Microsound in public space: compositional methods to enhance site-specific sound

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This article documents the resolution of a problem encountered during the design of a semi-permanent interactive sound and video installation currently being installed at a tram station located in Dublin, Ireland. This artwork generates video and multi-channel sound output in real time, responding to changes in traffic patterns on an adjacent street. While the visuals are composed from pre-recorded content, the sound environment explores the use of site-specific sound within public urban space by sampling and processing sounds that occur naturally in and around the station. Regulations involving the artwork's volume resulted in the sound output being reduced to a level at which it was too subtle to be noticed amidst the busy activity of the station. It was therefore necessary to strengthen the artwork's aural presence without interfering with the subtleties of the site-specific sound environment. A dynamic field of sine tones and rhythmic glitches was composed to augment the more subtle sounds of the installation. This juxtaposition of site-specific sound with compositional structures associated with the popular musical genre known as *microsound* proved to be effective, calling attention to the mediated sound environment even at low volume levels and balancing the artwork's presence with the other functions of the site.

1. INTRODUCTION: NOISE DESIGN AND SITE-SPECIFIC SOUND

Recent forms of urban design often consider large-scale media installations sited in public urban space as elements of a fluid or liquid architecture that is as much a part of the urban experience as traditional architectonic forms and urban infrastructures. Björn Hellström's book *Noise Design: Architectural Modelling and the Aesthetics of Urban Acoustic Space* considers this notion in relation to the use of sound as a component of public urban spaces (Hellström 2003). Hellström invokes John Cage and Luigi Russolo as well as the WFAE (World Forum for Acoustic Ecology) and the Cresson Institute (Centre de recherche sur l'espace sonore et l'environnement urbain) in his thesis, pursuing the belief that sound installations that work with 'the multifaceted, interlacing sonority and the variety of sonic rhythms and nuances that make up everyday acoustic space' support 'heterogeneous, seductive, and colourful' spatial forms that can diversify the experience of public urban locations (Hellström 2003: 29). Hellström's research introduces concerns usually confined to isolated artistic practices to a more concise design methodology that formulates conceptual tools for working with sound in specific urban contexts.

Hellström's work ties in with discourses surrounding site-specific art, extending from its inception as a place-bound tradition stemming from minimalist art in the late 1960s through more discursive formulations of site in the 1980s and beyond. Many forms of site-specific installation involve collaboration between artists, architects, urban designers, and various community organisations, resulting in projects that span the boundaries between urban design and artistic practice (Kwon 2004: 77). Following Hellström's research, it is apparent that one of the most important aspects of working with sonic interventions in public space is ensuring that the site-specific relationships established between design processes and their referent sites can be perceived by members of the public whom these processes seek to address. Sound artist Brandon Labelle and multimedia artist Achim Wollscheid have each pursued such issues in their work, constructing site-specific and site-responsive forms that act as interfaces or modes of interference located between a given referent site and the perceiving subject (Wollscheid 2001; Labelle 2004). These models of site-specificity explore the direct relationships between the referent site's input and the artwork's output, providing an intuitive dialectic that can be directly apprehended by the artwork's audience.

These concerns related to site-specific and site-responsive sound composition contributed to the design of the project documented in this article. Given that the project took place in a complex urban space, the contextual framework provided by the site was not merely a passive set of conditions waiting to be responded to, but an active agent that shaped the artwork's form, intervening with various functional requirements and practical intrusions. Before considering these problems and their subsequent solutions, this article will discuss the project's background and structure, providing a detailed evaluation of its programming, composition, interactivity and site-specificity.

Organised Sound **13**(1): 51–60 © 2008 Cambridge University Press. Printed in the United Kingdom. doi: 10.1017/S1355771808000071

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

As documentation of this project is still in progress at the time it was written, this article does not include specific reference to associated sound and video files. These materials will be available on the Internet along with more detailed information concerning the artwork's physical installation and technical set-up as well as links to all of the individuals and organisations involved in its inception and realisation.[1]

2. PROJECT BACKGROUND

In early 2004, artist Ciara O'Malley[2] invited me to join her in designing an interactive public art installation based on the work she had done the previous year after receiving The Fire Station Artists' Studios' 'Studio Award for an Artist in the Community'.[3] The project was entitled *Streets: Past, Present, and Future* (referred to hereafter as *Streets)* and was to be based on a vast amount of content collected during a series of workshops with community groups and individuals located in North Inner City Dublin in Ireland. This content, in the form of writing, painting, sculpture, photography, video, recorded conversation and mixed-media works, was themed on discussions of the local neighbourhood, highlighting individuals' personal experiences as well as views concerning the area's future. North Inner City Dublin has a reputation for both a strong sense of history and community as well as a significant array of problems, including drug abuse, violence and homelessness, and the area is currently undergoing rapid redevelopment and urban renewal. The *Streets* project sought to open up a constructive dialogue around these issues, and to give community members a chance to reflect on their experiences within this unique, dynamic section of Dublin. O'Malley's work through The Fire Station Artists' Studios had originally focused on developing similar content with a smaller number of community groups, culminating in a group exhibition held at Cluid Housing's Killarney Court Community Centre, earlier in 2004. The *Streets* project was planned in order to continue this work on a larger scale with the hope of developing a public artwork that would present the vital history and sense of community within this area of Dublin to the rest of the city, while creating a meaningful, fulfilling artistic process for the individuals who contributed their time and creativity by participating in the project.

Based at Fire Station Artists' Studios, I worked with O'Malley collecting this content in 2004 and 2005, simultaneously conducting workshops with project participants attempting to determine the form of the final artwork that would be able to accurately represent the diverse media that we were collecting. As the database of content continued to expand, the plan for the final artwork shifted from original concepts that highlighted more physical, sculptural elements to an entirely software-based system involving spatialised sound and a series of video projections. This system was to be somehow driven by live input taken from the site chosen for the final installation, which at that point had yet to be determined. The live input would tie the installation in with the social space of its site, connecting the audience's experience of place with the narrative emerging from the artwork. The video projections and sound output would be generated in real time from elements in the content database using custom-designed software, resulting in a constantly morphing nonlinear narrative that would reflect the dynamic nature of all of the opinions and reflections that the artwork was designed to represent.

Later in 2004, the Fire Station Artists' Studios, O'Malley and I approached the Railway Procurement Agency[4] (referred to hereafter as RPA) with a proposal to install this artwork at a recently completed tram station situated adjacent to the neighbourhoods explored by the artwork. RPA was planning to open the first lines of this above-ground tram system, the Luas,[5] in Dublin in late 2004, and the terminus at Connolly Station seemed an excellent location for *Streets* given the quantity and diversity of people who would be passing through the station on a daily basis. RPA accepted the proposal, and I began working with senior landscape architect Tony Williams and senior architect Neil O'Brien on planning how to integrate the art installation into the station's architecture and daily functions, projecting that the artwork would run for approximately two years. Given the amount of time required to finish all of the workshops with community groups, the software programming, and the physical installation of this artwork, the official launch date gradually shifted from early 2006 to early 2008.

3. PROJECT OVERVIEW

The Luas terminus at Connolly Station is a covered outdoor location situated along Amiens Street, a busy road with relatively diverse traffic conditions and pedestrian usage in North Dublin. The station is covered by a series of elegant off-white canopies stretched taut between support beams resting on columns, giving the site an open, modern ambience. At the north end of the site is a shelter area in front of where the trams stop to let people on and off, while two tracks stretch towards the south past a tapered pedestrian area containing benches, which extends beyond the canopies and merges with the adjacent sidewalk. The tram station is directly attached to the

[1]http://www.svenanderson.net/streets
[2]http://www.ciaraomalley.com
[3]http://www.firestation.ie
[4]http://www.rpa.ie
[5]http://www.rpa.ie/luas

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press





Figures 1 & 2. Canopies at Connolly Station, showing test projections during early stages of the development of the Streets installation (photos taken by Neil O'Brien).

older part of Connolly Station, which is one of the largest transportation hubs in the country, providing rail access to cities throughout Ireland. Luas trams that service various stations in Dublin enter and exit the station very frequently, often with only seven to ten minutes between consecutive trams.

Seeking to integrate the artwork's sound and video with the station's architecture as much as possible, *Streets* includes two video displays projected by two high-performance LCD projectors (Figure 4) and a six-channel audio system to distribute sound throughout the site. One video display is projected onto a five-metre screen located on the back wall of the shelter area while the other projects overhead onto an area approximately twice that size, fragmenting over the support beams and warping over the curvature of the canopies (Figures 1 and 2). The six loudspeakers are arranged in groups of two, covering the area inside the shelter (Figure 5), the area underneath the canopies (Figure 6), and also projecting down along the pedestrian area that extends out of the station along the train tracks. The installation runs for three hours every evening beginning at dusk, ensuring that the images displayed by the projectors are bright enough to be seen from a variety of perspectives in the station and from the adjacent street.

4. SYSTEM DESIGN

The installation's software system runs on three computers. Two workstations with high-end graphics cards render the real-time visuals and a consumer-grade desktop equipped with a multiple-channel sound interface produces the six-channel sound environment, also in real time. All of the video output, content management and control functions are carried out in VVVV (a graphical programming environment optimised for video processing and multiple-computer multi-media installations),[6] while the sound component of the installation is executed in Pure Data[7] and Audiomulch.[8] Synchronisation between the three computers is carried out through a combination of TCP and UDP connections allowing the individual software components to communicate with each other.

The artwork's visual output consists of text and still images extracted from a content database (comprising the contributions from community participants) and rendered in real time over a layer of video loops that my collaborator Ciara O'Malley and I shot in the streets of North Inner City Dublin (Figures 7, 8, 9 and 10). The content is organised into themes so that the images and text that are displayed can be assembled in different orders that form meaningful sequences. The backend structure creating this nonlinear narrative parses information from a database of XML files containing configuration settings, textual content, and pointers to associated still-image files. The backdrop of video

[6]http://www.vvvv.org
[7]http://www-crca.ucsd.edu/~msp/software.html
[8]http://www.audiomulch.com

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

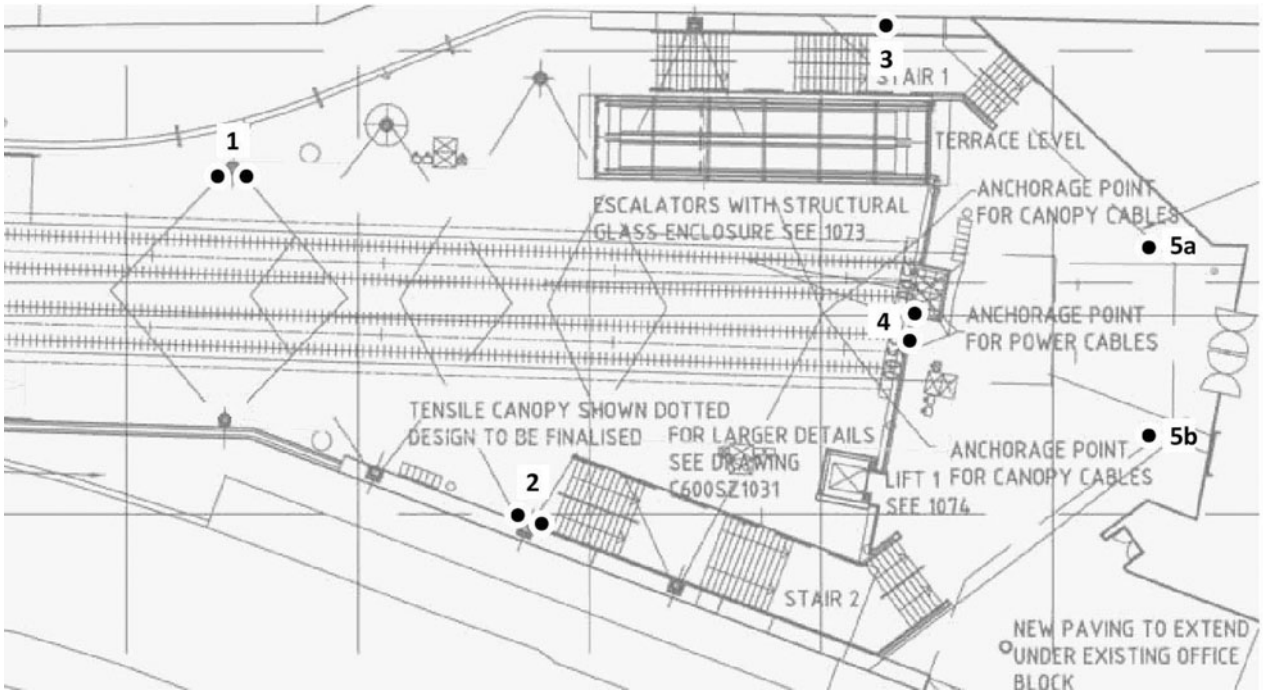


Figure 3. Equipment locations superimposed on site plan showing the two video projectors (4), stereo microphone (3), loudspeakers within the shelter area (5a & 5b), loudspeakers underneath the canopies (2), and loudspeakers projecting into adjacent pedestrian space (1).

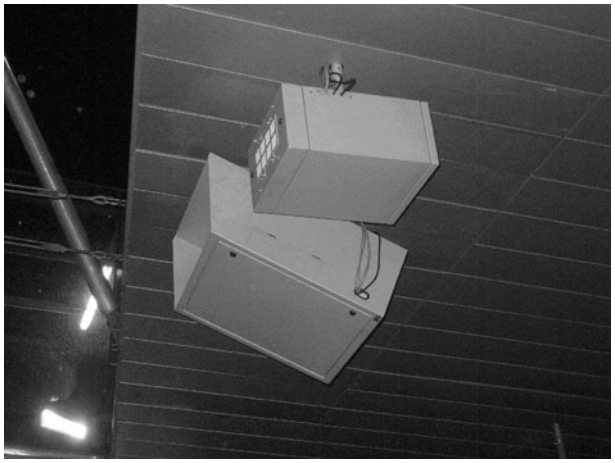


Figure 4. Projectors mounted within weatherproof enclosures in shelter area (photo taken by Neil O'Brien).

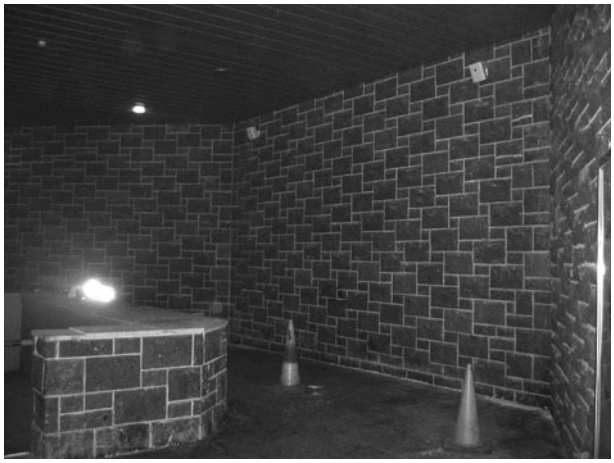


Figure 5. Loudspeakers in station shelter, above projection area (photo taken by Neil O'Brien).

footage shot in the surrounding community contextualises the more literal content of the text and the abstract content of the still images, providing the artwork's audience with a unique view of local histories and opinions that merges with images of local landmarks, street culture and residential settings. These layered visuals are subjected to subtle amounts of video processing and video feedback that distort them in real time and demonstrate the installation's generative, constantly evolving compositional process.

The strategy employed to guide this emergent visual narrative is based on the belief that different combinations of content segments create relevant meaning through both similarity and through contrast. The content is grouped into twelve major themes: Second Chance, New Beginnings and Recovery; Integration of New Communities; Children's Perspectives; Hopes for Young People; Personal Desires Concerning Housing; Current Situations and Problems Concerning Housing; The Past and Local Histories; Larger Scale Change,

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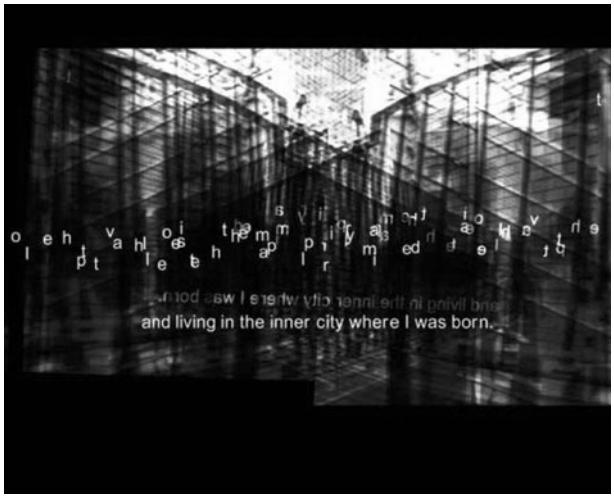


Figure 6. Loudspeakers mounted on canopy support columns (photo taken by Neil O'Brien).

both Hopeful and Critical; Community Improvement, both Hopeful and Critical; The Local Environment; Personal Hopes, Dreams and Aspirations; and Homelessness. These themes were constructed after reviewing all of the content gathered from participating community groups, in order to loosely organise the majority of the various contributions. Besides these themes, the software also has access to several groupings of content based on larger projects in which many participants created content with similar aesthetic qualities, such as a series of *haiku* paired with black and white photographs created by one participating community group. The software composes randomly generated playlists of these content groupings, within which it organises randomly generated playlists of individual content elements. Each content element consists of a series of images and a series of lines of text. As the images slowly pan, zoom and fade into each other, each line of text is composed in sequence and









Figures 7, 8, 9 & 10. Stills extracted from the installation's video output, demonstrating the layering and fragmentation of various images with moving text.

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

layered on top of the images. The text is animated so that each line appears and disappears in swarms of letters. This effect seeks to emphasise the real-time processes at work in the software, communicating the unstable nature of the narrative to its audience.

As the software continuously combines the content in different sequences, new stories are formed as diverse images and chunks of text are organised around each other. Passages with a greater sense of narrative continuity occur as the software cycles within a given theme, while the transitions between one theme and the next provide ample opportunity for unrelated written or visual content to coincide, often resulting in interesting juxtapositions of narrative perspectives. The content presents a variety of both images and writing, representing the diversity of the contributors, who varied greatly in age and experience. Despite this diversity, the general focus on observations relating to the past, present and future of North Inner City Dublin gives the project coherence, even when the written narrative jumps from one perspective to the next, or when images from different themes are layered on top of each other. This common focus combined with an allowance for a certain degree of indeterminacy ensures that the artwork is always creating new stories while still presenting a meaningful narrative, with the hope that the artwork will continue to engage the public who frequently pass through the station over the course of the installation's operation.

The sound environment produced by the artwork is intended to link the artwork's general theme – streets – with the activity of the street adjacent to Connolly Station. The artwork's response to its immediate aural environment gives it a sense of site-specificity and strengthens the correlation between the artwork's content, the surrounding neighbourhoods in which most of the artwork's participants live, and the tram station itself, whose modern architecture borders these neighbourhoods and serves as a symbol of change within this rapidly evolving section of Dublin. The installation captures the sound of pedestrian and motor traffic bordering the station on Amiens Street via a single-point stereo microphone located in a small, sheltered enclosure recessed in the wall of the station facing directly out onto the street. This signal passes through a minimal amount of hardware-based signal conditioning (rolling off overwhelming low-end frequencies produced by passing busses and limiting peaks in the signal produced by car horns and vocal outbursts close to the microphone) before it is fed into the installation's software where it is analysed in real time to determine the overall level of activity of the street and the surrounding environment (Figure 11). This value representing activity is sent to both the audio and visual software components where it controls certain parameters that shape the sound and video output.

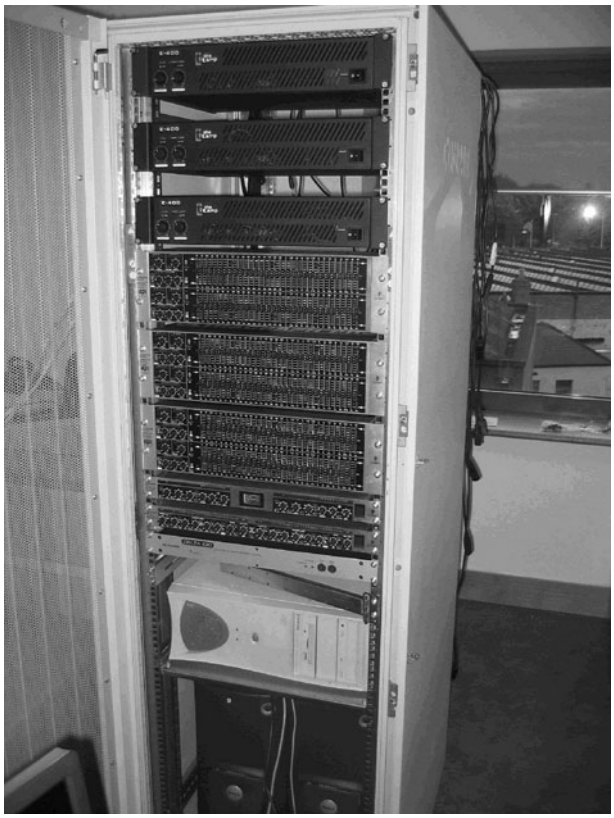


Figure 11. Equipment rack housing audio hardware and computers.

Following the analysis of the dynamics of the incoming audio signal, the stereo sounds are automatically cut into audio loops of varying lengths, fed through a series of subtle band-pass filters and dynamic granulation subroutines, routed through a series of panning and spatialisation modules, and output to the speakers within the station. These loops of minimally processed sounds capture fragments of passing traffic, pedestrian voices and other incidental noises from the street and layer them with the existing sound environment within the station. Given that the station's aural environment is generally dominated by the sounds taking place on the street, these processed sounds are directly related to the natural (that is, unprocessed) sound environment as experienced by pedestrians in various locations, calling attention to the manner in which the processed sounds respond to activity taking place around the site. In this manner, increases in traffic cause the installation to gradually produce a denser sound environment, as the series of overlapping loops panning through the station mimics the active sounds of the street. Less frequent traffic results in quieter, more detailed soundscapes in which waves of voices and the staccato sounds of footsteps captured by the microphone are juxtaposed against the distant hum of the city.

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

Despite the fact that the variety of sounds captured and produced by the installation is rather similar over time (focusing on the rather mundane traffic sounds that dominate the soundscape), the overall effect of the sound environment is quite compelling. The screech of a car braking in the street passes through the software and emerges five to ten seconds later as a slowly panning sound texture stretching from the speakers inside the shelter area out under the canopies and further down the tracks. Long periods of traffic result in a constantly evolving blanket of noise shifting between the speakers, with transient sounds within the loops enforcing a vague sense of repetition and rhythm. The voices of people passing near the microphone on their way into the station are played back for up to a minute, leaving floating scraps of speech dancing between the speakers.

The sound loops described above are synchronised with movements within both of the video projections output by the installation. As each sound loop begins, a slight visual glitch in the motion animating the composition of the video layers occurs, jarring the image slightly in both the horizontal and vertical directions and resulting in a slight reorientation of the patterns created by the real-time video feedback. These glitches are quite perceptible within a video display of such large proportions, as areas of brighter and darker contrast are very rapidly disrupted, breaking the constant, dampened movements that animate the artwork's visual layers. The precise synchronisation of these abrupt visual glitches with the cycle of audio loops ties together the experience of the station's natural soundscape, the processed sound environment, the large-scale video projections and the station's architecture.

The decision to maintain only an abstract link between the artwork's aural and visual components occurred early in the artwork's design phases while testing prototypes of the installation off-site. The original intent was to compose a significant portion of the final sound environment from fragments of speech extracted from audio recordings of a series of workshops based on roundtable discussions with participating community groups, concerning the various themes addressed by the artwork. Specific excerpts from these conversations would be played back to correspond with topics of similar themes within the particular visual content that the artwork was currently displaying, creating a more literal link between the aural and visual content. However, experiments using prominent elements of speech within the installation's sound environment demonstrated that such literal aural content would create the wrong effect within such a large, well-traversed public space, bringing the installation too far into the foreground of perception and becoming rather annoying to people who spent significant amounts of time waiting for trams in the station. This effect – which gave the illusion of disembodied voices hovering in the corners of the station – was deemed too distracting and surreal, and the need for a more subtle sound environment that could coexist with the station's natural sound environment became obvious.

Most of the Pure Data and Audiomulch patches were composed on site late at night within a control room in the station in which the equipment was located. Following each software tweak, I would walk out onto the station platform and observe members of the public within the station as they got on and off trams, waited for buses, or simply passed along the adjacent sidewalk. Based on these observations it was possible to determine how people were engaging with the artwork: People would look towards different speakers as sounds panned across their automated trajectories, turn quickly when a sound with a sharp attack emerged from the opposite end of the station, or pass through the station without noticing the artwork at all.

This iterative process of observation and tuning eventually resulted in the production of a satisfactory set of control parameters, including the setting for the overall volume level for the processed sound and the variables that shaped the manner in which the incoming traffic signal affected the processed sound and visual projections. Increases in audible traffic activity cause certain parameters in the visuals' composition to gradually speed up, resulting in a 'busier' visual composition. These parameters include the intervals between subsequent lines of text, the intervals between subsequent still images being displayed, motion filter settings that dampen and smooth translational and rotational elements of the visual layers' animation, and (most significantly) the frame-rate at which the videos shot in the surrounding neighbourhoods are played back. Quieter traffic and less activity results in very slow, smooth motion within the projections, with the background layer of video content playing back so slowly that it almost seems like a slideshow of still images fading into each other. Busy traffic results in more noticeable video feedback, rapid shifts in the layout of the various visual layers, and fast motion in the background layer of video content. The variables controlling how the installation reacts to changes in its environment are controlled by several filters that ensure that it responds not only to short events but also to gradual shifts in activity over longer stretches of time.

The settings that controlled this link between the surrounding aural environment and the installation's visual output were adjusted until the artwork presented a subtle, site-responsive interaction that could be intuitively understood after a few moments of listening and observation. The installation could be observed in detail by pedestrians standing underneath the canopies with a view of both the projections (in the shelter and on the canopies) and an essentially central location relative to all six of the speakers. The installation could also be experienced from the sidewalk along the street outside

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

of the station where passers-by heard the processed sounds emerging from the station and noticed the images on the canopies – at this perspective appearing more as abstract patterns of coloured light than any form of literal content.

5. PRACTICAL RESTRICTIONS IN PUBLIC URBAN SPACE

Unfortunately, this conclusion that the artwork was satisfactorily tuned to its site was premature. Discussions with RPA revealed that the installation needed to be turned down to a quieter overall volume level given the artwork's location in an operating tram station. The installation needed to be absolutely certain not to interfere with service announcements broadcast over the station's built-in PA system, and given that the neighbourhood across the street included residential properties, the installation's audio output needed to be reduced. Clearly these considerations had been taken into account before this point, but given the uniqueness of this installation and this site, it had been impossible to make any concrete decisions until the project was actually up and running.

The obvious answer to this problem was to reduce the overall volume of the artwork. However, after making this adjustment and conducting subsequent observations, it was apparent that at this reduced volume level, the installation's sound environment was too subtle for most people passing through the station to notice. The artwork's intention had never been to provide a sound environment that would occupy the foreground of the station's aural space, but for the artwork to produce a perceivable link between the station and the content it generated was crucial to its success. The artwork invested in developing a site-specific and site-responsive dialogue with the station; therefore, the references established by the processed sound environment needed to be distinct and audible.

This dilemma wasn't merely a result of restrictions involving volume. The installation was being heard, but it wasn't being perceived as distinct from the site's natural sound environment. Using only sounds extracted from the station's surroundings in order to explore a mode of site-specificity was resulting in the production of a sound environment that was too similar to its aural context. Especially given the degree of randomisation programmed into the sound processing (ensuring constantly varying loop times, panning curves, filter settings and granulation parameters) and the relatively minor use of recognisable audio effects (the filter settings minimising resonance at the cut-off frequency and the granulation merely stretching the sounds by a small time factor), the resultant sound environment seemed very 'natural', and was thus going unnoticed.

6. INCREASING AUDIBILITY WITH MICROSOUND

At this time, I considered two options to augment the sound installation in order to enhance its presence in the station. The first option was to increase the amount of processing being performed on the looped sound output, which would result in sounds whose clearly 'digital' or 'processed' nature would call attention to the installation's workings. The second option was to supplement the installation's site-specific sounds with a set of sounds that were foreign to the site, whose presence within the context of the station would capture the public's attention. I was quite hesitant to pursue the first option, fearing that using more than a subtle amount of processing would disrupt the integrity of the sounds, preventing them from providing the contextual references they sought to establish. Similarly the idea of augmenting the installation with sounds that evoked a context distinct from the station would destabilise the site-specificity that was crucial to the artwork's composition, unless the supplementary sounds were somehow neutral. It was also quite clear to me that developing a more 'musical' structure that presented discrete melodic or rhythmic structures into the space would overwhelm the processing of the site-specific recordings that I intended to augment.

With contextual neutrality in mind, I began to consider whether it would be possible to supplement the installation with a set of sounds produced using techniques derived from recent forms of post-digital minimalist composition such as *microsound* and *glitch* music. The output of experimental music labels associated with this style of music – such as 12k,[9] LINE,[10] Raster-Noton,[11] and Mille Plateaux[12] – often focuses on the production of abstract sound spaces denoted by fields of pure tones punctuated by fragments of audio clicks and cuts. Within these compositions, silence gives way to microscopic sonic structures and shifting digital repetitions, breaking away from notions of purely ambient music and pursuing a more active listening state while still retaining a purely abstract form in which 'notes, pulses, [and] textures bear no immediate relation to the world around them [or] to a language of melody or tonal narrative' (Sherburne 2002: 171). This genre of music is often self-referential in its pursuit of minimalism, stylistic subtlety and interrogation of the digital medium, simultaneously pursuing absolute reduction and an abstract commentary concerning 'the aesthetics of failure' (Cascone 2000), a concept associated with the digital errors that contribute to the modes of production utilised in producing this music.

[9]http://www.12k.com
[10]http://www.12k.com/line
[11]http://www.raster-noton.de
[12]http://www.mille-plateaux.net

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

Employing these production techniques in *Streets* constituted a drastic shift away from the purely site-specific approach to sound originally employed by the installation. However, it seemed to be one of the only options left, theoretically providing audible cues announcing the installation's presence and coexisting with instead of distracting from the artwork's responsive processes and contextual awareness. I proceeded to compose a structure reminiscent of many microsound compositions based on a series of sine waves and transient clicks that would provide a framework for the processed and looped site-specific sounds.

The oscillator bank that produces the sine waves is split into two groups each containing three tone generators, which are assigned random frequencies from a diatonic scale based on the fundamental frequency of 220 Hz and extending up through two octaves. New frequencies are assigned to the oscillators at intervals determined by the measurement of activity on the street provided via the microphone input. Heavy traffic results in shorter intervals between frequency assignments (between 10 and 30 seconds), while the absence of traffic allows these intervals to drift towards up to 90 seconds in length. The oscillators do not ramp to the new frequencies they are assigned – they snap to their new values abruptly, creating audible glitches and pops in the audio output. The output of these oscillators passes through a series of granulation modules set to produce long grains (between two and four seconds) that thicken their output and fragment and multiply the transient noises produced when new frequencies are assigned.

This constant field of modulating sine tones is punctuated by repetitive transient clicks, produced by passing microscopic fragments of low-frequency sine waves (less than 50 Hz) through a steep high-pass filter whose cut-off frequency modulates between 5 and 10 kHz. The period between subsequent clicks is calculated via methods similar to those used to determine the intervals between frequency assignments in the oscillator section, although the time-scale of these intervals is much shorter, with noisy traffic resulting in clicks separated by 2 to 4 seconds and quiet street activity increasing this separation to between 10 and 15 seconds. These clicks pass through subtle granulation (resulting in slightly delayed clicks playing both forwards and backwards) and through a reverberation module set to produce a long reverb trail at a very low volume level. Given that there are two modules producing these sounds, the installation's sound environment always contains two repetitive clicking structures that go in and out of phase with each other as their periods modulate in response to activity on the street.

The combination of oscillators and rhythmic glitches produces a busy soundscape that is dense enough to overpower the more subtle processed location recordings that were already so difficult to distinguish from the station's natural sound environment. To balance the two compositional elements, the clicks and tones are routed through a series of automated panning modules similar to those used to spatialise the location recordings. The random parameters used to generate these panning curves ensure that each set of sounds is routed to different speakers and that they pan through the station at different rates. The activity input from the microphone is used to generate slowly evolving volume envelopes that create an inverse relationship between the volume of the location recordings and that of the digital clicks and tone generators. With these morphing parameters determining both the volume and location of the sounds, the location recordings are brought in and out of focus, with the repetitive clicks and layered sine tones creating vague melodies and fragmented rhythms that call attention to the soundscape without taking too much attention away from the installation's site-specificity.

7. *STREETS*: CONCLUDING OBSERVATIONS

The artwork's sound output is kept at a minimum so that the volume envelopes generated by the software in response to activity on the street cause the installation's presence to oscillate in and out of listeners' peripheral hearing. More punctual sounds recorded by the microphone create peaks in the composition that are assimilated into the rhythms created by the periodic clicks and the gradual motion of sounds drifting between the station's shelter, canopies and extended pedestrian area. In order to strengthen the relationship between the sound environment and the generation of the video projections, a series of visual glitches based on abrupt, un-dampened translation and rotation of various layers of visual content are embedded in the visuals' software. These visual glitches correspond to the audio clicking sounds, creating a tight sense of synchronisation between the artwork's various media. The resulting composition is neither immersive nor purely peripheral; it does not overwhelm the tram station with its presence, but it pursues an agenda that is far more dynamic than that of an ambient sound or visual installation. Given the installation's unpredictable responses to its environment and the potentially challenging nature of some of the processed sounds (which can be quite noisy), *Streets* presents a diverse public audience with a challenging experimental sound environment while subtly suggesting musicality through the random tonal drones and shifting rhythmical clicking that underscore the composition's noisier elements.

The final version of the sound component of the *Streets* installation combining microsound and site-specific sound is played back at a significantly lower volume than the first versions of the software, ensuring that it does not interfere with the operations of the tram

https://doi.org/10.1017/S1355771808000071 Published online by Cambridge University Press

station or project too far across the street into residential neighbourhoods. This version was accepted by both my collaborator Ciara O'Malley and by my colleagues at RPA, many of whom felt that the artwork's presence in the station was greatly enhanced by the suggested tonal structures that occupied the low-end frequency spectrum. Observations demonstrated that the transient clicks were most often the first element of the artwork noticed by individuals passing by the station, as they were enhanced by the station's acoustics to result in very sharp, distinct sounds that could be recognised even when traffic was at a maximum. After discovering the clicks and their relationship to the visual projections, listeners slowly became aware of the sine tones and location recordings and often stood still at their location within the station to investigate how the sounds moved around them. Clearly, not everyone who encounters the artwork is interested in the sounds it produces, but quite frequently, when people hear a distinguishable sound from the street echoed through the installation's software, or notice the installation's general pace accelerate or decelerate in response to momentary bursts of traffic, they are at least momentarily interested in continuing to observe the installation's workings. Combined with the thought-provoking narratives that emerge from the installation's more literal visual content, this system presents a unique experiment linking a multitude of perspectives concerning the history and fate of a rapidly changing city sector with the physical, social and architectural context provided by a busy urban location used by a diverse range of people.

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