Context–Aware Computing for Persons with Disabilities

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INTRODUCTION

The prosperity of mobile services has made information available at our fingertips anywhere and at anytime. Nevertheless, mobile technologies still lack in resources compared to conventional information processing devices. Additionally, battery capacity restricts its working time. Despite these limitations in mobile technologies, expanding the capabilities of the technology is still an important technical issue for mobile computing (Dourish, 2001).

One of the evolving mobile computing models is Context-aware computing. Context-aware computing finds information in the surrounding environment, and uses contextual information such as: user location, nearby people and devices, and user activity to improve its wealth of information.

Context-aware computing was proposed several years ago. Since then, many researchers have studied this topic and built a number of context-aware applications to demonstrate the usefulness of this technology. The technology itself can play a key role in any system. First, it can change the user expectations by understanding human intentions and acting accordingly. Second, it attempts to satisfy the changing of device and application resource limitations. Moreover, it improves the quality of service by managing the changing environments, and providing different types of services over a long period of time.

Given these strong points about the technology, this article aims at exploring the field of Context-Aware Computing and how it is utilized in the domain of Persons with Disabilities. The term "Persons with Disabilities" is used to identify any individual with the need of assistance for medical, mental, and/or psychological disability whether it is from birth or occurred during the individual's lifetime.

The organization of the article is as follows: section 2 gives a brief background about Context-Aware Computing. Section 3 discusses the use of Context-Aware Computing by Persons with Disabilities. Section 4 sheds light on the future trends of this technology. Finally, section 5 concludes the article with challenges and future trends.

BACKGROUND

In general, context-aware computing is one type of ubiquitous computing technologies. It allows distributed computation and interaction via the environment by using portable devices and wireless communications rather than limiting it on desktop computers (Dourish, 2001).

Basically, making computers understand our real world is the idea behind context-aware computing. Here, the interaction between the human and computer can occur at a more complex level, similar to human-to-human interaction, and this kind of interaction has made "ubiquitous computing" realistic and valuable (Wu, 2001).

In 2010, Pettey and Stevens discussed the importance of context (Gartner, 2009), whereby they predicted that in 2012 relationships with context providers would increase, and by 2015 context will be the most significant factor for mobile services. They expect that it will also be associated with search engines on the Web to make context more readily available and to develop services that use context more easily (Lowe, Mandl, & Weber, 2012).

This section will give an overview of context-aware computing by presenting different concepts to understand the basic foundational principles behind context-awareness and mobile devices.

Context-Aware Computing

Context-aware computing can be defined as a system implemented in mobiles which has the ability to sense the physical environment of the mobile, and adapt its behavior accordingly. Context has a main role in the world of ubiquitous environments where it helps in determining which information or service to bring to the user. There are many factors of context such as location, accompanying people, surrounding resources, social situation and even nearby people, devices, lighting, noise level, network availability and many others. Context-aware applications are found in numerous areas, a mobile tour guide is one of the most common applications that use context to work.

The definition of context has progressed dramatically over time (See Table 1. Context was first defined by Schilit and Theimer as location, identities of nearby people and objects, and the changes of those identities as a result of the location changes. Later on, other concepts were added: time and emotional stats of the user, so context can have both physical and conceptual states that are related and of interest to an entity. Finally, Dey and Abowd (Abowd et al., 1999; Dey, 2001) defined context as:

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 application themselves.

Context-Aware Applications

Context-aware applications refer to any application with a technology that accumulates the available context of the user and provides more relevant services to him/her. Context, as mentioned previously, can refer to any information that characterizes location, nearby people or objects and the interaction between them.

In general, context-aware applications start performing tasks by gathering context data and then providing certain services such as managing, representing,

Table 1. Progression of context definition

1994	The location of user, the collection of nearby people and objects, as well as the changes to those objects over time.
	Context is the identity, activity, time and location.
	Context is the user's physical, social, emotional or informational state.
	Context is physical and conceptual states that are related and of interest to an entity.
	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 application themselves.
	Context is the set of environmental states and settings that either determines an application's behavior or in which an application event occurs and is interesting to the use.
	Context is a combination of any information that can be sensed or received by an entity which is useful to catch events and situations.
2000	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.

and service matching. So, when reviewing existing applications, it is important to consider the various features and tasks of specific categorizations. There are various categorizations of context-aware applications that have been proposed by different researchers. One of these categorizations is proposed by Mari Korkea-aho who divides context-aware applications according to their characteristics into four categories (Korkea, 2000):

1. **Office and Meeting Tools:** These applications find information in limited areas such as an office, especially since most computers are placed in office environments.
2. **Guides:** This is the most popular type of context-aware applications which tries to gather and manage information in the surrounding environment, and then works as a guide to the user.
3. **Fieldwork Tools:** Applications of this category consist of an archeological assistant tool, a giraffe observation tool, and a rhino identification tool.

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