SnuggleBot

A Novel Cuddly Companion Robot Design

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ABSTRACT

Loneliness is an increasing problem in today's world, especially during the current pandemic when people are finding themselves increasingly isolated. Social robotics research has highlighted how robots can be designed to support people and improve their mood and general wellness. However, we do not yet see widespread social companion robots in homes. In this project, we took a constrained design approach to developing a novel cuddly companion robot, focusing on simple and deployable technologies, while aiming to support people's wellbeing by helping with loneliness. We had three design goals that are simultaneously feasible and align with supporting wellness: the robot should be physically comforting, socially engaging, and require people to care for it. We present a simple prototype cuddly companion robot that implements these goals using simple, off-the-shelf technologies.

KEYWORDS

Domestic Robots, Companion Robots

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1 Introduction

General mental wellness issues, such as loneliness and related feelings, are an increasing problem in the modern world [1]. Loneliness is a particularly salient concern given the widespread isolation associated with the current global pandemic [2]. A more recent technological strategy to mitigate loneliness is to develop social robots: robots designed with human or animal-like features (e.g., faces, arms, legs) to communicate with people using life-like techniques (e.g., speech, synthetic emotions, facial expressions). This encourages people to interact with the robots as if they were a kind of social entity [3], [4]. Social robots can also impact a person's feelings, mood, and behaviors, just like other living things can [5], [6], with research demonstrating that even simple designs can improve wellness, increase motivation to exercise [7], or increase children's engagement in education [8]. While there has been a great deal of work on support robots for people with serious clinical conditions (e.g., the Paro robot for people living with dementia [5]), much less has targeted companion robots to help support everyday healthy people with loneliness. In our work, we present a novel companion domestic robot design and prototype, SnuggleBot, that we created specifically to support a person's general wellbeing.

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Figure 1. "SnuggleBot" prototype that is physically comforting, engaging, and requires people to care for it, to support wellbeing and mitigate loneliness.

2 Design approach

Our design approach was to focus on design goals from the perspective of a person's needs, and what behaviors and features will support people. Following, we investigate how to achieve those goals using simple, inexpensive, and deployable technology.

We selected three principles for our companion robot design to encourage engagement and to develop a sense of companionship: the robot needs to be physically comforting (i.e., soft, cuddly), socially engaging (i.e., encourages people to interact with it), and needs to be cared for (i.e., demands attention and maintenance).

We used physical comfort as a direct way to help people feel calm after touching, hugging, or cuddling with our robot. We drew

from an established thread in psychology, particularly Harlow's classic work on comfort in monkeys [9]: infant monkeys preferred to spend time with a cloth-made, warm mother proxy that did not have food, over a cold wire mother that had food, and turned to the cloth mother when scared. Similarly, physical warmth, touch and comfort can support people. Physical warmth can serve as a proxy for social warmth and connection [10], and even something as simple as a weighted blanket can reduce anxiety [11]. Doll therapy, for example, relies on holding and hugging something to improve wellbeing and meet some attachment needs of dementia patients [12]. We thus designed a robot to hold and hug that provides physical comfort and warmth, which we expect to contribute to developing attachment and companionship.

SnuggleBot aims to be socially engaging to encourage people to build a relationship and rapport with it, as even simple engagement can lead to empathy and attachment [13]. We designed our robot to have attention-grabbing features and gestures, and to react to attention it receives to encourage continued interaction.

We aim to make a robot that people must care for, similar to a pet or dependent; research on pet ownership shows how being a caregiver can support people by providing a sense of purpose and structure to owners' lives [14] and how pet ownership can be good for people's wellbeing [15]. Further, we hope that encouraging empathy and attachment of the robot as per the other design goals will help motivate people to care about the robot's needs and take care of it. We therefore designed a robot that requires people to care for it, to mimic the effects and impacts of having a pet.

3 SnuggleBot Prototype

We augmented a stuffed animal to include a pouch to hold a hot compress and simple robotic capability using off-the-shelf Phidgets[1]: actuated flippers, an actuated tail, and a glowing horn.

To support our physical comfort goal, we drew directly from Harlow's work [9] by selecting a mammalian, cute-and-cuddly looking stuffed toy: a narwhal (see Figure 1). Further, we added a heat compress to SnuggleBot to keep it warm and added weight to make it feel more comforting, like a weighted blanket. Thus, as people hold and cuddle with it, it has substance and feels warm. This follows existing research suggesting that people prefer to hug soft, warm robots rather than cold, hard robots [16].

For our social engagement goal, the robot will randomly wiggle its flippers to signal it wants attention as research suggests people will pay attention to a robot more frequently when it uses gestures [17]. The robot also has an actuated tail (see Figure 2) so that when it is being hugged, it will flap its tail to show happiness to encourage people to hug it more in the future. It will also communicate its needs by changing the colour of its horn as outlined below.

We designed the robot to require care from people, to be "content." It needs to be kept warm and hugged at least once a day. If the heat compress in its pouch gets cool, or if the robot wants a hug, the glowing horn (embedded RGB LED) changes colour to indicate this. This care requirement both gives people the positive benefits

Figure 2. SnuggleBot's embedded hardware provides feedback: its tail can move up and down, flippers can wiggle, and its horn can glow a range of colours.

of hugging something, and a task to do: people need to remove and microwave the heat compress when needed to keep the robot warm. We are exploring colour mappings for the robot's different needs. We use a Phidgets 5mm RGB Super Flux LED, a Phidgets temperature sensor, and an Interlink Electronics 1.5" Square 20N Force Sensing Resistor that detects when the robot is hugged.

Thus, the cuddly, weighted robot that needs to be hugged meets our physical comfort goal, requiring attention and maintenance meets our needing-care goal, and its communication of needs and feedback during interaction meets our engagement goal.

4 Evaluation

We intend to deploy SnuggleBot to homes as part of a longitudinal study to evaluate the impact of the robot on participants' wellness, and the cumulative effect of our three design goals. We will quantitatively and qualitatively assess if the robot is physically comforting, if people engaged with it, and if they took care of it.

We will recruit participants who self-identify as being lonely. We will conduct semi-structured interviews before deployment to get a sense of the participants' pre-existing feelings towards social robots. During the study we will conduct interviews and questionnaires once a week to monitor how the participants feel about the robot and their levels of loneliness and general wellbeing.

We will analyze our data to look for impact on loneliness and on participants day-to-day lives. We will focus on findings relating to our goals, for example, the impact of the physical warmth (there are mixed results in the literature [18]), the care regime, and the robot's communications. We will also ask participants questions about how, and how often, they interact with the robot.

5 Conclusion

We present a design approach and SnuggleBot, a cuddly companion robot to support people living with loneliness. We will finish implementation and deploy SnuggleBot into homes, quantitatively and qualitatively analyzing the impact of our design goals on participant loneliness and how they interact with the robot.

[1] https://www.phidgets.com/

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