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WAM Jam Party: Using Web Audio Modules in the Musical Metaverse

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Abstract—In 2020, the Web Audio plug-in standard, known as "Web Audio Modules V2" or "WAM," made a significant impact on the world of computer music on the web. These modules facilitate the creation of host applications that leverage reusable web components, such as note generators, virtual instruments, and audio effects. The WAM ecosystem now boasts over a hundred plugins of various types, supported by the WAM Community initiative, online tutorials, and multiple host applications. Sequencer Party, a real-time collaborative audio/visual platform built entirely from WAMs, designed for creating collaboratively music installations, exemplifies this ecosystem. We propose to demonstrate the first prototype of a new multiparticipant WebXR application that transposes the concepts of Sequencer Party into a persistent immersive world. It demonstrates the reuse of existing WAMs without modification by automatically generating 3D graphical interfaces suitable for VR/XR manipulation or by manually recreating dedicated interfaces. This highlights the potential of the WAM standard beyond traditional 2D web applications. For the 3D rendering of the virtual world, the BabylonJS framework was utilized, offering robust support for WebXR. A CRDT approach was chosen for state synchronization between clients. The software is open source and hosted online¹.

Keywords—Musical Metaverse, WebXR WebAudio, WebMidi, Web Audio Plugins, Web standards, Web Audio Modules, CRDT.

I. INTRODUCTION

The Musical Metaverse (MM) [1] is an immersive virtual space dedicated to musical activities, expanding on the broader concept of the Metaverse. It has recently gained popularity, reigniting interest in shared virtual environments within the realm of computer music. Applications include virtual concerts, educational tools, and collaborative musical performances. Transposing user experiences into conventional 2D applications generally does not work in an immersive environment, and new ergonomic and sensory approaches need to be employed [2].

The WAM application presented in this paper focuses on a persistent, real-time multi-participant immersive world for shared music creation, exploiting recent W3C web standards such as Web Audio, Web Midi, WebXR, WebGL, WebGPU, WebAssembly, WebSockets, now implemented in the web browsers of the most common VR/XR headsets available on the market.

II. WEB AUDIO, WEB MIDI AND WEB AUDIO

The Web Audio API and the Web Audio Modules (WAM) plugin standard

With the Web Audio API, developers can assemble nodes into a graph to create complex audio effects and instruments like delay effects, chorus, and synthesizers. Over the years, many high-level audio effects and instruments have been developed this way. However, chaining effects and instruments, as needed in music production, requires a higher-level standard. In 2015, Jari Kleimola and Olivier Larkin proposed the "Web Audio Modules" (WAM) standard for Web Audio plugins [3]. This standard was expanded in 2018 [4] and further evolved into Web Audio Modules version 2.0 in 2021 [5]. Dozens of WAM plugins are now available through the WAM Community Endpoint, comparable in quality and complexity to native applications [6]. Available WAMs (more than one hundred) include *note generators* such as: a piano roll, a programmable step, random note generators, chord generators, *virtual instruments*: synthesizers samplers, physical modeling of instruments (flute, clarinet, brass, djembe), audio effects (including all classics: flanger, chorus, reverb, distortion, fuzz, overdrive, etc.).

III. WAM JAM PARTY

Soon after the first publications on the musical metaverse and its eponymous research project [1], the idea of WAM Jam Party was born: a multi participant immersive application in which users could assemble collaboratively 3D WAM plugins and build music installations altogether.

The first prototype of WAM Jam Party uses WAM introspection to build 3D interactive GUIs from existing 2D WAM plugins, BabylonJS for the 3D rendering of the immersive world, and a CRDT algorithm is used synchronizing incrementally the states of all the elements between clients. While client states are updated 3 times/s, the server saves seamlessly the ongoing session into a file every second, making the world persistent. Special care has been taken for generating the 3D representation of WAM plugins, using an optional JSON file for the mapping of the internal parameters into the 3D world. Each WAM is represented by default as a box with draggable cylinders, boxes or push buttons for its parameters (Figure 1).

¹ <https://musical-metaverse.onrender.com/> source code
<https://github.com/Doori4N/musical-multiverse-vr>

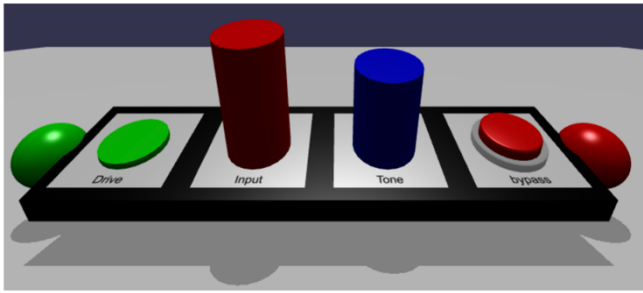


Figure 1: 3D representation of the Big Muff WAM.

A menu proposes a large set of WAMs enabling users to add elements in the 3D world (Figure 2). In addition, a green and a right sphere are located on the sides of the box, enabling users to connect WAMs together to form an audio graph (Figure 3). Connect a step sequencer to some audio effects and you have a first basic music installation. Any element can be moved, oriented, or have its parameters adjusted using different controllers (see Figure 4).

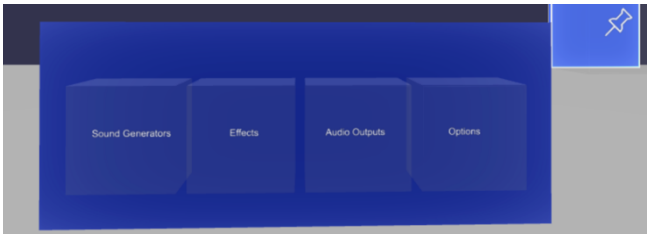


Figure 2 : main menu for adding elements in the 3D scene.

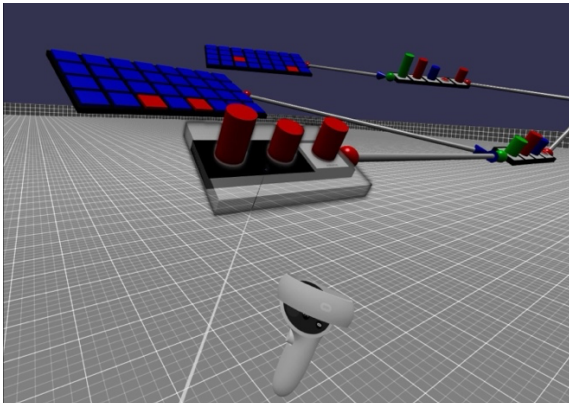


Figure 3: Example of a graph made of two note generators (step sequencer on the left), two instruments and audio effects.

In a multi participant session, each user can perform the same interactions. The sound produced by each installation is spatialized and changes as you move your avatar in the 3D world.

Each user in the virtual environment is represented by a simple avatar consisting of a body, head, and two hands. The avatar's head orientation is directly mapped to the user's VR headset orientation, ensuring that the avatar's gaze direction aligns with the user's actual view within the virtual environment. The avatar's hands are positioned and oriented to match the user's controller movements. This visual

representation provides a clear indication of the user's current actions, such as selecting WAMs or manipulating parameters.

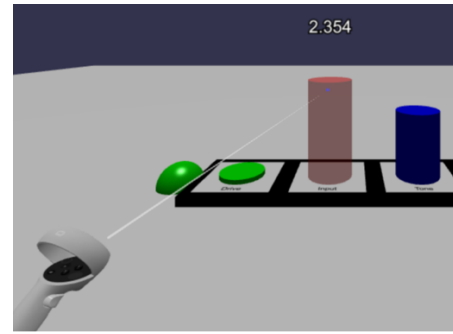


Figure 4: Example of highlighting a parameter.

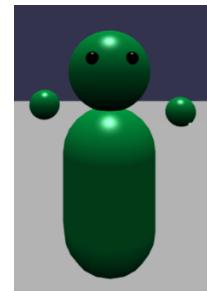


Figure 5: A player's avatar.

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