

# Padova Soundscape: a Crowdsourcing Approach to Describe the Sound of a City

[Position Paper]

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## ABSTRACT

This paper reports the results of an initial experiment on the acoustic description, called *soundscape*, of the city of Padova. A group of users has been involved in recording the sounds of the city and in tracking their position in space and in time using a web based interface. Collaboration and coordination among participants has been promoted using a wiki, where participants could assign themselves the locations to be recorded and define the standard to be followed. The result is the creation of an acoustic map of the city of Padova, which can be navigated in space and in time through a web interface. A mobile version of the interface is under development.

## CCS Concepts

•Information systems → Multimedia content creation; Geographic information systems; •Human-centered computing → Empirical studies in HCI;

## Keywords

soundscape; crowdsourcing; cultural heritage

## 1. INTRODUCTION

Cultural heritage is a broad term that refers to both tangible and intangible human artifacts and includes also natural elements that are relevant for a given place. Although these components can, in principle, be perceived by any sensory channel, most of the attention is usually payed to tangible artifacts that are visually perceived. As a consequence, the application of information technologies to the dissemination of cultural heritage has privileged the visual content. The role of music as a major witness of cultural heritage has never been disputed, and there exists a large number of projects regarding interfaces for music search and access, based on geographical location of the composition [3], music

similarity between music content [6] and graphical representation of self-organizing maps [5]. With the obvious exception of speech, non-musical audio received less attention even if the sound has a strong evocative impact of populations, places and historical periods.

The term *soundscape* refers to the acoustic environment that characterizes a location. A first characteristic of a soundscape is related to the balance of natural versus man-related sources [2], although it can be considered a combination of four kinds of sources:

- Earth: e.g. wind, sea waves, waterfalls.
- Animal: e.g. screams, calls, chirps.
- Human: e.g. voice of one or more persons, noise of a crowd, footsteps, claps, breath.
- Machinery: e.g. engines, alarms, mechanical parts in movement.

Soundscapes have been the subject of research by composers and musicologists since the seventies [7] and are increasingly gaining attention by the research community because of their relations with natural Human-Computer Interaction [4] and of their applications to immersive audio [1], which is very popular in the game industry. Soundscapes are also studied in other fields, for instance in public health research [8] with a focus on the impact of the noise produced by machinery.

This paper presents an approach to soundscape research aimed at the dissemination of the cultural heritage of a city. To this end, a number of sounds have been recorded in public places in the city of Padova (in northern Italy) and geolocalized on an interactive map. Since the acoustic environment of a given place can change during the day, spatial localization is paired with information describing the time intervals in which the soundscape is pertinent. For instance, a given square in Padova in the early afternoon is strongly characterized by the high pitched noises of school children coming back from school but, some hours later, its sound environment is mostly created by groups of young persons gathering for the happy hours; moreover, at noon the only audible song is the one of the church bells. Clearly, the narrow road few meters towards the center has a more stable soundscape, mainly silence with rare footsteps or bicycles, and the roundabout towards the highway is characterized by a continuous noise of city traffic. The final goal was to allow the user to navigate the sounds both in space and in time,

exploring the more active and the more calm areas, discovering the places dominated by machinery and the ones where natural sounds could still be heard.

## 2. PADOVA SOUNDSCAPES

This ongoing project has been carried out within a laboratory of the University of Padova on tourism applications of computer science (namely, the class in Computer Methods for the Organization of Tourism Services for the course in Design and Management of Cultural Tourism of the University of Padova). The different steps of the project are described in the following sections.

### 2.1 Tools and Formats

The first step in the project development was the choice of a suitable platform to manage geolocalized multimedia content. In particular, one of the goals was to select content according to temporal information. The platform that has been used for the project is *NeatLine* (<http://neatline.org>), which has been developed at the Scholars' Lab of the University of Virginia Library. NeatLine provides a user-friendly interface for the geolocalization of multimedia content using pre-existing maps, such as OpenStreet Map, or even digital copies of historical maps. The choice of NeatLine is motivated by its focus on temporal information, because each item can be associated to a temporal span of validity. The NeatLine graphical interface provides tool to associate geometries to multimedia content and, at the same time, to hide selected elements that are not relevant for a time period selected on a timeline. A simple guided tour and some templates of HTML5 code provided to be sufficient for the participants to learn the basic NeatLine tools to add content.

The second step regarded the choice of the formats to be used for the multimedia content, considering that each participant had to provide a sound recording of a different soundscape (that is, different places or different times), together with a picture of the area (possibly taken from the same position where the microphone was set and with a short textual description (free text and tags). Sound files had to be in MP3 format, with the standard sampling rate of 44.1 kHz and with the reasonable quality of 192 kbps. Specifications included the duration, which was mandatory set to 30 seconds for each location, the loudness normalization, and some post-processing on the beginning and the end of the recordings in order to allow a continuous loop of the sound signal. The picture had to be in PNG format, 72 dpi and with a size of 400x400. The name of the place and the time of recording were clearly visible.

Participants used their mobile phones to produce the content (both recordings and photos) and could carry out the post-processing tasks using free software available for mobile devices and personal computers.

### 2.2 Crowdsourcing

Most of the projects that aim at a large scale sampling of the territory rely on user-generated content. When a crowdsourcing approach is undertaken, there are some crucial aspects that have to be taken into account. The simple motivation to participate, which in this project was assured by the presence of a final grade for the participation to the laboratory, does not guarantee effective collaboration among participants and a standard quality of the user-generated content.

In order to promote collaboration, the project included a wiki and a forum where participants could propose new locations and schedule the recording sessions. Moreover, the wiki became the shared place where participants provided additional contributions to the project. For instance, they agreed on a color code for the different typologies of locations (churches, historical building, public squares) and proposed acoustic paths across the different locations. Notwithstanding these positive results, the presence of platforms for collaboration did not prevent that some locations had been over-represented, with many similar recordings of the same sound environment, while others have been neglected, with basically no recording. It can be noticed that many over-represented locations were also cultural landmarks of the city, but others (i.e. the train station, the entrance of the Department of Cultural Heritage that hosts the course) were chosen just because of they were easier to reach.

As regards maintaining a standard quality for the recordings, in this initial step it has been decided to simply make all the contributions directly available to all participants, who were invited to browse the content and comment the quality on the wiki. A possible approach for future developments can be based on a rewarding mechanism, exploiting some gamification concepts.

### 2.3 Results

Soundscapes have been recorded in the period December 2015 - January 2016. The total number of participants to the laboratory was 44. In a period of about two months they provided 166 recordings, meaning that the city of Padova is now described by about 1 hour and 20 minutes of sounds. Almost all the center of Padova has been represented and it is basically possible to have a *virtual walk* in the center and have the experience of hearing the sound of the city.

These initial results seem to prove the feasibility of a crowdsourcing approach at least for a city like Padova. The project is continuing as a M.S. thesis, in order to complete the sampling of the city.

## 3. NAVIGATING SOUNDSCAPES

Padova Soundscapes can be accessed via a simple web interface. The user can adjust a time span of his/her interest within the 24 hours and start to navigate aurally the city of Padova. Colored icons depicted on the interactive map – we choose OpenStreet Map among the available ones – guide the user towards different areas of the city. When an *acoustically active* location is at the center of the user interface the system automatically plays the related soundscape, which plays on in a loop until the user moves the focus away. This version of the prototype system provides also some visual feedback to the user. When a new soundscape is played the user is presented also with a pop-up window containing the view from the exact place of the microphone taken at the same time of the day. Our goal is to evaluate the effect of visual cues in respect of a pure acoustic interface. Since all locations are tagged, users can perform a textual search using acoustic features, sources and mood.

The project is still in its early stages. The first step will be the development for mobile devices, in particular tablets, where interaction will not be mediated by a pointing device. After the development of a prototype system for mobile great part of the activities will regard the evaluation of the user experience with different combinations of commu-

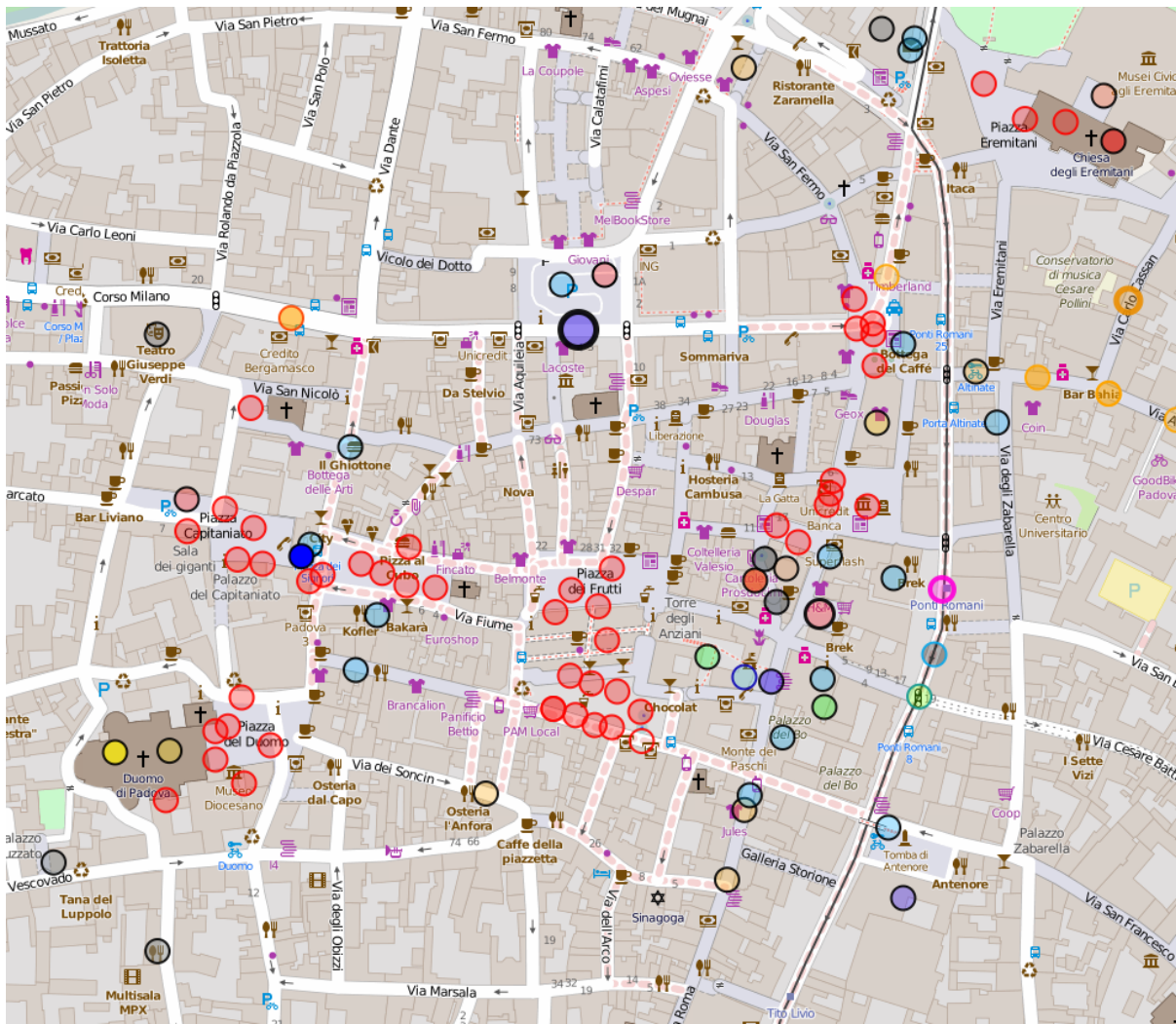


Figure 1: The interactive map where the participants added the recorded soundscapes. Each dot in the map is a different recording, made at different times.

nication channels: from the complete information which is available now on NeatLine to an audio-only interface.

#### 4. ACKNOWLEDGMENTS

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