Augmented Reality Animals: Are They Our Future Companions?

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ABSTRACT

Previous research in the field of human-animal interaction has captured the multitude of benefits of this relationship on different aspects of human health. Existing limitations for accompanying pets/animals in some public spaces, allergies, and inability to provide adequate care for animals/pets limits the possible benefits of this relationship. However, the increased popularity of augmented reality and virtual reality devices and the introduction of new social behaviors since their utilization offers the opportunity of using such platforms for the realization of virtual animals and investigation of their influences on human perception and behavior.

In this paper, one prior experiment is presented, which was designed to provide a better understanding of the requirements of virtual animals in augmented reality as companions. Through these findings, future research directions are identified and discussed.

Index Terms: Human-centered computing—Interaction paradigms—Mixed / augmented reality; Human-centered computing—Human computer interaction (HCI)—HCI design and evaluation methods—User studies; Computer graphics—Graphics systems and interfaces—Mixed / augmented reality

1 INTRODUCTION

A strong bond exists between humans and animals, and previous research has documented the multiple benefits of this relationship to humans' health and well being for a wide range of ages and populations, such as reduction of stress and increased social behavior [3, 10]. Various explanations have been provided for the source of humans' inclination towards animals such as the Biophilia hypothesis, social support theory, or the increasing affectionate behaviors towards infantile or cute faces such as the faces of many cats and dogs [2, 4, 8, 14]. However, existing limitations to human-animal interaction due to health reasons or public space laws suggest the exploration of new platforms for developing similar interactions. Advances in augmented reality (AR) and virtual reality (VR) technologies, their increased popularity, and prospective ubiquity has affected some of the humans' interactions, such as socializing with others through a platform like the VRChat¹. Also, increasing research in AR aimed at understanding humans' behavior and perception of other virtual entities such as intelligent virtual agents [11] shows promising opportunities for utilizing AR as a platform for realizing and researching virtual animals.

The remainder of this paper is as follows. Section 2 presents previous findings about virtual animals. Section 3 describes one of our prior experiments on virtual animals in augmented reality. Section 4 presents potential future research directions and Section 5 concludes the paper.

2 RELATED WORK

In this section, we discuss the previous research in the area of virtual animals and the benefits of human-virtual animal interaction.

¹https://www.vrchat.com/

2.1 Virtual Animals

Most people are familiar with the idea of virtual animals/pets through entertainment platforms from Tamagotchi pets² to more recent games such as Little Friends: Dogs and Cats³. To form a better understanding of the motivations of people who play pet games, through a survey and a laboratory study, Lin et al. identified that issues such as allergies and the emotional support provided through pet companionship are some of the reasons for playing pet games [9].

In most cases, virtual pets have been investigated for motivating and encouraging children in different areas such as education and the promotion of healthier choices. Chen et al. investigated the motivational influence of personal and class virtual pets, finding that 11-year old students increased their learning efforts with the inclusion of the virtual pets [6]. Byrne et al. studied the influence of a virtual animal and its range of behaviors (i.e., negative and positive) through a mobile phone pet game in children's adaptation of healthier eating habits [5]. They found a more positive influence when using the pet that was capable of both positive and negative behaviors. Similarly, Johnsen et al. observed the positive effects of interacting with a virtual dog presented to children through a mixed reality platform in the promotion of physical activity, where children could earn tricks for their dog the more they exercised [7]. The positive effects of the virtual animals in past research hold promise for more in-depth investigations of these entities in AR and for a wider range of populations and applications.

3 OWN PRIOR WORK

The presented experiment in this section is aimed at investigating human perception and behavior during an interaction with a virtual dog in AR, and understanding users' expectations of such an entity with an overarching theme of AR animals as potential companions.

3.1 Understanding the Influence of Awareness in Virtual Animals

With this experiment, published at ISMAR 2019 [12], we investigated the influence of strangers' awareness of a virtual dog and the responsiveness of the virtual dog to each strangers' behavior in AR on how participants perceive the virtual dog and the stranger and adjusted their behavior in response to these entities. In our 2×2 mixed factorial experiment, participants started with designing their virtual dog and through commands such as sit, eat, and jump got familiarized with it. Our independent variables were strangers' awareness of the virtual dog and the dog's responsiveness during a collision event where each stranger walks over the virtual dog in front of the participant. In the case of the strangers, they either wore a Microsoft HoloLens and verbally noted that they can see the dog in a space shared between them and the participants, or pretended to be distracted while walking over the virtual dog. In the case of the virtual dog, it was either responsive (see Figure 1a)) to the collision by falling over and getting hurt, or unresponsive (i.e., continuing its idle animation, see Figure 1b). We found that the responsiveness of the virtual dog to the collision, increased the sense of being together with the dog even though the collision event had a negative connotation. The virtual dog's responsive behavior

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²https://tamagotchi.com/

³https://www.nintendo.com/games/detail/little-friends-dogs-and-catsswitch/



(a) Responsive/Aware

(b) Unresponsive/Unaware

Figure 1: Screenshots of (a) the virtual dog being responsive, and (b) unresponsive of the collision event.

also decreased the level of positive affect participants attributed to the strangers regardless of the strangers' awareness of the dog. We asked our participants to walk their dog on a walkway shared with the stranger. We observed that regardless of the stranger's awareness and the dog's responsiveness, participants adjusted their walking behavior to match the dog and allocated physical space for it to walk on the walkway next to them.

4 FUTURE RESEARCH DIRECTIONS

In our previous experiment, we observed that the virtual dog was able to impact participants' locomotion patterns, and its behavior influenced participants' perception of the other persons and the virtual dog itself (see Section 3.1). Based on past work with real and virtual animals and our prior findings, we identified several research directions that warrant further investigation.

The virtual dog's capability of influencing its human in a social context offers support for investigating a more extensive range of behaviors (i.e., positive, negative, superpowers). In this direction, we aim to identify possible appropriate behaviors to enhance the realism of the interaction and the sense of co-presence between the virtual animal and its human in both public and private spaces. In this domain, we are interested in exploring the extent to which the virtual animal's spectrum of behavior can implicitly and explicitly influence users' actions towards their environment. For instance, can an agitated virtual dog that is responding to danger alarm users in a more natural way and on a subconscious level? Is a virtual dog that exhibits superpowers capable of empowering its human?

Previous research in the area of human-animal interaction has shown that both real pets and novel dogs are one of the most important sources of social support due to their non-judgmental nature and are capable of reducing physiological and subjective stress [1,13]. It will be valuable to investigate whether virtual dogs can create similar effects during their interactions with humans. In this domain, we are planning to investigate to what degree the presence of a virtual dog, its behavior, and placement can influence humans' stress and sense of comfort compared to not having one.

Also, with the ubiquity of Internet of Things (IoT) devices, we are planning to investigate the capabilities of virtual animals such as a virtual dog as an interface aimed at conveying the digital information to the user and its influence on user's decision making, sense of privacy, and trust compared to the current approaches of speechbased assistants and mobile apps.

Last, with increasing levels of information that humans receive every day, we are planning to investigate how virtual animals can reduce cognitive load and enhance memory and recall more intuitively. For instance, can virtual dogs improve users situational awareness through their interaction with things in the environment compared with the conventional visual/audio messages currently utilized?

5 CONCLUSION

In this paper, we described the potential benefits of realizing a virtual animal in augmented reality based on findings from the human-animal interaction field and described previous virtual animal research. We described our previous experiment geared towards gaining a better understanding of a virtual dog in augmented reality as a companion. Our findings indicated the ability of the virtual dog to influence both users' behavior and perception through its behavior. Last, we presented future research directions to understand further the virtual animal's different range of behaviors, its potential as an interface for the sensing world of IoT devices, and its impact on users' memory and recall through its behavior instead of common visual and/or audio messages.

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