TOWARD THE DESIGN OF AN

INTERACTIVE FANTASY SYSTEM:

DESCRIPTION AND FUNCTIONAL REQUIREMENTS

Brenda K. Laurel

3 November 1983

Atari Sunnyvale Research Laboratory

Table of Contents

List of Figures

Abstract

This is the first in a series of papers employing dramatic theory in the design of a computer-based system that is intended to create interactive fantasy experiences. While the design process will reflect the methodology of computer software design and must be informed by the techniques and limitations of the technology, the central activity will be the application of the principles of Aristotelean dramatic theory to interactive structure. This paper will provide a description of the proposed "Interactive Fantasy System" and an overview of the functional requirements of such a system.

1. Overview of a New Form

1.1 The Idea of Interactive Drama

A young woman sits before a personal computer console using the joystick to maneuver her starship into firing position as she fends off a simulated attack by a swarm of Zylon vessels. When the attackers are destroyed, she taps the keyboard to display a map of her quadrant of the galaxy on the screen to determine where other concentrations of Zylons are awaiting her. For now, she is assuming the role of captain of a starship, with the goal of defending the galaxy from the an alien onslaught.[1]

In Niven and Barnes' science fiction novel Dream Park, adventure game aficionados pay hundreds of dollars apiece to participate for two days in a simulated adventure. They assume characters with various magical powers and instruments, drawn from the lore of adventure gaming. They encounter holographic monsters, explosions, and hoards of murderous ghouls as they seek treasures in the world of the Cargo Cults of the 1930's.[2]

---

[1] "Star Raiders," home computer game (Atari, 1979).

[2] Larry Niven and Steven Barnes, Dream Park (New York: Ace Books, 1981).

There exists in our culture a number of deeply felt, shared fantasies of the kinds of experiences we might have with high technology. The idea of first-person, interactive excursions through imaginary worlds is one such powerful fantasy, which has been expressed in literature, film, and popular culture for decades. It is at the root of the desire which is evoked but only partially fulfilled by the video game fad. The wished-for experience might be compared to volitional dreaming, or to the idea of becoming a character in a play, affecting the action and outcome by making choices and performing actions in the imaginary world of the drama. What would it be like to be Hamlet or Captain James T. Kirk? How would it feel? How might one do things differently than the characters who have already been created? What could one learn by doing it?

Such an experience would afford the user pleasures which are both similar to and distinct from those offered by viewing or writing a play or by playing a video game. Like an audience member, the user could experience the "willing suspension of disbelief," allowing himself to participate emotionally in an experience without having to cope with any real-world consequences. Like a writer, he could control the thoughts and actions of a character and create or influence various events in the environment, and could have the pleasure of creating a new work of art. Like the player

of a video game or role-playing game, he could imagine himself to be actually involved in the experience as an agent by assuming a fictitious role. A playwright may in fact have similar experiences "in his head" as he works on a script: he may "enact" his characters in his mind, taking vicarious pleasure in choices, actions, and their consequences in an imaginary world. No form of experience currently exists, however, in which one could hope to partake of all these pleasures at once in any world more palpable than that of the imagination.

1.2 Critical Qualities of Interactive Drama

Using the theory of the drama and the tools afforded by computer technology, it is possible to imagine a system which would fulfill the fantasy of first-person, dramatic interaction in an imaginary world. What are the critical qualities of such a system?

First, the experience enabled by the system must be interactive. Interaction may be defined as "mutual or reciprocal action or influence."[3] A fully interactive experience is the product of ongoing collaboration between the principal participants. The principal participants in

---

[3]

The Merriam-Webster Dictionary (New York: Pocket Books, 1974), p. 372.

dramatically interesting way.[5]

The name, "Interactive Fantasy System," was chosen because it better suggests the critical qualities of the experience than the term, "interactive drama." To the uninitiated, "interactive drama" might refer to an interactive play-authoring system, and does not necessarily suggest the first-person quality of the desired interaction. Fantasies are typically first-person affairs, with emotionally satisfying structures and outcomes that are reminiscent of the drama. (The acronym "IF" is also more appropriate to the system than the alternative, "ID.") The functional requirements of an IF system are discussed in section 2.

1.4 Antecedents

Several forms which combine notions of interactivity and dramatic experience have contributed to the conception of the IF system. The three principal antecedents of the system are "traditional" drama, certain artificial intelligence programs, and certain interactive computer programs.

---

[5] Brenda K. Laurel and Eric A. Hulteen, "Simulation of an Interactive Fantasy System," research proposal, Atari Corporate Research, 1983.

the proposed interactive experience are the human user and a system animated by artificial intelligence. The interactive requirement means that the user and the system must have mutual or reciprocal influence on the action that occurs.

Second, the experience must be dramatic; that is, it must be productive of the pleasure associated with drama. That pleasure arises from the selection and arrangement of incidents and from the organic beauty of a whole. Drama does not provide an imitation of life in all its redundancy and confusion, but rather presents an imitation of action which, through artistic formulation, excludes unnecessary detail and complication and makes visible the causal connections among events. The dramatic form functions to maximize the pleasurable experience of emotion on the part of the audience (or "user").[4] The system, then, must be capable of structuring the experience in dramatic form.

Finally, the user must be able to interact with the system within the context of the experience itself, assuming (or creating) a role within the fantasy world. This quality can be described as "first-person experience," and it

---

[4]
Aristotle, Poetics, trans. Ingram Bywater, in Rhetoric and Poetics of Aristotle (New York: The Modern Library, 1954), pp. 230-3.

requires that the user's suspension of disbelief never be interrupted by attending to the system which is "behind" the fantasy world. Informational questions, error messages, and explicit prompts are examples of such interruptions, and can be characterized as "second-person" transactions.

The first-person requirement is best met by casting the user in the role of an agent, or character, within the fantasy world. This solution is also ideal in meeting the dramatic requirement of the experience: the user-character may be treated by the system, with some additional levels of inference and predictive modeling, as just another agent in the action being imitated. Thus the user's actions may be more easily integrated into the dramatic form.

1.3 The Interactive Fantasy System (IF)

"Interactive drama," then, is a first-person experience within a fantasy world, in which the user may create, enact, and observe a character whose choices and actions affect the course of events just as they might in a play. The structure of the Interactive Fantasy System proposed in this paper utilizes a playwriting expert system that enables first-person participation of the user in the development of the story or plot, and orchestrates system-controlled events and characters so as to move the action forward in a

1.4.1 Interaction in Traditional Drama

A play may be defined as an imitation of an action which is represented in a dramatic manner; that is, it is enacted by performers in real time, "as though they were actually doing the things described."[6] During the performance of a play, the relationship between the audience and the performance is severely constrained. The audience views the performance and may experience and investigate emotional, kinesthetic, and rational responses to the ongoing action. An audience member may communicate the gross nature of some of those experiences to the performers in the form of audible responses (laughter, applause, etc.). Those audible responses may affect the performance of the actors on stage, but will not, except in experimental works which are intended to be participatory, affect the course of the dramatic action or change a single line of dialogue. Beyond the secondary effects of audience responses upon the actors in the performance, then, no interaction between the audience and the play occurs.

The absence of interaction between the audience and the play is necessary in order to preserve the dramatic form. A play is an imitation of a whole action, accomplished through

---

[6] Aristotle, _Poetics_, p. 226.

the representation of a number of causally related incidents, each of which stands in organic relation to the whole. The selection and arrangement of those incidents is essential to the drama:

> The truth is that, just as in the other imitative arts one imitation is always of one thing, so in poetry the story, as an imitation of an action, must represent one action, a complete whole, with its several incidents so closely connected that the transposal or withdrawal of any one of them will [7] disjoin and dislocate the whole.

Interaction between the audience and the play must therefore be prevented in order to preserve the integrity of the play itself.

While interaction between the audience and the play at the time of performance is proscribed, there are occasions in which interactive play-writing can be successful. Actors in improvisational forms like the _Commedia dell'Arte_ are required to have sufficient knowledge of dramatic form and structure so as to create viable plays in real time, thus the actors' relationship to the play may be described as interactive. One might imagine an audience member or critic making suggestions for changes in a play to the playwright during the revision process. The critic is thus interacting

---

[7]
Ibid., p. 233.

with the play via the playwright. The thing that such examples have in common is the participation of a playwright, or the introjection of playwriting expertise, into the interactive process.

1.4.2 Child's Play and Role-Playing Games

Children at play exhibit a facility similar to playwriting expertise when they collectively create and maintain an internally consistent fantasy world for a whole afternoon (or series of afternoons). As Aristotle observed, much of children's play is imitation. The expertise which both maintains the integrity of the fantasy world and enables each participant to create, seemingly effortlessly, characters that are "good, appropriate, like, and consistent," is in fact humanity's native skill in imitation.[8] Although lacking the formal structure of drama and thus its distinct emotional and aesthetic qualities, the imitative play of children will serve as a powerful predictor of the behavior of human users of an IF system.

A highly structured form of imitative play, known as fantasy role-playing, is structurally quite similar to an IF system. "Dungeons and Dragons," the first role-playing game to enjoy wide popular appeal, seems from its inception to

---

[8]
Ibid., pp. 226-7.

have been especially popular with computer professionals and enthusiasts, and computer-based versions began to appear almost immediately (the genre of computer-based "adventure" games was the result).

Traditional (non-computer-based) fantasy role-playing is a collaborative affair:

> A fantasy role-playing (FRP) game is one wherein the players construct characters who live out their lives in a specially made game-world. The characters need not be anything like the people who play them. . . . The game world is operated by a referee (sometimes called a game master, adventure master, dungeon master, etc.) who sets up the situations which the players confront and who also plays 'the world.' An FRP game, then, is an interaction between players, who operate (run) characters, and a referee, who runs the world in
> 9
> which the adventures occur.

The bulk of the "rules" by which an FRP game is played consist in the fantasy world itself, and are either drawn from some documented lore (as in most FRP kits and books on the market today), arrived at consensually by the players, or a combination of both.

FRP games differ from an IF system in terms of

9

Greg Stafford and Lynn Willis, Basic Role-Playing: An Introductory Guide (Albany, CA: Chaosium Inc., 1980), p. 2.

enactment, personness, and dramatic structure:

> Most of the play is verbal exchange. The players
> tell the referee what they wish or intend to do. The
> referee then tells them if they can or may do it
> and, if not, what happens instead.[10]

The experience does not involve the elements of
spectacle and music as a dramatic enactment would, nor does
it occur in the first person, but rather through the medium
of second-person transactions with the "referee."   The
beginning and end of the game for each player are unique,
defined by the creation and death of the player's character,
and not by the shape of any whole action.

1.4.3 Story Generation through Artificial Intelligence

In the domain of narrative forms, computer-based
interactive authoring environments have been created.
TALE-SPIN, created by James Meehan at Yale University, is
described by its author as a program which "makes up stories
by simulating a world, giving characters some goals, and
telling us what happens." TALE-SPIN employs techniques of
artificial intelligence to generate stories, and allows a
human user to interact with the authoring process by
supplying "much of the information about the initial state

10
   Ibid.

of the world, such as the choice of characters and relationships between one character and another." In one of its modes of operation, the program simply reports everything that happened in the "story" which was generated on the basis of the given characters and their goals. In another mode, the program employs narrative expertise to eliminate obvious and redundant information and descriptions of events which had no interesting consequences. In its most interactive mode, the program can produce "Aesop-like fables" to illustrate a "moral" (e.g., "Never trust flatterers") which has been selected by the user.[11]

One might imagine a similar program which could construct plays rather than stories, thus providing an interactive playwriting environment. Just as TALE-SPIN produces stories which may be read later as any other story might be read, a play-writing program might be made to produce simple plays which might later be read or enacted. The play would be the result of an interactive authoring process, but the play as experienced by an audience would be no more interactive than any other "traditional" play.

11
    James Richard Meehan, "The Metanovel: Writing Stories by Computer" (Ph.D. dissertation, Yale University, 1976), pp. 15-6.

1.4.4 Interactive Computer Programs and Video Games

The similarities between certain types of interactive computer programs and drama are striking, and they provide examples of dramatic elements in interactive contexts. There exists a class of interactive works that are mimetic; that is, they imitate actions, things, and events that do or might occur.   Examples of such works are computer simulations of processes or events, such as the workings of a nuclear power plant or the development of a tropical storm.

A sub-class might be described as poetic, and it is differentiated from the class of mimetic interactive works in terms of its end cause. Poetry as an art has as its end cause the pleasurable experience of emotion. Even such emotions as fear and grief, the experience of which would, in life, be unpleasant, may be aroused and treated by poetic works in such a way as to provide pleasurable experiences for the audiences of such works. The emotional experiences afforded by poetry derive from the empathic connection of the audience to the piece; that is, emotions are experienced vicariously by the audience.   The absence of real-world consequences allows the audience to indulge in emotional experiences without risk, and poetic forms provide various kinds of resolution or catharsis which return the audience to a balanced emotional state.

Poetic interactive works have as their end cause to entertain, engage, or please the humans who play with them, inviting the user to partake of the vicarious experience of emotion and to delight in the imitation. The sub-class thus excludes mimetic works which are intended primarily to assist the human user by performing such tasks as computations, analyses, or instruction. Examples of poetic interactive works include video games such as "Space Invaders" or "Asteroids," maze games like "Pac Man," adventure games such as "Zork," and recreational simulations like "Poll Position." Some programs with the ostensible goal of educating the user also fall into the poetic class, as their primary value to the user is the pleasure of interacting with them. As Aristotle observed, man's delight in imitation derives in large part from the pleasure of learning,[12] a principle which often eludes those who design both video games and instructional computer programs.

Those poetic interactive works which imitate agents and their actions (as do most adventure games) and those which cast the user as an agent in the action (as do most video games and recreational simulations) are composed of elements which correspond to Aristotle's six elements of the drama

_____

12
    Aristotle, Poetics, p. 227.

(see Figure 1). An analysis of such works in terms of Aristotelean dramatic theory will suggest extensions of that theory in areas where poetic interactive works and drama diverge. That analysis will also yield a set of formal and structural criteria which will then be used to design a structural model of the IF system.

ELEMENT	IN DRAMA	IN POETIC INTERACTIVE WORKS
PLOT	The whole action being imitated. The outcome of the action will be the same in each performance.	The whole action, which is interactively shaped by both system and user. The outcome may vary with each interactive session.
CHARACTER	Bundles of predispositions and traits, inferred from agents' patterns of choice.	The same as in drama, but including the user as well as fictitious agents.
THOUGHT	Inferred internal processes leading to choice: cognition, emotion, and reason.	The same as in drama, but including the user.
DICTION	The selection and arrangement of words; the use of language.	The selection and arrangement of discursive signs, including visual, auditory, and other non-verbal signs, when used linguistically.
MUSIC	Everything that is heard.	(same)
SPECTACLE	Everything that is seen.	(same)

Figure 1-1:   Corresponding Elements of Qualitative Structure

2. Functional Requirements of the IF System

The IF system is intended to allow a human user to enter an imaginary world and to move through it as an active character, participating in an experience that is dramatic in nature. Contributions of persons with diverse theoretical and technical skills will be required to bring the IF system into existence. The system will necessarily be built by pieces, as essential techniques and tools are developed in many fields. The remainder of this section will be devoted to a discussion of the functional requirements of the IF system (see Figure 2).

2.1 Create a World

The IF system must provide a means for the fantasy world itself, the context of the interactive experience, to come into being. The physical characteristics, inhabitants, distinct environments, and laws of that world must be conceived and then represented in some manner to the user of the system. The world also includes some relevant history, which must be available to the system itself in order to orchestrate new events and dole out expository material to the characters (including the user-character).

The conception of fantasy worlds is and will almost certainly remain a task for humans and not for machines. Playwrights and novelists perform similar acts of creation when they define the worlds in which the actions they
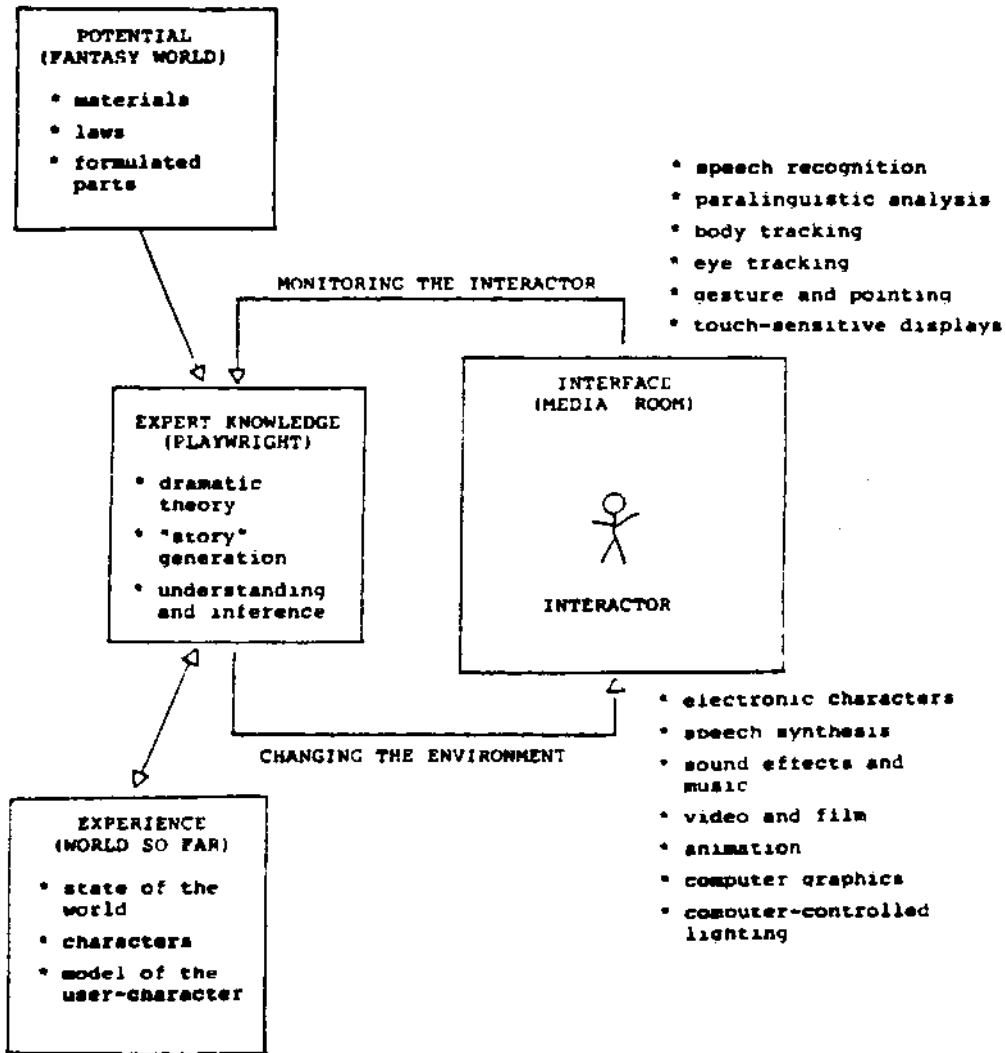
POTENTIAL
(FANTASY WORLD)

* materials
* laws
* formulated
  parts

* speech recognition
* paralinguistic analysis
* body tracking
* eye tracking
* gesture and pointing
* touch-sensitive displays

MONITORING THE INTERACTOR

EXPERT KNOWLEDGE
(PLAYWRIGHT)

* dramatic
  theory
* "story"
  generation
* understanding
  and inference

INTERFACE
(MEDIA ROOM)

INTERACTOR

CHANGING THE ENVIRONMENT

EXPERIENCE
(WORLD SO FAR)

* state of the
  world
* characters
* model of the
  user-character

* electronic characters
* speech synthesis
* sound effects and
  music
* video and film
* animation
* computer graphics
* computer-controlled
  lighting

Figure 7-1:   Overview of an Interactive Fantasy System

represent take place. The author of an interactive fantasy world, however, must cope with the additional requirements of the interaction. In a play or story, the author need only create those portions of the world which will be used by his characters. The author of an interactive environment must create a world that will support choices and actions on the part of the user-character which the author may not have foreseen. If the user is to have the widest degree of freedom in the interaction, the author must ultimately specify laws by which new environments and characters can be created, as conceiving of (and storing) representations of all possible phenomena in an imaginary world is an impossibility.

The representation of the fantasy world to the user may take several forms. In many computer-based adventure games, the world is represented in textual form on a screen. In other computer games, graphics, animation, and sound are used to represent the characters and the environment. The first-person requirement of the proposed system suggests that the ultimate representation should have first-person sensory characteristics; that is, that it should occur in three-dimensional space and should invoke all the senses of the user.

Whatever modes of representation exist in the interface

environment, a further functional requirement of the system will be to provide the means for translating the author's description of the world into a representation of that world for the user.   Currently, it is the work of humans to interpret that descrition and then to prepare materials in a variety of media to represent it, much like the creation of sets and costumes for a film or a play.[13]

2.2 Make the Experience Interactive

The interactive requirement means that the system and the user must be able to mutually and reciprocally influence the action. The "action" is composed of the events in the story that is unfolding during the interactive experience. The implication, then, is that the interaction must be manifest on the level of plot. The first-person requirement further implies that that interaction must occur in "real time;" that is, there may not be a perceptible delay for the processing of interaction (such a delay would constitute a destructive interruption of first-person experience).

Dramatic form employs enactment as its manner of imitation; therefore, the system should ultimately require no symbolic (i.e., non-enacted) inputs from the user. In

---

[13]
A description of a multi-media interface environment is provided in Laurel and Hulteen, "Simulation of an Interactive Fantasy System," p. 1.

concession to the limitations of current technology, however, a principle can be expressed that will maximize the ability of the interactive design to meet the dramatic requirement: because interaction must occur in the context of the fantasy itself, it follows that all communications between the system and the user occur in the modes in which the fantasy is represented. (This principle applies to traditional works as well: a novel, for instance, exists in a textual "mode," and its user interacts with it by reading.) If the fantasy world is represented in graphical displays and animation, for instance, the system may not require the user to interact in a textual mode. The medium of communication is the fantasy itself. If the world of the fantasy includes speech from the user, then the system must employ speech recognition and natural language processing techniques.

The plot, the selection (or creation) and arrangement (or order) of incidents in the experience, is successively formulated as action flows through the system. The interactive function of the system necessitates the design of structures for communication between the user and the system that can elicit and interpret the kind of information which is required for the synthesis of the plot. Because the informational criteria are essentially dramatic in nature, the interactive and dramatic functions of the system

are closely related.

2.3 Make the Experience Dramatic

2.3.1 Access to the World

The interactive, real-time synthesis of plot constitutes the central dramatic function of the system. To accomplish that funtion, the system requires access to all the elements of the fantasy world, as created by the author. That information describes the dramatic potential and delimits the range of possible events and actions within the plot.

2.3.2 Sensing the User

Because the choices and actions of the user-character provide materials from which the plot is created, they can be seen as contributions to material causality in the system. A functional requirement of the system, then, is to be able to receive and formulate (give dramatic form to) those contributions. Material contributions on the levels of spectacle, music, and diction must be sensed directly (with the use of such techniques as body tracking and speech recognition). User contribuitions that are of the nature of thought and character must be inferred by some intelligence within the system itself.

2.3.3 System Knowledge and Inferential Capabilities

The system must have a way to know what is going on with the user, the other characters, and the environment. It must create an internal representation of what has happened, what is happening, and what is likely to happen. In the latter case, the system must have a way to predict possible courses that future events will take, and to assign a probability to each predicted course.

The system must be able to interpret its knowledge of the past, present, and future course of events in a variety of ways. In order to construct a dramatic plot, it must be able to formulate and dynamically revise a description of the central action of the plot; that is, the whole action of which the events in the experience are parts. Further, it must be able to construct a logical hierarchy of actions and to trace the causal relations among them.

2.3.4 Dramatic Expertise of the System

In the creation of the plot, the system must be able to make several kinds of predictions and decisions. In order to create and maintain dramatic structure, the system must be able to predict the probable shape of the whole action. In this way, the system provides for itself an ad hoc version of the finished piece which can contribute to formal causality.

The system must be able determine what should happen next. Incidents generated by the system must conform to a variety of dramatic criteria: they must be appropriate in terms of the action being represented (material criteria), in terms of the evolving dramatic structure (formal criteria), and in terms of their probable effects on the course of the action (causal criteria).

The system must know the nature of and be able to produce beginnings and endings. That task requires the afore-mentioned ability to identify the central action of the piece. Another dimension of the task is the ability to stimulate the user's cooperation in creating a beginning or an end for the experience.

2.3.5 Creating and Animating Dramatic Characters

Except in those fantasy worlds where there is only one character (portrayed by the user), the system is responsible for creating and animating other dramatic characters. Some characters may be explicitly required by the fantasy world itself; the world of Star Trek, for example, always includes a   Spock." The possibility for creating other characters may also be allowed by the fantasy world, and in those cases, the system must be able to create them according to the laws of the world and the exigencies of the particular action unfolding in the interactive fantasy experience.

Characters are imitations of agents, and are differentiated from one another by their unique traits and predispositions. The system must represent those traits and predispositions for each character in actionable ways. Characters are also defined in terms of their goals and states. The system must be able to assess and influence the goals of each character and to monitor the changes in the various states of each character as the action proceeds. For each character, the system must also maintain information about his relationships with the other characters (including the user-character) and the state of his knowledge about the world.

Characters in the system may have varying degrees of intelligence, or self-motivation. They may be animated by the system either as puppets, or as self-directed agents whose actions are relatively autonomous. Given traits, goals, and predispositions by the author, for instance, characters may be most effectively animated by giving them the intelligence to produce speech and make choices in certain types of situations. Examples of such "intelligent, electronic characters" exist in some artificial intelligence programs. Other researchers are attempting to create

---

14
    See, for example, Meehan, "The Metanovel," and Joseph Weizenbaum, Computer Power and Human Reason: From Judgment to Calculation (San Francisco: W. H. Freeman, 1976), Introduction and Chapter I.

electronic pesonalities who are capable of generating their own graphical images and representing their actions through animation.[15]

2.3.6 Maintaining Formal Control of the User-Character

An important function of the system is to prevent the user-character from introducing new potential into the fantasy world; materials that are not represented in the fantasy world or admissible according to its laws cannot be handled by the system. Hamlet may not draw a laser weapon: a system operating on the knowledge of Hamlet's world would not know what a laser weapon is.

To prevent the breakdown of the system or the necessity for second-person communications, the system must employ the plot to influence the internal probability structure of the user. The system must be able to create, through the plot, lines of probability that will draw the user away from "fatal" mistakes. While it cannot be asked to prevent acts of perversity or vandalism on the part of the user, and even though some willingness on the part of the user to cooperate with the system can be assumed, the system is solely

---

[15]
Research projects involving self-motivated, self-representing characters are being conducted by Ann Marion, Susan Brennan, and others at the Atari Sunnyvale Research Laboratory; reports forthcoming.

responsible   for   guiding   the   action   in   a   dramatically
interesting direction.

In   other   words,   the   system   must   assume   ultimate
responsibility   for   playwriting.   As the master of the plot,
the system has control of the form the experience may   take.
This formal control is necessary in order to guarantee that
the structure of the piece is dramatic. It is also necessary
in order to maximize the pleasure of the user.   Theatrical
improvisations   of   the   classroom   variety   are   seldom
satisfying because the   actor   must   perform   two . different
functions   at   once,   thus   giving his full concentration to
neither.   He   cannot   lose   himself   in   the   experience   of
creating   a   character   because   he   must keep an eye on the
development   of   the   plot;   he   cannot   enjoy   the   act   of
playwriting   because   he   is   constantly   distracted   by   the
requirements of acting.   By assuming formal control   of   the
experience,   the   system   frees   the user to immerse himself
fully in the experience of his character.

2.4 Postscript and Focus of Future Work

papers in this   series   will   treat,   first,   the
extensions of   dramatic   theory   that   are   required   to
accommodate interactive structure, and second, the design of
the Playwright, the portion of the system in which   dramatic
expertise resides.   The objective of the series is to arrive
at   a   structural   model   of the Playwright and to delineate

relations between the Playwright and the rest of the system. A simulation of the IF system in operation, using a human in the role of Playwright, is planned by ASRL, to be used variously as an aid in modeling the Playwright, a means for refining the overall system design, and a way to create a sensible example of the kind of experience that the IF system is intended to enable.