

The Virtual Storyteller: story creation by intelligent agents

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Abstract

Character-based storyline development, where the story's characters are fully autonomous agents, gives no guarantees for the emergence of well-structured plots. Storyline development by script, where the characters have no autonomy at all, results in static plots and offers limited interaction possibilities. Therefore, often an intermediate approach is adopted where the characters are given limited autonomy in acting out a global script. We propose an alternative approach that does not make use of pre-defined scripts. Our approach has been implemented in the Virtual Storyteller, an agent framework where co-operating intelligent agents are responsible for the creation of the different story levels (plot, narrative, and presentation).

Introduction

In this paper we address the question of how to develop a storyline in virtual storytelling, i.e., storytelling by a computer. The available options range between a fully scripted storyline and a 'character-based' one, which emerges through the actions of the characters that play a role in the story. Before we start our discussion of this issue, and present our own -- intermediate -- approach, we first briefly explain what we mean by a storyline and what our minimal requirements on a storyline are.

In this paper, we distinguish three story levels.¹ The first level is the *storyline* or *plot*: a series of chronologically and causally related events that make up the story's content. The second level is the *narrative*: a representation of the plot from a particular point of view, where some of the plot's events may be left out or reordered. The third and last level is the *presentation*: a realisation of the story in a particular medium. In virtual storytelling, most stories are presented in the form of text or speech, or in the form of virtual drama, where the story is enacted on screen by animated figures in a virtual, graphical environment.

The focus of this paper is on automatic storyline development. It should be noted, however, that it is not always easy to separate the plot from the other story levels in virtual storytelling. This holds in particular for character-based storyline development in virtual drama, where plot

¹ These correspond to the *fabula*, *story* and *text* levels from narrative theory (Bal, 1985).

creation and presentation go hand in hand. Here, making a distinction between the different story levels may seem somewhat artificial. Nevertheless, the distinction is useful because in principle, one plot can be the basis for many different narratives, and one narrative can lead to many different presentations. The case where there is a direct, one-to-one mapping between the different levels is only a sub-case of this. Therefore, we will continue to speak of the storyline as a separate level even in those cases where it is fully integrated with narrative and presentation.

It is possible to formulate many different requirements on what makes a good storyline, such as unexpectedness, conflict, suspense, and the presence of interesting themes and/or characters.² However, to keep matters simple, in this paper we make the basic assumption that there are only two truly essential requirements for 'plothood'. The first is that a plot or storyline must be *consistent*, meaning that the plot's sequence of events is natural and in accordance with the story world; in particular, characters' actions should be in line with their own previous actions. The second requirement is that the storyline should be *well structured*, meaning that it should have a beginning, where some problem is introduced and the action rises, a middle, containing the action's climax, and an ending (in success or failure), where the action falls. This is called 'Freytag's triangle' (Freytag, 1863).

Existing approaches to storyline development

Two extreme approaches to storyline development in virtual storytelling are character-based and script-based storyline development. The two are diametrically opposed with respect to the amount of autonomy of the characters.

At the *character-based* extreme, the storyline emerges from the autonomous actions by a set of characters that are implemented as intelligent agents, with their own goals, personality, and emotions. This approach was adopted in one of the first text-based story generation systems, Talespin (Meehan, 1976). More recent examples are the virtual drama systems of Aylett (1999) and Stern et al. (1998). In general, storylines resulting from a character-based approach are fairly consistent, since the characters'

² Storytelling may have many different purposes, ranging from social bonding to giving lessons in morality. Here, we take as the main purpose of virtual storytelling that it should provide the user with an entertaining experience.

actions are ensured to be in line with their personality, and their own and other characters' previous actions. The character-based approach is also attractive from the perspective of interactivity, as it makes it possible for the user to influence the story's progress by controlling one (or more) of the characters. An important disadvantage, however, is that the resulting storylines often do not adhere to Freytag's triangle, rambling on without any climax or resolution and thus failing our second plot requirement.

At the *script-based* extreme, the characters have no autonomy or intelligence³ and therefore no control over the plot at all. Instead, the plot of the virtual story is either written by a human author (which more or less guarantees the result to be both consistent and well structured) or automatically generated. Automatic plot generation systems (e.g., Pemberton, 1989; Lang, 1999) are generally designed to meet at least our two basic plot requirements, but this goal is not always achieved. In particular, consistency in the sense of psychological plausibility may be low, since the characters in such systems are often interchangeable, having no distinct personality but just functioning as random building blocks for filling in a plot grammar. A general disadvantage of scripted plots is that they are static, which -- in the worst case -- limits their interest to a one-time experience. Creating branching scripts, where the choice between branches is made either at random or by the user, can solve this problem. However, even in this case the possibilities for interaction and plot variation are limited.

As we see, there are disadvantages to both extremes (giving either full or no control to the characters), and therefore several *intermediate* approaches to storyline development have been proposed. These solutions have in common that they give the characters limited autonomy in determining the plot. In most cases, this is done by using global scripts that leave some room for improvisation by the characters. In some systems, this script is given as part of the characters' knowledge (Hayes-Roth et al., 1999; Cavazza et al., 2001); in other systems, the characters rely on a virtual director to give them instructions based on the script (Kelso et al., 1993; Young, 1999). Although these intermediate approaches clearly represent a step forward from the two extremes sketched above, they also have their problems. One of these is that 'forcing' characters into actions prescribed by a global script may give rise to inconsistencies. For a discussion of this and other problems see Mateas & Stern (2000). Here, let it suffice to say that in our view, many of the remaining problems of intermediate approaches appear to stem from the fact that most of these still make use of a scripted plot (albeit a global one). This means that in any case, there are some pre-specified plot points, and the characters must somehow be made to reach these. In our Virtual Storyteller system, which we discuss in the following sections, this is different: the characters are not guided through a pre-existing plot, but create the plot together with a virtual director.

³ Except, possibly, the intelligence to play out their prescribed actions at the presentation level in virtual drama.

Overview of the Virtual Storyteller

At the University of Twente, we have developed the Virtual Storyteller, an agent framework for virtual storytelling (Faas, 2002). In the Virtual Storyteller, storylines are not pre-defined but created by the actions of the characters, guided by a virtual director. For a clear task division within the system, we choose to use a separate director agent who has general knowledge about plot structure, rather than giving such knowledge directly to the characters. Both characters (or 'actors') and director are implemented as intelligent agents, capable of reasoning within their own domain of knowledge. The characters can make plans to achieve their personal goals using 'story world knowledge': knowledge about their virtual environment and the actions they can take in it. The director is able to judge whether a character's intended action fits into the plot structure, using both story world knowledge and general knowledge about what makes a 'good' storyline. In addition to the actors and the director, the Virtual Storyteller also comprises a narrator and a presentation agent, which are responsible for the creation of the narrative and the presentation level of the story. The architecture of the Virtual Storyteller is shown in Figure 1. The agent framework for the Virtual Storyteller was built using JADE (Java Agent Development Environment; Bellifemine et al., 2001), and the agents' rule bases were constructed using Jess (Java Expert System Shell; Friedman-Hill, 1997).

The Virtual Storyteller has been developed in the context of the AVEIRO project (Heylen et al., 2001), concerning virtual environments inhabited by autonomous embodied agents. Among the environments we have developed is a virtual replica of a local theatre: the Virtual Music Centre (VMC), which provides a natural setting for a virtual storyteller. Our current focus is on story presentation by a 'traditional' storyteller: an embodied agent with speech output who tells a story using appropriate prosody, gestures etc. However, extensions to virtual drama are envisaged, where the characters act out the story on the stage of the VMC. This will also provide new opportunities for interactivity. More details on our current and future work on the Virtual Storyteller are given in the next sections.

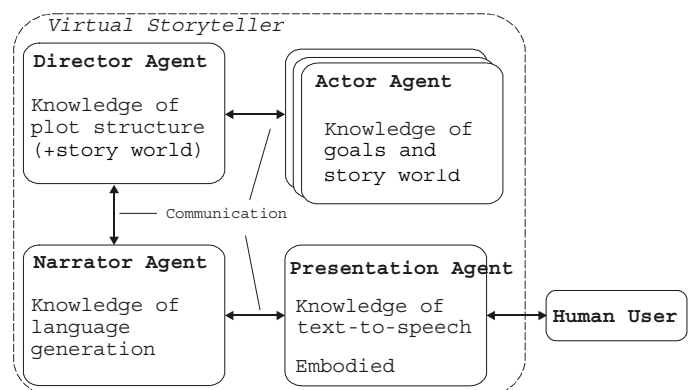


Figure 1: architecture of the Virtual Storyteller.

Plot creation as a combined effort

The approach to plot development adopted in the Virtual Storyteller can be categorized as an intermediate approach, in the sense that the characters do not have full autonomy in making up the plot, but are guided in their actions to achieve a well-structured storyline. A main difference with other approaches is that our director does not work with a pre-specified (possibly branching) storyline, but only has general knowledge on what makes a good plot. This means that the content of the story is not known in advance, but determined by the characters pursuing their individual goals in their virtual environment. This is much like the approach in systems like Talespin (Meehan, 1976), with the important difference that in our system, there is a director who watches over the structure of the unfolding plot. (The characters themselves ensure the consistency of the plot.) The director can use the following methods to control the characters' actions (based on the classification of Blumberg & Galyean (1997)):

- *Environmental*: introducing new characters and objects into the virtual environment.
- *Motivational*: giving a character a goal to pursue.
- *Proscriptive*: disallowing a character's intended action.

How often the director makes use of these control methods depends on the contents of his knowledge base. In our current implementation, the director knows about global plot structure in the fairytale domain. His knowledge base contains rules specifying that a story must have a beginning (where the characters and the environment are introduced), a middle part (where the main action takes place), and a happy end. To get the plot going, the director creates a setting (environmental control) and gives the characters a goal (motivational control). Before performing any action, the characters must ask the director for permission, which is where proscriptive control comes into play. For example, the director might keep the antagonist from killing the protagonist early on during plot development, to prevent a premature ending to the story. Alternatively, the director might allow the killing but afterwards introduce a new character to save the protagonist (using, e.g., a magic potion). Note that the director does not have *prescriptive* control: he cannot force a character to perform a specific action. However, he may try to 'push' the plot in the desired direction using environmental and motivational control. Whether this is sufficient to achieve adequate plots, still remains to be seen.

Currently, the characters' and the director's knowledge bases are still very limited, allowing only for the generation of extremely simple stories. In the near future, we intend to extend both, so the characters will be able to do more sophisticated planning and the director will be able to pose additional requirements on plot development. The next step will be to experiment with different kinds of rules for plot development, in different story domains. Our framework is well suited for this: it has been designed so that new (Jess)

rule bases can be easily loaded into both the director and the character agents.

Turning a plot into a story

The Virtual Storyteller currently aims at story presentation by a virtual narrator rather than by embodied characters. In this respect, it is more closely related to systems producing textual output than to virtual drama. Unlike most textual story generation systems, however, it explicitly takes the narrative and presentation levels into account. The agents responsible for this are the *narrator* and the *presenter*. The narrator converts the plot into a textual narrative by translating system representations of states and events into natural language sentences. An important subtask in this process is pronoun generation. As shown by Callaway & Lester (2001), the use of appropriate pronouns is one of the factors that most influence the enjoyment of a narrative. The natural language sentences produced by the narrator are sent to the presentation agent, which is currently implemented as an MS Agent that uses text balloons accompanied with speech synthesis to present the narrative (see Figure 2). In the future, however, we intend to base story presentation on our own work on speech synthesis and emotional facial expressions (Bui et al., 2001), which offers more advanced possibilities for using prosody and facial gestures to enhance storytelling.

Additional future work is story presentation in the form of virtual drama. This is a realistic possibility since in the Virtual Storyteller the characters already are intelligent agents, which 'only' need to be extended with a body and animation capabilities. In this scenario, the presentation agent will be no longer needed (its role will be taken over by the characters), and the function of the narrator will be changed from text generation to play writing, a task for which new, theatre-oriented knowledge will be required.

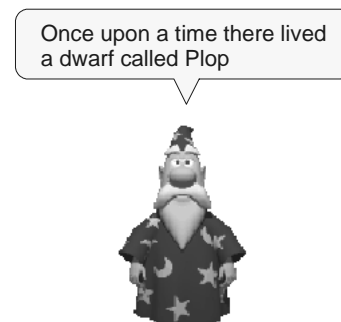


Figure 2: the presentation agent.

Interactivity

Although the current implementation of the Virtual Storyteller is not interactive yet, this is envisaged for future versions. We will start by adding a very simple form of interaction, where the user influences the plot by choosing the characters and their goals at the start of the storytelling process. This may be taken further by having the user take

on the role of the director during plot development as well, deciding which of the characters' intended actions are allowed. As shown in Figure 1, interaction of the user with the system is currently supposed to go via the presentation agent, which functions as the natural interface to the Virtual Storyteller. When, in a future version of the system, the presentation is carried out in the form of virtual drama, more direct interactions will be possible, for instance by having a user-controlled avatar join the actors on the stage. Alternatively, the user can be part of the performance's audience, and influence the performance by actively expressing enthusiasm or disapproval. For a more detailed discussion of these and other possibilities for user interaction in the VMC environment, see Nijholt (2000).

Conclusions

In our approach to virtual storytelling, the characters are implemented as intelligent, semi-autonomous agents. A virtual director, an agent with general knowledge about plot structure, guides their actions and ensures that a well-structured storyline emerges. We do not make use of pre-defined scripts, which means that the plot is not followed but really created by the characters, and which has the important advantage that the characters are never forced to carry out potentially inconsistent actions.

Our approach has been implemented in a general agent framework, the Virtual Storyteller, which covers all story levels and allows for further development in many different directions. The knowledge bases currently used in the Virtual Storyteller are still quite limited. We will extend these in the near future, and further explore the creative potential of our framework.

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