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# Drag ‘n’ Hear: Creating, Playing, and Understanding Audio Games Online

**Michael Urbanek**

TU Wien  
Vienna, Austria  
michael.urbanek@tuwien.ac.at

**Michael Habiger**

TU Wien  
Vienna, Austria  
michael.habiger@tuwien.ac.at

**Florian Güldenpfennig**

New Design University  
St. Pölten, Austria  
florian.gueldenpfennig@ndu.ac.at

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**Abstract**

Since the last couple of years, we have been aiming to advance our understanding of the audio games design process. As audio games are computer games that rely on sound *only*, they demand or invite the players to ‘build the game world in their mind’. Hence, compared to video games, missing visual information is filled in and created by mental imaginary. This makes the genre exciting and simultaneously open to both players with or without visual impairments. In terms of game design, audio games, however, bring additional challenges to the process. *How does a designer sketch games that he or she cannot see?* To explore such issues, we created an *open-sourced* online audio game editor that can function as a *sketchbook* for audio games. By studying how people use the editor to create audio games, we hope to better understand audio game design and foster the growth of this interesting game genre.

**Author Keywords**

Audio Games; Audio Game Editor; Audio Game Engine; Web-based; Platform; Design Process; Research Through Design

**CCS Concepts**

•Applied computing → Computer games; •Software and its engineering → Interactive games; Designing software;

“Audiogames, as opposed to video games are computer games who’s [sic] main output is sound rather than graphics. Using sound, games can have dimensions of atmosphere, and possibilities for gameplay that don’t exist with visuals alone, as well as providing games far more accessible to people with all levels of sight.”

– [audiogames.net](http://audiogames.net)



Figure 1: An audio game is designed by means of our editor (left) and played using headphones and a controller (right).



Link to a demonstration video:  
[https://www.youtube.com/watch?v=\\_59lfxl2tE](https://www.youtube.com/watch?v=_59lfxl2tE)

### Introduction & Related Work

Designing is often framed as a conversation. A conversation between the designer and people or stakeholders; or a conversation between the designer and the material he or she works with. A piece of reality is manipulated and made sense of for the sake of informing further manipulations. Donald Schön famously formulated such considerations when investigating the design process and the skills of practitioners when performing their profession (e.g., architects):

“A designer’s knowing-in-action involves sensory, bodily knowing. The designer designs not only with the mind but with the body and senses [. . .]. A designer sees, moves, and sees again” [6, p. 133].

In the context of audio game design, this quote illustrates a fundamental challenge. *How can designers find appropriate processes for designing audio games, when the only material the product is composed of is sound?* In more detail, in audio games, we face the challenge that the medium is

intangible, invisible, and time-based, that is, it unfolds over time and can only be processed sequentially.

Compared to video games, we know far less about how people design audio games or how we can support them in doing so. For sure, one important reason for this is the size of the industry. Video games are a huge business and audio games are a tiny niche market in comparison. Indeed, there are only few commercial titles available (e.g., *Feer* [1]). Most audio games were made by hobbyists and semi-professionals. However, there is a large online community of supporters and fans of audio games named [audiogames.net](http://audiogames.net). On the left column, we provide a definition for audio games as formulated by this influential community.

To return to the problem, designing audio games is a challenge and the audio game design process is under-researched. In the audio games literature, audio games were often evaluated in terms of what purpose they could be used for (e.g., for motivating people to physically exercise [5]). Furthermore, researchers provided design recommendations for

supporting the process (e.g., [9, 3]), while, we made the argument that prescriptive design rules will not always necessarily aid audio game design [8]. However, there is a lack of research that investigates the audio game design process *per se* (as opposed to supporting specific aspects of it with e.g. design rules), like Donald Schön did with his phenomenological inquiry into professional practice (e.g., [6]) or Tracey Fullerton with her comprehensive book on 'conventional' game design [2].

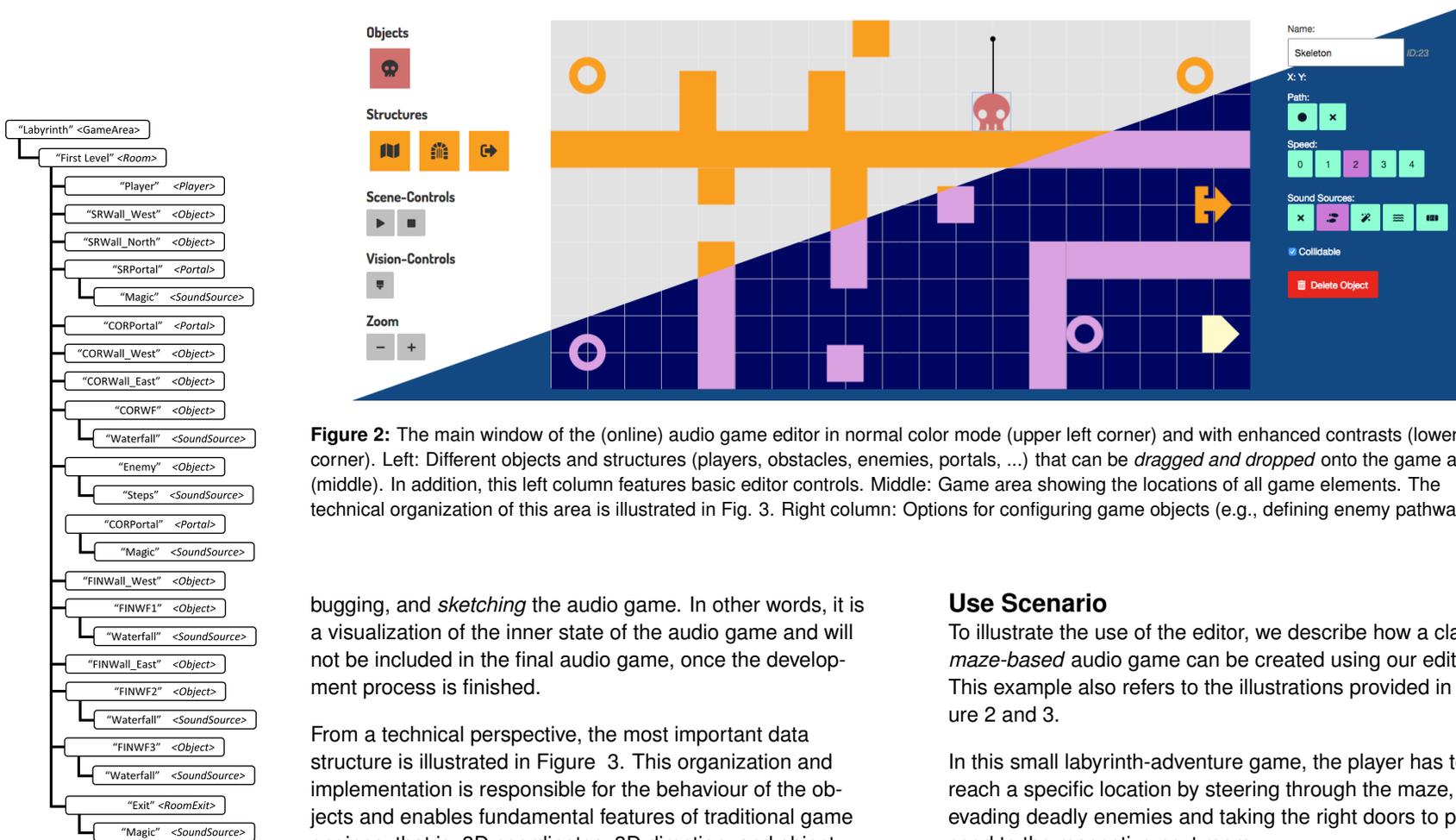
To address this gap, we decided to engage in design phenomenology and observe audio game designers in action, at first. However, as it turned out, it was very hard if not impossible to find audio gamer designers, who we could observe in their daily practice. There were too few and they were distributed around the world. For this reason, we shifted our research strategy and took a practice-based design research approach (e.g., [4]). That is, we started designing our own audio games and tools for creating audio games in order to generate design knowledge through these hands-on experiences. Insights from prototyping, conversations with experienced audio gamers, and reviewing the literature eventually led to the idea of creating an *open-sourced (online) audio game editor*. By means of this tool we also aim to reach more people who are interested in designing audio games and study their use of it. The overall concept is illustrated in Figure 1.

### Online Audio Game Editor - Description

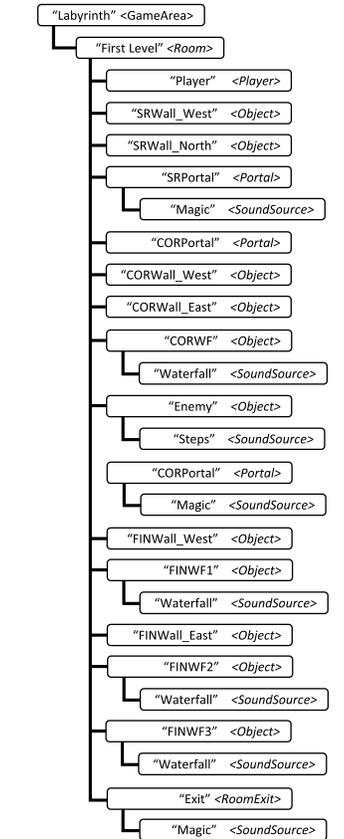
The requirements for the online audio game editor were elaborated in collaboration with experienced (visually impaired) audio gamers and (sighted) game designers. For example, we asked participants to create audio games from *Lego* bricks (each brick representing different game elements) and then mapped their analogue *Lego* prototypes to a digital, interactive version using *Unity3D* [7]. Hence,

we invited them to use a very quick (at least for them) *mid-fidelity* technique for creating audio games. Their feedback informed the underlying concept of the present audio game editor in a significant way. Most importantly, the editor should be easy to use – even for people with little to no programming experience – and accessible as far as possible. For this reason, we designed a principal interaction paradigm that can be used quite intuitively. Via simple *drag and drop* gestures, the users or designers are enabled to create their own games (see next section Use Scenario for an example) and to immediately *hear* the effects. To support people with impaired vision, the color-contrasts of the graphical user interface (GUI) can be enhanced, if required (see Figure 2). Moreover, we have implemented an *Application Programming Interface* (API) so that most interactions with the GUI can also be carried out using code (and text-to-speech software, etc.). Moreover, we kept the design of the main window, where most user interactions take place, rather 'simple'. As shown in Figure 2, this window is divided into three segments: a left column with game objects and structures (e.g., players, enemies, obstacles, etc.), a middle area where these objects can be arranged (the game area), and a right column with additional options for configuration. More objects and features are currently under development, so that the designers have access to 'typical' audio game object blueprints.

In summary, the intended target group for the editor are people interested in creating audio games with or without impaired vision. The graphical user interface of the editor, of course, requires some remaining vision or acuity. If a user cannot use the graphical user interface, the editor can be accessed via its API and conventional screen-readers, etc. Visually impaired and sighted players both can play the resulting games. As shown in Figure 2, the graphical rendering of the audio game is a tool for constructing, de-



**Figure 2:** The main window of the (online) audio game editor in normal color mode (upper left corner) and with enhanced contrasts (lower right corner). Left: Different objects and structures (players, obstacles, enemies, portals, ...) that can be *dragged and dropped* onto the game area (middle). In addition, this left column features basic editor controls. Middle: Game area showing the locations of all game elements. The technical organization of this area is illustrated in Fig. 3. Right column: Options for configuring game objects (e.g., defining enemy pathways).



**Figure 3:** The organizing structure of an audio game implemented with our editor. This particular example is described in Section Use Scenario.

bugging, and *sketching* the audio game. In other words, it is a visualization of the inner state of the audio game and will not be included in the final audio game, once the development process is finished.

From a technical perspective, the most important data structure is illustrated in Figure 3. This organization and implementation is responsible for the behaviour of the objects and enables fundamental features of traditional game engines, that is, 3D coordinates, 3D direction, and object size. The *GameArea* holds (multiple) *Rooms* that often correspond to different levels. Each room holds game objects like enemies and obstacles. We go on to describe an exemplary audio game to illustrate how compositions of these objects can make up an entire game.

### Use Scenario

To illustrate the use of the editor, we describe how a classic *maze-based* audio game can be created using our editor. This example also refers to the illustrations provided in Figure 2 and 3.

In this small labyrinth-adventure game, the player has to reach a specific location by steering through the maze, evading deadly enemies and taking the right doors to proceed to the respective next room.

To implement this game concept, the designer has to *drag and drop* a number of elements using the editor. As a first step, obstacles or wall objects could be arranged on the game area to form different segments that cannot be traversed. Then, the designer defines two pairs of *portals* that have the capability to 'beam' the player from one place to

another in order to change rooms. Hence, the player later has to find these portals and traverse them in the right order to make it to the exit. In order to make the game more difficult, a monster is dragged onto the game area. An additional waterfall object serves as a point as reference for orientation. To accomplish this behavior, the designer inserts an object, defines it as *non-collidable* (in contrast to, e.g., wall objects), and attaches a sound file (e.g., by recording it with the computer's built-in microphone and a water tap). Finally, the goal or end position is defined using the respective game element.

It is up to the designer to drag all objects onto the game area at once and then test-play the game or to chose a different development strategy and create the game in more and smaller steps. The designer can use the game controls on the left side of Figure 2 to start and stop the game at any time in order to debug it and to get a feel for the game experience.

### Drag 'n' Hear

While creating games as described in the section above, it became evident that designing audio games is indeed different from designing video games. This relates to the challenges that we outlined in the introduction (intangibility, invisibility, and linearity of audio games). The biggest limitations of the *Lego* prototypes described above, were their delayed interactivity and unresponsiveness. That is, the participants were not able to instantly test their ideas. Instead, they had to wait until the analogue prototype was mapped to a digital version. The audio game editor as presented in this paper, instead, can be considered as an 'auditive sketchbook' that allows a dynamic dialogue between the designers and their sound-design/ideas (c.f. [6]).

### Outlook

We have designed the presented (online) audio game editor for two reasons. First, we wanted to learn about audio game *design* during the process of its development. Therefore, we consider our endeavor as a practice-based design research project (e.g., [4]). Second, as future work, we aim at advancing our understanding of the audio game design process by observing how people make use of the editor for creating their own audio games. Hence, on the one hand, we plan to give interactive live demos during scientific conferences. On the other hand, we will recruit test-designers or participants via the Internet.

To this end, we are currently developing a related online platform where people can share and discuss their own audio games. Technically, people will be able to develop their games using our online audio game editor, they will be able to play it in this same environment, and they will also be able to share and discuss it.

This also means that as future work, we will continue to improve the accessibility of the editor and corresponding environment. This includes designing manuals and instructions that are accessible and understandable. We will release the project output including the software that we have created (editor, platform, ...) under an open-source licence to enable interested people to add improvements and to support project sustainability and longevity.

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## REFERENCES

1. Mental Home e.U. 2018. *Feer*. Game [iPhone]. (September 2018). Mental Home e.U., Vienna, AT.
2. Tracy Fullerton. 2019. *Game Design Workshop - A Playcentric Approach to Creating Innovative Games*. CRC Press, Boca Raton, FL.
3. Franco Eusébio Garcia and Vânia Paula de Almeida Neris. 2013. Design Guidelines for Audio Games. In *Human-Computer Interaction. Applications and Services*, Masaaki Kurosu (Ed.). Springer Berlin Heidelberg, Berlin, Heidelberg, 229–238.
4. Ilpo Koskinen, John Zimmerman, Thomas Binder, Johan Redström, and Stephan Wensveen. 2011. *Design Research Through Practice: From the Lab, Field, and Showroom*. Morgan Kaufmann.
5. Haechan Lee, Miri Moon, Taiwoo Park, Inseok Hwang, Uichin Lee, and Junehwa Song. 2013. Dungeons & Swimmers: Designing an Interactive Exergame for Swimming. In *Proceedings of the 2013 ACM Conference on Pervasive and Ubiquitous Computing Adjunct Publication (UbiComp '13 Adjunct)*. ACM, New York, NY, USA, 287–290. DOI: <http://dx.doi.org/10.1145/2494091.2494180>
6. Donald A. Schön. 1992. Designing as reflective conversation with the materials of a design situation. *Research in Engineering Design* 3, 3 (01 Sep 1992), 131–147. DOI: <http://dx.doi.org/10.1007/BF01580516>
7. Unity Technologies. 2012. *Unity*. Software Development Toolkit [Cross-platform]. (2012). <https://unity3d.com>. Accessed 4<sup>th</sup> April, 2019.
8. Michael Urbanek, Peter Fikar, and Florian Güldenpfennig. 2018. About the Sound of Bananas - Anti Rules for Audio Game Design. In *2018 IEEE 6th International Conference on Serious Games and Applications for Health (SeGAH)*. IEEE, 1–7. DOI: <http://dx.doi.org/10.1109/SeGAH.2018.8401361>
9. Bei Yuan, Eelke Folmer, and Frederick C. Harris. 2011. Game accessibility: a survey. *Universal Access in the Information Society* 10, 1 (01 Mar 2011), 81–100. DOI: <http://dx.doi.org/10.1007/s10209-010-0189-5>