Modeling Rich Characters in Interactive Narrative Games

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KEYWORDS
Virtual Character, Interactive Narrative, Theory of Mind, Social Norm, Emotion.

INTRODUCTION

Computing technologies have advanced rapidly over the past decade. Faster machines, better graphics, and more advanced algorithms become available every year. Moreover, the evolution of internet technology and the increasing accessibility of computing resources and mobile devices allow computing technologies to go beyond business and scientific computing, and become an important means for providing entertainment and facilitating communication. These advances have helped to enable a new form of media – interactive narrative games. Interactive narrative games allow a user to play a role in a story and interact with other characters driven by AI agents. The user's choices affect the unfolding of the story.

Because of the support of user interactivity and the use of computer simulated virtual environments, interactive narrative games are closely related to video games. In fact, the rapid growth of interest in interactive narrative games is in part motivated by the explosion of computer-based games in recent years. Compared to more traditional forms of video games, such as arcade games, action games, and even role playing games, interactive narrative games emphasize more of the social and narrative aspects of the experience. Story, of course, is a central part of the human experience both as entertainment and as a powerful tool for providing pedagogy. We watch movies, read novels and tell stories. Interactive narrative games provide an experience that integrates user agency with the engaging power of narrative.

Interactive narrative games have been recognized as a promising tool for providing both pedagogy and entertainment. They have been proposed for a range of training applications, e.g. [13, 20, 26, 35, 22] as well as entertainment applications, e.g. [10, 23, 3, 12, 11, 36].

In this paper, we discuss the design desiderata for interactive narrative games, and in particular for creating the virtual characters in interactive narrative games. We argue that a rich model of characters that are well-motivated, socially aware and have a "Theory of Mind" is needed. We discuss the state of the art work on modeling virtual characters. In particular, we present the approaches taken in Thespian [27, 26, 28, 29, 31, 30] – a decision-theoretic multi-agent framework for interactive narratives.

DESIDERATA FOR INTERACTIVE NARRATIVE GAMES AND VIRTUAL CHARACTERS

In media that involves narratives, such as movies, dramas and interactive narrative games, the coherence of the narrative is a basic design goal. Narrative, which is typically defined as "the semiotic representation of a series of events which are meaningfully connected in a temporal and causal way" [18] (Note that "Narrative" can be defined and used in more general ways. In this paper, we use the term "coherent narrative" or "coherence of narrative" to refer to this definition), has been shown as an important way for people to organize and make sense of their experience [2, 16, 17]. If the experience does not make sense to the viewer/user, the author cannot possibly reach his/her other goals.

Coherent narrative by itself does not necessarily lead to a dramatic or inspiring experience because it merely requires the causal and temporal relationships between events to be understandable to the reader/user. The author of interactive narratives often wants to create cognitive or affective effects in the user through the interactive experience. For example, many interactive narratives for training are designed to help the user practice social and cognitive skills, such as (social) problem solving [20], negotiation [38] and coordination skills [35] when the user is at certain affective states, e.g. highly stressed. More generally, interactive narratives have often depended on triggering the user's emotional responses to keep the user engaged and set up the environment for the user to learn or get entertained. For example, in FearNot! [20], which is targeted at helping the learner deal with school bullying, empathic responses for the victim are triggered by letting the user talk to a child character

who is the victim of a school bully. In both Façade [15] and Mimesis [23], the systems have a major goal of creating a dramatic tension arc, i.e. a slow increase in tension followed by a release. And of course, this is not unique to interactive narrative. Narrative forms in general seek to create cognitive or affective results. Tan, for example, describes films as "emotion machines" [37].

In discussing traditional narratives, Egri has suggested a central, key role for rich, fully fleshed out characters for narrative design. He argued that such characters are critical not only to narrative but also critical as key aspect to the process of creating narrative – that rich characters achieve autonomy in the writer's mind and can thereby serve as inspiration to the author [6].

The richness of character development is evidenced in the works of Shakespeare. The play Othello, for example, gives us a sense of the richness of character that an author may seek. In this play, Iago hates Othello and seeks his downfall. He hatches a plan to plant evidence that will lead Othello to the false inference that his wife has cheated on him. Iago believes that this false inference will lead Othello to kill his wife and consequently destroy himself. Here the richness of character can be observed. The characters have beliefs about others including how others think - they possess what in psychology and philosophy is called a "Theory of Mind". They have motivations and emotions. Finally, they understand the social structures and roles of which they are a part, such as marriage and spouse, the social norms associated with those roles and the consequences of violating them. In other words, the characters are well-motivated and socially aware.

Similarly, in interactive narrative games, we need to build characters that are well-motivated, have a "Theory of Mind", understand social norms and have emotions. These capacities in characters are not only important for creating a dramatic effect, but also necessary for allowing the user to understand the characters as they enable the characters to behave human-like.

CHALLENGES IN CREATING VIRTUAL CHARACTERS

The design of rich, human-like characters faces many challenges. This section discusses one of the key challenges – balancing the design of characters and the design of events.

Story is composed of characters and events. Any effects the author intends to reach are created by the design of the characters and the design of the events. Though characters and events are closely related, their designs are often in conflict with each other. Overemphasizing the design of events will result in having over-simplified or broken characters because the characters do not possess their own motivations and personalities, but are designed only to support the events. On the other hand, even with very rich characters, plot is still important. If all the consideration is given to craft characters, the overall story may lose its structure, and becomes a trivial story in which nothing happens [5]. An extreme example is a chat room, where the user interacts with real people but hardly has any structured experience.

In general, a balance has to be reached between the design of the characters and the design of the events. They serve as constraints to each other – when designing characters the author needs to think about how the characters' behaviors can be used to achieve the plot design, and when designing events the author needs to make sure that the characters are not broken or losing their distinct personalities for acting out the events.

THE STATE OF THE ART

There is a considerable body of work in the field of artificial intelligence and multi-agent systems on building interactive narrative games. In this section, we briefly review how virtual characters are modeled. This review compares how different interactive narrative frameworks create coherent narratives in the face of user interaction and how social normative behaviors and emotions are modeled in the characters.

Create Coherent Narrative

The coherence of narrative requires the causal and temporal relationships among events to be interpretable to the user, which usually implies that characters need to have consistent and human-like motivations. Most of the existing works on interactive narratives can be viewed as either adapting a plot-centric design or a character-centric design for creating coherent narrative.

Plot-centric designs emphasize the design of the events in the story, and the characters' actions are driven by the development of the plots. For example, In Façade [15], the story is organized around hand-authored dramatic beats. Based on a desired global plot arc, the drama manager chooses the next beat that is suitable to the context and whose dramatic value best matches the arc. In Mimesis [23], the authoring framework constructs story plans, which are the ideal linear narrative that the user should be told. When the user's action deviates from the story plan, the system either replans or prevents the user's action from being effective. I-storytelling [3] system plans over a

hierarchical tasks network (HTN) to realize interactive narratives.

In contrast, character-centric approaches for interactive narrative emphasize the design of individually plausible characters. The story emerges from the user's interaction with the characters. For example, FearNot! [20] uses planning based approach for modeling the characters' behaviors. It has explicit representations of characters' personalities and motivations, which affect the individual character's plan construction process. In MRE [35] and SASO [38], there is an extensive dialogue management subsystem in each character that incorporates explicit rules for dialogues. The agents have plans governing the coherence of their behaviors which take their personalities into account.

Most of the contemporary interactive narrative frameworks provide systematic support of either the design of character or plot structure, but rarely both. In these frameworks, it is usually up to the human author to ensure the design of the other component, which often turns out to be a significant undertaking. For example, it is extremely time consuming if not impossible to manually check whether the characters are well-motivated in all the possible paths through the story.

Model Social Normative Behavior

Social norms are commonly believed rules in social interaction. These rules serve as a guide for human behavior, and as the basis for their beliefs and expectations about others. Though norms are commonly followed, the tendency to follow norms is regulated by other factors, such as more pressing, personal goals.

In interactive narrative games, norm-following/violating behavior is often not explicitly modeled. Rather, they are modeled conjointly with characters' other behaviors. For example, in Façade [15], norms are encoded in the design of the beats and the beat selection process, i.e. the pre- and post-conditions of the beats. In I-storytelling [4], characters' behaviors including norm following behaviors are modeled using hierarchical task network (HTN) plans. In MRE [35] and SASO [38], the dialogue management subsystem incorporates explicit rules for normative behaviors, specifically conversational norms. The priorities of these rules are adjusted by agent authors to fit the characters' profiles.

Model Emotions

In modeling emotion, cognitive appraisal theories have had an increasing impact on the design of virtual characters. Appraisal theories are a class of leading psychological theories for emotion. Appraisal theories argue that a person's subjective assessment of their relationship to the environment, the person-environment relation, determines the person's emotional responses [24, 33, 19, 34, 25, 7]. For example, an event that is incongruent with the person's motivations and is caused by others may lead to anger responses; on the other hand, if the event is caused by the person himself/herself, the person will feel guilty or regret [24].

Similar to how social normative behaviors are modeled, many interactive narrative frameworks do not have an explicit model for the characters' emotions. Here we briefly review frameworks that model emotion explicitly. FearNot! [1] deployed the OCC model of emotion over its plan based agents. EMA [8], which is the emotion subsystem in MRE and SASO, follows the Smith and Lazarus theoretical model of appraisal [34]. EMA [8] defines appraisal processes as operations over a uniform plan-based representation, termed a causal interpretation, of the agent's goals and how events impact those goals. Cognitive processes maintain the causal interpretation and appraisal processes leverage this uniform representation to generate appraisal.

THE THESPIAN FRAMEWORK

This section presents a unique framework – Thespian [27, 26, 28, 29, 31, 30] – for interactive narrative design, which utilizes autonomous agents for well-motivated and socially aware characters, and multi-agent coordination to realize story plots. Thespian is able to create both rich characters and manage the development of the story during the interaction according to author specified plot design goals.

Thespian has been applied to authoring dozens of virtual characters in more than thirty interactive narratives. The first interactive narrative to incorporate Thespian is the Mission Environment of the Tactical Language Training System (TLTS) [9], which is aimed at providing rapid language and culture training. Thespian has also been used to model fables such as "the Little Red Riding Hood story" and the Fisherman and his wife. We will use "the Little Red Riding Hood" story as an example to motivate the discussion throughout this section.

Overview of Thespian

Egri Lajos, who is famous for his teaching of creative writing, has strongly argued for the importance of characters in narratives [6]. His view of narrative – of rich, well motivated, autonomous characters as a creative spark to the author, but that are nevertheless constrained by the author's goals for the plot – serves as inspiration to the approach taken in Thespian.

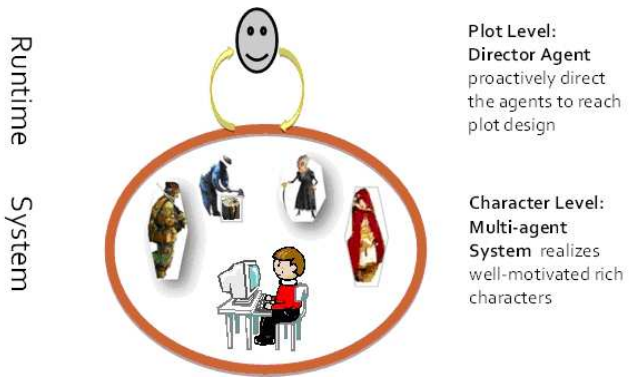

Figure 1: Two-layer Runtime System

Thespian uses a two-layer system for simulating interactive narrative, as shown in Figure 1. The first layer – the multi-agent system – is built based on PsychSim [14, 21], a multi-agent modeling tool for social simulation based on Partially Observable Markov Decision Problems (POMDPs) [32]. In Thespian, autonomous POMDP based agents are used for modeling each character in the story. These agents' behaviors are well-motivated and socially aware. They respond to the user based on both their motivations and the status of the interaction. To guide the development of the story, and therefore give the author control of the plot development, the agents are adaptively fine tuned during the interaction by a director agent, based on the author's plot design and the agents' prior interaction history with the user. In addition to the two-layer simulation system for interactive narrative, Thespian also contains off-line authoring processes to facilitate the author in designing the characters.

Next we will look at the model of the characters in more detail.

Character Modeling in Thespian

Create Coherent Narrative

Thespian creates coherent narratives by modeling characters with consistent and human-like motivations. Thus, the characters act like people and can therefore be interpreted in similar ways. Thespian contains a director agent for managing the development of the story, e.g. for creating certain plot structure during user interaction. When there is a conflict between the design of characters and the design of events, Thespian gives priority to keeping characters' motivations consistent.

In Thespian, each character in the story is controlled by a decision-theoretic goal-based agent. Each agent is composed of its state, actions, dynamics, goals, beliefs and policy.

An agent's state keeps track of the agent's physical and social status in the story. State is defined by a set of state features, such as degree of hunger, being alive, and degree of affinity with another character. The values of state features can be changed by both the agent's own actions, e.g. eat, and other characters' actions, e.g. being killed. Action dynamics define how the values of state features are affected by actions.

The character's motivations are encoded as the agent's goals. Each agent has multiple and potentially competing goals, e.g. keeping safe vs. keeping others safe, that can have different relative importance or preferences. For example, the wolf character can have goals of keeping safe and preventing itself from starving, with the former goal ten times more important than the latter. If the importance of the wolf's goals is the other way around, i.e. it is much more important for the wolf to not feel hungry than to keep himself alive, the wolf will try to eat people regardless of the situation.

Thespian agents have recursive beliefs about self and others, e.g. my belief about your belief about my goals, which forms a "Theory of Mind". The "Theory of Mind" capacity enables the agents to reason about others when making decisions, and thus makes them "social characters". When deciding what to do, a bounded lookahead policy is used by the agents. They project limited steps into the future, considering not only their own actions, but also other characters' responses using their mental models of other characters, and their responses in return. The agents choose the action that receives the highest expected reward to proceed. Thus, they act both true to their motivations and in reaction to the status of the world. For example, in the scenario shown in Figure 2, the wolf will react to Red differently depending on whether there is somebody else close by, and who is that. The wolf will choose different actions when the hunter is near and when the woodcutter is near, because the wolf has different mental models about these two characters.

The user is also modeled using a Thespian agent based on the character whom the user takes the role of. This model allows other agents to form mental models about the user and the director agent to reason about the user's beliefs and experience.

As part of the effort for modeling socially aware characters, Thespian models social normative behaviors and emotions. Next, we look at these models in more detail.

Model Social Normative Behaviors

Different from most interactive narrative frameworks, Thespian explicitly models norms in face to face communication using a domain-independent model built within

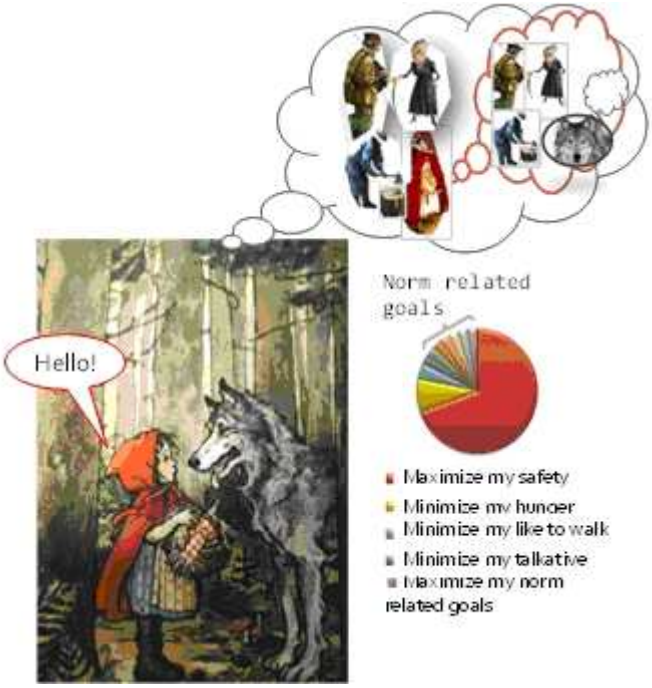

Figure 2: An Example of Character's Motivations and Theory of Mind

a decision-theoretic context [28]. More specifically, three norms are modeled: making relevant responses, following natural turn-taking patterns, and having appropriate conversational flow emerged. The computational model for norms consists of goals that motivate characters to behave socially appropriately, state features that keep track of the status of conversation, and action dynamics for updating these state features. Thespian agents representing characters are given explicit goals of following norms in addition to their other goals. Thus, the characters are allowed to reason about the effect of following or violating norms and achieving or sacrificing their other goals using a unified decision-theoretic framework. By default, Thespian agents act following norms, unless they have other more pressing goals. For example, the wolf will follow norms and greet Red if the hunter is not close by. If the wolf sees the hunter approaching, it will run away and ignore the norm.

Model Emotions

Thespian's model of emotions is based on Smith & Lazarus' appraisal theory [34]. Smith & Lazarus described two types of appraisal: primary appraisal and secondary appraisal. Primary appraisal concerns whether and how the event is relevant to the person. Secondary appraisal evaluates the person's potential for coping with the event. The result of the evaluation will be taken into account by the next primary appraisal process, and thus form an appraisal-coping-reappraisal circle in the agent's cognitive/emotion generation process.

Thespian models five key appraisal dimensions: motivational relevance, motivational congruence, accountability, control and novelty. Upon observing a new event – an action performed by an agent or the human user, each agent appraises the situation along these dimensions based on its beliefs and past expectations. When the agent makes its next decision, its coping potential is reevaluated. It also forms new beliefs and expectations. This updated information will be used for the agent's next appraisal process.

Thespian agents have mental models of other agents; they not only have emotional responses to the environment but can also form expectations of other agents' emotions. For instance, agent A can use its beliefs about agent B to evaluate the motivational relevance and novelty of an event to agent B. The result may be totally different from the appraisal performed from its own perspective. This allows us to create richer characters.

DISCUSSION AND FUTURE WORK

Thespian is a multi-agent framework for authoring and simulating interactive narratives. Its two-layer runtime system is capable of both creating rich characters and managing the development of the story during the interaction according to author specified plot design goals. Most character-centric approaches for interactive narrative can be viewed as only having the first layer of Thespian's runtime system. Therefore, it is usually hard for them to effectively control the development of the story in the face of user interactions. On the other hand, in frameworks that use plot-centric approaches, because a sophisticated character model is missing, the system cannot reason about how a well-motivated character should behave along different paths through the story. As a result, the author has to either sacrifice the richness of characters or spend extensive effort to define their behaviors.

Our future work is planned in several directions. First, we plan to further enrich our models of emotions and social normative behaviors. Secondly, to create the experience of "presence" is one of the ultimate goals of designing virtual environments. Despite that, many fundamental questions about this experience remain open, such as how to measure the user's experience without interrupting it. We are interested in studying how presence can be created and measured in interactive narrative games. Finally, social computing as a new paradigm of computing and technology development, has received increasing attention in recent years. Social computing refers to the computational facilitation of social studies and human social dynamics as well as the design and use of information and communication technologies that consider social context [39]. We want

to extend our work on modeling virtual characters to facilitate computer-mediated communications, such as virtual conferences and online chat rooms.

SUMMARY

Interactive narrative game is a new emerging field that has received increasing attention in recent years. Interactive narrative games provide an experience that integrates user agency with the engaging power of narrative, and have been recognized as a promising tool for providing both pedagogy and entertainment.

In this paper, we analyze the design desiderata for interactive narrative games and the challenge for creating rich characters in them. We argue that a rich model of characters that are well-motivated, socially aware and have a "Theory of Mind" is needed. In addition, a balance needs to be reached between the design of the characters and the design of the events in the story. We discuss the state of the art work on modeling virtual characters. In particular, we present the Thespian framework for interactive narratives. Thespian utilizes autonomous agents to simulate well-motivated and socially aware characters, which can generate their own behaviors when interacting with the user. During the interaction, Thespian's director agent fine tunes the configuration and behavior of the characters based on the author's plot design and their prior interaction with the user. The director agent does so without affecting the consistency of the characters' motivations. Thus, Thespian is able to create both rich characters and manage the development of the story during the interaction.

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BIOGRAPHY

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