Rethinking Prototyping for Audio Games: On Different Modalities in the Prototyping Process

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There are many similarities between prototyping for traditional computer games and prototyping for other interactive systems, for example, applications for the work place. In most cases, pen and paper are used to initially test design ideas and feasibility. However, in audio games pen and paper can be rather useless for sketching the user experience of sound. In this paper, we argue that conventional lo-fi prototyping techniques are less appropriate for audio game design and take a look at existing models of game design processes. In this course, we identify and describe a major challenge in prototyping audio games, which we named "Change of Modality".

Audio Games. Different Modalities. Game Design Process. Paper. Prototyping. Sound.

1. INTRODUCTION

Prototyping is part of a design process that enables the designer to test ideas at a very early stage of the process or to even generate new ideas. The early testing of ideas can reduce consequential costs to fix problems, should a bad idea go into production. Therefore, prototyping can be regarded as an early test for feasibility (Fullerton (2014)).

Today, prototyping is essential to the design of novel (interactive) products. Regardless of the context of use, be it a software for the work place, an interactive gadget to help us live healthier or a video game for leisure time, iterative prototyping is likely to be employed to improve the design.

In this paper, we are interested in the challenge of prototyping audio games. To this end, we take a look at prototyping processes for conventional video games and describe the particularities of audio games compared to conventional games. For example, we investigate the well-known design process as proposed by Fullerton (2014). Subsequently, we draft a proposal of what a prototyping design process for audio games might look like. In this course, we identify and describe a major challenge in prototyping audio games. This challenge has to do with a *Change in Modality,* which takes place due to the use of audio in audio games as the primary stream of information. We conclude the paper by discussing how this challenge could be addressed drawing on novel prototyping tools.

2. BACKGROUND

2.1 Prototyping and conventional video games

Prototyping is a central part of many video game design processes. Salen and Zimmerman (2004) describe the game design process as an iterative process that starts with *prototyping,* which is then followed by *playtesting*, *evaluation* and *refinement*. Another game design process formalization was proposed by Fullerton (2014). She describes the game design process from a game production and development point of view, detailing *physical prototyping* (pen, paper or other props) and *software prototyping* as separate stages. Every step in her model contains an iterative process that *generates*, *formalizes* and *tests* ideas, which eventually get *evaluated.* Should problems be identified in the design, the design work gets refined and iterated by starting the process all over again. A more open (less prescriptive) approach to game design was proposed by Schell (2014) who describes the process of game design by a *game design map.* Central part of this map is the *design process* that connects to *the designer*, *the game*, *the idea*, *iteration* and *playtesting*. Schell (2014) also describes an iterative prototyping process that, in comparison to Fullerton (2014), also considers design risks during the process to avoid 'dead ends' (wrong design decisions that might lead to product failure).

Overall, the proposed processes as briefly outlined above, suggest an iterative approach for prototyping in game design. The primary motivation is to avoid mistakes and to generate design ideas,

beginning at a very early stage of the process. In more detail, the prototyping for games can be summarized as follows.

Early prototyping in video game design processes involves pen and paper or other graspable materials. Usually, this kind of lo-fi prototyping is utilized as a first test of game mechanics and ideas. It is cost efficient, requires less effort in preparation but it is limited in its functionality. At later prototyping stages, software prototypes are developed to test, for example, gameplay with input devices, which cannot be tested at an earlier stage of the design process. Sound as an accentuating component in video games is also tested and implemented in these later stages of the design process. *However, does this use of prototyping also apply to audio game design? What are audio games?*

2.2 Audio Games & Sound

Audio games are computer games that feature sound as the only feedback a player receives, and they do not feature any visuals. The main target group of audio games are visually-impaired people, nevertheless, these kind of games can be enjoyed by everyone (Papworth (2010); Mendels and Frens (2008); Röber and Masuch (2004)). Usually, an audio game is played from a first-person perspective using spatialized sound. When playing audio games, players most of the time wear headphones for the best user experience (Drewes et al. (2000)) and to support the localization of sound sources. The latter characteristics are typical for 3D audio games. Although 2D audio games (including their design) offer space for exploration and design (see e.g. Jamison (2016)), they are limited in their dimensionality and complexity. For this reason, in this paper we focus on 3D audio games and its prototyping.

Audio games recently became more popular through an increased availability on mobile phones or tablets. Without any visuals, these games do not (or just to a small extent) need graphical computations which also enables them to run on older mobile devices. Without graphical computations, again these games consume less power in comparison to video games. Audio games feature the advantage that they are playable without 'staring' at the screen which makes them suitable for outdoor activities or places where visuals are distracting.

Most conventional video games also feature sound to enhance the user experience, of course. In the context of prototyping, this poses the question about *the difference between sound in video games versus sound in audio games.*

Audio in video games is complementary and accentuating the game experience and an important factor for immersion. As stated before, audio in video games is implemented and refined at a later game design stage. Without audio, video games are in most cases still playable although they suffer from a reduction in immersion. In contrast, audio in audio games is an essential component since it is the only output a player receives. Audio in audio games replaces UI elements, navigational feedback, feedback of player's actions, the gameplot, mechanics and meaning, which all together create immersion (Rovithis et al. (2014)). Therefore, an audio game becomes unplayable without audio.

This leads to the question if the different role of audio *does have an effect on the game design process. Is there a need for a specific audio game design process?*

3. AUDIO GAME DESIGN PROCESS

As we have seen in the previous section, there is a growing body of literature about the design process of video games. Although these documentations and recommendations for game design too find application in the design of audio games, there are upcoming voices in the community that call for a different design paradigm for audio games (see below). However, in contrast to games or video games, there is no existing scientific documentation that defines or describes a specific design process for audio games; not even the existence of such a process is mentioned in the HCI or game design literature, to the best of our knowledge.

Nevertheless, audio game designers use sound as the *basis* for their design activities, while video game designers use it as *part* of their design work (Rovithis et al. (2014)). This crucial difference indicates a distinct design process for audio games compared to video games. In a practical project, the application of this paradigm was tested during the implementation of the audio game *Drive*, which was successfully created under the premise of using sound as the main organizing principle throughout the design process (Velleman et al. (2004)). This was accomplished by focusing on the essence of the game and creating the soundscape accordingly (Velleman et al. (2004)). The focus on sound and on the balance between the game's functionality and sound aesthetics (Röber and Masuch (2004)) is an important difference to video game design since here balancing functionality with sound aesthetics is not necessary.

Whether established video game design processes can too be adapted and used for audio game design or whether a specific design process for audio games needs to be established is an under-researched question. However, as described above, there are indications that the foundations of the design process for video games are too
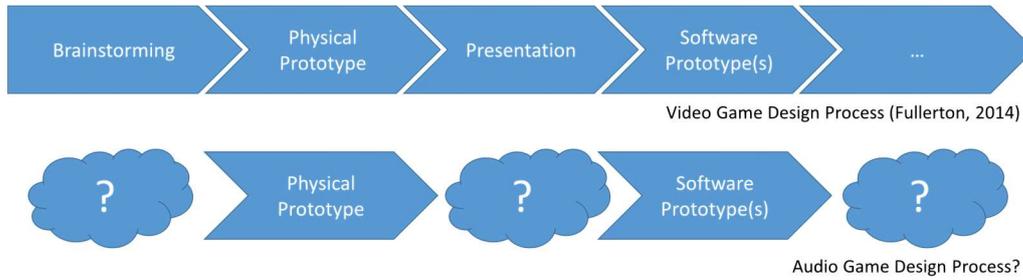
Figure 1: *Deducting the audio game design process from Fullerton's well-known video game design process (Fullerton (2014)) (top row; for better readability, the last three steps in the process Design Documentation, Production and Quality Assurance were omitted). Physical Prototype and Software Prototype(s) (see arrows at the bottom of the figure) represent stages in which an evaluation of ideas takes places.*

different compared to audio games to be applicable in a meaningful fashion. One promising starting point we propose for further research, is to investigate these differences in more detail.

In the opinion of the authors of this paper, there is a need for an explicit audio game design process. This assumption is indicated by the above listed differences in audio game and video game design. Although there is no definition of a specific audio game design process in scientific literature, a possible deduction of the audio game design process from an existing model is shown in Figure 1. The top row of this figure illustrates the video game design process as described by Fullerton (2014). Based on the assumption that the testing of ideas – which is essential to prototyping (Buxton (2010); Löwgren and Stolterman (2007)) – and the creation of a software prototype must also be present in audio game design, the second row of Figure 1 proposes a first abstraction of the video game design process towards a process for audio game design. However, as indicated by the cloudy question marks, this definition of a process for audio game design is far from being complete. One particularity, which needs further investigation before a model can be completed is discussed in the following paragraph.

4. PROTOTYPING AND THE CHANGE OF MODALITY

In game prototyping, there is a stage in which paper prototyping or similar lo-fi techniques are used to clarify and test game mechanics and ideas. In video game design, these prototyping techniques are suitable because everything is represented visually like in the final software prototype or product. Since the lo-fi prototype is represented visually, the idea of what the game might look like as well as how the game mechanics work can be assessed clearly. In audio game design, we argue that these prototyping techniques are not suitable.

The core component in audio games is audio which obviously cannot be fully represented through pen and paper or other common lo-fi prototyping tools. Pen and paper, when used in audio game prototyping, are a visual and graspable

representation of auditive information but this information unfortunately cannot be audibly processed (heard) in the process of prototyping. In other words, lo-fi prototyping seems to "lose some of its power" in audio game design since a direct mapping to the final prototype is not possible. There is a need to transform things we made from pen and paper to audio. We name this transformation *Change in Modality* (see Figure 2). It is the transformation from visual components to auditive ones, and it bears challenges to the audio game designer.
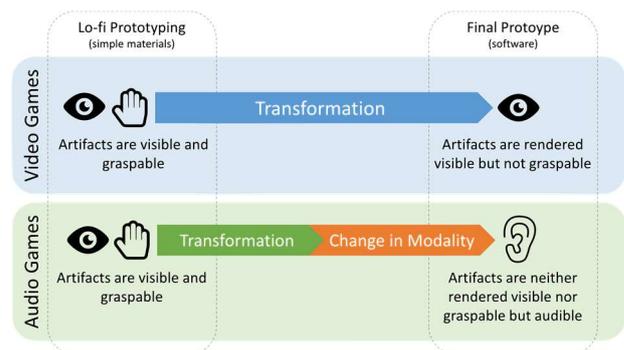

Figure 2: *Illustration of transformation processes during prototyping from lo-fi prototyping to the final software-based prototype. The Change in Modality challenges designers and their imagination during prototyping.*

While the implementation of game mechanics or ideas might work in a visual prototype, they might fail for a final audio game. E.g., a scenery with walls, a river and some trees is easy to grasp when drawn on a sheet of paper or represented by other props. However, without these visual cues the scene might be too difficult to understand for the player and game mechanics might fail or be uninteresting.

Rethinking prototyping in audio games: For the reason explained in the paragraph above, we suggest to avoid the described Change in Modality. This can be accomplished if we change the materials we use for lo-fi audio game prototyping (see Figure 3). This however demands smart prototyping artefacts that can embody audio and that are used in an early stage of development in analogy to pen and paper in video game design.

For example, smart building bricks could be used to assemble the walls described above. Sound sources could be placed as tangible representations within these brick walls. Headphones and real-time sonification can provide a means for the direct assessment of audio game ideas.
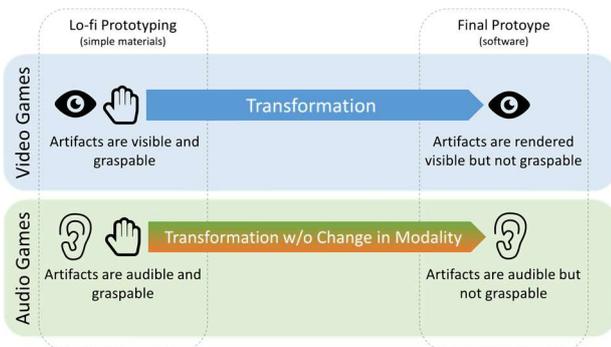
Figure 3: Drawing on audible and graspable artefacts, the Change in Modality in audio game prototyping can be avoided (e.g. TAGDK (Urbanek and Güldenpfennig (2017)). The transformation from lo-fi to the final software prototype maps audio in the prototype to the corresponding sound in the final software prototype.

The Tangible Audio Game Development Kit (TAGDK) represents a first step towards the adaption of early stage prototyping tools for audio game design that questions established prototyping tools (Urbanek and Güldenpfennig (2017)). The idea of TAGDK is to bypass the Change in Modality by incorporating computerized prototyping props that can be manipulated to render sound.

5. OUTLOOK

Under the premise of an audio game design process, which is different from the video game design process, it needs to be questioned if existing video game design prototyping methods are appropriate for prototyping in audio. In conclusion, we suggest to rethink game prototyping methods for audio games to avoid the Change in Modality.

Improving and developing audio game prototyping techniques for testing at an early stage can be crucial to promote the advancement of audio games. Novel methods drawing on graspable and auditive prototyping artefacts can increase the quality since *audio* should be included at the early stages of prototyping for *audio* games, allowing designers to explore their concepts in the corresponding modality and helping them to make the right design decisions. This will create costs, as new prototyping methods need to be developed, but the potential rewards are e.g. better tools for production or easier access to audio game design, hence – more audio games are made, which again can increase the discourse about the medium and quality of games in this genre.

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