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Creating On-Line Graphical Illustrations for Medical Texts

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ABSTRACT: We present a new approach for connecting textual and graphical information within interactive systems for medical illustration. In contrast to earlier approaches where text is used to label a predefined image, we focus on interaction based on long given texts. Thus our approach resembles work with medical textbooks rather than anatomical atlases. We aim at the creation of images and animations based on geometric models which illustrate the written contents of a given text.

1 GRAPHICS AND TEXT

Within printed teaching and reference materials, the connection between text and images is essential for the understanding of the concepts being explained. However, due to the physical properties of books, particularly medical texts with many pictures and interspersed text, the integration of textual and pictorial information is conceptually difficult for readers, as images and text referring to them are often on different pages (Waldeyer and Mayet, 1992). Indeed, often materials from different books must be integrated.

Multimedia systems try to overcome this problem by directly linking images and text. Thus a user may request an image as the illustration of a specific fact by activating a link. But also here, predefined images or animations are shown and a user generally has no possibility to request an illustration which exactly fits his or her intentions or reading history. As in textbooks, images accompany the text and are often displayed with no further direct connection to the text.

An analysis of some relatively new systems in the area of anatomy reveals that their focus is almost exclusively on the graphical representation. VoxelMan (Höhne et al., 1994) includes different views on the model and images created with different techniques (rendered, CT, MRT) in a single illustration which can be labeled upon the user's demand. Longer explanations can be shown, though no attempt is made so far to couple these directly with the illustration. By contrast, the Zoom Illustrator (Preim et al., 1996) pays special attention to the consistency of rendered images and their textual labels. The textual information displayed in the label is typically rather short (up to 30 words). The labels are directly attached to the graphical objects and thus the connection between graphics and text is more local on a per object basis.

We refer to systems focusing primarily on the graphical representation as *graphics-driven*. In contrast to this, we explore in this paper a *text-driven* system based on textual information. Graphics are generated dynamically based on the user's interaction with the text. Even without sophisticated linguistic analysis of the text it is now possible to produce graphics which reflect the contents of the text and the user interaction with it.

2 A TEXT-DRIVEN SYSTEM

Within our text-driven approach, textual and graphical representations are loosely coupled by the use of unique identification keys. In the medical domain the Latin names for objects are used for this purpose. Each graphical object in a geometric model is assigned such a key. The correlation between the identifiers and the real objects is performed by the *text-graphics mediator* providing access to graphical objects from the text representation and vice versa (see Figure 1). A given text (with additional information attached) is connected to a geometric model. Based on the connections, interaction is enabled. We define an *interaction task* as a specific user input (keystroke, mouse click) together with a reaction of the system. For each interaction task a specialized mediator is registered within the text-graphics mediator.

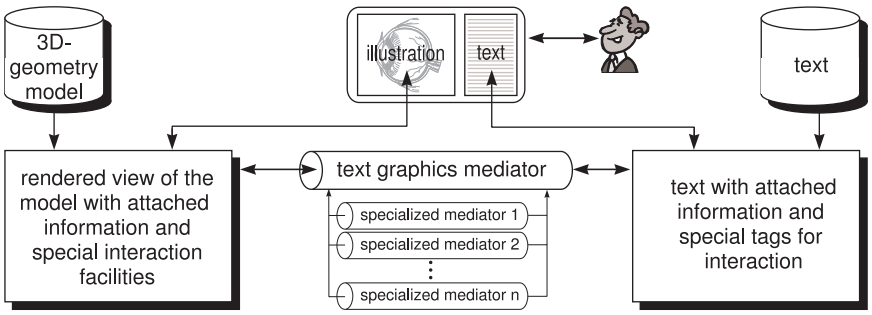

Figure 1: The text-driven system architecture.

When interaction takes place, all mediators registered for the particular task trigger the appropriate actions. The system's reaction then typically changes the presentation of all media involved.

2.1 MODELS FOR GRAPHICS AND TEXT

The presentation of graphics and text is based on two models:

Text: The text is the most sensitive part within this approach and thus the model underlying it is somewhat crucial. First, all aspects of the presentation of textual information have to be considered including text formatting and document structure. We use SGML as the source format since text formatting and structuring instructions can be included.

For interaction with the text, four different regions are of particular relevance: the whole text, the currently visible portion, a potentially selected portion, and individual words. An interaction event from the text being sent to the mediator includes all data assigned

to the respective region. The mediator gives instructions to the rendering component about what the image is to look like.

Graphics: The graphics view is based on 3D surface models which are rendered and displayed with OpenGL (our work can also be extended to voxel models). The requirements we impose on the geometric model are simple: Objects have to be differentiable from each other and should be identifiable by a keyword. To extend interaction facilities, a model structure can be established by grouping objects and assigning a unique identifier to those groups. There are no further requirements for the model if the program part for displaying and interacting with the graphics has a certain functionality. This includes geometric transformations of the model as well as the selection of specific model parts.

2.2 AN EXAMPLE: TEXTILLUSTRATOR

To prove the concept we implemented the system TEXTILLUSTRATOR (see Figure 2). The text of a book on anatomy is presented to the user together with an illustration generated automatically from a 3D model. The specialized mediators we use here allow for instance the following interaction tasks:

user interaction	*system reaction*
scrolling through the text	All objects contained in the visible text portion at any given time are highlighted in the graphics, all other remain gray.
selecting a word in the text	The corresponding object is visually highlighted and labeled in the image.
picking an object within the graphics	The text is scrolled to the first (most relevant) occurrence of the corresponding word in the text.

3 CONCLUSION

Our approach opens up a new avenue for text illustration by providing two key conceptual advances over previous approaches. First, the user can choose his or her geometric model for the illustration for a given text in SGML. Second, the user can switch between the text-driven interaction and the "normal" interaction (zooming and rotating the model) leading to more opportunities for spatial orientation within the graphics. As the availability and structuring of geometric models increases in the coming years, so will the appeal of the (possibly animated) illustrations which systems like ours produce.

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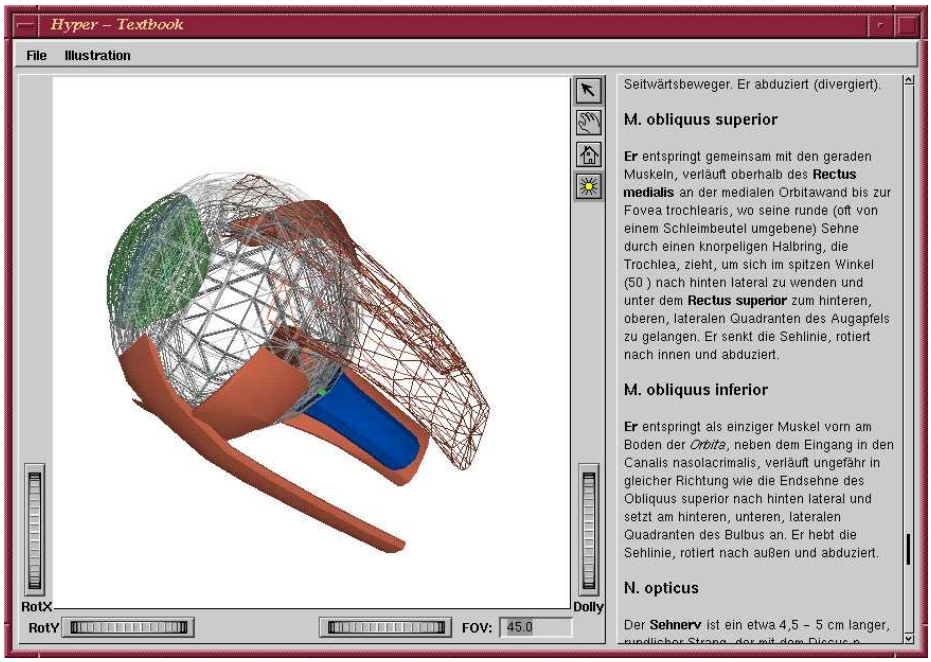

Figure 2: Screenshot of the TextIllustrator. The user is scrolling through a text and is simultaneously shown a dynamically generated illustration. For a clear presentation (on paper) we used a wireframe representation for non-selected objects and filled drawing for selected objects.