Hyper-UML

Specification and Modeling of Multimedia and Hypermedia Applications in Distributed Systems

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2. Objectives

Hyper-UML is a sub-project of the project "Methods and Patterns for Cooperative Hypermedia Design" introducing a new research topic and three new research groups to the project. The main targets of the Hyper-UML sub-project are closely related with the initial objectives of the project and is a critical theme in the hypermedia domain.

The objectives of Hyper-UML are the research and development of a unified graphical notation, a methodology and a tool prototype for the modeling of multimedia and hypermedia distributed systems. The resulting notation is intended to be a standard extension of UML. The need of such techniques has emerged at the industry in order to specify and maintain distributed systems and to explore different issues related with the specification and modeling of open hypermedia and multimedia applications; in particular we will:

- Study different aspects related with hypermedia applications running on open networks;
- Define a new notation for specifying this kind of applications;
- Specify a development process of the whole life cycle of hypermedia and multimedia applications in distributed systems;
- Define useful work products in form of diagrams or models supporting design decisions;
- Analyse the way in which systems defined with this notation can be mapped to real implementations;
- Explore possible application areas (such as electronic commerce, cooperative applications, etc.);
- Develop a tool prototype supporting the design of hypermedia applications in distributed systems.

3. Project Description

The exponential growth of Internet applications, specially WWW applications with all their multimedia aspects such as the combination of text, hypertext, images, computer animations, video, sound, etc. has raised the necessity for formal or semiformal methodologies for developing such applications. Typically a Web application running on the Internet is based on a client/server architecture and commonly has many distributed aspects. Applications (i.e. cgi scripts, Java applets, etc.) can be distributed among different servers as well as related HTML pages may be stored in different locations.

The aim of the Hyper-UML project is to research and to develop new techniques for the specification and modeling of multimedia and hypermedia systems in open networks as mentioned above.

Different modeling languages, such as UML [1,18,19], OMT [22] have been compared but none of them have shown capabilities in order to specify both graphical users interfaces and the navigation through information. To reach this target different hypermedia modeling languages have also been studied, such as OOHDM [23], RMM [5], WSDM [25]. The outcome of this comparison is that there is still a unified approach missing which combines the advantages of general purposes modeling languages, such as UML with multimedia and hypermedia modeling languages, such as OOHDM. A combination of both modeling

languages through a graphic notation is expected as a result of the Hyper-UML project. It is intended to describe real life distributed systems such as WWW-based systems for Intranets and extranets using such a notation.

Some case study is expected as a result of this new graphic notation. Electronic commerce, i.e. Electronic Shopping Centers as well as Electronic Journals are typical examples where multimedia and hypermedia modeling techniques are to be applied. To reach the objective of a tool prototype supporting the UML extension and the development process the requirement for such a tool have to be specified.

4. Project Results

Our approach is based on the UML specification language and the experience of the project partners in the projects OOHDM, ADDE, EPK-fix and FORSOFT which are briefly described in Section 7.

The expected results of the project are summarised below with the list of deliverables.

- Research on the completeness of the OCL (Object Constraint Language) including a possible extension for completing OCL;
- Standard UML extension;
- Work product description including a case study;
- Methodology for the development process;
- Requirements for a tool supporting the methodology;
- Tool prototype;
- Papers and technical reports.

5. Work Schedule

The table of below describes the distribution of tasks between the project partners.

Tasks	LIFIA	GIDIS	LMU	FAST
Kick-off workshop with presentation of proposal and partners expertise			X	
Research on the completeness of OCL			X	X
Draft development process description; Presentation of the research of OCL	X	X	X	X
Specification of the methodology for the development process	X	X	X	X
UML extension	X		X	X
Example and a case study for development process	X	X		
Requirements for a tool supporting the extension	X		X	X
Tool prototype			X	X

6. Reasons and Benefits for Cooperation

Multimedia and hypermedia are growing areas for industrial and commercial applications such as on-line applications, electronic commerce, and many others. Research on this area is a hot theme. The necessity of formal and semi-formal methods for the specification and implementation of such applications it has been pointed out.

The partners of both countries have expertise to be shared. The LIFIA and the GIDIS has multimedia and hypermedia know-how whereas the University of Munich and FAST have know-how in programming methodologies, user modelling, electronic-commerce and distributed systems. Combining the knowledge of the partners will make possible an ideal working group for the development and implementation of an object-oriented methodology for the specification of multimedia and hypermedia systems according to the state-of-the-art on this area. The resulting methodology will be used for educational purposes by the academic partners and for industrial applications at the industrial partner FAST.

7. Partners expertise

In the following related projects are shortly described, where the Hyper-UML project partners have worked.

OOHDM: According to OOHDM (see [23,20,4]), the development of hypermedia applications is a process consisting of four activities: Conceptual Design, Navigational Design, Abstract Interface Design and Implementation. These activities are performed in a mix of iterative and incremental styles of development; in each step a model is built or enriched. The cornerstones of the OOHDM approach are:

Conceptual Design: In this step a conceptual model of the application domain is built using well-known object-oriented modeling principles, augmented with some primitives such as attribute perspectives (multiple valued attributes).

Navigational Design: In this step the navigational structure of a hypermedia application is described in terms of navigational contexts, which are induced from navigation classes such as nodes, links, indices, and guided tours. Navigational contexts and classes take into account the types of intended users and their tasks. Nodes in OOHDM represent logical ``windows" (or views) on conceptual classes defined during domain analysis. Links reflect relationships intended to be explored by the final user and contexts or navigational contexts are sets of nodes, links and other possible nested contexts defining a sequence of navigational paths that maintain a given relation.

Abstract Interface Design: The abstract interface model is built by defining perceptible objects (e.g. a picture, a city map, etc.) in terms of interface classes. Interface classes are defined as aggregations of primitives classes (such as text fields and buttons) and recursively of interface classes. Interface objects map to navigational objects, providing their perceptible appearance. Interface behaviour is declared by specifying how to handle external and user-generated events and how communication takes place between interface and navigational objects.

Implementation: When the target implementation environment is not fully object-oriented, one had to map the conceptual, navigational and abstract interface objects into concrete objects, i.e. those available in the chosen implementation environment. This may involve the definition of HTML pages, scripts in some language, queries to a relational database, etc.

Dr. Gustavo Rossi and Alejandra Garrido have intensively worked on OOHDM.

ADDE: The Project ADDE (see http://www.fast.de/ADDE/ and [2,3]), short for Application Development for the Distributed Enterprise, develops an approach to support design of distributed work practice and ICT (Information and Communication Technologies) systems. It is intended to enhance and extend existing design practice, rather than replace it. Design decisions are supported by reports from the ADDE repository based on the ADDE model.

In ADDE is assumed that the enterprise will have a business strategy. Thus, the enterprise will have decided what business activities are to be supported by the applications and what territories it will operate in. It will also have determined who are its customers, partners and suppliers and where they are located. It is also assumed that, within the enterprise, the ICT architecture is not application-specific. The enterprise will have defined an ICT architecture that will support a range of applications - i.e. the architecture will be defined outside the application development, and the applications will, in general, comply with it. The users of ADDE are the application designer (main user), the project manager, the acquisition manager, the method owners and the tool vendors. Multimedia-Applications are typical applications for which ADDE has been developed, e.g. many types of users, distributed components, separation of client browser and server.

Dr. Alfred Helmerich is working at the ADDE project.

EPK-fix: The aim of the EPK-Fix project (see [7,6,10,8]) was the definition of a methodology and a specification language (epkml) as well as the development of a set of tools for the easy and low-cost production of Electronic Product Catalogues (EPCs) viewed as multimedia applications. Therefore techniques and methodologies developed under this project are also applicable to many other multimedia applications.

In the EPK-fix project a framework has been defined as a set of cooperating classes that make up a reusable design for such multimedia applications and a spiral-like development process has been defined to describe the steps to be followed in the production of EPCs. The following steps were performed in constructing that framework: identification of abstract and concrete classes, definition of attributes, identification of associations and aggregations between objects, choice of methods that reflect their behaviour, organisation and simplification of the model using inheritance, iteration to refine the framework, grouping classes into components or modules. The resulting interacting components are: structure, layout, direction, product database and services. The word direction has been selected following the idea of film direction. The contemplation of such multimedia applications can be compared to the action of seeing a movie. The viewer of the movie has no chance to modify the sequence of the scenes while the user develops his own screenplay making use of the navigation facilities. This concept is supported by authoring tools like Macromedia Director or Toolbook.

As specification language, the epkml language has been defined. epkml is a mark-up language including primitives for modeling the steps of above. For more information about epkml [7].

Prof. Dr. Martin Wirsing, Dr. Luis Mandel and Nora Koch have worked at the EPK-Fix project.

FORSOFT: The Project FORSOFT (see [14]) addresses the development of distributed information systems based on Internet technology and the programming language Java. When building these applications, one has to consider different aspects of distribution such as migration and redundancy. In addition, security issues are raised as the Internet is an open network.

The well known object-oriented methodologies do not address these issues in a common framework. The goal of FORSOFT is to enhance existing methodologies for this purpose and demonstrate its applicability in one or more case studies.

At the present Prof. Dr. Martin Wirsing, Dr. Luis Mandel and Nora Koch are working at the FORSOFT project.

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