Task Book Report Generated on: 04/19/2024

PI Name: Christoudias, Mario Ph.D. Project Title: Automatic Video-based Motion Analysis  Division Name: Human Research Program/Discipline: Program/Discipline- Element/Subdiscipline: Joint Agency Name: TechPort: No  Human Research Program Elements: (1) SHFH: Space Human Factors & Habitability (archival in 2017)  Human Research Program Risks: (1) SHFH: Space Human Factors & Habitability (archival in 2017)  Human Research Program Risks: (1) SHFH: Space Human Factors & Habitability (archival in 2017)  Human Research Program Risks: None  Space Biology Element: None Space Biology Special Category: None PI Email: mario.christoudias@veena.com Fax: FY PI Organization Type: NOUSTRY Phone: (617) 864-0636 x3133 Organization Name: Veena Technologies, Inc. PI Address 1: 6404 Ivy Lane, Suite 500 PI Address 2: PI Web Page: City: Greenbelt State: MD  Zip Code: 20770-1423 Congressional District: 5 Comments: Veena Technologies, Inc. corporate address is Greenbelt, MD. PI is located at Veena location in Cambridge, MA. Project Type: GROUND Solicitation Funding Source: Survey Source: Survey Source: Survey Source: No. of PbD Degrees: No. of PbD Candidates: No. of Bachelor's Degrees: No. of PbD Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: No. of Bachelor's Cardidates: Monitoring Center: NASA JSC Contact Monitor: Whitmore, Mihriban Contact Phone: 281-244-1004 Contact Email: mihriban.whitmore-16/inses.gov Flight Program:	cal Year:
Project Title: Automatic Video-based Motion Analysis  Division Name: Human Research  Program/Discipline:  Program/Discipline- Element/Subdiscipline:  Program/Discipline- Element/Subdiscipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Interport: No  Joint Agency Name: TechPort: No  Human Research Program Elements: (1) SHFH:Space Human Factors & Habitability (archival in 2017)  Human Research Program Risks: (1) Harta-Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture  Space Biology Element: None  Space Biology Special Category: None  PI Email: None  PI Email: Mario Adverse Outcomes Due to Inadequate Human Systems Integration Architecture  Proparalization Type: INDUSTRY Phone: (617) 864-0636 x3133  Organization Name: Vecna Technologies, Inc.  PI Address 1: 6404 by Lane, Suite 500  PI Address 2: PI PI Address 2: PI PI Web Page:  City: Greenbelt State: MD  Zip Code: 20770-1423 Congressional District: 5  Comments: Vecna Technologies, Inc. corporate address is Greenbelt, MD. PI is located at Vecna location in Cambridge, MA.  Project Type: GROUND Solicitation / Funding Source: SIR Phase II Source: Start Date: 01.01/2013 End Date: 08/31/2015  No. of Post Does: No. of Past Does: No. of Past Degrees: No. of Master' Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Candidates: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degree	
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Key Personnel Changes/Previous PI: NOTE: PI change from Neal Checka to C. Mario Christoudias, Ph.D. in 2015. Additional personnel are Prasad, Hard MS; Kethamakka, Sai MS; and Thangali, Ashwin PhD.	y Personnel Changes/Previous PI;
COI Name (Institution):	I Name (Institution):
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Understanding task performance and crew behavioral health is crucial to mission success and to the optimal design, development, and operation of next-generation spacecraft. Onboard resources, like a conventional 2D video camera, capture crew motion and interaction; however, there is a critical need for a software tool that achieves unobtrusive, non-invasive, automatic analysis of crew activity from this footage.  The proposed automatic video-based motion analysis software (AVIMA) supports this R&D effort by automatically processing and analyzing complex human motions in conventional 2D video without the use of specialized markers. Unlike many video analytics solutions, AVIMA goes beyond simple blob-based video analysis by tracking the geometric configuration of human body parts like the trunk, head, and limbs. This tracking enables human motion understanding algorithms to model and recognize complex human actions and interactions.	

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The resulting system will represent a substantial breakthrough providing benefits to an array of applications in video surveillance, human-computer interaction, human factors engineering, and robotics.

Aims for Phase II:

Phase II work will leverage the Phase I preliminary designs and prototype results to design and implement a complete human motion analysis and visualization tool.

- 1. Enhance the human motion analysis module to automatically estimate 3D human body pose from 2D video footage and to enable quick and robust tracking across a variety of operating scenarios.
- 2. Investigate and implement a video analytics module that employs state-of-the-art machine learning algorithms to interpret the subjects' movements with respect to their operational environment, objects in the environment, and other crewmates.
- 3. Design and implement a user friendly graphical user interface that allows the user to define events/actions to recognize, visualize, and quantify results more quickly.
- 4. Evaluate the usability, accuracy and robustness of the individual algorithms as well as the end-to-end software system both qualitatively and quantitatively. Test the prototype with potential end-users at NASA.

Aims for Phase II E: Phase II E: continues the work from Phase II, focusing on pursuing 2-D video analysis focusing on microgravity video (i.e., floating postures for person detection and tracking)

POTENTIAL NASA COMMERCIAL APPLICATIONS: Vecna expects the full-scope software system to have immediate and tangible benefit for NASA's Exploration Systems Mission Directorate (ESMD). ESMD focuses on the human element of exploration by conducting research to ensure astronaut explorers are safe, healthy and can perform their work during long-duration space exploration. Task performance and crew behavioral health are key concerns in the design, development, and operation of next generation space vehicles. Operations in confined, isolated, and resource-constrained environments can lead to suboptimal human performance. As such, there is a critical need for Vecna's proposed software tool that automatically processes and analyzes crew motion and interaction from video footage captured by a single conventional 2D video camera. Such a diagnostic tool will enable unobtrusive and non-invasive measurement of task performance and crew behavioral health.

## Rationale for HRP Directed Research:

**Task Description:** 

The proposed technology is applicable to a wide range of Department of Defense (DoD) and intelligence community areas including force protection, counter-terrorism, human activity monitoring, and surveillance and tracking. We see significant potential for application of this tool to support a range of tactical and strategic systems, including shipboard Navy CIC centers, Army field C3I centers, or USAF theater airborne command posts. A number of programs sponsored by the DoD (FCS, HumanID, CTS, Mind's Eye, Rail Security Pilot) employ video-based monitoring systems and would benefit from the proposed system. Also, Vecna will investigate commercialization opportunities in other sectors, including mobile robotics, interactive displays, and visual surveillance. Initial analysis of these market segments reveal both unaddressed needs as well as vast potential for rapid adoption and growth.

Research Impact/Earth Benefits:

As robotic systems become more commonplace in today's society, robust, intelligent interaction between humans and robots is essential. To interact with humans in a lifelike manner requires the robot to infer physical intentions based on visual cues. The proposed technology could potentially revolutionize human-robot interaction. In the surveillance market, automated screening provides an immediate and extant application opportunity for AVIMA. Digital signage and displays provide another venue for applying the AVIMA technology within healthcare.

Task Progress:

New project for FY2013. Reporting not required for this SBIR Phase 2 project. NOTE also PI change in 2015 from Neal Checka to C. Mario Christoudias, Ph.D.

**Bibliography Type:** 

Description: (Last Updated: )