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Representing and Using Character Feature Rules in Automatic Story Generation[1]

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Abstract: - Believable agents may not actually believable when their features 'look' unbelievable. Feature rules are commonsense knowledge, but are less studied in current story generation and animation research. In this paper, we propose a method for representing and using feature rules in story generation and animation. These rules can be triggered when their premises are true. For different characters, our method also uses feature rules differently to ensure feature differences in characters.

Key-Words: - Agent Believability, Feature Rule, Meta Feature Rule, Automatic Story Generation

1 Introduction

Story generation and animation is a promising research area of computer science, sociology, psychology, linguistics, etc. It is not a process of mechanical assembly, but an intelligent and artistic creation. This research area involves several disciplines such as Artificial Intelligence, cognitive theory, narrative psychology, media research, social computing, software engineering, literary, cultural studies, and dramas.

In 1976, James R. Meehan developed the first automatic story generation system ---- "TALE-SPIN" [1][3][6][14][16]. It used planning to generate fables about animals with simple drives and goals. The system's memorable, amusing errors revealed how difficult it is to automatically generate interesting stories.

From then on, many scientists and research groups devoted themselves to this field.

One of the most famous systems is Oz project[1][2][10][12], developed at Carnegie Mellon University, which is studying the construction of artistically effective simulated worlds including a simulated physical world, several characters, an interactor, a theory of presentation, and a drama manager. One of its primary research foci is to study how to create agents that appear reactive, goal-directed, emotional, moderately intelligent, and capable of using natural language. The agents are supposed to provide some signs of internal goals, reactivity, emotion, natural language ability, and knowledge of agents (self and other) as well as those of the simulated physical world.

"Virtual Storyteller", a part of the AVEIRO project, is also a multi-agent system for story creation led by Mariet Theune in Parlevink Research group at University of Twente [16][17][18]. In this project, the agents are used to perform specific tasks (tutoring, reception, navigation). Plots are not pre-defined but created by the actions of the characters, guided by a virtual director. Both characters (actors) and director are implemented as intelligent agents, capable of reasoning within their own domain of knowledge. The resulting plot is converted into a natural language text by a narrator agent, and presented to the user by an embodied, speaking presentation agent.

Besides, the Virtual Theater project, directed by Barbara Hayes-Roth, as a part of the Adaptive Intelligent Systems (AIS) project at Stanford University[6][7][15], aims to provide a multimedia environment, in which users can play all of the creative roles, and perform plays. Currently, this research focuses on building individual characters that are consistent with their unique emotions, moods, and personalities. Here, the actors are assigned standard roles in a familiar scenario, but improvise the details of their performance. Actors work together to improvise simple scenarios defined by three dramatic constructs: plots, roles, and characters.

The Actor Conference (ACONF) system was developed by R. Michael Young with his group at the University of North Carolina State[13][14]. The

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Actor Conference (ACONF) system is explicitly designed to take advantage of the strengths of both the character-centric and author-centric techniques and thus achieve both strong plot cohesion and strong character believability, which uses a decompositional, partial-order planner to assemble a sequence of actions, comprising the narrative.

At the University of Teesside, Marc Cavazza and his colleagues implemented an Interactive Storytelling system [3][4][5], which is character-based, and creates dynamic narratives with which the user can interact. Stories that emerge from the roles played by the virtual actors have a well-defined storyline. The storyline for their prototype is that one main character wants to invite another character out on a date. The emphasis of this work is on the relations between narrative descriptions and the dynamic generation of virtual actors' behaviors, who are imported from online repositories (character Ross, Rachel, Phoebe, and Monica).

It is obvious that the difficulty for a system to deal with a realistic character's feature is much more than an unrealistic character's feature. Unlike what have been researched in game industry, our purpose in this paper is to provide a method to represent and automatically use the character feature knowledge for realistic story generation, viz. feature design.

In the next section, we first show our motivation for the character feature design. And then in section 3, we present a list of features of story characters. Section 4 introduces a rule-based method for representing feature knowledge. Section 5 discusses how feature rules are properly used in story generation. In section 6 is development state of our model. At last, section 7 concludes the paper.

2 Motivation

To evaluate a story generation system, one of the most primary criteria is believability of the story generated [8][9][10][11]. As for a system for realistic story generation, character believability is crucial to story believability.

In an unrealistic story (e.g. fable), we might think it is appropriate to see a character like ghost with long ears, red eyes, blue hair, and big buckteeth. However, we can not tolerate a ghost-like man in a realistic story about our daily life. For example, we will feel happy to see Perseus killed Medusa in Greek Myth, but it is definitely strange if a woman who looks like Medusa would appear in "The Old Man and the Sea". Therefore we assume that:

1) There should be some common sense knowledge about when and how a character looks believable in our mind.
2) There are two important factors about character features: what a character looks like, and how its feature changes.
3) The knowledge about character features will influence our enjoying a story unconsciously.

In this work, we evaluate character believability in three perspectives:

1) Feature believability, which meets one's intuition about what a character looks like.
2) Emotional believability, which meets one's intuition about what a character feels.
3) Behavioral believability, which meets one's intuition about what a character does.

The character feature believability is the most primary one within these three perspectives because we see the feature of a story character before its emotion and behavior. Especially, character features bulk in visible media representation or interactive environment.

Probably, in some sense, character feature is unnecessary for story generation, none can deny its capability to evolve artistic impact of stories. But we observed that the above systems paid less attention on dynamic character (agents) feature design neither in narrative nor in visible image besides pre-described narratives or some pre-painted character images.

Feature design can be regarded as an indispensable component of story generation system. There must be characters in story. There must be features about characters. Especially, it is much more important for animation.

Feature design could influence the effect of a story. Spectators won't bear a bald and uninteresting story in which characters have same appearance. It is important for an automatic generated story that characters in is lively, and vivid.

The character features highly influence the believability of a story. Character features are inconstant, and change dynamically and temporally. They are determined with not only many factors of characters, such as emotion, mental state, health, identity, occupation, experience, and so on, but also the story plots. Imagining, when a little boy, a story character, grew up, he would have some beard on his jaw. Moreover, when he became old, the beard would become white from black.

Correspondingly, features also reflect the properties of story characters, such as age, occupation, and experience. Besides, features could imply story content. For example, when audiences saw a girl cried with tears in her eyes, it may be implied that she was sad, and something bad happened to her.

Character features should meet the general recognitions of people. They indicate the difference between characters, which could help spectators distinguish protagonists from deuteragonists.

For a general-purpose story generation system, it is unforeseen how the characters would be. So, it is impossible to preset the features of a character, and the only reasonable way is to use a dynamic generation algorithm.

3 Feature of Story Characters

For each story character in our system, there is associated a list of features, called *feature vector*. Features are classified into two categories: *p-features*, i.e. features of the character's parts, and *w-features*, i.e. features of the whole character.

A character's parts include *hair*, *forehead*, *ears*, *face*, *eyebrows*, *eyes*, *nose*, *mouth*, *teeth*, *arms*, *hands*, *figures*, *legs*, and *feet* (see Table 1), and each part is associated with a proper list of attributes (called p-attributes) and their value domain. For example, the attributes of hair are *length*, *color*, *shape*, and *headwear*.

Currently, our w-features include the attributes such as *name*, *petname*, *nickname*, *nationality*, *Gender*, *age*, *gait*, *figure*, *height*, *weight*, *emotion and temperament*. Maybe not all of these w-features are visible feature, but they could be used in literals narrative.

Table 1. Parts and p-attributes of story character

Part	**p-attributes**
Hair	*Length, color, shape, headwear*
Forehead	*Height, shape*
Ears	*Size, shape*
Face	*Color, shape*
Eyebrows	*Color, shape*
Eyes	*Size, color, brightness*
Nose	*Size, height, shape*
Beard	*Length, shape, color*
Mouth	*Size, shape*
Teeth	*Color, completeness*
Arms	*Length*
Hands	*Size, color,*
Figures	*Length, size*
Legs	*Length*
Feet	*Size, shape*
...	...

4 Representing Features

After the p-attributes and w-attributes are identified, feature rules can be designed. A feature rule contains a conjunction of premises and a conjunction of feature expressions. Its syntax is like "$Q\ \boldsymbol{P}_1 \wedge \boldsymbol{P}_2 ... \wedge \boldsymbol{P}_m \rightarrow \boldsymbol{FAV}_1 \wedge \boldsymbol{FAV}_2 ... \wedge \boldsymbol{FAV}_n$", where Q is quantifier, $\boldsymbol{P}_i$ are predicates, and $\boldsymbol{FAV}_j$ are either w-feature or p-feature expressions.

A w-feature expression is of the form ***WAE***(*character*, *w-attribute*, *value*). This expression reads as the *w-attribute* of *character* is *value*. Similarly, a p-feature expression is of form ***PAE***(character, part, p-attribute, value), and it reads as the *p-attribute* of the *part* of *character* is *value*. For example, ***PAE***(*Joe*, *eyes*, *color*, *red*) means that the color of Joe's eyes is red.

As for premises of feature rules, we have designed a list of predicates. This list is not exhaustive yet, and some common predicates are defined in table 2, whose meaning can be inferred by their names easily. With the predicates and feature expressions, we have designed a long list of feature rules based on our daily commonsense knowledge. For example, the following are fore rules:

1) ∀x:**Girl** *Gender*(x, female) ∧ *Crying*(x) → ***PAV***(x, eyes, color, red)
2) ∀x:**Girl** *Gender*(x, female) ∧ *non-black*(x) ∧ *Crying*(x) → ***PAV***(x, eyes, color, red) ∧ ***PAV***(x, face, color, red)
3) ∀x:**Child** *fat*(x) → ***PAV***(x, face, shape, round)
4) ∀x:**Child** *win*(x, game) → ***WAV***(x, emotion, joy)

The first rule postulates that for a crying girl, her eyes are red. The second rule also mentions the face color of a crying girl. The third rule states that a fat child has a round face. The fourth rule is about an emotion, which is a w-feature. It means that when a child wins a game, he or she is joyful.

Table 2. Some predicates used in feature rules

Predicate	Argument Specification
Gender(x, y)	x: character; y: female or male
IsaRole(x, y)	x: character; y: name of role, such as police, teacher, and doctor
Nationality(x, y)	x: character; y: name of country
Age(x, y)	x: character; y: a point or interval of positive integer
Temper(x, y)	x: character; y: type of temper, such as hot temper and mild temper, etc
Health(x, y)	x: character; y: status of health, such as healthy and weak, etc
Action(x, y)	x: character; y: action, such as laughing, crying, and running, etc
Emotion(x, y)	x: character; y: one of emotions, such as sad, fear, and happy, etc
Disposition(x, y)	x: character; y: one's usual mood, such as brave and cowardly, etc
Intelligence(x, y)	x: character; y: state of one's intelligence, such as clever, stupid, etc
Visage(x, y)	x: character; y: description of one's face
Social_Status (x, y)	x: character; y: name of social class
Wealth(x, y)	x: character; y: rich or poor
SkinColor(x, y)	x: character, y: color
...	...

5 Meta Rules for Using Features Rules

As we discussed in the introduction, feature rules are heuristics, leading the story generation and animation systems to describe characters in a believable manner. When there are multiple characters in a story or when there are several rules are triggered in a situation, *feature identity and integrity* may be violated, and thus we must follow several strategies or meta rules to attain those properties.

First, for a protagonist *c*, its features should be stated in a relatively detailed manner. This means, when N feature rules are applicable to *c*, their designated features can be potentially used to describe *c*.

Second, for an ordinary character *c*, even when N feature rules are applicable to *c*, the designated features may not actually be used for *c*, unless the features are substantially different from those in describing protagonists. This is important for maintaining identities of protagonists.

Third, we divide feature rules into two groups: *action-dependent rules* and *action-independent rules*. Action-independent rules are only used for once for each character. For example, rule 3 in section 3 is an action-independent feature rule, and we need only to use it once, if triggered, for a character to tell the reader or audience that the character has a round face. Action-dependent rules may be triggered whenever an action is performed by a character.

Forth, when several feature rules are triggered, they should be used in a hierarchical order which is in accordance to the hierarchy of human physical parts. For example, when a feature rule about the arms, a feature rule about the hands, and a feature rule about emotion are triggered at the same time, we should use the first two rules together. The order of using the first, third and then second would reduce the integrity of the story description, because arms and hands are more closely connected.

Fifth, not all of features of appeared characters in stories will trigger the feature rules. Those features, which may not contribute to the story plots in some circumstances, such as one's weight, can be ignored.

Finally, privilege of feature rules can shift dynamically. Those rules with most contributing features to some plots will be assigned higher privilege, and a low-privilege rule can't override high-privilege one.

6 Current State of the Development of the Model

Implementation of the model described in this paper has been under development, and we have implemented an all-purposed engine of reasoning.

As with any knowledge-rich AI system, the collection and using of appropriate character feature rule base is expected to be both difficult and crucial. Our feature rule base is constructed semi automatically from a large amount of corpus from Internet.

Currently, our character feature resource is mainly in form of text, because the immense effort to create and control graphical assets is still not well addressed. Nevertheless, it won't be the obstacle for our method being applied in general systems.

7 Conclusion

In the current research of story generation and animation, feature rules have not been emphasized.

To make story characters believable, we must consider their feature description. We summarized a list of character features, and proposed a rule-based method for representing feature knowledge. We also proposed meta rules for using feature rules in story generation and animation.

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