Designing specialized technology to aid assistance dogs

Conference or Workshop Item

Designing Specialized Technology to Aid Assistance Dogs

Charlotte Robinson
The Open University
Department of Computing and Communications
Animal Computer Interaction Lab
Milton Keynes, United Kingdom
charlotte.robinson@open.ac.uk

UbiComp '14, September 13 - 17 2014, Seattle, WA, USA

http://dx.doi.org/10.1145/2638728.2638842

Abstract
Interest is growing in studying canine and human relationships, especially working canines and their role in society. Interest is also growing in designing informed, user centered interactive technologies for animals. Combining these two themes, my doctoral research looks at creating user-centered, ethnographically informed designs for working animals (working dogs). The work examines existing design methodologies and posits new ones to contribute to a wider Animal-Computer Interaction (ACI) framework to design for and with animal users. Here I review the initial findings of the on-going work to develop an emergency alert alarm for assistance dog use.

Author Keywords
Canine design; participant design; user-centered design; animal-computer interaction

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Assistance dogs are ubiquitous throughout many societies. Guide Dogs for the Blind, Hearing Dogs, Mobility Assistance dogs, and Medical Alert Dogs are paired with humans to support them in their daily lives. My doctoral work investigates how we can design practical technological applications for assistance dogs that are designed specifically to support dogs themselves in their tasks. Assistance dogs perform a

Figure 1. A dog learning how to interact with an on-the-body emergency alarm prototype.

Figure 2. Pulling on the interface until it the 'tuggy' detaches will trigger alarm software.

variety of different tasks, including opening doors, helping load washing machines, retrieving fallen items, and even using ATM machines. I am investigating the potential of technologies that can support these dogs and others like them in their task of looking after their owner and exploring how specific designs might be able to help. In developing such technologies, my work seeks to explore the following research questions:

RQ1) *How can we design computing technology to assist canine workers in their tasks in a way that reflects their particular requirements?* Each individual canine user has a distinct set of requirements related to his role as an assistance dog as well as characteristics due to his canine physiology and psychology: how might these requirements and characteristics shape the canine interface?

Assistance dogs sometimes find themselves in emergency situations where their owner is incapacitated somehow, such as fallen, immobilized, partially conscious or totally unconscious. Given the emergency situations that can arise, my work has identified a need for a technological intervention to allow assistance dogs to call for remote help on their owners behalf [12]. This concept is based on anecdotal instances of dogs calling for help when their owner is unconscious [4, 5, 13] In investigating this particular practical application of ACI, I seek not only to support these particular canine users, but also to contribute to the development of a set of best practices and methods for designing for canine users, and contribute to the wider ACI narrative by developing best practices for designing for other animals as well dogs. This aim raises further questions, such as:

RQ2) *How can we practice user-centered design when our user is of a different species to ourselves as designers?* Canines cannot fill out surveys or rate their user experience on a discrete scale. Does this mean they cannot inform the designs intended for them to use? If not, what methodologies can we use to allow them to participate in the design process?

One goal of my research is to explore how to best have "conversations" with a canine user as we might a human user, and use relevant methods in order to develop best practices for canine design.

RQ3) *How do we draw upon existing HCI approaches (such as user-centered and participatory design) to inform ACI approaches?* And- finally- how can developments in emergent ACI methodologies then potentially inform existing HCI methodologies?

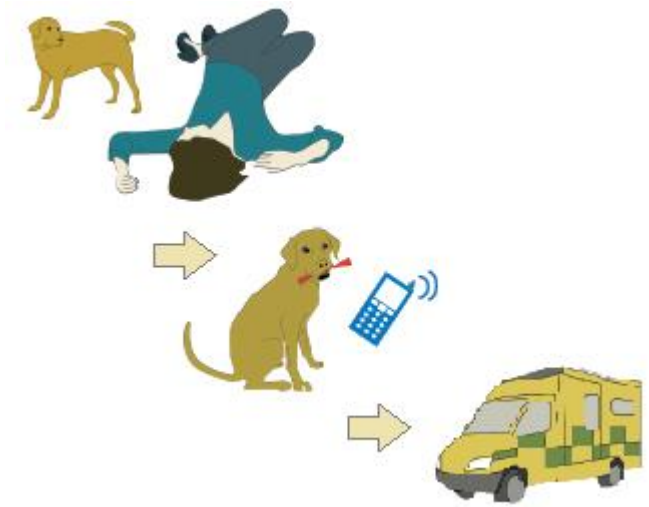

Figure 3. Example scenario: a diabetes patient has collapsed following a hypoglycemic attack. A dog's owner is incapacitated; the dog triggers an emergency alarm; detachable part of an interface off to trigger alarm software; external help arrives.

As Animal-Computer Interaction [11] is an emergent field, as interaction designer I seek to be influenced by

existing HCI approaches. User-centered design [1] is a natural approach as animals have different needs as users than humans. However, the methodologies of eliciting and understanding these needs have overlap with existing HCI practices.

Background

For decades, researchers have developed technologies that are either worn by an animal, used on an animal, or placed in an animal's environment, for various reasons. Examples of this would be fitting tracking devices onto animals in the wild to collect data of herd movement, introducing technologies to automate feeding processes in farming, or wearable sensors to collect biological data (for example heart-rate or temperature) from laboratory animals. In these contexts the animal is regarded as a part of a system or a source of data rather than an actor. However, from my research perspective, I am primarily interested in looking at what work has been done designing interactive technologies for animals where the *animal is an actor* in the interaction and has at least some degree of control over their own engagement with the technology.

In the literature surrounding this work, it is not often mentioned how design decisions were made concerning the dogs' requirements, for example in relation to the interaction. Whether or not the designers of these technologies considered the animals' requirements during the design process, there is no explicit discussion surrounding what informed that particular design and what exactly the dog's involvement was in the process.

However, recently, there has been a gradual change from designing technology that is simply applied onto animals, to designing technology that allows animals to take more active roles; from applying frameworks that rigorously account for the animals' specific characteristics, to borrowing methods that enable researchers to evaluate the technology from the animals' perspective.

Approach

Designing for non-human users presents unique challenges. For one thing, non-human animals have sensory, ergonomic, cognitive, and cultural characteristics which may be significantly different from those of humans. For another thing, there is the difficulty of using verbal communication, so often relied upon by interaction designers in the design process. My research seeks to further a paradigm shift whereupon designers do not merely design *for* a user with "special" needs (such as paws instead of hands), but rather *with* them to identify what the users themselves "want" from a particular interface. As an initial approach to find this out, we explored the idea of ethnography for requirements elicitation, a research methodology that uses observation, interviews, and co-location to understand user requirements [2, 3, 8]. More specifically, we explored the idea of multi-species ethnography, used to study mixed species environments [9] (in this case, dogs and humans sharing working and living environment.)

Figure 4. A dog pulls on a hanging mounted detachable interface.

Figure 5. A dog holds a bringsel, a commonly used alerting device.

Additionally, our initial tactic to do design requirements elicitation was to use modular prototyping so that elements of designs could be interchanged quickly and dynamically to account for working with non-verbal users.

Methodology and Initial Findings

My practical research has so far consisted of fieldwork with human-dog partnerships and has been organized in phases aimed at progressively uncovering the existing methods of communication in canine-human working partnerships, and also aimed towards uncovering particular needs for technologies to support these partnerships.

Scent Detection Dog Study (Completed)
Methodology: My initial ethnographic fieldwork was carried out at Medical Detection Dogs, a major scent detection and assistance dog training centre in the United Kingdom. Over a period of two weeks, I observed and participated in the daily training and work sessions of the canine and human staff, with an aim to conduct a multi-species ethnographic study to better understand design context.

Findings: From this initial study, several findings emerged. I realized that an emergency canine alarm could potentially be easily embedded in existing practices. For example, medical alert canines often use an item called a 'bringsel' to communicate with their owners. A bringsel is an item that a dog takes in his mouth when he wishes to communicate a specific alert. Additionally, this study exposed the requirement that the system would need to provide interaction feedback tailored to the dogs' understanding and training.

Canine Participatory Design Studies (On-going)
Methodology: For this area of practical work, my goal was to investigate how potential technologies, inspired by the initial canine-human ethnography, could progress toward concrete designs to meet the specific needs of actual working dog-human handler pairs. To accomplish this, I had continued to observe training sessions. We were inspired by mechanisms like pull switches, quick release magnet pull alarms, and quick release kill switches, because they did not involve dexterity but rather the ability to pull.

Findings: Through rapid prototyping and training session 'conversations', we discovered that an interface that has a detaching component that a dog can pull on with his or her mouth was preferable over a similar interface where nothing detaches. Non-detaching interfaces consistently seemed to confuse dogs and made it harder to engage with the interface. The detachment of the part of the interface that the dog pulls on is in it of itself a form of feedback; when it detaches, the dog knows it has accomplished its task. We also explored context-based requirements. For example, when the interface is out of the visual line of sight of their owner, some dogs are hesitant to leave their owners side to engage with it; others are not.

Human Requirement Studies (On-going)
Methodology: Practical work has also began in exploring detailed requirements of different types of owners of assistance dos. In-depth interviews and home visits are being conducted with current and potential owners of assistance dogs to evaluate their medical, environmental, and other requirements as potential users of a canine emergency alert system.

Findings: Thus far, we have found that assistance dog owners interviewed fall broadly into three types with their medical emergency, with some clients having more than one type possible: cognitive impairment, cognitive impairment with consciousness, or sudden diabetic collapse (unconsciousness). In moving forward, these different potential use cases will need to be considered.

Discussion

A Multi-species Partnership
My initial findings highlight that designing for assistance dogs means designing for a human-canine intimate partnership as a unit. At all stages of my research, it has been clear that the working dogs and their human handlers have dynamic, intimate relationships and ways of communicating. Thus the interface designed for one will closely effect the other. However, although this is a symbiotic partnership, each member within it has their individual user requirements between which there may be tensions. Therefore designing for such multispecies partnerships is a mediation process similar to that which would be undertaken in any interaction design project aiming at developing human technology. As the research continues, we find ways to balance the needs of the dog versus the needs of the human as they converge into the needs of the partnerships.

Ability-based Participatory Design
Additionally, when designing for canine users, designers need to be aware of their specific needs and capabilities as users- dogs from different breeds may have different physical and behavioral characteristics, and each individual dog has their own particular characteristics shaped by their personality, training and history- such as the needs of a dog who has been with his human handler for several years, and who has experienced many problematic hypo attacks, may require a design that is specifically attuned to his anxiety. Designers need to be prepared to "listen out" for these individual, more subtle needs, and engage with the dogs as individuals, in order for a better informed design to be likely to emerge. Existing approaches to ability-based design and participatory design with users with unique needs such as disabled users and children users [6, 7, 10] may helpful.

Dynamic Prototyping
From initial studies, it appears that the use of rough, interchangeable, easily modified prototypes could act as catalysts of such a conversation by enabling us and the dogs to engage in a rapid exchange of stimuli and responses. Also, by doing rapid quick and dirty prototyping, the stakes are low when ruling out certain designs. For example, if I had invested a lot of time and energy and resources into making a polished non-detaching pull-cord prototype, only to discover it absolutely has to detach or the dog cannot use it successfully, I might be more resistant to listening to the dogs preference than if the design is easily modified.

Future Work
We have been exploring technical implementation options and future work will begin to focus on overall system design while continuing to build on methodologies explored here such as multi-species ethnography and rapid prototyping, feeding into a larger framework of animal computer interaction design.

Doctoral School Program
The doctoral school program at UbiComp 2014 would be an excellent opportunity to get feedback and critiques from the community that could potentially identify any weaknesses. Especially because I have started significant work on my PhD, but still have at least 1.5 years to go until completion, it is ideal timing for me to engage with other researchers in a relevant setting. The experimental and ethnographic nature of the work makes it especially appropriate for a workshop environment.

Short Biographical Sketch
Charlotte Robinson started her PhD at the Open University's Animal Computer Interaction Lab in January 2013. She holds a BS in Computer Science from University of Washington awarded 2009, and a

Masters in Interactive Media from Goldsmiths, University of London, awarded 2011. From 2009 to 2011, she worked in industry as a technical program manager and software developer. Charlotte is advised by Dr Clara Mancini, the head of The Open University's ACI Lab, and Dr Janet van der Linden. Her expected completion date is January 2016.

Acknowledgements

We would like to thank the charity Medical Detection Dogs in Great Horwood, United Kingdom.

References

[1] Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centred design. Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications, 37(4), 445-56.

[2] Anderson, R. J. (1994). Representations and requirements: The value of ethnography in system design. *Human-computer interaction*, *9*(3), 151-182.

[3] Blomberg, J., Giacomi, J., Mosher, A., & Swenton-Wall, P. (1993). Ethnographic field methods and their relation to design. *Participatory design: Principles and practices*, 123-155.

[4] "Dog Dials 911 While Owner has Seizure", foxnews.com/story/0,2933,422341,00.html accessed September 2013

[5] "Dog Dials 911 to Save Owner" msnbc.msn.com/id/6359754/ns/health-pet_health/t/dog-dials-save-owner/#.T86b5UXDCAg , access September 2013

[6] Guha, M. L., Druin, A., & Fails, J. A. (2008, June). Designing with and for children with special needs: an inclusionary model. In *Proceedings of the 7th international conference on Interaction design and children* (pp. 61-64). ACM.

[7] Hornof, A. (2008, June). Working with children with severe motor impairments as design partners. In *Proceedings of the 7th international conference on Interaction design and children* (pp. 69-72). ACM.

[8] Hughes, J., King, V., Rodden, T., & Andersen, H. (1995). The role of ethnography in interactive systems design. *interactions*, *2*(2), 56-65.

[9] Kirksey, S., & Helmreich, S. (2010). The emergence of multispecies ethnography. Cultural Anthropology, 25(4), 545-576.

[10] Kroemer, K. H. (2005). 'Extra-Ordinary' Ergonomics: How to Accommodate Small and Big Persons, The Disabled and Elderly, Expectant Mothers, and Children (Vol. 4). CRC Press.

[11] Mancini, C. (2011). Animal-computer interaction: a manifesto. Interactions, 18(4), 69-73.

[12] Robinson, C., Mancini, C., van der Linden, J., Guest, C., Harris, R. (2014, April). Title In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM..

[13] "Saved by the Belle, a beagle who rang 911" smh.com.au/news/world/saved-by-the-belle-a-beagle-who-rang-911/2006/06/20/1150701555085.html

[14] Schuler, D., & Namioka, A. (Eds.). (1993). Participatory design: Principles and practices. Routledge.