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Behavior and appearance cram of Android Robot for HRI

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Abstract - **Human–robot interaction is the study of interactions between humans and robots. Human–robot interaction(HRI) is a multidisciplinary field with aid from human–computer interaction, design, robotics, artificial intelligence, natural language understanding, and social sciences. This is basic setback in robot development is its appearance and behavior. Namely, not only the performance but also the look of a robot influences human-robot interaction. However, there is no approach to overcome this problem. In order to utter this problem, we propose an android robot that has similar appearance as humans and several actuators generating micro behaviors.**

Index Terms— **android, robot, HRI, artificial intelligence.**

I. INTRODUCTION

An android robot is intentional to look and behave like a human, particularly one with a body having a flesh-like similarity. Traditionally, androids remained completely within the area of science fiction, frequently seen in movie and TV. Only in latest times have advancements in robot technology allowed the plan of well-designed and sensible humanoid robots.

Robots are artificial agents with capacities of perception and action in the physical world often referred by researchers as workspace. Their usage has been widespread in factories but nowadays they tend to be found in the most scientifically advanced societies in such significant domains as search and rescue, mine and bomb detection, military battle, scientific exploration, entertainment, law enforcement and hospital care.

These areas of applications involve a closer communication with the user. The idea of closeness is to use its full meaning; robots and humans share the workspace but also share goals in terms of task accomplishment. This close communication wants new theoretical models, on one hand the robotics scientist work to improve the robots utility and on the other hand to evaluate the benefits and risks of this new "friend" for our modern society.

With the advance in Artificial Intelligence, the research is focusing on one part towards the safest physical interaction but also on a socially correct interaction, dependent on cultural criteria. The objective is to build an instinctive, and easy communication with the robot through gestures, speech, and facial expressions.

Dautenhan et al. [1] refers to friendly Human–robot interaction as "Robotiquette" that defines it as the "social rules for robot behaviour (a ‘robotiquette’) that is comfortable and acceptable to humans". The robot has to become accustomed itself to our way of expressing desires and orders and not the contrary. But every day environments such as homes have much more intricate social rules than those implied by factories or even military environments. Thus, the robot requires perceiving and indulgent capabilities to build dynamic models of its surroundings. It needs to recognize objects, categorize and locate humans and further their emotions. The need for dynamic capacities pushes forward every sub-field of robotics.

On the other side of HRI research the cognitive designing of the "relationship" between the robots and human benefits the psychologists and robotic researchers the user study are often of interests on both sides. This research endeavours part of human society..

II. ANDROID ROBOT

Fig.1. shows the Japanese android robot that is developed as a prototype. To make the appearance closely look like humans, mold of a girl is made, and we carefully chose a kind of silicon that would create the skin feel human-like. The appearance is a Japanese girl. The prototype has nine DOFs in the head (five for the eyes, one for the mouth

and three for the neck) and several free joints to make a posture. The actuators (motors) are all embedded within the body. The touch sensor used here is a strain rate force sensor. The mechanism is comparable to human touch insofar as it detects touch strength while the skin is deforming. The android has four touch sensors under the skin of the left arm. Only four sensors can measure the touch strength all over the surface of the left arm. These tactile sensors enable various touch communications.

Fig.1. Japanese Robot

A. Hypotheses about Appearance and Behavior

Mori [4] mentioned the relationship between similarity and familiarity of robot appearance and motion to humans. Familiarity of a robot increases with its similarity of motion and appearance until a certain point, when a subtle imperfection of the appearance and motion becomes repulsive This sudden drop is called an “uncanny valley.” In the figure, appearance and motion are evaluated on the identical axis. It is, however, not constantly the case that they are evaluated in the same manner.

B. Theoretical basis

A number of theories have been proposed to explain the cognitive mechanism underlying the phenomenon:

Mate selection routine, stimulus-driven appraisals of uncanny stimulus elicit aversion by activating an evolved cognitive mechanism for the avoidance of selecting mates with low fertility, poor hormonal health, or ineffective immune systems based on visible features of the face and body that are predictive of those traits.

Mortality salience Viewing an "uncanny" robot elicits an innate fear of death and culturally-supported defenses for coping with death’s inevitability. Partially disassembled androids...play on subconscious fears of reduction, substitute, and annihilation: (1) A mechanism with a human facade and a mechanical interior plays on our subconscious fear that we are all just soulless machines. (2) Androids in various states of mutilation, decapitation, or disassembly are reminiscent of a battlefield after a conflict and, as such, serve as a reminder of our mortality. (3) Since most androids are copies of actual people, they are doppelgangers and may elicit a fear of being replaced, on the job, in a relationship, and so on. (4) The jerkiness of an android’s movements could be unsettling because it elicits a fear of losing bodily control."

ROBOT PERFORMANCE

1) Self-awareness: The degree to which a robot can accurately assess itself will have a direct impact on the ability of the human to efficiently interact with the robot. The less a robot is aware of its capabilities and the less it is able to recognize when it is having trouble, the more human monitoring and intervention is required. Self-awareness is particularly important when a robot must ascertain if involving the human is useful. For example, if a robot is operating far (in time and/or distance) from the human (e.g., a lunar rover with an Earth-based operator), it must be aware that it cannot ask the human for physical assistance and that obtaining cognitive/perceptual help may take considerable time. To qualitatively measure self-awareness, we propose assessing the following robot characteristics: (1) understanding of intrinsic limitations (mobility, sensor limitations, etc); (2) capacity for elf monitoring (health, state, task progress) and recognizing deviations from nominal; and (3) effectiveness at detecting, isolating, and recovering from faults (during both planning and execution).

2) Human awareness: A robot can also be scored on the degree to which it is aware of humans. Depending on the application, the robot may need to be sensitive to the human’s presence and have knowledge of the human’s commands (expectations, constraints, intent). Clearly, the level of “awareness” depends on the level of autonomy that the robot is expected to achieve and the role(s) played by the human(s). This capability can be dynamic and may include a user model that helps the robot recognize human behavior and react appropriately. Human awareness implies competency in various skills, the proficiency of which can be assessed independently or collectively. These include: (1) human-oriented perception (human detection and tracking, gesture and speech recognition, etc); (2) user modeling and monitoring (cognitive, attentional, activity); (3) user sensitivity (adapting behavior to user, measuring user feedback, recognizing

human state). A recently proposed metric is the number of "awareness violations" (awareness information that should be provided that is not provided) that occur during task execution. This metric is particularly well-suited to critical incident analysis, in which anomalous situations (operator or robot encounters a problem) are examined post-mortem.

3) Autonomy: The ability of robots to function independently is limited, though continually improving. This is especially true when robots face anomalies, or conditions, that exceed their autonomous capabilities. Though there are many application specific methods, a useful metric for measuring autonomy in general is "neglect tolerance". Neglect tolerance directly measures how a robot's effectiveness declines when the human is not attending to the robot. In particular, it measures the amount of the time the robot can be neglected before performance drops below an acceptable level of task performance.
We must note, however, that neglect tolerance encompasses numerous factors: task complexity, robot capability, user interface, and the user. Thus, the metric is only useful for obtaining an overall measure of a robot's autonomy, rather than specific details (e.g., failure modes).

C. Uncanny valley

Many subjects mentioned that artificiality of the android's appearance, behavior and imbalance between appearance and behavior on the questionnaire. The artificiality of eye motion in particular may cause an increase in the number of fixations on the android's eyes. To examine this prediction, it is necessary to ascertain whether subjects provide fewer fixations on a robot that has robotic appearance, such as ASIMO. We hypothesize that the frequency of fixation represents the evaluation of communication, and the evaluation varies inversely with the frequency.

D. Eye Contact

Some subjects mentioned that they could not make eye contact with the android. It is considered that the lack of eye contact causes the uncanniness. Some psychological researchers show that eye contact can serve a variety of functions. Distribution of fixation point fell on the girl (Left), android A2 (Middle) and android A3 (Right). Brighter point means high frequency of fixation. Human-human communication. It is estimated that eye contact and the android's appearance work synergistically to enhance communication. To ascertain this, we will compare with a robot that has a robotic appearance and no eye contact behavior.

E. Contingent motion

One subject answered that the android with motion (A2) was more uncanny than the still android (A3) because the motion was not contingent. Another subject mentioned that repeating same behavior of the android was unnatural. It is possible that
the lack of the contingent android's motion (A2) made no difference between A2 and A3 in the result. As described in section 2, a contingent motion of nonhuman object varies an infant's attitude. It is estimated that a contingent motion of the android provides an effect that works in synergy with its human-like appearance.

III. CONCLUSION

This paper proposed that the Human–robot interaction is a multidisciplinary field with aid from human–computer interaction, design, robotics, artificial intelligence, natural language understanding, and social sciences. This paper also dealt with the basic setback in robot development is its appearance and behavior. We have developed an android robot that has analogous manifestation as humans and several actuators generating micro behaviors. This paper has shown the primary hypotheses about the effects of robot appearance and behavior on human-robot interaction and the preliminary experiments to examine human reactions to the android.

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