Authoring Plan-based Narratives via a Social Network

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Abstract
One way of interacting with an Interactive Storytelling system is via an authoring system prior to plan-based narrative generation. In the search for a user-friendly authoring method for plan-based storytelling domains we have developed a method that captures important narrative aspects such as characters’ relationships as a way of defining a story. This represents a novel form of high-level authoring for plan-based storytelling which fits specific narrative genres: namely, serial dramas (or soap operas) where social relationships between characters act as a determinant for the narrative events that make up different episodes. The approach is implemented in a demonstration system which makes the dependency explicit: using a visual interface users can set social relationships between virtual characters and generate an episode based on that network. Stories are generated at run-time using a plan-based approach that exercises meta-level control over narrative trajectory via the use of pseudo-landmarks. Thus the system provides authors with a visual mechanism for the specification of key story determinants and observation of their impact on generated narratives. The demonstration system is set in the medical drama genre (in the style of serials such as *House*, *ER* and *Scrubs*). During the demo participants are able to interact freely with the system: setting relationships between virtual characters to “author” an episode of the drama in which the relationships they have set lead to peripeteia in the context of medical story lines; and then watching this episode as it is visualised as a 3D animation.

Introduction
In Interactive Storytelling systems, user interaction can occur at different stages: during the presentation of the story; and prior to story generation via an authoring system. Plan-based narrative generation has been shown to be applicable in both cases (Riedl and Young 2010; Porteous, Cavazza, and Charles 2010). In the search for a user-friendly authoring method that would capture important narrative aspects such as characters’ relationships we have developed a system in which the characters’ social network can be used to define a story. In this paper we present an interface for high-level authoring of plan-based stories that is targeted at those narrative genres, such as serial dramas and soap operas, where social relationships between characters act as determinants for the evolution of narrative across episodes.

This represents a novel mechanism for interactive narrative that reflects aspects of how modern dramas are shaped in specific genres, where situations and relationships are determinant. For example, advice in the contemporary film and screen writing literature advises authors to think initially, and perhaps primarily, of story in terms of characters, relationships and situations (McKee 1997; Phillips and Huntley 2009). This is the idea which we have explored in this work: to start from models of characters and the relationships between them, and then to explore the situations that can occur and the stories that will necessarily arise from that.

Our demonstration system is set in the medical drama genre where social relationships are in a constant process of dramatic change, where conflict dominates (Alexander et al. 1992; Greenberg, Abelman, and Neuendorf 1981) and which are known to elicit audience reactions to both dramatic events and character relationships (Bradley 2007). Interestingly, these genres are repetitive since they frequently feature different combinations of typical actions yet diversity is achieved via changes in the relationships between characters and the conflicts and situations that arise as a consequence of this (for example, series 1 of *ER* included repeated instances of: seduction, conflict over treatment, professional rivalry, battles to save patients and so on).

System Architecture Overview
The architecture of the system is represented in Figure 1 with the central components being the visual user interface (1), the plan-based narrative engine (2) and narrative visualizer (3), with co-ordination between them as shown.

User interaction with the system is via a graphical representation of a social network, representing the current state of the social relationships between virtual characters. This network has virtual characters as nodes (including their names and a picture of them), relationships between them as arcs and characters clustered according to their role such as junior doctors, patient relatives, nurses and so on. Due to the ubiquity of social networks the conceptual basis of this interaction mechanism is one that users are likely to be familiar with. Nevertheless it represents a novel form of
interacting with a storytelling system and one which users should find compelling. For ease of use graph drawing and layout of the social network is handled automatically using (Graphviz4Net 2011) which can generate graphs where all elements are fully customizable.

When an episode of the medical drama is to be generated the current state of the social network is used in the creation of a planning problem instance. This problem instance then forms part of the input to the narrative generator at plan-time, along with the domain actions. The planning problem instance that is created includes PDDL3 modal operators which specify a partial order over dramatically interesting narrative situations and content. At run time these are used like landmarks to control the trajectory of the output plan, in a decomposition-based approach, as reported by Porteous et al (2010).

The generated episode of the medical drama is visualized by a component that receives narrative actions and stages them in a 3D environment using the Unreal® game engine (UDK). In the staging of the actions the notion of “Smithian” cues (Smith 2003) is employed to enhance important narrative events. These include such aspects as lighting, music, camera angles and shot distance.

Virtual character dialogues are generated by the system at run-time and are passed through a text-to-speech system that synchronizes spoken utterances with characters’ lip-synching. The character dialogues are also displayed in the visualization window in the form of sub-titles.

**Narrative Generation**

Underpinning the system is a plan-based narrative generator featuring an implementation of Metric-FF (Hoffmann 2003) adapted to use landmarks for narrative control as described previously in (Porteous, Cavazza, and Charles 2010; Porteous et al. 2011). Their extension to planning with landmarks (Hoffmann, Porteous, and Sebastia 2004) provides a mechanism to ensure the inclusion of important dramatic points and their relative order within a narrative in a way that promotes story diversity whilst retaining the generative power of the approach. For the medical drama domain in which the demonstration system is set, such points of the drama can include tense clinical situations, strained relationships between characters, deceptions, confrontations and so on. Within this approach landmarks are represented

```plaintext
(sometime-before
    (medical-conflict-resolved DrGreen DrDixon riskyTreatment)
    (medical-conflict DrGreen DrDixon riskyTreatment)
)

(sometime
    (shown-relationship DrAdams DrGregory)
)

(sometime
    (shown-pressure-work DrBrown)
)

(at-end
    (medical-conflict-resolved DrGreen DrDixon riskyTreatment)
)
```

Figure 2: Sample PDDL3 modelling of narrative landmarks
Figure 3: Overview of Interaction with the Demonstration System: (1) users specify relationships between characters, select feature characters and goal theme; (2) episode is generated using current state of the social network and constraints C1–C4 to structure narrative; (3) view a visualization of it as a 3D animation (illustrated with screenshots and brief plot synopses).

declaratively, with partial orders specified over them using PDDL3.0 modal operators such as sometime-before, sometime and at-end and then used in a decomposition based planning approach to control the shape of a narrative trajectory as it is generated. At run time these constraints are linearised and used to decompose the process of narrative generation into a sequence of sub-narratives. A complete output narrative is produced by conjunction of the sub-sequences.

As an example, the episode illustrated in Figure 3 is generated for a problem instance which includes the constrained landmarks shown in Figure 2. The use of these landmarks ensures the generation of a narrative that contains suitable dramatic content. A selection of actions illustrating this narrative episode are shown in Figure 3.

System Performance

System performance was analysed in (Porteous, Charles, and Cavazza 2013) through hundreds of system runs, in terms of real-time performance, story diversity and leverage effect of the modification of the social network onto the generated narratives. This approach preserves the run time performance of our baseline narrative engine while showing the potential for moderate changes to the social network to yield large changes across hundreds of narratives generated in our experiments.

Demonstration Overview

During an interactive session with the demonstration system users are given the opportunity to “author” their own episode of the medical drama by specifying the relationships between characters in the social network, and then watching it. Through this process they can explore the difference in narrative possibilities as a result of changes in relationships between characters.

Step 1: Specify Relationships between Characters

Via the interface users can add and delete virtual characters from the network, choosing from an available set that includes 10 doctors, 5 nurses, 3 patients and 3 relatives. Similarly users can add, delete and modify relationships between the characters choosing from a classification of affective and romantic relationships as detailed in (Porteous, Charles, and Cavazza 2013). For ease of use all interaction is mouse and menu driven, with the use of (Graphviz4Net 2011) which gives Windows WPF control over the interface.

Relationships between characters can be symmetric or asymmetric. For example, part 1 of Figure 3 includes a symmetric relationship between Dr Green and Dr Dixon (they are professional rivals) and an asymmetric relationship between Dr Thompson and Dr Miller (he is antagonistic to her whilst she is attracted to him).
Step 2: Generate the Episode
Once a user has specified relationships in the network they can then generate an episode of the medical drama. At this point they are required to select feature characters for their narrative episode and to choose a “goal theme” for their episode from a menu of possibilities such as romantic intrigue, medical issues, pressure of work and so on. Once these have been specified they can select “Generate Episode” in the interface, as shown in Figure 3. They can also inspect the sequence of narrative actions that constitute the generated episode before watching its visualization (part (3) in Fig 3).

The relationships that the user has specified in the network impact on the likelihood of different narrative events occurring so, for example, if the user has set the relationship between a pair of characters to be antagonistic then the narrative is more likely to include confrontation between them, arguments, “ganging up” and so on. Inspection of the narrative at this point enables the user to assess its quality prior to watching the visualization. An example of a generated narrative is shown in part (2) of Figure 3.

Step 3: Watch the Episode
Once the narrative had been generated the user can select to view the episode and watch the visualization of it. As an illustration, part (3) of Figure 3 shows a series of screenshots from the visualization of the narrative generated for the configuration of the social network shown in part (1).

For this narrative the user selected Dr Green and Dr Dixon as the feature characters of interest and a medical theme for the goal of the narrative. It can be seen that the relationships specified by the user in the social network have a direct impact on the evolution and content of the narrative: the feature doctors are professional rivals and this is reflected in their interactions in the narrative which feature confrontation and a rival doctors plan to gain the upper hand when they spot the possibility. However in this instance the outcome of the narrative depends on relationships with other secondary characters: because the senior doctor, Dr. Laverick, brought in to the story is a close friend of Dr. Green they choose to support them rather than the rival doctor, Dr. Dixon.

Since the episode can also be viewed by other members of the audience the visualization will highlight key dramatic events so that the types of relationships between characters can be clearly recognized by the demo audience at large.

Conclusion
The approach implemented in our demonstration system represents a novel direction for narrative generation with a move towards a user-friendly authoring method that captures important narrative aspects – namely characters’ relationships – in a way that reflects how modern dramas are shaped in genres where relationships are determinant.

Acknowledgments. This work was funded in part by the European Commission through the FP7 Open FET “MUSE” Project (ICT-296703). Visual content developed by Catherine Dixon and Matthew Laverick of Teesside University. Character models purchased from aXYZ Design http://www.a.xyz-design.com.

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