BASADAEIR: HARVESTING USER PROFILES TO BOOTSTRAP PERVASIVE APPLICATIONS

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Abstract
Many pervasive applications profile their users in order to obtain context or personalise content. Traditionally, user profiles are built from scratch and individually maintained by the user. However, in many cases, much of the information required by an application is readily available from existing sources. We present Basadaeir, a tool that combines user profile data from a number of online sources with a local location sensing system and provides an API for accessing the data. This allows developers to quickly bootstrap pervasive systems and reduces their need to obtain data directly from users. A preliminary user study suggests developers see the value in Basadaeir, and that reducing the need to profile users promotes the rapid prototyping of people-centric applications.

1. Introduction

Pervasive applications use context data to make decisions about their behaviour. This can take the form of adapting to available resources, recognising situations and activities or displaying personalised information to users. Although context comes from a variety of sources, this paper focuses on what Henricksen classifies as *Profiled and Static information* [2] – information, provided by people, that changes infrequently. Gathering data for the purpose of personalisation is common practice. Many websites require their users to provide a name and email address, while social applications require relationships between people to be specified. Pervasive systems place additional emphasis on describing the relationships between people and the devices that can be used to identify their presence (e.g., their phone, or locatable tag).

Applications tend to have a significant overlap in their data requirements; in many cases this data exists in disjoint forms on the web. For example, social networking sites such as Facebook and LinkedIn are constructed around user profiles. Beyond basic information such as name, age and gender, these services expose contact details, information about mood, hobbies and interests (movies, books, bands etc.), and current and past activities. People commonly utilise multiple online repositories of profile data, which they maintain because their social network demands it.

We have developed an online profile and sensor data harvester called Basadaeir, that provides a single interface to many of these information sources, as well as to other sensed data from the user's environment. This marriage of sensor data with user defined profile information – accessed through a single interface – enables rapid bootstrapping of pervasive applications. It also provides a strong

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platform upon which data rich applications can be built.

Section 2 overviews Basadaeir and describes the developer API and two sample applications. We present the results from a preliminary study with developers who were asked to carry out tasks with an early prototype of the system in section 3. Related projects are discussed in section 4, and we conclude in section 5 with an outline of future work.

2. Basadaeir

Many applications require the provision of personal information before they can be used. We realised that this can be very frustrating for users, and set out to design a system to unite profile information from existing applications, and provide a straightforward means of making it accessible to others. The result is Basadaeir.

With Basadaeir, users identify external sources of information about themselves using pointers. This includes their Facebook id, Flickr username, Twitter username, etc. Basadaeir resolves these to retrieve profile information using the appropriate service API. This provides applications with access to disparate data from a single source, and removes (or reduces) an application's need to obtain profile information directly from users. Users may also identify devices that can be used to identify them, such as their mobile phone's Bluetooth MAC address,

For our prototype, we selected four services that are regularly used by members of our research group: Facebook, Twitter, last.fm, and Google Calendar. We also integrated Basadaeir with Construct [1], a middleware platform for context aware systems, to support the integration of live sensor data. For the purpose of this prototype, we focused on location data provided by a Bluetooth spotter network deployed throughout our building, however other sources of data are available. The Bluetooth spotter readings are tagged with unique identifiers that denote locations throughout our building.

Basadaeir provides a web-based interface where people can maintain their pointers to other information and an HTTP API that exposes the information that results from "resolving" these pointers. For the purposes of this study, we built a Java interface to the HTTP API that developers used to access this data transparently from within their applications.

To demonstrate Basadaeir, we implemented two example applications using the API (available at `basadaeir.ucd.ie`). The first, a simple in/out board, displays the whereabouts of registered users using the Bluetooth location system. Presence information is shown on a number of public displays around our building (figure 1) . A second application, the call for papers matcher, matches research interests from `academia.edu` to descriptions of upcoming academic events provided by `eventseer.net`. Situated in a public area, the application shows calls intended to promote collaborations between co-located users.

3. Preliminary Study

We conducted a small user study to gain feedback from developers about the data sources we had available, the ease of use of the API, and the likelihood that they would choose to use a system like Basadaeir in future projects. At the time of the experiment we had 33 registered users in the system, these people having been encouraged to register during the development of our prototype applications. We used two Bluetooth spotters to collect live information about devices in their vicinity: one in the

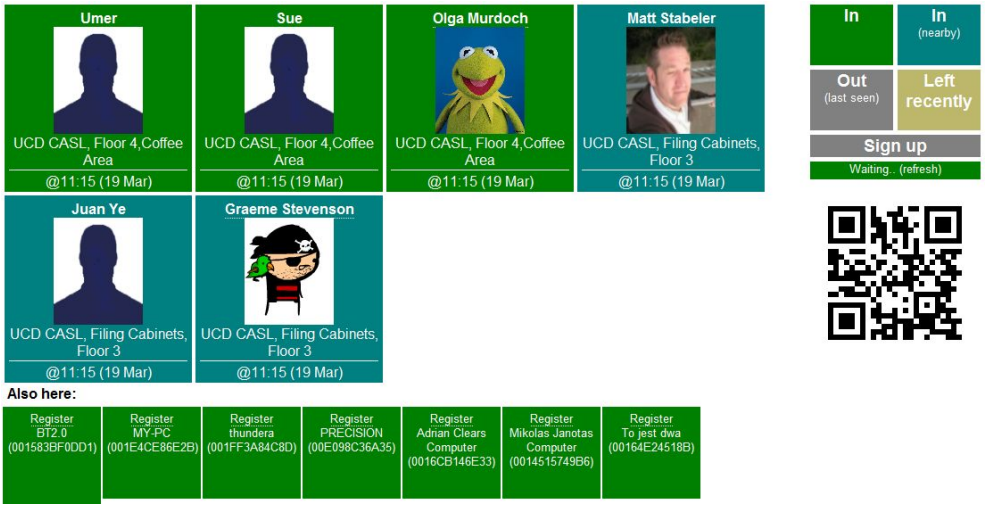

Figure 1. Screenshot of Basadaeir in/out board application - presence status indicated by key (top right)

building common area, and another situated in our main laboratory.

Five developers were asked to familiarise themselves with the documentation and to (1) write a simple application to group users by their location and show their current Twitter status, and (2) write an application of their choice which used several user attributes distinct from the previous example, in addition to Twitter status or last.fm song list. Participants were given an hour to complete these tasks and were then asked to complete a questionnaire about their experience. All of the participants were familiar with Java, the language of our client application, reporting skill levels from novice to expert.

3.1. Results

We found that participants were very positive about using the system. They felt they would benefit from its "ease of use", and that it enabled "rapid application development" and "code re-use". They thought Basadaeir could be used as a basis to "develop more complex systems" as " the most powerful thing is that location is the dynamic context upon which a (limitless) amount of user info can sit" (quotes from survey responses).

Participants desired access to more profile information than was available; in particular historic data, such as recent locations of users. They also wanted stronger search facilities for filtering information. A number of improvements to the Java API were suggested to provide easier access to information. More detailed meta-data about locations, such as the services they contain, was also desired.

Interestingly, the majority of developers had not used online APIs to access profile data before, but stated that the data provided would be useful to them. This suggests that while the rich data provided by Basadaeir is useful to developers, the effort required to obtain this data from online services individually is prohibitive.

The participants strongly emphasised a desire for additional data, and suggested a plugin system for implementing this. One participant suggested that if expanded with more sensors, "It would sit nicely below a 'situation' level, making this abstraction step easier".

Some applications produced in the final task included: a supervisor tracking system that used the

song playlist to determine the mood of the supervisor; a reminder system, based on when a user is first spotted during the day; and, a notice board system that displays profile information about people.

Participants reported that they felt limited by the Java API we provided, and that parts were difficult to use. We note that the API in this initial study was simplistic and have planned improvements for the next phase of development. Despite this, all participants felt they might use this form of tool support, and two were certain to use Basadaeir in the future. Given that the development of Basadaeir is in its initial stages, we believe that this is a positive sign that it will become viable for use by pervasive application developers.

4. Related Work

`spock.com` is a search engine that constructs records for people from publicly available sources. It attempts to proactively link information sources, and offers personal accounts, which allow this to be done manually. An HTTP based API for search provides access to limited profile information. Unlike Basadaeir, Spock does not resolve pointers to external sources of information.

Google's *OpenSocial* (`code.google.com/apis/opensocial/`) defines a common API for social applications across multiple websites to access data about people and their relationships and activities. OpenSocial is still early in development and is currently supported by a small number of websites. The emergence of this project supports the theory that the barrier to making better use of these online data repositories is the need to learn a range of APIs in order to interact with them.

5. Conclusions

This paper described Basadaeir, a tool that provides a unified interface to location sensor data and user profile information harvested from the web. Basadaeir reduces the workload on developers, by providing a means of quickly bootstrapping pervasive applications.

Our preliminary user study indicates that developers of pervasive applications are eager to have access to profile and sensor information about their users, but the effort involved in retrieving this data from existing sources is prohibitive. The results show that a system such as Basadaeir would prove useful in removing the need to solicit for profile data from users directly.

Plans to improve Basadaeir include expanding the number of data sources from which profile information is harvested, using feedback from our user study to improve the developer API, resolving conflicts between data from different sources, and increasing the quality of positioning data available to applications. We also intend to demonstrate how other sensor data, such as temperature, light, and humidity, can easily be incorporated into our system.

References

[1] Simon Dobson, Paddy Nixon, Lorcan Coyle, Steve Neely, Graeme Stevenson, and Graham Williamson. Construct: An open source pervasive systems platform. *Consumer Communications and Networking Conference, 2007. CCNC 2007. 4th IEEE*, pages 1203–1204, 2007.

[2] Karen Henricksen, Jadwiga Indulska, and Andry Rakotonirainy. Modeling context information in pervasive computing systems. In *Pervasive '02: Proceedings of the First International Conference on Pervasive Computing*, pages 167–180, London, UK, 2002. Springer-Verlag.