Fiscal Year:	FY 2011	**Task Last Updated:**	FY 06/14/2011
PI Name:	Sandor, Aniko Ph.D.		
Project Title:	Displays and Controls Interfaces		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
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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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	08/30/2010	**End Date:**	09/30/2013
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 9/30/2013 per HRP Master Task List information dtd 11/11/2011 (Ed., 1/5/2012)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Archer, Ronald (Lockheed-Martin/ NASA Johnson Space Center) Boyer, Jennifer L. (Lockheed Martin/NASA Johnson Space Center)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Future exploration missions will require much greater crew autonomy, particularly for suited operations. Crews will be extremely dependent on the information available within the spacesuit for monitoring their health and suit resources, and for performing tasks. Suit data such as battery power, oxygen remaining, crew biomedical data, procedure and task information, and navigational data are all needed by EVA crewmembers to successfully complete their mission. If informational displays are poorly designed, or not easily accessible, crews will not have access to critical data, putting their mission and personal safety at risk. Suits pose special challenges in terms of information display and interaction, given limited display real estate, and gloves and helmets compromise vision, hearing, and touch. The methods by which information is delivered need to support, not hinder, task completion. Current EVA crewmembers depend heavily on communication with the ground for completion of their tasks. Future missions to more distant destinations will require a much different approach to ensure crew independence. This line of research will focus on: 1) special techniques for formatting data delivered in a spacesuit, and 2) mechanisms for delivering and interacting with that data, given suit constraints. Researchers will first identify the different classes of information needed by the suited crewmember, then determine the modality and format of the data required for each class, and finally investigate the best technology solution to provide the data. Researchers will work with EVA Physiology, Systems and Performance (EPSP) researchers and developers using the metabolic data display issue as a case study. Various information designs and technology solutions will be empirically compared and requirements developed. Methods to be used consist of the following: Task analysis, to identify and understand the suited tasks to be performed, including interviews with EVA astronauts to understand suited information needs and issues from the astronauts perspective; literature reviews on different information display techniques for different classes of data (e.g., procedures, alarms, metabolic data) and available technologies (e.g., Head Mounted Displays (HMDs), cuff checklists, voice); and usability testing and experimental studies to assess human performance with the proposed designs using metrics such as error rates, task completion times, verbal protocol comments, and questionnaire responses, ratings, and rankings. Standard parametric and non-parametric statistical methods will be used for data analysis. Multiple methods, metrics, and information developed as part of the Information Presentation (2008-2010) DRP will be leveraged in this project, including information on labels, alarms, cursor control devices, HMDs, and health and status displays. Products developed as part of the Usability (2008-2009) Directed Research Project will be validated as part of this new DRP, including methods and metrics for error rates, legibility, and consistency.
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research, which requires focused and constrained data gathering and analysis that is more appropriately obtained through a non-competitive proposal.
Research Impact/Earth Benefits:	
Task Progress:	Suit data are displayed on specific EVA informational displays. Suits pose special challenges in terms of information display and interaction, given limited display real estate. Furthermore, gloves and helmets compromise vision, hearing, and touch. The methods by which information is delivered need to support task completion. If informational displays are poorly designed, or not easily accessible, crews will not have access to critical data, putting their mission and personal safety at risk. Current EVA crewmembers also depend heavily on communication with the ground for completion of their tasks that adds to the complexity of interfaces. Future missions to more distant destinations will require an approach that makes information presentation to EVA crews more efficient to ensure crew independence. A literature review was conducted on EVA display and control module and related studies on head-mounted displays, voice input and cuff displays used with EVA. Most studies reviewed were conducted by NASA JSC and NASA GRC. A second activity was conducting a series of meetings with EVA stakeholders on EVA consumable data needs. The purpose of this report was to summarize the data gathered on EVA consumable data information. This was the first step toward deciding 1) what data should be displayed for crew during and EVA, 2) what is the most critical data that need to be accessed at a glance, 3) in what format should the data be displayed. The results show that generally, a procedural quick look check of all critical consumable data would be important: at the beginning of an EVA, and more frequently toward the end of the EVA. The data should be presented in the same order and same format as much as possible for consistency. Color coding, icons, and graphs are good options if they are easy to interpret. Self-check reminders are good if they are customizable for frequency. Caution and warning messages should be associated with critical values and troubleshooting information should be made available along with the C&W message. The other crewmember's (buddy's) data should be available in the same format as own data, but is needed only in contingency situations. In case of teams of two or more the data can be checked when one checks their own data. When viewed, own data and buddy data could be presented side-by-side for easy comparison with clear indication of own and buddy data. These results will be used to design an software prototype display for EVA consumables. In a third study we evaluated a legibility method developed under the Usability Directed Research Project in FY10. The main objective of the evaluation was the use of an HMD while completing a procedure suited. The legibility part was very similar to the software method developed in FY10: the target items on the HMD screen were presented with rapid serial visual presentation for 1s and the participant task was to verbally identify the item. The results show that the method can be used in suited conditions and accuracy can be calculated as specified in the Human Systems Integration Requirements verification. A fourth study evaluated a modified legibility methodology in conditions when software cannot be used during a hardware evaluation. This objective was conducted as part of a larger suited evaluation in the Human Engineering Structural Mockup. The legibility method was a timed readability approach with time and accuracy recorded. A brief review of voice recognition software was also conducted with the purpose of using it for voice commanding during EVA operations. The review focused on general background information to understand advantages and disadvantages of voice recognition software. Furthermore, previous NASA studies using voice recognition software for EVA purposes were also reviewed.
Bibliography Type:	Description: (Last Updated: 03/03/2016)