Mars Habitation Constructor: An Autonomous Device Capable of Printing Structures on the Surface of Mars Using Native Materials

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The space industry plans to put humans on Mars by 2025, In order to make this a reality, they will require housing to protect them from the atmospheric conditions of the planet. Due to the astronomical payload transportation costs of space travel, these structures could instead be 3D printed on Mars using only native materials-regolith and water. The goal of this project was to design and construct an autonomous device with a three axis arm capable of 3D printing habitation buildings on Mars using indigenous materials. The project began by assembling the gearboxes and drivetrain. Custom parts were machined and constructed into assemblies consisting of a drive base, a backpack, a shoulder, an elbow and a wrist. These assemblies were connected together and wired to form the final prototype. A homemade, peristaltic pump was built and a custom Java program was written. Once programmed, actual print tests were performed. Current draw and repeatability/accuracy metrics were collected for analysis. After seven months of work, three conclusions were drawn. First, with the collected current draw data, the device would only require a radioactive thermal isotope generator rather than a large solar array. Secondly, the device has a working autonomous coordinate program and can execute it flawlessly. And finally, the device is able to print multiple layers of cement into a pre-programmed shape. In the end, a fully functioning prototype was constructed and was able to autonomously 3D print a sample from the cement and water mixture thus achieving the engineering goal!

Awards Won:

Fourth Award of $500