Context Aware Design: Bridging the Gap from Frameworks to Practice

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ABSTRACT
For nearly a decade, researchers had struggled with a widely accepted definition of context. Recently, the definition proposed by Dey, et al. provided a theoretical foundation for future research in context related area. The problem researchers face now is how to use such a general framework in practice. My dissertation will investigate the gap between the existing framework and practical design. I believe that this question could be partially addressed through the relationships among different dimensions of context. I will investigate these issues in a speech-based application with a particular focus on speech-based error specification technique.

Keywords
Context aware design, Speech recognition

Motivation
Most of the previous definitions of context focus on the surrounding environment (Schilit and Theimer, 1994. etc.). Dey (1998) introduced users' emotional and informational state into context, suggesting that context information also consists of information about users themselves. Schmidt, et. al. (1999) proposed a three dimensional framework that added the "user" information into the domain of context. In particular, they emphasized "user activities" as one important category of context.

Dey et. al. (2001) proposed an even broader context that, besides the environment and the user, also includes the application that the user is interacting with. They defined context as "any information that can be used to characterize the situation of entities that are considered relevant to the interaction between a user and an application, including the user and the application themselves." The three identities most relevant to context are places, people, and things. Dey, et. al.'s definition of context is a highly general concept that covers all the potential context information. The identification of the three major dimensions of context, especially "things", presents a high level framework for investigating context. However, as general as this conceptual model is, there is a bridge between this conceptual model and the practical application. The framework is fine in theory, the problem is how to use it in practice. Furthermore, the relationships among the three dimensions and how those relationships affect task performance has not been thoroughly discussed. Sears, et. al. (2003) suggested that it is essential to understand the relationships among different dimensions. For example, in a speech-based application, the quality of the output file is not decided by any of the dimensions alone, but by a combined relationship among user's speech quality, sensitivity of the microphone, the noise cancellation software, the noise level in the environment, and some other factors.

Research Question
In my dissertation, I will investigate the gap between the high level conceptual model and the application. The fundamental research question is:

How to identify, describe, and discuss important context information in a design problem.

I believe the above research question can be addressed through the relationships among the three dimensions of context: places, people and things, and how those relationships affect task performance and interface design. These issues will be investigated in the domain of a speech-based application with a particular focus on speech-based error specification.

Speech-based Error Specification
Speech-based error specification is a time consuming and error prone process. Sears, et. al. (2001) reported that even users with previous experience with speech applications still spend approximately one third of the task time moving the cursor to the words that need to be corrected. Although various research (Oviatt, 2000; Suhm, 2001, etc.) has suggested that the multimodal approach involving keyboard, mouse, touch screen or other input methods can be superior to speech-only solution in case of error correction, multimodal error correction is not feasible for users with physical disabilities that hinder the use of their hands or those who are engaged in hands busy tasks. In order for the speech system to be widely accepted by these users, speech-based error specification must be improved.

Interestingly, existing solutions of speech-based error specification appear to evolve from traditional data entry

systems with keyboard and mouse. Important potential information from the context hasn't been sufficiently investigated.

CURRENT STATUS AND FUTURE PLANS

Several studies have been conducted that identified key issues important for my dissertation, such as difficulties users experience when interacting with the speech application, causes and consequences of failed speech-based commands, potential important context information that hasn't been sufficiently explored previously, and several approaches to improve speech-based error specification technique. Future studies will focus on expanding the existing framework to address the relationships among context dimensions. A new error specification approach based on a combined perspective of different context dimensions will be further validated.

CONCLUSIONS

Although context aware computing has drawn much attention in the recent years, most of the studies focus on the physical environment. The three dimensional model proposed by Dey, et. al. (2001) broadened the dimensions of context and provided fare foundation for context related research. However, this model is still highly general and difficult to apply in application. Besides, the relationship among the three dimensions is still vague and largely unexplored. My dissertation investigates the gap between the existing high-level conceptual framework of context and the real application. The specific approach to address that problem is through the relationships among different dimensions of context. Addressing the above questions will enhance our understanding of context, demonstrate the importance of the relationship among the different dimensions of context, and promote more effective system and interface design.

Practically, by exploiting appropriate contextual information in the speech-based continuous dictation task, we will improve the efficacy of current speech-based error specification techniques. We will propose and evaluate a fundamentally new error specification approach based on users' task goals, system-generated confidence scores and other appropriate context information. This navigation anchor technique fundamentally changes the approach through which speech-based navigation has been achieved. Fine-tuning activities, which are integrated to our new approach, will provide insights for other types of interactions such as eye tracking and head-mounted navigation. More effective error specification techniques will greatly improve the efficiency and reliability of the speech-based dictation systems, which are especially important for users with physical disabilities or conducting hands busy tasks.

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