Structuring Location-Aware Interactive Narratives for Mobile Augmented Reality

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Abstract. In the ongoing project SPIRIT, we design entertaining forms of heritage communications through mobile augmented reality. The SPIRIT concept is based upon a strong storytelling metaphor. By using mobile devices (smartphones, tablets) as 'magic equipment', users can meet the restless spirits of historical characters. The paper describes the overall narrative and technical concept. In particular, it explores the narrative structures that are specialized for the intended kind of experience. Further, we show our first use scenario and demonstrator.

Keywords: location-based interactive storytelling, cultural heritage communication, augmented reality, narrative metaphor, narrative structure.

1 Introduction

In the ongoing project SPIRIT, we design and implement a framework for mobile and location-aware interactive digital storytelling, turning history lessons into adventures by serious games. Through the installation of our App, off-the-shelf mobile devices (smartphones, tablets) get transformed into 'magic equipment'. It allows users to meet the 'restless spirits' of historical figures, by interacting with virtual characters in augmented reality. This fictional metaphor serves as a narrative framing for all further design tasks. Beyond the use of a mobile device as a guide, our system enables enjoyable experiences of interactive storytelling, involving users emotionally as players.

After describing our first use scenario and demonstrator implementation, we focus on our structural design of all narrative aspects, such as authored story, plot evolution and interactive participation.

2 Related Work

Since the advent of mobile technology in work places and for entertainment, there has been continuing development on the identification of the user's 'context' in order to deliver suitable information situation-dependently. First and foremost this concerns the tracking of the location of a device, complemented by other environmental data such as

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time, noise, orientation, concurrent tasks or social environments. In cultural heritage (CH) settings, also the proximity of objects and artefacts plays an important role, as they often induce a narrative. Consequently, location-aware storytelling applications—especially, but not only for tourism—mostly structure a tour based on connecting places and objects [7, 10, 12]. In the CH context, the augmentation of perceivable physical remains with different kinds of digital information, including views into the past, point to attractive alternatives of educating about history. [10, 16, 18]

However, only few such augmented reality (AR) applications also involve mimetic storytelling or visualized drama [6]. Integrating all the above concepts towards mobile interactive storytelling has recently started to become a field of applied research. A pioneer example was the project GEIST [11], augmenting stages in the great outdoors with 3D animated historical figures. Long before mobile devices and services became ubiquitous on the market, this project explored the metaphor of magic equipment for CH that we now build upon, as it also used reference image data to achieve markerless tracking. Meanwhile, a trend towards Mobile AR games has become visible [2]. For example, Haunted Planet provides "outdoors mystery adventure games" [8] with the task to track down single ghosts in the neighbourhood, but without further interaction nor educational content.

Various applications of storytelling on mobile devices for CH have been described [11]. REXplorer [1] used the device metaphor of magic wands to cast spells, in order to combine history information with fun. Set in a graveyard, the project Voices of Oakland made voices of deceased inhabitants audible to visitors with appropriate equipment, providing location-based narratives [5]. Similar to SPIRIT, their goal was to achieve a genuine tone of the voices, avoiding funny "ghost and goblins stories".

Our conceptual approach is different in the sense that a coherent storyworld beyond ancient artefacts or locations is created by authoring and rule design, following our narrative framework. The storyworld can be experienced as an interactively evolving plot that is dynamically built through user interaction with the magic equipment. Further, it may include gaming elements (depending on the choice of authors) to reward and motivate players. We explore the use of video snippets for visualizing the AR ghosts, following the concept of [14] for conversational storytelling. This also involves the development of chroma-keyed video as an additional ARML 'Visual Asset'. [15]

3 Concept and Demonstrator

The SPIRIT approach relies on a holistic story metaphor that integrates all design levels—from logical content and narrative structure down to special media effects and interaction. Our mobile interface is an intrinsic part of the 'story', being designed as 'magic equipment' that users need to master in order to encounter ghosts. At the highest narrative level, 'contacting' and 'revealing' (visualizing) ghosts with the equipment implies that it is not easy to hold 'the connection', which playfully challenges one to use the interface 'the right way' and excuses for imperfections. This idea constrains further design decisions at other levels in a constructive way. Within

the humorous metaphor, 'reality' is not an issue, but 'believability', to be achieved by consistent behavior of the equipment and of the characters. For example, ghosts are known to be able to float in thin air, avoiding the problem with rendering believable floor contact in AR, which was reported by [6].

Figure 1 shows our first concept demonstrator, for which a story scenario has been developed. It can be played at any geographic location. Starting anywhere outside, a visual radar screen feedback on the device indicates the proximity of a spirit (similar to [8]), which can then be tracked down by walking closer. In Figure 1, the magic equipment has visualized a Roman soldier for the first time nearby a group of trees. Since the haunting Roman in the story literally had become accustomed to being invisible to today's Humans, he is at first startled and asks the user whether she can really see him and if she is able to understand Latin. Users can be given little tests and quests in order to let them create confidence with the spirits. The Roman soldier finally invites the player to visit him at his Roman fort, the CH site. If the site is visited with the magic equipment at some point after this encounter, the soldier will welcome the user there, being responsive to the previous encounter.

Fig. 1. First concept demonstrator of the magic equipment with basic interaction possibilities. The hovering Roman spirit waits for the user to act.

This first demonstrator has been built to not only set up the mobile media technology, but also to explore production steps. Tests on authoring, video and post production streamlining will be continued in repeated passes. Envisaged user input possibilities include change of location, physical movements, touch, video recognition and voice input without full natural language processing. Thereby the content structure evolves from simple to higher complexity, leading to a combined game and story engine development. A further research area concerns the addition of indoor positioning methods to the current GPS solution.

4 Narrative Structure

Many location-based narrative museum systems present one "object story" about each artefact or place encountered, at first quite structurally similar to audioguides. This often results in a narrative structure of single nodes that is either linear or minimally branched. [10] In some cases a hierarchical ontology is built [13] that holds together semantic units of several storylines.

However, in interactive storytelling research, there is a wide-spread perception that branching strategies are limiting the variability of experiences and thereby the user's freedom, because of the effort to produce the necessary ramifications explicitly. Different and intelligent methods to adapt an evolving plot to user actions have been researched in the community. So far, in mobile interactive narrative, these approaches have not yet been fully considered. This may be due to the fact that typical interaction is not as fast paced as for example in a Facade conversation. [6] On the other hand, users can walk around almost anywhere. Thus, the interaction scenario is physically barely constrained, letting it benefit from becoming semantically constrained by design, such as by metaphor (in our case 'magic equipment' and 'spirits'). Furthermore this results in an increased need to adapt the narrative dynamically.

4.1 Media Structure

At the media level, 'spirits' are visually represented as concatenations of short video clips. Adapting an approach of a previously implemented conversational story system based on video-snippets [14], for each narrative dialog act of one character, one video clip needs to be produced. During runtime, the dialog acts (and hence, the corresponding videos) are to be connected ad hoc in variable ways according to set rules that depend on each situation the user may run into. These rules contain default conversational turn-taking rules, as well as specific game rules invented by authors. The dialog acts include several 'tags' categorizing them into abstract types.

We also explore the production pipeline and design efforts involved, especially as there need to be produced many single bits of conversational parts. Our hypothesis is that typical teams involved in CH media projects may include media managers and designers who rather feel familiar with video production than with complex 3D animation projects including life-like characters. While both production techniques are labor-intensive for our purpose, it has been proven a challenge to create 'believable' characters by 3D animation without tremendous effort. [17] To avoid effects such as the "uncanny valley", designers either have to create totally realistic representations of humans or abstract the visualization toward cartoon or other simplistic style. However, as – with AR – we are embedding our visuals into the 'real' image of the environment and we do not want to fall into a funny-spooky ghost and goblin genre, we tend to avoid too cartoony styles. Consequently, we expect a video solution to be more accessible for CH media designers than comparatively believable 3D animation.

On the other hand, clear disadvantages of the video solution will remain, lying in the inflexibility of the medium when it would need adaptation to circumstances. These can partially be compensated by the metaphor of magic effects, allowing to rate

believability over reality. For example, some abstraction or rather diffuse styling is added by ghost-like visual effects overlaying the original video (compare Figure 1). This aspect also has to be tackled by more research into production principles as well as rendering and delivery. Current work includes the attempt to improve the transition effect between video snippets. Beyond rendered artefacts that simulate a constantly visible 'connection issue' attributed to the magic equipment, we need production principles that ensure some local registration of the 'center of gravity' of the spirit's body.

4.2 Story and Plot Structure

For the more abstract story logic, we distinguish between the 'storyworld' and the 'plot'. This is a similar distinction as the one made by Chatman [3] between story and discourse, with the characteristic that our plot (the 'discourse') will evolve dynamically during user interaction. We conceive a plot planning engine that is capable of interpreting the rules set by authors for a storyworld. The following list describes elements of the runtime plot.

Plot. The visitor's plot consists of a sequence of states that are influenced by encounters with our spirits. Although users can be given the task to look for such encounters by moving around, it may also be possible that they will be approached by ghosts at their current location when the plot planner launches an according event.

Encounter. In each encounter with one or more spirits, the magic equipment is used to let the user visualize ghosts and take turns in a conversation with them. Each turn consists of either user turns via the magic equipment, or spirit turns built of 'atomic narrative acts'. Each encounter also contains functions of the magic equipment to visualize and organize the spirit connection at a meta level, such as entry and vanishing behavior, and some help function.

Turn. Each turn organizes a set of 'atomic narrative acts' resulting in a video playlist. For a spirit's turn, one or more (e.g., dialog) acts can be concatenated. For a user's turn, one or more (e.g., physical) acts of the type 'feedback' or 'idle' need to be concatenated, in order to visualize the ghost waiting for the user to act.

AtomicNarrativeAct. Each act needs to correspond to at least one media asset (usually a video file in our first demonstrator). There are dialog acts and physical acts. All 'atomic narrative acts' of a spirit build its 'behavioral repertoire' defined in the storyworld. At each turn, selected acts are bundled into turns as elements of a structured turn-taking. Acts are tagged by one or more type attributes. Current types of the first demonstrator include 'Greet', 'Leave', 'Idle', 'Feedback', 'Location', 'Character', 'Info', 'QuestGoal'. The tags can be considered in the match making of appropriate acts.

Storyworld. All abstract diegetic (story-related) elements are defined during authoring in the storyworld. The main components are the atomic narrative acts, together with rules for their sequencing. They are associated with characters that have further

parameters corresponding to the location. Also the user is modelled as part of the storyworld, with variable states concerning location, information processed and achievements earned in the mobile game.

Figure 2 illustrates the three levels that all adhere to the spirit metaphor, regarding the choice of acts.

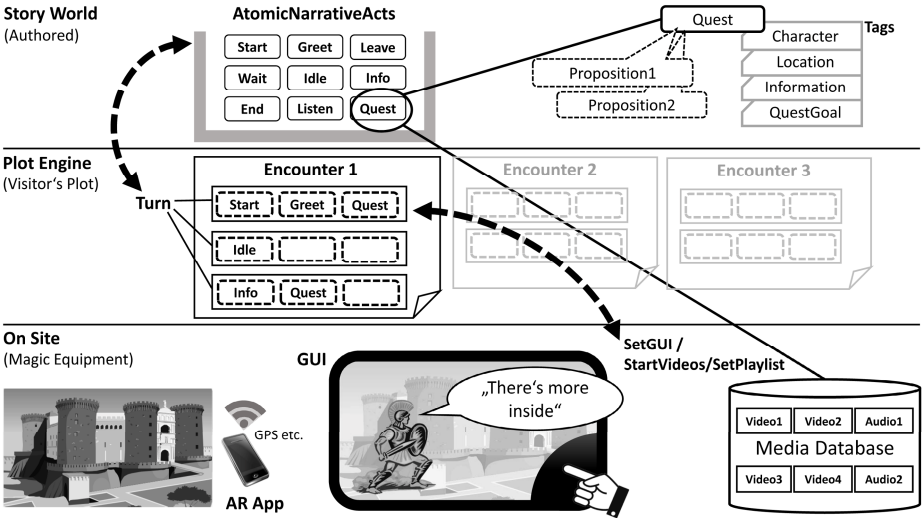

Fig. 2. Visualization of the three levels of the content structure. The *storyworld* contains all abstract elements that can be used by the *plot engine* to form the turn-taking with the user, who needs the *magic equipment* to visualize spirits.

4.3 Information Delivery

Unlike CH applications that focus on letting objects 'tell stories', the SPIRIT project creates a diegetic layer of a consistent world of spirits. Although a case study is currently produced for a Roman fort CH site, the concept is meant to be universal and adaptable to other historic sites. In the ongoing project, story templates and patterns will be further developed that can be reused in different contexts, easing the authoring involved in future applications by a standard modus operandi.

Informational bits are classified through tags attached to each narrative act. There are possibilities to convey fictional content and quests, as well as historical information. Ideally, each kind of information should be tagged accordingly during authoring. In our case study, fictional information is requested to be in line with the educational concept of reenactment of the partner site. After all, it is possible to structure content in a more entertaining way or strictly based on historically authentic locations and objects, depending on the authors.

4.4 Implementation

Our first demonstrator has been used to explore the content structure described above. The goal is to enable longer lasting experiences than only one tour by saving a game state of the visitor's plot at all steps (depending on preferences and privacy adjustments). The implementation of the first version of the structure is in progress, according to the diagram in Figure 3.

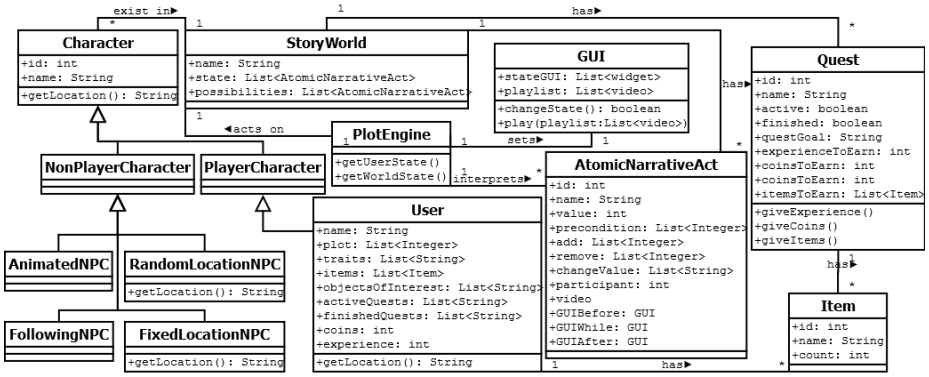

Fig. 3. UML diagram of narrative structural elements (here without the magic equipment and its encounters)

5 Conclusion

We presented a description of the ongoing project SPIRIT, its concept and first results. Our first demonstrator illustrates the basic interaction principle with the magic equipment. It has been used for specifying further development of the system and the content structure. Future work includes the development of indoor tracking technology, in order to be able to use all kinds of locations at museum sites. Further, we will develop a plot engine with authoring tools catering to our video-based approach for media designers. Finally, exhaustive content for a case study will be completed with the support of the Roman fort museum, including a business concept.

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