Scientists utilise breath and sweat to detect trapped humans

September 11 2011

Molecules in their breath, sweat and skin have been used to detect humans in a simulation of a collapsed building, raising the prospect of portable sensors for use in real-life situations, such as the devastating aftermath of the 9/11 attacks and more recent disasters in New Zealand and Japan.

Published today, Monday 12 September, in *Journal of Breath Research*, the study examined flumes of air to create a preliminary profile of molecules that could indicate human activity in a disaster zone, and it is notable for being the first of its kind to use human participants.

Over five days, in six-hour intervals, eight participants entered a simulator of a collapsed glass-clad reinforced-concrete building, which was designed, built and tested by the researchers from Loughborough University, National Technical University of Athens, University of Babe-Bolyai and University of Dortmund.

A variety of sensors, positioned throughout the simulator, rapidly detected carbon dioxide (CO2) and ammonia (NH3) with high-sensitivity in the plumes of air that travelled through the constructed rubble, highlighting their effectiveness as potential indicators.

In addition to these molecules, a large number of volatile organic compounds were detected; acetone and isoprene being the most prominent potential markers.

Interestingly, there was a marked decrease in NH3 levels when the participants were asleep; a finding the researchers could not explain and will investigate further, along with the build-up of acetone with increasing food withdrawal and the presence of detectable molecules in urine.

When trapped within a void of a collapsed building, casualties release volatile metabolites -- products of the body's natural breakdown mechanisms -- through their breath, skin and other bodily fluids, which can have complicated interactions with the building materials. Furthermore, these interactions change with conditions such as humidity, heat, and wind strength and direction, making the detection process much more difficult.

By creating a simulator that closely mimicked a real-life scenario, as well as using human participants, the researchers provided the most comprehensive insight into the processes that occur within disaster sites, raising the prospect of more accurate portable detection systems in the future.

The simulator itself was composed of three separate sections: the environmental section, which maintained the air flow, humidity and temperature; the void section, in which the participant was laid down; and the collapsed-building section, which was composed of densely packed building materials.

The researchers emphasised that the most important element of the study was the provision of safe and ethical experimental conditions for both the volunteers and research staff.

Co-author of the study, Professor Paul Thomas of Loughborough University, said, "This is the first scientific study on sensing systems that could detect trapped people. The development of a portable detection

device based on metabolites of breath, sweat and skin could hold several advantages over current techniques.

"A device could be used in the field without laboratory support. It could monitor signs of life for prolonged periods and be deployed in large numbers, as opposed to a handful of dogs working, at risk to themselves and their handlers, for 20 minutes before needing extensive rest."

An Institute of Physics spokesperson said, "As the first study of its kind, this preliminary work can be built upon to help prepare for future disasters such as those tragedies we've seen recently in Japan and New Zealand."

"The trapped human experiment" was performed under the EC FP7 project "Second Generation Locator for Urban Search and Rescue" Operations.

More information: "The trapped human experiment" 2011 *J. Breath Res.* 5 046006. Paper online: www.iopscience.org/jbr/5/4/046006

Provided by Institute of Physics