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Humanoid Robots Discovering Creative Creative Concepts Through Social Interaction

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Abstract

Psychologists and social scientists have been researching creativity in humans for several years, and it has gained the attention of artificial intelligence and robotics researchers as well. In this abstract, we discuss the emotional and conversational interface required for a humanoid robot to socially interact with children in order to learn new creative concepts. We briefly describe the approach we are taking to develop such a humanoid robot that can collaborate with children to discover creative concepts.

Introduction

Though human creativity has interested psychologists for decades, it has also recently gained focus in the fields of artificial intelligence and robotics. For example, there are robots that learn to create improvised music (Hoffman 2011). We are particularly interested in the artificial intelligence required for a humanoid robot to socially interact with children to learn new creative concepts. In this paper, we outline an approach for achieving this goal.

Although there are several methods for performing creative thought, such as breaking perceptual sets, we focus on the use of metaphors as a vehicle. Using metaphors is an example of the creativity-relevant skill of generating hypotheses that can lead to set-breaking and novel ideas. According to Indurkhya (1992), a "metaphor is an unconventional way of describing (or representing) an object, event, or situation (real or imagined) as another object, event, or situation". These metaphors can be used as heuristics to organize problem-solving, or design-thinking to solve loosely defined design problems (Rowe 1987, Antoniades 1992).

Creativity in Humanoid Robots

Creativity is the quality that is marked by the ability or power to produce through imaginative skill. (As a related aside, it is interesting to note that a key word used in this definition, *imaginative*, has an etymology based in the word *image*.) A dictionary definition of imagination is the ability to form a mental image of something not yet present. Boden (2009) defines creativity as the ability to generate novel and valuable ideas (e.g. concepts, theories, interpretations, stories). In describing novel, she defines two distinctions: psychological novelty, or P-creative, and historical novelty, or H-creative. A P-creative idea is one that is new to the person who generated it, while an H-creative idea is one that is P-creative and has never occurred in history before. She describes how novel ideas may be produced by combination, exploration, or transformation (Boden 2004). Transformational creativity involves transforming the space or style by altering or eliminating one or more of its defining dimensions.

Sociable robots have the ability to interact with humans by following normal human social cues and modes of interaction (Breazeal 2004). In order for robots to have the full range of interactive social behavior with humans, continued progress is required in artificial intelligence and human-robot interaction research. One area in particular that needs to be addressed is how to endow creativity in a humanoid robot and generate corresponding creative interactive behavior between a robot and a human (Stroud et al. 2013).

In order to perform creative actions, robots will have to learn creative concepts (Stroud et al. 2013). One naive approach for robots to exhibit creative behavior is for the robots to generate random concepts or perform random actions and determine their results. Another approach is for robots to learn creativity by interacting with humans.

In this approach, the humanoid robot will socially interact with a human and observe them while they are creating new concepts. The robot will use this interaction to learn how to incorporate those new concepts into its own vocabulary, or more generally, its own ontology (Williams 2004, Stroud et. al 2013).

Emulating Human Creativity

This is the approach that we are developing with our 3D printed, teen-size humanoid robot named MU-L8, or Emulate (Stroud et al. 2013). We are equipping Emulate with an emotion and conversation interface, SMILE, the "Smartphone Intuitive Likeness and Expression" app, using a Java Android phone and motion tracking software using the Kinect interface (Figure 1) (Russell et al. 2014).

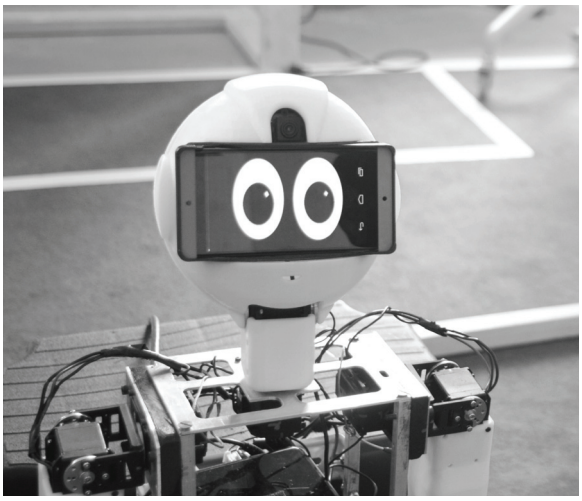

Figure 1. MU-L8 Humanoid with SMILE Emotion and Conversation Interface.

The SMILE app displays emotional states via a pair of animated, blinking eyes. The robot's emotional model is based on Ekman's basic emotions, in that there are six discrete emotional states, in this case Neutral, Happy, Sad, Angry, Confused, and Surprised. The state changes are triggered by keywords spoken to the robot. There are between 5 and 7 base keywords associated with each emotion, and the user can add more with the Learn function. Additionally, users are able to specify verbal responses to any keyword. When the user speaks a phrase or sentence containing the keyword to the robot, the robot parses out this keyword, transitions to the appropriate emotion, and speaks the appropriate response. In this way, it can achieve a basic form of emotional interaction with a user, and it is particularly designed to appeal to children.

Children often create metaphors through pretense play (Janes 2002). In our creative concept learning scenario, the humanoid robot will play a conversational game with a child in which the two collaborate to develop creative metaphors surrounding healthy snack foods. This game is described more fully in (Williams et al. 2013).

Conclusions and Future Work

We believe that AI research for creativity in human-robot interaction is a promising area to improve social robot interactions. We are progressing in the development of our creativity emulation framework for our humanoid robot and will aim to conduct experiments in the coming year.

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