A Tangible User Interface for Multi-User Awareness Systems

Richard Etter
Fraunhofer IPSI
Dolivostrasse 15, 64293 Darmstadt, Germany
richard.etter@ipsi.fraunhofer.de

Carsten Röcker
Fraunhofer IPSI
Dolivostrasse 15, 64293 Darmstadt, Germany
carsten.roecker@ipsi.fraunhofer.de

ABSTRACT
In this paper a music-based awareness system called 'Social Radio' is presented. The system focuses on small intimate groups and enables multiple persons to stay in touch using smart artifacts and tangible interaction mechanisms.

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Emotional Awareness, Music, Smart Artifacts, Multi-User Communication, Intimate Group Communication, Tangible User Interfaces, Aesthetics Artifacts

ACM Classification Keywords
H.1.2 User/Machine Systems, H.3.4 Systems and Software, H.4.3 Communication Applications, H.5.2 User Interfaces, H.5.5 Sound and Music Computing

INTRODUCTION
Over the last years, several applications emerged, that try to support awareness and informal communication using music [see, e.g., 1, 2]. The basic idea of all systems is to mediate a feeling of connectedness by enabling users to listen to the same music in synchrony. Although some of these systems proved to be successful in mediating awareness in peer-to-peer situations, they are not adequate to support awareness in small intimate groups, where multi-user communication is required.

Most systems only allow the transmission of one parameter to a single remote device. But in order to stay aware of family and friends it is necessary to provide users with easy and intuitive interfaces for exchanging personalized awareness information with several remote peers.

In the following sections, a multi-user awareness system is presented, that uses smart artifacts and tangible interaction mechanisms for sharing personal music in small intimate groups. The goal was to provide users with an easy and intuitive interface for controlling the communication settings and providing awareness information on an individual basis.

SOCIAL RADIO
Based on the goal to foster a feeling of connectedness in a small intimate group, the awareness system 'Social Radio' has been implemented. In order to seamlessly integrate the system into its physical environment, Social Radio was designed like an aesthetic sculpture (see Figure 1). The sculpture consists of several individual pieces, that can be physically connected to each other. The basic idea is to represent a family or circle of friends that consists of its individual members.

Figure 1: Social Radio Artifacts arranged as a sculpture.

Tangible Interaction Design
Social Radio enables a user to hear the music remote persons listen to in real-time. Each person has several artifacts at home that represent a personal circle of friends. One artifact represents one remote friend. Each artifact can be identified by the color of the light and an image that enables a user to personalize the artifact. User can control the artifacts via a tangible user interface. By placing an artifact on different sides its operating mode can be changed. Thereby user can individually configure with whom they share information. For example, by placing an artifact upside-down, the artifact is immediately deactivated

and no further data is shared with remote persons (see figure 2, position 1).

Figure 2: Social Radio artifacts in different modes.

The positions 2, 3 and 4 show different active modes. In all these positions, the artifacts present data from remote users by using sound and light. In position 2, that resembles a bridge, the artifact plays the music the remote person is listening to. The intensity of the light indicates how recently the song has been played. If the remote person is listening to music at that very moment, the maximum light intensity is used. Although music is ambient and often perceived in the background of a user's attention, it might be disturbing in some situations. This is taken into account by providing an operating mode where no sound is used (see position 3 in figure 2). In this position only light is used to indicate if a user is listening to music. The light illuminates the personal image that can be attached to the artifact and projects a shadow of the image on walls. Seeing the light a user might spontaneously decide to hear what the remote persons listens to by simply turning the artifact in position 2. Position 4 is the calmest of the 3 active positions. In this position only light with very low intensity indicates if someone is listening to music. Generally, there are manifold possibilities to map light intensity and music choice to the different positions of the artifact. The main challenge is to find the most intuitively understandable interaction mechanisms for the user. First informal user tests with Social Radio have shown, that users where able to rapidly understand the mapping model that was chosen.

Figure 3: Two groups of Social Radio artifacts.

Multi-Party Communication

The concept of an artifact representing a remote person enables a user to form groups (see Figure 3). Even in small intimate group, like, e.g., a family, the group members have different relations to each other and want to communicate individually. If two or more Social Radio artifacts are placed next to each other, they take turns in playing songs. This guarantees that two artifacts next to each other never play at the same time. Several artifacts form a group that only plays music of the remote persons the artifacts represent.

SOFTWARE INFRASTRUCTURE

The awareness system presented here has been implemented to a full extent. In each location, e.g. home, Social Radio consists of several smart artifacts and a server. The server retrieves information from other servers in remote locations and wirelessly controls the artifacts. On the other hand, the server provides information for remote locations. In order to retrieve information about the music a user is currently listening to, the server uses the API of iTunes [3]. The server provides the information about playlists and presence information in standard XML and makes it available via internet. This decentralized approach with multiple webservers was chosen, since it enables the system to support multiple homes and potentially multiple intimate groups, without storing all data on one server.

HARDWARE INFRASTRUCTURE

In order to support the interaction mechanism described in the last section, each Social Radio artifact is equipped with several sensors. The captured interaction data are transmitted via a communication module to a stationary server embedded in the environment. Using the UHF band for transmission enables communication distances adequate for home environments. The same communication module is used to control the ambient light feedback. To guarantee high-quality audio playback, the music is transmitted via sound hardware and speakers, integrated into the artifact.

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