R2-S2: ROBOTIC REMOTE-SENSING SCOUT

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Introduction: Space Policy Document 1 calls for the U.S. to lead commercial and international partners in returning humans to the Moon “for long-term exploration and utilization” [1]. The Moon Village Association shares this vision and adds on the importance of sharing information between these partners to facilitate cooperation [2]. This call is being answered by the NASA Artemis program, which plans to lead commercial and international partners towards establishing a sustained human presence on the Moon [3-5]. The Robotic Remote-Sensing Scout (R2-S2) concept is proposed to assist lunar EVA crews for Artemis III and subsequent crewed lunar missions. R2-S2 is a versatile co-robotic reconnaissance rover intended to dramatically reduce the risk associated with lunar EVA missions. R2-S2 has two primary modes of operation: 1) Teleoperated mode and 2) Autonomous crew-assist mode. R2-S2 comes in either a polar configuration or an equatorial configuration depending on the mission location.

Teleoperated Mode: In teleoperated mode, the lunar crew remotely operates R2-S2 from inside their lunar habitat to assess the safety of planned EVA crew missions (mission recon) or to conduct some tasks that would otherwise require a crewed EVA (remote exploration and inspection). For EVA mission recon, the teleoperator directs R2-S2 to the desired mission destination while gathering valuable sensor data that will aid in determining mission safety.

Autonomous Crew-Assist Mode: In autonomous crew-assist mode, R2-S2 provides support alongside the crew during EVA excursions. In this mode, R2-S2 livestreams EVA operations to Earth, carries tools, and performs specific tasks when voice-commanded by the crew (sample collection, telescoping, microscopy, detecting radiation, and other in situ sensor readings). R2-S2 also carries spare oxygen tanks and suit repair materials for contingency scenarios.

Onboard Capabilities:
1. Radio Antenna (10dB SNR to Earth DSN)
3. 360° LiDAR [7]
4. 360° HD Camera [8]
5. Stereo Telescoping Cameras [9]
6. Infrared Spectrometer [10]
8. Dual DC Motors (total 0.25 hp) [12]
10. Battery Pack (8-hr discharge)
11. Spare Oxygen Tanks (16-hr supply)
13. Sample Collection Drill [10]
14. Wheels (Rocker-Bogie Configuration)

Appendix H: Human Landing System, Option A Next Space Technologies for Explorations Partnerships

Future Work: Future concepts could include a robotic arm for more teleoperation capabilities, such as habitat maintenance and improved dexterity for in-situ sample collection. Storing R2-S2 in a temperate enclosure between missions must also be considered to ensure the battery stays within its operational limits.

Future Work:
- Autonomous EVA (remote exploration and inspection). For EVA mission recon, the teleoperator directs R2-S2 to the desired mission destination while gathering valuable sensor data that will aid in determining mission safety.
- Assist mode: R2-S2 provides support alongside the crew during EVA excursions. In this mode, R2-S2 livestreams EVA operations to Earth, carries tools, and performs specific tasks when voice-commanded by the crew (sample collection, telescoping, microscopy, detecting radiation, and other in-situ sensor readings). R2-S2 also carries spare oxygen tanks and suit repair materials for contingency scenarios.
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