Ecological Invitation to Engage with Public Displays

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ABSTRACT
Interactive public displays pose several research issues, which include display blindness and interaction blindness. In this paper, we shortly introduce our idea of a sound-based system to overcome the display blindness, and some experiments that we are carrying out in order to test its effectiveness.

Author Keywords
Public displays; peripheral interaction; sonic trajectories; display blindness.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Public interactive displays have been attracting the interest of both the research and commercial worlds, one stimulating the other in a positive virtuous circle.

From the commercial point of view, public displays turned out to be effective means to inform people on events, directories, or new products. Most of the recent implementations also exploit interactivity, therefore allowing to achieve a higher level of engagement of users, who gain an active role in a two-way communication.

From the researcher viewpoint, it is the interactivity that has generated the most interesting research questions in the area of public displays. Indeed, cross-field problems arise in terms of hardware (sensing devices), software (user interfaces, middleware), and social sciences (interaction paradigms, cultural-related issues, people's behavior). Two of the most investigated issues in the public displays field are *display blindness* and *interaction blindness*. In the first case, people do not take into consideration the display because of a content-based bias, or simply do not notice the display at all because of their relative positions. In the second case, given that people notice the display, they do not understand its interactivity, thus ruining all the engagement-based information purposes.

There are several works proposing solutions that are more or less effective for both the above-mentioned issues. Many of these works are based on social-related studies [7] and provide researchers with some useful monitoring tool to be used for further analysis [5]. Concerning specifically the interaction blindness, the available solutions mainly rely on particular designs of the visual interface [6]. Concerning the display blindness, the available solutions are mainly based on the stimulation of some senses, mostly sight [2] and hearing [1], but also touch, when networked wearable devices can be included in the playground [9].

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Figure 1. Sketch of a possible deployment

Here we propose the design of a sound-based solution to draw an "acoustic path" towards an interactive public display. The solution is designed to be integrated, both visually and especially acoustically, within an existing deployment of an interactive display [6].

DESIGN CHOICES
Public interactive displays should be peripheral to the attention and activities of passers-by. Still, it is important to convey an opportunity for interaction, in a way that is not disturbing and that can be voluntarily ignored. Pointing visually to an interactive hotspot is not always feasible and it is difficult to do in a subtle non-disturbing way. On the other hand, the sound is naturally suited to lead the eye, as it is not constrained by the narrow field of view. Under mild assumptions concerning the architectural environment and the nature of the stimulus, a sound event can be localized in space with decent angular precision, down to a few degrees, depending on stimulus and environment, especially in the azimuthal plane [10]. Spatial-visual localization is much finer, but temporal sequences of spatialized sound events can be perceived as trajectories and can be used to point to an opportunity for interaction [8].

Indeed, the sound of a ball falling down the stairs grabs the attention (check for example the well-known scene of the movie “The Changeling”[1]). A similar metaphor can be used to communicate an opportunity for interaction in a public display. An interaction spot can be signalled with the metaphor of the ball bouncing down the stairs or by other sound trajectories (e.g., a waterfall) that ecologically fit the soundscape. Sound, which could result irritating if continuously diffused in the environment, is activated when someone is in a reasonable proximity of the hot spot, and can be invited to cope with a possibly useful interaction.

System

Figure 1 shows an interactive display that uses a Microsoft Kinect to capture body movements of a person in front of it [7]. Here the audio system is made of four speakers arranged along a diagonal line, wired to two stereo Sonic Impact T-Amp amplifiers, each being fed by two channels of a MicroEdge 5.1 USB Audio Adapter. The speakers system is hanged and visible, in the form of four diamond-shaped flat panels made of thin plywood, 3mm thick, and 45x45mm large, each excited by a Dayton Audio DAEX25Q-4 (< 20 dB SPL variation over 70÷8000 Hz). The acoustic and visual nature of the system allows for flexible and context-related implementations, allowing for integrated “ecological” deployments. The simplicity of the needed hardware makes it suitable for retrofit installations.

Experiments

A first kind of acoustic stimuli is obtained by driving the speakers with bouncing (impact) sounds, thus directly implementing the ball on the stairs metaphor. Other audio patterns are possible, such as a liquid sound stream that traverses the four speakers, thus clearly indicating a directional flow. Another interesting pattern is a sequence of impacts simulating a stick being run along a picket fence, which can be designed to give the impression of a grid much finer than the four emission points [4].

The control condition is that of no acoustic invitation. The test condition is a spatio-temporal trajectory activated by a person present in an area surrounding the hot spot. The acceptance of the invitation, that is the fact that the person enters the hot spot and notices the display (possibly interacting with it), may be acknowledged by another acoustic stimulus. The number of interactions and other indicators of involvement are measured in the control and in the test conditions. Possibly, different kinds of acoustic sequences will be tested.

The acoustic stimuli are synthesized with the Sound Design Toolkit [3]. In a first run of testing, prerecorded stimuli are arranged into spatio-temporal sequences and played back to potential interacting individuals. In a second run of experiments, the acoustic stimuli will be made themselves interactive, or sensitive to the behavior of passers-by. The latter solution is preferable in an ecological sense because it allows generating ever-changing and context-sensitive sound generation.

[1] https://youtu.be/uaPLQidZub4

FUTURE WORK

We plan to use the proposed system design and deploy it in a real scenario, in order to conduct a long-term evaluation.

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