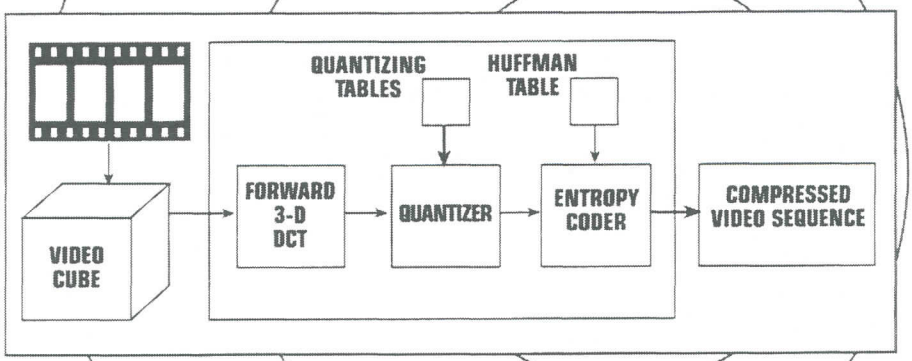
Handbook of MULTIMEDIA COMPUTING



Editor-in-Chief

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INTERACTIVE MOVIES

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Abstract. It is highly desirable for new types of media to emerge based on multimedia technologies, virtual reality technologies, and AI technologies. As an example of a new type of media, 'interactive movies' are proposed which will be created by the integration of conventional media such as movies, telecommunications, and video games. Interactive movies have the capability of creating a virtual world with various kinds of realistic/hyper-realistic scenes and computer characters. In addition, it can give people the ability to interact within this virtual world using speech and gestures. Therefore, people can experience stories in the virtual world through interactions with the characters and the environments of the world. In this chapter, the basic concept of such a new media will be described along with an experimental system we have developed.

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1. INTRODUCTION

It is highly desirable for new types of media to emerge based on multimedia technologies, virtual reality technologies, and AI technologies. The concepts of such new media are expected to be extensions of present trends in the areas of telecommunications, entertainment, and amusement. In this field, significant changes are now taking place. A single statement can describe these changes: a new technology is bringing cyberspace to telecommunications, entertainment, and amusement.

For example, in the field of telecommunications, the Internet is creating new communication sites. The Internet can be regarded as a huge cyberspace that links people all over the world. In the movie industry, which forms a huge entertainment market, digital technology and computer graphics give moviemakers the power to create hyper-realities – cyberspaces – on the screen. Video games, particularly role-playing games (RPGs) allow players to participate in the games as the main character and experience virtual reality, or cyberspace.

There is a high possibility that a new dream media will be created by combining these new currents of technology that are tiding over the fields of telecommunications, movies, and games. As one example of this dream media. we propose "Interactive Movies." Interactive movies produce a cyberspace that offers hyper-realistic images and scenes, and enables people to "enter" that virtual reality world. In cyberspace, people can interact with the human-like characters, animals, and plants in the story. This function enables an individual to create his or her own unique cyberspace, in which the person can act out the leading role.

In this chapter, we describe the positioning of interactive movies, and then we examine the requirements for constructing them. We will also introduce the details of an interactive movie project that we are currently working on.

2. POSITIONING OF INTERACTIVE MOVIES

2.1 CONCEPT

Interactive movies are a new type of media that integrates conventional media such as movies, novels, video games, and telecommunications. The closest description of interactive movies, in relation to conventional media, is "movies or theaters that allow the audience to 'experience' the story through participation." Interactive movies consist of the following elements:

(1) Interactive stories that allow the participants to interact.
(2) Participants who can individually "experience" the virtual reality created by the interactive story as the main character.
(3) Characters that interact with the main character in the story development.

2.2 EXAMINATION OF CONVENTIONAL MEDIA

For a medium to gain popularity, it must attract the interest of people and draw their attention. Conventional media use various methods to draw readers or audiences into the realities created by them and to affect their emotions. The following are representative types of conventional media.

(1) Novels and poems

Novels and poems draw on the power of words to lure readers into the world depicted by the writers so that the readers can "experience" what the writers intended to provide to them. The main factor that allows this is the imaginative power of people. People can envision an image in their minds from a verbal or written description.

(2) Movies

In a movie, visual images are shown on a large screen, and loud sounds accompany the images. Therefore, a movie appeals to both the visual and auditory senses of people, and draws them into the imaginary world shown on the screen. The rapid advancement of computer graphics technology in recent years has enabled the creation of imaginary situations and impossible events on the screen as if they were real. A movie pulls its audience into an imaginary world by feeding overwhelming visual and audio information to the audience, rather than stimulating their imagination.

(3) Video games

Video games, especially role-playing games (RPGs), present stories similar to those of novels in a game format. A player controls the story development by manipulating the main character. Although a variety of elements are incorporated, RPGs can be considered a new type of media that brings interaction into the stories of novels. It not only gives pleasant stimulation to people's senses, but also affects the players' emotions.

2.3 INTERACTIVE MOVIES AS A NEW TYPE OF MEDIA

We have examined the possibility of creating a new type of media by combining the story development capability of movies with visual and audio information, the power of novels to appeal to people's imaginations through a simple media form that uses words (language), and the interactive features of video games. Various attempts have been made in the past to create a virtual reality environment that interacts with its audience. These efforts include the creation of computer-generated characters [1][2] that can interact with people on behavioral and emotional levels, and interactive art [3]. However, in these achievements, the interactions were short-lived, and there was no story involved. The movie industry has long cherished the idea of audience-participating movies, but the actual application has been limited to primitive levels. RPGs are the closest in concept to interactive movies, but the essential difference is that RPGs require button operations for interactions while interactive movies aim to enable "person-to-person" interactions. Interactive movies have the following main features.

(1) Establishment of a cyberspace with images and sound

The use of CG, the mixing of CG images and actual footage, and the application of three-dimensional image and sound technologies enable the creation of a virtual reality environment that could not be offered by any other media in the past. This cyberspace provides an unprecedented level of stimulation to the imaginations of people.

(2) Immersion in the cyberspace

The cyberspace created by interactive movies does not exist separately from the audience, but the audience can enter this virtual reality environment.

(3) Experiencing the story in cyberspace

In an interactive movie cyberspace, the participant is more than an observer; the participant is the main character in the environment and experiences the story that takes place in that world. This is expected to provide a new realm of experience to people.

(4) Interactions in cyberspace

People can interact with other "residents" in a cyberspace – in the case of a movie, characters surrounding the main character – by talking and gesturing in the story.

The creation of these functions requires combined efforts in both technical and artistic areas. In many of the successful media such as movies and RPGs, creative efforts by technical and artistic people have been indispensable. Hollywood movies once entered a period of decline. However, the industry emerged from that dark age by successfully combining advanced CG technologies with know-how in artistic image rendering accumulated through many years of movie production. Like movies, RPGs are also acquiring artistic elements. For instance, the story setting and development in RPGs are well planned, and original music is produced and

inserted effectively to match the story. In developing the interactive movie, creating "advanced" interactions should not be the main focus of using the latest sound and image processing technologies. Instead, the interaction technology should be regarded as a means of enabling the audience to participate in the story interactively and to experience the virtual reality. For this reason, the technical features of interactions must be in balance with other elements. Artistic aspects are also important in interactive stories. Therefore, the use of artistic talents (script writers, visual artists, music composers, etc.) must be maximized in interactive movie production, so that the story takes full advantage of interactive features, the visual images captivate the viewers, and the music enhances the visual images.

Figure 1 shows how an interactive movie is related to each type of conventional media described above. Of all the basic elements in an interactive movie, the most important are the cyberspace generating functions and interaction functions. The cyberspace generating functions include the story generating function, the scene generating function, and the cyberspace character generating function. The following describes these basic functions in detail.

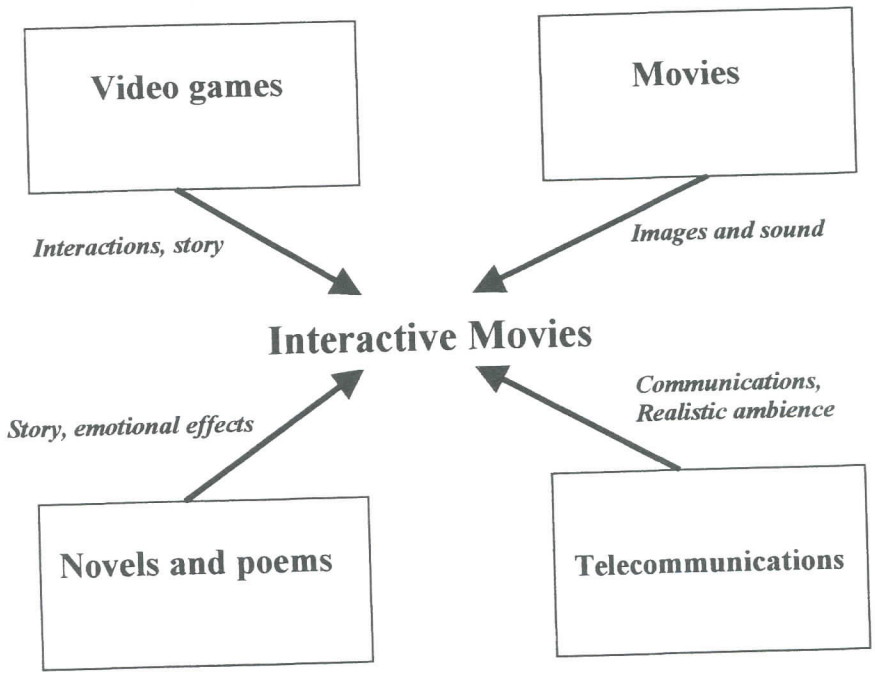

Figure 1. Interactive movies in comparison with conventional media.

3. STORY GENERATION

This section focuses on the details of the methods for designing and producing a story that develops through interaction with the audience. The following shows the systems of story development that can be applied to the construction of an interactive story.

(1) Semi-fixed story type

In the semi-fixed story type, the main plot of the story is predetermined. In this sense, it is similar to the fixed story type that novels and movies are based on. The semi-fixed story type,

however, provides a certain degree of flexibility during the progress of the story. This allows the participant to enjoy limited variations of story development through interactions. Current RPGs are categorized as this type. One advantage of the semi-fixed story type is that the accumulated know-how in story writing and movie making can be directly applied.

(2) Free development type

A story of the free development type has no scenario, and the story develops in a variety of ways depending on the interactions of the participant. Since it is impossible to predict what actions the participant will take in the story, the production group must consider all possibilities in designing the virtual reality environment. In a sense, this is similar to creating one whole isolated world; accomplishing this is close to impossible. At the same time, having free reign over the story development often puts the participant in a state of confusion, thus in some cases disabling him/her from making decisions.

Therefore, a story of the completely free development type is not expected to be created, at least in the foreseeable future. Considering these story development styles, the semi-fixed story type is deemed the most feasible.

4. SCENE GENERATION

To generate scenes in cyberspace, it is necessary to review the scene generating methods used in various media. The conventional scene generating methods can be roughly divided into the following two systems.

(1) Systems used in novels and poems

Novels and poems must draw on the power of words to communicate to readers. Illustrations are sometimes used in books, but their function is only supplementary. Writing conveys minimal information, and this is the very reason why novels and poems can appeal to the imaginations of people. In other words, novels and poems effectively use the power of written words to generate cyberspace scenes in the minds of readers.

(2) Systems used in movies

Movies use overwhelming images and sounds to generate scenes that the audience can see and hear. Their realistic images and sounds provide so much sensory input to the audience that the viewers can enjoy true-to-life experiences. This, however, may sometimes limit the range of human imagination.

The scene generation method used in recent years is based on a system used in movies, and applies advanced techniques to make the scenes more realistic. Nevertheless, no matter how innovative the images become, people soon grow accustomed to them. On the other hand, properly stimulated, the imaginative faculty of humans is capable of creating a cyberspace that no visual image or sound can match. In other words, virtual reality technology by itself has its limitations in the creation of cyberspaces. For the successful establishment of cyberspaces, the key point is to arrange a condition that works on people's imaginative power and appeals to their emotional faculty.

5. CHARACTER GENERATION

The most important but the most difficult task in producing an interactive movie is the creation of characters that interact with participants and draw them into the world of cyberspace. The following are important points for the generation of characters.

(1) Resemblance to humans

Creating human-like characters does not necessarily mean imitating the appearance of humans. Characters in animation movies do not always look identical to real humans; their

proportions and appearances are deformed to a large extent in many cases. People also instill their feelings into animal characters such as Walt Disney's creations. This is because those characters display a likeness to humans, not in appearance but through actions and behaviors, thereby reinforcing believability [5][6][7]. The characters in the interactive movie must also possess these qualities.

(2) Autonomous characters vs. animated characters

There are two methods of preparing character reaction patterns and the sequences of their motions. In one method, all of the patterns and sequences are prearranged as animated images, while, in the other method, the characters are given an autonomous function that enables them to automatically react and behave on their own to a certain degree. Extensive studies have been conducted on autonomous characters [5][8], but fully autonomous characters have not been developed yet. For this reason, the best approach to take at this time is to use animators for the creation of animated characters, and to gradually equip those characters with an autonomous function.

6. INTERACTIONS

The following describes the key points in achieving smooth interactions between the characters and the participants.

(1) Multi-modal interactions

Communications between people are based on multi-modal interactions. More concretely, in person-to-person communications, we use facial expressions and gestures in addition to verbal expressions. Interactions in interactive movies should also be based on more than one mode of communications, and use the combination of speech and gestures. This not only helps provide for more natural interactions, but also leads to deeper emotional involvement and the infusion of feelings by the participant.

(2) Non-verbal interactions

In person-to-person communications, information is conveyed by spoken words (verbal) and by other means (non-verbal). Non-verbal information includes personal information, emotions, and sensibilities [9]. Unfortunately, previous research activities in communications technology focused on developing a technology that supports verbal information exchange. However, the exchange of emotional and sensory information also serves a vital function in communications. To enable the characters in a virtual reality environment to carry out non-verbal communications with people, it is necessary to equip the characters with functions that recognize and express emotions [2].

7. EXAMPLE OF SYSTEM CONFIGURATION

Based on the above concept and considerations, we are currently developing an interactive movie system.

7.1 MAIN FEATURES

The main features of the interactive movie under development are summarized as follows:

(1) Collaborative work between artists and engineers

As stated in Section 2.3, it is essential to have artistic tastes in creating interactive movies, which are able to catch the heat of people and let them feel empathy. In our project, therefore, in such areas as the creation of an interactive story, music, and CG characters, artists played the main role. On the other hand, in the area of software and hardware system production as well as the interaction technologies, engineers are the key persons.

(2) Adoption of virtual reality technologies

Three-dimensional images projected on an arched screen recreate a true-to-life scene setting. These virtual reality technologies help draw the audience into the world created by the interactive movie.

(3) Natural interactions including non-verbal interactions

Speech recognition and gesture recognition functions are used to achieve natural interactions through verbal communications and gestures. In addition, to make non-verbal interaction possible, recognition of emotions involved in speech is introduced.

(4) Two types of interactions

Two types of interactions are introduced in the process of interactive stories to increase the chances of interactions between a participant and the movie world.

a) Interactions at points where the story development branches off into different directions. The results of the interactions at these points have major effects in the ensuing story development.

b) Interactions that have no effect on the story development. These actions allow the participant to enjoy communications and interactions with other characters in the story.

(5) Multi-story CG animation

Because an interactive story results in a complicated story development, a huge amount of animated images must be prepared for each and every story developing possibility. Although the amount of necessary images can be greatly reduced by equipping the CG characters with an autonomous function, taking that approach can result in unnatural animation as indicated in Section 5. In our research, therefore, we have placed our priorities on achieving the highest level of animation quality, and have prepared all the necessary animated images in advance.

7.2 SOFTWARE CONFIGURATION

Figure 2 shows the software configuration of our system.

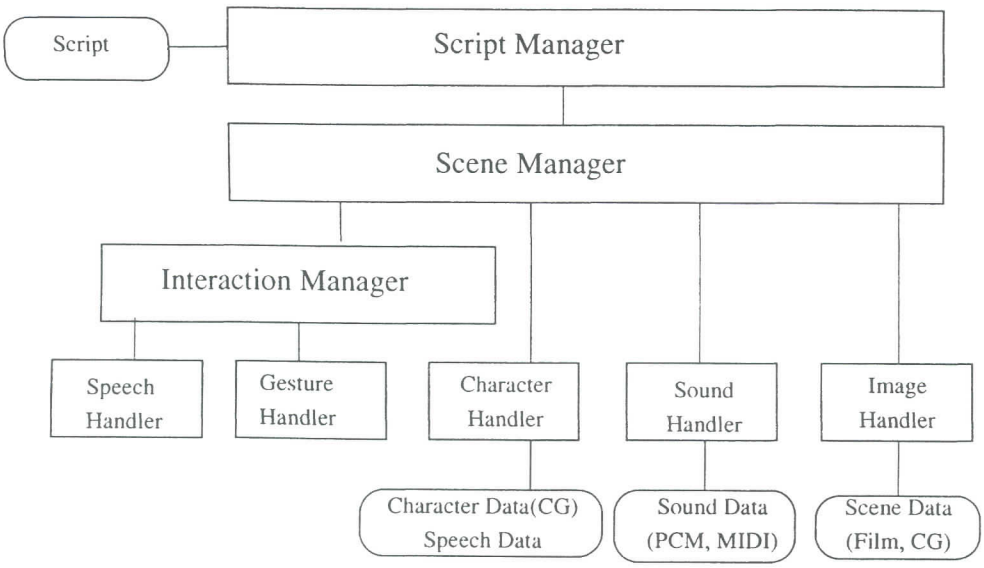

Figure 2. Software configuration.

(1) Script manager
The script manager controls the overall development of the story based on the interactive scenario produced from the script and scenario prepared by the storywriter. An interactive story consists of various kinds of scenes and transitions among scenes. Each scene also consists of various kinds of 'shots' and the transitions among these shots. The functions of the script manager are to define the composing elements of each scene and to control scene transitions based on an infinite automaton, as shown in Figure 3. The transition from a scene to one of possible consecutive scenes is decided based on the interaction result sent from the scene manager.

(2) Scene manager
The scene manager receives the definition of each scene from the script manager and controls the creation of the scenes. Each scene consists of the following factors.

a) Background scene and background music.
b) Character animations and their utterances including the timing for each utterance.
c) The kinds of interactions between a participant and these characters including the timing for the interactions.

The background scenes are made by mixing CG-generated scenarios and actual footage. At the beginning of each scene, the scene manager starts the output of the scene image and background music by sending commands to the appropriate handlers. The characters are generated by CG. Using the information of b), the scene manager starts the animation of each character by controlling the character handler and, at the appropriate time, lets them speak utterances. Additionally, at the predetermined time, the scene manager starts the interactions by sending commands to the interaction manager.

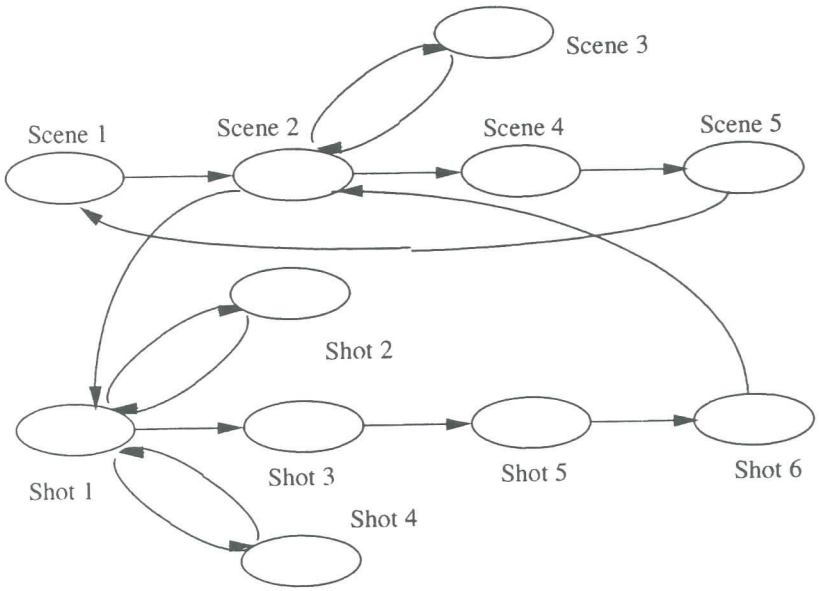

Figure 3. Scene and short transition.

(3) Interaction manager
The interaction manager is under the control of the script manager and the scene manager. The interaction manager controls the interactions that take place in each scene. The interactions are based on speeches and gestures. We use voice recognition, emotion recognition, and image recognition functions as the means of interaction. By receiving

commands from the scene manager that indicate the types and timings of the interactions, the interaction manager starts the speech recognition, emotion recognition, and gesture recognition by controlling the appropriate handlers. After receiving multiple recognition results, the interaction manager combines these recognition results, obtains the interaction result and sends it to the script manager through the scene manager, thus achieving a multi-modal interaction function (Figure 4).

(4) Handlers

The handlers are under the control of either the scene manager or the interaction manager. Their functions are to control the various input and output devices. We use the following handlers in our system.

a) Speech handler

The speech handler controls the speech recognition function and emotion recognition function. The speech recognition algorithm is based on an HMM while the emotion recognition algorithm is based on a Neural Network architecture.

b) Gesture handler
c) Character handler
d) Sound handler
e) Image handler

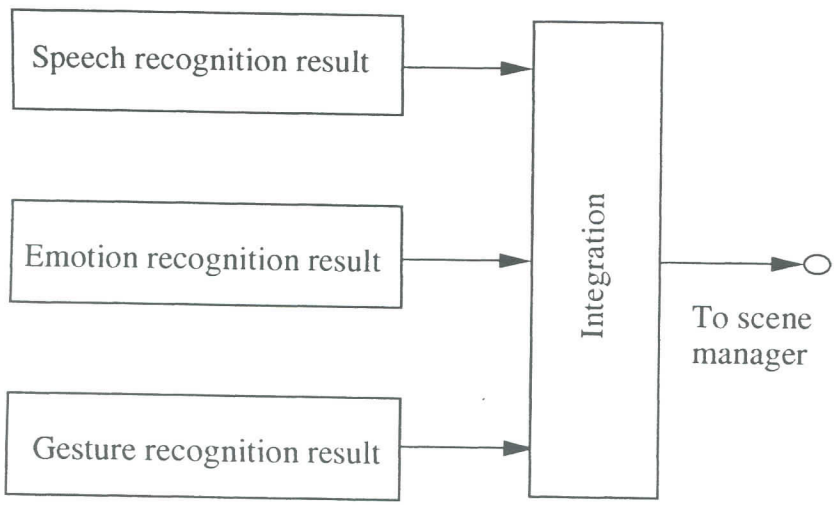

Figure 4. Function of the interaction manager.

7.3 HARDWARE CONFIGURATION

Figure 5 illustrates the hardware configuration. With a high-speed CG generating WS (Onyx Infinite Reality) serving the core function, the system also includes a speech recognition WS, a motion recognition WS, and voice and sound output WS. The visual outputs are projected onto the arched screen by two projectors.

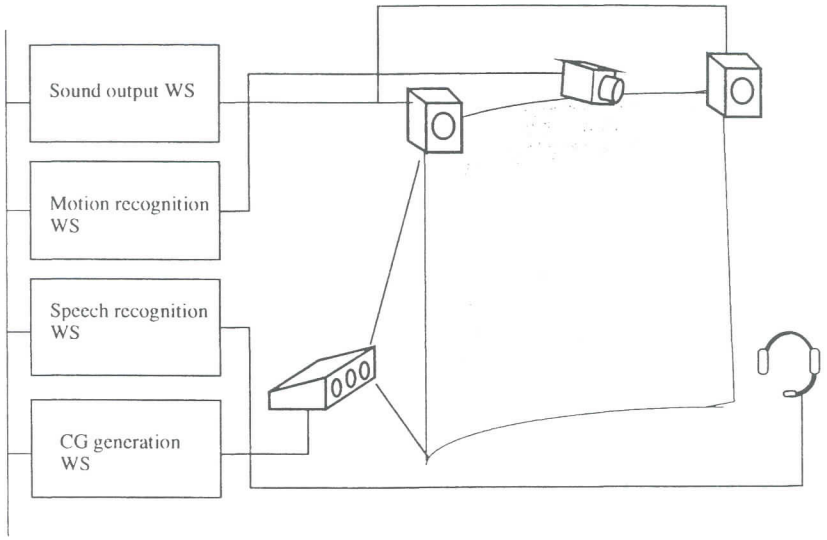

Figure 5. Hardware configuration.

8. EXAMPLE OF INTERACTIVE STORY PRODUCTION

We have produced an interactive story based on the previously described concepts and systems. We selected " Alice in Wonderland," a very famous story, and "Urashima Taro," one of the representative fairy tales in Japan, as the base stories for the following reasons:

a) These stories are familiar to everyone, so they can easily attract the attention of people.
b) These stories are simple, yet have a profound impact. Because they are simple, they can be easily reconstructed.
c) The stories contain visually attractive scenes.

The integrated interactive story is called "Wonderland." A brief summary of Wonderland is as follows. First, let's suppose you are a participant and will act the role of the main actor (or actress) in the interactive story. In a fairyland, you see a rabbit being cruelly treated by several gangsters. Upon sympathizing with and helping the rabbit, you are led to an electric pheromone castle – Wonderland.

The Muse, who is the princess and ruler of the Wonderland castle, warmly welcomes you. You experience various kinds of wonderful things such as musical entertainment, interactive poems, and so on. After having a good time, you finally decide to go back. Muse gives you, as a gift, a treasure box with a message not to open the box. After returning home from the castle, you find it difficult to keep your word to Muse not to open the box and finally open the box.

To make the story interactive, several branching points are included in the story. Examples of the branching points are as follows:

a) Whether or not to help the rabbit that is being cruelly treated by gangsters.
b) Whether or not to stay at the castle.
c) Whether or not to open the treasure box.

The participant must stand in front of the screen wearing a 3-D LCD-shutter glass and holding a microphone. The participant follows the story presented in images and sound, and participates in, and experiences, the story development through interactions with the characters in the story. Figures 6 and 7 show a participant interacting in the story.

9. CONCLUSION

This chapter proposes the concept of interactive movies, which are considered to be a new type of media that integrates various media types including telecommunications, novels, movies, and video games. In interactive movies, people enter cyberspace and enjoy the development of a story there by interacting with the characters in the story. In the chapter, we also tried to explain the relationships between this new media type and conventional media, as well as the technologies and systems necessary to achieve interactive movies. We also described the configuration of the system we are currently developing as an example of interactive movie application, and the context of the adopted interactive story based on famous fairy tales. We constructed a first-stage system, and are now evaluating this system. We plan to describe the details and evaluation results of the system in a separate report.

Figure 6. Example of interaction (1).

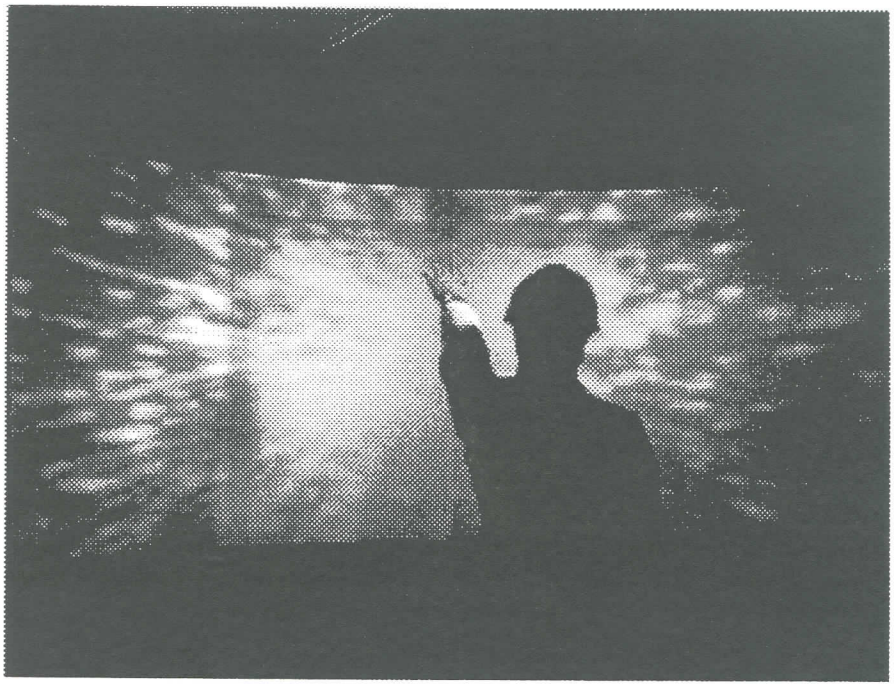

Figure 7. Example of interaction (2).

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Editor-in-Chief
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Handbook on Multimedia Computing provides a comprehensive resource on advanced topics in this field, considered here as the integration of four industries: computer, communication, broadcasting/entertainment, and consumer electronics. This indispensable reference compiles contributions from 80 academic and industry leaders, examining all the major subsets of multimedia activity.

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- ***Basic Concepts and Standards*** introduces basic multimedia terminology, taxonomy, and concepts, including multimedia objects, user interfaces, and standards
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Handbook on Multimedia Computing serves researchers and practitioners in the field, scientists and engineers involved in multimedia system design and applications, and anyone wanting to learn about the field of multimedia computing.

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