Urban Sound Design projects in Colombia. Exploring portability and the passerby sonic interaction.

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Abstract. The design of sonic interfaces intended to the urban environment has been showing new conceptual directions and creative forms. While recent computer music literature reports powerful and easy-to-use locative media resources, some urban designers have proposed a theoretical basis for the urban listening experience. Moreover, some interaction design studies have been examining sound as the link between the user and his/her context. These resources have served as motivations to undertake interface design projects exploring portability and sonic user-interaction in the local urban territory. This paper will discuss three mobile sound design projects developed under a postdoctoral research carried out in the Design and Creation Program at Caldas University, in Manizales Colombia. The Smartphone Ensemble (2015), the AirQ Jacket (2016) and Lumina Nocte (2016) propose portable audio interfaces that seek to empower the local passerby with tools to explore the urban environment. After the projects have been introduced, I will discuss the creative processes around specific topics: the design methodology, the technological implementation and the sound design practice.

Keywords: audio portability, mobile media, locative media, sonification

1 Introduction

In The practice of everyday life Michel DeCerteau warned about the opposition between a city view from “up there” that is totalizing and allows “seeing the whole”, and another view from “down below” where live “the ordinary practitioners of the city” (Certeau, 1984: 93). Likewise, It could think that the urban environment is twofold. It has a physical layer and an electronic one. According to Lemus, the urban spaces have “informational territories”, “zones of control of emission and reception of digital information for individuals who are circulating in the public space...” (Lemos, 2007: 129). In this paper, I will discourse about how new technologies are transforming the urban experience by creating a virtual image of the city. In particular, portable audio devices extend the incoming auditory data flow. They connect users with an informational layer of the territory: the sonic dataset about the city that is complementary with the physical space.

In the first section I will argue that portable sound interfaces have become exploratory tools in the negotiation between the physical and informational layer of the city. It will be taken into account historical, social and technological aspects of audio portability. A set of theoretical and artistic works developed in the field of Sonology will be briefly discussed. In the second section I will review three the design projects that I have been developed with members of the University of Caldas Design and Creation program. The Smartphone Ensemble (2015), the AirQ Jacket (2016) and Lumina Nocte (2016) propose sonic interfaces that seek to empower the local passerby with tools to explore the urban environment. The challenges, principles and conceptual directions of each project will be raised.

I will discuss common methodological, technical and disciplinary aspects of the previously presented projects in the third section. Although the creation of interactive audio systems over portable platforms drives to particular design decisions for the interaction, the interface and the material, I will confront and contrast the three creative processes in order to discuss procedures, techniques, tools and our interpretation of some sound design definitions. The last section will briefly discuss current technical activities of our urban sound design laboratory.

2 Audio interfaces and the urban experience

It is almost a commonplace to assert that the ubiquity of speaker systems gave rise to a new social role to sound. After World War II, sound media opened up a place in modern everyday life [Taylor,
2001: 72) and today they became essential commodities. Within this complex cultural phenomenon, I would like to draw attention to the early advent of portability as a regular feature in audio devices. It was in the 1950s and 1960s that transistors, magnetic recorders and electro-chemical cells established a technological convergence for a generation of audio gadgets: the walkie-talkie, the transistor radio, the megaphone, the portable audio recorder, the walkman, and then, the ipod and the smartphone. I wonder how audio portability transformed ways of perceiving, inhabiting and traveling around the city, particularly, I would like to reflect on the role of portable audio devices and interfaces in the transactions between the passer-by and her/his urban environment.

With regard to the exploration of the urban space, the interfaces that implement sound recording and playback capabilities have been extensively adopted. Sound recording media provide a valuable document about the city. In this respect, It is worth mentioning that the opposition between direct listening where the sound source is present, and indirect listening where electroacoustic media are mediating, drove to the Pierre Schaeffer’s emblematic concept of Acousmatics (Schaeffer, 2003: 47). That concept inspired composers to create phonographic versions of the urban environment in the form of electroacoustic pieces (Ferrari, 1970). Furthermore, in his study about the soundscape, Murray Schafer developed the concept of schizophrenic listening to illustrate the need to split the sound from its origin, such as a consequence of the advent of sound recording technology (Schafer, 2013: 133). In another work (Arango, 2015) I have suggested that the portable recording media foster a sort of schizo-topic listening because they encourage the pedestrians to detach the spatial urban experience from a verifiable phonographic document. That is precisely what, from my point of view, the soundwalks can do better than other recording sound practices. They take advantage of portability to capture not just the soundscape, but also the subjective listening experience. The soundwalks are didactic exercises, tours with a defined path where the goal is listening and recording the sounding environment in order to later compare the experience with the phonogram (Westerkamp, 2007: 49). In contrast to other field recording practices where the microphone remains static, the soundwalk recordings provide a description of the acoustic environment that is inseparable from the listening subject. In their series “Walks” Janet Cardiff and Georges Bures Miller (Cardiff&Miller, 2012) have taken advantage of the liveness and the performativity that portability can provide to recording media in order to create fictional narratives of the urban environment.

Another creative form that has been showing directions in the design of audio interfaces is sound mapping. The rise of online communities (Arango, 2014: 66) has favored the creation of platforms where people can access and sometimes share field recordings arranged on interactive maps of the cities. Although there are some remarkable experimental proposals (Stanza, 2002), (Locus Sonus, 2007), the soundmaps have been dedicated to create an information layer of the urban territory, composed by phonograms suggesting a correspondence with the physical space. In the particular case of Colombian cities, the soundmaps have been focused on preserve the immaterial heritage, in this case, the acoustic one. They have recently launched some soundmaps dedicated to observe the acoustic changes undergone in the implementation of a public transportation system (Llorca&Franco, 2008), the evolution of the graphic industries in Cali (Llorca&Cueilar, 2013) and the spontaneous street vendors in the downtown of Medellin (Caraball&Durand, 2015).

However, the urban listening experience has also been examined from the outside of electroacoustic media studies. In their study, Augoyard and Torge (Augoyard&Torge, 2005: 21) adopt the concept of sonic effect in order to restore a conceptual framework of the urban listening experience. From these urban studies point of view, listening is a complex phenomenon that cannot be explained just from the Schaeffer’s sound object and Schafer’s soundscape theories. The whole picture of the urban listening analysis should take into consideration other fields of reference, such as physical and applied acoustics, architecture and urbanism, psychology and physiology of perception, sociology and everyday culture as well as textual and media expressions. In the same direction, Hellstrom suggests that since it is not possible to embrace all these various disciplines, the sound designer “… operates within her/his own specialized knowledge field; thus sound design presupposes a disciplinary context and demands an approach to knowledge that emanates from a certain discipline” (Hellstrom, 2003: 36).

Today devices equipped with long-term rechargeable batteries, Internet connection through 4g, WiFi and Bluetooth, GPS geo-referencing tools, sensors and touchscreens produce a new technological convergence for the design of portable audio devices and interfaces, whose prime representative is the smartphone. Musicians, artists and designers have been explored the digital convergence around
portability in a new repertoire of locative media projects. Pioneer pieces such as Golan Levin’s Dialtones – A Telesymphony - (Levin, 2001) or Radio Concert for 144 mobile phones (Rohm&Ligna, 2003) by German collective Ligna and composer Jens Rohm took advantage of basic audio features embedded in early mobile phone models (ringtones, alarms, notification sounds, radio) to create interactive musical experiences. Other artistic oriented-projects such as NetDérive by Petra Gemeinboeck and Atau Tanaka (Gemeinboeck&Tanaka, 2006) or game-oriented apps such as Zumbies, Run or Oterp use smartphones context-awareness properties to create musical compositions and sonic fictional narratives related to the urban experience.

3 Design and Creation of urban audio Interfaces

The projects reported in this section have been created under a two-years postdoctoral research study entitled Sound Design for Urban Spaces. The research focuses on the design process of novel audio devices exploring mobility, portability and location-aware resources, in order to enhance local passerby listening experience. The study is held by Caldas University of Caldas Design and Creation program, in Manizales (Colombia). In the “Laboratorio de Sonologia” we have conformed a group of designers, musicians and engineers with whom I have been developing design projects around a set of questions raised in the study, such as: ¿What is the role sound in the human occupation of urban spaces? ¿How does sound act in the two-way link between the city passer and his/her mobile computer?

3.1 The Smartphone Ensemble (2015)

The Smartphone Ensemble (SE) is a Manizales based group of musicians and designers leaded by Daniel Melán Giraldo and Julián Jaramillo Arango, exploring musical expressivity of mobile phones in urban contexts. Smartphones portability is taken as an opportunity to envision alternatives to the standard performance space, supporting the idea of a musical ensemble of non-traditional musical devices that travels while playing. SE public presentations intend to be urban interventions, not traditional concerts. In this regard, SE improvisation based performances are structured according to short and defined tours around a specific public place in Manizales (the university campus, a neighborhood, a park, a building, a shopping mall, a market). In this spirit, atypical places can become a suitable performance space for SE musical interventions.
Since additional amplification is required in (noisy) urban environments, we designed a wearable speaker system for SE outdoor interventions and rehearsals. The members wear a speaker band in each arm in order to handle stereo parameterization. The first SE performance was carried out in the Manizales Gotera park on November, 2015 within the “electronic picnic”, a regular event organized by governmental institutions Vivelab and Clusterlab. A reduced version of the ensemble with only four smartphone players made the performance. The group walked through the park following a trajectory while improvising over four different musical ideas. Along the intervention some curious spectators approached to SE members asking for available versions of the musical instrument apps in order to join the smartphone parade. It strongly suggests that we may include the audience as an active participant in future events.

3.2 The AirQ Jacket (2016)

The AirQ Jacket is a wearable device that displays temperature and air quality data through light and sound. The jacket reacts to environmental conditions and notifies them to its user in a symbolic mode. While an active volcanic region emanating toxic gases surrounds Manizales, air quality becomes an important issue in the city everyday life. In this respect, the project aim to create a meaningful context for the passerby in the interpretation of scientific data about the city. The AirQ jacket is the MA degree project of fashion designer Maria Paulina Gutierrez.

The AirQ Jacket invites the passerby to interact with the environment in a feedback loop mode. This criterion came from Sonic Interaction Design theories by Rocchesso et al (Rocchesso et al, 2008: 3969). They propose that in sonic interaction phenomena, humans get into a feedback loop, where user actions govern the sound, and reciprocally, when the user listens to this sound, new decisions are demanded to take more actions. Moreover, they suggest that, although this interaction model comes from musical performance, it can be fruitfully used to complete non-musical tasks.
Fig. 2. The first prototype of the AirQ Jacket, a wearable computing design project developed in the Universidad de Caldas, Design and Creation Program.

The AirQ jacket creation process also looked into the field of perceptualization (Barras & Vickers, 2011: 153), in this case, the mapping of scientific data to visual and auditory stimuli. On the one hand, temperature and air quality data are visualized by two arrays of colored LEDs attached to the upper and lower sides of the jacket. The circuit maps the information in a traditional symbolic way: blue-to-red to show temperature in the upper side, and green-to-red to show pollution in the lower side. On the other, the sonification system runs in a custom-made artifact attached to the jacket that was built with a piezo-electric device located inside a plastic cabinet that totally kills the sound, unless you approach the ear, such as telephonic equipment. Our sonification strategy demands an exploratory analysis process from the user and adopts a “reference” or contextual sound (Walker & Ness, 2011: 26). The user hears a couple of regular metronomic ticks. The first one displays the temperature data changing the pitch and lets hear the pollution data changing the velocity. The second tick acts as a grid of reference, it represents “normal” state. When the user compares the two ticks he/she can appreciate the environmental conditions.

3.3 Lumina Nocte (2016)

Lumina Nocte is a suggested trajectory by the Caldas University Campus guided by a smartphone application that triggers audio samples when the pedestrian reaches some GPS coordinates. More than an audio-guide, Lumina Nocte tells a horror story. Nine audio samples recreate old uses of the University buildings where a group of Catholic Church sisters directed a residential school for girls. The fictional narrative simulates terrific scenes the buildings might have witnessed. The work was developed during a seminar focused on interactive design, with students Vanessa Gañán, Hellen Zamudio y Carlos Zuluaga. Lumina Nocte deals with the perception of memory via the auditory channel, exploring sound as a link between affective activity and the urban structures. On this subject Augoyard and Torge (Augoyard & Torge, 2005: 21) provided an analysis with several nuances and shades about the psychological proprieties of sound. They propose sound effects we have explored, such as anamnesis, phonomnesis, asyndeton, synecdoche and perdition.

Fig. 3. The pathway of Lumina Nocte over the map of the Caldas University Campus.

Frauke Behrendt have discussed the design technique of associating samples or audio processes to GPS coordinates (Behrendt, 2015: 5). While recognizing several examples with multiple directions where geo-referenced audio has been used, she relates the practice of “placing sounds” to an Augmented Reality (AR) acoustic modality. The Lumina Nocte audience can only access the content when they are physically present in the geographic location, thereby walking becomes a mode of interaction, a sort of remixing. As Behrendt quotes, each passerby had his/her own listening experience depending on the decisions he/she makes in terms of direction, length of the walk, and time spent in specific locations (Behrendt, 2015: 17).
4 Discussion

The creation of portable audio interfaces has been raised some conceptual insights that I will discuss in this section separately in three topics. I will address some methodological directions from design studies we followed in the processes reporting the original sources, the phases of our procedure and its implementation. Later I describe how we implement a set of alternative technologies in a context of designers and musicians. The last topic is sound design practice that will be examined from the perspective of the authors that have been previously discussed.

4.1 Methodology

Methodology is an important contribution from Design Thinking (DT) to computer music and instrument building practices. In the academic context where the interfaces were created, following a defined methodology has been helpful to organize the creative process, allowing us to complete the projects in limited periods of time and capitalize the laboratory practices. While research methodology literature is relatively abundant in contemporary design studies, we have adopted two main resources from DT. On the one hand, we used the three-phase systematic design method (analysis-synthesis-evaluation) provided by Christopher Jones (Jones, 1984: 9), where each of the prefigured phases determines a defined task. On the other, we included some insights from the Alain Findeli’s project-based methodology, where the research process is leaded by a design project (Findeli, 2008: 67).

As a result of the interpretation of these two theories we created a particular four-phase methodology that was wholly accomplished by the smartphone ensemble and is being adopted in the AirQ Jacket project. In the case of Lumina Nocte some conceptual and technical resources corresponding the initial phases were previously given in order to develop the project in a shorter period of time. While the program members were not familiar with sound design topics, I decided to include a previous phase to the original Jones scheme denominated “information and research”. It is focused on the collecting of a set of related works. Moreover, the synthesis phase was completely redefined in order to test multiple portable audio solutions, which meant a complete immersion in technical aspects and laboratory activities. Thus, our methodology consisted of four phases: (1) information and research, where relevant data were gathered, (2) analysis, where user needs were observed and identified, (3) synthesis or laboratory, in which the solutions were proposed and (4) evaluation, where proposals were valued. Theoretically, these four stages should overlap themselves and create a whole process that is expected to be cyclic, since the evaluation phase may be able to provide substantial incomes to make improvements in phases 2 and 3.

In the current development of the projects, the three initial phases could be successfully accomplished. The projects found relevant references (phase 1) that allow narrowing the problem down (phase 2) and conducting experiments with portable audio resources (4). However, the innovative and experimental character of the projects leaves many questions unanswered respecting the evaluation phase. One of the difficulties we encountered is that many human-computer-interaction (HCI) evaluation methods are devoted to measure system performance and user satisfaction in graphical interfaces. Although evaluation is a growing topic in New-Interfaces-for-Musical-Expression (NIME) design, it is also true that multiple directions are simultaneously being taken (Barbosa et al, 2015: 156), thus we could not find a theoretical scenario with clear and shared rules to evaluate our portable audio interfaces. The way we face the evaluation of the smartphone applications with the ensemble was by returning to the analysis phase, where the concept of musical expressivity was addressed, delimited and simplified. Then we decided not to measure device performance or user satisfaction, but musical expressivity in smartphone devices. It was defined as the index of precision degree, action-response correspondence and visual feedback quality. There is no space here to discuss the particular results of our survey, but in the report (Arango&Melan, 2016: 63), it can be found an attempt to measure musical expressivity on different smartphone input methods such as the tilt sensors, the multi touch display and the microphone.

4.2 Technological implementation

The synthesis phase of our methodology was focused on performing experiments with portable audio resources. It was an opportunity to engage new computer music practitioners coming from design studies. Accordingly, one important challenge in the technological implementation was finding
available tools with which designers and musicians, with little experience in audio programming and electronic prototyping, could create portable applications. Since each one of the above-mentioned projects had its “problem” sufficiently bounded, the laboratory phase focused on three directions: the programming of virtual musical instruments on smartphones, the sonification of environmental sensor data and the association of sound samples to GPS coordinates. Technical training on Pure Data and Arduino has been a periodical activity in the creative processes. It has helped the students to get into the possibilities and limitations of portable technology and has allowed them to create functional prototypes for the urban space. University campus has been the test-field where the experiments, rehearsals and tests have taken place and where we have tried with different musical ideas, improvisation criteria, app sketches, collaborative setups, choreographic dispositions and walking trajectories.

With the SE we have create virtual musical instruments using libPd library (Brinkman et al, 2011), that allows sketching audio applications in the Pure Data Vanilla distribution and retrieving sensor data from the smartphone. We have designed custom-made apps implementing FM, wavetable and waveshape synthesis, bandpass filters and arpeggiators among other methods. The GUI device of the instruments was created with Daniel Iglesia’s MobMuPlat (Iglesia, 2013) that provides a series of standard input methods. We have also implemented Landini protocol (Narveson&Trueman, 2013: 309) to build interconnected setups among SE performers. Since other systems and procedures allow similar results (Bryan et al, 2010: 147) Pure Data and MobMuPlat ease of use was useful in the SE environment of musicians and designers.

With Pure Data and MobMuPlat were also made some sketches of an application that could link audio content to GPS coordinates. The initial idea was an electroacoustic composition that advanced according to a walking trajectory. Although a set of tests was relatively successful, the seminar in which Lumina Nocte was conceived was too short to implement Pure Data. Then we found the Sonic Maps application (Pecino&Climent, 2013: 315) with which we efficiently solved the task needed to complete the project. Sonic Maps app allows the user to link sound samples to zones in a map and later hear them in the physical territory. The app invites the user to create his/her own experience by uploading original sound samples to a public audio server.

For its part, Air Q Jacket adopted a completely different approach. As well as other wearable technology pieces, the AirQ Jacket gathered crafting from programing and electronic prototyping on the one hand, and from sewing and dressmaking on the other. In this respect the interchange between audio and fashion design approaches leded to a non-standard format: a wearable computer-jacket. The circuit uses the Arduino microcontroller (pro version), an MQ-135 air quality sensor, a DHT-11 temperature sensor, four arrays of leds and a piezo-electric device. As it was described, the arduino code connects the sensor inputs to an array of dimming leds, and to the rate and tone of a couple of loops that drive the piezo-electric device. Because of the weight and comfort, the pattern making process was carried out taken into account the distribution of the circuit components on different parts of the jacket: the Arduino microcontroller behind the neck, the battery in a back-pocket, the piezo-electric hanging by the right shoulder and the arrays of leds in the front. We attached the circuit components and cables in a way that they can be completely extracted in order to the jacket can be washable.

4.3 The Sound Design Practice

In this section I will discuss sound design definitions, contrasting recent insights from design theory with our projects. As I understand the portable audio interfaces we have developed in the laboratory belong to a more general practice of sound design. Accordingly, I will gather some ideas on this respect from authors that have been previously reviewed on this paper. While sound design is an emergent practice, there is not a shared consensus about its boundaries and limits. However, the fertile debate that is being carried out around that topic helps us to characterize the design practice we have embarked.

As it was mentioned before, from the urban design perspective Augoyard suggests that there are multiple fields of reference that support sound design. However, in the same spirit, Hellstrom claims for the need of a disciplinary context for the emergence of sound design, according to this author “…the sound designer needs a disciplinary prefix in order to specify her/his disciplinary abode: industrial
sound designer, architectural sound designer etc" (Hellstrom, 2003: 36). While the local passer-by is the main recipient or end-user of our research, I would say that "urban" is the prefix that firstly comes to mind when I look for an associated context. The prefix "portable", instead, outlines a mode of interaction that takes place “down below” (Certeau, 1984: 93), where sound acts as a direct link between the user and his/her environment.

On this basis, we can also consider the definition of Rocchesso et al, since they define Sonic Interaction Design as the “... practice and inquiry into any of various roles that sound may play in the interaction loop between users and artifacts, services, or environments” (Rocchesso et al, 2008: 3969). This proposition settles closer to our idea that portable audio interfaces connects the passerby with “informational territories” (Lemos, 2007: 129) allowing him to explore the urban physical space with a sonic road map. In addition to the previously commented definition, I would suggest that the designer could be able to create a correspondence between the virtual and physical layer of the city.

Finally, I would like to discuss Frauke Behrendt’s classification of mobile sound. The study proposes a framework with four different directions where the above-described projects can be located: musical instruments, sonified mobility, sound platforms and placed sound. The app prototypes developed for the Smarphone Ensemble would belong to the Behrendt musical instruments category. Since the mobile phone were not designed with a specific musical purpose, play an instrument with it could be considered a kind of “mis”-use; even more when the musical performance is being carried out in the public space. Lumina Nocte could also be considered in Behrendt taxonomy: in the placed sound category, “… artists or designers curate the distribution of sounds in (outdoor) spaces, often – but not exclusively – by using GPS” (Behrendt, 2015: 7). The AirQ Jacket could be an example of Behrendt notion of sonified mobility. This category comprises works “…where audience mobility is ‘driving’ or influencing the sound or music they hear while being on the move” (Behrendt, 2015: 6).

5 Future Work

Since one of the main goals in the design of portable audio interfaces is to establish a strong link between the physical space and the virtual one, in the last phase of the postdoctoral research we intend to create other devices that trigger interaction loops. Accordingly, the current activities in the “Laboratorio de Sonologia” have been oriented to two main directions: the implementation of online services and the design of collaborative audio applications. While the program members have been exposed to programming and electronic prototyping, it is expected that they continue working on this activities in a second stage of technical training. In this regard, we have been exploring other resources to be included in future projects.

On the one hand, we have been exploring different versions of the ESP-8266 Wi-Fi module. This tiny device provides a low-cost solution to prototype internet-of-things (IoT) applications. Because of its portability and availability, it can be embedded in mobile devices, accessories or wearable interfaces in order to automate Internet services connections. On the other, we have been creating multimedia and multimodal sketches on the Raspberry Pi. While the vanilla version of Pure Data, Processing and Arduino are supported on the Raspbian operating system; Raspberry Pi outlines more complex tasks for the portable computer in the creation of urban territory exploratory tools. We have tested different sound cards for the raspberry pi such as the Hi-Fi Berry and the Cirrus Logic Audio Card in order to consolidate a high-fi portable audio creation platform suitable for non-expert programmers.
Acknowledgments and Funding

This work is the result of a research funded by Departamento Administrativo de Ciencia, Tecnología e Innovación (COLCIENCIAS), Grant 656.

6 References


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