

ACTIVE IMMERSION: THE GOAL OF COMMUNICATIONS WITH INTERACTIVE AGENTS

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Introduction

The creation of interactive animated agents is one of the most active research areas for researchers who are trying to develop various kinds of technologies that give such agents human-like behaviors. However, there are other important issues concerning the agents. One is the introduction of narratives into the behaviors of the agents. Since narratives are the basic way movies and novels take us into cyberspaces, they can be effective for creating really human-like agents. Based on this idea, we have developed an interactive movie system [1] in which people can act the main roles and enjoy the story development. At the same time, we have learned that the existence of spontaneous interactions is also the key to the success of this new media. Based on this lesson, we have developed a second system [2] where we tried to achieve a good balance between narrative-based and spontaneous interactions. In the first part of this paper we introduce our interactive movie system by focusing on how we achieved an integration of narrative-based and spontaneous interactions. Also, there is the important question: what is the objective of creating interactive animated agents? Although the technological aspects of such agents have been studied and discussed in detail, this critical question has rarely been discussed. In the latter part of this paper, we will discuss what is the ultimate goal of interactions with interactive agents.

Creation of Computer Agents with Spontaneous Interactive Capabilities

Overview

Movies are an established media that can make

people feel emotions and empathy. By introducing interaction capabilities into movies it is expected that we can create a new type of media in which people can become heroes or heroines while enjoying the story development. Based on this basic idea, we have been studying interactive movies. One of the key factors of an interactive movie system is the computer characters that interact with the participants who play the main characters. In the first system we developed, the behaviors of the characters were controlled by the narratives [1]. We have learned in evaluating the first system that the spontaneous reactions of the characters are as important as the narrative-based interactions. Therefore, we have tried to integrate spontaneous interaction capabilities into the movie characters by using emotion recognition.

Spontaneous Interaction

Figure 1 illustrates how interaction proceeds for both the first system and the second system. In the first system, the order of all interactions of a participant and the behaviors of the characters are predetermined. Therefore, the system control mechanism is rather simple.

The difference between the first system and the second system, as illustrated in Fig. 1, is that in addition to the predetermined sequence of interactions between the participants and the characters, unpredictable interactions, in other words, spontaneous interactions, occur. Therefore, the system must distinguish the predicted and unpredicted interaction results and handle the behaviors of the characters according to these two kinds of inputs. Furthermore, some fluctuations have been added to the responses of the characters to add naturalness to their reactions. These requirements have led to a distributed control struc-

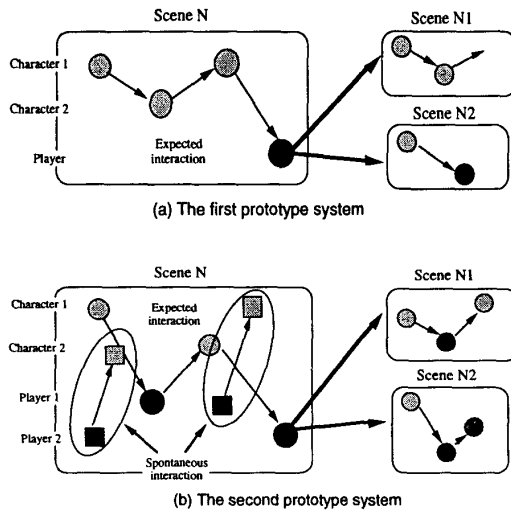


Fig. 1 Comparison of interactions between first system and second system.

ture instead of a top-down structure. Figure 2 illustrates the software used in the second system. The interaction manager in Fig. 2 is the key component controlling the behaviors of the computer characters.

Interaction Manager

The interaction manager is the most critical component for achieving the spontaneous behaviors of the characters. The interaction manager has functions for distinguishing predicted and spontaneous interactions and generating character reactions for spontaneous interactions. The details of these functions are described below.

(1) Distinguishing predicted and spontaneous interactions

It is difficult for the system to distinguish whether the speech of a participant is a predicted input or a spontaneous input when only using speech recognition technologies. To solve this problem, we have adopted a method in which both speech recognition and emotion recognition work simultaneously. When a reasonable speech recognition result is obtained, the input is judged as a predicted interaction, and the recognition result is utilized for generating the predetermined behaviors of the characters. When the speech recognition function fails to output a reasonable recognition, it is judged as a spontaneous interaction, and

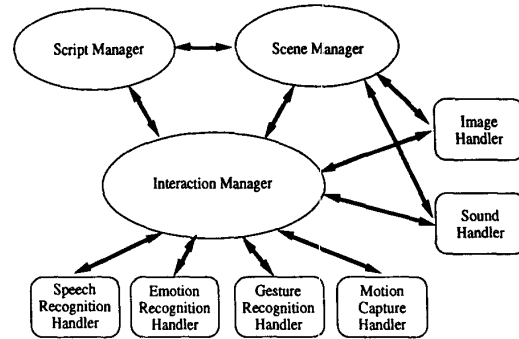


Fig. 2 Software configuration of the second system

the emotion recognition result is then utilized to generate the spontaneous reactions of the characters.

(2) Generating character reactions for spontaneous inputs

The basis of spontaneous interaction is a structure that allots each character an emotional state, and the interaction input from the participant and his/her interaction with the characters determine the emotional state for each character. Some leeway is given to how a response is expressed depending on a character's personality and circumstances. To achieve this, we chose to use the concept of the "action selection network" [3], which sends and receives activation levels among multiple nodes. A character whose accumulated activation level exceeds the activation threshold performs a specific action based on an emotional state. This mechanism enables more a more diverse type of interaction than the simple interaction involving a one-to-one correspondence between emotion recognition results and character reactions.

Examples of Interactions

We have produced an interactive story based on Shakespeare's "Romeo and Juliet." We chose "Romeo and Juliet" because it is a very well known story and people have a strong desire to act out the role of hero or heroine.

Basically, the system controls the progress of the story with character animations and character dialogues. The story moves on depending on the voice and gesture reactions of the participants and, as described before, interaction is possible at any time.

When the participants utter spontaneous phrases or sentences, the characters react according to the emotion recognition results. Consequently, this system can go anywhere between story-dominant operation and impromptu interaction-dominant operation depending on the frequency of the participants' interaction. Figure 3 illustrates examples of the scenes in the interactive movie system.

Evaluation

We have exhibited our interactive movie system at various exhibitions such as the Interactive Media Division of the Berlin Film Festival and Imagina, the largest conference/exhibition on computer graphics in Europe. A large number of people experienced our system by playing the role of Romeo or Juliet. Many of them reported that they felt a deep immersion that is somewhat different from the one they feel when they watch movies. Based on this experience, we have considered the objective of creating interactive agents.

The Goal of Communications with Interactive Agents

To more fully understand communications with interactive agents, it is important to consider how the ideal type of communications should be. The conventional image of communication is the transfer of logical information from the sender to the receiver. It can be considered that the original form of communi-

cations was more dynamic. The sender, the receiver, and the environment surrounding them become united, and it is possible to understand information as something shared between the sender and receiver and, moreover, as the relationship of the sender and receiver.

From such a viewpoint, ideal communications should include the following three elements.

- (1) Experience and synesthesia
- (2) Integration of physical and mental experience
- (3) Active immersion

Explanations are given below for each of these three elements.

Experience and synesthesia

Communications to date have meant the sharing of information (related to communications) between people, by having logical information sent and received. This, however, has indeed been "dry" communications.

The communications between a mother and her child, for instance, is close communications - both see and hear the same things in the same environment and, moreover, share the same feelings. More than the sharing of information, isn't it possible to call this a condition whereby a partner's feelings and one's own feelings are synchronized by both having the same experiences? From this perspective, we regard "experience and synesthesia" as the state of original communications.

Integration of physical and mental experience

Next, we consider the contents of "experience." "Experience" is created from experience involving the body and that involving the mind. The former merely means to move the body. A representative example is exercise, but even a thing moving only a part of the body is experience involving the body. For example, experience involving the body includes the emitting of sounds.

For the latter (i.e., mental experience), it can be considered that the functions of the cerebrum become involved in actions added to the functions of the five senses such as using words, reading books, listening to music, and looking at pictures. Of course, here the



Fig. 3 Examples of the scenes in the interactive movie system.

handling of logical information occupies a large space, but the handling of "kansei" information such as emotions and feelings also occupies a large space.

The original meaning of the word "experience" involves an "integrated experience" merging the above types of experience involving the body and the mind. The act of creating art such as drama, performance, and sculpture has a side including experience involving the body in that it achieves form by a practitioner being able to appreciate a high mental experience and moving the body with it. Accordingly, it can be said that one is able to appreciate a fascinating "integrated experience" when involved in the creation of such art.

Active immersion

There are probably various kinds of fascination and uplifting, but here the word "immersion" is used as a general term for these. In an integrated experience, many types of things that are felt give the sensation of uplifting and fascination, but can any such sensation be useful in achieving the ideal communications we discussed above? Here, we think it is important to make a key distinction. By carefully investigating immersive situations, we find that we can classify them into "passive immersion" and "active immersion."

Does not the level of consciousness differ between the two types of immersion, although there is no difference between becoming absorbed in passive immersion and in active immersion? Is there not a big difference in the condition of fascination between active immersion and passive immersion? The condition where one forgets oneself or the condition where one loses consciousness (fascination, hypnosis, trance) becomes a key factor that explains the feeling of passive immersion.

Active immersion, in contrast, is the condition whereby one's consciousness is maintained in a normal manner while that person becomes absorbed. Conditions of immersion while clearly maintaining consciousness include doing work with concentration and immersion in the act of creating art. Even in the case of sports, such conditions are experienced.

When such passive immersion or active immersion pays attention to the processes that take place, an interesting fact becomes clear. It is the existence or non-existence of interaction. We feel passive immersion

when we are only receiving information, such as when we watch movies. In other words, there is a lack of interaction here. In contrast, active immersion differs from the point of working on the object, such as creating art and participating in sports. In other words, interaction exists with active immersion. Consequently, the existence or non-existence of interaction is the key that distinguishes passive immersion and active immersion.

Evaluation of the Interactive Movie System

Here we evaluate our interactive movie system from the viewpoint of the base elements of communications described above.

(1) Experience and synesthesia

Narratives have a strong power to make people feel strong emotion and empathy toward the characters in movies. With interactive movies, through the interaction with other characters, it becomes possible to participate in the story development in collaboration with them. In addition, it is possible for synesthesia to be aroused by the characters of interactive movies. As a result, experience and synesthesia are expressed.

(2) Integration of physical and mental experience

By playing the role of a hero or a heroine and thus by experiencing the story development, people have a deep mental experience. At the same time, experience involving the body occurs in interaction activities such as speaking out lines or moving around. That is, it is possible to appreciate an experience that integrates physical and mental experience.

(3) Active immersion

An interactive movie system can provide an "active" experience in the sense of "to experience... story development by interaction through words and gestures with computer characters." This can be understood if it is actually experienced; it is easy for one to enter the condition of some type of immersion when proceeding to play a role through the power of narratives. According to this meaning, the proposed system has the power to achieve active immersion.

Other media where interactive animated agents play key roles have the same kind of characteristics as described above. This means that interactive characters can realize a high level of communications that con-

ventional media cannot realize.

Conclusions

In this paper, we introduced our interactive movie research as one example of new media where interactive animated agents play the key roles. We also considered the characteristics of ideal communications, and it was found that interaction with interactive agents has the capability to realize this ideal state of communications. Therefore, it is necessary to evaluate interactive animated agents based on the quality of communications they achieve with humans as well as the quality of their human-like behaviors.

References

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