

# New Musical Interfaces in Context: Sonic Interaction Design in the Urban Setting

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## ABSTRACT

The distinctive features of interactive sound installations in public space are considered, with special attention to the rich, if undoubtedly difficult, environments in which they exist. It is argued that such environments, and the social contexts that they imply, are among the most valuable features of these works for the approach that we have adopted to creation as research practice. The discussion is articulated through case studies drawn from two of our installations, *Recycled Soundscapes* (2004) and *Skyhooks* (2006). Implications for the broader design of new musical instruments are presented.

## Keywords

Music, Interaction, Urban Design, Architecture, Sound Installation

## 1. INTRODUCTION

This paper advocates a closer relation between public sound art and new musical interfaces. The position adopted is that new musical interfaces demand new musical contexts, and vice-versa. Arguments are based on an analysis of two of our interactive sound installations executed for public space, and upon bodies of evidence from art, design, music, and cultural studies. Some questions of interest include: What are the advantages and challenges that accompany new interactive technologies situated in urban space? What can be learned from accidental or incidental audiences, such as those found in public areas of the city? What criteria are useful to guide the design of sound interfaces in the public sphere? Considerations such as these can be understood to have a broader significance for the design of new musical instruments, including those outside public settings.

### 1.1 Characterizing urban sound installations

A typology of sound-based artworks in public space would exceed the scope of the present work. A broad categorization

can be made, into:

1. *Embodied, or instrumental* [3], *interactive sound installations* in public space, consisting of those installations that possess a physical embodiment or interface through interaction with the artwork is mediated;
2. *Non-instrumental interactive sound installations*, consisting of those whose quality depends on actions by those in its vicinity, but not in a way that is driven a tangible interface;
3. *Non-interactive sound installations*, in which a sound environment is presented whose significant sources of variation do not depend on actions by those in its environment

This paper addresses the first category of those listed above. Examples of interactive, embodied installations in public space are comparatively few. Producing these works poses a range of difficulties that are familiar to artists working in public space.<sup>1</sup> Although conditions vary between works and sites, among these challenges, one can readily cite the diverse audiences, often with no prior exposure to the work or training with its interface, making for a varied, changing, often transient user group. Exhibition conditions can be difficult, due to weather, logistics, and technical issues. Further, special consideration must be made for contextual sensitivity, and for the uncontrolledness of the spaces involved.

As a result, the complexity of these works must often be limited, relative to what might be accomplished in a gallery setting or in a traditional musical instrument design. Limitations on complexity pose a challenge to design for instruments that afford expressivity or expertise, because they must often have a fast learning curve. For reasons of accessibility, direct interface mappings (for example, gesture-to-sound mappings) are often preferred. This raises the question of how interfaces may be made simple without becoming boring. One answer evidenced by a number of works is a shift in emphasis from expressive and high-fidelity gesture-to-sound mappings (desirable traits for gestural music controllers for performance settings), toward technologies that serve other complex purposes. A work may instead be oriented toward revealing the invisible informational fabric of its surroundings, or toward creating new relations between people, or between people and their surroundings.

These works are notably challenged by their situatedness within often complex, multilayered, and multi-purpose areas

<sup>1</sup>Also noted in prior literature [2]. See the work by Greyworld (<http://www.greyworld.org>) for further examples.

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Figure 1: Recycled Soundscapes system.

of the city - settings with which they are forced at some levels to engage with. While one might regard these contextual issues as sources of interference that impede the functioning of interactive urban sound installations, we believe that artists are better served when they are able to profit from the rich constraints for design that accompany such working conditions.

## 1.2 Recycled Soundscapes (2004)

To make the discussion begun above more concrete, we discuss our work Recycled Soundscapes, a set of inter-related sound instruments that we installed at several sites during 2004, the last occurring in the high traffic public area of the Place Igor Stravinsky during one week as part of the *Resonances* festival at Ircam/Centre Pompidou, in Paris, France. This work has been described and analysed in detail in a prior publication [8], and we will only summarize the main points here.

The installation (Figure 1) consists of three large sculptural interfaces which allow to capture and perform sounds that are obtained in part from its surroundings. No written or verbal explanation is furnished to its users. Consequently, interaction with the system is a process of discovery, or of mutual explanation, on the part of users, with some offering their advice or perspective to newer arrivals.

### 1.2.1 Interaction description

Most prominent among the instruments of the installation is a tall red device called the Beludire. It allows for listening to and recording sounds from different directions in its surroundings, at a distance, by means of a set of headphones and embedded parabolic microphone. A button on the device allows the listener to select when to record a sound that is overheard. Once captured, the sounds are echoed, from loudspeakers integrated within the other two instruments. The recorded sounds are then archived as part of the acoustic memory of the location.

This memory may be evoked and performed by means of two other instruments, called Sonic Bowls, that allow to compose new soundscapes integrating previously recorded sound. Their input device is a reflective black dish, that users spin to generate a resonating sound, similar to a Tibetan singing bowl. As the interaction proceeds, the soundscape evolves through scenes incorporating bells and other

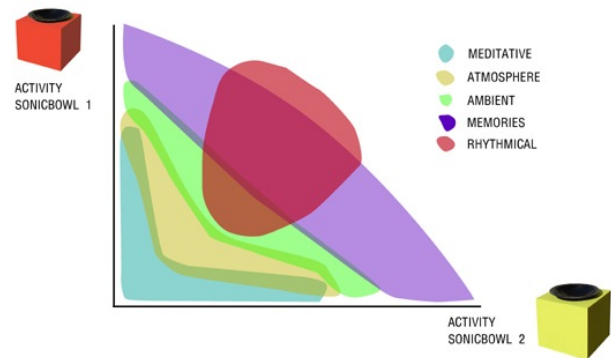


Figure 2: The soundscape becomes richer when two Sonic Bowls are in use.

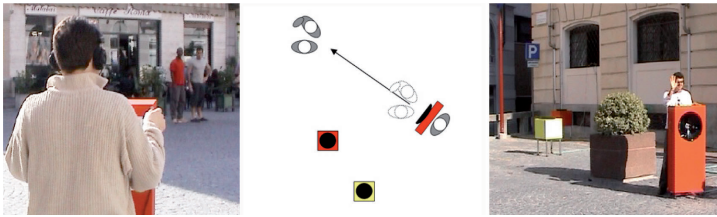
elements elicited directly in response to nuances in the manner of rotation. After a threshold of activity is surpassed, stored sonic memories of the location begin to be awakened from the bowl, unpredictably, and mixing with the other sonic elements into a composition closely linked to the manner and nuance of rotation of the bowl itself.

This composition is constructed out of a layering of mappings, depicted in Figure 2, providing a sonic terrain that may be both performed responsively and navigated according to measures assessing the level of interaction (amount, rate of spinning) effected over a set of timescales ranging from 50 milliseconds up to a more than a minute. At intermediate timescales, the sonic memories overlap one another and combine with other instruments. The precise gesture-soundscape mapping depends on the mutual state of both bowls, and comprises a range of moods, including meditative sonic layers, and more playful modes.

### 1.2.2 Observations and analysis

The installation forged a connection between sonic (performative, listening) activities, individual behaviors, and social interactions in its surroundings. A number of patterns were seen to emerge in the course of the several public experiments that were conducted with it.

*Social listening* emerged around the Beludire, whose users take on the conspicuous role of auditory spies relative to their surroundings. The device is somewhat polarizing, provoking occasional negative reactions among those who resented being overheard, but a willingness to explore the social-auditory connection on the part of others (Figure 3.) *Introspection and discovery* were seen in certain individuals, who spent significant amounts of time (from a few minutes, to a half an hour or longer) carefully exploring the sensual properties of the instrument, or its recorded contents. *Performance* was a common theme, as groups of participants constructed sometimes elaborate scenes, in which a certain performance was arranged to be recorded at a distance on cue. *Sonic play* was observed in both intended ways, with users accessing the playful modes of the instruments by performing both sonic bowls in tandem, and informally, as diverse games were constructed around the instruments. Finally, the devices became *focal points of curiosity and discussion*, with users exchanging advice with each other as to the intended use of the instruments, or speculating as to their possible mechanico-acoustical or logical functionings.



**Figure 3: Social dynamics generated by an auditory spy operating the Beludire.**

The range of social phenomena that were observed was in large part unplanned. Their observation suggests that, rather than posing undue difficulties, the public context of the work is likely its most enriching feature.

## 2. PROFITING FROM PUBLIC SPACE

The obvious challenges of producing interactive sound works for public space represent at the same time one of the features that makes them most interesting. Such spaces create opportunities for the exploration of alternate contexts, and for encounters with more and new users. The works can become, as in *Recycled Soundscapes*, platforms for the discovery of new use concepts for sonic instruments and for public space itself, uncovering structural and social urban design possibilities and, or new kinds of play. Such environments also foreground certain kinds of questions, such as those related to persistence and memory associated to a location. *Recycled Soundscapes*, for example, addresses this last possibility directly, by constructing a soundscape as a collective memory process.

Public environments provide special opportunities for the designer to situate her work in a complex ecosystem. In such settings, a more minimal sound and relational design may, suffice, provided appropriate consideration is given to their integration with context. Sonic details may well be designed at course levels, leaving finer ones, if present at all, to be discovered by the occasional, more sensitive, visitor.

Architects and designers of public space have for many years conceived of sensual encounters in the city as providing opportunities to enrich our conception of public space and relations in it. In design for public space, accommodation of a large range of actual and potential users is required. It is argued in Section 3 that this is significant for processes of democratization that may be driven by a work's intervention, particularly in interactive works.

### 2.1 Urban probes: design from context

Among the most important ways that public environments contribute to research on sound works is by providing them a context for design by discovery. This process can include an exploration of the potential latent in new interactive artifacts and sound at an abstracted and non task-oriented level. Its aim is to uncover social, conceptual, and structural opportunities for embodied sound interfaces in public space, and the various relations between people and environment that support them.

The methodology employed is based on lightweight, "fail-fast" experiments, involving the introduction of artifacts or systems into public spaces in which they may encounter and engage with a user population in a real world setting. Ob-

servations are gathered that accrete and highlight behaviors in people that may be caught up in the encounters. The results are used as the substrate from which new design ideas are developed. Such methodologies have appeared in several areas of interaction design over the past few years, manifesting as *Domestic Probes* [9], *Technology Probes* [11], and, in work by Paulos and Jenkins which lies closest in spirit to our own, *Urban Probes* [13]. Paulos and Jenkins describe these as, "provocative interventions designed to engage people in direct discussions about their current and emerging public urban landscape – and in the process, reveal new opportunities for technology in urban spaces."

Among observational techniques employed in studies highlighted here are video documentation, observation, interviews and discussion in context, play in context, and questionnaires. For *Recycled Soundscapes*, experiments were conducted over a half-dozen iterations in three cities [8].

## 3. PUBLIC INSTRUMENTS AS ALTERNATIVE MEDIA

The role of media in public space has long been of political import, whether to the agora of ancient Greece or the hybrid physical-digital byways of the 21st century metropolis. Interactive installations raise questions of individual and collective empowerment that hold particular significance. Considerations of the relation between democratic processes<sup>2</sup> and the appropriation of activities in public space have been reflected in alternative media theory. Clemencia Rodríguez has precised what she refers to as *Citizens' Media* as practices that involve the collective enactment of citizenship through the staging of interventions aiming to transform the accepted mediascape [14]. In her work, participants are given training with and access to videographic tools as means of critically confronting their collective legitimized identities and established social codes, by constructing their own images, those of their group, and their environment.

The medium of sound is charged with potential for such effects, due to its ability to *connect*, engendering senses of intimacy, ambiance, and shared experience.<sup>3</sup> One function of artistic interventions that aim at empowerment is to create new space for the mixing of opinion and identity. A poignant example is provided by Erika Rothenberg's *Freedom of Expression National Monument* (1998-2004) – a giant red megaphone on an elevated stand that is provided as a platform and visible marker from which any member of the public may make pronouncements. By contrast, in *Recycled Soundscapes*, a platform was provided for directed *listening* and recording. The way in which the recordings are subsequently de/recomposed transforms the process of self-representation into one of reflection. Through the playback instrument one elicits a mixture of recordings, combining ones own with those of others who came before.

### 3.1 Sociality as expanded performance

Interactive musical performance in public space addresses social and political questions more directly than occurs in

<sup>2</sup>E.g. Mouffe and Laclau [12] have considered social movements surrounding public space as part of a continuous negotiation of different opinions the plurality of whose antagonisms provide the seeds for positive social, cultural, and political change.

<sup>3</sup>Of course, many examples can be cited of sound reinforcing identities, through speech, music, or even soundscape.





Figure 4: Beludire: Focus on listening.

other, more traditional, venues. Sonic instruments for public space operate within existing social ecologies, in addition to the conceptual and aesthetic realms that they inhabit. Notions of expanded musical performance have definite significance for their design, but we must consider that in public, interactive installations like those being explored here, further disruptions of performer-audience dualities are inevitable, to the extent of a suspension of any controlled relationship between the two. Joseph Beuys [1], among others, is noteworthy for having argued for the engagement of the audience as a means to create non-imposed transformations of society, the audience thereby becoming the creator and the enabler of change. “Your activity is perhaps the only one that is capable of taking us back onto the road of non-constrictive action” (Beuys, 1978 [1]). He described this way of moulding and shaping the world as *Social Sculpture*, and over the years embarked on a number of works to articulate this idea – for example, in an urban tree planting action, called “7000 Oaks”, that was executed for Documenta 7 (1982).

Among other artists that have weighed our lived situation in urban space, the Situationist International movement is notable for its criticism of modern society as an ensemble of spectacles in which people are removed from the significant experiences shaping their own lives [4]. As a remedy, they deployed strategies such as *psycho-geography* and the *dérive* for reconnecting citizens and surroundings, promoting the transformative power of the chance physical and psychic encounter. They envisioned a labyrinthine city populated by purposeless installations designed to engage and disrupt the senses in new ways [4]. Recent researchers in mobile sound technology [10] and locative, urban gaming have adopted elements of this ethos as significant for the colonization of our cities by new wireless and sensor-based technologies.

## 4. SKYHOOKS (2006)

Skyhooks is an interactive sound sculpture that we first installed for two weeks during autumn 2006, in Kortrijk, Belgium, in the public square in front of the main theater building. The work was commissioned for the festival Happy New Ears, which ran during the same period throughout the city. Its visitors included several hundred guests visiting Kortrijk during the festival, and thousands more who happened upon it by chance in what is a popular city square.

The project consists of a skyscape filled with invisible sounding objects (ISOs) distributed throughout the three dimensional space above a large section of the square. These are performed with a set of five large, pink helium-filled bal-



Figure 5: Skyhooks: Group interaction.

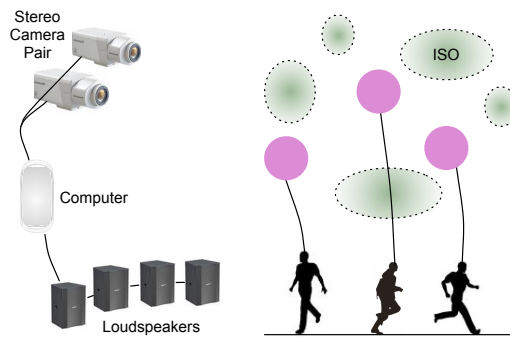
loons (1.5 meters in diameter), attached to helmets and mallets to be donned or held by users. These artifacts acted as instruments allowing to excite the menagerie of ISOs floating about substantial area of the square, an area approximately 30 meters by 30 meters in size. The use of such props was meant to reinforce the metaphor of sound as tangible matter, embodied in the ISOs that could be struck, overhead, with balloons. The sonic composition is generated by sound events driven by collisions between balloons and ISOs, and between balloons. Some motivation came from everyday experiences in which our gestures are mapped to sound: the ringing of a church bell, or the rhythmic running of a stick across a metal handrail. The sonic identities of the ISOs and of the balloons comprised a range of everyday sound events, including individual impacts with resonant objects (wooden bars, etc), cluster impacts with such objects, and other sounds reminiscent of natural sources.

### 4.1 Technical design

The work was required to be sufficiently robust for the rigors of outdoor installation, while being lightweight enough to develop and deploy within a short timeframe and with modest resources. The balloons are affixed at the end of tethers to blue, custom-modified construction helmets, and all electronic equipment is housed in a separate building. See Figure 6 for an overview.

The sensing mechanism is based on the color tracking of balloon positions in three dimensions, using a stereo pair of video cameras, with a 1.5 meter baseline. Rather than attempt detailed reconstruction of the position of each balloon, the work uses the inferred vertical and horizontal position within the field of view of the camera together with stereo disparity to determine balloon impact events with the ISOs or other balloons. If a collision is seen in the projected field of view for each camera separately, the two objects can be inferred to be in contact.<sup>4</sup> The video processing and tracking are implemented in Max/MSP/Jitter and the collision

<sup>4</sup>Other works reconstructing the detailed 3D position of a set of balls in space exist, but as in *Squidball* [7], they have tended to be much more complicated.



**Figure 6: Technical overview of the Skyhooks system.**

event detection is implemented in Javascript.

Sound events are parametrized by features of the collision between objects, including the inter-object distance, and speed of impact between the balloon and the ISO. Sound synthesis was based on a large library of sample instruments. Reproduction was accomplished with a four channel loud-speaker array set in the theater building's facade.

The system was designed to be technically invisible. Users were generally aware that the sounds were produced by loud-speaker, but, based on our interviews, were unconscious of the mechanism involved in generating the sound. The cameras and related equipment were not visible. The work was, facilitated by an assistant, who introduced a subset of participants (or those curious to learn about it) to it, providing them a helmet or mallet, and explaining the existence of the invisible ISOs hovering over the square. More participants obtained their interface from other participants, who could often be observed (as in Recycled Soundscapes) to create their own explanation for the operation and meaning of the work.

## 4.2 Observations

Observations were gathered from hours of video recordings, interaction and interviews with participants during the installation, and a range of intended and unintended phenomena were noted. *An upward diversion of attention* in visitors was apparent, as though the urban sonic space were extended vertically and rendered sonically meaningful. *Jumping* was a common behavioral manifestation. Visitors seemed to imagine themselves lightened by attachment to the balloon devices (which in reality left them heavier).

*A unity of modes of listening with walking behaviors* emerged, as many users explored the work by meandering around the area of the installation. A few, confused or unaware of the boundaries of the installations, wandered with helmets attached well beyond it, and out of the public square itself, listening for the invisible city-sounds they imagined themselves to be exciting.

*Play and self-organized performance* manifested in groups of 2-3 individuals improvising games or play, and negotiating rhythms, or in larger groups coordinating simultaneous events, such as the launching of several balloons into the sky toward the ISOs. *Isolated explorations* were likewise noted, with individuals engaging for a long time with a single ISO in a single location. One child was recorded while jumping toward an ISO for perhaps twenty minutes.



**Figure 7: Unexpected interactions in Skyhooks**

*Unexpected uses* were abundant, including *users on bicycles* effecting a speedup in the pace of events in the installation (Figure 7). A *wind-driven autonomous soundscape* appeared, as balloons otherwise at rest were blown about.

In interviews, some adults (especially those accompanying children), felt that the installation is “for the kids”. Adults accompanying children seemed less likely to interact with the installation. Some users were conscious of the comical image they presented when wearing a helmet attached to a gigantic balloon. Apparently more musically sensitive participants lingered to discussed aspects of the sound design at length.

## 4.3 Functional assessment

The work satisfied our main goals of gathering basic knowledge about contextual and individual interactions that might accrete around its elements. The balloon as interface is a displaced instrument over which the user has limited direct control, sometimes moving quite quickly over space. The loose connection and agency weaken the mapping between the user's intent and the sound generation, which we regarded as mostly undesirable. The most intentional phenomena in the work seemed to be the collisions between balloons themselves, where the sonic event could be associated to an unambiguous haptic and visual event. The physical embodiment of virtual sound sources undoubtedly leads to a stronger sense of presence. For some users, the mental model for the installation seemed to be a problem, as additional explanation or exploration was necessary to convey the concept behind the interaction. Undoubtedly this is because the scenario has no ready everyday correlate.

Practical advantages of this design are that it permits a large number of users to interact with the system in a more or less unconstrained way, without the danger that important system components may be damaged. Indeed, it proves robust to anything but the occasional lost balloon.

## 4.4 Documentation of installations

Further documentation of both Skyhooks and Recycled Soundscapes, including photos, sample video and sound record-



Figure 8: Walking to explore the skyscape.

ings, and prior publications (in the case of Recycled Soundscapes), is available from our website <http://www.zero-th.org>.

## 5. CONCLUSIONS

New approaches to the design of musical interfaces fall out easily from reflection on the distinctive qualities of sound instruments for public use in urban spaces. The NIME ethos undoubtedly values musical opportunities created by new technologies, but arguably also demands a consideration for alternative audience-performer relations, parallel theoretical developments in art, music, and cultural studies, and moreover for new contexts of presentation and exploration. Broadly considered, this last includes new cultural situations, unconventional arenas for art and music making (such as urban spaces charged with new technologies), and a critical consideration of the relation between interfaces for creating sound and their setting.

There is a strong precedent for richly reading sounds and musical instruments in context, with many examples provided by anthropology and cultural studies. Sonic cues have often been seen as distinctive of cultural territories, as for example in Alain Corbin's study of bells as acoustic markers of place in 19th century France [5]. Ethnomusicology has provided an immense number of relevant examples from explicitly musical sources.

Other areas of human-computer interaction have taken cultural contexts, and their role in design, more seriously than they have often been taken in the NIME community. In his essay "Implications for Design", Paul Dourish summarizes these developments in arguing for greater acceptance of the range of roles that ethnographic inquiry has taken in design over the last several decades [6]. Its contributions grew in scope from their narrow origins in the description of practices and habits of potential user groups, to broad framings of situated encounters and partnerships blending both sides of the designer-user exchange, as in the participatory design movement. Urban Probes were mentioned in this essay as one methodology that can be applied to the study of musical instruments in the city, but related methods exist that would be equally valuable to other contexts.

A familiarity with the history of music in most any culture can lead one to conclude that innovations are often formed and enlarged by connection to significant extra-musical cultural contexts, for example, in ritual music, theater, dance, economic conditions, etc. One might draw from this that new musical interfaces are unlikely to survive, impact the way we make music, or otherwise attain meaning through the creation of new technologies for musical interaction alone. Rather, they may be more likely to do so through their relation to the sonic and life contexts in which they are situated,

be they concert halls or city streets. As designers, we should profit from the integration of new contexts and new users into our creative research and practice.

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