

1st Approach Spatial Sound in X3D/X3Dom

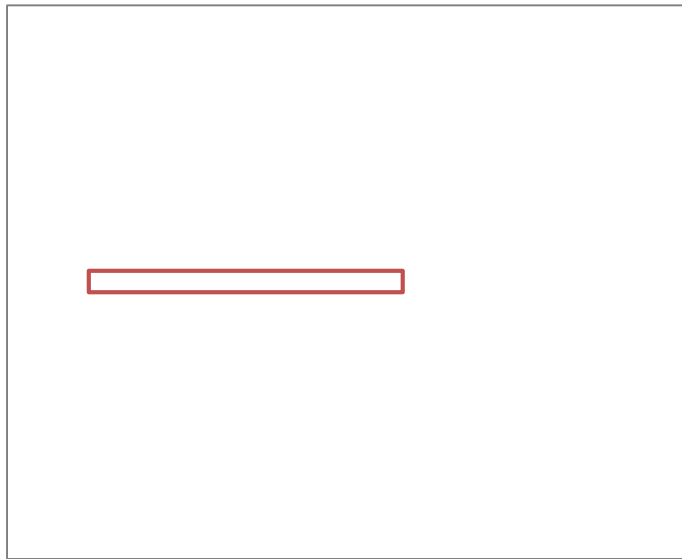
“Wrapping” X3DOM around Web Audio API

Andreas Stamoulias, Eftychia Lakka, Athanasios G. Malamos, 2015

Description of the approach

A method for the introduction of **spatial sound** components in the **X3DOM framework**, based on **X3D specification** and **Web Audio API**.

The proposed method incorporates the introduction of **enhanced sound nodes** for X3DOM which are derived by the implementation of the **X3D** standard components, enriched with accessional features of **Web Audio API**.



Base Components of Sound in X3D-Nodes

X3DSoundNode

```
X3DSoundNode : X3DChildNode {  
    SFNode [in,out] metadata NULL [X3DMetadataObject]  
}
```

X3DSoundSourceNode

```
X3DSoundSourceNode : X3DTimeDependentNode {  
    SFString [in,out] description ""  
    SFBool [in,out] loop FALSE  
    SFNode [in,out] metadata NULL [X3DMetadataObject]  
    SFTIME [in,out] pauseTime 0 (-∞,∞)  
    SFFloat [in,out] pitch 1.0 (0,∞)  
    SFTIME [in,out] resumeTime 0 (-∞,∞)  
    SFTIME [in,out] startTime 0 (-∞,∞)  
    SFTIME [in,out] stopTime 0 (-∞,∞)  
    SFTIME [out] duration_changed  
    SFTIME [out] elapsedTime  
    SFBool [out] isActive  
    SFBool [out] isPaused  
}
```

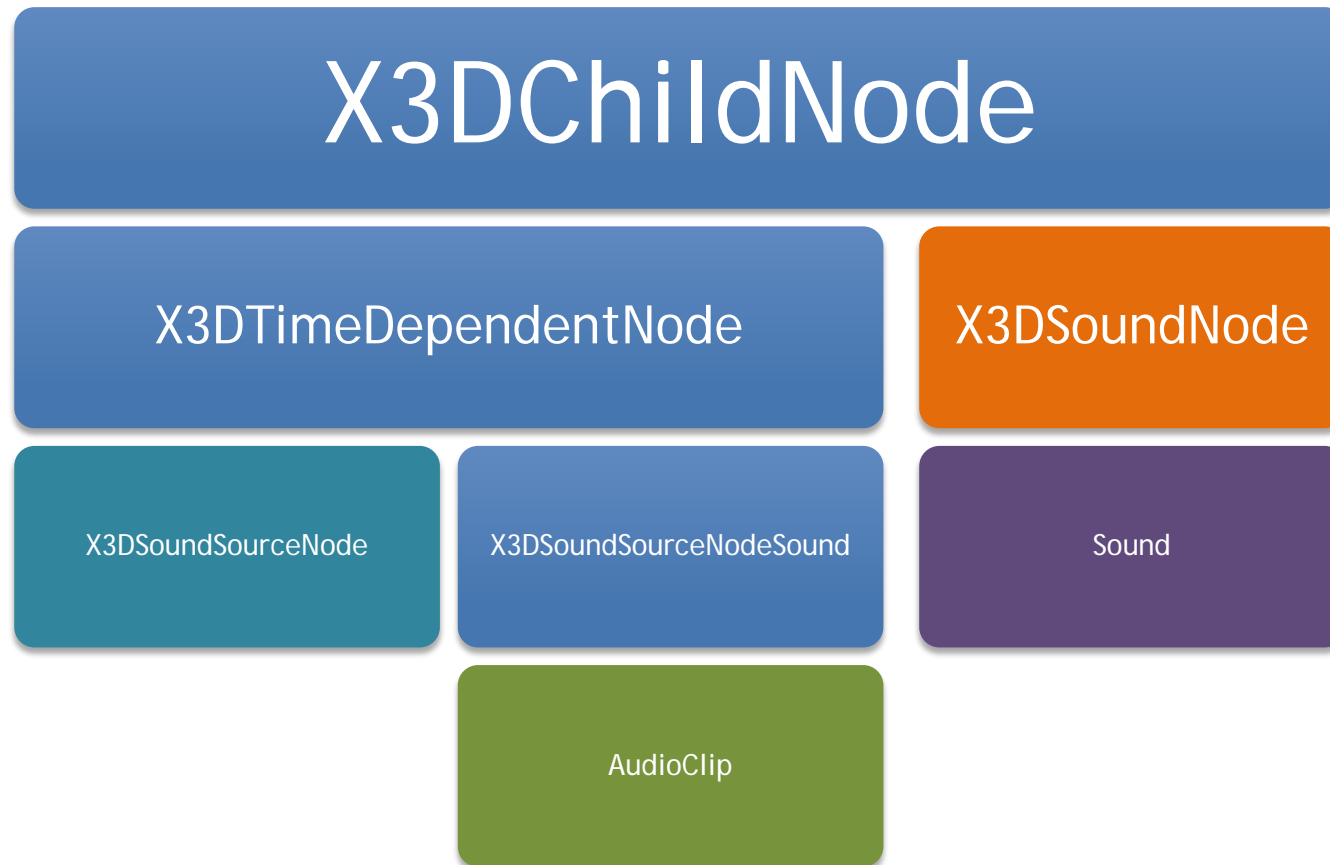
AudioClip

```
AudioClip : X3DSoundSourceNode, X3DUrlObject {  
    SFString [in,out] description ""  
    SFBool [in,out] loop FALSE  
    SFNode [in,out] metadata NULL [X3DMetadataObject]  
    SFTIME [in,out] pauseTime 0 (-∞,∞)  
    SFFloat [in,out] pitch 1.0 (0,∞)  
    SFTIME [in,out] resumeTime 0 (-∞,∞)  
    SFTIME [in,out] startTime 0 (-∞,∞)  
    SFTIME [in,out] stopTime 0 (-∞,∞)  
    MFString [in,out] url [] [URI]  
    SFTIME [out] duration_changed  
    SFTIME [out] elapsedTime  
    SFBool [out] isActive  
    SFBool [out] isPaused  
}
```

Sound

```
Sound : X3DSoundNode {  
    SFVec3f [in,out] direction 0 0 1 (-∞,∞)  
    SFFloat [in,out] intensity 1 [0,1]  
    SFVec3f [in,out] location 0 0 0 (-∞,∞)  
    SFFloat [in,out] maxBack 10 [0,∞)  
    SFFloat [in,out] maxFront 10 [0,∞)  
    SFNode [in,out] metadata NULL [X3DMetadataObject]  
    SFFloat [in,out] minBack 1 [0,∞)  
    SFFloat [in,out] minFront 1 [0,∞)  
    SFFloat [in,out] priority 0 [0,1]  
    SFNode [in,out] source NULL [X3DSoundSourceNode]  
    SFBool [] spatialize TRUE  
}
```

Base Components of Sound in X3D-Structure



Implementation of X3D Sound Nodes using Web Audio API functionality

X3DSoundSourceNode: AudioClip

Node	X3D	Our Approach	
X3DSoundSourceNode: AudioClip	SFString description	SFString description	WebAudioAPI:AudioSource
	SFBool loop	SFBool loop	WebAudioAPI:AudioSource
	SFNode metadata	SFNode metadata	WebAudioAPI:AudioSource
	SFTime pauseTime	SFTime pauseTime	WebAudioAPI:AudioSource
	SFFloat pitch	SFFloat pitch	WebAudioAPI:AudioSource
	SFTime resumeTime	SFTime resumeTime	WebAudioAPI:AudioSource
	SFTime startTime	SFTime startTime	WebAudioAPI:AudioSource
	SFTime stopTime	SFTime stopTime	WebAudioAPI:AudioSource
	MFString url	MFString url	WebAudioAPI:AudioSource
	SFTime duration_changed		
	SFTime elapsedTime		
	SFBool isActive		
	SFBool isPaused		

Implementation of X3D Sound Nodes using Web Audio API functionality

X3DSoundNode: Sound

Node	X3D	Our Approach		
X3DSoundNode: Sound	SFVec3f location	SFVec3f position	Web Audio API: PannerNode	
	SFVec3f direction	SFRotation orientation	Web Audio API: PannerNode	
	SFFloat maxBack SFFloat maxFront SFFloat minBack SFFloat minFront	SFFloat coneInnerAngle		Web Audio API: PannerNode
		SFFloat coneOuterAngle		Web Audio API: PannerNode
		SFFloat coneOuterGain		Web Audio API: PannerNode
		SFString distanceModel		Web Audio API: PannerNode
		SFFloat maxDistance		Web Audio API: PannerNode
		SFString panningModel		Web Audio API: PannerNode
		SFFloat refDistance		Web Audio API: PannerNode
		SFFloat rolloffFactor		Web Audio API: PannerNode
	SFFloat intensity	SFInt32 gain		Web Audio API: GainNode
	SFFloat priority	SFFloat priority		Web Audio API: DynamicsCompressorNode
	SFNode source	SFNode source		WebAudioAPI: AudioSource
	SFNode metadata			
	SFBool spatialize			
		SFVec3f velocity (new)	Web Audio API: PannerNode	

All Web Audio API registered nodes

▶ WebAudioAPI Node

- ❑ AudioSound Node
- ❑ AudioSource Node
- ❑ AudioContext Node
- ❑ AudioNode Node
- ❑ AudioParam Node
- ❑ OscillatorNode Node
- ❑ AudioBuffer Node
- ❑ AudioBufferSourceNode Node
- ❑ MediaElementAudioSourceNode Node
- ❑ MediaStreamAudioSourceNode Node
- ❑ BiquadFilterNode Node
- ❑ ConvolverNode Node

▶ WebAudioAPI Node

- ❑ DelayNode Node
- ❑ DynamicsCompressorNode Node
- ❑ GainNode Node
- ❑ WaveShaperNode Node
- ❑ PeriodicWave Node
- ❑ AudioDestinationNode Node
- ❑ MediaStreamAudioDestinationNode Node
- ❑ AnalyserNode Node
- ❑ ChannelSplitterNode Node
- ❑ ChannelMergerNode Node
- ❑ AudioListener Node
- ❑ PannerNode Node

Example

```
<X3D.....>
<Scene>
.
.
.
<AudioSound>
  <Transform USE='Audio1'/>
  <PannerNode position='0 0 0' orientation='0 0 1 0' velocity='0 0 0' coneInnerAngle='360' coneOuterAngle='360'
    coneOuterGain='0' distanceModel='inverse' maxDistance='10000' panningModel='HRTF' refDistance='1'
    rolloffFactor='1'>
    <PannerNode>
    <AudioSource loop='true' url=""sound/saxophone.mp3" "sound/saxophone.ogg" pitch='1.0' pauseTime='-1'
      resumeTime='-1' startTime='0' stopTime="-1"/>
    </AudioSource>
  </PannerNode>
</AudioSound>

</Scene>
</X3D>
```