Interactive Audiobooks: Combining Narratives with Game Elements

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Abstract. The authoring and the design of immersive, non-linear plots remains one of the main challenges in interactive digital storytelling. This paper introduces the concept of *interactive audiobooks*, which combines the potential of complex (non-)linear narratives (e.g. books and radio plays) with interactive elements from computer games. The design concentrates on a flexible degree of interaction, in a way that the listener's experience ranges between a passive listening to an interactive audio-only computer game. In this paper we discuss the story-engine used in interactive audiobooks, as well as present an authoring framework along several design guidelines to create them. Finally, we demonstrate the capabilities of our system with an adaptation of a short story from Edgar Allen Poe.

Keywords: interactive storytelling, audiobooks, story authoring, audio-only games

1 Introduction

Over the last years, audiobooks and radio plays have enjoyed a constant increase in popularity that is still on the rise. One reason is their convenient usability, as no special equipment and no continuous observation by the user are required. Audiobooks and radio plays are therefore often used by people who are committed to another (possibly boring) task, like driving or ironing, that requires visual but no continuous auditory attention. This lack of visual information requires an active participation and a focused attention of the audience in order to reconstruct the fictional universe. Oral presentations are therefore, compared to visual depictions of the same content, considered to be much more stimulant and immersive. By using linear plots and fixed story lines, the users of conventional audiobooks might detect additional details through a repeated listening, but can not experience a changed, nor influence the existing story line. This changes with the introduction of *interactive audiobooks*, in which the listener/player may and can intervene with the story at pre-defined and user-selected points using an auditory user-interface.

The idea of interactive audiobooks is simply to combine the narrative advantages of an oral storytelling with additional story-related interaction and game elements. The system is thereby designed with a varying degree of interactivity that allows anything between a passive listening to a free interaction as an auditory computer game.

The paper is organized as follows: After this introduction, Sec. 2 discusses related work ranging from audio-only computer games to the principles of interactive digital storytelling. The basic concepts of interactive audiobooks are then presented in Sec. 3. Here we also discuss the varying levels of interaction, story-dependent game elements, and the design of auditory user interface. Sec. 4 provides an overview of the system's architecture and presents details of the story- and game-engines used. The following Sec. 5 evaluates the concept by adapting a short story from Edgar Allan Poe as an example. Finally, we summarize the results and discuss possible improvements in Sec. 6.

2 Related Work

Audiobooks and radio plays build the foundation of our work and are at the same time the most prominent reference. While *audiobooks* often feature only one speaker, *radio plays* involve, depending on the plot, several actors and additional ambient-related sounds and acoustical effects. The commonality between audiobooks, radio plays, and printed literature is their underlying linear and static plot. One of the foci in digital interactive storytelling lies therefore in the design and authoring of non-linear plots and the development of techniques that integrates user interaction into the story-line.

Adventure games and audio-only computer games are the second support of our concept. Interactive audiobooks and adventure games, both focus on narration but also contain game elements to enhance the storytelling. Audio-only computer games on the other hand represent a small niche of game titles that are often developed by and for the visually impaired. Although, some of these games feature novel and intuitive sonification and interaction techniques, the majority is still rather simple and not comparable with regular computer games. Interactive audiobooks can therefore be seen as a union between auditory adventure games and radio plays; although complex narratives prevail game elements.

The available *interactive audiobooks* from digital publishing AG are language learning aids, in which translations are interactively blended over the read out text [1].

Our approach examines several challenges in interactive digital storytelling:

1. The design of intuitive authoring tools to create data structures required in story-engines and to design control mechanisms for narrative flow,
2. Mechanisms to achieve the same complexity as in real narratives, and
3. Mechanisms to maintain the coherency of plots after user interactions (i. e., to integrate the user's actions within a dynamic plot).

(1) The main focus in interactive storytelling lies in the development of formal representations to characterize actors (role, personality, and emotional status) and plot structures. Current story-engines represent plot elements with a varying level of detail: scenes, beats, or actions. The narrative flow is often controlled by simple mechanisms, such as finite state machines (FSM), but also more complex planning systems are used[1]. Although there are powerful authoring tools for FSM story-engines available, there are few approaches only that feature intuitive interfaces to design more complex internal

[1] For a more detailed discussion, we refer to the work by [2]).

formal representations, and who can also be used to control the narrative flow using inference mechanisms [3].

(2) The complexity of real narratives raises another challenge. The GEIST [4] and the Façade [5] projects impressively demonstrated how detailed narratives can be constructed by using basic elements, that are more complex then Propp's motivs or beats. These structures easily enable authors to design complex interactive narratives [6].

(3) Another difficulty is the coherency of dynamic plots, as user interactions might cause severe changes in the fictional universe. Plot structures based on automatically generated simulations contain an explicit representation of causal dependencies, which can be used to apply repair strategies in order to integrate the users interaction (see [7]). With the lack of formal representations for preconditions and the effect of actions, our system exploits manual specifications of the intended functional links between plot elements (e. g., setup & payoff [8], foreshadowing & pay-off [9]).

3 Interactive Audiobooks

The concept of interactive audiobooks aims to combine complex narratives with game elements from adventure- and audio-only computer games. Using story-dependent interactions, players can influence the development of the plot and drive it in their own direction.

3.1 Action and Interaction

Adding the right amount of action and interaction is not a trivial task. Audiogames and the therein employed sonification and interaction techniques were used as a basis for creating story-dependent mini-games. In a previous project and in a first attempt to create an interactive auditory adventure game, we adopted several sagas and myth around the cathedral of Magdeburg and integrated this into a 3D audio-only adventure game [10,11]. In here, the player, a tourist visiting the city, stumbles over several incidents and unveils a mystery surrounding the old place. The game is set in a 3D auditory environment, in which events are triggered over time and through user interaction. Although several assisting sonification and interaction techniques were used (e. g., head-tracking, spatialized sound sources, beacons, and earcons), evaluations revealed that players got lost very easily due to the possibilities of a free exploration. Therefore we restricted the user movements in interactive audiobooks. The *transportation* from one scene to another is now guided by a narrator and controlled by the story-engine, who motivates and mediates the change. Yet, some of the interactive parts require and are centered on 3D user interaction, similar to the mouse searches in classic adventure games.

3.2 Enhanced Story-Graphs

Story-graphs offer an interesting alternative to create a non-linear story design. This technique is often used by game designers to provide alternative plots and endings that are consistent with the player's performance. Our story-engine is based on such story-graph structures and further extended by *interaction nodes*. These interaction nodes

contain dialogs and story-dependent mini-games and allow the user to partially control the main character. The listener now actively participates in the narration and steers the plot within a predefined range. Fig. 1 visualizes a simplified story-graph, in which *narrative nodes* (light/green) and interactive nodes (dark/blue) intertwine. The story starts at the root node atop and traverses down till it reaches an end condition (*terminal nodes*). It branches at predefined points, at which decisions and challenges in the form of interactive parts are placed. The path chosen depends on the player's actions and decisions, but also on the main characters conduct defined by the story-engine.

An adaptable interpretation by a motival classification system offers here a more flexible narrative flow [12]. Appropriate narrative nodes are selected from a set of alternatives, in which plot elements can be omitted in order to jump to another more appropriate position. To maintain the plots consistency, functional dependencies between plot elements have to be considered. Therefore, payoff elements may trigger the inclusion of setup elements. Additional story correction techniques can be specified by the game designer (e. g., the player should not be able to kill one of the main characters if this is not part of the story-line).

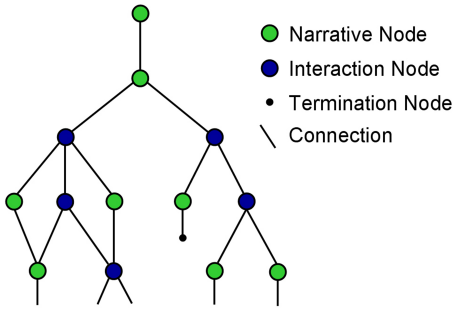

Fig. 1. Story-graph excerpt.

Before jumping to the authoring tools to design interactive audiobooks (e. g., Sec. 4), we need to discuss the specifications of narrative and interactive nodes, as well as address the potentials of the internal game logic used.

Game Logic: In order to design interactive audiobooks on the basis of complex linear narratives, authors have to segment the story into chunks and determine their arrangement within the story-graph. An internal logic controls thereby the development of the plot and maintains a coherent narrative flow. It therefore integrates with the story-graph and registers the users actions and decisions. Designers and authors are able to specify a simplified behavior of the main characters using several parameters. These conduct-variables are elements of the initial design and set up as part of the authoring, but may be adjusted to incorporate the players decisions and actions during the game play. Traversing the story-graph automatically (e. g., in non-interactive mode), the system chooses the *right path* according to the designed or adapted conduct-variables.

The amount of interaction that is expected by the user can be varied smoothly and is changeable throughout the story-line. This allows the user to start the story as a regular audiobook and later change it into an *interactive* audiobook with additional gaming and interactive components. Ahead each interaction task, the user has a short time slot (a few seconds) within he must decide whether he wants to interact with the system, or let it run automatically. This time slot becomes shorter after several non-interaction decisions, and is thereafter running in automatic-mode, but can be changed back at any time. The mini-games also feature a timer component. If the correct action within a certain amount of time is not made, the mini-game is lost. The story branches now into

a different path that penalizes the player opposed to the winning pathway, in which additional story details might be revealed.

Narration Nodes are the non-interactive parts and represent the basic narrative elements of the story. They contain the majority of (narrative) information (e. g., narrators voice, (internal) monologues, non-interactive dialogs, and ambient and environmental sound effects). The narrator of the story introduces the initial setting (the fictional universe), presents later advances, and drives the story-line. The (internal) monologues provide hints and guide the player, but should not dominate his decisions. Non-verbal ambient and environmental sounds effects, as well as background music denote a special group of narrative nodes. They usually contain no narrative information, but intensify the game's atmosphere, enhance the perception of the story, and deepen the player's immersion into the virtual environment.

Interaction Nodes are placed in between and sometimes in exchange of narrative nodes. They comprise story-related mini-games, dialogs, and techniques to influence the story-line or the behavior of the main character. In story-dependent mini-games, players can re-enact certain story events and therefore adding personal experiences to the story-line. These mini-games focus either on action and fast user reaction (arcade-style) or on a precise listening using a 3D interface to search for various items and hints (adventure-style). By searching for necessary items and hidden secrets, the listener/player actively participates in the story and its development. However, the mapping of some of these game elements to an auditory game play is not an easy task. For an intuitive determination of an items location, these objects are labeled with an acoustic beacon or earcon [10]. After its finding, a secret or additional information is revealed and the story proceeds. Dialogs and the interaction with other characters also provide details from the fictional universe and may influence the behavior of the main characters. The dialogs comprise pre-defined answers, but can also consider the mood of the main character to determine the right selection. Here we employ a small set of interaction primitives (e. g., *think*, *look*, *do it*, *do not*, and *exit*). These actions are custom fit to the current situation and provide the player with additional knowledge. Not all decisions lead in a different conclusion, but the selections made may influence the later story line.

3.3 Interface Design

The design of effective and intuitive user interfaces and interaction techniques are crucial aspects in the development of computer games. Moreover, the interaction should not distract the player from the game play and instead convey a feeling of being immersed into a virtual auditory world. Our interface employs therefore conventional game interaction paradigms, but also several new, more intuitive definitions.

Speech recognition would be the easiest and most convenient solution to control interactive audiobooks, but the absence of robust speech recognition technologies in mobile systems prevent such an implementation. An ideal platform are mobile gaming consoles, such as Sony's PlayStation Portable (PSP) or Nintendo's DS; but also modern Pocket PC's and PDA's offer enough power for acoustic rendering and playback. A simpler and less interactive system might also be realizable on iPod's and common MP3 players.

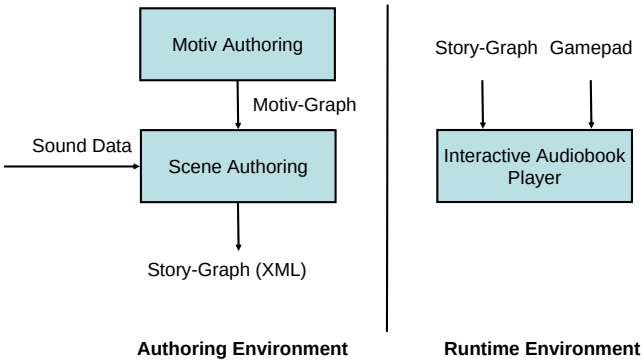

Fig. 2. Interactive audiobooks — system overview.

Our user interface is centered around a gamepad control and uses Sony's PSP game interface and design (see Fig. 4). This gamepad interface comprises a simplified joystick cross (left) and several buttons (right). Currently, a gamepad is the only interaction device to control the mini-games and the plot development. Future versions might also integrate head-tracking and real-time 3D sound rendering techniques for spatialized listening, or make use of additional sensors that provide further user feedback to adjust and fine tune the experience and the main characters conduct.

Using the joystick, players can control the character and search for items and hidden objects in adventure-style mini-games. The buttons are used to control arcade-style games, in which the player has to react quickly on certain inputs, and sometimes also repeatedly over time to achieve a certain goal. Acoustic feedback through earcons and the narrators voice is provided to convey additional information. Some of these arcade-style games were inspired by the recent adventure *Fahrenheit*, who employed many action mini-games as addition besides the actual story-line [13]. The dialogs and the in-game menu system are as well controlled using the gamepad and mapped as auditory display to various buttons and the joystick. This allows an easy interaction with the games and the setup of story and audio parameters.

4 System

The interactive audiobook framework is composed out of two modules. Figure 2 visualizes an overview of the system with the authoring part on the left and the runtime system on the right hand side. The authoring is further split into two parts, and enables an easy reuse of the designed motiv-graph also for other forms of interactive narrative.

The *runtime environment* is used for the presentation of the interactive audiobooks, and responsible for mapping the user's interactions to progressions in the plot (cf. Sec. 3.3). The *authoring environment* supports a hierarchical plot design, in which in an initial step authors specify abstract properties of important motivs that are part of the story-line (*motiv authoring*; cf. Sec. 4.1). In a second step, game designers and authors specify temporal and functional dependencies between motivs in the graph structure. As

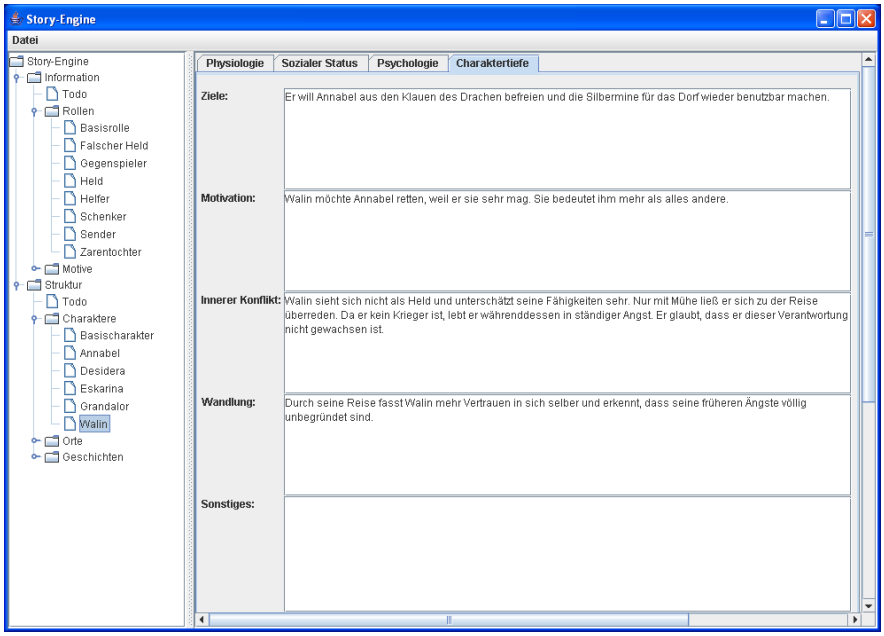

Fig. 3. Character input form.

these motivs often correspond to scenes, we refer to *scene authoring* as the refinement of motiv-graphs to story-graphs by the addition of interaction and termination nodes (cf. Sec. 4.2).

4.1 Motiv Authoring

One aim of this project is to enhance complex narrative structures that will later be combined with additional game elements. Therefore, it is crucial that professional authors and game designers can express their ideas in their own terminology. Thus, our authoring tool integrates concepts and approaches to develop and analyze the plot for complex narratives as well as for the elements of game design.

Several story analysts extracted commonalities in the plots of narratives, myths, and movies. Polti, Propp, Campbell, and Vogler [14,15,16,17], for example, proposed a small number of typical plot elements (*motivs*) and *archetypes* [18] or *dramatis personae* [15] to describe acting characters. Our system contains these motiv sets and examples of their realization in German folk tales. Moreover, our approach extends motiv-based authoring tools (e. g., [6]) by a semi-automatic classification of new plot elements according to known motivs (see [12]). But some motiv sets are not appropriate for certain genre or the iterative process of plot refinement requires more specific or more general motivs. Hence, authors can use, define, extend, and refine motiv sets to structure their plots.

Initially, authors describe the properties of all important entities of the fictional universe: characters, scenes, locations, and plot elements (motivs), which can be used for several episodes of a sequential. Moreover, they can specify temporal or causal dependencies between motivs that are visualized and represented in a *motiv-graph*. Authors have to provide as much information as possible about the dependencies between motivs, so that the story-engine can prevent an omission of plot elements required to establish them. For a more convenient visualization of motiv-graphs, authors can assign icons to motivs; the associated design principles are discussed in [12].

Fig. 3 shows a screenshot of the motiv authoring system. The navigation panel on the left hand side eases the access to dedicated input masks to characterize all story elements. The right panel presents the description of the main character in small interactive fiction. This input mask reflects Egri's model of personality [19], which considers physiological, sociological, and psychological aspects, all with up to 10 different points in any dimension. Egri's model also focuses on the goals, motivations, internal conflicts, and value changes for all characters. Hence, our framework contains a complex character data sheet that unites all these elements.

The representation of motivs contains formal and informal elements. Motivs specify the abstract structure of plot elements which can be specified by motival variants. Motivs also contain references to archetypes; these variable elements are instantiated by individual characters in different stories. Authors can select archetypes and characters from automatically generated lists (formal element) and characterize the content of motivs in natural language (informal element).

One main objective of our approach is to support the iterative plot and character development. Authors should be able to create incomplete plots and to redefine every formal specification. Therefore, plot specifications can contain gaps and inconsistencies (e. g., between the archetypes defined in a motiv and an associated scene description). Our system contains completeness and consistency checks, which generate ToDo-lists for authors as a reminder.

4.2 Scene Authoring

Inspired by authoring tools for (screen) writers (e. g., Dramatica [20]) and interactive fiction (e. g., DraMachina [21]), our system enables authors to integrate game elements in moderately adaptable narratives. The scene authoring module extends individual nodes of the motiv-graph with a more elaborated specification of narrative and interactive elements. Additionally, authors can supply auditory content for the narrative nodes (e. g., individual voices, background and ambient sounds). Finally, the game logic bridges and combines the narrative and interactive elements.

Fig. 4 displays a screenshot of the scene authoring module. It visualizes in the top left view the motiv-graph and provides in the middle display a more detailed overview of the current selected scene along the nodes and interactions possible. The larger window on the right hand side presents all information associated with the current node of the story-graph. Authors can specify acoustic realizations of narrative nodes (sound data files) or define the systems behavior at interaction nodes (actions, reaction, priorities). Action describing icons are simply dragged and added to the scene and filled with audio data and interaction details. Every icon represents here an interaction primitive

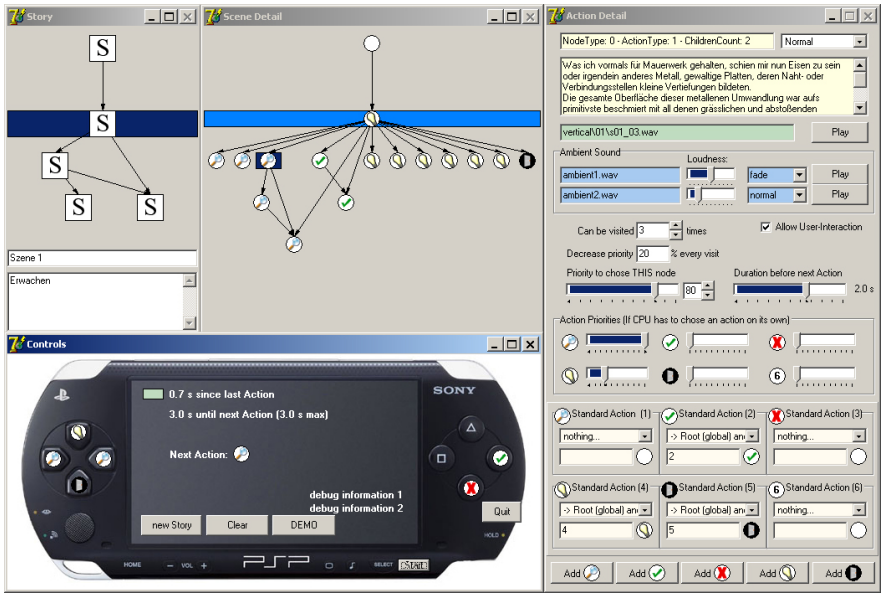

Fig. 4. Interactive audiobook authoring environment.

(cf. Sec. 3.3) and contains the time required to later complete the task. All actions and interactions can be tested online with the integrated runtime component visualizing a PSP gamepad, or by using a regular gamepad that is connected to the computer.

4.3 Implementation

The system was developed on the PC platform, although it was initially planned to design the runtime component for the PlayStation Portable (PSP). Due to difficulties in obtaining a licensed developer kit for the PSP, we moved to the PocketPC platform. This also features enough processing power to handle the story- and both game- and sound-engines. The motiv-authoring system is written in Java, while the scene authoring- and runtime-components are designed with Delphi and C++. The sound rendering is handled by OpenAL, atop which we build a simple mixer system that allows a blending between several sound sources and channels. Although OpenAL supports 3D sound spatialization, we currently only employ pre-rendered 3D sounds due to simplicity. Parameters, such as gain, pitch or roll-off, are adjustable for each sound source, and can also be mapped to the users game play. Additionally, using the OpenAL Effects Extension (EAX), reverberation and environmental acoustics can be designed to further enhance the scenes auditory realism.

5 Interactive Audiobook: *"The Pit And The Pendulum"*

This section provides a more practical look at the authoring and design of interactive audiobooks using a short story by Edgar Allen Poe as an example. First, we provide a

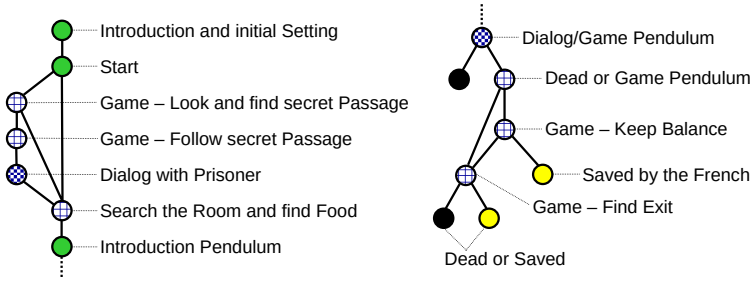

Fig. 5. Simplified story-graph from the interactive audiobook: "The Pit And The Pendulum".

brief summary of the story and describe our adaptations while transforming the plot into an interactive audiobook. Here we discuss the entire story line as well as the placement and the selection of the mini-games and other interactions. The second paragraph looks on the authoring process itself, while the last part discusses the results achieved.

Story and Adaptation: The story of "The Pit And The Pendulum" is one of the most popular works of Edgar Allen Poe and contains elements of the grotesque and arabesque. The plot is staged in a dungeon during the time of the Spanish Inquisition. The description of the hearing and the death sentence of its protagonist is very short and vaguely; the story itself centered around his endeavors to explore and escape his prison. One of the most scary parts in the story is as the hero awakens under a large pendulum with a razor sharp blade that slowly moves towards his chest. After several deadly situations, the hero is safely rescued in the last minute by French forces under the command of General Lasalle.

The plot as it appears in the original text is entirely contained in the interactive audiobook and can be experienced in the same way. Adding to this, the story has now three different endings, additional narrative to support a broader and more complex storytelling, three dialogs and several mini-games. Depending on the users selections and interaction, the story experienced can be the same as the original one, or completely different. A simplified story-graph of the interactive audiobook is presented in Fig. 5. It highlights on the key narrative components, the added narrative, the dialogs, as well as the mini-games.

Authoring and Design: The design and authoring of this example posed no major difficulties. The largest challenge hereby was the adaptation of the story-line to fit the new game play and the integration of interactions and mini-games. Here we first employed the motiv authoring tool (cf. Sec. 4.1) to integrate the additional narratives and alternative story-lines. The resulting motiv-graph was imported into the scene authoring tool (Sec. 4.2), from which we derived the final story-graph that is depicted in a summarized version in Fig. 5. The sounds, voices and music were recorded in a regular sound studio using professional voices, and after some mixing and compositing assigned to their designated nodes. A time-consuming task was the fine tuning of the individual scenes and the integration of the interactive game elements. Every scene and every scene fragment was individually set up and the time and priorities for certain in-

teractions were specified. The resulting scene graph now connects all events and scenes and contains verifications for the user interactions. In order to achieve the right balance between narration and interaction, several tests were necessary.

Discussion: The interactive audiobook "The Pit And The Pendulum" resembles the original text and further extends it by additional narrative and interactive elements. As the default traversal of the story-graph results in the original plot, the experiences in non-interactive mode are similar to listening to an audiobook. But it can also be an interactive auditory adventure game that relies on the listeners experience and skills to complete the original story or to deviate from the genuine path to explore an alternative story-line. The choice is up to the listener/player of the interactive audiobook.

Our current implementation comprises a tutoring level to teach the user interface along the game play and interaction techniques used. The duration depends on the degree of interaction and varies between 20 to 30 minutes. A preliminary user study with 17 participants between age 20 and 59 recognized the innovative concept of interactive audiobooks. About two third found the user interface intuitive, while others had difficulties to find the mini-games and interactive parts. This proves that the concept itself is valid, yet some aspects need to be improved.

6 Conclusions and Future Work

We have introduced the concept of interactive audiobooks that unifies the potential of complex narratives with interactive elements from computer games. Therefore the experience of the listener/player can range from a non-interactive radio play to an interactive auditory adventure game. The degree of interaction can be varied smoothly during the listening, and thus bridges active and passive media. In the paper we discussed principles to design non-linear plots for interactive audiobooks, presented a hierarchical approach to author complex story-lines, and proposed a new intuitive interaction scheme for narrative games. Comparing the here described authoring environment with other related systems, shows that the design and authoring of interactive audiobooks is more similar to the design of audiobooks and radio plays, than the creation of audiogames. The authoring and the design of 3D auditory worlds is, due to the added spatiality, a more difficult and challenging task.

Future work should include a user analysis to evaluate the balance and the design of the interactive parts, as well as to measure the usability of the user interface. Additionally, future improvements should also consider the development of a mobile system that is tailored to the needs of interactive audiobooks.

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