System Assessment and Validation for Emergency Responders

Summary

March 2005

Small Robot User Assessment: Vanguard MKII-T

The U.S. Department of Homeland Security, Office of State and Local Government Coordination and Preparedness (DHS SLGCP) tasked the Technical Support Working Group (TSWG) Operational Analysis (OA) Team to provide expertise and analysis on small bomb-disposal robots. For this project, the small bomb-disposal robot is defined as a robot weighing less than 400 lbs. In support of this assignment, TSWG developed a standardized process by which small robots are assessed according to user-defined requirements under operationally and tactically relevant conditions typically encountered by the responder community. In developing their assessment project, the TSWG OA Team evaluated the robotic system by allowing participants to deploy the robot in response to operational scenarios, which are common and well documented in actual bomb squad response reports. In addition, they identified tasks common to law enforcement and fire department bomb technicians requiring access to and defeating an improvised explosive device (IED). These tasks were inclusive of arrival, set up of robotic system, and access to the target, as well as employment of render safe procedures.

The first phase of this project, the user assessment of the Vanguard MKII-T, has been completed and the results are now available on the SAVER website. The second part of this analysis is the logistics support data which is being collected from the user over a twelve month period and will be included as an addendum at a later date.

Background

The use of robotics by law enforcement and fire department bomb squads is not well documented. Based on information from bomb squads across the nation, and from the FBI Hazardous Devices School, early RCVs were a mix of off-the-shelf and military procured systems.

One of the earliest documented uses of robots by civilian bomb squads dates back to the 1974-1975 timeframe. The Louisiana State Police purchased the British Wheelbarrow, manufactured by the Morfax Company. In the 1980s, some bomb squads procured off the shelf commercially available robot systems such as the U.S. manufactured Ferrett and the HARE, while other civilian bomb squads obtained military procured robots, through government channels. Over the years as the need has increased, more and more companies have begun designing and manufacturing robotic platforms for law enforcement and public safety use. These vehicles range from micro sized, used for reconnaissance in confined spaces, to remote controlled forklifts and Bobcats, used for moving suspect vehicles and placing large disruption charges.

In a study sponsored by the National Institute of Justice (NIJ) dated April 2000, nine key attributes were identified for bomb disposal robotics. Of these nine attributes, low cost was identified as the most important. In most cases, city governments tried to keep the cost of robotics to no more than the cost of a police car, approximately $30,000. As such, the ability of manufacturers to provide a quality system that meets the other eight attributes is a continuing challenge.

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For more information on the Small Robot User Assessment, visit the SAVER website or contact the SAVER Program Office.

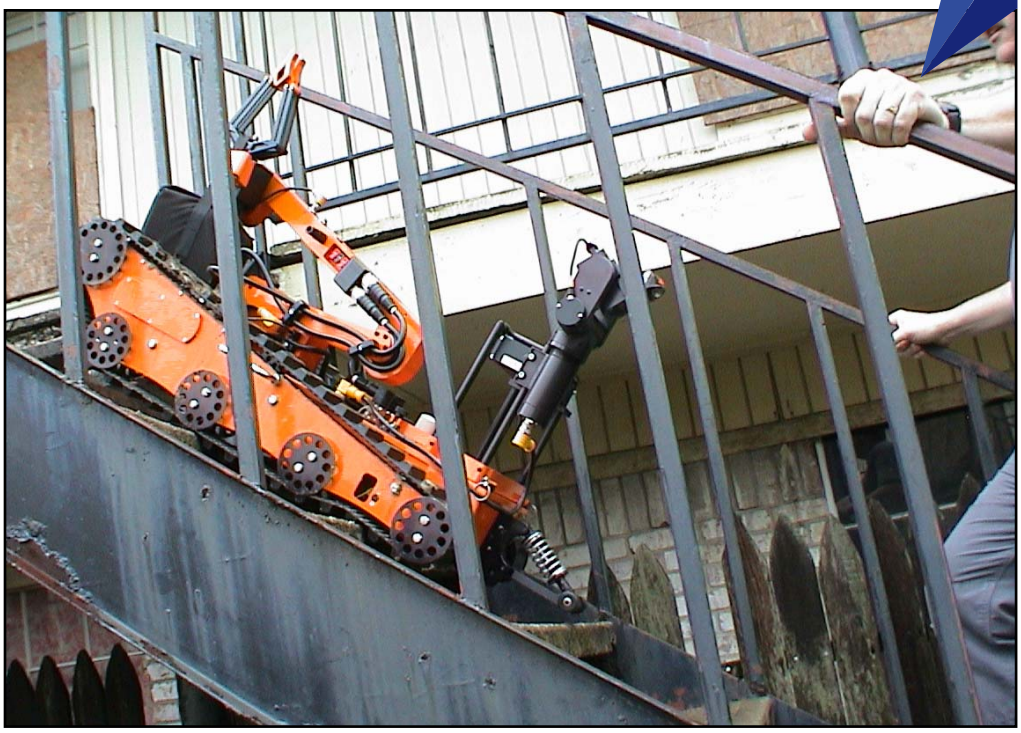
Current and Emerging Threat

The increased threat of terrorism, both domestic and international, presents a real challenge for bomb technicians. Domestic terrorists have proven to be innovative, with threats ranging from standard pipe bombs to the large scale Vehicle Borne Improvised Explosive Devices (VBIED) as seen in the Oklahoma City bombing. On the International front, terrorist groups like Al Qaida introduce the potential for complex IEDs, radio controlled devices, as well as the use of secondary devices used to kill bomb technicians. As a result, civilian bomb squads continue to have an increased need for robotics. The small robot category meets that need by providing a wide range of capabilities, that is easy to deploy, can be used in restricted areas, and at a significantly lower cost than larger robotic systems.

As a result of the increased need of robots and the importance placed on cost, the National Bomb Squad Commanders Advisory Board recently approved a National Strategic Plan for U.S. Bomb Squads. This plan supports their recent mandate that all certified bomb squads must have a robotic system by the year 2009 in order to maintain accreditation. As a result, it is important that bomb squads have access to information on the capabilities and limitations of the currently available small robotic systems, to aid them in the procurement of these systems.

Evaluation

The first small robot selected for this evaluation was the Vanguard MK II-T. DHS SLGCP and TSWG worked in conjunction with the Houston Police Department Bomb Squad (HPDBS) in performing the evaluation of this system. The Vanguard MKII-T robot was provided to the HPDBS for evaluation. The bomb technicians were given manufacturer's training and



then given two months to train/practice using the robot to perform specific tasks. During the evaluation phase, the two bomb technicians each operated the robot through staged IED response scenarios, designed to test the robot's ability to perform specific mission tasks. After completing the scenarios, the technicians were given a performance survey consisting of a list of forty robotic tasks that were performed during the response scenarios. The technicians were asked to rate how the Vanguard MKII-T performed each task on a scale of zero to five, with zero indicating the Vanguard does not have the capability to perform the task and five indicating the robot can perform the task easily. The tasks, while not all inclusive, represent a large percentage of common tasks in dealing with a common IED scenario. A chart identifying the tasks and their respective ratings is included in the final report. In addition, the tasks were grouped under the SAVER Quick Look category areas of capability, deployability, and usability. A list of the tasks and their ratings under these categories is provided in exhibit 1. The results are also displayed in the star chart in exhibit 2.

After completing the task assessment survey, the participating bomb technicians were interviewed. The technicians were asked to provide positive and negative inputs on the 39 technical characteristics of the MKII-T (Technical characteristics come from the TSWG Common Architecture Document for Robotics). This information is important in understanding the user's impression of the strengths or weaknesses of the system against each specific technical characteristic. This information can be found in the final report.

The HPDBS will maintain custody of the Vanguard and will be reporting maintenance and reliability data for a period of twelve months. TSWG will update its report as the information becomes available and these updates will be available on the SAVER website. The TSWG OA Team will continue evaluating other small robotic systems over the next year, and include those evaluations on the SAVER site as they are completed.

SAVER CATEGORIES	Overall Rating
Capability	
Direct RCV by OCU	
Visual Feedback	3.5
Control/Manipulate Robot	5.0
Audio Feedback	4.5
Deployability	
Off Load	
Remove robot from vehicle	4.5
Remove OCU from vehicle	5.0
Setup	
Operational systems check	4.5
Attach tool(s)	4.0
Breakdown RCV	
Safe tools	5.0
Remove all tools	5.0
Upload	
Place robot on vehicle	4.5
Place OCU in vehicle	5.0
Usability	
Deal with Obstacles	
Avoid obstacles	4.5
Remove obstacles	4.0
Negotiate obstacles	4.5
Negotiate Terrain	
Horizontal	4.5
Vertical (terrain other than flat)	3.5
Soft/Wet (mud, snow, sand)	4.0
Rough/rocky	4.0
Negotiate Stairs or Ramps	
Configuration change to negotiate stairs	4.0
Ascend/descend stairs	3.5
Turn on stairway landing/entrances	3.5
Defeat lock	4.0
Defeat knob	4.5
Negotiate Doors	
Open door	4.5
Secure door	4.0
Pass through door	5.0
Gain Access to Targets	
Manually	4.5
Explosively	4.5
Visually inspect inside of containers	4.0
Remove target from containers	4.0
Pick up and carry away	4.0
RSP/Interrupt Device	
Arm Tool	5.0
Position disruption tool	3.5
Aim disruption tool	4.5
Fire tools	5.0
Blow in Place Attack Filler	
Place charge	4.5
Withdraw robot	4.5
Initiate charge	5.0
Isolate components	
Manually with end effector (Grabber)	4.5
Place component in closed metal container	4.5

Exhibit 1. Task ratings sorted by SAVER Quick Look categories.

Exhibit 2. SAVER Quick Look chart.