Nene : An Interactive Pet Device

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Abstract
In the past decades, it has become widely accepted that pets have a positive effect on humans, which leaded to multiple studies on the effects of Human-Animal Interaction (HAI)[4][3]. However, there are many occasions where pet owners have to leave their pets such as working and studying abroad. Thus, we introduce 'Nene', a set of device, including an interactive cat-shaped device that reproduces in real-time features of a pet such thermal and haptic characteristics, and a mobile application for visual and acoustic features. In this study, we explore the psychological effects that Nene has on humans, focusing on loneliness and stress aspects. The evaluation shows a positive result as it provides a calming and relaxing effect to the users and potentially reduces stress and loneliness level. The result aims to open a new perspective for remote HAI for pet owners.

Author Keywords
Human Animal Interaction; Sensing; Haptics; Telepresence; Interactive Pets

ACM Classification Keywords
H.5.2 [User Interfaces]: User-centered design

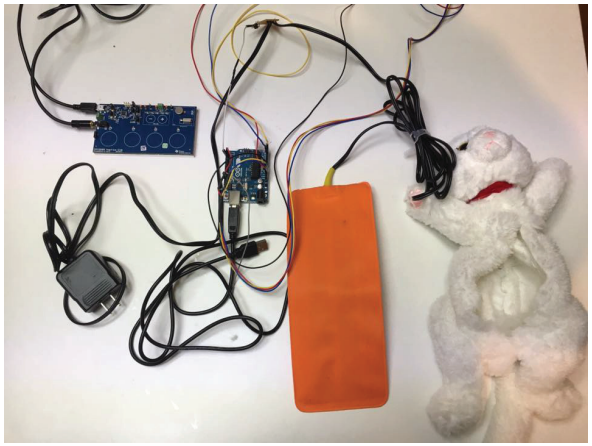

Figure 1: The user-end setup overview

Introduction and Motivation

Animals and humans have had long history together for thousands of years. As time past, humans started to domesticate them, which led to the popularity of household pets, e.g. dogs and cats, in this modern era. Human-Animal Interaction (HAI) has been proved by several studies to have beneficial effects on owners' health as a way to reduce stress and loneliness etc[4][3].

However, there are situations that force people to be apart from their pets such as working and studying aboard. Oftentimes, The lack of HAI between an owner and a pet can cause stress and loneliness for owners. To tackle the said problem, we would like to propose 'Nene'(a short form for 'sleeping cat' in Japanese), a set of device - an interactive cat-shaped device and mobile application, to create a real-time interaction by recording, streaming and reproducing the 'feeling' of one's own pet in real time. In this study, we explore whether the real-time simulations of a real cat using the Nene surrogate can reduce stress and loneliness level of pet owners that do not live with their pets. We tested our system over a period of 2 weeks with 5 different users, using both qualitative and quantitative tests. The result shows a positive effect on pet owner's stress and loneliness levels. Upcoming studies will investigate the possibilities, advantages as well as limitations of our approach to the remote HAI.

Related Work

The related work can be divided into two main approaches:

1. Interactive Virtual Pet for Entertainment Purposes

For decades, there were attempts to create virtual pets (also known as digital pet, artificial pet or pet-rising simulation) as an artificial human companion for a purpose of entertainment, as a substitute for a real pet. For example, Tamagotchi [2], a handheld digital pet, created in Japan and was a big hit toy of the 1990s. Tamagochi is a proving phenomenon that interactive virtual pets could have a big impact on people's emotional state as well as people's imagination could turn an object into a living thing.

2. Therapeutic Device for Medical Use

Paro is a baby white seal robot, used mainly in hospitals and extended care facilities for animal-assisted therapy [6]. The robot has five types of sensors in order to detect the environment and respond back to patients. However, Nene is not supposed to substitute for a real pet, but act as an interface, reproducing the characteristics of a real pet, such as sound, temperature, haptic sensations, etc.

Figure 2: Example of the video stream

Approach

Even though as shown in the related works, there are other solutions towards the stated problem, we believe that robots cannot replace owners' attachment toward their pets. Thus, we introduce Nene to tackle the problem of remote HAI while taking the attachment of the pet owner as a main consideration. One of the factors contributing to owners' attachment toward their pets is 'Individuality Recognition'[1]. Pet owners can recognize the individual characteristic and personality of their pets, through physical contact. Hence, Nene is designed to enable users to see their own pet through a real-time CCTV, hear the sound, sense the temperature and feel the breathing movement of a pet through vibration.

The four elements of Nene include:

1. Video Streaming: A real-time CCTV is linked with a mobile application. A user is able to see his or her own pet anytime anywhere via a mobile phone.
2. Audio simulation: Nene is able to transmit real-time pet's sound. On top of that, the device allows the user to communicate with their pet by transmit the owner's voice back.
3. Temperature: by using an infrared contactless temperature sensor, the real temperature of a pet can be transferred to Nene and as a result, the user can feel his or her pet's actual body warmth.
4. Purring vibration of their pet: We use the DRV2605EVM-CT module to transform the purring sound into vibration.

	D1	D2	D3	D4	D5
U1	Baseline	H	HS	HST	HSTV
U2	H	HS	HST	HSTV	Baseline
U3	HS	HST	HSTV	Baseline	H
U4	HST	HSTV	Baseline	H	HS
U5	HSTV	Baseline	H	HS	HST

Figure 3: H: Haptic Simulation S: Sound Simulation T: Temperature V: Visual Simulation

Evaluation

To assess the viability of our approach, we conducted a 2 week long user study with 5 adult subjects (4 females, 1 male), 21 to 33 years old, from different ethnic backgrounds, who live abroad and either have or used to have a dog or a cat in their home countries. Each participant tested the demo for 10 minutes for each of the 5 sessions and each session was conducted on a different day within a two week period. The basic idea of the study is to test the effects for different combinations of simulation modalities and compare them with a normal emotional state of the participants without exposure to the prototype (as a baseline). In every session, each participant's blood pressure and heart rate were recorded before and after the test. In addition, participants were asked to complete two loneliness tests (Campaign to end loneliness measurement tool[1] and UCLA 3-item loneliness scale[5]) before and after each demonstration. The test was conducted using a Latin Square experimental design which looks as on Fig. 3.

In the last session, there we added a post-test survey consisting of open-ended and Likert Scale questions, together

[1] https://www.campaigntoendloneliness.org/wp-content/uploads/Loneliness-Measurement-Guidance1.pdf

with an in-depth interview on usability and overall experience. The baseline condition showed a slight heart rate increase of 4.4 beats per minute, however, all other conditions showed no significant change in the heart rate. The blood pressure changes did not show significant results as well. However, we hypothesize that the 10 minute exposure period may be not enough to cause any significant changes.

The two loneliness scales gave some positive results. The first loneliness measurement tool shows that without the prototype, the participant's loneliness level increases by 0.75 points. But there was a noticeable decrease of loneliness when the participants interact with the prototype. The second scale also shows similar results. The loneliness level decreased by 0.25 points for the baseline condition, while 3 out of 4 days of using the prototype, show much higher decrease by 0.4 points of loneliness level. However the number of participants is not enough to claim any statistical significance, we still consider this to be a very promising result for the preliminary study. Moreover, 3 out of 5 participants show a decreasing trend in their loneliness levels over a course of 2 weeks.

Taken together, it can imply that the prototype provides a calming and relaxing effect to the users which potentially reduces stress and loneliness level, as well as can possibly be used as an easy alternative for Animal Assisted Therapy and Animal Assisted Activities.

Conclusion and Future Work

Our experiments show very interesting possible application scenarios for Nene. For example, Nene can be used in therapeutic scenarios for cases of depression and mental disorders, and can be an alternative solution to remote animal-assisted therapy and other animal-assisted activities. Also, with additional studies, it can give a new perspective for remote HAI for pet owners. For the future we plan to conduct a study on a bigger group and improve the prototype to increase the similarity with an actual pet.

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