# Pervasive Awareness

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## ABSTRACT
We are interested in systems that support awareness between individuals, by exchanging information that is automatically captured and presenting it to members of their social network. Here we demonstrate a principle for the operation of these systems which we describe as pervasive awareness: awareness information is aggregated opportunistically as mobile devices carrying some information migrate across space and cluster dynamically. We present a minimal demonstration of the principle where qualitative location information is used to select information offered by context capture devices (for the demonstration these are cameras).

## Categories and Subject Descriptors
H.1.2 [Information Systems] User/Machine Systems – Human Factors;, User-Centered Design; D.2.2 [Design Tools and Techniques]: Miscellaneous

## General Terms
Measurement, Human Factors.

## Keywords
Awareness Systems, Computer Mediated Communication.

## 1. INTRODUCTION
Awareness Systems are an emerging class of communication systems that support individuals to maintain with low effort, and often through incidental interaction, a mental model of the activities and state of another individual or group. An early example is the work around Media Spaces at Xerox in the 90's, see Bly et al [1], which supported co-workers within and across remotely located office-sites to maintain peripheral awareness of each other.

Our research explores two avenues for advancing the state-of-the-art in Awareness Systems, which together comprise the notion of *Ambient Awareness*:

- *Automatic Capture* of awareness information through context sensing and interpretation. An environment, e.g., a home equipped with context sensing capabilities, should construct a model of activities within its confines. This approach to capturing awareness information has been explored by several research works in the last five years. Notable examples are the Digital Family Portrait [4], where information about activity at an elderly person's home was captured through an installation of sensors and presented to their children, the Diarist [3] that had a similar purpose but provided a higher level of detail and semantic interpretation of the information captured, and the Whereabouts clock, where coarse location information of all family members was presented at a shared display in the kitchen [2]. These are just a few examples, from the application of such technologies for connecting home and family, but there are many more that use different approaches to context sensing and explore different ways of presenting this information.

- *Pervasive Awareness*. For mobile individuals, awareness information can be obtained from a surrounding (computationally augmented) environment, in order to be communicated to selected individuals. For example dad's mobile device may be tracked entering a train station and this fact may inform the family back home that he is on his way. An environment or, rather, a proxy representing that environment may compile such awareness information without any sensing at all. Rather, it may use information provided by numerous mobile devices to synthesize a model of the social situation. For example, the size of a crowd present at an open-air event, e.g., a rock-concert, does not need to be sensed when it can be roughly estimated by the number of mobile devices in the area announcing that are prepared to share with a pervasive awareness service their participation to this event.

The true potential of Ambient Awareness becomes evident when Automatic Capture is combined with Pervasive Awareness. An environment may supply a description of the context (e.g., fun-fair) and its content creation/capture capabilities (e.g., taking a picture on the roller-coaster). Mobile devices can regulate this information capture through embedded privacy profiles of their owners, (e.g.,


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such a privacy profile could consent to photographs being taken or even allow for the images to be directly visible to the family back at home). A richer (shareable) AV record of such a shared or public event may be created by combining information captured by different individuals. This record may be shared in a transparent way to the users, once their profiles for sharing information allow it.

Although many of the functions that such a concept allows can be implemented through traditional location aware applications, the concept of pervasive awareness is more flexible as it allows flexible and dynamic indexing and mapping of pieces of information, rather than pre-supposing a common location tracking infrastructure.

## 2. PERVASIVE AWARENESS DEMONSTRATION

Our demo of Pervasive Awareness was constructed by thinking the scenario of a conference delegate. Alex is a conference delegate and wants to keep photos of the events he experienced. He wants to use those photos to share his experience with his family members and friends. A Pervasive Aware conference and his Pervasive Aware phone can help him achieve that goal.

We begin with describing the Pervasive Aware conference. The conference has a number spaces in which events are taking place. In Figure 1, one can see the drawings of two such spaces, space 1 and space 2 that are equipped with a Pervasive Aware camera.

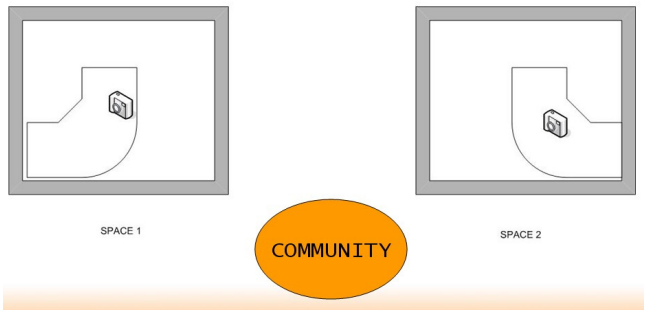


**Figure 1: Space 1 and 2 are equipped with Pervasive Aware cameras**

Practically speaking this means that there is a computer in each space which has attached a camera. The computer has two services installed. One service extracts its location and exposes it to the "Pervasive aware conference community" (hereafter community) and another service takes a snapshot of the place and makes it available to the community. The community itself by having the location information both from its subscribers and from its registered camera-agents, detects whether a subscriber is in the vicinity of a camera, and consequently makes available the corresponding pictures to her.

The location-awareness service is achieved by scanning for WiFi access points and sending its Mac addresses and names to the community.

While checking in the conference Alex was informed about this service and downloaded and installed the location awareness module in his mobile device. He has also subscribed in the community, fact which will enable him to receive the automatically captured photos.

While moving along the conference spaces, Alex's mobile device gives out Alex's location to the community. By "location" again we mean that the service running in Alex's mobile phone scans for WiFi accesses points, retrieves their Mac addresses and names and sends that information to the community. Alex has also subscribed to the same photo-sharing community of the two other conference spaces. When it happens that Alex is at the same location with a conference space, which automatically takes snapshots of occurred activities, then the photos taken by the space while Alex was in its vicinity will be copied to the profile of Alex (Figure 2).

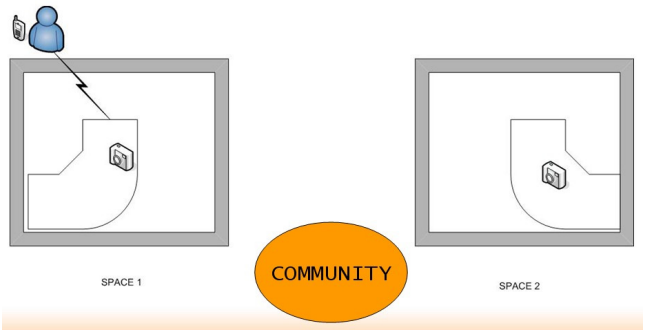


**Figure 2:**

The same action will occur when Alex is at another Pervasive Aware space (Figure 3).

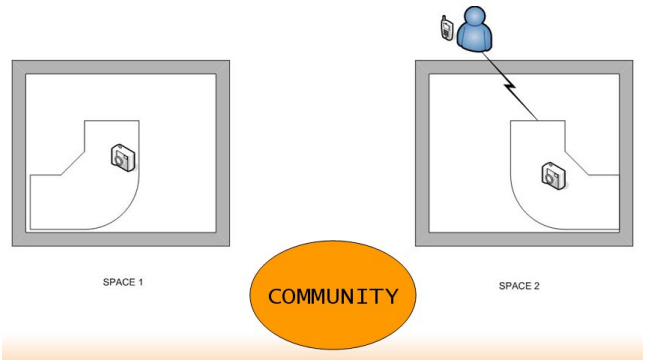


**Figure 3:**

Since his photos are in his profile they can be accessed by different media. One use case might be that Alex would want to receive the "freshly" captured photo of his location, assess it and send it to a member of his family (Figure 4).

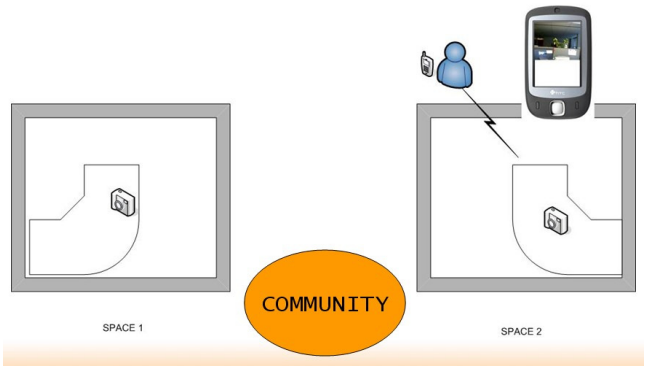


**Figure 4:**

## 2.1 Technology

We have used the smartphone of HTC Touch P3450 for the development of our demo. It runs Windows Mobile 6 professional. We programmed the mobile device application using Microsoft's .NET Compact Framework in C#. We use OpenNetCF libraries for controlling the WiFi adapter of the device. We keep participant's data in MS SQL Server CE.

The location aware PC part of the demo is developed with C# .NET, whereas the snapshot-service is developed using Microsoft windows video capturing API.

Essential for this purpose is extending the context capture mechanisms with a rich set of awareness information providers and developing mechanisms that will allow the specification of the information exchange sharing preferences between users.

# 3. CONCLUSIONS AND PLANNED FUTURE WORK

The current demonstration is only a proof of principle. We are currently extending this system to offer richer awareness information that will support two scenarios: opportunistic encounters of hotel guests, e.g., at a conference event, and connection of busy parents.

# 4. ACKNOWLEDGMENTS

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