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MUCS: A model for ubiquitous commerce support

Laerte K. Franco [a], Joao H. Rosa [a], Jorge L.V. Barbosa [a,*], Cristiano A. Costa [a], Adenauer C. Yamin [b]

[a] Interdisciplinary Postgraduate Program in Applied Computer Science, University of the Sinos Valley (Unisinos), Sao Leopoldo, Rio Grande do Sul, 950, Unisinos Ave., 93.022-000, Brazil
[b] Postgraduate Program in Computing, Catholic University of Pelotas, Pelotas, Rio Grande do Sul, 412, Felix da Cunha Street, 96.010-000, Brazil

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ABSTRACT

The evolution of computing technology and the emergence of wireless networks have contributed to the miniaturization of mobile devices and their increase in power, providing services anywhere and anytime. In this context, new opportunities for technology support have arisen in different areas, for example, education, games and entertainment, automobile, and commerce. We propose a model for *ubiquitous commerce support* (MUCS). This model uses ubiquitous computing concepts to look for deal opportunities for users who act either as buyers or sellers. This paper also describes two everyday scenarios, in which the MUCS model could be applied, and explains the implemented prototype to be used in them. Finally, we present the results obtained from a practical experiment, which was performed with the participation of users who filled out an evaluation questionnaire.

1. Introduction

About two decades ago, Weiser (1991) introduced a new concept called ubiquitous computing. He predicted a world where computing devices would be present in objects, environments, and even human beings. These devices would interact naturally with users in a transparent manner, without being noticed. When Weiser's seminal article was published, the computing technology needed to fulfill the ubiquitous computing vision was not available yet, which made his prediction somewhat futuristic. Nonetheless, since then, portable electronic equipments, including smartphones, and tablet and notebook PCs have become smaller and more powerful, providing access to interconnecting technologies based on wireless communications like Bluetooth, 3G, WiMax, and Wi-Fi. Those technologies have contributed to services provisioning anywhere and anytime. Furthermore, this evolution has brought new tools in different areas, such as education (Barbosa et al. 2008, Nino et al. 2007), automobiles (Li et al. 2005), games and entertainment (Franco et al. 2007, Segatto et al. 2008), and commerce (Galanxhi-Janaqi and Nah 2004, Gershman 2002, Lin et al. 2005, Roussos et al. 2003).

Many authors have been using ubiquitous commerce (u-commerce) as a reference to employ ubiquitous computing technology in the commerce of products and services. For example, the work of Galanxhi-Janaqi and Nah (2004) suggests that ubiquitous commerce is a new paradigm that combines wireless networks, TV, voice, and silent commerce with e-commerce. According to Roussos et al. (2003), u-commerce is intimately related to e-commerce and m-commerce, employing the infrastructure and the expertise of both. Nonetheless, u-commerce is characterized by the electronic identification of physical products and the seamless provisioning of business and consumer services in ubiquitous computing infrastructures.

Gershman (2002) identified the following prerequisites for the success of ubiquitous commerce strategies: (1) always be connected with the clients; (2) always be aware of the real context of the clients (where they are, what they are doing and what is available around them); and (3) always be proactive, identifying opportunities in real-time to meet client needs.

In this article, we define u-commerce as the integration of e-commerce, by electronically identifying physical products, m-commerce, by allowing users to shop anywhere and anytime, and ubiquitous computing, by allowing users to shop intelligently and intuitively with the help of a smart environment. Environment is characterized by the sensors use to identify contexts, for example, location-based services (Hightower and Gaetano 2001), and mechanisms that continuously evaluate the environment, trying to identify business opportunities among users. In this paper, we introduce a model for ubiquitous commerce support (MUCS). The main goal of this work is to identify business opportunities among users in ubiquitous environments.

The remainder of the article is organized as follows. Section 2 presents related works, focusing on describing models for u-commerce that are available today. Section 3 provides details on the MUCS model, presenting its architecture and each one of

* Corresponding author. Tel.: +55 (51) 3590 8161; fax: +55 (51) 3590 8162.
E-mail addresses: laerte.franco@gmail.com (L.K. Franco), joaohenrique89@gmail.com (J.H. Rosa), jbarbosa@unisinos.br (J.L.V. Barbosa), caccac@gmail.com (C.A. Costa), adenauer@ucpel.tche.br (A.C. Yamin).

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its basic components. In Section 4, we show the development of a prototype and two experiments performed to evaluate the proposed model. Section 5 concludes and presents future trends for the area.

2. Related works

Despite the fact that ubiquitous commerce is new, many models have been proposed. These models affect different areas, from the commerce of products in supermarkets to the control of parking lots. In this section, we will discuss the main characteristics of some models for u-commerce available today.

For example, iGrocer, discussed by Shekar et al. (2003) was designed to be a smart assistant, aiding clients in the purchase process in supermarkets. iGrocer tracks and retains consumers' nutritional profiles, suggesting the purchase of products or even warning about items that should be avoided. This is particularly practical for elderly people or those who need help to follow a specific diet. iGrocer also identifies the desired products, through barcode scanning, and gives the user information about the nutritional facts. In order to suggest product for the consumer purchase, iGrocer also combines the client's nutritional profile with ESHA Research (2010), a database of nutritional facts.

Another such application is MyGrocer, discussed by Roussos et al. (2003) and Roussos and Moussouri (2004). It is similar to iGrocer, and was designed to assist consumers in the food purchasing process. However, MyGrocer emphasizes the control of the stock of products in food-related businesses and households, using sensors on the shelves and in other locations. These sensors indicate the available quantity of a product, warning when something is missing or finishing. Roussos and Moussouri (2004) suggest the following possible scenarios for the use of MyGrocer:

- *Supermarket*. The client enters the supermarket and picks a supermarket trolley, which has a PDA with RFID readers to identify the products. The device recognizes the RFID tag of the client's affinity card and loads his purchase list. After that, the system indicates the best route to find the products faster. When the client inserts or removes products from the trolley, the system updates the purchase list, and also updates the in-stock inventory of the supermarket. At the end, the trolley passes through an RFID reader located next to a cash register, which rescans all the items in the trolley, calculates the total cost of the products, shows that information on the display of the cash register, and prints out a receipt for the customer.
- *Customer's home*. At home, people can store food products in compartments that have RFID readers installed, like a refrigerator and a cupboard. Whenever an item is inserted or removed, the system can automatically update information about what's in-stock.

Lin et al. (2005) present a generic architecture called the Pervasive Activity Manager (PAM). Its aim is to assist clients, giving complementary information of products to help the decision on the purchase of an item. PAM uses services supplied by stores, shopping malls, or even other customers. Below, we show some possible scenarios suggested:

- *DVD rental*. A client goes to a store in a shopping mall to rent a DVD. The client's personal device identifies, by means of an RFID reader, that he is holding a DVD for more than thirty seconds. At this moment, PAM gathers data related to the movie, based on the consultation of services provided by the DVD rental store or by connecting to the Internet. PAM shows the information to the client and if he wants to rent the movie, he can complete the operation through the mobile device.
- *Restaurant booking*. Suppose that there are two persons who are in different stores of the same shopping mall want to have lunch together. PAM checks the restaurants with cuisines of their preferences for table availability, notifying them of matching opportunities. At the end of the process, the clients choose one of the offers and book a table for lunch.

The u-commerce concept may also be applied to services. For example, EPARK was proposed to assist clients and employees in the process of parking payment and management (Mazzari et al. 2007). Some of its functionalities are a parking map, booking a parking space, and extending the booking time for a parking space. Another example of a u-commerce application in the service market is the Ubiquitous Tourist Assistant System (UTAS) of Chiu and Leung (2005). UTAS was designed to satisfy tourists' needs in situations where language is an obstacle. UTAS is capable of warning about delayed or canceled flights, obstructed roads, and restaurant or concert bookings, allowing the traveler's trip plans to be handled though a mobile device. Although there are many proposals for u-commerce, MUCS is the only model that focuses on the generation of business opportunities for users as clients or suppliers. In addition, MUCS is generic, so it is able to work with to support commerce for products and services in different areas.

3. The MUCS model

The MUCS model uses the ubiquitous computing infrastructure to identify business opportunities between clients and suppliers. The next subsections present a background on the model, its architecture, as well as the strategy used to identify, distribute, and deal with opportunities.

3.1. Background

The MUCS model is based on the five concepts. An Environment comprises all the physical area covered by the model, for example, a shopping mall, a home, a building or a city. A Context consists of the subdivisions of the environment. An environment is subdivided into one or more Contexts, for example, stores in a mall. A Dealer is a person or a company that supports transaction-making, by offering search services or by supplying other services or products. A Desire represents the services and products that a consumer wants to acquire. For example, different consumer Desires may include buying a camera, learning a language or having a certain type of food. An Offer indicates services and products that a Dealer wants to supply, for instance, selling a computer or teaching music.

Fig. 1 presents an example of a shopping mall using the MUCS Environment representation. In this Environment, the physical spaces of the stores and the food court are the Contexts. In the example, they are represented by the dotted rectangles. Dealers are located within the Contexts, which are represented by circles. In the figure, we can identify five Dealers in the food court, which may be restaurants or clients of the shopping mall.

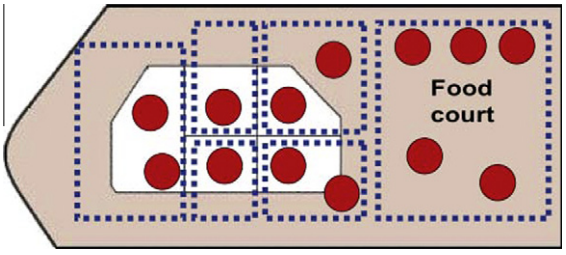

Fig. 1. Sketch of a MUCS environment.