System Assessment and Validation for emergency Responders

SAVER

Summary

June 2005

Small Robot User Assessment: Mesa Matilda Block II

This report was prepared by Applied Research Associates, Inc., for the Technical Support Working Group.

The U.S. Department of Homeland Security, Office of State and Local Government Coordination and Preparedness (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 31 to 400 lbs. In support of this assignment, the 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. The TSWG OA Team evaluates 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 are 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 the project is the user assessment of specific commercially available robots; the assessments of the first two robots are now available on the SAVER Web site. The second part of the analysis is the logistics support data, which will be provided by the users over a 12 month period, and will be included as an addendum to each of the robot evaluation reports after all the data is collected.

Evaluation Process

The small robots selected for the evaluation were purchased by the TSWG with funding from the SLGCP. The SLGCP and the TSWG worked in conjunction with the supporting Urban Areas Security Initiative (UASI) City Bomb Squads in performing the evaluation of the systems. A small robotic system is provided to the supporting city, and the bomb technicians are given manufacturer's training on the system. The organization is then given 30 to 60 days to train/practice using the robot to perform specific tasks. During the evaluation phase, two bomb technicians operate 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 are given a performance survey consisting of a list of 40 robotic tasks that are performed during the response scenarios. The technicians are asked to rate how the robot performed each task on a scale of zero to five, with zero indicating the system 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 assessment report. In addition, the tasks are grouped into the SAVER categories—capability, deployability, and usability.

After completing the task assessment survey, the participating bomb technicians are interviewed. The technicians are asked to provide positive and negative feedback on the 39 technical characteristics of the remote controlled vehicle (technical characteristics come from the TSWG

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For more information on the Small Robot User Assessment Project please see the SAVER website or contact the SAVER Program Support Office.

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 assessment reports.

Small Robot Assessment

The first small robot selected for evaluation was the Vanguard MK II-T. The SLGCP and the TSWG worked in conjunction with the Houston Police Department Bomb Squad. The Vanguard assessment was concluded in March 2005. The Matilda Block II Remote Control Vehicle is the second robot to be evaluated during the Small Robot User Assessment project. The Matilda robot is manufactured by Mesa Robotic of Madison, Alabama. The Matilda is one of several small robot systems purchased by the Department of Defense for use in Iraq. The basic system includes the platform with extended length standard tracks, a battery charger, and a briefcase operational control unit that provides radio frequency (RF) control and video. Additional kits and options can be purchased. For this evaluation, the Matilda system was purchased with the following options: manipulator arm with 300X zoom camera, manual take-up fiber optic control unit, recoilless disrupter mount with laser sighting, and the Duke Pro shock tube initiator. In addition, the TSWG supplied the evaluating organization with a recoil reduction adapter, which is required when firing a PAN using the recoilless disrupter mount. The Matilda was evaluated by the Minneapolis Police Department Bomb Squad.

The total task performance score was 145 points out of a maximum of 200 points. This is a subjective rating by the bomb technicians, and is based on the performance of the robotic system combined with the operating skill of the technicians. 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. For the bomb technicians' comments regarding the technical characteristics, see the assessment report located on the SAVER Web site.

The Minneapolis Police Department Bomb Squad will maintain custody of the Matilda and will be reporting maintenance and reliability data for a period of 12 months. The TSWG will update its report as the information becomes available and these updates will be available on the SAVER Web site. The TSWG OA Team will continue evaluating other small robotic systems over the next year, and include those evaluations on the SAVER Web site as they are completed.

SAVER CATEGORIES	Overall Rating
Capability	
Direct RCV by OCU	
Visual Feedback	3.0
Control/Manipulate Robot	4.0
Audio Feedback	3.5
Deployability	
Off Load	
Remove robot from vehicle	3.5
Remove OCU from vehicle	5.0
Setup	
Operational systems check	3.5
Attach tool(s)	3.0
Breakdown RCV	
Safe tools	4.0
Remove all tools	3.5
Upload	
Place robot on vehicle	3.5
Place OCU in vehicle	4.0
Usability	
Deal with Obstacles	
Avoid obstacles	3.5
Remove obstacles	3.5
Negotiate obstacles	3.5
Negotiate Terrain	
Horizontal	4.0
Vertical (terrain other than flat)	2.5
Soft/Wet (mud, snow, sand)	3.5
Rough/rocky	3.5
Negotiate Stairs or Ramps	
Configuration change to negotiate stairs	3.5
Ascend/descend stairs	3.0
Turn on stairway landing/entrances	4.0
Defeat lock	3.5
Defeat knob	4.0
Negotiate Doors	
Open door	4.0
Secure door	3.5
Pass through door	4.5
Gain Access to Targets	
Manually	3.0
Explosively	4.0
Visually inspect inside of containers	4.0
Remove target from containers	3.5
Pick up and carry away	3.5
RSP/Interrupt Device	
Arm Tool	4.0
Position disruption tool	3.5
Aim disruption tool	3.0
Fire tools	4.0
Blow in Place Attack Filler	
Place charge	3.5
Withdraw robot	3.5
Initiate charge	4.0
Isolate components	
Manually with end effector (Grabber)	3.5
Place component in CMC	3.5

xhibit 1. Mesa Matilda Block II Remote Control Vehicle

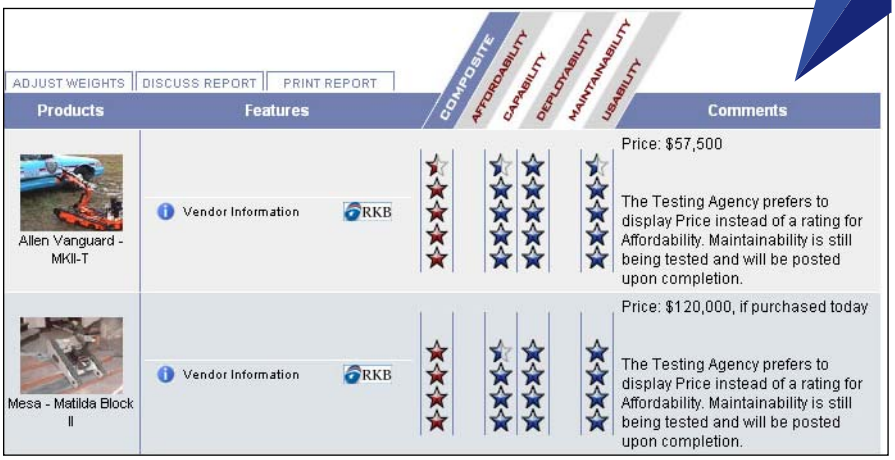

Exhibit 2. SAVER Web site: Small Robot User Assessment Quick Look