DRESSING SMART UNDER HELLISH CONDITIONS

Hot and hazardous conditions are part and parcel of jobs like fire-fighting and iron smelting. But smart electronic systems are helping to reduce that risk. Clever safety wear with built-in sensors keeps tabs on the working environment and the worker. One example, the SmartPro® fire-fighting suit, is set to become a danger disrupter when it is released next year.

The tiny sensors and microsystems embedded in protective work wear can detect dangerous gases in the environment and measure temperature and humidity inside and outside the protective clothing. This means data on working conditions (and the worker's physiological response) can be monitored and processed in real time.

Several market-ready smart-clothing technologies have been developed and tested by partners in the ADVANTEX project, funded by the EURIPIDES2 cluster programme. The 48-month project, which recently ended, focused on smart protective wear (jackets, gloves and boots) and integrated systems to safeguard workers in hazardous conditions, starting with fire-fighters.

"A key feature of the fire-fighting suit we developed is the accurate sensing of temperature in different layers of the suit, monitoring of toxic and combustible gases, and active illumination system and localisation system for tracking fire-fighters' movements," says Radek Soukup of West Bohemia University, ADVANTEX dissemination partner with expertise in smart textiles.

Holik International, a Czech industrial partner, has already commercialised one of the technologies coming out of the project. Its SensPro® protective gloves for fire-fighters include integrated technology so wearers can monitor the surface temperature of the gloves, and even measure the heat of nearby objects using an infrared sensor. The readings are shown on a highly 'visual' LED bar located on the glove, and at the same time transmitted via Bluetooth either to mobile devices with an installed SensPro® application or to a suit control unit (SCU), which in turn sends the data to the commander control unit (CCU). These readings can alert fire-fighters to impending heat build-up and danger. The SensPro® glove won the Reddot 2018 Award for best product design.

The project's many results have been well disseminated in leading journals and conferences, such as the European Conference of Protective Clothing (ECPC 2018). The smart fire-fighting jacket was awarded the Gold Prize at the AMPER 2017 electronics fair, and several of its components are patented or patent-pending, including the protective glove, suit-monitoring features, and rubber-based electrodes integrated into a shoe sole. According to Barattin, the technical partners – CEA-Leti, Vochoc, Applycon, Movea-InvenSense, Holik and APIX – have reported industrial and/or commercial breakthroughs thanks to participating in ADVANTEX. West Bohemia University has also made innovative contributions to the overall outputs.

Although the original idea for the project came from the Czech partners, it quickly became clear that expertise was needed in pinpointing fire-fighter locations (accurate 'inertial localisation' even indoors when satellite signals can drop out), low-profile MEMS-based sensors, and lightweight, robust power solutions.

> **" The real success came down to very good chemistry and leadership which ensured a friendly and creative atmosphere.**

For this, France's CEA-Leti was brought in to develop a radio frequency identification (RFID) UHF link system for remotely-powered sensor modules and sleek bulk acoustic wave (BAW) sensors – which are protected by international patents. For the remaining missing ingredients, two French commercial partners were recruited: Movea (which became InvenSense) covered inertial localisation, and APIX provided expertise in micro- and nano-electromechanical systems.

This unique cross-border match-up was ideally suited to the EUREKA programme, confirms Soukup: "Many of the partners had a positive experience working together in a EURIPIDES project, called INTEX, which is why we returned to the programme to fund ADVANTEX."