Using Mobile Devices to Personalize Pervasive Displays

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1. INTRODUCTION
Public display systems have long been a rich vein of research [5]. In recent years, deployments of such displays have become increasingly ubiquitous. However, while deployments have progressed apace, the range of real-world applications and usage models for such displays has remained relatively conservative with a focus on advertising and simple information dissemination.

Our work is motivated by a vision of the future in which public display networks act in tandem with personal mobile devices to form an open, pervasive computing infrastructure. As part of this vision we are particularly interested in supporting personalised content, customised for the preferences and needs of mobile users surrounding the display.

Personalising content on public displays can be achieved through many methods; recent work has often used the Bluetooth capabilities of mobile devices [6, 2]. However, power and privacy concerns may lead users to switch off the Bluetooth on their mobile devices, making them less useful for display personalisation. In this demonstration we show applications built using Tacita, an alternative method for allowing mobile users to make display personalisation requests.

2. DEMONSTRATION OVERVIEW
We previously demonstrated Tacita at HotMobile [4] and Mobisys [1] 2012. The system is comprised of four components: 1) an Android application that allows viewers to define content preferences; 2) a display component that schedules and renders content onto a display; 3) a set of Web applications designed for rendering on public displays; and 4) a map provider, which provides a database of display locations and available applications [Figure 1].

In a typical usage case, the mobile application [Figure 2] uses data from the map provider, combined with location awareness (using GPS, Wifi fingerprinting and Bluetooth), to determine that a user is near a public display that can provide applications matching their preferences. The mobile application then sends a personalisation request to the corresponding application indicating the display upon which to show the content plus any application-specific parameters (e.g. search terms, location filters). The application then sends a visualisation request to the display to ensure that the generated content is shown on the display.

This demonstration makes use of Yarely [3], a Python-based display node software (handling media playback, sensing, and scheduling) designed specifically with the goal of supporting open display networks. This demonstration shows a wider range of applications that previously shown at Mobisys and HotMobile. Our Yarely deployment currently consists of over thirty nodes distributed across five European universities.

Figure 2: Tacita Mobile App UI
3. INNOVATIVE FEATURES

The first key design decision underpinning our architecture is to support personalisation by having displays broadcast their capabilities for personalisation to mobile devices, rather than having mobile devices broadcasting user preferences or personal identifiers. Our approach is in contrast to most existing research in the area that has relied on users either explicitly broadcasting preferences or requests (as in Davies et al. [2]) or by being “observed” by displays (as in Sharifi et al. [6]). This approach is inherently designed to provide a basic level of scalability and user privacy since mobile viewers are not observable by the infrastructure.

Our second design decision focuses on how personalisation data is revealed during system use. User requests go directly to the applications that produce the content, and not to the display. This removes the need for viewers to have any form of trust relationship with displays or display owners that they encounter in their travels – all user interactions are with the applications that they have explicitly selected and with which we can assume they have established trust relationships.

With regard to technology, we use an Android application for user request generation. We combine a number of commonplace location technologies (GPS, Wi-Fi fingerprinting, Bluetooth propagation) to provide coverage for both indoor and outdoor locations.

4. LESSONS LEARNT

Experiments with Tacita in the real-world suggest that it can be used to effectively personalise displays in the most demanding usage model, i.e. walk-by personalisation by using a combination of location technologies and carefully selected triggering zones. We find that sensing location and triggering updates from a Tacita mobile client is at least as effective as previous methods using Bluetooth sensing at the display (e.g. [2]).

Intuitively the approach of supplying mobile clients with maps of public display capabilities has number of benefits. Firstly, the display trigger zones defined in the map provision are not restricted to those that can be achieved using RF propagation. Secondly, the Mobile App’s awareness of display locations (based on the map provision) also allow it to use available localisation sources intelligently, increasing energy efficiency. Finally, viewers do not need to keep their devices in Bluetooth Discoverable Mode all the time.

From a privacy perspective we find user studies validated our initial design decisions, supporting the idea that placing trust in an application provider was already commonplace (e.g. social networks, mail providers, games providers) and that users typically valued these relationships over those they had with owners of the public spaces they typically passed through.

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6. REFERENCES