Story Visualization Techniques for Interactive Drama

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Abstract

Research on interactive drama, or interactive fiction in general, mostly focuses on character and plot development. It is important to investigate the change of plot and character responses due to interaction in interactive stories. However, it is also important to investigate the change of visual designs and setups, including lighting color, position and angle, camera angle, position, and movement, and characters' movements and gestures, and their functions in interactive stories. While the importance of visual design is unquestionable in film and theatre, only a few research attempts have been made to devise a system that changes visual designs and setups depending on story interaction. The paper describes an approach to build story visualization systems that dynamically change visual designs/setups to suit plot and authorial intention, and to emotionally engage the participant in a dramatic experience.

1. Introduction

Story visualization is a term used to describe techniques by which directors and filmmakers compose visual pictures to tell a story, evoke emotions from the audience, and shape the entire experience (Block 2001, Seger 94). A visualization of a story normally involves decisions of (1) camera position, angle, and movement, (2) lighting angle, position, intensity, and color, and (3) blocking setups in terms of characters' positions, postures, and movements (Arijon 76, Seger 94, Cheshire and Knopf 79).

Story visualization techniques play an important role in creating and portraying a story. Adopting a particular visualization technique can turn a story from a drama to a comedy or from a comedy to a drama. Directors use such techniques to create mood, set pace, evoke emotions from the audience, and shape the entire experience. Visualization techniques are also used to give the audience information about the story; for example character positioning relative to light sources can be used to show particular characteristics of a character; positions of characters relative to the camera and to each other can give the audience particular information about their relationships (an example of such techniques can be seen in Citizen Kane).

I argue that story visualization is as important for interactive visual experiences, especially interactive drama and interactive stories, as it is for film. In addition to the many functions that visuals play in film and theatre, including arousing different emotions and intensifying the dramatic impact of situations, visualization materials (such as camera shots, lighting, and blocking) can provide additional information to guide a participant through an interactive experience by seducing him/her to take certain actions. For example, varying light intensity and the grouping of characters in a certain shot may encourage or discourage the participant from talking to a certain character or group of characters. Also, varying light intensity in a scene may lead the participant to focus his/her attention on more relevant artifacts (a technique used in Myst).

Visualization techniques used in film rely on character relationships, actions, author's intentions, and the dramatic shape of the story. Since interactive drama revolves the interaction around social relationships and story actions, it is inevitable that the plot, character relationships, actions, and character attributes will change due to the interaction. Therefore, there is a need for a system that changes visual designs depending on the change in the plot, character relationships, character attributes, and actions.

This paper introduces a proposal for a visualization architecture that is well suited for interactive drama. It focuses on using film and theatre visualization theories to create a language whereby artists can build expressive interactive stories that engage the participants emotionally and dramatically. Furthermore, the language allows the artists to tag visual designs to a condition that describes story situations where the visual design is applicable. Moreover, the system presented here will automatically adopt a default light design when none is authored by the artist.

It should be noted that some games could benefit from the system described here. Although interaction in most games revolves around space and puzzle solving, there are parts in a game that can utilize a film strategy for visual presentation. In fact games already use such techniques in cut-scenes, but in such scenes the plot and visual presentations are linear, i.e. they don't dynamically change to suit the interaction. In some cases, this might be a problem. For example, the game 'Summoner' had a cut scene showing the fall of a pirate after the player kills him. This scene is shown on the beach where the fight begins. I found out that it was easier to kill the pirate in another area where my allies reside. So I ran and dragged the pirate behind me and went all the way to the other area where my allies were stationed. The cut-scene of the pirate falling on the beach seemed artificial in this case, because the scene depicted was not where the pirate was killed. In cases like these games can benefit from a dynamic system that adapts

the visual design at run-time to characters' positions (among other variables).

In this paper, I will begin by discussing research efforts in the field of interactive narrative. I will then discuss the approach taken by this paper. It should be noted at this point that the paper presents work in progress.

2. Research Efforts in Interactive Narrative

2.1 Interactive Narrative

There are two types of interactive narratives developed by the industry and the research community: emergent and authored. In the next paragraphs I will define both types; for each type I will then review the different research attempts targeting the change of visual design to suit the narrative.

Emergent interactive narrative is a narrative that emerges due to the interaction between the participant and some animated believable characters. No narrative or story is scripted within the system, but a story emerges from the interaction. Examples of emergent interactive narratives can be seen in The Sims, Creatures, Cats, Dogs, and The Living Letters. Researchers working on that type of narrative tend to focus on character development. For example, the OZ project at CMU published a number of papers targeting the development of believable characters. The believable characters developed by the group use internal states, such as emotions, personalities, and attitudes, to build social relationships with each other and with the participants. They use dialogue and body motion to express their emotions (Bates et al. 92, Loyall 97). The type of stories that can emerge from such a technique is limited by the design of the characters.

An authored interactive narrative is an interactive narrative guided by an authorial objective, i.e. the author has a major premise that he/she wants to explore through the interaction and story.

There are few types of authored interactive narrative structures that have emerged in both research and industry. A non-linear authored narrative was developed where the participant can alter the narrative presented by choosing to explore a specific path in the narrative space. In such work, the narrative is fully scripted. The author carefully scripts the narrative with all its different branches. Examples of that type of interactive narrative can be seen in many hypertext interactive stories (Murray 98).

An attempt was made to produce a different type of authored interactive narrative. Mateas and Stern proposed the use of planning techniques to develop a plot dynamically where the choice of the next story action to execute depends on the history of actions and relationships that the participant takes and develops (Mateas and Stern 00). Additionally, there are a number of efforts being made in University of North Carolina headed by Michael Young to use planning techniques to revise the plot dynamically due to the change in the story situation influenced by the participant's interaction (Young 01).

This paper follows the type of interactive narrative described in (Mateas and Stern 00). However, it argues that in addition to changing the plot, a system should be built to select a particular presentation (visual setup) for the story unit depending on the story action, past events, authorial objective, character attributes, relationship values, and the dramatic intensity of the story unit.

2.2 Interactive Narrative Cinematography Techniques

Research attempts have been made in both emergent and authored interactive narrative areas to develop systems that change the visual structure based on interaction.

Tomlinson developed a system that changes lights and camera movements to present the user with an interpretation of the world based on the characters' emotions within the scene (Tomlinson 99). He used film grammar to select camera movements and induce a change in lighting color to show characters' emotions. Tomlinson's work represents one of very few attempts to change visual design/setup based on interaction. However, it focuses only on showing character emotions with no real goal behind such presentations. Alternatively, this paper focuses on authored interactive narratives and the implication of using visual techniques to show authorial objectives and engage the participant emotionally and dramatically.

Christianson et al. and He et al. used film-based cinematography techniques to guide an authored interactive narrative (He et al. 96, Christianson et al. 96). They used film idioms including shot types (long shot, medium shot, close-up) and conversation patterns (e.g. master shot of the scene followed by a medium shot of the characters followed by an over-the-shoulder shot of a character talking, then an over-the-shoulder shot of the other character taking, and so on…). The system would select an idiom depending on the story unit's action. For example, if the story unit is a conversation between two people standing in a hall, the applicable conversation shot from a list of film patterns will be selected and executed. The system only focused on camera shots. Lighting setups, character movement, and blocking were not addressed. Additionally, there was no connection between the plot structure, its dramatic intensity, and the visual setups chosen. This paper argues for the use of lights, camera, and characters' movements and gestures to show an authorial objective, evoke emotions from the participant, and show the rise of tension in the plot, in addition to showing the story unit's action.

It should be noted that film idioms may in some situations be inappropriate for interactive fiction. It is unclear that film patterns are the answer to the visual problem described here. I think that interactive fiction should come up with its own idioms and patterns.

However, this paper argues that film ontology may provide a useful starting point. Artists may build their own patterns using film ontology and link them to the interactive story.

3. Ontology

(API of primitive camera, character, and light actions)

There are a number of camera shots, character actions, and lighting primitives that are studied in film. As discussed above, this paper argues for using film ontology to build an authoring system that artists can use to build expressive interactive stories. This section details an API that is being developed using film ontology of camera shots, character actions, and lighting effects. Section 4 and to some extend this section describe how the API is used and linked to the story.

Considering the limit on the number of pages allowed, I would not discuss all camera, character, and lighting actions in detail nor enumerate them all here. I will only give some examples. For more information readers are referred to Cheshire and Knoph 79, Mascelli 65, and Vierra 93.

Before describing the API, however, the importance of such API should be reviewed. The API discussed here will help artists in a number of ways. (1) Artists can create film effects using familiar film terms. (2) Since film studied a number of camera setups, lighting setups, and character movements and their functions in creating expressive and engaging images, it is possible for an API created from such a study to help create engaging images for the interactive media. (3) The API provides artists with a technique and a representation for expressing a visual image to be portrayed in a way that is abstracted from the story itself.

3.1 Camera Shots

Camera setups vary in (1) position relative to the set and the characters in the scene, (2) angle with respect of the characters and the set, and (3) movement with respect to the characters and the set. The following describes the different setups. Camera-to-subject distance: long shot, medium shot, full shot, close-up, and two shot. Camera-to-subject angle: bird's-eye view, off-angle shot, high-angle shot, low-angle shot, and worm's-eye view. Moving the camera: panoramic shot, tilting shot, tracking or trucking shot, dolly shot, and crane shot. Other shots: matte shot and over-the-shoulder shot.

Artists can use functions such as **`(full-shot ?character)`** to get a full-shot of a particular character. These functions can be inserted at different times within the story depending on the interaction and the authorial intention (discussed later).

3.2 Lighting Effects

Lighting varies in terms of the effect it creates. The following categorizes different lighting effects. Character attitude or personality: for example silhouette effect on a character or under lighting of a character. Selective focus: for example, bringing out a character by lighting him/her brighter than the rest of the scene against a dim background. Modeling: using back lighting on a character and background lighting on the wall/set behind the character to bring the 3 dimensional nature of the character.

An artist can then use functions such as **`(silhouette-effect-on ?character)`** to get a silhouette lighting effect on a particular character. Like camera shots, lighting effects can be inserted at different times within the story depending on the interaction and the authorial intention. Linking lighting effects to the story will be discussed later.

3.3 Character movements

Character movements in drama are very significant. I am restricting the movement to only twenty physical actions that are expressive and essential to drama. For example, reaching out to another character, blinking, shivering, trembling, and kneeling. Artists can then compose high-level behaviors from such actions. For example, pray can be constructed as kneel with hands in a praying position.

Artists can use functions such as **`(kneel ?character)`** to get a character to kneel or can use a high-level behavior such as **`(pray ?character)`** to get a character to pray. Like camera shots and lighting effects, character action/behaviors can be inserted at different times within the story depending on the interaction and the authorial intention (discussed later).

4. Story Visualization System

While the system discussed here will implement a number of camera and character actions and link them to the story, the system focuses primarily on lighting. The author will act as a director telling the system what camera shots and character behaviors to execute and when to fire them given a story situation. Thus, the system will not reason about the camera or character actions. Alternatively, the system will use a reasoning system based on film rules to adopt the best lighting setup given the story situation and the authorial intentions.

Interactive Drama Architecture

I will first describe very briefly the overall process as illustrated in figure 1. Then I will discuss the subsystems presented in the figure in detail. Similar to Mateas and Stern's system, the system presented here basically adopts a reactive planning system that dynamically builds a plot and its visual presentation. As the architecture in figure 1 shows, a beat[1] will be selected given some story elements

[1] A beat is defined to be the smallest unit of action that has its own complete shape, with a central conflict and a mini-crisis (Benedetti 94). Used here to describe a distinct action in the story.

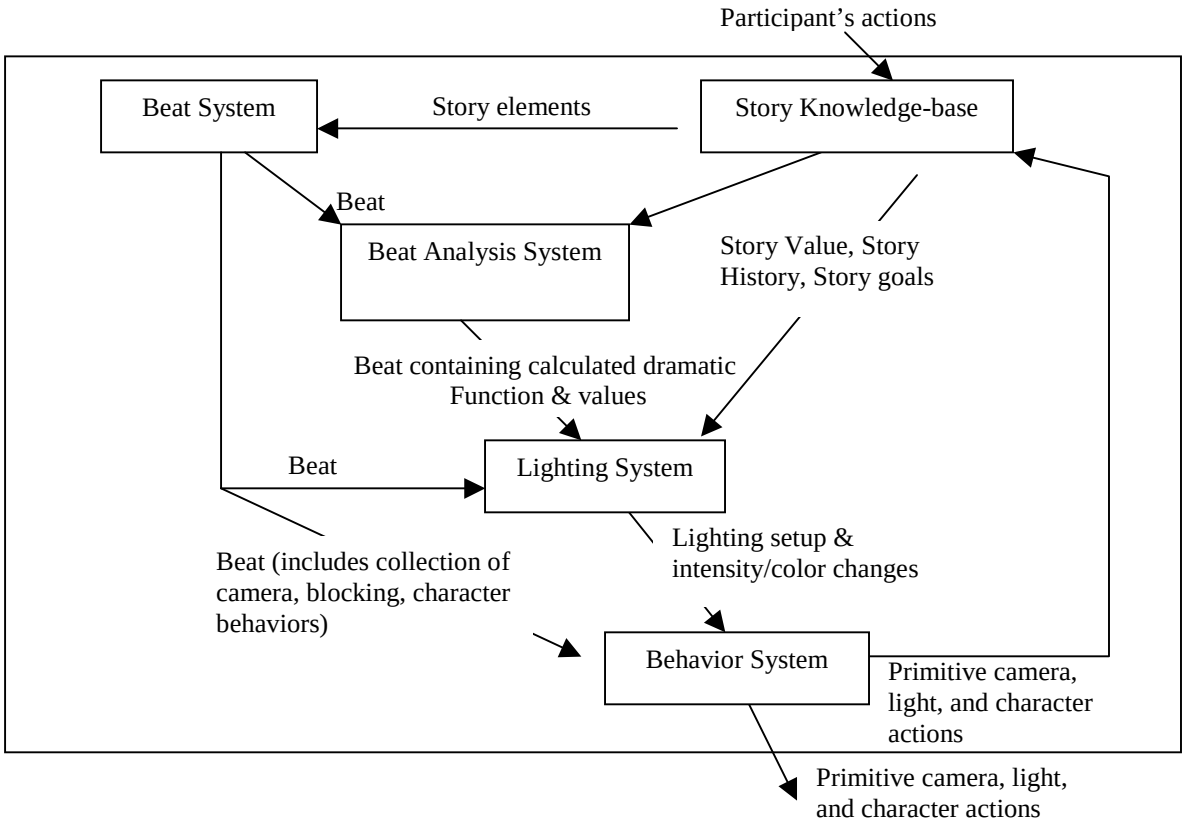

Figure 1. An Interactive Drama Architecture

(discussed below). Once a beat is selected a beat analysis system calculates the dramatic function and intensity of the beat. Dramatic function and Intensity of the beat are important to construct a lighting setup (angles, positions, color, and intensity) that parallels the story structure. Once the dramatic function and intensity of the beat are calculated, the lighting system determines the lighting setup. The behavior system will then break down the lighting effects given by the lighting system, camera shots and characters' movements scripted by the author within the beat into simple primitive actions. These actions are then sent to the graphics system.

4.1 Beat and Beat Analysis System

A beat system selects a beat to fire given the story elements, which include story history, the story values (e.g. relationship values between different characters in the scene), story goals, and participant's actions. This subsystem is very similar to Mateas and Stern's proposed beat system (Mateas and Stern 00).

The beat will consist of a number of fields:

- ***Beat objective (termination condition of the beat):*** when accomplished advances the system towards accomplishing story goals. Beat objective is used to select a beat given the story goals. A beat objective is represented as a state. For example, a beat objective can be 'to nudge the participant (named Archemedis) to make a decision to kill Clytaemestra', which is represented as follows:

```
(Decide     Archemedis
            (kill Clytaemestra)
            ?decision-result))
```

- ***Participant-based-Preconditions***. Describes when a beat is applicable in terms of participant's actions and goals. Beats can be applicable only if the participant did certain actions or is in a certain state. For example, we may have a beat that is only applicable if the participant didn't decide yet what to do in terms of the killing issue and another beat that is only applicable if the participant decided not to kill Clytaemestra. Both of these beats can be invoked to satisfy the objective above, however, each will include different actions, tactics, and visual images that will have different dramatic values, and thus engage the participant differently.
- ***Preconditions*** Describes the context within which the beat can be executed. These preconditions are mainly story states rather than participant's goals/actions.

- ***Beat action category***. This field categorizes the beat into an action category, such as dance, conversation, sword fight, etc. This is important, because different action categories will require different lighting setups.
- ***Plan*** Includes a collection of sequential/concurrent behaviors for the camera and characters. For example, some beat within the story may have the entrance of a character named Clytaemestra followed by the entrance of a character named Aegisthus as its plan. Such plan is represented as follows:

```
(Plan
    (Sequence
            (full-shot (entrance Palace-Hall))
            (Enter Clytaemestra Palace-Hall)
            (Enter Aegisthus Palace-Hall)))
```

  The behaviors represented in the plan such as 'full-shot', and 'enter' are all behaviors that are either high-level behaviors authored by the author and will be broken down into primitive actions by the behavior system, or they are primitive actions defined by the API developed by the system based on film theory describing camera and character actions (see ontology section above). For example, full-shot is a function that is defined by the system to trigger a cut to a full-shot of an object, a character, or a group of characters.
- ***Priority*** Denotes the priority of the beat. This is essential for conflict resolution.
- ***Dramatic function*** Describes the dramatic function of the beat as: a turning point, an exposition, or a conflict beat. The beat analysis system, as illustrated in figure 1, will use authored rules to determine the dramatic function of the beat given the history of the beats executed, the beat and its action, and the participant's actions.
- ***Dramatic value*** Describes the beat value in terms of its intensity. Like the dramatic function field, this field is calculated automatically by the beat analysis system depending on the history of beats executed and their dramatic values, the beat and its action, and the participant's actions.

To recapitulate, given story goals (or scene goals) represented in the story elements, the beat system will select an applicable beat, given the beats' participant-based-preconditions and preconditions, whose objective field matches a story goal. Once a beat is selected, the beat analysis system will determine the dramatic function and value of the beat as stated above.

Once the beat analysis system determines the dramatic function and value of the beat, the lighting system will determine the lighting setup. Then the behavior system will break down the behaviors given in the beat plan and the lighting setup into primitive actions that will be fed to the graphics engine.

4.2 Lighting System

The lighting system will use a problem solving technique to select a lighting effect given the story situation. Using rules based on film theory, the problem solving system will select a lighting effect from the pool of lighting effects supplied by the API depending on the beat, its action category, its dramatic function, its dramatic value, and shot type used. A number of rules for choosing a lighting setup are discussed in (Vierra 93).

Since lighting is an art and in some cases lighting rules may not be suitable for the effect the artists need to create, the system will allow the artists to override the rules.

Artists can merge their own lighting behaviors to the story using special rules that they author. The antecedent of the rule describes the condition specifying when the lighting effect is applicable in terms of story situation and values. The body of the rule defines the lighting effect using the API described above. Additionally, a transition qualifier will be needed to define how the light will change in the scene (e.g. a gradual fade-in/fade-out or a cut). Thus, artists can control the lighting effect produced in the image for all the situations that may arise in the story while also having the freedom to vary the lighting (and thus the moods) portrayed depending on the situation.

4.3 Behavior system

In addition to using a camera shot, a lighting effect or a character movement from the list provided by the API, artists can compose their own behaviors from the list of actions provided by the API. For example, an artist can compose a behavior blink, which is composed of a sequence of three actions: open eyes, wait for a second, and close eyes. The artist may also tag these behaviors with a condition, which describes when these behaviors are applicable given the story situation.

A reactive planning system will then be used to break down the behaviors described in the beat plan and lighting effects into a number of primitive actions and an execution schedule. Loyall addressed this issue in his PhD Thesis (Loyall 97). I aim to follow his architecture and develop a similar language for artists to use. However, the behaviors will include camera actions and lighting effects as well as character actions.

Conclusion

In this paper, I argued that story visualization techniques are important for interactive drama. I summarized the previous research done on the subject. I then outlined an approach that I am using to implement a story visualization system that changes the visual setups/designs presented to a participant in an interactive story. Furthermore, it was stated that the system focuses on lighting, and thus will use a problem solving technique to adopt a lighting setup (provided the author didn't supply the system with one) depending on a number of story elements including the beat action, its dramatic function and value.

It has been noted that this paper describes work in progress. I am collaborating with a number of artists in theatre and film to build and evaluate the system presented here. We are planning to experiment with an interactive story called *Mirage* based on an ancient Greek Tragedy. I am currently developing this story in collaboration with two other artists at Northwestern University.

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