Dynamic Generation of Dilemma-based Interactive Narratives

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Abstract

This paper presents a system which automatically generates interactive stories. These are focused on dilemmas in order to create dramatic tension. The system is provided with knowledge of generic story actions and dilemmas based on those clichés encountered in many of today's soap operas. The story designer is only required to provide genre specific storyworld knowledge, such as information on characters and their relations, locations and actions. These dilemmas and story actions are instantiated for the given storyworld and a story planner creates sequences of actions that each lead to a dilemma for a character (who can be the user). The user interacts with the story by making decisions on relevant dilemmas and by freely choosing their own actions. Using this input the system chooses and adapts future story lines according to the user's past behaviour.

Introduction

In recent years computer games from most genres have included a progressive story line to increase the immersive experience of the user and their enjoyment of the game. However, such stories are often linear (i.e. non-branching), and in almost all cases pre-defined, which reduces the replay value of these games. Research into interactive narrative generation (or interactive drama) tries to overcome these weaknesses. Most interactive drama systems (prominent examples include (Bates 1992; Cavazza & Charles 2002; Crawford 2004; Fairclough 2004; Karlsson *et al.* 2006; Magerko 2005; Mateas & Stern 2003; Rousseau & Hayes-Roth 1998; Sgouros 1997; Szilas 2003; Thomas & Young 2006; Young 2004)) are focused on generating short story lines and do not adapt to the user (see Section "Related Work" for exceptions).

In this paper, we propose a system that generates interactive stories which are long (potentially infinitely so), and that adapt to the user's behaviour. To add dramatic tension, the story incorporates dilemmas as decision points for the user. These dilemmas are based on the clichés found in many contemporary soap operas, such as the trade-off between personal gain and loyalty to a friend. Overarcing stories connect these dilemmas as points of dramatic tension within a coherent plotline which is dynamically created, based on the user's response and action choices.

Our goal is to keep the story designer's input to a minimum and the user involvement as high as possible. In the proposed system, the story designer provides the story background in the form of character information and other knowledge that relates to the world in which the story is to be created (e.g. the east end of London). The system then instantiates all generic knowledge on story actions and dilemmas accordingly and thus creates the narrative in collaboration with the user's actions.

This paper is structured as follows. First a general overview of the system is given, followed by a discussion of the story background representation. We proceed with a description of dilemmas; the story generator; integrating user actions; and the user modelling component. The paper finishes with a brief overview of related work, conclusions and future directions.

System Overview

The interactive drama knowledge base consists of: the storyworld (which contains information regarding the characters); story actions; and dilemmas which can occur in the storyworld. This information is partially genre dependent and provided by the story designer, with the remainder being hard coded. The knowledge base components are drawn upon in the generation of a narrative through planning. The user is able to interact with the narrative generator, and their actions effect the story experienced. A user model is employed to ensure that the user's enjoyment is maximised. The interactions between the system components are shown in fig. 1.

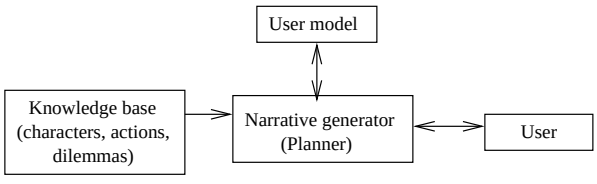

Figure 1: System components and their interactions.

The Storyworld

The storyworld consists of characters and locations at which the characters can be. These characters have various associated traits, as detailed here.

- Each character's associated domain independent attributes can include information such as attractiveness and gender. Their characteristics are more changeable over time, for example: generosity and morality. A range of values is associated with each attribute and characteristic.
- It is possible to specify genre specific character descriptions which are not fully deducible from other character traits but relate to specific storylines within the current domain, such as bad_boy and busybody.
- Characters have storyworld relationships with one another, including friendship and love. Relationships are unidirectional and have an associated strength, although feelings of one character for another affect the reciprocity.
- The characters hold storyworld principles, such as monogamy, which make their behaviour more believable. Under specified pressures and circumstances, principles can be broken (or their associated strength of belief reduced). Characters also have aspirations, for example wanting a baby.

A character's nature, principles and aspirations affect which actions and dilemmas they can participate in and also, ideally, the user's opinion of that character. Each character should act in a manner which is consistent with their traits and how they have acted previously, while at the same time avoiding predictability.

A series of genre-specific locations are required by the storyworld. At any given time in the story, each character is at one of these locations. Direct interactions between characters can only take place if they are at the same location.

Actions

Those actions which can take place within the storyworld must be specified for each domain. Every possible action should be included and although these vary between domains there remains a significant overlap. These can include characters falling in love, becoming pregnant and being involved in crimes – such as drugging or murder.

Each action has associated conditions which must be satisfied before execution (preconditions) and effects representing changes to the storyworld following execution. For example, the action of a character moving between locations l and k has preconditions of the character being at location l and the existence of a path between locations l and k. The effects of this action are that the character is at location k and is not at location l. This follows the STRIPS representation.

Before an action is made available to the system for use within a storyline an applicability check is carried out. An action can only be utilised if its applicability is high enough. This ensures that the action is of the type that the acting character is likely to make. For example, a more attractive character starting to fancy a very generous character. This check is supplementary to the preconditions of an action.

Every act that other characters within the system can make is available to the user who is able to freely specify their own actions within the scope of the current genre. The user inputs their action choices as two or three typed words which summarise the action they have chosen, for example 'move club' to move from their current location to the club. The system recognises a range of possibilities for each action. Additional options available to the user include being able to see the current state of the storyworld.

The system is able to provide direct responses to user actions through a system based on tit for tat reactions and utility scores. This involves a numerical utility value being assigned to each character in all story states. Actions change this value due to an author-defined (and potentially character dependent) corresponding change to the affected character's score. When the user acts in a way which affects the score of another character, that character responds by acting to change the user's score by the same amount. An example would occur when a character is fancied by the user, and thus has an associated positive score in that state. If the user stops fancying this character then the character's score is resultantly decreased. In response the character will act in a way which reduces the user's score by the same amount. For example, they could cease fancying of the user, or perhaps, feeling rejected, encourage (or bully) the user to betray a principle.

The use of utility values means that extension to additional actions requires only the association of a value with each. This method also makes system responses less predictable and more versatile. The responses update the state and thus effect the future path of the story - both immediately and in the longer term. These are an immediate effect of the user's actions and result in a story more specific to the particular user. This method is likely to encourage the user to act more, as they see an immediate effect of their actions, and to increase the believability of the characters.

Dilemmas

Field (Field 1984) states that "drama is conflict", that the dramatic interest in a story centralises on its conflicts. In genres which make use of clichéd storylines these are usually found to be essentially conflicts (or dilemmas). Writers utilise these dilemmas in the creation of stories. A general form of each such clichéd dilemma can be determined, and a computerised storywriter can create an interactive drama around these. Dilemmas require characters to make fundamentally difficult decisions within the course of the story.

Our experience showed that when more than two characters were involved in a dilemma it was either expandable to multiple two character dilemmas, or the characters receiving payoffs naturally divided into two groups with the same resultant utility. Therefore a decision on a dilemma involves only two recipients of utility payoffs. Five such dilemma categories were identified. These consist of all situations with two payoff recipients where there is a dilemma involved. This may require characters to be friends or enemies. The relevant categories are: Betrayal, Sacrifice, Greater Good, Take Down and Favour. Further details are given on each dilemma type in the following subsections.

Betrayal

When presented with a Betrayal dilemma a character must decide whether or not to take an action which would result in their best possible utility but simultaneously the worst possible outcome for their friend (or someone close to them). The decision would not involve a dilemma were the two characters not friends. A character having the option to be unfaithful to their partner is an example of the Betrayal dilemma.

Sacrifice

A character facing the Sacrifice dilemma is able to choose an action which will result in their worst possible utility but also the best outcome for their friend. These characters must be friends for this to be a dilemma. An example of the Sacrifice dilemma occurs when a character has committed a crime which their friend has been accused of and has the opportunity to admit to their crime and thus accept the punishment rather than allowing their friend to take the blame.

Greater Good

Involvement in a Greater Good dilemma means that a character is able to take an action which will result in their best possible utility but also the best outcome for their enemy. This would not be a dilemma if the characters were not enemies. An instance of the Greater Good dilemma involves a character deciding whether to give something (such as information or a friend) to their enemy in order to save themself.

Take Down

In the Take Down dilemma a character has the option of an action which will result in their worst possible utility but also the worst outcome for their enemy. The characters must be enemies for the dilemma to exist. A character deciding whether to harm their enemy in full awareness that they will be punished for this is involved in the Take Down dilemma.

Favour

The favour dilemma sees a character X able to choose between two actions where there will not be any immediate discernible benefit to X as a result of their decision. The utilites of characters Y and Z will change as a result of this action choice. If X chooses to take the action the outcome will be the best possible for Y and Z will receive their lowest utility – and vice versa if X chooses not to take this action. An instance of this dilemma occurs when a character must choose between potential partners.

As can be seen, the Betrayal and Sacrifice dilemmas are the inverse of one another, as are the Greater Good and Take Down dilemmas. This means that any dilemma which falls into one of these categories can be inverted to become a dilemma of the other category. All five categories are kept to increase ease of dilemma identification within specific genres. From these categories dilemma instances can be found and generalised for each domain. From the generalised form of the dilemma the system will be able to create new dilemmas. In the presentation of these wholly original stories are created.

It will not be possible to create great literature in this way – the use of clichéd storylines prevents this. However, such stories are enjoyed by many people and this method is common in such genres as James Bond films, soap operas (soaps) and "chick flicks". The story is built around the cliché, and it is the cliché as well as the story which the audience appreciate, the very repetitiveness and familiarity of the dilemmas adding to the dramatic interest.

The Narrative Generator

Prior to a dilemma being presented certain conditions must be met within the storyworld. These are the preconditions of the dilemma. It is the task of the storywriting system to achieve these preconditions. Given actions (including those for the user) within the storyworld the system can plan to satisfy a dilemma's preconditions. A plan to achieve a dilemma thus becomes a storyline. The interactive drama is made up of a series of such substories, dynamically selected according to appropriateness.

On being passed a dilemma the planner finds all plans to achieve this dilemma given the current storyworld state and background knowledge. In larger domains is may become necessary to impose a search depth limit, the effect of which will be that only shorter action sequences will be considered in plans for dilemmas. From these plans, the next most appropriate can be selected and execution attempted. If the execution is successful (this may depend on the user's action choices) the corresponding dilemma is presented. Once a decision has been made the system updates the storyworld state accordingly. The system can then plan from the new state for another dilemma – thus continuing the interactive drama. This sequence of events is demonstrated in fig. 2.

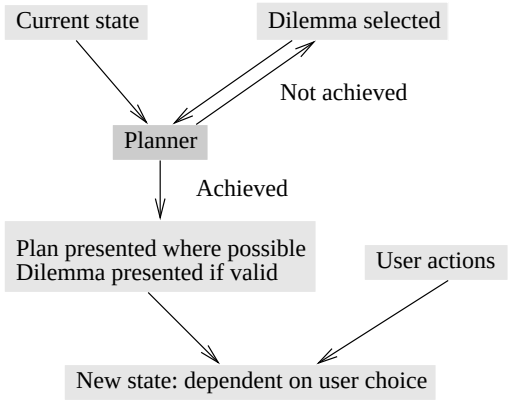

Figure 2: This figure gives an overview of the system moving between states dependent on plans, dilemmas and user decisions.

The sequence in which the dilemmas are selected for planning must depend on what has happened previously to become part of a consistent story. The frequency of dilemma use will need to be determined for each dilemma in all domains and considered when selecting a dilemma. It must be ensured that the user experiences a reasonable proportion and balance of dilemmas while the overall frequency is as

would be expected for the genre. Dilemmas with greater dramatic interest are preferred.

User dilemmas

The planner assumes that the user will act in a manner consistent with the way characters with similar traits act in soaps. Once a plan has been chosen its actions are presented until the preconditions of an action or the dilemma cannot be satisfied without the user's participation. If the user acts in a manner which satisfies the necessary preconditions at this stage then the presentation of the plan continues until a user action is required again. As soon as it becomes possible to present the dilemma this is done.

It must be ensured that the user is as free as possible while still experiencing dilemmas. In its current version the system is control-based. This means that the user selects actions until they choose to pass control back to the system, which then acts until a user action is required. When the user has control they can take any number of actions. The user can spend as long as they want considering their options.

The user will not always act in a manner which satisfies the preconditions of the next stage of the plan. Various methods are used to overcome this:

1. Multiple valid plans are maintained. The system only acts in accordance with those which the user is following and which are still valid.
2. Shorter plans are favoured, resulting in less opportunity for the user to violate the plan, while ensuring their actions still have an effect. Stories of the same length will involve more drama if plotlines are shorter.
3. The user is coerced into acting as required. For example, if it is necessary that the user be at location k a friend can move to ask the user to go with them to location k.

When presented with a dilemma the potential consequences of each decision must be clear to the user before they make their choice. Once they have chosen, these repercussions on the storyworld are implemented. The resultant state is thus entirely dependent on the user's decision.

As the user may require time to consider their actions, planning can take place while the user thinks. A thread adds potential plans to a list, and the system attempts to integrate the user's actions with the most appropriate valid plan.

Character dilemmas

Characters other than the user will experience dilemmas throughout the story. This increases the user's belief in the characters as they exist in the story in a manner not always directly related to the user. Their decision making will mean they seem more realistic, as their character traits will become clear through this. Planning for character dilemmas takes place in another thread which continuously updates a list of possible character dilemmas and corresponding plans.

All dilemmas are possible for any characters within the storyworld (given applicability and satisfaction of preconditions). If the user is not involved in the plan it is presented as a sequence of actions prior to a dilemma – of which the decision and outcome are shown to the user.

When the plan for a dilemma requires user action the methods discussed in the previous section can be utilised. The user is able to act in a way which could lead another character to a dilemma, thus increasing their involvement.

The proportion of non-user dilemmas can be adjusted – by the story designer dependent on the genre or dynamically according to the frequency of user actions. The system is able to create a non-interactive story, meaning that there is always a story whether or not the user chooses to act. This adds to the illusion that these characters exist outside the user's scope. It also gives the user the option of not acting in the storyworld, whether for a long or brief period of time.

The User Model

The user of an interactive drama system should be modelled rather than controlled. The story should adapt to the user's interactions rather than forcing the user to follow a particular storyline. A brief overview of the user model is given here and more details can be found in (Barber & Kudenko 2007).

The user model is used to identify which choices the user is likely to make. This, combined with a fixed author-defined 'interestingness' value for each dilemma outcome, is used to select the next dilemma to be presented to the user. Each dilemma has associated assumptions as to how the modelled values change dependent on the user decision. Once they have made their choice the user model is updated accordingly. The credibility given to the user model depends on how many times it has been updated and how recently the criterion being utilised was updated – since the user and their opinions are likely to change through the course of the interactive narrative. The probability of the user making a particular dilemma decision can be approximated by the user model. The system selects that dilemma which has the highest chance of leading to the most dramatically interesting dilemma outcome.

For example, there may be two dilemmas possible at a given stage. In one the user might have to decide whether or not to cheat on their partner - with an interestingness of 7 if they choose to do so, and of 4 if they choose not to. The other dilemma may require the user to choose between potential partners and have an interestingness value of 6 irrespective of the user choice. The user model then estimates the likely user choice and accordingly selects the next dilemma. So, for instance, if the user is expected (dependent on their previous choices) to cheat on their partner then this dilemma will be the next to be presented to the user.

This model can also be used to look ahead in planning. Rather than continually searching from the current stage, it can be determined which choices the user is likely to make and thus to plan from later stages. As a result responses to user actions will be more prompt. As the search becomes deeper this becomes less accurate.

Example Domain

The techniques discussed here are applicable in any genre which places a particular emphasis on stereotypes and clichés. It was decided to intially focus on the creation of

an interactive soap. This domain does not require an overall story arc but rather involves an infinite series of 'mini-stories'.

The domain of soap operas is commonly understood to revolve around stereotypical storylines which in many cases involve conflicting decisions. A range of such dilemmas which characters have faced in recent years from *Neighbours*, *Home and Away*, *Coronation Street*, *Eastenders* and *Hollyoaks* have been identified and generalised. These soaps were selected for their accessibility, familiarity and popularity with the general public.

All background knowledge specific to the considered soaps was added to the system, including STRIPS-style actions (such as characters falling in love) and locations (for example club and house). An action from the system is shown here with its pre- and postconditions.

```
Action:  X starts to fancy Y
Preconds:  fancies(Y,X) ∧ attractive X < 1
           ∧ attractive Y = 3
Effects:  fancies(X,Y)
```

Any characters can participate in this STRIPS representation action. Here an attractive person fancies someone less attractive. In a soap world (where looks are very important) the less attractive character will begin to reciprocally fancy the more attractive.

The plotline of a character being presented with a dilemma involving cheating on their partner has been used in all of the examined soaps. This demonstrates the frequent use of clichéd storylines in soaps. More specific examples of this include:
Eastenders: Jane has to decide whether or not to cheat on her husband Ian with the local bad boy Grant.
Coronation Street: Danny has the opportunity to cheat on his wife with Leanne, his son's girlfriend.
Home and Away: Kim has to decide whether or not to cheat on his girlfriend with his best friend Hayley.
Neighbours: Stu has the opportunity to cheat on his institutionalised wife Cindy with a local pretty girl – who previously went out with his brother.

In fig. 3 a dilemma is presented to a character other than the user. The interaction of the user with a plan for the same dilemma is shown in fig. 4.

```
Action is adam moves between park and club
Action is jill and adam get drunk
Action is adam starts to mutually fancy jill

adam has to choose whether to partner joe
or jill, where adam fancies both and the
feeling is mutual.
adam decides to go out with jill, they are
now partners, and joe no longer fancies
adam
```

Figure 3: This figure shows the build-up to and presentation of a dilemma in which the user does not participate.

```
Action is john moves between shed and house
Your friend john has come to the house to
ask you to go to the club with them, would
you like to go?
y
Action is you and john move to the club
Action is joe gets drunk
n
joe offers to buy you a drink.  Do you
accept?
y
You accept the drink from joe and get drunk
Action is joe starts to fancy you
fancy joe
You start to fancy joe
Who would you like to partner:  adam or joe?
Given that you mutually fancy both.
adam
You have chosen adam, you and adam are now
partners.  As a result of your choice, joe
fancies you less.
```

Figure 4: This example shows the user (their input is in italics) participating in a plan and then being presented with the corresponding dilemma. Where necessary they are encouraged by other characters to participate in the current substory. In the preceeding state the user already mutually fancies Adam.

Related Work

Other interactive drama systems use planning techniques. Mimesis (Young 2004) uses planning to achieve the story goals. This is much longer-term planning and is less flexible around the user's interactions - which are either accommodated in re-planning or intervened with. In the I-Storytelling (Cavazza & Charles 2002) system, hierarchal task network (HTN) planning is used. Each character is equipped with an HTN to follow in the story, which is defined before the story begins. There is very little allowance for user interactions in this system. In neither system is there any capability for the overall story to be dynamically created, but only for it to be dynamically adjusted.

More recent systems use planning techniques to create stories in collaboration with a user. In (Thomas & Young 2006) the planner is used to create each stage of a planning graph. The user is then able to choose from the subsequent options to decide which will appear in the final version of the story. The story presentation will be a mimesis-style experience. The system described in (Karlsson *et al.* 2006) involves planning for goal events. The user is able to specify some of these events and to prompt replanning for any. They may be ignored. The user then selects the final ordering of events, given any constraints. The resulting story is graphically presented at a lower level, without interaction.

Fairclough's system (Fairclough 2004) utilises planning techniques to dynamically create an interactive story in the fairy tale genre. There are a finite number of subplots and the user's actions determine which is experienced. A plan is then created for the subplot, which consists of a "sequence

of character actions" given to the NPCs as goals. The user has a reasonably high level of freedom but must adhere to a limited number of subplots. In contrast, our system will allow the user complete freedom and the dilemmas posed to the user will increase the dramatic interest of the stories.

Planning was used to create soap opera style stories in Lebowitz's UNIVERSE (Lebowitz 1987). In this it was necessary for the author to provide goals to the story-telling system. There was no interaction, and the stories produced were short.

Other systems utilise a user model. The IDA (Magerko 2005) user model is used only to direct the user within the story's pre-defined overall plot structure. In IDtension (Szilas 2003) the user takes turns with the system to choose actions for the story as a whole. If they are modelled to consistently choose actions which avoid violence, the system can present them with a dilemma in which they must choose a violent action in order to achieve the pre-defined goals of the story. The dilemmas here are for the user as an external observer of the system, rather than as a character.

Conclusions and Future Work

In this paper we presented an interactive narrative generator that is able to create long, and potentially infinite, story lines that incorporate dilemmas to add dramatic tension. The stories are dynamically created based on user decisions and actions as well as adating to the user's tendencies.

In future work the applicability check will be combined with an assumption model (based on previous user actions) when selecting user actions to be made available to the planner. This should mean that there is less need for other methods – such as coersion and maintainance of multiple plans – to ensure that the user is presented with dilemmas.

The extension of utility-based responses to use as dilemma implications will be investigated. This would cause actions rather than just relationship and emotion changes as a result of dilemma decisions. The stories could thus become more interesting but determining the exact score changes and maintaining relevance becomes more difficult.

In the current system all actions and dilemmas are shown to the user. This has the potential to adversely affect the story interest and change the manner in which the user acts. For example, if a murder is committed the user will know who the murderer was and the mystery will be destroyed. It would thus be an improvement to decide when information will be presented to the user, eventually revealing everything which is relevant to explain later actions and dilemmas. This adds to the realism as the characters in a story do not always see what happens to other characters, but as viewers usually will it is important to maintain a balance in this.

It may be advantageous to have a less turn-based interface, where the system and user can interrupt one another. It is ultimately intended to have a graphical simulation in which the user will see the storyworld as in conventional media but will be a character and able to act as such. In the short term pictoral representations may be possible.

An initial evaluation was carried out on 8 people with a limited gameworld. The users played for an average of 7 minutes and all but one stated that they would like to play the game again in the future. They rated the story interest with an average score of 3/5 and all felt that their actions were having an effect. We intend to perform a more thorough evaluation in future work.

There is potential for the creation of soap-specific dramas, with related characters, for example interactive *Eastenders*.

Although we chose soap narratives as the application domain the system is applicable to any story world. For this adaptation the story designer will only need to change the knowledge base accordingly.

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