Authoring Personalized Interactive Museum Stories

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Abstract. CHESS is a research prototype system aimed at enriching museum visits through personalized interactive storytelling. Aspiring to replace traditional exhibit-centric descriptions by story-centric cohesive narrations with carefully-designed references to the exhibits, CHESS follows a plot-based approach, where the story authors create stories around pre-selected museum themes. In this paper we place the CHESS system within the Interactive Digital Narrative field, describing the main objectives and requirements addressed. We present the system's architecture and outline its overall functionality. We describe the underlying storytelling model using examples from the stories authored using the CHESS Authoring Tool. Finally, we report key results focusing on the authors' perspective for the creation of personalized stories.

Keywords: Interactive digital storytelling, personalization, authoring tools

1 Introduction

The CHESS System is a research prototype that has been developed in the context of the CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) project[1]. It aims to enrich museum visits through personalized interactive *storytelling,* by (re-)injecting the sense of discovery and wonder in the visitors' experience. It uses personalized information to create customized stories that guide visitors through a museum and employs mixed reality and pervasive games techniques, ranging from narrations to Augmented Reality (AR) on mobile devices [1,2].

CHESS targets two "types" of users; visitors, who "consume" CHESS stories through their devices, and story authors, who design the experiences. Aspiring to

[1] http://www.chessexperience.eu/

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replace the traditional set of exhibit-centric descriptions by story-centric cohesive narrations with carefully-designed references to the exhibits, CHESS follows a plot-based approach, where the story authors (curators, museum staff and exhibition designers) write and produce stories around pre-selected museum themes. Two cultural institutions have participated in CHESS: the Acropolis Museum, devoted to the findings at the archaeological site of the Acropolis of Athens, Greece, and the Cité de l' Espace in Toulouse, France, a science centre about space and its conquest.

Similarly to the making of a movie, our approach to interactive story creation includes four main phases, namely scripting, staging, producing and editing. During scripting, the author chooses the main concepts and intervening elements, sketches the plot, and writes the narrative text. In staging, the author associates parts of the script with exhibits, paths and other spots in the physical museum space. Then, a set of multimedia resources is produced for the staged script, including audio-visual material, interactive images, games, quizzes, augmented reality models, and other illustrative applications. Finally, the author edits, selects, and orders the multimedia digital resources to implement the final script into a storytelling experience.

The CHESS experience is a unique non-linear combination of the story presented through the terminal on the mobile device used, the visitor's actions, the exhibits in the cultural heritage site, as well as the surrounding environment itself. When the visitor experiences the story on-site, she is subjected to five interlinked "experience modes": (a) walking from exhibit to exhibit, (b) observing an exhibit, (c) listening to narrations from the terminal, (d) interacting with the terminal to make choices, and (e) using the terminal in interactive activities such as games or AR. Obviously, the design of such experiences requires careful orchestration of different resources.

CHESS provides story authors with the CHESS Authoring Tool (CAT), a powerful authoring tool that enables the design and implementation of interactive stories for the CHESS system. CAT is based on a rich storytelling data model which uses graph-based representations to denote the story structure, along with structured meta-data to semantically describe the graph entities. During the visit, the story graphs authored are traversed by the Adaptive Storytelling Engine (ASTE), which uses visitor and contextual data to appropriately adapt the visitor's experience [3, 4].

In this paper we first place the CHESS system within the IDN field, describing the main objectives and requirements addressed. Next we provide an overview of the system architecture and workflow. We present the underlying storytelling model using examples from digital stories authored for the two cultural heritage sites using CAT, also explaining how these are utilized by the CHESS components during a visit. Finally, we report key experience and evaluation results, focusing on the authors' perspective for the creation of personalized stories.

2 Background and Related Work

To place the CHESS system within the IDN field, we first clarify its main underlying priorities and assumptions. The CHESS project integrates multidisciplinary research results and tools into a system capable of supporting cultural heritage institutions in the creation of personalized interactive digital stories for their public. Thus, simplicity and ease-of-use for non-programmers are critical priorities for CAT, the primary

environment for the crafting of stories. On the other hand, the main objective for museums is to convey accurate information about their collections to different kinds of visitors in a more accessible, meaningful and engaging way [7]. Thus, special emphasis is given to the script that communicates the cultural content and to the capacity to carefully review the knowledge conveyed through the various instantiations of the interactive digital story.

To address these needs, CHESS adopts a branching narrative structure for script modeling and representation. A similar structure is utilized to represent the editing level, where the authors specify the digital resources that will be used to manifest each part of the script. Unlike Storyspace [8], Rencontre [9] and other hyper-fiction approaches, CHESS enables story authors to define a procedural script flow and specify soft or hard constraints over the branches, depending on a variety of factors, such as visitor choices, past actions, visitor features, location, etc. Similarly to the ASAPS system [10,11] CHESS models the state of the experience through global variables, moving from simple branching systems towards a finite state machine. In CAT the script diagram is complemented with an attribute-like graphical user interface (GUI) component where authors can specify conditions over each branch, based on the values of global variables. In this way, story authors can effectively create stories based on a player visitor model and increase visitor agency by defining different story continuations based on the visitor's choices.

In addition, CHESS enables authors to account for a listener model, where the visitor has no agency in the story world. Even so, storytelling in CHESS remains a highly interactive process. A good human performer, museum guides included, continuously observes the reactions of the audience and adjusts the narration accordingly [12]. To simulate this process, the CHESS system implements generic visitor tracking and dynamic profile update techniques, and refines the visitor profile as the experience progresses. CHESS follows an implicit profiling approach, interpreting a predefined set of visitor actions as positive or negative feedback on the corresponding story graph entities. When certain conditions are met, explicit feedback menus are injected into the story to increase profiling accuracy. The visitor profile is used by the ASTE to make a personalized decision whenever a branching point is reached in the story graph [4]. From the authoring perspective, in order to leverage the dynamic profiling functionality implemented by the CHESS system, authors are required to annotate the story graph entities with a set of weighted features.

CHESS allows story authors to define and experiment with any set of visitor features, enabling them to create stories that adapt to a variety of visitor attitudes. They can do that both in the scripting and the editing level, prescribing alternative digital productions for the same script unit, to cope for example with different visitor moods [13]. Annotation based personalization has been widely explored in several personalization applications, as well as in interactive digital storytelling [12]. Aiming to be used by authors who are neither programmers nor experts in personalization issues, CHESS combines semantic annotations (using an open tag vocabulary) with a procedural branching representation of the story (presented in Section 4).

CHESS also pays special attention to the staging of the story in the physical world. Museum visitors experience a mixed reality environment made up of digital

characters and media assets that are situated in the physical space. From this perspective, the CHESS storytelling model can be related to the Mobile Urban Drama conceptual framework [14], where graph-based techniques are utilized to represent the story flow and branches may be conditioned on user actions, state, and environmental or other variables. However, in this case the graph is not complemented by annotations, thus accounting only for the users' past actions and ignoring their preferences and attitudes. Most notably, no authoring component is included in the software framework, requiring close cooperation between authors and programmers at all times. An editor environment was provided in the Mscape mobile media gaming platform developed by Hewlett Packard [15], allowing the creation of interactive stories that users can experience by following different storylines, but it targeted towards developers rather than non-programmers. Mobile based interactive storytelling has been supported by several software frameworks, in both urban [14-17] and museum environments [18, 19]. Yet most of these works focus on the visitors experience rather than on the authors, thus not addressing the authoring challenges raised.

A user friendly authoring tool is provided by ARIS[2], an open-source platform for creating and playing mobile games, tours and interactive stories. ARIS considers the user as a player and it uses a conditional quest model, unlocking quests when certain quests are accomplished. Hotspots are defined over Google maps. Unlike CAT, the platform doesn't allow using rich media (such as games, 3D or AR), nor loading or editing a customized map of a particular site.

CAT has been built upon INSCAPE[3] [21], an innovative visual authoring tool resulting from the eponym FP6 Integrated Project. The CHESS project extended and adapted this tool to support new concepts such as the mixed reality dimension of the stories and the adaptation capacities of the story to the visitor profile and context.

3 CHESS System Overview

Figure 1 depicts the high-level architecture of the CHESS system. Story authoring is accomplished with CAT. Besides editing the story graph, the tool enables authors to edit, annotate and enrich 2D and 3D maps, as well as to create narration and QR-scanning activities through activity templates. Additionally, CAT integrates an Asset Management Tool which enables authors to upload new digital assets (e.g. images, videos, audio files, etc.) with associated metadata (e.g. author, copyrights, tags, etc.). Authors can browse, search and display their project digital assets as well as to visualize the relations between them through a graphical, ontology-like diagram (the generation of which is based on the provided tags).

Authors can choose to store their story projects locally, for testing purpose, or to publish them. In the latter case, the story graphs are exported to the ASTE while the digital assets required to realize the story activities are exported to the Hub. The ASTE is responsible for traversing the story graphs while making decisions for

[2] http://arisgames.org/
[3] http://www.inscape3d.com

personalization, based on the visitors' profiles and actions. It is implemented using Enterprise Java Beans 3.0, hosted inside a JBOSS 7.0 server. The stories are internally represented in CML (CHESS Markup Language) under an XML-based format.

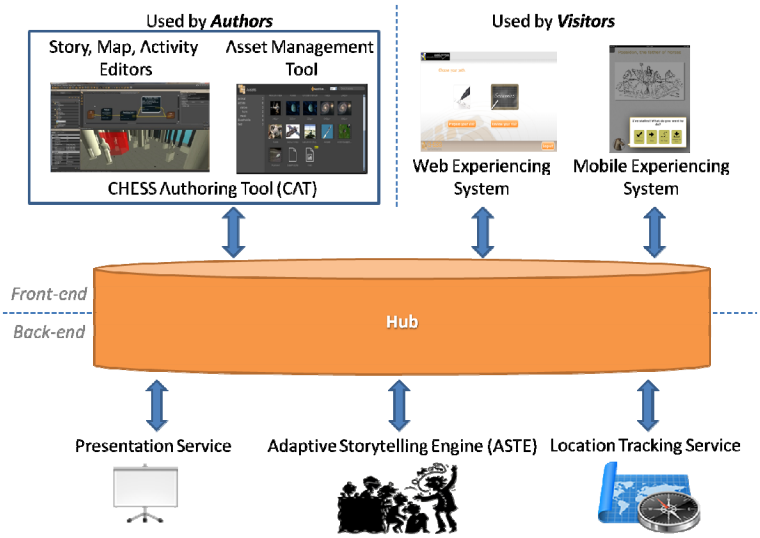

Fig. 1. Overview of the CHESS system components

The Hub lies in between the front-end and back-end components, supporting the communication among them. It is implemented as a web service (written in Python) running on the Tornado Web Server. When a story is published from CAT, the Presentation service processes the digital assets (e.g. images, audio files, etc.), creates alternate versions adapted to different network capacity and mobile device specifications, and then stores them in the Hub (using MongoDB, a "NoSQL" database that allows schema-less data storage). In this way, authors do not have to manage the specific capacity of each potential device used to experience a story; the publishing process of an interactive story has been reduced to pushing a button in the interface.

During the visit, the CHESS stories are delivered to visitors through the Mobile Experiencing System (MES), i.e. the framework running the CHESS experience on a mobile platform. It is based on InstantAR[4] App written with HTML5 and JS standards in order to support a large number of devices. The InstantAR Native App is optimized to display 3D content and embeds a state-of-the-art AR engine. In order to display the AR activities, the InstantAR App needs to be first installed in the visitor's mobile device. MES also acts as a sensing device to support adaptation: it gathers, holds and shares data about the user (position, orientation, device status, actions, etc.).

During the experience, MES continuously communicates over HTTP with the ASTE (through the Hub). The ASTE traverses the authored story graph using the visitor's profile to predict the appropriate story parts and informs MES about which

[4] http://instantar.org/

activity to fetch and display next. To do so, MES retrieves the appropriate version of the activity, depending on the current network and visitor's device conditions and characteristics. On the other hand, MES notifies the ASTE about the state of the presentation and visitor actions (e.g. completed, paused, skipped, etc.).

In places where GPS technology provides sufficiently accurate information, the Location Tracking Service is employed to create navigation activities, guiding the visitor from his current location to the next hotspot in the story. It has been tested in the environment of Cité de l' Espace, where navigation activities were instantiated upon visitor request, from the appropriate MES interface component.

Finally, CHESS also covers the pre and post visit parts of the experience, which are handled by the Web Experiencing System (WES). For instance, prior to visiting a museum, the visitors may browse information about it, play digital games, etc., while after the visit they can access an overview of their experience in situ. An important part of the pre-visit experience is the completion of a short, interactive questionnaire, the CHESS Visitor Survey (CVS). This is how visitors are registered in the CHESS system and their answers are communicated to the ASTE for initial profile elicitation. The WES uses Ajax technology to communicate with the ASTE Server through a REST protocol where messages are encoded following a specific XML specification.

4 CHESS Storytelling Model

CHESS defines a tiered storytelling data model in accordance to the authoring phases, distinguishing between scripting, staging, editing and producing the digital resources. In this section we describe the main entities under each level, showcasing how they are created by authors and then explaining how they are utilized by the CHESS components during the visit.

4.1 Scripting Level

The script is a directed graph decomposed into script units and script branching points (Figure 2). Script units contain a narrative text and have attributes, such as title, description, narrative text, purpose, etc. In general, the narrative text in each script unit should be kept brief, while at the same time as self-standing and complete as possible. The CHESS script units differ in their narrative purpose and have been defined by purposefully adapting the original "trajectories theory" for cultural experiences [20]. The main script unit categories are: *advance* or connect to main plot, *approach* (navigation hints to locate an exhibit), *engage* (confirm location), *experience* (give information related to the exhibit), *disengage* (closure of the exhibit-based information segment), and *re-connect* to main plot.

Script branching points on the other hand, are special constructs representing decision points where more than one script options are defined. Scripting is performed in the CAT Story Editor by creating script units and branching point nodes and connecting them with directed edges, denoting the script flow. Branching points are explicitly represented through dedicated nodes, since they have attributes as well. They can be i)

mandatory, in the sense that a menu should be displayed, informing the visitor about the valid alternative choices so as to choose how to proceed, ii) *automatic*, meaning that ASTE should take an automatic decision about which branch to follow, or iii) *optional*, denoting that ASTE should decide whether a menu will be displayed or an automatic decision will take place, based on its confidence for the visitor's preferences in the available choices.

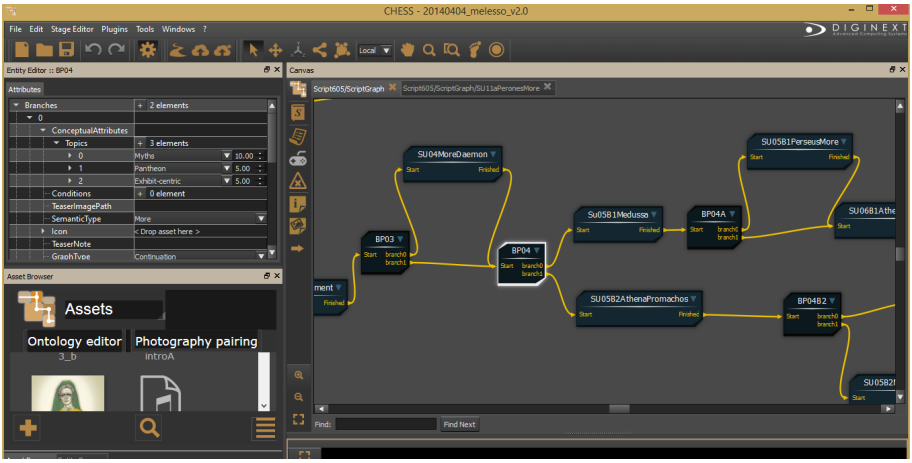

Fig. 2. Sample Script Graph in the Story Editor. The properties of the selected branching point (highlighted in white) are displayed and edited on the left panel

In the case of mandatory branching points, authors also specify the menu title as well as the template that will be employed to display the menu (image or snippet based). In the same way, authors can define conditions for each branch, which need to hold for considering it as a valid candidate continuation of the script. Conditions represent authored hard constraints and they can be based on a variety of visitor or contextual attributes. For instance, if a script unit refers to a previous piece in the experience, then authors can express this constraint on the appropriate edge, requiring that the visitor has previously successfully "consumed" the corresponding optional part.

Besides conditions, authors can also provide a set of semantic annotations for branches and script units. Several works in personalization applications focus on capturing user preferences on topics. Following this approach, authors can divide the narrative in script units based on the topics they cover and then employ (simple or complex) branching structures to link them. To enable the ASTE decide on which path matches best the visitors' preferences, authors need to assign particular topic labels to the script entities. In this way, when a visitor skips, for example, a script unit, the ASTE infers high negative feedback on those script unit topics and updates the visitor profile. Obviously, not all script units need to be annotated in this manner; for instance, those disengaging from an exhibit do not typically cover a topic.

4.2 Staging Level

Unlike a novel or film, where the user's (mental) teleportation to a different location setting may be described, implied or simply shown, in the case of museum experiences the story setting is bound to the museum physical environment. A good visualization of the museum map helps authors have a good understanding of the physical actions that the visitor will need to make during the experience. To that end, CAT enables two things: firstly, to visualize the story environment (i.e. the museum spaces) by adding a 2D or/and 3D maps to the stories project (Figure 3); secondly, to define custom hotspots over the imported maps, denoting areas of interest (areas around exhibits, windows, or any other place on the map). During staging, authors associate script pieces to specific physical locations, indicating explicitly where the user should be located in order to unfold the story.

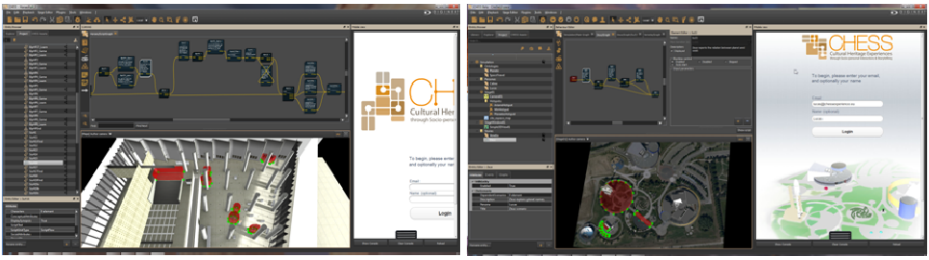

Fig. 3. 3D representations of the Archaic Gallery (left) & Cité de l' Espace (right) with hotspots (in red)

Whenever location transitions are required to follow the staged script, the visitor needs to be somehow prompted and guided to reach the corresponding physical location. In the case of the Archaic Gallery of the AM, the accuracy of existing radiofrequency-based location tracking technologies (including GPS) was inappropriate because of the spatial proximity of the exhibits, which required a robust sub-metric location mean. In this case, the stories adopted a hints-based approach, in which the narrating character invites the visitor to find the particular physical exhibit and provides a set of clues to do so. In this way, navigation is indirectly achieved and it is integrated with the story. On the contrary, for Cité de l' Espace, the authors did not need to focus on navigation issues, since it was automatically performed by the Location Tracking Service, which computes the best path to reach the target location from the current visitor location and displays it on the site map. In both cases, to ensure that the visitor has actually reached the right place, the authors defined location confirmation branching points in the scripting level, presented through menus or QR code activities.

4.3 Producing Level

Cultural heritage sites own increasing numbers of digital resources about their collections, amongst which high-quality animations and videos, produced by external

professionals. A logic objective is to be able to reuse these rich digital resources in different projects. To address this need, and aiming to provide authors with a system that supports them throughout all the phases of the authoring endeavor, CAT enables the creation of audio narration activities. Authors can import digital assets such as images and videos and synchronize them over a timeline, either with existing audio recordings or with new ones, produced with the text-to-speech technology integrated in CAT. In addition, CAT supports the creation of QR code scanning activities, generating QR codes that are assigned to particular hotspots. Authors can print and place them in the museum environment, so that when a visitor scans a QR code, the activity running on the MES translates it into a specific hotspot and MES notifies ASTE about the visitor's location. Finally, authors can import other types of productions, such as AR applications or sophisticated games. However, in this case, a technical expert needs to shortly intervene and create the appropriate manifest files that will enable the integration of the third-party components.

4.4 Editing Level

For each script unit in the script graph, authors create a graph containing the activities (e.g. digital productions) that will be employed to realize the script unit. Similarly to their counterparts in the scripting level, the activity graphs are directed graphs that contain activity nodes and branching points, enabling the authors to use different productions for the same script unit. For instance, different images and/or audio files may be chosen depending on the visitor's age, culture or language. Even entirely different types of activities may be adopted; a script unit about the coloring of statues may be realized with an audio-visual narration, an AR production, or a painting game.

5 Experience and Evaluation Results

The CHESS system was used at the Acropolis Museum and the Cité de l' Espace to author several stories, which were subsequently tested with actual visitors during the project's formative and summative evaluation sessions. Museum personnel participated in a one-day training session and then started to use the authoring tool for several weeks to complete the creation of the stories. The authoring groups were kept small, including two to five museum representatives, as would happen in a real world scenario. The technical partners provided support and guidance when needed and monitored the use of the tools, recording usability issues as well as needs for new functionality. This longitudinal evaluation of the tool has provided valuable insight as to its strengths and weaknesses, guiding its design iterations and refinement.

One of the system main strengths is that it allows quick prototyping of the story and to simulate the designed storytelling experience, thus significantly advancing the iterative process of analyzing and refining the story in all the authoring phases. As a result, several high quality experiences have been produced at both museum sites, with limited resources and in a short time (2-3 weeks), demonstrating the effectiveness of the CHESS concept and implementation [5,6].

Focusing on the authors' perception of the CHESS authoring methodology, authors quickly familiarized themselves with the branching structure of the storytelling model. Following the training, they were able to divide the narrative into script units and they created several types of stories (e.g. linear, including minor and/or moderately complex branches, reaching different endings based on prior visitor choices, including small dialogue-like sections with the visitor, etc.). However, authors faced some difficulties in grasping the declarative part of the model, coupled with the implicit profiling techniques, asking repeatedly for examples and directions.

At the beginning of the project, authors were guided to have particular personas in mind during story creation. A set of personas was defined for each museum, capturing the main types of its visitors, while authors annotated the story pieces with regard to the personas they were suitable for. The persona-based approach was very well accepted and efficiently adopted by the authors [22].

Moving towards an individual, rather than a stereotype basis, authors were guided to create stories with several branches, coping with different visitor preferences on one or more features of the story. For example, for the purposes of the summative evaluation of the CHESS project, authors created a story containing 13 branching points (4 mandatory, 6 automatic, 3 optional). Authors chose to proceed with story creation in the following way: they first created a linear story and then revisited it to "cut and paste" parts of the story under optional branches. The script tone and style was kept uniform, so branches were defined to cover different topics.

To evaluate the ASTE's decision making performance in the story, 10 visitors experienced the story in the museum's environment and then went through a post-visit interview. During the interview, the script graph was revealed to them, focusing on the branching points. The users were presented with all the available choices in each one and were asked to evaluate the system's decision in a three-point Likert scale (right, neutral, wrong) as well as to explain the reasons.

Table 1. Users' feedback over the experienced decision points in an example story

	Right	**Neutral**	**Wrong**
ASTE in all	105	9	13
Users in menus	38	2	10
ASTE in menus	40	2	8

Aggregating over all user experiences, the ASTE took 127 decisions. In the case of menus, ASTE performance is examined based on the ranking of the available choices; if the best choice is ranked at the first place, then the system's decision is right. Table 1 summarizes the users' feedback that was collected over the 127 decision points, showing that ASTE reached approximately 89% of right decisions. An interesting observation has to do with the users' effectiveness in the decision making process. Focusing on the cases where menus were displayed and users made explicit choices, we observed that the ASTE slightly outperformed the users. This result highlights the difficulty, from the authors' perspective, to define effective narrative snippets.

Due to the small number of evaluated sessions, and especially due to the strong, inherent dependencies with the particular story's content, the reported results should not be interpreted as absolute metrics of accuracy. Nevertheless, they provide valuable insights on the ASTE's performance, indicating that the authors can effectively leverage the CHESS system in the creation of personalized, interactive stories, so as to make personalized suggestions or even make decisions on the visitor's behalf.

6 Conclusions and Future Work

In this paper we present a general overview of the CHESS prototype system and we explain how it supports story authors during the scripting, staging, production and editing phases for the creation of personalized, interactive digital stories taking place in museum environments. Authors were easily familiarized with the branching graph structures and they adopted the persona-based approach for story creation. When asked to put the personas aside and move towards individual preferences, authors decided to follow a traditional topic-based approach, requiring guidance and support in the definition of a story structure that would effectively leverage the underlying profiling mechanisms. As part of our future work we plan to supplement the CHESS framework with detailed authoring guidelines, including several "good" and "bad" example stories, to illustrate the various ways that CHESS can be used. Finally, further stories are planned to be developed, to investigate and evaluate the system's performance over different story structures, while also adapting to a variety of features.

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References

1. Pujol, L., Roussou, M., Poulou, S., Balet, O., Vayanou, M., Ioannidis, Y.: Personalizing interactive digital storytelling in archaeological museums: the CHESS project. In: 40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology. Amsterdam University Press (2012)
2. Keil, J., Pujol, L., Roussou, M., Engelke, T., Schmitt, M., Bockholt, U., Eleftheratou, S.: A digital look at physical museum exhibits: Designing personalized stories with handheld Augmented Reality in museums. In: Digital Heritage International Congress, vol. 2, pp. 685–688. IEEE (2013)
3. Vayanou, M., Karvounis, M., Kyriakidi, M., Katifori, A., Manola, N., Roussou, M., Ioannidis, Y.: Towards Personalized Storytelling for Museum Visits. In: 35th International Conference on Very Large Databases, Profile Management, and Context Awareness in Databases (2012)
4. Vayanou, M., Karvounis, M., Katifori, A., Kyriakidi, M., Roussou, M., Ioannidis, Y.: The CHESS Project: Adaptive Personalized Storytelling Experiences in Museums. In: 22nd Conference on User Modelling, Adaptation and Personalization, Project Synergy Workshop, vol. 1181. CEUR-WS.org (2014)

5. CHESS demo at Innovation Convention, http://ec.europa.eu/research/innovation-union/ic2014/index_en.cfm?pg=showcase01
6. http://ec.europa.eu/avservices/video/player.cfm?ref=I088028, OfficialCHESSdemo
7. Bedford, L.: Storytelling: the real work of museums. Curator: The Museum Journal 44(1), 27–34 (2004)
8. Bolter, J.D., Joyce, M.: Hypertext and creative writing. In: Proceedings of Hypertext 1987, pp. 41–50. ACM, New York (1987)
9. Bouchardon, S., Clément, J., Réty, J.-H., Szilas, N., Angé, C.: Rencontre: an Experimental Tool for Digital Literature. In: Conference Electronic Literature in Europe 13 (2008)
10. Koenitz, H.: Extensible Tools for Practical Experiments in IDN: The Advanced Stories Authoring and Presentation System. In: André, E. (ed.) ICIDS 2011. LNCS, vol. 7069, pp. 79–84. Springer, Heidelberg (2011)
11. Koenitz, H., Sezen, T.I., Sezen, D.: Breaking Points – A Continuously Developing Interactive Digital Narrative. In: International Conference on Interactive Digital Storytelling, pp. 107–113. Springer International Publishing (2013)
12. Garber-Barron, M., Si, M.: Towards Interest and Engagement: A Framework for Adaptive Storytelling. In: 5th Workshop on Intelligent Narrative Technologies, pp. 66–68. AAAI Press (2012)
13. Tanenbaum, J., Tomizu, A.: Narrative meaning creation in interactive storytelling. International Journal of Computational Science 2(1), 3–20 (2008)
14. Hansen, F.A., Kortbek, K.J., Johanne, K., Grønbæk, K.: Mobile Urban Drama - Interactive Storytelling in Real World Environments. New Review of Hypermedia and Multimedia 18(1-2), 63–89 (2012)
15. Stenton, S.P., Hull, R., Goddi, P.M., Reid, J.E., Clayton, B.J.C., Melamed, T.J., Wee, S.: Mediascapes: Context-aware multimedia experiences. IEEE MultiMedia 14(3), 98–105 (2007)
16. Paay, J., Kjeldskov, J., Christensen, A., Ibsen, A., Jensen, D., Nielsen, G., Vutborg, R.: Location based storytelling in the urban environment. In: 20th Australasian Computer-Human Interaction Conference, OZCHI 2008, vol. 287, pp. 122–129. ACM (2008)
17. Ballagas, R., Kuntze, A., Walz, S.P.: Gaming tourism: Lessons from evaluating REXplorer, a pervasive game for tourists. In: Indulska, J., Patterson, D.J., Rodden, T., Ott, M. (eds.) PERVASIVE 2008. LNCS, vol. 5013, pp. 244–261. Springer, Heidelberg (2008)
18. Damiano, R., Gena, C., Lombardo, V., Nunnari, F., Pizzo, A.: A stroll with Carletto: adaptation in drama-based tours with virtual characters. User Modeling and User-Adapted Interaction 18(5), 417–453 (2008)
19. Lombardo, V., Damiano, R.: Storytelling on mobile devices for cultural heritage. The New Review of Hypermedia and Multimedia 18(1-2), 11–35 (2012)
20. Fosh, L., Benford, S., Reeves, S., Koleva, B., Brundell, P.: See Me, Feel Me, Touch Me, Hear Me: Trajectories and Interpretation in a Sculpture Garden. In: Computer-Human Interaction Conference, pp. 149–158. ACM, New York (2013)
21. Balet, O.: INSCAPE an authoring platform for interactive storytelling. In: Cavazza, M., Donikian, S. (eds.) ICVS-VirtStory 2007. LNCS, vol. 4871, pp. 176–177. Springer, Heidelberg (2007)
22. Roussou, M., Katifori, A., Pujol, L., Vayanou, M., Rennick-Egglestone, S.J.: A Life of Their Own: Museum Visitor Personas Penetrating the Design Lifecycle of a Mobile Experience. In: Computer-Human Interaction Conference Extended Abstracts on Human Factors in Comp. Systems, pp. 547–552. ACM, New York (2013)