Rapid Prototyping of Soundscapes for Heritage Spaces using Ambisonic Audio and 360 Video Technology

I'm going to speak today about a project I have been involved in and how I have adapted some of the audio technology I use to prototype a soundscape for this museum. I will explain the background of this project, and then some of the technicalities of the tools I am using, and why I think it is relevant. I will touch upon sound design theory that has informed my process. My methods here are very much the early phase of my journey in this field, and I look forward to your feedback. As this is a VR piece, it requires a headset for full understanding, and I have brought a working copy with me should anyone wish to experience it later. I will be disappearing around 2pm as I have teaching commitments.

Initial Project

In February 2019, I was approached by the Science & Industry Museum, to produce some student voice recordings of written accounts from the 1830's of the early passengers on trains. The SIM is the site of the world's oldest surviving passenger railway station ('Https://www.scienceandindustrymuseum.org.uk/whats-on/1830-station', n.d.) and has recently had a refresh, which these recordings were to be part of, and an audio experience would happen in the room. I requested the chance to also design a soundscape for the room, as it seemed like an opportunity to use sound in a new space and place outside of my usual experience – a way to think about sound design in a new way and the implications this would have on passive listeners in a space.

What is a passive listener? It is our everyday, the sounds we hear but are not focused on, unlike active listening, which is when we are expecting sound (Truax, 2001). For example, when people visit a theatre to see a show, they generally choose to do so. They expect the sound to have a presence and so become an active listener. In a museum, this is not necessarily the case. Museums are traditionally thought of a place with "The silent visitor standing still in front of an exhibition and gazing intently" (Bubaris, 2014). More recently museum exhibits are enhanced with digital media, changing this traditional viewpoint; one only has to look around this very museum we are in to see the influence of digital technologies. Previous work in this area suggests that by doing this, there are several barriers to using these enhancements. One might think instinctively of a mobile app as a method of augmenting an object, which in itself brings a 'digital barrier' to proceedings, as without the app you can't get the full experience that others are receiving. Though I am focusing on augmentation with sound, any work around museum exhibits and enhancement of experiences must consider the "influences of digital culture in society more generally"(Light, Bagnall, Crawford, & Gosling, 2018). Sound played in a space is a more accessible method of enhancement as the vast majority of people can hear. We live in a noisy world; people expect to be surrounded by sound and the sharing of this sound experience with others would be quite natural. It may not be a pleasant experience, depending on individual tastes, but it would not involve the extra 'effort' or hassle of bringing out a mobile phone, for example.

When I use the term 'soundscape' it is useful to define what this means. This term is generally used to define the sound of a place that the human picks up on. The International standards organisation defines it as the "acoustic environment as perceived or experienced and/or understood by a person or people, in context" (ISO, 2014)

As I write this paragraph on a tram home, the sounds around me are of people chatting, the clacking of the tracks. I cannot control these sounds specifically; I cannot press a button and the clacking changes to birdsong. It is this control that I can exercise in soundscape design.

Soundscape Design

Before using the virtual environment tools, the plan for soundscape creation started with sonic sketches created using standard computer editing software. Through these sketches, various initial lines of creative enquiry led to some unexpected questions to be asked. One I will spend a little time on here to begin with is that of access to resources and how this relates to authenticity; a problem that relates back to my previous findings from the work of Bagnall et al around museum object augmentation.

This museum (and wider museum group) has a vast archive of objects related to the space, which would be perfect to record and use in the piece but problematic in that (understandably) curators do not want fragile objects such as the original station bell sounded. My thoughts from this are not 'how do I fix this' but 'how accurate do sounds have to be, to invoke authenticity?' Nobody alive has any hearing recollection of the time period so why bother with authenticity? I became fixated on creating some sort of audio based archaeological dig. I am reminded of watching "Time Team" as a teenager, and just as they used to computer-generate visuals of the discoveries at the end of programme, I find myself wanting to do the audio equivalent. An illustrative example within the piece is the fanfare when the train leaves at the end; a real piece called 'I'd be a butterfly'. This piece was performed as the train set off in the 1830s. The sheet music is in the archive and I recorded a music student playing this piece for my soundscape. It is practical to think that this may be the first time in nearly 190 years that this piece of music has been heard on this site. However, there is no context to the contemporary listener, No explanation. And so, the audience is left confused. It is authentic, but people do not understand that it is. I have turned to my knowledge into entertainment sound design to try and find some resolution to this question. It is common practice that a sound effect is not literal. In Foley effects for visual entertainment, a breaking bone is often a recording of breaking a carrot. A bird flying away is rubber gloves slapped together. A fish out of water is a damp cloth slapped about a surface. These seem to bring satisfaction to audiences, so can these same principles be applied in the museum? But this brings me back to my concern – what is authentic, and does authenticity necessarily invoke authentic feelings or transport us back in time? And on that topic, how much of the visual surroundings of the space augment the acoustic, and vice versa?

My second big question was that of how the final product would be accessed. I feel the best environment for such a soundscape is to play from loudspeakers within the environment for all to hear, to remove the choice from the visitor. Headphones are a very personal listener medium. As soon as only you are listening to a device, there is no guarantee that your co-visitors are listening to the same thing. They are not having a shared experience. And shared experiences are shown to be positive in the museum space (Bagnall, 2019).

It is theorised by Barry Truax in his work *Acoustic Communication* that we have three modes of listening. "Listening-in-search" is the active seeking of audio cues in an environment; "Listening-in-readiness" is responding to sound cues in an environment without actively seeking them, and "background listening" which is subconsciously hearing/remembering details of the environment (Truax, 2001).

By placing the headphones on the listener, they are engaged and then 'listening-in-search'. They expect sounds to appear, they are hearing the environment, but they have a level of expectation of experience that comes with it. I would much rather explore the second and third options. I wish the soundscape to bring an element of *reminiscence* to the listener without them seeking it. Therefore, "listening in readiness" and 'background listening' are the effects I wanted concentrate on when further designing my soundscape. To clarify the differences between these, the classic example of "listening in readiness" is that of a crying baby in the night and the mother immediately waking up to respond, whereas other noises would not have stirred her. Background listening is that where you are subconsciously aware of sounds in a room, and can recall them later, but are not actively engaged in them at the time. For example, if you all think about your journey this morning you can probably remember and/or imagine the sounds of your environment though you paid no notice to them at the time.

Further problems then arise. To achieve this state, the environment is required to be of a particular quality, or rather *not* of a poor quality. The fidelity, or sonic clarity, of the environment needs to be of sufficient quality that these queues do not get lost as the energy spent by the listeners to pick out the sounds, i.e. reactions of 'what was that?' then causes disconnect and feelings of isolation (Truax, 2001). An effect not dissimilar to that of wearing headphones, though for different reasons; headphones are a high-quality environment but invoke a state of environmental disconnect, whereas a low-quality listening environment in a large reverberant room, as the museum station is, could cause a sonic disconnect that is lost upon the audience and induce the opposite effect than intended.

Rapid Prototyping

It is at this point that I came to the title of 'rapid prototyping'. Rather than moving back and forth between the museum space, proposing costings for in-room spatial designs, closing rooms for testing purposes for extended periods, perhaps a virtual environment can be used to quickly test soundscape ideas, and then bring them to curators/directors for approval, thus giving everyone a clearer vision of the final product.

It is here that the ambisonic audio tools are particularly useful, as they can simulate the sounds of these environments. Ambisonics is a way of recording and playing back sound that gives it a position in space. Sound recordings are usually constrained to being moved between speakers, whereas with amibisonics, sound can be mathematically processed to appear as coming from any position and distance in space. Imagine floating inside and at the centre of a large sphere. With ambisonic processed sound, you can move sound to anywhere inside the sphere boundaries, close to you, further away, moving around. This can then be replicated by loudspeaker or headphone playback. When combined with another audio technology – convolution reverb, the reverberation or echo characteristics of a real particular space can also be applied to the recordings and adjusted dependant on the distance of the sound object. This was important to my sound design prototyping process as it will allow me to make reasonable decisions about sounds in the space and how they might sound, without having to set up equipment in the space.

The add-on I have been using to make this more intuitive is DearVR Pro, which takes the control out of the computer environment and into virtual reality. Each sound is tagged as an object, which you can control and position in space from within the environment itself. Here is a short video of me working on the soundscape, inside the 360 video of the environment, and positioning these object.

Hopefully you can see here how this is intuitive, and decisions could be made. This method I demonstrate is what I will call a *freeform* way of working – each sound can be positioned in space wherever I choose, and automated to move around also. Once pleasing choices have been made, I would move to a *specific* way of working, placing fixed objects as playback points in the space, rather than sounds, and treating these as if they were the loudspeakers for the final piece in the room. This way, creativity can determine what will happen during the soundscape, and then control decisions can be made as to how to achieve this in the space itself. And all this can be done outside of the museum site. It is difficult to say how well this translates to the space as this is a stage of the process I have not yet achieved. There will be errors as it is difficult to very accurately simulate a space. But it is hoped that my work here presents an alternative and relatively accessible way for a sound designer working with these tools to develop environments quickly and make more informed choices.

Conclusions

When initially designing a soundscape for the room, the creative elements of the soundscape were the least problematic. However, the transference of these sounds into a space and the way that the visitor engages with was where the opportunities and problems lied. What began as a simple exercise in designing sound has led me down a path in a few short months of thinking more deeply about the nature of a space not designed to be used in this manner, and having a process applied to it that is different from its original intention. By turning to my VR and Ambisonic tools normally used for 360-degree video production, I was able to better imagine the sound in the space and have an intuitive design process that was quickly changeable and provided more experimentation of ideas. These ideas are then able to be presented to stakeholders to be discussed and modified without having to disrupt the space itself, ready for final installation. It must be re-iterated here that this process is not to design VR experiences, but to transfer these techniques across to sound design installations in spaces. It is merely these tools that are the connection. The idea to use these tools came from experiences during creation where questions around listener experience such as disconnect via headphones or disconnect via poor sonics quality appeared. Museum expectation is not something I ever thought I would be involved with but is at the front and centre of the project. Also, the nature of the museum visitor, be they a visitor, an audience, or an actor is incredibly important to this sound design, as they are the receivers of the work. I am yet to wholly make my conclusions as to whether this approach to design is worthwhile, but it has certainly raised many questions and this 'rapid prototyping' is a technique I will explore more in the future.

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