Informing and Socializing in Interactive Spaces: Delivering the Right Information to the Right Users

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Abstract: - The dissemination of large displays and personal mobile computing devices has created new opportunities for the joint use of these devices. Together these devices can enrich public spaces, promoting new and more engagement interaction mechanisms, giving users relevant information and providing important resources that can promote conversations and group activities. In this paper we explore the joint use of public displays and personal mobile computing devices, as equipments for the dissemination of personalized information that is delivered to users according to their interests and expectations. Three main aspects characterize our proposal. First, it encloses in the same system two types of devices for delivering information: mobile devices and large public displays. Second, the user only receives information of his interest point of view and the information is delivered through the most proper device. Third, our proposal combines into the same system two different perspectives: informative, providing users with information about their subscriptions and socializing, i.e. presenting, in a public display, information about the place, about users' interests and about interests of other people that visits the same place. We have developed and evaluate a partial prototype based on those principles. The results show that the system is easy-to-use, that it can support a wide range of activities and that the users recognize an added value of the system comparing to traditional approaches.

Key-Words: - information systems, interactive spaces, personalization, personalized information.

1 Introduction

The advent of ubiquitous computing and the dissemination of large displays and mobile computing devices have created new opportunities for the joint use of these devices. The emergence of these new opportunities led to the recent growth of several innovative applications using these devices, which currently can be found in numerous public places like airports, malls, train stations and many others.

The combination of public displays and mobile computing devices, such as mobile phones or PDA, lets foresee a range of novel applications that can go far beyond what is supported today and that is essentially in using these displays for advertising or broadcast some information of local interest. Together these devices (public displays and mobile devices) can enrich public spaces, promoting new and more engagement interaction mechanisms, providing users with relevant information and providing important resources that can promote conversations and group activities.

In this paper we explore the joint use of public displays and personal mobile computing devices with Bluetooth as devices for the dissemination of personalized information that is delivered to users according to their interests and expectations. The system is used with two main goals: informing users with relevant and appropriate information according to their profiles and promote socialization presenting, in a public display, general information that reflects the interests of users that share the place which are exposed to the system through the Bluetooth functionality of their mobile devices.

The remainder of this paper is organized as follows. In the following section we look at related work and how other researchers have also explored large public displays and mobile computing devices to inform and promote socialization. In section 3, we look in more detail into the concept of informing and socializing and expose the main characteristics of our system. In Section 4, we describe the software infrastructure to improve information and socialization in public and interactive spaces. In Section 5, we describe a partial evaluation of the system. Early results show that users found some advantages in this system comparing to traditional approaches and that this system can effectively support a wide

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range of activities for people. Finally, in Section 6 we present our conclusions and outline some of the future work.

2 Related Work

To provide a background, we will first survey existing work on systems that take advantage of the potential of personal mobile devices that people use in their everyday life to interact with other computing devices such as, large displays in public spaces in order to improve access to personalized information and promoting socialization.

The Campus News [1] is a Bluetooth-based mobile information network for distributing personalized Information. The information which will be sent is filtered by the mobile device according to a profile set by the user. Users have the opportunity to build their individual interest profile. Two different kinds of frontends were implemented, one for each group of users. One is the administration interface for the users which want to offer the information to the public. The second is a user interface for students. After logging in with the campus wide student login credentials the type of mobile phone and a target Bluetooth friendly name have to be selected and then interests can be selected from a tree menu.

BlueZone [2] presents a Bluetooth based communication service which is used to complement SMS text messaging to offer an alternative communications platform to students. It explores the use of mobile and smart devices as a platform for delivering mobile learning services and administrative information on a personalized basis. The infrastructure consists of a number of BlueZone communications servers which are able to deliver messages to handsets. To be served by the system each user should firstly realize his registration. Then each communication server continuously searches for new Bluetooth devices in range using the standard Bluetooth device discovery mechanism. If a device is detected, the server communicates with the BlueZone registration database in order to establish whether there are any pending messages for this end-user. If there are pending messages, the system attempts to transfer them via OBEX.

The BlueScreen [3] is a public display which selects and displays adverts in response to users detected in the audience. It uses Bluetooth-enable devices for identifying users and it explores history information of past users' exposure to certain sets of adverts. The main goal of BlueScreen is to select the best content to maximize exposure to the current audience and thus advertisements are preferentially shown to those users that have not seen them yet. A repetitive second-price sealed-bid auction is used as a selection mechanism to determine which advertising agent will display its advert on the next time slot. Each time an advertising has to make a decision about its valuation for the next cycle, it has two types of information on which to base its decision: i) history observation of exposed devices which were collected during the advertising cycles it won in the past and ii) the current set of detected devices which were in front of the display.

BlueBoard [4, 5] is a large display with touch sensing and a badge reader to identify individuals using the board. The onboard software acts as a thin client giving access to each participant's web-based content (e.g., home pages, project pages). The client also has a set of tools and mechanisms that support rapid exchange of content between those present. The badge's unique identifier is sent to a badge server database that authenticates the user, handing back a URL to that person's personal content. In ordinary use, the BlueBoard is intended for both very fast personal use (walk up, check your calendar, walk away), and for small group collaborative use (a small number of people stand around the BlueBoard to sketch ideas, pull up information from their personal space, compare notes, share content, create something new). When the BlueBoard is not in use by a user it show a loop of content pages that are relevant to the location (e.g. project web pages and other web sites of local interest such as home pages, the research home page, news sites, etc.).

There are many proposed systems for provide personalized information to users' specific needs. However, our proposal presents some particularities. Firstly, it combines into the same system two types of devices for delivering information: mobile devices and large public displays. Secondly, the user only receives information of interest from his point of view and the information is delivered through the most convenient device. Thirdly, our proposal combines into the same system two different perspectives: informative, providing users with information about their subscriptions and socializing, i.e. presenting in public display information about the place, about users' interests and about interests of other people that visits the same place.

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3 Informing and Socializing in Public Spaces

Information systems for public and semi-public spaces that explore the joint use of personal mobile devices and public displays had been attracted considerable interest in recent years and had been used to promote the delivering and sharing of information as well as promoting mutual experiences and socialization. The system described in next subsections was developed considering these two main goals: delivering personalized information and promote socialization.

To reach these goals the system must be aware of the users' needs and their interests and then it should be able to use this information to find and deliver, through the most appropriate device (personal mobile device or public display), the right information to the right users. To make this concept clearer in the next subsections we describe how the system gets the information about users, which content sources provide appropriate information, what an interaction zone is and how the system selects the most appropriate content to deliver to each user.

3.1 Knowing Users Preferences

In public spaces users are very limited in ways they can influence the behavior of the display, not only because of technical considerations arising from the lack of keyboard or mouse, but also because the display is public and shared. These limitations preclude the existence of direct feedback on the content presented and hinder the use of learning techniques that are commonly used in recommendation systems. This makes even more important to the system knowing the users interests, because only being aware of the users' needs the system is able to respond accurately and according to users' expectations. Thus, the system supports two distinct mechanisms for users expose their interests and thus to influence the system behavior.

Firstly, users may register in the system using a web form. Through this web site users can subscribe different groups of interest and associate to their profile their Bluetooth devices using the device address. This information is used by the system to subsequently deliver to the users only the information they are interested in.

Secondly, users can spontaneously interact with the system using keywords that specify their interests in their Bluetooth device name. These keywords are interpreted by the system and are used to search for related information within the set of RSS Feeds, predefined by the system manager, that are associated to each particular place.

3.2 Content Sources

There are two different types of sources that are used to provide content to be presented in the display and to be sent to the users' mobile devices through Bluetooth:

- Information from SIG (Special Interest Group): this information is provided by the SIG manager. This includes messages related to each group of interest. These messages are sent to users that subscribe the SIG through Bluetooth when a user was detected within the mobile zone (see figure 1). If messages are marked as public messages they can also be presented in the public display.
- Information from feeds: the system administrator is able to define a set o feeds which can be associated to each place (display zone). These feeds may represent content that is related to the nature of the place (e.g. in a technology school the system administrator may specify feeds about education, technology, jobs, institutional feeds, etc.). There are also content sources that are obtained specifically to satisfy users' requests. When users specify their interests using they Bluetooth device name the system finds, within the set of feeds defined by the manager, for related content. If there are no related content within predefined sources the system uses an API (see: http://api.destakes.com - given a particular keyword it allows to obtain a RSS feed with related content) for find related content.

3.3 Interaction Zones

The system comprises two types of interaction zones: the display zone and the mobile device zone (see figure 1).

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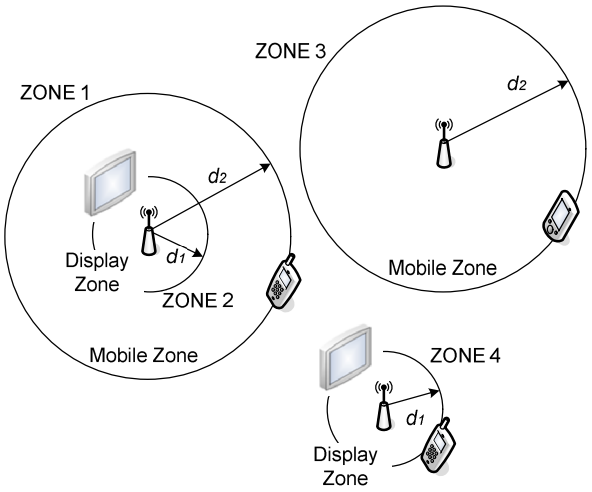

Figure 1 – Interaction zones.

Using Bluetooth scanners with different range, the system distinguishes two types of interaction zones: a mobile zone that covers a large range ($d_2 \cong 50$m) and a display zone with a Bluetooth short-range limited to a few meters ($d_1 \cong 10$m). The distinction between these two zones is very important because it is used to identify the user and his location and thus to select the most appropriate device to deliver the information.

3.4 Delivering the Right Information to the Right Users

Delivering the right information to the right users could be a complex process and involves information about users and their interests and about the characterization of the available information. The first task is to decide if each piece of information can be presented in the public display, where all people can see it, or if this piece of information is not classified as public and thus it should be delivered by the user personal mobile device. This is central to obtain a list of available content to be delivered by each device (personal device or public display). Because we use a specific software module to manage the content presented by each device type (mobile device or public display), after this attribution process each module is able to use a specific algorithm to decide what is the next content to be delivered and when it should be delivered.

3.4.1 Personal Mobile Devices

Only the information related to SIG the user already subscribed is delivered by personal mobile devices.

Every time a Bluetooth device is detected within the mobile zone the algorithm responsible for delivering this information follows the following steps:

1) Verify if it is a registered device
2) If not, goes to the end of the algorithm
3) Verify if there are new pending messages for this user (messages not yet sent to the device)
   a. Verify all subscribed SIG
   b. Verify messages state (active)
4) If not, goes to the end of the algorithm
5) Send all the messages to the mobile device
6) End

3.4.2 Public Display

Information presented in these devices includes public messages from SIG, content that is provided by the set of feeds that are defined by the system administrator for each particular place and also content triggered by the users' interactions trough keywords specified in their Bluetooth device name. To accomplish both goals the informative goal and the social goal, the display is organized in two presentation areas. One for presenting content related to SIG subscriptions (public messages) and other for presenting content related to the place (from feeds defined by the administrator) and content derived from the users interactions.

For the SIG area the algorithm performs the following steps:

1) Scan for BT devices in the display zone
2) Find public messages in their SIG subscriptions
3) Select the message to be presented, considering (cycling *N* messages):
   a. SIG subscriptions of devices detected within the display zone
   b. Presentation history

For the selection of the content to be presented in the panel with content related to the place, the algorithm is as follows:

1) If there are not users interactions within the display zone
   a. Cycling *M* most recent contents provided by the set of predefined sources
2) If exists users interactions
   a. Finds related content through predefined sources
   b. If necessary finds more related content through the API.
   c. Cycling between the related content

Currently we are working in different algorithms for improving the content selection in the public display.

4 Software Infrastructure

Figure 2 presents the solution scheme that implements the conceptual model defined in previous sections. The three main components of the architecture are:

- Application server: has a BT interface and is located on the building area where users can interact with the system.
- Web server: it includes all the business logic related to SIG administrator's interface (e.g. administrate the users' subscriptions and content administration) and related to the users' interface that allows their subscriptions and also their identification using the Bluetooth Device Address and the selection of one or more of the available SIGs.
- Database server: stores all information about the system, users and their interactions..

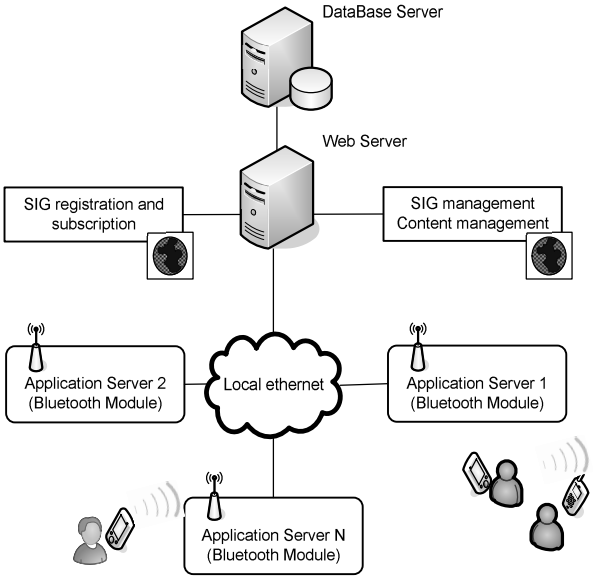

Figure 2 – Software architecture.

The infrastructure supports several application servers, a web server and several clients. The dynamic of the system is based on the following sequence of actions done by the users. Initially, the users must register themselves in the system. This is done by selecting their SIG and identifying their Bluetooth devices (Bluetooth Device Address). The Bluetooth module of the application server is continuously scanning for Bluetooth devices. Every time a new device is detected the system verifies in the database if it is a registered device. In positive cases the system verifies if there are new data (messages, alerts, notifications, etc.) for this target user. Every time some data is sent to a specific user, information about this action of the system is stored in a way to avoid multiple alerts of the same information. Users that were not registered in the system may also influence the display behavior using simple keywords in their Bluetooth device name.

5 Experimental Work

Till now we have developed and evaluated the first software module corresponding to the informative module (Application server, SIG management and content management, SIG registration and subscription). In next subsection we describe the prototype, the experiment an evaluation results. More details about this evaluation can be found in [6].

The software module corresponding to the large display was also already implemented but not evaluated.

5.1 Experiments and Evaluation Goals

To evaluate the system we have conducted experiences for a 3 weeks period. The system was installed in the main research lab of the Informatics Engineering Department and its interaction zone embraced the main entrance of the department and reaches out a zone of approximately 50 meters wide. People that frequent visit the interaction zone were mainly teachers, staff and students in technological areas. We have invited three teachers to act as a SIG administrators and to use the system as a favorite mean for interaction with their students. Each teacher was responsible for manage both content and subscribers of his class/SIG and they were also responsible for motivating their students to subscribe and use the system.

After 3-weeks of experiment, the system detected 103 distinct mobile devices with Bluetooth and 23 of them are registered in the system. The ratio of detected devices that received messages was at 22.3%. During this period the system delivered 62 messages, corresponding to 14 distinct messages, to 23 distinct students.

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5.2 Results and Discussion

To evaluate the users' acceptance of this system, after the experimental period, we've asked the users (teachers and students) to fill a questionnaire where they were able to express their opinion. Results show that teachers were able to successfully manage their SIG and improve the interaction with students. Additionally, they have identified as a benefit the usage of this system when comparing to the usage of traditional online software like e-mail, chats, e-learning platform, etc. Students rated as simple the system's registration task. Furthermore, more than 73% of them refer that the system presents some benefits over common online software to support students/teachers interaction. Additionally, the questionnaire includes two more questions related to users' privacy and benefit of the system usage. Only 17.4% of students activated their Bluetooth functionality specifically for this purpose. Respectively to the need of expose their device as a requirement for the system usage, more than 50% of students refers that the benefit obtained through the system usage overcomes the cost of the Bluetooth identification exposure.

6 Conclusions

In this paper, we propose a Bluetooth-based interactive system that combines public displays and personal mobile devices for delivering personalized information according to the users' location and interests.

A prototype has been built and discussed with a demonstrative user scenario. We run a partial evaluation focused on learning environments, but the system is also applicable in other shared public and semi-public spaces such offices, homes, companies and many others.

Preliminary results show that the users involved in the evaluation found some advantages in this system comparing to traditional approaches.

6.1 Future Work

As described in the previous section we are currently develop new algorithms for select content to be presented in the public display. After this process we plan to integrate all modules of the system and run a final evaluation using both, public display and mobile devices as information delivers.

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References:

[1] M. Maron and K. Read, " Campus News: An intelligent Bluetooth-based mobile information network," presented at international conference on mobile technology, applications, and systems and the 1st international symposium on Computer human interaction in mobile technology, Singapore, 2007.

[2] K. Mitchell, N. J. P. Race, D. McCaffery, M. Bryson, and Z. Cai, "Unified and Personalized Messaging to Support E-learning," presented at Fourth IEEE International Workshop on Wireless, Mobile and Ubiquitous Technology in Education, Athens, Greece, 2006.

[3] T. Payne, E. David, N. R. Jennings, and M. Sharifi, "Auction Mechanisms for Efficient Advertisement Selection on Public Displays," presented at European Conference on Artificial Intelligence, Riva del Garda, Italy, 2006.

[4] D. M. Russell and A. Sue, "Using Large Public Interactive Displays for Collaboration," presented at Workshop on Collaboration with Interactive Walls and Tables, Goteborg, Sweden, 2002.

[5] D. M. Russell, "Large interactive public displays: Use patterns, support patterns, community patterns," in *Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies*: Kluwer Academic Publishers, 2003.

[6] F. R. Ribeiro, J. Metrôlho, and M. Costa, "A Bluetooth-based Interactive System to Improve Relationships Between Actors in Educational Environments'," *WSEAS Transactions on Advances in Engineering Education*, vol. 7, pp. 33-42, 2010.