

Pervasive Computing in the Supermarket: Designing a Context-Aware Shopping Trolley

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ABSTRACT

Shopping in the real world is becoming an increasingly interactive experience as stores integrate various technologies to support shoppers. Based on an empirical study of supermarket shoppers, the authors designed a mobile context-aware system called the Context-Aware Shopping Trolley (CAST). The purpose of CAST is to support shopping in supermarkets through context-awareness and acquiring user attention, thus, the authors' interactive trolley guides and directs shoppers in the handling and finding of groceries. An empirical evaluation showed that shoppers using CAST behaved differently than shoppers using a traditional trolley. Specifically, shoppers using CAST exhibited a more uniform pattern of product collection and found products more easily while travelling a shorter distance. As such, the study finds that CAST supported the supermarket shopping activity.

Keywords: Context-Aware Shopping Trolley, Context-Awareness, Mobile and Pervasive Technologies, Shopping, Supermarket

INTRODUCTION

Shopping in the real world, i.e., grocery shopping in supermarkets is becoming an increasingly interactive experience. Concept stores like the Metro Groups Future Store have started using radio-frequency identification (RFID) tags to streamline supply chains as part of a checkout-free store concept (Metro Group Future Store Initiative, 2009). Other stores have

integrated self-checkout points to speed up the paying process, while others integrate barcode scanners where shoppers can retrieve information about products. Finally, manufacturers like Siemens-Nixdorf and MediaCart produce shopping trolleys with interactive touch-based screens where shoppers can find information related to the shopping activity, e.g., the shopping list or information about selected products (MediaCart, 2009).

With emerging high-speed wireless networks like 3G, people can now access a wide

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array of information while shopping, e.g. cooking recipes or product information, from the Internet on their mobile devices and thus, create their own unique shopping experiences. Hence, future shopping in the real world is likely to involve both handling of real world objects or smart objects (groceries) and at the same time mobile technologies for enhancing the experience.

Contemporary supermarket shopping is a complex activity, where shoppers try to find and identify products in often crowded and noisy environments. Furthermore, supermarket shopping is highly routine-based (Park et al., 1989) where shoppers typically purchase products in an attempt to try to save money, find biodynamic groceries, or compose a family menu etc. Introducing pervasive or ubiquitous technologies in supermarkets could possibly affect such shopping behavior and thus influence product placement and supermarket layouts. Also, trolley-mounted technologies like the MediaCart shopping trolley (MediaCart, 2009) introduce concerns of what products should stores show and promote on trolley-mounted displays, when should such products be displayed, and where in the store should certain products be displayed? Context-aware computing provides a theoretical solution to such challenges and questions as it utilizes context to promote seamless interaction between the user and the system. In studying context-awareness, researchers have considered who, what, where, when, and why questions related to the context of the system (Dey, 2001). Thus, context-aware computing could provide an interesting approach to pervasive computing in supermarkets, but its opportunities and limitations are still poorly understood.

In this paper, we describe the design and evaluation of a prototype for enhancing the shopping experience in supermarkets by actively acquiring the users' attention. Our purpose with the paper is to explore whether context-aware computing can support the shopping activity and help shoppers in finding products. Our prototype is called CAST (Context-Aware Shopping Trolley), and it supports supermarket shoppers by informing of product placement.

Elements of context-awareness are used in the solution as attempts to integrate the handling of products with the interaction with the mobile device (CAST).

RELATED WORK

Context-aware computing has been characterized as the ability of an application to discover and react to changes in the environment (Schilit & Theimer, 1994). Here, the word environment is used synonymously with context, as the application is described as aware of its environment and reacting to changes in this environment. The purpose of context-aware applications in general is to provide task-relevant information and services to the user. The systems are designed to achieve this goal by autonomously updating in reaction to changes in their context. This has also been referred to as implicit human-computer interaction (Schmidt, 2001) as computers take action based on implicit user activity, e.g., moving from one location to another. As such, context-aware computing is often mentioned as a key component of Weiser's vision of ubiquitous computing (Weiser, 1991).

Context plays an important role in the understanding and definition of context-awareness (Dey & Newberger, 2009). Researchers have defined and adapted context in numerous ways and as involving several (usually inter-related) elements. These elements include, but are not limited to location, objects, and task (Dey et al., 2001), or people, places, and objects (Dey et al., 2001; Dey & Newberger, 2009). With recent advances in mobile, pervasive, and ubiquitous computing technologies, context-awareness has become more interesting and viable for research in the past decade. Quite simply, where stationary computers (and their users) are located in a fixed location, mobility introduces the potential location dynamics. With changes in location, user needs can change, and context-aware systems are designed to react accordingly to changes in location (Dourish, 2004).

Several research studies have focused on context-aware applications where most of them

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