Chapter 8.2
Context–Awareness and Mobile Devices

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ABSTRACT

Context-awareness is a maturing area within the field of ubiquitous computing. It is particularly relevant to the growing sub-field of mobile computing as a user's context changes more rapidly when a user is mobile, and interacts with more devices and people in a greater number of locations. In this chapter, we present a definition of context and context-awareness and describe its importance to human-computer interaction and mobile computing. We describe some of the difficulties in building context-aware applications and the solutions that have arisen to address these. Despite these solutions, users have difficulties in using and adopting mobile context-aware applications. We discuss these difficulties and present a set of eight design guidelines that can aid application designers in producing more usable and useful mobile context-aware applications.

INTRODUCTION

Over the past decade, there has been a widespread adoption of mobile phones and personal digital assistants (PDAs) all over the world. Economies of scale both for the devices and the supporting infrastructure have enabled billions of mobile devices to become affordable and accessible to large groups of users. Mobile computing is a fully realized phenomenon of everyday life and is the first computing platform that is truly ubiquitous. Technical enhancements in mobile computing, such as component miniaturization, enhanced computing power, and improvements in supporting infrastructure have enabled the creation of more versatile, powerful, and sophisticated mobile devices. Both industrial organizations and academic researchers, recognizing the powerful combination of a vast user population and a sophisticated computing platform, have focused tremendous effort on improving and enhancing the experience of using a mobile device.

Since its introducion in the mid-1980s, the sophistication of mobile devices in terms of the numbers and types of services they can provide has increased many times over. However, at the same time, the support for accepting input from users and presenting output to users has remained relatively impoverished. This has resulted in slow interaction, with elongated navigation paths and key press sequences to input information. The use of predictive typing allowed for more fluid interaction, but mobile devices were still limited to using information provided by the user and the device's service provider. Over the past few years, improvements to mobile devices and back-end infrastructure has allowed for additional information to be used as input to mobile devices and services. In particular, context, or information about the user, the user's environment and the device's context of use, can be leveraged to expand the level of input to mobile devices and support more efficient interaction with a mobile device. More and more, researchers are looking to make devices and services *context-aware*, or adaptable in response to a user's changing context.

In this chapter, we will define context-awareness and describe its importance to human-computer interaction and mobile devices. We will describe some of the difficulties that researchers have had in building context-aware applications and solutions that have arisen to address these. We will also discuss some of the difficulties users have in using context-aware applications and will present a set of design guidelines that indicate how mobile context-aware applications can be designed to address or avoid these difficulties.

What is Context-Awareness

The concept of context-aware computing was introduced in Mark Weiser's seminal paper 'The Computer for the 21st Century' (Weiser, 1991). He describes ubiquitous computing as a phenomenon *'that takes into account the natural human environment and allows the computers themselves to vanish into the background.'* He also shapes the fundamental concepts of context-aware computing, with computers that are able to capture and retrieve context-based information and offer seamless interaction to support the user's current tasks, and with each computer being able to *'adapt its behavior in significant ways'* to the captured context.

Schilit and Theimer (1994a) first introduce the term *context-aware computing* in 1994 and define it as software that "adapts according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time." We prefer a more general definition of context and context-awareness:

Context is any information that can be used to characterize the situation of an entity. An entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves, and by extension, the environment the user and applications are embedded in. A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task. (Dey, 2001)

Context-aware features include using context to:

- Present information and services to a user
- Automatically execute a service for a user and
- Tag information to support later retrieval

In supporting these features, context-aware applications can utilize numerous different kinds of information sources. Often, this information comes from sensors, whether they are software sensors detecting information about the networked, or virtual, world, or hardware sensors detecting information about the physical world. Sensor data can be used to recognize the usage situation for instance from illumination, temperature, noise level, and device movements (Gellersen, Schmidt & Beigl, 2002; Mäntyjärvi &

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