Building a targeted mobile advertising system for location-based services

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ABSTRACT

Over the years, mobile advertising has grown to become a technology that allows an advertiser to promote products or services to targeted users efficiently and effectively. This is because the ubiquitous nature of mobile devices can provide contextual information and allow users to demonstrate preferences. This study proposes a targeted mobile advertising system (TMAS) that works as a platform to provide both merchants and consumers with context-aware advertisements. The approach integrates the advantages of both mobile and targeted advertising to allow merchants to disseminate location-based targeted advertisements while providing pull-type and personalized advertisements for consumers. To demonstrate the TMAS, we build a platform to provide highly relevant advertising to consumers and to guarantee that advertisements have an equal opportunity of being presented to consumers.

1. Introduction

Location-based services aim to offer personalized mobile transactions for targeted individuals in specific locations at specific times [45], using the knowledge of the location of an object and/or individuals [38]. The growth of mobile phones has provided an opportunity for such services. Mobile phones are by far the most popular personal communications device, and, as new multi-function mobile phones such as smart phones are widely adopted, they have emerged as a coveted media platform for marketers because they are personal, accessible anytime and anywhere, and location-aware [28,40,44].

Global mobile marketing spending is expected to be worth around $19 billion by 2011 [8]. However, the most vital problem for merchants is how to reach their valuable targeted audience. That is, how best to deliver an advertisement to the right mobile user in the right context effectively and efficiently remains an issue to be solved [13,49,52].

Currently, the most common mobile advertisement formats are Short Message Service (SMS) and Multimedia Message Service (MMS) [31]. These are push-type technologies that send messages proactively to mobile users [9]. Typically, push marketing is better for companies who have an established relationship with users, who have granted permission to receive such messages. This is referred to as permission-based marketing [6]. However, the mobile phone can be used as a user-driven media device to enhance the dynamics of business-to-consumer relationships [43,33]. It can be used

for pull-type marketing that sends information based on consumer requests [6]. This mode is most suitable for merchants with simple, time-limited, and location-related advertisements. Advertisements can even be restricted by quota, such as the promotion of a regional company, coupons in a local mall, a community yard sale, and so on. Moreover, future customers with smart phones can actively demand promotional information. Compared with push-based advertising, this pull-type approach, which allows customers to have greater involvement, has gained in popularity.

This paper proposes a targeted mobile advertising system (TMAS) for mobile advertisements based on pull-type marketing strategies. It integrates the strengths of targeted advertising techniques, pull-type marketing, and mobile advertisement technology. The framework not only allows consumers to identify and access personalized advertisements, but also enables the advertisers to design and present context-aware targeted advertisements. The remainder of the paper is organized as follows. Section 2 reviews the related literature on targeted mobile advertising and pull-type advertising. Section 3 outlines the system framework, and the demonstration is presented in Section 4. The final section highlights the contributions of the research and concludes the paper.

2. Targeted mobile advertising

Moving into the Internet age, the ability of Internet advertising to provide customization and personalization for web-based stores has been well recognized. Tools such as data mining, statistics, artificial intelligence, and rule-based matching are popular for building recommendation systems [22]. However, similar to the findings in [36], it was found that direct exposure to Internet advertising might not enhance web purchasing. Rather, the decision to purchase is determined

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by consumers' interests before surfing Internet stores [23]. Thus, a pull strategy is more effective than a push strategy on the Internet. Similarly, the contextual appeal to consumers is more important to advertisers on the Internet. With the development of mobile devices, the collection of consumer information, such as location, has become more convenient. Thus, mobile commerce provides a venue for context-aware, targeted advertisements to advertisers and personalized pull-type advertisements for consumers.

The purpose of providing targeted advertisements is to increase the effectiveness of advertising by ensuring the right person receives the right message at the right time [1]. Scharl et al. [35] suggested that targeted advertisements using mobile devices could provide consumers with personalized information, including information such as time, location, and interests. Thus, providing a targeted mobile advertisement involves both scheduling and personalization issues. Here, scheduling refers to which advertiser should send out promotions to whom at what time, given a limited broadcasting capacity, to maximize positive customer response and revenues for the merchant who pays for the advertisement. De Reyck and Degraeve [14] used integer programming to solve the problem and then developed a decision support system for automatically scheduling and optimizing the broadcasting of advertisements to mobile phones [15]. Similarly, Tripathi and Nair [42] applied the same technology with contact history information to better schedule the delivery of advertisements.

Personalized advertising is also important and challenging to advertisers. Unlike primary targeted advertisements that simply deliver a specific advertisement to segmented customers in a market, personalized advertising is more individualized [21]. Personalization aims to deliver suitable advertisements to a designated user rather than to a group of users. Generally speaking, an advertiser can personalize advertisements based on users' profiles and contextual information [5]. User profiles include their preferences and demographics [17], while contextual information includes location, time, user activities, and weather [49]. That is, users' long-term preferences are normally stored in profiles while their short-term interests are available from the contextual information [25]. Data mining techniques have been widely used in targeted advertising, especially on the Internet [27]. Techniques such as segmentation and clustering can be used to discover web access patterns and to solve other advertisement problems [10]. For example, through demographic analysis it was found that the unmarried working youth segment has a higher propensity to access pull-type mobile advertisements [32]. Similarly, the classification model can be used to match Web sessions with advertisements [27]. Other than data mining techniques, fuzzy logic can also be used to target advertising based on user profiles [50]. The assignment of appropriate advertisements to each active user can be accomplished according to the fuzzy rules stored in the system.

The delivery method of targeted mobile advertisements can be differentiated into push and pull marketing strategies [9]. Both strategies need to select targeted mobile users carefully. In push advertising, messages are proactively sent out to mobile users [9]. That is, information and marketing activities flow from the producer to the consumer [39], which is cheap and efficient [34]. SMS mobile advertising is one of the typical applications adopting a push strategy in the mobile environment [6]. However, acquiring permission from mobile users to deliver messages is always a problem [6]. In contrast, using a pull strategy, a mobile user pulls mobile advertising for his/her own use [6]. It is arguable that pull advertising might blur the line between advertising and service [20]. There are some successful applications using this approach. For example, Okazaki [31] proposed a mobile advertising platform, called "Tokusuru Menu", that allows subscribers to access promotional information delivered by various companies. Mahmoud and Yu [29] developed a mobile agent platform to compare shopping items in a mobile environment. Choi [11] proposed a GPS/Web-enabled mobile search mechanism based on a user's physical location and search intentions so that they receive

more personalized and locally targeted search results. A similar approach was taken by Yuan and Tsao [52], who developed a mobile advertising system integrating both push and pull modes, called MALCR.

Table 1 presents a comparison between this study and a number of other systems described in the literature. The targeted mobile advertising system (TMAS) proposed in this study is based on pull-type marketing strategies and anticipates the active involvement of consumers. Moreover, advertisers can use the framework to design context-aware targeted advertisements.

3. The targeted mobile advertising system

Merchants may prefer a platform that can promote a product to consumers in a timely, effective, and low cost way. Similarly, consumers would prefer to receive relevant and useful promotions. For example, a scenario in which a well-known pizza restaurant in a shopping mall wishes to promote its popular but high profit margin triple sausage pizzas to draw the attention from nearby customers before the peak lunchtime hour. The promotion may be limited to ten pizzas selling between 11:30 and 12:00. The advertisement should be easily prepared by the owner and distributed via a platform to the mobile phones of targeted customers who are nearby or whose favorite place to eat is in this shopping mall.

In this study, we develop a targeted mobile advertising system (TMAS) for mobile advertising. TMAS works as a platform linking merchants and consumers (mobile phone users). It uses personalization and pull techniques to deliver targeted advertisements that can better match consumers' needs. Specifically, it allows consumers to actively specify their demands, and a list of personalized advertisements will be delivered to them based on their contextual information and preferences. Similarly, a merchant can prepare an advertisement and access those consumers who are interested in it, and then further acquire consumer feedback from the platform to adjust their advertisement content and strategy.

The framework of TMAS, presented in Fig. 1, has three modules, Advertisement Management, User Profile Management, and Advertisement Intelligent Searching, which interact with databases and users. The Advertisement Management module manages the content of advertisements and the properties of targeted customers. The advertiser is allowed to revise both the content and properties. Commercial software, such as x10advertisements and csBanner (http://www.cgiscript.net), can be used for this purpose. The User Profile Management module is used for creating profiles for new consumers and updating existing ones. The Advertisement Intelligent Searching module, the key to TMAS, provides personalized search results

Table 1
Comparison between TMAS and other systems.

	Okazaki [31]	Mahmoud and Yu [29]	Choi [11]	Yuan and Tsao [52]	This study (TMAS)
Location-based service	No	Yes	Yes	Yes	Yes
Context-aware information	No	No	Yes	Yes	Yes
Mobile agent	No	Yes	No	No	No
Advertising platform	Yes	Yes	No	Yes	Yes
Personalized advertisements	No	No	Yes	Yes	Yes
Pull-type mobile advertisements	Yes	No	No	Yes	Yes
Consumers' active involvement	No	No	No	No	Yes
Targeted advertisements	No	No	Yes	No	Yes