must withstand a force of 20 lbs.
Capability of long-range data transmission	Data Transmission must have a range of 15 ft

DESIGN CONCEPTS

The team created multiple design concepts for the rover based on the project requirements and the customer needs and specifications. Concept 1 was a rock crawler design that can be seen in Figure 3. Concept 2 was a truck frame design that can be seen in Figure 4.

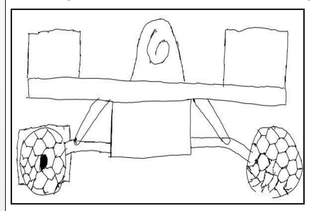

Figure 3: Rock Crawler Concept

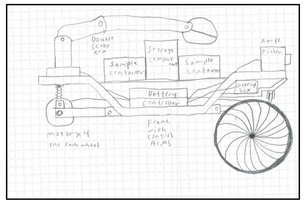

Figure 4: Truck Frame Concept

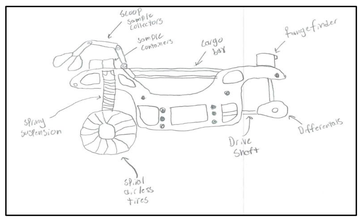

Figure 5: Split Frame Design

The third concept is a split frame design which is the design the team moved forward with, seen in Figure 5.

INITIAL BUILD

The team started with an RC car bought from a local hobby shop, Figure 6. New axles (Figure 7) and larger frame components (Figure 8) along with new differentials were designed to carry essential equipment like task gear (Figure 9). The initial build is seen in Figure 10.

Figure 7: New Axle Assembly

Figure 6: RC Car Purchased

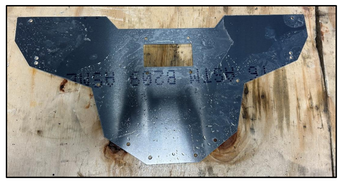

Figure 8: Frame Cut-out

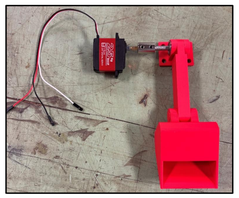

Figure 9: Scoop Subassembly

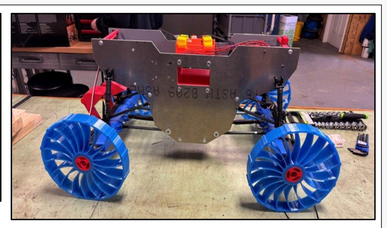

Figure 10: Initial Build

TEST RESULTS

The team performed various tests to determine the overall capability of the rover. These tests included:

- Traversing the rover over an obstacle course
- Running the code for the scoops and rangefinder
- Calculating the turn radius and clearance off the ground

Figures 11-12 show the first run that the team conducted on the obstacle course set up on campus. The obstacle course consisted of inclined ramps, cones, and tires with mulch. Figure 11 shows the rover going over the inclined ramp and Figure 12 maneuvering in and out of the slalom. With the team's design of the rover, there were no issues that occurred when the rover was driven throughout the course.

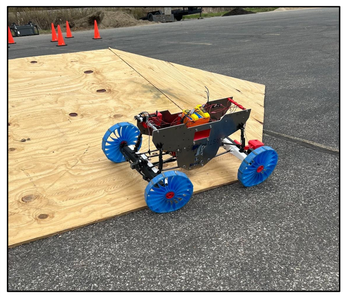

Figure 11: Rover on Inclined Ramp Obstacle

Figure 12: Rover on Slalom Obstacle

FINAL DESIGN

The final design of the RC Rover is shown in Figure 13. The final design has an aluminum frame that was cut on the water jet. The wheels shown in blue are 3D printed out of TPU a flexible polymer to provide shock absorption. The shocks, tie bars, motors, and servos were all taken from a stock RC car to be reverse engineered to meet the project needs. Figure 14 shows the rover collecting a sample for the sample drilling task, which the team designed scoops and 3D printed out of polymer. The rover also consists of a lidar rangefinder, which maps out the terrain by providing distances of certain objects.

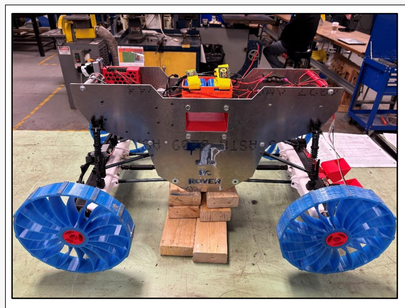

Figure 13: Final Build

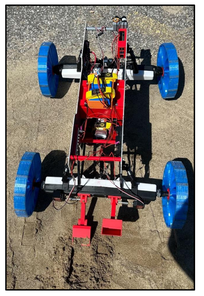

Figure 14: Sample Collection

CONCLUSION

The team worked through the engineering design process to produce a working RC rover. This was done by following the engineering phases laid out to keep the team on schedule. The RC rover is piloted by two controllers, one controlling the drive system while the other controls the scoop and rangefinder. The rover completed all tested obstacles successfully (Figure 15) and met the customer needs.

Figure 15: Final Rover Design During Test Demonstration

LESSONS LEARNED

The team learned many valuable lessons over the course of this project.

- The importance of keeping documentation up to date to ensure no detail gets missed.
- When developing and designing a product, clear communication amongst the team is crucial.
- Highlighting each team members skills will help with the efficiency of the completion of the project.

ACKNOWLEGEMENTS

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