IOP-MMI Project Proposal

Bijlage IV:Project plan

1 Project title

User-Centred Hypermedia Presentation Generation

2 Partners

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3 Goal

Ever-increasing amounts of information are being stored in multimedia databases, while the presentation methods used in the interfaces to these stores remain for the most part text-oriented and provide little or no true multimedia support. Even in current text-based interfaces query statement and result presentation are typically presented as separate tasks, and indeed modes, to the user, rather than as steps in an iterative, seamlessly integrated process. In addition, the presentation methods used are rarely able to take user characteristics into account, whether these be personal preferences or task related.

Taking these three shortcomings into account, our research goal is to develop a model for user-centric interaction with multimedia databases, making optimal use of the available media and appropriate interaction styles. In particular, this requires support for temporal synchronization and hypermedia linking within the user interface.

4 Innovation

Work from a number of different areas is relevant to the problem. In particular, technological advancements on the World Wide Web (the Web) make implementation of the research ideas more plausible. Research results in the areas of intelligent multimedia interfaces, including automated layout, user modelling, adaptive hypermedia, advanced information retrieval interfaces and hypermedia design methodologies are of immediate relevance. In the field of multimedia databases, research has focused on query formulation, retrieval and selection processes. The presentation of the ultimate result of these processes has, until now, received scant treatment.

We can build upon results from each of these areas. In intelligent multimedia interfaces a standard reference model for generating user-oriented multimedia presentations has been developed [BFMR97]. This is based on a number of implemented systems and encapsulates the necessary core of such a system. Closely related work includes automated spatial layout [CaBr97], although this in itself is insufficient since in time-based multimedia temporal layout is also required. An initial step towards incorporating a time-based document model within the SRM- IMMPS framework is [HaWB97].

Within the SRM-IMMPS approach is the underlying assumption that user-modelling plays an important role. This is also the case with work on adaptive hypermedia [Brus96][CaBr97]. In adaptive hypermedia it is assumed that an author has created a large amount of information, and the system reveals parts of the information to the user on the basis of an initial user model and the history of the interaction with the information. This contrasts with the intelligent multimedia presentation approach, where, on the grounds of the user's information request, a presentation is generated from scratch - including natural language generation of text, or views on 3D graphics models. For our purposes, we envisage a slightly different approach, where the individual media items already exist, but the structure bringing these together has to be created. Again, this requires the input from an explicit user model.

With respect to the problem of integrating the query and result presentation processes, Golovchinsky [Golo97] has carried out work in text-based information retrieval, combining the advantages of a powerful underlying full-text based retrieval engine with a hypertext presentation interface. The reader is provided with an integrated interface for browsing texts and following links, and also for selecting parts of the text for formulating and refining queries.

The multimedia database architecture and the feature extractors that are needed for answering queries about multimedia objects will be borrowed from the AMIS project. This "Advanced Multimedia Indexing and Searching" project is a collaboration between CWI, the University of Amsterdam, the University of Twente and the University of Utrecht. AMIS is funded by SION.

Finally, in terms of technology, developments within the World Wide Web Consortium will enable the project to leverage data and meta-data formats that conform to a recognised standard. For example, HTML can be used for text-based information, SMIL for multimedia information, and RDF for keeping track of information about the generated presentations.

[Brus96] P. Brusilovsky (1996). Methods and Techniques of Adaptive Hypermedia. Journal on User Modeling and User-Adapted Interaction, Vol 6, 87-129, (Kluwer Academic Publishers).

[BFMR97] M. Bordegoni, G. Faconti, M.T. Maybury, T. Rist, S. Ruggieri, P. Trahanias and M. Wilson (1997). A Standard Reference Model for Intelligent Multimedia Presentation Systems. *Computer Standards & Interfaces*, vol 18 (6-7).

[CaBr97] L. Calvi, P. De Bra (1997). Proficiency-Adapted Information Browsing and Filtering in Hypermedia Educational Systems. Journal on User Modeling and User-Adapted Interaction, Vol 7, pp. 257-277, 1997, (Kluwer Academic Publishers).

[Golo97] G. Golovchinsky (1997) What the query told the link: The integration of hypertext and information retrieval. In Proceedings of Hypertext '97 (Southampton, UK, April 8-11), ACM Press, pp. 67-74.

[Graf97] W. Graf (1997). Intelligent Multimedia Layout: A Reference Architecture. *Computer Standards & Interfaces*, vol 18 (6-7).

[HaWB97] L. Hardman, M. Worring and D.C.A. Bulterman (1997). Integrating the Amsterdam Hypermedia Model with the Standard Reference Model for Intelligent Multimedia Presentation Systems. *Computer Standards & Interfaces*, vol 18 (6-7) 497-508.

[Kamp95] T. Kamps and K. Reichenberger (1995). A Dialogue Approach to Graphical Information Access Designing User Interfaces for Hypermedia. Schuler et al. (eds.), Springer, Heidelberg.

Acquired knowledge

The knowledge developed within the project will be based on the combination of a number of existing technologies with the goal of improving the query/result interface to the user. As part of this, investigations will be carried out as to the usability of proposed designs. Designs will include ways of converting ranked lists of query results to user- tailored hypermedia presentations as well as interaction strategies with the presented information, e.g. extending the work done with integrating hypertext with text-based information retrieval to incorporate multiple media and synchronization issues.

In parallel with the interface design work, technological advancements will be made with methods of generating the resultant hypermedia presentation. In addition, the project will develop new underlying query methodologies which combine feature-based multimedia retrieval with semantic-based multimedia retrieval.

Desired results

The desired results include:

- the development of an underlying query language that supports multimedia querying at the feature-based and semantic-based levels;
- the design of a user-oriented system which can generate hypermedia presentations as an interface to the underlying information store;
- the verification of the utility of the designs through carrying out user trials. The information gathered by the trials would be used to feedback into the generation process and query language design.

Innovation

Previous research has focussed on query formulation, retrieval and selection processes in multimedia databases. The presentation of the ultimate result of these processes has, until now, received scant treatment. Through carrying out user trials with substantial sources of multimedia material we intend to capture sufficient design expertise to generate hypermedia presentations as a user-oriented front-end to the underlying database.

The innovative aspects of our approach are the development of design rules for the generation of synchronized, hypermedia user interfaces; the seamless integration of the presentation of the query result and query formulation feedback loop at the user-interface level; and the development of an underlying query language which integrates feature-based and semantic-based information extraction.

New in the Netherlands/Europe/the world?
The research in the project will build upon research already carried out on international and national levels. In particular, at the international level, work on user-modelling, adaptive hypermedia [Brus96][CaBr97] and integrating text-based information retrieval with hypertext [Golo97].

Within Europe, work has been done on the SRM-IMMPS reference model at DFKI (German Centre for Artificial Intelligence, Saarbrücken), as well as on automated layout at DFKI [Graf97] and GMD [Kamp95].

In the Netherlands related work has also been carried out at TNO-TPD (Multimedia Technology), TNO-TM (Information transfer in human-machine systems), IPO (Information Access and Presentation).

The proposed research has not been carried out previously, since it involves knowledge of a number of areas, in particular hypermedia design and development methodologies, declarative multimedia document technologies, document-oriented user-modelling, and access to multimedia database resources. It also requires the collaboration of a number of experienced researchers, rather than being possible with one or two isolated AIO positions.

Patent search
We do not intend to do a patent search. Previous work is widely published and our intended approach requires a broad range of expertise, rather than a single patentable idea.

Patent risks
We do not see the existence of patents as being a risk to the work in the project, for the reasons mentioned above.

Potential new patents
We do not expect that the work will be immediately patentable. Rather, we expect a number of high-quality academic publications to be the result in the short term, and in the longer term that the technology be transferred to industry, e.g. through contacts with companies such as Philips, Oratrix, or Lost Boys.

5 Motivation

Industrial relevance
The work is industrially relevant in general, since it is in the interest of information providers, e.g. on the internet, to provide information tailored to the individual user. The costs for providing individually created information is prohibitive, so that a concession between providing "one size fits all" and user-specific information is to allow the information to be tailored automatically.

Particular examples of this type of user tailoring are electronic (television) program guides, where viewers can browse through lists of available programs, preview clips of potentially interesting programs, and make their own selection for viewing. This particular example can used for an application prototype, for which Philips already has expressed an interest in cooperating during its development.

The results of the project are, however, more generalisable than to a single application. The results of our research will ensure that users can navigate through multimedia information by means of appropriately tailored interfaces at economically viable production costs. As such, personalised websites and e-commerce are also typical target application areas.

Expertise
The expertise of the partners is broad. At CWI the Multimedia and Human-Computer Interaction group has an international reputation in the areas of hypermedia document modelling, including synchronization and linking issues; the development of languages on the Web, in particular SMIL, HTML and XLink; in depth knowledge of other ISO document standards such as SGML, HyTime and MHEG; theoretical and practical experience with authoring hypermedia presentations and authoring systems.

At TUE expertise from both the Computing Science department (Information Systems Group) and the IPO institute (theme Information Access and Presentation) will be brought into the project. The expertise covers hypermedia modelling and browsing semantics, information retrieval through automated navigation, adaptive presentation and navigation of hypertext, and the generation of hypermedia presentations for multimedia database query output (not including time-based media).

Expertise from the UVA includes formal specification languages and semantics, probabilistic natural language processing, discourse structure, information retrieval, human computer interaction, visual representation systems and visual interfaces. In addition there are strong contacts with the "leerstoelgroep Woord en Beeld" at the Vrije Universiteit, which has expertise in the areas of indexing and classification of film and video images, domain knowledge of visual archives and the associated needs and problems of the end-users in this domain.

Industrial experts
Close contact with a number of industrial contacts is kept from the CWI group. In particular with Warner ten Kate at Philips through the HTML and SYMM working groups and with other joint project proposals. A joint project (U-WISH) is also being carried out with General Design, a company that designs web-based solutions for customers. Also, close contact is kept with Oratrix development b.v.—a newly formed company spin-off from the MM-HCI group. They are currently selling the GRiNS authoring system, but will be looking to new markets in a year or two. In addition there are contacts with innovative multimedia companies, such as Lost Boys and Tribute Multimedia, Amsterdam, who are open to joint projects and new technologies. There are currently no concrete plans for cooperation, but we expect if the project is funded that in the later stages of the project, prototypes can be developed in conjunction with Philips and with Lost Boys.

6 Compliance with IOP-MMI objectives

The research meets several of the objectives of the themes defined by the IOP-MMI, especially the themes on multimodal interaction and on navigation, orientation and situational awareness, and will build upon earlier research on user-centred design. The project will benefit from our contacts with experts from various disciplines (e.g. content providers, designers, and tool experts) from industry and other research institutes.

The research will contribute to navigation techniques through large collections of information, including customising the output of the system to the characteristics of the user. By reformulating the output of a query to a search engine into a hypermedia presentation we will also integrate browsers with search engines. This will not be done in isolation of the user, but will take the history of the user's interactions with the system into account. In other words, the interface will adapt to the user's task and situation. This will in turn facilitate and simplify the search process.

7 Approach

In this project 3 post-docs will be working concurrently for two years, following by another 3 post-docs. A "projectmedewerker" at CWI will be aiding the post-docs in the development of prototypes, and will help to assure that knowledge is transferred from the first group of post-docs to the second group.

The project is described in three parts here: CWI, UVA and TUE. Throughout these descriptions there are numerous cross-links.

CWI
The first post-doc will work on the construction of a conceptual framework for taking a number of "relevant" media items and combining them together in a presentation. This process is traditionally performed manually by skilled designers. The aim of this part of the project is to come up with design rules for spatial layout, temporal relations and navigational linking to support the automatic generation of synchronized hypermedia presentations. The presentations should be user-tailorable, meaning that they depend on contextual variables that can be influenced by the user. Presentations will depend on the user's network connection, display, computing power, etc., but also on explicit preferences for certain presentation styles.

The second post-doc will concentrate on extracting the multimedia items from databases. This will draw heavily from the SION AMIS project, which runs from 1997 to 2001. The AMIS project will deliver database technology and methods for feature extraction that can be used for answering queries. Also, the post-doc will extend the framework and architecture of the first post-doc to include adaptive features, as designed by the first TUE post- doc. Adaptivity means that evolution in the user's state of mind (including knowledge and preferences) and in the context are determined automatically, and taken into account when generating multimedia presentations.

The presentation framework and tools must also be extended to allow for the integration of (part of the) query interface with the presentation interface. This will enable iterative query formulation.

UVA

The first post-doc will first work on a classification of visual representation of information. This classification is then used to design a query language for multimedia databases, in particular databases containing text, images and video. Queries contain textual and graphical elements. The work will focus on the creation of the (visual) primitives that are needed in a multimedia query language. This work can partly reuse previous work of phd students at UVA, including Dejuan Wang (visual reasoning systems) and Mehdi Dastani (visual perception and automatic visualisation).

The second post-doc will concentrate on combining the visual query primitives with existing feature-extraction tools, such as those developed in the SION AMIS project. The post-doc will also investigate how information from query results can be fed back into the query language to do incremental querying. This work relies heavily on the presentation framework developed by the first CWI post-doc, and the heuristics for multimedia presentation generation developed by the first TUE post-doc.

TUE

The first post-doc will collaborate closely with the first UVA-postdoc on the design of a query interface that corresponds with the query language being developed at UVA. Query languages are generally not suitable for human users. A friendly query interface is needed that guides users through a simple dialog and that generates queries (in the formal language). Prototypes (mock-ups in the initial phase) will be evaluated through expert reviews and end-user experiments. The IPO institute provides the expertise for the experimental validation.

The second post-doc will concentrate on combining query interface and query output presentation (mostly developed at CWI) into a seamless whole. Given the complexity of multimedia querying it is expected that the interface will need to offer a combination of querying and browsing, i.e. that querying will be an iterative process. The post-doc will draw from experience gained from a TUE NWO (SION) project on the generation of multimedia query output presentation, and generalize these results to include time-based multimedia (e.g. video), as supported by the framework being developed at CWI.

Feasibility/Chance of success

The project has a high chance of success, since it builds on existing research and each partner has highly relevant expertise covering the necessary fields. The work will not be carried out in isolation, but embeds itself within complementary expertise, in particular the closely related work being carried out at CWI on fundamental multimedia database technology in the Gigaport and ICES projects. These will ensure that state of the art technology will be available to the project in addition to the necessary expertise. The goal of the proposed project is to ensure that well-designed, high-quality interfaces can be provided.

The widely interdisciplinary approach brings with it a risk, since large amounts of diverse expertise need to be integrated. It is for this reason that the partners have chosen for more experienced postdoc positions for the majority of the work.

Risks and possible alternatives

While the ultimate goal of the project is to automatically generate hypermedia presentations, if this proves to be infeasible (within the duration of the proposed project) then prototypes of the goal system can still be created by using semi-automated methods and including a human authoring task within the process. This will be possible because of the close contacts with Oratrix, who are developing manual hypermedia authoring software.

Because of the broad nature of the project there is a greater dependence on different technologies, in particular: multimedia databases, ontology servers, adaptive hypermedia engines, automatic layout engines, presentation platforms (multimedia browser). We intend to reduce the risks to the development of the project by using accepted standards as much as possible, e.g. XML, CORBA, SMIL, RDF.

Motivation of new equipment

The partners have not requested money for additional equipment, but have chosen to channel the total budget to personnel. We do intend, however, to make use of powerful state-of-the art multimedia database technology belonging to the CWI Data Mining and Knowledge Discovery theme. These resources will form part of CWI's contribution to the project.

Knowledge transfer

In addition to standard academic publication procedures in international journals and conferences, the project will encourage technology transfer to industry through working jointly on prototypes, e.g. with Philips and Lost Boys. Knowledge transfer will be on a longer, rather than a shorter, term basis, where rather than applying directly for patents from within the project, cooperation with commercial partners wishing to exploit the work will be encouraged. An example from CWI is the Oratrix spin-off from the Multimedia and Human-Computer

Interaction theme, where close contact is kept with the remaining researchers on mutually relevant issues such as the development of multimedia Web technologies.

8 Cooperation

Reason for cooperation
The proposed project is ambitious and requires expertise from a number of different, but related, research areas. The partners selected have a broad coverage of the expertise needed, and have close collaborations with groups with expertise in multimedia databases (CWI, Data Mining and Knowledge Discovery), user-centred design (TUE, IPO) and visual archives (UVA, VU Woord en Beeld).

The scientific responsibility of project lies with Prof. De Bra, while the day-to-day running of the project will be coordinated from CWI by Dr. Hardman. She will ensure that sufficient collaboration occurs among the partners through means such as regular meetings, email and telephone conferences.

The complementarity of the expertise of the partners is described in sections 5 and 7 of the proposal.

9 Patent application

The partners do not intend to apply for patents directly from the project. Software patents tend to be expensive yet barely effective, since even if one is in possession of a patent it does not prevent others from reimplementing extremely similar ideas that fall outwith the terms of the patent.

10 Visit abroad

Visits to research institutes and conferences abroad will be carried out when appropriate and funded by the participating partners.

11 Time/cost statement

The budgets for the partners are given in the application forms. A summary of the costs to IOP-MMI are supplied here. If further details are required, then please contact Dr. Hardman at CWI.

Table 1: **Project costs in K*f***

	Year 1	Year 2	Year 3	Year 4
CWI postdoc	112	115	119	122
CWI medewerker	-	111	115	-
TUE postdoc	108	114	113	120
UVA postdoc	108	114	113	120
IOP project costs	328	454	460	362
Total IOP project cost	1604			