Mobile Electronic Guides for the Masses: Optimizing Tourists Mobile Devices

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Abstract:
The use of wireless networks in mobile tourist applications has brought about many services that have been branded "necessary" in many research projects. Though, latest Eurobarometer findings argue that tourists are reluctant in using such services, arguing that high costs of roaming are the major deterrent factor. This paper presents the design issues and implementation of a context-aware 'mobile tourism' research prototype, which brings together the main assets of the Internet and mobile computing technologies. Namely, by using Internet web technologies it enables the creation of personalized portable tourist applications with rich content that matches user preferences. The users may download these customizable applications to their mobile device. Thereafter, network coverage is only an option as the applications execute in standalone mode.

Keywords: Mobile tourist guide, context-aware, social networks, Bluetooth, web technologies, J2ME, XML.

1. Introduction

Tourism is an industry which has adopted the use of new technologies. Computer science is connected with various tourist services (e.g. electronic tourist guides, digital interactive maps, tourist e-commerce transactions) mainly delivered via Internet. The Internet is a medium which is well tried and tested on many successful business models related to services provision Recently the term 'Mobile tourism' has come into the spotlight. This term represents a relatively new trend in the field of tourism and involves the use of mobile devices as electronic guides and maps.

Mobile devices present many unique characteristics that makes their use as electronic tourist guides particularly attractive, such as:

- ubiquity and convenience: mobile devices are portable, ubiquitous devices that come in many shapes and forms. There are various categories of mobile devices (i.e. Ultra Mobile PCs, Tablet PCs, PDA, Smart phones and Mobile phones). Even though there is a convergence of portable computing devices

[Kray et. Al. (2003)], mobile phones are still the most widely employed ubiquitous computing device readily available to tourists;

- positioning: by employing technologies like GPS and/or beacons (i.e WiFi, RFid, IrDA, Bluetooth) users may receive and access information and services specific to their location [Varshney (2003)];
- personalization: unlike PCs, handheld devices are typically operated by a single user, thereby enabling the provision of personalized services by wireless web portals [Ho (2003)].

However, several restrictions of mobile computing need to be carefully evaluated by tourist service providers: restricted energy capacity, limited computing power, amount of memory and storage space; small display size, limited color and font number support, small and hard to use keyboard (without the use of a stylus for most phones); limited bandwidth and high cost of wireless connections [European (2006)]. Admittedly, although the capabilities of the mobile devices increase, the 'resource gap' between mobile and stationary devices will always be there.

Most existing commercial applications and research approaches in the field of mobile tourism basically fall within three main categories [Cheverest et. Al. (2000)] that involve:

- navigational assistants, tourist or museum guides with pre-installed applications, namely rigidly defined content (in text, visual and auditory format) that cannot be customized according to user preferences (e.g.[MycityMate (2006)], [Micha et. Al. (2005)]);
- mobile devices that access mobile web portals, to browse or to update content (e.g. [iNav (2006)][Schwinger (2006)]);
- mobile electronic guide devices with content that is updated via external devices(i.e. beacons or GPS) when the user is in range of the tourist attraction [Anegg et. Al. (2002)][Cheverest et. Al. (2000)][Oppermann (2000)] or via mobile network connections [Anegg (2002)] to access context-aware services .

The first approach presents the weakness in which the content of the mobile application can not be easily changed or dynamically updated, giving users content or map data that may be outdated. This is much in line with weaknesses of paper guides and paper maps. The second approach implies the use of a mobile or wireless network to access Internet resources to portray information to tourists or to update information at regular intervals. This approach requires constant connection (airtime) of the mobile device with a mobile network to offer access to web content. Similarly, the third approach assumes some type of network connection and tracking systems (e.g. GPS or beacons) to provide location-based services. Recent European survey results show that current roaming charges are a major factor that prevents tourists from using mobile phones while abroad [European (2006)]. A high 81% of people questioned

stress the high cost of roaming makes phone usage prohibited while on vacation. From these survey results, it is argued that the use of airtime is not a preferred solution to the majority of tourists at this stage. Yet, network connection must be left as an option to users who wish to benefit from services provided via a network connection. High costs and user ignorance of costs are an issue which are not addressed in most research projects.

Indeed a WiFi infrastructure installed in a city would represent a fair solution to this problem. Two main issues arise from this solution [Brown et. Al.(2005)]. Currently, only a few mobile devices have the ability to connect to a WiFi network and currently WiFi coverage is not available to all cities, much less to small tourist cities such as those found in Greece. Another alternative which was researched is the use of Bluetooth technology. Most mobile phones today come with a Bluetooth communication port. Bluetooth connectivity is used to form a social network among tourists in the near vicinity to share content [Rudström et. Al. (2004)]. In this context, 'sharing' implies that users have the ability to input such content and that the content is available for sharing when users are in the vicinity of each other [Axup et. Al.(2005)].

This paper presents the analysis and design of a mobile tourist guide system and also its implementation in a prototype system, the myMytileneCity guide. The prototype includes a database-enabled tourist website which can be viewed from the internet via a PC (or a mobile browser). Tourists at the 'pre-visit' stage, planning to visit the city of Mytilene (Lesvos Island, Greece) choose content of personal interest (lodging, sightseeing, entertainment, etc.); based on that chosen content, the user is prompted for his/her mobile phone model, in which the prototype system dynamically generates a custom application, which operates on the users mobile phone. On a second stage, the users having received an SMS message, may download their application directly from their mobile device, or download to a PC and then to a mobile phone (through cable, infrared or Bluetooth). In contrast to applications that presuppose continuous connection to the service provider's network, the myMytileneCity guide does not pose such requirement. Following installation, the application is fully functional with no extra charge, even in places where the connection to the mobile network is not feasible.

2. Mobile phone design Issues

Designing for limited mobile platforms presents unique demands over designing for larger devices. The number of dedicated mobile phone applications are still few. Thus, users can not easily draw on past experiences in the use of such applications [Dunlop et. Al. (2002)]. Unlike PDAs, the majority of the mobile phone applications are downloaded over-the-air (OTA). This implies a lack of user manuals or "getting started" cards, long installation times and -possibly- high download cost. Mobile phone devices in general have less processing capabilities than PDAs. Hence,

applications targeting mobile phones need to be highly optimized and customized to meet a broad range of user and devices requirements.

There are several design issues that differentiate the requirements mobile phone applications and PDAs. The major differences between PDAs and mobile phones is currently screen size and the use of a stylus pen for input. For the design of mobile applications, one must consider the limited screen space the mobile phone has to offer and the limited input accessories which are available [Holtz (2005)]. The up springing of high end mobile devices has seen the use of larger screen sizes and some with stylus inputs (i.e. Sony-Ericsson P910), which however still represent the minority of the market share of mobile phone owners. Designers of mobile phone applications have to consider three main categories of screen sizes when designing applications [Holtsblatt (2005)], unlike PDA where standards in screen sizes do not vary considerably.

Assumptions of tourist behavior is based on literature review of Brown et al [Brown et. Al. (2003)]. Their work presented an ethnographic study of city tourists' practices which drew out a number of implications for designing tourist technology. According to this study a mobile tourist application should:

- make use of map for "location" findings. Apart from the use Points of Interest (POI), maps usage should offer the ability to show 'social zoning' (i.e. Location of café areas, swimming areas, good reading areas. etc.). Offering users to know where things are along a route of travel.
- include a pre-visit stage. The previsit stage offers the user information on what to do, tying it with how they can do activities (cultural barriers. avoid exploitation).
- have tourist content that is complete which should have information on when to do activities (tying what to do with when .i.e. opening times, times for best visit ,pre-booking, etc)
- should allow users to share experiences with others (at home or during the journey). This is generally recognized as the post-visit stage.

All these factors charge mobile application designers with new challenges, such as:

- design for mobility
- design for a wide user community
- design for limited input/output facilities
- design for providing information based on the user location
- design for user multitasking at levels unfamiliar to most desktop users

In this case, the users are tourists who are visiting the city of Mytilene. It is assumed that these tourists are familiar with the use of a mobile phone. This type of user will be highly mobile with little time to plan upon arrival. The system will make use of the

Internet (at the previsit stage) to allow tourists to personally configure their mobile guide according to personal preferences and mobile device technical characteristics (i.e. low end mobile phone will not have the option of audio). Users will be able to subscribe to the website to be notified of new content which is of interest to them. Upon arrival users shall want to have content readily available to them, yet have the ability to update content at any given time. Plans also exist to have info kiosk Bluetooth hotspots situated at the airport and the local tourist office. A map must be included to show all POI positioning and will make use of GPS to notify user once in the vicinity of a given POI. The map will also include areas of social zoning (i.e. café and restaurant zones). Input modalities (at this stage) will only include keyboard and soft keys of mobile phone.

3. The MyMytilene System Architecture

The design of the tourist guide application follows a two-step approach: On the first step, the user interested in a particular tourist destination visits a web site including information about restaurants, accommodation, sightseeing, events, night life etc. The user appends information of personal interest to its 'web suitcase' (abstraction of personal account) which may be stored and retrieved upon a future visit. The user is not obligated to create a personal account but it is suggested to create a personal profile which is used for recommendations from the system. When the user 'checks out', the suitcase's content is transformed to XML format. Following that, the system automatically generates an application (to be executed on the user's mobile phone) incorporating the selected XML-based tourist content (see Figure 1).

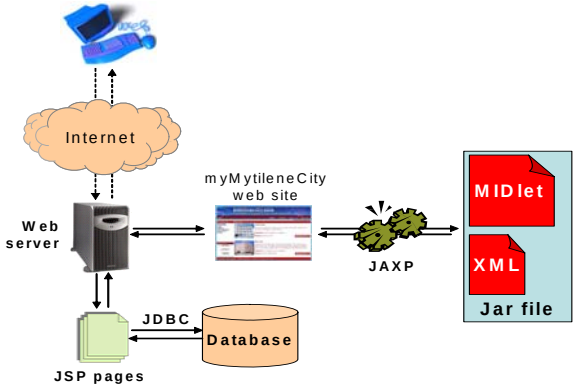

Figure 1. *Dynamic generation of a J2ME application through remote interaction with myMytileneCity web site.*

The web site has been designed so as to resemble e-commerce web sites. In the future, we plan to develop a 'parallel' mobile portal that will enable access to (i-mode/WAP/J2ME-compatible [Gavalas (2006)] mobile devices to remotely browse tourist information.

The MyMytilene mobile prototype implementation is based on the Java 2 Microedition (J2ME) platform released by Sun Microsystems [J2ME (2005)]. J2ME is a version of Java used for developing applications that can run on a consumer wireless device platform (like a PDA or mobile phone). J2ME applications are called MIDlets, and are packaged in *.jar files. They inherit the main assets of the Java language (i.e. platform independence, etc) and are supported by the majority of the mobile phone manufacturers . However, MIDlet programming has a steep learning curve as it requires Java development skills.

On the second step, the user downloads the generated jar file (temporarily saved on the web server) to its mobile device. Herein, the user is provided three options:

1. having received an SMS notification (including a link), the user downloads the application directly from the web server.

2 directly download the jar file to his/her mobile device (through end-to-end HTTP); depending on the jar file size this may be a time-consuming and costly solution as it engages the wireless channel for relatively long time.

3 download the jar file on two phases: first to a PC/laptop (though HTTP) and then to the mobile device (through Bluetooth or infrared); although separated in two phases, this method is usually more cost-effective and fast as it takes advantage of the higher transfer rates of the wired Internet and the wireless Bluetooth protocol.

Upon completion of the jar file download to the J2ME-compatible device, the latter is installed and loaded by the local AMS module (integrated within the J2ME platform). The MIDlet application is thereafter executed in standalone mode with no wireless connectivity requirement (upon request the user has the ability to synchronize to the backend system only to update the originally selected tourist content). On the client tier, we have designed a user-friendly map application that allows easy browsing of selected content; the latter is included within the downloaded jar file (in XML format).

The following figures present various parts of our prototype usage. Figure 2 illustrates representative screens of a mobile device emulator. Figure 1 (a) shows Points Of Interest which are located on a map. The user may selected to read the content of the selected icon. In a another view (b) an index menu is shown where a list of lodging preferences (c) and the (d) (e) a detailed description of a selected hotel. It is noted that the application's index menus and POIs are created dynamically. Specifically, the MIDlet first extracts the XML file from the jar file. Then it parses the XML code to dynamically build the index menu; for instance, the option 'Accommodation' will not be displayed in the index, unless the user has selected at least one hotel of interest.

(a) (b) (c) (d)

Figure 2. *Screens of a mobile phone emulator executing the myMytileneCity guide application.*

The tourist web application design also incorporates a 'push' content service. This service involves automatic user notification and dynamic update of the applications with content inserted into the database after the user has pre-selected his initial content preferences. The application update is completed with minimal user intervention.

To illustrate, let us assume that a user is particularly interested in a specific content type, e.g. music festivals. While surfing the myMytileneCity web site, it is likely that no content exists for this content category. The user then subscribes (registers) to the 'push content' service. In particular, the user fills in a form the content categories he/she interested in and also the exact period of visit (arrival and departure dates).

Upon the registration's completion, the server forks a dedicated thread (monitoring agent, MA) that periodically checks the database for new content. The MA is stationary and its lifetime depends on the 'interest period' defined by the user (i.e. the departure date from the tourist destination). On the event of having new information added by the web site administrator matching the subscribed content type (e.g. the arrangements for a music festival have just been finalized), the MA creates XML code with the description of the added content item(s), stores the XML file in the database and notifies the mobile subscriber through an SMS message. Although the added content's description is included in the SMS, the user is given the option to update his/her application with the new content items. In the latter case, the XML file may be downloaded either directly or through a PC; of course, the application's Java class files and the graphics do not need to be downloaded again, hence, the cost of update is minimal. The XML file is removed from the server's file system when downloaded or after a specific timeout period elapses.

4. Conclusions and Future work

According to a tourism expert and New York University Professor, Hannah Messerli, mobile tour guides will not replace tour guides or guidebooks, but they could help places that do not yet have plethora of guidebook documentation [Wired 2006]. Our perception is that mobile tour guides can be more vivid, immersive, enriching and exciting than books or live tours. This perception though is based upon future advancements in the field such as: further deployment of 3G networks (increased data rates, reduced cost of network connections); the upcoming of new services to change peoples' perceptions of cell phones (i.e that devices can be used for entertainment rather than solely for talking); the upcoming of new devices with increased capabilities (i.e support of Java by virtually all mobile devices); the overall cost of continuous network connection of mobile devices to the telecommunications operators network decrease.

In this paper a J2ME-based 'mobile tourism' research prototype has been presented. The main design objectives have been:

- to enable the automated creation of portable, personalized tourist applications (optimized for the specific user mobile device's model) with rich and customized content
- to minimize the wireless connectivity requirement of the mobile tourist guide application user (following the application's download and installation, network coverage is not further required as the applications execute on standalone mode, users should return online only to update their chosen tourist content)
- to cater for future dynamic application updates based on a 'push model', wherein new tourist content is pushed to the mobile terminal with minimal user intervention as soon as it is added by the administrator to the back-end database.

Regarding future work, the following directions are going to be studied:

- the design and implementation of Info kiosk incorporating a Bluetooth access point. The use of Bluetooth will be incorporated in these hotspots to allow users to update content of interest.
- use of the optional MIDP 'Location API' [JSR (2006)] which has been very recently released by Sun Microsystems to extend the tourist guide application so as to provide orientation, navigation and other location-based services (e.g. notifying the user when he/she walks next to a selected landmark)
- design and implementation of algorithmic solutions (that take into account several parameters such as the user profile, the period of stay, the whether conditions, etc.) for suggesting near-optimal, daily tourist itineraries for tourists interested in visiting a specific set of sites (e.g. museums, archeological sites, parks, zoos, etc.).
- design and implementation of a mobile peer-to-peer based framework using the JXME platform [JXME (2006)] for tourist-to tourist communication, in order to

bypass the need for downloading content via mobile carriers networks where charges apply. Currently, a study of the use of social networks which allow users via Bluetooth, to "share" content among themselves offering the ability for collaborative filtering of content is on hand [Axup (2005)].

As our research unfolds we are constantly following these technology advancements and incorporating them in our overall work.

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