Canine-Centered Computing

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Foundations and Trends® in Human-Computer Interaction

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is

L. Freil et al.. *Canine-Centered Computing*. Foundations and Trends® in Human-Computer Interaction, vol. 10, no. 2, pp. 87–164, 2016.

This Foundations and Trends® issue was typeset in LaTeX using a class file designed by Neal Parikh. Printed on acid-free paper.

ISBN: 978-1-68083-245-7

Full text available at: http://dx.doi.org/10.1561/1100000064

Foundations and Trends® in Human-Computer Interaction

Volume 10, Issue 2, 2016

Editorial Board

Full text available at: http://dx.doi.org/10.1561/1100000064

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Topics

Foundations and Trends® in Human-Computer Interaction publishes surveys and tutorials on the foundations of human-computer interaction. The scope is broad. The list of topics below is meant to illustrate some of the coverage, and is not intended to be an exhaustive list.

- History of the research community
- Design and evaluation
- Theory
- Technology
- Computer supported cooperative work
- Interdisciplinary influence
- Advanced topics and trends

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Foundations and Trends® in Human-Computer Interaction, 2016, Volume 10, 4 issues. ISSN paper version 1551-3955. ISSN online version 1551-3963. Also available as a combined paper and online subscription.

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Vol. 10, No. 2 (2016) 87–164

DOI: 10.1561/1100000064

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Contents

Abstract

Canines and humans have lived together for many thousands of years, to our mutual benefit. In addition to providing companionship, dogs can perform critical roles, such as assisting humans with medical concerns, searching for lost individuals, and detecting substances by scent. Researching how technology might be designed for canines has the potential to significantly improve the lives of both dogs and humans. We draw upon the extensive foundations and literature in human-centered computing to identify and adapt models and methods that are relevant for canines. Our work surveys the landscape of canine-centered computing and canine psychophysics, and generates a framework and set of guidelines to help inform the requirements, design, and evaluation of systems for canines. Our principal aim is to invite and challenge human computer interaction (HCI) researchers to contribute to the field of canine-centered computing, and we conclude with a call to action in this promising nascent field.

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DOI: 10.1561/1100000064.

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1

Introduction

Human–computer interaction (HCI) is a relatively mature field in computing. Design and system evaluation metrics, theories, frameworks, and guidelines have been extensively researched since the first ideas about interaction emerged in the 1960s [Meyers 1998]. One of the major tenets of HCI is that good design and system evaluation are critical to the success of new technologies. Recent research has begun to explore the possibilities of creating computing technologies for a non-human population: dogs. There are many domains in which dogs could utilize technology, from life-skill tasks such as being able to let themselves outside, to entertainment and games for enrichment, or monitoring for stress. Perhaps the clearest potential for combining dogs and computing is for working dogs, who can perform life-enhancing or even life-saving functions if they have access to usable computing technologies. Consequently, interest in studying design and evaluation for canine-focused systems has grown significantly in the last few years. This paper examines the history and the current state of the art in the nascent field of canine-centered computing (CCC). We provide a framework based on established human-centered computing concepts and methods to classify and compare CCC studies. Our hope is to borrow and adapt

foundations of human centered computing to create a foundation for canine-centered computing.

The intent of this survey is to provide a foundation that will enable an HCI researcher or practitioner who is familiar with HCI theory, models, and methods to understand and contribute to the new field of canine-centered computing. Webster's dictionary defines the word "canine" to be "dog," and we will use these terms interchangeably, to reflect the language of the literature. Human centered computing employs methods to examine cultures, organizations, and processes, to determine how computing might fill needs for users. The hope is that canine-centered computing can utilize variants of these methods in much the same way to investigate the world of dogs, their cultures, and their homes and workplaces, and determine where computing might augment, sustain, or improve the dog's life and work. To do so, we must develop a toolbox of canine-centered interaction techniques that can be applied, as appropriate, to a given situation or task. The HCI field has developed many such tools and techniques, and paradigms such as "windows, icons, menus, and pointers" have made computing accessible to much of human society. What interaction paradigms will make computing generally accessible to dogs? Answering that question is both exciting and challenging, as many interfaces for canines to date have focused on testing canine cognition for scientific purposes or have been developed for very specific tasks in human–canine partnerships where dogs have been expected to use affordances designed for humans. In this paper, we survey interaction techniques that seem promising in moving towards canine-centered computing, and we borrow from Norman's [2013] seven stages of action, Shneiderman's [1982] writings on direct manipulation, and Nielsen's principles for heuristic evaluation [1994] to guide the conversation. We also make a distinction between "interaction" and "interface." Canine *interaction* includes the entire cycle of cognitive evaluation and execution where a dog forms a goal, acts, observes, and evaluates the result of that action in the environment, and compares it to the goal. Training and cognition also play a large part in canine interaction. When we refer to a canine *interface*, on the other hand, we restrict ourselves to discussing the affordances that

help a dog determine actionable properties of the particular device (e.g., bite, tug, push, touch, etc.), the software and hardware that responds to a dog's actions, and the output devices that communicate the computer's state to the dog. We view canine-centered interfaces as a subset of canine-centered interaction, and canine-centered interaction as subset of canine-centered computing. Interfaces are focused on the sensors, actuators, displays, and other aspects of information transfer between the canine and the system. However, interactions include the larger set of systems beyond interfaces, such as monitoring systems that, unbeknownst to the dog, measure and record how a dog interacts with the system or the environment.

The recent surge in sensors and devices available for wearable and ubiquitous computing has provided ample opportunities for researchers to create canine–computer interfaces, enabling rapid advances and innovation. However, standards for evaluation in the field have yet to be established, and there is much room to evolve our understanding of how to develop appropriate interactions for dogs and their human partners. By sharing a survey of current techniques and grounding our discussion using established principles in HCI and HCC, we hope to help spur progress towards a theoretical and practical foundation for canine-centered computing.

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