Acoustic Augmented Reality

To assess the feasibility of spatialized sound as a learning tool and to enhance and build engagement with differing environments and biodiversity using contemporary technologies.

Introduction

Could a soundscape, presented using state of the art technology, help encourage more young people to take an active interest in differing environments? In a day and age when gaming sees players immersed in sight and sounds, apparently oblivious to the outside world, we hope to use IT to tempt more outside. The technique is called acoustic augmented reality (AAR) and sees sound brought in to boost what has so far been predominantly visual work.

The purpose of this CREST (Consortium for Research Excellence, Support and Training) funded pilot project is the prototype development of an Acoustic Augmented Reality (AAR) activity. AAR attempts to augment real time events in order to enhance participant experience. This project has the aim, through developing a facilitated soundscape experience of unlocking the academic potential of augmented sound.

Augmented Reality

Contemporary life is awash with the relatively new mediums of virtual and augmented reality. Unlike Virtual reality (VR), Augmented Reality (AR) allows an individual to experience the 'real world' and supplement reality without complete immersion inside a synthetic environment (Kesim & Ozarslan, 2012). Predominately visual and associated with computer technology, sound has until recently been overlooked within Augmented Reality (Wang, 2018). We often underestimate and neglect our sense of hearing in the study of environments around us and by becoming more attentive and critical listeners, we can identify and explore our environment in a richer way. Sound can be seen to play a critical role in driving the sensory and emotional involvement through an experience, with George Lucas even suggesting that

"*Sound is 50 percent of the movie going experience, and I've always believed audiences are moved and excited by what they hear in my movies at least as much as by what they see*" (Mellor, 2011). We suggest that these soundscapes which change over time and reflect interventions by human and nature can be used as educational aids and enhance appreciation and understanding of our environment

The adoption of computer game sound provides interactivity and variation of soundscape elements. These elements in the soundscape can be individually controlled in terms of volume and other properties affording augmentation of the natural (real) environment. AAR provides mechanisms to explore an environment throughout time: the past, present and future whereby we can introduce narrative, induce imagination, and provoke emotional responses

As this proposal is predicated on integrating the sonic signatures of wildlife into the environment so as to augment the participants understanding of that place and its potentials, integration/augmentation is key. By wearing headphones, even if we include feedback from the surroundings, the presence of a physical interface will detract from the immediacy of the experience. One could argue that from a sonic perspective, requiring participants to wear headphones is virtualising rather than augmenting the environment. For example, when groups are all wearing headphones - as in a silent disco, the result is a lower level of interaction. One reason is that when you put on headphones you are removing yourself from your environment to a significant degree - ambient sound is attenuated and your awareness of the sonic dimensions of place will be lessened.

Educational Potential / AAR Affordances

According to Akcayir and Akcayir (2017), the rapid technological growth of Augmented Reality provides great pedagogical potential, and educational researchers have increasingly recognised this. Through undertaking a pilot study, we will ascertain the potential use of spatialized sound as a learning tool with schoolchildren and older learners. The expectation is that by providing a sound augmented environment we will be able to enhance the participants' perception of and interaction with the real word (Kesim and Ozarslan, 2012). Prince (2017) advocates that "*pedagogical approaches that stimulate sensory awareness, by their very nature encourage and stimulate curiosity, exploration, inquiry, experience and communication and address these outcomes well".* A number of authors (Kalisch, 1999; Louv, 2008) go on to suggest a relationship between a child's cognitive development and knowledge retention and sensory stimulus found in an outdoor environment.

The use of AAR offers an alternative to "eye culture" (Berendt, 1988) whereby sight is privileged over other senses (Macpherson & Minca, 2005). Through helping to develop individuals 'sonological competence' (Schafer, 1993) their experience and attitudes can change subsequent behaviour and get an individual appreciate what we have lost in the natural world and what we could potentially have again. To get people to question, what was that noise? Be able to learn its name and then on to develop a concern for it (Macfarlane, 2017).

Methodology

As the focus of the project is to examine the educational potential from overlaying acoustic information onto the participants' physical world through spatial audio, and use experiential learning to enhance and build engagement with nature and biodiversity, a facilitated activity had to be devised. Hardware research in AR is currently focused on visual systems requiring head-mounted displays (Sicaru, Ciocianu, Boiangiu 2018). An approach predicated on sound allows the system to be decoupled from the individual and spatialised, such that no wearable apparatus is required. As such, the development of a portable rig of eight battery-powered units that could be deployed at various environments, both urban and rural was adopted. Given the resources available, it was decided that adapting commercially available systems would provide the most expedient solution to a proof of concept rig with a modular system chosen to allow for incremental development, potential for expansion and flexibility (See below).

Audio hardware

MiniRig 2 speakers have adequate weather resistance and run-time

Custom enclosures and Li-ion battery packs housed receivers for each speaker

A Fostex 1608 audio interface was selected due to its possibility to accept battery power in this case provided by a 12v sealed Lead-Acid Gel battery.

Audio transmission and reception utilized 2 Amphion 4 channel transmitters and 8 Amphion receivers.

Ultimately, the speaker/amplifiers are to be capable of autonomous operation with each unit housing a sensor, processor and speaker/amplifier. On triggering the first sensor, a pre-programmed set of sounds is played, with volume panned so as to suggest the movement of animals. Once the sequence is complete, if people are still within range, a second sequence is initiated. Multiple species and simultaneous virtual movements can be created. This proposal will be simple to deploy at any suitable location.

The next fundamental stage of the project will involve work with school groups to design a facilitated session whereby participants are given a variety of acoustic cues (mostly animal sounds) to encourage them to explore a woodland environment, and in the process experience a more immersive interaction with nature.

The techniques used for data collection and analysis will be based on involving and observing the young peoples responses to the experience, through various lenses, including literature, the limitations of the technology, the young people and the researchers. This is expected to be achieved through the adoption of a likert scale where pupils are to be asked to select their enjoyment of the facilitated experience; select their perception of the authenticity of the soundscapes; provide suggestions to improve the experience and provide their overall opinion. Alongside this Mayer and Frantz (2004) proposed a connectedness to nature scale (CNS) which can be undertaken pre and post the activity. This approach may illicit a further understanding as to the value of the approach adopted.

Preliminary Findings

In stage one of the project, the system was tested in an area of woodland within Northumberland, both with the research team and in turn with a small group of school children. Initial feedback was that it was evident that the technology works, particularly concerning the choice of speakers, which possessed both sufficient volume and clarity to be convincing. The speakers were also sufficiently discrete to maintain the illusion of a non-human-generated soundscape (Figure 1).

While in the initial testing, problems were experienced in hardware performance related to interference in the radio transmission of multichannel audio, these issues are relatively straightforward from a technical perspective. The next iteration of the hardware will address the issues revealed in initial testing.

Looking beyond the technological challenges of producing suitably robust and weather resistant components and the challenges in recharge and run times in battery powered equipment, if such systems are to be considered useful in education, staff training in the use of the technology must be considered.

Summary

Throughout the project to date we have seen encouraging results and it is clear that Acoustic Augmented Reality offers an exciting interface between education and environments. The need to maintain focus on the AAR technology is evident in both its reliability, portability to differing locations and ease of use for the facilitator. In conjunction with this there needs to be continued work with the school group to identify the particular pedagogical approach adopted through the design and implementation of the equipment in an educational setting. This is crucial if the potential is to be fully realized.

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