NTT9904-01
Human-Robot Dynamic Social Interaction

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1. Project Overview

NTT researchers are interested in the question of whether a physical robot produces a more direct emotional coupling with human beings than does a computer generated graphical image of a similar robot. At MIT we are building a robot that has human-like facial expressions and shoulder and neck gestures, and that perceives human motion and facial expressions. This is coupled to an emotional system so that the person and the robot naturally follow normal human communication social dynamics. This robot will be installed at the NTT Communications Science Laboratories in Kyoto where the response of human subjects will be measured and compared to their response a graphical face interface.

2. Progress through June 2000

During the first nine months of this project (through March 2000) we have achieved the following:

1. We completed a design for a new, more robust, robot head that we call Kismet 2. The new design was based on human anatomical models so that the gestures that it makes are much more human-like. The system includes seven degrees of freedom for gross anatomical movement. There are 4 degrees of freedom in the neck, including one non-human freedom which is neck extension. Humans achieve this motion through their shoulder structure but Kismet 2 has no shoulders. There are three degrees of freedom in the eyes. One tilt degree which couples both eyes together, and two independent pan degrees of freedom. The eyes each consist of one miniature color camera. The facial expression degrees of freedom are not included in this part of the design.

2. We completed the design of a new control system for Kismet. This is a rack mounted set of electronics which provides interfaces from computers to the electromechanical hardware of Kismet 2. This is a well documented design which will be easily reproducible, and also very maintainable at NTT.

3. We built the first prototype of the Kismet head system. This includes the mechanical components, motors, and encoders. We have verified the correct operation of this prototype, made a series of minor modifications, and are now ready to be able to reproduce it for the version that we will provide to NTT.

4. We fabricated the control system for the Kismet 2 prototype.

5. We have begun the design of the facial expression system for Kismet 2.

6. We have begun the software library to run the Kismet 2 head system.

The new Kismet is a significant step forward as an interactive humanoid head. It is much more life-like, and operates at much more human-like speeds in its response.

We expect to complete items 5 and 6 above by June 2000. We will also begin the fabrication of the facial features by that time. Furthermore we will complete the fabrication of the delivery control system for the NTT version of Kismet.

3. Proposed work for the year July 1, 2000 through June 30, 2001

During the second year of this project we will fabricate the delivery version of Kismet 2, and deliver it to NTT. The necessary steps for that are:

1. Complete the design of the facial expression system.
2. Fabricate the prototype of the facial expression system.
3. Fabricate the delivery version of the Kismet 2 head.
4. Fabricate the delivery version of the Kismet 2 facial expression system.
5. Complete the software library.

Once the system is delivered to NTT we will work closely in developing the experiments to be done that compare the embodied version of Kismet with a graphical version.

These experiments will require much subtle planning. For instance, we have noticed with Kismet 1, that as it engages its own interest with something else in the environment, and turns its attention away from a person's face, that person really feels as though they are in the presence of another being. It will be quite a challenge to see how to give that same qualitative capability to the graphical robot, so that it too engages things in the physical environment in which the person exists. Controlling for such subtle differences across the embodied and graphical worlds will be difficult, but identifying the relevant aspects of the world in order to do the experiments will be revealing in itself.