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Browsing and Querying Multimedia Report Collections[1]

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Abstract. In this paper a system and new methodologies that enable efficient exploration of distributed collections of multimedia reports are described. A conceptual model for the report and a method to semi-automatically create a hypermedia report network have been defined. The main issues addressed in this project were to exploit the textual component of a report to give a more evident semantic meaning to the data produced during the relative exam and to provide users with new interaction paradigms based on Internet technologies.

1. Introduction

MR BRAQUE (Medical Report BRowse And QUEry) is an implemented prototype system that allows physicians to compose diagnostic reports in an assisted environment [5] and to consult a report collection in a hybrid way, using both browsing and querying. In order to provide services to a Global Health Care System, Web technologies have been used to implement the human-computer interaction features.

In this work we focus on the modalities of interactive exploration of the document collection: new modalities for multimedia document retrieving have been investigated in order to provide physicians with efficient tools for exploring the source of knowledge represented by a medical reports collection. The paper is organized as follows: in Section 2 an overview of our multimedia report model is presented; in Section 3 we introduce the proposed modalities of interaction with the report collection; conclusions and future directions are discussed in Section 4.

2. Multimedia Report Modeling

We consider the medical report as a complex multimedia document [5] that is composed by two main elements: a textual component and a non-textual component. The textual component provides (textual) information about patient, about responsible diag-

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nostician, about exam conduction methods and a sharp description of data produced by the exam (images, bio-signals). Data produced by the exam represent the non-textual component of the document. At the moment we are considering only still image reporting. Hence, in the following of the paper we will refer to a set of still images as the

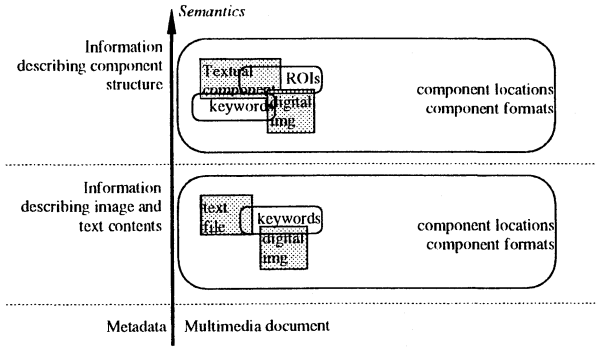

Figure 1 Enhancing Multimedia with the Use of Metadata

non-textual component of a report.

We think that the main objective of a report management system is to effectively transfer all the knowledge that can be extracted from the images by the diagnostician to the physicians who must take their decisions according to this knowledge. To achieve this goal an effective management of multimedia documents is needed. In particular it is necessary to make the images *semantically self-explaining*. To do that we make a massive use of *meta-information* [1], [6].

Fig. 1 shows two schematic solutions for the management of distributed multimedia documents in the WWW environment. Text component and image component are stored in flat files located in (possibly) different sites. To allow querying about the document as a whole, metadata about document composition (e. g. *URL* and *media type* of each component) and metadata about the whole document storage (e. g. *last modification date of the last modified component*) are needed. Moreover, data about the format and compression technique of the images must be provided in order to allow presentation. Besides, multimedia systems should be able to support querying on component content. This can be achieved only adding information describing component contents.

Our solution is to describe the report by means of a conceptual model [5] and to manage its structure by means of a OODBMS. Moreover, information about relationships between textual component objects referring to Regions of Interest (ROI) on the image component is managed. A ROI is a zone of an image that delimits the edges of some interesting feature of the image. In the hypermedia context, it is possible to define anchors on ROIs into images, allowing to attach links to ROIs. The concept of ROI can be easily extended to texts (a ROI is a sequence of characters) and to other type of multimedia objects: ROI descriptors depend on the media-type. We consider this as meta-information, that is data that describe the content of the textual component and of the images at the same time.

With this kind of management the system allows to describe the content of the components and permits to locate the objects inside the components. For instance, it is possible to locate the remarks inside the images and, if more than one remark is detected, it is possible to distinguish them.

3. Querying and Browsing the Report Collection

Querying is the main interaction modality to retrieve information from a database. The user specifies a set of properties to be satisfied by the target documents and the system gives back the documents corresponding to these properties. If the result of a query consists in a set of documents, a common way to present them to the user is to provide an index whose items represent hypertext links to each document.

Three different modalities of presentation of hypertext indices are presented in literature [4]: guided tour, indexed tour and indexed guided tour. They are represented in fig. 2. Anyway, in many contexts this paradigm may not be effective. For example, if the physician is interested in a patient's clinical history and, while analyzing each one of the patient's reports, he/she discovers some interesting remarks, relative, for example, to a specific pathology, he/she could be interested in analyzing the clinical histories of other patients with the same pathology. Hence he/she ought to go on at first with a

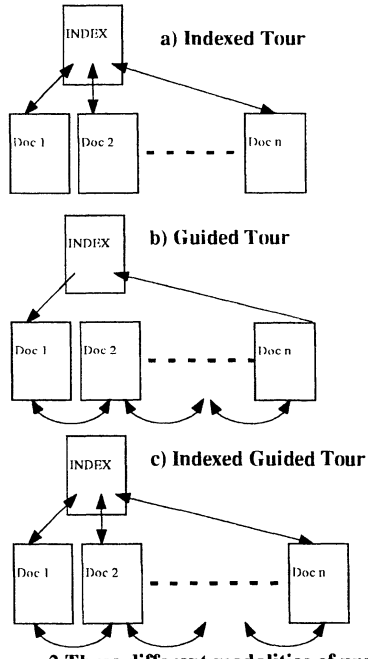

Figure 2 Three different modalities of presentation of hypertext indices

query to retrieve all the reports referring to the given pathology, and then analyzing the clinical histories (or part of them) of all the patients the retrieved reports belong to. In practice, the querying paradigm is used iteratively to create a browsing path through the report database (fig. 3).

In the MR BrAQue system, the main intuition is that the querying process has to be as transparent as possible to the user. The system allows to dynamically create an *orthogonal browsing network*, that is an hypermedia network such that, every time interesting information is found into a document, the physician can change the seeking criterion, choosing from the current document which properties are to be maintained constant in the prosecution. We call *orthogonal browsing* this kind of interaction because, if we represent all the query properties in a n-dimensional discrete space, we see how,

keeping constant $m<n$ of these properties corresponds to constrain browsing into a $(n-m)$-dimensional space. In fig. 4 a 2-dimensional example of this concept is depicted.

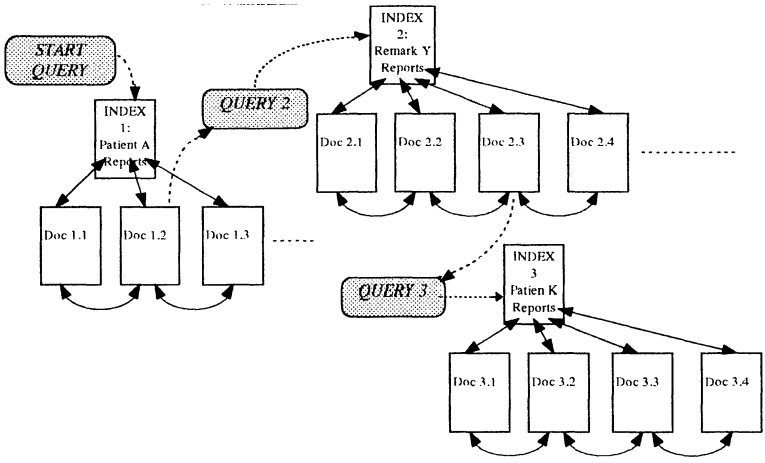

Figure 3 A Browsing Path through the Report Database

When all the query properties are set, the query is proposed to the system and the relevant documents are re-organized as a guided tour.

A suitable graphic interface shows the user a sort of navigation map organized into horizontal paths and steps: each step corresponds to a query submitted to the system,

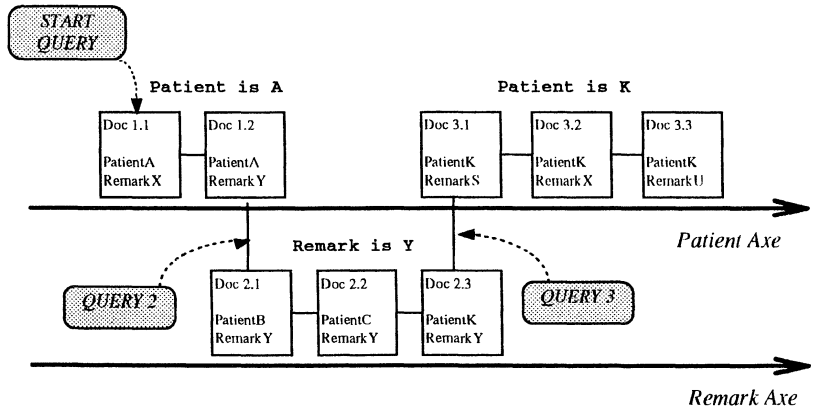

Figure 4 A 2-dimensional Orthogonal Browsing Path

while the following horizontal path corresponds to the fetching and browsing of a set of result documents.

4. Conclusions and Future Work

In this paper a mixin of the database and hypermedia paradigms for managing multimedia collections of diagnostic reports has been presented. The concepts of meta-information and orthogonal browsing have been illustrated: they are the main features of the MR BRAQue system, a hypermedia report management system developed at the Policlinico Umberto I of Rome.

The future directions of the project will be turned to generalize the system to support every kind of report, in particular reports for functional exams. For this purpose, we will explore the use of ontology in the requirements engineering area, to verify if it is possible to define and organize domain ontology able to represent the different kinds of reporting contexts and to be used as reference frameworks for setting up different system configurations. Besides, at the moment, we are exploring the DICOM standard [2] [3] structured report data model in order to make our system DICOM-compatible.

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