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DEVELOPMENT AND TESTING OF ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS FOR DEEP SPACE HABITATS

Abstract

As humans venture into deep space they will be residing in planetary habitats or orbiting platforms such as NASA's Deep Space Gateway. The University of North Dakota, thanks to a NASA grant, developed the Inflatable Lunar/Mars Habitat (ILMAH). The ILMAH is an analog planetary habitat used to aid in the research of new technologies and methods for crew operations while conducting a deep space mission. Currently at ILMAH, there are five modules that make up the analog space habitat. However, while the habitat can be used at full capacity there is no way to effectively monitor and control the environmental conditions and Life Support Systems (LSS) of the habitat. This project researches methods and technologies to develop an effective strategy for environmental monitoring and control of ILMAH's environmental and LS systems. Ultimately, through the integration of electronic hardware and computer software, the control system would be able to manage core habitat systems effectively with limited human interaction. The project is divided into two phases.

The first phase is the development and maturation of environmental data monitoring and collection system. The second phase is the design of an autonomous control system. Currently the development and refinement of the first phase of the project is under way.

The environmental monitoring system is comprised of two subsystems. Wireless sensing hardware and a web application. The two subsystems have been integrated at ILMAH and are currently undergoing rigorous testing on site. The sensor nodes have a microcontroller which takes in data readings from multiple environmental sensors. The data is compiled into data packets by the microcontroller and sent down the network chain to the main node, which takes in the data packets and dispatches it to the off-site database where a data handling algorithm parses the data and populates the database. The web application takes in data from the database and populates the user interface (UI). The UI allows users to visualize all the critical data for all the modules in real time but also offers more in-depth analysis for each module.

The environmental monitoring system will continue to be developed to a point of maturity where the data being collected can be manipulated by a control system that will manage habitat core systems without the need for constant human presence, as needed for future human deep space missions.

Keywords - Wireless Sensing, Environmental Control, Internet of Things, Deep Space, Habitat, Life Support