Fly! Little Me: Localization of Body-Image within Reduced-Self

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Abstract. In conventional interface design, manipulated objects are visually represented and an actor of manipulation is a user's physical body. Although it is a bodily contact between the user and the virutla objects, these virtual objects are detached from the user's physical body and are usually operated as target objects through an interface device. We propose a new type of embodied interaction based on visual-somatosensory integration to evoke localization of a user's body-image within a visual object on a screen. The major difference between conventional interation and the proposed framework is whether the center of the user's body-image is localized within the screen or outside of the screen. When the user's body-image is outside of the screen, manipulation of screen objects is transitive action, or target operation under a subject-object structure. In contrast, when the user's body-image is localized within a screen object, the operation of the object becomes intransitive action and the user operates the screen object as if he moves a part of his body. Although object manipulation as intransitive action indeed has a history as long as interface design itself, it has not yet been exposed to thorough inspection. To qualitatively analyze intransitive manipulation and effect of body-image localization, which we think is a core factor, we implemented an interactive system based on several proposed design principles and exhibited the system at a gallery opened for the public to collect qualitative evidences on the effect.

Keywords: Embodied Interface, Spatialized Display, Localization of Body-Image, Visual somatosensory Intergration. Categories and Subject Desciptors: H.5.2 [User Interfaces]: Evaluation/methodology, Interaction styles, User-centered design. General terms: Performance, Design, Experimentation, Security, Human Factors, Theory.

1 Introduction

We began with fundamental questions: what it is to manipulate intangible virtual objects whether it is textual, graphical or tangible, how it differs from physical objects and what types of new manipulation can be realized by a new mode of interaction. Manipulation conventionally is a *transitive* action that mediates between a user, or a subject, and an object being manipulated by the user. However, on close inspection, manipulation in

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digital media can be considered in two ways: transitive action and intransitive action (Fig.1). In case of controlling a virtual charactor on a screen using a game-pad interface, the controlled charactor can be either an object of manipulation being controlled by a user or a subject engaged in intransitive action such as jumping, runing and attacking enemies. Although the transition from the transitive to the intransitive is often unconscious, a user often feels very vivid bodily sensations in intransitive action even in technologically mediated environment. We, as a game player, often experience feeling of falling when the virtual charactor jumps from a high. There are highly fluid structures between a user and what is graphically represented and manipulated in an interactive environment. Even in case of conventional interface devices such as a mouse, the *proximal* object, or a mouse device, recedes from our awareness and the *distal* object, or a mouse cursor, vividly feels being a part of our body[1]. In neuro-physiology, this *out-of-body experience* is called localization of body-image. In majority of interface studies, emphasis is on interaction as transitive action and how we can make it more efficient by adapting new interfaces and interaction methods. Although interaction as intransitive action has not been paid much attention, it is another pivotal aspect in designing innovative interaction. The major difference between the transitive and the intransitive is where to locate a user's body-image or the self. Therefore, the prime issue in designing intransitve interaction is how we can extend a user's body-image and accomodate it within a virtually representaed entity on a screen.

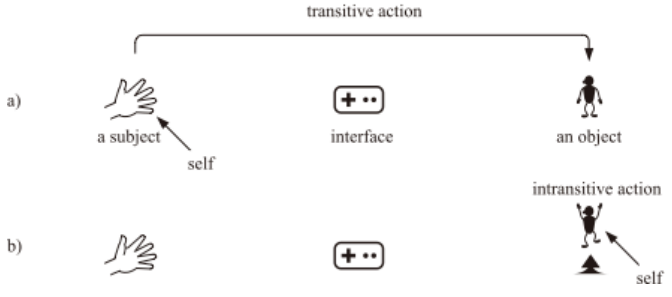

Fig. 1. Modes of interaction: the transitive and the intransitive in controlling a virtual self

We also expect that a result of this study turn out to be a effective experimental playground for brain science and neuro-physiology. Body-image and self-identification in visual media such as recorded monitor image of oneself and virtually controllable avators in virtual environments are becoming major topics in the fields. Although our physical body is thought to be identical to the boundary of our body-image or *the self*, a number of experimental evidences have shown that our *the self* does not simply fit into the boundary of bodily skin in some cases of disorder due to brain injury and congenital defect. Usually, experiments on these cases are done in closed lab environment and a method for inspection and expected results are also limited. Intending to extend human experience, interactive media can cast a light onto questions such as how our body-image can be extended and what the *self* really is. Going beyond merely phenomenological predications, we take an approach to pragmatically design interactive systems to clarify necessary conditions to evoke the body-image localization and its potential rolls in interactive systems.

2 Principles

We started with enumeration of several design principles that are considered to be necessary-and-satisfactory conditions to evoke localization of body-image within an external visual representation in a screen-based interactive systems: *Action, Synchronization, Feedback, Representation, Display*. Some of the proposed factors are already being studied in related fields mainly in physiological studies.

Table 1. Five principles for intransitive interaction

Principle	Effect
Action	kinesthetic quality
Synchronization	self-identification within virtual representation
Feedback	perception of the law defining the behavior of the virtual environment and the virtual self
Representation	extension/reduction of the virtual self
Display	spatialized representation of the virtual self

2.1 Action

A user is involved in an interactive system through his unconscious and/or conscious action. And, even extremely symbolical actions such as clicking, dragging or pointing with a finger are always accompanied by a specific kinesthetic sensation based on human muscular system. This bodily sensation gives a particular somatic quality to visual images responding to the user's actions. This somatic quality often is something that can only be described as *such-and-such feeling* at best and never became a subject of scrutiny under clear articulation. However, interaction is not viable without a user's action and the quality of the action determines the quality of interactive experiences. This is the starting point.

2.2 Synchronization

Coordination between a user's actions and visual responses is a next important factor. We human beings are capable of distinguishing what belongs to or is part of ourselves and what is not. Any signals changning simulnaniously with one's movement are perceived to be belonging to oneself in various modalities[2]. We are highly sensitive to visual images that move syncronically to our body movements just as a figure of oneself in a monitor image, a mouse cursor o n a computer screen and simply one's shadow moving on the ground. There is a series of studies on self-recognition in video images and also in other media based on other modalities[3]. It has been verified through a number of experiments utilizing various interactive instruments that syncronization of a visual signal largely contributes to perception and extension of one's body image[4]. In interactive systems as well, simultaneous perceptual stimulation and a user's motor-action contributes to vivid bodily awareness of what environmental change belongs to the user.

2.3 Feedback

A unignorable challenge for designing interactive experiences is to design experiences not possible in the real world and not only to mimic it with high fidelity. Not only being synchronized with a user in movement, the visual representation of the user has to behave in a certain way depending on the principles and models of the virtual environment. A user perceives the conditions and dimensions of the environment by an action and feedbacks to the action[5]. Therefore, to build a virtual environment to allow fascinating bodily experience, it is indispensable to think of how to design the feedback and how to make the virtual environment with vivid the actuality.

2.4 Representation

To engage a user in an interactive system through localization of a body-image, a virtual representation of the user has to be visually shown on a screen in some form. The representation does not necessarily have to be photo-realistic. Just as shown in studies on biological motion, we can detect even primitive representation such as points and lines as belonging to or a part of ourselves[6].

2.5 Display

The act of seeing is not a mere ocular phenomenon. It is rather an embodied act engaging a whole body. There are modes of *looking* that define spatial relationship such as *looking-down* and *looking-up.* Even with static visualization such as paintings and photos, it is always a matter of consideration how to deploy the displays. We see things in spatialized configuration. *Display* includes a certain kind of mechanism or format for viewing that forces a viewer to take a certain body posture or physical movements. *Display* also defines *Action* as mentioned earlier by prescribing kinesthetic constraints of human body.

3 Design

In this study, through verification of the above proposed principles, we aimed at creating bodily sensations that we have never experienced in reality. Feeling of flying is a

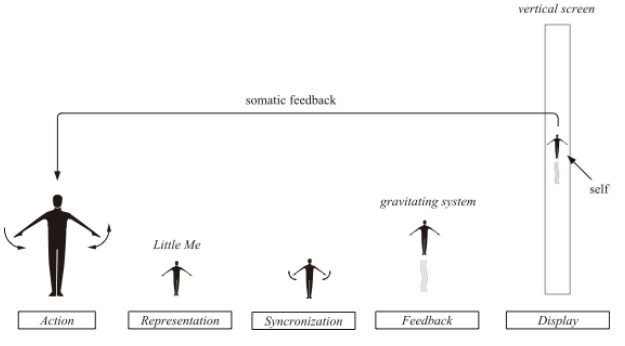

Fig. 2. A design plan for Fly! Little Me

bodily sensation that we humans have always been dreaming of and yet we cannot experience in the real life. It should be a very distinctive sensation just as we experience in a dream. We set up realization of the feeling of flying as an immediate goal for a further study.

4 Realization

We utlized a camera vision system to implement the design plan and named the system *Fly! Little Me*. When a user moves his arm like a bird, the camera vision system detects the movement by calculating the difference of the width of the silhouette between frames. A small silhouette of the user of 10 inches height (*little me*) is projected on a 20 foot-long vertical screen and moves toward the ceiling at a speed proportionally to the user's movement speed.

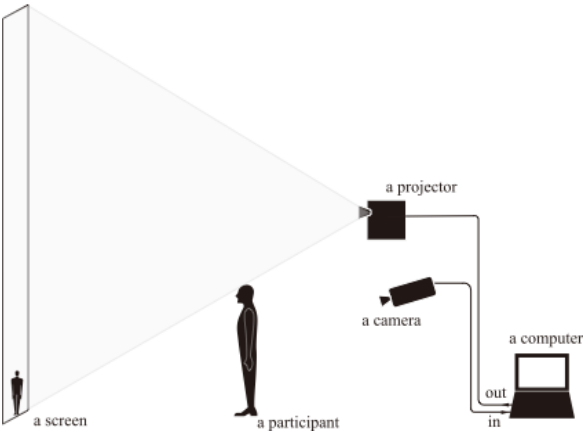

Fig. 3. The system diagram of the installation

5 Results

We installed *Fly! Little Me* at a show titled *Transform yourself*[1] and had 20,000 visitors. Most of the visitor's impression was that they vividly experienced feeling of floating in the air and enjoyed the novel sensation. Some visitors told that it feels like flying in dreams. That was a quite interesting testimony implying how wide varieties of bodily sensations it is possible to evoke in intransitive interaction.

6 Discussions

6.1 Controllability

Visitors felt frustration before getting the hang of how to fly and enthusiastically moved their arms. This emotional response shows that their body-image is deeply

[1] NTT InterCommunication Center [ICC] Kids program 2008 - *Transform Yourself.*

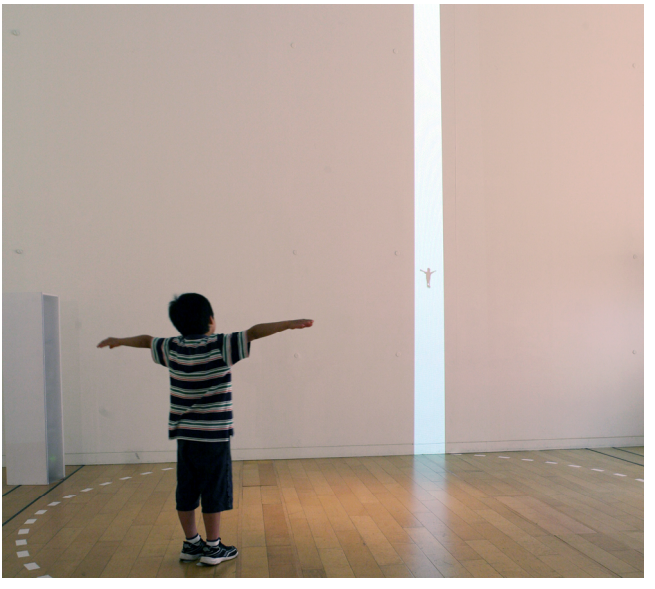

Fig. 4. Fly! Little Me

localized within the *little me*. Through trial and error processes in prototyping the installation, it was always an issue to configure how sensitively the visual representation should respond to a user's movements. However, It spoiled the pleasure when the *little me* flies way too easily. When the *little me* flies too sensitively, the response suddenly loses physical appealing and becomes mere manipulation of a moving image just as fast-forwarding and rewinding a video footage.

6.2 Spatialization

The effect of spatialized representation on the long portrait-oriented screen was substantial. When the *little me* reaches at the ceiling, a viewer leans backward to see it. The motor-sensation and the muscle tension strongly contributed to the *being- up-in-the-air* feeling. This was a evidence to prove the significance of *Display*.

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