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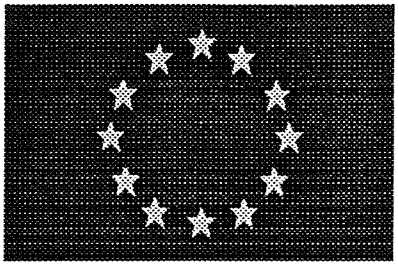

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Friday 9 February 1996

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THE BOTANIC GARDEN OF PISA ON THE WEB

Introduction

The explosion of hypertext applications and the popularity of the World Wide Web very much give the feeling that we found the "magic" solution to the old and well-known problem of making information accessible to everyone, according to his/her interests. However, only carefully designed applications, that make use of reliable and well-established tool and methodologies, can be really effective and of long lasting interest to the potential users.

In the following, we will remind some design issues that can lead to implementing effective hypertext applications and present a case study developed for the Botanic Garden of the University of Pisa.

The Pisa Botanic Garden was founded in 1543 by Luca Ghini, a worthy physician and botanist from Croara, near Bologna, after accepting the Chair of Botany at Pisa University from the Grand Duke Cosimo I de' Medici. Although it no longer occupies Ghini's original site, Pisa is the most ancient University Botanic Garden to have been founded in Europe.

The hypertext permits to visit interactively Pisa's Botanic Garden, i.e. a collection of living Botanic specimens. Presently the hypertext covers a reduced portion of this collection. The hypertext has been designed making use of methods and techniques coming from other areas pertinent to the management of data. In addition, a great importance has been given to the characteristics of the interface, aiming at the implementation of several interaction paradigms. As a consequence, the user has the possibility of moving freely in the hypertext, maintaining the control of its position, following different mechanisms: contiguity in space, classification affinity.

Basic issues in hypertext design

A main issue in hypertext design is the distinction between the extensional (or explicit) and the intensional (or implicit) links. While the first ones are explicitly stored in the hypertext nodes, the last ones are deduced from the context. Extensional links can be interpreted essentially as structural links, and therefore implement static and pre-defined associations between nodes. On the contrary, intensional links constitute the real richness of any hypertext, as they can be seen as an emulation of the human mind's

association mechanism. To make an example, the botanical entities "Prunus spinosa" and "Malus baccata" are related by the fact that both belong to the order of "Rosales".

However, this kind of association is relevant only if we are concerned with the characteristics common to genera and species belonging to the same family or order. A totally different association can link species living in similar geographic regions or climates, as well as having special usage or properties when combined, or flowering in the same period. It comes firstly that the number of possible links can be high, and secondly that the links are of different types, and therefore are of different relevance to the user according to his/her interests. To some users, certain links can be totally irrelevant. Links referring to glossary, whose relevance is null to a skilled user, are a typical example. Obviously, even the nodes are of different types, and their content should conform to the user's specific interests.

Finally, we must consider that a good practice in hypertext design is to not overload the nodes with too much information and too many links. A typical user will just display, but not carefully read up to the very end, nodes containing too much information. The presence of too many links in a page can disturb, especially if some of these lead to non relevant nodes.

All these considerations lead to the idea of having nodes and links that dynamically conform to the user profile, intended as a specification of the types of links and information he/she is interested to. From the technical point of view, these requirements imply that the page must be created dynamically, and retrieval links must be supported.

The hypertext: aim and content

The application has been built addressing a twofold purpose. On one hand, we intended to support, in a novel way, the conventional management activities, recording all the various activities that in some way can affect the heritage of the botanic garden as new accessions or treatments and repositioning of specimens, giving a new and more flexible interface toward conventional data stored in a traditional relational database.

On the other hand, the characteristics of the data, and the intent to support educational activities, constituted strong motivations towards the implementation of a hypermedia application. The implementation described in this paper constitutes an evolution of a previous experience implemented in a different hardware and software environment.

The first step has been the design of a conceptual schema of the database, where all the data are stored. In parallel, we identified the most suitable interaction paradigms, or metaphors, of interest for the potential users. Subsequently, all the data have been collected, checked and entered in a relational database.

The hypertext revolves around the Botanical Entities, which can be related one to another. Quite obviously, every Botanical Entity has some related multimedial documentation: bibliography, photos, drawings, wax models. A great emphasis has

been put on the navigation mechanisms, supported by several different metaphors. For example, the user can move from a classification scheme, and go to the Botanical Entity of interest, or is faced with a map, and can therefore chose the Botanical specimen that has a specific location in the garden. The user can switch from one paradigm to the other at his/her will, while the information is kept consistent.

Another important aspect is constituted by the implementation of multiple links: when a single anchor point in an information node is connected to several other information nodes, we display the available links. The user will choose the most interesting for his/her purposes. This relevant aspect is presently object of further development, as we are looking for a more "active" mechanism, that will attribute a weight to the links, and will take into account the interests of the user, as they can be inferred by the previously followed paths.

Keeping in mind that the user can give different relevance to various types of information, we developed a very simple "agent" that can mask or visualise the different types of links depending on the specific interests stated by the users. We are also considering the possibility of giving a precise semantics to the various paragraphs contained in the document, so that some of them could be dropped out, if they are non relevant to the user.

Finally, it is important to stress that the hypertext contains two different kinds of pages: some of them are static, as it is customary in almost all applications. The major part of the pages, however, is not statically predefined, but inherently dynamic, as almost all the pages are built "on the fly" as result of queries addressed to underlying database.

In fact, the user can access the information either using some partially predefined patterns, or using a general purpose user friendly SQL query interface, developed by CNUCE. In both cases, the application accesses the data in the database and formats them in a suitable format.

The technical environment

As it has been outlined above, the whole application heavily relies on a relational database, that stores data and other information, used by the application itself for several purposes like customising pages or identifying the relevant links. The database is accessed by a general purpose SQL interface. All the pages are subsequently formatted in HTML, and transmitted according to the HTTP protocol. Any manipulation occurs on the server site, so that the page can be visualised by any standard Web browser.

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COMPANY PROFILE

CNR
Consiglio Nazionale delle Ricerche, Istituto CNUCE, Pisa, Italy

Consiglio Nazionale delle Ricerche is the most important institution in Italy for public research. It was founded in 1923 as an agency with the mandate to represent Italy in the International Research Council in Brussels. The scientific, technological and operational units of CNR are structured into Institutes, Research Centres and Groups. The permanent staff is currently about 6700 and the annual state funding is approximately 1billion ECUs.

CNUCE is an Institute of the CNR covering strategic research areas in IT such as Software Engineering, Computer Networks, Image Processing, Database, Computer Graphics and Visualisation. The Institute participates in most of the major national research activities in the field and plays a central part in the organisation and management of these activities. In order to promote know-how and technology transfer, the Institute has close co-operation with a number of industrial R&D centres.

Active participation in teaching activities takes place within several Universities, as well as through a yearly teaching program directed to the technology transfer toward the industrial world. In addition, about twenty students per year carry their thesis in Computer Science, Engineering and Mathematics under the supervision of CNUCE researchers.

The Software Engineering, Hypertext and Hypermedia Group is presently devoting his research interests to several items, both in the area of software engineering and in the hypertext/hypermedia. In this last area, the main interest is given to design methodologies, distributed hypermedia architectures, advanced services on the networks. In all these areas, the implemetation of case studies, or the participation to international projects, act as a test bed for evaluating the research results, or as a stimulus towards new ideas.

CV

Short CV of Oreste Signore

Oreste Signore took the degree in Physics on 1970. Initially he had been working on high energy physics and nuclear fusion. Since 1973 he is staff member of CNUCE (Institute of CNR - Pisa), where has now the position of senior scientist.

His activity has covered several areas of interest, like: operating systems, information retrieval systems, database management systems, database design, information systems. He has been involved as group leader in several national and international projects. He has been member of the ISO Working Group 3 (Database), concerned with the Information Resource Dictionary System (IRDS), SQL-1 and SQL-2 standards.

His present interests cover user interfaces, hypertext/hypermedia and software engineering (especially as far as reverse engineering area is concerned). He has been university professor for several years in various universities. He his autor of more than sixty publications in journals, books, international and national conference proceedings.