An Integrated Approach to Information Systems through Graphical Interfaces: Case Studies for Local Administrations

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1. Introduction

This paper describes an approach to Information Systems which relies on the potentiality of graphic interfaces as an integrated mean of accessing information. It is a way of reasoning complying with an hypertextual model of reality.

The case studies we describe refer to projects designed in recent years for the local Public Administration by CSI-Piemonte, Consortium for the Information System, a public company founded in 1977 as a joint venture of the Regional Government of Piedmont, the University and the Polytechnic of Turin. CSI takes the role of system integrator for the Public Administration and aims at promoting the development and implementation of computer science among local institutions, organizations and companies.

The following are the projects considered in this paper:

- the Information System of the County Council of Piedmont, particularly the regional law data bank (Arianna) and the connected accessing and drafting functions;
- the Local Pole of the National Environment Information System (Polo SINA), which relies upon a standardized software to access a structured data base (BDA, Alphanumeric Data Bank), a textual data base (BDTEXT) and an image data base (BDI);
- the project for the management of administrative procedures (241). In 1990 the Italian Parliament approved a law (Law No 241) aimed at improving the transparency of administrative actions. Workflow software, integrated inside a regional information subsystem, was set up to support both the efficacy and efficiency of offices, as a preliminary step towards the construction of local views which will allow the final user to know, at any moment, where the dossier is, why it is late, who is responsible, and so on;
- the activation interface. A common monitor capable of activating and accessing all the information system resources was built up with two aims: to make the resources visible to any user; to make them available by means of transparent activation paths.

2. Accessing Information

The above mentioned projects have to deal with the common problem of making large and complex legal information databases available to several kinds of users, most of which are inexperienced.

In this section a common key for understanding the depicted projects is offered, to point out experiences, problems, perspectives starting from the consideration that legal documentation support involves three great branches: texts; images; alphanumeric data; these are to be connected with the world of office automation.

Texts are usually created by word processors and made available via information retrieval software.

Fig. 1. Accessing Information
Images are usually acquired via scanner or other instruments, stored and made available via specific software.

Alphanumeric data are usually stored and retrieved inside database management systems.

The management and accessing systems used in the three worlds are depicted in Fig. 1.

An integrated vision of these worlds generates high added value to information.

Building that vision is not easy. It implies linking environments which usually live together, in isolated sites, inside information systems: the database management system, which offers rigid and deterministic data access; the information retrieval system, where elastic and cooperative access tools are found; office automation, usually very friendly and very far from the system information resources.

The integrated vision must match with a well structured object-oriented database.

Final aims were:

1) To be consistent with different approach philosophies, to have a unique interaction environment;
2) To have integrated queries.

To reach these aims, our steps were:

a) To have a unique information retrieval system for searching both texts and images;
b) To integrate IR and RDMS by establishing permanent links between data stored in different fields;
c) To have a supermonitor;
d) To have an integrated navigator in display time.

This involves building applicative strata which allow navigation between data, that is using the graphic access modalities as hypertext modalities which integrate the different access approaches.

The above mentioned projects were designed in a client server architecture, with UNIX servers and Windows clients.

Here are their common outlines:

– Using a client server architecture which encourages the co-operation between local, departmental and central processing resources;
- Using office automation tools integrated in a homogeneous and friendly environment which encourage user's autonomy;
- Emphasys to the phase of data analysis and description;
- Using support tools like help online and tutorials;
- Using data and process catalogues;
- Using supermonitors like common supervisors.

The interface, or Supermonitor, is based on an architecture which relies upon nets and net services according to the scheme in Fig. 2.

*Fig. 2. Activation Interface for SIRE Computer Environment*

The objects managed and the functions offered are illustrated in Fig. 3. The interface does not just give a completely different appearance to the standard ways of workability, but makes a connection between all the managed objects, giving therefore the user the possibility of effective interaction with a system of distributed objects.

The main screens on which the interface operativity is based are:

*Entering window in the Regional Informative System (SIRE)*

It allows access to SIRE, after having verified the operative opportunities made available to the user. It is the main security tool of the
system, which allows flexibility in access and standardization in use at the same time.

Start window

From this window it is possible:

- To execute the procedures the user is allowed to;
- To consult the list of the procedures grouped per subsystem. The procedures will appear:
  - subdivided in management Processes, technical-administrative Processes, internal administrative Procedures and support Procedures (window Access per Subsystem);
  - or grouped per levels of the regional Organizational Structure. The activated levels are those of the Departments, of the Sectors and of the Services (window Access per Organizational Structure);
- To consult the Data Banks (Subjects catalogue, Alphanumeric data
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bank, Textual data bank and Images data bank) of the subsystems (window Data Bank Query).

The procedures have been described, when possible, in functions, formed in their turn by elementary modules called "operations". In this way, the direct execution of the operation or of the chosen function is allowed.

It is also possible to ask for the execution of the selected procedures by consulting the lists per subsystem or per organizational structure. The possibility of activating the procedure will be allowed only after the verification of consistency with the qualification table of the user declared when he entered the informative system.

As far as consultation is concerned, transversal procedures of general interest are allowed to everybody.

The archives used by the access and activation interface of SIRE are active catalogues as they describe the present situation of objects, and allow users to activate processes and personalize the connections among objects.

Such catalogues are divided in two groups: archives of procedure activation and archives for data bank query. For future developments and for the parts on server it is then necessary to have the catalogues of clients and servers, of basic software, of transactions, and so on.

Archives of procedure activation

To this group belong all the tables on which are made verifications, controls and recovery of information essential for the execution of the procedures, functions and operations forming the SIRE.

In these archives the organizational structure of the Piedmont Region (Departments, Sectors, Services) is stored, as well as the subsystems, subdivided in sectoral and intersectoral themes.

Moreover, there are all the archives related to the procedures:

- Procedures
- Functions
- Operations

which, in the Procedures table, include the link with the subsystem and the necessary information for their identification in management Processes, technical-administrative Processes, internal administrative Processes and support Procedures.
Finally there are the tables which connect the procedures with the services and the users:

- Procedures / Services
- Users
- Procedure Activation.

The last, in particular, allows the link up of each regional employee qualified for using administrative procedures, to the procedures for which he is authorized for updating data.

Files for data bank query

To query the alphanumeric, text and image data banks, the interface uses, for each subsystem, a series of tables which allow for the activation of the functions of its modules.

At present the module Catalogue of the Subjects allows the data which are in the alphanumeric data bank to be searched through the described link between the data and a specific subject.

A table describes the catalogue concepts (nodes) and their hierarchic relations. A second table allows the connection between the catalogue nodes and the files of the data bank. Moreover, information is stored in the archives (metadata), both of a descriptive (i.e. sources, updating frequency, and so on) and a structural kind.

Another function offered by the catalogue of the subjects is the link with an item thesaurus, in which it is possible to navigate through relations of a semantic kind (broader or narrower concept, synonymy, correlations between terms).

The module of Access to the Alphanumeric Data Bank partly uses files from the previous module (archives of procedures activation). In the construction of SQL modules of a query, this module provides a check function of the relations among the tables (join). Such a function is based on a table describing a classification of the keys for all the files of the Alphanumeric Data Bank.

The module of Access to the Textual Data Bank can use catalogues to make a preselection of searched documents easy. At present there are catalogues of authors, documents and subject kinds.

In the following Figg. 4 and 5 examples of the Council Supermonitor can be found.

By means of the Supermonitor it is possible to associate every user to
FIG. 4. Supermonitor. User Profile Management

FIG. 5. Supermonitor. Searching the Process Catalogue
all and only the information system's functions which he has preliminarily been authorized to use (see Fig. 4).

Furthermore, the Supermonitor makes it possible to search the catalogue of the Information System resources (see Fig. 5 for an example query).

3. Accessing a Legal Information System, Arianna

The contribution that computer science can offer in the documentation field, particularly in the judicial and legal domains, involves several aspects.

The most immediate: the information patrimony is extremely wide and fragmented, and to gather it on magnetic support represents a way to physically gather in a sole point all that which is needed.

But documentary computer science must go farther. Storing shapeless masses of unstructured data in isolated files, fed by extemporary flows unchanged from the context which generates information, implies creating in a few time information sepulchres.

To avoid that, two operations have to be carried out: reasoning about the databases structuralization, which is a means to structure knowledge; anchoring, by means of adequate organizational and technical flows, documentary data bank loading to the reality from which the information derives. This implies positive consequences on the decision-making processes too.

Arianna

In the case of the Information System developed for Piedmont's Regional Council, e.g., the information system can supply, besides the databank which collects the enacted laws, tools which allow the user to intervene in the law making phase. The automation of this phase, with the analysis of organizational procedures, involves the whole assembly structure, activating articulated mechanisms which can help in rationalizing daily work and improve the quality of new laws.

The database structuralization must consider the access paths which connect the different forms of the objects (texts, images, alphanumeric data) and the objects between themselves. In the Piedmont Region case, in twenty years, 1,283 laws were passed. They gave raise to 18,500 references to other norms. The tangle is thicker and thicker with time, with the amendments growing exponentially on the base of the first fundamental laws.

The phenomena is further overburdened by the fragmentation of the
amending norms: despite recommendations and circular letters, the amending norms almost never operate as an integral substitution of the text. More often they just replace a word or a phrase, taken outside the context.

So it is very hard to give transparency on what is really happening, on what is in force and what is repealed.

Computer science can contribute to the hard process of rebuilding the law in force. Used in a global project, involving organization, it can bring efficiency and can act on decision-making processes, improving the quality of new laws, by means of the automation of self-repeating processes and the formalization of rules and methodologies.

In Arianna five kinds of information are stored:

- data which describe the law iter;
- texts photographed at different moments;
  - tags and links to other files (e.g., chapter of budget);
  - links between rules;
  - links between texts.

The access interface to Arianna is shown in Fig. 6. An example of interaction between individual productivity tools (in this case the electronic spread sheet) and access transactions to data is represented in Fig. 7.

**Fig. 6. Arianna - Integrated Access**
4. INTEGRATED ACCESS TO STRUCTURED AND TEXTUAL DATA

Information system users often need to access heterogeneous data stored in different kinds of databases and particularly structured or numerical data, traditionally stored in large databases, and related written texts, e.g. laws, books, or papers internal to an organization. Papers are often managed by Text Management Systems, which are capable of efficient document indexing and provide rich Information Retrieval and search facilities.
The designers of Information Systems should be able to define logical links between data and texts at the level of a single field in a record, i.e., in some tables within the alphanumeric database some fields should be defined as "pointers to" documents stored in the TMS. As an example, consider that many companies need an authorization from the local Government for activities having an impact on the environment. Such authorizations are listed in a table which contains traditional data as the name, the address of the authorized subject, i.e., the company, a code for the kind of activity, and the time limit for the authorization, but a link to a paper, stored in a TMS, is also required, describing in detail the technical aspects of the activity, and a quantitative and qualitative study about the impact on the environment.

More often, however, a link should exists at "metadata" level: an object in the database, e.g., a table, should be attached to a document which describes it.

A typical case occurs for laws about Environmental Protection: data from automatic monitoring of chemical and physical parameters may be stored into one or more tables in a database; on the other side, there are laws and other official documents which state the maximum values allowed for such parameters, and describe the correct procedure for data monitoring. An application should allow the user to retrieve data, analyze them with several statistical functions, automatically check that all data satisfy quantitative constraints, and make some graphical presentation of the results. However, the user should also be able to look at the laws which state the limits for the analyzed parameters, and examine the text associated with them e.g., in order to check that the results meet some qualitative requirements stated by the law, and to extract a portion of the law to be included in the final report.

In many cases traditional hypertext structures proved to be useful in order to access alphanumeric data through a kind of path which drives the user within the information system. The user moves through the pages of a hypertext, looks at laws stored in the pages, and navigates through hypertextual links which connect related pages. At some point, applications may be attached to the hypertext, in order to perform specific tasks, and the user can ask the system to execute them by pressing some special button, or issuing a command.

Unfortunately, in some cases this simple strategy is not sufficient. Text Data Bases periodically grow, new laws must be added to the data base, and some of them may change previous laws, by repealing or modifying parts of the old ones. This makes the costs of maintaining a hypertext
structure up-to-date with the data stored into the TDB unacceptable, especially when thousands and thousands of documents are managed.

We have developed a solution which consists in three modules, a Catalogue, an Alphanumeric Data Base and a Textual Data Base (see Figg. 8, 9)

**FIG. 8.** *BDA - Accessing the Item Catalogue*

**FIG. 9.** *BDA - Building a Query*
and 10). Each module has been integrated with the others, in order to give the user the maximum of visibility and flexibility in the access to the Information System. Our application has been developed for a client server architecture where data can be managed on different servers, each server corresponding to a particular service, that is one for each module, and the client side has all the knowledge necessary to provide integrated access to all the information. Finally, most of the Catalogue data, and all of the Alphanumeric Data Base data are stored in a Relational Data Base, and accessed by SQL.

The Catalogue performs the task of helping the user to access the information system. Conceptually the Catalogue is a hypertext which allows the user to move along logical links between nodes, with each node representing a different concept in the application domain. For example, a Catalogue in the health management domain may include a classification of hospitals and departments, a taxonomy of pathologies, as well as geographical, economical and administrative concepts (i.e., administrative zones, population, industrial and other productive activities, etc.).

Pages are organized in an oriented-graph structure. Most data in the Catalogue are stored into tables in the database, and the interface has the goal of presenting data to the user in order to give him the best possible
access to all the information stored. A link to a thesaurus gives the user the opportunity of finding alternative terms for a given concept, or exploring analogies and other correspondences.

The Catalogue also contains data about tables stored in the Alphanumeric Data Base. Nodes in the Catalogue representing concepts may have a link to nodes representing archives; thus the user may examine a description of those tables in the Data Base which concern a given argument. When the user arrives at an archive node, he/she can access the data by calling the interface to the Alphanumeric Data Base, the second component of our system. He/she can compose and perform a query on up the table, and examine the results, as will be shown later. Alternatively, he/she can mark the table and save its name in a special list, which will be used by the interface to the Alphanumeric Data Base in order to perform queries.

An interesting facility comes from the fact that each field in each table in the Information System may be attached to some comments and other information about the kind of data stored in the field. The user is able to look at comments by selecting a field listed in the node associated with an archive. Information about the single fields will be also used by the interface to the Alphanumeric Data Base in order to determine possible links between tables.

Both kinds of nodes may have links to documents stored in the TDB: The user may access them by calling up the interface to the Textual Data Base, which loads the document and shows it to the user. Also this interface will be described later.

A general purpose Interface to the Alphanumeric Data Base gives the user the capability of building his own queries, in a graphical way. The interface supports the construction of an SQL query, and is general enough to allow the user to access all the tables in the Alphanumeric Data Base.

The user may build queries involving one or more tables in the Information System. He/she can choose the tables by selecting them from the list of all the tables he/she has an authorized access to; alternatively, the tables marked during the navigation through the Catalogue are automatically loaded into the list of selected tables.

The tool forces some limitations on SQL; in fact only SELECT statements are allowed, with WHERE and ORDER BY clauses supported. WHERE clauses may contain any comparison conditions between fields, or between fields and constants, linked by AND, OR and NOT operators; parenthesis are also supported. Actually nested SELECT statements are not supported, as well as functions. Removing the limitations is actually at project.

While building the query, the user may always interrupt his work and
come back to the Catalogue, as well as have direct access to the nodes representing the metadata associated with the archives. The system also helps the user in building his own query by showing comments about the single fields.

In order to construct the query the user may select single fields, and load them into one of the three clauses of the SQL statement, SELECT, WHERE and ORDER BY. A syntactic control forces a correct construction of statements: e.g., after a field has been loaded into a WHERE clause the user cannot load another field until a comparison operator (as "="","<", or "LIKE") has been inserted. Insertion of comparison operators, boolean operators, and parenthesis occurs through buttons. Constants may be inserted as second terms in a comparison expression through a window activated by a button.

The interface proves to be very useful because many syntax or typing errors are automatically saved thanks to the rules of the interface. Moreover, a powerful feature consists in a semi-automatic link operator between tables: a specific function may be activated by the user in order to examine which are the possible link fields between two tables. The system builds the set of possible links between the two tables, by examining the description associated with each field. The user may select one or more links, and the system automatically includes them into the WHERE clause, putting them in AND with the rest of the clause, and taking care of the correct level of parenthesis.

This simple facility is the basis for an automatic check of the connectivity of the query. It is possible to ensure that all the tables inserted in the query are correctly connected with the others, and automatically suggest a list of possible linking conditions to the user.

Another innovative feature, inherent to our approach, is that the results of a query are automatically loaded into an electronic spreadsheet. Each record is inserted into a row of the sheet, and each field lies in a column. If the number of records to be loaded is greater than a certain limit, e.g., 20 records, before starting the operation the interface asks the user whether he/she really wants to load the results, showing the exact number of records to be loaded.

This choice has proven to be very useful. Users may make complex queries, saving their results locally on a sheet which is familiar to them, as well as to everyone working in graphic workstations, either PC-based, or UNIX-oriented. Moreover, users may access documents and retrieve them on their own word processor. Most personal productivity tools can easily exchange and integrate data: finally users may easily write their own reports
by including all the work they have performed on the different Data Bases, and have full access to graphic (e.g. diagrams), print and save facilities.

The third module is the *Interface to the Text Data Base*. The user may easily access documents by contents: he can examine the vocabulary of all the terms, choose one, and have a list of the documents containing it, called the result set. Moreover, he can write expressions following the CCL (Common Command Language) standard, which allows traditional Information Retrieval operators, e.g. word or set combination and truncation operators, in order to build complex queries to the Data Base, and combine several result sets into newer ones.

When the user looks at the set of documents resulting from a query, and decides to access one of them, the system loads it through the network into a local word processor. The user may then read, or print the document, extract part of it and put it on his own paper, e.g., a report, together with other data, such as that taken from the Alphanumeric Data Base.