Safe Rescue

A new approach to search and rescue

Combining sensor and communication innovations, the ITEA project Safe Rescue provides first responders with a clear overview of the locations and physiological conditions of personnel affected by industrial accidents. This will save the lives of both responders and casualties by optimising the rescue process.

Project origins

When faced with an industrial accident, the tasks of emergency responders include locating and evacuating staff, identifying casualties, evaluating physical states/dangers and providing first aid. Time is of the essence, but information sharing between search and rescue agencies and emergency medical services remains difficult and potential secondary issues may be missed. Further complications include a lack of sensors to immediately assess abnormal physiological conditions and the inability to integrate results into a single output for quick analysis.

As a software instrumentation platform, the Safe Rescue project aims to improve the situational awareness of emergency responders and the response accuracy of dispatchers. This is based around a series of software and hardware tools which can locate staff in real time and determine their physiological status and the environmental hazards around them, either through their own communication or via an instrumentation package. This information is then depicted in a dashboard overview of the incident location. An AI-based decision support system for emergency dispatchers will also improve survival rates and avoid secondary incidents by planning and executing a rescue in the most efficient manner possible. Overall, these innovations will enable the location and evacuation of all individuals as quickly and safely as possible.

Technology applied

Safe Rescue's key output is a set of wearable orientation sensors consisting of three main devices: a wristband, a helmet and a gateway. The helmet incorporates both a Bluetooth Low Energy antenna array card and narrowband antenna card in order to transmit a casualty's vital data from the wristband to the gateway, while a personal tracker is used to obtain

Personal Tracker

Emergency Vest

Wristband

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location information on first responders. An emergency vest also includes hazardous gas sensors to detect the levels of carbon-dioxide and oxygen in the accident environment. Besides communicating with rescuers, the hardware also communicates on the internal network so that casualties can be located prior to the arrival of an emergency team, while a low-latency

reliable mesh network is used to maintain coverage despite infrastructure damage.

Safe Rescue has also developed innovative software to support this system, such as an angle of arrival algorithm to determine the direction of first responders in relation to one another and a relative positioning algorithm to determine their position. A key development is the Location and Situation-Aware Emergency Management Engine (LSA-EME), a specialised decision support and training mechanism which includes a decision recommendation toolbox. Members of the SafeRescue team have provided input to this tool and algorithms have

transformed these into recommendations for safety-critical situations. Likewise, an event generator tool simulates events for the purposes of training, such as if a new member joins the team. All of these location and situation data and decision recommendations are ultimately combined in an emergency operations dashboard which uses an existing location tracking system to follow the

position of first responders in real time.

Making the difference
One of Safe Rescue's notable achievements is the high TRLs (6-8) of its outputs, which will soon enable application in areas outside of the project. The wristband, for instance, was developed to track the heart rate and oxygen saturation of first responders but is now being transformed into a social distancing sensor for easier contact tracing in the face of COVID-19. The mesh network algorithm, meanwhile, can also be applied in a wearable radio for soldiers during both tactical operations and rescue missions; similarly, the LSA-EME mechanism will continue to be developed into separate products for the fire department, police and other operational teams.

In regard to commercialisation, the incident and emergency management market is expected to grow from roughly USD 93.44 billion in 2018 to USD 122.94 billion by 2023 at a compound annual growth rate of 5.6%; Safe Rescue's product class is expected to have first mover's advantage and capture a share of the market potentially comprising hundreds of thousands of users. The first steps are now being taken towards this goal: the mesh network algorithm (including hardware) is being tested militarily by Aselsan and 11 gateway pieces have been sold, while GOHM is adapting the gas sensors for atmospheric control of fruit storage containers and has signed a sales agreement for 1000 units.

In terms of dissemination, Safe Rescue has formed the basis for a PhD thesis on effective communication in post-disaster situations and a graduate course on user experience for emergency cases. As the technology can potentially make the difference between life and death, special attention has also been paid to usability. An evaluation of the emergency management dashboard has therefore been conducted and identified 13 suggestions to improve usability. Following the end of the pandemic, Borçelik intends to conduct workshops on use-case scenarios, initial prototypes and further usability assessments, helping to ensure that the results will continue to save lives long after the project's conclusion.

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Major project outcomes

Dissemination
> One PhD thesis on effective communication in post disaster situations
> Graduate course on user experience for emergency cases
> Several presentations at conferences / fairs

Exploitation (so far)
New products:
> A set of wearable orientation sensors consisting of:
  > Personal Tracker with bluetooh and narrow band antenna array
  > Wristband to collect the wearer's vital signs
  > Emergency vest with hazardous gas sensors
New services:
> Relative positioning simulator
> Situational awareness services with vital sign sensing, heart rate measurement and oxygen saturation measurement
New systems:
> Location and situation aware emergency management engine (LSA-EME) decision support system