A Vision of Sound

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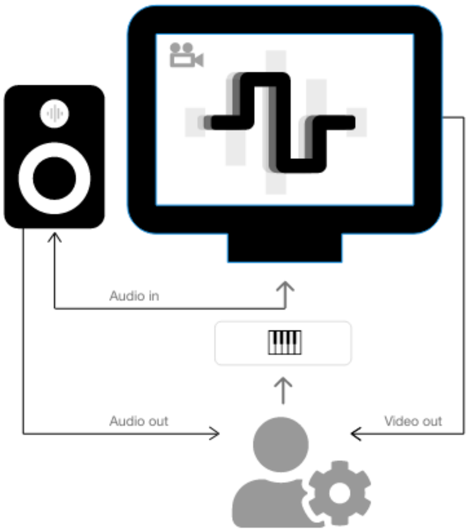
http: https://www.doc.gold.ac.uk/~pkins001/web/VisionofSound/index.html

(use Google Chrome for best performance)

Project Description

A Vision of Sound is an online interactive installation using synthesis to visualise and explore how sound waves have shaped our world and imagination.

The project will be run from within a webpage with animations and generative art guiding the audience visually through a number of different topic-based scenes.
A built-in synthesiser with the option of 5 different oscillators and effects will be provided within the system allowing the user to generate sounds.
The synthesiser will be triggered using the computer keyboard and a user interface will be provided to allow the audience to select animations and manipulate the sounds, in turn animating the artwork.
The diagram (right) shows the signal flow of information as the user makes a decision based on what they read, hear and see.



We hope to provide an insight into the use of soundwaves as well as the affects in our world.

Audience Participation

Through participation this experience will spark an interest in how soundwaves can be used artistically as well as in the world of science. As we cannot see sound, we hope to bring this visual element to life providing relevant animations along with detailed narratives to help explore a selection of topics.
Allowing the audience to generate sound and witness real time effects to the visualisation will create an immersive and individual experience.
A user interface will make the project easy to use, presenting controls to manipulate sound and a built-in instruction manual, narrative menus and buttons to select animations. Hot keys will allow quick access to the menu system.

Testing

Project Proposal and development:

The initial project proposal has been tested on a number of students who have submitted feedback.

Through this response changes were made to the format and design of the poster as well as to clarify the topics which would drive narrative behind the animations. This was extremely important in early development to make sure the proposal was understood, and a connection could be made with the animations.

Prototype testing 1:

The first prototype showed basic animations responding to microphone input through the computer and basic GUI elements were provided to allow the user to make changes to the animations. Feedback was positive towards the visual aspect but engagement towards the narrative would benefit from further clarification of the topic and theme of the project.

Participants in the testing phase were asked how this could be more immersive and the response was to add synthesis allowing the audience to create sound and see visual effects from their actions.

This led to a decision to focus on synthesis using the maxilib library and removing microphone input and the p5.sound library helping to optimize performance.

To encourage engagement using the synthesiser a fully functional GUI will be provided with rotary control, this design based upon a Korg Monologue synthesiser (right).

Prototype Testing 2:

Response to a developed prototype was overall positive however some recommendations were made including:

- changing the colour of the control panel to re-focus the viewers eyes on the animation.
- resizing the control panel, so it fitted across the bottom of the screen.
- Improve the GUI and add more features and menu options.

Final testing:

The last testing stage demonstrated to a number of students a fully developed version of the project. Response to feedback included a number of changes:

- changing text size and colour of the built-in instruction manual and menus to aid easy reading of the text.
- adding buttons to select animations along the bottom of the screen. These buttons are also highlighted when selected to show which animation is currently on display along with a title of the animation.
- enabling the user to show or hide the control panel
- allowing the user to capture a screen shot of the animation
- creating buttons with easy to read labels to show/hide the control panel, show/hide the narrative and show/hide the instruction manual.
- further development of the control panel included changing size, colour and position of text as well as removing values from the rotary knobs leaving a cleaner looking display.

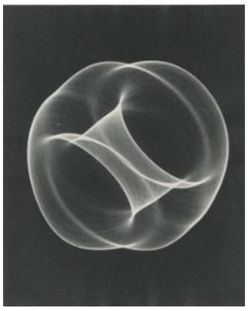
You tube video link documenting project progression:

Animations & Narratives

Scene 1: oscilloscope.

A simple oscilloscope used to help the audience see the shape of a soundwave.
This can be useful to reference wave forms showing a variation of shapes as the synthesizer is manipulated. [1]

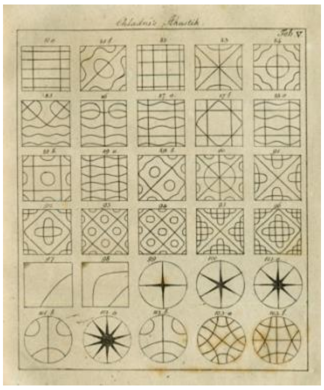
Scene 2: The art of sound.



Ben Laposky Oscillon 40

Inspired by Ben Laposky's 'Oscillons' created in 1953 and "one of the pioneers of electronic art" [2]. This sketch demonstrates how sound waves have been used to create art. This animation replicates some of Laposky's work with an oscilloscope.

Scene 3: Science and Shape.



Chladni figures [4]

In space sound exists in the form of electromagnetic vibrations that pulsate in similar wave lengths as sound waves. Taking inspirations from NASA's "sounds of the sun" [3] and how they used technology to capture sound in space.
This animation is also reflective of an experiment created in the 18th century when **Ernst Chladni** invented a technique to show the "various modes of vibration of a rigid surface creating patterns which naturally occur" [4]. Some of these shapes appear in this animation.

Scene 4: cellular symphony.

Discover the rhythmic sound of living cells, based on an experiment by James Gimzewski and Andrew Pelling who "first made the discovery that yeast cells oscillate at the nanoscale" [5].

Scene 5: Seismic activity.

Earthquakes create seismic waves which "pulse through the layers of earth below and on the surface" [6], invisible to human eyes and ears but observable as sound waves which can be recorded and monitored to provide advance warning of a coming seismic event. This animation demonstrates waves moving through a mountainous terrain.

Scene 6: Oceanic square.

Both soundwaves and waves in the sea share some properties: “periodicity in both space and time, frequency, amplitude, wavelength and velocity” [7].

This scene demonstrates how different types of energy effect the sea from manmade disturbance, for example “the stranding of whales from sonar” [8] and environmental phenomena like a square wave which can cause dangerous currents.

Scene 7: Sonic Boom

A sonic boom is a loud noise created when an aircraft flies through the sound barrier.

As sound is triggered the particles are drawn towards the centre of the animation representing a “cone of pressurised air molecules” or “shockwave” [9]. As the trigger is released the molecules move apart representing an aircraft moving “faster than the speed of sound or Supersonic” [9].

Scene 8: Noise Pollution

This animation explores the effect of noise pollution within a city and how it can affect our lives. “Excessive noise can have detrimental effects on human health, amenity, productivity and the natural environment. “[10].

The Buildings represent a bustling city whilst the landscape and rain symbolize the effect of noise pollution on the environment and our mental state.

Scene 9: Chromesthesia

Chromesthesia is a phenomenon in which hearing is simultaneously perceived with sights or feelings of colour. It is defined as “the eliciting of visual images (colours) by aural stimuli” [11]. “Chromesthesia evokes strong emotional connections to music because the listener associates different pitches and tones to certain colours, which in turn, produces specific feelings.” [12].

In this animation sound modulates the shapes and the mouse position controls the background colour and changes the structure of the forms demonstrating the use of multiple senses.

Tools and Technical aspects:

- Generative art and animations created in JavaScript.
- Maxilib Library to create a synthesizer.
- Rotating knobs Library.
- Computer keyboard used to trigger sounds.
- Audio monitors will be required to create sound.
- Web Access.

Challenges

The most challenging part of the project will be making the audio signal create interesting and relevant alterations of the animation & art, it is important that the concept is not lost through experimentation and the visuals do not overwhelm the observer.

Creating sounds can take much processing power so it is important to consider this when creating animations so as to optimise performance and prevent the sound quality from distorting. Due to this problem some animations have had to be reduced in size in order for the project to work efficiently.

Initially 3D animations were to be used within the project, however this caused deterioration in sound quality and it was necessary to remove WEBGL so as to improve performance.

On the home screen one 3D animation has been used as a display, this animation responds to the microphone input on the computer.

The extension from the original proposal was applied to create a synthesiser to modulate the sounds, in all this made for a more immersive experience.

Code examples

Code for animation of Scene 2: Artistic Influence.

```
function circles() {
   for(var i = 0; i < 40; i++)
   {
     push();
     noFill();
     strokeWeight(2);
     stroke(i*15, ndb * 100)
     translate(width/2, height/2.5)
     rotate(ndb*input);
     ellipseMode(CENTER)
     ellipse((i * sigBuf[i] + ndb),//x pox
           i * 2 + (1+ndb),//y pos
           300 + (sigBuf[i] * 1000), //width
           100 + (sigBuf[i] * 5000)) //height
     pop();
   };
};
```

Code for Synthesiser:

```
//SINE WAVE
  var sin_osc_sig = ((sin_.sinewave(freq + sin_freq + mod) * ((osc_Am.sinewave(Am_freq) + 1)/4))) * sin_amp;
  var sin_sig = sin_osc_sig * env_0.asr(attack_time, release_time);
  //sin cell envelope
  var cell_sin = sin_osc_sig * env_1.ar(3, 3);
  //////////////////////////////////////////
  //SQUARE WAVE
  var sq_osc_sig = ((sq_.square(freq + sq_freq + mod) * ((osc_Am.sinewave(Am_freq) + 1)/4)) * sq_amp);
  var sq_sig = sq_osc_sig * env_0.asr(attack_time, release_time);
  //cell trigger
  var cell_sq = sq_osc_sig * env_1.ar(3, 3);
  //////////////////////////////////////////
  //SAW WAVE
  var saw_osc_sig = ((saw_.saw(freq + saw_freq + mod) * ((osc_Am.sinewave(Am_freq) + 1)/4)) * saw_amp);
  var saw_sig = saw_osc_sig * env_0.asr(attack_time, release_time);
  //saw cell envelope
  var cell_saw = saw_osc_sig * env_1.ar(3, 3)
  //////////////////////////////////////////
  //TRIANGLE WAVE
  var tri_osc_sig = ((tri_.triangle(freq + tri_freq  + mod) * ((osc_Am.sinewave(Am_freq) + 1)/4)) * tri_amp);
  var tri_sig = tri_osc_sig * env_0.asr(attack_time, release_time);
  //cell trigger
  var cell_tri = tri_osc_sig * env_1.ar(3, 3);
  //////////////////////////////////////////
  ///WHITE NOISE
  var noise_osc_sig = ((whiteNoise(0.2) * ((osc_Am.sinewave(Am_freq) + 1)/4)) * noise_amp);
  var noise_sig = noise_osc_sig * env_0.asr(attack_time, release_time);
  var cell_noise = noise_osc_sig * env_1.ar(3, 3);
```

logic for button animation selection:

```
    //////SELECT ANIMATION1/////////
    if ((mouseX > this.bX - 13 && mouseX < this.bX + 12)
        && (mouseY > this.bY - 12 && mouseY < this.bY + 13))
    {
      key1 = true;
      /////////////
      key2 = false;
      key3 = false;
      key4 = false;
      key5 = false;
      key6 = false;
      key7 = false;
      key8 = false;
      key9 = false;
    }
```

Function and logic to show/hide controls when clicking a button.

```
  this.clicked = function()
  {

    if ((mouseX > this.bX - 35 && mouseX < this.bX + 35) ///VIEW CONTROLS//
        && (mouseY > this.bY - 12 && mouseY < this.bY + 13))
    {

      if (viewControl == false)
      {
        viewControl = true;
      }
      else if (viewControl == true)
      {
        viewControl = false;
      }
    }
```

Bibliography

JavaScript Libraries:

p5.Js [online, JavaScript Library], *used to create the animations.*

p5.Sound [online, JavaScript Library], URL. *used for microphone input.*

MaxiLib and MaxiExtras, [online, JavaScript Library], URL. *Used for creating the synthesiser.*

Rotating knobs: Created by: Miles DeCoster, [online, JavaScrip library], URL. *Used for creating GUI on synthesiser*.

Technical References, includes sources and inspiration used to create sound visualisations:

creative audio visualizer [online, article], URL.

Mike Brondbjerg, 2019, Explore data visualisations with p5.js [online, article], URL.

Daniel Shiffman, 2016, Code Train: Loading Sounds [online, video tutorial], URL.

Daniel Shiffman, 2016, Code Train: Circular Graphing [online, video tutorial], URL.

Daniel Shiffman, 2016, Code Train: Graphing Amplitude [online, video tutorial], URL.

Daniel Shiffman, 2016, Code Train: Microphone Input [online, video tutorial], URL.

Daniel Shiffman, 2016, Code Train: Amplitude Analysis [online, video tutorial], URL.

Daniel Shiffman, 2016, Code Train: Terrain Generation [online, video tutorial], URL. *Scene 6, Seismic activity.*

Daniel Shiffman, 2016, Code Train: Sound Visualization: Frequency Analysis with FFT [online, video tutorial], URL.

Scientific Research, includes sources used as an inspiration defining the topics:

[1] Chattopadhyay, D. (2006). Electronics (fundamentals And Applications). New Age International. pp. 224–225. ISBN 978-81-224-1780-7. Research into an oscilloscope and its uses.

[2] Ben Laposky, 'Composite Oscillons', V&A [online, article], URL, *Scene 2, the art of sound.*

[3] Sounds of the Sun | NASA [online, article], URL, *Scene 3, Shape and Science.*

[4] Ernest Chladni, Entdeckungen über die Theorie des Klanges, 1787, [book], *Scene 3, Shape and Science.*

[5] The Rhythmic Sound of Living Cells [online, article], URL, *Scene 4, Symphony of cells*

[6] British Geological Survey, Seismic Waves [online, article], URL, *Scene 5, Seismic Waves.*

[7] Chris Woodford, Sound [online, article], URL, *Scene 6, Oceanic Square.*

[8] Underwater Noise: Consequences, Ocean Care [online, article], URL, *Scene 6, Oceanic Square.*

[9] NASA Armstrong Fact Sheet: Sonic Boom, 2017 [online, article], URL, *Scene 7, Sonic Boom.*
[10] Environmental noise: Department for Environment , 2014 [online, article], URL, *scene 8, Noise.*
[11] Anderson, Errol. "Chromesthesia: Feeling Music in Colours," *Noisey: You Need to Hear This*, 2013, [online, article], URL, *scene 9 chromesthesia.*
[12] Makhlin, Jessica, "Chromesthesia as Phenomenon: Emotional Colors" (2014). Writing Programs. 12, *scene 9 chromesthesia.*

General Research, used to develop the proposal:
Seeing Sound [online, article], URL.
Imagination can change what we hear and see [online, article], URL.
We turn brainwaves into sound for music and medicine [online, article], URL.
Sound waves, Geometry and Patterns , [online, article], URL, *Scene 3, Shape and Science*
Applications of sound wave technology [online, article], URL.

Web Development:
mmtuts, 2018. [online, video tutorial], URL, *General layout and design:*
Rizwan Khan, image gallery slider 2016, [online, video tutorial], URL, *image gallery slider.*
easy tutorials, Contact Form, 2018, [online, video tutorial], URL, *Contact Form.*