**INTRODUCTION**

Biomedical monitoring, environmental monitoring, and countermeasure delivery are essential to manned spaceflight. However, there is currently no in-flight method to integrate the multitude of different devices, to synchronize data streams, to allow on-board data viewing, or to help integrate countermeasure or therapy capabilities. As a result, considerable time and training burdens are placed on astronauts and ground personnel for medical data collection and management. To address this gap (ExMC 5.01), we are developing SpaceMED: an end-to-end platform to integrate in-flight data acquisition, synchronization, storage/archiving, display, control and decision support, to which distributed medical and environmental systems will be able to connect and interact.

**METHODS**

The SpaceMED platform is designed as a highly configurable, multi-process system composed of three modular software layers. The MEDcomm layer implements IEEE standard protocols for plug-and-play communication with hardware components in their native “language” (e.g., Bluetooth, WiFi, USB, Radio). An RFID tagging system enables easy and rapid pairing of devices with people or physical locations. The MEDproxy layer provides a guaranteed-storage path to a relational database to compile, synchronize and query data coming from the MEDcomm layer. Data can be extracted and viewed from the database, and a real-time data pipe has also been implemented. A flexible key:value based storage design enables re-configuring data and sensor relationships without altering underlying data tables. The graphical MEDview layer provides browser/HTML5-based, cross-platform data visualization (supporting Windows, iOS, Android and Linux). Multi-computer scalability for each layer and robustness to loss of signal (LOS) remain key features. A data path using OpenDDS is being developed to integrate with NASA ExMC’s Exploration Medical System Demonstration (EMSD).

**RESULTS**

Version 2.1 of the SpaceMED prototype platform has been completed and was demonstrated to NASA in Sept 2013. Testing and optimization is ongoing, but to date MEDcomm has achieved 12 kHz of synchronized data throughput, using 6 wireless sensors (ECG x2, accelerometry x2, EMG, and CO2) each running at 500Hz with (on average) 4 bytes/sensor. Multi-computer configurations and LOS robustness have been tested, as well as simultaneous webcam audio and video streaming during data acquisition. Through-the-database display latencies are typically <2 sec. MEDview enables selective viewing of historical or real-time data as well as photos, video and text annotations.

**DISCUSSION**

The SpaceMED prototype provides a single platform for integrating both existing and future biomedical and environmental monitoring, diagnosis and countermeasure devices, including those not designed to operate together. The autonomous nature of data acquisition and management will eliminate substantial time and training demands on astronauts for system use and maintenance, as well as providing new real-time synchronization and onboard display capabilities. We are actively planning integration of SpaceMED with the EMSD ground demonstration in 2014.

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