Developing a Room Calibration System

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Name
Ema

Level System Current Progress & Prototypes

SPL Conversion From Microphone Sensitivity

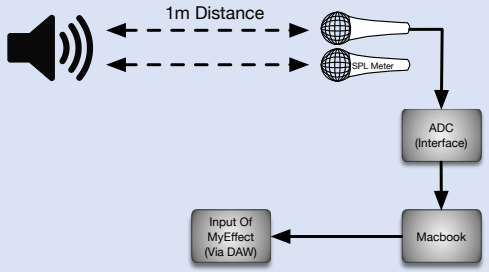
The main issue in developing the level system was understanding how to maintain an accurate SPL reading while considering the different amplification stages within the signal chain.

$$94 + 20\log_{10}\left(\frac{\text{Input RMS}}{\text{Microphone Reference}}\right)$$

Equation to Convert to SPL from known microphone reference sensitivity

Microphone Calibration

Calibrating the microphones directly into MyEffect was the solution to maintaining accurate SPL readings. The calibration process is described below:



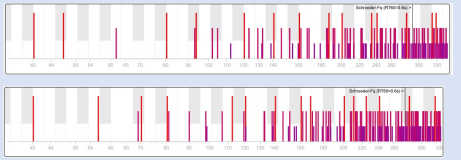
Current Prototype Features

- ❑ **SPL Response – Sets the window size in terms of the RMS calculation which will determine either a 'Fast, Medium or Slow' SPL reading**
- ❑ **Microphone Choice – Sets reference for SPL calculation in relation to the microphone being used for calibration**

Frequency System Current Progress & Prototypes

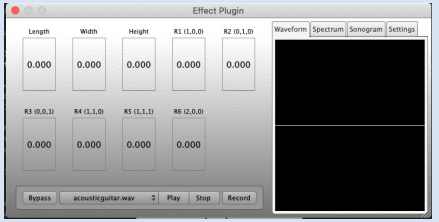
Room Mode Predictive software

Room mode predictive software was used to analyse 8 different home studio listening environments.



Prototype Room Mode System

The prototype system calculates some of the lowest frequency room modes within a selected room and sets adjustable bandpass filters to these room mode frequency's so they can be manually attenuated.



Prototypes Video Link:

Objectives

- **To understand and analyse the current industry leading software-based room correction/calibration systems**
- **Produce an operational level calibration system**
- **Produce an operational frequency response calibration system**
- **User testing provides evidence of perceptual benefits through the application of the system**

Proposed Systems (User Standpoint)

Frequency Response System

A calibrated microphone is setup in the listening position → Twelve sine wave sweeps will be output while a user slowly moves the microphone around the listening position → The plugin will calculate the room response by averaging the dB discrepancy from the recorded sweeps in relation to a flat response → The room response curve will instigate a filter bank to flatten the room curve and provide a theoretical 'flattened response' in the listening position

Level System

Microphone Placed in LIstening Position → User Sets Desired dB SPL Level → User Sets Desired Weighting A or Z → Noise Signal Output Through Loudspeakers

Microphone Records Noise Signal Connected to Input of Plugin → Plugin Processes SPL Calculation and Displays Output → User Adjusts Monitoring Levels Until Desired dB met → End Tone/ Pattern Plays Signalling Test Complete

Paths to Systems Completion

The paths describe the core elements of each system which still need developing to have completed operational systems .

Level System

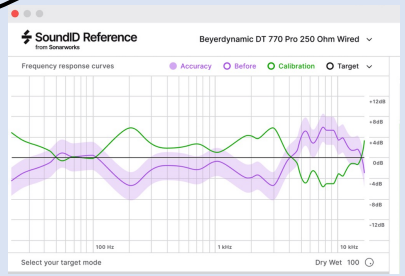
A Weighting Filter Design → Solve Interface Preamplifcation issue → Develop Dynamic Gain System

Frequency System

Accurate Microphone Frequency Calibration → Develop Test Sequence → Develop Room Curve Comparison Method → Design Automated Filter System

Room Correction Software Analysis

The functionalities of the software's detailed below were used as a guidance to create the systems for this project.



- **Room EQ Wizard -** Room acoustic measurement software which contains SPL configuration functionality.
- **ARC System 3 -** Contains a correction system which mirrors the frequency test process proposed in this project.
- **Sound ID Reference –** Correction software which operates in a similar fashion to ARC 3 but has varying variables such as the amount of sine sweeps within correction process.

A Psychological Analysis on the use of Repetitive Music in Film


Objectives

- To see if music affects the human unconscious
- To see how repetitive music affects the brain
- To find out why film directors use repetitive music in films

Methodology

- A questionnaire was created with 15 questions to get further findings on repeated background music in film
- 47 participants took part in the questionnaire
- Findings from the questionnaire are still being analysed
- A virtual study has also been given to 10 participants
- This virtual study consists of listening to different repetitive clips

Evaluation

Strengths: A wide sample size makes findings more accurate

Limitations: Had to limit the number of questions so that participants wouldn't click through when fatigued.

Also, the results from the online study have been affected from uncontrollable variables that could have been controlled if in person.

References

- Enterprise (2020) *How Music Affects the Brain.* Available from: https://enterprise.press/stories/2020/06/01/how-music-affects-your-brain-16468/
- Science Daily (2019) *Why is the Brain Effected by Harsh Sounds.* Available from: https://www.sciencedaily.com/releases/2019/09/190920111349.htm

Background Context

Music and the unconscious mind

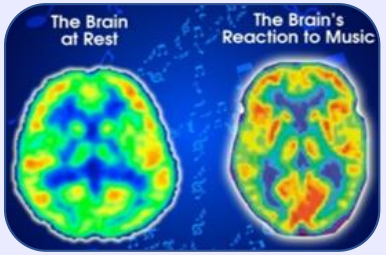
Music can effect the unconscious mind in many different ways from changing your mental state, helping your memory to changing your way of thinking. The unconscious mind occurs below the level of consciousness that deals with deeper mental processes, Freud (1900) was the first to start exploring this idea of an unconscious. Researchers have even found that listening to music can shown improvement in patients in comas.

Repetitive music on the brain

Repetitive music has shown to have lots of psychological effects on humans, both good and bad. It can trigger different emotions, such as relaxing the mind, and it can also enhance learning and development. Rhythmic repetition can mesmerise us but not as much as music.

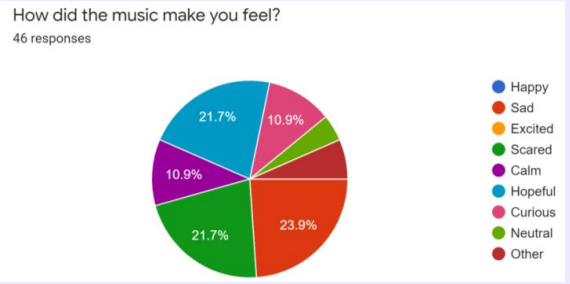
Background music in film

Background music is used to add emotion and to also set the scene in a film. Specific music is repeated in different scenes to both inflect emotions in different ways in the viewer and also to help build a sense of community and familiarity. According to Gorbman (1990) there are seven different principles of film music.

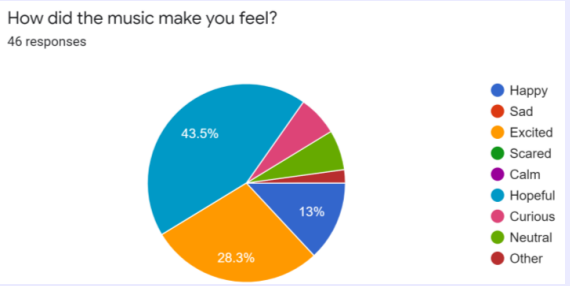


Conclusion

- Findings from the questionnaire show that emotion is influenced by background music in films, and that the same piece of music can create different emotions in different scenarios
- My predictions for the findings of the study is that repetitive sounds can trigger different emotions as well
- This is because once the brain has discovered a harsh sound it activates the amygdala, hippocampus and the insula, which are all areas related to aversion and pain, which is why some people might find repetitive sounds annoying (Arnal, 2019)



These graphs show participants emotions towards the same piece of film music played in different scenes



CUBES

PROJECT AIMS

a) Complete a literature review of VRMI, VMI, Computer Music Controller and Music Games design principles and state of the art.

b) Develop an interface capable of both innovative and canonic interactions (Carranco J, 2018).

c) Create a mapping system capable of linking Unity inputs to an audio device within a low-latency environment.

d) Implement an Audio Engine for Cubes, which should be capable of: sequencing, synthetizing and sampling sounds.

e) Research software development paradigms while deepening the knowledge of different languages such as C# and Max/Msp.

f) Develop and build a custom 3D VR based Unity project to work as Cubes' User Interface, the program should have a satisfying and comprehensive UX.

INTERFACE

The UI is entirely developed using the Unity Editor and it is composed by a series of cubes. Two of the faces of the cube are interactable and contain the interface of a virtual instrument. The cubes are capable of being twisted, rotated and moved around the 3D field, their position on the X, Y, Z axes affects some of the sound qualities (such as volume and panning). A good care is gone into designing how things are going to move, not only how they will look (Wang G, 2014).

MAPPING FRAMEWORK

Between the two major systems for audio data networking, MIDI and OSC, the latter has been chosen for its proven compatibility with the Unity engine. The focus has been put on creating a "transparent", fast mapping system, keeping in mind that the link between every gesture and the consequent sound modification should be very clear (Frisson C, 2021).

AUDIO ENGINE

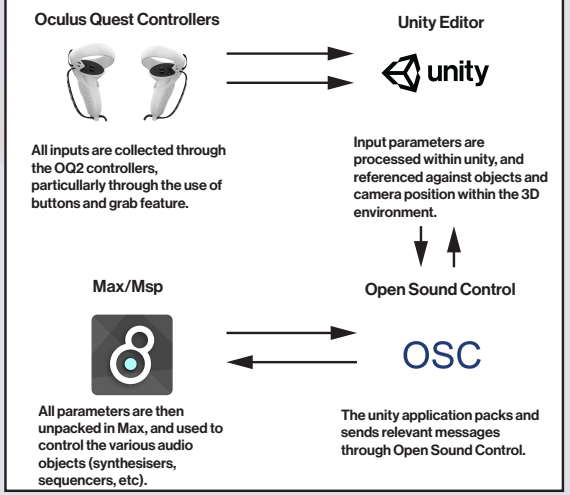
All the audio processing happens in Max/MSP patches. Here the sound is synthetised, sequenced and output too, some informations about the audio are then sent back in order to achieve user feedback and help the user interface with the application.

PROTOTYPE VIDEO PRESENTATION

QR Code

Link

SYSTEM OVERVIEW



WHAT'S NEXT

Involve musicians to test the project functionalities.

Further develop the first quantized instruments using the feedback collected

FEBRUARY

Tighten up the software of the project.

Develop a second instrument and map it.

Run final feedback sessions.

Start sketching a project report.

MARCH

Analyse feedback, make adjustments.

Try to meet at least one of the stretch goals.

Tighten report content for final submission.

APRIL

Project Submission.

UWE BRISTOL

References:

Flute and Trumpet Physical Modelling Synthesizer Plugin

The aim of this project is to create a synthesiser plugin that will mimic the sound of a flute and a trumpet and make hybrids of both instruments.

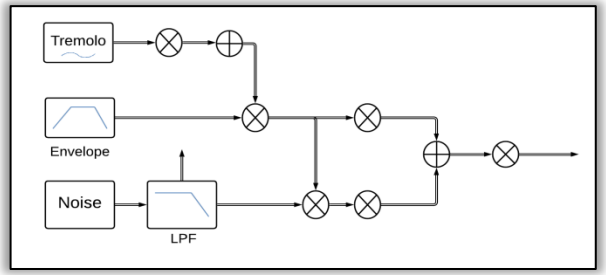
Physical Modelling VS Waveguide

Imitate the sound of an instrument through physical modelling requires numerical integration of the wave equation. These methods require multiplication and/or addition for each point defined in an instrument, thus is highly computationally.

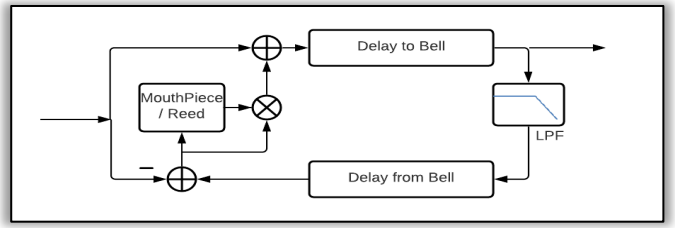
An practical alternative is digital waveguide synthesis.

This method imitates the operation of the different acoustic parts of the instrument and is based on the travel waves that propagate along a path, using digital delay lines.

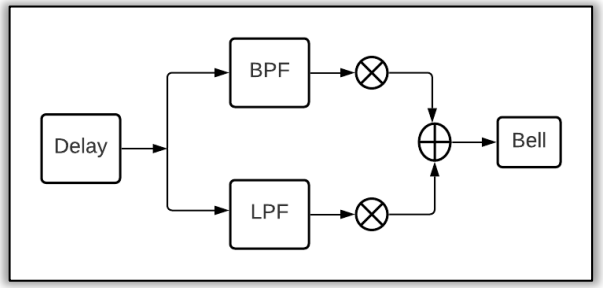
This second method has been chosen to achieve the proposed objective.



Wind instrument Breath Input Diagram



Flute Mouthpiece Diagram



Flute Bore/ Tube Resonator

Next Steps

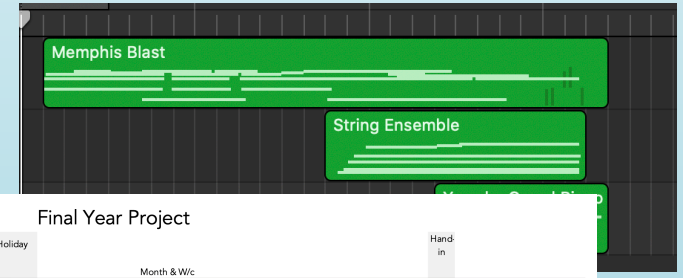
- Turn modular synthesis trumpet into waveguide synthesis using delay lines.
- Analyse Impulse Response and behaviour of both acoustic instruments.
- Abstract the common functioning of both instruments in a C ++ class.
- Make different classes for different parts of each instrument.
- Create the GUI to combine the different parts of the instrument.
- Add more wind instruments.

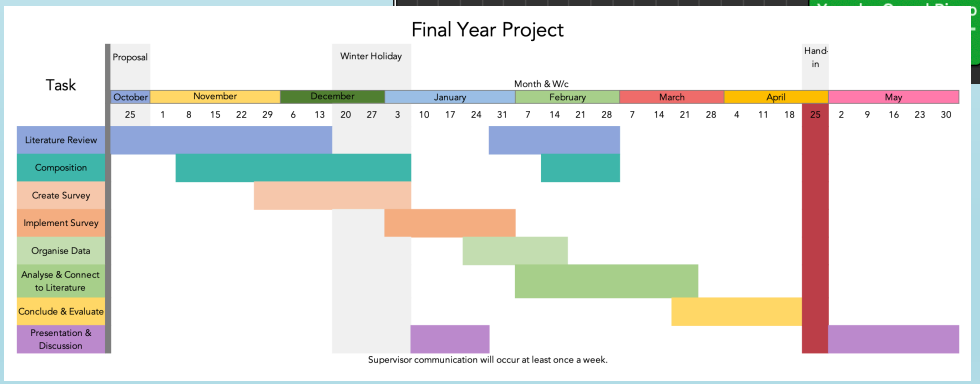
What makes new or previously unheard music nostalgic?

'It has been found that nostalgia is triggered more often by music than other stimuli' (Juslin, Liliestrom, Västfjäll, Barradas, & Silva, cited in Garrido 2019).

An investigation into nostalgia in music.

- Where does it originate?
- What types of nostalgia exist?
- Can it be triggered reliably?





The Project...

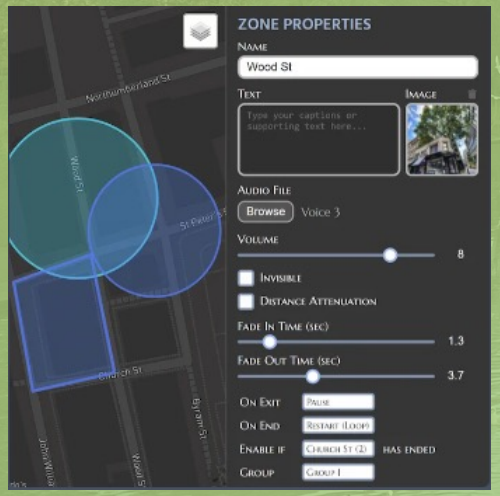
- After extensive research into music-evoked nostalgia, and a set of preliminary interviews (pre-survey), a small collection of compositions were created to aid the final survey in finding out what features of new music (mostly timbre quality but also harmony/tonality) make it nostalgic.
- This is coupled with general theories of nostalgia, to separate the term into its different facets and origins (triggers), and investigating which different emotions can be closely linked to nostalgia.
- Finally, this gives way to a set of theories based on how nostalgia could be created most consistently – reliably transporting listeners to places and times they have *and* have not experienced, on command.

THE EASTVILLE PARK SOUNDWALK

Project Aims

This project aims to use Sonic Maps locative audio software (2021) to play different manipulated sounds from Eastville park in Bristol to a listener based on their GPS location within the park.

The goal is to make the listener experience the natural sounds of the park in a way they have not experienced them before, encouraging them to sonically engage with their surroundings.

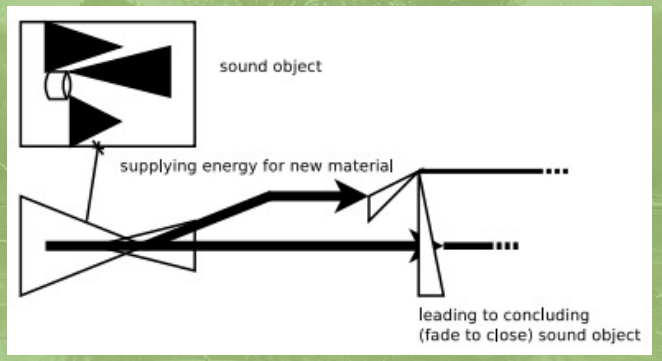


Editor mode of Sonic Maps Locative Audio Software (2021)

Sonic Art Research + Prototypes

Before creating the artefact itself, much research into sonic art and 'soundwalking' has been conducted to develop skills that will improve the artefact.

David and Adrian Moore's 'Sonic Art: Recipes and Reasonings' (2012) provided some knowledge of 'Sound Units' which help visualise sounds to distinguish them from one another.



'Sound Unit' from Sonic Art: Recipes and Reasonings (2012)

The concepts introduced by these sources, among others, inspired the first prototypes made with nature recordings from SoundSnap (2021). A Video prototype demonstrating what certain areas of Eastville park may sound like can be viewed here.

Soundwalk Research + Design

Now that the project is fuelled with more knowledge and understanding of sonic art, field recording sessions at Eastville Park can now start taking place.

The project has now taken a more 'soundwalk' type approach with inspiration from soundwalks like Battery Radio's 'Inside Outside Battery' (2013), but only focusing on the soundscape element.

The recordings from Eastville Park will centre around the large lake in the park and some of the forest area surrounding it.

References:

- Moore, A. and Moore, D. (2012). *Sonic Art: Recipes and Reasonings*. [online] Univeristy of Sheffield. Available at: https://www.cambridge.org/core/journals/organised-sound/article/abs/spectromorphology-explaining-soundshapes/A18EBE591592836FC22C20FB327D3232 [Accessed 22 Oct. 2021].
- SonicMaps Locative Audio (2021). *SonicMaps - Locative Audio*. [online] sonicmaps.xyz. Available at: https://sonicmaps.xyz/ [Accessed 21 Oct. 2021].
- Battery Radio (2013). *Inside Outside Battery*. [Sonic Art] Available at: https://apps.apple.com/ca/app/inside-outside-battery/id1334324383 [Accessed 8 Jan. 2022].
- SoundSnap (2021). *Download Sound Effects | Soundsnap Sound Effects Library*. [online] www.soundsnap.com. Available at: https://www.soundsnap.com/ [Accessed 15 Nov. 2021].
- Galloway, K. (2018) 'Curating the aural cultures of the Battery: Soundwalking, auditory tourism and interactive locative media sound art', *Tourist Studies*, 18(4), pp. 442–466. Available at: 10.1177/1468797617723764.