

## Wireless Mobile Sensor System Monitors Vital Signs of Astronauts in Real Time

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### Background/Problem

To guarantee the safety of astronauts on board the space shuttle or international space station it is necessary to continuously monitor their basic vital signs. Ideally, the system used to accomplish this task is non-invasive, lightweight, and robust so it can be used in all operational scenarios without impacting the astronaut's performance. Currently, vital signs are monitored only during exercise routines and EVAs (Extra Vehicular Activities, or space walks). The systems used are hard-wired, cumbersome, and the acquisition and archiving of measured vital signs is non-automated and often requires manual entry. There is clearly a need for a better solution, which is presented here.

### Method and Tools

NASA Ames and the National Biocomputation Center at Stanford University jointly developed a portable physiological monitoring system that combines user-friendly medical sensors, portable computing platforms, a wireless network architecture, and intelligent software for data display, storage, and analysis. The vital signs sensors are based on a commercial home-healthcare system and measure ECG, respiration, heart rate, pulse oximetry, and temperature. All sensors are integrated into a single harness that is easy to apply and completely non-invasive. The sensor harness includes a signal-conditioning device that is connected to a Pocket PC that formats and transmits the data to a wireless LAN access point inside the shuttle or station. From there it is distributed to wireless portable display devices, a local database, or downlinked to Mission Control. Data distribution is accomplished by a switchboard server, which receives input from a variety of sensors using a standard protocol, and distributes the information to multiple viewers. The system integrates with the existing wireless LAN on the space station, and is expandable to include environmental sensors as well. The software supports various sensor types, handheld and head-mounted wireless display devices, and is able to alert the crew when the measured vital signs exceed pre-set limits or conditions.

### Novelty

The system presented here differs considerably from other telemedicine systems that are currently on the market. Most systems available today are inadequate for the operational scenarios encountered by astronauts. They do not address the unique challenges encountered in space: the need for wireless real time monitoring, the ad-hoc establishment of a wireless network which includes multiple subjects and a variety of multiple display devices, and the high degree of

robustness and reliability that is required. Our system was designed to address these aspects.

#### Results

A prototype of the system has been developed and is currently being tested in close collaboration with NASA Medical Operations personnel at Johnson Space Center. The results of this test will be used to further refine the system and optimize the software to facilitate its transition into both space and ground-based medical operations at NASA.

#### Conclusions

Our sensor system addresses the need to monitor vital signs of astronauts continuously and in real time, with low impact on the astronauts' daily activities. It was designed as a modular system and allows the integration of other sensors, wireless LAN standards, and computing platforms. Its use is not limited to space applications, it can potentially be used in medicine, home healthcare, and military applications as well.