Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Physiological Status Monitoring (PSM)

The U.S. Fire Administration (USFA) has conducted a series of annual studies of on-duty firefighter fatalities, with the latest release being the Firefighter Fatalities in the United States in 2010[(1)]. *The report states that the Line of Duty Deaths (LODD) average is about 100 a year among firefighters, half of which are attributed to heart attacks. In addition, sixty-two percent of all LODD occur between alarm, suppression, and return from a fire call. These results have identified a clear need by the fire service community to have a tracking mechanism for the health status of firefighters.*

What is PSM?

PSM, also known as personnel physiological monitoring systems, provides a way to collect, record, and report a user's vital signs. The main purpose of PSM is to allow a relatively nonintrusive measure, in real time, to record basic physiological parameters (e.g., heart rate, breathing rate, skin temperature, etc.) for extended periods. PSM consists of a suite of sensors, a wireless transmitter, and a remote monitoring station. The sensors are typically attached to the wearer by a strap around the chest or embedded into fabric. The collected information is transmitted to a remote station for monitoring or it is recorded within the device and later downloaded for analysis and interpretation. The information or data could help an incident commander, safety officer, or other relevant medical official to determine whether their personnel are fatigued, dehydrated, injured, or healthy.

PSM has been used in hospitals for a number of years; however, the technology is rapidly advancing for use in emergency response and military scenarios. The conventional PSM used in hospitals could not be used for wearable physiological monitoring applications needed for emergency response scenarios due to the following reasons[(2)(3)]:

- The hospital PSM is too bulky to be used for wearable monitoring;
- The gels used in the electrodes dry out when used over a period of time, which lead to an increase in the contact resistance and degradation of the signal quality;
- The gels used in the electrodes cause irritations and rashes when used for longer durations;
- There are a number of wires from the sensors to the data acquisition system which hamper the movement of the wearer;
- Sensor signals are affected by the motion of the wearer as the electrodes float on the layer of gel; and
- The sensors used in hospital monitoring systems are bulky and are not comfortable to wear for longer durations.

In addition, transmission of data can be a challenge in emergency response scenarios due to interference from tall buildings and other obstacles, or from operating in remote areas.

What is PSM not?

PSM is not a replacement for medical staff or doctors. It will not provide an overall health assessment from a few vital signs. PSM cannot predict or stop a heart attack. In addition, there are multiple data manipulations, calculations, and assumptions taking place so that it is almost impossible for the readings to be 100 percent accurate. This is not to say that the information is useless, but it does need to be examined by a trained professional.

Applications:

Military - The military has been investing, developing, and working with PSM technology for many years. Currently only small teams of Special Forces and other elite groups are using PSM along with location and tracking to monitor themselves during training regimens for short missions. These elite groups are small in numbers and often have to face many adverse situations. Their stress levels are generally high and it is important to be able to track that. The military uses a Performance Specifications document that describes the type of system to be used, as well as the type of information to be presented.

Emergency Responders - Currently, there are a few fire departments and police departments using the technology to develop better training regimens for their personnel. Although PSM has been around for many years and a lot of progress has been made, the technology still has not reached the level needed for wide spread usage. There are many issues regarding the successful deployment of an integrated suite of sensors, and there are limitations regarding the data transmission, the location of the integrated sensor, and the sensors themselves.

Ongoing Government Research and Development

The InterAgency Board for Standardization has included physiological monitoring as well as location and tracking and body worn electronics on their research and development priority list for several years. The U.S. Department of Homeland Security is working on the Physiological Health Assessment Sensor for Emergency Responders (PHASER) Program that combines integrated sensing, signal processing, event recognition, and wireless communication[4]. The Technical Support Working Group (TSWG) has sponsored the development of a personnel monitoring system, Zephyr, that can collect, record, and report vital signs[5]. The U.S. Army Research Institute of Environmental Medicine (USARIEM) is leading an effort for a Warfighter Physiological Status Monitoring (WPSM) system that interprets data from a suite of wearable physiological sensors to infer a soldier's current health status on the battlefield.

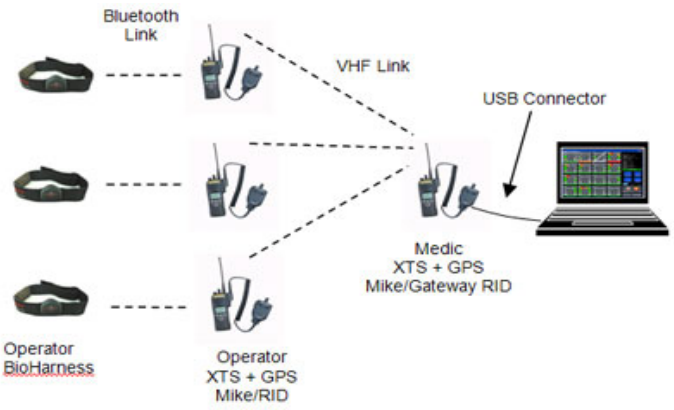

Figure 1. TSWG's Zephyr System

Limitations

One of the biggest obstacles for PSM is transmitting the measured data back to where it can be interpreted, correlated, or analyzed. There are challenges with the bandwidth, as well as some of the environments. In addition, there are areas of concern identifying who gets to see the data and how will it be interpreted. This is medical information and not everyone is qualified to make medical interpretations from the recorded data. And finally, a gap that continues to surface is which vital signs to measure. The situations vary and are dependent on factors, such as environmental conditions, and level of rest, levels of hydration, levels of stress.

References

(1) *Firefighter Fatalities in the Unites States in 2010*, September 2011, U.S. Fire Administration, FEMA, http://www.usfa.fema.gov/downloads/pdf/publications/ff_fat10.pdf, accessed October 2012.

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(4) *Where There's Smoke, There's a Signal*, Department of Homeland Security, n.d., http://www.dhs.gov/where-there%E2%80%99s-smoke-theres-signal, accessed October 2012.

(5) *Personal Physiological Status Monitoring System*, Technical Support Working Group, n.d., http://www.tswg.gov/subgroups/tos/tactical-communications-systems/zephyr-physiology-monitoring-system.html, accessed October 2012.