Desktop 3-D Interactive Drama – Applying Design Principles from the Performance Arts

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Abstract

Increasing emotional engagement in 3-D interactive environments is a hard, but important problem. It is important for its potential utility in increasing motivation, involvement, and engagement. These constructs are not only useful for entertainment applications, but also impact training and edutainment applications due to the impact of emotions on learning (Ulate, 2002; Wolfe, 2001). Many researchers have explored several techniques, including enhancing the story content to stimulate emotional engagement, developing new algorithms for dynamically creating stunning visual effects, and enhancing 3-D sound. Theatre and film have integrated many techniques that increase engagement, attention, and emotional involvement. In this paper, I describe a set of new design techniques integrated in an architecture that uses theatric and cinematic theories, specifically acting and screenwriting methods, to stimulate and improve emotional engagement in 3-D interactive narratives. In this paper, I discuss two research directions: (1) defining an interaction model for 3-D interactive narrative based on screenwriting theories, and (2) developing an actor-based agent architecture to simulate believable actions within an interactive narrative. The resulting architecture was implemented and tested within *Mirage*, an interactive story based on the Greek Tragedy *Electra*. Based on the critiques from several participants, I deduce that the resulting architecture presents significantly encouraging design techniques that can potentially increase emotional involvement and dramatic content of an interactive desktop 3D VR experience. The system and approach presented in this paper demonstrates an important new direction that adds to the set of techniques currently used and expand the design methodologies to include methods from disciplines, such as performance arts, theatre, and film.

1 Introduction

Creating and enhancing emotional engagement in 3-D environments is imperative. The impact of such enhancement is unquestionable for the entertainment industry, but is also significant for applications such as training, educational games, and therapy. Enhancing emotional content in such environments is a large topic involving research in areas such as story construction, graphics, environment design, design of input devices, voice synthesis, and interactive music; examples include (Madej, 2004; Morie et al., 2002; Morie & Williams, 2002; Swartout et al., 2001). In this paper, I focus on story and action. In particular, I discuss a new interactivity model for expressing participant's action. I use the term interactivity model to denote what the participant does in an environment. For example, in most video games, players' interactivity models are constrained to (a) navigation of space, (b) killing enemies, or (c) solving simple puzzles. In addition, I also present a new model for story and character representation based on theories from theatre and performance arts. It should be noted that there is much research involved in designing new methods for enhancing emotional engagement through lighting (Seif El-Nasr & Horswill, 2004; Tomlinson, 1999), camera movements (Tomlinson, 1999), audio (Boer & Boer, 2002), and sensory systems (Morie et al., 2002; Morie & Williams, 2002). These techniques should be integrated with the proposed work.

For several years, the game industry (I use the game industry here as an example, edutainment and training applications follow similar methods) have held panels at the Game Developers Conference, talks (Kane, 2003; Lazzaro, 2005), and published books (Freeman, 2003) on the topic of emotional engagement and games. However, the problem still persists. The interaction models used in games are very limited, which restricts the evoked emotions to basic emotions, such as fear, anticipation, and frustration. In addition, game developers often use linear or limited branching narrative structures to allow screenwriters to design and control the story to create complex design structures as the ones discussed in (Freeman, 2003; McKee, 1997). These linear or limited branching narrative structures frustrate the user and usually do not evoke the desired emotions unless the user abides by the designed structure. In games today, drama and conflict is scripted and often feels 'plastic'. Most of the techniques currently used do not sufficiently create conflict *within* the player.

Few research groups have attempted to develop techniques for enhancing emotional engagement. For example, Young proposed a plan-based interactive narrative architecture, where plans are revised depending on users' actions, thus enhancing the adaptability of the story to user's actions (Young, 2000). This, however, does not necessitate a dramatic experience. Peter Weyhrauch proposed an interactive drama manager that uses game theory to select a story event given the current story state, thus sustaining drama and conflict (Weyhrauch, 1997). The drama manager is based on heuristics, and thus there is no formal theory that is embedded in the design to preserve drama or conflict. Andrew Stern and Michael Mateas developed an interactive story based in a domestic drama (Mateas, 2000). Their work presents a new leap towards implementing a drama. However, one limitation of these previous models is the absence of a formal model of temporal dramatic progress within an experience. Therefore, most of these models are not designed to preserve or evoke drama; it is often up to the author to use the architecture wisely to evoke the intended emotional response.

Improving emotional involvement has been a subject of study in many disciplines, such as theatre, film, and the performance arts. Several techniques have been formalized and documented to create conceptual frameworks and guidelines for producing engaging performances. In particular, theories from screenwriting and acting (Bruder, 1986; Freeman, 2003; McKee, 1997; Meisner, Longwell, & Pollack, 1987; Stanislavski, 1936, 1949) are specifically relevant to the design and development of an interactive drama. This paper describes several design techniques based on screenwriting and acting theories.

2 Lessons from the Performance Arts

In this particular section, I will discuss several methods borrowed from disciplines, such as film and theatre. In the next section, I will discuss the architecture within which these methods are materialized.

2.1 Dramatic Arc

In a typical film or a play the drama escalates to a peak (the crisis point) then it is released. The shape of dramatic tension through time can be visualized as an arc, and thus called the dramatic arc (Baid, 1973; Styan, 1960). The arc is not a smooth arc, however. As Benedetti describes the play is composed of scenes and scenes are composed of beats (the word beat here defines the small unit of action that has its own complete shape with a goal and an action), each has its own arc with a turning point where tension reaches its maximum point after which tension is released (Benedetti, 1994).

This concept is useful, because it defines a temporal function of tension within an experience. The dramatic arc forms the basic form of drama exhibited in most performances. Thus, one can evoke the same kind of dramatic experience by preserving the dramatic arc through the definition and representation of a temporal function simulating the dramatic arc. Of course such endeavour is technically very challenging. I will discuss an alternative method in section 3.

Comparing the relationship between tension and time to the relationship between emotion and performance or memory retention from the psychology literature reveals an interesting relationship. Several psychological studies suggest that performance, including memory retention, forms an inverted-U shaped curve in relation to tension/arousal (Williams, Landers, & Boutcher, 1993; Yerkes & Dodson, 1908). In other words, as the tension increases memory retention increases in time up to a point and then it starts decreasing with the increase of tension. This is an important analogy, because it implies that the concept of dramatic arc can also have a significant effect on learning, and thus representing it may have a significant impact on educational and training applications.

2.2 The Ticking Clock

The concept of the ticking clock has been used as a dramatic device in many performances and productions. It defines several techniques, including dialogue, visual hints, or projections of possible outcomes and/or events that are doomed to happen in the future. Examples include the clock reaching 6:00p in the *Saw* or the train arriving at noon with the bad guy on it in *High Noon*. This kind of instrument can be very effective in creating anticipation.

2.3 Character Through Line

The character's through line is a term used in acting theory to describe the role that a character takes in a scene. It is also used to describe the characters' objectives and the manifestation of these objectives through the scenes and the

play (Stanislavski, 1936, 1949). This is an important concept, because if represented can sustain character consistency through maintaining character goals and behaviours.

2.4 Acting – Defining Tactics and Beats

In performing a character, the actor needs to define his/her character's super objectives, their tactics, and their beats throughout the story. The super objective defines the character's goals within the story. The tactics define the set of behaviors that the character undertakes to achieve his/her needs. Character beats define a single unit of action within which the character has a defined sub-goal and action. Within each beat, the character chooses a goal and a tactic. He/she continuously monitors the other characters or the environment evaluating the success or failure of the chosen tactic (Benedetti, 1994).

Analyzing character action according to goals and tactics gives characters direction and consistency. In addition, using tactics and constant feedback to evaluate the tactics is an important method for achieving a more believable character – a character who has a goal and direction. This framework is also easy to realize using an agent-based architecture, as I will discuss later.

2.5 Defining Actor's Goals

One important rule that Bruder describes is: actors choose goals for their characters within a particular beat, such that the goal (a) includes other character(s) in the scene, and (b) is in conflict with other character(s) on stage (Bruder, 1986). This is essential to create and sustain conflict in the scene. I found this rule to be very effective in acting and improv classes. It encouraged involvement and increased emotional engagement.

This technique can also be used in an interactive environment by rewriting the rule to: at least one character in the scene should choose a goal that includes and is in opposition to the user. This creates conflict and sustains the drama as defined in relation to the user. It also enforces a user centric architecture.

2.6 Emotions through Action and Activity

"An actor cannot play an emotion; an actor can only play an action; emotion must arise out of action (Bethune, 2004)." One of Stansloviski's greatest lessons is to project emotion through action (Stanislavski, 1936, 1949). Rather than playing an emotion, actors should play the action and encode the emotion in the action through parameters, such as speed, intensity, shape, and direction. Another important lesson that could be transferred from acting models is the use of activity for an actor. Instead of having an actor stand on stage empty handed, it is often useful to use an activity through which the actor encodes his/her emotions and purpose.

This, however, presents a major technical challenge. Fully-articulate characters are hard to develop, especially in real-time. Currently games use pre-canned animations that artists prepare or are generated by motion capture equipment to show a specific emphasis or statement. However, this implies that the emphasis and sub-text (i.e. meaning behind the statement) should be predetermined at design time. However, with an adaptive dynamic story system, such assumptions can no longer be sustained. The only alternative is then to modify in real-time the pre-canned animations. Even with advancements in graphics and gesture systems (Cassell, 1998; Kopp, 2001; Vuilleme, 1999), such problem still presents a major challenge. Using activity adds another layer of complexity to the problem.

In the architecture described here, I am not presenting a solution to this problem. Instead, we have produced several animations with different 'adverbs' attached to them for the same action. This is time consuming and labor intensive. However, my focus is to evaluate the design implication of integrating several design methods into an interactive narrative architecture. Thus, improving this element of the architecture will be kept for future research if the proposed design methods are successful.

3 Architecture

Using the principles discussed above, I developed a desktop 3-D interactive drama system. The system is composed of a story engine, several character agents, a director agent, and a user model which is continuously refined as the interactive experience progresses. To give the reader a brief overview of how the system works a summarized version of the system architecture is shown in figure 1. The story engine, similar to the work of Mateas and Stern (Mateas, 2000, 2001), is responsible for selecting a story event to execute based on a set of authored story actions, the number of characters in the scene, their identity, their objectives, and story history. The story engine, unlike the

work of Mateas and Stern, also accounts for the level of conflict and tension in the situation using the user model when selecting a story action to fire. Given a selected story action, the director agent then allocates sub-goals to the different characters in the scene. These characters then choose tactics that can achieve the goals suggested by the director agent. The character agents continuously monitor user's actions and the situation evaluating the level of success or failure of their tactics. If a tactic fails, another tactic is selected, and so on. Depending on the tactics, the tension level, context, and the success and failure of other tactics, character agents select an action and use adverbs to selectively tune the action to express an emotion.

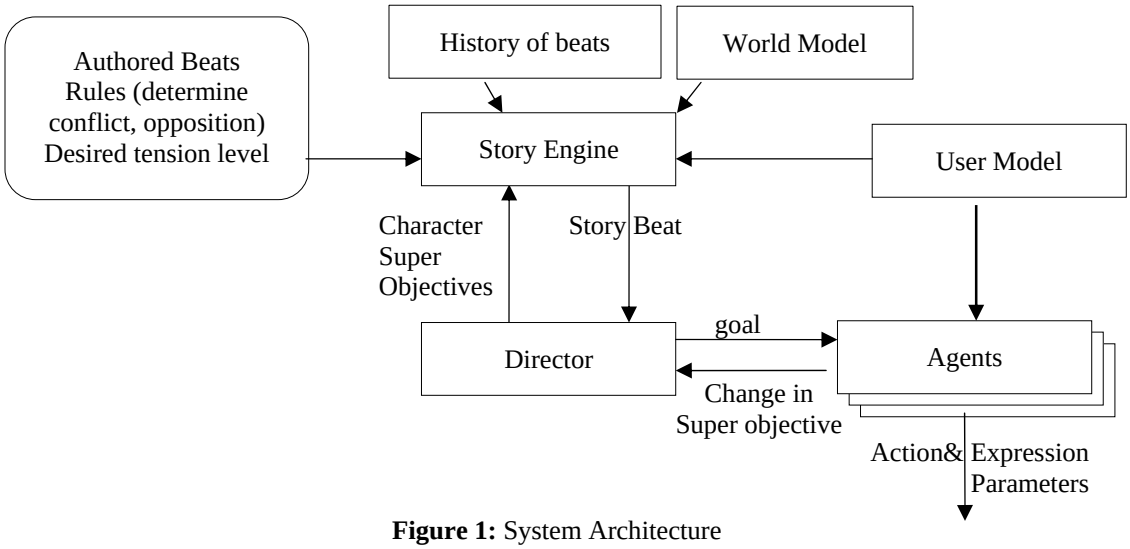

Figure 1: System Architecture

3.1 The Interactivity Model

Before I start describing the details of the architecture shown above, I would like to first introduce the interactivity model adopted in this architecture. Games and other interactive media use puzzle solving, navigation of space, or simple quests as an interactivity model. Alternatively, I seek to explore an interactivity method based on story and drama. I have spent a year experimenting with different techniques. This exploration phase resulted in an interaction model based on building a player character and allowing it to transform and grow through the story. Such technique is often referred to, in screenwriting theory, as the *character arc* (McKee, 1997). To establish this model of interaction, I used a simple user modeling technique based on stereotypes.

User modeling is an extensively explored topic within several areas of research, including web-based searches, Intelligent Tutoring Systems, and conversational agents (D. Browne, 1990; Maybury & Wahlster, 1998). Many user models have been developed, including models fitting users into stereotypes (Rich, 1979; Tsiriga & Virvou, 2002), inferring users' knowledge (D. Browne, 1990; Maybury & Wahlster, 1998), inferring users' cognitive model (e.g. learning styles and personality), estimating users' goal and plans (H. Kautz & Allen, 1986), and modeling and inferring users' mood and emotions (Picard, 2003). The models used to infer these characteristics differ depending on the concepts modeled; for example, a simple questionnaire can suffice for collecting information on users' knowledge, but such techniques may not suffice for inferring users' cognitive model.

Inferring user intentions or goals is a hard problem although some solutions exist (H. A. Kautz, 1987; Pollack, 1986). For interactive narrative, the problem is simpler because the narrative provides a context that can be used to infer the goal. Thus, I use some rules that estimate user's goals based on story context. The story context is symbolically represented based on the story beats, scene configuration, time, tension level, and the history of story beats executed.

I used a personality model based on character stereotypes from screenwriting. The following vector represents the vector space of stereotypes modelled in the current implementation of the user model:

<hero, violent, self-interested, coward, and truth-seeker>

Given a user action, the history of user actions, and the story context, a rule-based system is used to modify the user model reflecting the user's choice. The system uses very simple rules, such as 'if user advances to attack unarmed characters then advance user on the violence scale'. The architecture includes a language that authors can use to write rules for more complicated inference involving behavioral patterns and character relationships. The system also calculates a confidence measure of its current user character estimate. This measure is defined as a function of (i) the time it took the user to make a choice and (ii) the conformance to the estimated pattern given the predicted user character, which was simply calculated as the max of the vector above. For example, if the user took the most violent action in a situation, and it took him/her x seconds to make the choice after a choice has presented itself (e.g. an action prompt or an object of interest appeared), then the system will use the time it took the player to make the choice as well as the evaluation of the action in terms of the model above. This is based on the assumption that time can indicate that the user is not 100% sure of the action. Thus, if it took a player 10 seconds to make the violent action choice and it took another 50 seconds to make the same choice, then the system will interpret the first player to be more violent than the second.

This model is overly simplistic. It represents a first attempt to explore a different direction in interactivity models within an interactive narrative – a space based on character development and character archetypes. This initial approach shows great potential for exploring better methods that can enhance current implementation.

3.2 System Details

3.2.1 The Story Engine

The story engine keeps track of its current state including history of selected story beats and character relationships. Given the moral of the story or story goal, a set of authored story beats, an estimation of the user's character, and the story state, the story engine selects a story action or beat to fire. Story beats are represented as a collection of subgoals that need to be solved in parallel or sequence. Simple story beats are represented as a collection of direction goals for a director agent to process. Direction goals are goals that can be solved by characters, the camera, or the lighting agents. A beat is then represented using the following structure:

Trigger: a beat-goal that the beat solves

Preconditions: defines the context that enables this beat.

Postconditions: defines the actions or side effects of the beat

Subproblems: define the sub problems that need to be solved for the beat to succeed. This subproblem field can be: (a) collection of beat-goals that need to be solved in sequence or parallel, (b) collection of direction-goals that need to be solved in sequence or parallel, or (c) a combination of both (a) and (b).

To compute a collection of simple story beats, the story engine uses a reactive planning algorithm similar to RAPs (Reactive Action Packages) (Firby, 1989). The algorithm is summarized as follows:

1. Make a list of goals, put story goal in the list
2. current goal = Pick a goal from the list of goals
3. for all applicable beat (given the preconditions) that can solve the current goal
    a. If beat is a simple Beat then go to step 2
    b. else loop through subproblems
        i. if goal is a beat-goal, add goal to the list of goals
        ii. else add goal into direction goals to be solved, keep timing information, and variable info.
        iii. go to step 2

Through out this process timing information and variable associations should be kept and synchronized (Firby, 1989; Forbus, 1993; Loyall, 1997).

The story engine takes several constraints and elements into account when selecting a story beat to fire. One of these elements is the dramatic intensity or tension level. This is an important element, as described above to preserve the dramatic arc, dramatic tension will need to be evaluated, increased, or decreased at any point within the interaction. The method by which the system allows for such modulation of the dramatic arc is through selecting beats that increase or decrease tension appropriately given the current tension level, the scene, and timing.

This process requires evaluating the beats and determining how they influence the current situation. This is a hard problem to automate, since much information about context, meaning, and common sense will need to be encoded.

Instead, the system is designed to allow authors to write rules to identify shifts in dramatic tension through beat changes. These rules allow the story engine to compute increase and decrease of the dramatic intensity given a specific beat pattern, the user model, and context information (e.g., relationship values between characters), e.g.:

if	beat#2 is followed by beat #5
and	Electra is using the threatening tactic on the user
and	user is judged as the violent type
then	increase dramatic intensity by 10 increments.

Thus, using these rules and current assessment of dramatic tension, current beat and history of beats, as well as user actions and timing, the story system can determine appropriate beats to fire given the required tension level and the shape of the dramatic arc.

There are many limitations to this approach. First, this method of preserving the dramatic arc is very simplistic. It, for example, encodes the dramatic arc as a simple monotonic function, while as I discussed in section 2, the dramatic arc should be encoded in a non-monotonic function, including several climaxes and releases. Second, encoding all possible transitions and their dramatic significance in terms of tension change is a very time consuming and laborious task. As discussed earlier, however, this paper does not propose a silver bullet. Instead, it proposes an architecture that explores several techniques borrowed from theatre and film. The current implementation is greatly simplified for the sake of determining the significance of the design methods adopted.

3.2.2 Character System

Once a character goal is given to the character agent, the agent uses a similar technique to beat deconstruction to deconstruct the character goals into simple actions (Loyall, 1997). Given the current context, the world model, the beats fired, the character's super objectives, the user model, and the character's goal given by the director agent, the behaviour engine chooses a collection of actions that will solve the character goal. Actions are represented by an action, an adverb, and an actor; for example (Walk Electra slowly) is a behavior where the action is walk, the actor is Electra, and the manner in which an action is performed is slowly. Therefore, an action can be animated in different manners defined by the adverb. For example, 'take the sword' is an action that is defined as three animations 'take sword eagerly', 'take sword hesitantly', and 'take sword regretfully'.

One major difference between this architecture and previous work, such as the work by Loyall (Loyall, 1997) or Mateas (Mateas, 2000, 2001), is in the agent's ability to dynamically adapt to the user's behaviors and the use of user modeling. Agents continuously monitor mouse movements and mouse clicks for clues to infer the direction of user's attention and user's goals and intentions. Given these inferred values, the agent will continuously adjust its success or failure rates until failure reaches the tolerance limit. If failure occurs, the character will (1) declare the behavior a failure, (2) update the user model, and (3) choose another behavior to solve the character-goal. The algorithm can be summarized as follows:

1. Choose behavior plan given user stereotype, character goal, failed behaviors
2. for each time tick
   - 2.1. monitor user action assessing current behavior
     - 2.1.1 if failure limit reached, fail behavior and go to step 2.
     - 2.1.2. Update user model

4 Implementation and Results

4.1 The Setup and Dramatic Devices Used

I transformed the legend of the house of Argos into an interactive story, called *Mirage*. The story introduces the user/participant as a new character called Archemedes, son of Aegisthus and Clytaemnestra. He was given away to a farmer when he was a baby since the kingdom was unsafe for him. When his foster parents reveal his false identity, he starts a journey back to Argos. Since he was spirited away from the palace at an early age, he does not know much about the history of Argos. The interactive experience begins there.

This particular setup projects the user in the middle of two conflicting sides: Electra (his sister) and Clytaemnestra and Aegisthus (his parents). This is a significant setup to ensure drama and conflict. In addition, the choice of going to Argos is visually projected to show different clues, thus allowing users to create different motivations for their own character. For example, he could be going back to Argos for power, for money, or just to find out the truth. The reason is never revealed in the experience, it is up to the user to build the motivations for their character.

Most dramatic narratives have a clock, which defines the anticipation and builds tension (McKee 97). In *Mirage*, I constructed the story such that the dramatic tension increases with the anticipation of Orestes' (Electra's brother and Archemdis' half brother) arrival. However, the interpretation of Orestes' arrival is different depending on the participant's choices and goals.

4.2 Scenes from *Mirage*

Below I discuss several scenes from *Mirage* showing the adaptability of agent's behaviors to user's goals. The architecture was a product of iterative design. As described above, the plot varies in response to estimated user stereotype. To fully appreciate the interactive narrative system, readers need to interact with the system. Even a video of the system, will not suffice to show the dynamic nature of the interaction and improvisational ability of the characters. In order to show variations in the plot, I will use screenshots and dialogue.

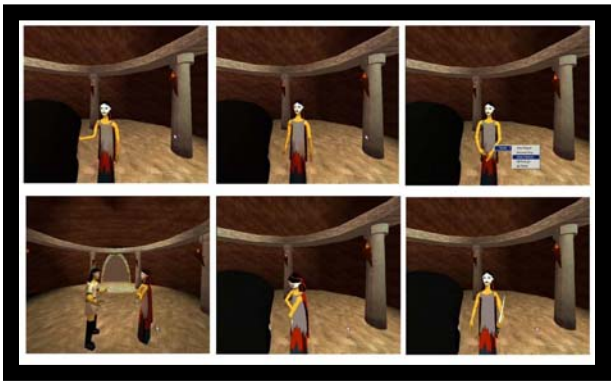

Figure 2: Showing outcome when user as truth seeker type (character choice: truth seeker)

Table 1: Dialogue for Figure 2

ELECTRA
Archemedis, listen. I know this isn't what you thought you were coming here to do. But if you *did* come to find out who you really are, maybe this is your chance. It's the sort of thing that makes heroes. Are you going to run away from this, or face it? Decide quickly, they'll be here any minute.
<user made a choice here to find out the truth>

ARCHEMEDIS
Listen, I don't want anything to do with any curse.

ELECTRA
But—

ARCHEMEDIS
I don't want to get the plague, I don't want to murder any royalty-- I just want to meet them. I want to find out who my real parents are. And who I am.

ELECTRA
I've already told you, she's a murdering whore and he's a tyrant with no right to the throne. As far as the real you goes—

ARCHEMEDIS
Yeah, I'd like to get a second opinion from somebody less crazy before I go on a killing spree. Besides, I'm sure if I explain the situation—

Electra pulls a SWORD.

ELECTRA
Let me explain the situation.

Figures 2 and 3 show several screenshots from *Mirage* for which dialogue scripts are shown in Tables 1 and 2, respectively. The figures show two characters: Electra and Archemedis. Archemedis is under the control of the user.

Electra is an agent; she selects behaviors to achieve the character goals given to her by the director agent. The camera and lighting agents also play a role in choosing positions and orientations to show and support the narrative. In this scene, Electra is trying to convince the user to help her kill the king and queen. The figures 2 and 3 show two variations on the scene depending on user's model. In figure 2 Electra, realizing that the user is the truth seeker type as inferred by the user model, reverts to violence to achieve her goal. Figure 3, on the other hand, shows some exchange where Electra realizes that the user is the coward type and is leaving, she quickly reverts to blocking his way and telling him that he may have the disease too and he needs to kill his parents to save himself.

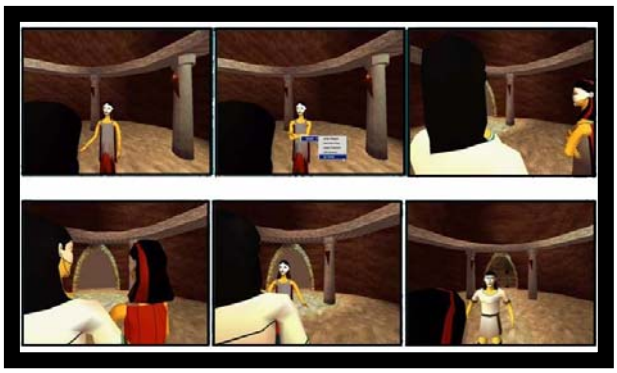

Figure 3: Showing dynamic change of tactic within the interactive story (character choice: coward)

Table 2: Dialogue for Figure 3

ELECTRA
Archemedis, listen. I know this isn't what you thought you were coming here to do. But if you *did* come to find out who you really are, maybe this is your chance. It's the sort of thing that makes hero – (interrupted)

<user made a choice to just leave>

Archemedis starts heading towards exit

<Electra fails her current behavior>
<She searches for a better argument (different behavior)>
<she replans>

<Electra's new plan includes:stop user from leaving
use 'user has the plague' argument/behavior to get him to listen>

Electra blocks user from exiting

ELECTRA
So, what, you'll just carry the plague back to them? I'm sure they'll be happy to see you.

ARCHEMEDIS
What? No! I don't have the plague!

ELECTRA
I wouldn't be so sure, Archemedis. You don't look well. Are you feeling OK?

ARCHEMEDIS
Don't kid around--

ELECTRA
I'm not kidding. You've been exposed to it. If you're going to get sick, it will be in the next few hours. There's only one way to be sure you won't get the plague. You have to end the curse.

As discussed above, characters adopt different behaviors. They continuously monitor the user to identify agreement, conflict, and loss of attention or interest. Electra monitors the user in *Mirage* through mouse clicks, change in

orientation, and action selection. In figure 3 she started using a behavior only to realize that the user has lost attention and is heading for the exit (shown in the third image within the figure). She then corrects the user model and chooses another tactic to get to her goal, as shown in the figure.

4.3 User Feedback – Evolution of the Design Process

I used a user critique method for evaluating this experience, similar to film critique. I invited several professionals from theatre and film to an interaction session with *Mirage*. They were invited separately. Each was given 10-15 minutes with the interactive story then asked to write a critique of the experience. Most of these professionals have played games and interactive fiction before, thus they were familiar with interaction models and techniques used in games. Since they are film and theatre professionals, they are also familiar with film and theatre techniques. I asked a total of 5 participants to engage in this informal and preliminary evaluation process. During the process of development, I also engaged and collaborated with several theatre and film professionals and educators to come up with this prototype system. The 5 participants involved in this evaluation are different from the individuals engaged in the collaborative effort of defining and designing the system.

This is a highly qualitative method and very subjective, of course. However, it will give us an indicator of how well the technique works and what needs improvement. The critiques were very encouraging. First, all participants noticed that the characters were more responsive than in video games or other interactive fiction productions. Since I didn't explain the system or the models behind the characters this result in itself is positive. Three of the participants recognized that the response of the character is changing depending on the action and the level of 'aggression' that they took in their choices. Also, all of the participants liked the fact that Electra refined her tactics quickly drawing the sword and threatening the user, which they described as a 'major dramatic shift'.

They also included several graphics techniques to include, such as using facial expressions or changing masks to express emotions. Many have commented that the choices of camera angles need improvement to emphasis the action. Two participants asked to include other characters and objects on stage. One participant, a director, asked to use objects and activities with the characters rather than have one-on-one conversation.

5 Conclusion

In conclusion, I have presented a new architecture encoding several design techniques which I adapted from acting and screenwriting theories. My focus was to evaluate the potential use of such design techniques to enhance emotional content in interactive 3-D narratives. I described the system and the current implementation. I described the many limitations of the system. I also discussed a brief summary of the critiques collected on the system. It is hard to quantitatively evaluate such system, but easier to evaluate its engagement value when interacting within it. According to the critiques and our (me and my collaborators) assessment of the system, I believe that the design techniques discussed in this paper can lead to a significantly better design for an interactive experience increasing and enhancing emotional involvement and engagement. Such an architecture may have an impact on training, educational, entertainment applications. However, the road to proving such a claim is still long and requires many prototypes in different systems beyond what is presented here.

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