

Mechanisms and Functions for a Humanoid Robot to Express Human-like Emotions

Kazuko Itoh, Hiroyasu Miwa, Yuko Nukariya, Massimiliano Zecca,
Hideaki Takanobu, Stefano Rocco, Maria Chiara Carrozza, Paolo Dario, Atsuo Takanishi
#59-308, 3-4-1 Ookubo, Shinjuku-ku, Tokyo, 169-8555 Japan
E-mail: itoh@suou.waseda.jp (Kazuko Itoh)

INTRODUCTION

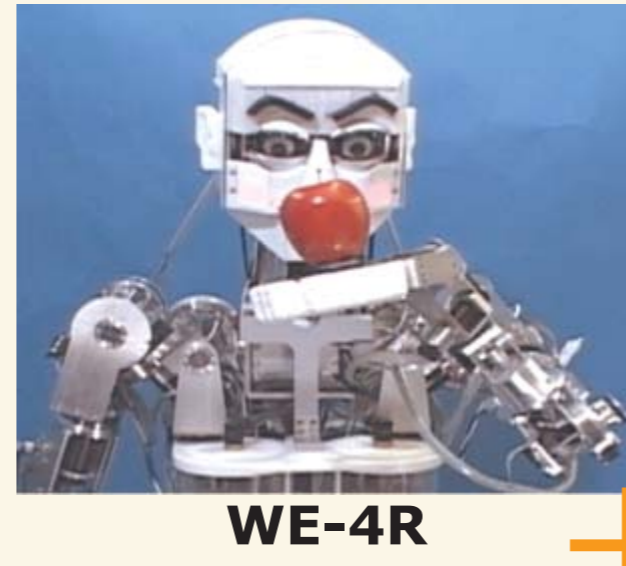
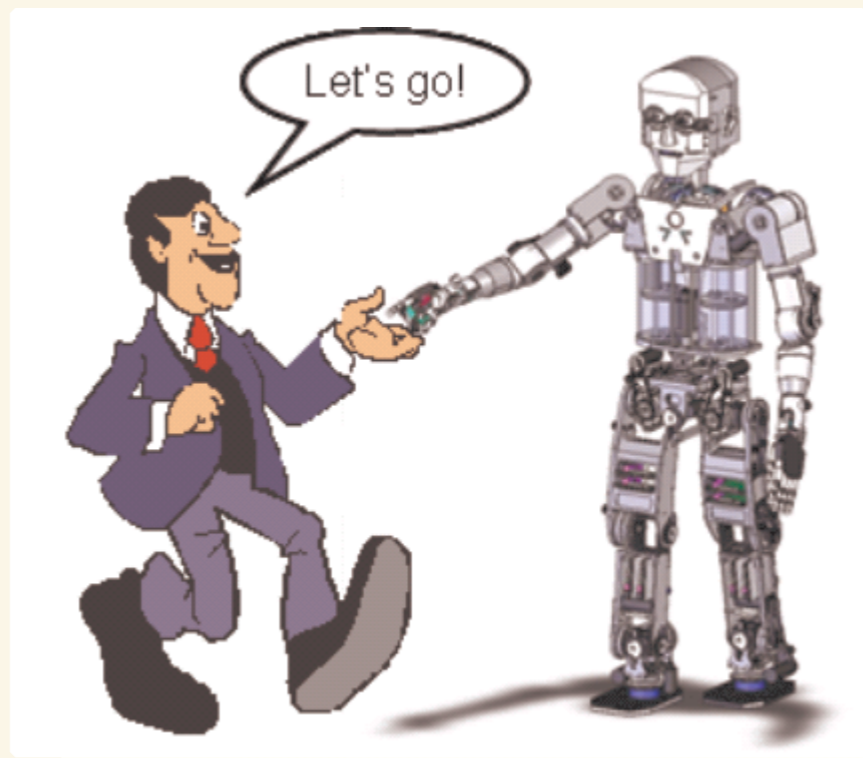
Present

- Industrial Robots
- Manipulation
- Programming by Human
- Tool for us

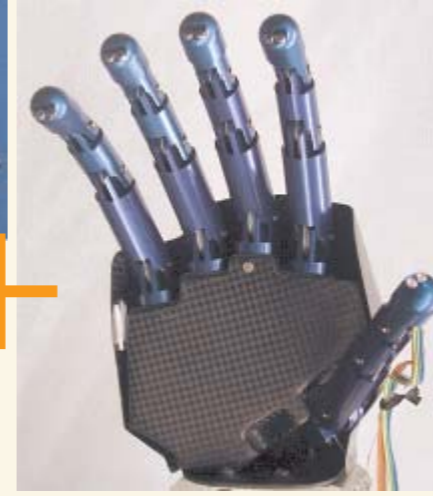


Future

- Personal Robots
- **Communication**
- Self Reprogramming
- Partner for us



WE-4R



RCH-1

OBJECTIVE

Hands made by metal and styrene foam
1. Just Sense put objects on its palm



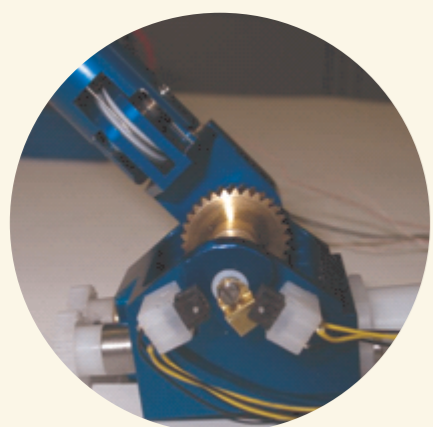
Emotion Expression Humanoid Robot WE-4RII (Waseda Eye No.4 Refined II)

1. Sense
 2. Grasp
 3. Express Emotions
- Interactive Motion
Various Behavior

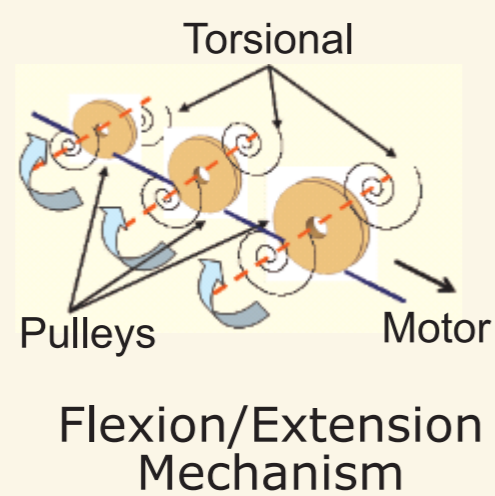
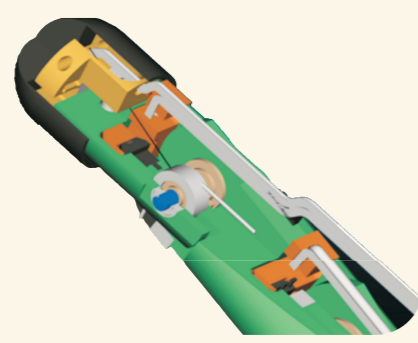
Emotion Expression Humanoid Robot WE-4RII

RCH-1

RCH-1 has in total 16 Degrees of Freedom (DOF) or 6 Degrees of Motion (DOM), 1DOM/3DOFs for each finger (flexion/extension) plus one DOM for thumb positioning (adduction/abduction). Each finger is underactuated, and its movement is driven by a single cable actuated by a motor placed in the freedom. The total eight is 320 grams. The new hands has been designed and realized in order to be capable of basic gesture, for interaction with users and for expressing emotions, and to realize different grasping.



Adduction/Abduction Mechanism



SENSORS

Visual

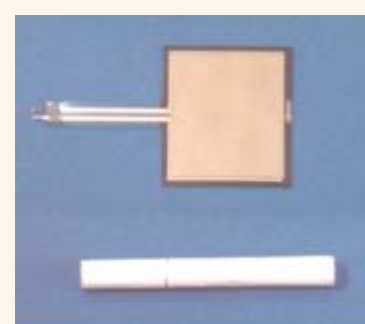
CCD cameras in the eyes → Target color

Auditory

Condenser microphones in each ear
→ Sound direction from its loudness and phase difference

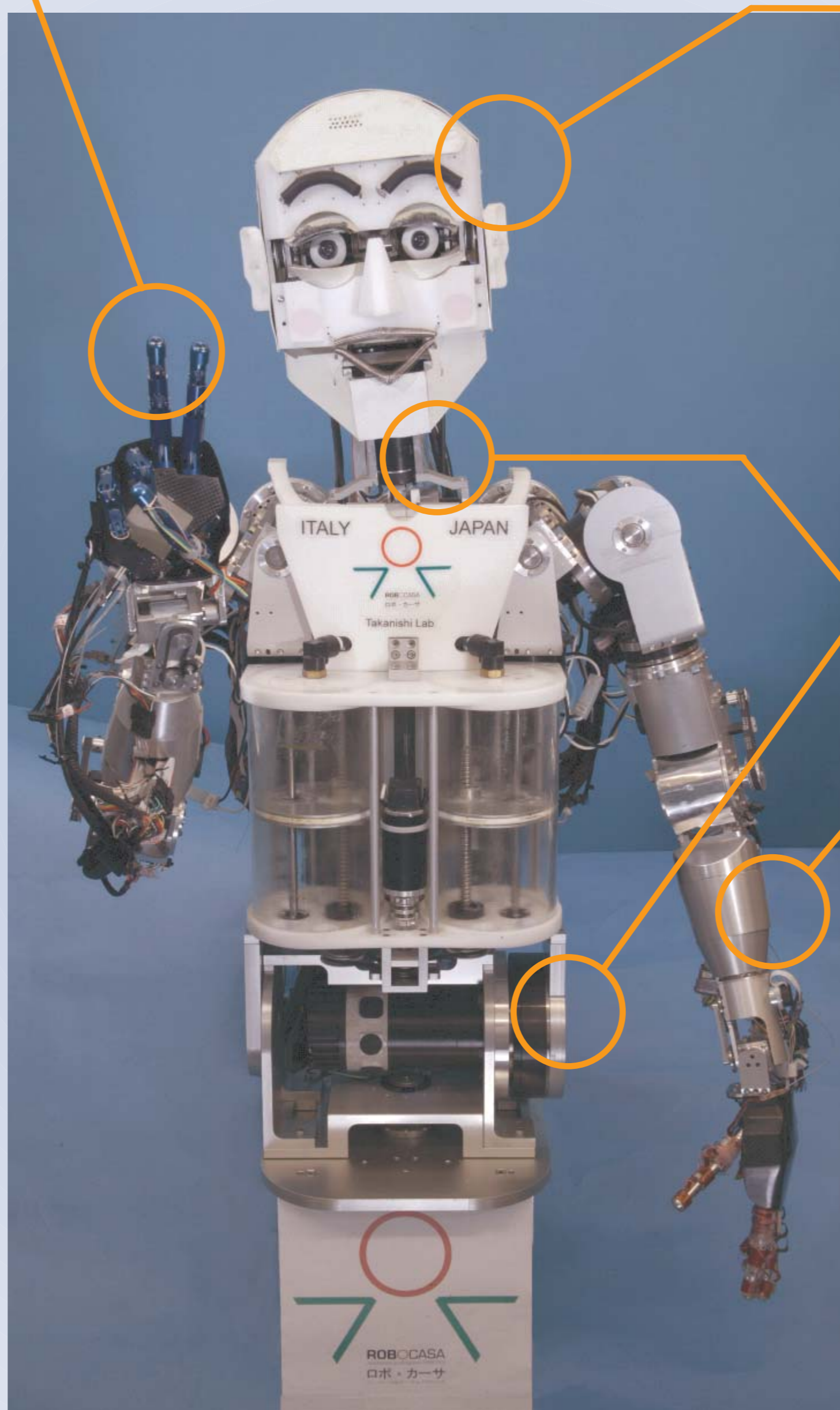
Olfactory

Four semiconductor gas sensors behind the nose
→ Smells of alcohol, ammonia and cigarette smoke



Tactile

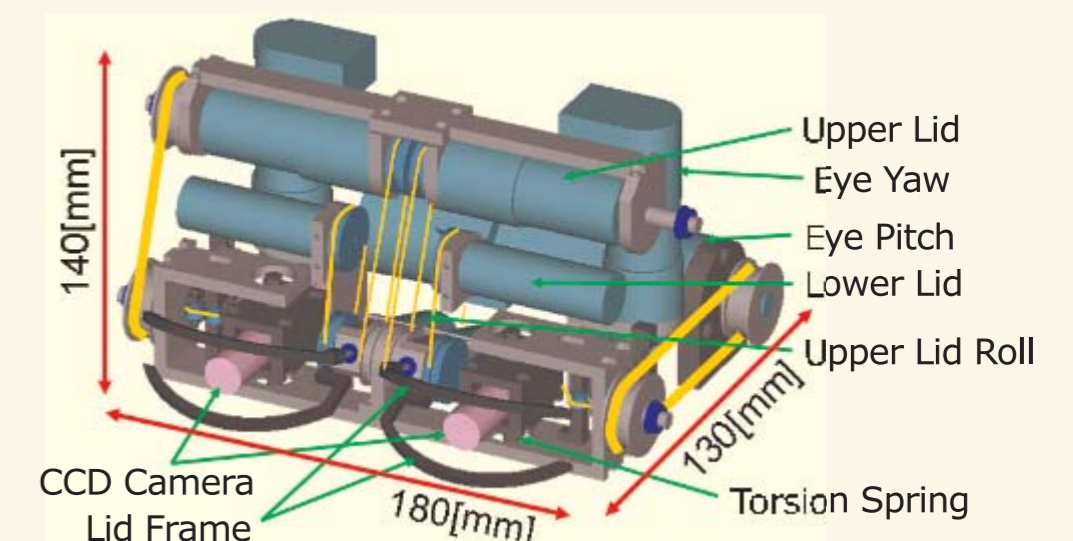
Two-layered FSRs on the cheeks, forehead, top of the head and side of the head
→ Touching behaviors "push," "hit" and "stroke"



HEADWARE

Head Part

WE-4RII composes its facial expression using its eyebrows, lips, jaw, facial color and voice. The eyeballs pitch axis motion mechanically synchronizes the opening and closing of the upper eyelid motion by a belt driven mechanism between the eyeballs pitch axis and the upper eyelid axis.

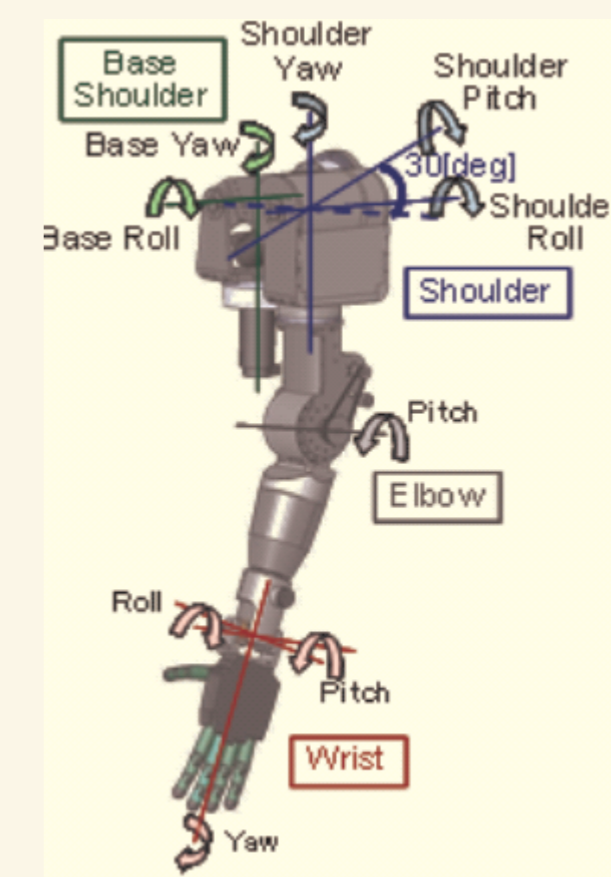


Neck & Waist

Since the robot keeps a distance from its eyes to the target, it bends backward or leans forward depending on the target distance using its neck and waist.

Arms

Humans can shrug or square their shoulders. Therefore, we added two degrees of freedom at the base shoulders for more emotional expression than the usual robot arms. We leaned the pitch axis 30 [deg] from the horizontal plane in order to avoid the singular point in a common use range.



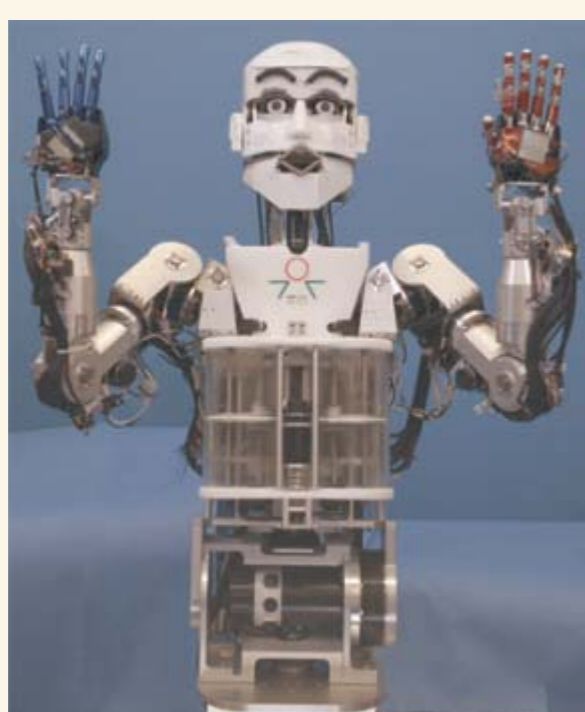
Degrees of Freedom

Part	DOF
Neck	4
Eyes	3
Eyelids	6
Eyebrows	8
Lips	4
Jaw	1
Lungs	1
Waist	2
Arms	18
Hands	12
Total	59

EMOTIONAL EXPRESSIONS



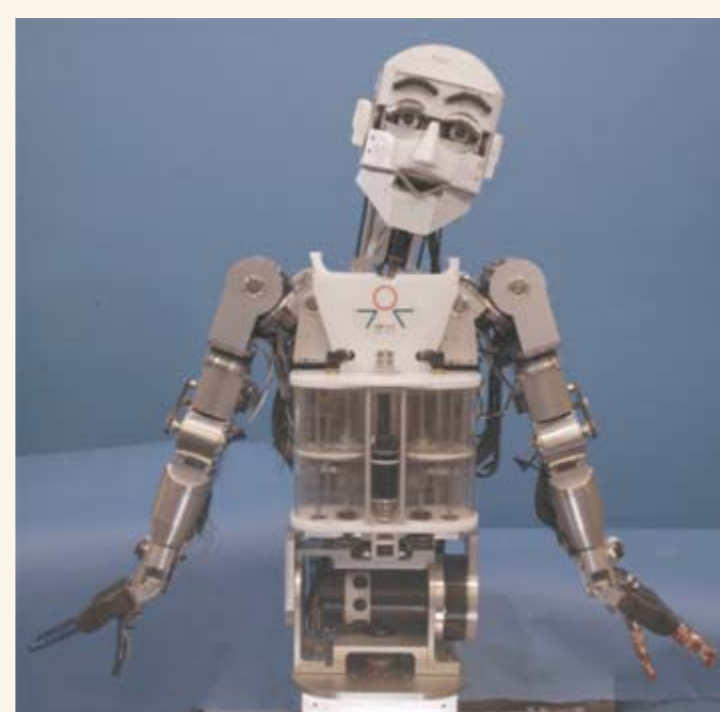
Neutral



Surprise



Sadness



Happiness



Fear



Anger



Disgust