

Mobile HolstenTour: Contextualized Multimedia Museum Guide

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ABSTRACT

Modern museums provide visitors with mobile, context-aware information and guidance systems. Unfortunately, these systems often suffer from several technological drawbacks: expensive infrastructure, complex maintenance and content modification, difficult to learn user interfaces, manual location specification requirements, etc. Visitors have to rent, learn, carry and return yet another mobile device. On the other hand, most modern nomads already own high-performance mobile devices: smart-phones. But acceptance to install museum software on a personal device is rather limited. In this paper, a novel mobile, context-aware museum information system is introduced that runs on the visitors' mobile phones without any prior installation. We outline the technical principles of the underlying Medient infrastructure and present HolstenTour as an example service instantiation for the famous Museum Holstentor in Luebeck, Germany.

Categories and Subject Descriptors

H.5.m [Information Systems]: Miscellaneous

General Terms

Management, Experimentation, Human Factors.

Keywords

Context-awareness, Ajax, Bluetooth, Museum, Tourguide

1. INTRODUCTION

With the advancements in mobile, pervasive and ubiquitous computing and the growing number of other edutainment possibilities, museums are looking for ways to create new, more engaging experiences for their visitors. Museums are one of the best environments to apply and test new interactive applications with mobile devices, since museum visitors can be seen as "mobile users without precise goal and with the need for context-dependent information" [4], and museums usually have lots of unused digital information available [9].

Mobile devices could be used to provide different types of media-rich information to users. Most current implementations offer

context-dependent information based on location [8], which can be identified in in-door museums either as the exact location of a person in relation to a museum exhibit or the general location of person in relation to a museum room [4]. Various technologies can be used for location-tracking such as Bluetooth, Infrared or Radio Frequency Identification (RFID).

A number of mobile multimedia applications for museums and infrastructures enabling mobile multimedia in museums are introduced here. The e-Wallet project [3] is a museum tour guide that adapts according to the individual interests and contexts of a visitor and allows for sharing museum experiences. It is implemented around a semantic web framework and a semantic web rule reasoning engine. Context is gathered through RFID and motion sensors and visitors are equipped with a PDA to interact with various applications. COMPASS [10] is a tourist application that adjusts its services according to user interests and current context. The system is based on a recommender system integrated with a context-aware application platform. COMPASS tracks the location of a user by using the mobile network or GPS technology (out-door location tracking). A clickable map with user's location, surrounding buildings, buddies and other objects is displayed to the user (on personal mobile device) depending on his/her profile and goal. Interactions include calling a buddy, finding museums nearby, etc. MUSE [5] is a framework for building applications that provide multimedia content and services through multiple channels. The platform is comprised of a number of stationary and mobile devices, which are connected either by cable or wireless connection. A wearable device called WHYRE is used to control on-site stationary applications. WHYRE has multiple sensors to enable context gathering for navigation and providing information. User location is detected based on WLAN access point signals. MoMo [7] introduced the concept of hybrid museums - mobile devices such as PDAs are deployed to serve personalized digital content to users in order to enhance the edutainment experience. In this project a full-scale infrastructure for museums was implemented with the .NET framework. Applications running on the infrastructure enable museum visitors to explore data on museum items, interact with other visitors, etc.

Although all these examples have technically varying approaches, they all require either pre-installation of respective software on

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the users' devices before the museum visit (COMPASS) or equipping users with new devices during the museum visit (e-Wallet, MUSE, MoMo). But the user acceptance to install unknown software on a personal device is rather limited. Established cultural institutes like museums will achieve a higher level of trust; nevertheless most visitors will avoid the additional overhead of setting up software on their own device or learning to interact with a new device while starting their museum tour.

In this paper we therefore avoid both approaches and offer context-based, location-aware media services on users' private devices without any prior installation. We outline the technical principles of the underlying Medient infrastructure and present HolstenTour as an example instantiated Medient application for the Holstenor Museum in Luebeck. In general Medient infrastructure is based on wireless networks similarly to the UbiqMuseum infrastructure introduced above.

2. SYSTEM ARCHITECTURE

The HolstenTour system is based on Medient, a service oriented architecture using web services in an event-driven approach [1]. Core concept of Medient is the use of reverse AJAX [6] and standard communication technologies like Bluetooth to realize context-aware push services on mobile devices without any prior installation of proprietary software. AJAX-enabled browsers on smart phones automatically show dynamic web pages triggered through context events (e.g. changed location). This decreases the computational load on the client device and reduces traffic load in the network.

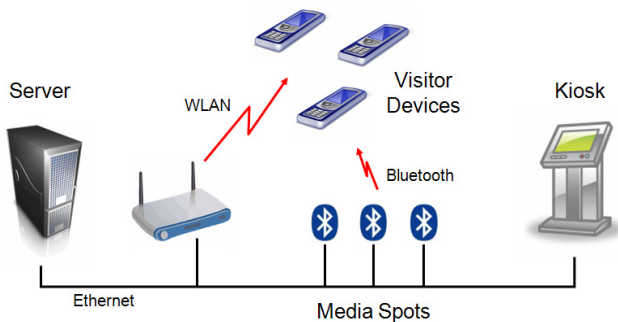


Figure 1. System Architecture

The HolstenTour instantiates the Medient concept with a setup of connected components (Fig. 1):

- A web server is hosting a set of web pages presenting different exhibition items in specific locations of the museum and running the HolstenTour Reverse Ajax implementation which keeps track and manages all active AJAX-based web applications running on the visitors' mobile clients.
- "Media Spots" are small Bluetooth scanners which are used to detect nearby Bluetooth devices. The media spots are located at important exhibition locations and update the detected visitors' devices with specific content for the respective location.
- At the entrance of the museum, a welcome kiosk equipped with a touch screen is running a multimedia rich application. Visitors get introduced to the concept and can familiarize themselves with the different

available rooms through maps, videos, audio and messaging.

- All media spots, kiosks and visitor devices are controlled and connected via Medient server through AJAX and SOAP communication.

The communication with the mobile devices is realized by combining WLAN and Bluetooth. WLAN allows for high bandwidth content channel and online streams. The Bluetooth radio signals are used for near-by device detection, local data transfer, and messaging using the Object Exchange (OBEX) Protocol. Moreover, all Bluetooth equipped Media Spots are using XMLHTTP requests to announce any newly found visitor device to the web service. The reverse AJAX technique is used to push information and control the mobile client remotely.

The HolstenTour application does not require any special installation, and potentially runs on any mobile device that hosts a web browser with AJAX support. We used Dell Axim v50 PDAs for testing and later upgraded to Nokia N95 mobile phone handsets.

Once the scanning media spot assigned to the welcome kiosk detects a new user mobile device, a message is being sent to the server. This information triggers the input mode of the terminal through continuously receiving requests of a dedicated web service. Hence, the visitor is able to navigate through a virtual presentation of the museum. As soon as the visitor finishes the tour selection, the selection is automatically updated in the database using SOAP. Afterwards, the server sends a Bluetooth bootstrapping message via the scanning media spot to the mobile client. When the message is opened by the user, the mobile browser is automatically directed to the HolstenTour web application. While the visitor is touring inside the museum, media spots are able to detect and update the visitor's location and report it to the server. The client side AJAX-request on the mobile device browser recognizes the change and automatically requests the new address assigned to the actual space, hence the played content on the mobile client corresponds to the current location of the user in the museum.

3. INTERFACE DESIGN

At the entrance of the museum, an interactive application on a touch-screen equipped kiosk welcomes the visitors, which can place their mobile devices on an indicated area (equipped with a hidden Bluetooth sensor) and select aspects of the exhibition that they find interesting.



Figure 2. Kiosk at Museum Entrance

Elements exposed in different rooms or areas of the museum have been contextualized in the real city and allocated graphically on an interactive map, in order to make the selection process more meaningful and easier for the user (Figure 3).



Figure 3. User Interface on Kiosk

The touch screen enables visitors to select the elements of interest by pressing on them. This triggers a video, which depicts the journey from the museum to the place where the element is to be found in reality, illustrating the relation between the exhibit topic and the corresponding location in town (Figure 4).



Figure 4. Video Illustrating Exhibition

At this stage, the visitors can compose their own tour guide by adding the selected elements to a bar at the bottom of the screen. A “Finish Selection” button takes the visitors to the final step in the selection process, where the chosen elements are mapped to the mobile device placed on the kiosk. An SMS is sent to the user via Bluetooth and by accepting the message, the mobile device browser is redirected to the customized museum's information portal page.



Figure 5. User Interface on Mobile Device

The focus of the service then moves to the mobile device, where a map of the museum's inner structure is displayed (Figure 5).

The rooms containing the selected elements are depicted with the same icon that identifies the corresponding items in the kiosk interface, establishing a visual connection between both parts of the service. The spatial metaphor of the map used again in the mobile device is intended to provide the visitors with an orientation tool that allows them to navigate the physical museum according to their preferences (Figure 6 Left). When the visitor moves from room to room, dynamic content is displayed in the form of web pages with embedded sound and textual information that change according to the location of the visitor in the museum (Figure 6 Right).



Figure 6. Left: Navigation Map. Right: Multimedia Presentation on Exhibition

4. CONCLUSIONS AND FUTURE WORK

The prototype of the HolstenTour project was implemented and tested at the ISNM campus. By using the Medient infrastructure, we were able to support a museum tour guide on mobile phones without prior installation. The functionality of the system was validated with a setup of some examples rooms equipped with Media Spot device detectors. Response times of the systems were sufficient to generate a fluent walk through the simulated museum with error-free media presentation on the triggered web pages. Since the system is tracking the user devices individually, multiple users could have been supported at the same time.

The HolstenTour application has demonstrated the capability of the system to afford the use of context aware mobile multimedia applications and services without requiring the users to worry about installations of any kind or acquisition of extra devices. The map presented on the mobile device acts as a tour guide and at the same time offers multimedia information about specific items. The support of audio content allows the users to direct their attention to the exhibits while visual and textual explanations enable them to review missed details. In this way, museum visitors can focus on their preferred exhibition objects as they browse the museum in a desired sequence of rooms and exhibits.

The current instantiation of HolstenTour is just a starting point and many more services could be incorporated, including more detailed levels of information, ranking services, bookmarking features, etc. We are currently working on an enhanced version for the cultural foundation in Luebeck and planning to offer the system to the museum visitors to get more experiences in a real trial. With the experiences gained in the prototype developed, we are confident, that the system could provide an enhanced museum visit while avoiding the common problems of proprietary installations.

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