Journal of Homeland Security and Emergency Management

Volume 5, *Issue* 1 2008 *Article* 9

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Recommended Citation:
Ferworn, Alexander; Ostrom, Devin; Barnum, Kevin; Dallaire, Mike; Harkness, Denis; and Dolderman, Mike (2008) "Canine Remote Deployment System for Urban Search and Rescue," *Journal of Homeland Security and Emergency Management*: Vol. 5: Iss. 1, Article 9.
DOI: 10.2202/1547-7355.1422

Canine Remote Deployment System for Urban Search and Rescue

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Abstract

The Canine Remote Deployment System (CRDS) is a dog-mounted remote delivery system for patients trapped in rubble when human contact is precluded but access by disaster dogs is possible. The system is capable of deploying items to the trapped individual by placing them in a pouch—called an "underdog"—attached to the release mechanism. This paper describes the device, how it works, how it has been used and how it might be employed in future disasters.

KEYWORDS: USAR, canine search, CAT, CRDS

Introduction

The structural collapse of occupied buildings in urban areas can result in humans becoming trapped in voids formed by debris and deformed structural elements. This problem is discussed in Hnatko (2007) and in Collins (2006), among many other sources. It is the job of the emergency responder to find and extricate these trapped individuals as quickly and safely as possible. Often the extrication must be delayed, as the trapped people must first be found and reasonable steps taken to get to and finally rescue them.

While there have been many suggestions for automated or robotic mechanisms to traverse rubble and find casualties, including Koichi et al. (2006), Tadokoro (2005), and Gyoda (2007), often the first and best hope for finding live people in rubble is the Urban Search and Rescue (USAR) canine team. The team consists of a human handler and a trained dog. Trained canines use their sense of smell, agility, and speed to find trapped people and indicate their presence and general location through sustained barking. Under ideal conditions, the canine handler interacts with the dog, and, working together, they will find people.

McGuigan and Friedman (2006) suggest various circumstances at a disaster site that will preclude the handler from being allowed to enter the "hot zone" of the collapse. This might be for safety or other reasons. However, there may be no restriction placed on their dogs. This simple fact could lead to the situation where a disaster dog finds a live patient, indicates their presence to the handler, and then leaves the patient, who may have to spend hours or perhaps days alone without assistance until a rescue team can reach them. This situation has been identified as leading to many difficulties, including, as Tucker et al. (2000) and Ursano et al. (1995) suggest, a host of psychiatric problems for the patient, including post traumatic stress.

The Department of Computer Science at Ryerson University and the Provincial Emergency Response Team (PERT) of the Ontario Provincial Police (OPP) have developed the Canine Remote Deployment System (CRDS). The CRDS is used to deliver equipment and supplies to patients trapped in rubble as soon as a dog wearing the CRDS has found them. The CRDS is part of a larger initiative called the Canine Augmentation Technology (CAT) project as discussed in Ferworn et al. (2006) and Ferworn et al. (2007).

The CRDS System

The CRDS consists of three parts: a wireless transmitter carried by the handler or assistant; the CRDS receiver, which is normally attached to a canine body harness; and an equipment pouch—the underdog,which is slung under the brisket of the dog. This arrangement is shown in the figure below.

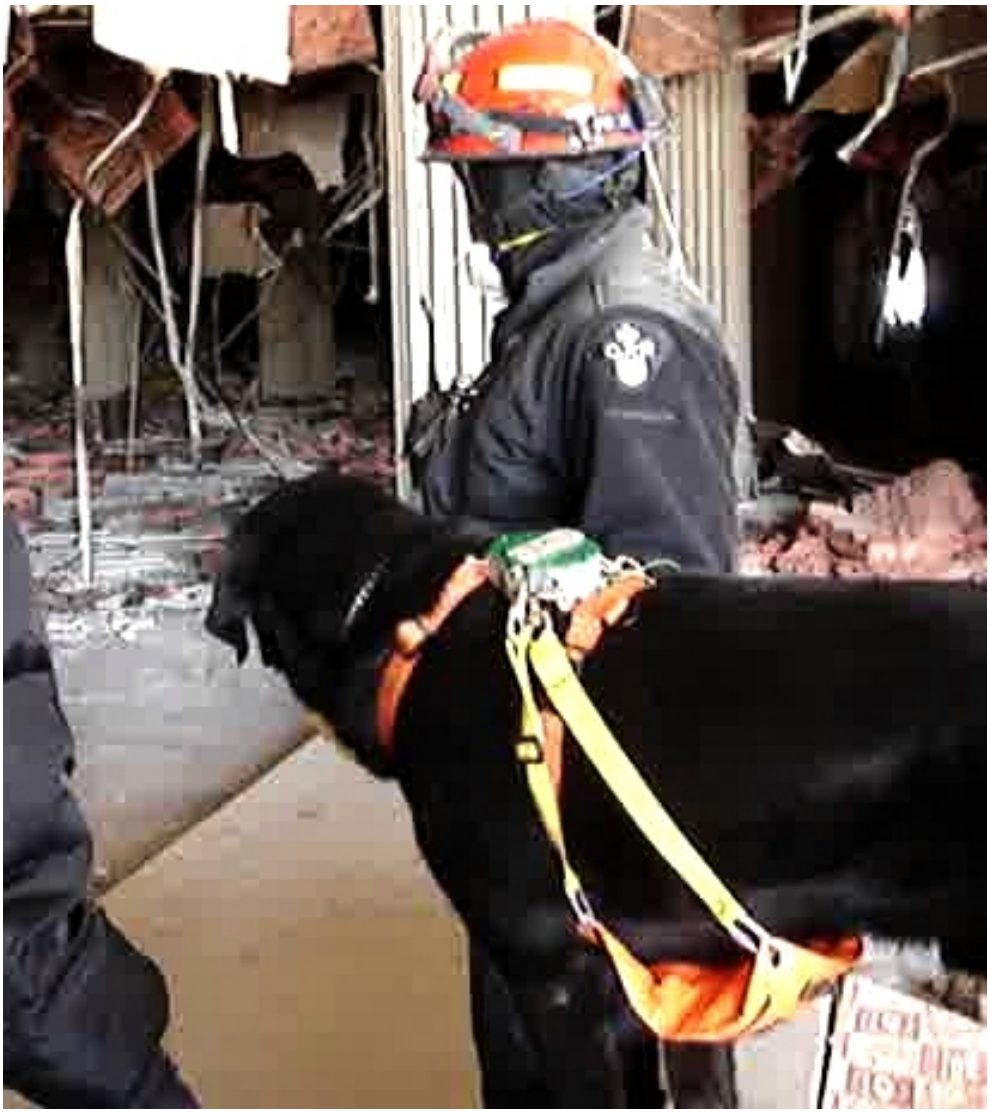

Figure 1 USAR Canine Dare with CRDS and Underdog loaded

Receivers and transmitters come in pairs and are not interchangeable with other units. Each transmitter sends an encoded "phrase" that corresponds to a specific receiver that is capable of releasing a set of retaining pins. Matching of pairs of receivers and transmitters is done for several reasons. First we must ensure that only the handler can activate the release mechanism—not someone who might be using another CRDS unit. Second, it is possible to "gang" multiple CRDS units on the harness of a single dog, allowing multiple underdogs to be carried and dropped to a single or multiple patients.

Figure 2 USAR Canine Darby with ganged CRDS and underdogs

Figure 3 Underdog being released after canine is directed to an elevation

The Protocol

In search operations the CRDS harness is placed on the canine at an appropriate time, and the underdog is slung under the dog and attached to the release pins of the CRDS receiver. Before the canine is released into an area where trapped humans are suspected, the unit is turned on. The dog will search the site in the usual way. If the dog comes across a trapped individual, a bark indication will be given. If the handler can see the dog and what it is barking at, they can wait until the dog works its way near the suspected location of the patient. If the dog cannot be seen but can be heard, the handler must wait for a few seconds while the dog continues to bark in case the dog is attempting to get closer to the scent, causing the indication. In either case, the CRDS is activated when the handler or assistant presses the button on the transmitter. An encoded signal is sent to the CRDS receiver that triggers the pins to rise and the underdog to be released from the dog. The canine can now be recalled, leaving the underdog behind.

The Underdog

The underdog is essentially a waterproof florescent bag whose contents can be accessed through a zipper. In darkness, the bag can be equipped with a set of glow sticks or other illumination that can help in relocating the patient when human are allowed to enter the site and helps the patient retrieve the bag.

The underdog is slung under the canine by a set of straps attached to the release pins of the CRDS on top of the dog. It was experimentally determined that slinging the underdog between the hind and fore legs of a dog both provided protection for the contents of the bag and was readily accepted as “normal” by all dogs we tested. The method has the added advantage of putting the load as low as possible on the dog to minimize the affects on the dog’s agility.

Figure 4 Underdog released on top of a quarry hidden under the mattresses.

Many items can be placed in the underdog, including a two-way radio, water, food, medical supplies, cameras, and a range of sensors. The intent is that the patient will be able to reach the bag. But this is not always necessary or possible, and good results have been found when the underdog falls near enough to the casualty that his or her voice can be picked up by a voice-activated radio. In practice, we have found that most underdogs are dropped within ten feet of a trapped individual.

Different Dogs Different Results

To date, over a dozen USAR canine teams from three Canadian USAR Task Forces have used the system at two structural collapse exercises hosted by Canada Heavy Urban Search and Rescue (HUSAR) Task Force 3 (Toronto). The CRDS is now operationally deployed with the three canine teams assigned to the PERT, which forms part of the canine resources of Task Force 3.

While all dogs we have tested have readily accepted the apparatus, the results they achieve can be quite different. For example, canines trained in USAR alone tend to drop the underdog within ten feet of the patient, where the scent plume is probably the strongest. On the other hand, USAR dogs that have been cross-trained in mountain rescue tend to maneuver a great deal closer to the patient if they can. In one instance, a border collie tunneled into an entombed patient and dropped the underdog on the patient's chest.

The Three-Dog Protocol

The CRDS is part of the CAT project, which seeks to provide additional facilities to canine teams and the rescue effort they support. In normal operation, the CRDS is employed in what has come to be known as the "three dog protocol."

If it is suspected that live patients are trapped in the hot zone of a disaster and human entry is precluded, the search will be conducted in three phases, employing three dogs—possibly using a dog more than once. Initially, a canine is sent in "nude." If the dog finds one or more patients through a bark indication, the dog will be recalled and a second search conducted with a CRDS-loaded dog. The nude dog is employed in order to establish the presence of a patient without risking the safety of a dog who might become hung-up in the rubble while wearing the CRDS harness. We are currently working to create a self-shedding version of the CRDS in order to mitigate this risk.

When the second dog indicates the patient's presence, the underdog will be dropped and the canine recalled or sent on to other patient sites. Finally, a CAT-equipped canine will be sent in. When this canine finds the trapped person, the pan-tilt cameras on CAT will be employed to send back video to the rescue team.

Often it is difficult to determine where the casualty is trapped simply from the video. But since the location has been marked by the underdog, the CAT cameras can first look for the underdog as a visual reference point to increase the chances of finding and recording the patient.

The result of this protocol is illustrated in the figure below. The reflective stripe of a first responder acting as a quarry can be seen in the middle of the image. However, this image was taken from a video stream that was "scrubbed," starting from when the underdog, which can be seen in the upper right corner, became visible. In this particular instance, the patient could not reach the underdog as he verbally reported to rescuers that his arms were pinned, but the underdog still proved useful to mark his location.

Figure 5 Casualty in Rubble with underdog

Current Work

Three CRDS units are in testing with the canine handlers of the PERT and, by extension, in use with Canada TF 3. In the most recent national structural collapse

exercise, held on 23-25 November at the old Constellation Hotel in Toronto, over 25 operational drops were performed with the three CRDS units available, with only a single failure reported.

Future Work

Numerous improvements are being planned. At the moment, the system has very poor all-weather performance, as no attempt has been made to waterproof the CRDS release mechanism. This has resulted in some interesting situations involving cops with hair dryers rehabilitating systems after a dog has rolled it in the snow. We are also working to shrink the size of the system to better accommodate smaller dogs. In conjunction with CRDS and CAT, we are working with canine handlers to devise a release mechanism that will assist the dog in freeing itself should it become "hung up" in the rubble it is searching through.

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