Interactive Music Science Collaborative Activities
Team Teaching for STEAM Education

Deliverable 4.3
First Version of 3D design environment for music instruments

<table>
<thead>
<tr>
<th>Date</th>
<th>06/10/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author(s)</td>
<td>Carlos Acosta (LEOPOLY)</td>
</tr>
<tr>
<td>Contributor(s)</td>
<td></td>
</tr>
<tr>
<td>Quality Assuror(s):</td>
<td>Petros Stergiopoulos (EA), Renaat Frans (UCLL)</td>
</tr>
<tr>
<td>Dissemination level:</td>
<td>PU</td>
</tr>
<tr>
<td>Work package</td>
<td>WP4 – Core enabling technologies modules of iMuSciCA</td>
</tr>
<tr>
<td>Version</td>
<td>1.0</td>
</tr>
<tr>
<td>Keywords</td>
<td>3d design, virtual musical instrument</td>
</tr>
<tr>
<td>Description</td>
<td>First version of the 3D design environment for musical instruments.</td>
</tr>
</tbody>
</table>

H2020-ICT-22-2016 Technologies for Learning and Skills
iMuSciCA (Interactive Music Science Collaborative Activities)
Project No. 731861
Project Runtime: January 2017 – June 2019
Copyright © iMuSciCA Consortium 2017-2019
Executive Summary

In this deliverable we present the first version of the 3D design environment for musical instruments. At this stage in the project there will be four virtual instruments: a monochord, a circular membrane, a rectangular membrane and a xylophone. The user can alter virtually some boundary conditions and, by coupling this to a sound engine of Ircam, the user can hear the result of this manipulation. The mentioned virtual instruments can be accessed by the following URLs:

- https://makers.leopoly.com/create?application=imuscica-V1&instrument=monochord
- https://makers.leopoly.com/create?application=imuscica-V1&instrument=circle-membrane
- https://makers.leopoly.com/create?application=imuscica-V1&instrument=square-membrane
- https://makers.leopoly.com/create?application=imuscica-V1&instrument=xylophone
Version Log

<table>
<thead>
<tr>
<th>Date</th>
<th>Version No.</th>
<th>Author</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-09-2017</td>
<td>0.1</td>
<td>Carlos Acosta (LEOPOLY)</td>
<td>Initial content</td>
</tr>
<tr>
<td>29-09-2017</td>
<td>0.2</td>
<td>Carlos Acosta (LEOPOLY)</td>
<td>Add suggested modifications by quality assurors</td>
</tr>
<tr>
<td>06-10-2017</td>
<td>1.0</td>
<td>Vassilis Katsouros (ATHENA)</td>
<td>Submission to the EU</td>
</tr>
</tbody>
</table>

Disclaimer

This document contains description of the iMuSciCA project findings, work and products. Certain parts of it might be under partner Intellectual Property Right (IPR) rules so, prior to using its content please contact the consortium head for approval.

In case you believe that this document harms in any way IPR held by you as a person or as a representative of an entity, please do notify us immediately.

The authors of this document have taken any available measure in order for its content to be accurate, consistent and lawful. However, neither the project consortium as a whole nor the individual partners that implicitly or explicitly participated in the creation and publication of this document hold any sort of responsibility that might occur as a result of using its content.

This publication has been produced with the assistance of the European Union. The content of this publication is the sole responsibility of iMuSciCA consortium and can in no way be taken to reflect the views of the European Union.

iMuSciCA is an H2020 project funded by the European Union.
TABLE OF CONTENTS

Executive Summary ........................................... 1
1. Introduction ........................................... 5
2. Installation and technical requirements .............. 5
3. Detailed description of core enabling technology .... 8
# List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATHENA</td>
<td>ATHENA RESEARCH AND INNOVATION CENTER IN INFORMATION COMMUNICATION &amp; KNOWLEDGE TECHNOLOGIES</td>
</tr>
<tr>
<td>UCLL</td>
<td>UC LIMBURG</td>
</tr>
<tr>
<td>EA</td>
<td>ELLINOGERMANIKI AGOGI SCHOLI PANAGEA SAVVA AE</td>
</tr>
<tr>
<td>IRCAM</td>
<td>INSTITUT DE RECHERCHE ET DE COORDINATION ACOUSTIQUE MUSIQUE</td>
</tr>
<tr>
<td>LEOPOLY</td>
<td>3D FOR ALL SZAMITASTECHNIKAI FEJLESZTO KFT</td>
</tr>
<tr>
<td>CABRI</td>
<td>Cabrilog SAS</td>
</tr>
<tr>
<td>WIRIS</td>
<td>MATHS FOR MORE SL</td>
</tr>
<tr>
<td>UNIFRI</td>
<td>UNIVERSITE DE FRIBOURG</td>
</tr>
<tr>
<td>VR</td>
<td>VIRTUAL REALITY</td>
</tr>
<tr>
<td>AR</td>
<td>AUGMENTED REALITY</td>
</tr>
<tr>
<td>CPV</td>
<td>COLOR PER VERTEX</td>
</tr>
</tbody>
</table>
1. Introduction

Leopoly offers a complete digital asset creation platform and content management solution specializing in easy to use 3D and VR / AR tools, content management and asset libraries in the browser, on mobile devices and in Virtual and Augmented reality (AR/VR) and stand alone applications for many industries including

- 3D Printing
- Augmented Reality
- Virtual Reality
- Retail & ecommerce
- Game Development
- Web Development

Our aim is to provide the best solution to create and deploy amazing digital content on any platform easily and effectively. Leopoly tools and features are under continuous development by applying of state-of-the-art technology and improving our engine.

2. Installation and technical requirements

Leopoly web-based engine can be set up in unlimited way and most of the options can be found on https://makers.leopoly.com. One of the 3D editor engine’s advantages is that it can (and preferred to) be tailored for the given object so user can only manipulate the object as designer allows. This will be the case for iMuSciCA instruments, where tools of Leopoly will be chosen and set up for the given virtual instrument object. In the following URLs we present sample virtual musical instruments in the 3D editor engine. For each one there has been added a control panel that allows the user to define basic parameters of the virtual music instrument that modify its sounding behaviour.
https://makers.leopoly.com/create?application=imuscica-V1&instrument=monochord

https://makers.leopoly.com/create?application=imuscica-V1&instrument=circle-membrane
Leopoly engine is supported by most recent versions of Edge, Chrome and Firefox browsers. No additional apps or plugins are needed to run the editor.
3. Detailed description of core enabling technology

A short video of Leopoly’s numerous tools and supported platforms can be found here:
https://www.youtube.com/watch?v=OSe6Rc0Pa3U

Technology
Leopoly’s proprietary 3D Engine is built up from the ground in C++ and WebGL allowing us to offer clients high quality, custom turn-key products that are lightweight and deployed faster for any platform. Our engine and modular development processes are key to enabling our team to remain agile and provide superior products for every client.

All of our 3D and VR tools are available everywhere you are.

- Modular C++ Engine utilizing WebGL and very soon WebVR technology to bring our 3D and VR engine to the Web.
- Cross-Platform Availability
  - Web Browsers (Firefox, Chrome, Edge...)
  - Mobile devices (Android, iOS)
  - AR/MR/VR Platforms (HTC Vive, Oculus, HoloLens, Meta...)
- Browser based 3D and VR applications and asset creation.
- VR 3D modeling applications and asset management

Features
We make it easy for you to create, customize, assemble, share, import, and export 3D files and digital objects within seconds. Leopoly offers a wide range of 3D design tools and products from our premier ShapeLab applications for 3D modeling in the browser and in VR to 3D product configurators and multi-user collaboration using our 3D sculpting and parametric design tools. We also offer a huge online gallery where users can save, store, share their creations. Check out some of our products and services below.

Platform Features
- 3D/VR/AR sculpting and painting
- 3D engraving (images, text and patterns)
- Microsite creation and deployment
- Manage assets and users through a simple web interface
- Create 3D editors and configurators easily and no programming required
- Add multi-user collaboration tools to any project
• Developer API for customizing everything, including the tools, user interface and much more
• Create embeddable 3D and soon WebVR content
• Import/Export all major 3D and vector files. Texture maps and CPV supported
  ○ .STL, .OBJ, .WRL, .FBX, .PLY
  ○ .AI, .SVG
• Import 3D Scan Data
• Repair 3D meshes and scan data automatically

Shape Lab Products
• ShapeLab VR - VR 3D modeling tools available on Steam / Oculus Store / Vive port
• 3D editing tools available in any browser and on mobile devices
• ShapeLab LT - 3D editing on Mobile VR platform compatible including GearVR and Google Daydream

3D Sculpting and Painting
• **Pull/Push** the surface directly with different intensity
• **Erase** the surface you do not need or like
• **Smooth** the surface to decrease polygons and simplify your creation
• **Flatten** the 3D object to create perfectly flat surfaces
• **Edge** the grooves or any part of your object
• **Sculpt** the object as if it was plasticine
• **Shift** parts of the mesh to move features and details around as needed
• **Mirror mode** enables you to sculpt on both side of the object symmetrically
• **Modify** Paint color, hue, saturation & brightness and Color picking tools

Parametric Design
• Create primitive objects like square, cylinder and spheres, and define segments and radius
• Specify unit of measure
• Define objects segments
• Modify the vertical resolution and the sides of the object
• Twist objects to deform them into fun and useful shapes
• Squeeze objects to modify specific regions
• Wave/Ripple the object on X, Y, Z axis
• Scale on any axis or uniformly