Webxophone: Web Audio wind instrument

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ABSTRACT

In last few years, a musical application has developed by developer and computer software company such as sound effects, midi controller, musical instrument for music playing and collaborate musical works in mobile, tablet PC with iPhone or Android. Especially, by Web technologies, Web audio application with Web Audio API have expeditiously studied thought JavaScript that possibility of novel and flexible language. The Webxophone is a web wind instrument designed for mobile with the web and mobile technologies that microphone input (for blowing), multitouch (for fingering button), Gyro sensors, sound processing and synthesis in real-time on the web without install. This paper aims to present a web wind instrument application like saxophone through Web Audio API with JavaScript for musical expression and various musical performance.

CCS Concepts

• **Applied computing** → **Engineering** • **Applied computing** → **Sound and music computing** •**Computer systems organization.**

Keywords

Web Audio instrument saxophone; Web Audio API; JavaScript.

1. INTRODUCTION

Web technologies have gradually developed with JavaScript and HTML5 such as web site, editor: Google doc[1], various library: jquery[2] and multi-media web application for web-browser, mobile and tablet. Capabilities with JavaScript [4] can build various web audio application such as musical instrument and sound synthesizer have developed for musical expression and playing without application install in portable mobile phone with Web-Audio API[3][2][5][7] that multimedia factors for audio processing, synthesizing, visualization and controlling media on the web browser. The Webxophone is a novel web audio instrument created for the mobile phone. Webxophone has designed gently blowing into the microphone, a multi-touch interface of six

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[1] web word editor in online

[2] novel javascript library site:https://jquery.com/

[3] www.w3.org/TR/webaudio

fingering button, and movement by Gyro sensors.

The Webxophone aims to build a web audio wind instrument application thought Web technology for a mobile user, and easiness to play with potable mobile phone. Also, the application can be played through web-browser such as Google web site.

This paper has presented a web wind instrument application like saxophone through Web Audio API with JavaScript for musical expression and various interactive performance on the web browser without application install among a few minute.

2. RELATED WORKS

Mobile music works have been variously provided for interactive performance The Smule Ocarina [13] is a wind instrument for the iPhone with microphone input, multitouch fingering, accelerometer sensor and sound synthesis. In this mobile musical instrument, it seems flute-like and works via breath-control with touch finger-holes. However, it has built for iPhone with Chuck that audio synthesis programming language. Also, we should download and install in app store. The Pocket Gamelan project [9] by Greg Schiemer is performed with mobile phones to create sound effects with the speakers thought networking system. Microphones in mobile have been used to control and to use for sound synthesis that lives. Pocket Gamelan has presented an interactive performance with mobile phones. The Cellphonia [12] is an open source cell phone karaoke that uses the micro-phone for audio online stream-cast. CaMus [10] project that mobile phones can be used musical performance device such as visual tracking system of cameras of mobile phones for widely used performance interface for musical interaction. Also, there are numerous Web audio works that library and expended frameworks. Interface.js [11] has presented control of sound framework that works with mouse control, touch screen in PC or mobile phone. Also, Gibberish.js [11] is a useful sound effect library and framework for audio processing that can be used in mobile and tablet PC. Other example libraries, web audio expanded : WAAX[8] [6] was developed to control audio processing based on Web Audio API that WAAX has served an audio framework for application Such as a library, Audiolib.js [3] was an audio processing library for web audio. It enables to created sound effects and provides to build the audio framework. Tuna.js [1] is also an audio processing library for web audio application for musical expression.

3. WEBXOPHONE DESIGN

The Webxophone aims to build a web audio wind instrument application thought Web Audio API with HTML5 for computer musical playing, and to control without application install on a mobile phone. Also, the application can be played thought web-browser. The design concept of the web instrument application is comfortable to play and control, and easiness to use without added practice. This is a web instrument not only for musicians but also non-musicians.

Figure 1. shows a six fingering button and tree control but-ton with each role in the mobile phone.
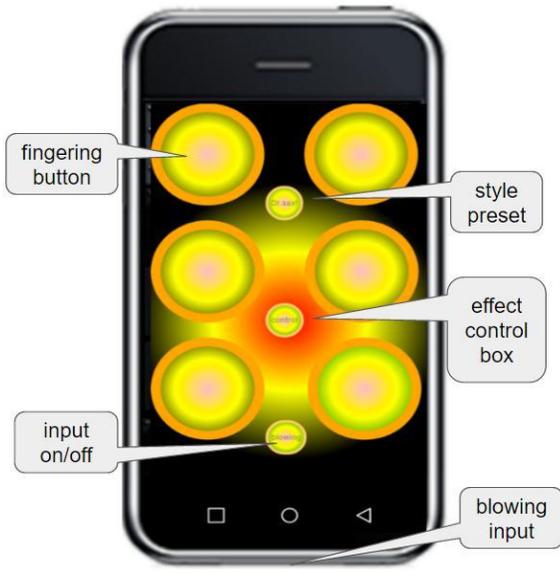
Figure 1. Functions of button.

3.1 Application Structure

Basically, the structure of web audio wind instrument can be separated into four parts : 1. main fingering and control screen, 2. preset box, 3.effect control box, 4. on/off switch.

3.2 Motion Data through the Gyro Sensor

Generally, the musician makes gestures as the mood of the music flows. The player has no gestures in the intro of the music, as the playing music is building up that changes and a musical emotion become dynamic, the player's gesture and emotion are depending the rhythm, like a dance. Moreover then, a player is lifting up the instrument or mic which is a usual gesture in the climax section, is generally performed with high pitched melody. Also, playing a fast phrase is uncomfortable for sustained high-pitched. Lifting up and Lifting down is the most gesture of instrument player and singer. By using Gyro sensor, such gesture of performer is converted to digitized sensor value with natural. Also, the collected data from an improvised performance is a useful resource to control acoustic effects or other media in real-time. [Table 1] is about the range of Gyro data from performer's gesture and digitized tilt value.

Table 1. Data Value of Gyro Sensor

	Angle	Data
normal	0	0
lift up	0 - 45	0 - 1000
bending forward	0-60	0 - -1000

As shown in [Figure 7], tilt value of tilt sensor is 0 when normal playing form, 45 when the Webxophone is raised up, and -60 when it is inclined to the player's body. The player is free to set conversion range of sensor data for the performance.

3.3 Data from mic speakerphone

The microphone receives volume data from very soundless breath to strong blow, and converts into a range of 0 to 1. This feature also allows controlling the data in addition to the melodic elements, acoustic material like blowing to control parameter data.

3.4 Data through fingering button

To play the instrument and controlling interface smoothly, fingering button are placed on six yellow circle button which can be changed during touch on button gives high accessibility to the performer. Especially, the button is designed to be controlled by six fingers, and very effective for the sound processing and sound effecter parameter control on the setting of the presets. The Webxophone have developed pentatonic scale and tree octave that six fingering button show each note and octave. Also fingering style is a similar piano that the one button plays one note. Also by an angle of lift up and lift down with Gyro sensor in the mobile phone can control octave position.

Table 2. Music note Features

Mode	Set
scale	pentatonic
scale range	3 octave
fingering	like piano

In this section, we have suggested scale note and fingering style to novel web audio application.

3.5 Sound Control Box

Figure 2. Sound control box screen.

The sound control box is sound setting and sound data control window. Basically, the web has build Frequency Modulation Synthesizer that main sound timbre harmony fingering pitch, modulator frequency and depth value. Also subtractive synthesis is similar filter effects. We can control "cutoff" and "resonance" value. For smooth sound, we have set stereo reverb. Figure 2 shows slide and dial of data parameter in sound control box.

Table 3. Sound Processing

Mode	Type
main timbre	FM synthesizer
modulator	subtractive synthesis
effect	stereo reverb

3.6 Webxophone instructions

We have presented using Webxophone instruction for musical playing.

1. Open a Chrome browser and access website: https://drsax.github.io/DrSAX/DrSAX/webxophone.html and allow mic input alert window.
2. Turn on below small button(on/off) and test micro-phone.
3. Touch a fingering such as piano playing and blowing in same time.
4. Control a pitch note by gesture that lifts up and lifts down.

4. PROGRAMMING

Generally, webxophone has developed with Web Audio API in javascript and HTML5. The main timbre of sound is Frequency Modulation Synthesizer(FM) with Subtractive Synthesizer and reverb. We have designed value control of FM: modulator frequency and depth, cutoff and resonance of subtractive Synthesis and reverb gain.

4.1 Sound of Webxophone

```
1   var osc = context.createOscillator();
2   var reverb_convolver = context.createConvolver();
3   var masterGain = context.createGain();
4   var lowpass =context.createBiquadFilter();
5       navigator.webkitGetUserMedia({
6                audio: true,
7                video: false
8       },
9   function(stream){
10    mic = context.createMediaStreamSource(stream);
11    },
12  function(error){
13    alert('Unable to get the user media');
14        }
15   );
```

Listing 1: Setting sound of Webxophone

Listing 1. presents the setting sound of Webxophone that from line 1 to 4 shows oscillator, reverb, gain and filter. Line 4 is kind of filter, it is used for Subtractive synthesis. It has 2 data value that "cutoff" and "resonance". From 5 to 15 shows audio input setting by "GetUserMedia". It works only "https://" because security in Chrome.

```
1.  function micInputon() {
2.    mic.connect(analyser);
3.    osc.connect(lowpass);
4.    lowpass.connect(amp);
5.    amp.connect(reverb_Gain);
6.    amp.connect(masterGain);
7.    masterGain.connect(context.destination);
8.    osc2.connect(amp2);
```

```
9    amp2.connect(amp3);
10   amp3.connect(osc.frequency);
11       osc.start();
12       osc2.start();
13       backReverb();
14       frameLooper();
         }
```

Listing 2: Connecting units

Webxophone have built audio input and FM synthesizer and subtractive synthesizer and reverb. In Listing 2, Line 2. shows audio input connecting "analyser" for getting input data value by blowing. From line 3 to 7, FM Synthesizer connected subtractive synthesizer to reverb to main out. From line 3 to 7 shows FM synthesizer connecting. From line 11 to 12 execute "osc" and "osc2", From line 13 to 14 shows reverb using and audio input data control.

4.2 Fingering Button

Fingering button can control musical note by touch screen and degree of mobile. Listing 3. show touch button with setting pitch note. From 2 to 9 is to set touch data and to change color gradient of a button. From 10 to 16 shows pitch note of degree in mobile that lift up, lift down and normal.

```
1 box3.addEventListener('touchstart', function(e){
2 var touchobj3 = e.changedTouches[0]
3     startx3 = parseInt(touchobj3.clientX)
4  statusdiv3.innerHTML = startx3 + 'px'
5  e.preventDefault()
6  document.getElementById("box3").setAttribute(
7          "style","background: radial-gradient( pink, red,
black)");
9       osc2.connect(amp2);

10      if(sensor > 1)
11         { osc.frequency.value =  c_note*4; }
12      else if(sensor < -2)
13         { osc.frequency.value = c_note; }
14      else
15         { osc.frequency.value =  c_note*2;}
16   }, false)
```

Listing 3: Pitch control by button and degree

4.3 Effects Control

In listing 4, from line 1 to line 8 presented a preset data setting that FM frequency and reverb gain, cutoff data, resonance and main out gain. We can control data value by dial and slide in sound control box that FM synthesis (moduallator frequency : 0 to 2000, depth : 0to2000), subtractive Synthesis("cutoff : 0-2000", "resonance" : 0-20), reverb(gain : 0-1). From line 9 to 13 shows pentatonic scale frequency of each note that change 3 octave by an angle of lifts up, lifts down and normal in a mobile phone.

```
1 function timbre(){

2      amp.gain.value = 0;
3      osc.frequency.value = 0;
4      osc2.frequency.value = 0;
5      amp2.gain.value = 1000;
6      reverb_Gain.gain.value = 0.3;
7      lowpass.frequency.value = 1037;
8      lowpass.Q.value  = 20;

9      g_note=392;
10     a_note=440;
```

```
11    c_note=523;
12    d_note=587;
13    e_note=659;

14    }
```
Listing 4: Effects data setting

5. PERFORMANCE

The Webxophone presented in this work is based on the Web Audio API in javascript for web wind instrument (Figure 3).It works fingering button and degree and audio input of microphone. We have played a Webxophone for a demo: https://youtu.be/jYfYbFA_kUo.

5.1 Discussion

From demonstration video, we thought strengths and weak-nesses of the feature of Webxophone which have been mainly used.

(1). The Webxophone has an advantage of connecting with web browser easily and fastly. Therefore many users can enjoy it simultaneously. However then, it is difficult to control that on/off and to play without practice or explanation.

(2).The Webxophone needs a preset optimized and an-other control web application such as separated sound control box. Actually while playing, we can not control sound timbre or parameter value. If we have a control web application with another mobile and tablet, Webxophone can be controlled in real time while playing.
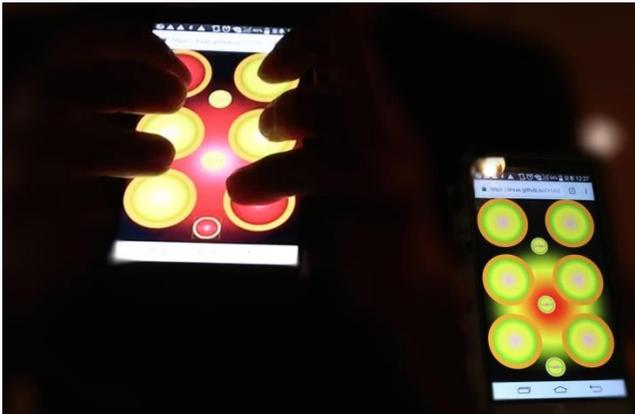

Figure 3. Playing Webxophone.

6. CONCLUSIONS

In computer music field, Musical application has expeditiously developed by computer musician and mobile company for musical playing with mobile users. This paper aims to present a web wind instrument application through Web Audio API with JavaScript for musical expression and various musical performance.

The Webxophone is a web wind instrument designed for mobile with web and mobile technologies that microphone input (for blowing), multitouch (for fingering button), Gyro sensors, sound processing and synthesis in real-time that gets a sound input data through microphone in the mobile phone by blowing of a user. The webxophone can be played octave frequency pitch by an angle in a mobile-phone that lift up, normal and lift down. By this technology in the mobile phone, we can build novel web wind instruments that can easily be created with real-time audio processing, sound effects, and media installation work with artistic emotions for interactive musical works on the web page without application install in real time.

7. WEBXOPHONE SITE

We have served Webxophone application on the web site to a user. Site of web application link is showed below.

• Webxophone: The mic position is on the top.

https://drsax.github.io/DrSAX/DrSAX/webxophone.html.

• Webxophone: The mic position is below

https://drsax.github.io/DrSAX/DrSAX/redphone.html.

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