# Towards Situated Public Displays as Multicast Systems

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**Abstract.** Within organizations diverse asynchronous, unreliable multicast channels to push information chunks already exist. These usually include posters, newsletters, intranet pages, print media and talks. Situated public displays have the potential to complement these channels, because their properties of being situated and public make them superior to conventional information channels in certain situations. In order to present the information that is most interesting to users and thus improve the efficiency of information distribution, we propose to learn a model of the spatio-temporal behaviour of users, find clusters belonging to certain organizational subgroups within this model, gather profiles for some of the users and use the estimated profiles of clusters to optimize the information presentation on the displays.

## 1 INTRODUCTION

Imagine you are a student staying around the university for most of the day. You read the newsletter, posters, intranet pages and print flyers. However, you do not have a fixed workplace and feel somehow disconnected from the information flows within the institutes and not being part of it. One day a number of large displays are installed throughout the department showing information chunks about ongoing activities within the institutes. As you enter the building in the morning, you have a quick glimpse of about two seconds on one display to see what is going on today. You notice that there is an interesting talk you have not heard of before, there are two student jobs available and a new research project you are interested in is being announced. You consider these public displays convenient because you do not need any hardware yourself to use them. Furthermore they do not interrupt you during important tasks, since you are only wandering in the hallways anyway and only spend a few seconds to access information. The key advantage of the displays is that they provide information tailored to your interests.

## 2 RELATED WORK

Various situated public display systems, displays that are installed in public spaces and adapt to their temporal, spatial and social context, already exists. The aim of the GroupCast [4] system is to sense which people are nearby and display information related to their mutual interests to spark informal conversations. The CWall System [3] shows information chunks provided by colleagues and emphasizes the importance of the cost/benefit ratio, but focuses on small "Communities of Practice" instead of whole organizations. The Plasma Poster Network [2] resembles a real poster board where anyone could post items and focuses more on intense interaction with the display than our 'passing by' approach. In contrast to these displays that are located in places where many people pass by, Hermes [1] is an example of office door display systems where visitors can for example leave messages to the owner of the respective office.

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## 3 COSTS AND BENEFITS OF SITUATED PUBLIC DISPLAYS

One hypothesis of our work is that situated public displays will only be adopted if the benefits they provide are higher than the costs they incur. On the one hand the costs that occur for the user reading a chunk are determined by what he could have done in the same time otherwise (opportunity costs). These costs depend both on the total time people spend looking at the display as well as on the exact moment. When they are interrupted in some important task the costs will be higher. On the other hand, the benefits for a user reading some chunk are determined by the value of the information transmitted. This depends on whether the information is yet unknown to the reader, and whether it is interesting to the reader at the current time and the current place.

Besides increasing the efficiency of information distribution, more advantages can be identified. First, the system can be used by anyone who does not need to have an own workplace, internet access, email, or mobile phone. Second, discussions can be sparked between people who would otherwise not know of their mutual interests. Furthermore, the displays can provide better situational awareness by showing what is going on *right now* in the organization, and organizational awareness by showing what is going on in general, and thereby make people more feeling part of the organization. The displays also enable opportunistic behaviour, so one could just enter the organization, see what is currently going on and participate in those events.

## 4 SITUATED PUBLIC DISPLAYS AS MULTICAST SYSTEMS

We want to build an asynchronous, unreliable multicast system for information chunks that are created by people within the organization or sensors within the buildings (sources) and adressed to people within the organization (sinks). The information chunks will describe the organizations status and be either dates (time and place related, like lectures), staffing (like job offers), or pure status information (like project status, publications etc.). Displays are placed where many people pass by, and information should be transferred to people during a time window of two to five seconds while they pass the display. The goal of our work is to improve the efficiency of information distribution by providing information that is tailored to the reader. To achieve this, information about the interests and the spatio-temporal behaviour of people will be gathered (sensing), a model of the population of the organization, their interests and spatio-temporal behaviour will be learned (learning), and the information presentation will be optimized according to this model (acting).

## 5 SENSING

To adapt the information presentation to the users, both the spatio-temporal behaviour of users and their interests need to be measured. We propose using bluetooth to measure the spatio-temporal behaviour for users who opted in to be logged. Despite the relatively low spatial and temporal resolution of this method (a scan takes about 11 sec.), because most users always carry their mobile phone along, we estimate that a huge amount of data can be gathered using this method.

To measure the interests of users we propose using a combination of different methods. We will provide a facility by which users can download content to their mobile phone or forward them to their email adress. Using bluetooth, we plan to measure the time that people spend in front of the display to estimate whether they are reading content. We are also experimenting with video based face detection to measure whether people are looking at the display and thus probably reading content.

We will provide a web site where people can inspect and delete data gathered about them. They will also be able to edit their profiles, and thus enable the system to provide better individualization of information. There is no need to store personal information like names along with the profiles, as they will only be related to a bluetooth address.

## 6 LEARNING

As with the sensors, we will need two different user models, one to describe the interests of users and one to describe their spatio-temporal behaviour. Regarding the interests of users, we plan to apply bayesian networks to integrate the information from the different sensors. Regarding the spatio-temporal behaviour of users, we consider to use a time geography based approach to describe the trajectories of different users and find clusters among them. To augment the interests models of users for whom few information is available, we intend to use interests models of users within the same spatio-temporal cluster.

## 7 ACTING

The goal of our work is to provide the information chunks that are most interesting to users of the system to improve the cost/benefit ratio for the users. To achieve this, for each display and each time point the probability that users from a certain cluster are near to the display will be calculated from the spatio-temporal user model. This measure will be weighted with the probability that users from those clusters show interest for the different information chunks. The chunk with the highest expected value will then be displayed.

## 8 STATE OF THE IMPLEMENTATION

We currently have installed two prototype displays in our department, one in the main entrance and one in a main hallway (see Figure 1). We are about to install a third display in the second entrance. Currently, on the left part of the display information chunks are displayed in turn without further personalization and are provided display time proportional to the number of letters. Outdated chunks are automatically removed. The first display is running for five months, we have about 10 users regularly submitting information chunks and more than 600 users reading them. Up to now, about 100 information chunks have been posted with a WYSIWYG editor implemented in Java. In addition, on the right part of the display information regarding the building like whether the library is open and information regarding the immediate surroundings of the building, like weather, menu of the cafeteria and bus departure times are displayed. On the bottom, a news ticker shows more general current information.

**Figure 1.** One of the displays installed in the hallway, with information chunks regarding the organization on the left, information regarding the immediate surroundings on the right and a newsticker with general information on the bottom.

## 9 FUTURE WORK

We presented an approach to improve the efficiency of situated public displays interpreted as an asynchronous, unreliable multicast channel. As next steps we want to finish both the implementation of the sensing hardware and the interaction with the displays with a Java MIDlet on the users mobile phone and gain first experiences with collecting data. We want to further explore the interest model and the spatio-temporal model and implement them. We want to determine how clusters in the spatio-temporal model can be found. Finally, we want to determine how the user model can be exploited to maximize efficiency of information distribution within an organization.


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