DHS Science and Technology Directorate

X-Ray Scanning Rover

Equipping bomb technicians with a sleek, low-cost tool to disarm explosives

Improvised explosive devices (IED) pose a great danger to the bomb technicians charged with disarming them. To counter this threat, the Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) First Responders Group (FRG) is developing and testing equally sophisticated diagnostic tools so responders can quickly determine whether suspicious objects contain explosives without putting their own (and bystanders') lives at risk.

Technicians currently use a range of commercially-available x-ray scanners, but most have drawbacks that hinder a swift and safe response. For instance, mobile scanners are typically mounted on trucks—not suitable for indoor use, tight spaces or between parked vehicles. They are also very expensive and do not offer remote operation. On the other hand, portable scanners mounted on robots are easier to maneuver but they offer a small imaging area that makes it hard to effectively scan larger objects. These scanners are also not equipped for multi-view or 3-D imaging that is needed to see through any clutter. Finally, handheld scanning systems require repositioning and rescanning of objects to stitch together images for a clearer picture—a tedious and time-consuming process that does not lend itself to scanning large numbers of packages left at response scenes.

The DHS S&T FRG is working on a low-cost solution that incorporates the best features of current systems and addresses their drawbacks. The objective is to build a portable, maneuverable imaging system advanced enough to capture high-resolution images to easily identify and characterize critical IED components such as power sources, detonators and electronic circuitry. This advanced imaging system is housed in an unmanned robotic platform—the X-Ray Scanning Rover (XSR)—allowing technicians to more easily disarm the device from a safe distance.

Responder input driving prototype development

FRG developed initial XSR prototypes in 2012 and 2013 with Smart Imaging Systems Inc. (SIS). The prototypes were built on a custom robotic platform with a fold-out arm capable of scanning multiple objects in a matter of seconds. Unlike most existing scanners that use pulse x-ray energy for detection, the XSR features a continuous, fan-shaped operating x-ray beam, allowing a higher degree of penetration to capture images through dense packaging. The prototype also offers 3-D coordinates that define the location of an explosive device within a package, a capability previously not found in scanners.

The X-Ray Scanning Rover offers technicians a mobile, high-resolution imaging system that can quickly scan multiple suspicious objects.

In April 2013, FRG demonstrated the XSR for responders and bomb technicians in the Washington, D.C. metro area. Their feedback included a recommendation to integrate the XSR scanning technology into the robotic platform that technicians currently use to conserve space in transport vehicles. FRG and SIS plan to conduct additional user assessments to gather feedback on integrating XSR into the existing robotic platform. Additional improvements to stabilize the scanning arm and software enhancements were also suggested.

FRG and SIS are working to incorporate responder feedback into designs for the next generation of prototypes, anticipated to be released in spring 2016.

Looking ahead: Field testing with responders and enhancing XSR user interface

The next phase of prototype development will include upgrades to the XSR software and user interface, including automation of critical functions and a single display of all data, images and video captured. Once the next prototype devices have been built, FRG and SIS will conduct a series of tests with first responders in an operational field setting.

To learn more about the X-Ray Scanning Rover, contact SandTFRG@dhs.gov.

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