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LBES: Location Based E-commerce System

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Abstract: Mobile devices as they are found in today´s market contain advanced technical capabilities, enabling, therefore, the sustainability of complex software applications. Such capabilities are responsible for conveying several fair opportunities when it comes to the creation of value added services to users, among which location-based mobile services (LBMS) are greatly focused. Therefore, this paper puts forward an architecture designed for location-based e-commerce system, that is, a system thought of to enable a given user, depending on his/her present location, to search, book and still purchase products in his/her surroundings.

Keywords: Ubiquitous, E-commerce, LBMS, E-business, Mobile-Devices.

1. Introduction

Currently, it is rather common to find in the mobile devices a rich set of technical features and functionalities. In fact, it has become quite ordinary to bump into devices equipped with a wide range of technologies, adding up to a significant processing capacity, distinct communication technologies like GPRS (General Packet Radio Service), UMTS (Universal Mobile Telecommunications System), 802.11x, Bluetooth, Infrared and NFC (Near Field Communication), location abilities such as GPS (Global Position System) or through one's service provider, detection of movement using accelerometers, among others.
Such assembly of technical abilities allows the equipments to support complex software applications as well as the execution of several services, including LBMS.
Bringing environment-contextualized information and services to users through their mobile-devices seems yet to be roughly explored as an electronic business, regardless of the fact this is quickly changing, considering the set of applications that appear to be boosting within the mobile market in the last months, for instance, those designed for the iPhone platform (Communications, 2009; Earthcomber, 2009; LightPole, 2009).

It is, therefore, within this context that we set forth an architecture for a system and location-based e-commerce system. More precisely, such system is thought of to provide a given user, who may intend to identify potential suppliers of products/services in a given geographical proximity, the possibility of searching these same products/services, making reservations to buy and even concluding the purchase, by the way of the very convenient use of a mobile device.

This paper is structured as follows: the next section presents the literature review, followed by the presentation and discussion of the system architecture and, then, the analysis of the system prototype. The final section is completed with some relevant conclusions obtained from this paper.

2. Background

The ever growing and wide spread of mobile devices with increasing technological capacity playing the role of mobile computing platform together with a particular feature that stays permanently close to the personal life of individuals (Raento, Oulasvirta, Petit, & Toivonen, 2005; Srivastava, 2005), explains its status as privileged tools for the development and implementation of the "context-aware" concept, while referring to applications and services (Raento et al., 2005; Rao & Minakakis, 2003). Currently, it is, in fact, the real-time obtained geographical location the preferred basis upon which the services with context related information, in which the individual is also included, are provided (Toye, Sharp, Madhavapeddy, & Scott, 2005). Obtaining this information has been facilitated and has become more efficient, besides fast, mainly due to the widespread introduction of technologies such as GPS in mobile devices or the use of networks of service providers (Rao & Minakakis, 2003).

The concept of LBMS opens in a new direction to the development of content and applications for mobile platforms (Helal, 2008; Vaughan-Nichols, 2009), as well as ways to integrate the latter - concerning its hardware particularities and communications - into the already existent and working digital services networks, presenting, however, the opportunity to innovate because an ubiquitous and personal vehicle associated with growing multimedia facilities, are capable of leading to real-time relevant, personalized and contextualized services and contents, which can be presented transparently to the user and in the very palm of his/her hand (Toye et al., 2005).

Regarding to the economic potential that may be well acquired by service providers, their profits range from traditional operators to virtually any entity with a web platform ready to be accessed by mobile devices or to provide their services using web services (Farley & Capp, 2005; Oriana, Veli-Matti, Sebastian, & Lasse, 2008). This stands for a whole new market that combines together the mobility and contextual domain, a role very much played by the ever present element of day-to-day: the mobile phone. There are already some examples of location-based services for individuals and public institutions, namely services of virtual waiting lines, issuing tickets for transport, social networks, urban planning, pedestrian navigation and others, being then briefly described as an example.

A service of virtual waiting lines is described in (Toye et al., 2005), allowing that a restaurant customer does not have to hold for a table in the lobby. Using a mechanism of local context - a visual tag (QR Code) the client uses his/her mobile device to photograph the element of context and an application previously installed to decode the content, which in this case contains a series of addresses providing Bluetooth connections between the client's mobile device and restaurant´s server. The customer is, therefore, informed about the average time of waiting, the number of people standing ahead of an individual and then asked whether if one desires or not to be placed in the virtual queue. If yes, the customer is then asked to indicate how many people will be served when available. Finally, the client may now wait for his/her turn lightly, taking time to go shopping or doing any other kind of service that he/she is required to accomplish. The user will then be notified by the system of the restaurant, through SMS, letting the client know when to get back and be served in the shortest time possible.

Additionally, the SitOrSquat.com (SitOrSquat.com, 2009) site puts forward the possibility to find, for example, a bathroom near your present setting. In detail, as soon as we insert a given

location within the map presented, it moves towards the selected location where we may find all the bathrooms registered in the systems which are thus shown. Furthermore, when we click on the bathroom icon, a small window containing basic information about that bathroom appears and if we click on the icon corresponding to the name of the bathroom, more and detailed information on another window is also made available. It is again possible to use this service on mobile phone by downloading it to your Blackberry or iPhone, and, in addition, to find precisely how to get to the nearest bathroom by again sending a SMS and following the instructions as provided.

The WhosHere (Honan, 2009) consists of an application set for digital social networks and is also able to show other users that are geographically close, through the basis of provided information about the current location of the individual, and likewise facilitate the interaction between them by means of short written messages. Similarly, it also allows performing searching activities among available users, based on criteria such as whether the person is available or not for friendship relationships, casual encounters, among others. Furthermore, accessing users' profiles and further exchange of their respective multimedia information, like photographs, turned out to be possible as well.

The Mobile Cab Finder, CAB4Me (cab4me.com, 2009), consists of an application whose main feature relies on making easier for us to find a taxi and is available for the T-Mobile G1 Android phone. All we have to do is to choose our location/setting on a map and we are then shown where the nearest taxi is, if available. By clicking on the call tab, the local cab companies are likewise illustrated. If registered on the database, the companies and its related information, such as payment methods and car types, are also on hand. If there are no registered cabs for one area, a local web search is performed.

Selling public transports tickets based on the user location (Bohm, Murtz, Sommer, & Wermuth, 2005) is a relatively new reality coming with a really simple concept: the user dials a check-in number when one is about to start using public transports and is located using their mobile services provider and multimedia activities, such as photographs. Next, and once one takes the public transport and selects the journey, within the area covered by the service, it goes all the way through and as long as one desires. It only takes the user a quick contact to the check-out number when the journey is finished. Thus, based on the initial position, final position and the public transports network, the service is able to calculate the value to charge and follows by automatically deducting it from the account belonging to client´s mobile operator. Tickets selling for sport events and music concerts, as well as related promotions is also described in (Farley & Capp, 2005).

LBMS can also help to change urban planning and strongly influence public administration policies (Ahas, 2005). Mobile devices can precisely pinpoint their geographic location and also supply a saved user profile. Together, they provide the basis to study – through certified entities, due to privacy issues and only with the user consent - time and space social flows in a given geographic area. By creating flow charts and models, public entities can know what are the most travelled streets, roads, routes, visited locations, among others, but also by using a statistical approach, the expected people on a given geographic location, at a given day and time. This information will greatly help to plan public services, urban development and transportation routes/timetables.

Finally, a pedestrian navigation aid system is described in (Arikawa, 2007). In this, a user is shown as capable of selecting a destination within a city along with some preferences/conditions to make the journey. The mobile application will, based on the user's initial geographic position and through a web-service, obtain the optimized route from source on the way to destination, respecting the most the user's conditions. Meanwhile, as soon as the journey starts, it will also provides a detailed step-to-step guide and visual representation of the urban scenario in the user's mobile device detecting, for that purpose, the direction to where the user is heading for. Some

services, like the location of restaurants, shopping malls and transport platforms in the vicinities are also made available, providing a complement to the main navigation aid service.

3. System Architecture

The system that we propose relies on the availability of information and services, based on the location of those who request them. Consequently, it is intended that a given user by means of a mobile device with a previously installed application, may be allowed to search products/services using his/her mobile phone. The research is prepared by indicating an expression of research (identifying the product/service required) together with the action range (maximum distance) in which the user wishes to collect the product or acquire the service. The running of the research enables the establishment of a link between the mobile device to a location based search engine, which in return will provide a list of suppliers of products/services in the surrounding area as selected, based on the information from previous index of products/services and made available by the suppliers who are afforded access in the system.

Once in the possession of information about potential suppliers, it is up to the user to decide which supplier he/she requests and make an immediate booking or purchase, if it is something the user looks for.

As can be seen in Figure 1, the system LBES is made of several components that are described below: Mobile Device (MD), Location Based Search Engine (LBSE); Stores (S).

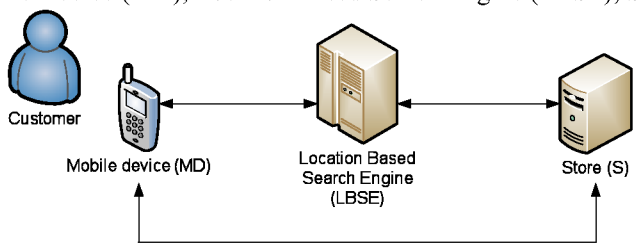

Figure 1 - LBES Global Arquitecture

MD: It stands for devices such as a PDA or mobile phone which enable the user to search, reserve and/or buy products/services in a selected geographical area.

LBSE: Consists of a search engine whose function relies on indexing products/services from several stores, in a primary and initial stage of the process, and in a second phase, replying the requests on products/services search by MD.

S: Represents the suppliers systems of products/services, in which it is registered the information about products/services available in stores belonging to these suppliers.

In the overall operation of the system, it is possible to identify several of its moments, whose messages exchanged among the various components are represented in Figure 2, as follows:

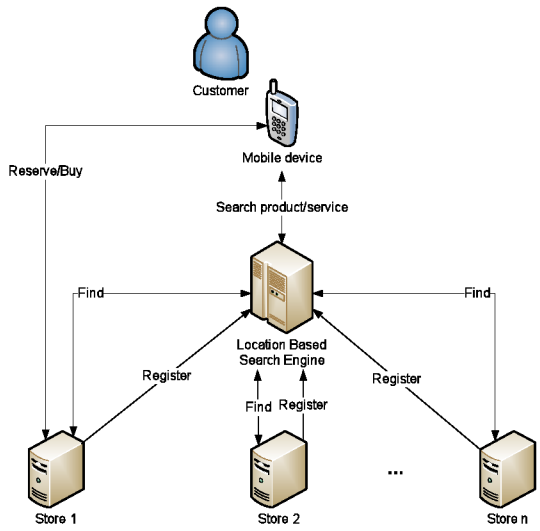

Figure 2 – LBES architecture detail (general exchanged messages)

First moment:

- Each S system is registered in LBSE system (message "Register").

Second moment (ciclic):

← Each product/service is indexed by LBSE (message "Index").

At the final stage of the second moment the products/services will become available in the LBES system for further search.

Third moment:

← The user, by means of a MD, configures the search that he/she wants to carry out, defining some parameters, such as the maximum distance from his/her specific location and a search string of the desired product/service;

← At that moment, it is sent the "Search product/service" message from the MD system to the LBES one, indicating what search is effectively selected by the user. Through the latter, it is accordingly sent a response by the ELBSE to the MD system containing the list of products/services as found in the surroundings, and resulting from the search as previously conducted;

← If the user desires, he/she may as well book or purchase either a certain product or service directly in one of each stores shown up as the result of the search he/she has completed. For such purpose, it will be sent a "Reserve/Buy" message from the MD system to one of the S systems. As a feedback, in case the purchase is indeed possible, the user will be delivered an electronic sort of confirmation of the referred reservation/purchase action through his/her MD.

4. Prototype

The LBES system was put into practice by making use of the Android operating system for mobile devices exclusive application purposes, whereas Linux proved to be relevant in the system repository of events. Such performance did implicate the use of a range of technologies, such as Java, Web services (PHP), Apache and MySQL. In general, these technologies were used because

they are open source, which reduces the implementing costs and are furthermore supported by a broad community of users, enhancing its development with the addition of new features.

Regarding the recent operating system named Android, enabling, nonetheless, a direct interaction with the Google Apps (e.g. Google Maps), it has got significant advantages when developing applications in a well established language (JAVA), not to mention the remarkably ever growing applications market developed by its supporting community.

Screenshot 1 Screenshot 2 Screenshot 3 Screenshot 4

Figure 3 – LBES prototype screenshots

In **Figure 3** there are several screenshots of the application especially designed for mobile devices.

When started, the application automatically loads a global terrestrial map indicating the user's present location and providing him/her the possibility to start a given search (screenshot 1, by touching on the map). Once the map is loaded, the user is able to navigate freely on it, as well as zoom in, zoom out and change the way the map is showed. Then, by simply laying an hand on the map, the "Search" option shows up, allowing the user to insert the search keywords related to with the product/service he/she wants to look for (screenshot 2) in its corresponding small window in the middle of the screen. The confirmation of the undergoing search (screenshot 2, button "ok") will activate an HTTP request to be sent to a web service. The HTTP request will therefore contain a *Simple Object Access Protocol* (SOAP) message with several parameters: the product/service introduced, the user location, the server IP address and the function that will be called. Subsequently, the web service returns all the stores containing products/services connected to the search keywords introduced and the results are shown on a new window (screenshot 3). To verify the product/service price, the user must select one store from the search result list by clicking on it.

Once the product/service as retrieved is selected, it is shown the price regarding the product (screenshot 4). As future work and consequent developments, the prototype features are expected to put into action the reservation/purchase facilities.

5. Conclusions

LBMS are promptly arising and on the way to become part of everyday routines, and this is mainly due to the fact that they offer contextualized real-time services, meaning an unquestionably help and a promising future assistance in the context of both professional and personal lives, through one's own ever-present mobile device.

The system as proposed in this article comprises a whole new way through which users may indeed search and obtain information about products/services sold in their geographical proximity, providing an effective interface skilled at obtaining structured, focused and timely information, which, so far up to present, is not possible to achieve by any other means with similar efficiency. Therefore, we strongly believe and support that the system we have been studying and describing absolutely represents a new and ultimate step in the context of LBMS systems.

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