Remote Arrhythmia Monitoring System Developed

Telemedicine is taking a step forward with the efforts of team members from the NASA Glenn Research Center, the MetroHealth campus of Case Western University, and the University of Akron. The Arrhythmia Monitoring System is a completed, working test bed developed at Glenn that collects real-time electrocardiogram (ECG) signals from a mobile or homebound patient, combines these signals with global positioning system (GPS) location data, and transmits them to a remote station for display and monitoring. Approximately 300,000 Americans die every year from sudden heart attacks, which are arrhythmia cases. However, not all patients identified at risk for arrhythmias can be monitored continuously because of technological and economical limitations. Such patients, who are at moderate risk of arrhythmias, would benefit from technology that would permit long-term continuous monitoring of electrical cardiac rhythms outside the hospital environment.

Embedded Web Technology developed at Glenn to remotely command and collect data from embedded systems using Web technology is the catalyst for this new telemetry system (ref. 1). In the end-to-end system architecture, ECG signals are collected from a patient using an event recorder and are transmitted to a handheld personal digital assistant (PDA) using Bluetooth, a short-range wireless technology. The PDA concurrently tracks the patient's location via a connection to a GPS receiver. A long distance link is established via a standard Internet connection over a 2.5-generation Global System for Mobile Communications/General Packet Radio Service (GSM/GPRS)[1] cellular, wireless infrastructure. Then, the digital signal is transmitted to a call center for monitoring by medical professionals.

Three-lead ECG signal displayed at a call center along with real-time GPS tracking of a patient's location.
Long description.

The call center is a personal computer with an Internet address that collects and displays the ECG signal in the traditional strip chart fashion. Because the GPRS network capacity is shared among many users in a given coverage area, data throughput varies. Software developed for the call center monitors the data rate, buffers the ECG signal as needed, and dynamically adjusts the display update to keep the strip chart in constant motion.

Non-ECG data are also transmitted from the patient event recorder to create a safer, viable system. The event recorder can display a low-battery indicator and send an alert to the call center to ensure the condition is acknowledged and addressed. In addition, a patient can send a noncritical medical alert to the call center by pressing a button on the event recorder when a heart flutter or other unusual feeling occurs. The time of the alert is marked in the ECG signal stream for later inspection by a cardiac specialist. Finally, a panic button is available to patients to send a critical alert for help. Call center personnel will be able to dispatch 911 services and provide them with the most recent GPS position to locate the patient.

---

[1]Global System for Mobile Communications/General Packet Radio Service.

References

1. Daniele, Carl J.: Embedded Web Technology: Internet Technology Applied to Real-Time System Control. Research & Technology 1997, NASA/TM-1998-

206312, 1998, pp. 165-166.
http://www.grc.nasa.gov/WWW/RT1997/7000/7750daniele.htm
2. York, David W.; and Ponyik, Joseph G.: New Web Server--the Java Version of Tempest--Produced. Research & Technology 1999, NASA/TM-2000-209639, 2000, pp. 177-178. http://www.grc.nasa.gov/WWW/RT1999/7000/7750york.html

Find out more about this research:
Embedded Web Technology: http://live.grc.nasa.gov
Remote arrhythmia monitoring: http://microgravity.grc.nasa.gov/grcbio/heart.html

Glenn contact: David W. York, 216-433-3162, David.W.York@nasa.gov
Authors: David W. York, Michael A. Mackin, Kathy J. Liszka, and Michael J. Lichter
Headquarters program office: OBPR
Programs/Projects: JGBEC, TTPO