
Species-Appropriate Computer Mediated Interaction

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Abstract

Given the importance of our non-human companions, do we not want to extend social media to our non-human co-species? If "human computer interfaces" should be designed for "Anyone. Anywhere." (the theme of CHI 2001), then why not for all species? Recent pioneering efforts have shown that computer mediated interactions between humans and dogs, cats, chickens, cows, hamsters, and other species are technically possible. These efforts excite the imagination and challenge our understanding the basic nature of computer mediated interaction.

Keywords

Species-appropriate interfaces, Computer-non-human interfaces, cross-species interaction

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

We humans share this planet with thousands of species, many of which intimately share our lives as food sources, pets, and companions. We interact with these species in many ways, consciously and unconsciously. In the case of our favored companions,

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we communicate and play with them, and, in fact, endow them with the same love as we give other humans. The importance of these relationships is beyond dispute.

With the emergence of computer network supported social media, we see new forms of interaction between people, despite distance and circumstance. But, to date, our cyberspace is highly “anthropocentric”. How would we extend these social media to our non-human co-species? What would we gain? What would we learn?

This paper is organized as follows. The second section considers what “species appropriate” computer interfaces are, and what is interesting about them. Using inexpensive sensors and actuators, recent projects have extended computer mediated systems to include some of our non-human co-species. The third section discusses these pioneer developments, which show what is technically possible while raising important questions. The last section concludes.

Definition and Problems

A “species-appropriate” computer interface is a system that enables a non-human to interact with a computer in a (species-specific) meaningful way. Usually, this also involves interacting with humans via the computer as well. This definition is intended to exclude simple “surveillance” in which animals and objects are tracked and monitored by computer, with no deliberate interaction with the system or other participants.

Species-appropriate computer interfaces raise three general problems:

1. Species-appropriate computer interaction mechanisms
2. Species-appropriate tasks
3. For multi- and cross-species computer-mediated communication, there will be translation and mapping between the species-specific modes.

As in any design, there are many important questions to ask. What are the goals of the participants? How do the participants understand the interaction? What do the participants gain from interacting with the computer? Commonly used methodology (self-report questionnaires, ethnography, etc.) may suggest design goals—at least from the human point of view—but will not be sufficient to understand the entire situation.

Reisner calls these systems “asymmetric interfaces,” due to the substantial differences between the participants, noting that “animals do not read manuals,” have their own “cognitive models,” and, for instance, cannot use common physical interfaces [17]. Lee et al. raise similar points with regard to poultry, and note, for instance, the value of human stroking to the welfare of poultry [10].

For obvious reasons, the vast majority of computer interactions are focused on a tiny array of very human-centered modes:

- Human language specific interfaces
- Visual information tuned to human eyes
- Physical media tuned to human hands and skills

Some computer interface technology may cross species boundaries more easily, including:

- Audio (“vocalization” and other sounds)
- Haptic interfaces
- Sensors and reactive systems (e.g., video tracking, accelerometers, touch sensors)

Not only are physical interfaces designed for humans, the computer mediation presents tasks that humans understand. Computer interfaces built with these techniques are inaccessible to non-humans. For non-humans to participate, the system must make sense in the participants’ world.

Finally, in order for the participants to communicate, collaborate, or compete, the virtual world within the computer system must be translated to and from their species-specific input/output and tasks. How should this be done? What kinds of virtual worlds allow this mapping?

Pioneering Work

Recent pioneering efforts have successfully broken the species barrier for computer-mediated interactive systems. These projects show what is technically possible, and point to interesting design challenges. Of particular interest here are interactive systems that benefit both the human and the animal.

Dogs have been popular and enthusiastic participants in cross-species, computer mediated communication experiments. Several Web-based systems allow a human to interact with a dog via a web browser (e.g., Human Computer Dog Interface [20], Rover@Home

[17]). These simple systems enable the human to see and hear his dog via the Web, and the dog to hear the human and receive treats. The dog’s environment may also include appropriate physical interfaces, which the dog might chew, paw, or sniff (e.g., an “alley oop” in [17], various concepts suggested in [11]).

Similar systems can be built for cats, e.g., [13, 14, 25]. For example, Young et al. ([25]) describe an interactive playground for a cat and human. Sensors detect the actions of the cat, enabling automated lights and toys to entertain the cat. The human can watch via web cam, and may participate by remotely operating the toys.

These systems are straightforward extensions of human-pet interactions mediated by the internet; implemented through commercial animal training techniques, industrial animal management, and human ‘web cam’ technology.¹ For example, Human Computer Dog Interface ([20]) and Rover@Home ([17]) are essentially internet-enabled extensions of standard “clicker” training for dogs, made possible by inexpensive web video, audio, and mechanical food dispensers.

Evaluating the “user satisfaction” in such systems requires consideration of benefits for all the parties. Computer mediated versions of ordinary human-pet interactions would seem to be useful for remote monitoring of pets or farm animals, and beneficial for “latch key” pets. A few studies give empirical support for these claims (e.g., for chickens [10], hamsters [10], and dogs [17]).

¹ See [24] for a review of patents in this area.

Other projects include “wearables” and haptic interfaces. For example, “wearables” have been demonstrated for a dog [19], cow ([2], p. 354) and chicken [10, 15, 16]. When correctly designed, wearables enable the animal to move and act naturally, while receiving and sending information via computers. Interestingly, a wearable can place significant computational intelligence at the direct disposal of the non-human (e.g., a planner [19] or signal processing [2]).

These interfaces may enable radical possibilities for human-animal interactions. For example, the “Sensor Cow” ([2]) enables cows and humans to perform improvised music and dance together (though it is not clear how the bovine participants might interpret such an activity).

The “Poultry Internet” demonstrates an even more disruptive potential: the system implements a two-way haptic interface between humans and chickens [10, 15, 16]. The chicken is fitted with a vest equipped with actuators that can deliver “strokes” in response to computer signals. In turn, the human may use wearable and tangible interfaces to feel “pecks”, and to “touch” by stroking a physical analog for the chicken.

This system provides species-appropriate multi-modal interfaces for each participant, including 3D graphics (for humans), tangible interfaces (for humans), haptics (for both humans and chickens), and video tracking (of chickens). In this case, the computer system not only implements the species appropriate physical interfaces, it mediates semantics across species: natural actions of the chicken are converted rendered in meaningful signals to the human, and vice versa. Furthermore, the

two-way haptics simulate intimacy: human manipulation of a tangible interface creates pleasurable stroking via the chicken’s wearable, while natural actions of the chicken create immediate physical sensations for the human.

An even more interesting case from the same lab is the cross-species computer game, *metazoa ludens* ([21-23]), in which a human and hamster play an interactive chase game, in a shared virtual environment, accessed through a species-appropriate interface.

The hamster’s interface is a mutable 3D surface programmed to represent the terrain of the play world, along with a robot target to chase. The human’s interface is a visual rendition of a 3D world and avatar. These interfaces are mapped to analogous features in the virtual game world, so that the terrain is represented to each in a species-appropriate rendering, with the avatar for the human linked to the robot target. In this way, the human and hamster can chase each other through a fantasy terrain, collaborating to enact a shared narrative.

What of the other living creatures of our world? As computer vision and sensing improves, it should be possible to extend many interfaces to fish, reptiles, and insects. For example, it may be possible to create sonic and other interfaces for aquatic species (e.g., [6]—but could a fish play an acoustic game such as [12]? Would whales like to play computer games with us?).

Going further, we can consider other species, including plants [1, 3, 5, 7, 8, 18], and microbes [4]. These species have very simple behavior (and no known nervous system), so “interaction” is radically different

than for mammals or other animals. One notable design constraint is that the temporal scales are radically different (much slower than human for plants ([18]), much faster than human for microbes([4])).

Discussion

The systems reviewed here are not especially practical, but they suggest that computer mediated interaction with animals is technically possible. Their greatest significance is to raise questions and excite the imagination.

It is generous to provide expensive and powerful technology to our co-species, but who benefits from these systems? It is easy to imagine these systems could benefit humans and pets. But they also force us to think very broadly about computer mediated interaction.

The examples discussed above push our notions of how to interface with computers (forget about keyboards, menus, and help pages!), challenge design and evaluation methodology (forget questionnaires), as well as basic assumptions and theory.

These systems challenge us to understand the basic nature of interaction. Thinking of the computer mediated system as a form of interactive theater (a la [9]), then what is the cross-species story being enacted? How do we understand, describe, and evaluate such systems?

Ultimately, these systems seek to create understandable and pleasurable experiences across radically different conceptual views, to create a virtual world that makes sense to participants with

dramatically different behavioral and cognitive repertoires, with significantly different motivations, and even different time scales. This virtual world must then be “rendered” to and from sensory and motor events in species specific mappings.

Is this not the essence of computer interface design for any social media?

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