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RESEARCH NEWS

How to combat radiological weapons

Safety assistance system warns of dirty bombs

The threat of terrorism in Europe has been on the rise in recent years, with experts and politicians particularly worried that terrorists might make use of dirty bombs. Fraunhofer researchers have developed a new system that will be able to detect possible carriers of radioactive substances, even in large crowds of people. This solution is one of many defensive measures being realized in the REHSTRAIN project, which is focused on security for TGV and ICE high-speed trains in France and Germany.

For a long time, experts have been warning of attacks using dirty bombs, where terrorists mix radioactive material into conventional explosives such that it is scattered by a subsequent explosion. This is a real danger; ISIS, for instance, claims to have access to radioactive material. Security agencies are aware of the threat: last June, a U.S. port terminal in Charleston was evacuated and closed for several hours following a warning that a dirty bomb was on board a ship moored there. Once the all-clear was given, security personnel stated that they were being deliberately overcautious and had reacted accordingly.

Dirty bombs are not a form of nuclear weapon, since they do not rely on a nuclear chain reaction occurring after they have been set off. The radioisotopes needed to make dirty bombs, such as cesium-137, cobalt-60, americium-241 or iridium-192, are easier to get hold of than fissile material for nuclear weapons; they are used in many nuclear medicine departments at hospitals and in research centers, but also for materials testing in industry. "Five grams of cesium – scattered by a couple of kilograms of explosive – is enough to cause billions of dollars' worth of damage, to say nothing of the psychosocial effects and the impact on health. People who want to build these bombs are risking death through exposure to radiation – but that is unlikely to deter terrorists," says Prof. Wolfgang Koch, a mathematician and physicist who heads the sensor data and information fusion department at the Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE, based in Wachtberg, Germany. Fraunhofer FKIE has developed an assistance system capable of detecting radiological threats in a stream of people and warning security personnel; this is the institute's contribution to the Franco-German REHSTRAIN project, which is researching the vulnerability of ICE and TGV high-speed trains (see box: "The REHSTRAIN project at a glance"). Fraunhofer FKIE is developing the system as a subcontractor to Hochschule Bonn-Rhein-Sieg.

Contact
Janis Eitner | Fraunhofer-Gesellschaft, München | Communications | Phone +49 89 1205-1333 | presse@zv.fraunhofer.de
Silke Wiesemann | Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE | Phone +49 228 9435-103 | Fraunhoferstrasse 20 | 53343 Wachtberg | www.fkie.fraunhofer.de | silke.wiesemann@fkie.fraunhofer.de

Data protection writ large

The assistance system comprises several components: a sensor network, commercially available Kinect cameras, and data fusion software. The sensor network is made up of gamma spectrometers, which detect and classify gamma radiation. "Most of the materials that lend themselves to being used in a radiological bomb emit gamma radiation, which cannot be shielded. That's why we use this kind of sensor," Koch explains. The next phase of the system will be able to tell which substance is emitting the radiation, and whether it is being carried on someone's person or is present inside their body – perhaps because they are on medication such as radioactive iodine. Although individual sensors can provide data on the type of material and the intensity of its radiation, they cannot pinpoint its location. This calls for a network of gamma sensors connected to Kinect cameras as used in the gaming industry. The advantage of these cameras is that they provide not only images but also information about distances. Mounted on the ceiling, they record groups of people like a hilly landscape, which means they can precisely track even the busiest streams of people. "We know at any given point in time where each person is located. But of course, we don't know their identity – and that is an essential consideration for data protection," Koch adds. Biometric tracking of potential terrorists should be undertaken only when there is sufficient reason to do so.

System clearly identifies carriers of dangerous substances

Once these devices are connected to each other, they can record people in both time and space, and their data fused. Sophisticated mathematical evaluation algorithms then filter out the desired information from the huge amounts of data. "We use artificial intelligence to do this. The algorithms help us calculate the movements of the only person with whom the gamma sensor readings can be correlated. That identifies the potential attacker," Koch explains.

If they were applied at critical spots – in entrance areas and approaches to railway stations and airports or other public buildings – assistance systems of this sort could report information about radiological threats to, say, transportation company surveillance systems. The question of who has access is one for security personnel and the police.

Fraunhofer FKIE has been granted permission to experiment with weak radioactive substances, and has already successfully tested its system in the laboratory under the supervision of a radiation control agent. REHSTRAIN has been officially presented as part of a project workshop at FKIE, which in addition to partners from Germany and France was also attended by potential end-users.

The REHSTRAIN project at a glance

The terror attacks on the Brussels Metro in March 2016 showed that rail infrastructure is at risk of terrorism. Security concepts and strategic security analyses are essential protective measures against possible attack. With their open, extensive rail networks, the ICE and TGV high-speed trains present a particular security challenge. In order to guarantee the security of those traveling across borders, the partners in the REHSTRAIN project – short for Resilience of the Franco-German High-Speed Train Network – are researching how vulnerable French and German high-speed train services are to terrorist attack.

REHSTRAIN aims to protect critical rail infrastructure using a range of counterterrorism measures and to adjust security requirements to match changing threats. Research is being conducted into how smoke spreads through tunnels and how tunnels behave structurally following an explosion or a fire. The findings will be transferred to a management cockpit that has an overview of the entire rail network. The software for the complex sensor network will use artificial intelligence to help prevent attacks and to deal with the consequences of an attack swiftly and decisively – for instance by calculating alternative routes.

The German Federal Ministry of Education and Research BMBF is providing 1.5 million euros of funding to the project, which is scheduled to run from October 2015 to January 2018. Prof. Stefan Pickl of the Universität der Bundeswehr München initiated this groundbreaking idea and has taken on the role of project coordinator.

Project partners
- Universität der Bundeswehr München
- Hochschule Bonn-Rhein-Sieg, Sankt Augustin, Safety and Security Research Institute, Rheinbach
- TH Köln University of Applied Sciences
- HBI Haerter GmbH, Heidenheim
- German Federal Institute for Materials Research and Testing (BAM), Berlin
- ARMINES-LGI2P4, Nîmes
- Laboratoire central des ponts et chaussées (IFSTTAR), Bouguenais
- University of Technology of Troyes

Associated partners
- Deutsche Bahn AG, Berlin and German Federal Police, Potsdam

Further information: www.sifo.de/files/Projektumriss_REHSTRAIN.PDF (German only)

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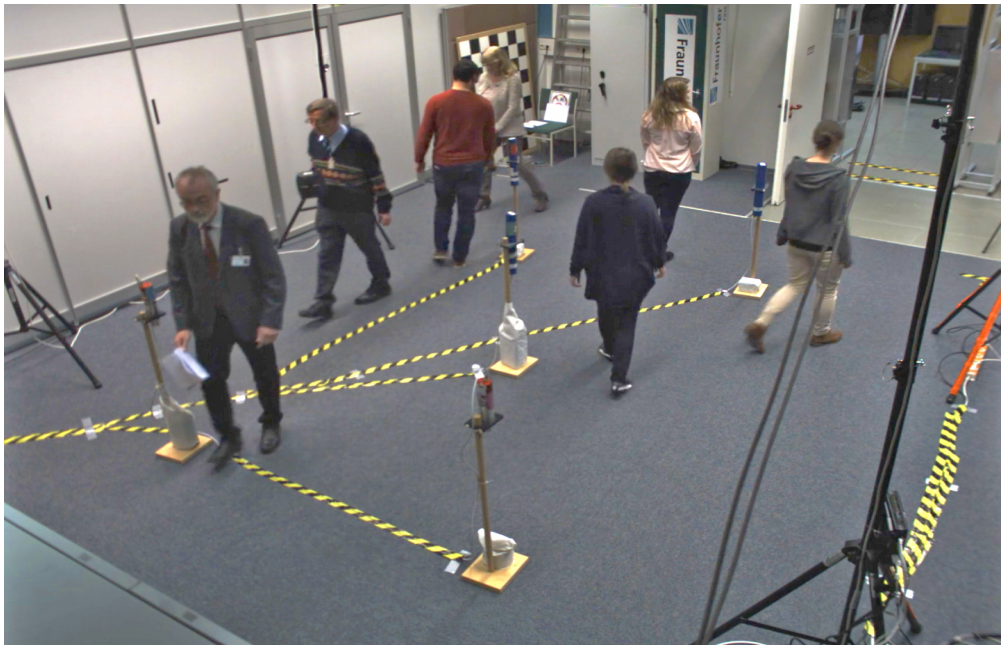

Lab testing at Fraunhofer FKIE to see how robust the security assistance system is: it must be able to clearly identify the carrier of a dirty bomb without sounding a false alarm. © Fraunhofer FKIE | Picture in color and printing quality: www.fraunhofer.de/en/press