Demonstration of a Mobility-enhanced Pedestrian Navigation on Mobile Devices

Tetsuo Yamabe*
Nokia Research Center
Nokia Japan Co.,Ltd
Tokyo, Japan
tetsuo.yamabe@nokia.com

Kiyotaka Takahashi†
Nokia Research Center
Nokia Japan Co.,Ltd
Tokyo, Japan
kiyotaka.takahashi@nokia.com

Tatsuo Nakajima
Dept. of Computer Science
Waseda University
Tokyo, Japan
tatsuo@dcl.info.waseda.ac.jp

ABSTRACT

Current mobile interaction is not well designed with considering mobility. Even though user attention is an important human factor for user interface design, current mobile service is too attention-consuming for moving users to perform tasks. This is because mobile service is still pursuing desktop-miniaturization trend, and it is designed to work in stationary situations (e.g. "sitting on a chair", "standing on a street"). It makes mobile services not truly helpful in real mobile environments, since such situations are ideal and most of the time mobile users are in action while on the move.

In this paper, we propose a dual-mode approach to design mobile services. Our approach aims to decrease a user's cognitive load by enabling users to retrieve information with less attention. The dual-mode approach provides a simplified interaction style (named *simple interaction mode*) to a mobile service, in addition to a conventional user interface (named *normal interaction mode*). While some of research activities aim to realize unobtrusive user interfaces for moving users, their advantages from conventional user interfaces have not been sufficiently evaluated. Therefore, we have prototyped a pedestrian navigation service in order to clarify feasibility of our approach.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: Interaction styles, Prototyping, User-centered design

General Terms

Experimentation, Human Factors, Performance, Design

Keywords

mobile computers, interaction style, interface design

*Ph.D. student in the Department of Computer Science, Waseda University (yamabe@dcl.info.waseda.ac.jp)

†Ph.D. student in the Graduate School of Information Science and Engineering, Tokyo Institute of Technology (takahashi.k.bg@m.titech.ac.jp)

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1. APPROACH AND DESIGN ISSUES

Fine usability allows a user to perform tasks with less attention, and it is important especially in mobile computing environments [1]. For example, *Situational Disabilities* is caused due to changes in the user's posture and surrounding environments. Usually, users can set up or adjust their working environments appropriately in stationary situations (e.g. adjust light position in a room). However, in mobile computing scenarios, users move around, and physical conditions could make it hard to perform complicated interaction with mobile services. Furthermore, *Fragmentation of Attention* occurs in such a multitask environment [2]. Unlike stationary situations, users have to interact with mobile devices while performing their main tasks (e.g. move their legs to walk and look around to evade roadblocks). Users can not pay enough attention to the services in such a dynamic and complicated mobile context. Therefore, mobile user interfaces should require minimum attention in order to allow the user to concentrate on prior tasks (e.g. elaborate sentences in a mail, browse web sites).

Our approach aims to minimize the user's cognitive load by simplifying interaction in order to maximize benefit of mobility. While moving, the user has to handle multiple information and events, so he/she can not or should not actively interact with mobile services. On the other hand, the user should be interrupted when important events are monitored by the service (e.g. "the user is following a wrong way"). To realize this concept, mobile services should represent minimum, but important information effectively. In Figure 1, an overview of the design framework is shown with a pedestrian navigation service as an example. Logical service components are identified at the lower left of the figure. Also, we pointed out three important characteristics as below.

Simplicity: Our framework makes mobile services non-interactive to decrease the number of interaction cycles. In the framework, mobile services provide a *simple interaction mode* in addition to the conventional user interface (that is named *normal interaction mode* in the figure). In the example, the pedestrian navigation service provides five kinds of user interfaces in a simple interaction mode. Like status indicators, the simple user interface allows a user to check status of the service at a glance. Duration of an interruption caused by the service becomes minimized, and thus the service can work even if the user's attention is fragmented in a multitask environment.

In the simple interaction mode, the mobile service mainly focuses on tasks that do not require complex interaction for the user. This means that the mobile service should be designed to keep its semantics as simple as possible in the simple interaction mode. In the example, one essential point of the route navigation service is "to guide a user to the destination". Needless to say, most of the information that the map includes is excluded from the simple user

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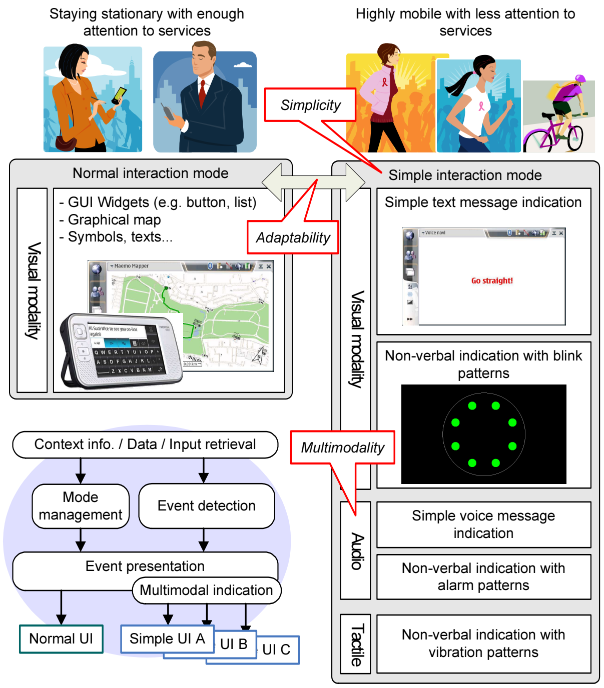

Figure 1: Overview of the mobile service design framework

interface. However, it still aims to achieve the same task without explicit inputs from the user. (If the user wants to operate the service, the mode can be switched to the normal one.)

Also, the interaction style changes to an event-driven model in order to achieve the task with minimum interaction. This means that the mobile service should be designed to detect important events for the user and notify them in a smart way. In the figure, the event detection component retrieves context information (e.g. location data), several kinds of service-related data (e.g. route information) and the user's input to detect events. Detected events are represented by the event presentation component.

Multimodality: When the user's perceptual ability is limited according to physical limitations, mobile services should notify events with an appropriate modality that can reach the user's perception. In Figure 1, the multimodal indication component selects an appropriate modality channel and assigns a corresponding simple user interface. Availability of modalities is managed in the mode management component, and it is determined based on the input (e.g. context information of the surrounding environment).

As explained above, this service design framework forces services to be simple and task oriented. Instead of limiting freedom of interaction, important information for users can be determined and simplified. The simplified information is easy to convert, and it can be represented on various modalities. In the example, three kinds of modalities are shown: visual modality, audio modality and tactile modality.

Adaptability: Since the framework provides two kinds of interaction styles and multimodal input/output, adaptability is required to control the modes. As discussed above, mobile services should occupy the user's attention as short periods as possible. Otherwise the fragmentation of attention may get worse. To decrease unnecessary interaction, the service should autonomously change the mode or modality according to the situation.

2. DEMONSTRATION

In this demonstration, we mainly focused on the simplicity, since we have to evaluate how our dual-mode approach affects a user's behavior as the first step. To identify feasibility of our approach, we selected a pedestrian navigation service for prototyping. It is one of the location-aware services that are successfully deployed in the market, but further improvements are still required as described in Section 1. Also, we believe that empirical studies on the service can be a basis for other mobile services for moving users.

We prototyped the pedestrian navigation service based on a geographical mapping visualization software. Some simple user interfaces, the event detection component and the event presentation component shown in Figure 1 are implemented in the prototype. In Figure 2, the pedestrian navigation service's service flow and examples of event indication patterns are presented. In this demonstration, we present a video that shows how the pedestrian navigation service and simplified user interface work.

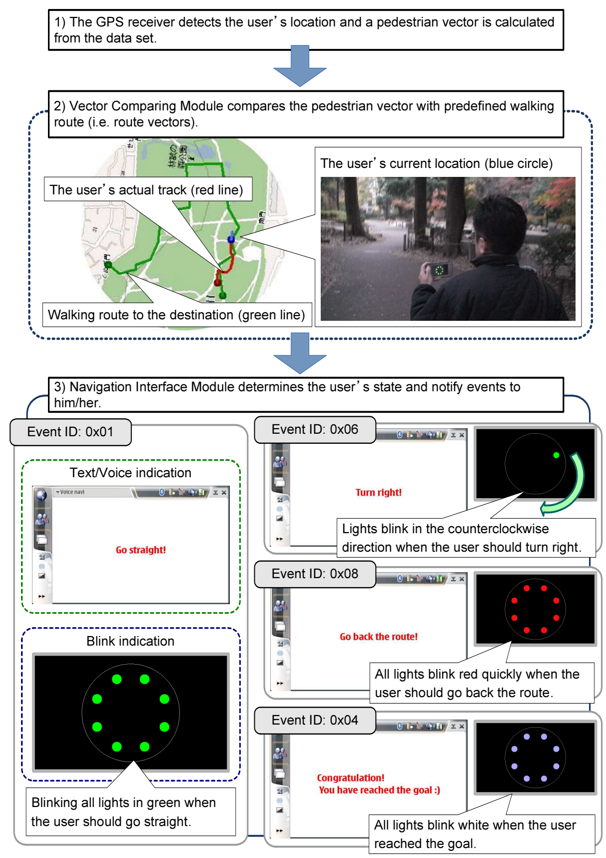

Figure 2: Service flow of the mobile pedestrian navigation and event indication pattern examples

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