The Concept of a Robot

James E. Young, Ehud Sharlin, University of Calgary, Takeo Igarashi, University of Tokyo

Introduction

The understanding that we develop about the many objects and entities in our lives has many levels and is very complex. For example, when a person looks at a calculator they will not simply see a plastic box with rubber buttons, filled with electronics and a battery. They will also see a portable device to help with simple mathematics; more than a simple sum of the physical pieces. This subjective interpretation of an entity is what we call constructing an entity's *concept*, a particular set of characteristics and properties that people apply to an entity to form a meaning they can use and understand. This meaning is then used to inform on what to expect from an entity and how to interact with it.

The concept of an entity is constructed differently from person to person, with particular influence from existing understanding of similar entities, previous experiences, and the idea of affordances. This means that it is often difficult to generalize and understand what concepts people construct and how they construct them. However, gaining an understanding of these points will help us understand why people react to particular objects in particular ways. Furthermore, such knowledge can be used by designers to inform the design of objects, enabling them to aim for particular reactions and specific understandings.

In the realm of computers, designers often play directly on this idea by using metaphors (such as a desktop and trash can) or by copying existing successful methods (such as the keyboard and mouse or the start menu) to heavily influence how a user constructs the concept of a particular interface. A recent trend in computing, however, is moving away from the traditional desktop PC toward more physical interfaces that have an increasingly dynamic presence in our physical space. Examples include Tangible User Interfaces [Ishii and Ulmer, 1997] and Robots, both of which pose interesting questions on how people are constructing the concepts, as these technologies are fundamentally different from predecessors.

In our work we focus on robots, particularly domestic robots. Robots are fundamentally different from traditional computers in that they have an intelligent and dynamic physical presence in the everyday lives and spaces of everyday people. Which previous understanding, experiences, and entities are people drawing from to understand these robots? One particular study [Forlizzi and DiSalvo, 2006] has shown that people construct their robot's concept by relating them heavily to living things through anthropomorphism and zoomorphism, treating their robot as a kind of pet. The field of sociable robotics [Breazeal, 2002] takes advantage of this fact by building robots that have human or animal traits, thus increasing the inclination of users to construct the concept of the robot based on experiences with living things. Our work follows this approach and we look at how principles from sociable robotics affect the concept of a robot. We focus on particular interface designs, and consider how particular characteristics affect how people construct the concept of their robot.

Goal

The focus of our research is to try and gain an improved understanding of how people construct the concept of a domestic robot. Taking cues from sociable robotics, we want to understand how the design and interface characteristics of the robot relate to what people feel and think, and why, when they experience a robotic interface. From this, we will create initial sets of guidelines to describe this relationship, building a model that designers can use to mold how users react to their interfaces.

Methods

We will implement three robotic interfaces based on sociable robotics principles, each focusing on a different design characteristic. The three instances in our current planning are: cartoon-based visual representation, characteristic interactive motion paths, and robot sound expression. These three are selected as simple instances of the particular design issue. For example, cartoons are simpler than human faces, sound effects simpler than speech, and motion paths simpler than gait. This avoids many complexities and enables us to explore our questions from a higher, more fundamental, level. Following, we will observe people interacting with robots with and without our updated interfaces, using these instances to reflect on how people construct the concept of their robot.

Cartoon-based visual representations (presented at HRI 2007 [Young et. al, 2007], see Figure 1), is a technique that places familiar cartoon and comic artwork on a robot to represent the robot's personality and state. Cartoon art is familiar to people, visually simple and rich with social meaning and content, and so we expect this kind of interface to have a serious impact on how people construct the concept of the robot using it, changing how they treat and interact with a robot. Our current implementation does this using a mixed-reality lens overlay interface over an iRobot Roomba robot.

Figure 1: a screenshot of Jeeves.

Characteristic motion paths are the way that a robot moves about its space. Most traditional robots devise their motion path using a mathematical and algorithmic model based on some function such as efficiency or thoroughness. The resulting path looks expectedly robotic and mechanical, and lacks feeling and emotion. We plan to implement several interactive motion path systems using the iRobot Roomba, where the Roomba reacts to user movement in either mechanical or emotional ways. For example, the Roomba could react shyly, aggressively, or angrily. We expect that the change in characteristic of the motion path will have a strong effect on how people understand the Roomba as a robot in their home.

Robots, in general, make sound effects. Whirring motors, clicking relays, and beeping components help shape the science-fiction inspired idea of what a Robot is supposed to be. We will look at alternative styles of sound effects, from cute Robotic sounds such as R2D2 from Starwars, to sound effects such as animal or animal-like noises. We also expect that this will have an impact on how people perceive the robot, how they feel around it, and what they expect from it.

These three simple instances will help us understand how various factors of a robot's design affect how people construct the concept of the robot and perceive it as an entity in their space.

Conclusion

Through these systems we will approach the question of how people construct the concept of a domestic robot, focusing on particular design characteristics. The largest challenge facing this project is to create meaningful evaluations and user experiments which can observe user reactions, involvement, engagement, levels of comfort, and their general overall response and impressions of the robots. As part of this, we need to better understand the psychological foundations behind our ideas. From these evaluations we hope to be able to present a better understanding of how the various aspects of robotic interfaces affect how people construct the identity of the robot.

References

[Breazeal, C] Breazeal, C., Designing Sociable Robots, The MIT Press, 2002.

[Forlizzi and DiSalvo] Service robots in the domestic environment: a study of the roomba vacuum in the home. In Proc. HRI '06, pp 258—256, New York, NY, 2006.

[Ishii and Ulmer] Ishii, H. and Ulmer, B. Tangible Bits: Towaqrds Seamless Interfaces between People, Bits and Atoms. In Proc. CHI 1997.

[Young et. al] Young, J., Xin, M., Sharlin, E., Robot Expressionism through Cartooning. Proc HRI 2007, Washington DC, 2007.