Synthetic Personality in Robots and its Effect on Human-Robot Relationship

Shelly Park[1], Ehud Sharlin[1], Yoshifumi Kitamura[2], Ellen Lau[1]

1. Interactions Lab, Department of Computer Science, University of Calgary, Calgary, AB, Canada, T2N 1N4

2. Human Interface Eng.Lab, Osaka University, Suita, Osaka, Japan

Abstract

Synthetically generated emotional behaviors in robots can encourage humans to perceive robots with more interest and draw more human attention. Effectively implemented emotional behaviors can help robots to appear more intelligent and can even compensate for limited artificial intelligence by letting humans use their imagination to interpret the robot's behavior. In order to test human reactions, Sony Aibo is used to program two distinctive dog behaviors: playful and fearful. The goal is to study and evaluate the reactions and responses of humans as well as testing the effect different robotic behaviors have on the robot's usability in a specific task.

Keywords: Human-Robot Interaction, Synthetic Emotions, Emotional Robotic Behavior, Aibo, Robot dog, Social Interaction

1 Synthetic Emotion in Robots

The human emotional system plays a vital role in our survival, social interaction, cooperation and learning. Likewise, machines will need some way to express emotional behaviors when they face similar conditions [1]. However, since human emotions have more than a logical and rational component, we do not qualify robotic emotions the same way as we do with human emotions. Rather, we see robotic emotions as only interface behaviors that merely elicit the perception of emotions. We assume that a set of communicative and sociological behaviors is associated with emotional behaviors and we are mimicking these behaviors using Sony's AIBO robot dog (Figure1).

The perception of emotion is very subjective – it is specific to different people and situations. The role of emotional robots is to give humans the sense of social companionship and attachment to the robots. In the future, synthetic emotions will play a larger role in the way robots interact with humans. Moravec argues that PCs in 2003 are "100,000 times too weak" to even decently perform like an intelligent being [3]. However, because of the anthropomorphic nature of robots, humans tend to attribute intentions to robot's behaviors.

The extent to which people attribute emotional properties to machines has been explored by Friedman, Kahn and Hagman [4] who researched how people view their Aibo robots in terms of five categories: Technological Essences, Life-Like Essences, Mental States, Social Rapport and Moral Standing. One very interesting finding is how even a primitive social interaction between current robotic technologies can create so much emotional responses from humans. People believed that AIBO has intentions and spoke of AIBO as having unique mental qualities or personality. The interesting aspect to this finding is that people want to perceive their robots like real pets and attribute dog-like emotions to Aibo, even if the robot itself is not capable of having and expressing these ranges of emotions.

The idea of exploring emotional behaviors in robots with facial expressions and body postures are explored by various researchers such as Breazeal's [2] work on Kismet, robot that can communicate its emotive state to humans through various facial expressions, body posture and gaze

Figure 1: AIBO

direction. For this project, we are mimicking dramatic and extreme emotional dog behaviors with a robot dog, Aibo, and explore how such dramatic emotions affect how humans perceive and interact in different scenarios.

2 Implementation of Emotional Behavior

For this project, the most recent version of Sony Aibo, ERS-7M2/B, is used. The Aibo robot dog has a number of touch sensors: head, back, chin and four paws. It has a color camera for vision and two microphones in its ears for stereo hearing. Aibo also has IEEE 802.11b compatible wireless LAN. It can play music, dance, talk in synthetic human voice, search and fetch its pink ball and bone.

The emotions we are implementing are playfulness and fearfulness. The behavior is coded using R-CODE [5] macro language that allows the developers to focus on conceptual behaviors rather than low-level programming at joint movement level. The difficult part of programming robotic movement is choreographing the joints to maintain balance at all times. Another challenge is trying to convey playful and vibrant behaviors using the limited physical vocabulary of Aibo's joint movements and coding within the boundaries of the robot's expressiveness.

We have implemented a convincing dog behavior that can express an emotional state that conveys either fearfulness or playfulness for several minutes for as long as the user study takes place. The human or environmental interaction is minimized. During the sequence, Aibo is directed to follow one single sequence that depicts an emotional state.

In the playful, we programmed Aibo to express an emotional behavior that wants humans to play with Aibo by seeking affections from nearby users. We programmed Aibo to imitate a playful dog by wagging its tail, panting with its mouth open and barking happily to draw some attention. Although unnatural to real dogs, replacing dog sound with synthesized short music file for denoting happiness is found to be very effective.

In the fearful state, we programmed Aibo to mimic a behavior of a frightened puppy situated in an unfamiliar situation. Aibo is growling, walking backward from the audience, and crying frighteningly for help. The dog is not trying to cause fear in the audience but only showing its fear and seeking comfort. We want to find out whether people can distinguish such behavior and react to Aibo like they would with a real puppy.

3 Evaluation

We would like to examine how AIBO's synthetic emotions affect its usability and survivability. One experimental approach will be to see how different synthetic emotions change the way Aibo is being perceived by users. A basic question we want to explore is how Aibo's synthetic emotions can affect the way it is being perceived, and more explicitly, what it is being perceived to be: is the Aibo perceived to be an object? A toy? A robot? A puppy? A computer?

We plan to place Aibo in a crowded environment, on leash, much like a lost puppy. Aibo will follow one of the two emotional states that we designed.

We will monitor the testing site using a video camera. We will try to observe which emotional state draws more responses from people, whether good, bad or indifference. We will compare our results to control experiments where the lost entities are a notebook PC and a real puppy.

We hypothesize that the anthropomorphic nature of robots will draw more human attentions in a large crowd relative to a none-dog shaped object. We want to find out whether such reaction is based on a novelty of seeing a robot or a reaction to a synthetic emotion. The implication of this experiment is to address the future robot designs such as shapes, but also to find out the necessary behaviors required of robots in asking for help in public places and determining a set of synthetic emotions that will improve its usability and survivability.

4 Summary

We are trying to find out how the robots are being perceived given a certain behavioral patterns and how this pattern changes the robots usability and survivability. The evaluation process is ongoing and preliminary evaluation will be done in the fall of 2005.

References

[1] D. Norman. *Emotional Design: Why We Love (or Hate) Everyday Things.* Basic Books. pp. 161-211. 2004

[2] C. Breazeal and R. Brooks. "Robot Emotion: A Functional Perspective", *Who Needs Emotions: The Brain Meets the Robot*, MIT Press. 2004

[3] H. Moravec. "Robots, After All". CACM (Communications of the ACM). Oct 2003, pp. 90-97, http://www.frc.ri.cmu.edu/~hpm/project.archive/robot.papers/2003/CACM.2003.html

[4] B. Friedman, P. Kahn, J. Hagman. "Digital Sociability: Hardware Companion? – What Online AIBO Discussion Forums Reveal about the Human-Robotic Relationship." CHI 2003. Proceedings of the conference on Human factors in computing systems. April 2003.

[5] Sony Aibo Open-R website. http://openr.aibo.com/openr/eng/index.php4