Stories Animated: A Framework for Personalized Interactive Narratives using Filtering of Story Characteristics

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Abstract

Interactive storytelling opens exciting possibilities to personalized narrative creation, providing a more compelling and immersive experience than traditional narratives. In this work we propose a creative framework in which the author can specify story characteristics (such as genre or complexity) on a story structure in order to generate interactive stories tailored to personalized constraints. The story generation model combines a branching story structure with a planning algorithm that filters and recombines story fragments based on characteristics, generating a high-level interactive scenario that satisfies all authorial constraints, and provides sufficient abstraction from the technical implementation. The scenario is then simulated in a real-time storytelling system, featuring autonomous characters and camera control. As a demonstration of our approach, we have authored an interactive narrative based on the Brothers Grimm fairytale "Godfather Death."

Keywords: personalized interactive storytelling, computational creativity, 3D animation

1. Introduction

With the emergence of interactive storytelling as a new form of media, there is a clear need to provide efficient and expressive computational models for interactive narratives.

Interactive narratives have the potential for personalized storytelling experiences. User-defined constraints adjust the story to appeal to individual preferences. Recent efforts to model character attributes or authorial and character goals [9], and character points of view [6] offer more personalized experiences. Yet these approaches are limited to a predefined scope of characteristics to alter the storyline that each system can handle. Few interactive storytelling systems can provide user-customizable characteristics that can dynamically be adjusted, simulated, and affect the story progression, which is one crucial issue our system hopes to address.

In this paper, we propose a hybrid story model which significantly augments the branching model's expressiveness by employing planning techniques to dynamically generate interactive storylines which correspond to selected authorial constraints (e.g. story complexity, genre, and user-defined descriptors) while maintaining crucial plot structure through a story graph. We couple our model into a framework with a real-time animation engine, featuring high-level control of virtual characters and automated camera placement.

Our contributions are: (i) provision of an expressive hybrid model for formalizing complex narratives and generating interactive stories that fulfill selected narrative characteristics (ii) a creative framework for interactive narratives that demonstrates high independence between authoring and 3D simulation (iii) a 3D animation engine which enables the simulation of the generated interactive narratives.

2. Related Work

Narratives are an irreplaceable element when discussing creativity. How to tell a compelling story by combining discourse (expression), story (plotline), and narration (organization of events) is crucial to artistic design [5]. With interactive technologies in the picture, multimedia storytelling further explores the aspects of automation, personalization, and presentation.

Story generating techniques provide ways for authors to recombine new stories from existing ideas, thus enriching the content without extra authorial effort. In order to break down a narrative to fine-grained fragments for story generating, we survey literary theories on narrative structure. Vladimir Propp [8] and Chatman [3] both propose models to break down narratives into well-grained units. In the literature of drama management, interactive narratives are generally formalized using AI planning or graph branching models, composed of fragments. In [6], the concept of "beats" were introduced as a collection of goals and actions for each story fragment, allowing the user to specify events, goals, or preconditions in each beat. The vignette was proposed in [10], comprised of an action, character, and current states, bringing the story down to very concise character-action-state statements. Character-based approaches [11] provide more dynamic plot lines and wider story possibilities. However, these approaches have limited expressiveness and require a good understanding of the underlying techniques and models. Branching graph models present an interactive story as a simple directed graph composed of plot nodes, and transitions leading to specific nodes depending on the user's choices [12]. The authoring of such models is most intuitive, and has thus received significant attention and development from the research community.

Interactive narratives were first recognized as a vessel for integrating storytelling with multimedia environments that contains visual-audio content by [13]. From hence on, a wealth of research saw bloom for virtual storytelling environments with autonomous character, lighting, and camera models that adapt in real time to various scenarios [1][2][4].

3. Framework Design

Our system's workflow comprises three main stages: authoring of story fragments and story graph, generating an interactive story under authorial constraints, and linking to the 3D content and simulation in the virtual environment.

3.1 Authoring

The interactive narrative is represented as a story graph (see Figure 1) made up of three components: the fragments of story content, the edges which link the fragments, and the grouped fragments which we term moves.

We design the story fragment as the minimum unit. Fragments are similar to beats [6] or vignettes [10], but we do not explicitly place any actions or representational information in the fragment. A fragment involves a scenario, an abstract representation of the story status, and specifying any branches, parameters, and characteristics. Story characteristics are the features of the story content and discourse in a narrative, including plot modes, genre, complexity, interactivity, perspective, and time sequence.

The fragments are linked together using edges. An edge represents an implicit and direct precedence constraint between two fragments, similar to the explicit formulation of precedence constraints in AI planning models. Constraints added on the edges represent preconditions for the fragments. This increases the degree of control for the author and allows multiple instances of the same fragment to be reused throughout the story graph given different preconditions.

Given a pool of authored story fragments, we can then link them to form moves. We say a move is a complete unit of development in the story beginning with the introduction of a lack or villainy and goes through intermediate events to come to some liquidation or resolution of the lack. The usage of this term is derived from Propp's definition of a move [8]. A move is made up of multiple story fragments interlinked, and a story may have multiple moves.

3.2 Story Generation

The generation of an interactive narrative is implemented as a double graph traversal on the authored story graph. Given a number of user-defined constraints over story characteristics and fragment descriptors (basically semantic tags such as Death or Betrayal), our algorithm outputs a sub-graph of the story graph. This sub-graph is augmented with new conditions on edges to ensure that no path is taken in the interactive story which would lead to a fragment or to an end which violates the specified constraints.

As an illustration, the specification of a *short tragedy*, with a *good hero* is expressed as:

$$(complexity \leq 2) \wedge tragedy \wedge (hero_{kindess} \geq 3)$$

where $(complexity \leq 2)$ constrains the story to a maximum length of two moves.

We consider three categories of authorial constraints (i) checking the absence of a binary descriptor (negation of a descriptor), (ii) checking the presence of binary descriptor, and (iii) checking constraints on a quantified descriptor.

During the first traversal, contradicting nodes are removed (checks absence of a binary descriptor). It then traverses from bottom up, evaluating and posting the end conditions on the edges to ensure authorial goals are met (checks presence of a binary descriptor and constraints on quantified descriptor) by propagating the authorial constraints onto edge. Finally, nodes whose arity is null are removed. This process is demonstrated in Figure 1 in which we have an input story graph and the result of the filtering algorithm.

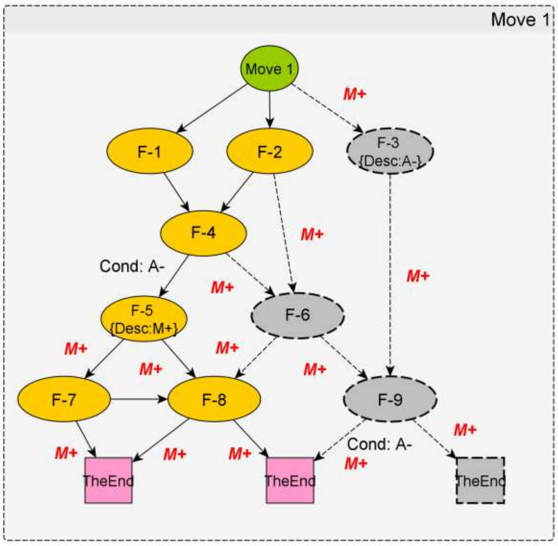

Figure 1: A sample story graph filtered under the condition of *M+ = true and A- = false*. The algorithm (1) checks absence of a negated binary descriptor, (2) ensures presence of binary descriptors while evaluating quantified constraints (edge descriptors in red), and (3) removes dead ends (nodes greyed out).

3.3 3D Environment

The simulation of our interactive story is performed by a 3D animation engine featuring a smart control of characters coupled with a fully automated cinematography system, which we refer to as *The Theater*. The key feature of our approach is to decouple the semantic description of scene and character behaviors from their 3D geometric implementation in the 3D environment. Each story fragment is linked to an authored XML scenario which describes the high-level character behaviors occurring in the fragment. The author specifies behaviors at a semantic level (e.g. meet someone in a room or exchange utterances with a character). Our 3D character animation engine then computes the locations, paths, and animations for the characters, given the geometry of our 3D environment and the behaviors to simulate.

4. Demonstration

The demonstration is based on the Brother's Grimm fairy tale "Godfather Death." The final authored story has a total of 7 moves and 79 unique story fragments, which leads to more than 1000 variations.

Using our algorithm we generated sample stories from the authored story fragments based on user given constraints. Left part of Figure 2 displays a story generated with the constraints *complexity* = 1 and *tragedy* = *false*. As can be observed from the example, the algorithm correctly ends the story in one move, and the ending is not a tragic one. This plot combination corresponds to Chatman's plot mode of "A noble hero succeeds."

Another example is a story that tries to model Chatman's mode of plot where a villainous protagonist fails (right part of Figure 2). We set the constraints *complexity* ≥4, tragedy = *true* and *kindness* <0. Again, the algorithm correctly produces a story of the requested complexity (4 moves), and ends the story in a tragic ending (the boy dies). Interestingly, this variation is very close to the original "Godfather Death" story, only differing at decision point 1, where the Father throws the son out.

The demo video is available using this link: `https://vimeo.com/63299165`

5. Conclusion

In this paper we have designed a story model for interactive narrative generation that takes into consideration user preferences while ensuring authorial goals are met.

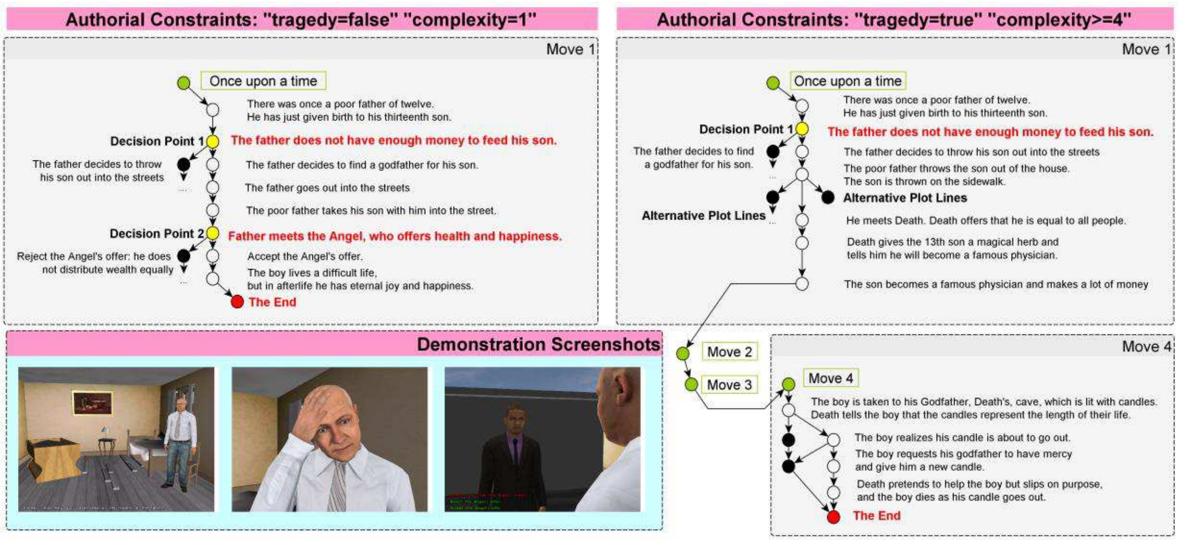

Figure 2: Two stories generated under different constraints and simulated in the 3D environment.

The story generation mechanism is integrated into a comprehensive interactive storytelling platform as an incremental step to developing cross-media storytelling platforms. The flexibility of the framework allows easy bridging throughout the creative process, from authoring, story generation, to interactive simulation.

Further work will focus on utilizing this mechanism to provide graphical authoring tools that will ease the creation process, and also more context-aware virtual cameras and characters to fully bridge the authoring environment with the 3D representation.

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