

The Huggable: A Therapeutic Robotic Companion for Relational, Affective Touch

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Currently, companion animal therapy is used in hospitals, nursing homes, and other facilities to improve the lives of people. Unfortunately, it is not practiced in many facilities due to the fears of allergies, bites, or disease. Even in facilities that do allow this form of therapy it occurs for a short time each time as a schedule activity. These restrictions have created a new form of therapy where robotic companions are used either when the real animals are not available or as a complement to a current companion therapy program.

The Huggable, shown in Figure 1, is a new type of robotic companion inspired by companion animal therapy with the goal of functioning as a team member that works with the staff of the facility and the resident to promote the overall health of the individual (Stiehl, Lieberman et al. 2005). This system consists of both the Huggable robot as well as a separate computer placed at the nurse's station. The Huggable and the nurse's station computer communicate via an 802.11g wireless connection.

The Huggable features a combination of traditional and novel technologies to promote both a compelling interaction as well as a useful tool for research and healthcare. The Huggable features a full body "sensitive skin" consisting of temperature, force, and electric field sensors, shown in Figure 1, underneath a soft layer of silicone skin to promote a pleasant tactile interaction. The Huggable uses silent, back drivable, voice-coil actuators in its neck which limit the risk of damage to the person or the robot. A pair of small video cameras in the eyes and a pair of microphones in the ears provide visual and auditory input to the Huggable. An inertial measurement unit (IMU) senses the body movement of the Huggable as it is held in someone's arms. All of this information is then processed by a 1.8GHz Pentium M PC-104+ Embedded PC with 1GB of RAM, 802.11g networking, and an 8GB compact flash hard drive inside the Huggable. A speaker in the mouth of the Huggable provides audio output. Finally, the Huggable has eight actuators which provide the motion for a 3-DOF neck, 2-DOF coupled eyebrow, 1-DOF coupled ear, and 2-DOF coupled shoulder mechanism.

Much of the interaction with companion animals is through touch in which the animal is petted, scratched, rubbed, patted, etc. In response, the animal turns to look back at the person or demonstrate another response, for example a cat purrs while it is petted on its back. The Huggable is unlike other robotic companions in that it is designed with an emphasis on these types of relational, affective touch interactions. The Huggable is not only able to detect where on its body it is being touched, but most importantly how it is being touched – such as if it is slapped or being petted. Additionally, the Huggable uses the electric field sensors of its "sensitive skin" to detect very light touch that cannot be detected by the force sensors alone, and in combination with the temperature sensors determine if it being touched by a person or by an object. This distinction is very important since



Figure 1: The Huggable (left) and Skin Sensors (right)

the Huggable should respond more expressively to touch initiated by a person than incidental contact with an object. The data from the IMU can be combined with the "sensitive skin" information and the joint angle information to determine how the Huggable is being held, such as if it is sitting on someone's lap or being held in a person's arms. Once the Huggable determines its orientation, the video cameras in the eyes are used to locate the person's face and the Huggable turns to look up at the person. Thus the Huggable is capable of relational touch interactions such as nuzzling into the person when it is held in someone's arms.

In addition to these relational touch behaviors, the Huggable also features a set of behaviors based upon visual and auditory input for cases in which the person is not in close proximity or physically touching the Huggable. The Huggable is able to detect the location of motion and faces in a scene. For example, as a person approaches the Huggable, the Huggable notices and engages that person by looking back at them and demonstrating a pick me up or other gesture.

The Huggable is much more than a fun interactive robotic companion. It is being designed to be used in tandem with a separate computer at the nurse's station to promote the overall health and wellbeing of the individual. The nurse's station computer is able to access video, audio, or other sensor data from the Huggable and display it on the screen. This information can be used in cases in which the nursing staff needs to instantly get information and respond, such as if a person who was holding the Huggable has fallen. Similarly, if a young child scared on their first night in a hospital is holding the Huggable tightly and rocking it back and forth, this information can be sent to the nursing staff prompting them to come into the room to comfort the child. The Huggable can also be used to gather information over a long period of interaction and report changes in activity that could be precursors to more serious problems, such as if a person suddenly becomes more aggressive with the Huggable, or might show a much lower level of activity.

References

- Stiehl, W. D., J. Lieberman, et al. (2005). The Design of the Huggable: A Therapeutic Robotic Companion for Relational, Affective Touch. AAI Fall Symposium on Caring Machines: AI in Eldercare, Washington, D.C.

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