Creating Web3D educational stories from crowdsourced annotations ☆

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ABSTRACT

3D representation and storytelling are two powerful means for educating students while engaging them. This paper describes a novel software architecture that couples them for creating engaging linear narrations that can be shared on the web. The architecture takes advantage of a previous work focused on the semantic annotation of 3D worlds that allows the users to go beyond the simple navigation of 3D objects, permitting to retrieve them with different search tools. The novelty of our architecture is that authors don't have to build stories from scratch, but can take advantage of the crowdsourced effort of all the users accessing the platform, which can contribute providing assets or annotating objects. At our best knowledge no existing workflow includes the collaborative annotation of 3D worlds and the possibility to create stories on the top of it. Another feature of our design is the possibility for users to switch from and to any of the available activities during the same session. This integration offers the possibility to define a complex user experience, even starting from a simple linear narration. The visual interfaces of the system will be described in relation to a case study focused on culture heritage.

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1. Introduction

3D representation for the web has been available since the advent of the first VRML specification [1]. From 1995 to present different specifications have been proposed. Millions of users have accessed 3D worlds using both open-source and proprietary browsers and platforms, in some cases sharing the experience with remote users, as it happens for 3D multi-users environments such as Second Life. Usually the access to these environments is realized using browsing paradigms that allow the users to navigate the 3D worlds walking, flying or rotating around viewpoints chosen by the content authors. Unfortunately this access model enables often only a partial exploitation of the 3D worlds that result

from a complex and time-consuming modeling work. That is the reason why in recent years a number of researchers have proposed the use of annotations for exploiting further their potential. The association of high-level descriptions to geometric entities has enabled the access to content through searching paradigms, retrieving specific components of the 3D environments after a keyword-based search or more sophisticated queries involving also spatial operators. Besides, the introduction of folksonomic annotation styles has enabled common users to describe the 3D components with their own words. In this work the term annotation will be referred both to the use of keywords belonging to an ontology/taxonomy, to free tags belonging to a folksonomy and even to extended description associated to 3D entities. The novel approach presented in this work builds on a previous research work related to 3D annotation [2] but goes a step further, introducing the possibility to use the annotation work done by the users of the ToBoA-3D platform for creating 3D narrations that can be shared on the web. The shift is paramount: from the

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free navigation and search of an annotated 3D environment to the possibility of designing and sharing, on the top of it, engaging educational narrations. In our proposal, stories don't start from scratch, but from the annotation work done by the users of a shared platform for annotating 3D environments. The overall workflow is novel as well. While some proposals described in literature take advantage of tools for enabling single content experts to annotate 3D objects [3], no workflow includes the crowdsourced annotations and the possibility to create a story starting from them. This approach opens interesting opportunities for the educational domain, starting from the creations of engaging lessons delivered as narrations. The software architecture described in this work can be seen as a sentient multimedia system, because it allows people distributed over the network to gather, annotate, process and retrieve distributed Web3D resources, taking advantage of the crowdsourced effort done by many users playing different parts (e.g., content provider, content annotator, content browser, story creator and listener) even in the same session. The rest of the work is organized as follows: Section 2 will consider the related work; Section 3 will describe the features of the annotation architecture where we started from; Section 4 will describe the requirements of our storytelling system, focusing in particular on the crowdsourced approach and the integration of the different user activities; Section 5 will present the user interfaces for the creation and the navigation of stories; Section 6 will draw the conclusions.

2. Related work

Among the different proposals for describing 3D objects and worlds on the net, a special role for their longevity is reserved to VRML and to its heir X3D [4]. VRML and X3D plugins associated to web browsers have allowed millions of web users to navigate Web3D worlds. The latest implementations permit even to play X3D worlds using only standard web browsers compliant with WebGL [5], enlarging further the number of platforms and users that can access 3D representations on the web. While the representation of 3D geometrical entities on the web is an interesting opportunity for communicating knowledge, their annotation permits to exploit the potential of virtual representation, allowing users to go beyond the simple navigation of 3D worlds. For this reason in the last few years a number of proposals for adding semantics to the components of 3D worlds have been made, based on different specifications such as MPEG-7 [6], Collada [7] or X3D [2]. While most of these proposals focus on annotations referred to predefined ontologies, some researchers have focused also on the use of tags as a complementary means for annotating 3D entities with an informal approach more suited to common people [2]. The benefits of using social tagging in education and, in particular, in cultural heritage contexts have already been described in [8]. As noted by Scopigno et al. [9], the greater challenge for digital technologies is the creation of tools that use 3D models for supporting cultural heritage research. In this respect, the annotation of 3D models is only a first step for supporting more appropriately cultural heritage studies. We claim that the application of storytelling techniques to annotated 3D worlds belonging to the cultural heritage domain can bring great advantages for researchers and pupils. The benefits of

storytelling for educational experiences have been demonstrated by several studies [10,11]. As far as cultural heritage is concerned, in literature there are different examples showing how storytelling techniques can be profitably used for engaging students while learning. The techniques used can be different, relating the different fragments of the narrations to photos and videos [12], real environments [13] and virtual representations [14]. As far as the latter ones are concerned, most examples are focused on the delivery of linear and non-linear stories rather than on authoring tools. The proposals for the creation of stories can be split in two different categories: the "autonomous agents approach", where a set of software agents influences the evolution of the story [15], and the "drama manager approach", where a software architecture controls the narration on the basis of the story model and of the narrative choices of the author [16]. The approach described by Kriegel et al. [17] belongs to the first category. The authors present an authoring tool for the narrative agent architecture "FAtiMA". The system allows the creation of a story starting from the behavior of the characters. The authors specify the actions that the character can perform, the goal that she can reach and the way in which she interacts with the story events. The process starts with the decision on the story setting, and the placement of the characters and objects in the story. After the set-up of the scene, the author specifies the behavior of all the participating characters. Both the delivery and the authoring of the story happen inside a 3D environment. The approaches described in [18–20] belong to the category of drama managers, with a stronger emphasis on the story structure rather than on the characters. Mehm et al. [18] describe a system named StoryTec, which allows the creation of story-based serious games. This system is conceived for people with low skills in computer science. Teachers can use this tool for creating small educational games that can be played during courses; game programmers and content producers can take advantage of StoryTec as a prototyping environment for developing and testing ideas. The story is divided in units, which the author can link together in order to create a path through the story. Once the story path is established, the author defines the details by adding objects to the scene and specifies the events and the actions for each step of the story. The whole system is built on a hybrid 2D/3D framework based on the Windows Presentation Foundation libraries and provides different components for managing the creation of the narration: stage editor, story editor and resource center. The first one is a WYSIWYG editor and is required to define the details and objects of the single stage of the story. The author can take any object available on the resource center (for example a 2D or 3D asset, a sound file) and insert it into the stage using a drag and drop interface. The second component, the story editor, allows creating the story structure. This interface allows the author to specify the path through the story, connecting with arrows the visual objects that represent the stages. The author takes advantage of the story editor also for specifying complementary information for the playing phase, such as annotations or the expected time the user will remain in a given stage. Robertson et al. [19] introduce the authoring tool named Adventure Author. The tool is based on a 3D game engine, which gives to the story a graphical aspect similar to the graphics of commercial videogames. This tool has been