Fiscal Year:	FY 2016	**Task Last Updated:**	FY 09/13/2016
PI Name:	Vos, Gordon Ph.D.		
Project Title:	A Tool for the Automated Collection of Space Utilization Data		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Organization Name:	Wyle Laboratories/NASA Johnson Space Center		
PI Address 1:	SF3 - Habitability and Human Factors Branch		
PI Address 2:	2101 NASA Pkwy		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058-3607	**Congressional District:**	36
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	07/21/2014	**End Date:**	05/31/2018
No. of Post Docs:	1	**No. of PhD Degrees:**	1
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	1
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Williams, Thomas	**Contact Phone:**	281-483-8773
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Flight Program:			
Flight Assignment:	NOTE: End date change to 5/31/2018 per E. Connell/JSC HRP (Ed., 3/22/18) NOTE: Extended to 10/01/2018 per E. Connell/JSC HRP (Ed., 4/24/17) NOTE: Element change to Human Factors & Behavioral Performance; previously Space Human Factors & Habitability (Ed., 1/19/17)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	This HERO FLAGSHIP NASA Research Announcement (NRA) response has been written to address item J of Appendix A of the NRA (Automated Data Collection Tools for Habitability Design and Assessment), PRD (Program Requirements Document) Risk of Incompatible Vehicle/Habitat Design, as well as associated IRP (Integrated Research Plan) Gap Space Human Factors Engineering (SHFE) SHFE-HAB-09. The objective of this proposal is to develop and validate an automated data collection system that delivers data useful in the analysis of space utilization and vehicle habitability pertaining to crew activities on the International Space Station (ISS) as well as potential long duration space missions. The investigation will utilize two independent technologies, 3D RFID-Real Time Location System (RTLS) and Microsoft Kinect 3D volumetric and anatomical scanning tools, integrating them into a single solution. The project will advance the integrated system through validation using the Human Research Program (HRP) Human Exploration Research Analog (HERA) platform. This synthesis of 2 technologies will enable HRP to collect all of the specific data and metrics requested by the NRA, as well as several additional measures. This comprehensive data collection methodology will provide data regarding: (a) the number of crew present in each area of the vehicle at any given time, (b) the quantity of time crew spend at each workstation in the performance of tasks, (c) the physical orientation of crew while utilizing the provided volume, (d) frequent or common translation paths and traffic flow patterns within the volume, (e) operational flow/volume required for mission tasks by single or multiple crew in the vehicle, and (f) 3D biomechanical and postural data related to individual and team based tasks. The expected significance of this project is that it will provide NASA with a quantitative methodology for collecting data 3D space utilization data that is validated for use in flight analogs and has potential direct applicability for use in actual flight environments. This is a capability that does not currently exist at NASA, and will have a significant positive impact on NASA’s ability to generate quantitatively derived net habitable volume requirements by task and mission. It will also feed directly into the use of computational modeling and simulation for habitat/vehicle design by providing a valid method to generate input data for modeling efforts.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The results of this study and the tools developed can be leveraged in the design of habitats, vehicles, and constrained environments on Earth. The tools will allow for automated assessment of the volume used by personnel in the execution of a given task, as well as their interaction with other personnel collocated in the same work environment. This has application in the design of multiple environments including maritime, naval, aviation, space, and ground based environments.
Task Progress:	- Created laboratory R&D environment at Johnson Space Center (JSC) Building 15, with additional lab environment at University of Nebraska-Lincoln (UNL) - Programming work on multiple fronts including RFID and Kinect data collection: - Graphical User Interface (GUI) and integration framework for the system - Creation of rendering framework, integration with standard Windows form functionality, etc. - Visualization and analysis technologies - Environment loading, transparency modulation, wire-framing - Camera control modes (1st and 3rd person perspectives) - Point cloud acquisition, bill-boarded geometry shader based rendering, accumulation/buffering over time, and hard disk based data storage - Skeletal tracking of up to 6 people simultaneously, with real-time calculation of joint angles - Volume calculation from point cloud data (multiple methods / algorithms implemented) - Collection of data from the Ultra Wide Band Radio Frequency Identification - Real Time Localization System (UWB RFID-RTLS) system - Current work is focusing on integration of multiple Kinect devices for more fully realized volume determination.
Bibliography Type:	Description: (Last Updated: 06/19/2018)