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Digital Humanities in the Historical Soundscape Research: Sound of 18th Century Naples

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ABSTRACT

The historical soundscape is a timely research topic and arouses interest in the fields like history, architectural acoustics and urban musicology. While the approaches in these disciplines are diversified in themselves, the latest phenomenon of digital humanities suggests more holistic attitudes to the subject. Can these novel digital methods help us to give a satisfying answer to the popular questions of sound history? How might the past have sounded, or is it possible to hear past sounds? This study tries to show that problems like lack of adequate historical evidence or poor quality of digital reconstructions are likely to be solved at a certain level with the advancing digital humanities technologies. A brief review of the available digital humanities methods that can be applied to the historic soundscape research is provided. It uses natural language processing, digital mapping, acoustic modelling, and extended reality techniques to trace the soundscape of 18th century Naples.

Keywords: historical soundscape, digital humanities, virtual acoustics

1. INTRODUCTION

This paper describes the steps of a digital reconstruction study on the historical soundscape of 18th century Naples. It is based on a series of digital humanities methods dedicated to each step of the reconstruction work and includes a sound source seeking game on an interactive 2D map to encourage users to experience the 3D spatial sound reproduction.

Since the advent of computational acoustic modelling techniques [1], it has been applied to historical buildings in architecture, and in a number of studies, their acoustic features have been the subject of study [2-5]. This resulted in raising awareness on the cultural value of acoustics of the historical spaces and led to the born of the "acoustic heritage" notion [6] unless it has been assessed as a part of "intangible" heritage in the current literature [7]. On the other hand, the developments in the last two decades in computation technology which is reflected in physically-based rendering and acoustic modelling approaches in the meantime, have provided the possibility to calculate dynamic acoustic scenarios. Contrary to former static calculation softwares, this novel approach of Virtual Acoustics, which can include multiple mobile sound sources and give the receiver the possibility of moving in 6DoF [8], opened new ways of working with acoustic heritage. Henceforth, not only the ceremonies held in sumptuous palaces, or the masses in parish churches, soundscapes of the public events or acoustics of urban squares can also be studied with the digital methods [9].

2. METHODOLOGY

Inherently, working with the historical soundscape and study of building acoustics differs on several accounts. Since the only way of hearing past sounds is passing from the reconstruction studies, digital recreation of historical soundscapes necessitates more grounded strategies. We embrace it in four main stages; acquiring historical data, sampling, auralization/reproduction and representation. This approach of historically informed soundscape, which was detailed in [10], can be applied to the several cases. All the steps can be accelerated by applying the latest digital humanities methods. Earlier applications of text analysis on historical data acquisition, 3D spatial sound design for auralization and virtual reality for representation were applied to the case of 18th century Naples in this study. The daily soundscape of Naples's historic centre was reconstructed on a 2D interactive map as a sound sources seeking game.

The flowchart, seen in Figure 1, was followed starting from a sample archive composed of a limited number of historical sources from/about the period. A summary of this application is presented in the following sections.

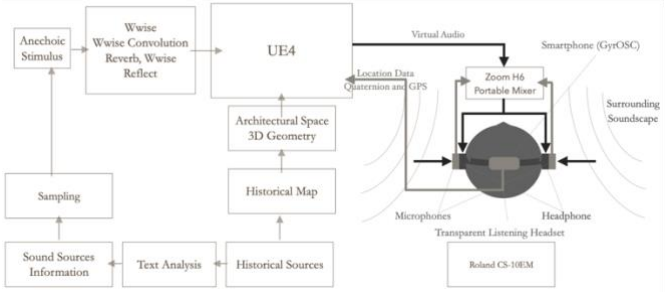

Figure 1. Application flowchart

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3. HISTORICAL SOUNDSCAPE RECONSTRUCTION

3.1 Historical Data Acquisition / Text Processing

Gathering evidence for historical soundscape has always been a complex and labouring process. The earwitness accounts have become one of the featured sources for historical soundscape studies over the years [11, p. 8]. The traveller accounts, diaries, guidebooks, royal, vice-regal diaries, ceremony records, notarial archives, music books, journals, and a few used the visual sources as well. Among this large number of archival sources, the difficulty and slow data acquisition are the humanities' common and major research challenges.

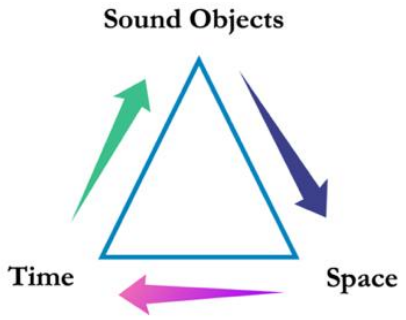

Figure 2. Historical Soundscape Elements

Historical soundscape data acquisition comprises three major parts; (1) Time, (2) Space and (3) Sound Object-Event. Three parts of this triangle seen in Figure 2 must be scrupulously scrutinized to lead reliable soundscape reconstructions. Linking the historical sources to crosscheck is of capital importance. In such cases, some interpretive steps can be taken as well. The information for the sampling and the architectural plans, sketches and images must be collected and then provided for the auralization process. Not just the type and properties of sound, the entire scenario of the sound event, artistic directives, guides, and instructions for the performances are also required for the voicing-sampling process [10,12].

This study's approach to historical soundscape suggests using text processing methods to determine sound sources of the case period. This way of investigating all historical records entails working with not only a straightforward case book or books; it requires extensive databases constituted by hundreds of books from several libraries and collections [13]. Only by this way can more reliable results be obtained by discovering interconnectedness of several sources, and only this way each part of the historical soundscape triangle (time, space and sound objects) can be discovered deservedly. Considering that creating such a database is out of this project's scope, the application was applied to a selection of historical records for 18th century Naples as a case study. Some of the primary visual sources were also analyzed with these textual sources. GATE, a Natural Language Processing (NLP) toolkit, is used for text analysis. It is an open-source toolkit for text processing and allows to write a simple keyword-based information retrieval application for historical soundscape instead of struggling with the major challenges in NLP like machine learning or natural language understanding. One of the most effective solutions for information extraction is to use keyword-based gazetteers by considering ontologies and helpful classifications. We took advantage of the source-oriented structure of historic soundscape research. We generated a gazetteer, a very basic and popular approach used to find the occurrences of entities such as cities, countries, geographic names of places, organizations, companies, through a list containing names of these entities. The application for historical soundscape research was prepared in GATE with its other ready-to-use components/processing resources oriented to complete different tasks at each phase of the analysis.

As a result of the application, some of the most cited sound sources were determined. As expected and in line with the analysis on visual sources, vendors, horse carriages, horses, and dogs are shown up as most mentioned urban sound sources in textual sources too (see. Figure 3).

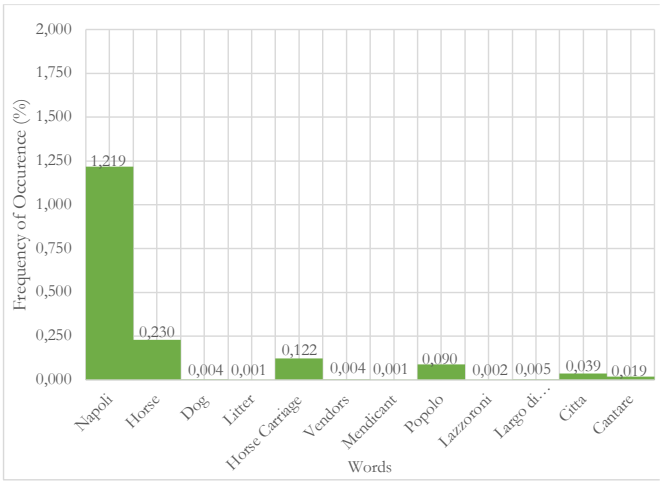

Figure 3. Frequency of word occurrences analysis for some of the soundscape elements

The analysis here was focused on the sound sources of the entire period instead of a more detailed focus which could have been place and time specific. But that analysis was left to the future works. Besides, even it is not mentioned in this short paper, the sampling process, especially recording human sounds of the period, is of significant importance for having authentic sound reproductions. We had the support of stage actors and singers in this stage where we tried the follow the tendencies in the early music.

3.2 Spatialization / 3D Spatial Sound

After having unearthed all necessary information on sound sources and providing necessary directives for the performation, human sounds were recorded in

anechoic chamber and environmental sounds were recorded in the situ or recordings from online sound databases were used when needed. Later on 3D architectural space was modelled in the game engine (UE4) based on a historical map of the period, and sound sources were placed according to the created scenario.

Basically, some market points were determined to place vendor cries, and the churches were identified to locate church bell as sample sounds to create 3D sonic environment. Vendors, horses and dogs scattered around the square and horse carriages were directed to the palace. A group of singing people were placed at the corner of a street connected to via Toledo. Eventually, auralization was done through an audio middleware (Wwise) designed to provide 3D spatial audio for game engines. The used sound engine for this sound reproduction includes several calculation methods. The details of these methods and the performance of analysis of the middleware are provided in [14].

3.2.1 Sound Reproduction System and Head-tracking

The auralization can be presented to the users in various ways. The conventional listening practices with the headphones isolate the listener from his/her acoustic environment. In addition, sounds are traditionally produced for a fixed source and specific receiver positions specifically in the music industry. This way of virtual audio listening created its own aesthetic norms with the stereo, and the music production sector strongly promoted it because it is easy to mix translation across all stereo systems. However, contrary to standard stereo based audio production, virtual (binaural) audio provides the listener with 6 DoF movement, namely all basic ways of a rigid object can move through 3D space. This approach promises a more natural mode of listening and give a chance to the audience to discover acoustic space freely.

In the case of using HMDs, motion tracking is done by the sensors of HMD, but when the traditional DAWs are used, or the concept of augmented audio is followed, motion tracking has to be provided with some external sensors. In this study, thanks to the OSC networking protocol, the location and rotation info were gathered from an OSC messaging application (GyrOSC) which is developed to work on any smartphone running IOS operating system, but applications developed for Android mobile operating system or any device/sensor that can send OSC messages can also be used. The information gathered from the sensor is transmitted to the game engine, and auralization is calculated in real-time regarding user position in the 3D environment for each frame.

3.3 Representation / Interactive Map

The map used to represent 3D spatial audio was the Zannoni's map of Naples, as it existed in 1790. It is designed as an interactive map to serve as a useful guide helping users find their way in the 3D space of a historic environment.

Figure 4. Giovanni A. Rizzi Zannoni "Pianta della Città di Napoli Come Esiste nel Presenta Anno 1790"

The user's movement and head orientation were represented on the map with a player icon, as seen in Figure 5. The motion on the map was restricted with bodily movement, which is a key to finding one's way and to get closely acquainted with the acoustic space. Whether digital or real, the bodily movement contributes to the sense of being there. As Niall Atkinson emphasized, "way-finding" is a fundamental way to "knowing one's self in relation to others and to a common identity." [15, p. 178]

Figure 5. Graphical User Interface of the Application

Originally, the game engines's first person template was used to create 3D environment and to place sound sources. Then the historical map was generated with the help of widget blueprints, which serves to create GUIs. The minimap concept, which has been used in most of first-person games, was used to create the map to represent all game objects over by marks. The point of player and the point of interests (sound sources in this case) were added to GUI as an overlay. The options for users to choose whether they want to use the application with or without GPS, rotation sensors, and background sound were presented in the game intro. A profiling survey was added to the game intro as well.

The application is designed to work for different scenarios in-situ, remote, with or without sensors. The users can walk around the virtual environment by using W-A-S-D on the keyboard to walk for a specific direction, mouse to change head orientation and mouse

scroll wheel to zoom in and out. At the end, the application was formed as a full screen, and a sound seeking game was included. During the game, users try to find the location of the historical sound sources by following their ears. If they press the "F" while thinking that they are in the 8 meters range, the sound source appears on the map and becomes visible as found sources and player-source distance is saved to calculate user game points. The success of sound localization of the system will also be assessed in future through the controlled tests with the help of total wasted time and average user game points.

As mentioned, the quaternion data flow for head orientation and the GPS data flow for user's location were included in the game. But then the preliminary test showed up used smartphone's GPS sensor accuracy (2-5m in best conditions) was not at the expected level to conduct this kind of study successfully. Therefore, GPS is provided as an option. The user can set the right condition for the game play through settings tab in the game intro GUI. It is possible to choose one sensor only, as using the map with head rotation sensors to change game character's head direction, W-A-S-D keys can be used for bodily movements.

A video record of the game play was provided in the [16], and a study on the perceptual assessment of the application was also planned as future steps.

4. CONCLUSIONS

The early approach here to the text processing method within the historical soundscape concept is promising, thanks to the research's object-based target. Similar research on olfactory references is under investigation in the project of Odeuropa [17].

The study showed that we might reconsider our approaches to digital audio design techniques that have changed fundamentally in the last two decades. The traditional channel-based, static stereo sound will give way to object-based 3D spatial audio entirely in the not too distant future. To place the sound sources into three-dimensional Euclidean space not just helping to create physically based environments, it is also more appropriate for the presentation of non-spatialized sound samples.

As a result of this application, it is possible to say that interactive HIS maps are an effective way to study historical soundscapes. Using historical maps increases the perception of the reconstruction as historical, and as conceived by Tim Ingold "they resemble storytelling than map-using". They are considered condensed histories. Not just sound sources, other related historical information can be considered in the same way rather than using static GIS. The high integration capacity of VR with its standard or graphical coding features brings an infinite number of possibilities to light.

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