

M. Zecca, K. Endo, N. Endo, Y. Mizoguchi, T. Kusano, K. Itoh, A. Takanishi. Design and evaluation of the soft hand whs-1 for the emotion expression humanoid robot KOBIAN. *Gerontechnology* 2008; 7(2):249. Personal robots and robot technology-based (RT) assistive devices are expected to play a major role in our elderly-dominated society, with an active participation to joint works and community life with humans, as partners, and as friends. In particular, these robots are expected to be fundamental for helping and assisting elderly and disabled people during their activities of daily living (ADLs). Therefore we developed a new bipedal walking robot, named KOBIAN<sup>1</sup>, capable of human-like movements and of human-like emotions. This robot is expected to be capable of interacting with surrounding people both physically and psychologically. A fundamental role for this interaction is played by the hand, which should both be capable of grasping and of gestures. To this purpose, the Waseda Soft-Hand 1 (WSH-1) was designed and realized (Figure 1)<sup>2</sup>. This paper presents the description of WSH-1 and its preliminary evaluation. **Methods** WHS-1 has 4 motors to control 5 underactuated fingers by using antagonist wires for flexion and extension (thumb ab/adduction; flexion/extension of (i) index; (ii) middle; and (iii) thumb, ring, and little fingers). The hand weighs 180 g, or, 950 g including the forearm (Figure 1). Three different prototypes of hand were evaluated: (i) hard type (all the hand is made by rapid prototyping); (ii) soft type (the palm is made by Septon with inserts in rapid prototyping; soft fingers are made by silicon, with Septon cover); (iii) mixed type (hard palm in rapid prototyping, soft fingers made by silicon with a Septon cover). Two groups of users participated to the preliminary evaluation after providing the informed consent: Group #1 (2 young subjects; age 24±1.7) compared Hand (i) and Hand (ii); Group #2 (12 elderly subjects; age 76±9.9) compared Hand (ii) with Hand (iii). 15 semantic differential questions were used: (i) soft/hard; (ii) warm/cold; (iii) desirable/undesirable; (iv) pleasant/unpleasant; (v) safe/dangerous; (vi) positive/negative feeling; (vii) human-/machine-like; (viii) smooth/rough; (ix) enjoyable/painful to touch; (x) gentle/frightening; (xi) like/dislike; (xii) familiar/unfamiliar; (xiii) positive/negative; (xiv) positive/negative sensation; (xv) friendly/unfriendly. A 5-point scale, ranging from 1 to 5, was used, with 3 meaning the neutral response. **Results and discussion** The results of this preliminary evaluation are presented in Figures 2(a) and 2(b). Overall, the Soft hand is evaluated better than the hard hand; less clear difference exists with the mixed hand. Interestingly, Group #2 gave a much more enthusiastic response.

**References**

1. Endo K, Momoki S, Zecca M, Saito K, Mizoguchi H, Itoh K, Takanishi A. ICRA 2008 (accepted)
2. Carrozza MC, Cappiello G, Stellin G, Zaccone F, Vecchi F, Micera S, Dario P. IROS 2005; pp 1271-1276

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**Address:** Waseda University, Japan; E: zecca@aoni.waseda.jp

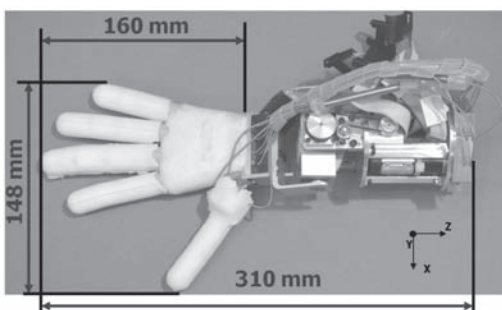
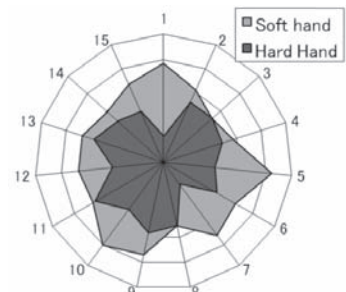
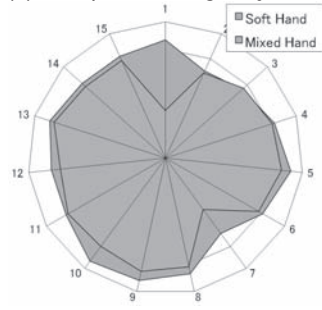


Figure 1 Picture of the first prototype of WSH-1



(a) Group A – Young subjects



(b) Group B – Elderly subjects  
Figure 2: Result of the preliminary evaluation