REALISTIC ENOUGH? DESIGN CONSIDERATIONS FOR SOUNDSCAPE SIMULATORS

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1 Introduction

Urban soundscapes reflect life and behaviours in a city as they evolve over time. How can we capture and render these dynamics for soundscape design and evaluation purposes? A simple way is to record and reproduce a soundscape directly. While this might be useful for evaluation, it falls short for design time given the difficulties in isolating and manipulating individual sounds from the recording. Furthermore, you cannot record a soundscape that does not yet exist. The alternative method, which we focus on, is through auralization with bottom-up simulators wherein every aspect of an environment can potentially be simulated. This includes 3D models of spaces, people's behaviours, sound sources, weather, nature, lighting, and the very physics behind them to create the illusion of navigating a real space. While this can give the widest control over designing and evaluating a space, production of highly accurate simulations is resource intensive and requires a wide interdisciplinary set of skills. How much realism, then, is required? This work focuses on design-time for non-sound experts and stakeholder engagement, contrasting it with evaluation purposes where relevant.

1.1 Supporting auralization and designs with stakeholders through technology

Urban sound planning still predominantly relies on policies based on noise limits that fail to consider the auditory experience of city users. To shift practices towards the auditory experience, the inclusion of more stakeholders at earlier stages is crucial. However, as acoustics is technical and inaccessible to most, discussions on sound should occur through the accessible medium of the auditory experience.

Soundscape simulators make it possible to quickly iterate through many different possibilities to both raise sound-awareness, support exploratory designs, and help non-sound experts make informed decisions. Furthermore, as the focus is on creating positive auditory experiences amongst stakeholders, an emphasis should be placed on fast, informative, and fun exploratory experiences to encourage active and meaningful participation that retains interest over time. These needs are distinct from those during a formal evaluation stage of the soundscapes themselves, although a reasonable balance between the two can be expected.

As such early-stage technology-enhanced practices are still uncommon, our experiences in the development and evaluation of our in-house soundscape simulator City Ditty are shared. City Ditty supports real-time interaction and modifications of both sound sources and environmental contexts (e.g. time of day, season, weather). Through its accessible interface, it supports soundscape design and interventions which can be experienced over any time or location [1]. This simple-to-use interface has supported users to both learn about soundscapes and implement their own simple designs in less than an hour. To further encourage best uses of such new tools in this manner, the following is design recommendations are presented.

2 Three design lenses for realistic soundscape simulators

We address realism through the concepts of *plausibility*, *ecological validity*, and *hyperrealism*, and place them into context for considerations of soundscape simulator functionalities. I.e., Is it ok to *just* present itself as a believable environment (plausibility)? How faithful should it be to real-world settings and from which perspective (e.g. matching physical or cognitive realities) (ecological validity)? Can features of the environment be enhanced or exaggerated for impact (hyperrealism)? These questions were considered during the development of City Ditty (Figure 1) [1]. City Ditty seeks to be operable by non-sound professionals and support integration into urban projects with minimal expertise and resources. Through this, it encourages more diverse urban professionals and city users to contribute to how their cities will sound through participatory approaches. Given these aims, we discuss how suitable levels of realism may be suitable to fit people's needs at technical, practical, and theoretical levels by considering these three lenses for design.

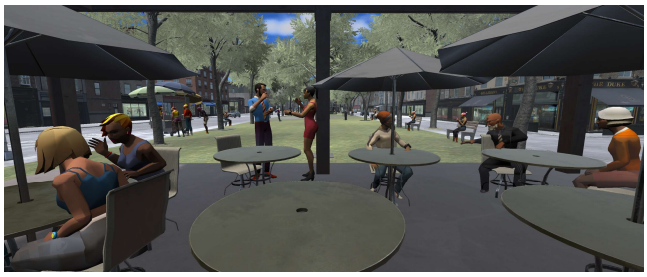

Figure 1: Screenshot of City Ditty. Demos available online: https://www.youtube.com/@MultimodalInteractionLab.

2.1 The dynamic lens of life: create plausible experiences, not full-fledged acoustic models

Creating a plausible sound environment should focus on the experiences of people and how to create and share them. By demonstrating and contrasting different ways to enhance a space, this can enlighten and spark ideas that draw from people's own personal experiences and expectations for a space. Indeed, simple demonstrations can enhance one's sound-awareness and prompt reflections on one's own experiences,

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both positive and negative. This stage is similar to brainstorming as there are no bad ideas yet; the goal is to engage people in discussion, so people need to be encouraged to speak freely of their own experience. As discussions progress, ideas can be refined into what is feasible or not with the help of experts. Furthermore, by allowing stakeholders to control the software themselves, it can help demystify sound planning and empower them to take an active role toward more inclusive designs which may be stilted when needing to go through an intermediary person. Indeed, taking an active role and assuming shared ownership of an idea can also help retain stakeholder interest and participation over time.

To support an open mindset that focuses on an auditory experience, Yanaky et al [1] argue in favour of designing towards a *plausible urban ecology* during early prototyping phases. Rather than a full-fledged acoustic model, it can be considered a *light acoustic model* that enables real-time modeling and rendering that is *realistic enough* to support a vibrant, believable reality. This light model can support the exploration of different human-centered soundscape designs that can supports exploration and creativity.

2.2 The flexible lens of exploration: Support functionality over ecological validity

Context plays a huge role in the auditory experience which is why people need better tools to explore this. For instance, soundscape reproduction is often optimized for a single point in space or sweet spot. Yet the auditory experience of an urban space can differ greatly at even several meters away, and at different times of the day [1]. During early consultation and design stages, giving people the flexibility to explore and experiment with sound in real-time can be much more valuable to the immediate task than an inflexible but hyper-realistic rendering. Given time, tools may be able to accommodate both real time interactions and ecological validity in ways that a hyper-realistic reproduction can provide, but as resources can be limited, erring on the side of supporting explorability and creativity is preferred.

That said, one must not misrepresent the urban jungle. Although stakeholders should be encouraged to try multiple things, misrepresenting the urban experience can lead to disappointment and flat-out rejection when their ideas are taken to the next level of planning by acousticians. This is both the responsibility of a knowledgeable facilitator to guide stakeholders through what is feasible, as well as the software itself. Facilitators should encourage free experimentation, but eventually need to reign things in. As for the software itself, City Ditty, for example, sets individual sound source levels based on databases of sound levels measured at 1m from the source, and then applies distance attenuation, occlusion effects, and reverberation models (see [2] for details). Although less complex than acoustician-directed software, it can produce a sufficiently plausible sound environment.

2.3 The foggy lens of distortion: Hyperrealism and reality-bending improvements

Finally, the lens of distortion encourages breaking the rules of realism when justified. By utilizing attention-guiding methods such as increased hyperrealism, sound levels or other features on individual sound sources (e.g. an extra loud fountain or musician) and/or by diminishing surrounding sound-sources' quality, this technique can be used to help demonstrate concepts like sound-masking via water features or help stakeholders emphasize their desires for a space [2]. While this technique results in a *less* acoustically accurate sound environment, these can help stakeholders express strong preference that can be translated into solid plans by acousticians. For example, the addition of a loud musician can express a desire for music to permeate a larger space; a loud fountain can represent the enjoyment of water features themselves, or alternatively, just a general desire to obstruct unwanted sounds which can be further investigated together through different means. Although the creativity of stakeholders is wanted, the facilitator of these sessions must ultimately help interpret these desires and manage expectations whenever reality is bent to avoid later disappointment. All parties should understand that these early designs will eventually be translated and interpreted by acousticians who will find an implementation that follows the overall spirit and specific needs of the stakeholder design. These interpretations should, of course, be brought back to the stakeholders, even if modeled through different software.

3 Discussion

These three lenses highlight different ways of supporting stakeholder engagement with urban sound. In short, avoid technical jargon and focus on their auditory experience. Provide lifelike environments and functions to explore and be creative and do whatever is necessary to help people understand and be understood. Get them started with several ideas, consider their past experiences, then give them free control before reigning it in. By the end, several ideas can be presented to experts who can help realize feasible designs.

Other questions remain on the very nature of modeling the dynamic behaviour of people. What is an 'accurate' simulation, given the idiosyncratic nature of human behaviour? Is it realistic enough? We suggest that for design time with stakeholders, the answer lay in the realm of the flexibility provided by the idea of a plausible urban ecology. However, when advancing to later steps of how realistic people's behaviour needs to be for formal evaluations of soundscapes, this remains a work in progress.

Acknowledgments

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References

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