Design of a Robotic Face for Studies on Facial Perception

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1. Introduction

People can perceive and respond to very humanlike robots (androids) as if they were human. Thus, androids open the door to a new methodology for exploring human cognition and interaction. They can be used in place of human stimuli as an apparatus in social, cognitive, and neuroscientific experiments. However, if an android is to substitute a human being in experiments, it is essential to control for the effects of appearance by designing it to look and move much like a human being as possible. A handful of systems that have been designed under these criteria are being used effectively as human simulators in a wide range of social situations. However, the opportunities where they could be used in cognitive research are still limited. A reason for this is because some of their gestures remain impaired by unnatural kinetic and anatomical features. With this motivation, we have undertaken the research project of designing and developing a gynoid head, we call Uma [FIGURE 1]. Uma is a human-size and anatomically accurate gynoid face that aims to overcome the most important mechanical shortcoming of current android technology.

2. Mechanical Design

We present Uma, a very expressive and anatomically accurate gynoid face. Uma is based on a new mechanical architecture paradigm that enables a modular approach where exaggerated expressiveness is freed for mechanical interference while overcoming most drawbacks of the current android technology at the same time. By replacing the unnatural kinetic and anatomical features present in most android systems to date with kinematics that are almost functional equivalent to the human musculoskeletal system, Uma aims to improve the realism of the gestures that she will be able to produce, thus reducing the state of uncertainty in subjects about what is being observed.

With life-sized dimensions, human actuation speeds and ranges of motion, precise bi-directional control over each facial muscle, and exact points of origin and insertion [Flores et al, 2007 & 2014], researchers can alter the robot's behavior during a face-to-face interaction making Uma a suitable tool for controlled experiments. HD cameras in her eyes record subject's responses and promote experimentation in gaze discrimination and joint attention.

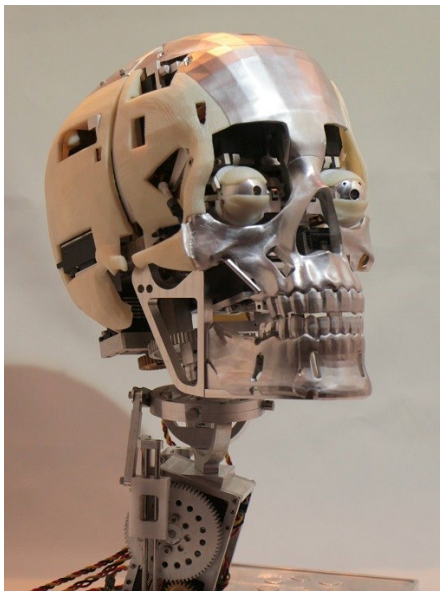

Figure 1. *Image of Uma, our gynoid head.*

3. Results

Uma is capable of 35 Degrees of Freedom (DOF) of which 6 are in the jaw, 12 are in the lips, 8 are in eyes and eyelids, 4 are in the upper face, 3 in the neck, and 2 in the tongue.

4. Conclusions

We are designing a novel 35-DOF gynoid that can match human facial movement properties. Based on this design, we are proceeding to our next phase to cover the model with skin so that we can begin our studies on facial perception.

References

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