BEHAVIOURAL INTERACTION OF CHARACTERS FOR VIRTUAL STORYTELLING

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ABSTRACT

In this paper we describe a fully implemented prototype for interactive storytelling using the Unreal™ engine. We describe the important mechanisms involved in the variability of plot instantiations, within a scenario of sitcom genre. We also provide an evaluation of the concepts of how the dynamic interactions between agents and/or the user influence the generation of story, with first results of examples

INTRODUCTION

In this paper, we present results from a first version of a fully-implemented storytelling prototype, which illustrate the generation of variants of a generic storyline. These variants result from the interaction of autonomous characters with one another, with environment resources or from user intervention.
The development of artificial actors and AI-based animation naturally leads to envision future interactive storytelling systems. A typical interactive storytelling system would be based on autonomous virtual actors that generate the plot through their real-time interaction. Besides, the user should be allowed to interfere with the ongoing action, thereby altering the plot as it unfolds.
Many interactive storytelling models have been proposed: user-centred plot resolution (Sgouros et al. 1996), character-based approaches (Young 2000) (Mateas 2000), anytime interaction (Nakatsu and Tosa 1999) and the need for narrative formalisms (Szilas 1999). Previous work has identified relevant dimensions and key problems for the implementation of interactive storytelling, among which: the status of the user, the level of explicit narrative representation and narrative control, the modes of user intervention, the relations between characters and plot, etc.
Some of these problems derive from the inherent tension between interaction and narrative (Young 2000) (Mateas 2000). Interactive systems demand user involvement but often at the expense of a real storyline; on the other hand, a strong narrative dimension is traditionally conceived with a user as spectator rather than being actively involved. Our solution to this problem consists in limiting the user involvement in the story, though interaction should be allowed at anytime. This is achieved by driving the plot with autonomous characters' behaviours, and allowing the user to interfere with the characters' plans. The user can interact either by physical intervention on the set or by passing information to the actors (e.g., through speech input).
In the next sections, we will introduce the important concepts of character-centred storytelling as well as a brief description of our implementation. Results of variants in story generation are illustrated with an example.

CHARACTER-BASED STORYTELLING

The storyline for our prototype is based on a simple sitcom-like scenario, where the main character "Ross" wants to invite the female character "Rachel" out on a date. This scenario tests a narrative element (i.e. "Will he succeed?") as well as situational elements (the actual episodes of this overall plan that can have dramatic significance, e.g., how he will manage to talk to her in private if she is busy, etc.). Our system is driven by characters' behaviours. These actually "compile" narrative content into characters' behaviours, by defining a superset of all

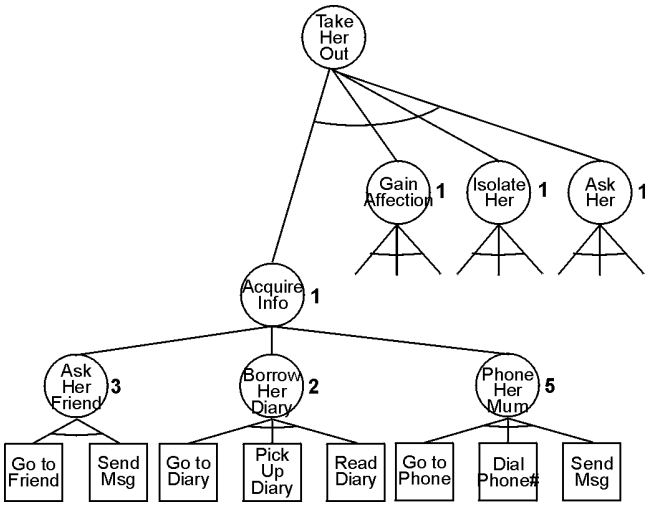

Figure 1: HTN Representation for Character Behaviour

possible behaviours, represented by a plan for each character. Dynamic choice of an actual course of action within this superset is the basis for plot instantiation (Young

2000). In that sense, this addresses the causality/choice duality described by Raskin (Raskin 1998) in storytelling, though this choice takes place within the limits of the formalism used to represent possible behaviours, which is a plan-based formalism (Young 2000). This can be illustrated by considering the overall plan for the character Ross (see Figure 1).

In order to invite Rachel, he must for instance acquire information on her preferences, find a way to talk to her, and finally formulate his request (or having someone acting on his behalf, etc.). These goals can be broken into many different sub-goals, corresponding to various courses of action, each having a specific narrative significance.

The initial storyline should actually determine not only the main character's plan, but those of other characters as well. The problem of dependencies between characters' roles has actually been described within modern narratology, though not to a formal level. Narrative functions can be refined into bipolar relations between a couple of actors, emphasising the asymmetry in their roles (Barthes 1966). We have adopted this framework to define the respective behaviours of our two leading characters. We started with the overall narrative properties imposed by the story genre (sitcoms). In terms of behaviour definition, this amounts to defining an "active" plan for the Ross character (oriented towards inviting Rachel) and a generic pattern of behaviour for Rachel (her day-to-day activities).

AI-BASED CHARACTERS' BEHAVIOUR

Individual agent behaviours are produced by solving the set of sub-plans described in the preceding section, which are represented by Hierarchical Task Networks (HTN), such as the one of Figure 1. Using formal properties of these plans, it is possible to generate solution plans by searching directly the AND/OR graph of the HTN with an algorithm such as AO* (Tsuneto 1997) (Pearl 1984). In our system (Cavazza 2000), this is done with a "real-time" variant of AO*, which interleaves planning and execution and supports re-planning that is required when a character's plan is altered through interaction with another virtual actor or the user. The terminal actions (e.g. reaching a location, using an object, interacting with other actors) forming the plan are actually played in the graphic environment through their corresponding animations. The dramatisation of these actions constitutes the story as seen by the user.

The "virtual sitcom" prototype described in this paper has been developed using the Unreal™ game engine. The Unreal™ environment provides most of the user interaction features required to support user intervention in the plot, such as navigating about and interacting with objects within the virtual set and its use has been previously reported in prototyping interactive storytelling (Young 2000). The system has been fully implemented as a set of template C++ classes, which can be used as native functions from within UnrealScript™, Unreal™'s scripting language.

USER INTERVENTION

The user watches the story as a spectator. At this stage he can follow the story from any character's perspective or navigate on the virtual set while the action is in progress. From his understanding of the current action, he can choose whether to interfere or not with the characters' goals. Characters' actions are dramatised through the timing of appropriate animations. Because the actors are playing a role rather than improvising, their actions are always narratively meaningful. Hence, if a character moves towards a given object, it is likely to bear significance for the story and can be the target for user intervention. For instance, if the user sees Ross moving towards Rachel's diary, he can choose to steal or hide that diary (see Figures 2 and 3).

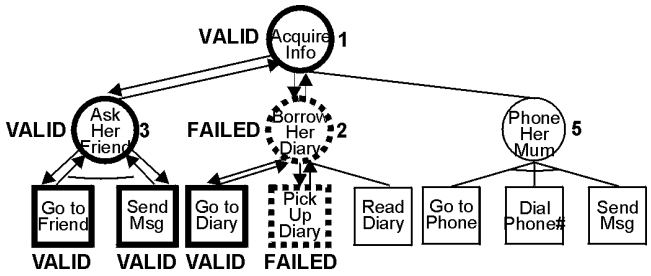

Figure 2: Re-planning on Action Failure

Figure 3: Dramatisation of Action Failure

The user can intervene by either acting on physical objects on-stage that bear narrative relevance (and are often obvious, such as keys, letters, gifts, weapons, etc.). These objects being resources for actions, they will force the character into re-planning or action repair, which, being dramatised as well, will create a new course for the plot. The other mode of interaction consists in influencing actors using speech recognition. This form of influence will become the main one in further developments of the system and will include:

1. providing information needed by the actors to complete their plans (e.g. Rachel's preferred gifts) (see Figure 4)
2. giving doctrine advice that influences the personality of an actor (i.e. recommending a friendly behaviour towards certain characters)
3. trying to alter the mood of a character

4. getting actors to perform certain actions that have narrative consequences, such as moving to a certain location that increases the probability of meeting other characters

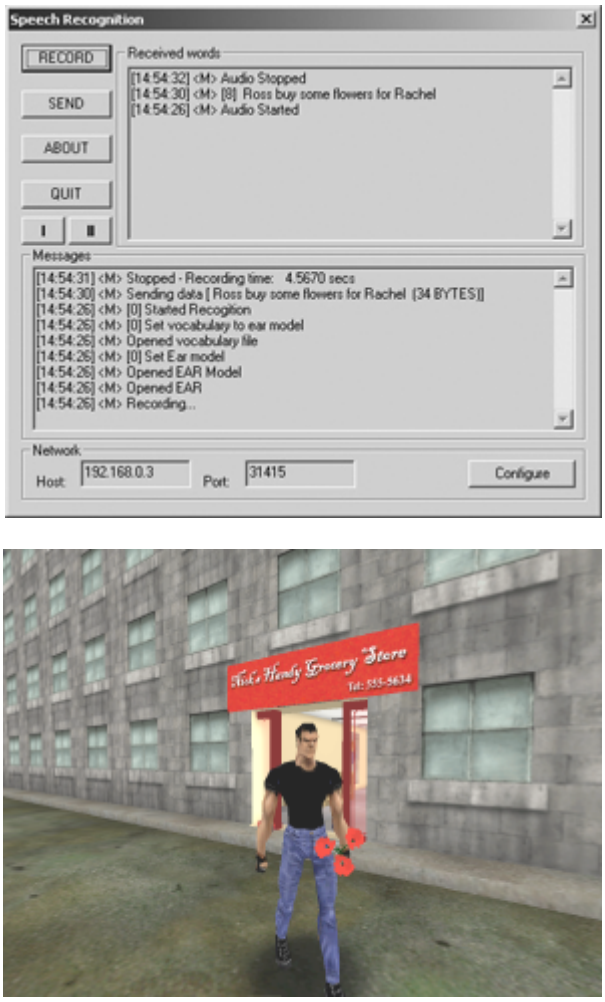

Figure 4: Speech-driven User Intervention: "Ross, buy flowers for Rachel"

RESULTS

While the conditions for character interaction lie in the on-stage spatio-temporal instantiation of the storyline, additional mechanisms are required to recognise these interactions and propagate their consequences.

Figure 6 (see next page) illustrates an entire story instantiation. Ross wants to use Rachel's PDA to retrieve relevant information regarding her preferences. He goes to Rachel's bedroom (a), unseen by Phoebe, who is preparing some coffee (b). As the user discovered Ross' plan, he decides to remove the object from the virtual environment (c) to alter the on-going storyline. Ross reaches the location of the PDA (d), unaware of user intervention (e). Ross makes a new decision to talk to Phoebe (f), as she may provide him with the relevant information. Ross interrupts Phoebe regardless of what she is doing (g). As Ross was rather unkind to Phoebe, she decides to lie to him concerning Rachel's preferences, telling him to offer Rachel a box of chocolates (h). In a different story instantiation, if Ross were more careful when asking Phoebe, she would have responded more positively to his request, by telling him to buy roses instead. After succeeding in gathering important information, Ross goes to purchase his gift for Rachel from the shop (i, j). After buying the box of chocolates (k), he goes back to the flat (l, m) to offer them to Rachel. As she is alone, he goes (n) and asks her out, which she inevitably refuses (o).

This example illustrates the interaction of the two main characters' plans. These plans are designed from narrative principles. It appears that exploring actors' behaviour in storytelling is more feasible within narrative genres that display the simplest storylines, as such developing "virtual sitcoms" seems a relevant first step in the pursuit of interactive storytelling. As its own name suggests, sitcom standing for "situation comedy", a significant fraction of the story interest arises from the situations into which the actors find themselves. For instance, the fact that Rachel could misunderstand the situation where Ross was talking to Phoebe, then triggering the emotional reaction of jealousy (see Figure 5). Her state of mind being modified (i.e., she gets upset), Rachel will then leave the room. The succession of "small" interesting situations is a mechanism for cause-and-effect relationships (Raskin 1998), providing the basis for dramatic story generation.

Figure 5: Situation Comedy (Rachel Is Jealous)

Though plans are designed from global narrative principles, considering the current story genre, they are run independently. The bipolarity between the characters' plans was defined to emphasise the asymmetry in their roles (Barthes 1966). The overall narrative properties imposed by the story genre defined interaction between the main character's "Ross" and its supporting role's "Rachel" behaviours. The generic pattern of Rachel's day-to-day activities may interfere with Ross' "active" plan, as illustrated when Ross want to read Rachel's diary while she is already using it. This interactivity between characters' behaviours must be emphasised visually when it demonstrates narrative relevance.

As part of the story believability, mechanisms in action recognition will help to make the characters' emotional status visible to the user, so he can understand their interactions. The variations in characters' emotions and

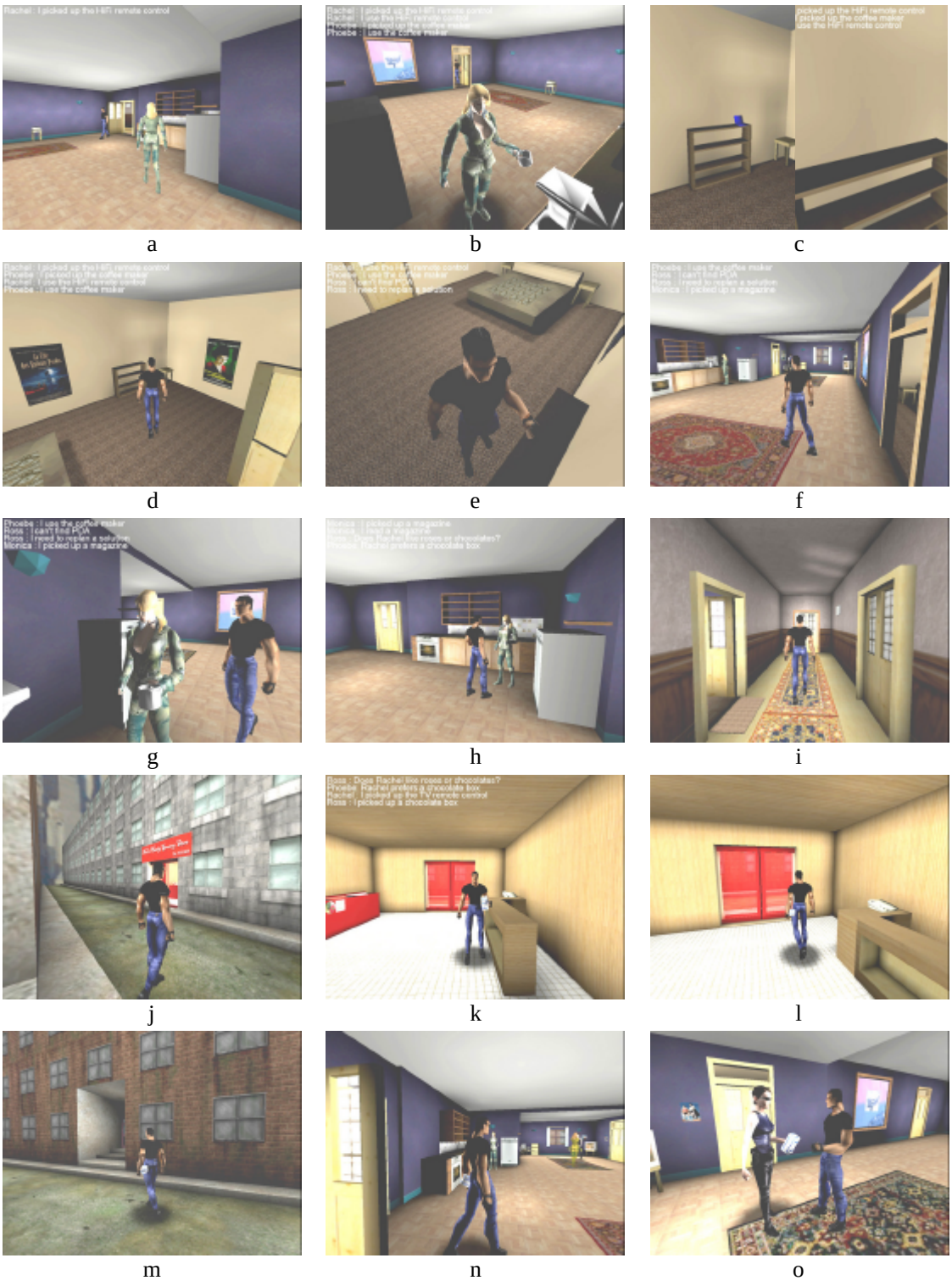

Figure 6: Example of a Story Instantiation

moods must emerge from situations relevant to the story genre without changing their overall personality profile. For instance, Rachel's mood towards other characters can vary according to the meaning of their actions for Rachel (e.g., jealousy). The next generation of real-time animation engine (i.e., Unreal2™) will help representing facial expressions, or detailed non-verbal behaviour (e.g., body postures) to improve the dramatisation of events through physical characterisation.

Above the planning and interleaving of actions, explicit situated mechanisms for reactive behaviours (Geib 1994) are needed in order to deal with specific situations (e.g., Ross suddenly meets Rachel on his way). This implies high-level action recognition of interactions between characters' behaviours. If a narratively meaningful (considering the story genre) situation arises, the mechanism would act on the character's current plan by ordering a re-planning of its action.

CONCLUSION

We have shown that, although actor's behaviours are deterministic, the interaction between actors could considerably contribute towards story variability. This degree of unpredictability conditions the generation of dramatic situations. The character-centred approach has the advantage of being modular and extendable to many actors.
Further work is to be dedicated to developing more complex storylines within differing genres, scaling up using multiple plans for each actor to increase characters' interactions and narrative function recognition.

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