LA BIBLIOTECA CIEGA

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ABSTRACT

LA BIBLIOTECA CIEGA

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In 1955, Argentine writer Jorge Luis Borges was appointed Director of the National Library at the same time he was losing his sight completely. In his "Poem of the Gifts", he reflects on the *magnificent irony* of being given at once "the books and the night". LA BIBLIOTECA CIEGA (The Blind Library) is a site-specific sound art performance in two parts composed for the very reading room of the library where Borges stood sightless surrounded by books.

For the first part, three short acousmatic pieces for 3D sound were composed, each one using recordings of a different consonant. Employing analysis and resynthesis techniques, each piece takes the recording of a single phoneme to turn it inside out, unfolding in the process their latent acoustic beauty.

The three pieces on the second part explore unusual techniques of imprinting and reproducing sound, using a series of custom made instruments that turn light into sound. Mechatronic optical turntables, sonic backlights and bars of light were designed and built by the artist, and performed by members of the Banda Sinfónica de Ciegos, an orchestra of blind musicians.

Chapter one of the thesis briefly introduces the main concepts, technologies and components present in the project. Chapter two provides a historical overview on some of the experimental art and technologies that informed the production and development of the project. Chapter three discusses previous works by the author where elements from LA BIBLIOTECA CIEGA can be traced. Chapter four is

a detailed account of the project's creation process, methodologies, technologies, ideas and final exhibition form. Chapter five considers further developments made since its premier, its links to current work, and future directions for the project.

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DEDICATION

To Teresa Riccardi and Nina Hipólita.

Chapter 1: INTRODUCTION

1.1. Overview

LA BIBLIOTECA CIEGA is a site-specific sound art performance commissioned by Secretaría de Cultura de La Nación Argentina as part of a cycle of new media pieces premiered at Argentina's former National Library, today the Centro Nacional de la Música (Music National Center). This Center is currently the host for the Ballet Folklórico Nacional (the National Folk Ballet), the Compañía Nacional de Danza Contemporánea (the National Contemporary Dance Company) and the Banda Sinfónica Nacional de Ciegos (the National Symphonic Band of Blind Musicians).

Figure 1 View of the reading room of the former Library as it looks today

LA BIBLIOTECA CIEGA was premiered on December 4th, 2011 as the final piece of this yearlong cycle. The piece was originally commissioned for the old reading room of the Library, a spectacular 30 meter-high space with zenithal natural lighting coming through large semicircular windows known as thermal or Diocletian windows. The building, planned in 1899 by Italian architect Carlo Morra, follows the 19th century Parisian academic style.[1] The façade takes decorative elements from classical architecture, such as Corinthian columns, a Greek frontis and roman-inspired ironworks.[2] It is divided in three blocks, the second one being the reading room.

In 1955 Jorge Luis Borges was appointed as its new Director and remained in this position until 1973. Coincidently, when Borges took office, his sight, which has been gradually decaying since his youth, finally failed him entirely. Despite his blindness was growing progressively, he never studied braille, and was therefore no longer able to read after the complete lost of his sight. Since then, he would always need someone else to read for him. His experience of literature became mediated by the voice ever since, listening to someone reading or dictating a passage to be written down.

LA BIBLIOTECA CIEGA takes inspiration from this ironic circumstance, that put no other than Borges, a writer who imagined "paradise as a library", at "the center of nine hundred thousand volumes" and yet incapable of reading a single one of them. Borges himself reflected on this in his extraordinary *Poem of the gifts*:

> No one should read self-pity or reproach
> Into this statement of the majesty
> Of God, who with such splendid irony
> Granted me books and blindness at one touch.[3]

[1] http://es.wikipedia.org/wiki/Centro_Nacional_de_la_M%C3%BAsica.
[2] http://es.wikipedia.org/wiki/Centro_Nacional_de_la_M%C3%BAsica.
[3] Jorge Luis Borges Selected Poems 1923-1967. Edited by Norman Thomas Di Giovanni. Allen Lane The Penguin Press, Great Britain, 1972.

Divided in two parts, also called chapters, each one builds its own specific relationship with the site and Borges' *ironic grant*. The first one is composed of 3 acousmatic pieces for 3D sound produced from recordings of single phonemes that are played back in complete darkness through an immersive 8-channel Ambisonic array surrounding the audience. It also dives deep into the sonic matter of language, exploring the hidden soundscapes within the *smallest sonic units capable of conveying a distinction in meaning*. By zooming in at such a large scale into each phoneme, the general contour of it is lost in favor of a dynamic focus on its details, rendering the original letter unrecognizable. As it often happens in poetry, language's sound and meaning are put in tension, in this case, through the algorithmic manipulation of its most basic acoustic elements. Such an immersion into the atoms of language occurs at the darkened heart of a former National Library, thus producing a series of relational echoes throughout the piece and re-contextualizing the act of listening.

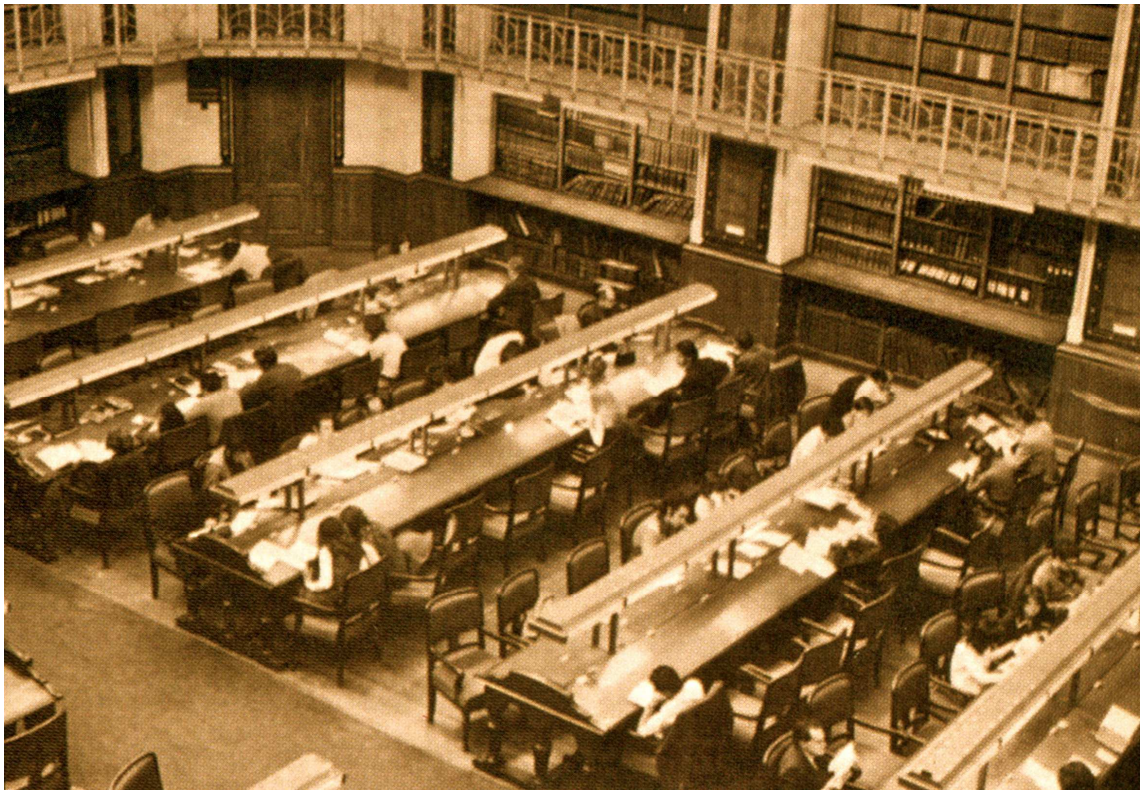

Figure 2 View of the reading room when it was still functioning as the National Library

The second chapter proposes a performative connection with the background inspiring the piece. The complementary pairs of reading/writing and light/darkness – installed by the circumstance of a blind

writer directing a library – are elaborated within a performative system consisting of a series of custom made devices that take light as their input and produce sound as their output. Outdated forms of sound inscription were revisited and reformulated to build the devices for this system, focusing mainly on optical sound technology. Three different kind of instruments were developed, all sharing a similar idea in how they read and write sound: they all use light as a source for sound production. Mechatronic optical turntables, sonic backlight and bars of light were designed and built by the artist. Though all of these instruments have electronic components, the presence of the human body is necessary to activate them and generate sound. In addition, each instrument builds a different relationship with the body, since a different body gesture, posture or action is needed to play them. Members of Banda Sinfónica de Ciegos (an orchestra of blind musicians which coincidently use the former Library as their rehearsal space) were invited to perform these devices. The lights they could not see became the immaterial reader of the sound waveforms carved out on acrylic discs or sheets. While the room was still darkened, the only lights present were the ones generating the sounds, small LED dots hovering over a dark background.

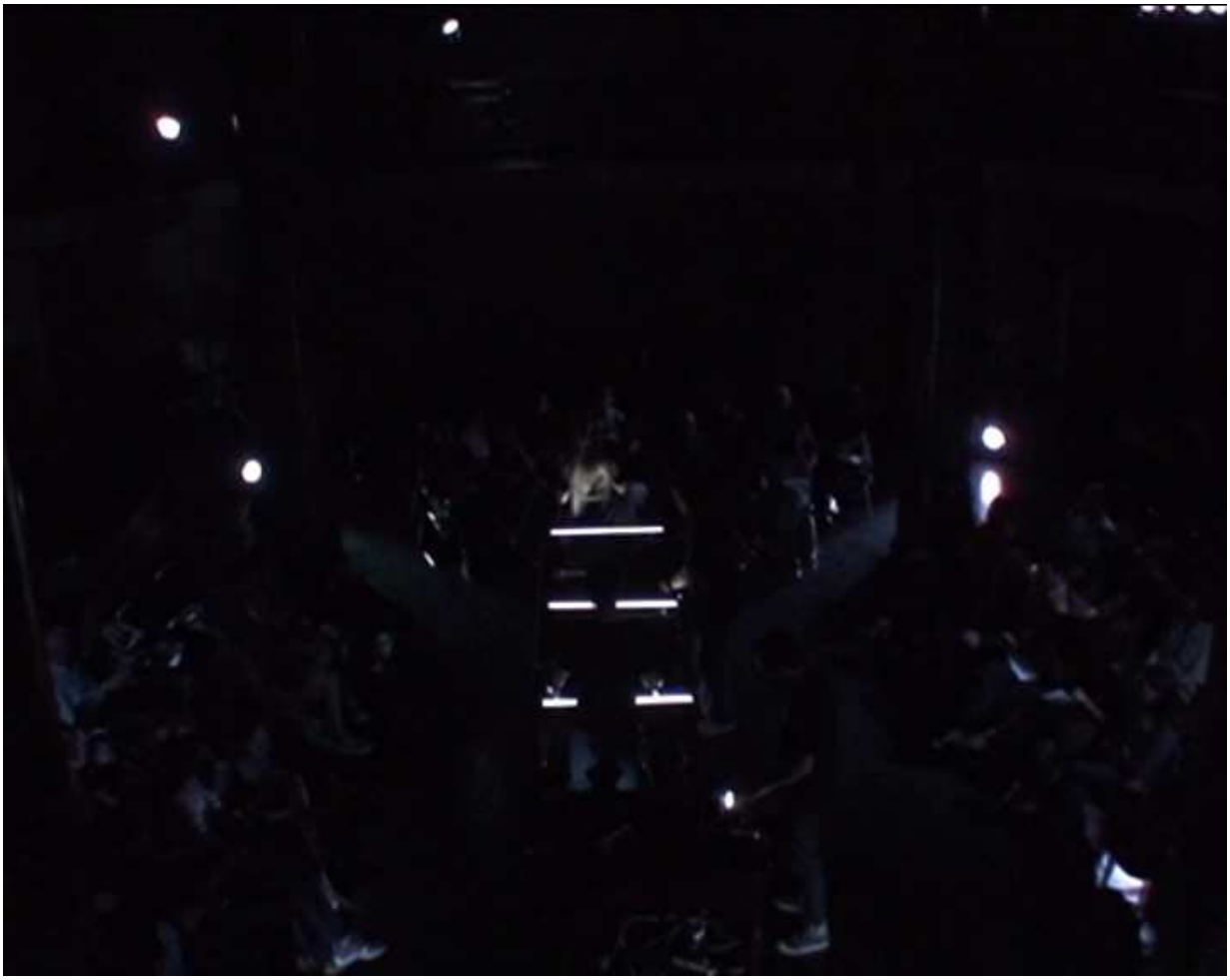

Figure 3 View of the room during the performance of LA BIBLIOTECA CIEGA.

By experimenting with alternative methods of sound inscription and transmission, LA BIBLIOTECA CIEGA becomes a sonic speculation on reading and writing. In Borges's darkened library, we immerse ourselves in the depths of the phonemes' hidden soundscapes, in a quest for language's ultimate acoustic matter and meaning, while blind musicians read to us a passage written in light and shadow, a language that can only be heard through the interaction between humans and machines.

Chapter 2: HISTORICAL BACKGROUND

2. 1. Introduction

In his essay "Kafka and his precursors", Borges sets out to recognize Kafka's voice in texts of diverse literatures and periods. Starting from Zeno's paradox, his survey includes works by Kierkegaard, Leon Bloy, Lord Dunsany and Han Yu, among a few others. By the end of it, he concludes:

> "If I am not mistaken, the heterogeneous pieces I have enumerated resemble Kafka; if I am not mistaken, not all of them resemble each other. This second fact is the more significant. In each of these texts we find Kafka's idiosyncrasy to a greater or lesser degree, but if Kafka had never written a line, we would not perceive this quality; in other words, it would not exist. The poem 'Fears and Scruples' by Browning foretells Kafka's work, but our reading of Kafka perceptibly sharpens and deflects our reading of the poem. Browning did not read it as we do now. In the critic's vocabulary, the word 'precursor' is indispensable, but it should be cleansed of all connotation of polemics or rivalry. The fact is that every writer creates his own precursors. His work modifies our conception of the past, as it will modify the future. The early Kafka of Betrachtung is less a precursor of the Kafka of somber myths and atrocious institutions than is Browning or Lord Dunsany."[4]

What follows intends to be both a historical overview of art works, devices and ideas that resonate within LA BIBLIOTECA CIEGA and recognition of the multiple voices that inform the piece. Or to be more precise, a historical overview through these voices. Therefore, the artists, art works and historical events that will be pointed out are relevant in terms of identifying and understanding the components of LA BIBLIOTECA CIEGA as an artwork. As a consequence of this approach, some of the art

[4] Borges, J.L. Labyrinths. Selected Stories & Other Writings. Edited by Donald A. Yates and James E. Irby. New Directions Book, 2007.

and events to be discussed are not necessarily of indisputable historic relevance, but hopefully our reading of them gets sharpened and deflected through the discussion of my work, as it reveals its own idiosyncrasy.

2.2. The many voices in Resonances Turbulences & Explosions

Section 2.2. presents the historical precursors to the first part of LA BIBLIOTECA CIGA: the series Resonances, Turbulences & Explosions. It is an overview of music works, art projects and scientific developments that focused on the voice as a material where its sonic component is no less than the meaning it might convey.

2.2.1. Vox Ex Machina

"Vous êtes mon ami – je vous aime de tout mon Coeur – Leopoldus Secundus – Romanorum Imperator."[5] The first words spoken by a mechanical voice were both a love declaration and praise to an Emperor. In 1780, Wolfgang von Kempelen successfully designed and built the first machine that produced human speech. A feeling of magical horror took over those who first heard how something completely non-human could produce such a humanly effect. Hence, machines had a voice, completely changing our relationship with them, for speaking is a way to reach the other. When machines started talking, technology started talking back at us.

[5] "You are my friend – I love you with all my heart – Leopold The Second – Emperor of the Romans". Cited by Malden Dolar in his book "A voice and nothing more", who took it from Parret (2002) who cited the original source: report by Windisch "Lettres de M. Charles Gottlieb de Windish sur Le Joueur d'échecs de M. De Kempelen. (Basel, 1783).

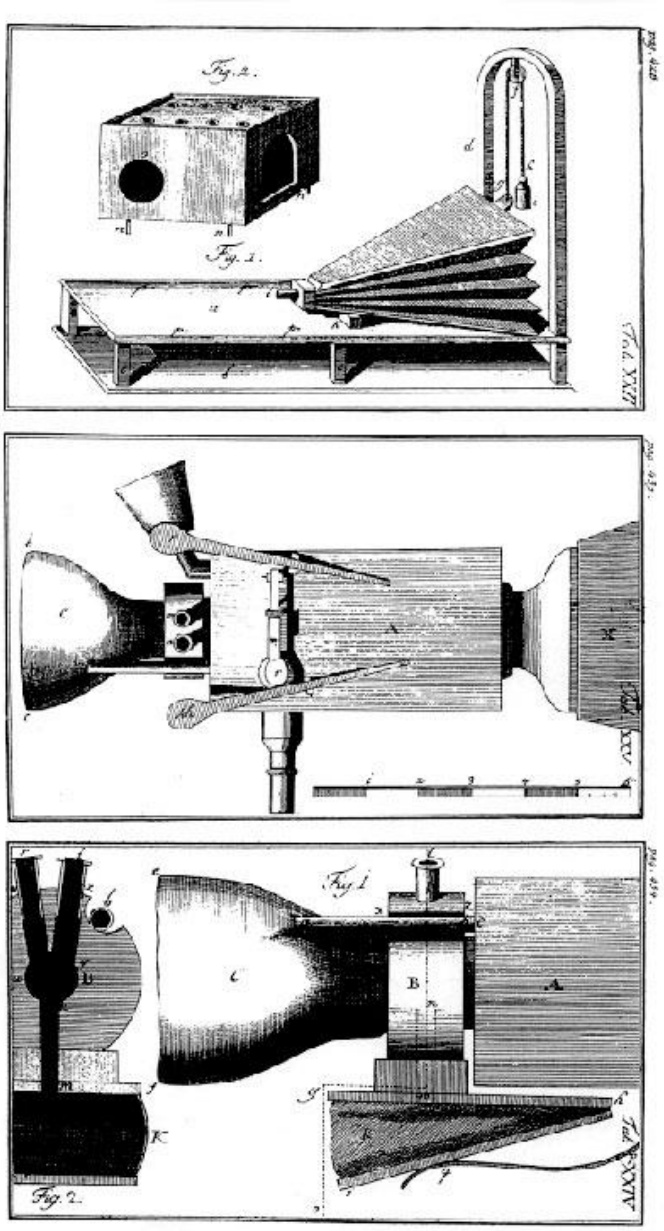

Figure 4 Schematics of Vin Kempelen's Speaking Machine, from 1780.

Almost two centuries later, Max Matthews made a computer sing for the first time – another love declaration, this time with marriage proposal included:

> "Daisy, Daisy,
> Give me your answer do!
> I'm half crazy,
> All for the love of you!
> It won't be a stylish marriage,
> I can't afford a carriage
> But you'll look sweet upon the seat
> Of a bicycle built for two."

But a few decades before Matthews set the basis for digital synthesis, a British physicist achieved artificial speech synthesis by hand-drawing the waveforms of a voice directly onto the optical strip of a "talkie". E.A. Humphries, who was working for the British International Film Co., managed to reproduce the voice of an actress by studying the shape of her vocal spectrum and drawing new words as if uttered by her. Such achievement took place in the midst of many experiments happening all across Europe since the 1920s involving optical sound and different forms of early sound synthesis.[6] Examples of this are the Russian inventors M. Gribkov and D. Tambovtsev who were working on seldom speech synthesis devices. Gribkov created what he called the "Govoriashaya mashina" (The Talking Machine), a device that incorporated a set of gramophone records with pre recorded sounds of speech related to the alphabet activated by a special optical image recognition system that recognized the graphical shapes of the alphabet to automatically read written text and to reproduce coherent speech.[7]

[6] For a summarized history of optical technology please see section 2.3. A flickering history of Light and darkness.
[7] Smirnov, Andrey (2013). Sound in Z. Experiments in sound and electronic music in early 20th century. Koening Books, London.

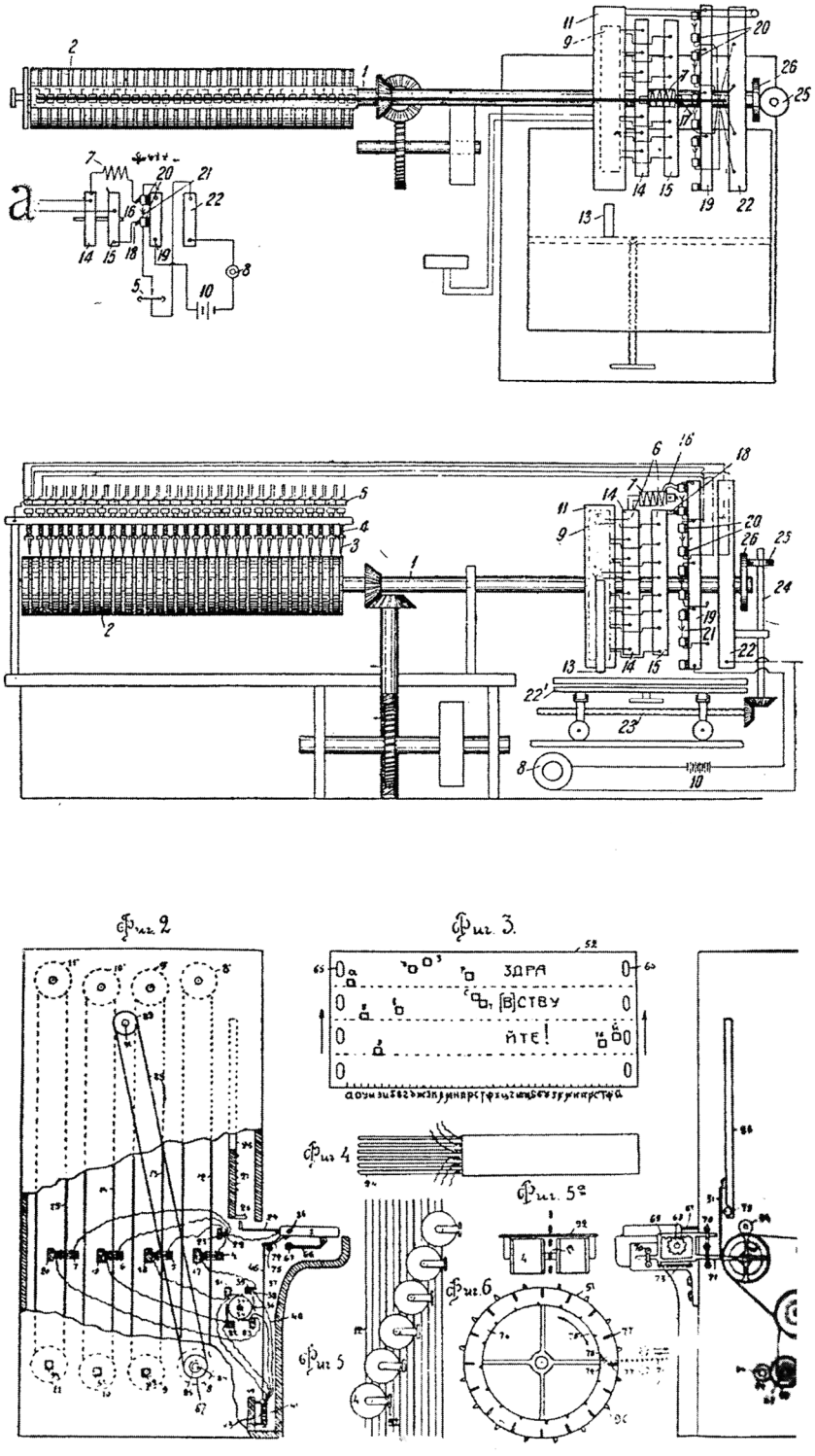

Figure 5 Top two diagramas belong to M. Gribkov's Talking Machine from 1929. Bottom image corresponds to the diagram of the mechanical keyboard by Tambovstev from 1925.

Tambovtsev's sophisticated machine consisted on a mechanical pressure-sensitive keyboard that could reproduce speech, a singing voice, and other complex sounds with the additional capability of controlling their pitch and volume. It used a system of infinite loops of steel tapes with recorded sounds (later replaced with an optical support on film), movable against the poles of electromagnets working as magnetic heads.[8] The instrument was capable of realizing a sort of concatenative synthesis to reproduce speech and singing and incorporated a program mechanism based on punched tape that was able to play pre-programmed sequences of speech phonemes, forming words and phrases.[9]

By 1927 with the implementation of optical sound technology in industrial filmmaking, the study of the acoustics of the voice gain new impulse since the actual waveform of the sound could be clearly seen in great detail. This technology opened up the possibility for new research on speech production and spectrum analysis in general.[10]

However, artists and poets were exploring the tensions between language's sound and meaning before we could look directly into the sonic shape of words. Futurist and Dada sound poets like Hans Arp, Kurt Schwitters and Raoul Hausmann were producing and performing their texts based on cacophonies, invented words, syllable mash-ups and cut-ups, and the sonic matter of language in general. This tradition of forcing sound and meaning to collide into unresolved tensions and sheer musicality was continued and re-appropriated to different extents by many South American abstract poets and writers such as Brazilians Mario de Andrade, Álvaro de Campos and Augusto de Campos, Peruvian César Vallejo and Argentinian Oliverio Girondo.

Such tradition continues until today. Around a decade ago French writer Jacques Rebotier wrote his *12 essais d'insolitude* based on heavily used everyday expressions taking advantage of and counting on the intonations most commonly used to say these phrases.[11]

[8] Smirnov, Andrey (2013) Op.Cit.
[9] Smirnov, Andrey (2013) Op. Cit.
[10] It is interesting noting how optical technology and speech synthesis are linked, connecting the central elements developed in each part of LA BIBLIOTECA CIEGA. For other interesting examples about this, please see section 2.3.3. Optical sound pioneers in South America: the cases of Fernando Crudo and Fernando von Reichenbach, later in this chapter.
[11] Rebotier, Jacques. Le dos de la langue. L'arbaléte, Editions Gallimard, 2001.

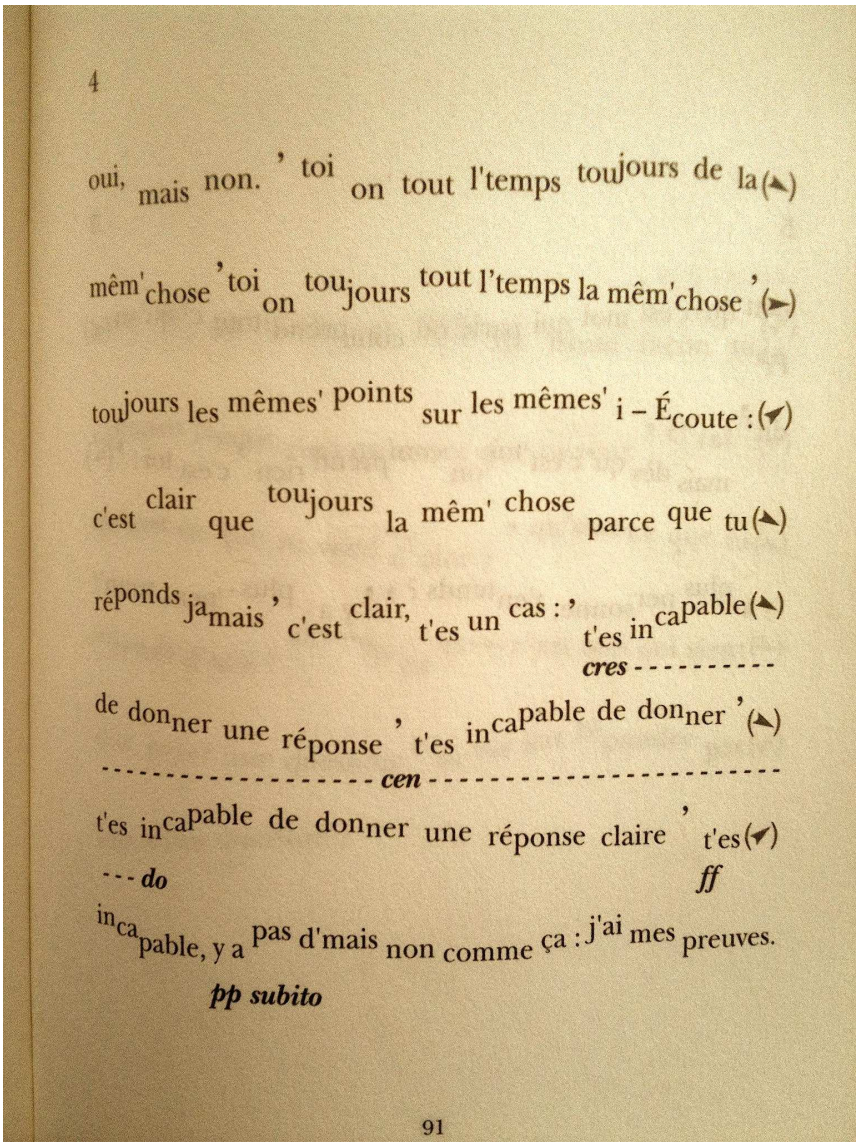

Figure 6 Page from 12 essais d'insolitudes by Jacques Rebotier.

Greek composer George Aperghis composed a series of solo voice pieces called *Recitations*, where language becomes source for sounds and speech a reference for sonic articulations, rhythmic gestures and melodic contours. Using seemingly algorithmic techniques, he manipulates syllables in repetitive and accumulative ways, giving the impression of the progressive construction of a phrase, sometimes beginning from its last syllable to its first one though not necessarily putting together a sentence with a clear meaning. Such use of repetition and accumulation renders language as a sonorous web where

poetic rather than consensual meaning arises. As meaning gets eroded through repetition, the sonic component of language comes to the forefront creating melodic and timbrical contours.

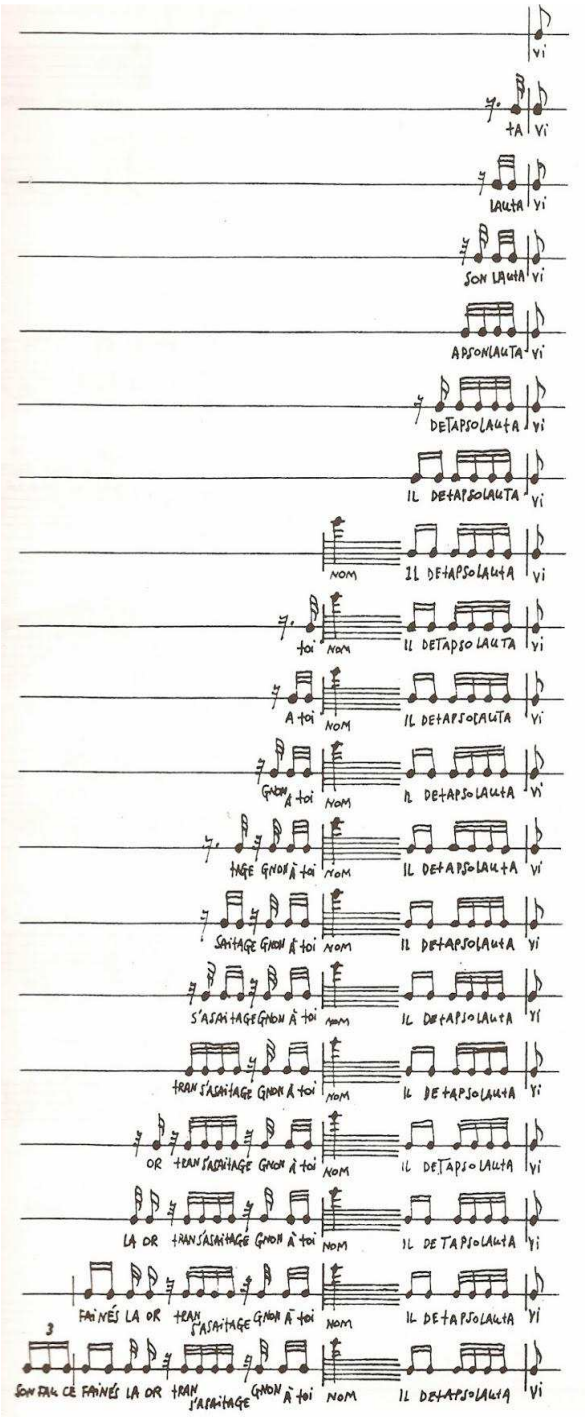

Figure 7 Excerpt from the score for Recitations #8, for solo voice by George Aperghis.

Steve Reich's phase pieces started out as experiments with voices recorded on the streets. *Come out* from 1966, starts with the same fragment of speech ("Come out to show them") re-recorded in each channel of the stereo image. As the piece evolves and the recordings get out of sync, a phase shifting effect emerges blurring the boundary between sound and meaning and emphasizing the rhythmic and melodic curves of the phrase. The resulting texture grows in complexity as more copies of the same fragment are added out of sync. The ear starts segregating each phoneme as a different layer within the texture and identifying different rhythmic patterns as the accent gradually shifts from one beat to the next. Plosives separate themselves from fricatives and vowels, turning the phrase into a specific timbre palette developed by the piece.

Argentinian composer Eduardo Bértola produced in 1975 his work *Tramos,* applying collage techniques to recordings exclusively taken from the radio, mostly of people talking. In the way he edited them, he managed to incorporate into the piece not only the political resonances of the voice (since many were actual news reports), but its geographical and social class background by highlighting the accent of the speakers as a signifying (sonic) element. In his electronic piece *Orillas* (Riverbanks) from the late 80's, Francisco Kröpfl, another argentine composer, records a voiced and an unvoiced version of a poem and divides it into phrases, words, syllables and phonemes to create new meaning through repetition or recombination of these materials. Others had used similar procedures since Luciano Berio composed Thema (Omaggio a Joyce) in 1958, where the recording of "Sirens", a poem taken from the Ulysses, undergoes a series of procedures to break down the words into their "resonance colors", playing with the musical gestures implicit within them. And even before that, Stockhausen's *Song of the youths* deals with the recording of a biblical text, classifying the sounds resulting from his editing procedures into seven degrees of comprehensibility, while it also imitates syllables and phonemes electronically using sine tones, pulses and filtered white noise. These methods can be thought of as a handmade version of the analysis and resynthesis digital tools that were only to be available much later.

Perhaps another handmade expression of a complex transformation technique is Trevor Wishart's *Red Bird* where a seemingly spectral modeling process is at times applied to various vocal utterances. Words and syllables are alternatively transformed into completely different sounds, using these

transformations to produce psychological connections and convey meaning, in a way it resembles Bértola's editorial assembles.

Yet another example of an apparent digital process is Robert Ashley's *She was a visitor* from 1967. A single performer repeats the sentence of the title for the entire performance, while a choir divided into groups, each headed by a leader, picks up random phonemes from that sentence to sustain them softly for the duration of one natural breath. The staggering of the phonemes in time resembles certain digital processes developed later on that allowed for stretching a sound without changing its pitch.

In the beginning of the 1970's, Charles Dodge started his explorations of similar issues regarding the musicality of speech within an entirely digital realm. In the resulting series of *Speech Songs*, he used early digital speech synthesis software developed at Bell Labs to produce music employing exclusively an unaccompanied computer-made voice. With *Speech Songs* the musicality within speech goes beyond the human sphere introducing the research on musical concerns also within the way machines talk.

Approaching these concerns from a different perspective Alvin Lucier, back in 1969, used his own voice to start a recursive process of recording and playback that led to the progressive erosion of his speech, transforming it into an evolving sound that gradually takes (becomes) the shape of the space where it is resonating. In his piece "I am sitting in a room", the voice, the space and the electronic medium come together as an example of all these components functioning as a feedback system. "The resonant frequencies of the room articulated by speech" become the final output of this iterated process through which the sound and meaning of his voice get corroded over time as it exposes the acoustic blueprint of the room. Lucier's piece became a reference not only for new ways of using electronics to manipulate the voice, but for several other artistic explorations which were starting at the time such as conceptual art, systems aesthetics and process works.

Such works relying on systems were early analyzed and described by theorist Jack Burnham, who foresaw a shift from an *object-oriented* to a *system-oriented* culture in which art works would engage with their audience in a two-way communication, where each one is transformed by the other. This conception of art evolved into a wide variety of productions, known generally as new media art, where

a multiplicity of disciplines comes together at the intersection of art and science. Many compelling examples of this aesthetic can be found at DXARTS, where artists, theorists and scientists from many backgrounds converge at their academic program.

Amongst these examples we find *Tropos* by Juan Pampin, a site-specific sound installation where "sonic graffiti" are created using texts sent by users over the internet, which are then sang by computer generated voices at the bathrooms of Centro Cultural de España en Buenos Aires (CCEBA).[12] Pampín extended the Festival Speech Synthesis System[13] so that these artificial voices were able to sing melodies composed by a computer agent according to the content and syntax of the messages.[14]

Another work produced in DXARTS by James Coupe, takes advantage of Pampin's speech synthesis developments to create four 'nodes', each with full control of an email account, set up to attract as much spam as possible.[15] Each node of *The Difference Engine* searches the Internet for the meaning of words selected from the spam emails it receives based on their singularity, using distinct evangelical melodies to sing what it finds into the gallery.[16]

Software development is also an important type of production within the DXARTS community. His founder, Richard Karpen, was a key contributor to the development of a DSP process commonly known as *warp*, a process based on granular synthesis techniques, allowing for a sound to be stretched or compressed without changing its pitch. The first implementation of this process was done in CSound using a NeXT computer and eventually led to the SNDWARP unit generator.[17] He first used it in his piece *The Other,* where several excerpts from Beethoven's Seventh Symphony (and a short passage from his Fourth) are "stretched and compressed in time, twisted, squeezed, transposed, counterpointed, and so on",[18] creating an otherworldly atmosphere where Karpen's music appears to *sharpen and deflect* our own listening of Beethoven. In a very borgesian turn, Karpen seems to read in Beethoven his own

[12] http://www.pampin.org/tropos/index.htm
[13] Festival is a general multi-lingual speech synthesis system originally developed by Alan W. Black at Centre for Speech Technology Research (CSTR) at the University of Edinburgh.
[14] http://www.pampin.org/tropos/index.htm
[15] http://jamescoupe.com/?p=23
[16] While at DXARTS, I had the chance to work with Coupe on further developments of the Festival System, producing the recordings of real voices used for testing new algorithms developed by Simon King and Junichi Yamagishi at the University of Edinburgh.
[17] http://www.csounds.com/manual/html/sndwarp.html
[18] http://faculty.washington.edu/karpen/TheOther.html

unwritten music, creating at the same time a new piece that transforms our understanding of the music by the German classical composer.[19]

Another software created by a DXARTS faculty is ATS (Analysis Transformation Synthesis), developed by Juan Pampin in 1999 and first implemented in the Lisp language. ATS is an analysis and resynthesis tool that breaks down the frequency and amplitude information of each partial of a sound over time, allowing for their individual manipulation and eventual synthetic reconstruction of the original sound.[20] Pampin used this process extensively in his 3D sound piece UOM,[21] where a slow evolving mass of resynthesized metallic sounds (generated from the recording of a gong) finally becomes the sound of a typewriter over which we hear the mix of a real and a resynthesized voice speaking.[22]

The use of synthetic voices, analog and digital processes and software developments in these pieces was of great inspiration for my ongoing explorations on the tensions between sound and meaning in speech, adding to the series of motivations that led to my dissertation project. Working in such research environment where similar interests on the voice were being developed was challenging and stimulating, helping me to enrich my own investigations.

[19] During the development of my Tertulia Mirogoj project, I used extensively the process developed by Karpen to make the sound of specific syllables linger on, sustaining it in time and dynamically revealing its sonic content. The kind of experimentation and information I was able to achieve with this technique provided me with great insight on the acoustic content of speech, which in time became a central topic of LA BIBLIOTECA CIEGA. Please see Chapter 3 Previous Works for more on the Tertulia Mirogoj project.

[20] For more on ATS and its relation to LA BIBLIOTECA CIEGA, please see section 4.2.2. Production and technical processes in Resonances, Turbulences & Explosions in Chapter 4. La Biblioteca Ciega.

[21] UOM is the acronym for the metal worker's union in Argentina and was presented at IMPA, a metal factory ran by its workers which serves as cultural center after office hours, along with La Bonaerense/La Federal, a 3D sound piece by Nicolás Varchausky that uses recordings from police radio communications. By initiative of Varchausky, both composers produced a specific work for this site, which were presented together as La Estrella Federal in reference to the speaker setup designed by Varchausky and perfected by Pampin for diffusing them, which resembled an 8-point star and surrounded the audience with two sets of 4 speakers arranged in two squares 45° offsetted from each other, one at ear level and the other one placed 4 meters high. For a more detailed description of this set up and an analysis of UOM, please see Chapter XII from Música y Espacio: ciencia, tecnología y estética. Edited by Gustavo Basso, Pablo Di Liscia and Juan Pampín.

[22] In the way UOM explores the extreme details of a recorded sound source through analysis and resynthesis techniques, makes an immersive use of the space, incorporates the referential qualities of the specific site, and gets paired up with another separate piece to create a whole, it becomes a direct reference to LA BIBLIOTECA CIEGA in general, and its first chapter, Resonances, Turbulences & Explosions, in particular.

2.3. A flickering history of Light and darkness

Section 2.3 reviews the various influences that are part of the second chapter of LA BIBLIOTECA CIEGA: Photosensitive Volumes. It presents an overview of the history of optical sound technology through the experimental implementations produced by artists, musicians, filmmakers and engineers since its invention up to our days. It also introduces pioneers in the development of this technology in South America.

2.3.1. The thunder and the lightning

One of the most ancient experiences of the coupling between light and sound might have been the lightning and the thunder. Even older than mankind, this phenomenon has dazzled humans for ages, whether they attributed it magical powers, saw in it sacred signals or simply deduced information about an upcoming storm. It is often a non-synchronized audiovisual experience as well, creating a dramatic gap between one another. Hearing and seeing become at the same time connected and disjointed.

> *"...Es el trueno y el rayo. Es el oído y el ojo. Es el cantante y el vidente. El oráculo opuesto al adivino. La oreja poseída que transmite a la boca que repite es un cuerpo a cuerpo verbal con el más allá de la lengua, o con lo otro de la lengua o con la totalidad de los lenguajes que han precedido a la lengua…"* [23]
>
> *El odio a la música*, Pascal Quignard

Time lies, therefore, at the center of this suggestive relationship between light and sound. Through the gap it creates, anything can emerge or disappear. Time is what keeps them apart and connected at once. And it becomes a sort of mediator, making this connection less linear and open to the unexpected, by adding this interval. This is how we can think about the lightning and the thunder, in terms of a time interval and hence, a modulation or transformation interval as well.

[23] "... It is the thunder and the lightning. It is the ear and the eye. It is the singer and the seer. The oracle opposed to the fortune teller. The possesed ear transmitting to the mouth that repeats is a close verbal combat with what's beyond language, or with language's otherness or with all the languages that preceded language…" Translation by Nicolás Varchausky.

The physical phenomenon of the lightning is described as a powerful sudden flow of electricity or electrostatic discharge that superheats the air to plasma temperatures along the length of the discharge channel in a short duration. Gaseous molecules undergo a rapid increase in pressure and thus expand outward from the lightning creating a shock wave audible as thunder.[24] This sudden apparition of light creates sound. But not any sound, a sound with a broadband spectrum. That is, a sound whose partials are not organized as multiples of a fundamental, since there is not really one. As a consequence, all partials have the same importance since there is no hierarchy that orders them in a recognizable way. What we hear then, is commonly described as noise. In fact, a timbre, a cluster, a mass of sound, an explosion. As the whiteness of the lightning suggests the confluence of all colors, the noise spectrum is also an analogy for the coexistence of all sounds. In this sense, the lightning and the thunder potentially become a powerful raw material encapsulating all that can be heard and seen. Perhaps it is because of this syncretic potentiality that we have always been fascinated by these manifestations, since they bear more than the promise of a storm, but the possibility of all things to unfold.

But as much as this fascination lingers on since ancient times, it took the invention of electricity and the development of the early recording devices for artists to have the opportunity of experimenting with new ways of inscription, generation and reproduction of sound using highly controllable light sources. Chapter two of LA BIBLIOTECA CIEGA attempts to bring light and sound together within the digital space by refurbishing early experiments of optical sound technology and expanding them through the use of code and algorithmic techniques. Next section provides an overview on how the specific technology of optical sound was appropriated and used by experimental artists since its apparition, and on how it relates to current digital signal processing.

2.3.2. Experimental pioneers of optical sound

The history of optical sound is closely linked to the first developments on the production of synthetic sounds and was first used commercially as a way to have a synchronized soundtrack on films. The new optical recording technology translated sound waves via the microphone and a photosensitive selenium

[24] http://en.wikipedia.org/wiki/Lightning#Lightning_strike

cell into patterns of light that were captured photo chemically as tiny graphic traces on a small strip that ran parallel to the celluloid film images.[25] The possibility of inscribing sound in a visual manner led to various kinds of research, from acoustic measurements and timbre classifications, to synesthetic studies and speech analysis. The photographic basis of this technology allowed for the magnification and enlargement of the sound waveform, creating a detailed depiction of the spectral components of sonic matter. It is not surprising that many experimental artists, sound engineers and animation filmmakers quickly started to draw their own waveforms to create sounds, speeding up the rich history of sound synthesis and spectral manipulation. Some of these early experiments focused on the reconstruction of actual sounds, while others synthesized new ones from scratch. A proliferation of optical sound devices populated the decade of 1930, many of them putting in practice the theories by Helmholtz and Fourier, basing their sonic output on generating and controlling simple waveforms and producing additive synthesis. Though these devices often entailed a painstaking process to create a sound (such as hand drawing waveforms or designing and building multiple discs), some artists managed to make that process fairly straightforward by assuming more exploratory strategies the sonic output would not necessarily be predictable. Such approaches achieved an exciting immediacy in the generation of sound (like Fischinger's ornamental sounds), often times arriving at radical sonic results.

As it often happens, the development of a particular technology involves the confluence of research in various domains. Sound artist Derek Holzer surveyed the most salient scientific discoveries and artists who helped to develop the technology of synthesizing sound from light, which he describes as "a curious combination … of mathematics, physics, electronics and communications theory, which found realization in the industries of motion picture films, music, surveillance technology and finally digital communications."[26] We have used his timeline as a guide for our account of pioneering artists and devices using optical sound that relate in a more or less direct manner to Photosensitive Volumes, chapter two of LA BIBLIOTECA CIEGA.

[25] Levin, Thomas, E. Tones out of nowhere: Rudolph Pfenninger and the Archaeology of Synthetic Sound. Grey Room 12.
[26] We based our account of optical sound pioneers on a timeline created by Derek Holzer as part of his residency at the Tesla media arts laboratory, in Berlin, Germany over the months of Oct-Dec 2007, and at STEIM during the last two weeks of February 2008. For accessing the complete timeline, please visit http://www.umatic.nl/tonewheels_historical.html

We depart from the filing of the first known patent for sound on film created by Eugene Lauste, a former Edison assistant, in 1907. He was the first to transform sound into light waves that could be recorded directly onto celluloid. A little over a decade later, Lee De Forest perfected this technology setting the basis for future commercial applications on the film industry. His system recorded the sounds photographically onto the celluloid as a strip next to the images.

But before the adoption of Lauste's invention by industrial cinema, a series of Russian avant-garde artists were also experimenting with other methods of sound inscription based on light. Futurist painter Vladimir Baranoff Rossiné created in 1916 the Optophonic Piano, which used a series of revolving painted glass disks, filters, mirrors and lenses to modulate a light source, which was picked up by a photo-electric cell controlling the pitch of a single oscillator. This device was somewhat the starting point for many keyboard devices that took advantage of the many developments surrounding optical sound technology. In 1927, Pierre Toulon and Krugg Bass created the Cellulophone in France, which generated sound through a series of rotating discs with equidistant slits cut into them. A light beam flashed through the slits and on to a photoelectric cell, creating an output signal with the help of a vacuum tube oscillator. The frequency of this signal was a direct consequence of the speed at which the disk was rotated.

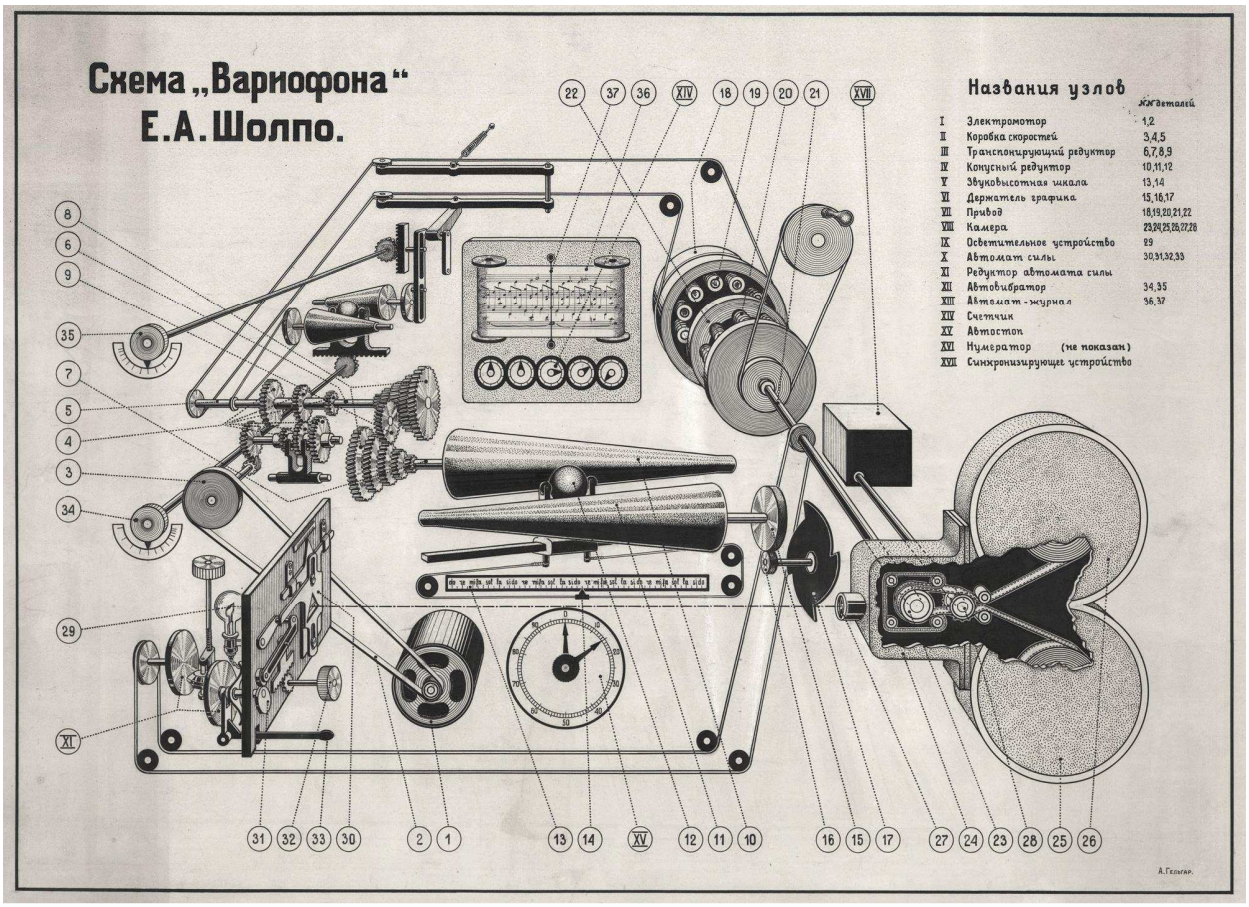

Figure 8 the Variaphone diagram.

By the turn of the decade, Russian filmmaker Abram Room produced the first sound film in Russia, inspiring many of the people involved in it to pursue further experiments on sound synthesis through graphical means. Such were the cases of Arseny Avraamov and Eugene Scholpo, who in 1930 produced seldom milestones within this realm. Avraamov generated the first hand-drawn soundtrack for a film by shooting drawn waveforms on an animation stand. On the other hand, Scholpo developed the Variaphone in collaboration with renowned composer Georgy Rimsky-Korsakov. Unlike Avraamov's technique of shooting still images, the Variaphone used "paper disks with circular images of combs with appropriate shapes of cogs, rotating synchronously with a moving filmstrip."[27]

[27] Smirnov, Andrey (2013) Op. Cit.

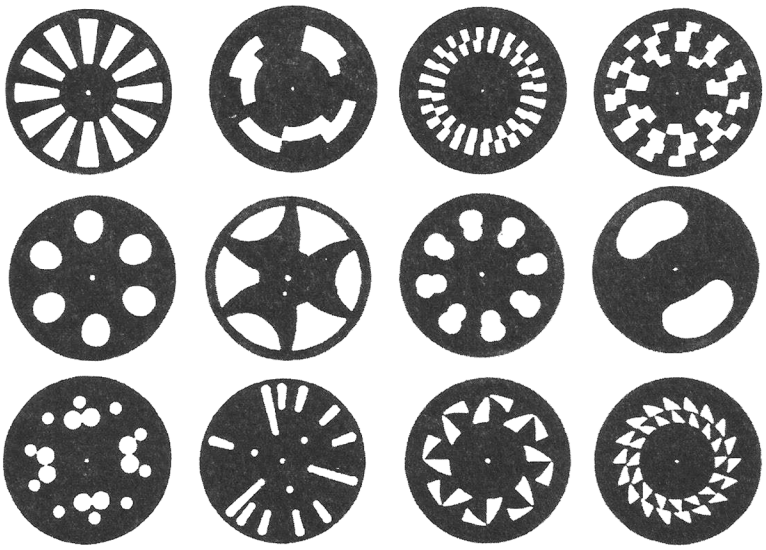

Figure 9 Optical discs for the first version of the Variaphone.

In parallel to the developments in Russia, similar efforts and experiments were taking place in several other European cities. Rudolf Pfenninger was adopting related methods for sound synthesis using animated hand-drawn sound waveforms to create the soundtrack for his films in Munich. Oskar Fischinger, another German pioneer of abstract animation working in Berlin, was exploring "the musicality of moving graphic form in the tradition of animated cinematic synesthesia", drawing patterns of abstract forms on paper which were later photographed onto the celluloid as if it were the soundtrack for a film. His works were gathered in a compilation called Experiments with Synthetic Sound, which established the basis for his "absolute film", "drawn music" and "sounding ornaments" theories.

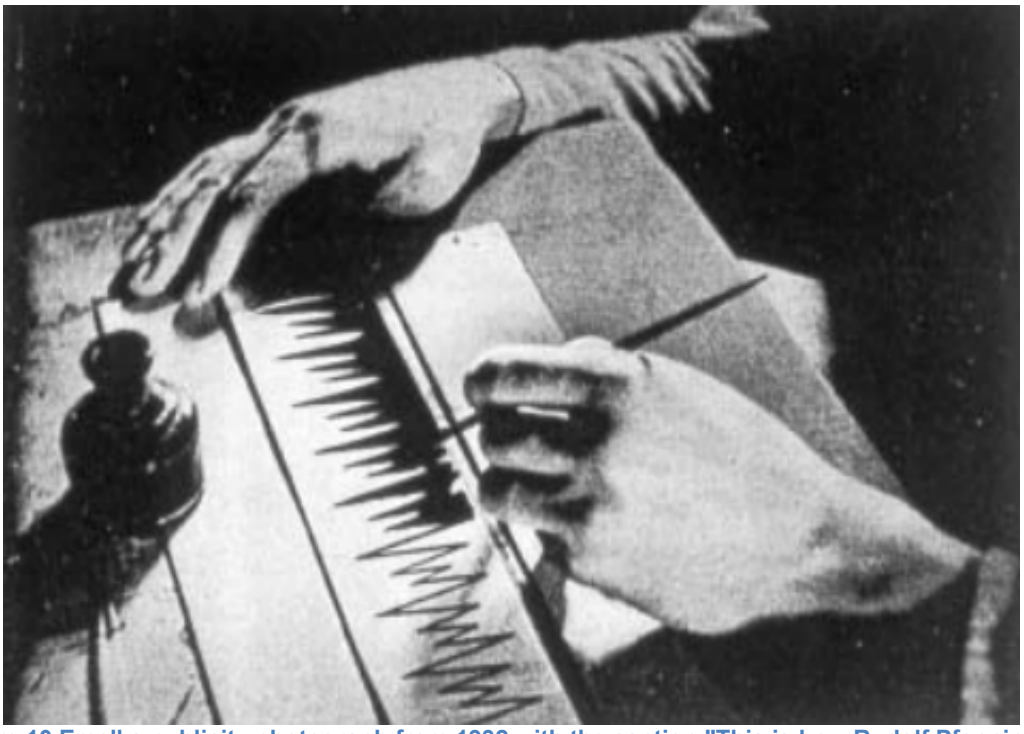

Figure 10 Emelka publicity photograph from 1932 with the caption "This is how Rudolf Pfenninger's 'Sounding Handwriting' is drawn".

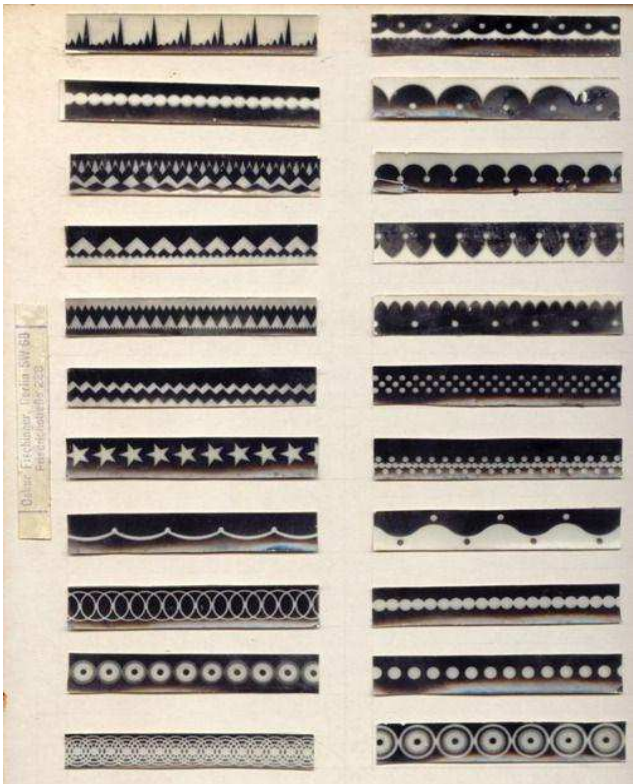

Figure 11 Oskar Fischinger's ornamental sound strips.

László Moholy-Nagy re-photographed the optical soundtrack to make it also the visual content of his film *Tönendes ABC* from 1933, in order to show the correlations between the visual forms and their corresponding sounds.

In 1936, F. Sammis invented the "singing Keyboard", an instrument that played electro-optical recordings of audio waves stored on strips of 35mm film, which were triggered and pitched when the player pressed a key.[28] This instrument set the basis for modern samplers and inspired several future devices such as the Mellotron and Chamberlin that used a similar technology of triggered and pitched magnetic tape recordings[29], and the Optigan, based on optical sound recordings.

Evgeny Murzin, a Russian engineer who had been working on optical sound synthesis since the late thirties, built in 1958 the first working version of his famous ANS synthesizer, a polyphonic photo-electronic musical instrument that could obtain a visible image of a sound wave, as well as synthesizing a sound from an artificially drawn sound spectrogram.[30] In his improved version from 1964, sine waves printed on five glass discs summed up a total of 720 individual tracks, spanning 10 octaves. The modulated light from these discs is then projected onto the back of the synthesizer interface.

[28] Holzer, Derek. http://www.umatic.nl/tonewheels_historical.html
[29] Holzer, Derek. http://www.umatic.nl/tonewheels_historical.html
[30] http://en.m.wikipedia.org/wiki/ANS_synthesizer.

Figure 12 The ANS Synthesizer.

In the early 1970's, a subsidiary of toy manufacturer Mattel released the Optigan, an electronic keyboard instrument that used pre-recorded optical soundtracks, encoded on 12" clear plastic film discs, to reproduce sound.[31]

[31] The Optigan became an early inspiration for my interest in optical sound, which in time turned into the Photosensitive Volumes that populate the second chapter of LA BIBLIOTECA CIEGA.

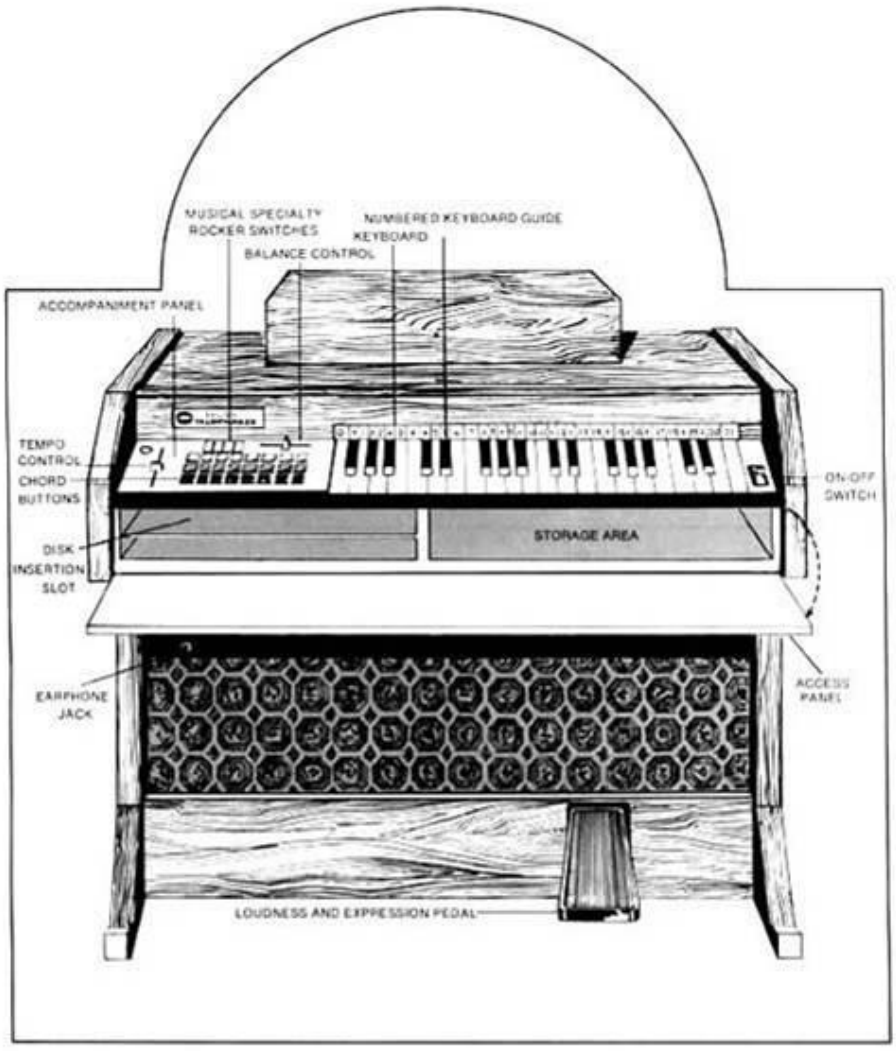

Figure 13 Diagram of the Optigan.

Also during the seventies, some artists gave continuity to many of the Soviet avant-garde experiments in sound-film, such as drawing shapes and patterns directly onto the filmstrip like in Norman McLaren films in collaboration with kinetic sculptor and filmmaker Len Lye, or French composer Jacques Dudon photosonic spinning discs printed with just intonation scales.

American inventor James T. Russell has been credited with inventing the first system to record digital information on an optical transparent foil, which is lit from behind by a high-power halogen lamp.[32] His patent granted in 1970 eventually led to the commercial production of the Compact Disc in the late

[32] https://en.wikipedia.org/wiki/Compact_disc

1970's and early 1980's. The CD is an evolution of LaserDisc technology, where a focused laser beam is used that enables the high information density required for high-quality digital audio signals.[33]

Artist Paul De Marinis experimented with laser beams as a means for reading sound from several different supports, such as phonographs, wax cylinders and even a clay cylinder. In his show *The Edison Effect* from 1995, he reflects on how "our sense of time, memory and belonging have all been changed by the exact repetition implicit in mechanical recording."[34] The reflected light from the laser hitting the record groove is picked up by photoelectric cells that turn the audio information into an electrical signal and finally into sound. The result ranges from a fairly discernible original to a very distorted one.[35]

For De Marinis, playing a phonograph record without using a needle transforms it in "a holographic object", in which the mix between the noises arising from its surface and the recorded sounds they carry create "a havoc of misinterpreted intentions and benign accidents."[36] In a way, De Marinis' Edison Effect could be thought of as a pataphysical archaeology of media, as well as a critique of the way we relate to memory in a society increasingly obsessed with the virtualization of memory, being for him the CD technology of the time the fulfillment of the "emancipation of memory from touch."

[33] https://en.wikipedia.org/wiki/Compact_disc
[34] De Marinis, Paul. The Edison Effect. A Listener's Companion. Apollo Records, 1995. CD.
[35] Please see section Optical sound pioneers in South America: the cases of Fernando Crudo and Fernando von Reichenbach later in this chapter for another early device based on the reflection of light from a surface.
[36] De Marinis, Paul. The Edison Effect. A Listener's Companion. Apollo Records, 1995. CD.

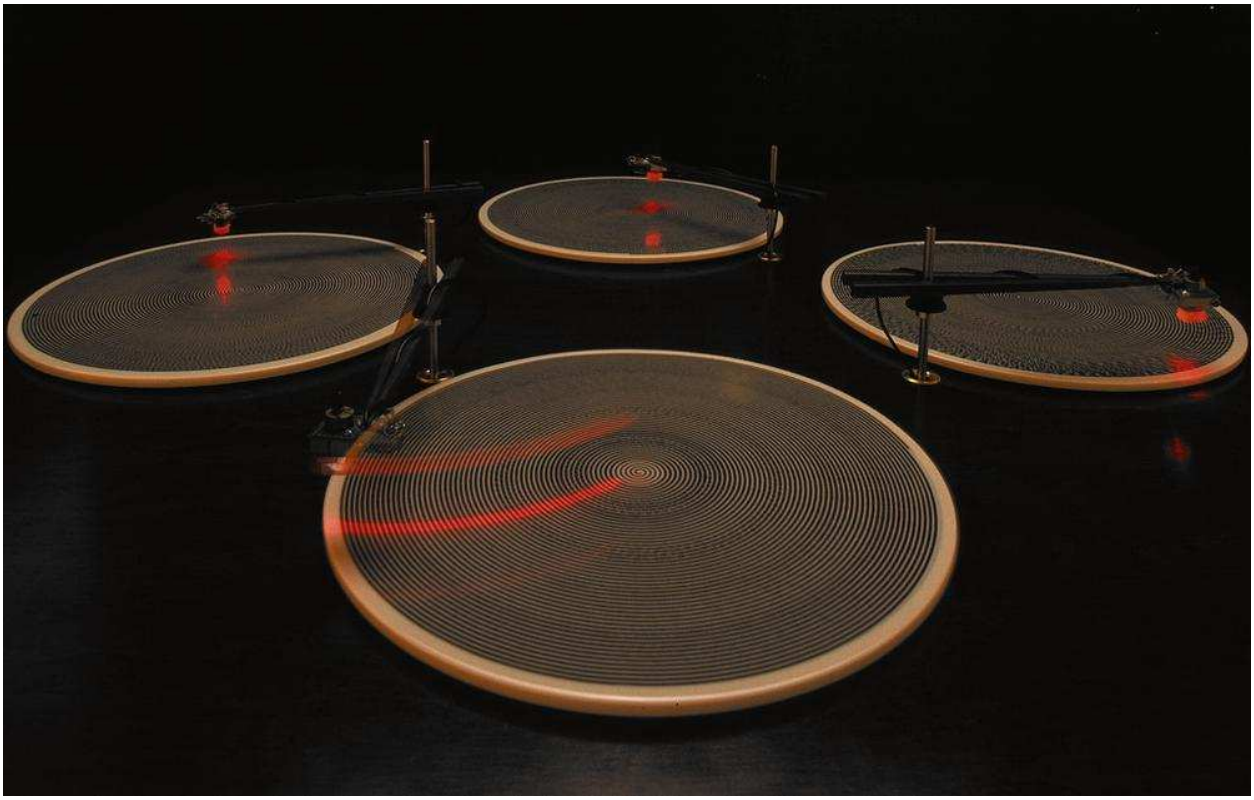

Figure 14 The Edison Effect by Paul De Marinis.

Already in the 2000's, Berlin based sound artist Derek Holzer continued along Dudon's path, creating low-fi devices using an overhead projector and several clear discs with regular patterns printed on them, attached to small motors that made them spin. A series of photoelectric cells on the wall would catch the light and shadows cast by the various discs that Holzer manipulate with his hands, producing singular and dynamic audiovisual performances.

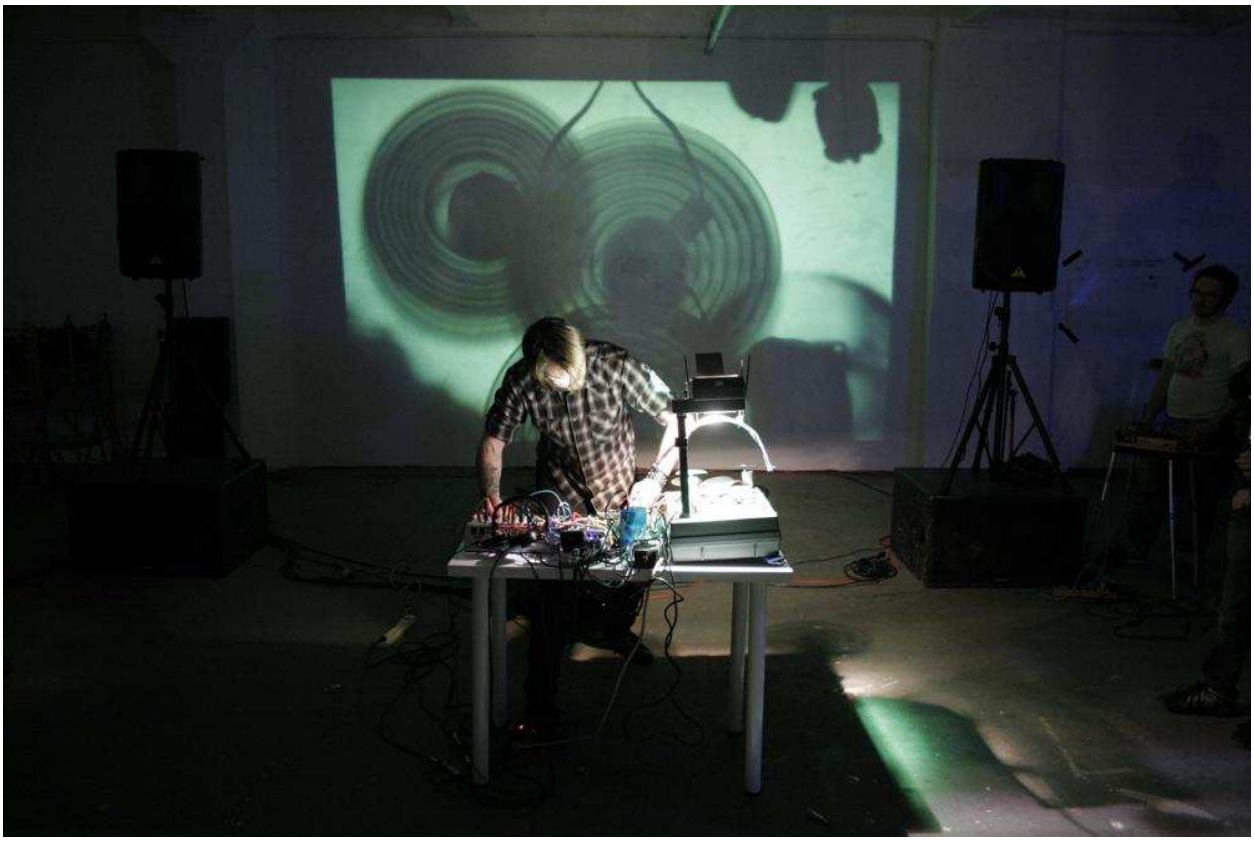

Figure 15 Derek Holzer performing his optical sound set.

2.3.3. Optical sound pioneers in South America: the cases of Fernando Crudo and Fernando von Reichenbach

In Argentina we find the pioneering work of Fernando Crudo,[37] who in the late 1920's dreamt of a device that could reproduce sound printed on paper using regular printing techniques. He wanted to print public speeches or live concerts on the newspaper. His ultimate vision consisted on the possibility of having the recording of the evening concert at the local Opera House the day before, printed on your Sunday newspaper, and be able to listen to it. In the very early 1930's he had already patented and built this device. On its edition of July 15th, 1933, the French newspaper Le Journal – which was the first French paper to be printed daily – printed an entire page with the oscillogram of "Bésame otra vez", a complete tango performed by Osvaldo Fresedo.

[37] I took the information on Fernando Crudo from the research done by Jorge Petrosino and Ianina Canalis at Universidad de Lanús, Buenos Aires as presented during their talk at the Semana del Sonido, Rosario, Santa Fé, 2014.

Based on the early optical sound research for film, 25 year-old Crudo first patented his invention in 1931, introducing two basic changes to the optical sound technology of the time. One of the differences consisted on switching from the more typical optical sound technique where a transparent waveform printed on a dark background would modulate the light coming through it according to the sound's intensity, to using paper's reflective quality instead. His invention took the light reflected on the moving paper and transformed it into sound. The other innovation was introducing parallel stripes instead of the single long stripe as featured on films, so it would fit the newspaper format. Since the process of printing the sound involved burning images on a negative film, he needed the biggest celluloid sheet he could get to compete with the 2 to 4 minutes of sound that other mediums could store at the time. Such celluloid sheets would be roughly 40x50cm in size, fitting almost perfectly the size of a newspaper. The parallel stripes had a slight inclination that would help rebuild the sound as a continuous track when put on a cylinder. He called his invention "fotoliptófono". By 1939, he had patented his device in over 30 countries. The fotoliptófono had great repercussion in the press, and attracted a series of wealthy investors. Enthusiastic reviews of the time announced on the front pages "a revolution in the phonographic industry" and even the "possible bankruptcy of the record and the needle". By 1950, his fotoliptófono became stereo.

Crudo's design had a series of advantages over other mediums. The overall sound quality was comparable to that of the phonograph but it had better frequency response and a similar dynamic range. Better results were obtained on illustration paper rather than on newspaper, and you would get the best possible sound when reading directly from the celluloid print. Though it was all subject to the quality of the print and the paper, it would had virtually no wear over time since there was no physical contact with the paper while playing it.

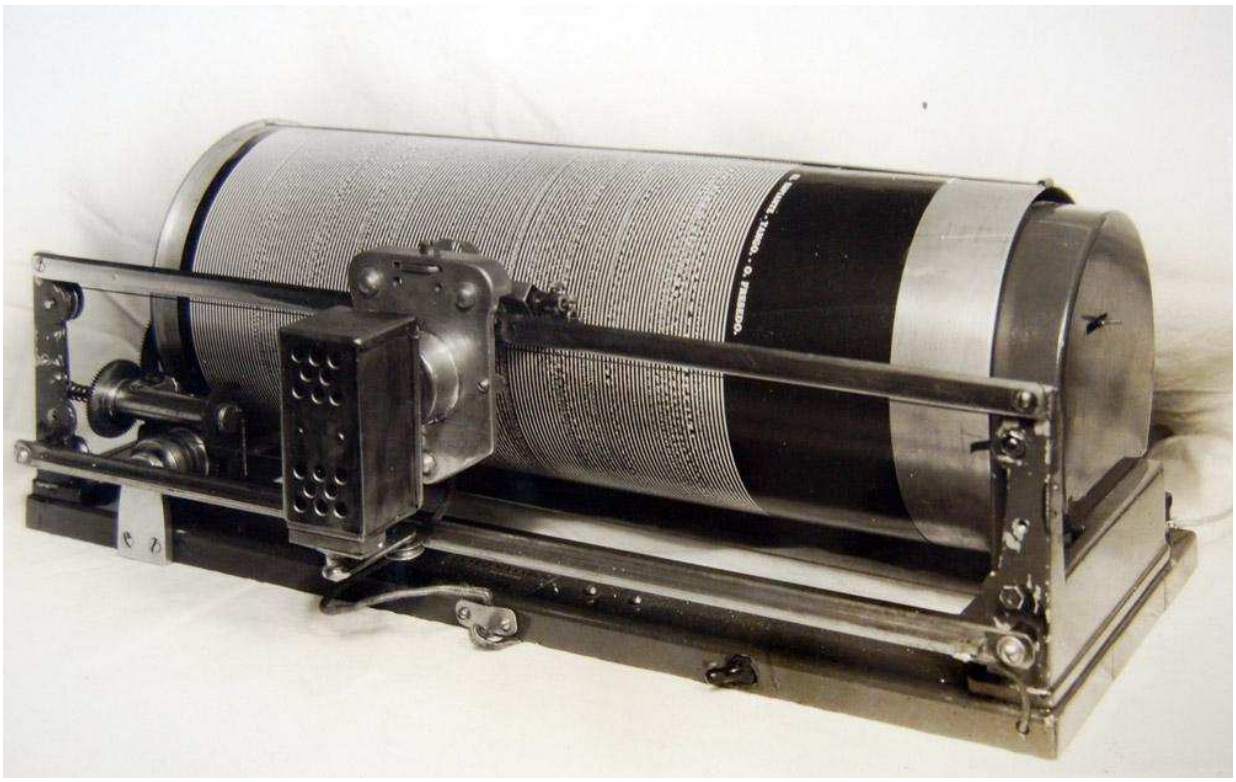

Figure 16 The Fotoliptófono by Fernando Crudo (Courtesy of J. Petrosino and I. Canalis)

As a commercial stunt, they installed a fotoliptófono on a bus, getting the device to work without a problem despite the cobblestone roads. Since there was no "needle" involved, that is again, no contact between the player and the paper but only a light source and its reflection on the printed surface, the bumpy ride would not affect the continuity of the reproduction at all.[38] Other benefits were that if the page had wrinkles on it, they would not affect the sound. Even a stain or a scratch would have almost inaudible consequences. A scratch on a record was far more destructive than an imperfection on the paper. Also, storage capacity was dramatically improved since 100 records weight 20 kilos while 100 sonic pages barely 1 kilo, plus they occupied a lot less space. From a marketing point of view and unlike any other device, the sonic paper also allowed for ads to be printed along with the actual music, sharing the same space, without interference with the actual sound.

Another significant advantage was that buying a sonic page would be a lot cheaper than buying a record, and both would store the same length of sound. While you would pay between $1.5 to $2.5 for

[38] In addition, this might have been the first advertisement on public transportation using sound ever.

a record, a “página sonora” (sonic page) would cost less than $0.30. Once you owned your player, getting new music was a bargain.

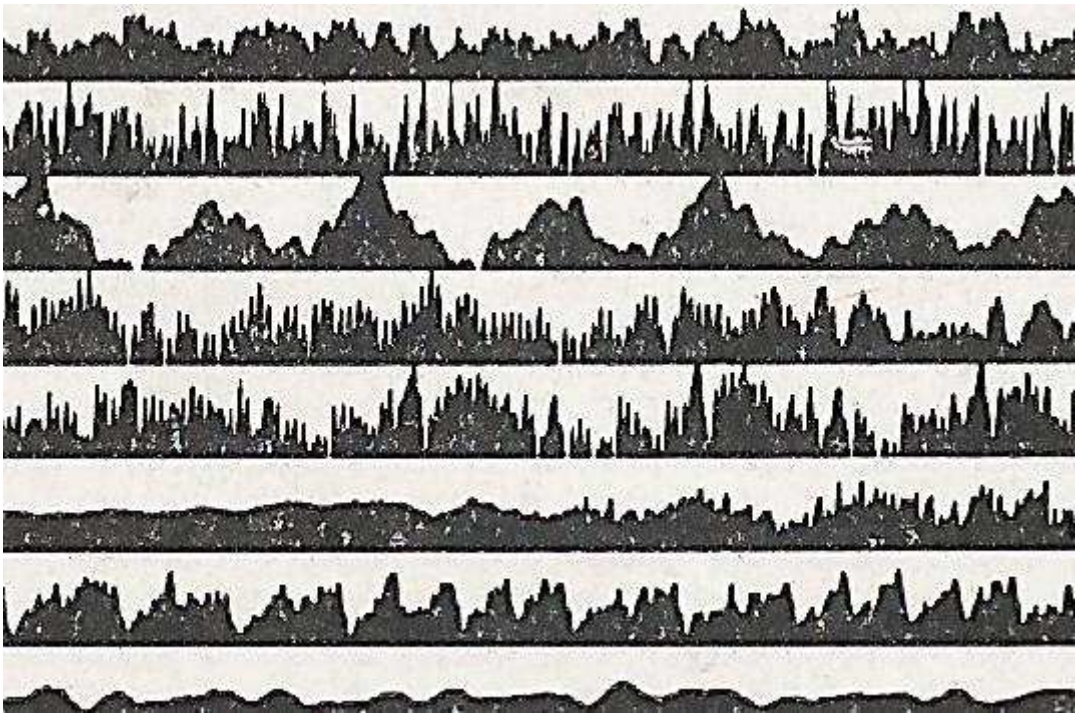

Figure 17 Detail of a "sonic page" (Courtesy of J. Petrosino and I. Canalis)

Despite the positive feedback, clear advantages over other mediums, several important sponsors supporting the project, and reknown Korn publishing house releasing the prints, the fotoliptófono never achieved mass production as a commercial device. Delays and hesitations on the negotiations between several companies who wanted the invention, plus the beginning of WW2, might have prevented Crudo from introducing his invention into the market. Instead, he found a new home for it. When Argentina’s Archivo General de La Nación creates the Archivo de la palabra (Speech Archive) to record public speeches and folk music, they chose the fotoliptófono as their main support. In 1945, they create the Phonetics Lab, taking advantage of the fotoliptónofo’s visual depiction of sound waves. In this way, they could easily look at the waveforms and study the phonemes, by simply making a bigger print of the word they were interested in. Mercedes Álvarez Puebla de Chaves published a thorough study on the acoustics of speech called “Problemas de Fonética Experimental”, for which she extensively used Crudo’s device. The book from 1948 also comes with many images of the phonemes she studied.

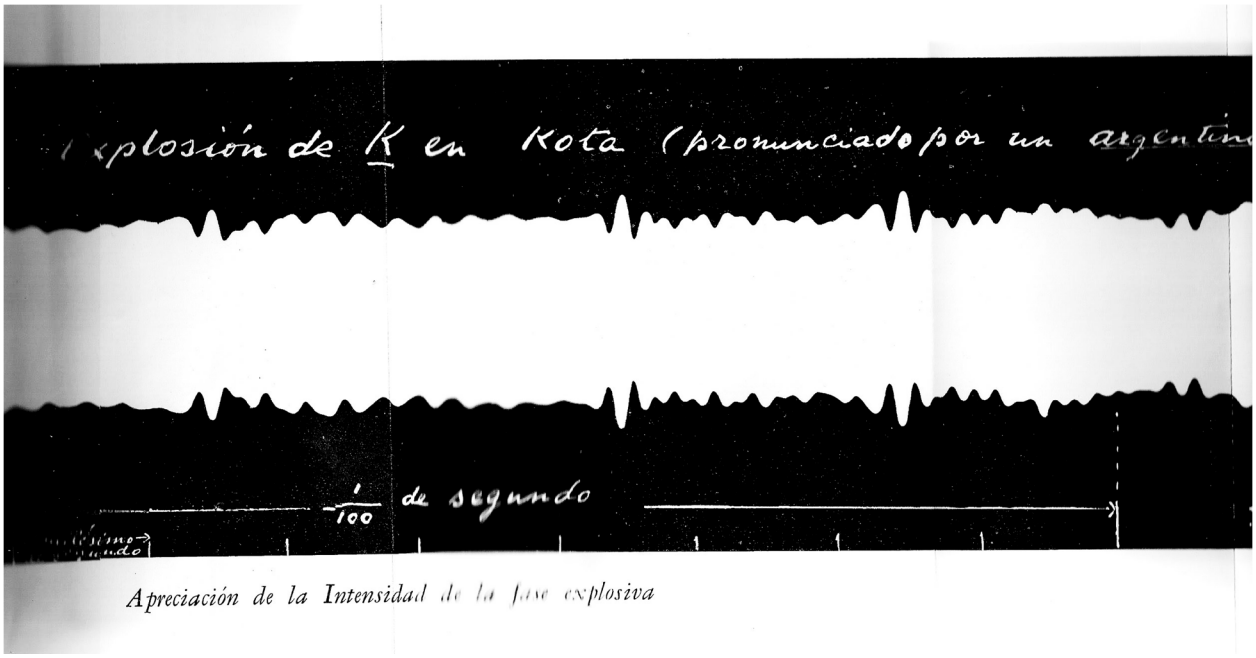

Figure 18 Detail of the explosive phase of /k/, from "Problemas de Fonética Experimental"

In the late sixties Fernando von Reichenbach, another argentine inventor, developed a series of devices using light or visual inputs to create sound. His inventions would always reconcile the latest technological developments with scarcity of resources, often anticipating to industrial developments to come.

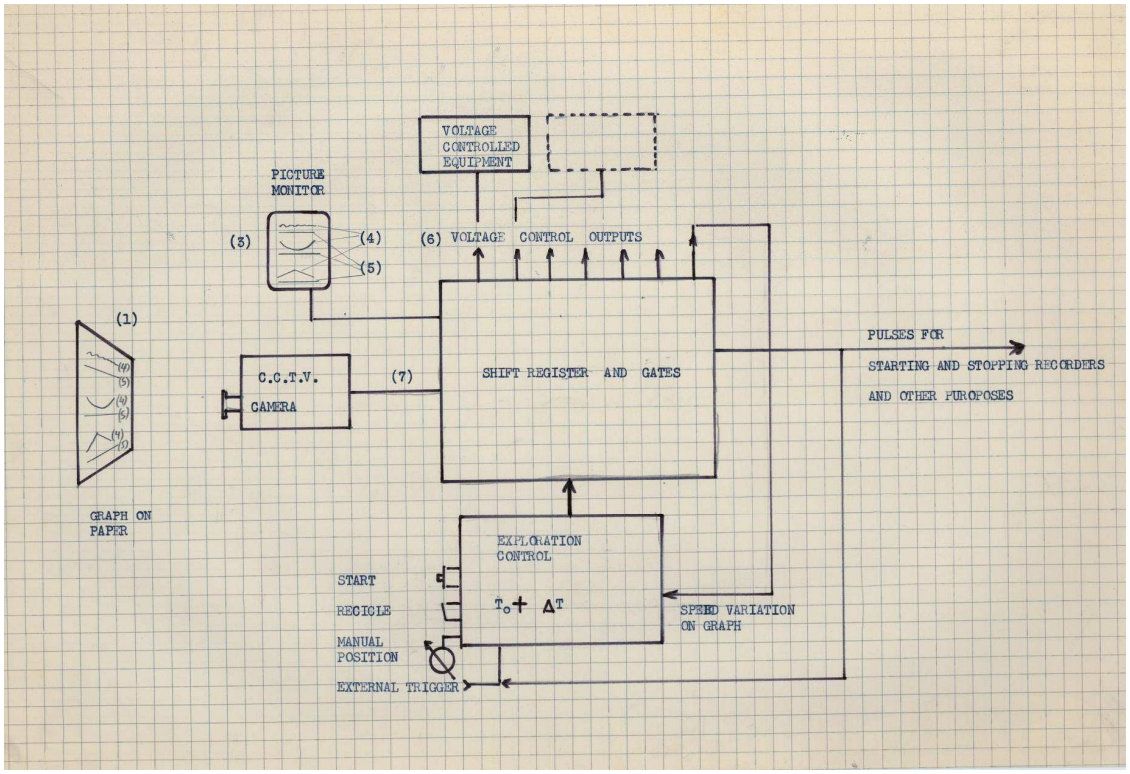

Figure 19 Original diagram for Catalina by Fernando von Reichenbach (Courtesy of Archivo Fernando von Reichenbach)

In 1973, he filed a US patent for *Catalina*, a analog graphic converter capable of synthesizing sounds from an graphic score viewed by a video camera. The images captured by a closed circuit TV system would be turned into digital information used to program voltage control signals. The graphical representation was read *point by point* and at different speeds, which automated envelopes could control. The system could loop on a particular area of the graphical score and store control presets.[39]

[39] Quoted from an original typewritten text by Fernando Von Reichenbach. Courtesy of Archivo Fernando Von Reichenbach.

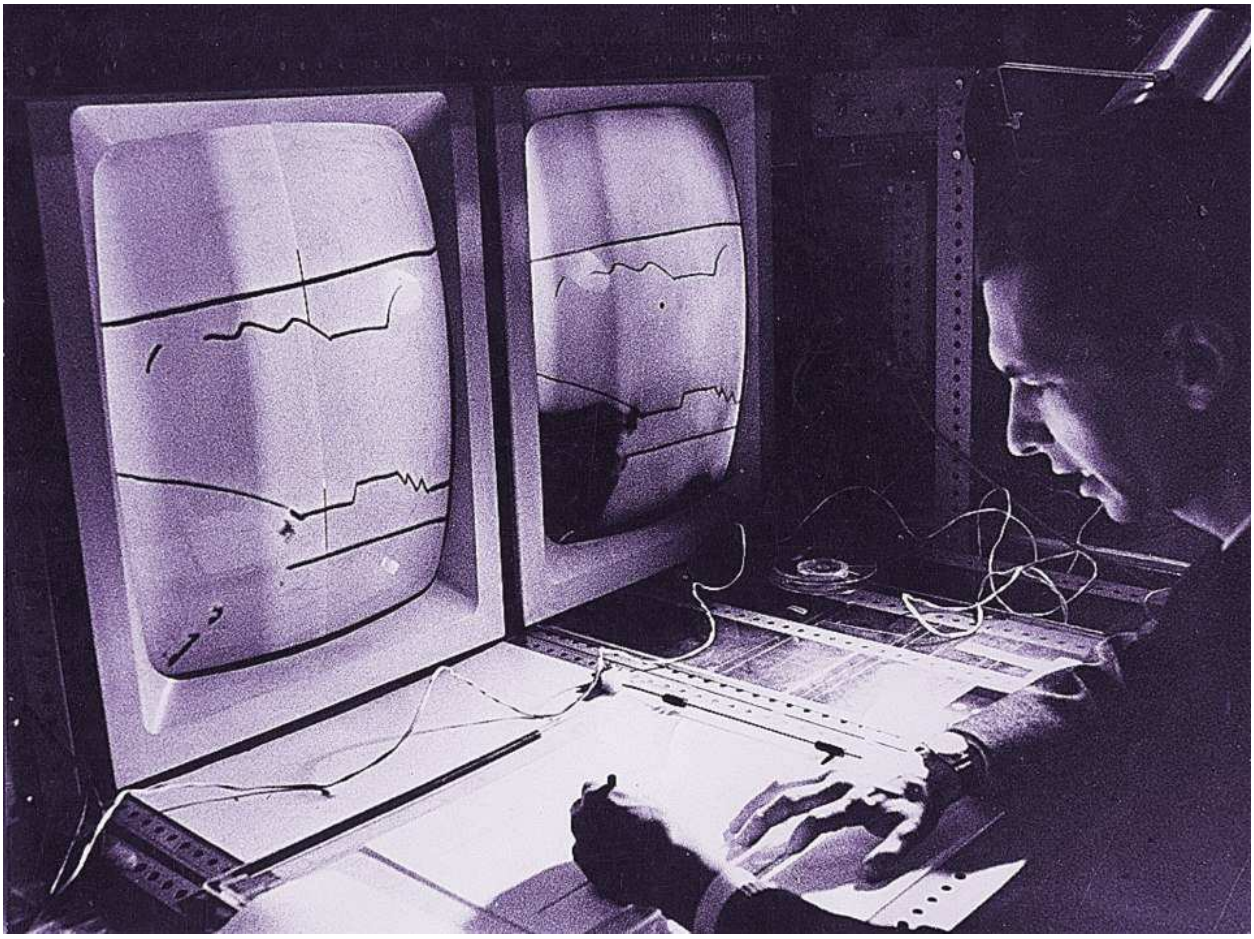

Figure 20 Fernando von Reichenbach working on Catalina (Courtesy of Archivo Fernando von Reichenbach)

Catalina constitutes a clear precursor for Iannis Xenakis' 1977 UPIC (Unité Polyagogique Informatique du CEMAMu) system where the composer drew lines on a screen with a light-pen representing pitch, which changed over time depending on the direction of the line.

Another invention by Reichenbach consisted on an optical sound spatializer that used degrees of opacity and transparency to create spatial trajectories for sound. It could move sound in circles by distributing and attenuating a stereo signal on 6 amplifiers using a wide transparent tape, which passed in front of a series of photo-resistors. Strips of different colors and transparencies attached to this tape determined the degree of attenuation in each amplifier necessary to create the illusion of sound moving around the space.

Reichenbach created many devices for generating and controlling sound during the 60's and 70's while working at music and art institutions such as Instituto Di Tella's CLAEM (Centro Latinoamericano de Altos Estudios Musicales), CICMAT (Centro de Investigación en Comunicación Masiva, Arte y Tecnología) and LIPM (Laboratorio de Investigación y Producción Musical) labs among others. Many of these devices used light sensors as a central part of their design. His ultimate goal was to design technology that was sensitive to art, facilitating the work of the artist. He collaborated with innumerable artists, musicians, actors and dancers specially while at Instituto Di Tella, where he was appointed as Technology Director between 1966 and 1971. In 1972 he was awarded the Guggenheim Grant, with which he creates famous analog graphic converter.

The cases of Crudo and Reichenbach are interesting local references to LA BIBLIOTECA CIEGA, as they illustrate the parallel research going on in Argentina in terms of experimentation and development of devices linking light and sound.

Chapter 3: PREVIOUS WORKS

3.1. Introduction

During my 4-year PhD residency at DXARTS I worked on five main areas of interest: performance, sound in space, systems art, the voice and algorithmic processing. These interests informed most of the courses I took and the works I produced in those years.

For pursuing studies on the voice, I worked with Dr. Ludo Max at the UW's Speech and Hearing Department. The interaction with him was of great inspiration and provided me with profound insight of the complete chain of respiration, phonation and articulation involved in speech production, opening new conceptual and practical directions to my work. Eventually, these studies encouraged me to commit to such a large-scale project as the Resonances, Turbulences & Explosions series.

La Biblioteca Ciega also takes advantage of the power of algorithmic processing mainly by means of SuperCollider. These were new tools I acquired at DXARTS, working closely with Juan Pampin and Josh Parmenter. Also with Pampin, I worked on spectral modeling techniques and first order Ambisonic codification for sound spatialization in 3D, reviewing, researching and implementing these techniques within SuperCollider, which also made their way into the dissertation project. These studies eventually took me to adopt SuperCollider as the new software platform for my artistic production, and to incorporate algorithmic processing as the mindset and conceptual framework for it.

Taking independent studies with dancer and choreographer Jen Salk, Associate Professor and currently head of the Dance Department, became an entry point to performance studies and practices. I started working with her on Speaker Performing Kiosk, a piece mainly developed over the first 2 and half years of the PhD, which has a strong performative component. However, these studies also helped to install performative concerns within my whole work. In this sense, LA BIBLIOTECA CIEGA also incorporates these concerns and topics discussed with Salk.

James Coupe introduced me to the history and theory of systems art aesthetics and became a reference for my mechatronic investigations and design and fabrication interests. His insights on the conceptual root of such a complex art practice enriched my perspective on art in general.

For two years I worked with John Sahr, director of the Remote Sensing Lab at the Electrical Engineering Department. We explored the basics of remote sensing techniques and I was able to achieve a 2D virtual model that calculated the locations of a moving source calculating the echoes on the floor and ceiling through correlation transforms. Furthermore, John encouraged me to learn Python, another object oriented programming environment, so we could "speak the same language".

Last but not least, the continuous dialogue, lively discussions and uncompromising critiques with Richard Karpen along the 4 years of my PhD – sometimes as part of formal exchanges in the form of Independent Studies credits, sometimes as informal chats – deeply shaped my understanding of art, and the implications and nature of its relationship with science and technology. His work, always creating a network of suggestive connections within and outside the music world, became an unavoidable reference.

Upon arrival to DXARTS, I created an aesthetic compass to guide me within these new territories but also to walk away from as new ideas, processes and relationships came into play.

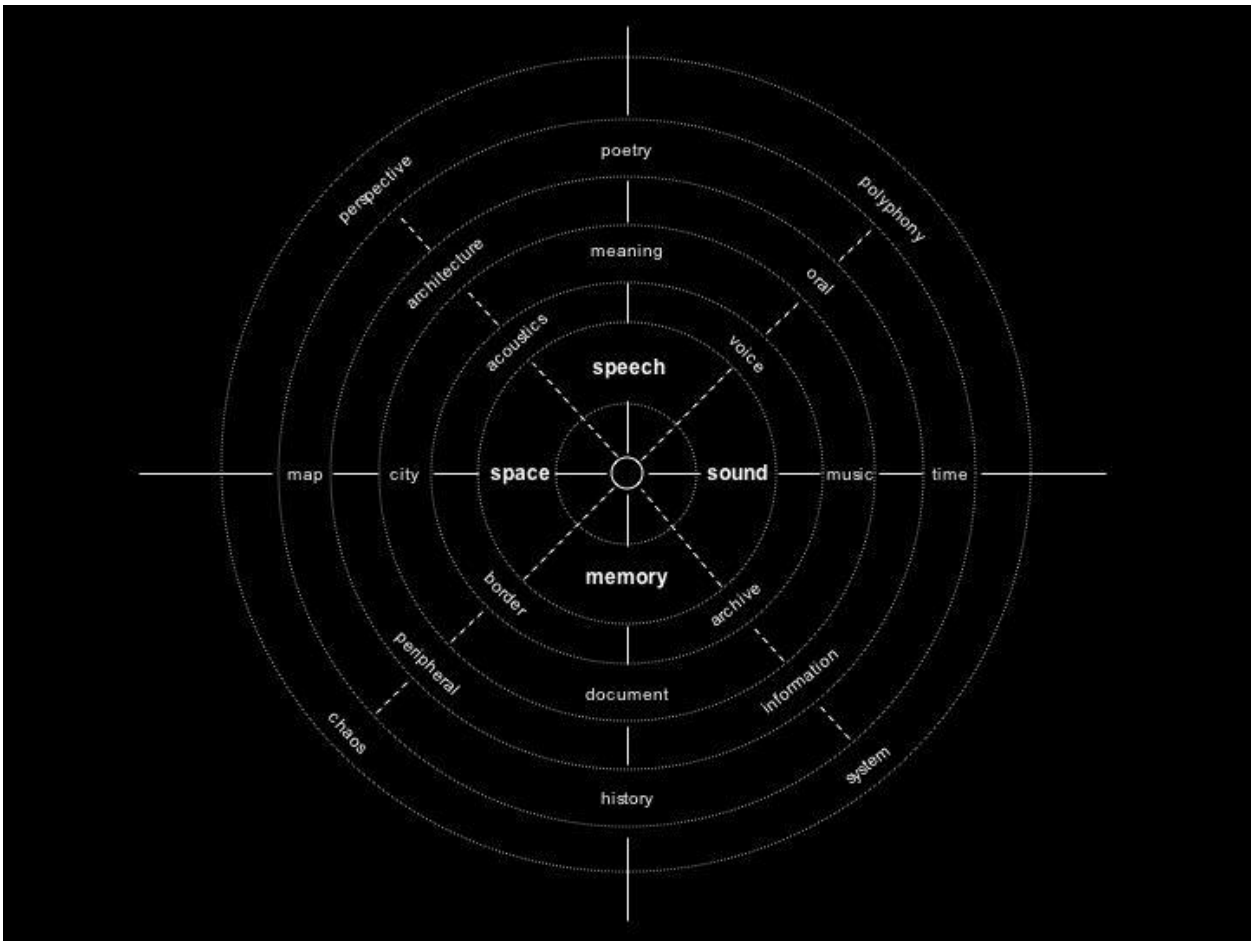

Figure 21 Aesthetic Compass by Nicolás Varchausky.

What follows is an account of a selected group of pieces produced or further developed while doing the PhD, which best describes the nature of my research.

3.2. The Voice

My interest in the speaking voice as a musical material started around 1986 when I received from my parents a portable cassette recorder as a gift for my 13th birthday. I immediately began producing recordings everywhere I went, fascinated by the multiplicity and apparent ubiquity of voices in the streets of Buenos Aires. As the years went by, and the devices evolved from cassette to DAT, from MiniDisk to solid state and memory cards, I started to formalize this practice and order the recordings

into a sound archive, which in 2000 became a research project called Archivo PAIS, part of a Research Program at UNQ (Universidad Nacional de Quilmes) where I was already teaching.[40]

3.2.1. Archivo PAIS

Archivo PAIS is an ongoing sound archive project exploring the tensions between sound and meaning in spoken word. It researches on the musicality within speech and in the sounds produced in public spaces. It uses these sounds as a reference for structuring and as a material for creating music compositions that are based open both to their acoustic and semantic qualities. This coincidence incorporates in a way the context and subject of enunciation into the musical composition. When we hear a person speaking, not only do we listen to the meaning of the words, but also to the voice's particular timbre and dynamic fluctuations, accents, melodic gestures, rhythmic patterns, and what Barthes called its grain: the presence of the body leaving traces on the quality of the voice. The referential quality of speech adds a final layer of complexity in which both sonic and semantic levels influence each other. The use of different accents, intonations, and timbre modulations can violently change the literal meaning of spoken language, just as the context of meaning can modify the way we listen to a sound. Drawing upon these interests, PAIS develops its archive as an ongoing project of sound recollection, using at times its material to produce musical and interdisciplinary works in public spaces. These works explore music within oral speech and conceive public spaces as memory *loci* with the ability of modifying the perception of sounds within them.

Archivo PAIS is organized in four main sections or *voices*:

- The Voice of the Market
- The Voice of Institutions
- The Voice of God
- The Voice of Art

The Voice of the Market is populated by recordings of street vendors that offer unregulated products as part of the extended informal economy common in emergent countries. Mostly recorded on trains,

[40] Programa Teatro Acústico (Dir: Oscar Edelstein), Proyecto I+D PAIS Proyecto Arte In Situ. The acronym PAIS stands for Project Art In Site. Archivo PAIS is now being developed within the research project I+D Sistemas Algorítmicos de Espacio y Tiempo en el Arte Sonoro (S.A.E.T.A.S. UNQ/Dir: Nicolás Varchausky).

busses, subways or sidewalks, these voices are extremely varied in their melodic contours and vocal production, and usually present ingenious texts to attract their potential customers.

In the Voice of Institutions, the Archive collects voices that speak in the name of public or private organizations, such as a train or Bus Company, an airline, the Federal Police or the State itself. Many of them are often mediated by a certain electronic device (megaphone, loudspeaker, radio system, etc) that adds a particular grain to its surface, and they not necessarily speak with a neutral accent. This sometimes produces humorous effects, since the voice of the State is by definition a voice without an accent (Dolar 2007), rendering its message absurd when the City Government is incarnated by a voice with a clear local accent.

The Voice of God gathers recordings from street preachers. Typically, these preachers speak in the name of alternative religions rather than the official cults. An inflamed rhetoric possesses them and their crowd is always on the move. Many of them produce a non-stop hallucinated speech without any silences, hesitations or gaps. Their stories are usually florid and convoluted, and some of them do not lack a certain degree of absurdity as well.

Finally, the Voice of Art holds recordings of street or amateur musicians, singers with or without accompaniment and children singing or reciting poems for change. The counterparts of the professional or institutionalized artist, these voices become the soundtrack of the city's artistic surplus. In their painful effort against the noise they are immersed in, the music or poetry rendered by them is often highly affected by it.

The Archive focuses on anonymous voices incarnating the informal counterpart of power discourses, raising questions on what does a document mean or entail, what should be preserved and how the relevance of a particular record is decided. These voices are also a common part of the soundscape in cities around South America (and other peripheral areas of the world). An interesting feature of most of them is that speakers have intuitively developed their own personal vocal technique that allow them to be heard not by simply increasing their volume and speaking louder than the rest, but by producing custom timbre modulations to fit into the spectral gaps left by their noisy surroundings. It is because of

these rare techniques that their voices surpass the noise of traffic, public transportation (on which they usually work), heavy machinery or even other vendors, thus producing a unique variety of spectrums, timbres, modulations and intonations which constitute a unique collection of sounds and one of Archivo PAIS main interests.

As a sound resource, the Archive has been providing materials for my pieces for a long time now, including some produced at DXARTS, such as *Radio Volodia Sector* (where recordings from the Archive where part of the radio broadcast produced by the project) or *Tertulia Mirogoj* (where a whole section of the piece was done entirely with voices from it).

3.3. Systems Art

Many of the pieces I was able to produce at DXARTS can be described as systems art pieces. In these pieces we'll find automated processes being triggered by the presence of the audience or some other kind of real time input. As these systems are put in motion, they reveal unexpected relations, content and information giving us new insight on each of its components and their interaction.

3.3.1. Radio Volodia Sector

By the end of my first year, I produced a piece called *Radio Volodia Sector* as the final for the DX471-3 Mechatronics series, a class that challenged me with new aesthetic and technical knowledge. The piece was a site-specific installation project that included a performance component. A Vladimir Lenin statue in Seattle was turned into an antenna that broadcast the real resonances of the environment captured by a microphone inside it, and the symbolic resonances within it. The system would also monitor the activity of Taco del Mar's cash register machine – a shop a few feet away from the statue – which triggered a series of pre-recorded sounds including the radio ID and recordings of street vendors from all over the world, courtesy of Archivo PAIS. The transmission had an approximate range of 300 feet and went on for a week, 24/7. On the day of the opening, I incarnated an *Ethernaut* who would walk around the area in search for the physical limits of the broadcast, placing signs at its borders and producing a series of actions next to the statue: tuning radios to the broadcast and placing them around it.

Figure 22 Video still from the video documentation of Radio Volodia Sector.

Some of the inspiration for the piece came from Churchill's "iron curtain" famous speech, where he refers to the ideological conflict and physical boundary dividing Europe into two separate areas after World War II. The piece paraphrased the idea of that divide acknowledging that classic geopolitics had led to a new kind of divide, a digital or information divide which unlike its predecessor, it is ethereal:

> "A transparent curtain has descended upon us. What yesterday took the form of an impenetrable wall of ideology that distributed geopolitical power on both sides of it, today disappears into a transparent curtain of information that invisibly installs the logic of the market in everything. Space is now organized through the new immaterial dialectics of Signal/No Signal. As a way to transcend it, the statue has been turned into an antenna whose broadcast intends to create a void in this invisible curtain by establishing an ethereal space of memory in

real time, in which what returns is not the past as such, but as possibility."[41]

Figure 23 Front view of the Lenin statue with antenna coming out of his back.

Three different signs were produced. One was placed right next to the statue, with a description of the project. The other two were placed at the perimeter of the sector, one stating the beginning (or the end) of it, the other a No Signal gap in the transmission. Once again, the aesthetic for the signs was taken from the Checkpoint Charlie signs at the limit of east and west Berlin after the war.

[41] Varchausky, Nicolás. Radio Volodia Sector, 2008. Unpublished writings.

Figure 24 Signs placed at the perimeter of the transmission during performance of Radio Volodia Sector.

This project also took me to tap into the community, as I interacted with Pete Bevis, the sculptor who put together the statue after it arrived in three separate pieces from Slovakia (and who became a close collaborator to the project), Anne Slope from the Fremont Art Council, Mark Tubic from the Fremont Chamber of Commerce, John at Taco del Mar (who also allowed me to leave my equipment up and running inside a small storage at his shop), Jay at Royal Grinders (an ice cream shop next to Taco del Mar), the owner of the land where the statue is placed and the mother of the late original owner of the statue, other fellow grad students and administrative at DXARTS, who collaborated lending their voices for the project, among others.

Radio Volodia Sector also addresses my interests in the creation of art works for a specific site or space.[42]

[42] For further ideas on this please see section 3.3.3 Tertulia Mirogoj.

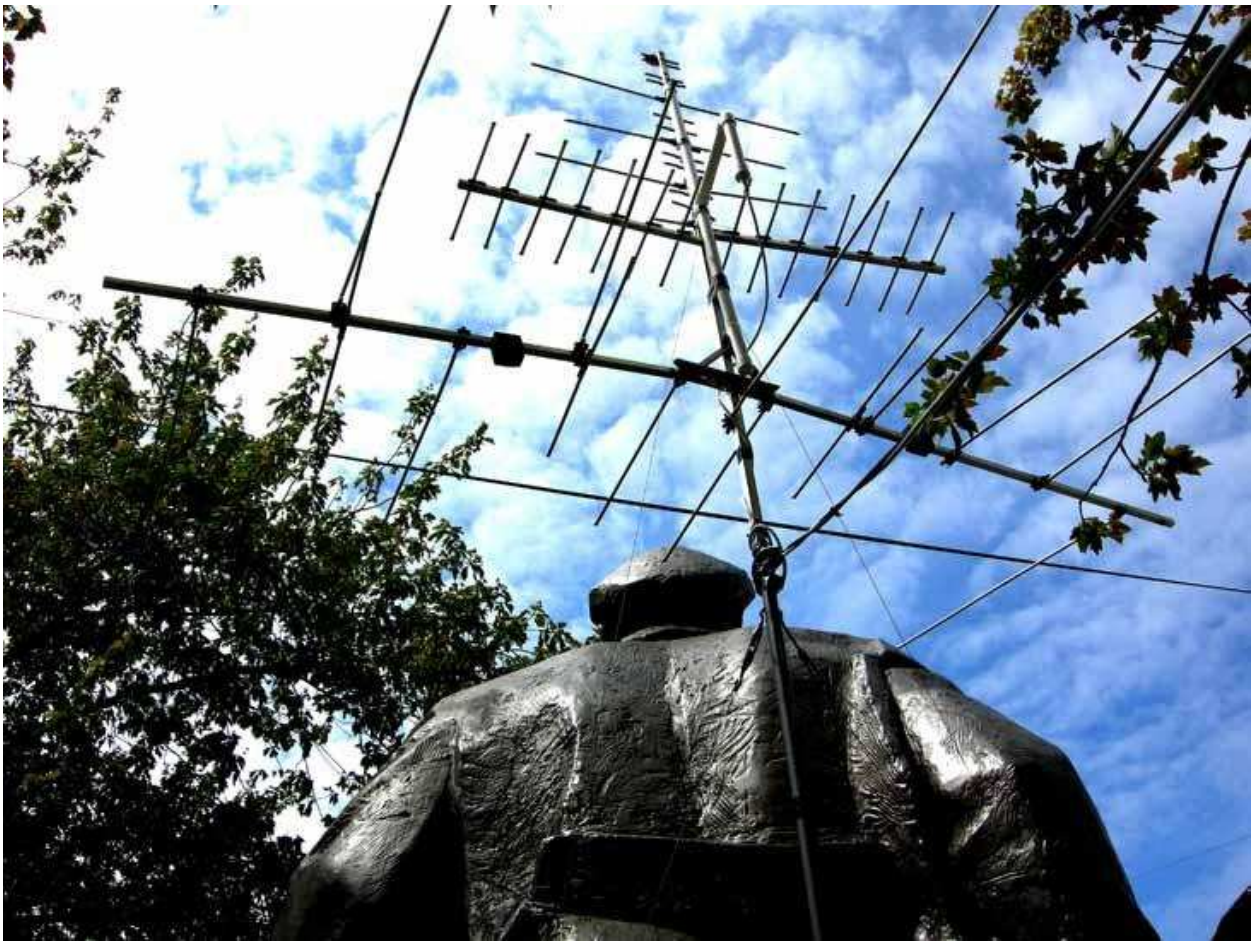

Figure 25 Rear view of the Lenin statue with antenna coming out of its back.

3.3.2. Greetings from the Fearful Sphere

Another project that can be associated with the systems art aesthetic was *Greetings from the Fearful Sphere*, a telematic piece on and about the Internet. This project explores the bi-located quality of the Internet: the imaginary space, ubiquitous and instantaneous, and the physical counterpart needed for that imagination to exist, which spreads out a hyperbolic length of cabling, electricity consumption and machines.

By visiting a website and submitting your email address, a system traces back the physical path taken by the message that connects the locations in the real world between the visitor and the website's host, algorithmically generating in real time a series of postcards composed of images, local weather information, news and facts about each of the cities encountered along that path, sending them back

to the user through email. As an afterthought element, each postcard features a "Post Scriptum", a quote taken from Italo Calvino's "Invisible Cities" adapted to match the postcard's main text, often triggering uncanny relations between all the elements within it. In Calvino's book, Marco Polo describes to emperor Kublai Khan the many cities he had encountered over his years of traveling. Inspired by this intimate recount of far and exotic geographies, *Greetings from the Fearful Sphere* tries to create a personal connection between the system and the user in the form of a travel diary, raising awareness about the physical dimension of the Internet.

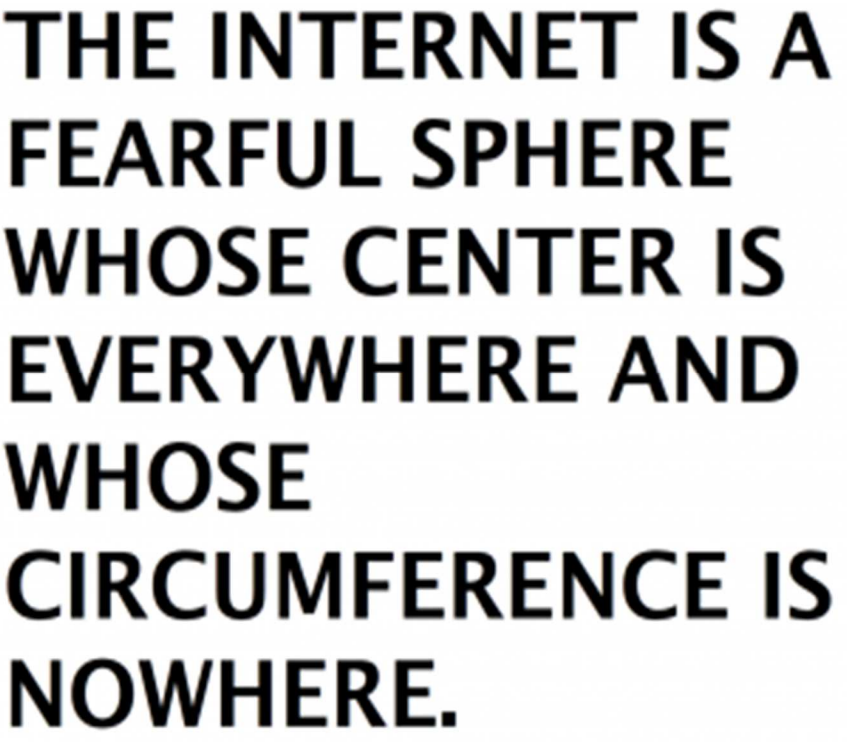

Figure 26 Detail of the home page for the project Greetings from the Fearful Sphere.

The title paraphrases Borges' short story The Fearful Sphere of Pascal, where the idea of "an infinite sphere whose center is everywhere and whose circumference is nowhere" is traced back along the history of mankind, revealing how it was alternatively used to describe large, elusive, omniscient and/or omnipresent entities such as God, the Holy Spirit or Nature. The project finds a new depositary for this metaphor on the Internet, as a pervasive technology with an ambiguous spatial location and undefined limits.

The speed at which information travels through the internet creates the illusion of space and time being abolished: if any point is equidistant from infinity and the infinitesimal, there's not really a where; if past and future are irrelevant due to instantaneity, there's not really a when. On the other hand, the physical reality suggests a one-dimensional space, a linear itinerary, a line drawn between the sender and the receiver. The project exposes that line and speculates on the implications entailed in our different understandings of that space.

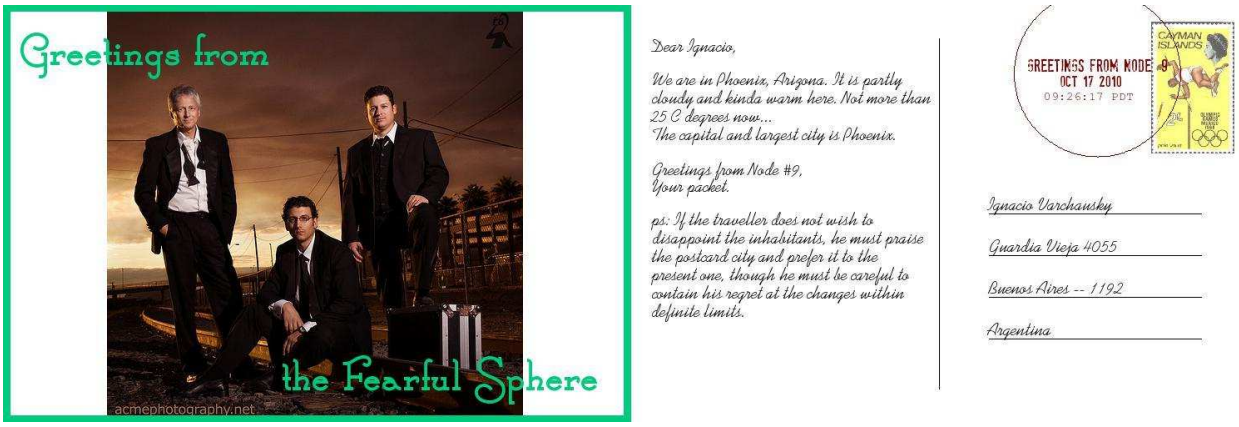

Figure 27 One of the postcards generated by the system in Greetings from the Fearful Sphere.

The project was completely implemented on Python, another software I came to learn while at DXARTS, which expanded my algorithmic knowledge having an impact in the rest of my art practice.

3.3.3. Tertulia Mirogoj[43]

Tertulia is a large-scale sound and visual installation in collaboration with argentine visual artist Eduardo Molinari that took place at the Mirogoj Cemetery in Zagreb, Croatia.[44] It involves real-time computer generated audio diffused through an array of 40 speakers and 14 points of visual interventions using everyday objects, videos and performance actions. It proposes a metaphorical conversation with our ancestors, a reflection on remembering and forgetting through the creation of a shared aesthetic experience within this intimate landscape. Visitors to the installation are allowed to

[43] The 23rd Eurokaz Festival produced the project, in the summer of 2009.
[44] A first iteration of the project took place at Recoleta Cemetery, Buenos Aires, and was part of the Proyecto Cruce (Crossroads Project), produced by the V Festival Internacional de Buenos Aires, in 2005.

walk through the Cemetery during the night, encountering a series of visual compositions along the way while being immersed in an ever-changing territory of sound.[45]

In this second iteration of the project, the space is approached as an integrated geography, the paths designed for the audience formally resembles a radio (metaphorically transforming the space into both a receiver and a transmitter), and a real time system is created for the sound composition.

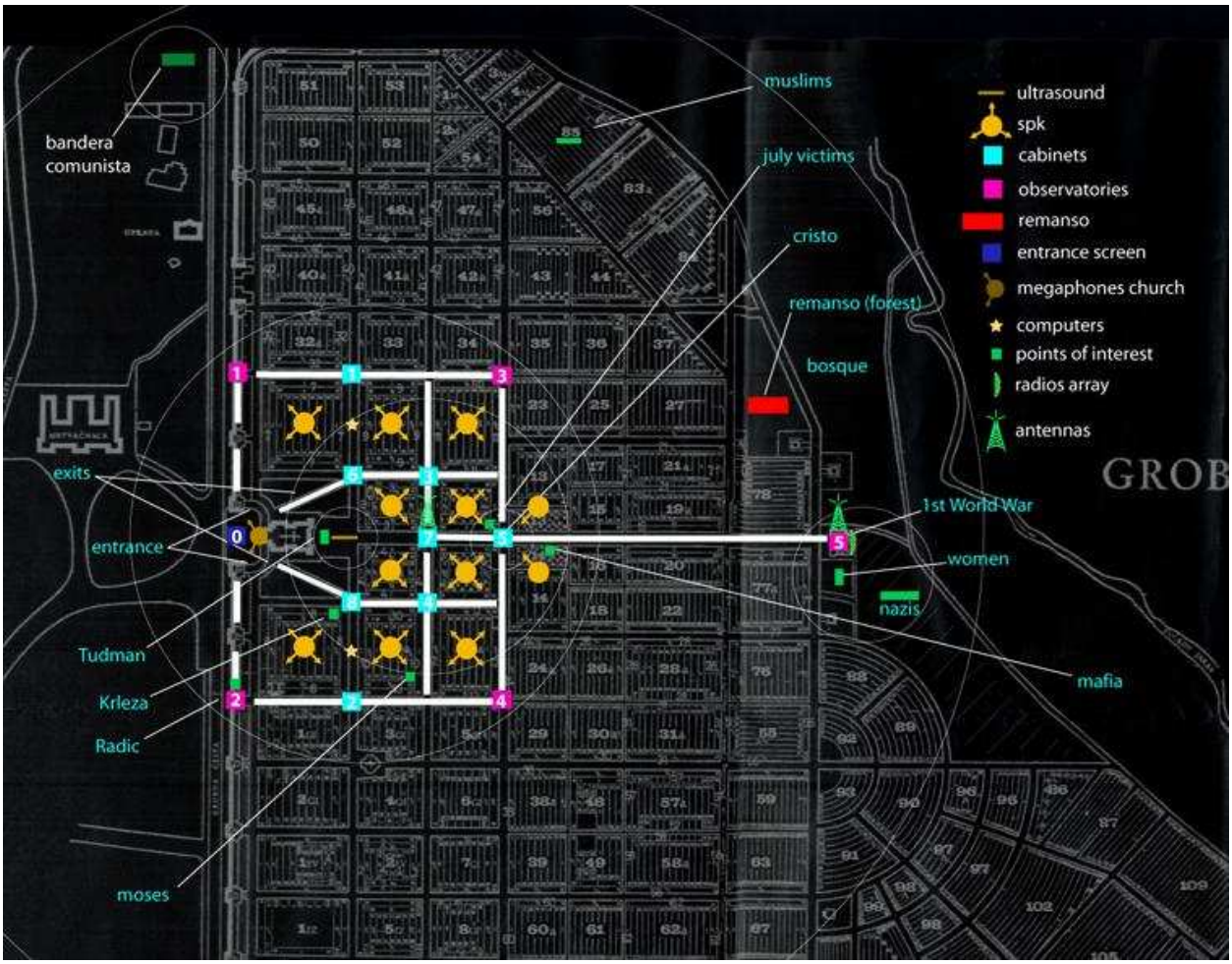

Figure 28 Map of the Mirogoj Cemetery depicting the location of the speakers, cabinets, observatories, transmitters, computers and the path for the audience in Tertulia.

[45] Varchausky, N; Carver, S; and McCrea, M. The Tertulia Project at Mirogoj Cemetery: A constellation of voices, names and spectral transformations in space, Emille The Journal of Korean Electroacoustic Music Society KEAMS, 2011.

Visually, a series of intimate spatial interventions (cabinets and observatories) involving objects, photographs and video are placed at the crossroads of the paths, that functioned as resting stations pacing our walk through the cemetery and displaying a multiplicity of visual records – real, intervened and fictitious – from the Croatian and the World's history.

Sonically, a computer system is powered by the several generations of names present at Mirogoj – the nominal mass of Zagreb's past – creating a series of sound "Fluxes" transformed and spatialized in real time. A series of "Synchronies" articulate these fluxes over time, creating single sonic gestures that unfold over the space following pre-designed trajectories. Recordings of real voices were also used – mainly for one section – product of a research on the Croatian National Radio Archive (HNR). A final sonic layer was introduced using a low power FM radio transmitter. It broadcast a computer-generated voice – heard through portable radios placed at every Cabinet – delivering in Croatian a series of algorithmic transformations of a specific verse of Borges' poem "El Golem":

> "And like ourselves, it gradually became
> Locked in the sonorous meshes of the net
> Of After, Before, Tomorrow, Meanwhile, Yet,
> Right, Left, You, Me, and Different and Same."[46]

This voice was created using a trainable speech synthesis system designed by Ivo Ipsić, Sanda Martinčić Ipsić and Miran Pobar at the Department of Informatics of the University of Rijeka and based on hidden Markov models (HMM).

The sound was diffused through an array of 40 speakers and attempted to create a space within a space: a transparent territory of sound, an immaterial topography that changed dynamically as you walked through it, where each member of the audience became the centre of the listening.

Tertulia Mirogoj is a reference for both the algorithmic and the site-specific developments undertaken while in the PhD, and incorporated two additional collaborators for the production of the sound component. Scott Carver developed a computer framework for organizing, playing back, processing and

[46] Borges, J.L. Selected Poems 1923-1967, Edited, with an introduction and notes by Norman Thomas Di Giovanni. Translation by John Hollander.

mixing all the sounds for the installation. This general environment included a series of spatialization tools that enabled me to design unique and poetic spatial behaviors – such as geysers, arcs, tides and whorls – on such a large and unusual site, using an infrequent disposition of speakers. Another interesting feature was the Virtual Speaker System, that allowed us to place speakers on a map of the cemetery and preview the sound at different locations, which proved to be crucial for knowing, as early as possible, of how things would sound before getting to the site. Another collaborator was Michael McCrea, who created a series of specific SuperCollider libraries for digital sound processing and helped on the development of the computer framework. One of these libraries, The Voice instrument, was designed to allow any sonic material (the source) to activate a process in which the material resonates with the harmonic structure of an altogether different sound (the target), while fluctuating with the internal dynamics of a singing voice. For the project, the target became a series of short samples taken from Croatian a capella folk songs.

The overall contribution by Carver and McCrea was essential to produce this large-scale project, and working together with them was one of the most enjoyable experiences of this period, all for what I am deeply grateful.

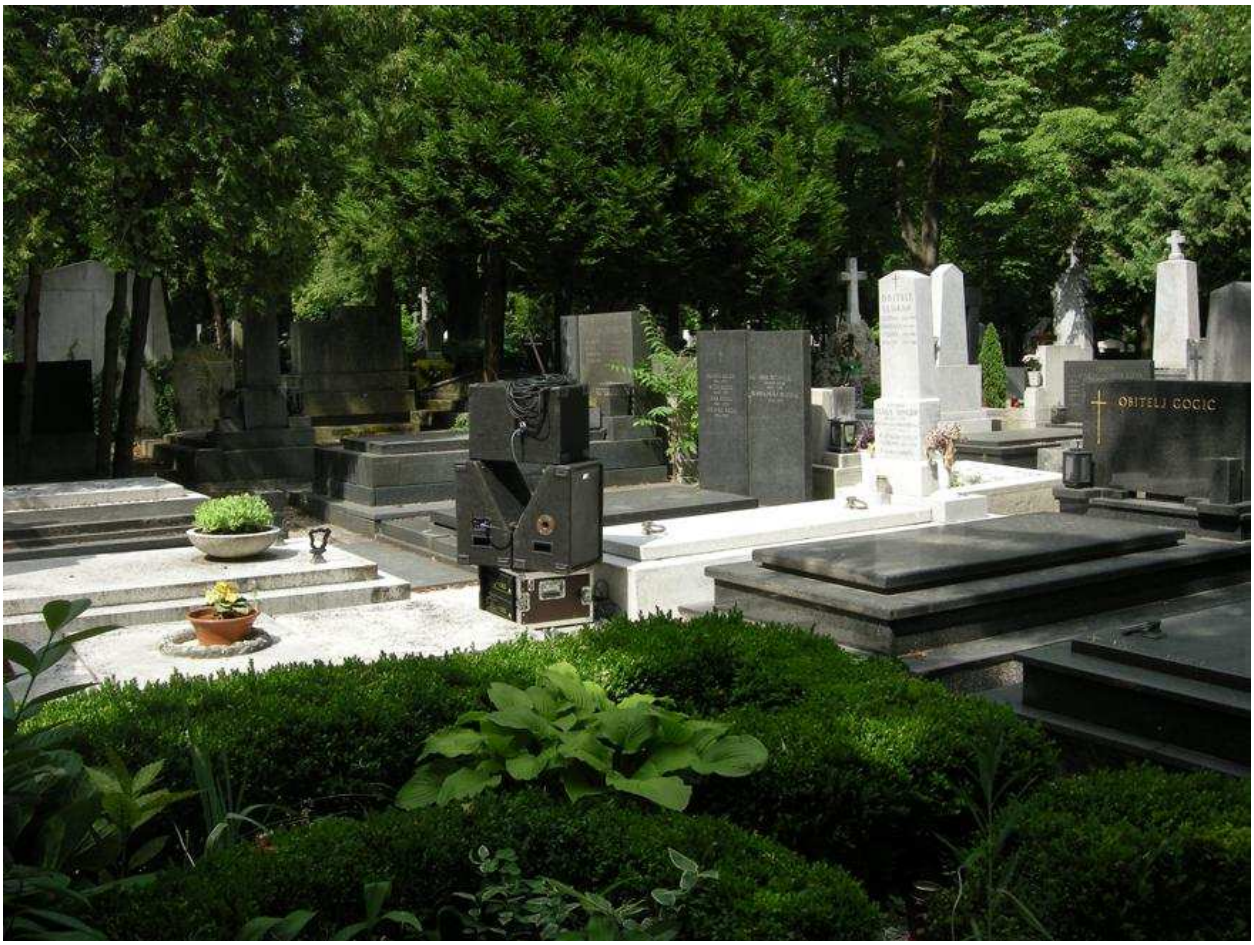

Figure 29 Speaker cluster at Mirogoj Cemetery during setup for Tertulia.

3.4. Performance

This section describes a performance project that became one of the main developments I did at DXARTS, the Speaker Performing Kiosk project. In it I explore performance interests and the role of the body in relation to electronics, real time environments, algorithmic processing, recursive systems and sound spatialization.

3.4.1. Speaker Performing Kiosk

An immediate reference for the second chapter of LA BIBLIOTECA CIEGA can be found in the work I finished during my second year at DXARTS, the SPEAKER PERFORMING KIOSK. This piece is a sound performance project that takes the form of an autarchic performing device: a portable self-contained

sonic node designed to potentially be performed at any venue or site. It develops the idea of the speaker not as an object that *reproduces* sound but as an object that *generates* it, creating an electronic instrument that uses analog feedback as its raw material. Holding two wireless microphones in his hands, the performer transforms the emerging sound in real time both acoustically – by moving through the space and physically exploring and altering the resulting interference patterns – and digitally – by means of a computer software (SuperCollider). No pre-recorded sounds or sensors of any kind are used. All sonic material is created in real-time by the performer's actions. While inside the device, the performer creates fields of resonance and shifting currents of air pressure in the space using his body as an antenna to interact with this hybrid system.

This "stand-alone" device consists of an aluminum cubic structure of 8x8x8 feet that can hold its own light and sound systems.[47] The eight speakers and the two microphones become the actual sound sources, while the room, the computer and the actions of the performer modulate them; acoustic and digital data are entwined, unbalancing the sound flux into a feedback choir. Within this set of interactions, the performer is sometimes in control of the system while others, the system controls him.

Though being an entirely electronic instrument, it creates a relationship with the space that resembles that of an acoustic instrument, since the speakers are the actual sound sources – there's no sound reinforcement – and they are positioned in such a way that they diffuse sound in an omni-directional way. Also the very nature of feedback, as the signal passes through the elastic medium of air and re-enters the digital world through the microphones, provides a highly organic sound despite being produced entirely by electronic means. The signal subtlely but noticeably is affected by a large amount of very small modulations over time as the different processes disturb each other, once again simulating what happens with acoustic signals.

When the body enters the SPEAKER PERFORMING KIOSK, it closes the feedback loop, which activates the constant generation of sound. The presence of the body inside or nearby the system is needed to

[47] Artist Tivon Rice while working on the collaborative performance proposed the current look and feel of the cube with Michael McCrea and myself called *Continuidad de los Parques*, an ArtSparks production.

produce sound. The actions of the performer are not previously composed as in a choreographed but emerge from the physical search for sound generation and modulation. Thus it is the sound that guides the body while it explores the space in search for sounds and their possible transformations. In this way, the system builds a relationship between the body movements and the sound that results extremely linked to the resulting sound, avoiding arbitrariness and stepping away from (at least traditional) dance concerns.

Figure 30 Varchausky performing with his Speaker Performing Kiosk at MAMBA Museo de Arte Moderno de Buenos Aires.

Also in this piece we can trace both the interest in developing custom made devices for sound production along with the performative concern and the involvement of the body within technological environments, all of which are part of the PHOTOSENSITIVE VOLUMES as well. It was also particularly for this piece that I first developed the custom computer framework that would serve as a template for various following projects using real time algorithmic processing, including LA BIBLIOTECA CIEGA. The

Kiosk outputs an 8-channel Ambisonic signal. Although the speaker's layout does not follow the ideal distribution for obtaining the best results out of the Ambisonic decodification, after experimenting with other systems of sound diffusion, this unorthodox use of Ambisonic would still prove to work better than the rest.

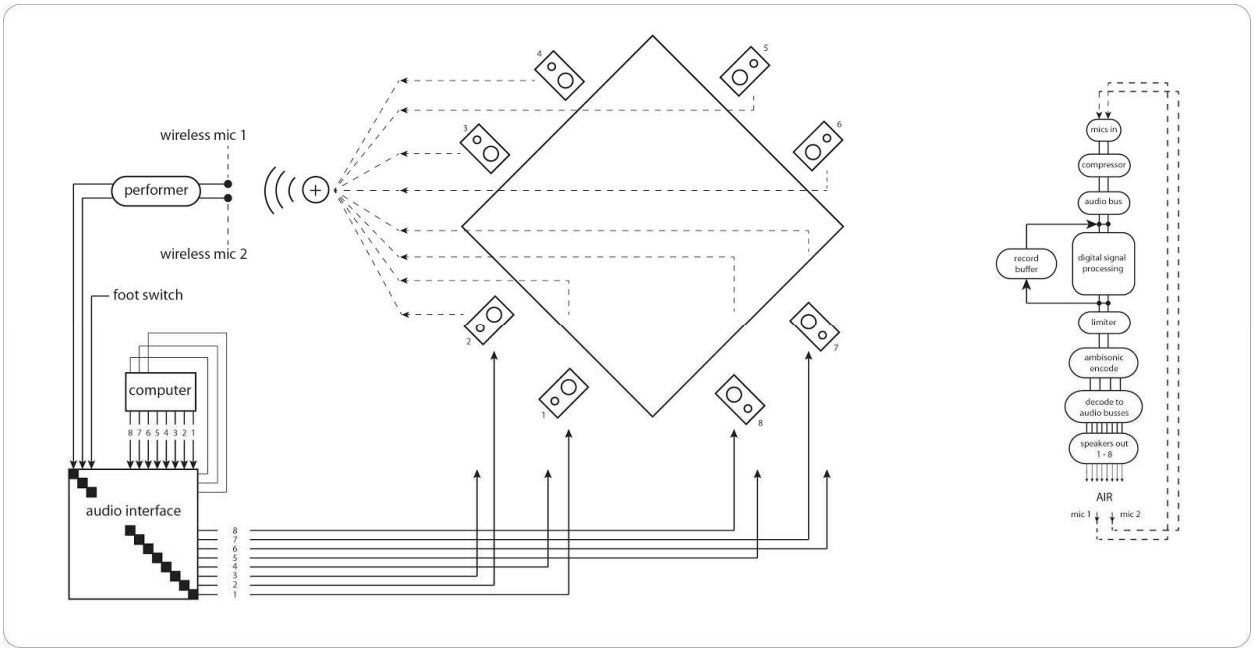

Figure 31 Diagram of the sound flux in Speaker Performing Kiosk.

Chapter 4: LA BIBLIOTECA CIEGA

"Nadie rebaje a lágrima o reproche
esta declaración de la maestría
de Dios, que con magnífica ironía
me dio a la vez los libros y la noche."[48]
Poema de los dones, Jorge Luis Borges.

4.1. Introduction

In 1955, Argentine writer Jorge Luis Borges was appointed Director of the National Library at the same time he was losing his sight completely. In his "Poem of the Gifts", he reflects on the *magnificent irony* of being given at once "the books and the night". LA BIBLIOTECA CIEGA (The Blind Library) is a site-specific sound art performance in two parts (which we will call chapters) composed for the very reading room of the library where Borges stood sightless surrounded by books.

The project is broadly inspired by the specificity of the former library, metaphorically using it to name, produce and structure its main contents. It taps on the themes of reading and writing from an auditory perspective, experimenting with obsolete media techniques of inscribing and reproducing sound, and exploring the aural allure within letters through the analysis and resynthesis of phonemes.

Since the phonograph and other devices became popular supports for sound, their inscriptive attributes "became coterminous with the legacies of writing, universal alphabets and languages". [49] LA BIBLIOTECA CIEGA takes advantage of this link to speculate on how reading and writing sound can address issues about memory, meaning, representation and new media in our world today. Taking Borges' anecdote as a reference, the project also introduces the dichotomy of light and darkness as a referential component to interact with. Darkness is introduced as polysemic element, as the whole

[48] "No one should read self-pity or reproach
▫Into this statement of the majesty
▫Of God, who with such splendid irony
Granted me books and blindness at one touch."
Poem of the Gifts, translated by Norman Thomas di Giovanni.
[49] Kahn, Douglas. Noise Water Meat. A history of sound in the arts. Cambridge, MA: MIT Press, 2005.

piece takes place in a completely darkened room. Not only it becomes an immersive invisibilization host for it but connects several of its individual elements to the borgesian setting that surrounds the project.

As the smallest unit of a library, the book is alluded as the formal organizer of the piece. In this way, an index or table of contents is settled which describes its two parts as chapters. Each chapter is in fact a separate piece in itself, for LA BIBLIOTECA CIEGA is in essence the careful pairing of two different pieces: *Resonances, Turbulences & Explosions* and *Photosensitive Volumes*. These pieces did not previously exist to LA BIBLIOTECA CIEGA but were specially conceived to work together as a whole and be premiered at that space. LA BIBLIOTECA CIEGA can then be thought as a third piece emerging from this unique combination at that specific site, or as a whole that it's greater than the sum of its parts.

The first chapter is divided in three parts named after three different consonants. Each of these parts is a 3D sound piece that uses the recording of each of these phonemes as their raw sonic material. The acoustic atoms of language are examined and reassembled into a series of unexplored inner soundscapes, unfolding the hidden aural beauty within words.

The second chapter gathers three different "volumes", or pieces created for a series of custom made photosensitive instruments that turn light into sound. Blind musicians, who use the light they cannot see as the invisible needle that activates them, perform these instruments. These instruments are built based on optical sound technology, which is appropriated and brought into the coding space of digital processing. These Volumes are named after the specific location at University of Washington's Suzzallo Library of three different books written by Borges.

4.1.1. The former Library

One of the starting points for the project was understanding the implications of producing an artwork at such location. The specificity of the site was therefore approached by defining a set of spatial *formants*[50] – acoustic, geographic, architectonic, historic, symbolic, social and political – that could potentially become part of the piece as structural elements in dialogue. In terms of Henri Lefevbre, such sites do not have a fixed set of relations, but "a horizon of meaning: a specific or indefinite multiplicity of meanings, a shifting hierarchy in which now one, now another meaning comes momentarily to the fore, by means of – and for the sake of – a particular action."[51] These formants guided our work through the dense network of relations suggested by the site turning the project into a form of reading and writing on the territory. This territory is defined as a kind of abstract *zone*, or abstract space where all this confluences, becoming a malleable surface where information can be gathered from or read, as we can decode all its layers of signification, and transformed or written upon, using sound – but also appealing to the rest of our senses – as a tool to interconnect those layers in multiple ways.

Listening is a heuristic experience defined by physical and psycho acoustical elements, as much as spatial and temporal, in which not only hearing but also the rest of our senses get involved. The acoustics of a space change our perception of sounds, as well as our behavior within it. Its aural dimension has a defining influence in how we occupy and conduct ourselves in a particular room.[52] Recent studies on aural architecture are trying to account for such interactions. However, the way a sound is perceived can be changed not only by acoustics, for a sound can potentially trigger any of the resident formants within a site, building a listening situation that can substantially transform the value of what we hear. When such a thing happens, sound can incorporate its context of meaning – that is, its

[50] In *The production of space*, Henri Lefebvre takes the idea of acoustic formants from composer Pierre Boulez to understand the several layers of meaning present at a certain space.
[51] Lefebvre, Henri. The Production of Space. Trans. Donald Nicholson-Smith. Paperback ed. USA: Blackwell Publishing, 2007.
[52] Blesser, Barry, and Linda-Ruth Salter. Space Speak, are You Listening?. Experiencing Aural Architecture. 1st ed. Cambridge, Massachusetts: MIT Press, 2007.

symbolic, social, political, geographical, historical and economic dimensions – as an experiential filter. Therefore, the context of meaning can mediate our listening, establishing a hyper-listening mode (as in a hypertext, which can link to or make present several other texts within the same literary space) with the power to transform sound in a way it is hard to measure. Sensorial and intellectual vectors then traverse us, transcending the purely acoustic perception to be demanded by our cultural competence as sound and meaning influence each other.[53]

4.1.2. Darkness

Darkening the room, placing the performers at the center of the space and surrounding the audience with speakers were decisions taken to create a particular listening condition. As suggested in the beginning of this chapter, darkness in both parts of LA BIBLIOTECA CIEGA plays a crucial role in defining the experience as a whole. It is used both in a symbolic and experiential way. While it sensibilizes and sharpens our senses allowing for a more intense concentration on the details of the sound material, it is also a catalyst for connecting to a specific context of meaning (the library ran by Borges), which would deflect our listening. The lack of a frontal spatial organizer – since the audience surrounds the performers, who are placed at the center of the space – or any visual reference at all plus the multiplication of perimetral sound sources, enhances the attempt to transform each member of the audience in the center of the listening. This specific use of darkness has reminiscences of Georg Friedrich Haas String Quartet No. 3, *In iij. Noct*. This piece of music is also performed in complete darkness, with the musicians placed at each corner of the room. As it happens in LA BIBLIOTECA CIEGA, Haas immerses not only the audience but also the musicians in this pitch-black space, using darkness not as a constraint but as a structural decision of the piece as well as a poetic experience. Thus, the musicians need to learn their parts by heart, while using a series of musical cues as guides during the performance. Although it shares similar performance conditions with LA BIBLIOTECA CIEGA, both pieces

[53] Other influential ideas about space appear in The Practice of Everyday Life by Michel de Certeau, where he distinguishes between "place", as a stable configuration of positions (the image of a school building and the administrative structure it implies), and "space", which he defines as "composed of intersections of mobile elements" (students, teachers, and personnel making use of that place in practical terms). Also interesting are recent writings by Martin Dodge and Rob Kitchin on how code becomes a space *transductor*, as increasingly more spaces are relying on software to function. The ultimate example is the airport, which would be reduced to a useless wearhouse if the code that runs the communications, the booking of flights, the landing and takeoff of planes, the lighting, the security cameras, and even the escalators and elevators, crashed.

approach the common issues such conditions pose through different strategies.[54] Darkness in LA BIBLIOTECA CIEGA arises poetically as the extension of blindness into the space, creating an empathic relationship between audience and performers, and as need of the specific system of sound production rather than as an exclusively musical previous condition.

In the way LA BIBLIOTECA CIEGA produces and gathers two pieces which can (and did in fact) have their individual and independent development later, it proposes a structure where what takes place is not the integration of both pieces into one, but the interplay of their suggestive associations with the site in a renewed context of meaning where they modulate each other as a result of their proximity and common placement. That interplay and modulation is what LA BIBLIOTECA CIEGA as a piece might ultimately be.

4.2. Chapter one: RESONANCES, TURBULENCES & EXPLOSIONS

"... que lo que parece claro y preciso pertenece al orden de la conjetura,
casi de la invención, que la mayor parte del tiempo la evidencia
se enciende y se apaga rápido más allá, o más acá,
si se prefiere, de lo que llaman palabras…"[55]
Glosa, Juan José Saer

The acousmatic pieces on the first chapter constitute the starting point for the series RESONANCES, TURBULENCES & EXPLOSIONS: a long-term project which intends to create a new 3D sound piece out of each letter's spectral components. Presented as an acoustic exploration of the alphabet, the series takes its name from the basic acoustic properties of speech: when we speak, we filter turbulent streams of air, resonate in our heads periodic interruptions of those streams and release abruptly built up pressure under the glottis.

[54] For a more detailed explanation of the strategies developed to work with performers in complete darkness, both in Haas and the present dissertation piece please see the section 4.3.9. Rehearsing LA BIBLIOTECA CIEGA in this chapter.
[55] " … that what seems clear and concise belongs to the world of conjecture, almost of invention, that most of the time evidence appears and disappears fast beyond, or before, if you will, of what we call words…" Translated by Nicolás Varchausky.

The series took form as a derivative of my General Exam prompt at DXARTS, which challenged me to create a series of audio postcards in the form of 3D sound pieces using only consonants as their sound source. It also represents the continuation of my decade-long artistic research on the tensions between sound and meaning within spoken word, and its possibilities as a musical material. Evolving from my early pieces that explored the poetic resonances of everyday speech using field recordings and collage techniques, the current series reaches an utmost abstraction point in these investigations and refinement in its techniques.

The project relies on a process of analysis and resynthesis of recorded phonemes to extract the raw materials that will be used to compose each piece, exploring and expanding the inaudible details of the acoustic component of letters. Their hidden sonic treasures are unraveled through digital means and algorithmic processes, unfolding them in an immersive three-dimensional sound spatialization set up.

4.2.1. Sound and meaning

All our social life is mediated by the voice, and voices constitute the very texture of society, as much as the intimate nucleus of subjectivity.[56] The voice as a musical material entails a series of complex resonances involving collective concerns and personal exposure, as it also becomes an opportunity to reflect upon the paradoxical relationship between sound and meaning in speech.

Sound is a commonly ignored element of language, despite its radical influence on meaning. The ultimate significance of a word or phrase is conveyed through the intonation of the speaker. Melodic gestures, rhythmic patterns, timbre fluctuations, stresses and pauses can each one by itself alter, undermine or even completely deny a word's literal meaning. It is through sound that language reaches its utmost complexity, because sound opens up the possibility for its multiplicity of meaning. *What* is said might not be enough to fully understand a statement, if we don't listen to *how* it's been said.

The series focuses on these tensions, surgically transforming every partial and bringing to the forefront the acoustic richness of speech. Taking the highly concentrated information in the brief recording of a phoneme and expanding such materials into a surround sound piece changes our everyday perspective

[56] Dolar, Mladen. Una Voz y Nada Más. Trans. Daniela Gutierrez and Beatriz Vignoli. 1st ed. Buenos Aires: Manantial, 2007.

on language, placing us at its subatomic core. It is perhaps the lush of these soundscapes which best confronts the listener with both sides of it. By exaggerating something we do not normally consciously consider and denying what we give for granted about it, a fundamental disappointment is created, enabling a gap for aesthetic possibilities. These pieces do not focus on the voice as a vehicle for meaning nor as an object of artistic admiration but rather play at its crossroads, with "an object voice which doesn't go up in smoke in conveyance of meaning and which doesn't solidify either in an object of fetish reverence, but an object which functions as a blind spot in the call and a disturbance of aesthetic appreciation."[57] It is in the voice as a *subjective object* where a third level of engagement arises. This emerging third voice incorporates elements from psychoanalysis, theatre, poetry and oratory. Crafting an art form that successfully deals with these elements to create an aesthetic experience is one of the goals of my work with the voice.

In the history of music we can find numerous discussions in this regard, particularly in religious music, where the dramatic tensions between the voice and the word or between the music and the lyrics were put repeatedly in question, favoring sometimes one, sometimes the other. As Mladen Dolar puts it, "the entire history of the opera, from Monteverdi to Strauss (Capriccio), can be written through the spyglass of this dilemma."[58] We can frame this discussion within a larger confrontation between "absolute music" – as a pure and abstract form using the "non-referential" sounds of traditional instruments – and vocal music – where the lyrics would introduce a non-musical component through their explicit semantic level. And the voice has always been at the center of all this. From the Renaissance motets imitating sounds of battles or bird singing, all the way through Baroque Opera to Musique Concrete, this discussion is still reverberating among current artistic productions. As mechanical means of sound recording and reproduction were perfected, the technology to manipulate the real sound of voices was finally introduced into the art world, radicalizing even more this discussion. Poets like Mallarmé, the Dada avant- garde, the Futurist sound poetry movement, along with radical radio plays like *Pour finir avec le jugement de Dieu* by Artaud, stretched language to its

[57] Dolar, Mladen. Op. Cit.
[58] Dolar, Mladen. Op. Cit.

limits through a radical use of its sonic component, informing the work of many electronic music composers from Pierre Schaeffer and Stockhausen to Trevor Wishart, John Cage and Georges Aperghis.

Because there is no way out of this dialectic relationship, since words need sound and the presence of sound folds back into the word to question it closing a critical feedback loop between them, the voice becomes the rich locus of "expression versus meaning, expression beyond meaning, expression which is more than meaning, yet expression which functions only in tension with meaning (it needs a signifier as the limit to transcend and to reveal its beyond)."[59]

In the context of previous works where I used the speaking voice as a material where actual meaning – though scattered, recontextualized or isolated – could be understood, *Resonances, Turbulences & Explosions* appears at a first glance to have resolved that tension in favor of the pure sensual element. But the hyperbolic distance between the original recordings and the resulting soundscapes propose a jump in scale, which is in itself a redefinition of the same issues although within the *smallest sonic units capable of conveying a distinction in meaning*. The phoneme has the power to change meaning but again, this power is invested through sound. The disproportionate acoustic detail that the pieces bring into the forefront may appear to dissolve this power but the critical feedback loop remains intact at its origin, for it can never be fully removed. Enlarging the acoustic contents of phonemes into a perceptible scale, rather than diluting these tensions, enhances the very paradox at the core of language's struggle between sound and meaning, as meaning bursts into sound, and sound ends up resignifying meaning.

4.2.2. Production and technical processes in *Resonances, Turbulences & Explosions*

Initially, we produced the recording of a series of letters, mostly consonants. Meghan Trainor, also a PhD student at DXARTS at the time, generously lent her voice and her time to record several words and phrases of nonsense speech, which mainly included the letters I was going for: /S/, a fricative, voiceless, alveolar consonant; /f/, a fricative, voiceless, labiodental consonant; and /k/, a plosive (or stop), voiceless, velar consonant. There was no particular reason to choose these letters as the first ones of the series, but it was intentional to have three letters produced in three distinctive ways,

[59] Mladen Dolar. Op. Cit.

taking place at different parts of the mouth, involving the tongue and filtering the air column in contrasting ways. As a labiodental consonant, the sound for /f/ is produced at the very edge of the mouth, almost outside of it, with the superior teeth slightly biting the inferior lip. For /S/, the tongue is pushed against the top of the palate, right behind the front teeth. The distinctive sound of /k/ takes place at the glottis, as it suddenly releases built up pressure under it. These choices gave me a fairly wide variety of voice production qualities, which were later exploited in each piece, at times exaggerating or contradicting them.

Once each letter was isolated through standard editing, we proceeded to analyze their acoustic components using the Wavelet transform in MATLAB. This process created a series of sound files, which would then be imported into SuperCollider to complete the resynthesis process. As a way to check how accurate the analysis turned out to be, the first step was always to try to resynthesize the letter as close to the original as possible. This would give us a reference for any further processes. Once this was established, all resynthesis processes would use these acoustic components differently, trying to step as farther away from the original as possible. Through the analysis of the original recording, we could extract each frequency and its correspondent amplitude in time. This became the raw sonic material for the generation of all the sounds in each piece.

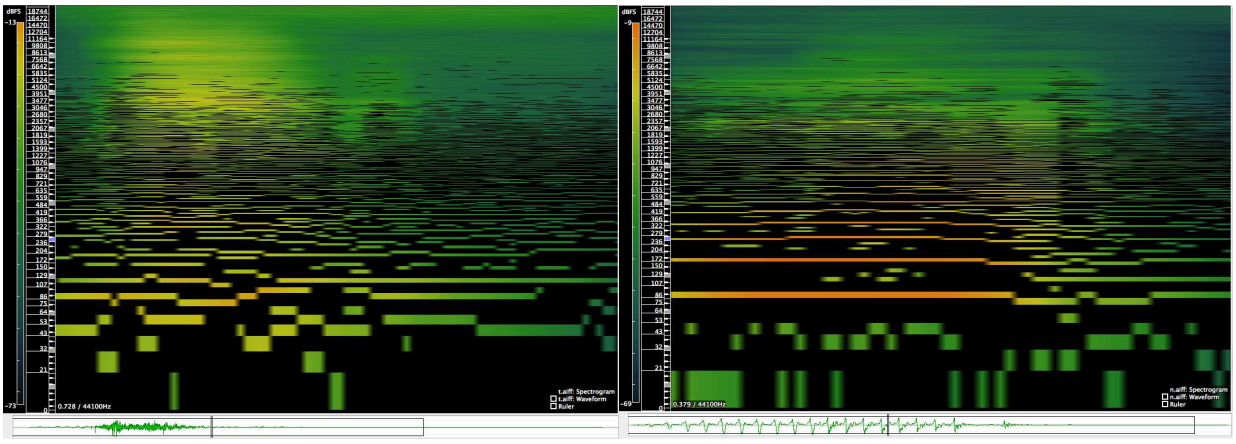

Figure 32 Logarithmic spectrogram view of peaks for /t/ (left) and /n/ (right)

Another analysis and resynthesis tool used during the composition of the pieces was ATS (Analysis Transformation Synthesis), a spectral modeling system based on a sinusoidal plus critical-band noise

decomposition.[60] This open source software developed by Juan Pampin creates an '.ats' file containing the information for frequency and amplitude over time for each spectral component. This file can be loaded in SuperCollider to produce spectral manipulations on individual components as well as on different sets of groups.

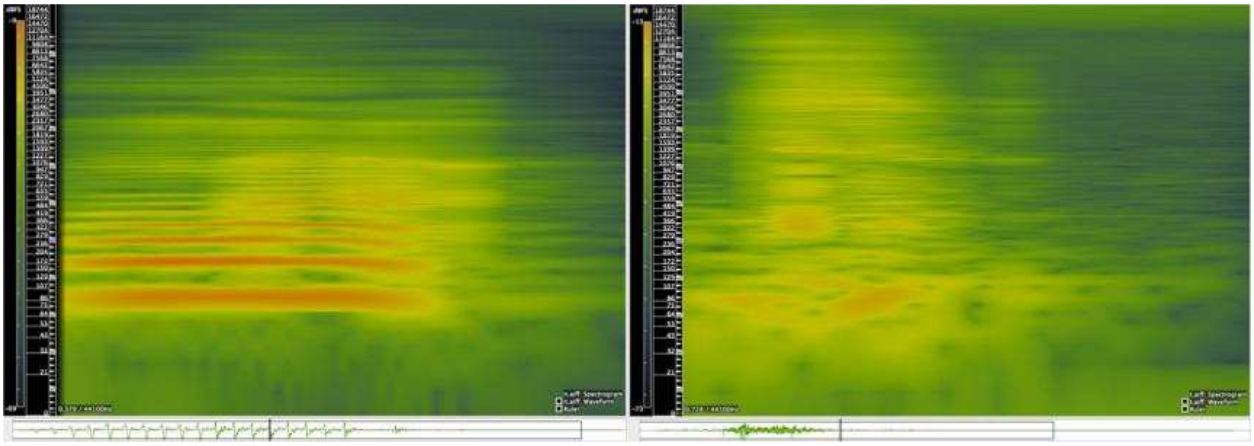

Figure 33 Logarithmic spectrogram view of /n/ (left) and /t/ (right)

All the materials in these pieces were generated out of each letter's original spectral components as spoken by a 30-year old North American female from Seattle. A wide variety of transformations were done within SuperCollider to the raw signal, including applying different envelopes controlling the amplitude, frequency and speed reproduction of each component. A variety of granular processes and dynamic filtering were also heavily used in combination with these envelopes.

4.2.3. Composing Resonances, Turbulences & Explosions

As you start composing a piece which will be part of a series along other twenty plus pieces, it is clear you need to develop specific compositional strategies. Composing those many pieces would take long enough to discourage any previous formal planning of the totality. I did not want to constrain myself to a plan that would most likely expire after a few years into the work and maybe a dozen pieces already finished. Instead, I decided to have a modular approach without a completely clear idea of a final form. Each piece would try appearing to be self-contained in terms of its form and character,

[60] Pampin, J. (2004) ATS: A System for Sound Analysis Transformation and Synthesis Based on a Sinusoidal plus Critical-Band Noise Model and Psychoacoustics. Proceedings of the 2004 International Computer Music Conference. Miami, USA: Computer Music Association.

attempting to address a specific kind of challenge, interest, material, technique and spatial narrative. In this way, the series itself becomes a research platform and the pieces ground for experimentation.

For the first two pieces (/k/ and /S/), the elements explored are specific for each one. In the last piece however, I introduced an idea that may or may not be explored further in the following pieces, as in /f/ you can hear briefly materials from both /k/ and /S/. This occasional return in perhaps only a few pieces of some materials or spatial designs present in another piece might offer an opportunity for an interesting overarching unity once the series is completed. These recurrences, along with the specifics of each piece's search, can help the series build a sense of belonging over time as it creates (or appears to create) its own syntax, vocabulary and sensibility. And it will be only through time that I will discover what this really means in practical terms. So as more pieces are composed, the more I will learn about the totality. Eventually, I foresee a point of inflexion when I will be able to understand this totality and compose the last pieces in a way they can help to re-signify the rest into a coherent whole. Or not. Until then, I am intuitively exploring new compositional issues with each one without fully understanding where this will take me. I leave some non-trivial decisions for further down the road; for instance, I am not exactly sure how many pieces I will compose, as I am not following one alphabet in particular. These first pieces where done with recordings by a native English speaker, but future ones might not. This is not the objective exploration of one alphabet or another but the poetic immersion into language as a generative source for sound in tension with meaning.

As a consequence of the challenges posed by the project, modularity became the access point for unraveling its many facets: timbre, spatialization, articulations, techniques and form. The length of each piece is also not fixed, but a pattern seems to be emerging with already 6 pieces composed. This pattern suggests there are at least three different average lengths: less than 3 minutes, less than 6 minutes and less than 10 minutes. This varied set of lengths gives a good opportunity for a partial (and eventually a complete) play of the series, whether it is for a concert situation or for producing a release. There are no intentions of either composing or playing back the pieces in alphabetical order or in any order in particular. Their modularity allows for rearranging the pieces and their order of execution according to context, every time they are showed. This decision provides flexibility to the

form and a liberty prior to composing any new piece that greatly attenuates the overwhelming feeling that embarking in such a large-scale project can produce. It also unlocks the workflow by breaking an otherwise hard to grasp totality into easily manageable units.

Partly as the result of a decision and as a consequence of the specific materials obtained through the analysis and resynthesis process, every piece so far suggests in some way a reference to a particular natural (or at times urban) soundscape. This soundscape quality appears to be another recurrent feature that might be present throughout the rest of the pieces, adding to the construction of their overall identity and poetic resonances as it links language –perhaps the most artificial invention of them all– to nature.

4.2.4. /k/

For this piece, the idea was to explore how specific changes in articulation and register can affect the spatial location of a sound. A series of short sounds at clearly defined spectral niches appear, one by one, and slowly begin to move as they change their articulations from short to continuous. Each one travels from a distinct point in the Ambisonic sphere (in fact a series of tight small zones where each sound would hover before initiating a trajectory to a new zone) to another one in the exact opposite side of it in the horizontal axis but at a different point in the y axis, describing a sort of half spiral or warped arch. In their trajectory to this new zone, they evolve from a chirp like sound, which helps to identify its spatial location more easily, to a continuous sound, which makes its spatial location far more ambiguous. Following a structure that resembles a baroque canon, a first sound appears and presents itself for the first 30 seconds, after which a new but similar sound makes its appearance at a different zone in the space, until finally a third sound (occupying a third distinct zone) is heard which cues the beginning of the articulation changes and eventually the presentation of a new series of short sounds. So as the first sounds dissolve into continuous textures, new short sounds appear over them, following similar behaviors. This process goes on, new textures and new short sounds get added, until an overall texture resembling a nocturnal forest soundscape seems to emerge. Up to this point, the piece's density has been growing progressively, finally occupying the sphere completely, but though accumulative, this progression is not building up towards a climactic point but to the installment of a

lush texture. Once this texture is achieved, a dismantling procedure is then initiated which ends up dissolving it completely. To get to that point, the timbre of the soundscape gets less dense, quieter and thinner, until all sounds finally stop and the texture disappears completely into silence. By the time silence is established, the form has described an arch evolving from short sounds clearly located in space to long sounds sprawled all over the sphere.

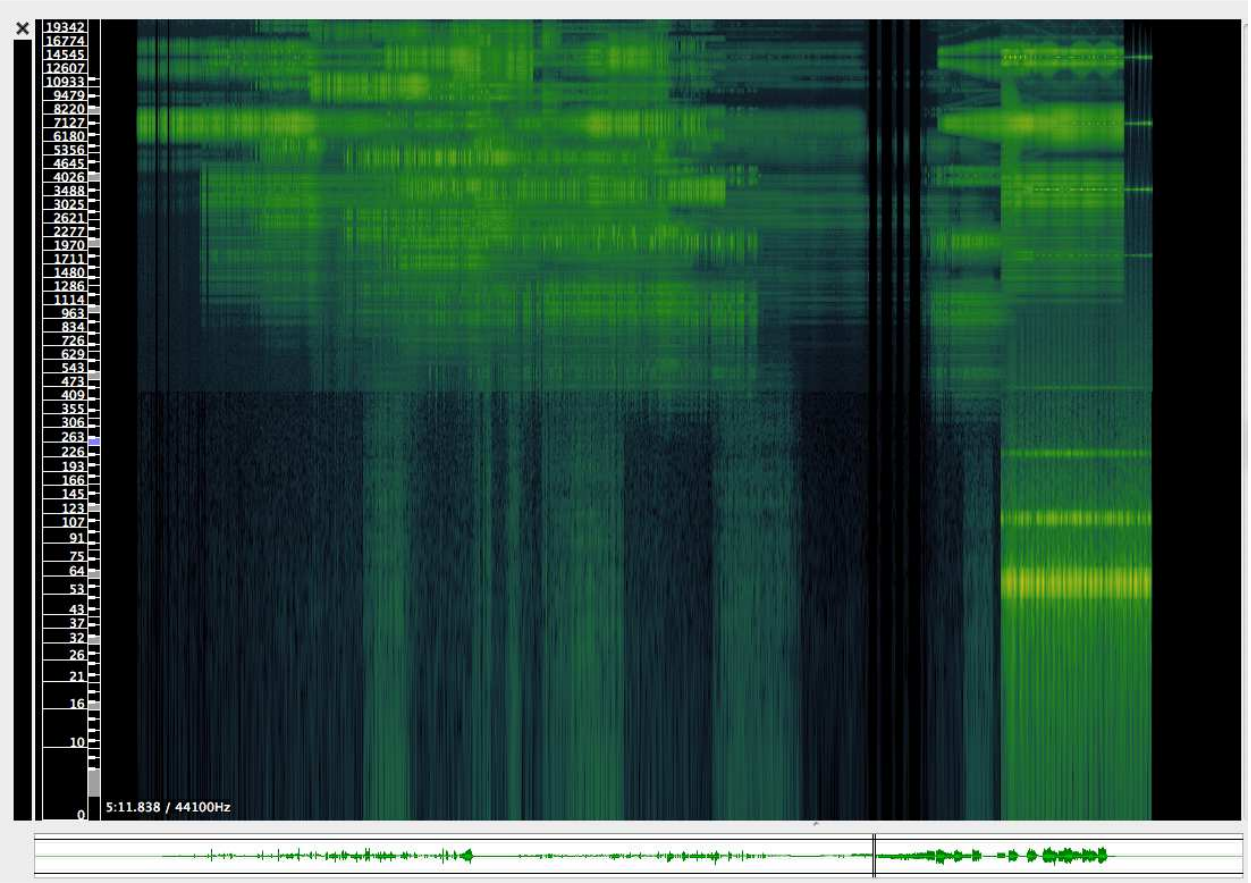

Figure 34 Sonogram of /k/, logarithmic view. The low end appears clearly only by the end of it.

During the silence, only a few and brief signs of activity can be barely heard. What comes next appears first to be the re-installment of the previous texture built over 5 plus minutes, but it suddenly grows into a new fully formed soundscape, with surviving elements from the former one plus mostly new sounds. Most importantly, it is only now with the fairly sudden appearance of the new soundscape that we hear for the first time the low end of the spectrum. This use of the spectral range provides a

distinctive mid-high sound to the whole piece, setting the basis for other pieces to include such kind of decisions. The total duration of /k/ is 7 minutes and 53 seconds.

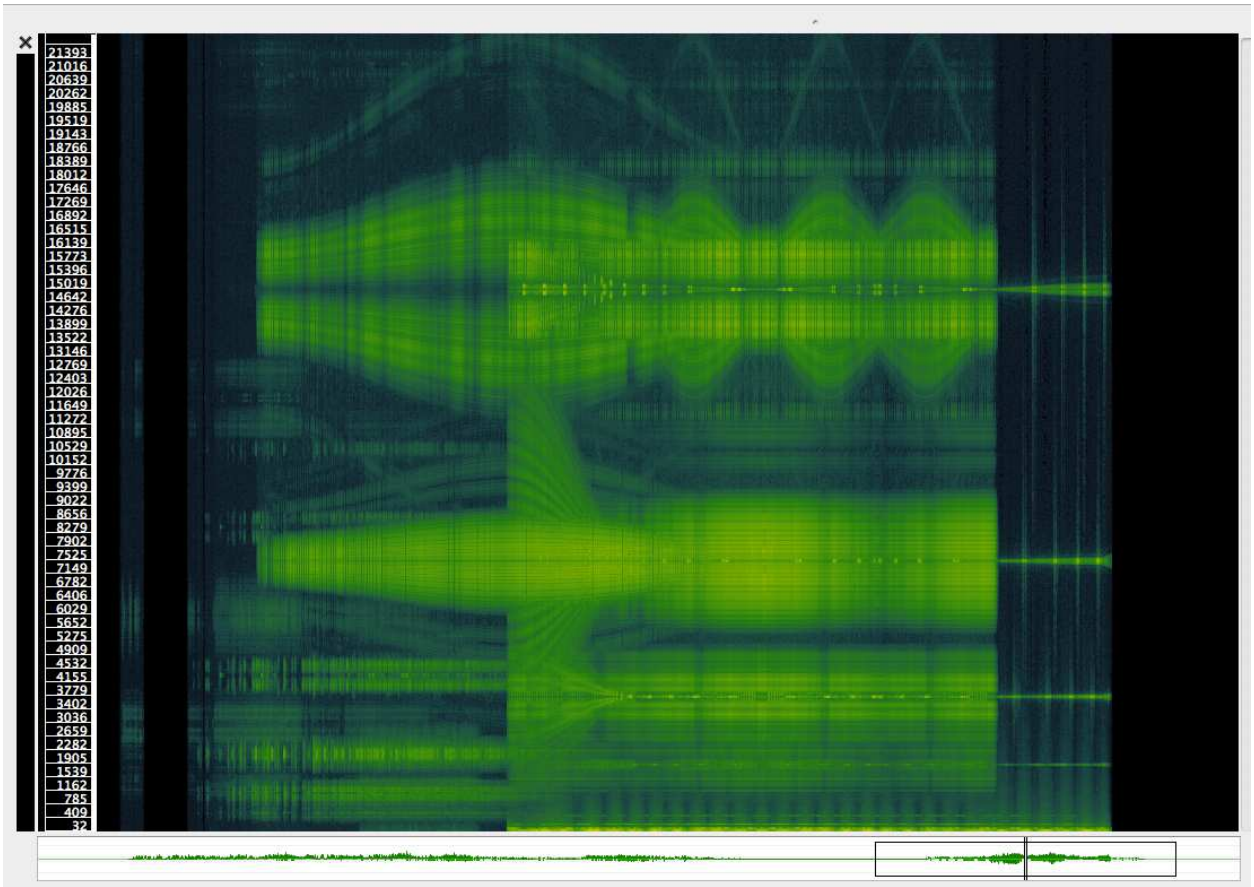

Figure 35 Sonogram detail from the ending of /k/, linear view.

4.2.5. /S/<sh[ow]>

In this second piece, a completely different approach was taken. This time, the exploration occurs within a continuous and turbulent flux of sound. This flux grows by discernible steps although not in such a linear manner as in /k/. The spectral range is practically fully occupied within the first minute and as new currents of sound are added or modified, the density grows in depth and the texture thickens. Since the very beginning of the piece there is a subtle fluctuation in pitch as every thread of the texture glides continuously up or down almost imperceptibly. Since the overall timbre is mostly a noise-based texture, the pitch itself cannot be heard as such but an overall sense of instability is experienced instead. This instability occurs in space as well, since the texture is produced by

granulating various versions of the phoneme into thousands of grains and assigning a distinct spatial location to each one of them. This creates a global texture that appears to be stable in space in the horizontal axis but slightly trembling within a minimum rotating angle. This effect can be compared to the idling of the short sounds in /k/ within a close spatial zone, only this time it is a full range texture that appears to slightly vibrate in the sphere. But while the x axis seems fairly stable aside from these small tremors, the texture clearly grows in depth in the y axis, generating an increase in the pressure level against our bodies. As this pressure builds up, shifts in its harmonic dimension –the vertical axis of simultaneous sounds– can be heard. Once again, not as actual pitches but as noise bands changing and rearranging themselves following a block behavior suggesting chords. At this point, a high and iterated layer glides up taking the texture to its climax. Once this layer reaches its highest point, a series of downward spirals begin, initiating a descent that will end with the single lowest sound in the piece and with it, its first section.

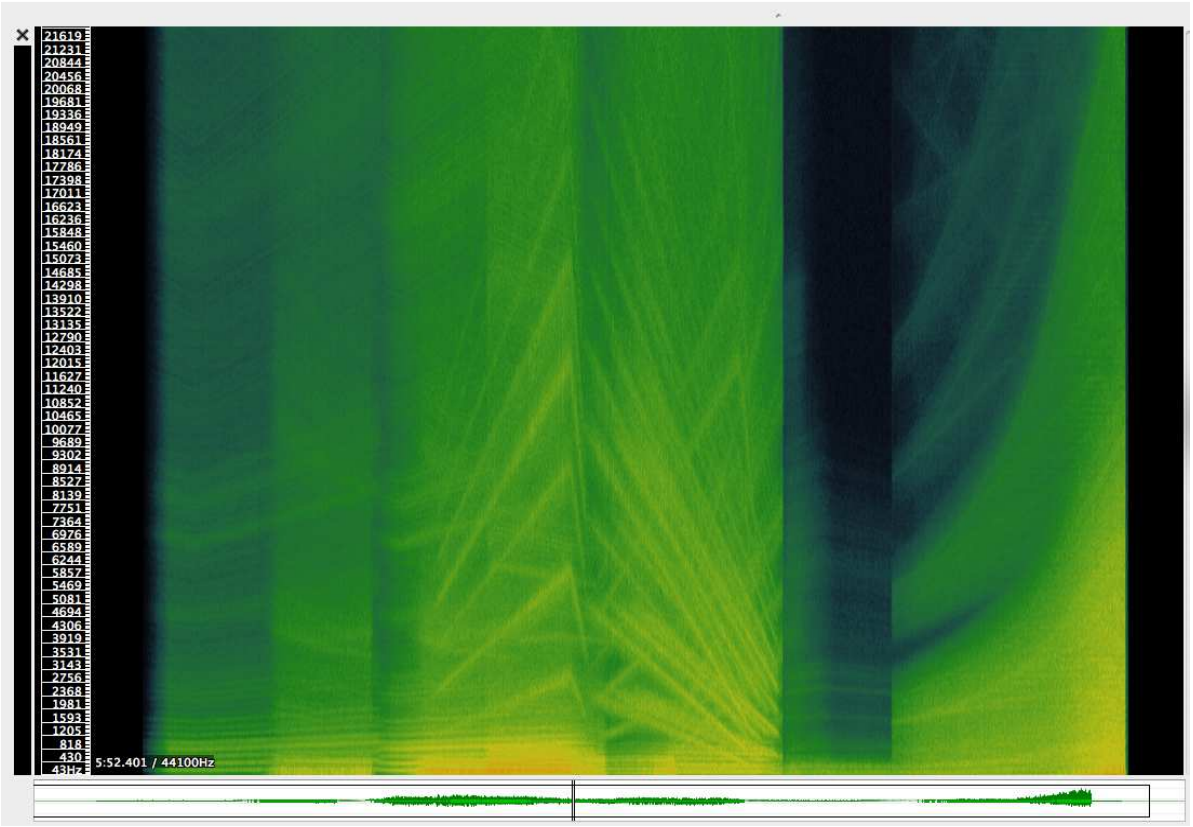

Figure 36 Sonogram of /S/ <sh[ow]>, linear view.

The soundscape image in this case suggests turbulent streams and lush currents in an eerie static state. Or as if we were traveling with those currents just as fast, making our context seem as it was not moving at all. The almost tactile accumulation of energy – suggesting movement– within these streams of sound and their apparent immobility produce an unsettling feeling of tragic imminence. All this sets the character for /S/, which tends to generate a contrast with the previous piece. Although the form has reminiscences of /k/, in the way it builds and dismantles a structure. But while in /k/ there is a structural discontinuity that informs both the micro level (as the piece is based on short discontinuous sounds) and the macro level (eventually the sound flux is discontinued by silence), in /S/ what prevails is the continuity of the sound flux as an organizing element –both for single sounds as for the global form. Therefore, the curve of its development never reaches zero (silence) and has more of a bell shape as oppose to /k/, which has a rather long exponential attack and a fairly fast logarithmic decay.

The second section of /S/ starts with the low sound remaining after the climax, which also has an interesting spatial idling effect. This time, the whole x plain is constantly but minimally tilting in various directions within predetermined angles at a slow random rate. In the way it balances, this spatial treatment creates a sound that appears to be floating on water. Out of this slow unstable mass, the last sound of the piece emerges. A fairly raw noise-based timbre –not far from pink noise– grows in intensity and spectral range for over a minute until it fully fits the sphere, it become pushed towards its center-front as it reaches its loudest point and stops abruptly. This extremely sudden and surprising interruption of such an intense noise with full range spectrum generates an interesting *after-image* type of effect, as some frequencies –depending on the room and the listener– appear to linger on for a little longer after there is no more sound. The total duration of /S/ is 7 minutes and 52 seconds.

4.2.6. /f/

/f/ stays away from the accumulative processes present in /k/ and /S/ and proposes instead to build itself around a series of gestures and a variety of spatial situations. Unlike the other pieces, /f/ never quite establishes a single soundscape nor maintains the same spatial strategy throughout it. Alternately, it plays with additions and subtractions around the initial gestures, which eventually allows to quote timbres and gestures from the other two pieces. There is a dominating *electrical*

timbre quality to the piece, and perhaps a much more mechanical –urban?– general feel which introduces man-made –as oppose to natural– soundscapes as a possible referential texture to be further developed in future pieces. But it does connect to /k/, for instance, in that these timbres are largely iterated and have a thick grain surface quality. And it differentiates itself from the rest since a wider range of articulations and transitions populates it.

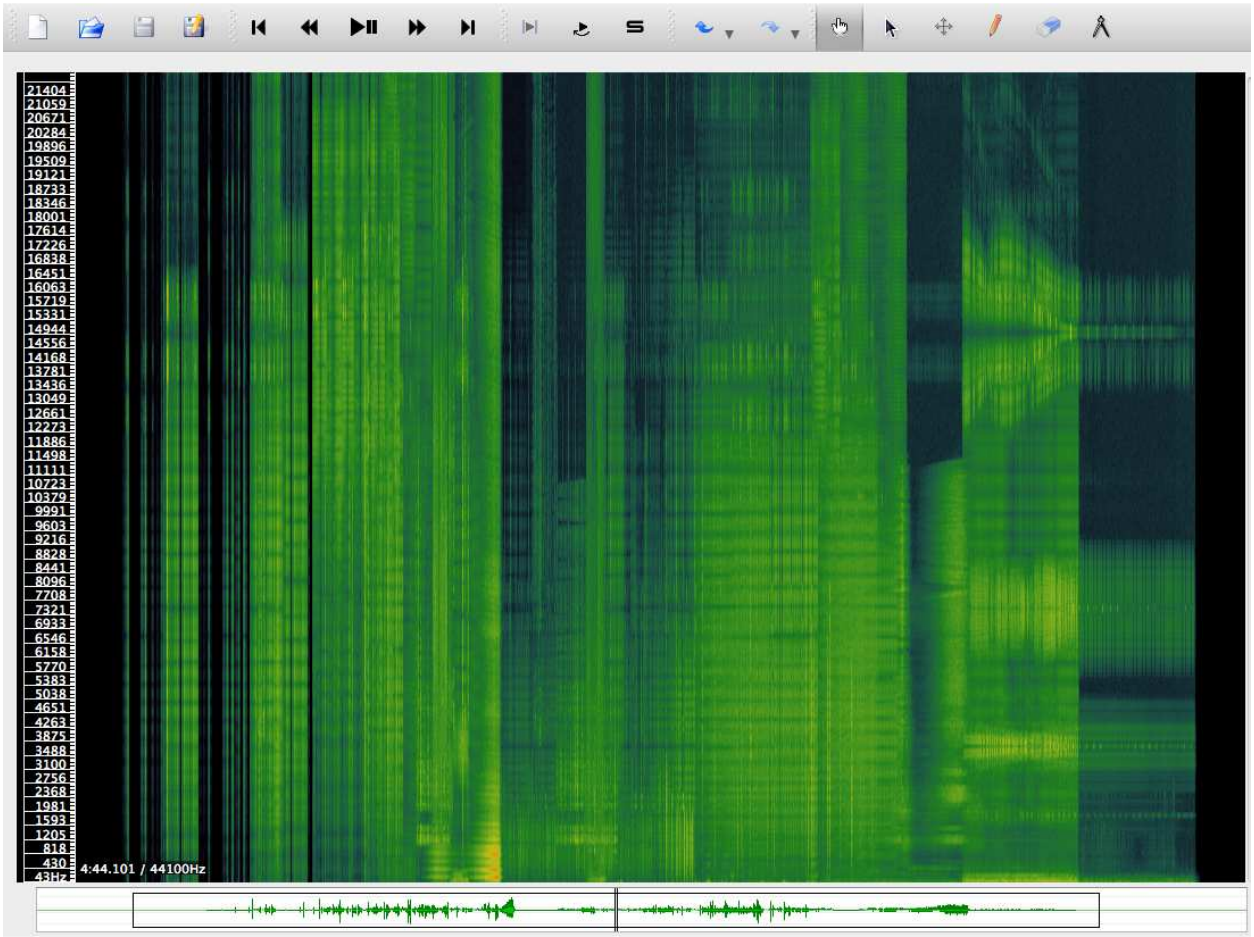

Figure 37 Sonogram of /f/, linear view.

This variety also shows in the spatial treatment. Textures occurring closer to the listener leave place to environments that appear to be farther away, with a distinct reverberating quality. More dynamic timbre-spatial gestures become recognizable describing, for instance, an apparent waterfall coming down from above into the center of the sphere and receding far back as it hits the ground, only to recommence the gesture one more time. Punctual sources coexist with sounds that are spread out,

close objects with distant ones, short sounds with continuous sounds, passages with high density of elements alternate with sparse textures, and the spectral range is actively occupied and emptied throughout the piece. This heterogeneous quality, in comparison with the other two pieces, gives /f/ its character. The total duration of /f/ is 4 minutes and 44 seconds.

4.2.7. The spherical narrative

A series of spatial metaphors were designed and implemented using first order Ambisonics within SuperCollider in all three pieces. Downward spirals, orbits, flares, geysers, tides, blasts and other suggestive spatial behaviors were design to describe specific trajectories in space. For achieving such imaginations, I used mostly the ATK (the Ambisonic Toolkit) library, a toolset gathered, authored and developed by Joseph Anderson, which is now a collaborative open source project.[61] ATK addresses the holistic problem of creatively controlling a complete soundfield, facilitating spatial composition beyond simple placement of sounds in a sound-scene. The artist is empowered to address the impression and imaging of a soundfield—taking advantage of the native soundfield-kernel paradigm the Ambisonic technique presents.[62]

As previously stated in this chapter, each piece tries to focus on a particular spatial approach using a set of spatial metaphors. What these metaphors might have in common is the intention of creating an aural experience where each listener becomes the center of the listening. Although such idea can be more extensively explored when working on an installation setting –where hybrid spatialization paradigms might be utilized and the audience might be moving around–, it is still the underlying idea in terms of spatial treatment, not only for these pieces but also for my work in general. What this idea suggests is a space that attempts to avoid a central organizing listening point in favor of a multiplied or dynamic center created by the location of each listener. Again, when working within the Ambisonic sphere this concept quickly finds its limits as you step off the sweet spot, but even with such a limit, bearing such an idea in mind produces a different mindset for mixing and working spatially. On the other hand, an installation setting offers an opportunity to achieve this perhaps in a more effective or

[61] Among other developers are Juan Pampin and Joshua Parmenter.
[62] http://www.ambisonictoolkit.net/wiki/tiki-index.php.

discernible way. In a situation where there might simply not be a chance to even have a sweet spot at all, the construction of space needs to be re-signified through alternative speaker placements and a hybrid technical approach, in addition to the design of the possible audience's errands. And all this takes you to conceive and compose the whole sound in a different way. This thinking is intended to become part of this series, as it imagines a listening situation which does not privilege any given front, allowing the pieces to be heard facing any point in the space. The implied Ambisonic sphere is understood as having no common front or back, sides, above or below except as relative to each listener. This spatial concept connects with our everyday subjective experience of sound, which finds us always at the center of the sonic image, and for which we are never in an unbalanced position in regards to the sound sources surrounding us.

4.3. Chapter two: PHOTOSENSITIVE VOLUMES

For the three pieces on the second chapter – referred to as PHOTOSENSITIVE VOLUMES – a series of custom made instruments that use the basics of optical sound technology were designed and built by the author, taking the form of mechatronic optical turntables, sonic backlights and bars of light.

These instruments would essentially take a modulated light source as their input, and create sound as their output. An early inspiration for my interest in optical sound came about right after moving to Seattle, in the fall of 2007, when I bought an Optigan Organ in a garage sale.

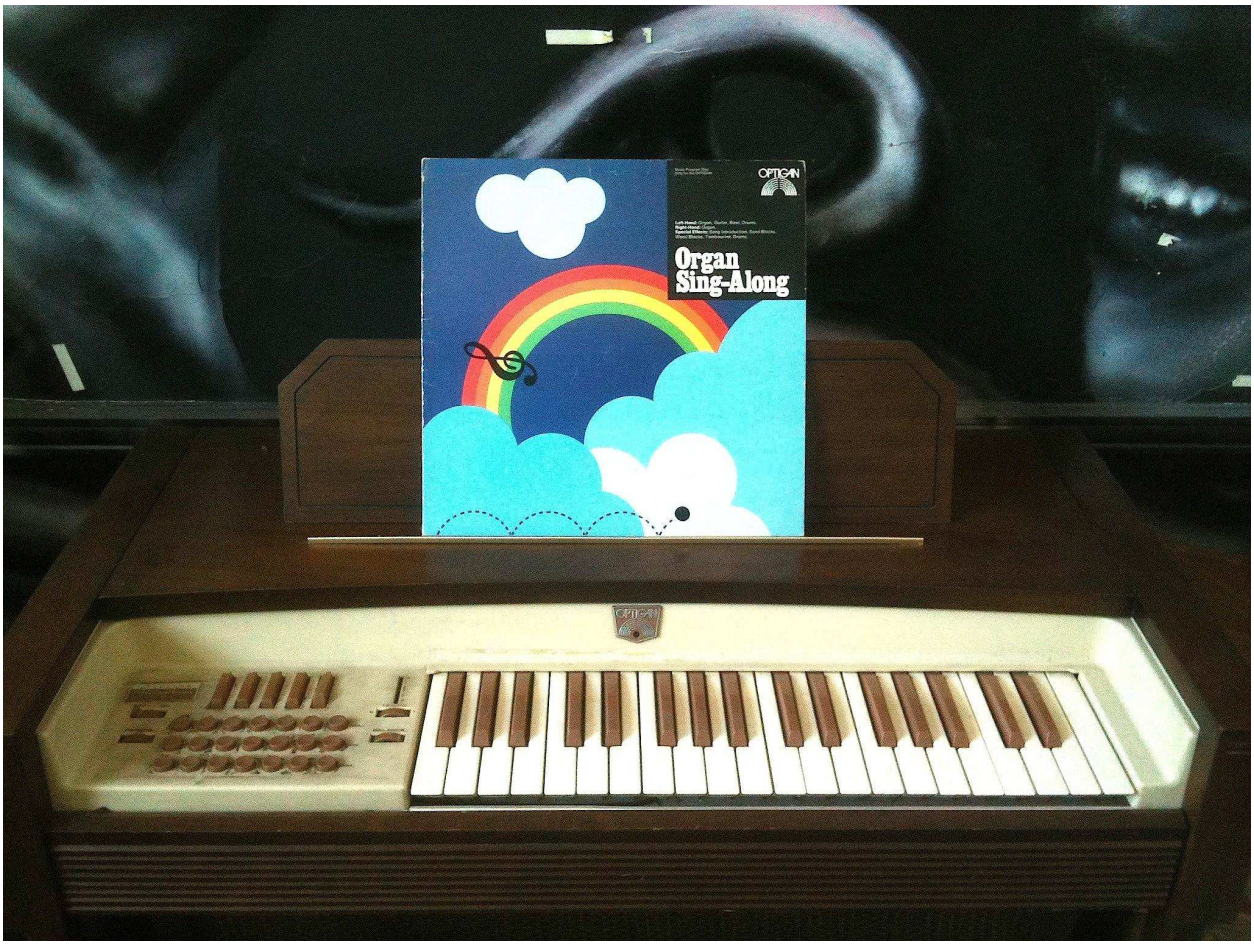

Figure 38 My Optigan.

The Optigan is an electronic keyboard instrument that uses pre-recorded optical soundtracks to reproduce sound. Its playback system functions much like the storage and reading of an optical soundtrack as was used in motion pictures, using a light bulb to energize a row of photodiodes on the opposite side of spinning, 12" diameter clear plastic film discs (officially referred to as "Program Discs") encoded with fifty-seven concentric optical tracks. The system is capable of playing all its samples perfectly synchronized to a particular tempo, which can also be changed, although it affects the speed reproduction of the disc and thus the global tuning of all samples. Each track on the disc is a two second loop of actual musicians performing all major, minor and diminished chords in a particular music style, such as Latin Salsa, Country Western, Polynesian Village, etc. Certain models are stereo (one speaker is used for amplifying the keyboard sounds and the other for the accompaniment

triggered through a series of buttons) and come with a balance control and a reverb, the amount of which can be controlled.

Figure 39 Detail of an Optigan disc.

In the fall of 2010, we did an independent research with Tivon Rice to learn more in depth about optical sound technology and its possibilities within systems art. As a result of these studies, Rice produced Rip #4 (short arguments about inscription), a series of kinetic sculptures that creates audio as rotating waveforms modulate light emitted from a small bulb, presenting a tangible relationship between the recorded mark and the resulting sound. It was during this research that I started producing the optical instruments that would become part of the second chapter of LA BIBLIOTECA CIEGA.

Figure 40 Rip #4 by Tivon Rice.

The first experiments consisted on creating new discs for the Optigan. Calculating the placement of the optical grooves, sky maps were transposed into a custom made Optigan disc creating a random series of bursts and pops. Afterwards, we started experimenting using the small solar panels taken from sun-powered garden lamps to transduce LEDs controlled with an Arduino into sound. We chose the

electronic circuit to turn the light fluctuations into voltage differences and modeled the board and casing for it.

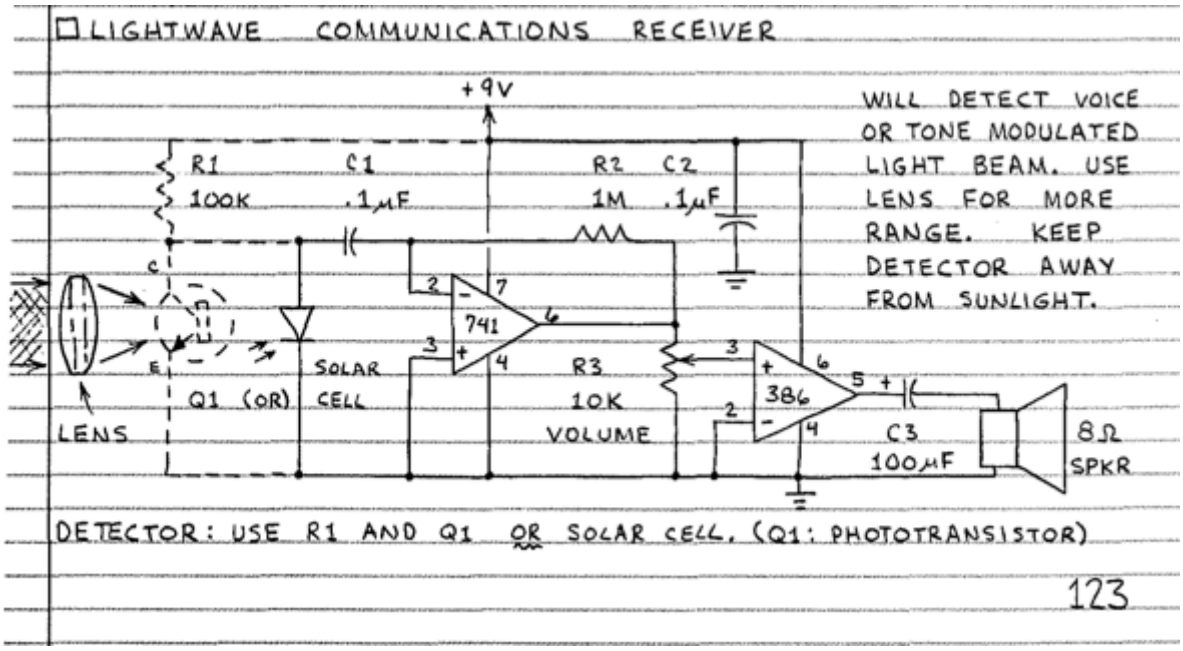

Figure 41 The electronic circuit that receives light and outputs voltage differences.

We later started producing different prototypes for the discs, with originally designed waveforms. Rice designed the casing for the photo-resistors so they would be as isolated as possible from any other unwanted light source except the one placed right in front of it, and added a small acrylic lens to focus the light beam on the sensor. As we both started working on our individual projects, I began prototyping the instruments, first the turntables and the discs they would use, later the backlights, finally the bars of light.

In addition, earlier that year in the spring of 2010, I passed my General Exam, which challenged me to create a series of audio postcards using only consonants as their sound source and planted the seed for what would become the first chapter of my dissertation piece, *Resonances, Turbulences & Explosions*.

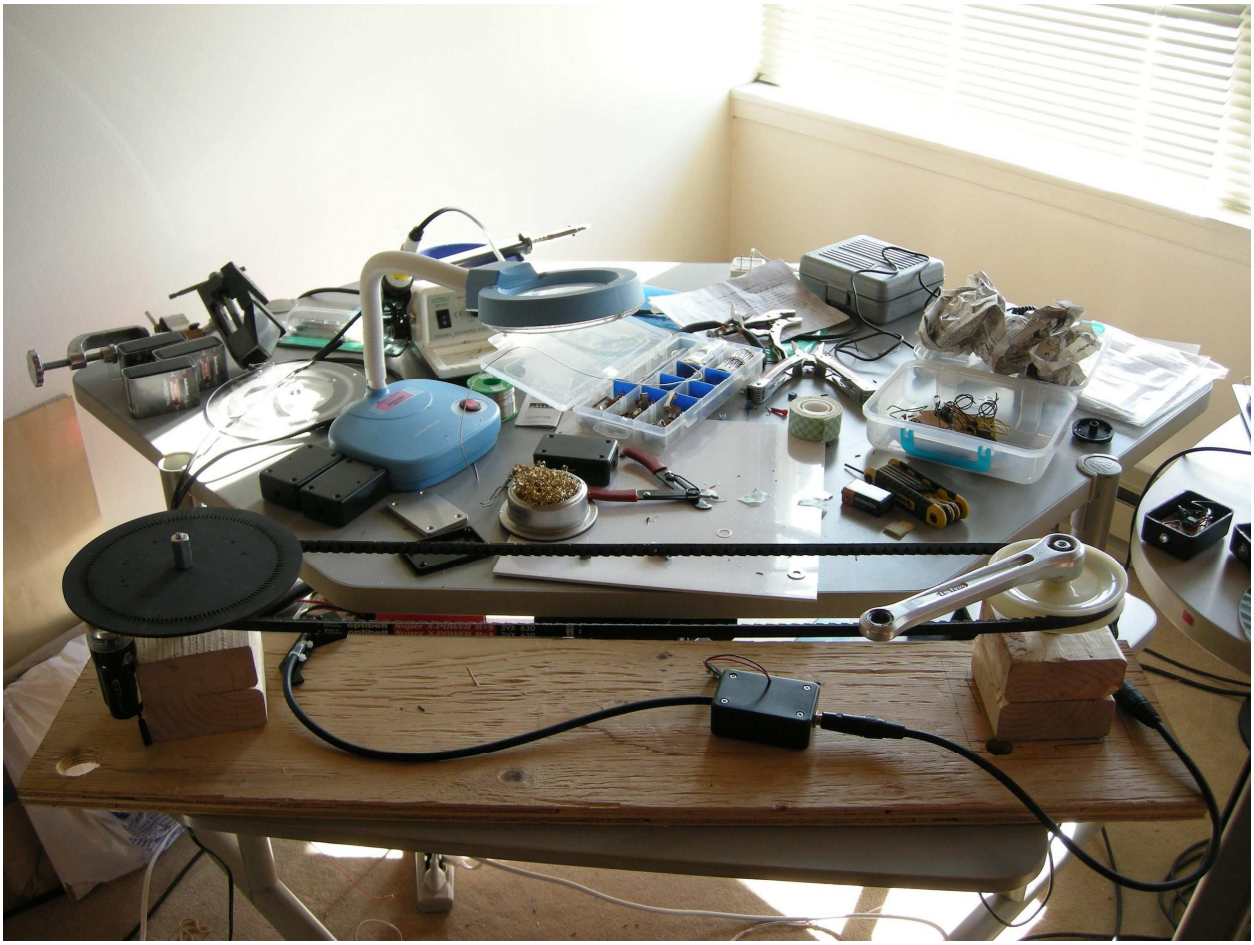

Figure 42 Prototype of an optical turntable.

4.3.1. Media Archaeology

Rereading old, obscure, forgotten or discarded texts is one of Borges' recurrent procedures, present in innumerable of his short stories. This section resumes these ideas and confronts them with recent studies on media archaeology, "a 'discipline' of reading against the grain".

In their introduction to Media Archaeology, Erkki Huhtamo and Jussi Parikka quote media critic Geert Lovink describing these studies as an "hermeneutic reading of the 'new' against the grain of the past, rather than telling of the histories of technologies from past to present".[63] Also according to Huhtamo and Parikka, "media archaeologists have challenged the rejection of history by modern media culture

[63] Most of these theories follow Michel Foucault's understanding of archaeology, as a way to dig into the background reasons why a certain cultural object, theory, statement or discourse emerges, survives and prevails over others.

and theory alike by pointing out hitherto unnoticed continuities and ruptures." As a consequence, "suppressed", "neglected", "dead ends", "losers", and "inventions that never made it into a material product" populate the territory of this practice. Among other thinkers working on similar ideas, we find the radical work of Siegfried Zielinski, who avoids describing his practice as "media archaeology" and talks about the "deep time of the media" instead, trying to reconcile radical contemporary artists whose art practice rage against the cultural industry with other figures of the past whom he sees as counterculture icons. Thus, Zielinski's take on media archaeology often focuses on marginal events or people, defying universal worldviews and chronological accounts of history, favoring local or peripheral experimentations, reviewed in a non-linear manner. In this sense, comes closer to a Borgesian conception of tradition when he suggests not to "seek the old in the new but find something new in the old".[64] For him, old media is not deprecated but the host for a "sense of possibility" that assigns "no more importance to what is than to what is not."[65] But while Zielinski remains in the speculative possibilities of "what is not", Borges perspective seems to effectively change history altogether (or at least its logic of causes and effects) through the mere act of reading. What becomes compelling about this idea is that it revitalizes not the future nor the past but the present, and the act of reading (and writing) turns into a vertiginous tool of creation and transformation with concrete consequences and revealing powers. This praise for the present appears not without a hint of irony in Borges' Pierre Menard, the author of the Quixote, where a writer challenges himself to write pages that exactly coincide, word by word, with Cervantes' novel. To justify his task as a radical literature project, he argues:

> "To compose Don Quixote at the beginning of the seventeenth century was a reasonable, necessary and perhaps inevitable undertaking; at the beginning of the twentieth century it is almost impossible. It is not in vain that three hundred years have passed, charged with the most

[64] Zielinski, Siegfried. Deep Time of the Media : Toward an Archaeology of Hearing and Seeing by Technical Means. Cambridge, MA: MIT Press, 2006. WorldCat. http://worldcat.org.
[65] Zielinski, S. Op. Cit.

> complex happenings - among them, to mention only one, that same Don Quixote"[66]

What Menard suggests is that the same passage written (or read) in the past means a completely different thing if read (or written) in the present:

> "It is a revelation to compare the Don Quixote of Menard with that of Cervantes. The latter, for instance, wrote (Don Quixote, Part One, Chapter Nine)
>
> ... la verdad, cuya madre es la historia, émula del tiempo,
> depósito de las acciones, testigo de lo pasado, ejemplo y aviso
> de lo presente, advertencia de lo por venir.
> [... truth, whose mother is history, who is the rival of
> time, depository of deeds, witness of the past, example and
> lesson to the present, and warning to the future.]
>
> Written in the seventeenth century, written by the "ingenious layman" Cervantes, this enumeration is a mere rhetorical eulogy of history. Menard, on the other hand, writes:
>
> ... la verdad, cuya madre es la historia, émula del tiempo,
> depósito de las acciones, testigo de lo pasado, ejemplo y aviso
> de lo presente, advertencia de lo por venir.
> [... truth, whose mother is history, who is the rival of
> time, depository of deeds, witness of the past, example and
> lesson to the present, and warning to the future.]
>
> History, mother of truth; the idea is astounding. Menard, a contemporary of William James, does not define history as an investigation of reality, but as its origin. Historical truth, for him, is not what took place; it is what we think took

[66] Borges, J.L. Pierre Menard, Author of Don Quixote. Translated by Anthony Kerrigan.

> place. The final clauses - example and lesson to the present, and warning to the future - are shamelessly pragmatic."[67]

As in *Kafka and his precursors*, writing in the present modifies the past or grants it new meaning. After Menard, we will never read Don Quixote the same way again:

> "'My undertaking is not essentially difficult,' I read in another part of the same letter. 'I would only have to be immortal in order to carry it out.' Shall I confess that I often imagine that he finished it and that I am reading Don Quixote - the entire work. - as if Menard had conceived it?"[68]

This idea of the present as perhaps the most transformative element of time has been extensively developed and taken to a whole new level by Juan José Saer, another argentine writer whose work is quite influenced by Borges. In her recent book on Saer, Florencia Abbate defines the many subjective experiences of time present in his writings not as the use of a historic time, chronological, linear, but as a subjective vision of time which manifests itself through the static display of past or future horizons starting "now" in the present, conceived in all its density.[69] In most of his novels and short stories, Saer writes always about the same characters and the same –although not completely disclosed– geographical location. His writings are the desperate and obsessive attempt to grasp what we call reality, multiplying the many "nows" of the present as a strategy to achieve an ultimately impossible task.

In chapter two of LA BIBLIOTECA CIEGA, obsolete technology of optical sound is revisited in light of the symbolic echoes of the building, bringing back the past not to repeat it but to reinterpret it. When we remember, we create a new instance of a past event, embedding it in a new temporality. In Agamben

[67] Borges, J.L. Pierre Menard, Author of Don Quixote. Translated by Anthony Kerrigan.
[68] Borges, J.L. Pierre Menard, Author of Don Quixote. Translated by Anthony Kerrigan.
[69] Abbate, Florencia (2014) El espesor del presente. EDUVIM. Programa Sur Global, UNSAM.

words, “memory cannot give us back what it was as such, that would be hell. Instead, memory restores possibility to the past.”[70]

The piece goes back to early experiments on optical sound to draw inspiration and speculate on the unexplored possibilities of such media and its resonances today, bringing this technology to the digital arena, embedding it in a particular poetic context. There is no nostalgia or longing for a better past[71] in this movement. Instead, there is a symbolic choice and appropriation of a specific technology *sharpened and deflected* by the digital paradigm. In addition, the performative aspects and algorithmic processes in real time bring further deviations into the piece, proposing a hybrid interaction between analog, digital, physical and virtual realms. The presence of the old media in LA BIBLIOTECA CIEGA serves a poetic purpose, introducing inscription concerns across analog and digital platforms, in relation to the site’s formants.

As it’s been suggested earlier in this chapter, media archaeology theories are not far from the way Borges understood the role of the writer and literature itself. But they lack of the interesting twist posed by the argentine writer, when he suggests that new art works cannot only help us understand the past in new and multiple ways, but effectively change our perception of it. The past is therefore not a fixed mosaique of events but a flexible and dynamic mesh to be constantly reshaped through interpretation. For instance, his reading of Kafka takes him to think anew the work of several writers, building a surprising genealogy of predecessors to the Czech author. For Kafka is the *actualization* of a literature built upon “somber myths and atrocious institutions”, inventing an unlikely connection (not speculative but real) between texts and writers that would otherwise be lost and that did not exist before Kafka. Not unlike the character of his own short story Pierre Menard, when he rewrites the Quixote word by word claiming it as a new work, written in a new present context, and therefore producing a completely different meaning and having a different impact, for nothing can really be written twice.

[70] Agamben, G. “Difference and Repetition: on Guy Debord’s Films”, in McDonough, T., et al. “Guy Debord and the Situationist International. Texts and Documents”. Ed. Tom McDonough. Cambridge, Massachusetts: MIT Press, 2002.
[71] I borrow this expression from a sticker of Archivo Caminante, a project by friend and artist Eduardo Molinari.

In this sense, Borges essay resignifies media archaeology studies as it closes in a feedback loop the current theory: it is not only the past that helps us rethink the present but it is also the present that brings new light into the past. Thus, the artist's vision can reach powerful effects not necessarily by introducing the unknown from the future in the form of new media, but by producing an event in the present which takes us to revisit what we gave for granted.

Artists working with obsolete and discarded media for many years now first introduced the current interest in old media now addressed by scholars. The works by Paul De Marinis and Toshio Iwai are often inspired by old media or even become interventions on actual outdated devices. Many of their works entailed a relentless research that put both past and present under perspective.

As the fragility of the digital support in general becomes more apparent, and the shortening of software and hardware's life expectancy in particular arises as an issue, media archaeology as a discipline could help to raise awareness about how we relate to technology altogether, not only from scholars and artists who have been pioneering such research but from governments, corporations and the media industry itself. And though these new actors from outside the art world can certainly contribute valuable insight and concrete responses to the rapid decay cycle of the digital, it is perhaps in the arts where lies the greater potential for unexpected connections between the old and the new, which could therefore lead to original responses to such concerns.

4.3.2. Design and Fabrication for Photosensitive Volumes

An important part of the *Photosensitive Volumes* involved the design and fabrication of a series of instruments that turned light into sound. During almost a year, we produced the necessary research, tried out various prototypes and finally came up with three original designs we describe as optical turntables, sonic backlights and bars of light. The materials used were wood, motor belts, bicycle cranks, skate bearings, custom metal axis, plastic laundry line pulleys, acrylic, bolts, screws and nails, microphone clips, LED flashlights and strips, custom electronic circuits, black paint and glue.[72]

[72] I'd like to take this opportunity to thank Tivon Rice for so generously helping me with the process of imagining, designing, scouting for materials and building these instruments.

The final design for the turntables involves a belt and pulley system activated by a hand crank that gets an acrylic disc to spin. Each of the discs has a different sound waveform carved out by a laser cutter. The performer plays the disc by spinning it and bringing a small flashlight closer to the perforated groove. Underneath it, a light sensor reads the fluctuations of light as it passes through the cutouts. An electronic circuit takes these fluctuations and turns them into voltage differences, in other words, into an analog sound signal. A computer transforms these analog signals in real time using the SuperCollider software and spatializes them through the same 8-channel Ambisonic array surrounding the audience during the first chapter, creating an immersive sonic experience. What the audience hears is the interaction of the waveform on the disc, the digital processes and the actions of the performers, who can modify dynamic envelope and duration, as well as volume by moving the light closer or farther from the disc, and pitch by spinning the disc faster or slower.

Figure 43 Final version of an optical turntable (PH: Daniel Trama)

The backlights produce sound in a similar way, but the waveform cut-outs are linear and performers manipulate sensors instead of lights. Inside them, a long LED strip would give the necessary light to the instrument. To perform them, the musicians hold a sensor in each hand and pass them longitudinally over the top of the backlight, without touching it, following the linear waveform. This gesture can be produced with both hands at the same time, hence reading two different parts of the waveform at once. Also, they can read the waveform in both directions, from left to right or backwards. In a way, the sensor in their hand acts as the playback head of a tape recorder and the acrylic strip with the waveform cutout becomes the tape onto which a sound has been recorded. Therefore, passing the

sensor faster or slower modifies the sound's pitch, as when modifying the playback speed of a tape machine.

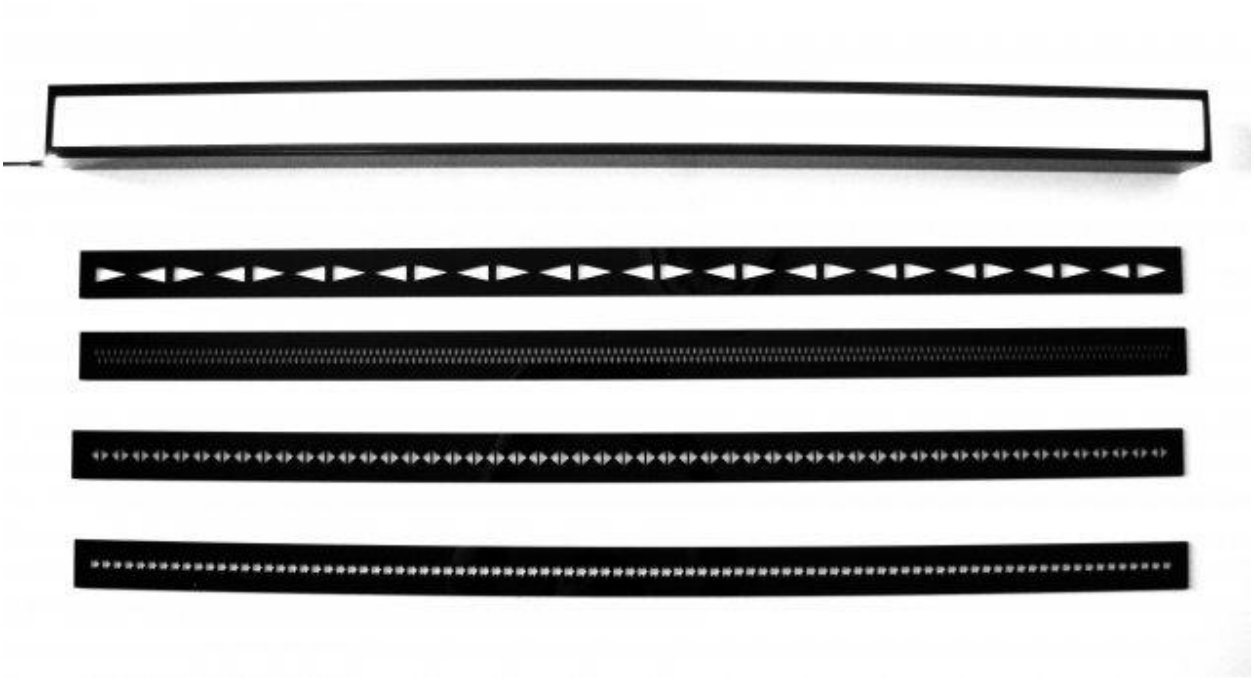

Figure 44 View of a backlight with four linear waveforms (PH: Daniel Trama)

The backlights can also be played without any linear waveform on them. Using only the illuminated surface on top of it, performers can pass their sensors perpendicularly over the lightened surface, quickly back or forth to generate a sort of burst or pulse, which will be transformed by the computer. These percussive sounds were used mostly for Volume 2, discussed later in this Chapter.

The bars of light turn on and off in chaotic patterns controlled by a fourth performer[73] through a microcontroller, generating complex sound waveforms after going through a similar electronic circuit as the turntables and backlights, that converts those light patterns into sound. Built with two solid acrylic 25cm rods, these bars are stuck vertically on top of a black box, inside which an LED is placed at the end of each one and a light sensor right next to it. The Arduino used to control its on and off patterns is also inside this box. In this case, there is no physical modulation of a light beam but a computer-generated series of fluctuations imitating in a way what the discs or the linear waveforms do

[73] For the premiere of LA BIBLIOTECA CIEGA, I was the fourth performer.

to the light that goes through them. Unlike the rest of the instruments, which use a clear and defined gestural action to be activated, the bars of light have a more cybernetic approach into sound production, taking advantage of the automatization capabilities of the computer. It is computer together with the Arduino the ones that algorithmically generate the waveforms by controlling the light modulations and fluctuations picked up by the sensor. During performance, I could also change these fluctuations using a MIDI controller.

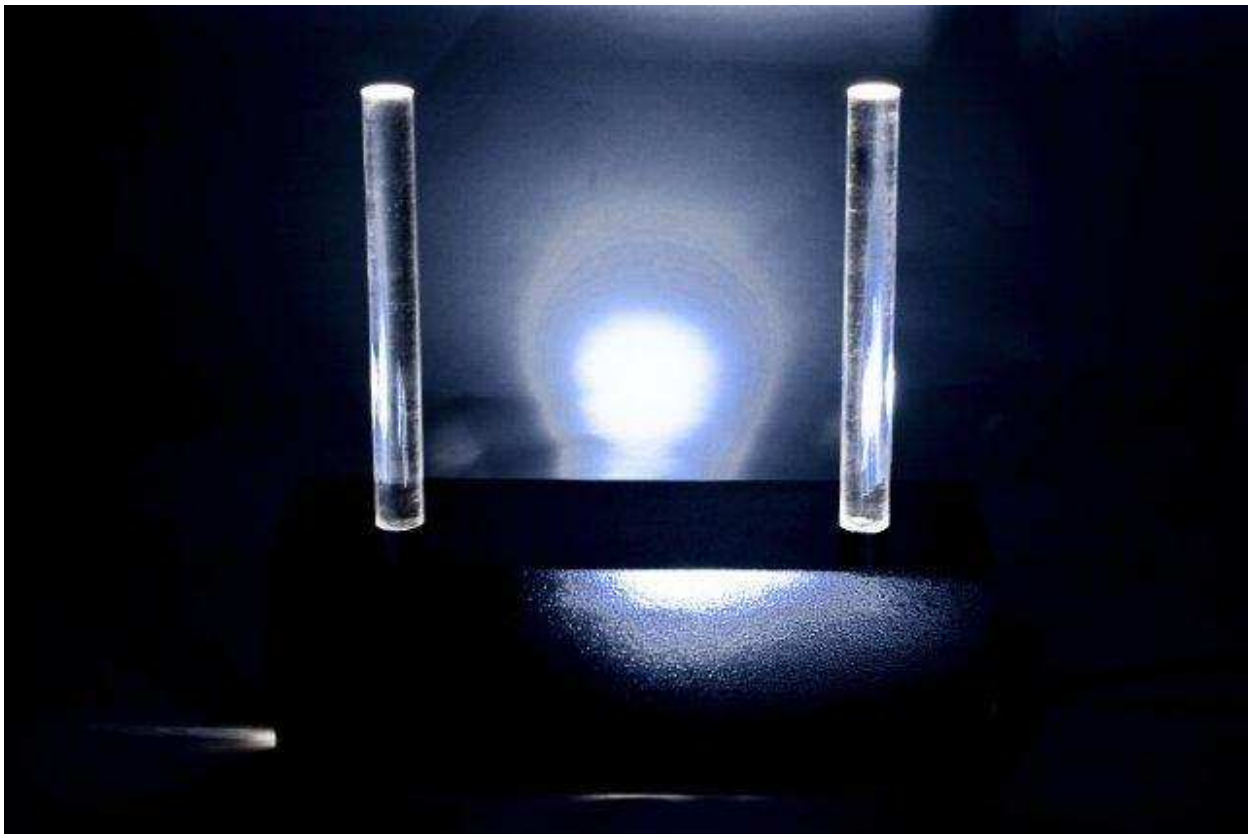

Figure 45 The bars of light (PH: Daniel Trama)

The waveforms were designed in Rhino and did not come out of a pre-recorded sound but were drawn from scratch, rendering a form of visual sound synthesis. Most of the waveforms were periodic and composed of small and geometric bits of sound, which related the process to granular synthesis techniques as well. Different *window shapes* – which generated different envelopes for each *grain* – were designed for a total of 24 discs, each one holding a single waveform.

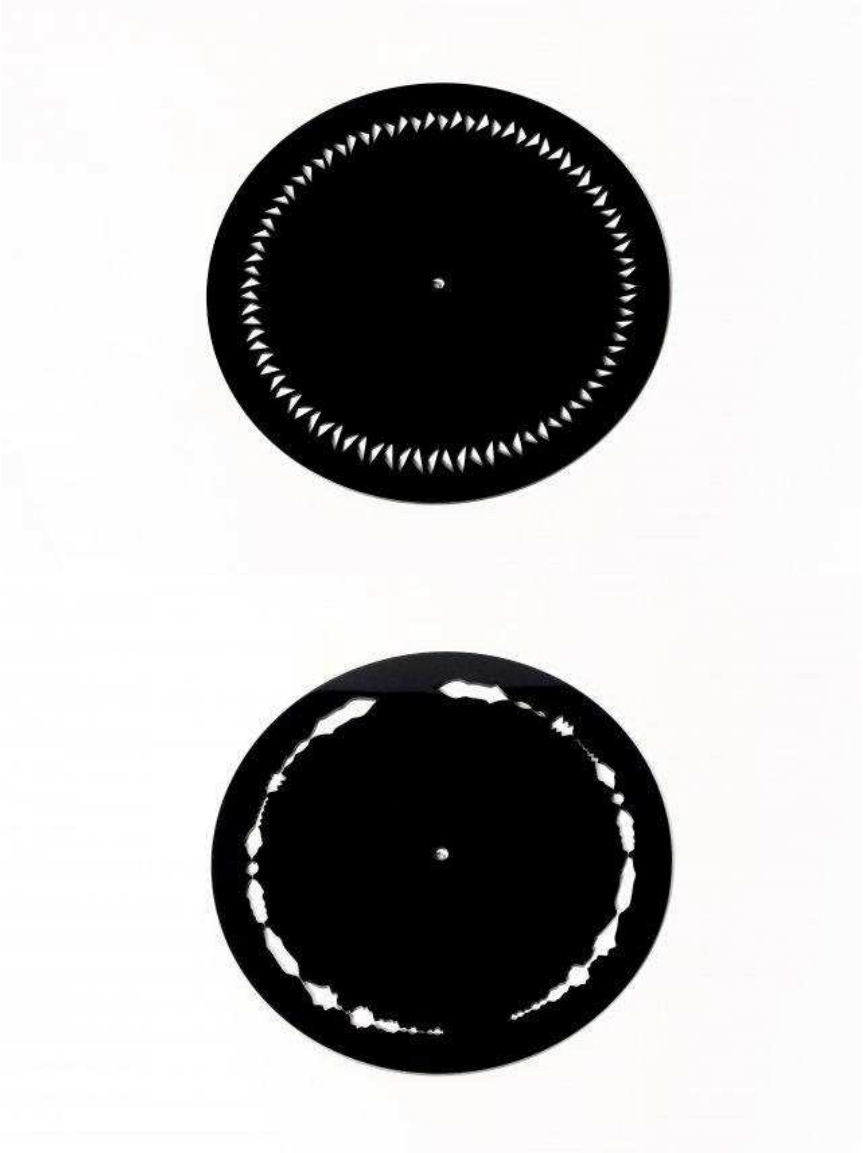

Figure 46 Two discs used by the optical turntables.

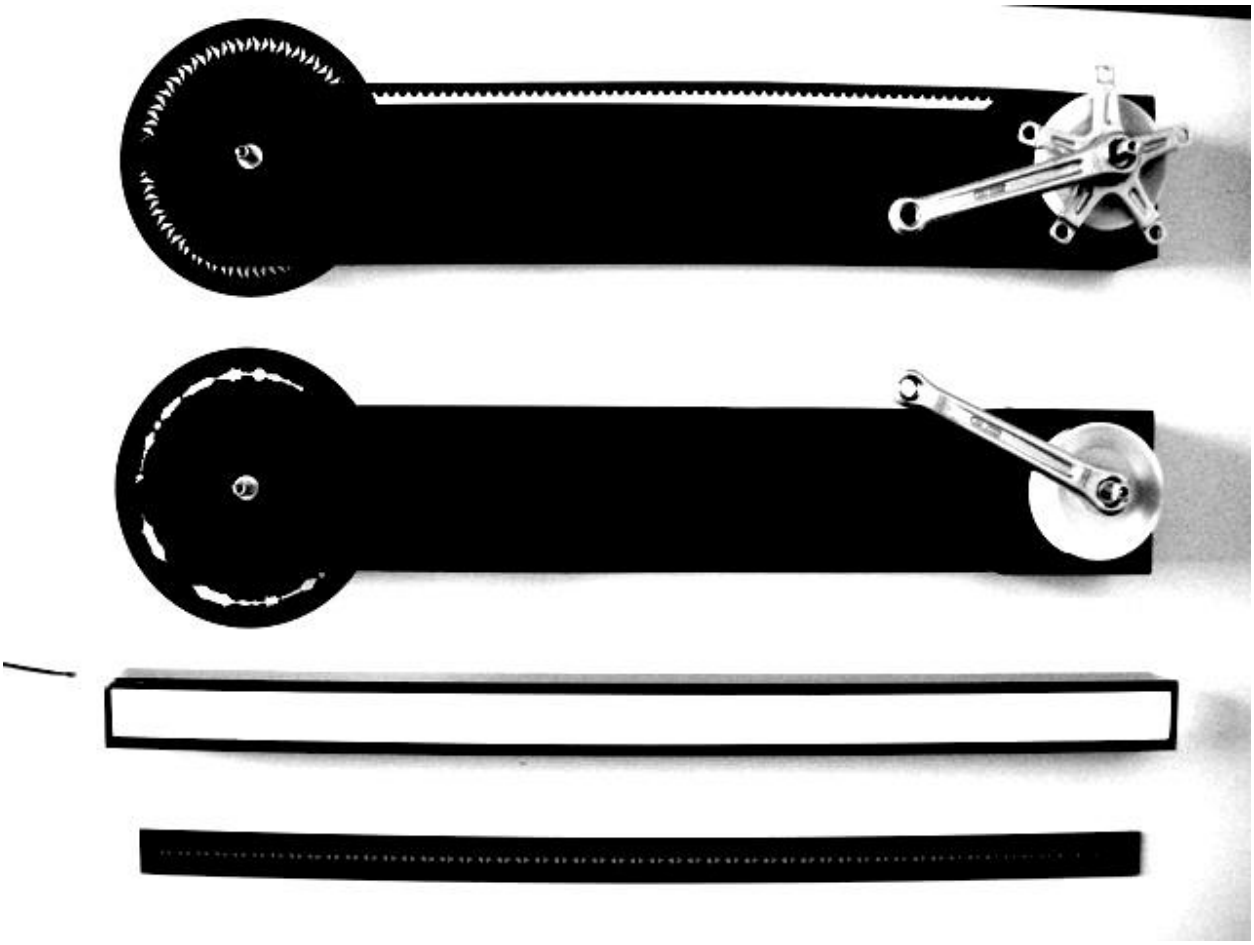

Figure 47 Complete set for one performer: two turntables, a backlight with linear waveform and discs (PH: Daniel Trama)

During the performance, each of the performers operated a set of two turntables with up to 6 discs each, which they would change over the course of the performance, and a backlight with one linear waveform.

As stated above, the complex patterns assigned to the bars of light were manipulated live by myself using a midi controller[74] mapped to the intensity and flickering patterns of the LEDs, controlled through a microcontroller virtually connected to SuperCollider. My role as a the fourth performer was mostly the real time processing of all the sounds generated by all the instruments, but I would occasionally play one of the turntables as well.

[74] UC-33 Evolution by M-Audio.

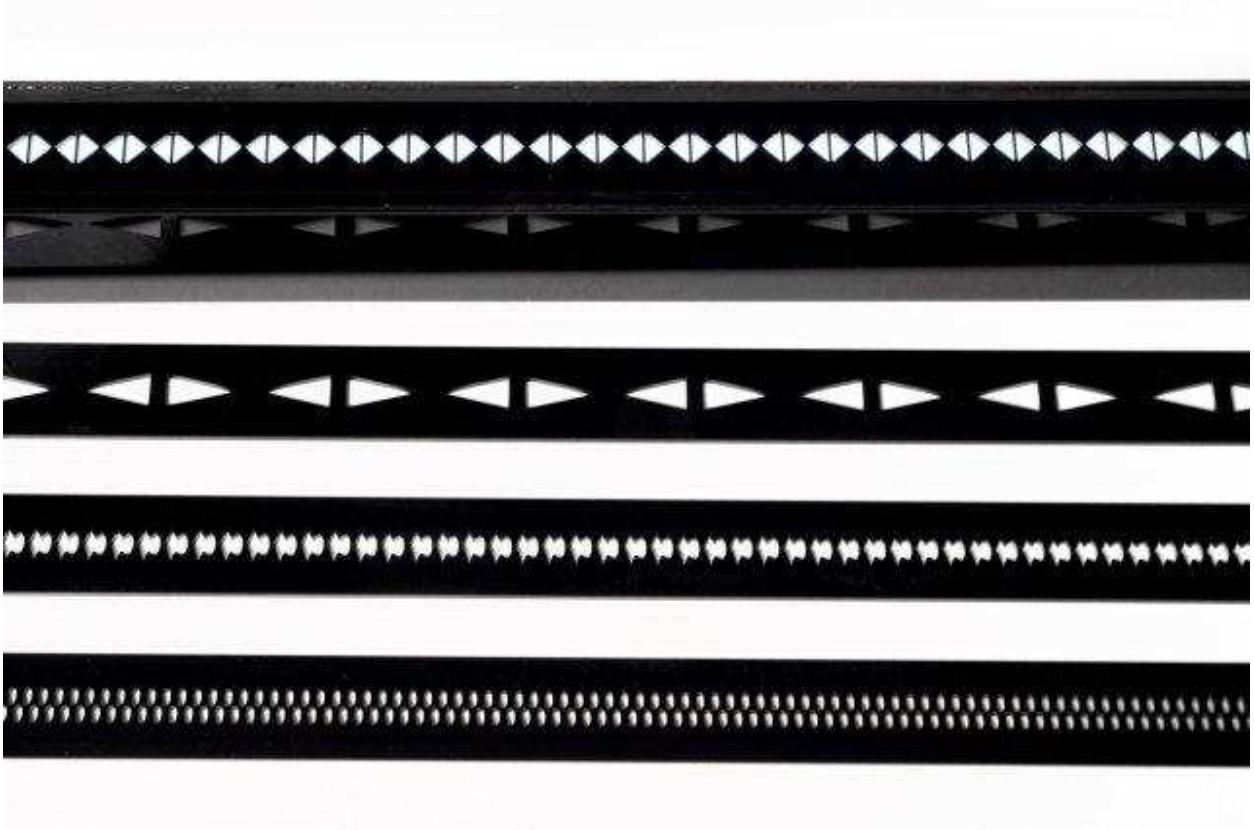

Figure 48 Detail of a backlight with linear waveforms (PH: Daniel Trama)

4.3.3. Composing Photosensitive Volumes

These Volumes took their final form after an intense period of rehearsals with the musicians from Banda Sinfónica de Ciegos. A series of guided improvisations provided me with the basic materials and possible interactions between performers and instruments that were crucial for the composition process. This approach was crucial since we were dealing with new instruments that needed to be explored. Improvisation was also a carefully introduced element in certain parts of the performance, mostly affecting some interactions and their length. All three Volumes are performed as a single piece without silences articulating them. There is also not a clear separation between the end of the first chapter *Resonances, Turbulences & Explosions*, and the beginning of the second Photosensitive Volumes, as the space remains in silence and complete darkness until the first sound of Volume one, and the first light that creates it, occurs. This builds a continuity between both chapters and preserves and guarantees the impact of the first light to be seen after ~25 minutes of total darkness.

4.3.4. Vol. 1. PQ7797.B635 L3 1964

This Volume begins with a short sequence that serves as an introduction to the whole piece, consisting of a series of sub low beats and brief intersections of a percussive material both produced with the bars of light and performed by myself. This introduction lasts as long as it takes the rest of the performers to step on the scene, get in position and ready to play their instruments. What follows is a synchronized gesture produced by the four of us, each one using a turntable, resulting in a coordinated wide metallic band.[75] This material gets developed into a series of waves to create an unsettled mass within which different sections of the spectrum get alternatively illuminated. As this texture finally dissolves into a transitional sound, a rhythmic section makes its way in. The rhythmic materials are divided into a lower and higher end of the register and interplay openly until the sound for the next Volume is heard, which triggers their slow fade out.

4.3.5. Vol. 2. PQ7797.B635 A7 1957

This Volume is divided into four parts and mainly explores percussive sounds and rhythmic gestures, using all three backlights without their linear waveforms and both bars of light. For this Volume, performers grab a sensor in each hand and quickly pass them over the backlight to produce bursts and pulses, which are processed by the computer and turned into bell like sounds. The tail of these sounds glides slightly up or down.

In the first section, one bar of light subdivides the tempo using click-sounds and the other one adds a sub low single beat with a long tail every time the structure halts and resumes. Over this subdivision, the rest of the short percussive sounds occur displaying a varied timbral palette of registers, pitches and articulations. After one of this halts, the computer records the last gesture and loops it in an irregular way while the bars of light produce regular low registered subdivisions of the main tempo with shifting brightness. A very brief silence introduces the third section: a smooth texture of subtly gliding pitches where all performers use both sensors at once quickly and constantly passing them over the backlight to create a continuous signal and the computer generates the ascending or descending

[75] For a description of how such gestures were synchronized please see section 4.3.9. Rehearsing LA BIBLIOTECA CIEGA, later in this chapter.

curves in pitch. Imbricated to this section appears the fourth and last part of this Volume, dominated exclusively by the bars of light which produce regular beats at various speeds modified through a midi controller. A polyrhythmic texture emerges from the interplay of the two bars of light until all sounds get carried higher in the register and only a crackling texture is left with the aid of a turntable has been added. Over this sound, the last Volume will start.

4.3.6. Vol. 3. PQ7797.B635 Z918 1986

The final Volume is basically a fairly static structure built upon the accumulation of resonating grains that lingers on with minimal changes creating a state of reverie. The setup uses the three backlights with their linear waveforms on top of them, plus four turntables, two of them played by the same performer at once. A major second motif is built between two of the turntables and picked up by the computer that uses it to generate a background texture overlapping layers of both sounds at the same time. The texture grows in its spectral range and extra layers with similar timbres are added or replace existing ones, but the overall sound remains pianissimo. This texture dissolves into the final gesture of the Volume (and the piece), elaborated with sounds resembling sleigh bells.

4.3.7. Spatialization and real time processes

The sound spatialization during the Photosensitive Volumes used the same Ambisonics array as in the first chapter but with a different approach. At this point in the beginning of chapter two, the space had changed since now four performers carrying small flashlights occupy its center. Although barely lit, the scene is quite different from the previous 20 minutes and the devices, a 3-meter long original table from the former reading room and 4 silhouettes can be guessed in the darkness. Because of this, the sounds produced by the instruments were located in the Ambisonics sphere at fixed locations and only very few sounds described any movements. Hence, the idea of the instruments as point sources was reinforced, generating a stronger link to the musicians performing them as well. A balanced distribution of the materials in the Ambisonics sphere was designed and maintained, for the most part, throughout the three Volumes.

On the other hand, the real time processes and modulations set up in SuperCollider were far more dynamic and continuously changing. All analog signals generated by the photosensitive devices were routed into the computer for further processing. A digital framework written in SuperCollider would receive these signals and transform them to various degrees, sometimes simply applying postproduction processes, and sometimes transforming radically the original signal. Most of the signal-processing happening inside SC included dynamic control of their parameters through midi controllers operated live. This allowed for great flexibility during the performance, which alternated moments of great precision with others where improvisatory techniques were used. Any parameter from any sound could be modified using the UC-33 midi controller, which also triggered pre-designed and random curves for timbral transformation and only occasionally, spatial trajectories or the reassignment of fixed points in space.

The digital architecture inside SC created a series of digital inputs at the head of group 0 that would receive the analog signals through the sound card's physical inputs and send them to virtual busses. In group 1, a series of different objects would pick the signals from the virtual busses and process them, sending their output to a B Format encoding synth. This synth would take the processed mono signal and create an Ambisonics 4-channel signal with a specific spatial location or trajectory along the 3D sphere. All Ambisonics signals generated at the end of each process would then be sent to a 4-channel virtual bus, where one synth, at the tail of group 0, would receive and decode them into eight distinct signals, sent to the physical outputs of the sound card, to be distributed through the eight speakers available at the performance space. The hierarchy of this architecture permitted various synths to take the same (or any other) incoming mono signal and process it in parallel, in an orderly manner.

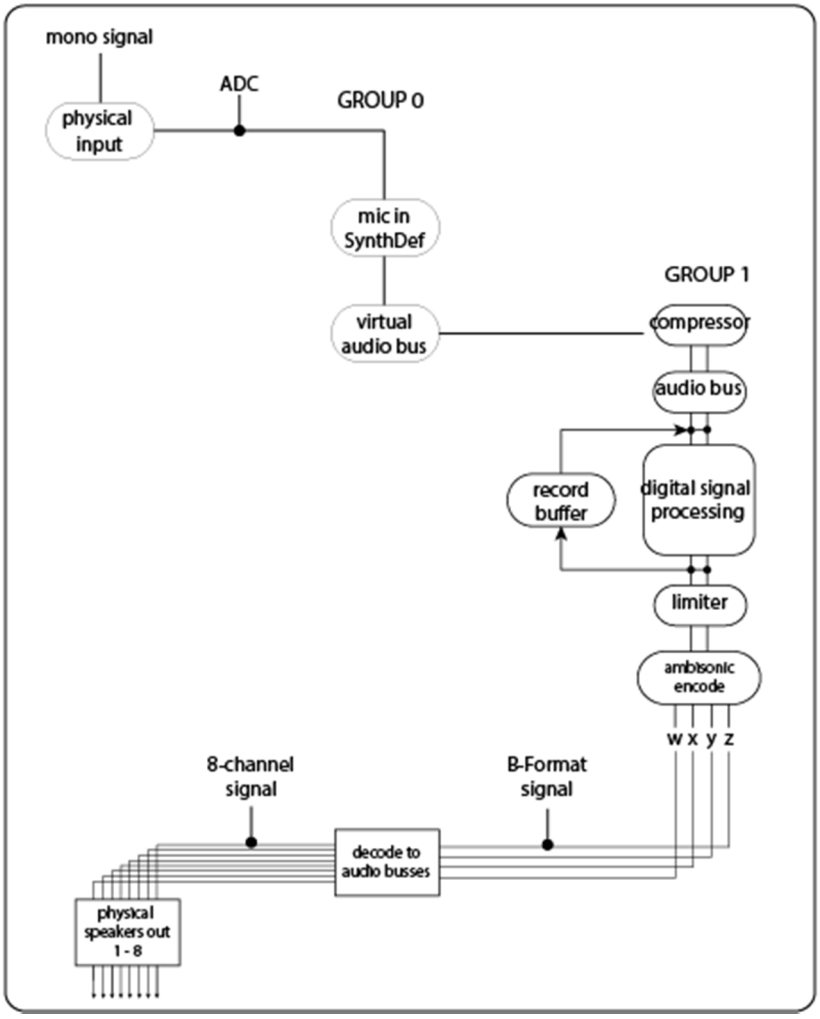

Figure 49 Diagram of the node tree of processes in SuperCollider.

All the final code used during performance was wrapped within the ProcMod library (Processing Modules), a specially designed set of tools by Joshua Parmenter for live performances. This library is extremely helpful when organizing a series of processes in time, making it very easy to prepare and trigger these processes. Once the order and quantity of processes is decided, an event score wraps everything up in a consecutive series of steps; then is only a matter of triggering (in this case with the computer spacebar) the next process.

4.3.8. The body: performance vs ergonomics

Already in the early stages of their design, it was decided that these devices were not going to be automata but need the human presence to produce sound instead. In this sense, each instrument proposes a different way of interacting with the body of the performers that emerges out of their specific forms, dimensions, electronics and mechanisms for sound production.

Figure 50 Detail of a turntable in action (PH: Daniel Trama)

In the case of the turntables, the hand crank and the disc are almost a meter away from each other. This produces a posture of the arms and hands that is a bit similar to the one needed to play the piano, except the performer is standing and the arms are kept mostly at steady distance (that separating the hand crank and the disc) from each other. While one hand moves in circles (in any direction) to activate the hand crank, the other hand goes up and down getting the light closer or farther away from the disc, regulating the intensity of the sound. During various moments of the piece, the performers were required to play two turntables at once. To do so, the lights were clamped on a small metal

salient attached to the base of the instruments specifically placed for that purpose so they could use both hands to move each hand crank. With the lights fixed at a certain distance from the disc, sound intensity would not change, but more sounds could be played at the same time increasing the vertical density. This also produces a different body gesture, as both hands are moving in circles and the performer needs to stretch quite a bit to reach both turntables at the same time.

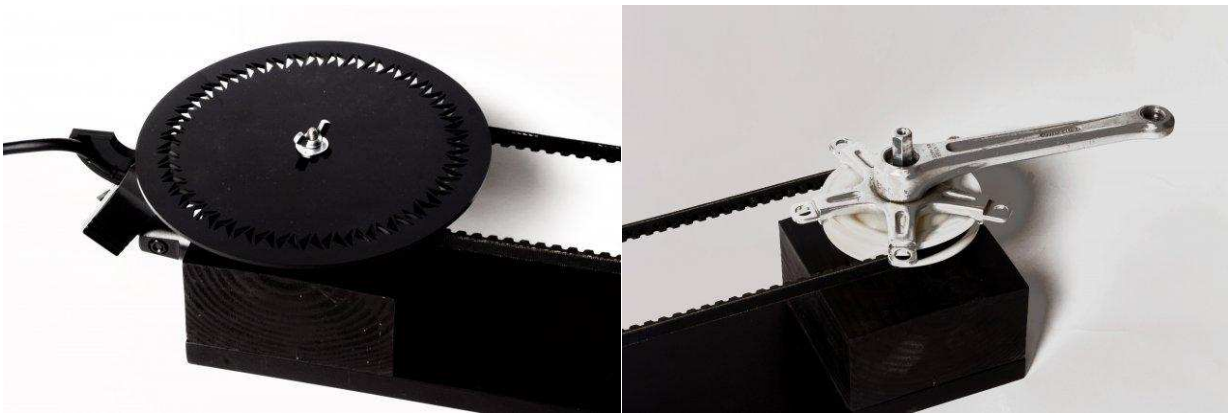

Figure 51 Deatil of a mounted disc and a hand crank on a turntable (PH: Daniel Trama)

The backlights are one meter wide and allow two different ways of playing them. One of them is with the linear waveform on top of it. In this case, the performer holds a light sensor in each hand and passes them over the waveform, back and forth, and thus playing it linearly or backwards. The resulting gestures is a movement along the surface of the device, like a linear sweep following the object's form but without touching it, that can be done at different distances – controlling in that way the dynamics of the sound – and with both sensors at the same time. The other performance possibility is to use the backlight without the cutout on top of it, which leaves a wide and even surface of light. In this mode of operation, the performers quickly pass the sensors across this surface producing short bursts or percussive sounds. Once again, both sensors can be used and rhythmic gestures can be easily created.

Figure 52 One sensor with the case for the electronic circuit (PH: Daniel Trama)

4.3.9. Rehearsing and Performing La Biblioteca Ciega

To perform these Volumes, I called members of the Banda Sinfónica de Ciegos. This orchestra of blind musicians founded in 1947 is currently integrated by 69 musicians and has a repertoire of over 250 compositions, including works by Gershwin, Piazzolla, Debussy, Holst and Troilo among others.[76] Interestingly enough, their rehearsal space is at the former Library, which currently hosts the Centro Nacional de La Música.

The performers that took part of LA BIBLIOTECA CIEGA did not have previous experience performing contemporary or electroacoustic music, nor were part of any sound art project before this experience. Cristian Alderete plays the trombone in the Banda, and has a group where he sings, plays the guitar and composes songs in the argentine folk tradition. Marcela Chavez plays alto sax in the Band and studied theatre for many years. Javier Cabanellas plays tenor sax in the Band, and is a more jazz oriented

[76] http://www.cultura.gob.ar/elencos/banda-sinfonica-nacional-de-ciegos-pascual-grisolia/

musician. Despite he had never performed contemporary music before, he was aware and appreciative of contemporary music composers and their works. All this offered quite an interesting background to work with and their full commitment and sensibility to the project improved the piece in many and unexpected ways.

The rehearsal process proved to be challenging and entailed a series of unusual decisions. Because the custom-made instruments use light to generate sound, it was impossible to rehearse in normal lighting conditions. The light sensors embedded in the instruments would react to any natural or artificial light, creating unexpected and undesired sounds. In order to work in the best possible setting, we decided to rehearse in a completely darkened room where light (or the lack of it) could be controlled. In this way, we managed to create a controlled environment where the only lights in the room were the ones used by the performers to produce sound. Another challenge posed by the piece was how to synchronize a common gesture during the live performance. As part of my research, I had the chance to be present during several rehearsals of the Banda Sinfónica de Ciegos where the conductor would use a set of sounds (breathing, whispers, slap mouth noises or soft hits with the baton) to communicate with the performers while they were playing. Since blind orchestral musicians are particularly trained to learn their parts by heart, we ended up memorizing most of the piece's actions, sections and changes. But there are few situations in the piece where accurate synchronization is needed between all the performers. To accommodate this need, we developed a couple of strategies to achieve such precise gestures. For example, in the beginning of the piece, we have to synchronize a series of rather long gestures created with the turntables. We had to start all together, make the discs spin at a relatively common and steady speed and stop all four of us at the same time. For this event, we used a slightly sonorous deep breath to signal the beat before the beginning of the action (anacrusa), and then mentally recited the first verse of Borges' *Poem of the Gifts*[77] (at a previously agreed speed) to determine the length, tempo and end of the action. Another situation that happens later in the piece requires once again that all the performers stop at the same time, hold a pause for a few seconds and resume their playing also at the same time. In this case, we relied on the more traditional deep breath

[77] This verse is quoted in the beginning of this chapter.

on the previous beat. As a final example, we also used different musical cues throughout several moments of the piece to mark the entry or the end of one or various sounds, to trigger the beginning of a certain gesture or set of interactions, to change discs on a turntable or switch between instruments, lights and sensors. There was not a sole conductor; instead we would share this role depending on the context and section of the piece. For instance, in the initial synchronized gesture described above, each one of us would alternatively cue with a quick breath the beginning of each new the gesture.

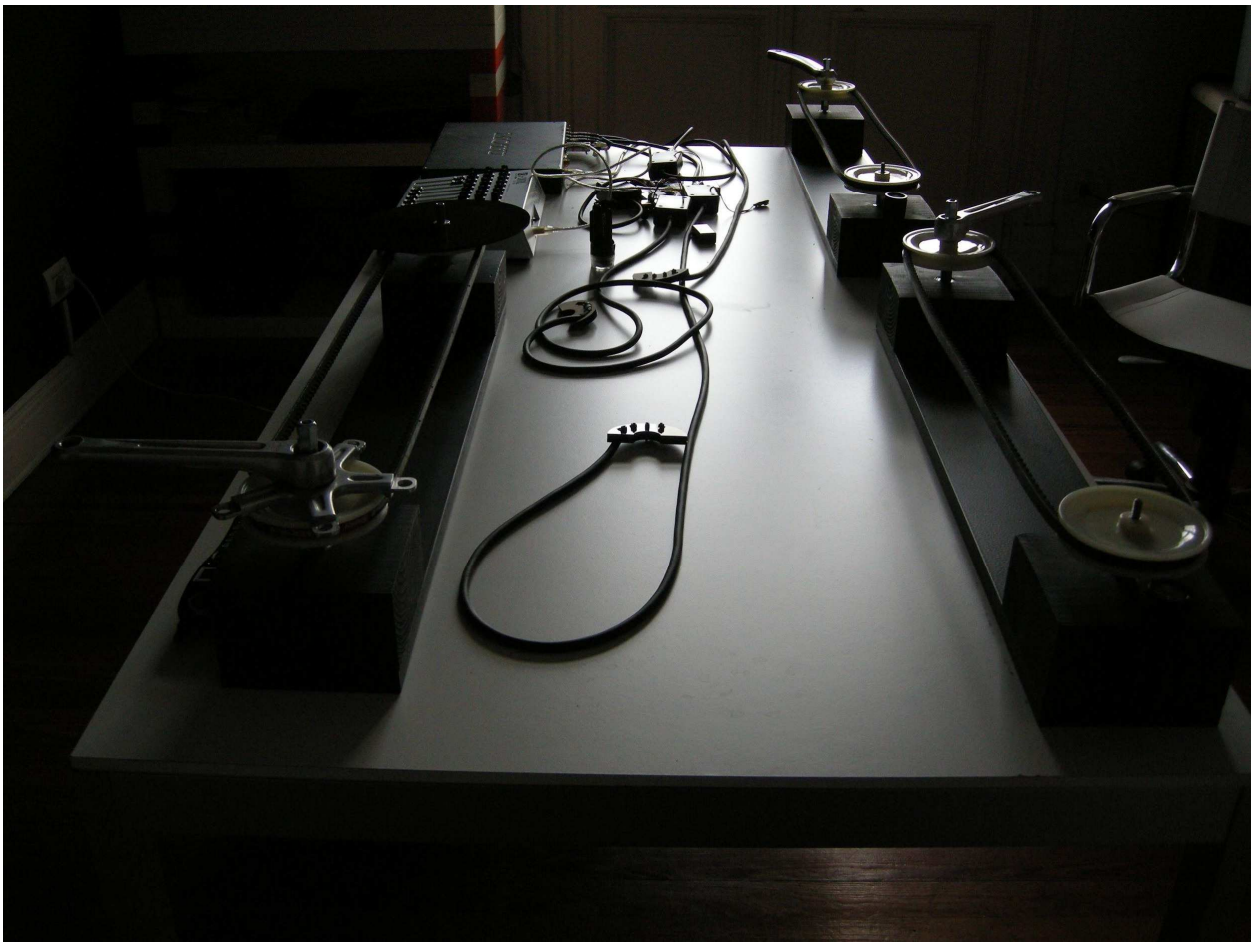

Figure 53 A halt during rehearsals

These strategies remind us once again of Haas's 3rd string quartet mentioned earlier in this chapter. This quartet has a fixed number of sections that can be played in any order, and not even all of them have to be played necessarily. The musicians use certain gestures and motifs to lure the rest of the performers into playing a particular section of the piece, guiding themselves exclusively through the

own piece's sound material. As a series of cues, each performer decides which section should be played next and tries to convince the other by playing the first motifs or bars of it. For a moment right before each new section, it is uncertain what will happen next in the piece. But once a section is finally picked, it will be performed in a precise manner. Hence, the form, length and sections of the piece change with every performance. LA BIBLIOTECA CIEGA has a fixed order for the sections, but due to the nature of the rehearsal process where improvisation was an important part of the generation of materials and interactions, the length of the piece may vary as performers can decide whether to linger on particular passages of each section and to extend the transitions between them.

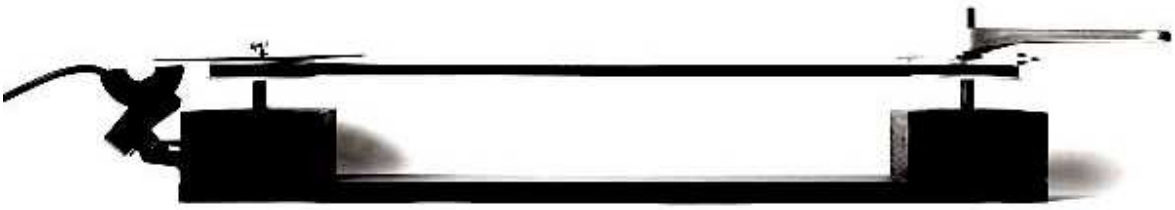

Figure 54 Side view of an optical turntable (PH: Daniel Trama)

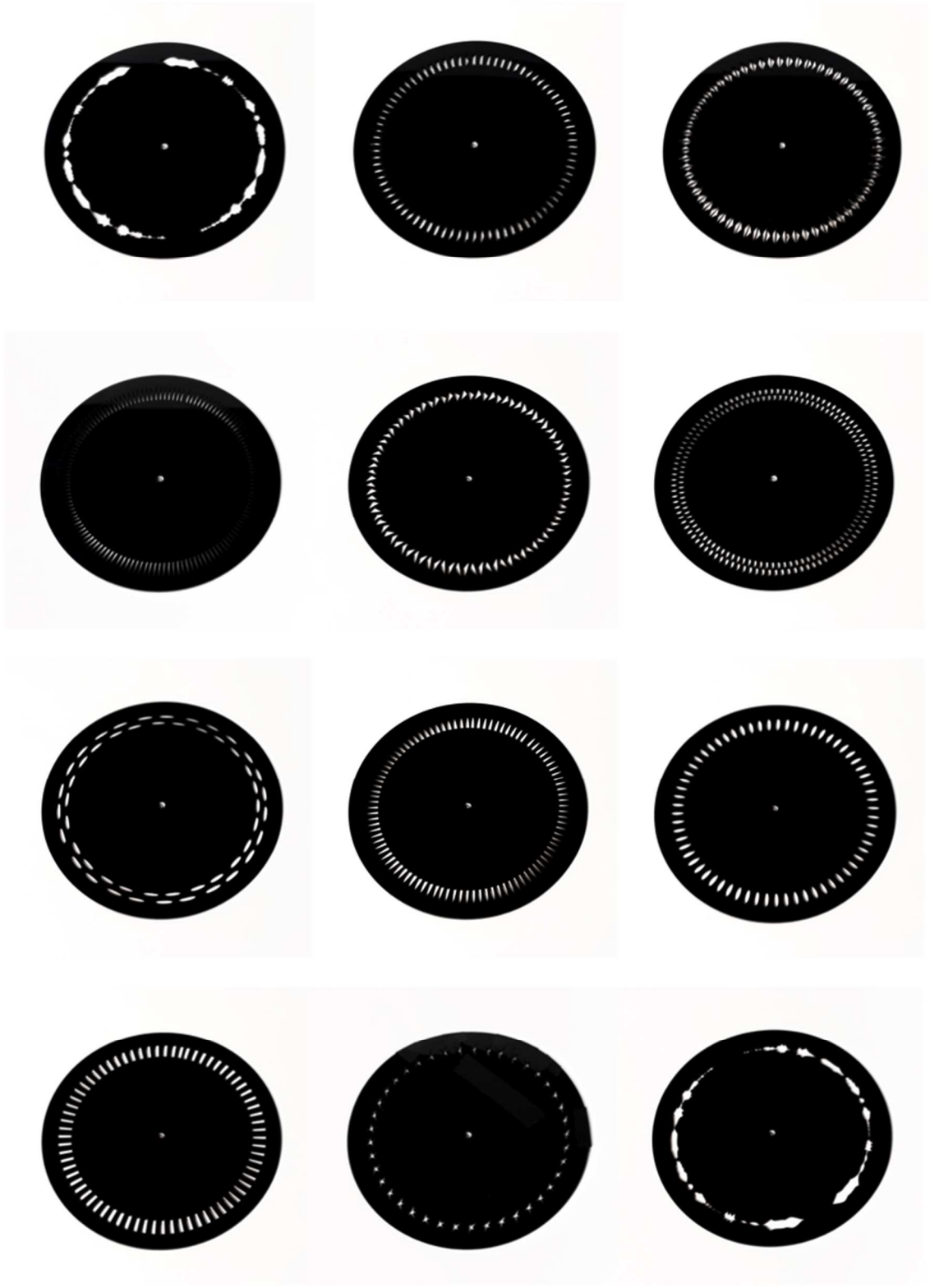

Figure 55 Various discs for the optical turntables (PH: Daniel Trama)

Rehearsing LA BIBLIOTECA CIEGA in complete darkness created a totally unfamiliar situation that took me to experience things a little bit in the way the other performers did daily. This helped me understand from a different perspective their working and creative process, and it also generated a deep bonding between us. In this way, the piece also opened a space for the exploration of new interactions and sensitivities. In this way, the piece also opened a space for the exploration of new interactions and sensitivities. Early on during the process of rehearsals, it became clear that a darkened room should also be the setting for the live performance. Although the technical issues that forced us to avoid any kind of lights – other than the small LEDs we used for sound generation – were minimized or solved a while before the day of the show, keeping the site of the performance as dark as possible was an opportunity to immerse the audience in the same sensorial conditions in which we worked the piece.

Chapter 5: FUTURE WORKS

5.1. Prix Ars Electronica

In 2013, LA BIBLIOTECA CIEGA was awarded an Honorary Mention in the Sound Art & Digital Musics category at Prix Ars Electronica, a yearly international new media competition in Linz, Austria. Since 1979, Ars Electronica has been bringing together artists in the field of electronic and interactive art, computer animation, digital culture and music, being one of the oldest festivals of such kind. The theme for 2013's edition was *Total Recall The Evolution of Memory*. It was described by its organizers as "an endeavor to elaborate on how we human beings deal with storing our memories, preserving them, and also, at times, trying to forget." The focus was set on three main areas: (neuro) scientific findings and insights about what memory actually is and what meaning it possesses for our consciousness and our identity; the various cultures of remembrance and the diverse storage media used in the past and the present; and future forms and methods of conserving memory. The jury considered that LA BIBLIOTECA CIEGA achieved "its powerful expressiveness" through an "emotive, theatrical, sight-specific and history-related performance."[78]

But as described in the previous chapter, LA BIBLIOTECA CIEGA can be thought of as the careful pairing of two different pieces. This allows for further developments of each of its parts separately. Since its premier, both parts had new instances of their own in several different contexts.

5.2. Future Photosensitive Volumes

New Photosensitive Volumes (IV-V-III bis) were composed and premiered in 2013 as part of ESCUCHAR Pequeño Festival de Arte Sonoro[79], a sound art series of performances at Museo de Arte Moderno de Buenos Aires (MAMBA). For these new pieces, the instrument set up was similar to the original with the addition of two extra bars of light and a small stroboscopic light. However, this time only one member

[78] Cyber Arts 2013. International Compendium - Prix Ars Electronica 2013. Hatje Cantz Verlag, Germany. In the original Cyber Arts catalog, the work is literally described as "sight-specific" instead of "site-specific". Whether it is a typo or not, it is certainly introduces an interesting idea in the context of the project.
[79] ESCUCHAR is curated by Leandro Frías and Jorge Haro. These new pieces were premiered during the opening of the new Auditorium at the Museum of Modern Art in Buenos Aires.

of Banda Sinfónica de Ciegos and myself were the performers, which generated a more active presence of the body since we had more devices and less people to perform them.

After working with these optical instruments for a while now, I believe there are still some potentially interesting ideas to elaborate a little further. The bars of light, for instance, generate sound after a light sensor captures their flickering patterns, which are controlled by a computer. Therefore, complex waveforms are generated *without* any other physical modulation, unlike what happens with the discs on the turntables and the linear acrylic sheets on the backlights which modulate the light that passes through their cut-outs before it is capture by the sensor. Thus, the computer enables the chance to work on these complex patterns through mathematical functions in various and extremely precise manners. Not only we have a exact control of the on and off patterns but the intensity of the light and its modulations, which offer the possibility to generate just about any automated series of sonic curves. Enlarging this set up by adding multiple computer-controlled devices can be the basis for an interesting installation piece. Also in a performance setting, this type of control on a large number of devices could create a compelling synesthetic environment.

Regarding the jump in scale, it would also be interesting to try a different light source instead of the LED lights and experiment with actual theatre lighting, like fresnels, pars, licos and even fluorescent lights. The visual impact could be much stronger and rather than optical sound could technology, perhaps other methods of controlling sound through light could be developed. For instance, taking advantage of the strong magnetic field this powerful lights produce, a series of sustained sound could be created, modulated by the intensity of the lights, which could also be controlled digitally.

Another fascinating possibility in terms of designing and building more devices is to work on one that could play numerous discs or waveform patterns at once to produce modulations such as AM, RM or FM. Early optical sound devices like the Variaphone could do this, but at the time, artists and engineers were only experimenting with additive synthesis. Sound artist Derek Holzer has been performing using a more casual set up including an overhead projector and transparent circular slides with printed waveforms, hooking them up directly to small motors and manually overexposing the slides onto the same sensor. This approach does not allow for specific control over gestures and timbres. It would be

quite interesting to create, for instance, a device for optical granular synthesis that could be fully programmable. Interestingly enough, in his 1946 seminal paper Theory of Communication, Dennis Gabor sets up the basic ideas for granular synthesis proposing an optical device as a mean to implement them. He made this "experimental frequency convertor", as he calls it, modifying a 16-mm sound-film projector, including specific windows for the envelope of each grain, and a slotted drum to work on the size and quantity of grains. Following up on this particular device, but bringing it into the digital space and object oriented coding paradigm, can likely lead to interesting sensorial and conceptual outcomes as it becomes a hybrid machine incorporating both new and obsolete technology in unexpected contexts.

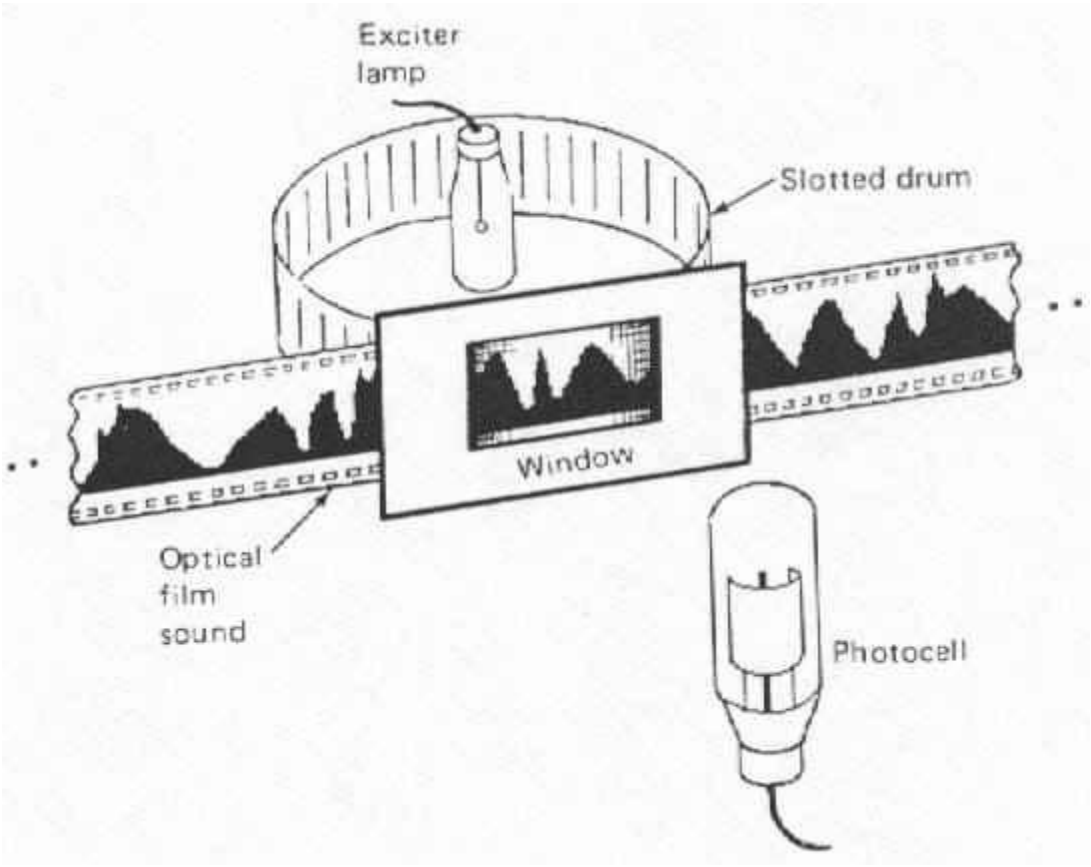

Figure 56 Frequency convertor with sound-film by Dennis Gabor.

Another final idea for a future development of the research regarding optical sound, is considering the possibility of working on the device built by Fernando Crudo to read sound printed on paper. Jorge Petrosino and his team at Universidad Nacional de Lanús have been researching on Crudo's

Fotoliptófono for many years now and restoring the sonic pages that are left and the device itself, which is fully functional at this point. Being able to use Crudo's device or parts of his design would open up many opportunities for artistic production. Moreover, if we think about how that device ended up being adopted by the National Archive as their main support for historical speeches, that is, becoming the official support for Argentina's oral memory, the chance for doing a project that synthesizes both chapters of LA BIBLIOTECA CIEGA in a single piece seems only logical.

Ultimately, going back to Borges' library to do both chapters together again but with different PHOTOSENSITIVE VOLUMES and new pieces from RESONANCES, TURBULENCES AND EXPLOSIONS would be a nice and interesting alternative version of the piece.

5.3. Future Resonances, Turbulences & Explosions

The series *Resonances, Turbulences & Explosions* had also a new impulse since the premiere of LA BIBLIOTECA CIEGA, due to a grant given by Fondo Nacional de las Artes in Argentina in 2013. This grant was awarded for the creation of three new pieces, /t/, /n/ and /a/. In 2014, /t/ and /n/ were premiered at CMMAS, Centro Mexicano para la Música y las Artes Sonoras, in Morelia, Mexico.[80] In 2014, these two pieces were also featured in the DXARTS Fall Concert that took place at Meanny Hall, University of Washington. The first three pieces of the series, featured in LA BIBLIOTECA CIEGA, were also part of the 2011 DXARTS Fall Concert, which happened roughly a month before the Argentine premier of the pieces as part of this doctoral project.

As an acoustic exploration of the alphabet, this series attempts to produce almost 30 3D sound pieces. So far, only 6 have been done in the course of nearly four years. At a constant rate of three pieces per year, it would take around 8 more years to complete the series. To accomplish such a task, it is imperative to keep getting funding opportunities and supports from institutions to continue and eventually conclude this ambitious large-scale project. Also, the persistence in time entails compelling challenges in relation to software development, media supports and personal artistic evolution. By the

[80] The concert was curated by argentine composer Pablo Di Liscia and featured only premieres by argentine composers. CMMAS is directed by mexican composer Rodrigo Sigal.

time the project is finished, not only we'll have an estimated of 3 hours of music, but a sonic history of how the idea of the piece changed over time and possibly reinvented itself.

Another interesting side development for these pieces is to produce partial releases in digital and physical formats. As new pieces are composed, the curatorial possibilities of the material expand. Eventually, the sum of all of them could make a durational performance, as well as a very interesting publication including all the pieces in various formats (stereo, UHJ, B-Format, etc.), a visual depiction of the alphabet using the spectrograms of all the phonemes used, information on the premiere dates and locations, etc.

Finally, I'd like to work on an installation piece that is a derivative of the same research but takes a completely different direction, and uses synthetic speech techniques. The idea is to research on the different accents within speakers of the same language, and on how accents from speakers of other languages transform a specific one. An accent is a sonic trace of cultural background, social belonging and geographical location. Pascal Quignard puts it quite bluntly:

> Nadie escucha su propia voz, que es un rostro. Nadie escucha su propio acento, que es un lugar. Nadie escucha la inflexión de su voz, que ofrece la tarjeta de presentación casi japonesa con el signo de pertenencia social al que apela por sus intenciones. Nadie escucha y todos obedecen a ese sonido, a ese acento, a esa inflexión que los guían.[81]

But an accent is also *a sound built collectively*. Just by listening to it, most people will recognize someone's origin, either if it is local –recognizing the accent of a specific state–, or foreign –recognizing by the accent the country of origin of a non-native speaker. The project would explore and reflect on the digital accent: do machines have an accent? Can they get, create or accidentally produce an accent? Among the various possible approaches to this idea, I imagine a particular one, at this point.

[81] "No one hears their own voice, which is a face. No one hears their own accent, which is a place. No one hears their own vocal inflections, which is the almost japanese personal card with the sign of their intended social class. No one hears but everyone obeys that sound, that accent, that inflection that guides them." Quignard, Pascal. Retórica Especulativa.

When building a synthetic voice out of real recordings of speech, the standard procedure is to make those recordings consistent in timbre, tone, intonations, etc. Meaning mainly that you want to record the same (native) speaker producing the same kind of speech for all the sample recordings. What would happen if we feed such system with inconsistent data? That is, sample recordings of various speakers, maybe with different accents and native languages themselves, intonations and timbres? In an installation version of this idea, a system would collect speech utterances from the audience and build over the length of the exhibition a collective voice out of all these contributions. The system could be designed to receive online contributions as well. The project will end up creating an enigmatic voice that'll be the digital expression of the specific body of contributors, different every time the piece is exhibited. Since intelligibility is not the goal of the system, but the creation of a digital accent, the development of this synthetic voice will ultimately become the construction of a timbre where sound and meaning are explored within the digital realm.

The research developed at DXARTS in general but for this dissertation project in particular will keep informing current and future works. It is interesting to note that this research will not only be useful for projects that can be considered direct derivatives from this dissertation, but also for projects that are more loosely related to it.

APPENDIX

LINKS

Draft Stereo Mixes of Resonances Turbulences & Explosions:
https://soundcloud.com/nvarchausky/sets/resonances-turbulences-explosions

Descriptive Short Video & Full live recording of Chapter Two: Photosensitive Volumes
http://prix2013.aec.at/prixwinner/8247/

Press
http://www.perfil.com/ediciones/2011/12/edicion_633/contenidos/noticia_0031.html

Awards
http://www.aec.at/press/files/2013/05/Prix-Ars-Electronica-2013_Winners_en.pdf

LA BIBLIOTECA CIEGA CREDITS

- Composition, instruments design and real time processing: Nicolás Varchausky.
- Photosensitive Instruments performed by: Cristian Alderete, Javier Cabanellas, Marcela Chavez.
- Live Sound: Daniel Hernández.
- Photosensitive Mechanic: Bruno Krauchik
- Consonants spoken by Meghan Trainor and recorded at DXARTS-UW (Seattle, WA, USA).
- Video documentation shot by Pablo Ziccarello.
- Video documentation edited by Caroline Neal.
- Photos of Instruments by Daniel Trama.
- With thanks to Cristian Alderete, Javier Cabanellas, Marcela Chavez, Marcos González, Maestro Cladera, José Luis Castiñeira de Dios, Tivon Rice, Meghan Trainor, DXARTS and the University of Washington, Archivo PAIS, Proyecto I+D S.A.E.T.A.S.-UNQ, James Hughes, Stelios Manousakis, Martin Jarmick, Pablo Di Liscia, CCME-UNQ, Teresa Riccardi.
- Sponsored by Yamaha Music Latin America S.A. Sucursal Argentina.
- Produced by Secretaría de Cultura de la Nación, Centro Nacional de la Música, Archivo P.A.I.S., Proyecto S.A.E.T.A.S. (UNQ), DXARTS (University of Washington).

SPATIAL LAYOUT

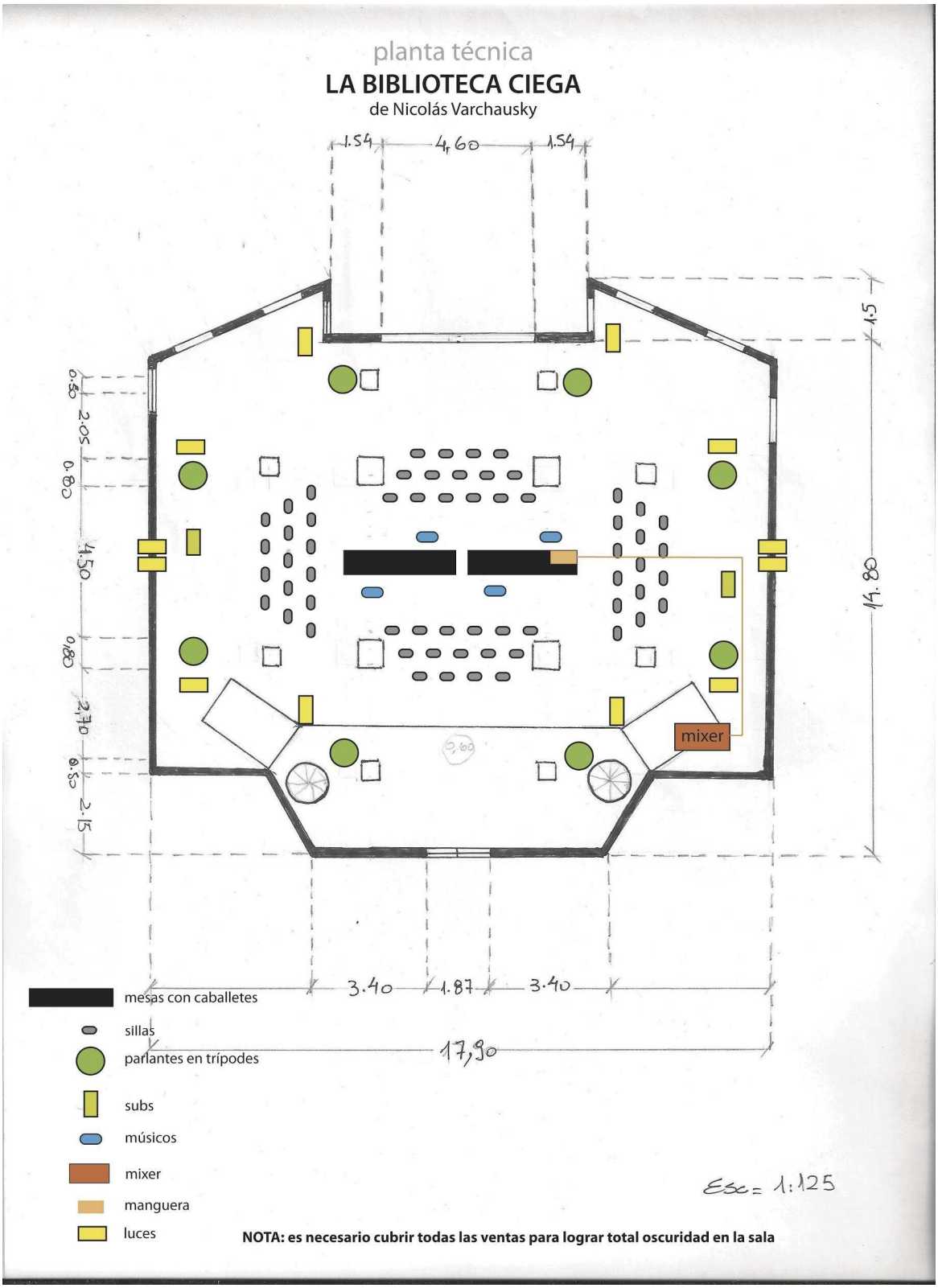

Figure 57 Floor plan for LA BIBLIOTECA CIEGA

EXTRA VISUAL DOCUMENTATION

PROTOTYPES

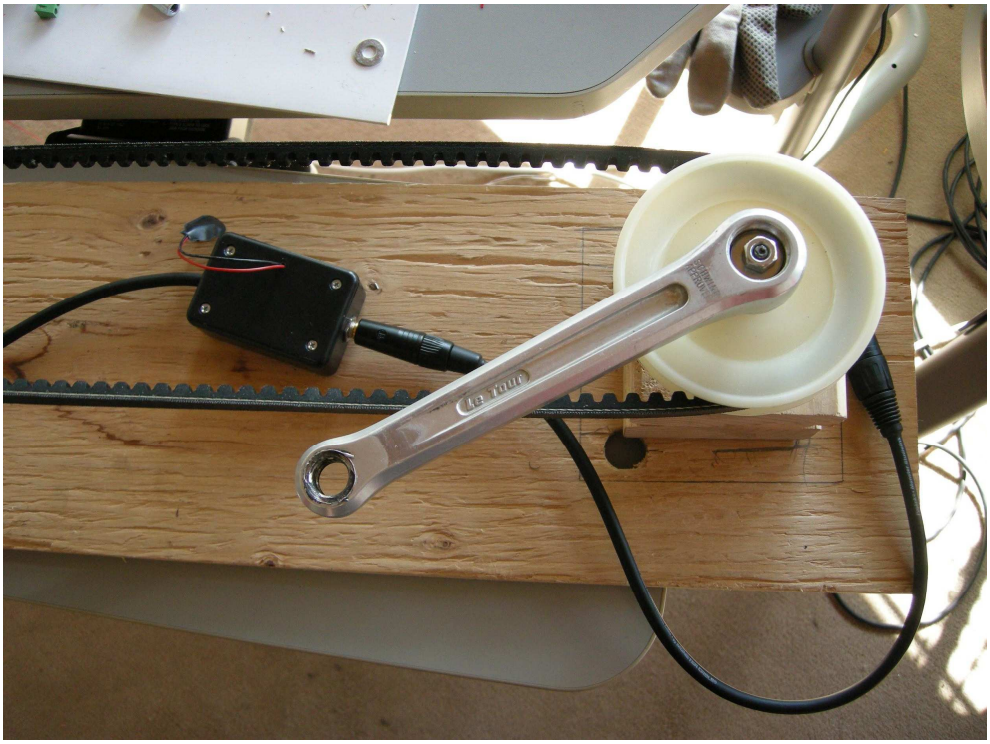

Figure 58 Detail of the hand crank from a prototype turntable.

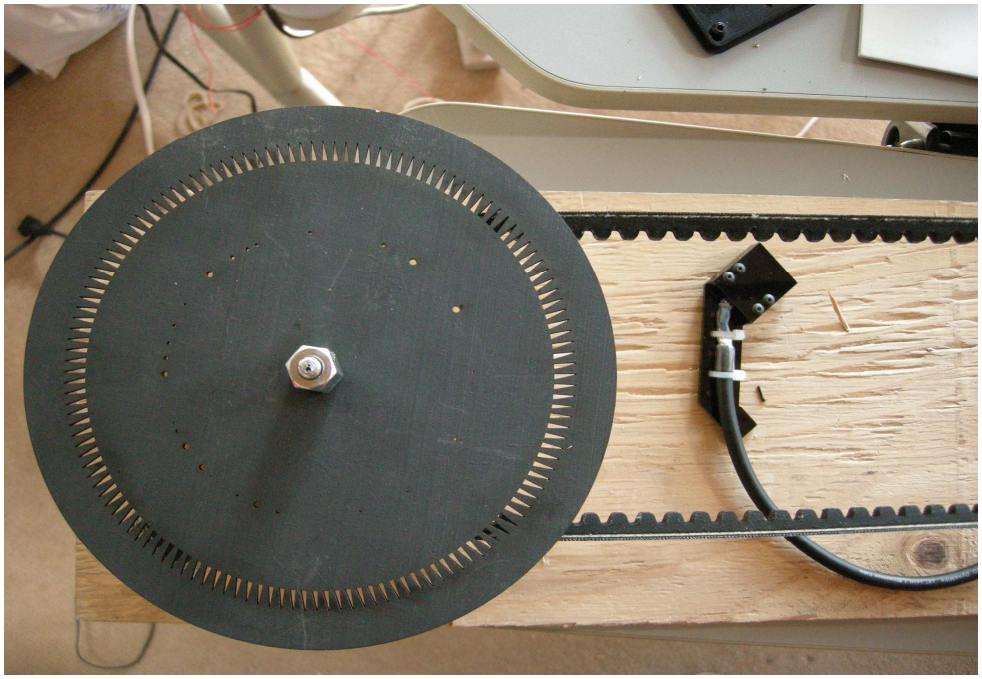

Figure 59 Deatil of a disc mounted on a prototype turntable.

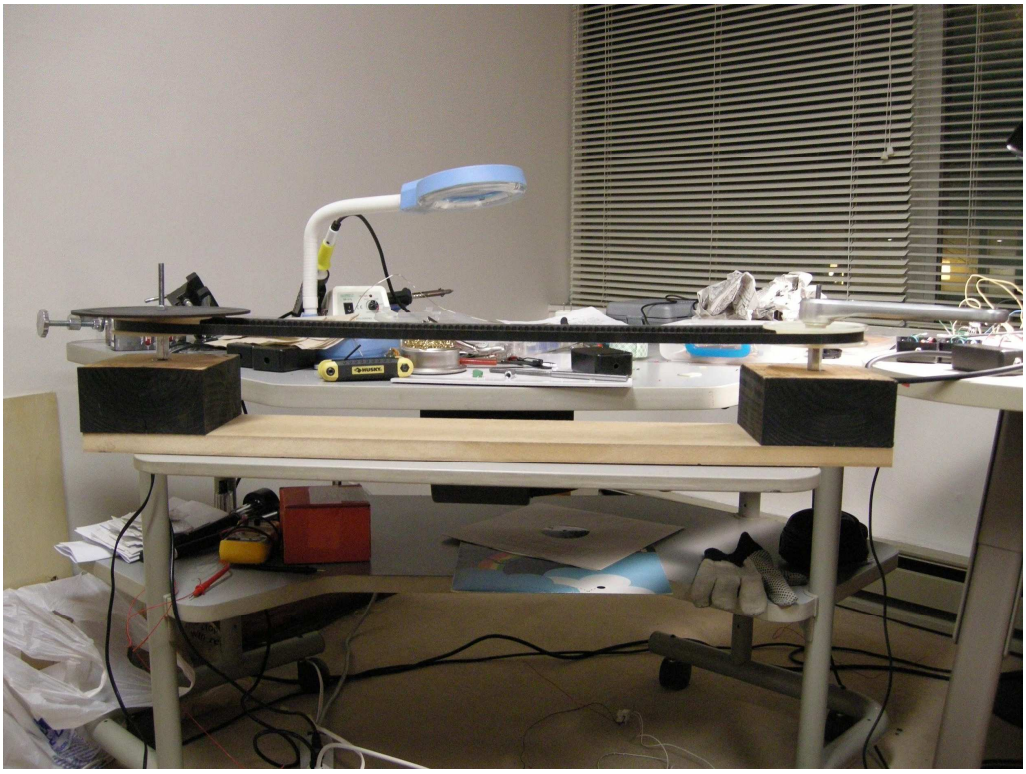

Figure 60 Side view of a prototype turntable.

CONSTRUCTION

Figure 61 Rhino setup and laser cutter.

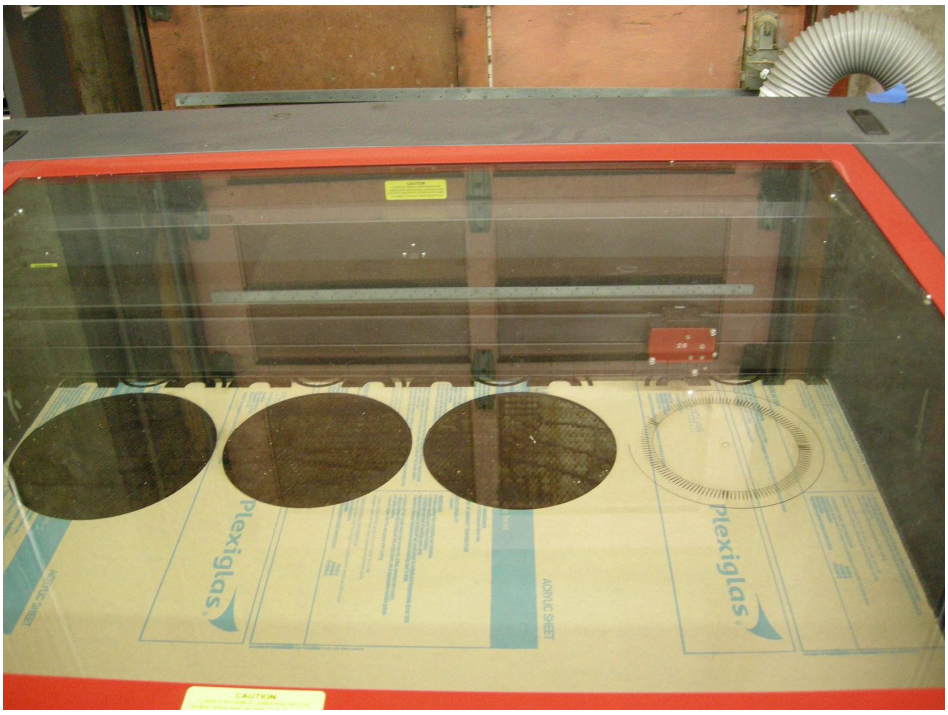

Figure 62 Cutting the discs with the laser cutter.

REHEARSALS

Figure 63 First rehearsal setup.

Figure 64 Marcela and Cristian trying out the instruments for the first time.

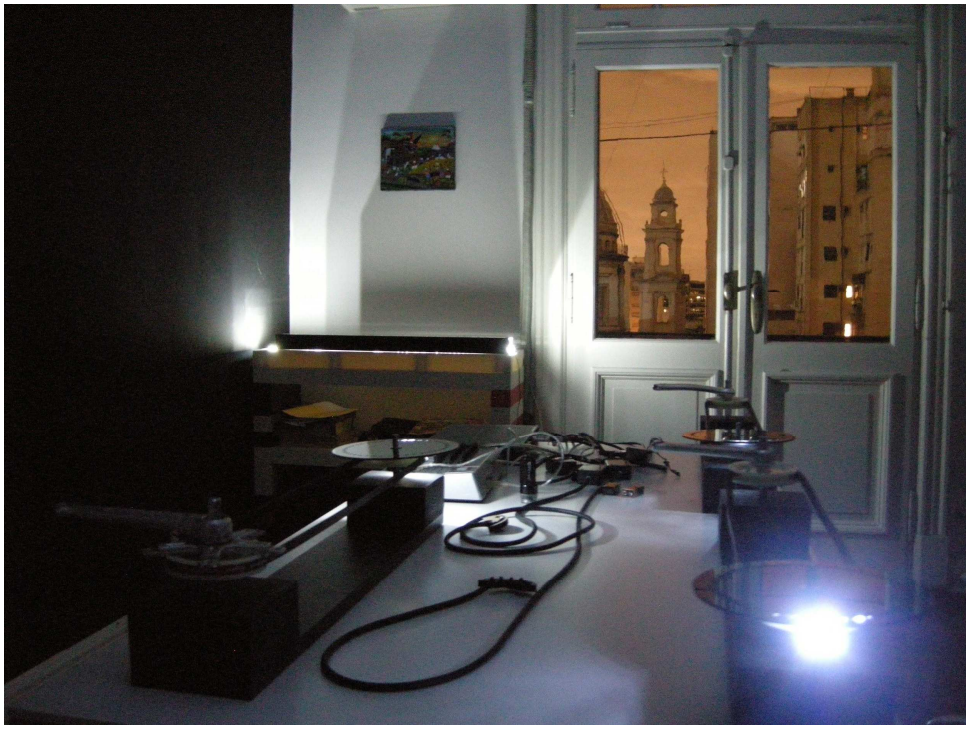

Figure 65 View of the rehearsal space at night.

Figure 66 View of a backlight in the rehearsal space.

LIVE

Figure 67 Performing LA BIBLIOTECA CIEGA.

WAVEFORMS

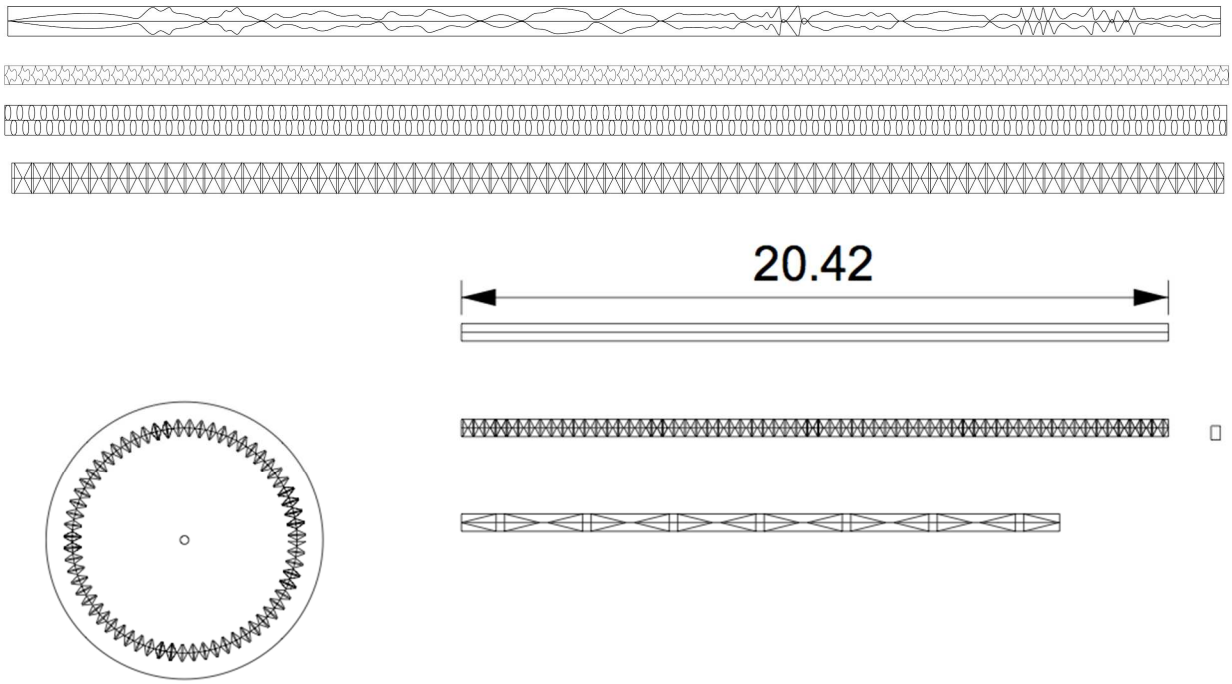

Figure 68 Designing the waveforms in Rhino.

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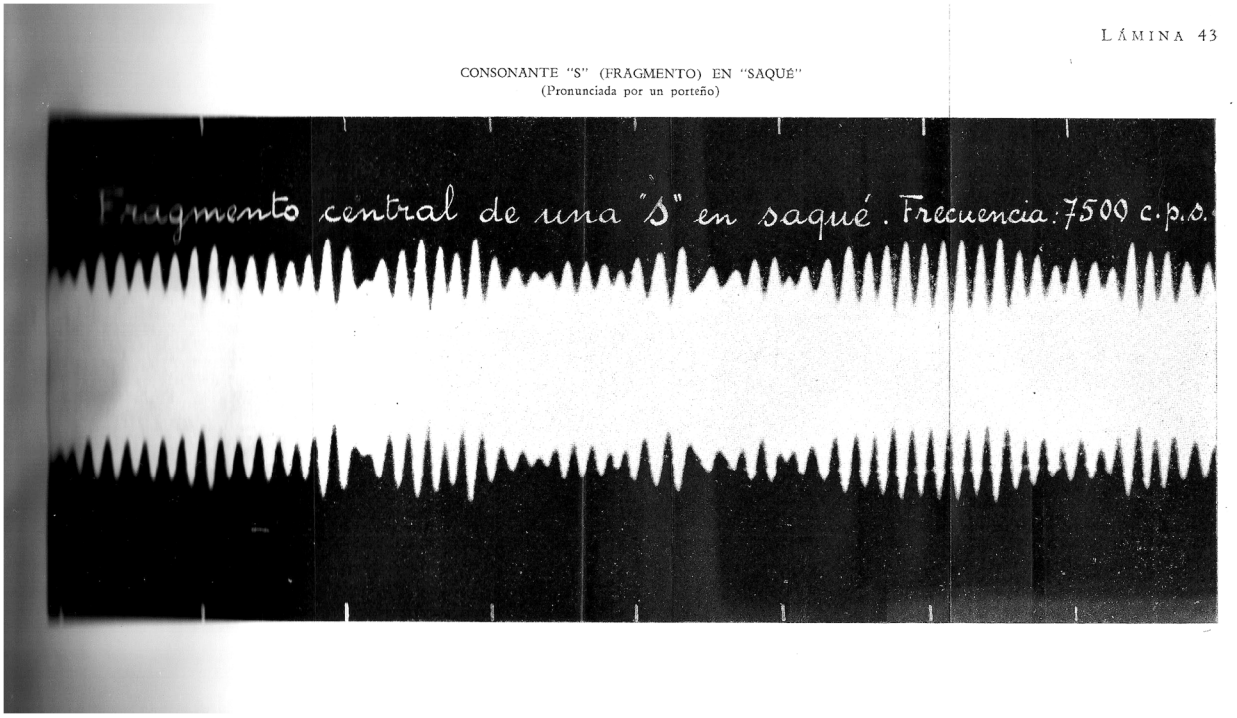

Figure 69 Central fragment of the phoneme /S/ in "Saqué", from "Problemas de Fonética Experimental".

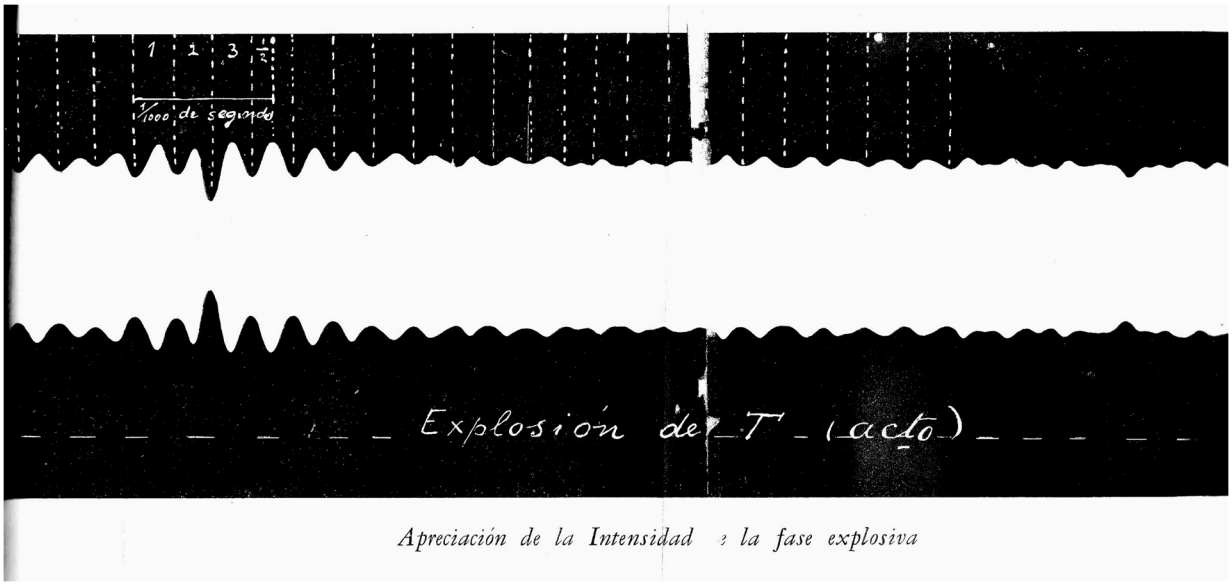

Figure 70 Explosion part of the phoneme /t/, from "Problemas de Fonética Experimental".

CONCERT PROGRAM

Figure 71 Front view of the concert program with information in braille.

LA BIBLIOTECA CIEGA *es una obra comisionada para la antigua sala de lectura de la ex Biblioteca Nacional y está compuesta en dos capítulos:*
1. Resonancias, Turbulencias y Explosiones y 2. Volúmenes Foto-Sensibles I-III.
En el primero, se presentan en total oscuridad y sonido envolvente tres piezas electrónicas realizadas cada una a partir de la grabación de una consonante diferente. Estas grabaciones fueron analizadas y re-sintetizadas revelando a través de procesos algorítimicos el paisaje interior latente en cada una de ellas.
En el segundo, miembros de la Banda Sinfónica de Ciegos manipulan en vivo una serie de instrumentos que transforman luz en sonido. Tocadiscos mecánicos foto-sensibles, backlights sonoros y barras de luz serán expandidos en tiempo real por una computadora y utilizados para crear tres piezas performáticas.

Instrumentos foto-sensibles:
CRISTIAN ALDERETE JAVIER CABANELLAS MARCELA CHAVEZ

Composición, electrónica en vivo y diseño de instrumentos:
NICOLÁS VARCHAUSKY

Diseño de Sonido:
Daniel Hernández

ARCHIVO PAIS
PROYECTO S.A.E.T.A.S. [UNQ]

Secretaría de Cultura Presidencia de la Nación

YAMAHA

Universidad Nacional de Quilmes

D:ARTS
Center for Digital Arts and Experimental Media
University of Washington

Figure 72 Rear view of the program for LA BIBLIOTECA CIEGA.

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VITA

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