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Multi-touch Gesture and User Mental Representation Research

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Abstract: According to the appearance of a conceptually new type of interface, multi-touch gesture technology, it might fundamentally change the interaction mode between user and the system. This study aims to understand the mapping relationships among users' mental representations and operational styles of multi-touch gesture. A total of 30 users were divided into two groups according to their cognitive styles (verbalizer and visualizer). And 23 most common PC system tasks were identified as the experiment tasks. The researcher used wizard-of-Oz form of multi-touch prototype and the retrospective recalled method to collects and analysis users' thoughts qualitatively. The results found significant differences between verbalizer and visualizer.

Keywords: Mental representation, cognitive style, multi-touch interface, multi-touch gesture.

Introduction

In the history of the interaction design between human and digital systems, the user-interface has long been the most important issue for both research and practical field. With the appearance of a conceptually new type of interface, multi-touch gesture technology, it might not only fundamentally change the interaction mode between user and the system but also impact the ways of design thinking in terms of operational and interactional perspectives. However, scholars in the past seemed to put most of their efforts on the technical part of multi-touch gestures but virtually neglected the interaction part especially the mapping issue between Users' mental representation and the task operation. From the user's perspective, questions such as the mappings between users' mental representation and finger-gesture operations as well as what kinds of tasks might be applicable for using the traditional operational mode (Window, Icon, Menu, Pointer) or the multi-touch gesture interface, are largely left unknown and require for further study. Therefore the primary purpose of this study aims to understand the mapping relationships among users' mental representations and operational styles of multi-touch gesture.

1. Literature Review

1.1 Multi-touch gesture

Most gestural interfaces can be categorized as touch-screen and free-form currently. This study focuses on touch-screen interface, as so-called touch user interfaces (TUIs), usually require the user to be touching the device directly. And touch-screen interface like touch panel or touch pad. Although forms of gestural device can vary wildly from massive touch-screen to invisible overlays onto environments, there are at least three general parts in controlling touch gesture device: a sensor, a comparator, and an actuator [1]. As for the

definition of gestures, in a broad sense, gesture is any physical movement that a digital system can sense and respond to without the aid of a traditional pointing device such as stylus or mouse. However, this study applies the narrow definition that using fingertips to do some movements like a wave, a touch or draw a line. For the past of 40 years, we have been using the same human-computer interaction paradigms, the WIMP interface: Windows, Icon, Mouse and Pointers designed by Xerox PARC in the1970s. Although the WIMP conventions will continues, the appeal of touch gestural interface may take users into a new era of interaction design.

1.2 Mental representation

Norman had addressed three models of the concept of user-centered design (UCD): *The designer's model, the system image, and the user's model.* For people to use a system successfully, they must have the same mental model (the user's model) as that of the designer (the designer's model). But the designer only talks to the user via the system itself, so the entire communication must take place through the "system image": the information conveyed by the physical system itself [2].While the challenge toward touch gestural interface design is that without the aid of graphic user interfaces (GUIs), the system images become transparency. It leads a condition that users have to find out how to operate the system by try and error. Therefore, designers should try an overall way to collect and understand the mental representation of users while they are facing to operate a touch gesture.

The nature of mental representation can be presented by different forms of conversion, such as images, pictures, patterns, sentence and mental state and so on. “Representation” as some ideas or something meaningful appears in the brain. In other words, mental representation helps people can make the concept more clear and specific [3]. When users operate the touch gestural interface, the mental representation of users will predict how the gestural system works. So users will create their own gestural operation mode in order to help themselves to explain the interaction between inner world (human brain) and outer world (the system). It calls a process of user mental presentation in operating touch gesture and this study defines three dimensions of the process: Individual difference [4], mental simulation [5] and Parsimonious.

1.3 Cognitive styles: “verbalizer” & “ visualize”

According to the dual code theory, human cognitive systems were divided into two sub-systems- verbal system and visual system. This theory postulates that both visual and verbal information are processed differently and along distinct channels with the human mind creating separate representations for information processed in each channel. Both visual and verbal codes for representing information are used to organize incoming information into knowledge that can be acted upon, stored, and retrieved for subsequent use [6]. Hence, cognitive style can be interpreted as an individual who faces on problem solving, thinking, perception and memory of the pattern mode. Moreover, this study purposes that users are two types of cognitive style: “visualizers” and “verbalizers”. Take “verbalizers” for example, verbalizers usually good at interpreting the semantic stimulus like a word, a sentence and so on. If verbalizers receive some nonverbal stimulus like looking at a picture, verbalizers often have a tendency that using words to interpret an image, even they will ignore the nonverbal stimulus in normal situations. Nevertheless, there are some specific conditions or somehow the characteristics of verbalizers change their usual performances. That is why this study will try to figure out: users who are different types of cognitive style,

who will have some tendency, habit, preference or specific performance toward multi-touch gestural operation.

2. Methodology and Research Procedure

Accordingly, a total of 30 users were recruited and were divided into two groups according to their cognitive styles (verbalizer and visualizer) before participated in this experiment study. And 23 most common PC system tasks were identified as the experiment tasks. The researcher used a wizard-of-Oz form of multi-touch prototype and the retrospective recalled method to collects and analysis users' thoughts qualitatively. And, Methodologies of the experiment are "the internet questionnaire of SOP"[7] , "Wizard-of-Oz prototyping" and "Retrospective Recalled" method. According to the literature review, there are many technical restricts in the real product of multi-touch panels, software, machine and systems. Therefore, in order to avoid these kinds of unimportant restricts, the "Wizard-of-Oz prototyping" may make subjects believe that they are interacting with the real computer system without doubt. Also, it is more realistic than paper prototype [8].Thus, when subjects are doing 23 tasks of multi-touch gesture onto a touch panel; they have no ideas with knowing the panel cannot work. The researchers will display the outcome of the tasks in the other room and record every movement of the multi-touch gestures which subjects just did. After finishing all tasks, the researchers will ask them to watch the recording video. And subjects will explain the reason why they display and what ideas come into their mind at that time. That is, asking subject think aloud their ideas retrospectively.

3. Discover and Results

The study results found significant differences between the verbalizer and the visualizer. From the user's perspective, the tasks that may be not applicable for using multi-touch gesture interface are for instance: Initiate Web explorer, Copy, Paste, Save, Search, Delete, Stop and Minimize. In contrast, the tasks may be applicable are: Select, Zoom-in, Zoom-out, Rotate, Back, Initiate WORD, Undo, Close, Initiate MSN, Initiate FACEBOOK, Initiate Email, Initiate audio/video player, Play and Maximize. The studying findings expect to contribute to the further design references of Touch User Interfaces.

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