



Modeling users' task performance on the mobile device: PC convergence system

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Abstract

This study aims to establish a model-based approach for user interface design that simultaneously considers the system's information hierarchy, users' task procedure knowledge, and system interfaces. The approach is based on a framework that contains multiple interaction models to express both system elements and users' knowledge. The framework evaluates system interface through the interaction between user's knowledge on interface, task procedure and information structure perceived by the user in the system. The interface is evaluated by its contribution to the users' task performance and system navigation.

These three factors were defined as design factors that affect users' task performance. Through the crosscheck process of models, the relation between information, interface, and task procedure is calculated into combined difficulty index (CDI) that expresses the difficulty of a system interface that users would experience during the use of system. A user test was conducted for the validation of the CDI. The difficulties of the interface of a mobile healthcare system were predicted with the CDI, and the predictions were compared with the experimental results, where the users' performance showed consistence with the prediction.

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Keywords: Interaction model; Task-information link; UI problem detection; Difficulty index

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1. Introduction

Usability problems of designed systems are often caused by the gap between the designer's knowledge and user's knowledge. System provides users with higher goal and the means used to achieve the goal. The task is a procedure to achieve the goal in the system and all interfaces used for the task are the means for the goal. During the usage of system, users adopt bottom-up knowledge of the system while designers adopt top-down knowledge for the system design process (Rouse, 1991). Designers are already aware of all the functions of the system and just relocate them into the interface, but users must get the information and infer the location of functions from the interface (Nielsen, 1993). It is necessary for an interaction model to express the system side and user side simultaneously. The usability problems users experience during the navigation of the information devices are similar with the users' cognition problems in the navigation of the physical space.

The main purpose of this study is to explain the difficulty of a system interface as a combined effect of various elements in the system design. For this purpose, we have considered the task procedure model, the information structure model and interface model of a system, as the three basic models are selected based on the users' space cognition model of Wickens and Hollands (1999). The user's tasks are divided into cognitive operations and physical operations. The usability of a system is expressed with a difficulty index, which refers to the sum of difficulties users experience while performing both cognitive and physical tasks. If a design change occurs in the interface, task procedures, or information structure, the difficulty index is also changed. This change indicates the effect of the design change on usability. Thus, designers can easily predict the result of the design and the usability of a system.

2. Background

2.1. Model-based interaction design

Model-based interaction design is one of the methods to design and evaluate the system interaction. Model-based interaction design is proposed to emphasize the important features of a system (Szekely, 1992) and to reduce the complexity of the design process (Paternó, 1999). GOMS (Card, Moran and Newell, 1983) and TAG (Payne and Green, 1986) are the most widely accepted interaction models and adopt rule-based structure of text format. Other models, such as TKS (Johnson et al., 1988), Trident (Boadart et al. 1995), ConcurTaskTrees (Paternó, 1999) adopt the diagram format. TAG is useful to evaluate the consistency of tasks and interfaces, but the application of TAG is very difficult (Newell and Card, 1985). In contrast to GOMS and TAG, the ConcurTaskTrees (Paternó et al., 1997) is a diagram-based hierarchical task model that expresses user's task knowledge structure. The ConcurTaskTrees (CTT) defines a task as an activity to perform for reaching a goal. In CTT, the task can be allocated

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