

DHS Science and Technology Directorate

Wireless Physiological and Environmental Monitoring (WiPEM)

Firefighting effects on health

Firefighting is exceptionally strenuous and dangerous work that can have significant health consequences for first responders, including death. According to the National Institute of Occupational Safety and Health, of the 1,094 firefighters who lost their lives from 2005-2015; the leading causes of death (57 percent) were cardiac arrest or asphyxiation. Remote monitoring of vital signs that measures heart rate, respiration and other physiological factors can help reduce negative physical outcomes.

Wireless monitoring in dangerous environments

To protect the health and lives of firefighters, the Department of Homeland Security Science and Technology Directorate (S&T) is developing a Wireless Physiological and Environmental Monitoring (WiPEM) system that transmits relevant individual data back to an incident commander and enhance the safety of first responders. The system transmits critical physiological status data on multiple first responders to the incident command station for monitoring purposes. It also provides incident commanders with critical environmental conditions surrounding a first responder to enhance situational awareness.

Saving first responder lives

This new technology will allow for simple identification of first responders who are in danger of heat exhaustion, exposure to hazardous gases or a critically low air tank supply. Sensor information is first relayed wirelessly to a device, such as a smartphone, worn by the first responder. The smartphone then passes the information through Long Term Evolution (LTE) public safety cell phone networks or via land mobile radios on the P25 emergency spectrum. Incident commanders and medics can access the data through an app that shows the physiological strain status (green, yellow or red), gas detector readings, air tank levels and the Personal Alert Safety System alarm status for each individual responder. Informed decisions can then be made whether to remove a firefighter from an operation for his or her own safety.

Phase I accomplishments

Under a Small Business Innovation Research program agreement with S&T, the Physical Optics Corporation (POC) development team successfully identified heartbeat,

skin temperature and respiration from the temple region inside a firefighter self-contained breathing apparatus (SCBA) mask. It also demonstrated the ability to maintain an airtight seal around the SCBA face mask all while monitoring physiological parameters. POC also successfully transmitted WiPEM physiological sensor and gas sensor data wirelessly via Bluetooth to Android-based smartphones.



The flexible WiPEM unit is mounted inside the SCBA mask. The curved piece rests against the firefighter's temple.

Two-year Phase II effort

During the current second phase of the WiPEM project, POC will mature the physiological sensor design and develop a fully functional prototype integrated with an existing SCBA that will be used to conduct a user operational field assessment in late 2016.

The final prototype will incorporate four major components: (1) an array of physiological sensors integrated directly onto the SCBA, (2) an array of miniaturized environmental sensors in a wearable package, (3) processing and communication electronics compatible with the Public Safety band of the LTE cell phone network and (4) ergonomic mechanical packaging.

The novel design of the open-architecture system is compatible with existing personal protective equipment. POC will work with industry leaders like Scott Safety to obtain certification for various applicable National Fire Protection Association standards in the future.

Phase II is scheduled to be completed in early 2017.



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To learn more about WiPEM, contact SandTFRG@hq.dhs.gov.