Project Introduction

Frequent, short-term crew exposure to elevated CO2 levels combined with other physiological impacts of microgravity may lead to a number of detrimental effects, including loss of vision. This technology project seeks to develop a prototype of a real-time location system integrated with a CO2 sensor to monitor and correlate space-time-CO2 concentration with physical symptoms and functional evaluations of impairment. The CO2 sensor will be integrated with a low-power ultra-wideband (UWB) communication system with location-tracking capability. Although the initial development is oriented to the measurement of CO2, the system concept can easily be adapted to accommodate other types of sensors.

Recent findings indicate that frequent, short-term crew exposure to elevated CO2 levels combined with other physiological impacts of microgravity may lead to a number of detrimental effects, including loss of vision. To evaluate the risks associated with transient elevated CO2 levels and design effective countermeasures, doctors must have access to frequent CO2 measurements in the immediate vicinity of individual crew members along with simultaneous measurements of their location in the space environment. To achieve this goal, a small, low-power, wearable system that integrates an accurate CO2 sensor with an ultra-wideband (UWB) radio capable of real-time location estimation and data communication is proposed. This system would be worn by crew members and would automatically gather and transmit sampled sensor data tagged with real-time, high-resolution location information. Under the current proposed effort, a breadboard prototype of such a system will be developed. Although the initial effort is targeted to CO2 monitoring, the concept is applicable to other types of sensors. For the initial effort, existing EV Modular Instrumentation System (MIS) Wireless Sensor Network (WSN) hardware will be leveraged to integrate a low-power CO2 sensor with a commercially available UWB radio system with ranging capability. In addition, potential for integration of this system with EV's Electronic-textile System for the Evaluation of Wearable Technology (E-SEWT) will be evaluated.

Anticipated Benefits

Following development and testing in several JSC labs to characterize location accuracy with CO2 sensors, a garment can be created to integrate electronics with sensor for CO2 mapping on ISS or future exploration missions. The system can be expanded to include other sensors, such as noise, O2, or other bio-telemetry data, that must be correlated with localization data. In addition, aspects of the technology can be applied to other applications where location-tagged environmental data is required from a mobile device.
Primary U.S. Work Locations and Key Partners

<table>
<thead>
<tr>
<th>Organizations Performing Work</th>
<th>Role</th>
<th>Type</th>
<th>Location</th>
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<tbody>
<tr>
<td>Johnson Space Center (JSC)</td>
<td>Lead Organization</td>
<td>NASA Center</td>
<td>Houston, TX</td>
</tr>
</tbody>
</table>

**Primary U.S. Work Locations**

- Texas

**Organizational Responsibility**

- **Responsible Mission Directorate:**
  Space Technology Mission Directorate (STMD)

- **Lead Center / Facility:**
  Johnson Space Center (JSC)

- **Responsible Program:**
  Center Innovation Fund: JSC CIF

**Project Management**

- **Program Director:**
  Richard T Howard

- **Program Manager:**
  Carlos H Westhelle

- **Project Manager:**
  David Hafermalz

- **Principal Investigator:**
  David Hafermalz

[For more information and an accessible alternative, please visit:](https://techport.nasa.gov/view/12094)

Printed on 08/27/2020 06:50 PM GMT
Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
Completed Technology Project (2012 - 2013)

Images

12094-1376604392820.jpg
Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(https://techport.nasa.gov/image/2222)

12094-1376604443592.jpg
Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(https://techport.nasa.gov/image/2223)

12094-1376605515791.png
Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(https://techport.nasa.gov/image/2224)

Technology Maturity (TRL)
Start: 3
Current: 3
Estimated End: 4

Technology Areas
Primary:
- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.4 Environmental Monitoring, Safety, and Emergency Response
  - TX06.4.1 Sensors: Air, Water, Microbial, and Acoustic