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Multimedia Presentations: The Support of Passive and Active Viewing

Elisabeth André, Thomas Rist

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Deutsches Forschungszentrum für Künstliche Intelligenz GmbH

Postfach 20 80
67608 Kaiserslautern, FRG
Tel.: (+49 631) 205-3211/13
Fax: (+49 631) 205-3210

Stuhlsatzenhausweg 3
66123 Saarbrücken, FRG
Tel.: (+49 681) 302-5252
Fax: (+49 681) 302-5341

Deutsches Forschungszentrum für Künstliche Intelligenz

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Friedrich J. Wendl
Director

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Multimedia Presentations: The Support of Passive and Active Viewing

Elisabeth André, Thomas Rist
German Research Center for Artificial Intelligence (DFKI)
Stuhlsatzenhausweg 3
D-66123 Saarbrücken 11, Germany
e-mail: {andre, rist}@dfki.uni-sb.de

Abstract

In contrast to conventional printed text which allows for passive viewing only, computer-based presentations can support various forms of user interaction and let the user play an active part at presentation time. As each presentation style has its own strengths and weaknesses, we aim at a multimedia presentation system that supports both passive and active viewing of the generated material. We start from our previous work on the plan-based synthesis of multimedia presentations where all presentation acts have been planned and realized by the system. However, in the approach presented in this paper, we allow certain presentation acts to be planned and/or realized by the user as well. We augment structuring principles for non-interactive multimedia presentations and integrate them into a uniform framework. Finally, we sketch how modules of WIP, our existing presentation system, can be reused and extended.

Contents

1 Introduction

Using computers for the presentation of information is promising for at least two reasons: First, new presentation forms can be realized. Presentations generated by a computer system may contain a mixture of multiple media including not only static components such as written text and graphics, but also dynamic media, such as speech and animated pictures. Moreover, such presentations may support user interaction, e.g., by means of hypermedia techniques. Secondly, there is an increasing interest in the design and implementation of intelligent presentation systems (e.g., see [5,6,7,13,14,21,27] and also [22] for an overview). This research leads to systems that automatically decide how to use computer-based presentation techniques in order to communicate information to individual users in particular situations.

In our previous work [3,28], we developed the automatic presentation system WIP which can generate illustrated instructions for the operation and maintenance of technical devices. The benefit of WIP lies in its ability to present the same information in a variety of ways depending on the settings of generation parameters such as user characteristics, target language and resource limitations (cf. [20]). For example, if the system is to instruct a user in operating a physical device, it may accomplish this task either by means of a pure textual instruction, a picture sequence, or a text/picture combination. However, since WIP was designed as a completely non-interactive system, only *passive viewing* of the presentations generated is supported, as with conventional printed documents. One problem with such presentations is that a user's actual needs must be anticipated. Although WIP relies on different user profiles to control the generation process, there always remains a high risk that the system starts from false assumptions concerning the user's previous knowledge about the domain and presentation techniques. But even when a presentation contains all the information needed for a proper understanding it may fail because the user doesn't take notice of a single, but important detail. For example, Weidenmann [29] found that information provided in the pictures of illustrated texts is often not assimilated by readers - not because the pictures are badly designed, but because readers simply don't look at them.

Fortunately, computer-based presentation systems can support various forms of user interaction[1] which may be used to overcome some of the problems arising from the nature of fixed presentations designed for passive viewing only. In this paper we will speak of *active viewing* of a presentation if the user has to interact with at least some parts of the presentation. Hypertexts are well-known examples of presentations which require active viewing. In the context of multimedia presentations, further forms of interaction may be supported as well. In

[1]For the purpose of this paper, we restrict ourselves to interactions based on simple methods such as using a mouse to point, select, scroll, or navigate in 3D-space. Other interaction devices, such as natural-language access to visual material (e.g., see [1,26]) are beyond the scope of the paper.

particular, the medium of graphics provides interesting opportunities for active viewing. For example, a presentation may include hypergraphics in which picture constituents are mouse-sensitive and lead to other presentation units. As far as the graphics generation process relies on 3D object models, users can be encouraged to undertake arbitrary walk-arounds and walk-throughs. For some purposes it may even be useful to provide the user with illustration techniques, e.g., to construct exploded, or cut-away views, with which 3D-objects can be explored.

Active viewing to a certain extent circumvents problems concerning content selection, media choice and medium-specific realization. In contrast to systems like WIP, responsibilities are simply shifted from the presentation system to the user; i.e., users may identify their information needs and determine presentation formats. In this way, what people read, see and hear is augmented by what they experience. Enthusiasts for hypermedia presentations may add that involvement of a user in the presentation is always a good means to enhance attention. However, overstressing active viewing for the purpose of information presentation creates its own problems. Experience, e.g., with hypertext systems shows that a user may lack an efficient strategy (or even any strategy) for extracting information, and that she may become lost while navigating freely through the complex network of information nodes of a hypermedia presentation (e.g., see [9,17]).

In the light of these considerations, it is straightforward to aim at a multimedia presentation system that supports both passive and active viewing of the material generated. In such a system the effectiveness of presentations can be optimized by combining multiple media with these two different presentation styles. For example, the coarse structure of a presentation will be determined and exhibited by the presentation system while active viewing will be made possible at certain points, e.g., to let the user perform elaborations such as exploring graphical presentation parts. In this paper, we will sketch how the plan-based approach developed in the WIP project for the design of multimedia presentations can be augmented in that direction.

2 Approach

In earlier work [2,4], we have shown that multimedia presentations follow structuring principles similar to those of pure text. One dimension of the structure of a multimedia presentation (intentional structure) is determined by a hierarchy of *presentation acts* whereby each act serves to fulfill a particular intention of the presenter. Another dimension (rhetorical structure) can be characterized by the roles that acts play in relation to other acts. In order to find out which relations may occur between textual and pictorial document parts, we examined various illustrated documents. Among others, we found that the relations between the parts of a picture and between them and text often correspond to the relations proposed in textlinguistic studies, e.g., the Rhetorical Structure Theory (RST, [12]). As multimedia presentations follow structuring principles similar to those of text, it has been possible to extend work on text-planning [15] to the broader context of multimedia presentation. To synthesize multimedia presentations, we have defined presentation strategies representing combinations of multimedia presentation acts that are performed to achieve a certain presentation goal.

In our previous presentation system WIP, all presentation acts were planned and realized by the system. The main idea behind this paper is to allow certain presentation acts to be planned and/or realized by the user as well. Four cases can be distinguished:

- *A presentation act is planned and realized by the system.*
  This situation is assumed, e.g., in the WIP system where no user interaction is supported.
- *A presentation act is planned by the user, but realized by the system.*
  This case occurs when allowing for follow-up questions. Here, the user initiates a certain presentation act, e.g., to elaborate on a certain topic; but the execution is done by the system.
- *A presentation act is planned by the system, but realized by the user.*
  This situation occurs when the user is requested to interactively explore the material presented.
- *A presentation act is planned and realized by the user.*
  This case corresponds to the classical hypermedia situation. The user herself inspects the available presentation parts in order to retrieve the information she is interested in.

In order to handle presentations including material for passive and active viewing, we augment the structuring principles mentioned above.

First, we distinguish between *presentation acts* and *exchange acts*. Whereas presentation acts, e.g., the description of a process, refer to material to be presented, exchange acts, such as rejecting a request, relate to interaction with the user. Both kinds of act may be complex or correspond to elementary speech acts (e.g., formulating a request), pictorial acts (e.g., visualizing an object trajectory) or gestures (e.g., mouse-pointing to an object in a picture). Like presentation acts, exchange acts refer to a particular goal (e.g., the user is able to identify a certain object). Explorations undertaken by the user are then regarded as sequences of exchange acts. For example, a walk around an object in 3D space is interpreted as a series of requests to see the object at different angles and the corresponding system reactions. The advantage of this approach is that we don't have to introduce special exploration acts since they can be treated in the same framework as presentation acts and exchange acts.

The second extension aims at a description of the rhetorical structure within a uniform framework. Therefore, we extend our own work on the rhetorical structure of multimedia presentations in a similar way as others did to customize RST for the structural description of natural-language dialogues (e.g., see [24][2]). To describe not only the structure of the material to be presented, but also the structure of the interaction process, we define new relations, such as *comply-with-request* or *acknowledge*. The introduction of these relations enables us to describe the rhetorical structure of a multimedia dialogue on two levels: the *content level* and the *exchange level*. Assume the user clicks on a certain part in a graphical presentation and the system provides the name of this object. In this case, a *comply-with-request* relationship holds between the two exchange acts, and there is an *elaborate-part* relationship between the graphical presentation and the textual explanation.

3 Example Scenarios

In this section we discuss several presentation scenarios and describe their underlying structures. The examples are taken from WIP's lawnmower and modem domains. In all examples, we assume that the system (S) explains to the user (U) how a certain domain object is composed.

Scenario 1:

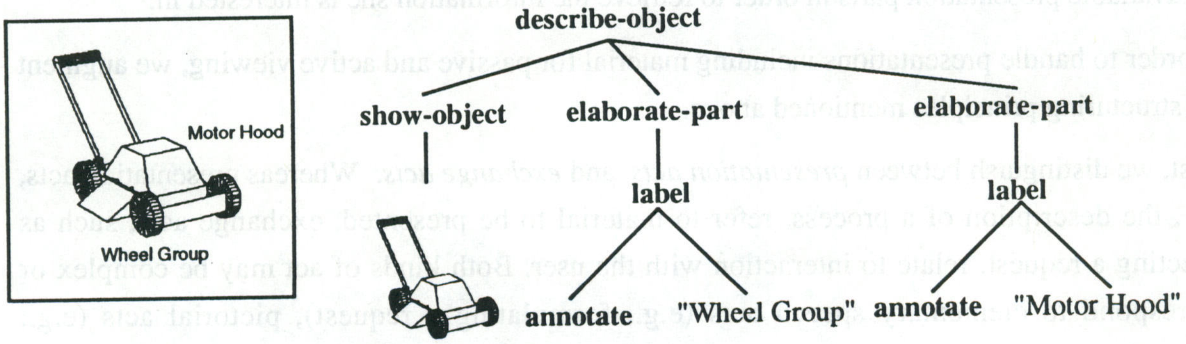

Fig.1: Elaborations planned and realized by the system.
Left part: Presented material. Right part: Corresponding discourse structure

The first scenario is a typical example of a presentation that supports only passive viewing. It corresponds to the kind of presentation generated by the WIP system. The document shows a

[2]Although Maier and Sitter were also concerned with graphical retrieval dialogues in the MERIT system [25], they didn't attempt to describe the structure of the presented multimedia material in a uniform formalism and only concentrated on the structure of the text generated.

diagram of a lawn-mower that is elaborated by two labels (cf. Fig. 1). While the root of the corresponding discourse structure is a complex presentation act, the leaves are elementary speech acts and pictorial acts.

Scenario 2:

S: <picture of the lawnmower>
U: Clicks on the wheel group
S: Provides a menu of possible follow-up-questions
U: Selects "What is it?"
S: Annotates the wheel group

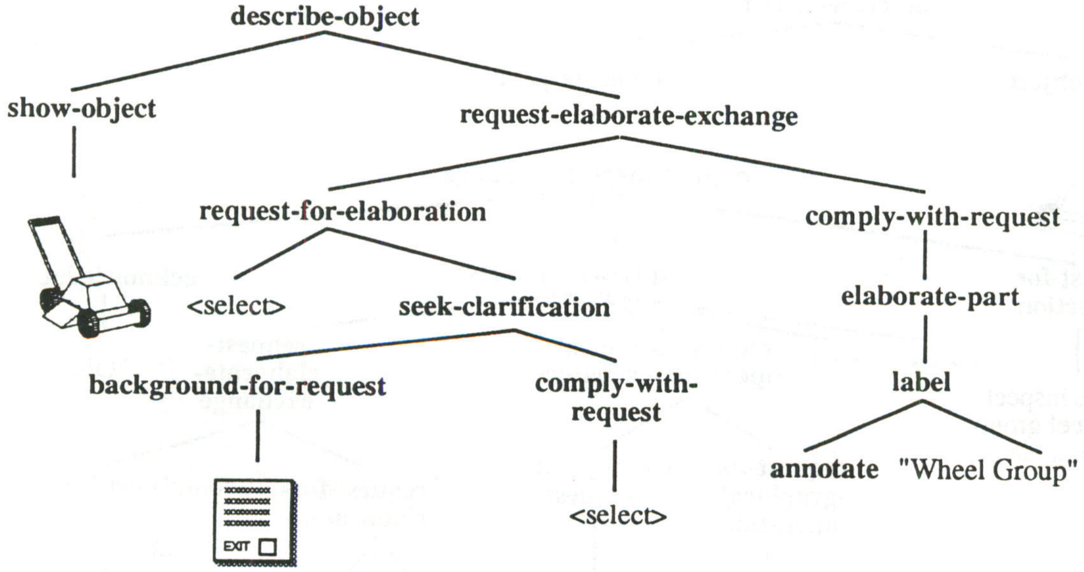

Fig. 2: Elaboration initiated by the user, but realized by the system

In scenario 2, the system shows a picture of a lawn mower, but then the user takes the initiative and clicks on an object part. The system interprets this as a request for elaboration. However, since it is unclear which kind of elaboration is requested, the system provides a set of possible follow-up questions. The user indicates that she wants to know what kind of object it is. Whereas the user initiates the elaboration, it is up to the system to realize it. In our case, the system prefers a graphical annotation to a pure textual description, such as "This is a wheel group". This example also shows that active behavior of the user can cause the system to modify an initial presentation. In other situations, a restoration of a previous document state might be necessary where it is not possible to incorporate the user's suggestions coherently.

Scenario 3:

S: <picture of the lawnmower>

S: "Please inspect the wheel group in the middle of the figure".

U: Walks around the wheel group

U: Zooms into the wheel group

U: Explodes the wheel group

U: Clicks on the wheel nut

... (as in scenario 2)

S: Annotates the wheel nut

U: "OK"

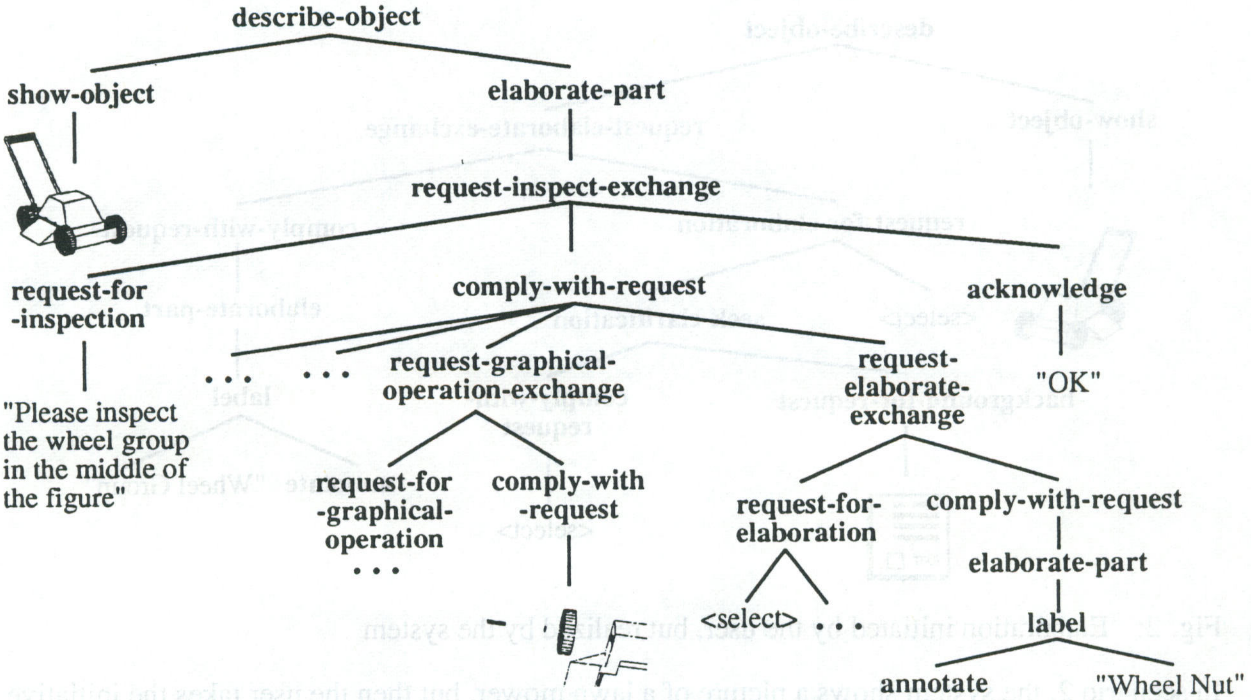

Fig. 3: Elaboration planned by the system, but realized by the user

In the first part of scenario 3, a picture of a lawn mower is shown as in scenario 2. But here the system suggests an elaboration and requests the user to inspect the wheel group which is shown in the middle of the picture. The user then applies several illustration techniques. She first changes the angle, zooms into the wheel group and then explodes it. In contrast to scenario 2, the system has planned this elaboration, but decided to have the user realize it. During the exploration, the user, in turn, asks the system for a further elaboration as in scenario 2. After a while, the user informs the system that the exploration is done and that the system should continue its presentation. However, the user has drastically modified the initial picture. Thus, the system should restore the initial document state before it continues.

Scenario 4:

S: <picture of the modem>

S: ... (describes the single components of the modem)

S: "There is a special transformer for power supply inside the modem".

U: Separates the cover from the modem.

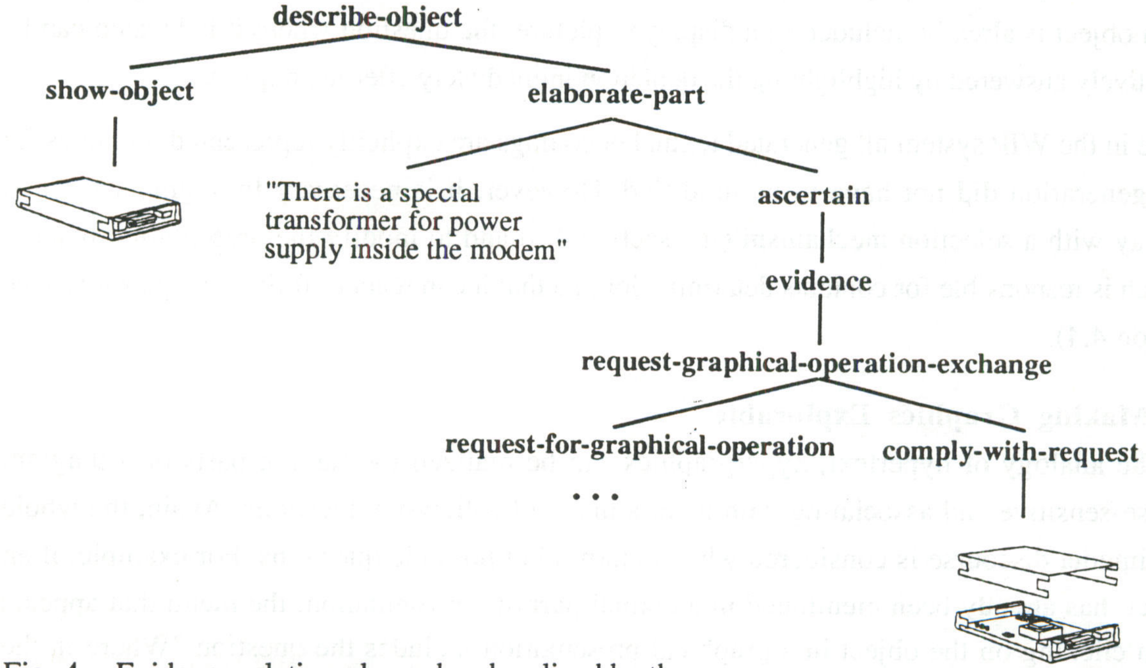

Fig. 4: Evidence relation planned and realized by the user

In scenario 4, the system provides a description of the modem. It shows a picture of it and verbally describes its components. When the system informs the user that there is a special transformer inside the modem, the user wants to verify this claim. Therefore, she interrupts the presentation and applies the explosion technique to the modem cover in order to make the internal components visible. In this example, all decisions leading to the exploded modem were taken by the user.

4 Realization

In order to design a system supporting active and passive viewing, we rely on modules developed within the WIP project. In particular, we reuse the core modules for presentation planning [4], text generation [10], and graphics generation [19].

4.1 Adding Hypertext Facilities

As a simple step from static text towards hypertext-style presentations, referring expressions for domain objects are made mouse-sensitive. Mouse-clicks are then interpreted as the desire to ask a follow-up question concerning the selected object. In order to circumvent problems with natural-language analysis, we provide the user with a menu of several possible questions she may ask (see also [16,18]). Typical questions are "What function?", "What does it look like?", "Where is it located in the picture?" etc. As the last question indicates, the whole multimedia discourse is taken into account when determining the set of questions to appear in a menu. On the other hand, questions can be answered otherwise than with text - the requested information may also be presented graphically or by means of several media. For example, if the depiction of an object is already included in a displayed picture, the question where it is located can be effectively answered by highlighting the depiction immediately after the request.

Since in the WIP system all generated textual encodings are explicitly represented, modules for text generation did not have to be modified. However, it is necessary to augment the text display with a selection mechanism (see section 4.3) and to modify the presentation planner (which is responsible for contents determination) so that it can react to follow-up questions (see section 4.4).

4.2 Making Graphics Explorable

On the analogy of hypertext, hypergraphics can be realized by making parts of a diagram mouse-sensitive and associating with them a menu of follow-up questions. Again, the whole multimedia discourse is considered when determining possible questions. For example, if an object has already been mentioned in a textual part of a presentation, the menu that appears when clicking on the object in a graphical presentation includes the question "Where in the text?". Hypergraphics facilities are only one way to let the user interact with graphics. In the WIP system, we have developed 3D and 2D techniques which can be used to build up various illustrations of 3D-objects. For the purpose of automated graphics generation, these techniques are selected and applied by a graphics design component. However, some of the techniques can be offered to the user to let her visually explore domain objects herself. For example, if on-line navigation in 3D-space is allowed, the user may look at objects at angles different from those chosen by the system. Also, the user may apply the "explode" or "cut-away" technique to retrieve more information about how compound objects are assembled, or to look through an object.

The step from static graphics to hypergraphics does not cause serious problems because a representation of graphical encodings is already provided by WIP's graphics generation component. Situations in which the user herself is allowed to apply illustration techniques are more difficult to handle. Whereas in hypergraphics the user wanders from one part of a presentation to another without modifying a part previously visited, this is no longer the case when applying illustration techniques. For example, if the user cuts away an occluding object, the picture contents changes - not only because the object is differently presented, but also because further objects have now become visible. With regard to the superordinate multimedia discourse, we have to update the semantic representation of a graphical presentation after each user modification and send this information to the presentation planner so that it can influence further design decisions. From a technical point of view[3], it does not matter whether the user or the system applies an illustration technique; therefore, WIP's mechanism for building up semantic descriptions of graphics is used for both cases. Another interesting question is how to coordinate design decisions made by the system and the user. So far, we treat user-driven modifications on illustrations in an "overwrite" manner. Thus, in order to ensure presentation coherency the system may have to restore a previous presentation state after a user exploration. As an alternative one can follow a recent approach by Seligmann and Feiner [23]. In their interactive illustration system IBIS, user interactions are interpreted as additional constraints on the illustration which have to be met by the system during user exploration.

4.3 Replacing Static Layout by Display Management

We introduce a *display manager* that basically accomplishes two tasks. On the one hand, it has to determine effective screen layouts for hypermedia-style presentations. In contrast to WIP where the system has only to determine how blocks of static text and pictures should be displayed on a screen page (or likewise printed on paper), a static 2D page layout is not sufficient for hypermedia presentations. Rather, layout becomes a dynamic process in the 2.5D screen space. For example, when expanding a hypertext node, the system has to decide how to present the new information. In some cases, temporary pop-up windows will suffice, in other cases it would be beneficial to permanently integrate a new presentation part into the display. As a starting point, we map relations between new presentation units and units already displayed onto spatial constraints and rely on WIP's constraint-based layout approach [8]. On the other hand, the display manager maintains user interactions. Interaction events such as mouse-movements and clicks are recorded and forwarded to the presentation planner.

4.4 Extending the Presentation Planner

As in the WIP system, a presentation planner is responsible for selecting and organizing the contents and for determining an adequate combination of presentation media. In order to support active viewing, the following augmentations have been necessary.

Augmenting the repertoire of presentation knowledge

Presentation strategies in WIP contained combinations only of multimedia presentation acts. Consequently, WIP was able only to synthesize documents for passive viewing. To support both passive and active viewing, we add presentation strategies that include presentation acts as well as exchange acts. On the one hand, this increases the bandwidth of presentations. On the

[3] In view of the effects on the user, things are more complicated. What can we assume a user knows after applying several illustration techniques? As a rough approximation, we assume that the effects of active viewing can also be achieved by providing the user with a sequence of snapshots of the single-step results. However, we are aware of the fact that this may be inappropriate in some cases.

other hand, we need decision criteria for determining adequate combinations of the two presentation styles. Since this problem has rarely been addressed so far in the context of an automated multimedia presentation system, suggestions from empirical HCI research (e.g., see [11]) are of particular interest. Currently, our system encourages user explorations in the following situations: to show what an object looks like, to show which parts it is composed of or to inform the user about object locations.

Anytime Interruptions

An interactive system should be able to react immediately to the user's feedback. Therefore, the current presentation situation should be evaluated after each planning step. Fortunately, such behavior has already been supported by WIP's presentation planner. An advantage of WIP's presentation planner is that it may be interrupted after each planning step to allow reaction by other components (e.g., the medium-specific generators). Each time the presentation planner is activated, a planning monitor decides which action (deletion, modification or expansion of nodes) should be performed next. In case of expansion, it also determines the next goal node to be expanded. In the interactive version of the system, new discourse goals set up by the user are given high priority. Since the current situation is evaluated after each planning step, the system is able to react to the user's feedback promptly. In this respect, the system differs from most interactive systems in which interaction is only possible at prespecified decision points or after the complete realization of a particular presentation plan.

Continuously Updating the Presentation Structure

If the user sets up a new discourse goal (e.g., a request for elaboration as in Fig. 2), the system has to relate it to the existing presentation plan. For example, it has to recognize that the exploded view in Fig. 4 is connected to the verbal description "There is a special transformer ..." via an evidence relation. A simple heuristic is to check whether there exists a presentation strategy containing an extension as suggested by the user. If this is the case, the new material will be incorporated into the existing document. If no matching strategy can be found, the system regards the extension as an "excursion" (i.e., an unexpected focus shift) from which it should return before it continues the presentation. In such cases, the initial document state will be restored.

5 Conclusion

In this paper, we argue that it is advantageous to allow for both active and passive viewing of multimedia presentations. The user benefits, among others, from the fact that different styles of information extraction are supported. From a technical point of view, this increased flexibility does not necessarily make presentation design more complex since the system can be relieved of difficult design decisions by involving the user in the design process.

We have extended our previous work on the synthesis of multimedia presentations as to support active viewing. By introducing presentation acts and exchange acts and adding rhetorical relations to describe the structure of interactive presentations, a uniform treatment of different presentation styles becomes possible.

Although, at first glance the appearance of such a presentation shows some similarities with conventional hand-wired hypermedia documents, there are fundamental differences. Most hypermedia documents can be described by a fixed set of available presentation units (such as text fragments, images, video clips etc.) and a fixed set of links between these parts. In contrast to that, in the presentations we suggest, all material will be generated by the system - thus, the content and form of a presentation can be flexibly tailored to particular needs. Since user interaction may enforce the generation of new presentation parts at presentation time, links between parts cannot be established in advance, but have to be dynamically created.

To build a concrete system with the characteristics described above, we reused and extended core modules of our previous presentation system WIP. It turned out that relatively small changes had to be made in order to obtain a prototype. Last but not least, this prototype provides a good starting point for further research on multi/hyper-media presentation planning.

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