Exploring Assistive Technology for Assistance Dog Owners in Emergency Situations

Conference or Workshop Item

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ABSTRACT
Many vulnerable individuals own an assistance dog. Previous work has shown that a domestic alarm, Ringsel, allows assistance dogs to "call for help" via a canine interface that they interact with by pulling a detachment off with their mouths. Here we discuss the potential for systems like the Ringsel to leverage distinct behavioral patterns exhibited by the canine users to aid the automatic detection of emergencies by being used in coordination with existing assistive technologies for emergency detection and response.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and Presentation]: User Interfaces

General Terms
Design, Human Factors

Keywords
Assistive technologies; assistance dogs; animal-computer interaction

1. INTRODUCTION
Many vulnerable individuals own specially trained assistance dogs to help them with everyday tasks. Mobility assistance dogs are matched with owners who have impaired movement, due to conditions such as Multiple Sclerosis, and are trained to do a variety of physical tasks such as opening doors, pressing buttons, loading laundry, picking up dropped objects, bringing over the phone when it rings, or even taking cards out of cash machines [1]. Medical alert assistance dogs are paired with owners who are affected by conditions such as Type 1 Diabetes, Addison's, and Epilepsy [8], and are trained to warn their owner of an oncoming medical emergency. Recently, technologies have been developed to support dogs in assisting their humans [10, 11]. This emerging multidisciplinary research and application area integrates assistive technology and animal-computer interaction, focusing on the animal as the user [7], to offer opportunities for intelligent systems to support these human and assistance dog partnerships.

Assistance dogs have shown to be very reliable in detecting or alerting to on-coming emergencies. For example, Diabetes Alert Dogs can be trained to detect minor changes in their handler's blood glucose levels, thus being able to warn the handler before they experience a hypoglycemic episode. Similarly, seizure alert dogs have been shown to be able to alert their handlers of an oncoming epileptic episode, thus allowing the handler valuable time to get in a safer environment. To support and augment the capabilities of such assistance dogs, we have developed an alarm system, Ringsel, that the dogs can use to remotely call for help on behalf of their handler when the handler becomes incapacitated due to their condition. The dog interacts with the system by using their mouth to pull off a special canine attachment from the interface, called a "bringsel", thus triggering the system to sound a local alarm and call for outside help (see Figure 1). Past work has demonstrated that, with appropriate training, the dogs are able to successfully interact with this alarm in response to emergencies, thus providing their handler a way to get much-needed help to the home [10].

However, due to the critical nature of medical emergencies, the lesser the margin for error the better, thus we propose that detection mechanisms that can support or complement the dogs' interaction with alarm systems should be explored. In particular, the behavioral patterns that the dogs exhibit in emergency situations provide additional information about the immediate circumstances of their assisted human, thus monitoring the dog's behavior may improve the precision of emergency detection systems. We propose that synchronization of canine behavioral data with other data collected by monitoring ambient assistive technologies could significantly improve the reliability of such technologies. We suggest that a dialogue between the canine computer interaction community and assistive technology community is needed to insure the most recent developments in both research areas are leveraged in new technologies.

2. RELATED WORK
2.1 Emergency Detection Systems
A range of assistive environment systems have been developed to aid in the detection of falls within the home. These include worn devices, video imaging, and heat mapping systems that detect emergency situations based on the state of the human present in the environment. While many of these systems have high detection success rates, there are still margins of error [5, 9]. Additionally, some ambient systems that detect specific emergencies, such as seizures, may be very effective in one part of the environment, but not applicable elsewhere; for example a seizure detection system installed in a bed for overnight episodes, would not detect episodes happening when the person is not in bed. On the other hand, wearable devices may be obtrusive and therefore are only worn for a limited time during specific activities. However, assistance dogs are typically within sight or hearing distance of their handler at all times. Therefore, because of the ubiquitous nature of an assistance dog, many people use assistance dogs in addition to assistive systems for emergency detection and response.

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2.2 Canine-Computer Interaction

Dogs' body language and movements have been observed to infer the emotional state of the dog. Brugarolas et al have worked to develop a "canine body area network" employing motion sensors to provide real time feedback about canine behaviour during training [2]. The authors utilized machine-learning algorithms to identify canine posture through wireless inertial sensing with 3-axis accelerometers and 3-axis gyroscopes, in order to improve the welfare of working dogs by monitoring their behavioral patterns. Additionally, many systems on the market leverage RFID technology capable of reading implanted microchips or tags worn on a collar to identify the proximity of particular animals to specific objects or their presence in specific locations. Additionally, recent work has produced systems by which working dogs are able to remotely transmit information back to their handlers. This information can include their location or biometric data, or even intentional signals from the dogs [3, 4]. Finally, another range of applications have been developed specifically to enable working dogs, including assistance dogs, to carry out remote communication tasks by interacting with a wearable vest interface that the dog is able to bite, pull, or touch with their nose to communicate with a handler [6].

3. AN ASSISTIVE CANINE INTERFACE FOR EMERGENCY USE

3.1 Autonomous Use

Previous work has introduced a system called Ringsel, a mounted device that is designed for dogs to be able to retrieve a special object, a bringsel, pulling it from the device to trigger alarm software [10]. One way that a dog might use this system is by receiving real-time instruction from the owner. For example, if a person is physically unable to access a phone and needs to call for help, she can verbally or gesturally give her dog the command to activate the alarm. This level of interaction is straightforward because the owner is able to direct the dog so the dog knows exactly what task it needs to accomplish. However, people in emergencies will not always be able to direct their dog as they would for usual tasks, and in these cases dogs have been trained to react to behavioral cues, such as a person falling or seizing. Since these are unique behaviors that the person only exhibits in an emergency, the dog can be trained to automatically interact with the alarm system when they see this behavioral cue.

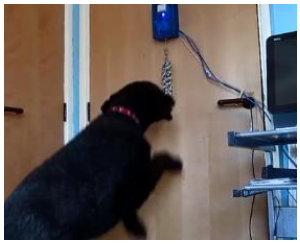

Figure 1. An assistance dog activating a canine alarm.

3.2 Monitoring and Detection

In situations where it is difficult for assistive technologies to detect an emergency, we envision that a detection system could monitor the dog's behavioral patterns, including those indicating the dog's failed attempts to interact with the canine alarm. In particular, location and posturing may provide valuable clues that an emergency is occurring. For example, when their owner was experiencing an emergency, a dog would often repeat certain behaviours that they would not otherwise exhibit during normal circumstances, such as pacing around the owner, or repeatedly nudging and pawing at the owner. Indeed, assistance dog owners and trainers that we interviewed during the development of Ringsel reported to us that the dog's posturing would change when a person was having an emergency; some medical alert dogs would repeatedly jump up, for example; others may lay down but not relaxed, with their head up. Additionally, while most assistance dogs are desensitized to "routine" emergencies, dogs that are facing an emergency they are not as trained to deal with, or dogs that are especially distressed, may produce distinctive vocalizations that indicate distress. Data from these vocalizations, over time, could be analyzed against emergency situations, thus identifying predictable patterns.

4. CONCLUSION

We propose that communication technology for assistance dogs is an integral part of assistive solutions for vulnerable people. These include interfaces like Ringsel designed to allow dogs to actively call for help in emergencies that could be complemented by monitoring solutions able to detect the dogs' behavioral patterns typically associated with such emergencies. This approach could also be used to improve the reliability of existing assistive monitoring technologies.

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