MOBILE LOCALITY-AWARE MULTIMEDIA ON MOBILE COMPUTING DEVICES

A Bluetooth Wireless Network Infrastructure for a Multimedia Guidebook

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Abstract: This paper describes the implementation of a Bluetooth Village Guide Book (VGB) scenario for use in the Kelvin Grove Urban Village located in Brisbane, Australia. An Information Point Station Network (IPSN) was developed, along with software for two types of mobile computing devices. The implementation consists of several Information Point Stations (IPSs) placed at locations of significance, with access to information items on a centralized server. Once a user is registered on the network, he/she is given the opportunity to experience context- (and eventually user-) aware information on demand and in various multimedia formats. These information items are selected by the user, either by way of a menu system appearing on their mobile computing device or a more intuitive pointer-tag system. Information items are then 'beamed' to the user's mobile computing device for the user to view. Bluetooth was selected as the medium of choice due to its prevalence on most modern mobile computing devices such as Personal Digital Assistants and mobile (cell) phones. This fact, coupled with the nature of Bluetooth communications lacking the requirement for line-of-sight meant users could retrieve location-aware information at the "locality" level. The implementation was found to be successful and was tested with multiple users accessing information items from a given IPS as well as multiple IPSs attached to the centralized server. Still, there is further work to be done on the VBG software, the user-registration system and on creating an embedded solution for the individual Information Point Stations.

1 INTRODUCTION

In recent years, the development of sophisticated mobile computing technology has lead to the widespread usage of mobile computing devices (MCD) such as mobile phones and personal digital assistants. This has lead to new ways in which people can access and share information. The sophistication of MCDs has also lead to the development of mobile multimedia services and communication features. Applications such as web browsing and game playing are now common features on mobile phones. The Connected Communities Project associated with the Australian Centre for Interactive Design aims to build an information communications technology infrastructure that allows residents in a community to share general information about their environment using MCDs.

This paper presents an application by the Connected Communities Project to develop a Multimedia Guidebook information system for use in the Kelvin Grove Urban Village (Kelvin Grove Urban Village Webpage), located in Brisbane Australia. The Multimedia Guidebook information system allows the user to access specific information related to their immediate surroundings. Multimedia Guidebooks are commonly used in museums and other tourist facilities. The information accessed can be images, audio or text. The guidebook also has

authoring features which allow the user to leave text comments related to their location. These comments can be viewed by other users at that location.

The multimedia guidebook system implementation consists of information point stations (IPS) placed at specific locations of interest. A point of interest can be a monument, a building or any article of significance. Each information point station contains media information relevant to its location. The user can use their personal digital assistant (PDA) or mobile phone to access media information stored in an information point station. The transfer of media information between the IPS and the user's MCD is facilitated using the Bluetooth wireless communication protocol. Bluetooth was chosen as the transfer medium due to its availability on most MCDs. The type of media material transferred includes text, images and audio formats.

Another interactive method of selecting information from the guidebook was also developed. It consists of a pointer and tag system that allows the user to select to view information without using their mobile computing device. The user selects the information to be accessed by aiming a pointer at a tag.

This paper is organized into 6 sections. Section 2 presents a review of related work. Section 3 describes a typical user scenario. Section 4 discusses the implementation of the multimedia guidebook network infrastructure. Future areas of investigation are discussed in section 5 and conclusions are drawn in section 6.

2 RELATED WORK

Multimedia Guidebooks can be found in museums and other tourist attractions. Usually guidebooks support only audio information but there are projects to develop more sophisticated guidebooks. An Example is the Exploratorium (Hsi 2002) was developed for an older PDA platform. No guidebooks have yet been developed for the latest smart mobile phones. Existing guidebooks tend to use older short-range wireless protocols such as infrared communications. Infrared has been surpassed by Bluetooth (Bluetooth SIG) in many applications because it does not require line of sight, supports ad-hoc networking and has more robust data communications.

The Exploratorium guidebook provides the user with information about exhibits in a museum. The Exploratorium guidebook deploys Radio Frequency ID (RFID) beacons, 802.11b wireless LAN and HP Jornada PDAs. When a user with a PDA comes within range of an exhibit that has a RFID beacon, the beacon's ID is sent to the PDA via infrared. Information about the exhibit is requested by the PDA and the result is returned via the 802.11b LAN.

Pointers more commonly known as remote controls are used in everyday life to control devices such as television sets. Pointers can be classified in terms on the communication medium used. Most commonly used pointers use infrared. There are projects to develop pointers that use laser light. One such project described in (Ringwald 2002) developed a laser pointer linked to a PDA so that it can control devices remotely. So far pointers have not been used with guidebooks or other applications that require the user to select information.

3 USER SCENARIO

The scenario of a Multimedia Guidebook gives the user the opportunity to experience context-aware information on demand in various multimedia formats. Typical interaction between a user's mobile computing device and the Information Point Station Network (IPSN) involves 3 major processes: a registration process; a connection and requesting process; and an online-authoring process.

Before being given access to the IPSN, a user is required to register and download the Village Guide Book (VGB) software onto their mobile computing device (MCD). The user is assigned a unique User Identifier (UID) which is used to authenticate the user when access to the IPSN is attempted. It is envisaged that this registering process could also involve the setting of personal viewing preferences to further adapt the user's experience of the information available from Information Point Stations (IPS).

As the user roams around the Kelvin Grove Urban Village site, he/she may choose to access the IPSN when approaching a point of interest near an IPS, at which point, the user will run the VGB software on their MCD. Once the software has established a connection to the IPS, the user is able to browse a menu of information items related to that point of interest. An example of this menu system is shown in Figure 1a). When the user selects a menu item, the corresponding information is downloaded wirelessly from the IPS and seamlessly executed by the MCD. Information items can be audio, text or image files. Once the user has finished using the IPS, the VGB software will disconnect from the IPSN.

Figure 1: a) Menu Browser on the IPAQ – b) Pointer prototype – c) Tag prototype

Figure 2: IP Station Network. (M = Mobile Device, P = Pointer, T = Tag, IPS = IP Station)

The other method that a user may employ to access information from the IPSN is by way of a pointer (Figure 1b) and tag (Figure 1c) system also developed for the purposes of this scenario. This pointer-and-tag system allows the user to point to the specific information they require, without the need of connecting to a particular IPS and searching through a menu for the information they require. The pointer is attached to the MCD, and the user intuitively points this to the tag associated with the information they would like to view. The user's experience of an information item once it is downloaded via Bluetooth is the same regardless of how the user selected it.

The final process in the user's interaction with the IPSN, is the process of online-authoring. This is the process whereby a registered user can request and view a piece of information and comment on it for the benefit of the rest of the community for the purpose of establishing a dynamic repository of personal annotations and recommendations. Currently, the VGB software offers the possibility for the user to upload a textual comment for any viewable item. This notion of online authoring could be extended to accept photos or other multimedia information from MCDs.

The goal of offering context-aware information is achieved by ensuring that information retrievable from a given IPS pertains to local sights, important nearby artefacts, or tagged items located physically near the IPS.

4 IPSN INFRASTRUCTURE

The Multimedia Guidebook system implementation consists of information point stations (IPS) placed at specific locations of interest. Each IPS forms part of
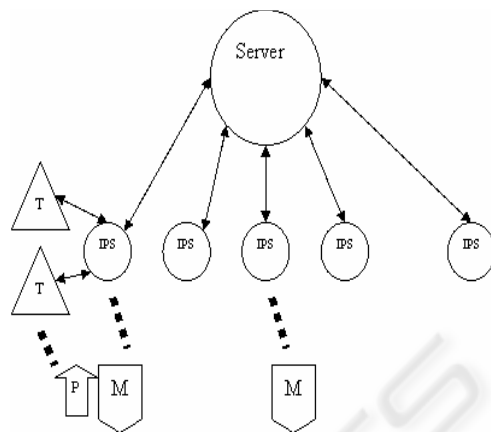
an Information Point Station Network (IPSN). The IPSN is shown in Figure 2. The IPSN consists of a central server, information point stations, mobile computing devices and pointer-tag system.

The Bluetooth serial port and Object Exchange File transfer (OBEX-FTP) profiles are used to connect the MCD and the IPS. The serial port profile (SPP) functions as a control channel. A specialized control protocol was used to request information from the IPS. The OBEX-FTP profile is used to transfer files from the IPS to the MCD. An Ethernet connection is used to connect the IPS to the Server. The tag system is connected via conventional RS232 to the IPS.

The server controls the IPSN. It communicates to each information point station (IPS) via Ethernet. The server monitors each IPS and controls its user database. Each user database contains the user Identifiers (UID) and preferences of all registered users. The server consists of a Linux computer with an Ethernet hub.

Each IPS contains a wireless Bluetooth transceiver and may also connect to tag devices. The Bluetooth transceiver is used to communicate to the mobile computing devices. The IPS will authenticate the user and supply the requested information items via Bluetooth. The current implementation of the IPS is a Linux computer with a wireless Bluetooth USB Adapter. The open source Linux Bluez Bluetooth stack (Bluetooth Z Webpage) is used to facilitate the Bluetooth connectivity to the mobile computing device.

The mobile computing device can be a PDA or a mobile phone. The MCD software allows the user to browse for information items and initiates the connection to the IPSN. The user's experience of media information such as images, text or audio is achieved by using the corresponding viewers or audio players on the MCD. For example, if an image

was to be viewed, it would be opened using the onboard software image viewer. All viewers were either integral to the MCD, or freely downloadable.

The MCD software was implemented on a HP IPAQ 5550 PDA running Pocket PC 2003 and a SonyEricsson P910i SmartPhone running Java 2 Microedition (J2ME) (MicroSystems). The IPAQ MCD software was also integrated with the pointer-tag system by connecting the pointer to the MCD through an RS232 serial port in order to set the UID used by the pointer to request tagged items.

The pointer was implemented as an embedded solution using a microcontroller and a custom laser transmitter. The pointer was designed to a have a low physical profile in order to make it less obtrusive to the user. The tag was also implemented in a similar manner to the pointer except that it employed a laser detector to determine when the user had selected the tag. The pointer transmits the user's Identifier (UID) to the tag. Once the UID has been received, the tag transmits a request for information instruction using a specialized control protocol, to the IPS via RS232.

5 FUTURE WORK

Although functional prototypes were created of all components of the IPSN system, some areas were highlighted for further work. Registration (both on-line and on-location) needs to be implemented, taking note of security and privacy issues. Further capabilities for public commenting, like adding photos and other multimedia as comments, are yet to be implemented.

Other areas where further work can be concentrated are with the user preferences and thus user-aware information. For the hardware, the information point stations (IPS) are yet to be converted to an embedded processor platform. An embedded IPS platform could be housed in a special casing that makes it less susceptible to environmental conditions.

6 CONCLUSION

A Multimedia Guidebook information system was created to allow users to access specific information related to their immediate surroundings using their mobile computing devices. The guidebook was designed to provide information about the Kelvin Grove Urban Village in Brisbane Australia. This village guidebook (VGB) allowed the user to view images, listen to audio and read textual information at a specific location. The VGB also allowed the user comment on a specific piece of information. Commentary could be viewed by other users that are in specific location. Another interactive method of selecting information from the guidebook was developed. It consists of a pointer-tag system that allows the user to select to view information aiming a pointer at a tag. The requested information is then viewed on their mobile computing device.

The infrastructure created consisted of information point stations (IPS) placed at locations of significance. A network of IPS units was created. Each IPS communicated to the user's mobile computing device using Bluetooth communications. The types of mobile computing devices that could be used are PDA and mobile phone platforms. The future work of this project includes developing user registration, creating embedded information point platform and improving the VGB software.

ACKNOWLEDGEMENTS

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