# [S]ynthesizer.

## Developing upon a cartophonic understanding and interpretation of green space

by **MELISSA ERNSTBERGER** and **LUKA LAVAL**

**In a world where the emphasis on visual data is ever-growing, this project contributes to the small but growing field of *cartophony*; exploring sonic methods for the mapping of spatial environments [1, 2].**

**As an alternative to visual mapping practices, the emphasis is placed on providing those who are visually impaired with a tool for understanding their 'where' [3]. This sees the merging of sound composition, software coding, geo-technology, and accessible interface design.**

### CONCEPT

The output is conceptualized in a prototype Android app: *[S]ynthesizer*, which synthesizes the external environment into a sonic map. In the context of green spaces, topological features (i.e., "structural elements") of water, grass, gravel, and trees are *sonified*. The user is able to explore this sonic landscape through in-built mobile geo-technology at their own pace.

### COMPOSING A SOUNDSCAPE

Musically, the main challenge was to attribute sounds with a cognitive relation to the structural elements they represent. Sounds were collected from open-source field recordings [4] and synthesized sound libraries. These samples were then manipulated to create a unique sound typology; i.e, assigning sound descriptors (timbre, pitch, sound length) to structural descriptors (feature type, attribute, entity/field). Trees, for example, are sonified using a short, discrete, wooden wind-chime sound sample. To differentiate between species, each tree-type is attributed a different pitch (D3, F2, C2).

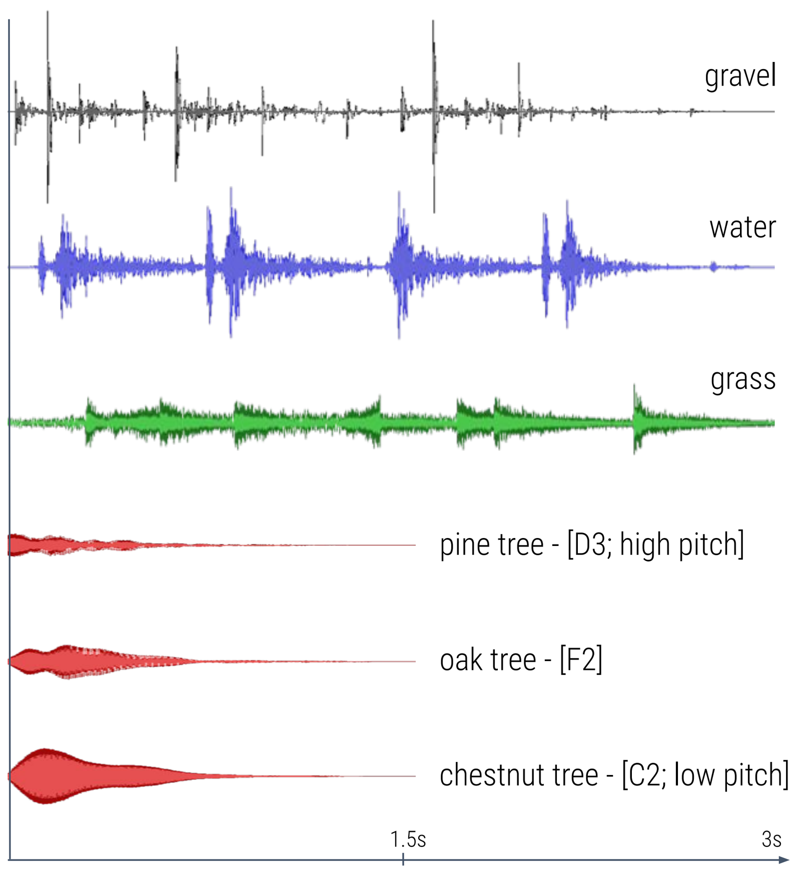


*Fig. 2: Sonically distinguishing structural elements, where x = seconds (time).*


*Fig. 1, Introducing [S]ynthesizer, the mobile prototype app for sonic mapping.*

### CODING A SOUNDSCAPE

The app, built with Expo and React Native, detects user location with GNSS and user orientation with the built-in magnetometer. The app is coded to pair these two parameters with each (sonified) structural element within a defined area, to simulate a user-centered soundscape.

The angle of user orientation to each structure, calculated using the rhumb line bearing of the two points, makes use of both L/R audio panning and volume to provide a spatial sense of direction (see *Fig. 3*).

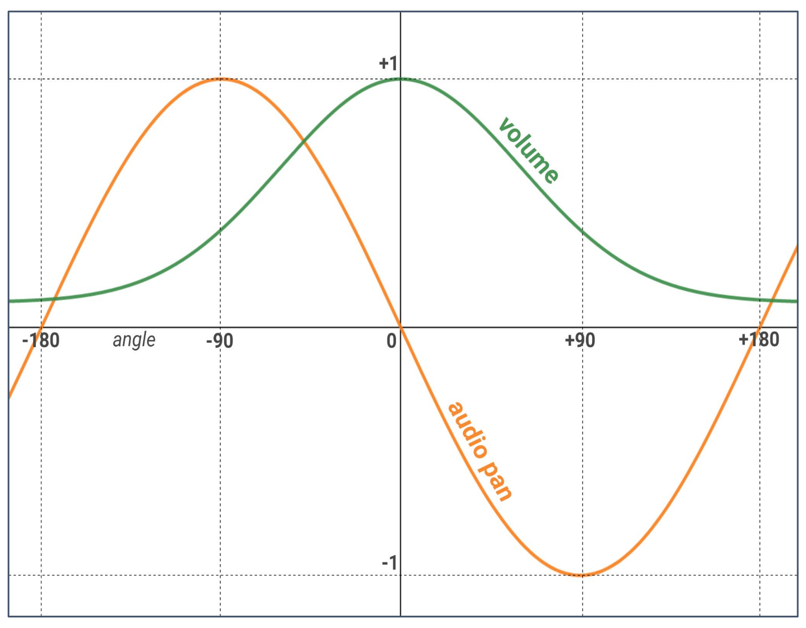


*Fig. 3, L/R audio pan and volume functions, where x = angle and y = volume[0;1] / pan[-1;1].*

L/R **audio pan** follows a sinusoidal function while **volume** follows a gaussian function. When directly facing a structure (at 0°), volume is 100%. As one changes direction, the volume for either L or R smoothly decreases to a cap of 10% at +/-180°.

Distance, calculated individually between user location and each structural element, is further sonically represented via sound loops. As a user navigates their environment, sound loop duration is iteratively updated to represent the (increasing/decreasing) distance of the user to a structure.

### ACCESSIBLE DESIGN

To maintain an accessible user-friendly design, the app's visual output is kept minimal. All app commands and legend features are communicated via automated voice-over, with commands initiated through haptic feedback. Four simple screen swipes allow for ease of app-navigation: right for instructions on *Usage*, left for the *Legend*, up to *Play*, and down to *Pause*. A simple black-yellow high-contrast color scheme displays the app's four commands on screen. This color choice is inspired by the unofficial black-yellow logo symbolizing blindness or visual disability across Germany [5].

### CHALLENGES

Key technological limitations impacted the output of the prototype app, namely:

- Mobile GPS accuracy
- Apple compatibility for audio pan
- Sound editing library for Expo

Limited user-testing further prevents a holistic understanding of the emotional and cognitive interpretation of attributed sounds, especially from a visually-impaired perspective. Further testing and sound development would be needed, both to enrich the creative process as well as utilize user-feedback.

### CONCLUSION

Through an innovative, interactive prototype app, this project has advanced on studies utilizing sound in the field of mapping practices. Moving away from a solely map-as-function approach, the app further demonstrates the emotional and interpretive potential of soundscape design to enrich human-space- and -place-understandings.

#### IMPRINT

Mapping Project
Winter Semester 2022/2023
Technical University of Munich

Luka Laval

Melissa Ernstberger

#### SUPERVISOR

Juliane Cron, M.Sc.
Chair of Cartography and Visual Analytics

#### KEYWORDS

cartophony, sound typology, sonic landscape, visually impaired

#### LINK

https://github.com/lukqca/synthesizer

#### SOFTWARE

Audacity
Ableton
React Native
Expo

#### REFERENCES

[1] Thulin, S. (2018). Sound maps matter: expanding cartophony. *Social & Cultural Geography,* 19(2), 192-210.

[2] Adhitya, S. (2017). Representation. In S. Adhitya (Ed.), *Musical Cities: Listening to Urban Design and Planning.* (DGO-Digital original, pp. 47–60). UCL Press.

[3] Gartner, G. (2022, Oct 13). The relevance of modern Cartography. [Keynote lecture during M.Sc. Cartography Welcome Week].

[4] Freesound. (n.d.). Retrieved January 12, 2023, from http://www.freesound.org/

[5] Goethe Institut. (n.d.). Living with disabilities. Retrieved January 28, 2023, from https://www.goethe.de/

*This project was created within the Cartography M.Sc. programme – proudly co-funded by the Erasmus+ Programme of the European Union.*

Technische Universität München | Technische Universität Wien | Technische Universität Dresden | University of Twente. ITC | Erasmus+ | cartographymaster.eu