ATARI RESEARCH MEMOS
on the subject of

INTERACTIVE FANTASY

and related topics

Brenda Laurel
Atari Sunnyvale Research Laboratory
March 1982 - November 1983

IF at the Atari Lab

The Atari Sunnyvale Research Laboratory was founded by Dr. Alan Kay in early 1982. The charter of the Systems Research Group was to do research about and develop prototypes of entertainment products and environments for the 1990's. The lab was extremely well-funded and staffed with many of the brightest and best of the Atari community, recent graduates of the Media Laboratory at MIT, and other fledgeling wizards.

This collection of papers documents my early research in interactive fantasy systems. Important contributions were made by several of the members of the Atari Systems Research Group. Eric Hulteen designed and implemented a media room environment and collaborated on much of the theoretical work. Members of the research staff, especially Michael Naimark, Susan Brennan, Scott Fisher, Chris Crawford, Alan Kay, Dr. Arthur T. Fischell, and Jim Dunion were instrumental in the development of the interactive fantasy concept. Outside the lab, other key contributors were Jeffrey Schwamberger, Clyde Grossman, Professor Donald R. Glancy of Ohio State University, Doug Lenat of Stanford University, and Ray Bradbury. My deepest thanks to all of them for their wild brainstorms, thoughtful analyses, and enduring optimism.

These papers are copyrighted by me because they were never officially published or copyrighted by Atari. They should be cited as unpublished papers. They are arranged chronologically and most have titles. Many had Atari Research Memo numbers at one time, but the numbering system has not survived the last several years. Luckily, the author has.

Readers should know that these papers represent preliminary work. The bulk of my work in this area was created after the lab's demise and is published in my Ph.D. dissertation, "Toward the Design of a Computer-Based Interactive Fantasy System", The Ohio State University, 1986. The dissertation contains a formal discussion of the theory of IF, a survey of component technologies, and a proposed system architecture. It also contains a bibliography of resource materials and other IF research.

FIRST-PERSON SIMULATIONS AS LEARNING ENVIRONMENTS

Brenda K. Laurel

March 15, 1982
Atari Sunnyvale Research Laboratory

Prepared for the NSF/NIE Conference on
Educational Computing, Berkeley,
April, 1982.

FIRST-PERSON SIMULATIONS AS LEARNING ENVIRONMENTS

INTRODUCTION

I would like to explore and expand upon the recommendation found in section 1.2 of An Agenda for Action formulated by the National Council of Teachers of Mathematics: ". . . as new technology makes it possible, problems should be presented in more natural settings or in simulations of realistic conditions." The Council has expressed the awareness that the adults of tomorrow must be equipped to solve problems and make choices in "high-technology" occupations, and that simulations are effective tools for developing the necessary problem-solving skills. I want to explore the strengths of interactive simulations as learning environments, analyze the particular strengths of first-person simulations, and discuss the powers of the form and their real-world consequences. Ultimately, I want to identify the ethical potential of simulations and examine its implications as part of the problem-solving skills that today's student will bring to bear on the real world.

INTRINSIC MOTIVATION

In his thesis, "What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games" (XEROX Cognitive and Instructional Sciences Series CIS-7, 1980), Thomas W. Malone supports the thory that the quality of intrinsic motivation optimizes the effectiveness of learning environments and activities. Among the key characteristics of intrinsic motivation identified by Malone are challenge, fantasy, and curiosity. In other words, an intrinsically motivating activity engages the user on those levels.

Dr. Caleb Gattegno and others have suggested that learning is [illegible] enhanced by providing rich sensory involvement with the learning activity -- visual, auditory, tactile, and kinesthetic. If all of the above elements are combined, they lead to the hypothesis that learning is optimized in the presence of qualities which engage the whole person in the learning activity. Stated thus, the theory is at least as old as Aristotle and has been argued successfully for centuries.

It is easy to see how an interactive computer simulation can

incorporate most of the above characteristics, including the elements of sensory stimulation, multiple levels of difficulty, and stimulants of curiosity such as novelty and complexity. Excellent models already exist in the category of games. The element of fantasy in computer simulations, however, has powers and applications beyond those usually recognized by software designers. Fantasy is seen by Singer (19xx) as a means of susstaining a high level of mental arousal or involvement, and by Arnold (1979) as a means of suspending a child's learned assessments of the nature of possibility and thus of his own limitations.

FANTASY, IMITATION, AND CHARACTER

The presence of fantasy in an educational computer simulation would seem to violate the NCTM recommendation that "problems should be presented . . . in simulations of realistic conditions." But unless the computer simulates exactly what a child of eight would do in the absence of a computer, the element of fantasy is already involved. The real question is how does fantasy work in a learning activity, and how can its powers be employed to teach the problem-solving skills needed in the "real world?"

Aristotle observed in the Poetics that humans learn by imitation. To imitate is to engage in first-person fantasy: "What if I were a flower, a cowboy, a mommy, or a starship captain?" It would seem to follow, then, that the most educationally powerful simulations are those in which the user has a first-person role; that is, the user acts as a character in the action of the simulation. But how does the simulation shape the first-person fantasy, or character, of the user?

In answering this question, the similarities between a simulation and a drama are instructive. A simulation, like a play, is an imitation of an action made up of a series of incidents. Characters move the action forward by making choices and acting upon them. In a play, the form that the character's actions will take is defined by the form of the plot -- the series of incidents that make up the whole action. The material of "stuff" of which the character's actions are made is the matrix of words and thoughts offered up to him by the world of the play. The actor, however, may not interject his own skills or judgments into the character; the imitation is "closed" by the script. A simulation is very much like a play, except that the "stuff"

available to the user for formation of his character includes not only the materials offered up by the world of the simulation, but also his own knowledge, skills, and faculties. The events that occur on the basis of his choices and actions are not fixed in a script, but flow from the interaction. In this sense, the simulation is an "open" form. The user has a double matrix of possibilities for action.

CHARACTER AND CHOICE

The ability to climb into a role or character in a simulated environment may "engage the whole person" in one imaginative stroke, presenting at once a new world of conceptual and sensory materials and a rich matrix of new possibilities. The applicability to real-world problem-solving seems clear: simulations can provide opportunities to develop the skills needed to assess new situations and to conceive of new problem-solving strategies. What may not be clear are some of the other levels of learning that are accessed by first-person simulations and the strengths and dangers inherent in them.

A great deal of work has been done to extend the levels of cognition accessed in learning activities "downward" from the computational and rational to include the intuitive and sensory. What is not acknowledged is that as we move from the abstract to the concrete, from columns of figures to contextual problems involving whole actions and whole people, we are also engaging the upper levels of analysis and choice-making in a world charged with meaning.

In the protean game of "Hammurabi," the user plays the role of king, with the task of controlling resources in order to satisfy the populace and maintain his position of power. That he must exercise particular mathematical skills and concepts is fairly obvious. In some versions of the game, he may even be encouraged to access the compter as a tool for more complex calculations, thus learning something of the uses of the computer in problem-solving activities. But what he is also learning by default in all versions of the game that I have seen is that there are acceptable levels of death by starvation which must be incorporated in the "winning" strategy.

Characters make ethical as well as expedient choices. In the imaginative leap that engages the whole person of the

user, the ethical category is opened, and what may fill it is something that the designers of the game neither perceived nor took responsibility for.

Should some other ethic have been wired into the "Hammurabi" simulation? Must teachers of mathematics now assume responsibility for identify appropriate ethics for their students? What happens when a "good" ethic is wired in?

In the game of "Star Raiders," the user must blow up as many enemy ships as he can in order to protect the galaxy. There is no "negotiation" option. There is no interaction on the ethical level. The user's choices are binary: either blow up the enemy ships and win, or don't and lose (or be perverse and blow up your own starbases). Although the ethical stance ("protect the galaxy") may be deemed acceptable, the ethical faculty has not been exercised or developed; it has simply been defined by default.

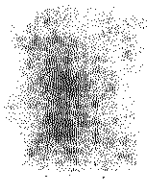
Are such scenarios really conducive to the development of problem-solving abilities that are applicable to the real world? How will they serve the genetic engineer, the nuclear physicist, or the concerned citizen of tomorrow?

FACING THE ETHICAL COMPONENT OF SIMULATIONS

The ethical component of first-person simulations is real. As an element of intrinsic motivation, it is powerful. In the skills matrix of real-world problem solving, effective use of the ethical mode is enormously important, both in the process of formulating key questions, and in the ability to visualize and evaluate consequences. The question for software designers and teachers is not whether the ethical dimension exists, but how the ethical faculty can be exercised and developed to the end of effective problem-solving in the real world.

Part of the solution is flexibility: educational simulations should allow the user to play with different ethical sets and to observe their consequences, or to formulate explicitly the ethical dimensions of the problem. Programs must be designed to recognize user strategies and demonstrate their implications. The path of possibility from choices on any level must be demonstrated in the first-person mode. Finally, the ethical component should be opened up for user interaction and discovery.

The first and most important action we can take is to become aware of the ethical dimension inherent in the form of first-person simulation. We must observe how it is defined, who defines it, and what -- whether we like it or not -- is ultimately being learned.



RESEARCH PROPOSAL: THE POETICS OF INTERACTIVE FORM

The objective of the research is to analyze the powers of certain interactive works as art. We sense intuitively that interactive works can have art-like powers--the ability to arouse emotions or to stimulate a sense of beauty, for instance. The goal is to identify those powers, and then to discover the formal and structural mechanisms through which they are realized.

The similarities between certain interactive works and dramas are striking, and they suggest that the existing body of dramatic criticism can provide a place to begin the work of analysis. We can identify a class of interactive works that are mimetic; that is, they imitate actions, things, and events that do or might occur in some real world (the worlds of Oedipus, Hamlet, and Frodo Baggins are equally "real" in the sense of dramatic probability).

We can identify a sub-category of mimetic works whose primary intentions involve entertaining, engaging, or pleasing the humans who play with them, thereby excluding works whose goals are exclusively computational, analytical, or even instructional. The resulting class may be called poetic, and it includes many games, computer-generated worlds, simulations, and a whole host of unborn genres.

Within such poetic works, we can identify elements that correspond to the primary elements of the drama:

SPECTACLE:	everything you see
MUSIC:	everything you hear
DICTION:	meaning-bearing signs and symbols
THOUGHT:	mental processes implied by what is said and done
CHARACTER:	a bundle of traits or predispositions to act in a certain way
PLOT:	the whole action being imitated

Likewise, we can investigate interactive works in terms of some traditional aesthetic criteria, such as:

MAGNITUDE:	of a size that can be taken in by the viewer, so that it may be perceived as beautiful
RHYTHM:	the pleasing arrangement of action over time
WHOLENESS:	organic unity

(next page)

The straightforward application of such critical concepts can help us assess the quality of interactive works in ways that are already different from the standards that are normally applied ("human factors" criteria, focus group results, product test criteria, etc.).

The most interesting part of the research, however, requires the formulation of new theories in areas where linear dramatic and interactive forms diverge: the realm of the user as an agent in the dramatic action. Our understanding of the drama depends upon the plot as the whole action and formal cause of the piece. By formal cause, we mean that which provides the organizing principle for all of the other elements of the piece. But what happens when the shape of the whole action is variable, depending upon the real-time choices of an intelligent agent who exists at once inside and outside the work? Is it possible to design a scheme of probability, a frame for user action, that can still provide the necessary organizing principle? Or will the intrusion of that willful agent blow the form apart? What we are seeking is a structural understanding of beauty in a made thing that accomodates the unpredictable.

The preliminary work on this question is theoretical. By playing with the dynamics of formal and material causation, we should be able to arrive at a theoretical model. That model might take the form of a mutable character, defined in terms of both dramatic probability and degrees of freedom. From there we should be able to predict the structural effects of mutable character on the piece. The next step will be to create a "living" software model that we can observe and tweak. The criteria for success will be aesthetic in nature: questions of magnitude, wholeness, and other principles of beauty can be applied. Of course, we will want to ask the obvious: "Does the piece work as art in every instance? Is it emotionally satisfying? Organic? Pleasing? Beautiful?"

For the known and potential uses of our medium, the implications are quite powerful. Perhaps we can learn how to invoke the powers of empathy, emotional arousal, and catharsis in such "open-ended" works. Can we find a real-time aesthetic that will transform our hybrid efforts into a new way of making art? Can we employ computer technology to exponentiate artistic pleasure and richness as it has informational and computational power?

I believe that we can. The form has tremendous powers that we have yet to actualize, and that actualization depends as much upon new artistic theory as upon new technology. The idea of mutable character is but one facet of our new "poetics." The introduction of that or other equally powerful concepts may allow us to systematically transform the poetics of linear drama into a comprehensive theory of interactive works as art. That is my hope.

(next page)

What form can we expect the proof of such a theory to take? A single exemplary work could be "merely" serendipitous. One thing we can do is apply our new theory, in the form of criticism, to existing works and evaluate the effectiveness of subsequent transformations. Numerous candidates exist! A more generative application of theory lies in the design of authoring environments. To some extent, every work reflects the assumptions inherent in the tools used to build it. Most computer programs reflect the logical/mathematical grammar of their authoring languages; many shortcomings in human factors are attributable to this bias. With an art-based theory of the nature of interactive works, we should be able to construct an authoring environment that emphasizes dramatic and aesthetic principles over logical/mathematical ones. Such an environment would open the medium as a creative palette for non-engineering-oriented artists. An interesting proof of our theory would be a work, employing the full power of the medium, created by Ray Bradbury, Arthur Miller, or Frank Frazetta with such authoring tools.

The user-participatory possibilities inherent in interactive form appear to obscure its status as art. When the line between artist and audience/user becomes blurred, things tend to collapse in chaos. The artist, sensing loss of control, may simply walk away from the form as a dead-end experiment. The haphazard interaction of audience members in sixties' theatrical experiments like "happenings" and some performances of the Living Theatre created just such un-beautiful, inartistic experiences; both genres have disappeared. But when the energies of artist and audience/user are woven, as thesis and antithesis, into a new artistic whole, the possibility exists for an artistic synthesis in which real formal evolution can occur. Jerzy Grotowski's Poor Theatre, for instance, casts audience members in choral roles, providing a means for dramatic integration of their participation which enhances rather than erodes the artistic power of the new theatrical form.

We brush against these questions every day in our work in human factors, game design, and even artificial intelligence, but we rarely conceptualize them as artistic questions. The tremendous body of knowledge in literary and theatrical criticism, as well as theories drawn from linguistics and structuralism, can surely inform our efforts to find "what works."

B. Laurel
12/10/82

INTERACTIVITY

Conversation with Michael Naimark, 4/6/83

IMPLICIT VS. EXPLICIT INTERACTIVITY: Naimark sees this as a major distinction, and presented the following examples:

A. A user may select one of thirty video "channels" (offerings, pieces) by pressing one of thirty buttons. The channel of his choice is then displayed on the (single) monitor.

B. A user may select one of thirty video channels by deciding which of thirty video monitors, each displaying a different channel, that he wishes to attend to.

Case (A) is "explicit;" case (B) is "implicit." A goal would seem to be to strive for systems that operate with implicit interactivity; that is, the user is never asked to step back and make an explicit choice.

SIMULTANEITY

How might implicit interactivity be expressed? Naimark noted that Andy Lippman, current head of MIT AI lab, believes that the quality of "simultaneity" is criterional of true interaction. By this he means that the user and the system must be simultaneously monitoring one another. The interaction is an ongoing collaboration, with "inputs" (lousy word) from both parties (user and system).

This is related to the idea of a system that "models" the user in some way and implements implicit (potential?) choices by noticing how the user is behaving in relation to the system--his learning or browsing styles, for instance, or his apparent skill level (in the case of a game or CAI activity). This scenario is a bit insidious.

OBSERVATIONS

I think that the implicit/explicit distinction is a useful one, but insistence on implicit interactivity as Naimark defines it might preclude some forms of overt choice-making that could be pleasurable. The distinction can be made finer in the context of interactive drama.

To have the experience of behaving like a character inside an imaginary world, the user must be allowed to make explicit choices in the PERSONA of the character. Assuming a WILLING

SUSPENSION OF DISBELIEF, then those choices are made in the first person. The operand(s) of those choices should always be within the imaginary world itself; that is, the user should not be required to have explicit interaction with the SYSTEM or to make choices at the system level.

Rather than defining choices made by the user "in character" as a subset of what we have called explicit interaction, it would be more productive to posit the existence of a third category of interaction: DRAMATIC INTERACTION. We will use the term "explicit interaction" to refer to those choices made at the system level, and not within the context of the imaginary world that the system imitates. We will use the term "implicit interaction," as we have defined it above, to refer to those cases where the user's influence on the system (and thus on the experience itself) is accomplished indirectly, without the overt expression of choice. An example of implicit interaction in the context of interactive drama would be the modification and subsequent impact of probability heuristics within the system.

(SEE color diagram, "KINDS OF INTERACTIVITY", 4/6/83)

The most important distinction among the three can be expressed as the EXPERIENCE OF PERSON-NESS. We wish to preclude "explicit interaction" because we sense that it is intrusive--that it interrupts or even destroys the user's ongoing exerience by forcing him to shift his attention to another order of problems. This is why branching interactive movies, videodiscs, or software packages feel like a kludge. Once the user is "inside" the interaction, we want him to stay there and be perfectly comfortable; in other words, we want him to be having a "first-person" experience.

In dramatic interaction, then, the user stands in first person relation to the experience. In explicit interaction, the user operates in second person relation to the system, making, as it were, imperative statements to it. In implicit interaction, the user feels himself to be in third person relation to the system, as he is not invited (or able, unless he is very clever) to attend to or control the way he is impacting the experience.

THE MIDDLES ARE BORING

Conversations with Naimark, #2
4/13/83

"The middles are boring" is a direct quote from Dr. Alan Kay, and an observation that holds true in a wide variety of contexts. In an "interactive branching" scenario, whether in computer or videodisc software, the response of the system that directly follows the user's choice/action at a "node" provides the user with a "first-person rush"--an immediate sensation of interactivity or power. Lipmann observed the phenomenon of this "rush" at the branch points in the Aspen Disc: when a user directs the system to "turn left," it is the actual turn--the transition which immediately follows the choice--that is such a pleasurable moment. The linear sequence which follows the choice node; that is, the journey through the movie-map to the next corner or node were choice is possible, is comparatively boring.

In most current interactive computer software, the same phenomenon occurs. The location of the choice "node" is, if not explicit, at least quite poorly camouflaged and readily apparent to the user. In the case of most current models of interactive fiction, for instance (the text adventure game is a good example), the user knows that once he has made his input, he must now sit back and view the results. In all but the best of systems, those results are also quite obviously predetermined, implying that the user choice has been forcibly interpreted as one of a finite set of anticipated responses.

The net effect may be expressed as a disruption in the experienced person-ness of the interaction (SEE interact.x for a discussion of kinds of interactivity). Following the choice node, the user passes quickly from a first- or second-person experience to a third-person one.

At this point it may be worthwhile to try to describe how a third-person experience feels to the user. Moving back to the grammatical model for a moment, we notice that by "third person" we mean the pronouns, he, she, it, and they. Now, in every "interactive" experience the assumption is that the user is a participant. In a third-person experience, however, there is no "I" to feel or act; there is not even a "you" that might denote the system's recognition of my presence. Either I become invisible to the system in that it is ignoring me completely, or I am suddenly dragged through the portal--through the proscenium arch, as it were--to be one of the many he-she-it entities on the other side.

It is no wonder, given the existential implications of this

predicament, that sudden shifts to the third person can cause a certain malaise. The obvious aesthetic consequences of such a disruption are but a superficial subset of the cognitive ones: the user is literally yanked into a view in which he completely disappears.

(NEXT: How videogames succeed.)

Inter Office Memo

CORPORATE DIVISION
Corporate Research

To: Distribution

From: Brenda Laurel

Subject: HUMAN/DOLPHIN FOUNDATION Date: 11/16/82

WILD SPECULATIONS:

Interspecies Game

Is there a video game we could imagine that a human and a dolphin could play together? Of course, HCD couldn't sell it (without an extensive marketing effort to get hardware into dolphin homes, or into all those joints where humans and dolphins hang out together). However, such a game would let us ask some real basic questions about the nature of interaction and "fun." We could also ask some esoteric ones about the nature of imitated action, semiotic thresholds, cognitive and kinesthetic response patterns, etc. etc. All this in addition to the obvious questions about interspecies communication!

Spinoff Game

Successful design/implementation of the above would give us enough data about dolphins to simulate a dolphin persona inside a video game for humans, yielding a superb learning/game product, based on a topic with tremendous popular appeal.

Thoughts

Seriously now, folks, this is just crazy enough to be great. I suggest that Sandra and I and whoever else is interested go brainstorm with the Lilly folks and come up with two proposals: one for research, and one for a consumer product. Whaddaya think?

Distribution:

Steve Arnold
Kristina Hooper
Alan Kay
Ted Kahn
Mike Liebhold
Ann Marion
Bob Stein
Sandra Williams
Steve Weyer
Jeff Sarnoff

BL:jck

The "Tool" Metaphor
Some Speculations

B. Laurel
6/20/83

The idea of computers (and/or software) as tools has been the most pervasive metaphor applied to the technology from its inception. I want to start by suggesting that "tool" as a idea does not describe the whole potential of computing power; there are kinds of computer uses and experiences that are possible which are not at all tool-like. In fact, the tool metaphor is often destrictive because it induces us to build inappropriate and dysfunctional interfaces.

Let's start by thinking about what we mean by "tools." I can think of three varieties right off the bat, and I'm sure there are more, distinguished by their functions and uses.

The most common sort of tool (at least until quite recently) is what we might call a concrete tool. Its function is to manipulate real-world objects. The desired outcome of its use is also an object or event in the real world. The function of a hammer, for instance, is to drive or extract nails; the desired outcome of its use is to construct or dismantle real-world objects. The function of a pen is to apply ink to a surface in a controlled way; the desired outcome is to create text or drawings.

A second sort of tool might be called a perceptual tool. Its function is to augment our sensory capabilities. The outcome of its use, however, may or may not be a real-world object or event. A microscope, for example, extends our visual perception. It may be used to learn more about the nature of cells ("pure" science) or to isolate a disease agent in order to affect a cure ("applied" science).

A third kind of tool can be described as a symbolic tool. It neither manipulates nor amplifies real-world phenomena, but rather operates on symbols. Like a perceptual tool, the intended outcome of its use may be "pure" or "applied." The calculator is an example.

The important thing to notice is that for each of these kinds of tools, the function is distinct from the outcome. One rarely uses a hammer for the sheer joy of randomly driving nails. If that were the intended use of a hammer, we would probably describe it as a toy rather than a tool.

The difference between a toy and a tool is just this: for a toy, there is no distinction between function (what it DOES) and outcome (what we want to accomplish by doing it). The experience of the toy's function is pleasurable in real time. The function

IS the outcome. The same thing may be said of art.

Computers and software can indeed be used as tools. A word processor, for example, has the function of creating and editing text, and the outcome of producing documents, files, code, etc. A calculation program does not significantly differ from a calculator or an abacus in terms of function and outcome. In these instances, the computer may be said to emulate or provide enhanced versions of other kinds of tools. Although such tool-like uses of computers may be functionally more complex and efficient and may produce outcomes that are much greater in magnitude than those of the tools they emulate, the basic natures of their functions and outcomes remain the same, as does the distinction between them.

Such applications are, as we know, a subset of what computers can be made to do. Some applications, like adventure games, we might describe as "toys." Others, like synthesized music, could be described as "art." If we wish to persist in defining the computer itself as a tool, then the associated functions and outcomes must encompass all such uses (more of this later).

How, then, is the tool metaphor destructive? Let's consider an example of a computer activity: the garden variety adventure game. The function of the program is to allow the user to "play" in an imaginary world. She moves through unknown spaces, usually with the goal of gathering treasures, while avoiding or overcoming obstacles and gnarly monsters. The outcome of the experience is the experience itself -- the pleasure of the activity in real time (expertise gained through repeated use serves to enhance this pleasure).

But let's look at what the interface is telling us about the functional qualities of the program. The user may press "N" to move north, for example, or "(control)lobj" to view a list of objects. If she wants to change the qualities of her magical sword, she may suspend play, view and manipulate a list of attributes, then re-enter the action of the game. In this view, the interface functions to allow the user to communicate with the program, as distinct from pursuing that "pleasurable experience" which we identified as the outcome. Thus the interface creates a tool-like distinction between function and outcome in a context where, as we have observed, they are theoretically one in the same.

This inappropriate distinction is an artifact of the tool metaphor. If we think of something as a tool, we assume its function and outcome to be distinct. The tool-like "access language" of the interface is pulled into being by the force of the metaphor. The result is a kind of estrangement, a distancing from the very experience that is the whole raison d'être of the program. This habit of mind, more than hackerliness or the "state of the art," explains the common weaknesses of the human/computer interface.

To return to an earlier question, if we try to think of the computer itself as a tool, how do we define its functions and outcomes? I suggest that its function is to represent a wide array of phenomena, including tool-like and un-tool-like activities. The outcome of its use, it seems to me, is the representation iself. This is the meta-level that I think we fail to grasp. Even when we use the tool metaphor appropriately in particular applications or activities, we invoke it inappropriately in our image of the technology itself. An example of this phenomenon is a piece of file management software being worked on by some of the people Kristina and I encountered at UCSD last week. The "interface problem" was described by one of the programmers thus: "How do we make it easy for the secretary to know what "\\'del" is good for?" Thus, even in a tool-like activity, functions are split from outcomes at the whole-system level so that the "access language" does not manage files, but rather talks to the file-management program!

The tool metaphor at the highest level dooms us to the recursive nihtmare that plagues every discussion of human/computer interface.

(Next flame: New Metaphors)

:I: Notes
Exerpts from Two Interactions

B. Laurel
7/5/83

NOTE: The text in UPPER CASE represents user input. Gestures, visual output, etc. described in the "stage directions" in parentheses.

* * * * * * * * * *

(Looking out forward view screen at long-range view of planet) MR. SPOCK?

SPOCK: Unfamiliar technology and code, captain, but the distress signal appears to have originated here (viewscreen shows magnification of equitorial region, with blinking pointer).

FALL INTO STANDARD ORBIT, MR. SULU. LIEUTENANT UHURA, KEEP SENDING THAT REPLY AND LET ME KNOW THE MINUTE YOU ESTABLISH CONTACT. MR. SPOCK, DR. McCCOY, MEET ME IN THE TRANSPORTER ROOM. (Turns to Intercom) SECURITY --?

REILLY: Yes, Captain?

TWO ARMED SECURITY PERSONNEL TO BEAM DOWN WITH US -- IN FIVE MINUTES.

REILLY: Yes sir.

(Flips off Intercom, returns to first-person visual of the bridge; moves to lift; sound of doors closing behind) TRANSPORTER ROOM. (Sound of lift engaging)

IF THAT DISTRESS CALL IS GENUINE, WE ARE GOING TO HAVE TO INTERVENE IN THEIR CIVIL WAR TO AVOID THE COMPLETE DESTRUCTION OF ONE OF THE SENTIENT SPECIES ON THE PLANET.

"I don't have enough information to consider violating the prime directive -- better not pursue this line of thought until I get down there and see for myself."

RIGHT. (Lift doors open; visual scan of corridor; walks to transporter room. SPOCK, McCOY, and SECURITY GUARDS are already in place to beam down. Walks to transporter platform). ENERGIZE. . .

* * * * * * * * * * * *

BUILD A WORLD, PLEASE . . .

"Right. I'm listening."

USE WHAT YOU KNOW SO FAR ABOUT MY FAMILY AND GIVE ME WHAT YOU CAN PUT TOGETHER ON 1966. IN THE KITCHEN, EVENING, MOM AND DAD AND ME SITTING AROUND THE TABLE.

"Right. I have personality information on your parents and I know something about what that kitchen looked like. How's this?"

GOOD. MAKE THE TABLE A LITTLE BIGGER, AND MAPLE, NOT WALNUT . . . THE WINDOWS ARE RIGHT BUT THE CURTAINS SHOULD BE ORANGE, AND CLOSED . . . SHE ALWAYS KEEPS THEM CLOSED.

"I'll remember that." (Screen image is adjusted)

HERE'S THE SITUATION. JIM AND I HAVE BEEN OUT IN MY CAR LAST NIGHT. THIS MORNING MOM FOUND HIS WALLET AND COMB IN THE BACK SEAT . . .

"Excuse me, can you tell me something about Jim?"

OH YES . . . JIM MARTZ . . . YOU SHOULD BE ABLE TO FIND HIM IN THE DIARY . . . HE WAS MY STEADY BOYFRIEND SINCE '64 . . .

"Right. Go on . . . "

SO MOTHER FINDS THIS STUFF AND DECIDES THAT WE ARE SCREWING. SHE DECIDES TO FORCE US TO GET MARRIED. HERE'S THE DIALOGUE AS I REMEMBER IT . . .

(Reports a 5-minute dialog)

YOU GOT THAT?

Yes. What do you want to do?

OKAY, PLAY ME WHAT YOU HAVE AND I WANT TO JUMP IN ABOUT THE TIME SHE SAYS "WE WILL GIVE YOU YOUR BEDROOM FURNITURE AND TWO THOUSAND DOLLARS . . ."

Okay. Ready?

(Dialog begins, goes on for a few minutes)

MOTHER: . . . and we will give you your bedroom furniture and two

thousand dollars . . .

WAIT A MINUTE, MOM. I DON'T THINK IT HAS TO WORK OUT THIS WAY. WHAT WOULD IT TAKE FOR YOU TO FEEL BETTER ABOUT THIS . . . ?

(At this point the dialog begins to diverge from the original scenario . . .)

* * * * * * * * * *

Notes on Interestingness in Interactive Stories: Some Playwriting Principles

B. Laurel
Created 8/11/83
Last Revised 8/12/83

Overview

The idea of attaching an intelligent playwriting system to an extant story generator is attractive for several reasons. The problems of representing characters and providing the means for them to make choices that are manifest in action are largely solved, at least conceptually, in a system like Meehan's Tale-Spin. Further, the character and thought levels of Tale-Spin are already equipped to listen to the advice of the "Storyteller" portion of the program, which currently functions, in one mode, to apply story-based criteria to clip redundant, unimportant, or boring detail from the output story and, in another mode, to synthesize a story to exemplify a fable or moral. The next logical step is to replace (or transform utterly) the Storyteller with a program which aims to alter the output of the system in two directions: to enable a user-character interface, and to employ dramatic techniques to augment "interestingness."

To implement some important dramatic techniques, it will also be necessary to expand the scope of human-authored materials upon which the system may operate, specifically to provide materials which are generative of accidental incidents and of dramatic reversals. Although we may wish later to develop ways to automate the authoring of materials (technially, the specification and delimiting of POTENTIAL), assuming that such authoring will be "hand-done" for the moment will allow us to focus upon the design and implementation of a playwriting expert as our first order of business.

This paper will hopefully ask more questions than it answers.

Theory of the User-Character Interface

Tale-Spin deals with the generation and telling of stories and, as such, uses a narrative form: the stories are episodic in construction, and are meant to be read by a non-interacting user. Once the second-person transactions with the system that are necessary to initiate action have been completed, the user's experience of Tale-Spin is essentially in the third-person mode. It is important to recognize also that the user need only establish the initial conditions of the story; the system

operates independently to synthesize the story from these inputs.

The interactive system which we envision is different in several crucial aspects. We wish to enable the user to move about in the "story" as one of its characters. First and most important, this would transform the user's experience into a first-person mode. The operation of the story generator itself would also be fundamentally changed. Currently, Tale-Spin allows the user to describe characters with traits and goals. The system then creates those characters and those features of an environment which are necessary to them, AND NOTHING ELSE. The story is generated from these materials, using the planning and action structures that are part of the "generator" itself.

Allowing the user to move about in the story as a character means that the user-character's choices and actions must be taken into account at every moment, as they are continually affecting the states, goals, and actions of other characters and the state of the "world" at large. What must the system do to accomodate this stream of inputs?

First, it must provide a means for the other (generated) characters to form models of the user-character. Each character's model will be based on the information about the user-character to which he has been exposed, as well as upon his own traits and predispositions (literally, what he is inclined and equipped to notice). Second, the system itself (specifically, the "playwriting" program, of which more later) must maintain and update a model of the user-character in order to know what is ultimately "true." This is a harder problem than it seems, for without sophisticated user constraints, the system is theoretically no better equipped than any of its characters to know the actual states and goals of the user-character.

Further complications arise from the fact that the user-character does not have the same organic relationship to the potential embodied in the story world as one of the characters that has been created with it. By their very nature, system characters are incapable of introducing new potential into the story world -- they can only formulate that potential into possibility in the pursuit of their goals. But what is to keep the user-character from introducing new potential (that is, materials which are unknown to the system in its current configuration) and thereby blowing the system up? The essential user-character problem is one of information: how can the story world (system) and the user-character exchange necessary and reliable information without violating the first-person imperative (that is, without resorting to second-person techniques like "question-and-answer" and "error messages")?

Three distinct solution strategies can be used to address the

various aspects of the problem. The problem of communicating information to the user-character about the potential of the story world in a first-person mode can be re-cast in cognitive terms: how does the user know what is possible, or "where the edges are?" The concept of EXPOSITION, borrowed from the drama, suggests a solution that operates in two ways. In plays, "exposition" is the presentation of materials and information which define the limits of the world of the play (context). The total of expository materials is made available to the audience, so in a way, the audience has the same kind of global access to context information as the playwriting program would have in our system. Exposition is also relevant to the specific characters in the play. Many of the interesting complications in a drama result from the differences in content (completeness and reliability) as well as order of presentation of expository information to various characters. This character-specific exposition corresponds to the distinctions in knowledge about the story world held by the various characters in our system.

In a play, exposition is an ongoing process, operating through and around the dramatic action, with a higher concentration of exposition occurring at the beginning of the play. Exposition would occur similarly in our interactive system, with the highest concentration at the beginning of the interaction. We might propose an "expository interval" before the dramatic action begins, during which the user would simply observe the "world in progress," gaining information about the context and characters. This strategy assumes that the entrance of the user-character into the story world functions as a sort of inciting incident, or formal beginning, of the dramatic action. Later, expository material could be doled out to the user-character as well as to the other system characters, according to access opportunities (being in the right place at the right time), goal to know (as Meehan's characters can question one another, for instance), and the potential for each morsel of information to create interesting dramatic situations (determined by the playwriting program).

A second technique for creating cognitive boundaries is to control which assertions on the part of the user-character are acknowledged by the system and become manifest in the action. If the user-character attempts to introduce or operate on potential that is beyond the boundaries of the story world, that assertion can simply fail to produce results. If user-character Joe Bear attempts to solve a problem by asserting that he has magical powers that will enable him to find honey, for instance, the action subsequent to that assertion can simply prove him wrong -- at the same time supplying the information that such powers are not part of the potential of the story world. This technique, while obvious and simple, is less intrusive and destructive of first-personness than a second-person question or error message.

(It also raises the whole issue of the relationship between degrees of freedom and the potential for pleasurable experience, which is beyond the scope of this paper but will be treated later).

(3) A third facet of the user-character problem is how the system can construct a model of the user-character for its playwriting operations which has a maximal degree of reliability. Of course, the two techniques for informing the user about the potential of the story world will help to prevent accidental errors on the part of the user in communicating his own goals, traits, and strategies, but will do nothing to preclude intentional misrepresentation. Little attention can or should be paid to intentional misrepresentation as vandalism, since human perversity will always find a way to assert itself anyway, but misrepresentation for dramatic ends (as part of a strategy for achieving a character's goal, for instance) should be accomodated and utilized as elegantly as possible.

The technique which the playwriting program might use is one of successive approximation, making and updating a "best guess" version of the user-character model whenever the user-character acts (action in this sense includes both sayings and doings). That best-guess model can then be used to orchestrate the lines of dramatic probability in the story world, and less reliable versions may also be used to create and maintain alternative probability structures (which will in turn enhance both the complexity of the plot and the richness of dramatic alternatives available to the playwriting program). When certain elements of the user-character model are shown to be erroneous, the relevant lines of probability can be re-directed on the fly, and the alternate lines can be examined for their usefulness in light of the new information. How lines of probability are configured will be discussed below.

*** INCOMPLETE DRAFT ***

(continuation of Interestingness paper)

Last revised: 8/12/83

Dramatic Probability: Introduction

Dramatic probability may be defined as the causal relations among incidents in a play. In review, we know that a play is an imitation of an action and that it has a beginning, a middle, and an end. While a play is constructed of many actions (and their agents), it is ultimately an imitation (or representation) of a single, higher-order action which unifies the whole, and it is the progression of this superordinate action which provides the beginning, middle, and end. Dramatic probability is the means by which the action moves forward.

We can describe all the potential for dramatic action which exists at the beginning of a play as a world of POSSIBILITY. Possibility, then, includes anything that might or could happen within the context of the play's world. Hamlet at the beginning of Hamlet, for instance, could possibly return to school after his father's funeral. Why not? Forward motion in the plot is accomlished through the formulation of possibility into probability. As Hamlet unfolds and Hamlet has a conversation with his father's ghost, it becomes PROBABLE that he will remain in Denmark, at least until he has more information about the ghost and the circumstances of his father's death. Later in the play, as Hamlet verifies the ghost's story in various ways and as we see Hamlet's deep loyalty to his father and his desire for revenge emerging through the pattern of his actions, that line of probability is further refined to predict that Hamlet will remain in Denmark until his father's death is avenged.

In many plays, several major and often contradictory lines of probability exist through the play until the final moments. It appears probable that Claudius will eliminate Hamlet before he can avenge his father's death throughout much of the play, but as the action proceeds, it is also probable that Hamlet will succeed in killing Claudius. (By contrast, it is not probable that Ophelia will slay Hamlet in revenge for the death of Polonius, judging from her actions and what we infer about her character).

At the end of a play, one line of PROBABILITY is finally formulated into NECESSITY. Again in the case of Hamlet, the probability that the evenly matched wills and intentions of Hamlet and Claudius will produce a conflict that ends in the death of both characters becomes inevitable, and other lines of

probability are withdrawn. It is this final movement from probability to necessity that signals the end of the action (and of the play). From the vantage point of that final necessity, we can clearly see the causal chain of events that led to the outcome, producing the emotional and cognitive sense of closure that we feel at "the end" (we have probably all seen films of plays with "crummy endings" which failed to meet the causal, and therefore the emotional and cognitive criteria, of dramatic necessity).

The causal linkages of events, then, established the movement from possibility to probability to necessity and provides the play with its emotional shape. A story generation program like Tale-Spin is capable of creating one type of causal linkage which establishes probability and unifies the action of the story: the causality of goal-oriented behavior. The central character has a goal; there are obstacles to his goal which consist of the goals and traits of other characters (nested hierarchically); and the character ultimately either succeeds or fails. Here is a simple Tale-Spin example:

Media Room Event
Revised Proposal

Created 8/15/83
Last revised 8/17/83

Laurel and Hulteen
Fischell-Turing Productions

Review of Original Proposal

Our initial proposal involved a production of an existing script, THE VELDT by Ray Bradbury, in the media room. The script was chosen because it features a futuristic children's playroom which is quite similar to the media room we are developing here at ASR. The production was to provide motivation and direction for "bringing up" certain aspects of the media room and especially to give us the occasion to work with video and animation on the walls of the space. We were also interested in using the project to attract the attention of Bradbury, in hopes of persuading him to collaborate with us on other interactive projects.

The primary shortcoming of the original project was the lack of opportunities for real-time interaction due to the presence of a "closed" dramatic script. While the design and realization of the media and environment were directly in line with our common research goals, the dearth of interactivity made those efforts less generalizable to other projects. The temptation to revise the script in order to create a more interactive environment was strong, and would have resulted in complicated negotiations with Bradbury's agent. It would also have involved a great deal of script-writing, with a high cost in time and energy. Finally, the purely theatrical aspects of the production were largely "extracurricular" and difficult to justify in terms of person-hours required to do the job.

An alternative project we will propose can meet some of the same goals as the Veldt production:

1. Provide a focused activity to stimulate and integrate development of the media room environment and media design and production.

2. Provide a demonstration of the technical and interactive capabilities of the media room that will stimulate creative collaboration with theatrical and performance artists.

3. Create an occasion for group collaboration and celebration.

Our new, improved project will also meet some specific research goals more directly and will provide more generative results.

The First Fischell-Turing Production: Overview
(In collaboration with Arthur Fischell and Alan Turing)

The central goal of the F.T. Project is to see how a first-person, interactive fantasy system implemented in the media room might work. We envision meeting that goal by creating (in the fine tradition of the Architecture Machine Group) a simulation of a single-user interaction with such a system. The project represents a convergence of the theories and techniques being developed in the media room project (Hulteen and others) and in the interactive story project (Marion, Laurel, et. al.). The actual event will have the flavor of a planned improvisation, using operational technical elements where they exist and human improvisation for portions of the system that are still in the conceptual hacking stage.

The project will utilize a structure which is based on the interactive story idea, with a playwriting expert system (PLAY-RIGHT) which enables first-person participation of the user (INTERACTOR) in the development of the story or plot, and which orchestrates system-controlled events and characters so as to move that collectively generated story forward in a dramatically interesting way. The media room environment may be seen as the interface for the interactive story experience.

The operational elements of the system will include some interactive devices, video, graphics, and animation, sound, and some other environmental effects. We will employ portions of the design (if not the actual code) of Meehan's story generation program, Tale-Spin, as well as the design of the PLAY-RIGHT and other elements of the interactive fantasy version of that system (SEE attached system diagram and "Explanation of I.F. System" below).

Again, our purpose is to study the design of a system, major portions of which have yet to be implemented, by simulating its operation. The exercise will be improvisational in the sense that humans will enact roles that will, hopefully, later be automated -- much like "enacting" a machine which has some working parts, with humans filling in for the parts that are yet to be built. Such human participation is necessary simply because machines are not available that can perform these tasks, and yet we need to see how the system works before we can build those machines. One of our jobs will be to observe how well humans perform at a task which we hope to program computers to do later. We suspect that a person may not, for example, be able to

perform the PLAY-RIGHT task in real time. By identifying the nature of both the difficulties and successes that our human PLAY-RIGHT encounters, we can use the information gathered to continue design of the I.F. system.

The F.T. project will address the research goals mentioned in the first section of this paper, and it will also allow us to:

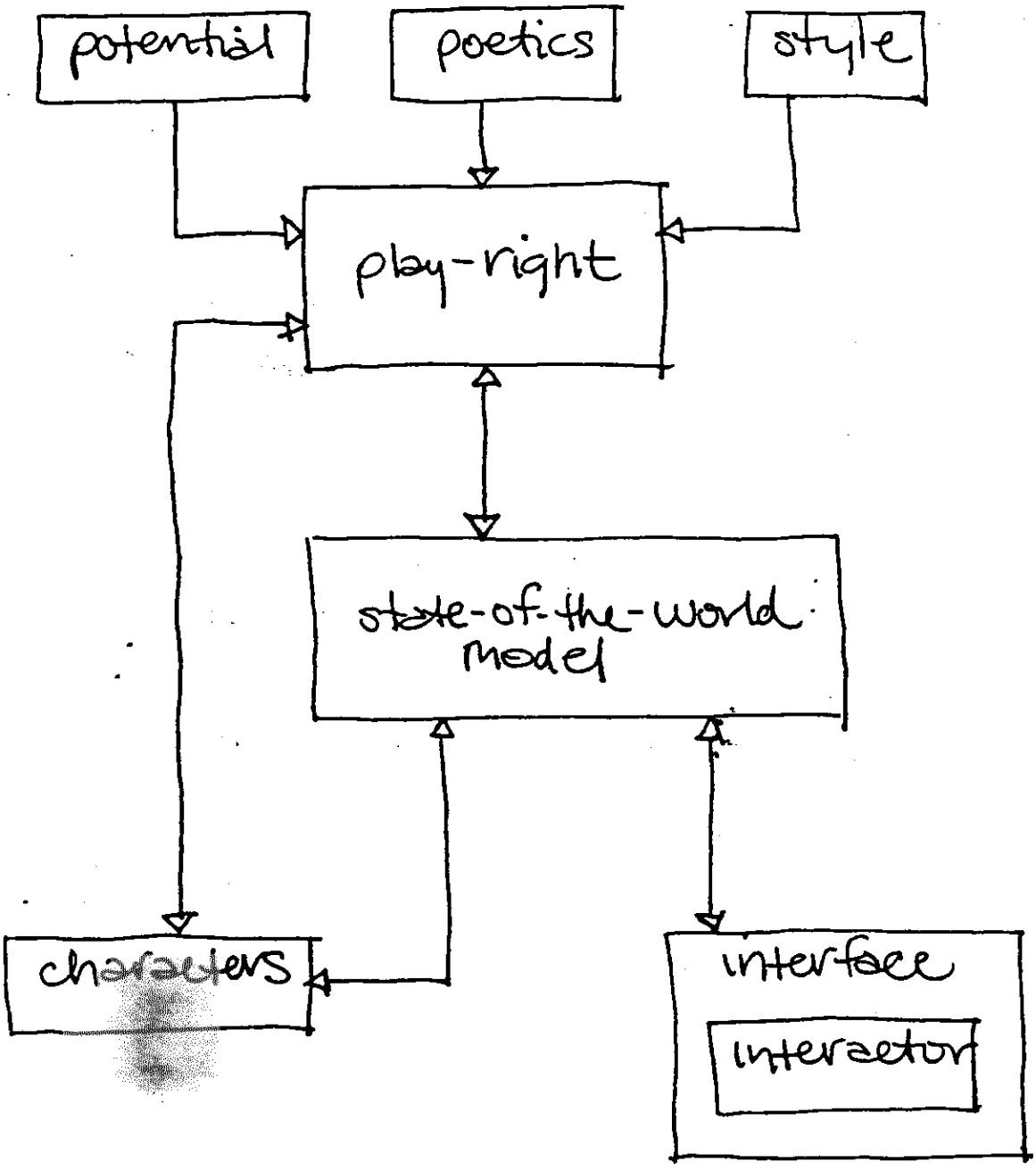
1. Involve theatrical or perfomance artists (like Ray Bradbury or Chris Hardman) in the position of the PLAY-RIGHT, whose actions and heuristics may later be modeled in the creation of the expert system.

2. Incorporate and make extensive use of many interactive devices and strategies.

3. Create visual, auditory, and other sensory materials (relevant to our chosen subject domain) and design techniques for accessing and integrating those materials in real time.

4. Refine the design of an interactive fantasy system, which may be implemented with a variety of interfaces, including the media room.

5. Further sharpen our image of the media room by exploring an interesting sample "application."



Proposed Structure of Interactive Fantasy System.

Explanation of the Interactive Fantasy (I.F.) System

(Refer to diagram, "Proposed Structure of Interactive Fantasy System.")

PLAY-RIGHT: Plans and orchestrates plot development. Material resources include the Potential, the Characters, and the Play-right's model of the Interactor. Formal (heuristic) resources include the Poetics and rules pertaining to Style (or genre).

STATE-OF-THE-WORLD MODEL: A passive element of the system which contains a computer model of the dramatic environment, including the history of the world as well as the current state of affairs, which is read from and written to by the Play-right, the Characters, and the Interface.

CHARACTERS: Computational personalities that know their own nature and can make choices and perform actions in the context of the State-of-the-World Model. They are also capable of accepting new orders (psychotherapy or enlightenment) from the Play-right as the plot develops. In effect, their traits and predispositions are continually formulated by the Play-right.

INTERFACE: Implemented in the media room for this project. The Interface is an active system which consults the State-of-the-World Model and provides a dynamic, sensory representation of the action. Conversely, it reads the interactor's outputs and transmits them to the State-of-the-World Model for inclusion in the current environment.

POETICS: The dramatic rules and heuristics utilized by the Play-right in the construction of the plot. These include notions of dramatic form and structure, causal relations among the elements of the drama, methods for creating various types of incidents (suffering, discovery, and reversal), and means for creating and maintaining lines of dramatic probability.

POTENTIAL: Literally, all the materials of the story world, which are defined by a human author before the system is placed in motion. Only characters, objects, and events which are formulated from these materials can be included in the plot. Potential may be described to the system in various states of formulation; for example, it may include general descriptions of the traits of beings which may inhabit the world and/or formulations of specific characters, depending upon the desires of the author.

STYLE: This "box" may actually contain notions of form or genre (e.g., tragedy, comedy, or melodrama) as well as functional descriptions of styles (e.g., expressionism, realism, or neo-classicism). It is unlikely that these functions will be

differentiated from the operations of the Play-right in the F.T. version of the system.

INTERACTOR: The (human) user of the system. He/she is allowed to interact with the system through the Interface, which controls access to all forms of human input and output. The Play-right generates a predictive model of the Interactor for the purposes of orchestrating the plot. Each Character also creates a unique model of the Interactor as part of his/her knowledge about the world.

What It Will Be Like

Successive Approximation: We envision several iterations of the F.T. experience, allowing us both to tweak the system design and to fill in obvious holes in areas like video and sound. Here is a rough outline of steps in the "pre-production" phase of the process:

1. Meet with interested parties to discuss the overall project, then zero in on technical and creative needs. The theatrically-oriented task assignments from the Veldt project can be largely eliminated, but we hope that the technical and creative commitments made by various researchers to the previous project can be carried over into this one.

2. Person associated with each area of responsibility creates a cost estimate, which we will roll up and present to Kristina for analysis and approval. This will include equipment, person-hours, media, and consulting (primarily the PLAY-RIGHT person).

3. Second group meeting with PLAY-RIGHT in attendance. Attempt to make a decision on the content of the story world. Based on both project goals and resource requirements, create a schedule for the entire project.

4. Design and development of story world, media, and environment.

Here is a proposed version of the "running" phase of the project:

1. Meet with PLAY-RIGHT person to discuss story and review media developed to date.

2. FIRST RUN: This will be the most improvisational session. It should allow us to create a version

of the story that we will use in future runs. It will also serve to identify obvious flaws in the system design and holes in the media which we can repair. We should begin videotaping with this session.

3. SUCCESSIVE RUNS: We envision a finite number of successive runs, with the intention of creating a version which is exemplary enough of our system that we may combine the videotape and some comments to create a viable concept presentation or "demo." This demo will stand as documentation of the I.F. project-in-progress and may also be used as an example of the media room in operation (it may also be used as an adjunct to Laurel's thesis).

4. Future use: At the conclusion of the last scheduled run, the project may be torn down or run again with different artists and/or story worlds. In any case, such future uses should be considered new projects.

Unique Qualities of This Application: Beyond the technical characteristics of the project are some more subjective or artistic qualities which are equally valuable to our research. One of the objectives of the Veldt project was to employ the media room environment in an activity that was centered around the arousal and purgation of emotions, as opposed to the rational or objective representation of knowledge. The F.T. project, operating as it will within a fantasy domain and employing dramatic techniques, preserves this focus. Such "dramatic" usage of the environment has as its outcome a kind of pleasurable experience that is associated with drama, fantasy, and imagination, as distinct from the pleasure that results from the satisfaction of curiosity or the acquisition of knowledge.

Currently, it is productive to distinguish between these two types of outcomes, especially on the levels of context and functionality. The end cause of an interactive fantasy experience is presently conceived as distinct from that of a session with an encyclopedia, and it seems necessary to explore the emotional and artistic dimensions of interactive media in a context where the existence or relevance of those dimensions is not a subject of debate. The interactive fantasy world provides that context. Of course, as we continue to work on both ends of the interactive spectrum, our understanding of the uses of emotion and aesthetics in the representation of knowledge will grow. As our thinking moves in that direction, it is not unreasonable to propose that the I.F. system be used as an interface to various knowledge domains. This is how a convergence of these two currently distinct lines of inquiry may occur.

****SECOND DRAFT FOR YOUR REVIEW****

Research Proposal
Simulation of an Interactive Fantasy System

Created 8/15/83
Last revised 8/25/83

Brenda K. Laurel
Eric A. Hulteen

Project Description and Research Goals

The central goal of the proposed project is to see how a first-person, interactive fantasy system implemented in the media room might work. We envision meeting that goal by creating a simulation of a single-user interaction with such a system.

By "interactive fantasy" we mean a first-person encounter with a fantasy world, in which the user may create and portray a character whose choices and actions affect the course of events just as they might in real life. The structure of the Interactive Fantasy system, described in detail below, utilizes a playwriting expert system (PLAYWRIGHT) which enables first-person participation of the user in the development of the story or plot, and which orchestrates system-controlled events and characters so as to move the action forward in a dramatically interesting way.

The Media Room, the proposed environment for the project, is a prototypical human interface which is intended to include all available forms of person/machine communication. Current capabilities include speech recognition, speech synthesis, touch sensitive displays, rear screen projection, videodisc, videotape, computer graphics, body tracking, four channel audio, music synthesis, and a LISP machine computer. Planned additions to the room are eye tracking, additional body tracking, a real-time animation system, and digital audio capabilities. Olfactory and thermal effects may also be employed in the Interactive Fantasy simulation.

The project represents a convergence of the theories and techniques being developed in the media room project (Hulteen and others) and in the interactive story project (Marion, Laurel, et. al.). The actual event will have the flavor of a planned improvisation, using operational technical elements where they exist and human improvisation for portions of the system that

have yet to be fully designed or implemented.

Again, our purpose is to study the design of a system, major portions of which have yet to be implemented, by simulating its operation. The exercise will be improvisational in the sense that humans will enact roles, portions of which may later be automated -- much like "enacting" a machine which has some working parts, with humans filling in for the parts that are yet to be built. Such human participation is necessary simply because machines are not available that can perform these tasks, and we need to see how the system might work before we can build those machines.

One of our jobs will be to observe how well humans perform at a task which we hope to program computers to do later. We suspect that a person may not, for example, be able to perform the functions of the PLAYWRIGHT task in real time. Other functions in the system, such as the creation (authoring) of the fantasy world, may always be more elegantly and appropriately performed by humans than by machines. By identifying the nature of both the difficulties and successes that our human participants encounter, we can use the information gathered to continue design of both the human and machine elements of the Interactive Fantasy system.

The Interactive Fantasy (IF) simulation project is designed to meet the following research goals:

1. Involve literary, theatrical, or performance artists in the position of PLAYWRIGHT, whose working methods and heuristics may be modeled in the creation of the PLAYWRIGHT and POETICS portions of the system.

2. Employ the talents of those same artists as authors or creators of the fantasy world itself, observing the problems encountered in order to design authoring techniques and aids that will facilitate such creative contributions. We also hope that the experience will provide generative liaisons with such artists which can contribute to a variety of projects in the lab.

3. Provide the opportunity for observation and analysis of the overall design of the IF system.

4. Incorporate and make innovative use of various interactive devices and strategies.

5. Create visual, auditory, and other sensory materials (relevant to our chosen story domain) and experiment with techniques for accessing

and integrating those materials in real time. These results should be generalizable to other projects (e.g., the encyclopedia project) which may utilize the Media Room as an interface.

5. Further sharpen our image of the Media Room by exploring an interesting sample application.

Explanation of the Interactive Fantasy (IF) System

(Refer to diagram, "Proposed Structure of Interactive Fantasy System.")

PLAYWRIGHT: Plans and orchestrates plot development. Material resources include the POTENTIAL, the CHARACTERS, and the PLAYWRIGHT's model of the INTERACTOR. Formal (heuristic) resources include the POETICS and rules pertaining to STYLE (or genre). In the IF simulation, we expect that the same person who performs the PLAYWRIGHT function will also act as author of the fantasy world, a distinctly and permanently human task (see POTENTIAL, below).

INTERACTOR: The human user of the system. He/she is allowed to interact with the system through the INTERFACE, which controls access to all forms of human input and output. The PLAYWRIGHT generates a predictive model of the INTERACTOR for the purposes of orchestrating the plot. Each CHARACTER also creates a unique model of the INTERACTOR as part of his/her knowledge about the world.

STATE-OF-THE-WORLD MODEL: A passive element of the system which contains a computer model of the dramatic environment, including the history of the world as well as the current state of affairs, which is read from and written to by the PLAYWRIGHT, the CHARACTERS, and the INTERFACE.

CHARACTERS: Computational personalities that know their own nature and can make choices and perform actions in the context of the STATE-OF-THE-WORLD MODEL. They are also capable of accepting new orders (psychotherapy or enlightenment) from the PLAYWRIGHT as the plot develops. In effect, their traits and predispositions are continually formulated by the PLAYWRIGHT. In the IF simulation, the CHARACTERS may be represented variously by human actors and machine-simulated personalities.

INTERFACE: Implemented in the media room for this project. The INTERFACE is an active system which consults the STATE-OF-THE-WORLD MODEL and provides a dynamic, multi-media representation of the action. Conversely, it reads the INTERACTOR's outputs and transmits them to the STATE-OF-THE-WORLD MODEL for inclusion in

the current environment.

POETICS: The dramatic rules and heuristics utilized by the PLAYWRIGHT in the construction of the plot. These include notions of dramatic form and structure, causal relations among the elements of the drama, methods for creating various types of incidents (suffering, discovery, and reversal), and means for creating and maintaining lines of dramatic probability.

POTENTIAL: Literally, all the materials of the story world, which are defined by a human author before the system is placed in motion. Only characters, objects, and events which are formulated from those materials can be included in the plot. POTENTIAL may be described to the system in various states of formulation; for example, it may include either general descriptions of the traits of beings which may inhabit the world or formulations of specific characters (or both), depending upon the desires of the author.

STYLE: This portion of the system might contain notions of form or genre (e.g., tragedy, comedy, or melodrama) as well as functional descriptions of styles (e.g., expressionism, realism, or neo-classicism). It is unlikely that these functions will be differentiated from the operations of the PLAYWRIGHT and author in the IF simulation project.

Description of Project Phases

We envision several iterations of the IF simulation, which will allow us both to successively modify the system design and to fill in obvious holes in areas like video and sound. Here is a rough outline of steps in the pre-production phase of the process:

1. Meet with interested parties to discuss the overall project, then zero in on technical and creative needs.

2. Create and present for approval a cost estimate for all aspects of the project, including equipment, person-hours, media, and consulting.

3. Discuss the project with selected artists and identify PLAYWRIGHT for first round of simulations.

4. Meet with project team and PLAYWRIGHT. Select story domain. Based on both project goals and resource requirements, create a schedule for the entire project.

5. Design and develop story world (POTENTIAL), media, and interactive environment.

The running phase of the project will include the following steps:

1. Meet with PLAYWRIGHT to discuss story and review media and environmental features developed to date. Refine and augment materials as necessary.

2. Produce first run of the simulation. This will be the most improvisational session. It should allow us to create a version of the story that we will use as an example and for fine-tuning future runs. It will also serve to identify obvious flaws in the system design and holes in the media which we can repair. We should begin videotaping with this session.

3. Produce successive runs of the simulation, with the intention of creating a version which is exemplary enough of our system that we may combine the videotape and some comments to create a viable concept presentation or "demo." The demo will stand as documentation of the IF project-in-progress and may also be used as an example of the Media Room in operation.

4. Analyze and evaluate results. At this point we may want to consider future runs with modified system design and/or different artists participating in the simulation.

Meta-Outcomes: Exploring the Uses of Emotion

In addition to its scientific value, the IF simulation is intended to explore some subjective and artistic issues which are equally relevant to our research. One of the our objectives is to employ the Media Room environment in an activity which emphasizes emotional response. The IF system is intended to create for the user a kind of pleasurable experience that is associated with drama, fantasy, and imagination, as distinct from the pleasures that result from the achievement of functional goals or the acquisition of knowledge.

Currently, it is productive to distinguish among these various outcomes, especially as they reflect the assumed relations between context and functionality. The end cause of an interactive fantasy experience is presently conceived as distinct from that of a session with an encyclopedia, and it seems necessary to explore the emotional and artistic dimensions of

interactive media in a context where the existence or relevance of those dimensions is not a subject of debate. The interactive fantasy world provides that context. Of course, as we continue to work within the entire spectrum of interactive forms, our understanding of the uses of emotion and aesthetics in the representation of knowledge will grow. It is not unreasonable to propose that the IF system may someday be used as an interface to various knowledge domains. This is how a convergence of these two currently distinct lines of inquiry may occur.

Simulation of an Interactive Fantasy System: Some Fanciful Scenarios

Created 9/6/83
Last Revised 9/9/83

Brenda K. Laurel

A DARK CARNIVAL

Orientation

What follows is a pastiche of conversations and descriptions drawn from an imaginary run of the IF Simulation (SEE "Research Proposal: Simulation of an Interactive Fantasy System"). Through the conceit of dialogue, this paper is intended to give the reader a sense of what the simulation might really be like, and to address some of the questions and issues that are sure to arise during the course of the project. I have used the world created in Ray Bradbury's book, SOMETHING WICKED THIS WAY COMES, as the context for the imaginary events described here. Readers who are not familiar with the story may obtain a synopsis from me, or may borrow the book.

Pre-Production

ATARI: What does the town look like where the action takes place?

BRADBURY: Well, there are five versions of the story itself that will give you a sense of the locations and landscape-- the original version of THE DARK CARNIVAL, the screenplay based on that version, my novel, SOMETHING WICKED THIS WAY COMES, the recent screenplay I wrote for Disney, and of course the film itself. The effects people at Disney did a great job of building the town and designing the landscapes used in long shots. The actual "town" is a collage of a hundred places, all with a certain feeling in common, sprinkled across northern Illinois, some places in Ohio...

A: Sounds like plenty of resources. If we can obtain some of the Disney footage it would be great, but it also sounds like we know where to shoot if we decide to do it ourselves. What about the carnival?

B: There's always a danger in making things too concrete.

Again, Disney did a great job of obscuring things, bending the light, focusing on the mysterious-- they did a wonderful job with the train, for instance. It's a typical midwestern traveling show, but "through a glass darkly"-- the tents are black, the facades and posters are ominous-- and of course you can smell it and feel the pricking of your thumbs--

A: That's interesting-- how would you describe that smell?

* * * * *

A: ...so the action would probably begin in that upstairs bedroom, with the sound of the approaching train, and the light blinking on in Tom Nightshade's window-- does that sound right?

B: Yes, I think we could begin there. So You <the Interactor> might open the window and talk to Tom, or get frightened and snuggle down into the shadows--

A: Or call Dad--

B: Or climb down the trellis and run off through the wisteria, toward the railroad tracks...

* * * * *

B: How can we be sure You will make it to the Carnival at all?

A: I'm not sure we need to. Maybe You try it six or seven times and then You just can't stand it any more-- You have to go and see--

B: Yes, and we can probe your imagination with the incidents we create in the story. Is the sound of the train not enough? The smell? A certain whisper in the air? Or perhaps a leaflet blown in the window--

A: That's right. As the Playwright, you can do that-- keep creating incidents that stimulate curiosity until You can't stand it any more--

* * * * *

A: Yes, we can use eye tracking to cue magical transformations. When You look away from that block of ice, for instance, the movement of your eyes can immediately trigger the new image, so that when You look again, the Dust Witch is there, inside the ice...

B: Wonderful. Couldn't we use distorted video to create the

hall of mirrors in real time?

A: Sure-- and work the transformations with computer graphics...

* * * * *

B: We hope that something different will happen for each person who enters the fantasy world-- and each person's experience will be a different length, too. Suppose somebody wants to just stay in there until we run them out. How does the user know when he's done?

A: Well, we eventually want our Playwright program to know enough about the nature of endings in drama to be able to invent one. This means that the program (you, in this case!) has to be able to identify the central action of the story -- the spine of the plot. Of course that spine may be different for every trip through the fantasy world.

B: Yes, I can imagine that. Say in one version that our user gets to the carnival and, through a series of incidents, becomes convinced that he must reveal Dark's identity to the whole town. The story must move so that he is finally able to do it.

A: Or not, definitely not.

B: Yes, that would be an ending, too... but it wouldn't be as much fun. But how will your program know that that's what that particular user if focusing on?

A: Well, how will YOU know?

B: (Chortling.) I see what you're getting at. Well, I'll watch what he does and listen to what he says and try to infer his intentions...

Dress Rehearsal

B: (In the Media Room) The bedroom looks great. I especially like the moonlight splashed across the floor over here, and the cloud shadows--

A: (Naimark) It's amazing what you can do with scrim--

B: Now I'm walking over to the window-- I want to open it and look out-- what do I do?

A: (Hulteen) Go for it--

(BRADBURY approaches the window and reaches toward it. Sound of window opening. The wall he is facing dissolves to the view outside the window. He turns back to see that the room is still represented on the remaining walls. He backs away from the window a few steps-- we hear it close, and the wall restores an interior view.)

B: Okay, I'm going down the trellis to the yard.

(He "opens" the window again.)

B: What do I do now?

A: (Laurel) Jump!

(Bradbury takes another step. The screen becomes a blur. Sound of feet hitting the grass. Bradbury turns. Behind him is the wall of the house and the trellis; before him is the yard. Night sounds grow louder, and there is a scent of wisteria. Bradbury stands sniffing. There is the sound of an approaching train in the distance, coming from the left.)

B: Here it comes. I want to run, but I'll hit the wall.

A: This is a tricky one. Sweep your arm in the direction you want to go, and try to indicate the speed you want to travel with the movement. Like throwing a ball, or commanding a battallion to move "onward."

B: (Gestures rapidly and forcibly with his left hand. The yard whirs by, then the woods, until there is simply a blur). Yiiii! How do I stop?

A: (Marion) Gesture!

* * * * *

B: (Viewing animation sequence of the Dust Witch searching for the kids.) No, she is much more... diffuse... much less explicit than that. What you're showing me looks like a Halloween cliche.

A: What does she look like, then?

B: She's a color-- Disney got it pretty well, I think-- a sort of ghastly green aura that moves around-- leaving silver trails where her fingers touch the roof, the trees-- seeking-- And when we do glimpse her, she's incredibly old-- receding from life as a mummy does, receding from the senses--

A: So what we need is more like ambient light and visual textures to communicate her presence-- and we can use computer graphics to paint the trails.

B: Yes, I think so-- and the sound of the fingers scraping, and of the air in the balloon-- breathing, almost-- but dry, dead sounds...

* * * * *

(The whole crew stands inside the "control room" built for the Playwright.)

A: These displays indicate what's going on with eye tracking, body tracking, pointing and gesturing. The body tracking display is the best-developed; if we find out that any of the others is inadequate, we will default to video feedback. You'll be able to hear what the speech recognizer understood with these earphones.

B: What if the recognizer doesn't understand something?

A: It often won't-- but then, people often don't, either, in regular conversation. Let's try it. If we can't get enough information to make good guesses from context, we can default to live audio for the simulation. The idea, though, is to work within our technical constraints whenever we can. That's why we hope you'll be able to use these displays instead of an actual picture of the user moving about the room.

* * * * *

B: Okay. My job, as I understand it, is to weave the story around the person walking around in the world we've created. What are my tools?

A: Well of course your most valuable tools are your imagination and your skill as a storyteller. You know what a good plot is like, and you know how to motivate characters by throwing incidents and contexts at them. The "user" of our fantasy could be thought of as just one of those characters, wandering around in your imagination-- self-motivated to the extent that he is alive for you--

B: -- yes, and characters often surprise me as I'm writing stories--

A: -- and yet you manipulate them through the settings and plots you weave; you poke at them to see what will develop.

B: Yes. And of course sometimes there are specific incidents

that I know I want to include. They are in a certain sense inevitable...

A: That's what we've tried to capture in some of the fixed sequences we've created-- jumping out of the window, running toward the train, moving through the hall of mirrors, or hiding from Mr. Dark in the Library.

B: Those are all pretty big chunks of action, though. Aren't we losing flexibility?

A: Yes and no. You are losing some flexibility in the internal structure of those incidents. But you gain some ease and scope in changing plot direction. In that sense, these big chunks increase overall flexibility in the plot. And you have some little pieces, too...

* * * * *

B: But we can't simply try to make our "user" just like Will-- that wouldn't be any fun.

A: No, but we know what kinds of transactions with this world would be really interesting from a dramatic point of view. We can try to create incidents that will make it probable for the user to make certain kinds of choices-- to orchestrate the action so that those essential Will-like qualities are drawn out--

B: Yes-- curiosity, daring, an attraction to the Dark that is balanced by a real joy in living--

A: And so, as Will wandered around that little town in your imagination, as you were writing the story, what kinds of things did you do to give him the opportunity to express those qualities?

B: The conversations with Tom Nightshade are one example-- the complement that Tom provided in every choice that the boys made together.

A: And if our "user" is more like Tom than Will?

B: Then the complement he needs is more like Will than Tom...

* * * * *

A: We want to get at the "rules" you use to guide a plot in an interesting direction.

B: (Drawing himself up.) Well, I certainly wouldn't consider

myself a formula writer-- I'm not sure I use any "rules"--

A: That's precisely why we want to observe how you do this. When we design expert systems, we try to include not only the explicit knowledge of an expert but the "rules" by which he makes good guesses-- his hunches and intuitions, if you will. Sometimes they form patterns, and by observing them we-- and you-- may discover some of the heuristic "rules" you use in doing your work.

B: ...hmmmm...

A: ...and so we want you to do your best to talk us through each decision you make, at least the first time through, so we can get a glimpse of those processes.

B: Well, I'll try.

A: We're also trying to get at categories of things that might live in your "toolbox" -- kinds of incidents, for instance. When is it time in a story for a surprise?

B: I see what you mean. Well, the boys get a surprise when Mr. Dark shows them his "living tattoo." It functions as immediate, sensory evidence that Dark is extraordinary and powerful and takes the action to a higher level of suspense.

A: And a "reversal" might be another category...

B: Yes, an incident that completely changes your expectations...

* * * * *

B: I think I understand what you want me to do in constructing the story. But how does it become real for the "user?"

A: The "room" is going to respond in a number of ways, as you know. There are a limited number of slides and video sequences, as well as the computer graphics and lighting effects we looked at earlier. You also have the sound library and some capability to create new sounds as you need them. In addition, you have the "electronic personalities"-- the other characters-- who can be made to speak and act, within some technical constraints.

B: Yes, you showed me the Dust Witch and Mr. Dark "personalities." I can control general placement and gross movement with the joystick, and can have them speak dialogue. But it's entirely likely that other characters will need to make an appearance-- maybe even some who weren't in the original story.

A: We know that, and I'm afraid we aren't far enough along to be able to create them for you on the fly. We thought we'd try to have it both ways for the simulation, so that you could at least have the experience of creating a new character if you need one, and so that we could observe how you do it. In order to do that, we've plugged another human into our simulated machine. He's a professional actor, and you can talk to him through the microphone on your headset.

B: You know, this is beginning to remind me of Niven and Barnes' DREAM PARK...

A: Yes, DREAM PARK was a real inspiration for us, just as your own story THE VELDT was... These are pretty powerful ideas, and it shouldn't surprise us that a lot of us have had them...

B: (Peers over the top of his glasses.)

First Run of the Simulation

NOTE: Statements in parentheses () are descriptions of events. Statements in brackets <> represent unspoken thoughts. Statements in CAPS describe actions that occur between the "fleshed out" segments of the interaction. The USER is denoted as U, the INPUT to the Playwright in the control room as I, the PLAYWRIGHT as P, and the OUTPUT of the media room as O. These various views of the action are also successively indented, so that a single view may be followed sequentially.

* * * * *

U: <It looks like I'm in a bedroom-- I'll assume it's mine. I wonder what's out the window.>

I: (Body tracking display indicates user moving toward "window" projected in north screen.)

P: She's moving toward the window. Get ready to open it. Wait for the gesture.

U: (Reaches toward window.)

I: (Polhemus display indicates gesture toward window; body tracking display shows another step north.)

P: Fire the window opening sequence.

O: (Window opens in video image on north wall.

Sound of window opening. Night sounds become louder. Wisteria smell is dispersed.)

U: <Wow! A summer night... looks like a small town... >

* * * * *

THE USER MOVES INTO THE YARD, HEARS THE PASSING TRAIN, AND DECIDES TO WANDER OFF TOWARD THE TRACKS.

* * * * *

O: (Circus train rushing by on east screen. Engine roar doppler-shifts as the train seems to move southward. Train passes out of view; empty tracks illuminated in moonlight.)

U: A carnival!

I: (Speech synthesizer recieves output from recognizer and produces phrase, "A carnivore!")

P: Must be "carnival"-- She's got it, but she's not moving. Let's try a strange glow in the southern sky.

O: (Red and yellow searchlight beams produced in computer graphics sweep the sky on the south screen.)

U: <What's going on over there?>

P: She's still not going for it. Give me some carnival music.

O: (Distant calliope music drifts in from the south.)

U: <Oh my God, they're setting it up-- in the middle of the night-- I've got to see this.>

I: (Body tracking registers a few steps south; polhemus shows a moderately accelerating, sweeping gesture toward the south with user's left hand.)

P: Okay, she's running at a moderate pace. Let's go to the carnival.

* * * * *

THE USER RUNS TO THE CARNIVAL SITE AND SEES THAT THE TENTS ARE

BEING SET UP. SHE NOTICES THE FORM OF A SMALL BOY IN THE SHADOWS.

* * * * *

U: Who are you?

O: (Electronic character speaks: "It's me, Tom, silly. Your best friend, remember?")

U: <I'll play along with this, I guess. I want to get closer to the action.> Oh, hi. Hey, let's sneak over there and have a look around, okay?

I: (Speech synthesizer blurts, "Hi... sneak over... look around, ofay?")

P: Good. We've got a lot to process here-- let's have Tom take the lead and get them there slowly, from the west.

O: (Tom: "Sure, follow me." Tom moves slowly across the south wall as carnival tents grow closer on the east screen. Calliope music grows louder.)

* * * * *

TOM AND THE USER HAVE MOVED UP TO A LARGE TENT REPRESENTED ON THE EAST SCREEN. THE USER SUGGESTS THAT THEY LOOK INSIDE. THEY DISCOVER THE CAROUSEL. JUST AS THEY APPROACH IT, MR. DARK APPEARS FROM BEHIND THEM, INTRODUCES HIMSELF, AND ANNOUNCES THAT THE CAROUSEL IS BROKEN. WHEN DARK HAS GONE, OF COURSE, THE USER DECIDES TO CLIMB ONTO THE CAROUSEL.

* * * * *

O: (The carousel is shown on the east screen, while the other screens reveal interior surfaces of the tent. Tom is displayed on the north screen, near the carousel. The night sounds have resumed following Mr. Dark's exit.)

U: I wish we could ride it. <I wonder if there's any way to climb onto it.>

I: (Body tracking shows user approaching very near east screen. Speech synthsizer mumbles, "wish... ride....")

P: Let's get her on the carousel--

O: (Sound of feet hitting metal as user steps toward east screen. Images on other screens drop down an apparent two feet. Tom: "Hey, Mr. Dark said you're not supposed to be up there!")

U: (Walks southward "around" carousel.) These horses sure look scared. (Turns back to Tom.)

I: (Body tracking registers user's movement. Speech synthsizer says, "horses... look scared.")

P: Good, she's moving around it and she's beginning to get an ominous feeling. Adjust the images so she can't see Tom. Make it generally darker to increase the suspense.

O: (West wall is completely dark; other walls filled with views of the carousel from its edge. Footstep sounds continue in sync with user's steps. Night sounds stop abruptly.)

U: Tom?

I: (Synthesizer says, "Tom?" Galvanic skin response display shows a sharp jump. Body tracking shows that user has turned to face out toward the darkness and has taken a step "away" from the carousel.)

P: She's getting scared, and she's trying to get off. I didn't expect that. Start the carousel with a jolt.

O: (Loud mechanical sound of low frequency shakes the floor. Loud carousel music, with speed and volume gradually increasing. East wall continues to display carousel while streaks of color blur across the blackness on the other screens to indicate accelerating rotation. Image on east screen is gradually replaced with a blinding yellowish glow.)

U: TOM! MAKE IT STOP!!!

* * * * *

TOM STOPS THE CAROUSEL. THE USER STUMBLES BACK TOWARD THE CENTER OF THE ROOM AND NOTICES THAT SHE IS MOVING SLOWLY IN RELATION TO THE IMAGES ON THE WALLS. HER VISION SEEMS BLURRED AND SOUNDS ARE LESS DISTINCT.

* * * * *

O: (Tom: "Oh my God, Susan. You're... OLD!")

U: What do you mean? Why can't I hear you very well?

P: Let's give her some evidence. Use eye tracking output to place a "mirror" within her view.

O: (Tom follows the user to the "mirror." Tom: "Look!" Video image in the mirror frame is the face of an extremely old woman.)

* * * * *

TOM AND THE USER ARE DISCOVERED BY MR. DARK. AFTER A CHASE THROUGH THE SHADOWS AND TRAILERS OF THE CARNIVAL THEY MANAGE TO RETURN TO THE CAROUSEL. TOM HAS SUGGESTED THAT RUNNING THE CAROUSEL BACKWARDS MIGHT REVERSE THE EFFECT. THE USER JUMPS ON AND TOM OPERATES THE CONTROLS.

* * * * *

O: (The carousel image is once again stationery on the east screen, while colors course across the others to indicate counterclockwise rotation at a moderate rate. The music plays backwards.)

P: This is too easy. Let's have one last surprise. (Moves Mr. Dark into the scene next to Tom.)

O: (Dark: "I told you the carousel was BROKEN!" Dark grabs Tom and takes the controls. The carousel motion increases drastically.)

U: TOM!!! (Begins to move around the room.)

I: (Body tracking shows user moving around. GSR is going nuts.)

P: What's she doing? I can't make sense out of the body tracking display. Let's go to video-- okay, it looks like she's trying to find a way out. Let's turn up the gain.

O: (Tom: "HE'S GOT ME!!! GET OFF THE CAROUSEL!!!" Carousel continues to accelerate.)

U: (Runs around the room trying to find a way off the carousel.)

I: (Body tracking shows user moving rapidly around the room. Polhemus shows frantic gestures.)

P: Ignore the gestures. Surround her with the carousel for five seconds then use the body tracking to keep an open screen just out of reach.

O: (All screens show carousel with superimposed whirling colors. After five seconds, a blank screen begins to "anticipate" the user's movements. Tom's voice comes from the blank screen: "Jump! Susan, do you hear me? JUMP!")

U: <If I stay on here much longer I don't know what will happen. The only place to jump is into that void that keeps showing up over there, where Tom's voice is coming from.>

I: (Body tracking shows slower movement; frantic gestures are still indicated.)

P: She's getting tired. Let her catch the window.

O: (Motion on all screens slows gradually. Tom: "Jump! PLEASE jump!")

U: (Runs toward the blank screen.)

I: (Body tracking shows rapid approach to west screen.)

P: Now.

O: (Carousel is shown madly whirling on east screen. Other screens are now stationary images of the interior of the tent. Tom is near the controls on the south screen. Dark is running toward the user, superimposed over the east screen. Tom: "PUSH HIM! SUSAN! PUSH HIM!!!")

U: (Pauses for a moment then runs directly at the east screen. The image of Dark looms in the center, directly over a touch-sensitive display. User pushes on the screen.)

I: (East TSD registers user contact.)

P: All right, she's pushed him onto the carousel. That should do it. Now let's get them out of there.

O: (Tom: "Leave him! That will finish him! Let's get out of here!")

U: (Gestures toward the opening in the tent on the north screen.) That way!

P: Now it's time for a final twist. You don't mind, do you?

O: (The screens show the countryside landscape at a blurring pace, with the carnival receding in the west. Suddenly the motion stops and the user is once again in the interior of the bedroom, as before.)

* * * * *

Postscript

It may concern the reader that this particular experience would probably scare the hell out of the user. The potential for the arousal of fear is high in this particular world (and in many of the worlds that might be created by Mr. Bradbury). We should imagine that a user will ultimately be able to choose from among several different worlds, some of which are more benign. By choosing this one, our user has expressed a taste for horror, and the system has responded appropriately.

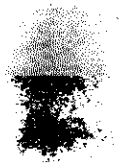
TOWARD THE DESIGN OF AN INTERACTIVE FANTASY SYSTEM: DESCRIPTION AND FUNCTIONAL REQUIREMENTS

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.

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

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.

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 disjoin and dislocate the whole.[7]

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 which the adventures occur.[9]

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 nonverbal 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

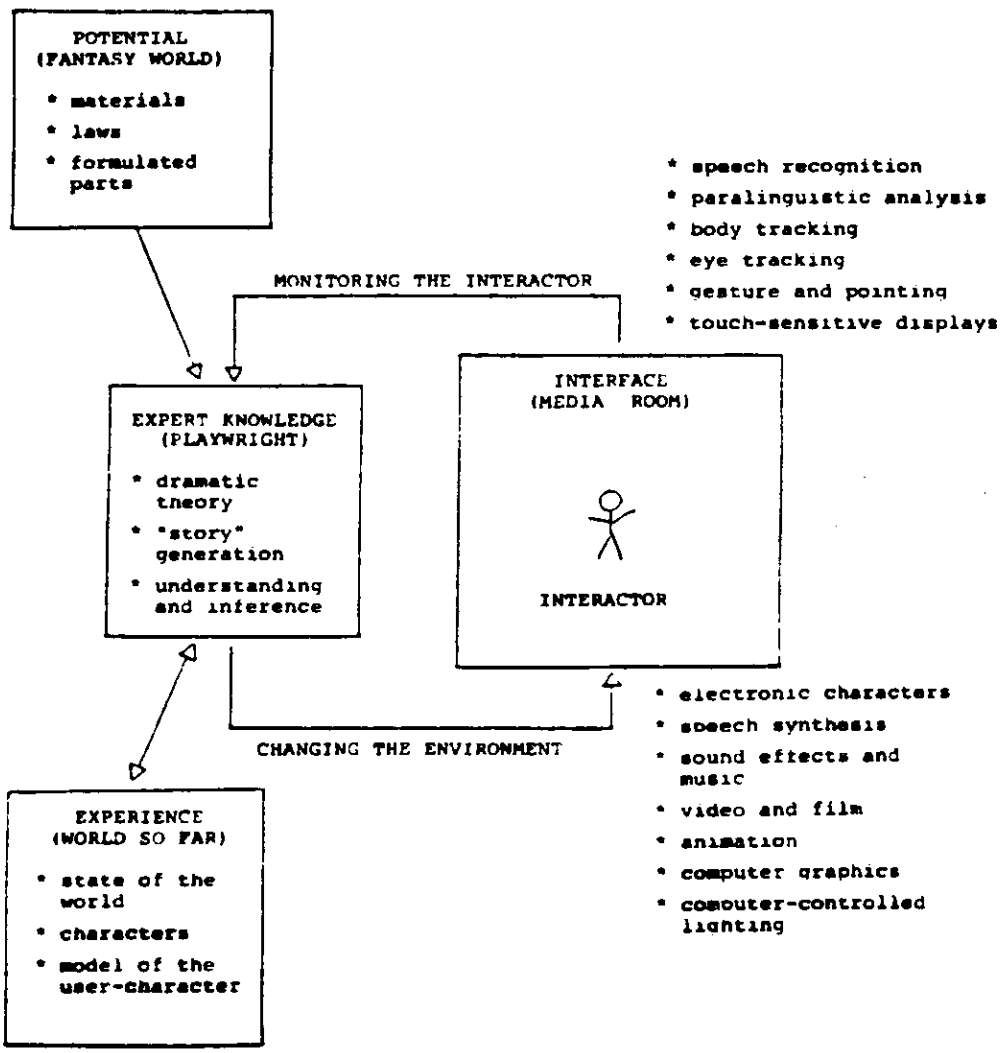


Figure 2-1: Overview of an Interactive Fantasy System

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 "Mr. 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.[14] 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

Future 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.