

Audio Maze 2.0 (contd.)

Experience topology through audio

...

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GitHub Repository: <https://github.com/Paulpanther/AudioMaze/>

Recap (Audio Maze 1.0)

Audio Maze is an maze game where players must find the exit of a grid-based labyrinth through audio-cues.

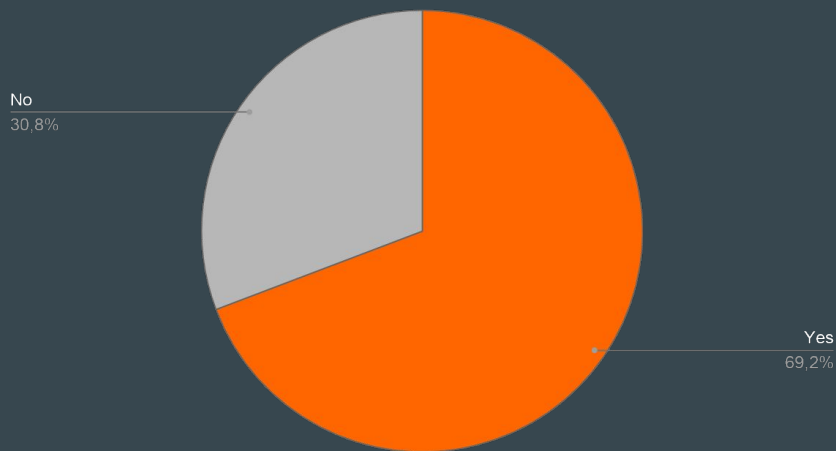
<https://drive.google.com/file/d/1bqn7-t9AExWF2sFLx8ITLt2WWrD1KPen/view?resourcekey>

Features included in first version

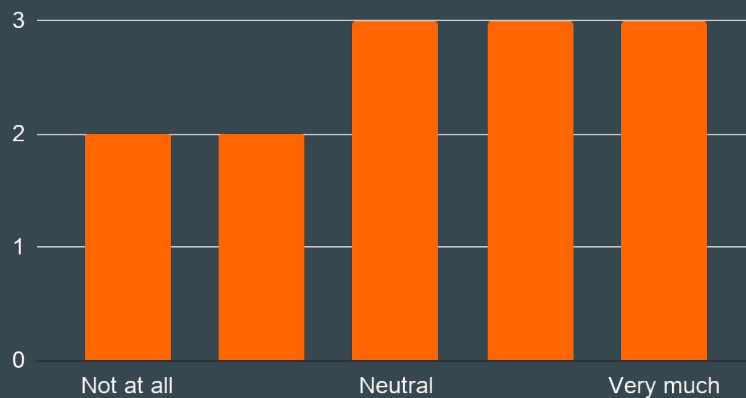
Multiple environmental sounds like footsteps, wall-scratching and wall-bumping create a realistic virtual soundscape. Other artificial sounds, like the shepard-scale for the progress to the goal and the clicking on rotation are used for important information. A quiet wind-noise indicates the directions the player can walk. The progress is also sonified with music that builds itself up, to create motivation to finish the game.

User Study from first version

Have you reached the goal?



How musical appealing is the game?



Problems with first version

“Hard to concentrate on specific sounds”

“Some elements are too distracting, others too quiet”

“Audio does not sound pleasant when mixed”

Goals

We want to better integrate music and sounds into each other.

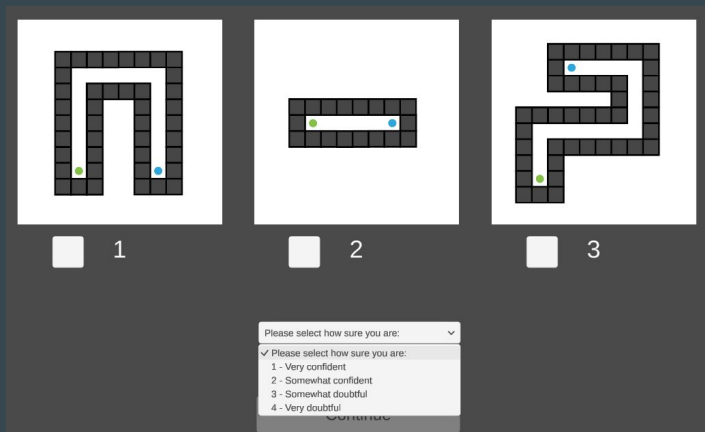
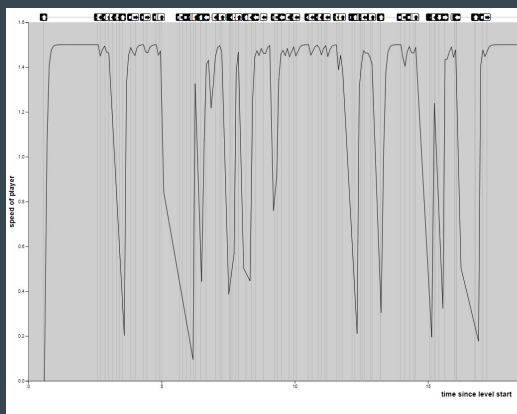
We want the players to learn the “sound concepts” step-by-step in a tutorial to not overwhelm them.

We want to have better data logging to have more data to analyse.

User Evaluation

Quantitative: We log data to measure...

- Time needed for each level
- Spatial Awareness (do people recognize visual representation of their level)



We also do a quantitative survey see if the participant had fun and understood the mechanics.

Data Sonification: Audio Maze

paul1999mai@gmail.com [Konto wechseln](#)

Der mit Ihrem Google-Konto verknüpfte Name und das verknüpfte Bild werden gespeichert, wenn Sie Dateien hochladen und dieses Formular senden. Ihre E-Mail-Adresse wird nicht in die Antwort eingeschlossen.

Please enter your age

Meine Antwort

Please indicate your sex

☐ Female

☐ Male

☐ Prefer not to say

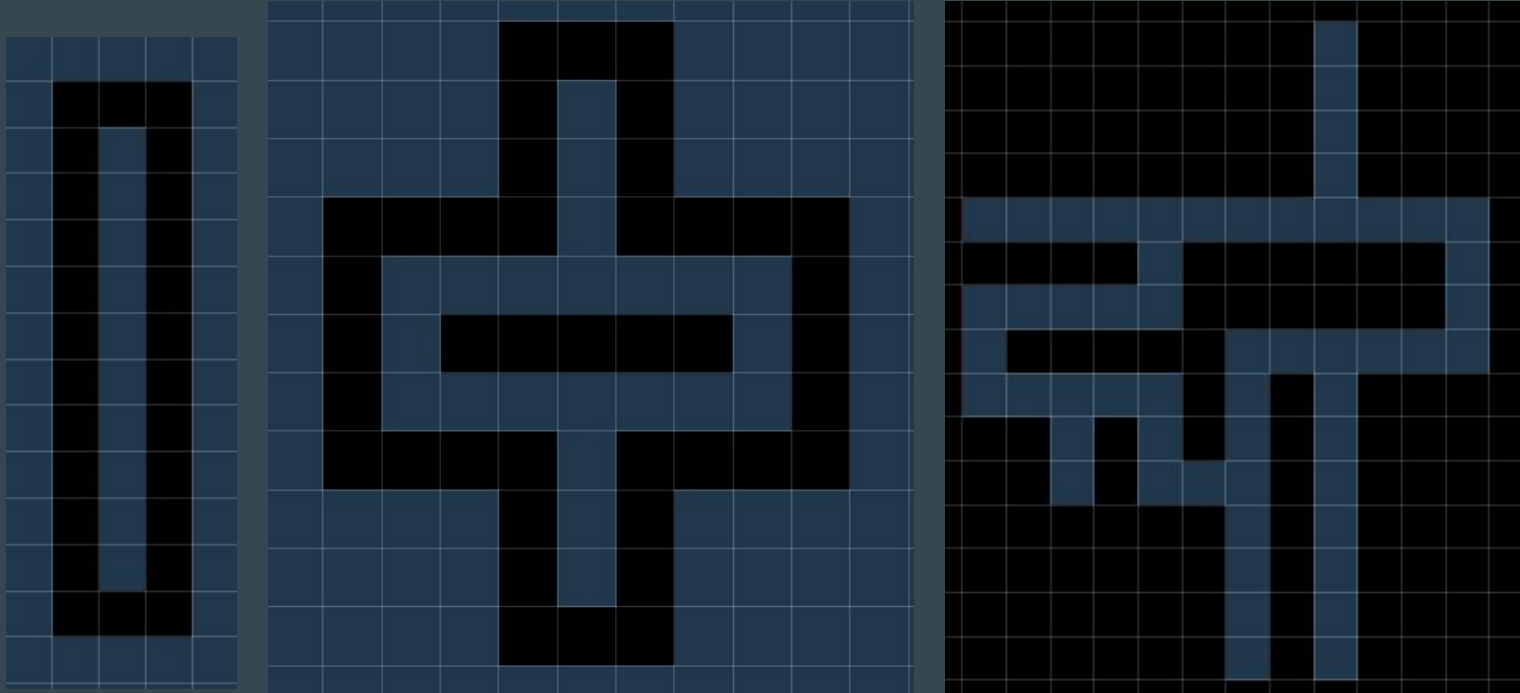
☐ Sonstiges:

How often do you play video-games?

1 2 3 4 5

Never ☐ ☐ ☐ ☐ ☐ Very often

Levels



Note: These are not the actual levels, to not spoil the game for you ;)

New Audio Platform



We changed from the internal Unity Audio System to FMOD.

FMOD is a specialised Digital Audio Workstation for working with games which communicates with Unity via an API.

FMOD allows easy 'no/low-code' set up of audio interactions and transitions which gave us the opportunity to quickly prototype and experiment with audio.

Sound-Elements: Music

<https://drive.google.com/file/d/1yrDx9iYW35BzGofCjDEzZEAgSaVcsfnC/view?resourcekey>

The music consists of multiple tracks. The further you get to the goal, the more tracks are played.

Sound-Elements: Environment

<https://drive.google.com/file/d/1buihP6K4VLaHu9yRcuEgZlKu5S-w7Tta/view?resourcekey>

Like in AudioMaze 1.0, footsteps, wall-scratching and -bumping is sonified.

Sound-Elements: Orientation of the player

<https://drive.google.com/file/d/1q9IVpnFvOVMpbOI7CHbyQA7EDWmnyfLs/view?resourcekey=0>

Because the rotation of the player is a very important information for the user, its sonification has to stand out. When the player looks away from the direction of the goal, the music gets distorted.

Sound-Elements: Junctions

<https://drive.google.com/file/d/1V9o20JevQX0kr7YoVlrZ745QxLgZjOCa/view?resourcekey>

<https://drive.google.com/file/d/1OEhM483hbXPlNHmNBklHtvvjiR3KnP2I/view?resourcekey>

Junctions require the player to make a decision and should therefore be noticable. We simplify and only distinguish between left and right and not the full 360°. We also don't sonify open pathways in front and behind the player, because these are open most of the time.

Conclusion and Planned Work

The new sonification is very different from AudioMaze 1.0. We use less elements, but each element carries more information. Also we mix most sounds into the music.

To test whether this improves on the old design we want to continue testing and properly analyze the results of our studies in a formal manner and finally compile the results into a paper.

Limitations and Future Work

We are measuring and comparing different navigation approaches in a virtual space with no visuals, we do not know how this will come into effect in real-spaces or situations where visual feedback is added.

Measuring spatial awareness is difficult and could be improved.

There are plenty of avenues for future work. One could build a system with a similar approach to ours but use it in combination with traditional GPS systems to navigate through real life locations.

Literature

Balan, Moldoveanu, and Moldoveanu, "Navigational Audio Games" 2015 - Games for blind people, can potentially improve spatial awareness.

Gaudy, Natkin, and Archambault, "Pyvox 2: An Audio Game Accessible to Visually Impaired People Playable without Visual Nor Verbal Instructions." 2009 - Design Recommendations and guidelines for creating a navigational audio game.

Hermann, T., Hunt, A., Neuhoff, J. G., editors (2011). The Sonification Handbook. Logos Publishing House, Berlin, Germany, 2011 - More design recommendations for how to Sonify, especially for game-events.

Clemenson, G.D., Maselli, A., Fiannaca, A.J. et al. Rethinking GPS navigation: creating cognitive maps through auditory clues. Sci Rep 11, 7764 (2021). - Similar research project comparing two different types of navigation as we do, but in the real-world with a sonar-based system.

Clemenson, G. D., Henningfield, C. M. & Stark, C. Improving hippocampal memory through the experience of a rich Minecraft environment. Front. Behav. Neurosci. - In depth investigation of cognitive spatial maps, provided inspiration on how to test it.

Acknowledgements

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