FutureBody: Design of Perception Using the Human Body

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ABSTRACT
We created a new interactive design concept “FutureBody” that generates or augments new perceptions for users. The concept of FutureBody consists of two elements, “active searching” and “embodiment,” allowing users to search their environment actively and to emit indirect feedback to activate users’ embodiments. We believe this concept will form the basis for a new perception design methodology for people.

Categories and Subject Descriptors
H.5.2 User Interfaces: Haptic I/O; D.2.2 Design Tools and Techniques; Evolutionary Prototyping

General Terms
Design, Human Factors.

Keywords
Visual aid device, FutureBody, CyARM, Spatial Information, Perception Design, Augmenting Perception.

1. INTRODUCTION
We have developed a haptic visual aid device named CyARM to allow the visually impaired to perceive distance information intuitively [1,7]. The design concept of CyARM was based on the metaphor of physical arm motion. Suppose that you try walking with your eyes closed; you will attempt to investigate your environment by extending your arms in front of you. When an extended arm touches objects, you will intuitively bend your arms at the elbow. However, if no objects are in front of you, you will naturally extend your arms (Figure 1). To realize this intuitive metaphor, CyARM transforms the measured distance information into the tension of a wire that is connected onto the user’s belt loop (Figure 2). If objects are at a short distance, CyARM pulls the wire tightly so that the user feels stronger tension and that her/his arm is forced to bend. However, if objects are far away, CyARM stops after giving just enough slack to the wire so that the user can extend the arm and feel nearly no tension.

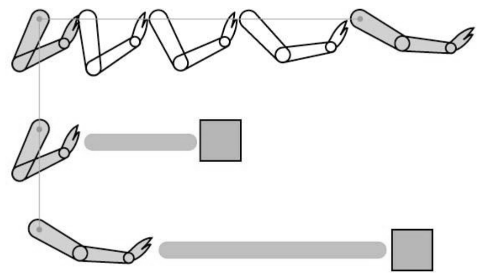

Figure 1. Metaphor of arm’s motion and recognizing objects.

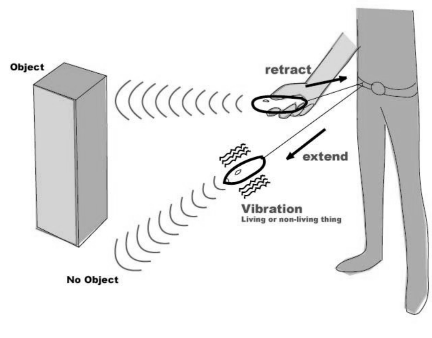

Figure 2. Concept of CyARM.

The results of our evaluation experiments clearly showed that CyARM succeeded in providing the distance information toward objects to users intuitively. Moreover, we unexpectedly demonstrated that the users, by means of CyARM, could comprehend other kinds of spatial information about the object, e.g., the shape and surface condition of objects [5]. The results suggest that CyARM may not only compensate for existing or lost perceptions but also create or augment other kinds of perceptions for users.

2. REQUIREMENTS FOR AUGMENTING ONES' PERCEPTION

Why does CyARM succeed in providing or augmenting the rich spatial information for users even though it only transforms the measured distance into the tension of a wire? We assumed that the following two distinct features of the device are primarily involved; one allows users to search their environment actively, and the other feeds the distance information back to users' embodiment indirectly.

2.1 Active Searching

The first salient feature of CyARM is that the user can actively search for obstacles in any direction while holding the device. Therefore, the user can receive various kinds of distance information about the obstacles in various situations, e.g., if the user has different arm postures or positions. In this case, the user's body is not just a receptor of the distance information from CyARM but a prompter to accumulate the various distance information. This means that the user's perceptions are working actively while s/he is holding CyARM. However, most studies of augmented reality or augmented human assume that peoples' perceptions are working rather passively. Moreover, searching the surrounding environment requires the user's spontaneous will or consciousness. We regard this spontaneous will or consciousness as a significant key to motivate such users to actively search.

2.2 Embodiment

The second feature is that CyARM transforms the distance information into tension in the wire to make the user's arm bend or stretch indirectly, while most conventional visual aid devices transform the measured distance information into abstract representations directly such as sounds or vibrations, e.g., a higher pitch sound means a closer distance to a certain object [2,3]. We believe that the origin of perception is peoples' physical activations or embodiments. Therefore, the user's perceptions are directly affected by CyARM's indirect feedback action, which pulls or releases the wire to make the user's arm bend or stretch. Such indirect feedback action by CyARM also activates various sensory functions, e.g., haptic or somatic sensations from the fingers and arms. As Neisser pointed out [6], human sensory functions have strong commonalities, and the spatiotemporal patterns of these sensory functions that have strong commonalities are significant in shaping our perceptions. Thus, CyARM's indirect feedback action accords with Neisser's argument.

3. FutureBody

To sum up the aforementioned salient features of CyARM, the newly created or augmented perceptions caused by using CyARM (e.g., rich spatial information such as the shape of an object) are generated not only by receiving the feedback from CyARM as fingers' or arms' motions but also by activating the physical body to search the surrounding environment actively. Therefore, the perceptions generated because of this device allow the users a bilateral information exchange with the environment (i.e., receiving environmental information from the device and searching the environment with the device), so these perceptions would be similar to our existing perceptions like "seeing" or "touching."

On the basis of these arguments, we created a new design concept that generates or augments new perceptions for users; because the generated perceptions from this concept should augment users' existing perceptions and should form new body configurations, we named this concept "FutureBody." The concept of FutureBody consists of two elements, "active searching" and "embodiment." They allow users to search their environment actively and to emit indirect feedback to activate the users' embodiment.

We have just started creating various combinations between stimuli emitted from the device and allowed behaviors for users with the device to create or augment new perceptions, like "FutureBody.Finger [4]," which transforms the measured distance information into the angle of the 1-DOF link, whose motion is intuitively associated with a finger's bending action (Figure 3). We believe that our developments will form the basis for a concrete design methodology to generate or augment new perceptions for people.

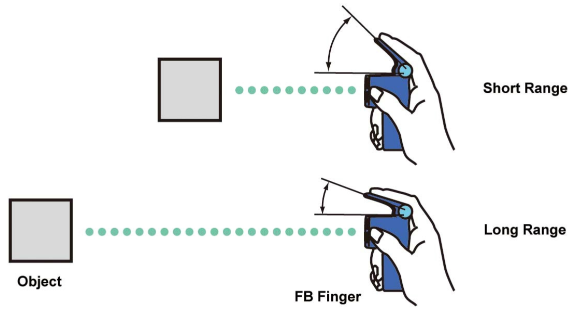

Figure 3. Concept of FutureBody.Finger.

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