



D4.4 3D Sonic App

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¹ **R**=Document, report; **DEM**=Demonstrator, pilot, prototype; **DEC**=website, patent fillings, videos, etc.; **OTHER**=other

² **PU**=Public, **CO**=Confidential, only for members of the consortium (including the Commission Services), **CI**=Classified, as referred to in Commission Decision 2001/844/EC

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EXECUTIVE SUMMARY

D4.4 “3D Sonic App” consists of the various applications (using the marketable name “the PlugSonic *suite*”) that were created to import, edit, process, manage and create audio content within the PLUGGY Social Platform and Curatorial Tools. The PlugSonic *suite* includes the following applications:

- PlugSonic Sample – to edit and process individual audio samples within a web-based platform
- PlugSonic Soundscape – to create and experience 3D interactive soundscapes within a web-based platform
- PlugSonic Soundscape Experience Mobile – to experience the 3D interactive soundscapes created with the web-based application, within a mobile-based (iOS) platform

The deliverable is of type OTHER and this report is an accompanying report to the actual developed software.

Video demonstrations of the various applications can be found at the following links:

PlugSonic Sample Video Demo:

<https://imperialcollegelondon.box.com/s/pqusrapf7u31nbu09p437esyfdlez77m>

PlugSonic Soundscape Video Demo:

<https://imperialcollegelondon.box.com/s/pobay28g1ogjfu198fdzhbky1qavkl0x>

PlugSonic Soundscape Experience Mobile Demo:

<https://imperialcollegelondon.box.com/s/j6dqjdb958r9m8vgxs5e53ha2c9jps5j>

1 Introduction

D4.4 – 3D Sonic App is a deliverable of type OTHER and this document is its accompanying report.

In the next paragraphs we describe the web and mobile apps that make up the *suite* we call PlugSonic. The apps, divided into PlugSonic Sample and PlugSonic Soundscape, are integrated into the PLUGGY social platform and a part of the platform’s curatorial tool, both accessible under the address <https://pluggy.eu>. They are developed to manage all the audio content necessary to create virtual exhibitions; enhance on-line and/or on-site visits to museums, monuments, archaeological sites; share tangible and intangible cultural heritage.

The social platform and the pluggable apps make use of standard (mono/stereo) sound files to be used in voice descriptions, audio narratives or sound accompaniment to the platform’s exhibitions, as well as to create interactive and explorable 3D audio narratives and soundscapes.

The PlugSonic Sample app has been designed to edit sound files and apply audio effects, and the PlugSonic Soundscape app to create and experience spatialised soundscapes.

The PlugSonic Soundscape app is further split into Soundscape Create and Soundscape Experience. Soundscape Create is available only as a web application and it is used to curate and test the 3D audio narratives and soundscapes. Once completed, Soundscape Create allows to save the exhibition and publish it in PLUGGY for everyone to enjoy it using the Soundscape Experience apps. Soundscape Experience is implemented both as a web and as a mobile (iOS) application, and allows users to navigate the interactive soundscape. Soundscape Experience does not allow to modify the exhibition in any way.

In this way PLUGGY users, whether institutions or citizens, are given all the necessary instruments; without the need for specific devices, external tools (software and/or hardware), specialised knowledge or resources.

Both the Sample and the Soundscape app use off-the-shelf web development technologies and libraries. HTML and CSS languages have been used to create the web page and define its aspect; while JavaScript (JS) to make the apps dynamic and interactive. To build the user interface (UI) we used ReactJS. The sound spatialization has been done using the 3D Tune-In Toolkit library³, developed by the same team in a previous project (<http://3d-tune-in.eu/>)

Both apps use a responsive design to scale the UI to different devices and screen sizes, and are touch enabled to be used on any device with touch screen.

³ https://github.com/3DTune-In/3dti_AudioToolkit/

2 PlugSonic Sample

Figure 1 shows the UI of the PlugSonic Sample web application, integrated into the PLUGGY social platform. As explained in the introduction PlugSonic Sample can be used to edit and apply audio effects to any audio file uploaded to the PLUGGY social platform. The modified audio file can then be saved into the social platform, or exported to the user's device, and used in any exhibition (e.g. Blog Story, Time Line, PlugSonic Soundscape etc.).

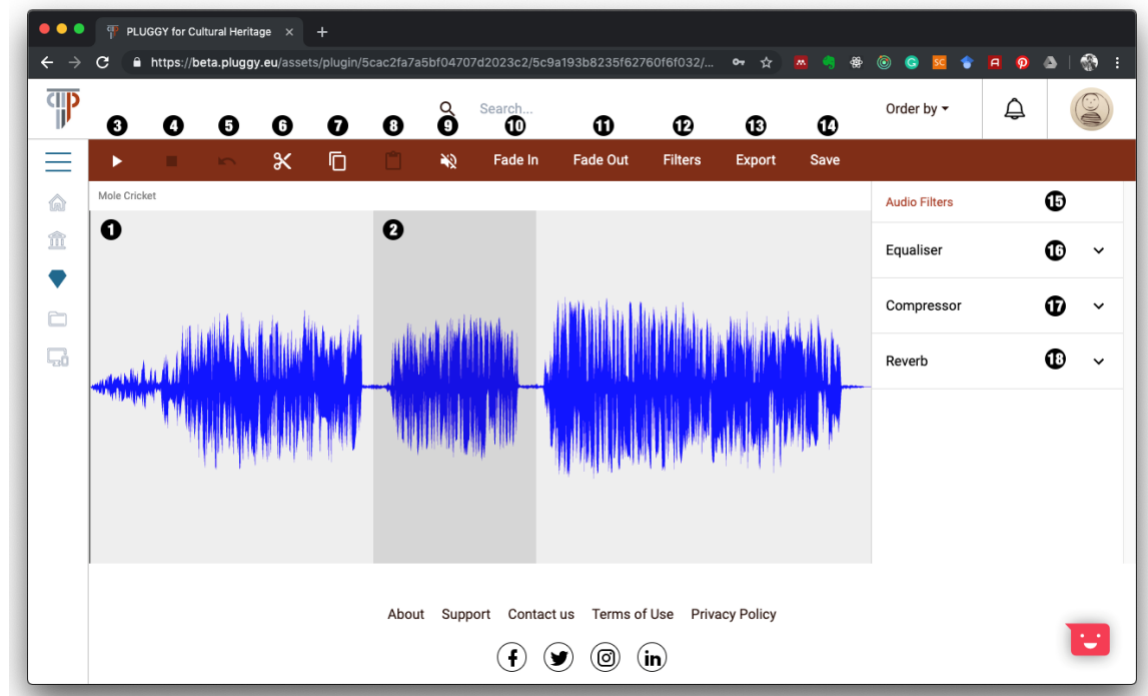


Figure 1 - PlugSonic Soundscape user interface

With reference to Figure 1, the user interface includes:

1. Waveform of the audio file with filename on the top left corner
2. Use of mouse to control the playback start and end points and select parts of the waveform to be modified
3. Play button to reproduce the whole audio file or the selected part
4. Stop button to stop reproduction
5. Undo button to cancel edit actions
6. Cut button to cut part of the waveform
7. Copy button to copy part of the waveform
8. Paste button to paste cut/copied part of the waveform
9. Mute button to mute part of the waveform
10. Fade In button to apply a volume fade in to the selection
11. Fade Out button to apply a volume fade out to the selection
12. Filters button to open the filters/effects menu (15)
13. Export button to save the modified audio file to the users device

14. Save button to save the modified audio file to the PLUGGY social platform
15. Audio Filters/Effects menu
16. Equaliser panel. Includes: lowpass, highpass, bandpass, lowshelf, highshelf, peaking and notch filters
17. Compressor effect panel with threshold, knee, ratio, attack and release controls
18. Reverb effect panel. Includes small, medium and large room reverbs

PlugSonic Sample Video Demo:

<https://imperialcollegelondon.box.com/s/pqusrapf7u31nbu09p437esyfdlez77m>

3 PlugSonic Soundscape Create

Figure 2 shows the UI of the PlugSonic Soundscape web application, integrated into the PLUGGY social platform. As explained in the introduction PlugSonic Soundscape allows the creation and exploration of interactive 3D audio narratives and soundscapes. Users can create a soundscape selecting the Soundscape type when creating a new exhibition through PLUGGY's curatorial tool.

After setting the soundscape's title and description the user can proceed with the creation. At this point the Soundscape Create web app is loaded. The user can define the shape and size of the room (width/depth/height) and proceed to populate the virtual environment with sound sources retrieved among the audio assets previously uploaded to the social platform. After uploading the sound sources the user has many settings available for each sound source to define the type of interactions between the listener and the sources.

At any point during the soundscape's creation, the creator can explore the soundscape to verify the results. The exhibition can then be saved to the social platform and published so that any user of the PLUGGY's social platform can access it and experience it.

It is also possible for the user to create a recording while navigating the soundscape and export the recording as a .wav audio file which will include all the properties of the 3D audio rendering in a standard stereo audio file.

The user has also the option to export the soundscape's metadata. This is to allow the user to keep a local copy of the soundscape. Also, the metadata can be imported into any application capable of interpreting it. In the case of PlugSonic, the metadata can be imported back into Soundscape Create web application or it can be opened with Soundscape Experience Mobile (see paragraph 5). There are two formats available to export the soundscape. The simple metadata, which will require a connection to access PLUGGY's social platform and retrieve the audio files; or the metadata including the assets, in which case, the soundscape can be experienced off-line since the audio files content will be included into the exported soundscape file.

With reference to Figure 2, Soundscape Create includes:

1. Virtual room used for the curation of the soundscape
2. Listener's icon representing the position of the listener in the virtual environment
3. Sound sources' icons representing the position of each sound source in the virtual environment
4. Play button
5. Stop button
6. Record button to record and export a .wav file of the rendered 3D audio
7. Touch arrows button to open a panel showing the touch arrow controls (necessary to navigate the soundscape on a touch screen based device)

8. Search tab. To search and retrieve audio sources from the social platform.
9. Sound sources tab. Showing all the settings for each sound source. Each sound source has the following options:
 - a. On/off toggle to activate/deactivate the sound source
 - b. Volume slider
 - c. X/Y/Z position sliders to position the sound source in the virtual room
 - d. Loop toggle to choose if the sound source will loop or play only once
 - e. Spatialisation toggle to choose if the spatialization engine will be active. When off the source is reproduced as a mono/stereo file depending on the original file format
 - f. Reach toggle. To turn on/off the interaction area. The interaction area (in yellow in Figure 2) is used to control the interaction between the listener and the sound source. When on, the listener will be able to hear the specific sound source only when they are inside the interaction area.
 - g. Reach radius slider to choose the size of the interaction area
 - h. Reach behavior dropdown menu. To choose the type of action the app will perform when entering/exiting the interaction area.
 - i. Fade in and out. Playback will start as the user clicks the Play button but the source source's volume will fade in/out as the listener enters/exits the interaction area
 - ii. Start when entering. Playback will start as the listener enters the interaction area
 - i. Timings dropdown menu. This menu allows to set an order in the reproduction of the sound sources. The reproduction of a specific source can be constrained to the start of another one.
 - j. Hidden toggle. To hide or not the sound source in the Soundscape Experience apps so that the user cannot see the source's position on the screen.
 - k. Delete button to delete the sound source from the soundscape
10. Room options tab. To set the size and shape of the virtual environment. The room has the following options
 - a. Shape dropdown menu (rectangular or round)
 - b. Size text fields (Width/Depth/Height)
 - c. Room floorplan drag and drop. Allows to load an image to be used as the soundscape's floorplan.
 - d. Reset listener position button. To reset the listener's position to coordinate (0,0)
11. Listener options tab. To set options regarding the 3D audio rendering engine. The listener options are the following:
 - a. Performance mode toggle. When ON, the performance mode is enabled, requiring less computational effort, useful for low performance devices.
 - b. HRTF function dropdown menu. To select the head related transfer functions to be used for the 3D sound rendering
 - c. HRTF sample length. To choose between 128/256/512 samples long HRTFs

12. Exhibition tab. To set the exhibition's options, save and publish the exhibition. It includes:
- Title text field. To set the exhibition's title
 - Description text field. To add a description of the soundscape
 - Tags text field and icons. To add/delete tags to the exhibition
 - Save button. To save the exhibition in the social platform
 - Publish/Unpublish button. To make the exhibition available or not to the social platform users.
 - Import button. To import a previously exported soundscape in either format (metadata or metadata+assets)
 - Export metadata button. To export the exhibition's metadata (will require access to PLUGGY social platform to retrieve the audio files)
 - Export metadata+assets button. To export the exhibition's metadata and the audio assets in one file (will NOT require access to PLUGGY social platform to retrieve the audio files. Can be used when off-line)

PlugSonic Soundscape Video Demo:

<https://imperialcollegelondon.box.com/s/pobay28g1ogifu198fdzfbky1qavkl0x>

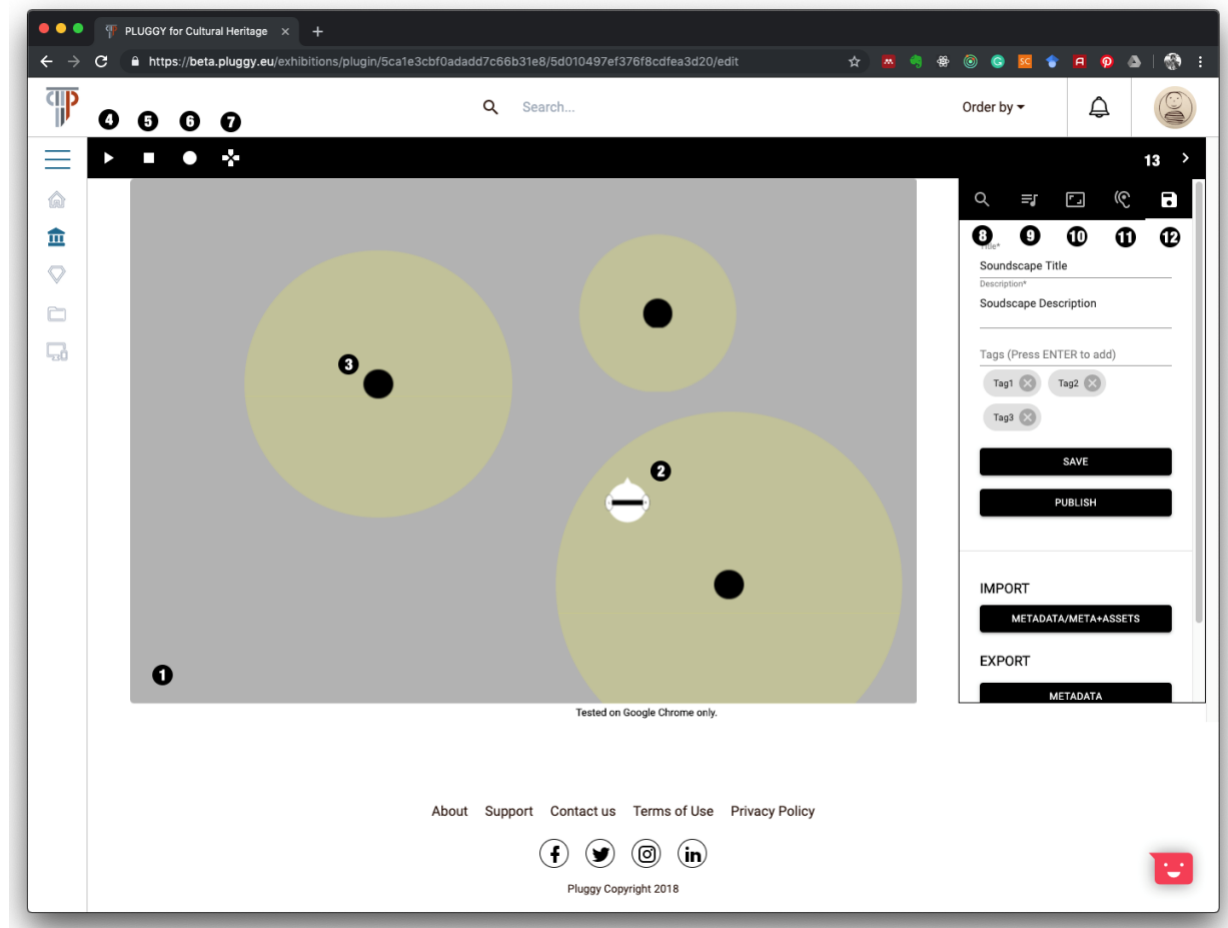


Figure 2 - PlugSonic Soundscape Create user interface

4 PlugSonic Experience Web

Figure 3 shows the user interface of the PlugSonic Soundscape Experience web app. The only controls available to the user are the playback and record buttons, the access to the touch arrows controls, and the listener's options. Also, the exhibition's title, description and tags are visible but not editable.

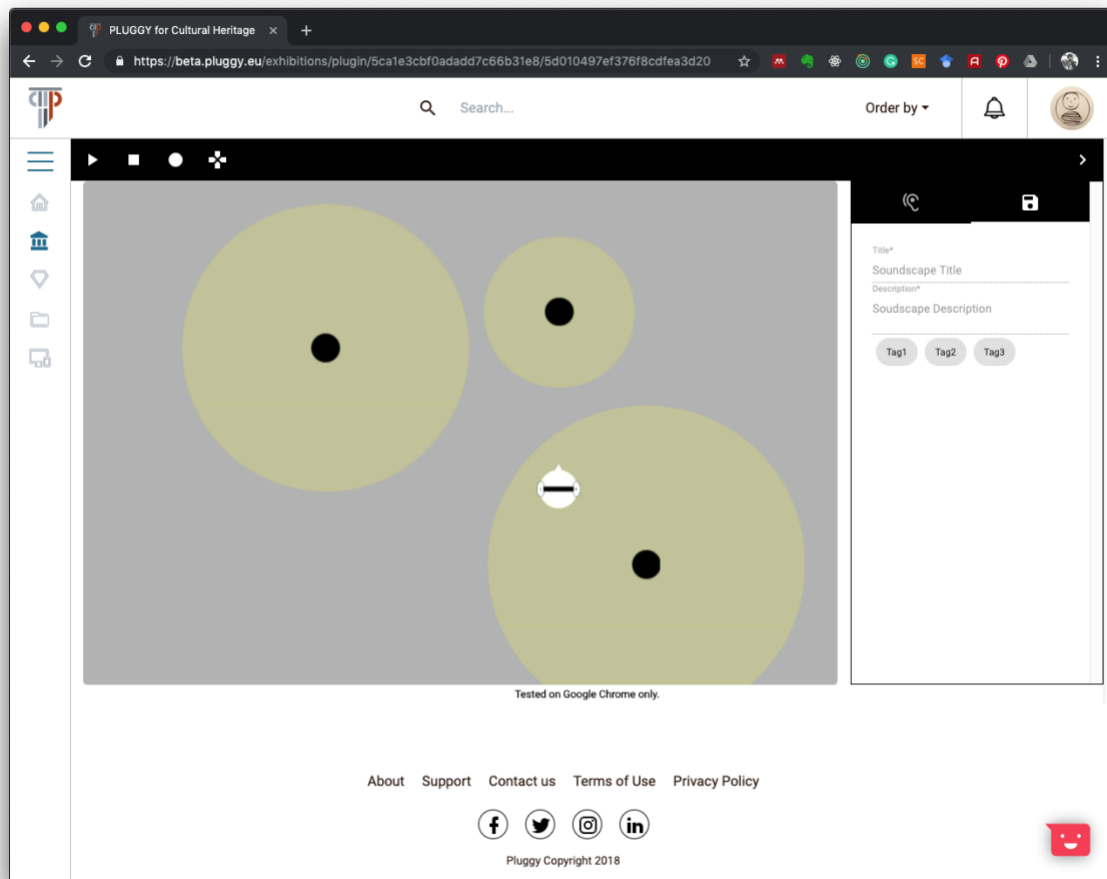


Figure 3 - PlugSonic Soundscape Experience user interface

5 PlugSonic Soundscape Experience Mobile

Figure 4 shows the user interface of the PlugSonic Soundscape Experience mobile app. Users can move the listener's icon using their finger and can change orientation rotating the device. Soundscapes can be loaded from the PLUGGY social platform using the QR code reader on the top-right corner or importing the metadata. The app also has controls for the reverb settings, a button to reset the listener's orientation, play and stop button, and a button to choose the HRTFs.

PlugSonic Soundscape Experience Mobile Demo:

<https://imperialcollegelondon.box.com/s/j6dqjdb958r9m8vgxs5e53ha2c9jps5j>

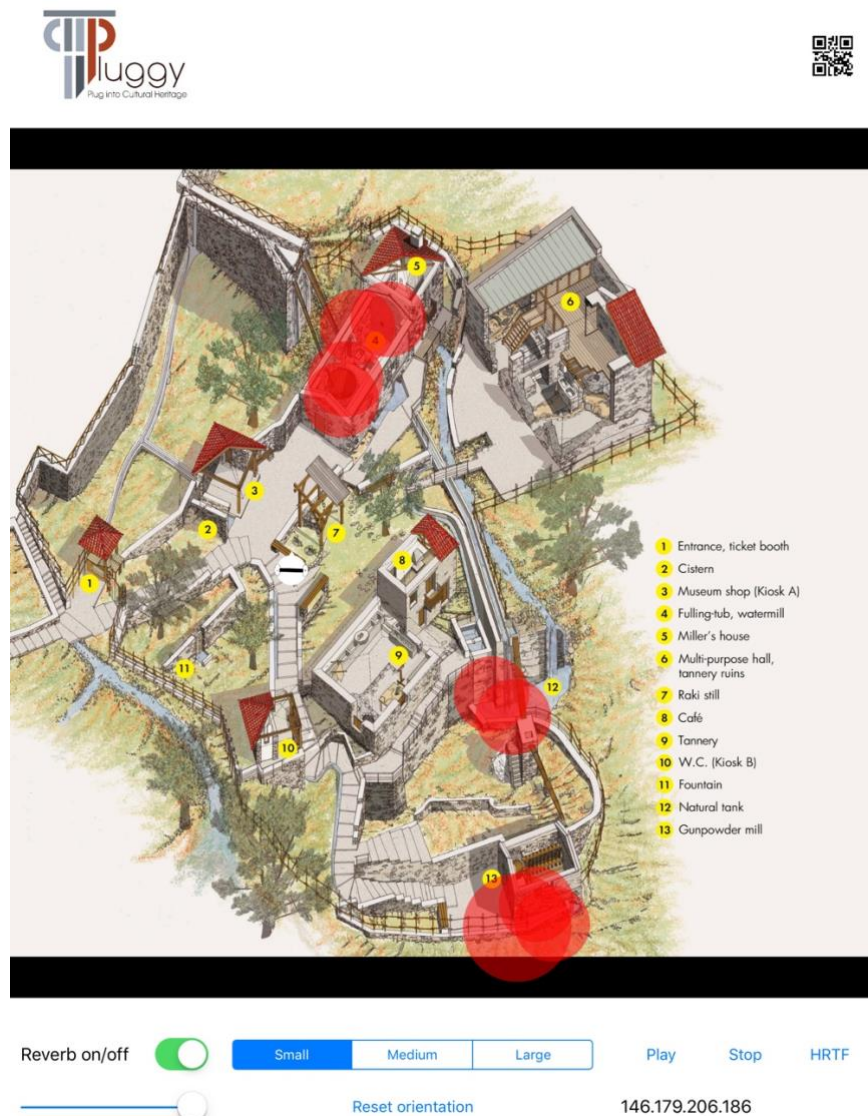


Figure 4 - PlugSonic Soundscape Experience Mobile app user interface

6 Deviations from Description of Action

Looking at the original text appearing in the submitted version of the DoA, the following description of **T4.4 3D Sonic App design and implementation** is reported:

The aim of this task is to design and implement an application for the creation of 3D sonic narratives and, more in general, for allowing the creation 3D audio content within PLUGGY. A 3D audio engine will be implemented, using both already available software components (e.g. the 3D Tune-In Toolkit - <http://3d-tune-in.eu/>) and custom-made modules. The audio engine will then be integrated in the 3D Sonic App, where specific modules for creating audio content will be implemented. These modules will include:

- *Selection, editing and mixing of audio from already-existing sources (e.g. user-imported audiofiles, sample libraries, etc).*
- *Automatic generation of audio content from non-audio material (e.g. sonification, generative and reactive music systems, etc.)*
- *Creative sound effects (e.g. reverberators, phasers, stereo spread algorithms, etc.)*

All these modules will be available both in the 3D Sonic App, and where required also in the other modules (e.g. the 3D audio engine could be used also in the AR app, see T4.1).

The only deviation from this description is the fact that we eliminated from the workplan the automatic generation of audio content, which has been substituted by the work on the development of a mobile-version of the PlugSonic Soundscape Experience application. This decision was dictated by feedback obtained during the participatory design stage at the beginning of the project, consisting in early discussions with general public and sound experts.

7 Conclusions

This deliverable presented the results obtained in the design and implementation of the PlugSonic suite. The suite includes: two web applications, PlugSonic Sample and PlugSonic Soundscape (in the Create and Experience versions). The web apps are integrated in the PLUGGY social platform and are used to edit audio files (Sample) or to create and experience interactive 3D audio narratives and soundscapes (Soundscape). Together with the web version, also a mobile version (for iOS) of the Soundscape Experience app has been released.

Therefore, the PlugSonic suite, gives institutions and citizens, an immediate and easy way to curate and enjoy cultural heritage content in different ways and formats, without the need for specific knowledge or understanding of the underlying technologies.