

Web Wall Whispers: an interactive web-based sound work

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ABSTRACT

Web Wall Whispers (*www*) is an interactive sound work that heavily relies on the web audio technology to enable a virtual high-quality multimodal exploration of a monumental mural. The user's navigation through the artwork generates a unique interactive musical composition at every access, in a challenging paradigm of open form based on a virtual dialogue between the visitors and the composer. The project is conceived as a part of the *Segni per la Speranza* (*spls*, Signs for Hope) multimodal artwork, a project aimed at the reappraisal of urban outlying areas. All the constituent materials are freely distributed under the open source GNU General Public Licence, thus allowing the build-up of extensions or new versions of this multimodal artwork paradigm.

1. SIGNS FOR HOPE

In June 2016, the Italian Ministry for Cultural Heritage and Activities called on the Promotional Committee for the Italian Contemporary Art Foundations to come up with and implement an original artistic and cultural project aimed at the redevelopment of urban outlying areas. Fondazione Spinola Banna per l'Arte carried out a project called *spls*, aimed to contribute to the artistic development of a suburban neighbourhood in Turin. This one-year work shows the social significance of art and innovation, and their potential in fostering civic integration by stimulating the people's sensibility for beauty. The result is a unique multimodal artwork declined through visuals, music and web arts, whose design and realisation involved a local network of research centres and higher education institutions, as well as the work of young students and artists.

The use of web technologies in the implementation of *www* allows the artwork to be experienced everywhere, through the simple use of desktop or mobile devices. The audiovisual exploration itinerary unfolds through high-resolution documentary images and relates them to instru-

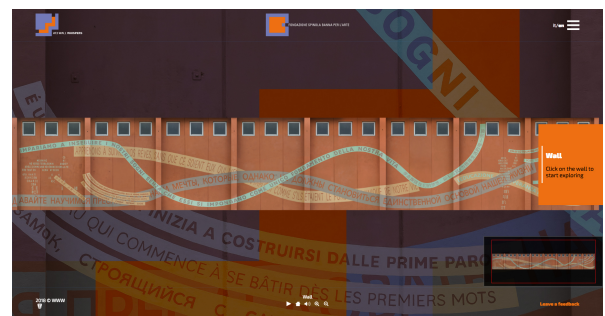


Figure 1: Screenshot from *www* navigation interface
mental and electronic music, recordings of texts on the mural read by the students, dialogues and sounds sampled during the creation of the mural itself, and their mutual hybridisations implemented through sound processing.

www has been inaugurated on April, 18th 2018, and is available at the URL <https://www.webwallwhispers.net/>

2. INTERACTION DESIGN

With *www*, the artists' objective is to conceive an audiovisual interpretation of *opera aperta* (the open work [1]): a form defined by users and their listening modalities, conditioned by the visual aspect, and guided by an intertwining of constraints imposed by the author. Author and actor of fruition participate in the creative process.

The core of the interaction is the image viewer: the user is encouraged to explore the high resolution version of the mural (see Figure 1) through zooming and panning actions. Each one of these actions leads to sound changes, giving the user an active role in the composition. The navigation has been designed with six different *layers*, each one with an increasing zoom factor on the wall image and a different *soundscape*. The user is free to move horizontally or vertically, exploring areas with different musical contents, or to switch to another zoom layer, either closer or wider.

Sounds are integrated as virtual speakers in specific spots on the mural, mapped differently on each zoom layer for a total of more than a hundred points. Each speaker is activated according to the current user's view, by the definition of a layer-dependent notion of distance: each speaker falling inside the so-called *play area* (i.e., a circle around the view centre, see Figure 2) starts playing. A linear distance and



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Web Audio Conference WAC-2018, September 19–21, 2018, Berlin, Germany.

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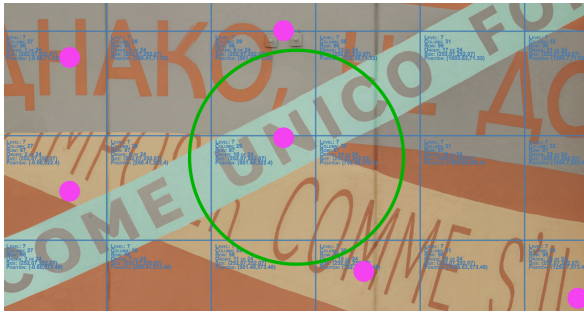


Figure 2: Example of user view with virtual speakers (magenta dots) and play area (green circle)

azimuth value are calculated for each virtual speaker referring to the view centre. Sounds are then organised in the acoustic space through binaural encoding according to their own azimuth, and their distance is simulated by using filters and artificial reverberation. The sixth and deepest layer behaves differently: no virtual speakers are placed on the wall but four sounds are always playing. Each sound is associated to one of the four main colours of the mural and its volume depends on the corresponding colour percentage present in the current user view.

Furthermore, the interactivity is reinforced by short sounds triggered when the user performs an action such as a mouse click or a zoom command.

3. TECHNICAL DETAILS

www is based on a pure Javascript client-side web application, which, differently from other projects [3], does not need any server-side support and can be hosted as a static web site. The application handles visual and audio contents at the same time, thus the development evolved through the implementation of efficient solutions for both these media.

The visuals are obtained from the deep-zoom navigation of a super-high resolution image: about 150 pictures of different sections of the mural were stitched together and subsequently organized in a mosaic of more than 300000 tiles (blue lines in Figure 2) according to the TMS scheme¹, which creates a pyramid of images at multiple zoom levels. The client-side navigation of the multi-level image has been supported by the open source framework OpenSeadragon², further customized to personalise the interactive exploration.

The music consists of a corpus of pre-composed tracks, whose overall duration amounts to about 90 minutes. Sound materials are obtained by computer processing of different original recordings: voices of students reading the texts on the mural (in Italian, Russian, Chinese, French); conversations and sounds of machines during the working sessions on the mural; field recordings in the gymnasium behind the wall; excerpts of music works by Stefano Gervasoni.

To make this large corpus available in a web application, we combined the *Web Audio API* functionalities with the *HTML5 <audio> element*, so that all the audio material is progressively delivered from the server in real-time. Audio streaming is implemented using the HTTP Live Streaming (HLS) [2] protocol and the support of the HLS.JS³ library for client-side media handling. Without the streaming

support, the large corpus of audio and video data used by *www* would take several minutes to download to the user device before the user experience (that is, the navigation) could start. In addition, using a media stream audio source allows audio processing with minimum buffering and huge savings in memory usage. Finally, this solution largely extends the possible interactions of the user with the audio material, making it possible to cherry-pick portions of audio from the large corpus stored on the server and stream only what is necessary for real-time playback and processing.

The result is a never-repetitive user experience, which can happen in quick and timely explorations, evolve to the typical time span of a concert, or be carried out as a traditional audiovisual installation.

4. CONCLUSIONS

spls-www is the starting point of a collaborative local network involving schools, research centres and institutions. The artwork, its constitutive materials and the knowledge produced for its realisation belong to the community: future students, artists and researchers of the involved schools and institutions have the responsibility to take care of it, as well as the opportunity to re-adapt the work and extend the concept to other use cases and contexts, such as museums, monuments, urban or natural landscapes.

Technically speaking, in this work the combination of visual and sound in response to the user interaction, the use of a large number of real-time audio effects, the scheduling of many fading curves and the frequent presence of concurrent audio tracks pushed the *Web Audio API* infrastructure to the edge. Consequently *spls-www* heavily relies on the efficiency of web audio implementation in the modern browsers to achieve real-time audio playback without interruptions.

Waiting for further improvements in the audio graph definition and rendering speed, the fully-functional version of the application is currently supported on Google Chrome and Opera, while a lite version has been developed for other major web browsers such as Safari, Firefox or Edge, in order to provide a smooth navigation experience at the expense of less interaction possibilities. On mobile devices the audio effects are reduced due to the limited processing power. Further limitations have been implemented on Apple iOS because of its lack of support for the *createMediaElementSource* API that allows the real-time streaming capabilities of the work⁴.

5. ACKNOWLEDGMENTS

The authors thank Fondazione Spinola Banna per l'Arte for having promoted and produced the project.

6. REFERENCES

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¹<https://goo.gl/Jbiocy>

²<https://openseadragon.github.io/>

³<https://github.com/video-dev/hls.js>

⁴<https://goo.gl/EKHxVc>