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REPRESENTING ENGINEERING-KNOWLEDGE USING MULTIMEDIA

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1 Introduction

This issue deals with the representation, distribution and re-use of knowledge in computer-aided engineering processes. This is still is a great problem – especially in the context of distributed design processes – and at the same time of increasing interest to practice. The term „knowledge" describes product as well as process knowledge.

The „intelligent" application of multimedia can contribute to overcoming existing problems and therefore to simplify and considerably accelerate engineering processes. As will be shown multimedia can not only simplify the retrieval of required information and the communication, but it can also open new channels to knowledge elements which so far were seen as difficult or even impossible to capture.

In order to apply multimedia efficiently and to ensure correctness a database is necessary to link the different digital models involved with the (additional) multimedia elements. In this database, both the links and the necessary organisational information can be managed and regularised.

2 State of the art

The designer's traditional IT-tool is the CAD-system. Although a part of the product knowledge already can be represented in CAD-systems (2D/3D models, [geometric] history trees, parametric relations between [geometric] elements), another part of the product knowledge and the entire process knowledge, however, have to be kept outside the system (in other systems' data files, in text documents, sheets, graphs, charts, pictures and so forth) or are not represented at all. Engineering/product data management systems (EDM/PDM) are seen as tools to integrate knowledge distributed across several different systems and media. This, however, takes place on the level of linking models to one another and does not include the handling of information added to elements of these models. But in engineering more detailed support and a wider range of accesses to the internal knowledge of the (engineering) systems is required.

In this contribution we will show how a group of engineers can use multimedia techniques and multimedia elements in combination with the entities of a CAD-system for knowledge representation and communication in practice.

3 Enhancement of the knowledge representation

Multimedia is a new technology today, expanding with the growing Internet. Very complex connections can be illustrated in an easily understandable way using multimedia. Moreover, multimedia is a wide communication platform for exchanging different types of documents (for example text, voice, picture, video or Internet pages) and combinations of it, named hypermedia. Figure 1 shows an example of such a multimedia scenario. As usual in a CAD-system the assembly is linked together with the models of single parts and modules. Besides this links to models and technical documents outside the CAD-system are demonstrated in a hypermedia graph. They contain pictures ( ), spoken messages ( ), video sequences ( ), text documents ( ) and links to Internet pages ( ).

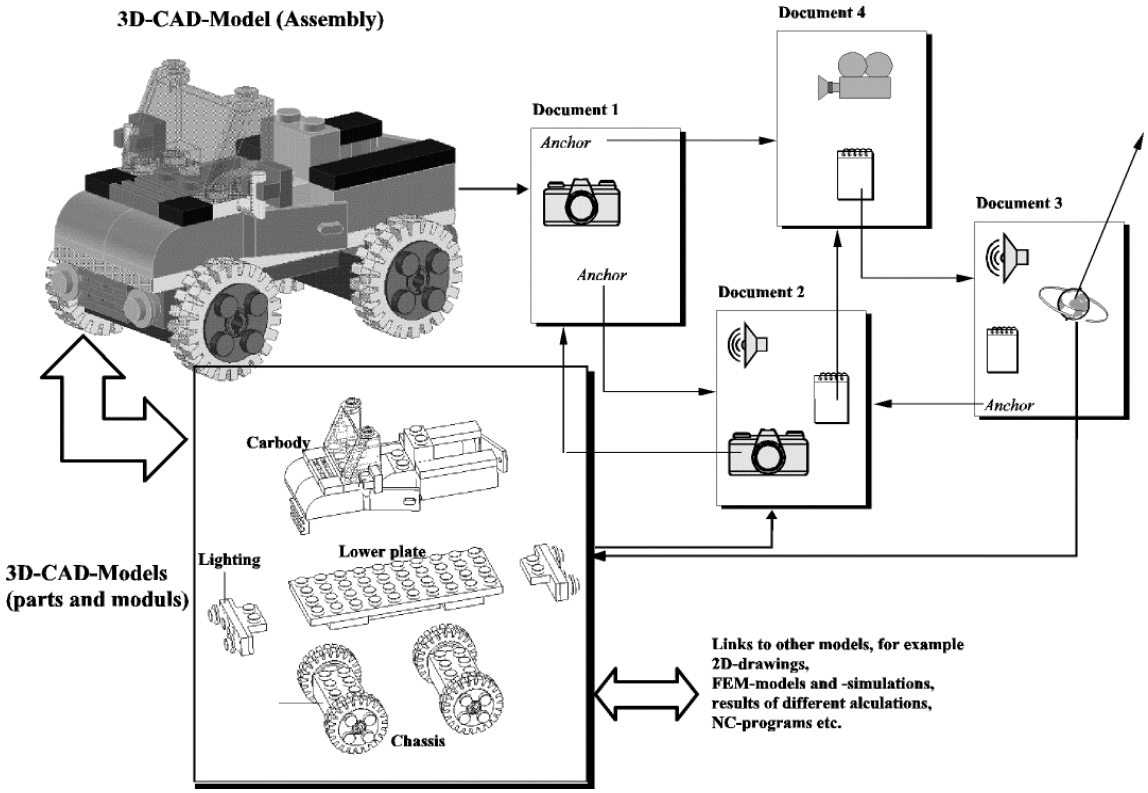

Figure 1. Using multimedia for design process and knowledge representation: example of a hypermedia graph

These links may be controlled using a database as part of an EDM/PDM-system so that information can only be added and modified by authorised persons (shown in figure 2). As a result, information can be considered to be valid knowledge. Moreover, information can be sent directly to a specific group of persons. In this way, information can be distributed in a purposeful manner. On one side the native CAD-models can be re-used together with the multimedia elements in the engineering process; on the other side the models can be converted into a neutral format, such as VRML (Virtual Reality Markup Language), and the multimedia information can be transformed in such a manner that the model, the explanations and the interrelations can be represented in the Internet. As a further result, the processes between all persons involved can be sped up considerably and the work flows over the whole process become more efficient.

The direct linking between CAD objects and multimedia elements is the special feature of this concept. Links should be able to point to all entities of CAD data structures (vertices, edges, ..., features, parts, assemblies), related attributes (parameters and relations, tolerances) and all other elements derivable from these.

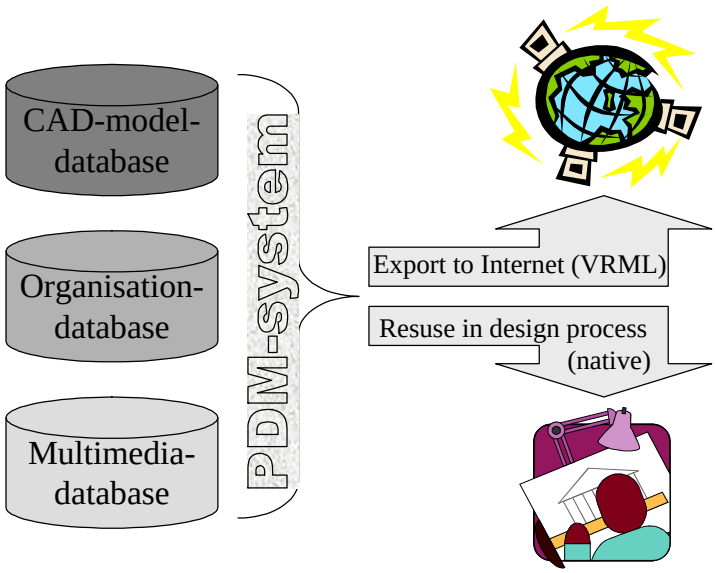

Figure 2: Combination of CAD-models, organisation-data and multimedia-elements to be re-used in a CAD-session or to be exported to Internet

Although closely linked to CAD objects, all the multimedia elements in this concept remain in native formats and can be browsed into the CAD-environment like any Internet application. If CAD formats would become more open or standardised in the future, the whole concept could be realised independently of particular CAD platforms.

The integration of CAD and (different) multimedia elements also offers new functionalities in the future. One vision could be the automatic translation of spoken messages into text format.

These text files could be scanned for matching patterns or used as parts of the product documentation.

However, an appropriate database management system must be applied to control the responsibilities and the links.

4 Realisation of a prototype software

At the Institute of Engineering Design/CAD a prototype software based on the concept introduced in section 3 was developed („MUMEFA“ – acronym for „MUltiMEdiaFeAture“). The knowledge representation is implemented by adding links between CAD objects directly into the CAD environment and multimedia elements created and stored outside. New functionalities required concern the handling of links between the objects of the CAD-system and the multimedia objects.

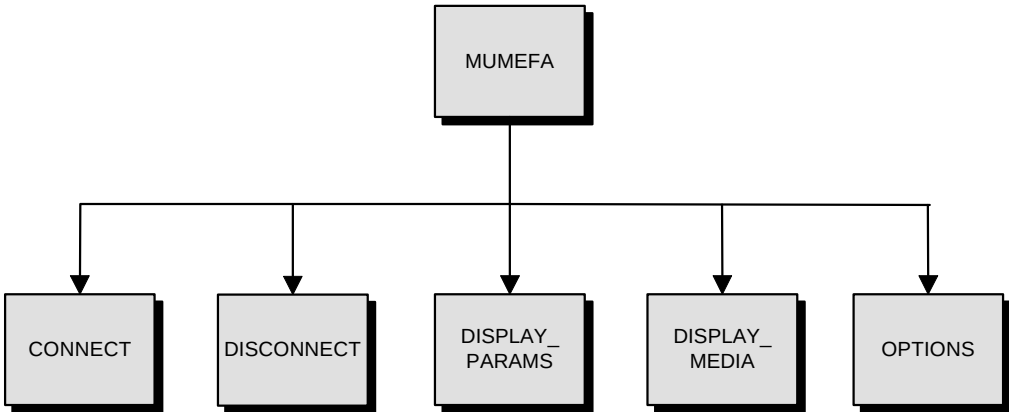

Figure 3. Overview over the functionality for handling the links between CAD objects and multimedia elements

Figure 3 shows the highest-level structure of the implementation of the prototype. The functions handling the links relate essentially to creating links to multimedia objects using the function CONNECT and to deleting links using the function DISCONNECT. The creating operation introduces a new link between a chosen CAD object and a new or selected multimedia object. Of course a CAD object can be linked to more than one multimedia object (of

different types, too). The creating operation also starts the appropriate application for defining the multimedia object itself (for example a text editor or a voice recorder). A user can see and identify existing links to the CAD model by highlighting the CAD object (operation DISPLAY_PARAMS). He/she can start the corresponding application, such as showing the picture or playing the video/audio sequence, by a double-click (function DISPLAY_MEDIA). If the application does not exist, the models and the content of the related links are converted and set into an Internet page wich can be seen using a browser. The applications related to particular multimedia elements can be defined or exchanged during the runtime using the OPTIONS module; the default application is a browser. Manipulating the links can not be solved automatically: On the one side the multimedia objects linked to a CAD object can be substituted by other multimedia objects; on the other side multimedia objects must be splitted up or merged if the CAD objects are splitted up or combined.

5 Application

The functionalities shown can be of advantage in distributed engineering environments; this distribution of processes can be in time, person or location. All persons familiar with using the CAD-system have access to the additional knowledge represented by multimedia elements. The management of different types of information and the control of access can be done using a database or using an EDM/PDM-system. Moreover, persons not familiar with CAD can be integrated into the engineering process by using a viewer for the native CAD-models or a browser for the exported Internet pages.

6 Conclusion

The combination of multimedia techniques and CAD functionalities is an ideal tool for the support of distributed engineering processes. Knowledge can be represented and re-used in a very easy way directly in the CAD environment. The communication can be done very easily using the Internet. In the context of product (and process) data management multimedia techniques can be applied to represent additional knowledge. EDM/PDM techniques are used to control access, responsibilities and links. Basic requirement for implementation is an open environment with access to the internal data structures and objects of the CAD-system.

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