I HEAR BANGALORE3D: CAPTURE AND REPRODUCTION OF URBAN SOUNDS OF BANGALORE USING AN AMBISONIC MICROPHONE

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Abstract

This paper describes the project, I Hear Bangalore3D, which is an attempt to capture and render 3D recordings of various iconic locations of the city of Bangalore. First order ambisonic recordings were done and processed so that they can be played back using a speaker array configuration through real time matrixing or using headphones through binaural renderings of the recordings. This project has both aesthetic and informational use to it. Coming off a sister project, I Hear NY3D, which took a similar route in Manhattan, this project also aims at comparing the noise levels and other information of different cities in different parts of the world.

1. Introduction

Over the month of January, the Immersive Audio Research Group at New York University's Music and Audio Research Laboratory was involved in capturing ambisonic recordings of various iconic locations of Bangalore, India. Recording urban sounds in this manner can have a number of different purposes as described in the following section. It also presents us with a few challenges along the way, some direct and obvious challenges like, safety: While recording in urban environments, we have to be careful with our microphone placements to ensure safety of everyone and the equipment; while some less obvious challenges like the disturbance caused by curious passers-by stopping by to try and interact with the recorder thus adding noise to the recording.

1.1 Goals

The goals of this project are two fold, aesthetic and informational. From an aesthetic point of view, these recordings were done to create a sound map of the city, wherein a person can enter the environment represented by the sound without physically being in that location. The noise level measurements done alongside the recordings will enable us to process the audio and recreate the same environment in terms of sound pressure levels (SPL) present during the recordings. From the informational standpoint, this project aims at analyzing the noise levels of different parts of the city thus drawing attention to how noisy and unhealthy our environment actually is. Finally, the project aims at doing a comparative noise level analysis, wherein noise levels of similar locations of Bangalore and Manhattan would be compared to see noise levels of similar locations in different parts of the world are.

2. Previous Work

The concept of capturing urban soundscapes for research purpose is not new in the field of audio. [5] in their Citygram project attempt to achieve locative sonification and urban audio data is captured through android-based remote sensing devices. This data is subsequently used for geospatial research. [2] did a CitySounds project in Melbourne, Australia that created an interactive 3D Audio-Visual Cartography. These were non-3D audio integrated with 3D visuals. [1] and [3] worked on creating the opposite of what Lacey and Harvey did: visual augmentation of a primarily 3D auditory experience of an urban soundscape. This work falls along the lines of work done in [1] and [3].

3. Method

3.1 Locations of Recordings

The audio recordings took place in the city of Bangalore, India. The recordings sites were carefully chosen to provide a good spread both in terms of geographic locations of the city and sonic environments while trying to ensure that the captured location is an iconic part of the city. The locations chosen were:

i. Town Hall Junction
ii. Cubbon Park
iii. Lalbagh Botanical Garden
iv. Silk Board Junction
v. Brigade Road
vi. Chowdaiah Road next to golf course
vii. Jayanagar shopping complex

As mentioned above, these were iconic locations of the city and the environments ranged from high traffic density junctions (town hall, silk board) to quiet, serene settings

(Cubbon park, Lalbagh Botanical Garden), to highly populous, shopping locations (Brigade Road, Jayanagar Shopping Complex) and high speed vehicular traffic (Chowdaiah Road).

In addition to choosing these iconic locations, attempts were made to record at a time that best represents the sonic environment of the location. That is, the sounds that a native would instantly associate the location with. For instance, recordings at the Town Hall Junction took place on a Monday morning around 9am when there is a rush to get to work and the vehicular and pedestrian traffic is at its highest.

3.2 Sound Capture

The sounds were recorded using a Core Audio TetraMic. This is a four-channel Ambisonic microphone carrying four cardioid capsules in a tetrahedral configuration, recording audio in the Ambisonic standard A-format. The microphone was mounted on a stand and placed approximately 1.75m above the ground. Care was taken to ensure the microphone remained perpendicular to the ground and remained stationary (barring during windy conditions) throughout the length of the recording, which typically lasted 1.5 to 2 hours. The audio was captured on a Tascam DR-680 portable multitrack recorder. This was also used to supply phantom power to the microphone. Data recorded was stored in a SD card in the Tascam recorder in 44.1kHz-16bit wav format. The noise level readings were taken through a Galaxy Audio CM-130 sound pressure level (SPL) meter in standard A-weighted (dBA) format.

3.3 Sound Processing and Reproduction

Short contiguous excerpts of the audio were selected from the long recordings and segregated from entire audio. These were carefully selected such that they were at least largely representative if not completely of the entire recording. These excerpts were still in A-format and were converted to B-format as the next step in the processing phase. This was done using the software and calibration files provided by Core Sound.

B-format to 16-channel playback conversion was done using MATLAB and this was tested in the Spatial Audio Research Laboratory at New York University (NYU).

For Binaural rendering, the output of each speaker in the 16-speaker configuration at the research laboratory was convolved with the Head Related Impulse Response (HRIR) of that speaker (measured with a Neumann KU100 dummy head). These 16 convolved signals were then aggregated to one signal to give the virtual playback through stereo headphones.

4. Discussion

The process of on-site recordings and reproducing them in an audio research laboratory and over headphones provided insight into the types and qualities of sounds present in different environments in the same city. In addition, from an aesthetic side, an interface was created through which one could listen and compare similar locations of both cities. The noise measurements gave a measure of the sound pollution of various parts of the city. Comparisons between New York and Bangalore showed that the quieter areas seemed to have lower dB levels in Bangalore and the noisier areas tended to be noisier in New York. For instance, Central Park had a mean noise level of 58dB while a comparable location in Bangalore – Lalbagh had a mean noise level of 49dB. On the other side of the spectrum, average levels in New York averaged around 95dB while they were around 83dB in the noisy areas of Bangalore. This seemed to direct in the direction of the city of New York generally having a higher noise floor as compared to Bangalore. A reason for this might be the design of the city and the high-rise buildings, which trap the sound.

5. Future Work

This project compared the soundscapes of both cities from an aesthetic side, and preliminary noise analysis (mean readings) was conducted. As the next step, noise pattern analyses could be carried out wherein the patterns of noise variation across the entire recording session could be compared. This can inform us about the variation of a place but also how similar locations differ in noise patterns across a period of time.

6. Acknowledgements

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7. References

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