IMPLANTS

a 24 channel outdoor sound installation for Zodiak Center For New Dance

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ABSTRACT

This paper documents the design and installation of IMPLANTS, a 24 channel outdoor sound installation I created in Helsinki in 2016 for Zodiak Center for New Dance. While it primarily explores the artistic decisions and processes, it also investigates the research that informed these processes, the reasons leading to my decisions, and later reflections upon how succesful those decisions were.

A large part of this paper goes into technical detail, why I purchased particular components, how I assembled them, the electronic and acoustic challenges, the data flow development and not least, the logistical challenges. At the heart of my project was the quest to achieve a meanignful artistic and sonic experience in that outdoor location within that budget. Making the installation weatherproof and secure, however, was a major challenge which influenced most decisions.

It is hoped that sharing this experience can assist my colleagues and classmates in their own outdoor media art. To any Media Labber interested in creating a multi-channel outdoor sound installation, this paper could be a useful way of gaining quick insights into the challenges, strategies, tricks and obstacles. To them I dedicate this work and wish GOOD LUCK.

ACKNOWLEDGEMENTS

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And special thanks to Laura Basevi for all the hours and weeks she was forced to listen to me tweaking sounds in our living space, which was completely immersed in speakers.

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1. THE MISSION

INTRODUCTION

In April 2016 Zodiak Center for New Dance asked me to create a sound installation for a community garden at Antinniitty in Kannelmäki, Helsinki. My proposal was a multi-channel audio system, 24 speakers placed around the garden allowing sound to move freely about the garden surrounding and encircling its visitors. I built IMPLANTS in summer of 2016 and installed it that September.

1.01 WHY IMPLANTS?

The community garden at Antinniitty began its life in 2016, superimposed on a patch of mud. Strips of land were designated and seeded but it did not resemble a garden for many months. It was a space with little else than a few sticks and some string, that did not really stand out from its surroundings. There was no sound emanating from anywhere inside its boundaries, and no identifiable characteristics, other than dirt. I felt that a distinct auditory selfhood could help unify everything within the space that was to be the garden. There was no noticable life therein. It seemed that sound could bring life to the space. I wanted to bring to a garden in Helsinki some impressions of life I'd experienced in gardens and nature much further south. The sounds of my home in Australia are strikingly louder and busier sounding than any place I'd visited in Finland - not necessarily sweet or beautiful - but bursting with life, or at least the sounds of it.

Life in Finland is noticably quieter than other countries where I've spent time. The streetscape, the forests, offices, hallways and gardens can feel hushed to a newcomer. People and living things seem at first, further apart. The Liro (*Tringa glareola* - Wood Sandpiper) for example, sounds incredibly polite compared with the obnoxious squawks of Australian cockatoos, gallahs and ravens, the full bellied groans of koalas bellowing from trees or the diabolic growls of possums.

Loud sounds screaming out of nearby trees is what I grew up with, what I heard at night as I drifted off to sleep. Distant wookie-like koala groans, bats rustling inside the wall just centimetres from my ears. In the morning I'd awake to screeches of cockatoos. In Finland I had been given two years of comparitive silence, time to explore my own head. This was probably a healthy opportunity but not always comfortable. I sometimes missed the vivacious cacophony and spontaneous chorus of the Australian forest. The forest or 'bush' is considered a realm in itself. People who escape citylife are said to have 'gone bush'.

But in this project, probably more important than the sounds themselves is the spatial carnival and kaleidoscopic jack-in-the-box-ing of these bush dialogues and choruses. If you are to lie on your back on the forest floor with your ears open, the sounds seem to appear and reappear in magical, shifting formations around your periphery. Sometimes the sounds are still but often they are moving, usually high above you.

I was always drawn to the music of Anton Webern for this quality. His *klangfarbenmelodie* brought moving reflections and refractions of colour to the orchestra. Kaleidoscopic shifts and spatial colourisation made the timbre structurally integral. But nowhere have I heard this more beautifully realised than by animals in the Australian bush.

While birds were a primary motive to my goals at Antinniitty likewise were insects. Like birds, they move around the garden, circling, swirling, disappearing, reappearing, emerging and converging. Here I must mention the politely circumspect nature of Finnish bugs, at least sonically. It's hard to imagine a place more teeming with mosquitoes than northern Finland. The air seems filled with them, they hover above lakes by the million and yet hardly make a sound. I compare this with the near deafening outbursts of sonic energy coming from the insect life of places I have visited in northern Australia or south-east Asia. The insects can overpower any other sound.

When I visit my antipodean home I am sometimes struck and startled by what I believe to be the influence of these creatures on the people, the sense of sonic sociability and the perceived threshold of insolence. At what point does someone's voice become offensively loud? By my own Australian standards, I have never heard this threshold crossed in Finland.

I wanted to bring some of my aural experiences to Antinniitty. It didn't necessarily need to be loud or obnoxious but I wanted to introduce a sonic energy and sense of effervescent movement to the patch of land where the plants were slowly, steadily growing. I felt that by giving the garden its own sonic universe it could become its own being. That individualised audible traits and a sonic charisma could help the garden find an identity within its own auditory and physical surrounds.

1.02 ZODIAK AND 'MINUN NIMENI ON'

IMPLANTS formed part of Zodiak's 'Minun Nimeni On' (My Name Is) project, an 'outreach' program based on the Helsinki Model of the Cultural Office, which encourages communal participation in art and culture. In 2016 Minun Nimeni On inaugurated the Antinniityn Yhteisöpuutarha, a community vegetable and herb garden in a public field, in a residential area of Kannelmäki, Helsinki. Under the guidance of gardener Janne Länsipuro, free weekly workshops saw the creation of a large vegetable garden by participants from the community, which they developed and maintained throughout the summer months.

The cultivation and eventual harvest of the vegetables coincided with an end of summer Urbaaniluonto-Sadonkorjuujuhla (Urban Nature Harvest Party). The event showcased the communal garden and the sound installation, with performances from professional and local dancers, which were choreographed in the garden by Jenni Kostinen and produced by Terhi Pursiainen.

In this introductory chapter we will take a deeper look at Minun Nimeni On and outreach programs, and at the principles of community gardens and their impact on communities and societies. First though, let us investigate the relatively new artform of Sound Installations.

1.1 WHAT IS A SOUND INSTALLATION?

1.11 SOUND INSTALLATION VERSUS MUSIC

Music is essentially an expression in time. It's quality and sprit have are temporal, whether represented on a stave or recorded onto audio tape. Its tones, shapes, and the expressions within, evolve and devolop in the continuous unravelling of time. Even *Generative Music* pioneers such as Brian Eno, who have sought to free music from linnearity, while offering compositional structures that could walk and breathe on their own, were always connected and focused on the listener's relationship to time.

Visual art, on the other hand, is an expression in space. An observer's time is generally not prescribed by the artist, and artwork can be viewed in a flash of milli-seconds or scrutinised for days. The temporal element is usually left to the viewer's discretion. What *is* specified is the viewer's presence in the prescribed space. In an art installation the location, setting and environmental factors are paramount. Its treatment and existance in a place, its spatial dimensions, the way it interacts in its environment, the experience of being in it – whether its for seconds for hours – are its core criteria.

A sound installation, rather than organising sounds in time, organises sounds in space. The term first appeared in the late 1960's, coined by artist Max Neuhaus

to describe some of his own works. These works had no beginning or end, they were 'placed in space rather than in time.' (www.max-neuhaus.info/soundworks/) Neuhaus understood our sense of place as depending on what we hear, as well as what we see and feel. So a place's given social context could be affected by altering its aural context. He set out to build a new sense of place using sound. His well-known work 'Times Square' was installed in 1977 in a Manhattan streetscape, under subway grills, creating an island of sound. People passing by are drawn into a deep resonating and undulating drone that is able to change their mood. People can enter and exit any time they choose, there is no performance. The sound eminating from the grate underfoot mixes with sounds of traffic and seeks to transform the place, to give it new meaning. (Ouzounian, 2008) Neuhaus, talking about this work, said:
'...the important thing about this kind of work of mine is that it's not music. It doesn't exist in time. I've taken sound out of time and made it into an entity. Place is what I make the work out of. I work by ear in the place itself.' (Zuckerman, 2002)

While the term 'sound installation' emerged from Neuhaus, its conception arose steadily during the 20th century as artists began to fuse art with normal everyday life. The Futurists structured recordings of everyday sounds, the Dadaists introduced everyday objects into art galleries. In Western art music there was a growing influence of everyday street life, street sound and street music. The social upheavals of the 1960's brought this fusion to a head, and sound installations arrived as an innovative means of transforming places, or at least perceptions of places.

1.12 SPACE VERSUS PLACE

This distinction is a complex one. There are thousands of pages of philosophical discussion about it, particularly in the realm of human geography. Arguments and theories go back at least as far as Aristotle and Plato. I touch on it here because the site of this sound installation had been a vacant stretch of land with pathways swiftly steering pedestrians around it and away from it. It spends much of the year as a muddy bog, described to me by more than one local as 'wasteland' prior to the communal garden.

In geographer Yi-Fu Tuan's *Space and Place: Humanistic Perspective* (1979) he argues that 'place incarnates the experiences and aspirations of a people. Place is not only a fact to be explained in the broader frame of space, but is also a reality to be clarified and understood from the perspectives of the people who have given it meaning.' He goes on to claim 'we know the world from sensation, perception and conception' and that while 'places yield to the techniques of spatial analysis... [they are a complex mix that is] ...rooted in the past and growing into a future...

[and calls for] ...humanistic understanding.[...]Original space [on the other hand] is a contact with the world that precedes thinking.'

Place could be defined as two things: one's position in society and one's spatial location. It is difficult to distinguish which is physical and which is metaphorical. The two meanings overlap in language and in physicality, eg. 'close friends'.
Space could be defined as a physical location which does not possess these attributes of place. A space is 'free' and often desireable to artists who like a 'blank canvas'. But site specific art rarely provides a blank canvas. Spaces are loaded with shared histories, relationships and expectations.

Put more simply, a place could be a particular or lived space. I understood the area at Antinniitty that became the garden to be previously unlived and largely unparticular. There was relatively little shared history and it was mostly a 'somewhere' that people walked past without much emotional consideration. In my thinking, a primary goal of the communal garden project, and therefore IMPLANTS was to give this space the status of 'place'. To harbour and cultivate not only vegetables, but cognitive and emotional significance. Ultimately a shared care.

1.13 VISUAL SPACE VERSUS ACOUSTIC SPACE

Visually we tend to perceive the boundaries of a space and its size in terms of length, width, height. We organise distance by interpreting an object's relative size to another. But listening focuses on intangible experiential boundaries. We hear the *volume* of a space by interpreting its long reverberation time or sharp frequency resonances. For the ear, a space's volume is most important, while for the eye it's the boundary. But visual and aural boundaries are often inconsistant with each other, for instance a glass wall is an aural barrier but not a visual one. A curtain is a visual barrier but not an aural one. The two systems can collaborate and reinforce each other but more often the separate interpretations are inconsistent.

In *Spaces Speak, Are You Listening?* (2006) sound engineer and writer Barry Blesser discusses the importance and influence of auditory and acoustic arenas in architecture and in any space. An acoustic arena is described as a 'region where listeners are part of a community that shares an ability to hear a sonic event.' (p.22) He uses the example of a cocktail party to explore the clusters and interplay of multiple acoustic arenas. Blesser reaffirms his initial point stating that a space is outlined in more ways than physical boundaries, and auditory arenas are often more useful for exploring social interactions.

Virtual partitions, such as background noise – similar to how darkness creates visual partitions - can close off outside areas and thus create auditory arenas. A single conversation in a room full of mingling people is only available to those within that particular auditory arena. Background noise makes an auditory arena inaudible to people outside its boundaries. An arena is wherever a sonic event is loud enough to overpower background noise, which exists everywhere in the natural world. Auditory arenas therefore bounce into each other and intersect when multiple listeners and sonic events are at play.

1.14 DIFFUSION

Two channel stereo can be thought of as the simultaneous use of two audio streams, a left and a right, which are organised in spatial configurations that enable the creation of 'phantom' imaging between the two loudspeakers. The goal of the sound designer is maximum illusion. But the path from left to right is a single axis. Any sonic positioning and movement must be along this one axis.

With diffusion we introduce more channels, more loudspeakers and therefore more illusion. There are now multiple axes. Edgard Varèse's *Poème Électronique* was a seminal work in the development of acousmatic sound diffusion. *Poème Électronique* was originally composed and designed for the Philips Pavilion at the 1958 Brussels World Fair. Varèse used sounds not normally associated with music, recorded onto tapes. More than 300 speakers filled the pavillion, controlled by sound projectionists with rotary telephone dials. Varèse designed a spatialisation scheme, which made the most of the pavilion's unusual shape.

Varèse has remained an influencial figure for composers and sound artists, as his approach to music was ground breaking. Varèse claimed: 'It was Helmholtz who first started me thinking of music as masses of sound evolving in space, rather than, as I was being taught, notes in some prescribed order. . . I made some modest experiments of my own and found I could obtain beautiful parabolic and hyperbolic curves of sound which seemed to me equivalent in the visual domain.' (Ouzounian, 2008, p.83) He described the form in his music as 'different shapes or groups of sound constantly changing in shape, direction, and speed, attracted and repulsed by various forces.' (ibid:81) The chief acoustic engineer of the *Poème Électronique* was quoted as saying 'the listeners were to have the illusion that various sound-sources were in motion around them, rising and falling, coming together and moving apart again.' (ibid:62)

Acousmatic composer Dennis Smalley has described sound diffusion as the 'sonorising' of the acoustic space and the enhancing of the sound-shapes and structure in order to create a rewarding listening experience. (Austin, 2014, p.10).

Diffusion's multiple sound sources lead us to the idea of *immersion*. Music performances had long been crafted and adapted to suit the tradition and architecture of concert halls, with an audience locked to their seats. In *Poème Électronique* they were free to move around and explore the sound, to immerse themselves in it. Traditional symphonic music, theatre, and cinema is largely a passive experience. They sit and receive. The spatialisation of sound invites people to discover the work with active exploration and participation.

1.15 TECHNOLOGY – POSSIBILITIES, LIMITS, DANGERS

Digital audio processing has opened many possibilities to sound designers and artists. A multitude of syntheses can be generated and run concurrently. Sound can be mapped with almost limitless possiblilities. With all these new possiblities of complex and innovative media has come a flood of projects rich in technical prowess but starved of artistic content. As I approached the possibilities and technology new to me, I found myself desperately clinging to the rope of artistic truth while the battle of technology threw me every which way. Constant logistics, troubleshooting, and logical problem solving does not always lend itself to inspiration and artistic magic. With an impending deadline came the responsibility to produce a functional installation. So I need to acknowledge that this at times took priority over aesthetic considerations and artistic thinking.

1.16 THE NON-EXISTANCE OF SILENCE

'Any acoustic signal induced in a space will inevitably be overlaid by a soundscape already present in that space.' (Hölzl, 2003, p.24)

This idea became a form of water torture during my days of final adjustments on the sound design of IMPLANTS. Environmental noise cannot be ignored and in this case, could not be out-muscled. It provided a lingering, persistant and scolding backdrop which my sound design needed to accept and work with.

1.2 MINUN NIMENI ON

Zodiak is an established dance company in Helsinki, based at the Kaapelitehdas cultural centre (Cable Factory). They showcase numerous productions, workshops and happenings throughout the year. 'Minun Nimeni On' is a branch of their Outreach programme, centred in the district of Kaarela, in Helsinki's north. The mission of Minun Nimeni On is to involve local people in artistic and cultural workshops, performances and events, providing opportunities for them to participate with professionals. These opportunities are open to all and free of charge. This initiative is funded by the City of Helsinki Cultural Office.

Minun Nimeni On began in 2012 in Vuosaari (an eastern district of Helsinki) and has offered workshops and events led by professionals in a wide range of artistic fields. In 2016 the Urban Nature project was launched, which included the garden at Antinniitty.

Zodiak's Outreach programme is based on the Helsinki Model. The Helsinki Model has been developed by the Cultural Office to provide a participatory and inclusive accessability to arts and culture that is balanced across the districts of Helsinki. The main objectives are to bring cultural opportunities to wider regions of the city, to facilitate collaborations between professional artists and community members, encouraging residents to take a more active role in art and culture, and to allow professional artistic work to reach wider audiences. The Cultural Office recognises a tendency for community residents to be spectators and believes that offering them a more active role in art culture can help build and empower regional communities.

The Helsinki Model was inspired by a model for cultural activities realised in Lyon (Kuusi & Tolvanen, 2011).

1.3 WHY A COMMUNITY GARDEN?

Our evolution as humans has thrived on livelihoods as members of communities. According to a correlation between primate brain size and average social group size, we can only maintain about 150 stable relationships. This number was propsed by anthropolgist Robin Dunbar in the 1990s (Krotosky, 2010). Living in tribes, on farms or in villages, our own place within our immediate community formed a pillar of our own personal identity and feelings of self worth and self esteem. Only recently have we found ourselves in gigantic and anonomous cities. Sprawling masses of built up 'civilisation' where individual faces blend into a mash of chaos and impersonal contact, avoidance and exclusion. Those who cannot find their own valued position are confronted with a feeling of worthlessness and eventual destitution. Our cities become places not of collaboration but of isolation. Particularly on the fringes, in areas of relative low income and education, we can find in cities all over the world areas of urban destitution. Psycologists and social workers try to tap into our evolution by finding our lost desire for communal living and self-worth.

Green spaces are swallowed and filled by the concrete of cityscape. People battle to pay their rent, to keep food on the table. There is no space and no time to grow their own food. But for anybody who has been able to, growing the food on one's own table is a wonderful step forward in mental wellbeing. As we become more estranged from the food we eat, a deep desire to form connection and understanding of what goes into our mouths and bodies is filled. We can free ourselves from the carcenogenic fertilisers of mega-coprorations and the sterility of supermarket aisles.

In the competitive force of cities and capital competition, we find an increasingly **ex**culsive world. One in which people distinguish themselves apart and above anyone they can. It seems a necessity of the business world to divide communities, categorise them, then attack them with the sharpest blade of target marketing they can procure. Much of this categorisation involves casting groups and subgroups, who are encouraged to define themselves by ostricising others. Basing their own identities on what they are not, they reject groups and categories who seem to fall under different categorisations. There is a growing culture of division, which encourages us to focus on what divides, rather than unites us. Technological advances, television and social media have helped develop this. People turn away from their neighbours, often identifying themselves more readily with categories of people who exist geographically far away, if at all. The result is a disconnection from those immediately around them, a disintegration of community, at least in a local sense.

A commununal garden offers a locality an opportunity to find their way back to each other. The benefits have been observed in studies in many countries, and include at their core: an increased sense of wellbeing, self-esteem and community.

Studies have also shown that gardens can bring people together into a collective community of people, who act on shared interests. A local, neighbourhood politics is on offer, which touches people more directly, and is more directly available than state or national politics. Community gardens are usually long term projects, that unite people in their opinions and ideas more permanently. Though the activism of community gardeners has gone far beyond gardening and into wider politics, it would seem that the main focus of the gardeners is the garden itself. Community gardeners are influenced by the ecology of the gardens and seek to bring this understanding to the wider world around them.

Gardens provide physical tasks that are often tackled by groups of people banding together. Shared practical work involved in planning, planting and maintaining the garden are at the heart of community building. People work together to get things done. Menial and physically tiring tasks are managed in teams and often people will step back to admire and discuss the work done and the 'fruits' of their labour.
The additional benefit is the food that is produced. This becomes a common

resource that can be shared and enjoyed. Sharing food is a tradional social lubricant, bringing people together and minimising awkward, self-conscious feelings.

At Antinniity there were weekly gardening sessions. Janne Länsipuro presented workshops and helpful hints on cultivating vegetables. As the garden grew, there was a weekly yield that was shared. At the harvest event the food was catered entirely from the garden's produce. There was opportunity for sharing of ideas and cultural exchange. One Congolese lady was collecting specific parts of pumpkin leaves that the rest of the group had discarded. She explained that it was an integral ingredient to her home village's most favourite soup.

2. THE IDEA OF IMPLANTS

In the context of Antinniitty, the section designated as the garden eventually became self-contained visually by the presence of tall and vibrant plants. Everywhere else in the large field is either grassland or pathway. Visibly, a visitor can enter 'the garden' by stepping off the pathway as it curves past. Off the clean path and onto the dirt. While the boundaries do give some kind of border and confinement, there is not really an identifiable *environmental change* that stimulates the other senses as one steps into the area.

By superimposing an 'auditory arena' those within it would form a community distinguished by their shared ability to hear those specific sounds. People passing by, if they noticed the sounds, could step into the arena to explore the sounds and the space. Anyone continuing on would remain outside this acoustic community. An objective of IMPLANTS was therefore to give acoustic adhesian to the visible and physical boundaries of the space. To reinforce the identity of the communal garden and to unite the people in it.

Figure 2.1 The garden and IMPLANTS in September 2016

Figure 2.2 The initial plot in May 2016. Visual borders would be formed by the plants themselves, while the auditory arena formed by IMPLANTS would reinvorce them, encouraging a community spirit inside.

Returning to the point about the auditory arenas of a cocktail party, I found this structure very interesting in relation to nature's own cocktail parties in gardens and forests. Clusters of birds and insects are communal in their own acoustic arenas. They form their own sonic interplays which are inclusive to anyone or anything that hears them. If I could establish an interplay of smaller acoustic arenas within an overall auditory arena (the entire garden) visitors and gardeners would be encouraged to spend time further exploring the nuances of the space, the sound, and therefore the garden.

On first visit Antinniitty seems a calm place. There are no cars or machines in sight. People move through it sparsely and quietly. But as I spent more hours in this space working with my ears, the commotion of a nearby highway became more and more obtrusive. Although invisible, the junction of two highways lurked only a few hundred metres away, relentlessly bawling out the roar of traffic, with all its explosions of pistons slamming up and down, screaming through the trees and into our tranquil garden.

I wanted to reaffirm the identity of a community formed within the region of the garden and within the auditory arena of the garden. The noise of the highway already formed an auditory arena that confined everyone in the vicinity. I wondered if IMPLANTS could block out the highway sound. If it could form a community inside united by their shared escape from road noise. But I later realised that this would require more power than I could conjure from my small amplifiers and loudspeakers. Moreover, the volume required would almost certainly encroach upon passers by and nearby residents.

My priority was an auditory arena that supported the visual and physical boundaries of the garden. I wanted those within the garden to be united by their auditory arena. If it was easily audible to everyone in the district, the enchantment of a sonic garden would be lost. The installation was to be primarily for gardeners and people visiting the garden. I wanted it to be immersive and its impact to be subtle. The idea was to encourage people to listen closely and further explore both the sound design and the garden.

With diffusion I could configure several axes of sound, allowing a gardener to be surrounded and immersed in sound. With computer-aided mapping techniques sound could be a medium to sculpt and shape the space. Much like bees and birds flying simultaneously on their different flight paths around a garden.

While birds and bees generally project sound within a narrow frequency range, I wanted to focus the sound design on our human range. To invite gardeners and visitors, at least subconsiously, to consider the sounds of insects as music. As if they were singing to each other. What if our own sounds or our own music could fly freely around a garden? Or suppose that our own universe, as that of a bee, is right here in this garden.

Figure 2.3 One of 24 speaker boxes I installed at Antinniitty, containing an amplifier and an 'exciter'.

Figure 2.4 IMPLANTS and the garden in bloom, just before the 'Harvest Party' in September 2016.

3. THE PHYSICAL CHALLENGE

3.1 GETTING ELECTRICITY TO THE SITE

On first inspection of the site, immediately following my gleeful moments of artistic fantasy, came a sobering acknowledgement of the logistical situation. There was no electricity anywhere. We discussed the possibliblity of tapping in to the street lights but decided a better course of action would be to approach a neighbouring house, and ask to borrow power from them.

The following Saturday Terhi Pursiainen (Minun Nimeni On producer) and I knocked at the door of the closest neighbouring house, some 25 metres from the garden site, and asked if we could run a cable there from their house. Eventually they consented.

After attaining permission from the council to bury the cable I purchased 30 metres of underground cable protector. In late August I dug a trench and buried this pipe, containing a long piece of string, which would be used to pull through the electrical cables. With these pipes in place, cables could be simply pulled through the pipe for installations or performances at the site in later years.

Figure 3.1 Protective pipe I dug into the ground to contain the electrical cables that connected electricity from a neighbouring house to the sound installation.

3.2 A QUESTION OF SECURITY

Zodiak expressed concern at the security of equipment. How could we safely store a computer on site? The initial plan was to have a secure and weatherproof box in the garden, containing computer, sound cards and power supply for the amplifiers. This was considered inadequate by Zodiak management. They wanted the computer offsite. So I had to find a different solution.

Storing all the equipment at the house would require a huge amount of cables. Every speaker needed its own cable to the sound card. The total audio cable required (when the sound cards were stored in the garden) was an estimated 400 metres. Moving them to the house meant an additional 600 metres of audio cable. Then there were also the power cables to amplifiers. The expense of cables this long was undesireable to the producers. From a technical point of view, such long audio cables would mean a loss in audio quality and an added latency. The sound cards needed to be located in the garden.

I researched USB extension cables. The three Esi Gigaport sound cards needed to be connected to the computer (and powered) by USB. There are active USB cables available up to 30 metres long. This was precisely the minimum distance we required. I purchased three 30 metre active USB extension cables and ran them through the same pipe as the electricity cable. This allowed 24 channels of audio, available in a locked box that I buried in the garden.

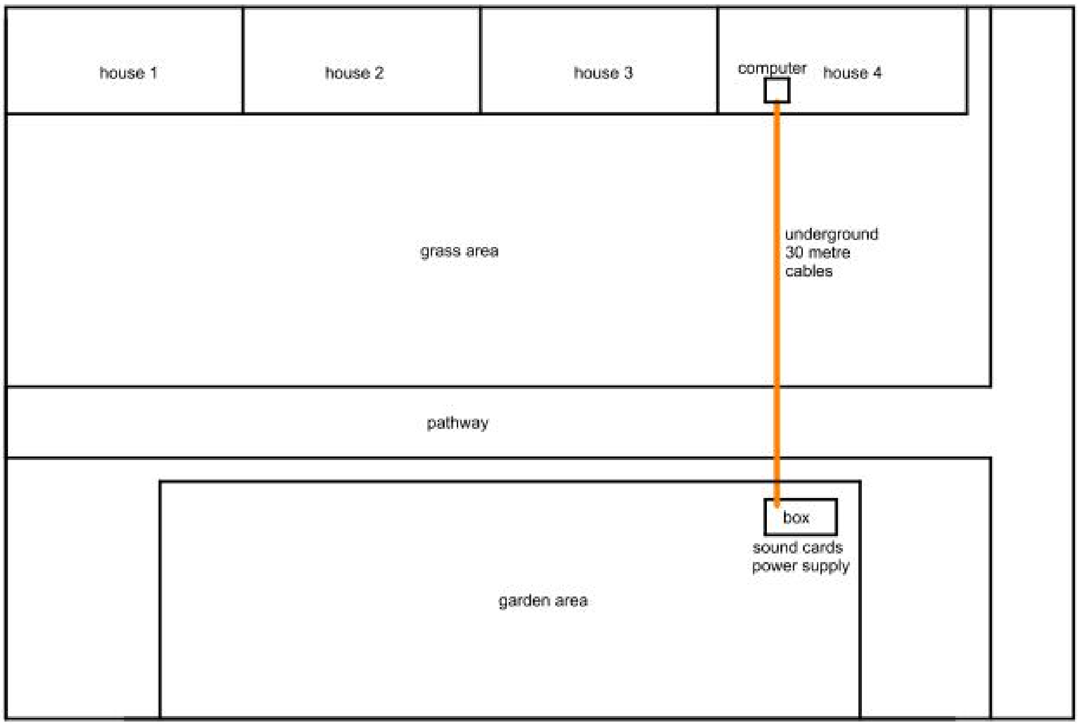


Figure 3.2 The computer was stored securely in a neighbouring yard. Sound cards and power supply were connected by underground cables approximately 30 metres long.

3.3 CHOICE OF AMPLIFIERS AND SPEAKERS

With the project's budget casting a constant restriction on options I hunted around for low priced but adequate amplifiers that could be used to power my small speakers. After trial and error with two or three different types I purchased

25 small kit amplifiers from Bebek in Helsinki. Each KEMO B075 produces up to 15 watts. All 24 amplifiers had to be assembled.

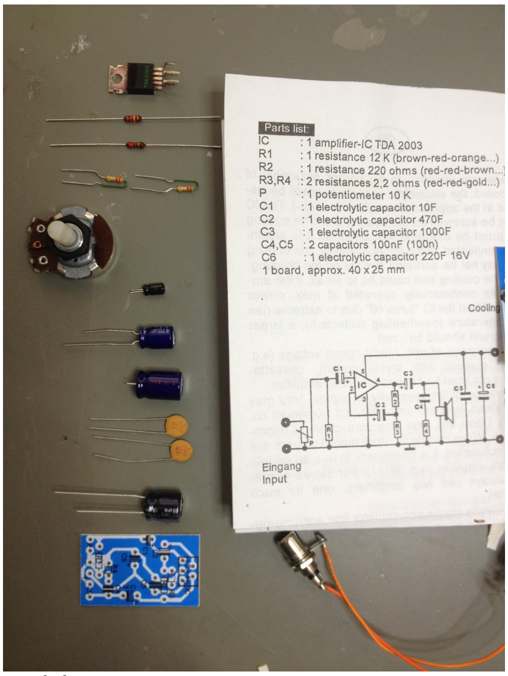


Figure 3.3(A) The KEMO B075 ampifiers come as a kit.

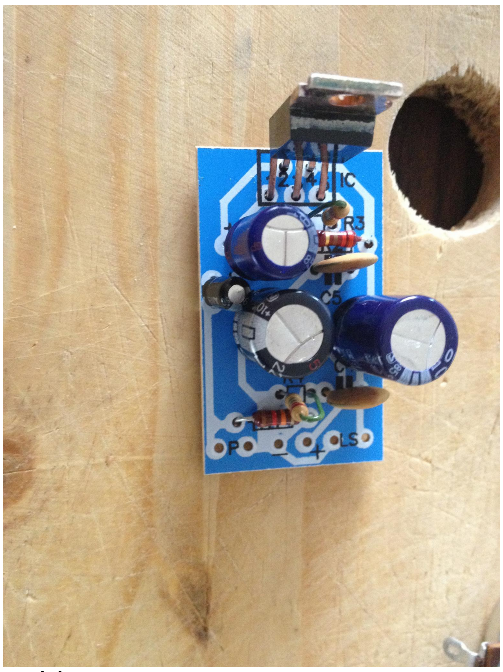


Figure 3.3(B) The first amplifier is assembled

3.4 SPEAKERS

Several speakers were trialled, but the critical factor was weatherproofing. The speakers were to sit outside for several weeks and waterproof casing would be necessary. I began to research boat speakers but these generally brought the material costs well over budget. I purchased and trialled the 20W Visaton SL 87 WPM, which has watertight outside casing. I then discovered the 10W Dayton Audio DAEX25W-8, a completely sealed and waterproof exciter.

3.5 WHAT IS AN EXCITER?

An exciter is principally a speaker without a membrane. A speaker uses a cone diaphram to reproduce vibrations of the voice coil and move air around it. An exciter, by contrast, uses the vibration from its own mass to apply force from the voice coil directly to the surface it is mounted to. A pleasing sound occurs through the exciter's ability to excite a typically flat surface at a single point.

From my experiments, while the speaker was louder, it did not have anything like the frequency range coming from a well mounted exciter. In the small speakers, any frequencies below 200 Hz fell away and sounded tinny. When the exciter was placed in a resonant wooden box, such as an old wine bottle case, the resulting sound was far richer. Bass tones could be heard with as much presence as the trebles. Although nearly twice the price of the speaker, it became clear to me that the exciter was much more appropriate, for its superior weatherproofing, and for its superior (though quieter) sound. The DAEX25-8 exciters are available in Europe from Sound Imports in the Netherlands.

Figure 3.4 The DAEX25W Exciter.

3.6 POWERING 24 AMPLIFIERS AND SPEAKERS

On consultation with electronic engineer Petteri Mäkiniemi I bought a Meanwell SP-240-12 power supply from TME (tme.eu). I daisy-chained 4 separate circuits, each one delivering 12 volts to each of its 6 amplifiers. Each exciter was powered by its own mono amplifier.

Figure 3.5(A) The Meanwell SP-240-12 power supply

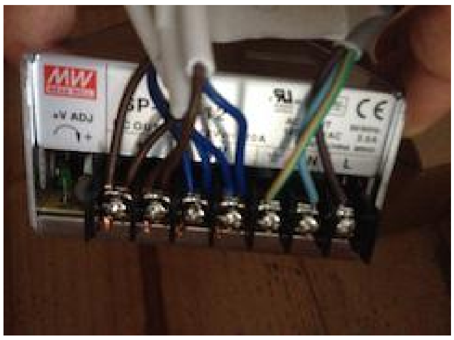


Figure 3.5(B) Daisy chained to the 4 circuits

The 4 power circuits (blue, pink, yellow and green) are shown in the 25m x 10m garden below. All cables were dug underneath walking pathways, hence the parallel pattern. I didn't want cables in garden beds where gardeners use sharp tools to dig and move soil. The power supply was placed in a locked box, buried in the garden.

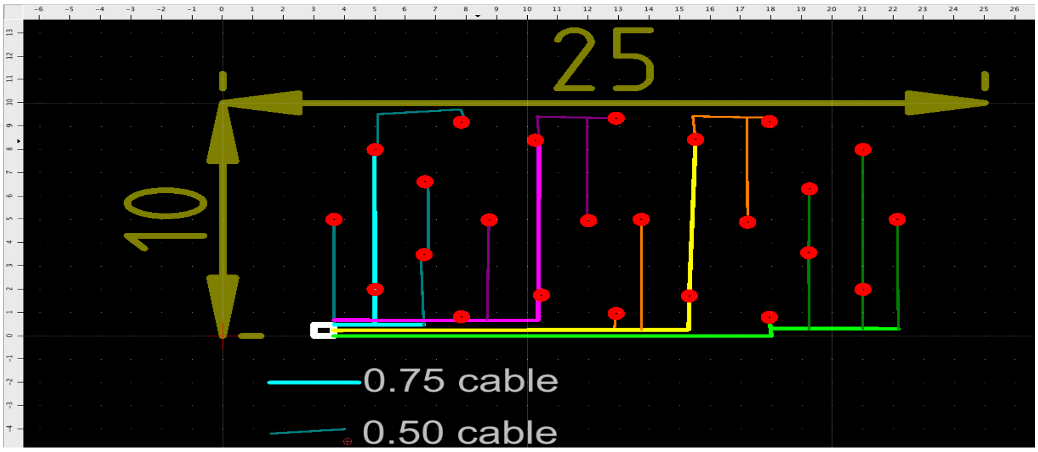


Figure 3.6 The 4 circuits shown by colour with thicker line representing thicker cable. The outer perimeter is 10 metres by 25 metres. The cables were to be installed under the pathways and not in garden beds, hence the right-angled configuration. This was to reduce risk of a gardener's tool striking cables.

3.7 RESONANT ACOUSTIC DESIGN OF EXCITER BOXES

Having made the choice to buy 24 exciters, the quality of sound in the sound installation rested on the effectiveness of the material the exciters were mounted to. I experimented on all kinds of surfaces and objects. The wine case remained an impressively resonant surface but by far the best sound I achieved was resting the exciter on the back of an acoustic guitar.

I contacted a Helsinki based luther, Mayim Alpert, who I knew had built dozens of violins and guitars. My objective was to build 24 resonant sound boxes at absolute minimal cost. By now I was at the end of my materials budget. The boxes had to come cheaply. Mayim explained that the key was to use as thin a wood as possible. He suggested spruce for framing the boxes as it was light and reasonably durable. For the panelling he suggested thin plywood. I knew the boxes had to be durable enough to stand the outside conditions and the possibility of a teenager's boot. But with strong glue and screws, it seemed that a 3.5mm plywood box would be reasonably strong. After sourcing low price spruce cladding and plywood sheets, I worked out the most cost effective size for each box and cut the components. I then assembled each box by screw only, knowing they would need to be disassembled for shipment to Finland and then reassembled in Helsinki.


Figure 3.7(A) Acoustic speaker box components.

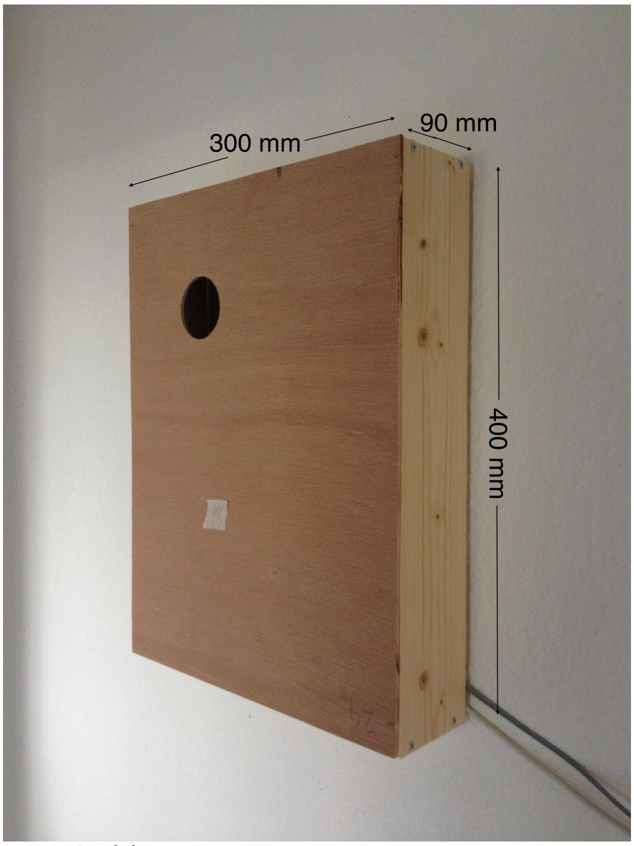


Figure 3.7(B) An assembled speaker box.

The size of the box was roughly equivalent to the belly of a guitar but a lot easier to build. As suggested by the luther I put a hole on the front of each box to allow greater resonance but the unhindered emittance of waves. The sound was better with a bigger hole but I felt the hole needed to be small enough to stop someone from reaching inside to steal the exciter.

3.8 DEVISING 24 INDEPENDENT CHANNELS ON A LOW BUDGET

Multi-channel sound cards can be expensive. Given the low wattage of my audio output and the budget of my project, the choice was clear. The ESI Gigaport HD+ offers 8 channels of output and is the most affordable option on the market at this time. I bought two of these and borrowed a third from MediaLab. Running the three Gigaports in aggregate as a single output device is a straightforward procedure on a Mac.

In Audio MIDI Setup you simply create a new aggregate device and tick the boxes of the devices you wish to include. Each device needs to be plugged into the same USB port for the configuration to work seamlessly the next time.

3.9 DEVICE LIMITS

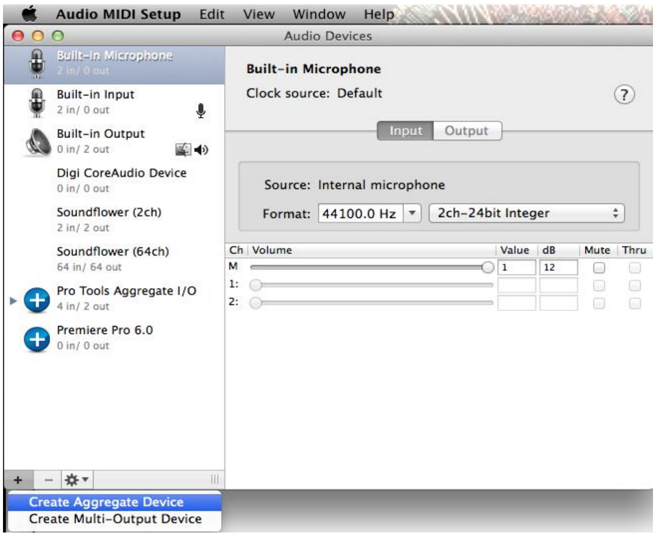


Figure 3.8 Combining multiple sound cards as an aggregate device.

An obstacle for running 3 x USB audio interfaces was the limits of the 2012 Mac Mini, which is the computer on offer for external projects at MediaLab's Support Hub. Unfortunately these computers, while furnished with four USB ports, cannot architecturely support more than two USB audio devices. The newer 2014 Mac Mini does support four output USB devices but MediaLab does not have these. After much troubleshooting, failing and despair, I was able to borrow a stand alone iMac from MediaLab for the month of September. Though larger, more conspicous and an older machine, this computer provided the three independently supported USB hubs this project required.

Figure 3.9 A large iMac, safely stored in a locked box in the neighbour's yard.

3.10 MAKING THE SYSTEM WATERPROOF

The computer was placed in a watertight road case on the porch of the neighbouring house. The power supply and 3 Gigaport sound cards went inside a waterproof container inside a locked box with weep holes cut into the sides to allow any condensation to escape. This box was put into a hole in the garden, which was then covered. At one point the box was uncovered during the night. It seems that whoever did it, was deterred by the lock and electrical cables, and didn't attempt to break in.

The sound boxes needed to be lacquered to prevent any warping due to wet weather. This was done before installation at the Cable Factory. I lacquered every panel and reassmebled each box this time using wood glue. The front panel had to remain unglued so the amplifiers and speakers could be accessable for any troubleshooting or adjustment, so were fastened using small screws with unusual heads. It was hoped no strangers in the night would have the right screw driver handy to bother looking inside the boxes.

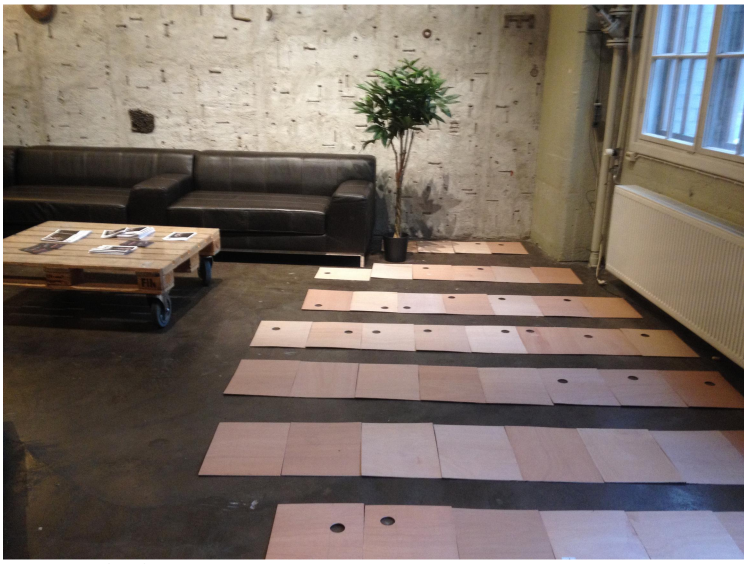


Figure 3.10 Lacquering the box components at the Cable Factory.

The exciters were stuck to the inside wall of each box, somewhere near the centre, but each was tested to hear where the best sound was produced. The amplifiers needed to be protected from the weather. They sat on raised platforms under glass jars, which protected them from any water than might come through the sound hole in the box.

3.11 MOUNTING THE SPEAKER BOXES

Lengths of bulky scrap wood were cut, with points at one end and then bashed into the ground with a sledge hammer. The boxes were then screwed to the wooden stakes.

Figure 3.11 Speaker boxes were mounted on large wooden stakes bashed into the ground.

3.12 THE VISUAL LOOK OF IT

As the sound boxes were placed around the garden, we began to notice their resemblance to bird boxes. As people passed by there was a general curiosity about what they were. Some people thought they were weather measuring devices, science experiments, or bird boxes. Before the finished installation actually opened nobody seemed to realise they were speakers. Each had its unique positioning and sound hole position. There were some confused looking faces in Antinniitty.

3.13 LIMITS TO REFINEMENT

Security of the iMac in the neighbouring house came at a cost. Once the installation was running there were a huge number of adjustments to be made. The large garden was very different to the indoor space where I developed the project in England. I would walk around the garden noting down adjustments I needed to make and then needed to walk approximately 200 metres across the park, into the entrance to the neighbourning house, and around to their back porch. Sometimes I would walk all the way back to the garden only to find my adjustment was not appropriate at all. I began to wear a trail in their lawn and there was often mud stuck to my boots which fell off along the way. One day they asked me how long I was going to spend walking in and out of their yard. I began to be self-conscious of invading their space, and once the major adjustments to sound levels and sequencer were made, felt any other adjustments had to be made sparingly, preferably when they weren't home.

I built a wireless Arduino system where I could change sequencer settings and master volume remotely. But I still had to be fairly close to their fence, which meant I was too far away to hear the change yet too far from the computer to get visual feedback and know for sure what change I had made.

4. SPATIAL FORMATION

To harness the possibilities of the multi-channel system, the sounds needed to be not only localised, but spatially animated. Just as bees fly around a garden, I wanted my sounds to effortlessly fly from one speaker to the next, across the space in between. The basic parameters I wanted to be assignable were:

- which orbit, or path the sound would be taking
- which direction it would be travelling
- how fast it would be travelling
- from which channel it would originate

Twenty four speakers allowed several different formations. I wanted people to be able to walk around and explore the space, while different events and animations encircled them and passed by them. This would generate several interacting sonic arenas, which formed smaller regions within a larger region, which was then intersected by other passing sounds. The result, I hoped, would be similar to the multi directional movements of sound made by birds and insects flying around restlessly.

After much deliberation I decided to implement the following model, utilising three separate, interlocking circular orbits, an outer perimeter orbit, and two straight lines.

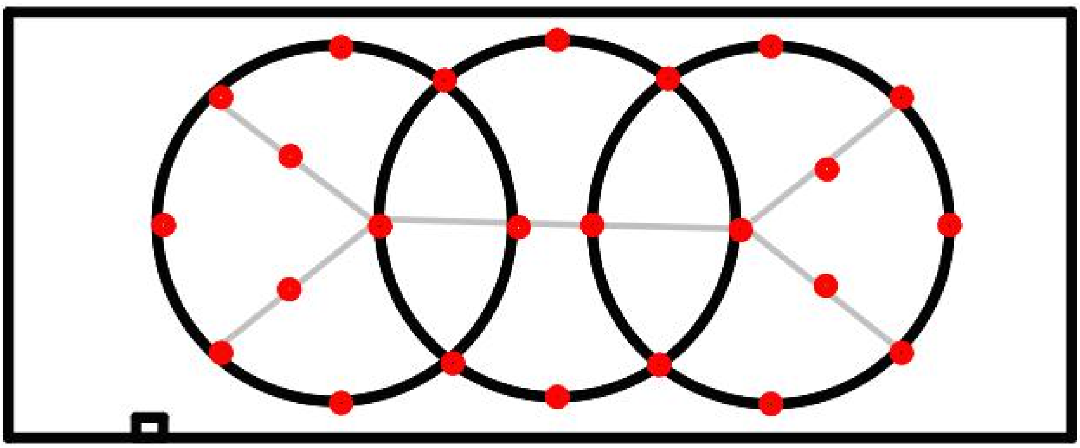


Figure 4.1 The speaker configuration. The 24 speakers shown in red created 3 illusory circular orbits, which intersected. Linear 'orbits' where also formed (shown in grey).

The three circular orbits consisted of 8 speakers each. Each lineal track also used 8 speakers, while the outer perimeter enlisted 16 speakers (see the diagram below). It was hoped that at any point in the garden a listener would experience several sound paths simultaneously, but be more focused on one or two of them, depending on position. This would encourage the active participation of people, who could experience different sensations depending on where they stood or crouched.

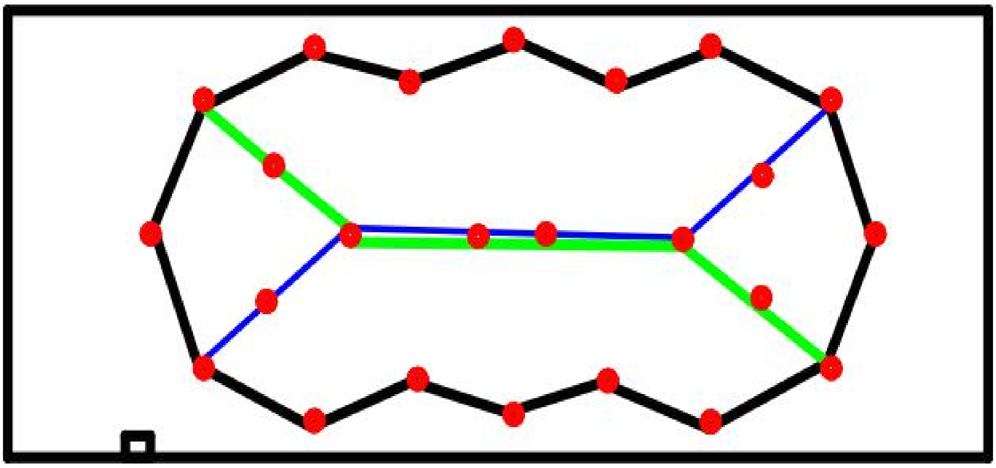


Figure 4.2 An outer orbit formed at the perimeter with lineal tracks depicted in blue and green.

As in stereo pan imaging, an illusion of movement is given by decreasing the volume in one channel as the volume in its adjacent channel is increased.
Current methods for multi channel imaging include distance-based amplitude panning (DBAP), vector-based amplitude panning (VBAP) and ambisonics.

4.1 ORBIT-BASED AMPLITUDE PANNING

For this project I devised my own method, based on orbits, let's call it OBAP. The time to complete an orbit was divided by the number of channels in the orbit, then that number is sequencially plotted along the orbit equally at each point. So if a 'moving' sound stops exactly half way between two speakers, the amount of volume emitted from each is equal. As it moves one way the volume is increased, while equally decreasing in the speaker channel it came from. This creates the illusion of movement.

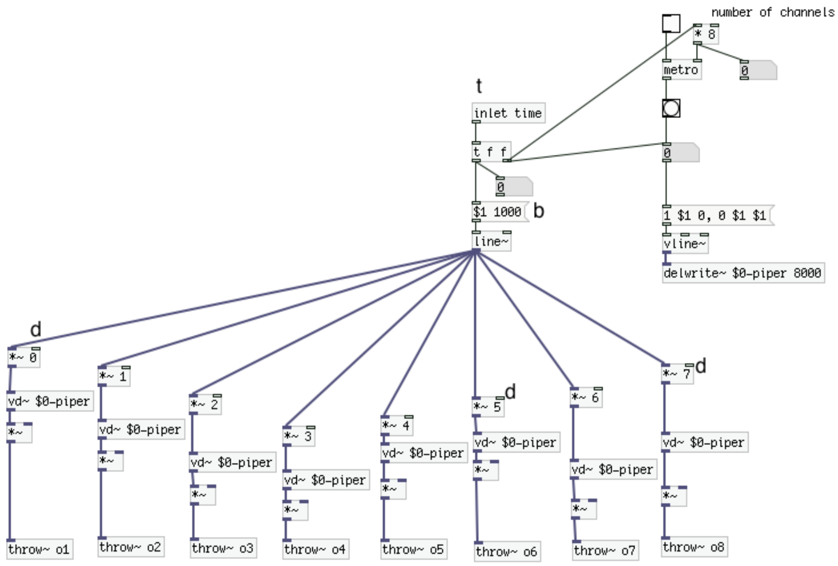


Figure 4.3 The amount of delay on each channel (d) is applied sequentially: Zero for the first channel, 1x*t* for the next channel, 2x*t* for the next channel and so on. This value is then overridden according to the direction and origin of the orbit, as shown in Figure 4.4.

The metronome sends a pulse each time the cycle is complete (8x*t*), which starts a new orbit.

The 'inlet time' (let's call it *t*) is the amount of time it takes for the audio in a channel to reach maximum value (1). It is then returns to minimal value (0), taking the same time to get there.

The value 1000 ms (b) gives a one second buffer, allowing the system to deal with sudden parameter changes without digital sound pops.

The amount of delay on each channel is applied sequentially: Zero for the first channel, 1x*t* for the next channel, 2x*t* for the next channel and so on. The metronome sends a pulse each time the cycle is complete (8x*t*), which starts a new orbit.

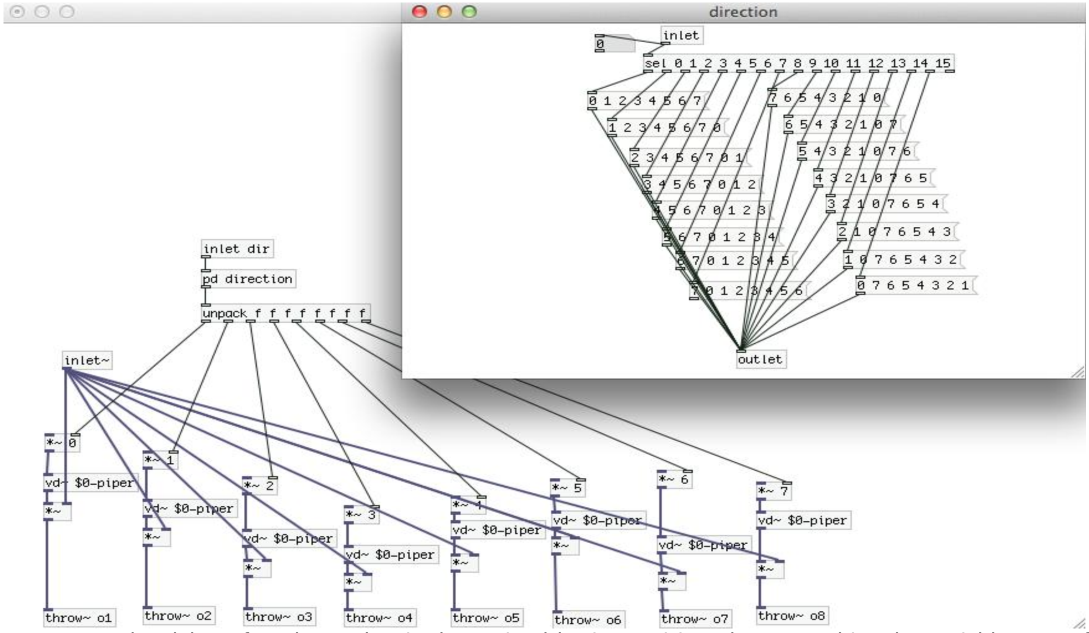


Figure 4.4 The delay of each speaker is determined by its position along an orbit. The variable rate of delay defines the speed of an orbit. Thus at the second speaker the sound signal has completed one-eighth of its circular 'journey'.

To assign an orbit's direction and starting point I plotted out all the possibilities in a subpatch enabling any possibility to be selected. In this 8 channel case, there are 16 possibilities, as shown in the 'direction' subpatch. The messages on the left here prescribed a clockwise motion, those on the right travelled the opposite way.

The resulting signals of all the different instances are then sent to the sound card's respective channels via an envelope follower, allowing a visual indication of the audio going into each channel.

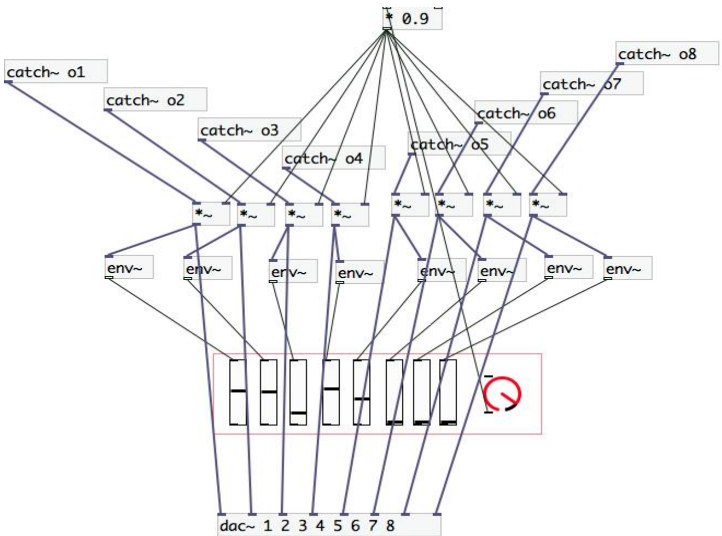


Figure 4.5 The 8 channels are routed to provide a visual monitoring of the signal levels as they orbit.

Finally the six orbits were integrated into a field of sonic whirlpools. A person in the garden was encirled, passed by and narrowly avoided by several different sounds, which are the focus of the next chapter.

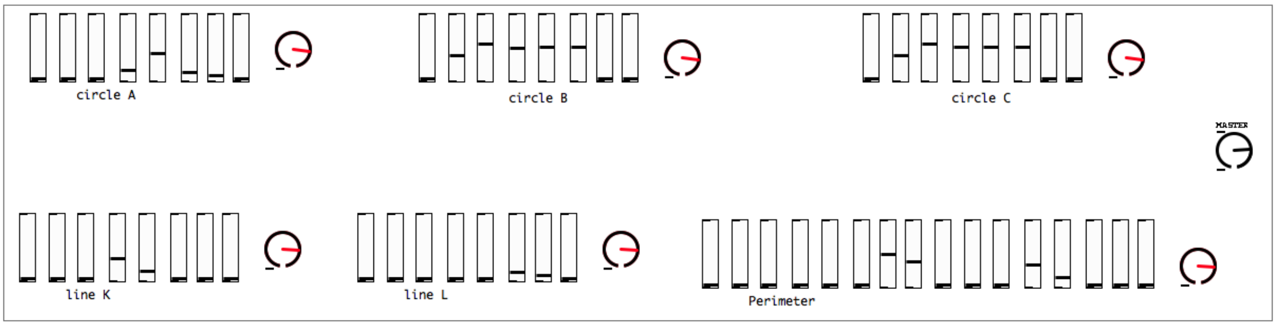


Figure 4.6 Each orbit can be viewed visually in realtime.

4.2 LINEAR TRANSITIONS

Experts in diffusion would probably point out that my OBAP model is built on a linear transition from channel to channel. They may argue that a linear transition does not mimic a real world moving sound as well as a sinusoidal transition. I accept the point. But with a steadily approaching deadline and all kinds of other challenges piling up, I tested my sounds on the linear model and felt sufficiently satisfied with the sensory experience. Moreover I felt that in the context of this project – modestly powered sound sources in an outdoor setting with background sound to contend with – the difference in the sensory experience was not signifant enough to justify the time and effort required to revise the OBAP model. Time was ticking and I needed more of it. Any refinement of my OBAP model was pushed along to a future project.

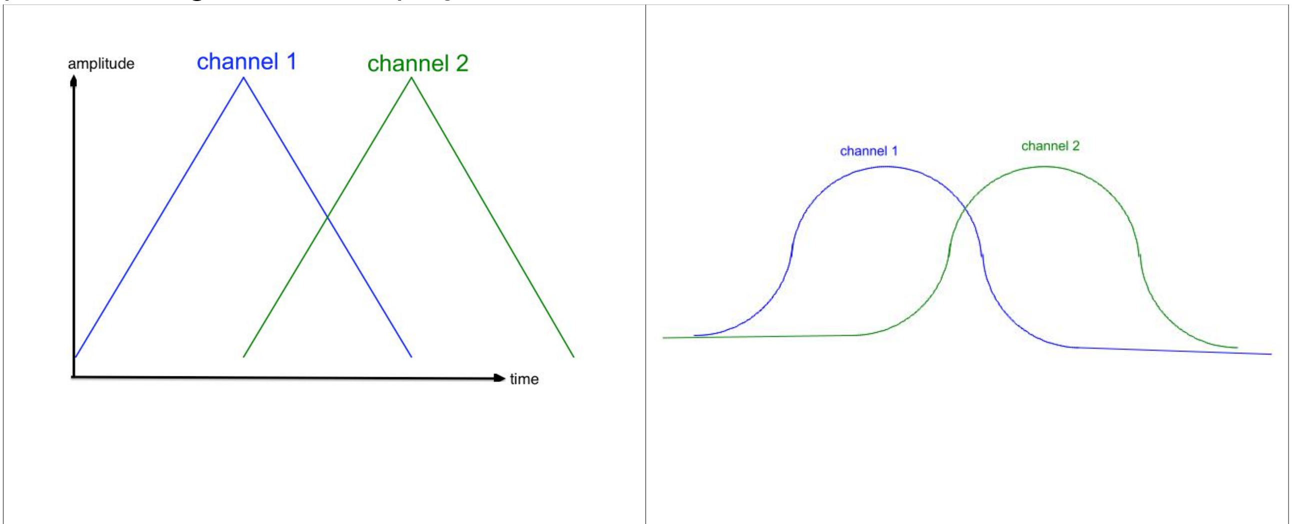


Figure 4.8(A) Linear transition from one speaker to another	**(B)** A sinusoidal transition would probably produce a more realistic illusion of movement.

5. THE SOUND DESIGN

5.1 SPATIALISED STEMS

My first sonorisations of the 24 channels were spatialised treatments of existing music I had written. I took a few compositions, which had varying thicknesses (in terms of texture) and separated the individual layers or *stems*. For the first piece this meant 6 stems, for some later experiments there were 15 to 20 stems. The first more tradional music piece was made up of kalimba 1, kalimba 2, harmonium, piano, harp, voices. The following diagrams shows one mapping option.

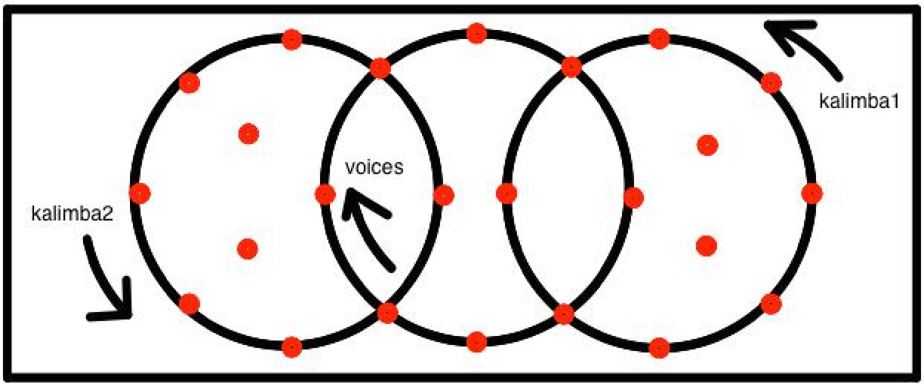
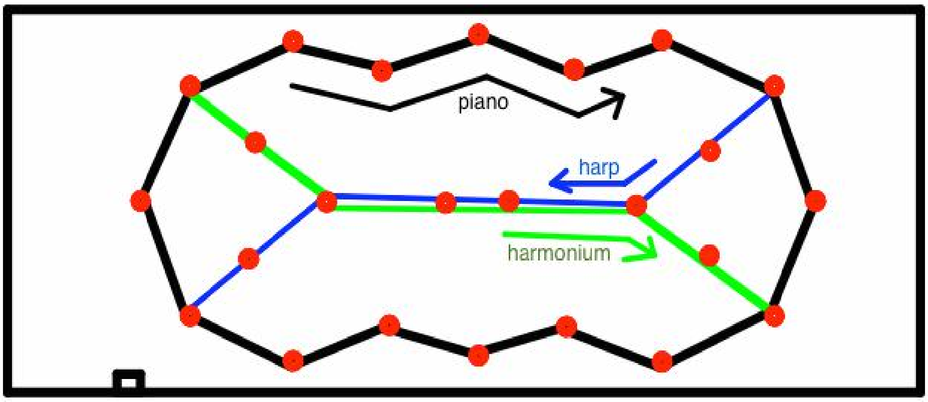


Figure 5.1(A) Circular movements of different instruments around different orbits. A visitor's location within the garden dictates their sonic experience.



(B) The piano track orbits around the perimeter while harp and harmonium tracks run along the lineal paths. These run simultaneously with the orbits in (A).

Someone slowly strolling through the space hears a different concentration of instrumentation, depending on where they are and at what point of the piece of music they are. The parameters of direction, origin and speed were randomised to encourage greater variation and autonomy.

In pieces with more stems, they were doubled up so that two or more audio files were being played in the same orbit. The direction, speed and origin, however, were independent for each audio file. This meant that one sound could pass through or overtake another. This was an exciting thought and the effect was sometimes surprisingly magical. The danger was the suseptibilty of all the loud parts arriving simultaneously on one 10W exciter. When it happened the combined sound was distorted and unpleasant. To prevent this, the overall level had to be dropped and denser compositions were excluded from the list.

In the event sequencer, if an audio file based event was selected, the following attributes were randomly chosen by PD:

- the piece of music (or sound)
- assignment of each stem to any orbit (ensuring all orbits were used)
- speed of each orbit
- direction of each orbit
- which stems would be muted (to give added variation)

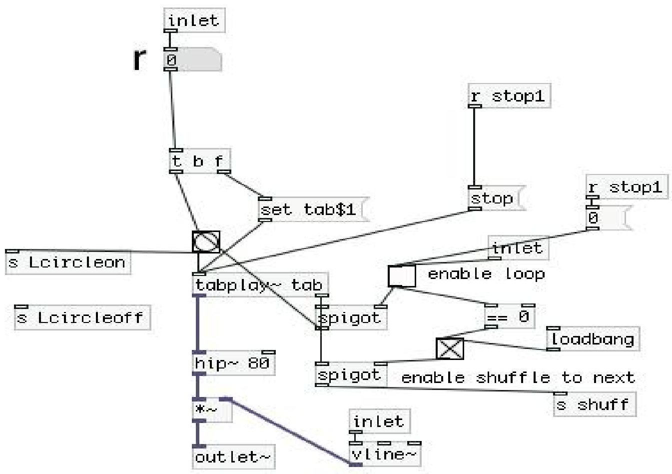


Figure 5.2 A randomly selected number (r) sent into the tabplay~ object assigned the corresponding audio file to a particular orbit.

In order to prevent the same audio file being played at the same time, a series of non-repeated numbers was generated using the shuffle object, and output as a series of numbers, then sent to the respective audiofile players. The generated numbers are in a random order but none are repeated.

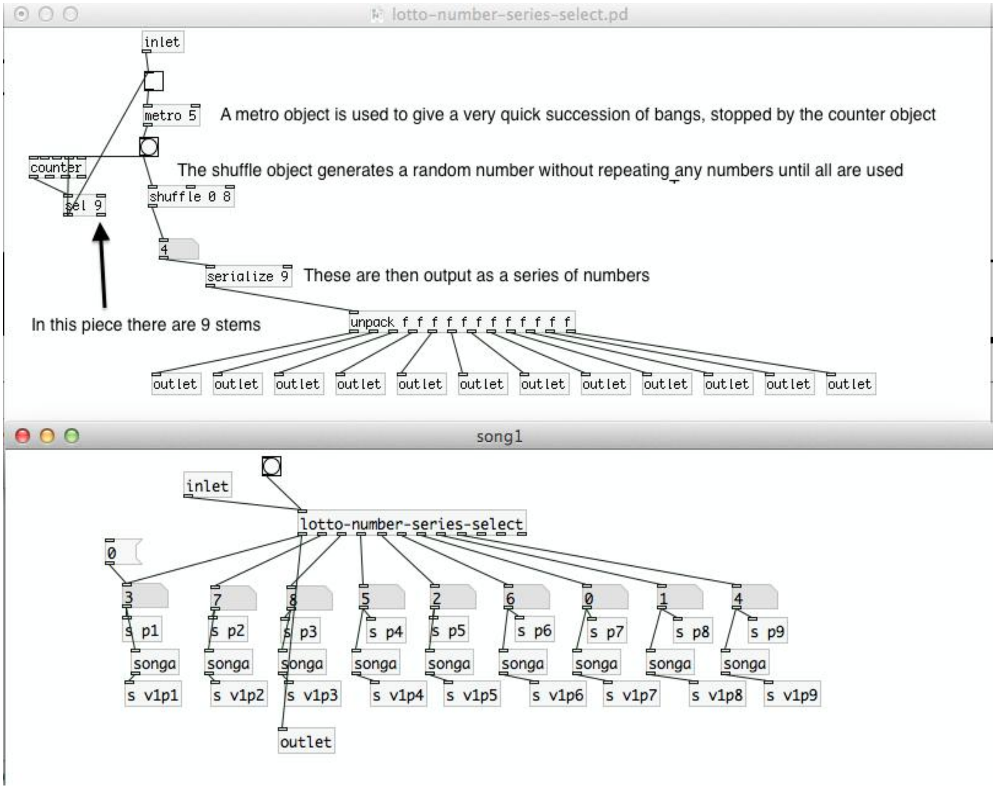


Figure 5.3 Each individual audio stem is allocated to its own exclusive orbit. The selection method is a lottery style draw.

5.2 HYPNOMATIC

Running concurrently with this project was a collaboration I was involved in as sound designer, collaborating with Arlene Tucker. We were given access to a sound recording library by Active Crossover: Mooste. It was a large archive of field recordings including animals, old engines, enormous tanks, fences in the wind and more. We were asked to make a piece of sound art using them however we saw fit. I cut up a lot of different recordings, overlaying them with each other and experimented with side chain compression to use the signal fluctuation of one recording to trigger and manipulate another. Sometimes the source recording was then removed. I had one 15 minute piece comprised of several smaller pieces, which I felt were perfect to use in IMPLANTS. I exported them as 12 individual mono layers and fed these into the system of IMPLANTS. These formed three of my 10 major events.
audio download link: https://cronica.bandcamp.com/album/hypnomatic

5.3 USING AUDIO GATES TO CREATE REACTIONS.

I wanted to use motion sensors so that there could be sonic reactions to the movements of people in the garden. Unfortunately, as the computer was more than 30 metres away and inside a secure weather-proof box, the idea was dropped. Instead I created a provoke/react event. An audio file was selected at random from a pool of loud and sudden thuds from a localised area, generally 3 or 4 speakers close together. This was intended to startle anyone who happened to be nearby. After the thud came a reaction: A huge flock of birds (Australian cockatoos) who 'took flight' in an outburst of screeches and screams moving quickly in cirles around the garden. There were also simultaneous outbursts from frogs and insects. The frog sounds and insect sounds moved much slower than the birds but it was a cacophony remeniscent of reactions to distant gunshots in the rural Australian setting where I grew up.

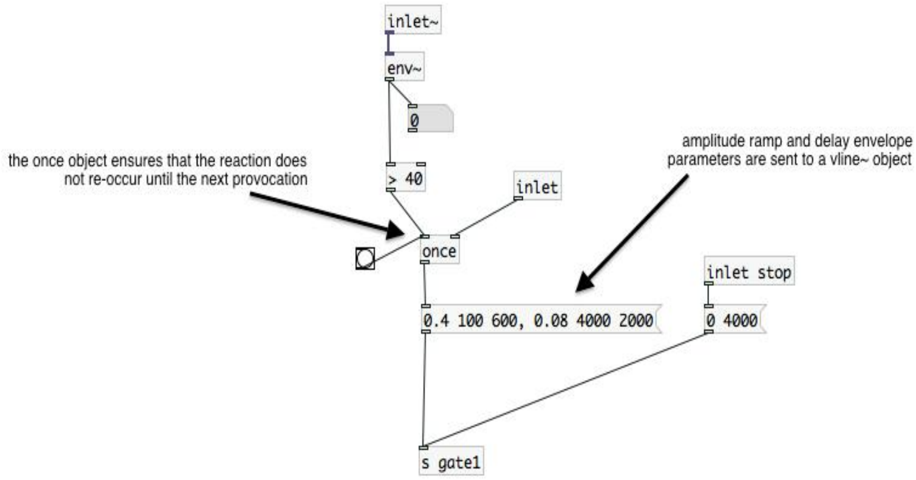


Figure 5.4 This gate triggered reaction means that any time a signal amplitude of 40 is reached from the 'provocation' the 'reaction' audio file is fed a particular volume envelope. In this case it is quickly raised to 0.4 and 2 seconds later slowly lowered to 0.08.

Once engaged, a signal with an RMS amplitude above 40 dB caused the reacting audio to jump up after 600 milli seconds and then slowly fade right down after 2 seconds. This combined with the circular movement produced an illusion of the animals calming down. As the animal reaction sound files were quite long and of variable durations, and with the varied speed and direction of orbits, the reaction was always unique.

5.4 SYNTHESISED SINGING INSECTS

Using Andy Farnell's synthesised insect patches for PD in his book *Designing Sound* (chapter 50), I began to experiment with flies, crickets and cicadors and also made a few of my own. But when using my sound orbit multi channel panning system I found the flies to be the most effective. They sounded real, and every bit as annoying as real flies. So I began to experiment with the frequencies of the buzz, having them sing intervals sometimes with slow glissandos. Then I introduced a second and third fly. With one fly a Major 10^{th} above and another a whole tone below, it took on a buzzy dominant 7^{th}chord. I then introduced a series of intervals and glissandos which the 3 flies sang as a choir.

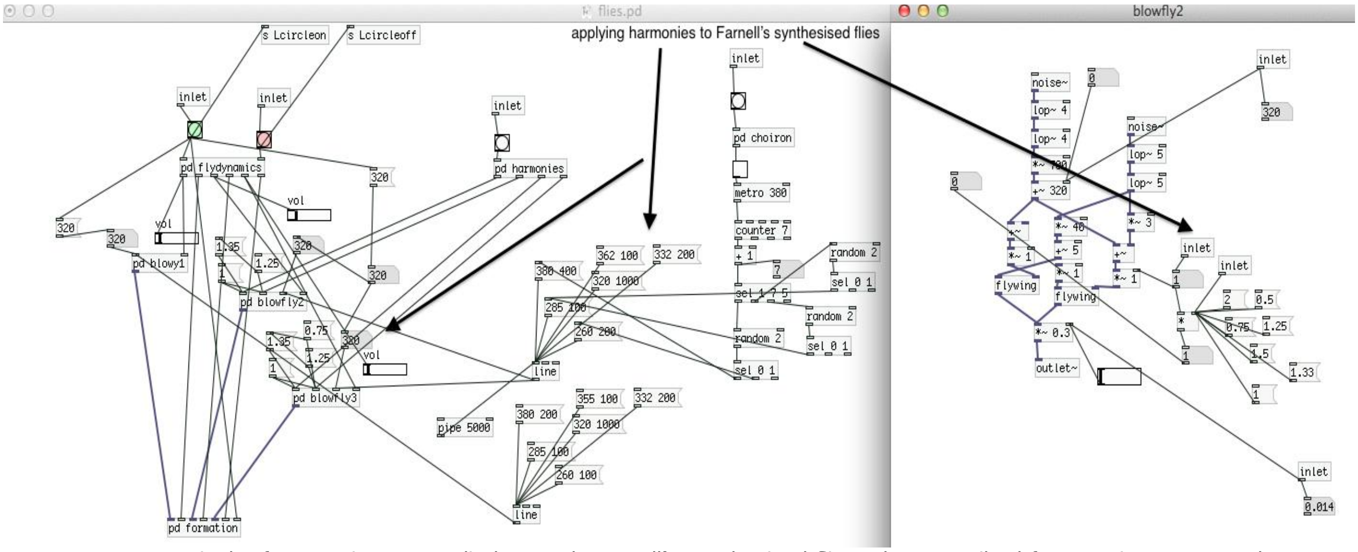


Figure 5.5 Particular frequencies are applied to Andy Farnell's synthesised flies. The prescribed frequencies are very close to a dominant 7th chord, giving a choir-like effect.

I began to wonder if the buzz of a fly was music to another fly's ears. I downloaded some royalty free opera recordings and added them to the circular orbits. Now as a singing fly flew away, a human tenor singing Bizet's *La Damnation de Faust*, or Rossini's *Il Barbiere de Siviglia* arrived and circled in the same movements and fluctuations as the flies. Sometimes they all sang together. The harmonies were often complimentary and interlocked. I chose this juxtaposition partly to encourage the idea that insects were singing, and partly for comic surprise. The volume levels were not high enough for the average passer-by to notice. You needed to spend time in the garden to realise what you were hearing.

In order to reduce the relentlessness of the flies, and to make the sound more realistic, a fluctuating volume subpatch caused the loudness of each fly to rise and fall independently of each other, in addition to the orbiting movement.

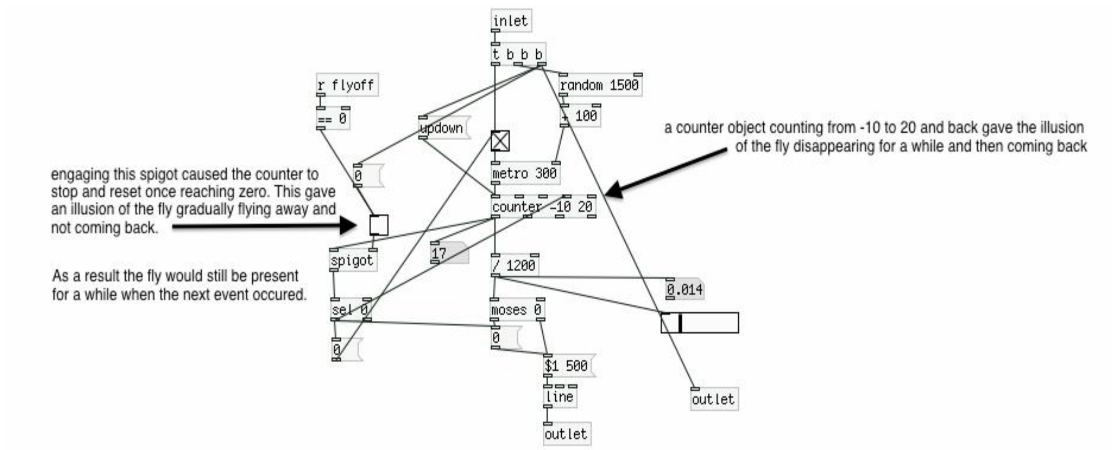


Figure 5.6 The entrance and exit of individual flies were timed so that they seemed to fly away and then come back after a certain time. The volume fluctuations combined with orbital movement and small frequency fluctuations gave quite a realistic illusion of moving flies.

5.5 RHYTHMIC BIRDS

With the aim of surprising passers-by I contacted Macaulay Library and obtained permission to use some of their nature recordings. I loaded some of their high quality recordings into a step sequencer patch in PD. I wanted people passing to initially think the birds were real but to gradually come to realise they were not. I selected the best short snippets from each recording, and each would be randomly allocated to one of 16 steps, in its own unique speaker. The main parameter I chose to establish was the number of steps in each bird's sequence. This would be a number between 16 and 26 which would gradually countdown to 16. The effect was quite randomly spaced bird chirps that gradually fell into a 16 step rhythmic groove. Once established the groove accelerated into a crescendo. Once reaching fastest tempo and loudest volume, the birds stayed in rhythm but suddenly slowed to a very slow tempo for two cycles and then stopped.

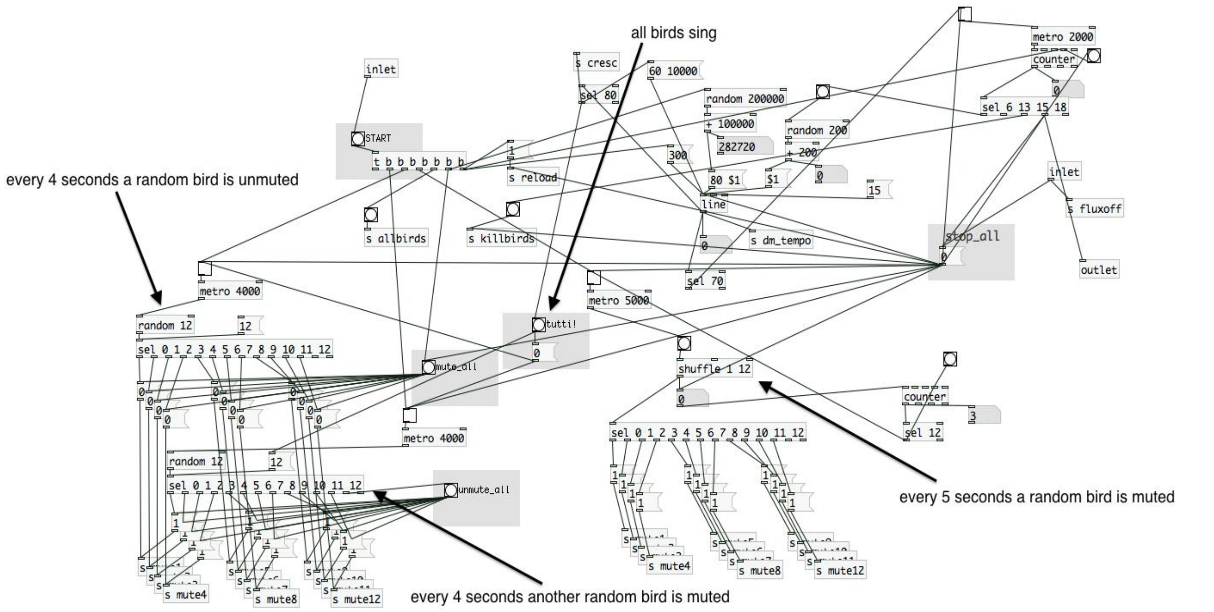


Figure 5.7 Bird calls in a step sequencer began in an arhythmical, sporadic and more realistic manner, which slowly metamorphosed into a precise 16 step groove with *tutti* that accelerated and grew louder.

I added a flux subpatch similar to the flies volume fluctuations, so that the volume of each bird would vary somewhat. I also introduced a random muting sequence so that the number of birds chirping would keep varying. Towards the end of the event as they grew louder and faster, every bird would be unmuted.

The bird patch was set to 12 channels with each bird appearing in 2 speakers far apart from each other. This seemed to create a neater and less chaotic sounding cacophony than having 24 individual birds. This patch was unique from all the other patches in that it did not utilise the OBAP system. The birds remained stationary, as they were not intended to be in flight.

5.6 THE MAIN SEQUENCER

It was surprising how complicated the main sequencer became. There were ten main sound events, which were to be started and stopped in a shuffle mode. It was important that each event would properly stop when it was supposed to, and that another would start reasonably soon after. It was also important that it was still operating after several days left unattended.

Countless times a singing fly would appear at the wrong time. The synthesised flies tormented me much like real flies in the hot sun. Eventually I developed dependable stop mechanisms for each event and a STOP ALL button. Once this all worked the overall sequencer became simple enough. But some precautionary measures were necessary, as shown below.

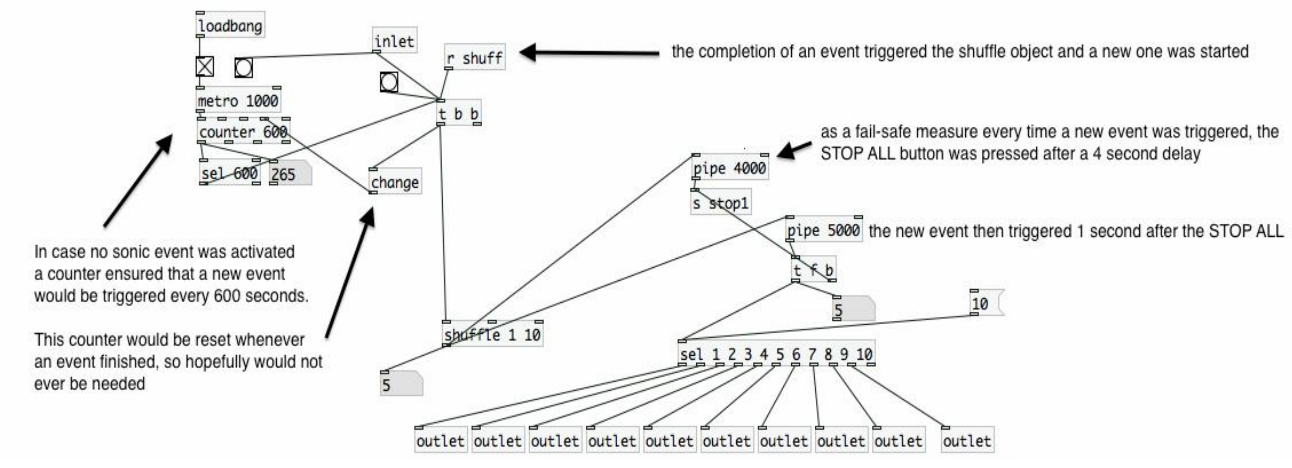


Figure 5.8 Precautions in the main sequencer were necessary to avoid very long silences and to ensure no unwanted audio was triggered during a sequence. There were so many events and reactions that they would suddenly appear otherwise. Synthesised flies would annoyingly appear during other sequences. They became as annoying as real flies.

6. LEARNING OUTCOMES

6.1 IT'S OUTDOORS

By far the most crucial and prominent influence on this project was its outdoor location. As an electrical system, as a sound system, as an artistic idea and communal contribution, the physical and logistical effect of it being outside dominated virtually every decision.

The need to waterproof every joint and connection in 24 channels of audio (more than 600 metres of electrical wire) was a significant task in itself. Then there were the speaker boxes, the speakers themselves, the amplifiers. Everything needed to be safeguarded against rain and soggy wet ground. This water protection added a great deal to the cost of the project and also to the time in planning, evaluating options, and installing.

The biggest consequence to the aesthetic result was environmental noise. At any given moment, certainly before 8pm, distant traffic was a persistant disturbance with sporadic outbursts that seized all aural attention. I had to remind myself that the outdoor setting was entirely the point of IMPLANTS, that my intuitive longing for a quiet indoor space was against the objective.

An added repurcussion of the noisy background was a loss of perceived sound in motion. Each speaker became more isolated and sometimes its own solitary and momentary auditory arena. Softer sounds became isolated islands that simply appeared and abruptly disappeared, rather than a larger passage of sound that orbitted the garden. This was a disappointment. Sound orbits were the main feature of IMPLANTS, at least in my mind. I felt that in this Antinniitty setting, the speakers needed to be more powerful, and the distance between them reduced.

Having said this, the budget presented considerable challenges in attaining bigger speakers and amplifiers. I don't believe it was possible to get a more powerful sound with an appropriate frequency range with the money I had to spend. Along with the budget constraints, was the unexpected complaint from one neighbour that some of the sounds were interfering with her sleep. This was surprising to me, as I had until this point, been trying to find a way to make everything louder. It led me to applying a timer to the installation, so that all sound was switched off between midnight and 7am. It does demonstrate the need for a perfect balance between maximised illusion for people inside the garden, and minimised disturbance for those outside. This points to smaller speakers and more of them, so contradicts my following note.

The layout of the system had to be planned, tested and constructed offsite, long before installation. Since every cable needed to be waterproof, it was not possible to alter the layout once the system was assembled. All my testing took place in a quiet and dry indoor space. Extensive outdoor testing most probably would have led to changes in the spacing of speakers and the choice of speaker itself. Most probably it would have led to a setup with fewer speakers and amplifiers, fewer audio channels and a much smaller more powerful and concentrated audio arena. In short, a very different installation.

On the other hand, it was the scope and size, the 24 channels and multiple moving sound orbits that made IMPLANTS such a challenging and exciting escapade. The installation itself could be called an extensive test. The system survived three weeks in a public space, in the weather. This demonstrates the feasibility of such an endeavour. The frustrating obstruction of this Antiniitty instance was the humdrum of highway traffic within a few hundred metres.

The system remains intact and can be relocated fairly simply. A quieter location, even an indoor setting remains an enticing alternative. With a quiet backdrop the intersecting sound orbits can provide an exhilarating experience. What is clear, is that the sound design itself must be customised for the acoustics of the chosen space, and the chosen sound sources.

6.2 BIRD HERTZ

In Antinniitty certain frequencies seemed to resonate through the exciter driven sound boxes and cut through the background noise far more effectively than others. It seemed important that the spectrum was fairly narrow, otherwise cumulative sounds would stack up. Sounds with too broad a frequency range caused the exciters to distort.
Recordings of birds, for example, could be heard clearly at anytime. The bird sounds generally had very narrow frequency ranges and short durations.
Here are some frequency spectrum analysis snapshots from some of the bird recording audio files I used:

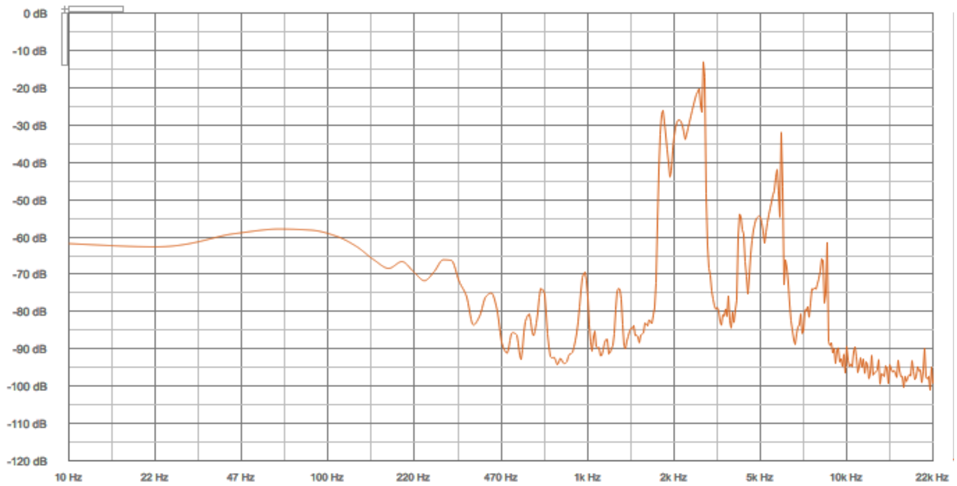


Figure 6.1(A) Frequency spectrum analysis of a Bristle Thighed Curlew. The characteristic chirp sits well above the 1k Hz hum of traffic and is easily audible.

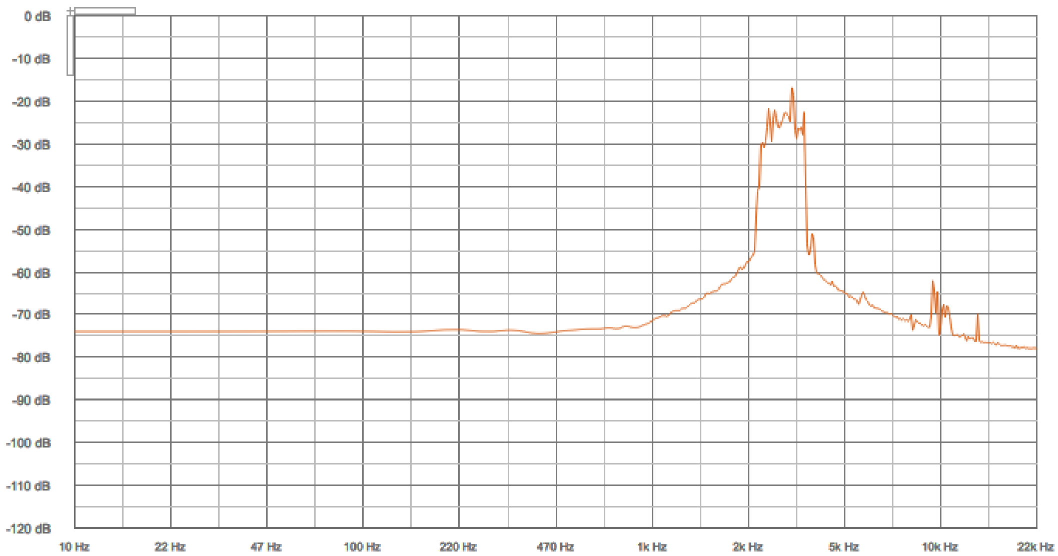


Figure 6.1(B) Frequency spectrum analysis of a Tanager.

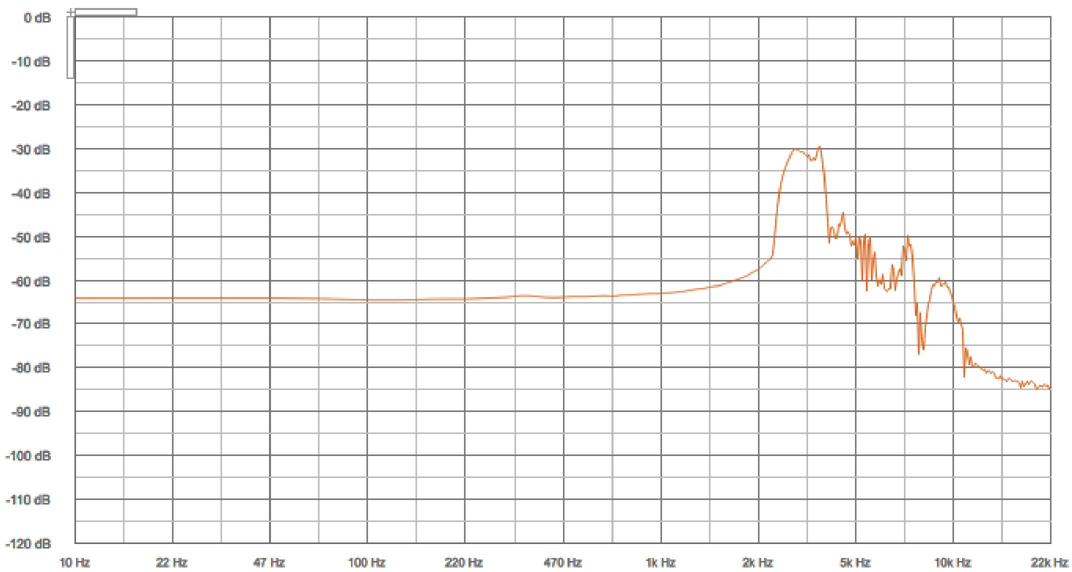


Figure 6.1(C) Frequency spectrum analysis of a Wood Sandpiper. Likewise easily audible over the 1k Hz background traffic noise.

We can see in these graphs the peak sound of these three birds is around 2000 hertz. This was typical for most of the bird recordings used. According to a report by Euronoise in 2003 (Sandberg) the prominent peak in road noise is typically around 1000 hertz. It would seem then that a birdsong can sit comfortably above this.

Below are frequency spectrum representations of some sound recordings I used, which were far less prominent and sometimes difficult to hear through the speaker boxes in their Antinnitty setting. Though present and satisfying in the indoor test setting, they were all but lost in the garden.

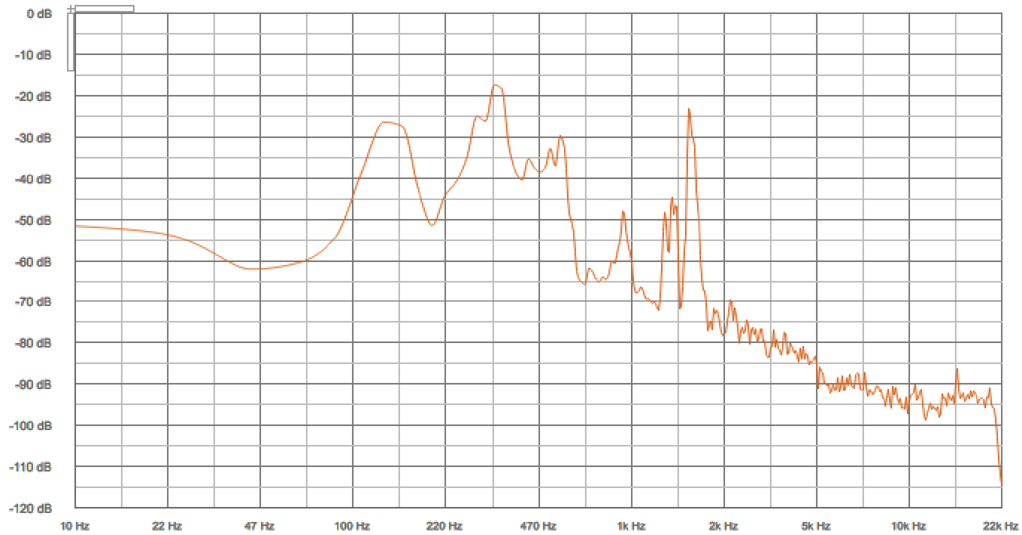


Figure 6.2 Frequency spectrum analysis of an instrumental recording which was difficult to hear in the Antinniitty setting. Its main characteristic frequencies are competing with the background noise.

It would seem these sounds were casualties of the nearby highways.

Also characteristic of the birdcalls were their narrow frequency ranges. This would allow several sounds fed into a speaker to fuse together without overloading their small capacity. Some of my sound events needed the volume lowered to avoid distortion but then became inaudible unless one's ear was very close to a speaker.

The human voice recordings depicted below, though satisfactory on their own, tended to easily distort when mixed with other sounds. It would seem that due to their initial treatment, reverb and compression, the resulting frequencies were two broad and often too similar to allow adequate room for layering.

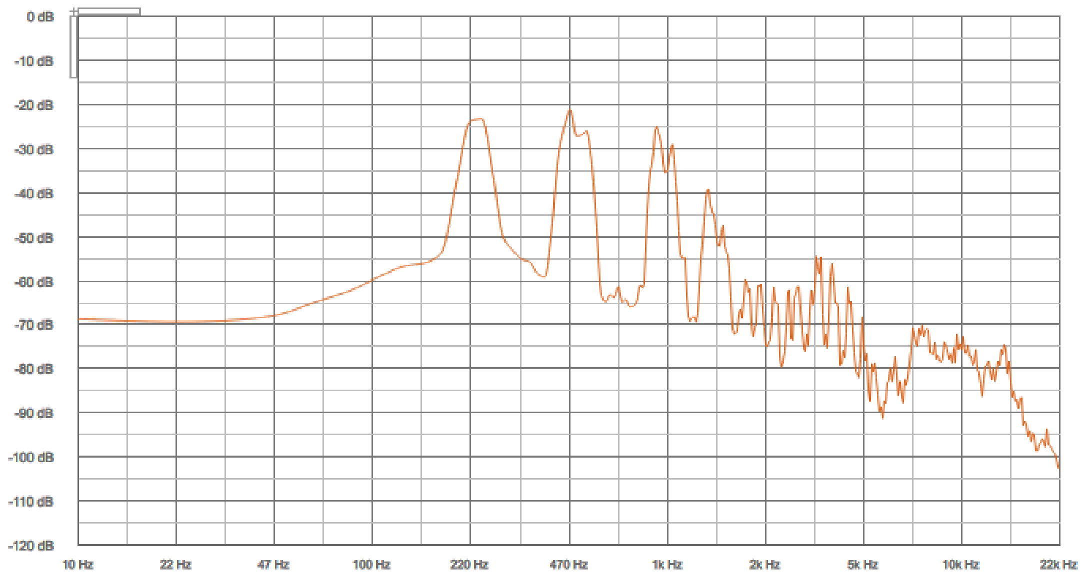
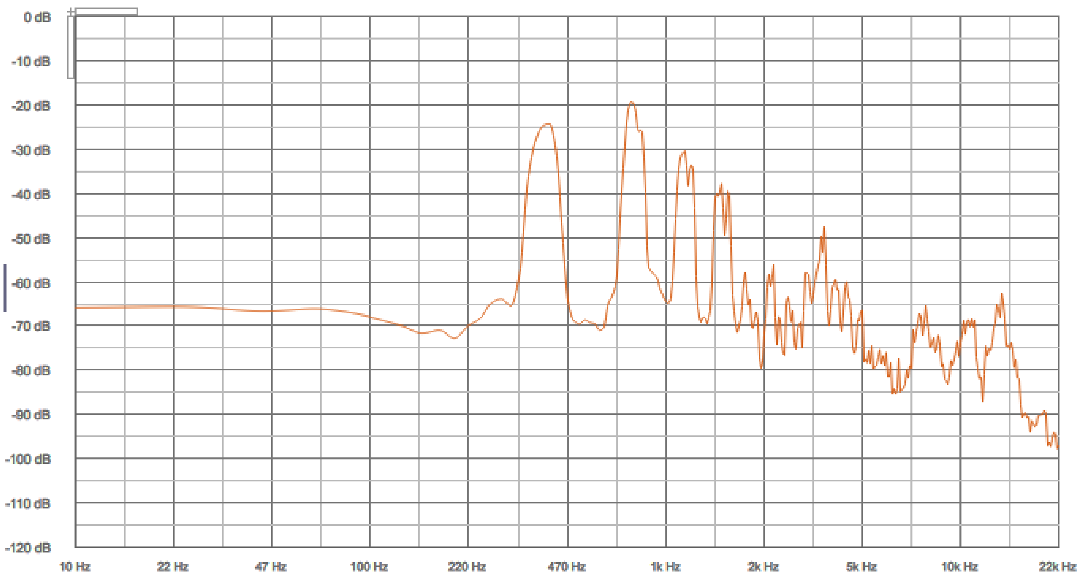


Figure 6.3(A) A treated vocal recording which sounded satisfactory on its own but tended to distort the exciter speakers when combined with other similar audio signals. The small 10W exciters seemed unable to withstand multiple signals of similar frequency.



(B) Again here the breadth of the frequency range led to distortion when mixed with other sounds at relatively high volume in the same channel (and speaker).

The representation below shows problems with a field recording that formed part of a sound sequence which was problematic in IMPLANTS. Though the sound in question was characteristically midrange in frequency and rather gentle in character, it tended to distort very easily. The graph shows imposing lower frequencies. In higher volumes these low frequecies overpowered the small exciters. Had I realised it during initial tests I would have filtered out all the lows.

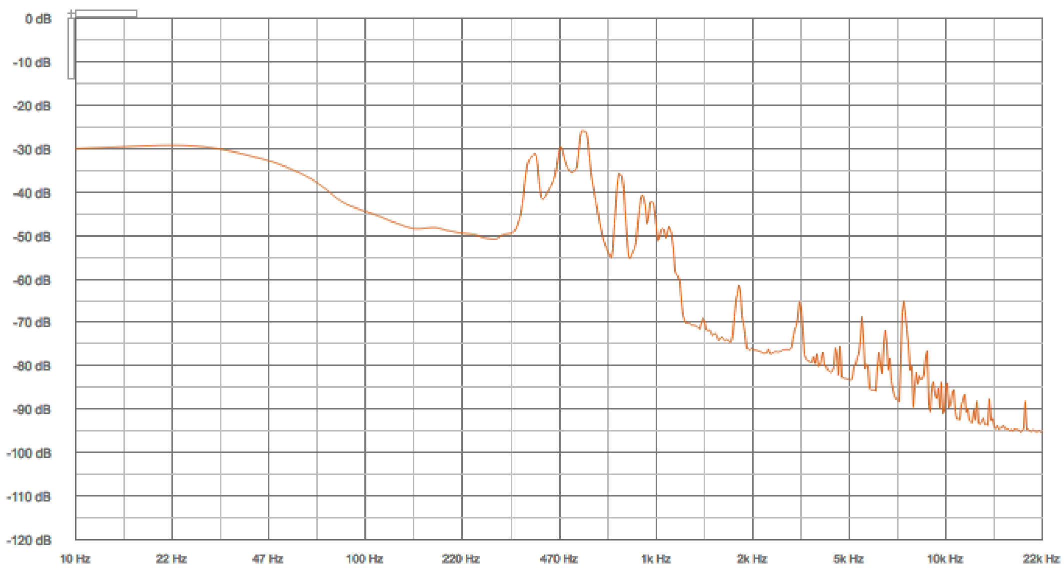


Figure 6.4 Obtrusive low frequencies that overpowered and distorted the 10W exciters. The low frequencies had little to do with the audible characteristics of the sound but ruined the audible experience. I should have filtered out these lows with EQ.

6.3 WERE EXCITERS JUSTIFIED?

The clarity of the bird calls might have been perfectly adequate with small speakers, thus alleviating the need for more expensive exciters and acoustic sound boxes. But in some of the other sounds, the richer frequency range was much more pleasing through the IMPLANTS exciters and boxes.

6.4 DYNAMICS

When considering the different events and the level of satisfaction derived, it wasn't merely a sound's frequency that gave a pleasing or disappointing result when orbiting the garden. A sequence that seemed to actually work better in the garden setting than in the indoor tests was a passage with a stuttering, flickering character. The combination of sounds had natural yet unique rhythms which were very sporadic in dynamic. The sudden and constant fluctuations allowed louder sounds to orbit around the garden without interfering with other sounds or overloading speakers. As there were quite intense fluctuations of sound, a listener could keep track of several orbits simultaneously. As one became suddenly quiet another would come into focus from further away. A listener was thus able to hear different sound gestures moving from different parts of the garden at different speeds and in different directions. The result was kaleidoscopic to the ears.

The waveform diagram below shows amplitude versus time. Here we see the sporadic dynamics of different sound stems over a ten second period.

Figure 6.5 Shorter duration *stocatto*-like sounds allowed a more sporadic and kalleidoscopic listening experience as the changing timbres moved around on their orbits. This proved to be a more successful approach, in the 24 small speakers.

By contrast, we see below a representation of what transpired to be a far less effective sound sequence. The experience, though pleasing in a small room, became rather monophonic in Antiniitty where the sound sources were spaced further apart and background noise was a significant factor. The longer, more constant sounds overlayed and blocked each other, not to mention the risk of distortion when given higher volume.

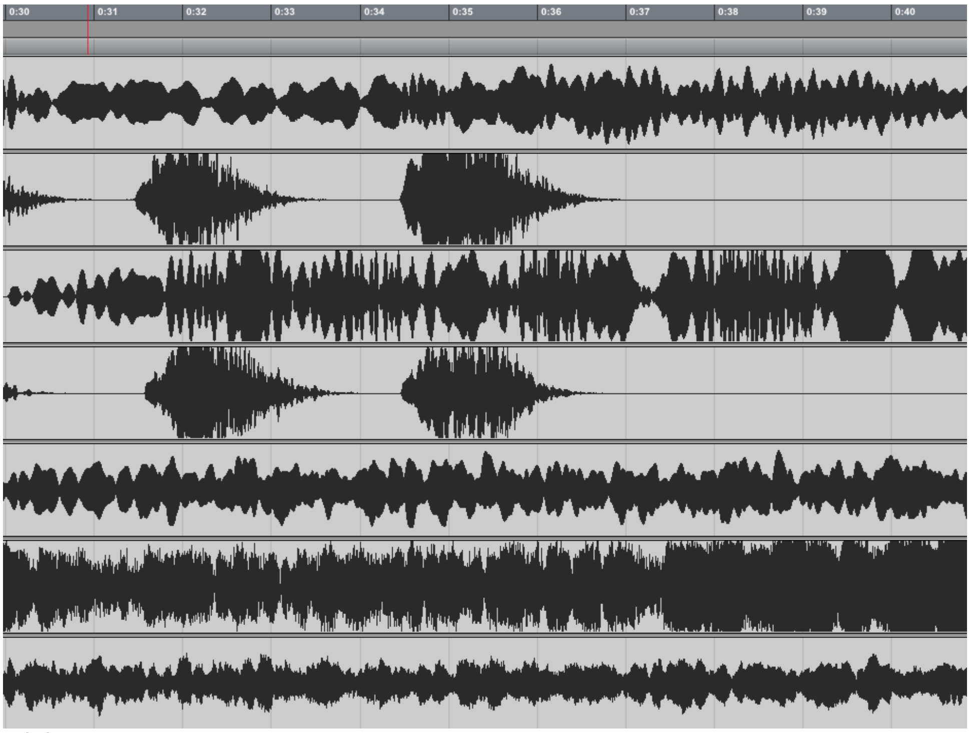


Figure 6.6 Longer, more sustained sonic gestures tended to block and mask each other, leading to less interesting sound textures. It also increased the risk of distortion in the 10W exciters.

With this in mind, we get further understanding of why the short and sharp bird calls were so easily audible. In the waveform diagram below, we see how quickly the birdcalls come and go, allowing temporal space for other birds.

6.5 NEXT TIME

In future projects, it seems the first thing to analyse would be the background noise. Take a reading with a decibel meter, make a recording of background noise and analyse it. This could function as a starting point for designing sound. Although this was an elaborate and unusual setting, basic mixing principles come into play and are a major consideration. Applying distinct notch filtering to every sound, imposing frequency characteristics around the background noise instead of competing with it.

In terms of sound orbits I believe the example of sporadic and capricious sound as explored in Figure 6.5 provides a valuable insight on how to get more spatial effect from the given resources. Quickly fluctuating dynamics allowed moving sounds to suddenly disappear and reappear, almost like intermittent bursts of moving gunfire. This may become exhausting after time but is definitely worth exploration and further study. In terms of the garden and my connection with flying insect sounds, the sporadic dynamics offer a more conversive effect, like quick little comments and arguments and counter arguments fired on multiple orbits.

Also important to point out is a slight rejection of my argument in Chapter 4 about spatial imaging and linear transitions between channels. While in my indoor test setting the linear transitions seemed to adequately suffice, it became apparent later that in the garden, with its wider spacing between speakers, and environmental noise factor, a sinusoidal transition (see Figure 4.8) between channels may well have improved the illusion of moving sound. The illusory sound space between speakers was lost with quieter sound. It merely disappeared in one speaker and reappeared in the next. This was primarily a consequence of the wider spacing of speakers and background noise, but it must be acknowledged that a sinsoidal model would have made a bigger difference than I anticipated back in the testing room in England.

6.6 GETTING HELP

More generally, it is important in a project like this to keep an eye on its entirity. Working solo means one mind occupied with every aspect. It is very easy to get bogged down on a detail, with time dwindling away. Collaborating in a team is definitely preferable, for the sake of discussing ideas, developing the strong ones and discarding the weak. And for relegating tasks.

Rather than assembling 24 amplifiers, I could have bought them pre-fabricated from China for the same cost. This would have saved me many hours but required faith in postal services and customs. As a school project, I was able to improve my soldering skills and electrical troubleshooting. But in any future multi-channel projects I would opt for pre-made amplifiers!

Digging the big electrical cable trench by hand and then scratching every wire into the ground by myself was very time consuming and tiring. There really didn't seem an alternative and at the time I welcomed the idea of getting outside onto the site, getting my hands dirty in the garden. But it took a lot of time and energy away from the sound design itself.

Storing the computer offsite, though necessary for security (according to the producer), was a significant hinderance in achieving the most desireable possible result. Fine tuning the sounds and the levels was too difficult to achieve single handed. The computer was too far away to control remotely with the equipment I had, and walking the 300 steps everytime I wanted to change something was an annoyance to me and moreso the neighbours. A skilled assistant at the computer with a walkie talkie may have been a considerable help to me, though possibly not favourable to the neighbours.

One of the main considerations of this project was who it was for. Was I building it for everyone in the vicinity, people walking their dogs, neighbours, or gardeners? I chose the people in the garden. I wanted to encourage people to spend more time in the garden. If they explored every path and plant, they would likewise experience a lot of change and development in the sound installation. If they were gardening they would get to know the different events but now and then be startled by something unexpected. This work was primarily for the gardeners. I was conscious of the time they spent pottering around and the sound was designed for them. I didn't want to annoy them with loud and persistant sounds. It was intended to be subtle and immersive. It was designed for active participation and exploration. The trade-off of this was that it went unnoticed to much of the public. It generally wasn't loud enough to stop someone and pull them into the garden for twenty minutes. Many times I saw people pause, listen passively for ten seconds and continue on their way, often without stepping off the main path. This is an interesting dilemma. How to make something bold enough to impact everyone yet careful and subtle enough to immerse and support those working alongside it for several hours? It is difficult to achieve both. I have a feeling it's not entirely possible.

6.7 FUTURE PLANS

IMPLANTS now sits in a storage room at Kaapelitehdas. With everything configured, connected and functional it would be much easier to install a second time. This depends on Zodiak and the direction of Minun Nimeni On. The budget they have for next year is quite low and they may well opt for more performance projects and less public artwork. I would love to install it again but given the time taken, cannot do it for free.

One way to make the installation less of an ordeal would be to form a small team of new media designers. The speaker boxes could be fitted with LEDs for example that wavered in colour and intestity depending on the strength and frequency of the audio signal.

Another option could be to invite other sound designers to compose a work for the IMPLANTS installation. That way I could ask them for help installing it, they could further develop possibilities in moving sound in the garden, and offer more variety to the discerning public. We could showcase particular composers at particular times.

My feeling is that the location may be an obstacle. While composing for 24 channels of moving sound in a garden is an exciting idea, the combined factors of Aninniitty's location 18km outside central Helsinki and the inconspicuous environmental noise will make it difficult to sway professional sound designers. But MediaLab sound students may be interested...

In any case, the apparatus can be installed elsewhere. In a quieter garden, or even indoors. Into a large and dark room. This would be my preference!

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