Chapter 10

On Non-Humanoid Expressive Robots

The platform serving to illustrate the core implementation of this work's research (described in Chapters 6 and 7) is a non-humanoid robot, a robotic desk lamp. Its design process is described in Chapter 9. In the following chapter we will briefly outline some of the considerations for pursuing a path of non-humanoid design for expressive robots in human-robot interaction.

10.1 Non-antrhopomorphic character design in art

Be it for reasons of technological constraints or artistic experimentalism, artists have often attempted to create valuable works within frameworks of imposed limitations. At times these constraints had a surprisingly positive impact on the final product, proving to be not hurdles but rather inspirations.

In the field of character animation, this principle is classically associated with "The Dot and the Line" [Jones, 1965], in which complex narrative and character development are implemented using two very simple characters, a dot and a line (Figure 10-1). All expression is performed in motion, timing and staging alone. While technically impressive, this film is also often quoted for distilling the core principles of expressive cartoon "acting" without other visual aids.

Figure 10-1: Screen capture images from Chuck Jones' 1965 short "The Dot and the Line".

More recently, in a similar example of utilizing technical limitation, Lasseter [1986] produced "Luxo Jr." which features two simple desk lamp characters. For lack of appropriate 3D modeling and animation software, Lasseter used only basic 3-joint rigid characters and, once again, all character expression and narrative is implemented trough motion in these 6 joints, with heavy reliance on sound cues. This short continued to become a textbook example of narrative 3d animation using simple motion and sound effects. "Luxo Jr." also served as one inspiration for the design of the robotic desk lamp in this dissertation.

10.2 Non-humanoid expressive robots

It is similarly worthwhile explore robotic characters digressing from humanoid and anthropomorphic modeling, and instead focus the design effort on simplicity and motion. We also urge robot designers to consider familiar objects and embellish them with actuation and animation. Several reasons for this have been discussed in the past [Duffy, 2003],

including the exceeding expectations one has of a robot bearing a human form, the need for emphasis on behavior over appearance, and the avoidance of the so-called "uncanny valley".

We also believe that the evaluation of non-anthropomorphic robots, and in particular familiar objects which were embellished with robotic traits, encourage people working with such robots to consider their relations to such "moving inanimate" objects, as opposed to building upon the preconceptions brought to the interaction by previous human-human interaction.

We would like to offer two additional design considerations:

10.2.1 Freedom of exploration

A traditional design path in robotics imitates the human physique and features, building robots that usually have one or more of: arms, eyes, mouths, a head, or a human-like torso. Much of mobility research is also concerned with the imitation of human-like legged locomotion (e.g. Sakagami et al. [2002]).

This approach, based on the implicit assumption that the human form and our behavior are a pinnacle of design or evolution, inherently falls short. It views the human example as a practically unattainable goal towards which small advances can be made, bringing the robotic simulacrum a little closer to the human ideal. Starting with a void, the direction of such imitation is clear and constrained by the human example. Its merit is strictly evaluated with respect to the human original.

In contrast, starting the design process with an existing artifact allows a certain freedom to explore different avenues of embellishment. Without a set ideal guiding the robot design, the same familiar object can be imagined through a variety of evolutions. In our example, a robotic desk lamp superseded a regular lamp by allowing the light beam to change color and using an iris to focus the beam. We defined five degrees of freedom and their extent, thus defining the movement capabilities of the lamp. By specifying the trajectory of the

lamp's movement, we design the robot's attitude and its implied "personality", in the character animation meaning of the phrase. All of these are not constrained by a "robotic lamp ideal", but instead grow out of the familiarity of the robot's ancestor, the household desk lamp. This lack of preconceived ideal allows for more creative freedom in the robot design process.

10.2.2 Market feasibility

The second driver to consider HRI research on non-anthropomorphic expressive robots is that of market feasibility. While humanoid robots are developed in many research laboratories, their advent into the consumer market is still unforeseeable.

Considering simpler non-humanoid forms with fewer degrees of freedom holds the promise to study human-robot interaction that is relevant to more imminent consumer products. To date of this writing, 5-DoF robots, including their mechanical design and control software, are not far-fetched possibilities for mass-manufactured products.

In addition, focusing robot design around familiar existing household objects may allow for more rapid market acceptance, as these artifacts' utility in people's homes is well-established, while the introduction of humanoid robots is bound to require a paradigm shift before becoming common practice.

Additional merits from HRI research in simple, non-humanoid expressive robots include the possibility of exploring human reaction to basic physical animation, with the opportunity to systematically explore simple controlled affective response. Moreover, such robots boast a cost-effective design, allowing for evolutionary prototyping, frequent re-implementation, and large-scale replication.