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ADVANCED INFORMATION TECHNOLOGY IN BUILDING MAINTENANCE SUPPORT.

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Abstract

In the existing KBS-MEDIA (knowledgebased systems - media) environment demonstrators have been built to support different phases in the building process- Building Maintenance, Material and Vendor Information, City Advisor, etc. In this environment new concepts and tools are tried out in connection with using, building and maintaining the systems formed by advanced software and new media. New tools for building and using the systems have been defined, created and tested.
Demonstrator systems from projects concerning 'Building Maintenance' and 'Material and Vendor Information' are referred to in the paper. The users have on application level access to the underlying facts bases (also audio/visual) and tool boxes through a context dependent interface. Existing databases are also transferred to the system. Background agents are created to help users/system-builders to control the access and growth of the systems during use. Different representations are used (analogical, hypertext, relational databases, neural nets, decision trees, objectoriented, etc.) which are loosely linked and more or less formalizing our real world. Great emphasis is on the user interface which has multimedia properties. The systems form demonstrator environments used to capture, test and communicate ideas admitting fast prototyping of the next generation integrated systems for the building industry.

Keywords

Building maintenance, product information, conceptual modeling, man-machine interaction, knowledge representation, hypermedia, artificial intelligence, agents, tools, document, demonstrator.

Introduction

Since the autumn 1987 the work on building a KBS-MEDIA (knowledgebased systems-media) environment has been carried through at the department of Structural engineering at Lund University. The environment hosts the development of demonstrator systems which are used to capture, test and transfer ideas among system end users in the building process and the system builders/tool makers. Demonstrator systems from projects concerning 'Building Maintenance' and 'Material and Vendor Information' are referred to in the paper.

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We are now located in a turbulent phase of development where we are shifting paradigm from what we can call the industrial capitalism to something new. We try to see possibilities and risks in the new technique. New concepts are constantly formulated and "agreements" slowly radiated from new patterns of thinking and acting. We must onward perform some tests. How can we in different situations by using computer support enhance our intellect and enrich communication between people? How do we communicate our experiences? It was easier before. We then often formulated isolated models (reproductions) in different problem domains. After that we put those often rather static models into the computer systems using available software. And so we will continue to do. The news is that we have (or will have) to formulate the rules which governs the growth of the systems. Yesterdays programmer will become tomorrows toolmaker. It is very important that we try to transmit possible efficiency gains to something that will raise quality. For example to give us more time for a thorough study together with a client in the early phases of a project and comprehensive as built documentation for successful later use and management of the building and its facilities.

The systems we are formulating today may provide us with dramatically better communication tools (communication rooms, personal "telescreens", virtual realties etc.). Behind the system interfaces dwell more and more capable representations which are closely related to search strategies and those parts of our reality that we try to model. See also (Christiansson, 1990a, 1990b, 1990c).

The project "Advanced Information Technology in Building Maintenance Support" the "Delphi" project is now in its final stage. The project is carried out together with The Lund Academic Society (dwelling foundation) with contacts to the Swedish Building Regulation Authorities. The end users are people involved in building maintenance and tenants. A part of the 5000 flats that the students have access to in Lund is stored in the system as data in database and images on a video disk. Two scenarios have been studied - hiring out flats and repair of wash-houses.

The project aims at (1) study the possibilities and limitations with new information technology in connection with advanced systems for building maintenance support, (2) contribute to the formulation and conceptual modelling of such systems and (3) provide a demonstrator as a vehicle for future development within the area.

The KBS-MEDIA concept

More details about the knowledgebased systems-media environment can be found in (Christiansson, 1989a, 1990b). The most powerful features of the KBS-MEDIA environment are:

* clearer and more obvious connection between application and computer stored model
* integration of advanced software tools as knowledgebased systems,

neural nets, hypercard and relational databases

* simplified knowledge elicitation and dynamic growth, change and validation of models
* use of different knowledge representations in cooperation (object oriented, decision trees, neural nets, relational databases, frames, analogical, symbolic, procedures, hypertext, rules, etc.) and search strategies (map analogies, pattern recognition, tracking, etc.)
* offer of adapted tools for problem solving (decision support, information browsing and search, model building and maintenance tools, background agents, navigation palettes)
* design of powerful man/machine interface
* tools to access, collect and handle very large information volumes
* computerized models supported by real life pictures and sound as well as computer generated pictures, drawings, animations and sound.
* integration of optical distribution and storage media to support different computer stored models
* tools for acquisition and handling of great picture volumes
* powerful tool for knowledge transfer (training, education, communication and spread of information)
* fast and simple prototyping
* Demonstrator for capture, test and communication of ideas.

Figures 1 and 2 show the logical layout of the demonstrator in the KBS-MEDIA environment. The main control of and communication with the system is performed by the user through a context container. The in-context

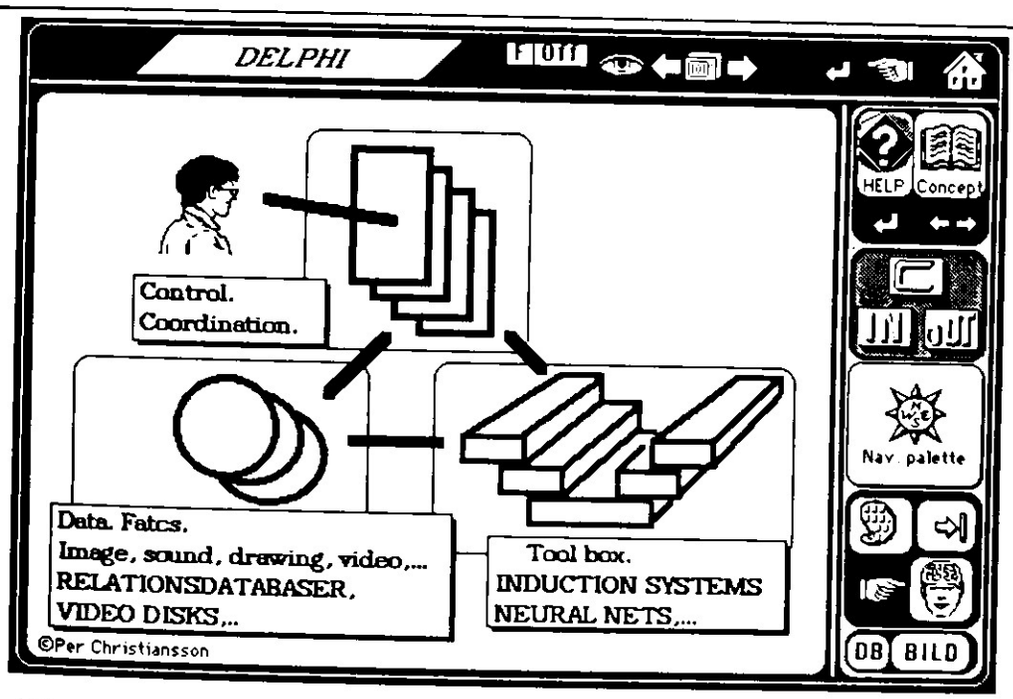

Figure 1. Logical layout of a demonstrator of a building maintenance system. Ideas are captured, tested and communicated between end-users, researchers and "tool makers" in a demonstrator.

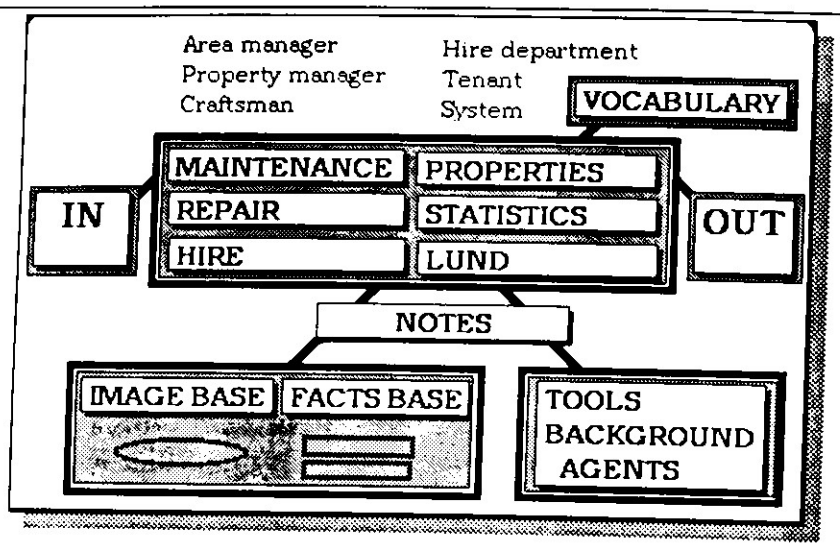

Figure 2. Logical layout of the "Delphi" demonstrator. Three levels are distinguished: The context level with different views (maintenance, repair, hiring etc.) to the system, the facts bases and tools/background agents and the intermediate notebook or short term memory.

holds information about for example user descriptions (property manager, craftsman, hire department, tenant etc.), activity (repair, hire etc.), output specification (brief output, complete report, message delivered), special access conditions (learn/navigate modes, filters), and tool settings (active/passive agents etc.). The context is view dependent and stored in a HyperCard program.

Separate facts bases belonging to the application are connected; (a) alphanumerical information in relational databases, (b) images, film, sound on optical videodiscs, (c) text, sketches, speech, animations in HyperCard and (d) images and drawings on hard disk or CD ROM. The tool box contains context dependent tools as navigation palettes, special advisory agents, help agents, application specific procedures, model building agents, vocabularies etc. Background agents possess knowledge about applications or computer tools (sometimes the border is not sharp).

In the KBS-MEDIA environment the background agents use induction systems, neural nets and HyperCard stored procedures. Communication between users and the system takes place in the context environment. This communication passes short-term memories/"note-books" which are also used by the background agents. Normally the note-books only have to be visible to the user on request or under certain views.

The following hardware is used: Apple MacIIs, videodisk- and CD ROM players, B/W scanner, S-VHS Videocamera and recorder, sound sampler and video digitizer. The main software are HyperCard from Apple, MacBrain (neural nets) from Neuronics (Chait and Jensen, 1988), SuperExpert (induction system) from Intelligent Terminals Ltd, see also (Christiansson, 1986) and Oracle (relational databases) from Oracle Corporation.

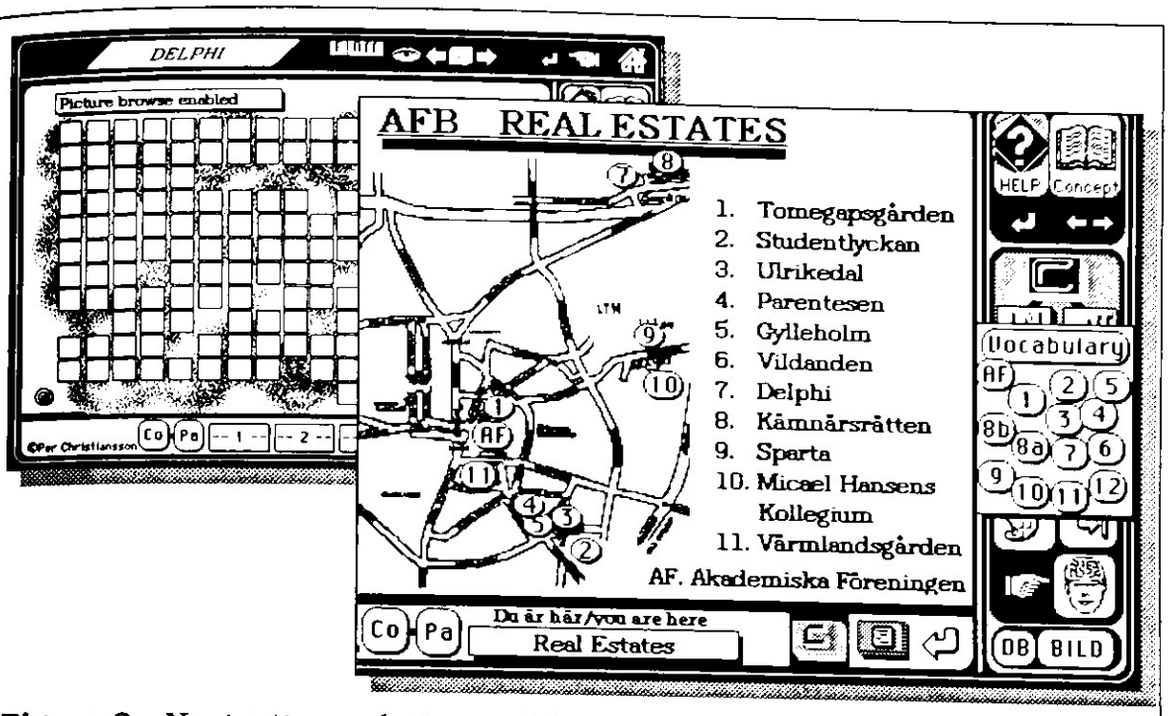

Figure 3. Navigation palettes and "agents" details from the "Delphi" demonstrator.

Knowledge representations. Building and using the models.

The success of the conceptual modelling of an application is among other things dependent on available tools, agreed definitions and vocabulary for the application and available representations and search/reasoning capabilities. In the KBS-MEDIA environment the formulated models are loosely coupled containing partially redundant information due to openness for different views and varying detail levels on the information. Under influence of "connectionist" thinking and distributed representations this circumstance may be reassessed.

Existing data structures and information volumes (like real estate data, tenant/hiring information and maintenance system) have been slightly transformed and integrated with new information like images on videodisk. The conceptual modelling activities have to a great extent been performed through scenario development together with end users (maintenance people and hiring department).

Different users have different access rules to the system. If the system is in LEARN mode the user has access to model building tools otherwise it is possible only to navigate in the information space and extract information. Navigation and search mechanism is reinforced by among other things: (1) the multi media interface, (2) multiple search paths, (3) associative search, pattern recognition and information maps, (4) navigation palettes and browse tools and (5) help from background agents and guided tours.

Conclusions

The paper describes and exemplifies how modern information technology may impact the properties of future building maintenance systems. Examples have been picked from ongoing research under the heading KBS-MEDIA LAB, knowledgebased systems media lab.

Acknowledgements

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