HTML Web Audio Elements: Easy Interaction with Web Audio API Through HTML

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ABSTRACT
The JavaScript Web Audio API has a powerful but low-level and complicated structure. Therefore, many JavaScript-based wrapper libraries exist, which are intended to simplify its usage. This paper presents a completely new approach, which translates the API into HTML Custom Elements and allows definition, usage and control of complex audio scenarios using only normal HTML elements.

CCS Concepts
- Software and its engineering → Data flow architectures; Frameworks;

1. INTRODUCTION
JavaScript has a foundational influence on modern web application development. This is in particular due to the many new features and APIs which were added to the language over the last years [4, 9]. One of these features is the Web Audio API that enables production, playback, editing and analyses of audio files in a web browser [1]. Because of its low level and partially complicated interface, there are already several libraries that provide simplified wrappers [5, 7]. However, one crucial obstacle remains: the interaction of user interaction layer written in HTML and the processing layer written in JavaScript. In order to simplify this interaction, a relatively new approach is to represent imperative JavaScript objects as declarative, HTML elements. With HTML Custom Elements, which are currently being standardized, new and valid HTML elements can be defined that allow description and controlling of functionality through attributes with normal HTML syntax [2]. By using this concept, our new HTML Web Audio Elements enables purely declarative generation and control of complex audio processing within pure HTML markup and without additional JavaScript interaction.

2. HTML WEB AUDIO ELEMENTS
The main idea of HTML Web Audio Elements is to simplify the interaction between the Web Audio API-driven, JavaScript-controlled audio processing layer and the corresponding HTML-based user interaction layer in an easy and clean way. To achieve this, the HTML Web Audio Elements are divided into two main groups: non-visible elements, which define the functional behaviour and visual elements that expose this functionality to the user. Source code and working usage examples are available at the project homepage www.pub.tgm.io/webaudio-elements.

2.1 Non-Visible Elements
The non-visible elements are intended to translate the Web Audio API core nodes into HTML DOM nodes, which keep the general API’s audio graph structure unchanged. JavaScript properties are represented as HTML attributes and methods as attribute changes. This structure allows communication between different elements by listening for attribute changes via mutation observers [8]. A usage example is given in Figure 1.

Loading Audio Data
The most basic element is the <webaudio-context> element. Using this element automatically instantiates a Web Audio API AudioContext, which all other audio-elements rely on. It should be used as the parent for all associated elements.

Audio data can be loaded and decoded by specifying a <webaudio-buffer> element. Its read-only state attribute reflects the current status: waiting, downloading, decoding, ready or error. Once audio data has been loaded, it can not be changed anymore. Instead, a new element must be created.

Playback
Playback is managed by the <webaudio-source> element, which holds a reference to the corresponding <webaudio-buffer> through its buffer-id attribute. Changing the state attribute to one of playing, paused or stopped controls playback. At the same time, the current audio position is available in the pos attribute. Creating more than one source element referencing the same buffer is possible and provides features such as simultaneously playing the same audio material at different positions.

Audio Processing and Routing
The elements discussed so far only provide functionality for handling, but not for processing audio data. For filtering, gain control etc., processing elements exist, which can be used either in a global context or local source mode. The
3. BROWSER SUPPORT

Even though both the Web Audio API and especially HTML Custom Elements offer completely new implementation approaches, their underlying specifications are neither standardized nor fully implemented in any browsers to date. Therefore, the current HTML Web Audio Elements implementation is a trade-off between proposed specifications, browser vendor announcements and available implementations. Currently, only Chromium-based browsers meet all requirements for non-polylilled, dependency-free execution. However, only features are used which have nearly passed the standardization process and whose realization have already been started by all major browser vendors.

4. CONCLUSIONS

The HTML Web Audio Audio Elements offer a completely new way of creating audio-related web applications. Because of their standardized HTML implementation, all necessary steps to load, play and even process audio data can be performed without writing a single line of JavaScript code. The declarative and hierarchical structure is easy to read and to understand, which makes them accessible to less experienced programmers. However for widespread usage, browser support is essential. It is expected that community-driven development will lead to many more freely available processing elements.

5. REFERENCES