A Team For An Emergency

EurekAlert

The earth is shaking, buildings are collapsing, power and utility lines as well asroads are destroyed. A disaster can have many causes, but usually the outcome is the same: chaos, panic and dedicated but overtaxed first responders. The people lying buried under the rubble hold hopes for a speedy rescue, but sometimes it takes hours or even days to work through an entire area. To make matters worse, the work of rescue personnel can become extremely dangerous. Because every minute counts when the work of saving lives is concerned, robot-supported systems are increasingly used to accelerate search operations. According to the International Federation of Robotics (IFR), the rate of growth in the use of these helpers is expected to increase to 17 percent by 2013. The experience of the past several years also shows that the impact of special robots is very minor because individual devices and systems often cannot function with one another in the field.

In the ?Sensor Network with Mobile Robots for Disaster Management" project, Fraunhofer scientists from a variety of disciplines have teamed up to solve this problem and develop a system that can effectively network all kinds of robots and sensors with one another. The team includes the Fraunhofer Institutes for Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe, for Manufacturing Engineering and Automation IPA in Stuttgart; for Intelligent Analysis and Information Systems in Sankt Augustin, for Integrated Circuits IIS in Erlangen and for Physical Measurement Techniques IPM in Freiburg. Also involved in the project, advising the researchers and as potential end customers, are the Technisches Hilfswerk (THW, the German federal disaster relief organization) and the fire departments of Berlin and Mannheim.

A mosaic of information

After disaster strikes, first responders must first get an overview of the area involved. Existing maps and data are useful, but only up to a point if there are no more buildings standing and roads have been blocked or destroyed. The helpers have to reorient themselves, and the only way to accomplish this is with the aid of technical equipment.

Even in this reconnaissance phase of the mission, networking plays a role. ?To help people, we have to find them first. To accomplish this, we use ground-based units, airborne robots and other autonomous sensors that fan out across a broad area to gather a large volume of relevant data in a short period of time," explains project coordinator Helge-Björn Kuntzee of Fraunhofer IOSB. These sensors make use of radar and laser scanners as well as optical cameras. Specially developed multi-source SLAM algorithms have the capability of generating a current 2D/3D map of the landscape using data drawn from disparate sources. For instance, these algorithms can combine low-resolution images taken from the air with close-ups of destroyed areas taken at ground level. Using these images, responders can more

quickly identify dangerous areas and the sources of damage. This gives them a better appreciation of the overall situation. Researchers are also working to develop autonomous sensors and multisensor probes that do not operate visually but respond to odors or sounds instead. For instance, these sensors are quicker at leading rescue teams to people trapped beneath the rubble who are banging to try to attract attention to themselves. Chemical sensors are particularly important to rescue personnel because they can signal the presence of gases.

A question of coordination

Once potential victims and have been located, the second step consists of mission planning. For this stage, the scientists want to create a system design to provide dynamic networking of all team members. People and robots need to be coordinated - to ensure that the right tools make it to the right location, for instance. This must be possible on an ?as-needed" basis, even if the surroundings change - due to collapsing buildings or aftershocks. Still, robots should be able to find their way through the rubble, usually without collisions. ?The network must be robust but flexible at the same time, and dynamically modifiable. Circumstances can change very quickly in danger zones," Helge-Björn Kuntzee explains of the high demands involved. To keep all responders linked despite extreme conditions, the scientists are developing their own protocol technologies combining conventional WLAN technology with standards of their own.

SENEKA is designed to quickly deploy technological innovations in practical situations. The robots and systems should be simple to operate and combine. The network is undergoing testing in emergency exercises by fire department personnel. The researchers hope that reliable teamwork between man and machine will make it possible to save more lives in the future.

SENEKA is one of seven ?Markets Beyond Tomorrow" projects. In these researchers are working to find solutions to the pressing problems of the future.

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