

Ontologies for Authoring, or Authoring Ontologies?

Diana Arellano¹, Javier Varona² and Volker Helzle¹

¹*Institute of Animation, Filmakademie Baden-Württemberg, Ludwigsburg, Germany*

²*Mathematics and Computer Science Department, Universitat de les Illes Balears, Palma de Mallorca, Spain*

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Abstract: In the last years the use of ontologies has broadened to areas that until some time ago were unthinkable, like storytelling or context/content representation. The main problem with the use of ontologies is that the user responsible of authoring the story needs to input every single element that is required for the story to make sense. Depending on the case, this might be a tedious task. However, once it is done, different stories can be developed by reusing the already defined concepts. The objective of the paper is to provide examples of applications where the use of ontologies conveyed “authoring effort” with satisfactory results. We also state our opinion of why it is better to use ontologies for such tasks, explain our own experience with an use case and propose ideas of what could be enhanced, or taken from other areas, to improve the authoring process.

1 INTRODUCTION

Storytelling, the interactive art of using words and actions to reveal the elements and images of a story, while encouraging the listener’s imagination (National Storytelling Network, nd) is an area that has received special attention during the last years. According to (Peinado et al., 2004), the automatic construction of story plots has always been a longed-for utopian dream in the entertainment industry. Many factors need to be taken into account to produce engaging narrative, and when it comes to automatic storytelling, creativity and methodology are two elements that go together hand in hand.

Other reasons that have led researchers to find better techniques for automatic storytelling, or automatic content creation, deal with economy, improvement and independence of the narrative generation.

From the economical point of view, reducing the times for story creation might translate into reducing costs. Having a tool that permits fast generation of stories, without an specialised author, would be a great asset (e.g. stories in video games for Human-Computer-Interaction (HCI) applications).

Automatic and intelligent storytelling can also be beneficial in the resultant quality of the product. Imagine the plot of a story where the event A causes the event B, which in turn causes the event C, and so on. If the author could have a software solution that allows him/her to change just a portion of the story

and get the subsequent logical changes, then new and original plots might arise.

If these scenarios were accomplished, that would lead to an independence of the narrative generation, where the author and the machine would deal with the creation of not just one story, but as many as the logic behind the storytelling generation allows.

Our intention with this paper is twofold. First we will review and analyse different works that have approached storytelling through ontologies. Then we will present our opinion in this matter based on our experience developing a system for creation of daily life-based stories. Our position is that although the use of ontologies results in “authoring effort”, the obtained results can open the insights of story generation to a broader audience with more creative outcomes.

2 WHAT IS AUTHORIZING? WHY ONTOLOGIES?

If we take a look at some of the English dictionaries, we see that *authoring* is defined as the process of creating content in any kind of media: books, websites, or magazines. This process is performed by a person, the *author*, who can be aided by using *authoring tools*. An authoring tool is usually a piece of software that facilitates, enhances or guides the author in the creation of content.

Conversely, the concept of ontology belongs to the field of philosophy since Aristotle characterised it by the study of existence, a compendium of all there is in the world. Nowadays, it has evolved in great measure in computer science related fields as artificial intelligence (López et al., 2008), ubiquitous computing (Heckmann et al., 2005), body movement of virtual characters (García-Rojas et al., 2006), and context representation (Benta et al., 2007). An ontology is defined as an explicit specification of an abstract, simplified view of a world to represent. It specifies both the concepts related to this view and their interrelations (Obrenovic et al., 2005).

In this regard, we will analyse how two different fields as ontologies and storytelling have merged as a response to the problems and needs in the storytelling world. From our perspective, content and context are part of the storytelling in the sense that “content” would be what conforms the story, and “context” what situates the character in a given scenario.

The following subsections explain the difference between “authoring ontologies” and “using ontologies for authoring”. The first one deals with the creation of the ontology itself, and to be effectively done it requires expert knowledge; the second uses ontologies as the mechanism or tool for authoring the content of the stories.

2.1 Ontologies in Authoring

The creation of new stories, scenarios and situations, requires not only a great amount of creativity, but also a lot of methodical work in order to keep the story interesting and meaningful.

In analogy to a puzzle, a finished story could be seen as the assembled puzzle, while the ontology would be the compendium of the pieces of the puzzle that depending on how they are placed fit together, or not. Nevertheless, thanks to the power of inference of the ontologies, these pieces can be correctly assembled in different ways giving a variety of logical results. This would be achieved through “ontology engineering”, which is described by (Chen et al., 1998) as a research methodology that enables the accumulation of knowledge and supports knowledge reuse and sharing. The ultimate purpose of ontology engineering is to “provide a basis for building models of all things in which information science is interested in the world” (Mizoguchi and Ikeda, 1996) cited in (Chen et al., 1998)). Therefore, ontologies and story authoring can be conveniently combined given that the first provides the method and the structure, while the latter provides a quasi unlimited number of scenarios to be described and inferred.

Among the researchers that have worked in the *authoring of ontologies*, (Dimitrova et al., 2008) tried to overcome the author’s need of expertise and knowledge on ontologies for creation of content by developing ROO. ROO (Rabbit to OWL Ontology authoring) is a user-friendly tool that guides the authoring of a conceptual ontology, which is then converted to a logical ontology in OWL. As a result, none of the ontologies created by inexperienced authors were usable without modifications. That led Dimitrova et al. to consider the involvement of domain experts and additional support besides the existent error messages.

(Konstantopoulos et al., 2009) proposed ELEON, a system for ontology authoring that enables authors with domain expertise, but no technological expertise, to create a new application domain and the corresponding ontologies. Their domain of application was cultural heritage repositories in order to automatically generate adaptable and customised textual descriptions of the cultural objects for a variety of audiences and purposes. As a result, the ontology helped to automatically infer missing profile parameters, alleviating the burden of explicitly providing all necessary details for large numbers of objects.

Other authoring tools include ONTOTRACK (Liebig and Noppens, 2005), which combined a graph-based hierarchical layout with an instant reasoning feedback in one single view. Liebig and Noppens chose this approach because, in their opinion, the most natural layout for an ontology is a hierarchical layered graph. As a result ONTOTRACK constituted a first step towards an easy-to-use interactive ontology editor, even for non-experienced users and especially large ontologies.

In the same direction, the SWAT project developed a number of techniques and tools focused on users who wished to encode or query knowledge without deep understanding of RDF, OWL, or other specialist languages. From a system that generates mathematical word problems (Williams, 2011), to a tool that allows users to read and edit axioms in natural language - SWAT Tools Verbaliser (Third et al., 2011), their aim was to facilitate the ontology’s authoring process.

2.2 Authoring based on Ontologies

In this section we review the other side of the coin: works that have used ontologies for authoring content, specifically for creation of stories and narrative.

One of these works is the The Virtual Storyteller (Swartjes and Theune, 2009). The Storyteller is a multi-agent story generation framework based on the emergent narrative approach, which states that

stories emerge from character behaviour. The authoring system is implemented in an three-step iterative cycle: idea generation, implementation and simulation. Regarding ontologies, the Virtual Storyteller makes use of a number of OWL ontologies: The *Storyworld Core* upper ontology for the storyworld simulation knowledge, the *Fabula* upper ontology that defines elements of the fabula (e.g. Actions), domain-specific ontologies that determine subclasses of the Storyworld Core or Fabula ontologies, and Presentation-specific ontologies containing classes and properties for specifying a lexicon and common sense rules for natural language generation (Swartjes, 2010).

DGiovanni is another open source multi-agent architecture for building interactive dramas. It uses OWL ontologies to support the creation of different stories and to feed the system with story-related information (Müller, 2011). In DGiovanni the user is another actor of the story. Nevertheless in the authoring process to generate a new story, the user needs to create the ontology with all the story-related concepts.

DRAMMAR is an ontology of drama presented by (Damiano et al., 2005), which integrates the basic aspects of drama with agent-based theories. The ontology consists of two levels. The directional level encodes the specific traits of drama in a Drama-unit (<Plot, Direction, Actor>). The actional level unfolds the rational and the emotional perspective in terms of the facts in the Drama-unit, the goal of the Drama-unit and the attributes of the characters. These facts can be actions, characters and character beliefs, which allow the elicitation of emotions according to the OCC model (Ortony et al., 1988).

Nakasone et al. (Nakasone and Ishizuka, 2006) also presented a generic storytelling ontology model, the Concept Ontology. They defined a set of topics in which the story, or part of the story, is based. These topics are linked through a pseudo-temporal relation that ensures a smooth transition between them. As this ontology was for storytelling, the defined classes were related to scenes, acts, relations, characters of the story and their roles. Its main advantage was that it provided the elements for creating a story according to narrative principles.

3 THE GOOD, THE BAD AND THE UGLY

As it occurs in most of the situations in life, the solution to a problem might have advantages, disadvantages, and working elements with a not so suitable approach. In the case of storytelling, content genera-

tion and ontologies something similar occurs; that is why we have entitled this section “The Good, the Bad and the Ugly”, because as in the movie of the same name, the good and the ugly end up working together to achieve a goal, whereas the bad is always around until someone makes it disappear.

Our own experience during the development of ontologies has allowed us to get a better perspective of the advantages and difficulties faced by expert and non-expert domain users and developers. In the next subsections we will present our opinion about the good, the bad and the ugly things when working with ontology-based storytelling. In further sections we will express our conclusion about the topic and propose what would be the path to follow in order to make the “bad” disappear.

3.1 The Good

Storytelling and content authoring have become a very mature and engaging area of research thanks to the efforts of different groups and persons who have contributed along the years to make it the way it is. This fact itself is a good sign that the field is evolving and fruitful results have been achieved.

One example is the number of upper ontologies that have been developed for definition of story elements, context representation or emotion elicitation. Proof of this are the upper ontologies DOLCE (Gangemi et al., 2002), SUMO (Niles and Pease, 2001), SOUPA (Chen et al., 2004), or the upper ontologies DRAMMAR and the Concept Ontology, mentioned Section 2.

An important aspect of ontologies is that they provide the knowledge base that is needed to give structure to the stories, while adding the “surprise” factor by inferring unexpected situations from this previous knowledge. Therefore, having well-defined ontologies with enough instances of their classes and relations provide an almost unlimited universe of stories that can be elicited in much less time.

It is precisely this power of inference what makes ontologies so suitable for automatic storytelling. Inferring new knowledge from already existent one provides the computational creativity needed in this field. Moreover, the new techniques for translating ontology language into natural language convert ontologies into a powerful resource for content creation and context representation in storytelling.

In addition to the above, the possibility of defining affective elements in the ontologies gives stories another dimension, in which the characters and the elements of the world are seen nearer and closer to our experiences. The elicitation of emotions, the person-

ality of the characters or the mood of the story are important for storytelling, and the fact that they can be achieved through ontologies makes them even more suitable, as it results in more empathetic and engaging stories.

3.2 The Bad

The drawbacks of ontologies are related to the process of authoring by non-expert users and the consequences of bad-defined ontologies. In some cases, users are presented with the task of enlarging ontologies by adding new concepts and relations that would be used in new stories. If the user is a domain expert, then this task does not represent a major challenge. The problem is when the user is not an expert and needs to learn and understand the language and tools to construct the ontology.

That is the case of the “Virtual Storyteller” (Swartjes and Theune, 2009) where the user needs to work directly on the ontology, and if necessary, to update the files with the ontology rules written in Prolog. Although the results obtained are of great quality thanks to the iterative process it follows, it might result overwhelming for a user with no experience in the area.

According to (Liebig and Noppens, 2005), users are faced with comprehension problems such as the proper use of role hierarchies, the influence of transitive roles on reasoning, or the effect of domain and range restrictions. All this entails a significant amount of system failures caused by implicit modelling conflicts or misunderstanding of the inference algorithms. Furthermore, the consequences of those faulty axioms usually remains hidden until the system is used or intensively tested.

Another issue is the unpredictability of the system (Peinado and Gervás, 2006). It means that if the automatic storyteller infers new situations that are not logic or have no coherence with the narrative structure, then the research effort can claim little merit. That is why exhaustive tests should be performed to measure the originality of the resultant stories and improve the representation of the fictional world.

3.3 The Ugly

As “ugly” we have categorised all those procedures and methodologies that are tiresome for the user to accomplish. For instance, the creation of new instances or individuals for the ontology classes, or even worse, the definition of new classes and relations for a story that cannot be inferred from the actual knowledge can be time consuming and bothersome. Specially when

new logic rules need to be formulated in order to come up with the correct meaning of a story.

Evidence of this is the work of (Müller, 2011), which despite producing very reliable results, requires extensive authoring in order to define new instances of story and context elements. Nevertheless, once all the instances are created, the events can be generated very straightforward.

A second aspect that can be considered as inconvenient is the lack of universality in certain concepts. An example is the representation of the plot structure. There are a number of theories like the ones of Vladimir Propp, Lakoff or Barthes (Peinado et al., 2004), that propose different type of grammars and representations. Therefore, if an ontology does not cover a specific plot structure, then the whole process of ontology authoring has to be realised, leading to the problems faced by non-expert users developing ontologies.

4 GOOD AND UGLY TOGETHER - USE CASE

In this section we will give an overview of the development and evaluation of ontologies for our Context Representation framework. For more details the reader can refer to (Arellano et al., 2011).

The objective of our work was to describe the context (inner context, based on the Belief-Desire-Intention (BDI) theory plus personality traits; and outer context, which is the world and its entities) of virtual characters. To that end, we proposed a semantic framework where we authored two ontologies. The *personalityEmotion* ontology considered all the concepts that define a character from a psychological-affective point of view —goals, preferences, social admiration with other agents, and personality (inner world). The *event* ontology described the environment that surrounds the character (outer world) and the occurring events in terms of four w-questions: *what* happens, *where* it happens, *who* are the actors, and *when* it happens (Figure 1).

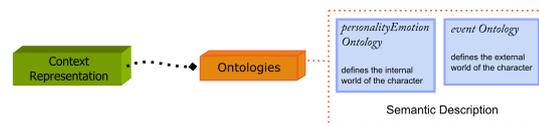


Figure 1: Context Representation with Ontologies.

The difference between our approach and the ones in the Section 2 is that we combined in one system both the influence of the outer and inner world of the character to simulate its context. Furthermore, we can

use these relationships to trigger new emotions in the character.

To prove that our ontologies and the contextual module we implemented have the potential to feasibly reproduce any given context and elicit corresponding emotions, we carried on a perceptual experiment. For that purpose, we chose three scenes of two movies—*Léon* (1994, directed by Luc Besson) and *Downfall* (2004, directed by Oliver Hirschbiegel), which were simulated in our framework. The goal was to reproduce the same context and content manifested in those scenes, and to achieve the same emotional output as the one experienced by the real actors. The script excerpts of both movies (with the scenes emotional output) were taken from (Schapp, 2009).

From both movies scenes, we extracted the events, character's preferences, descriptions of the locations and admiration among characters, in order to introduce them in our Context Representation module. The correspondence between the resultant emotions and the emotions manifested by the actors in the scenes was a hint that our framework indeed reproduced the movies context and the right emotional output. The emotions for each scene of *Léon* were fear, pity and sadness, respectively; and for the *Downfall* were fear, discourage and disappointment.

The same approach for evaluating our framework was taken using a scene extracted from the Robert Aldrich's film *What Ever Happened to Baby Jane?* From the specific scene that presented the two sisters Blanche and Jane, we defined 5 events: (1) Blanche is hungry, (2) Jane enters Blanche's bedroom with a closed tray, (3) Blanche is alone with Jane in the house, (4) Blanche does not believe that Jane is capable of putting a rat in the food, (5) Blanche opens the tray and sees the rat, (6) Jane hears Blanche opening the tray. These events were introduced in our framework, generating a set of emotions in the main character of the scene (Blanche), which corresponded to the emotional states of the real actress. For instance, in the event (4) the emotion with greatest intensity was gratification (intensity = 0.64), indicating that Blanche does not think that a not satisfactory event will occur, but she is not sure. This emotion can be manifested by a slightly smiling face, which is the facial expression of Blanche in this exact part of the movie.

These results demonstrated that it is not only possible the use of ontologies to create and simulate stories. Moreover, they can be used to establish the relationships between both the outer and inner world of the characters, becoming a tool to extract and manipulate the affective states of those characters, and their influence in the development of the story.

The ugly aspects of our framework corresponded to the authoring of new instances to create new stories. Although we tried to make the interface as intuitive and straightforward as possible, it was still time consuming. However, automatic techniques, like content extraction or data mining, could be applied to reduce the process to the selection and reuse of existing instances, instead of creating new ones.

5 DISCUSSION AND CONCLUSIONS

Ontologies constitute a powerful tool to represent knowledge and thus can be applied to a large number of fields. Nevertheless, this power comes with great responsibilities, which forces an accurate definition of concepts, relations and rules in order to achieve logical results. For its part, storytelling, content authoring and their automation is a very ambitious goal that is being approached by leaps and bounds thanks to a general iterative process, carried on by the researchers.

Nevertheless, there are still too many concepts to be described, too many theories to be implemented, too many rules and cases to define in order to achieve better inference. All of this would permit the generation of stories where the user has little to do; or on the contrary, where the author can have a lot of creative influence but little effort.

Ontology-based storytelling is an area that still has much to offer, but it will be possible only by the joint effort of the professionals that work on it. Ontologies represent knowledge, and the larger the knowledge the better the results that can be obtained. In the same direction, ontologies which are compatible among each other, with different levels of refinement regarding concepts definitions, and that contain a number of instances for different story domains, would allow the production of different and numerous stories without the need of low-level authoring.

Perhaps the way to go would include the addition of other technologies or fields that can help developers and authors with little, or no experience to lessen the burden of creating new ontologies from scratch, or enlarging them with new data. For instance, combining ontologies with web semantic and data mining can improve the authoring process, allowing the extraction of information and creation of new concepts in a more automatic way.

In a different note, there are some areas that can benefit from the use of ontology-based storytelling like computer graphics (i.e. video games) or HCI, where simple stories are required to perform differ-

ent experiments. For instance, a generic evaluation of user perception usually demands having a context or a story the user can work with. Thus, having a tool for the authoring of simple plots within a specialised domain can enrich and facilitate the whole procedure.

In conclusion, a good alliance between ontologies and storytelling has been already created, and it is our task as researchers to enrich and improve it to make it better and applicable to a larger number of fields.

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