Robot Birds:

Enabling socializing opportunities through human-robot interaction

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***Abstract*— Animals therapy serves as a unique tool for caregivers in both eldercare and therapeutic situations. Music therapy is also an established therapeutic practice. Robot therapy is a new field of research where robots serve a similar function as therapy animals. This paper looks at robot bird companions. The aim is to leverage the benefits of both animal therapy and music therapy. The robot companions interact with people through music and motion and also serve to facilitate interaction between people. There is potential for the birds to be used as a positive social tool in therapeutic and eldercare situations.**

Keywords—robot therapy, music therapy, ai, social robots.

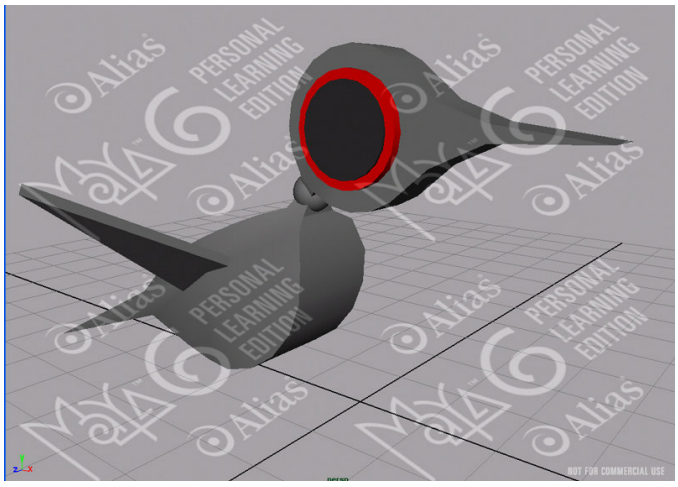

Figure 1. Bird robot model.

I. INTRODUCTION

More and more robots are playing an active role in people's lives. Robots are becoming social companions. Robots can help us clean our homes, play games with us, even serve as the family dog. Robots are beginning to play a role in therapy situations. In a similar way to how researchers have studied the benefits that animals or music offer in terms of people's positive interaction with them, researchers are also looking at how the unique social affordances that robot systems offer can be used to improve the quality of people's lives, especially the elderly and those that need various types of therapy.

Animal therapy studies have shown that pets can improve the quality of life of their owners and often minimize tension between family members[15]. Heart attack patients who were pet owners were shown to live longer than non-pet owners. Pets have been shown to promote psychosocial development in children[16]. Studies where animals are brought into homes of non pet owners have shown that animals can help reduce blood pressure during mildly stressful tasks, and animals present during medical procedures were shown to reduce chronically ill children's physiological and psychological stress[17]. Animal assisted therapy (AAT) is becoming an established discipline with multiple successful studies that show the benefits of therapy that includes animals from dogs to sea turtles[15].

Music is another area that has been shown to be useful as a tool in different types of therapy. Reduction of pain and stress, social facilitation, and mood enhancement are some of the beneficial effects music therapy can elicit. Music therapy is helpful across different types of therapy situations, from eldercare to autism to neuro-degenerative illnesses[21][22][23].

Robot bird companions are a new type of therapy robot. They will interact with people and help facilitate social engagement. These robots listen to their owner's songs, learn from the song and sing back a new song that incorporates parts of their owner's song. The robots also sing with other bird robots like themselves. Robot owners will be encouraged to bring their robot with them to meet owners of other bird robots and let the birds interact. The robot is a social facilitator for the owner.

The following sections describe the concept and preliminary design for the robot bird companion therapy robots.

II. Animal, Music and Robot Therapy

A. Animal Therapy

In the past few decades, animal therapy has become an established practice. The unique social qualities that certain animals offer, such as the benign loyalty and endless positive energy of a golden retriever, make them good companions for many people, especially those with anxious or insecure personalities[18]. The non-evaluative presence an animal offers can reduce the psychological stress response that a stressful task might produce[30]. This calming effect is probably the strongest reason why animal therapy is effective. The positive reinforcement that an animal offers can also serve to reinforce a person's self worth[31].

Animal assisted therapy (AAT) is defined as:

> "AAT is a goal-directed intervention in which an animal that meets specific criteria is an integral part of the treatment process. AAT is directed and/or delivered by a health/human service professional with specialized expertise, and within the scope of practice of his/her profession.
>
> AAT is designed to promote improvement in human physical, social, emotional, and/or cognitive functioning [cognitive functioning refers to thinking and intellectual skills]. AAT is provided in a variety of settings and may be group or individual in nature. This process is documented and evaluated[4]."

Any design for a robot intended for therapeutic or companion purposes needs to address ways to similarly improve the psychological and physiological condition of the subject.

B. Music Therapy

Most people enjoy music on a personal level. They have songs that they like, that they hate, that make them feel good, or remind them of certain events. Often these feelings for music are felt at an emotional level that is beyond explanation. In a similar way to how animals can allow people to drop their defenses and communicate in a relaxed way, music also taps into a part of a person that transcends typical social interaction. Music can free a person from the constraints of spoken language and allow them to communicate in a more emotionally expressive way.

Robin Dunbar has suggested that the performance and enjoyment of music has a strong social component, both by nature of its being processed in the brain in a similar way to language, and because music and language are important means for humans to form and maintain large groups[29].

Music therapy has shown benefits to many different types of patients as well[21][22][23]. Some of the primary goals of music therapy follow[19][20]:

- Enhancing the mood and the general psycho-physical condition of patients
- Reduction of psycho-physical tensions
- Alleviate pain
- Relaxation and rest
- Musical education and enhancing the appreciation of music
- Improve social interaction and communication

The robot bird companion seeks to exploit these same mechanisms to give a person a socializing connection to the bird and other bird owners as well as the emotional expression that singing enables.

C. Robot Therapy

Robot therapy is a new field of research. Robot therapy is defined as:

> "a framework of human–robotic creature interactions aimed at the reconstruction of a person's negative experiences through the development of coping strategies, mediated by technological tools, in order to provide a platform for building new positive life skills. In a broader sense, the innovative concept of robotherapy offers methodological and experimental justification for the use of non–pharmacological interventions based on stimulation, assistance, and rehabilitation techniques for people with physical and cognitive impairments, special needs, or other psychological problems.
>
> The goal of psychologically-oriented [robot therapy] in studying person–robot interactions is twofold: (1) offering a research-justified modification of the robotic creature's appearance and behavioral configuration that will be well-suited for the particular type of psychological and physical profile (e.g., specially designed robots for persons with depression, cerebral palsy, attention deficit disorder, sensory disintegration, dementia, physical immobility, anxiety, autism, loneliness, etc.), and (2) providing individually–tailored non–pharmacological interventions based upon people's needs and preferences[3]."

Robot therapy is dependent on robots that can interact with humans in socially acceptable ways. People react to the specific appearance and shape of social robots[1][5]. There is a need to match the appearance and functionality of the robot to the specific interaction situation[2].

[13] describes four different categories of appearance for social robots. They are: human type, familiar animal type, unfamiliar animal type, and imaginary character type. The robot bird companions fall into the unfamiliar animal type robot. Most people are somewhat familiar with birds, but usually have had only very limited interaction with them. Birds comprise only six percent of household pet ownership[14], making them far more uncommon as pets than dogs, cats, or even fish.

Working with a robot modeled on an unfamiliar animal has the benefit that people are less likely to attach prejudices and expectations to the robot and the interaction will not have to overcome the influence of the prejudicial bias. Other research has shown the benefit of working with unfamiliar animal type robots. For instance, experiments with Paro the robotic baby seal showed positive results when the robot is incorporated into more traditional therapy situation. A rise was shown in communication between the patient, the robot, and the therapist when the robot was included in the therapy session [11].

Robins et al. [12] point out that therapy robot designers need to be careful that they are creating robots that correctly match the functionality needed for the specific therapy situation. For instance, with certain conditions such as autism in children therapy robots need to be social mediators and not social isolators that reinforce antisocial behavior.

The robot bird companions are designed to create non evaluative opportunities for their owner to create music and receive positive feedback. The companions are also designed to promote engagement with other companion birds and their owners around a common interest, namely the birds.

1)Overview of Therapy Robots

There have been a number of robots that have been used in therapy situations. NeCoRo[26] is a robotic cat that with fur, sensors, actuators and learning algorithms simulates a real cat. It can get tired, hungry, purr at sweet behavior and get angry at violent behavior. Kuma & Tama[27] were created as eldercare companion robots that would react to touch and sound and could be programmed to say things like reminding a person to take medication. Therapeutic Robot Seal Paro (Paro was certified as the most therapeutic robot in February 2002, and entered the Guinness World Records in the 2003 edition.) Research showed this robot very effective and sought after over time in use at elderly care center[13]. AIBO is a popular robot dog. Therapy research using AIBO however shows a significant falloff in popularity as participant gets over the novelty of the robot[28]. My Real Baby[24] is a robot modeled after a traditional doll. It can laugh, cry, frown and smile and is embedded with sensors and a behavior language operating system that allows it to respond to tickling, burping and get tired. PaPeRo[25] is a personal childcare robot intended to recognize people, communicate and play games with children. Muu2 & Emuu [6] are emotional robot interfaces that are meant to serve as personal assistants in home settings. Nursebot Pearl[8] is an eldercare robot that gives directions and reminders to patients.

III. ROBOT BIRD COMPANIONS

Robot bird companions are intended to serve as both an engaging interactive companion that will sing in response to a person singing to it, and as a social facilitator that will encourage its owner to seek out other bird owners with whom the owner's bird can sing.

The bird is designed to look like a stylized version of a hummingbird. The robot will have 6 degrees of freedom. One for the beak, three for the neck, one for the feet and one for the wings. The primary sensor for the bird is a microphone that will be used to listen to the owner's song. The robot will use a camera with Haar-classifier face detection software to orient itself to the owner. The actuators for the bird animations will be standard stepper motors for all degrees of freedom except for the wings, which will use voice coil actuators. There will also be a speaker to project the bird's song.

The robot will be controlled by software that maps different sound input to specified audio and robot animation output. The robot listens to its microphone input and will run a classifier on the signal to test whether there someone is singing to it. When there is singing, the bird will listen to the song. The bird will check its memory for songs that match the current one. If it remembers this song, the bird will wait for the singer to pause and then sing back its variation of the song.

While singing the bird will dynamically change its version of the song to incorporate new musical variations from the person singing along with it. While the bird is singing, the bird will listen to see if the person is trying to sing along with the bird. If the person is trying to sing along, the bird will continue to sing. If it sounds like the person is singing a new song, or making other sounds, the bird will stop singing and listen for new opportunities to join in a new song.

The bird's behavior animations will be chosen based on a simple model of the emotional content of either the song it is singing or the song the owner is singing. For instance, if the song has a fast tempo with lots of high-pitched sounds, the bird's animation will also be quick. If the song is slow and monotonous, the bird's behavior will be more fluid and broad. The emotion model will be based on the simple dynamics of the song such as tone, tempo, and energy of the sounds. These parameters will be clustered along different emotion dimensions, such as happy<->sad or agitated<->calm and the animations will be parameterized accordingly[32]. When there is no behavior animation for a specific emotion, the bird will interpolate between the nearest two animations.

The birds will react to other birds the same way they react to people, by listening to their songs and responding in kind.

IV. CONCLUSION

More and more robots are being built to serve as social companions. They are being used in many different ways, from personal assistants that let us know when we have email to therapy robots that help autistic children break out of the antisocial behaviors that define their disease. In this paper we have described the influences of and concept for a new type of social therapy robot called the robot bird companions. Animal therapy research has shown that a person can lessen anxiety when interacting with non-evaluative animal companions. Music therapy research has shown that a person can alleviate pain and reduce stress when engaging in both producing and listening to music.

The robot bird interacts with its owner through song. The hope is that act of singing with the bird will enable the owner to relax and enjoy the interaction and hence distract themselves from the problems that they might be seeking to

alleviate through therapy. Similarly we hope the birds will serve a socializing function. Because the robot birds are able to learn from and sing with other robot birds, the owner will be encouraged to interact with other bird companion owners. Because the robot birds serve as a non-judgmental companion, they can act as a social facilitator that both connects people to each other through a similar point of reference, the bird, and allows people a safe companion to reinforce their self-value.

ACKNOWLEDGMENTS

Thank you Cynthia and Bruce for your guidance on this project.

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