A Web-based Environment for Medical Collaboration in a Regional Healthcare Network*

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Summary

The Center for Medical Informatics and Health Telematics Applications (CTI-HTA) at the Institute of Computer Science, FO.R.T.H. is actively involved in the creation and evolution of the regional healthcare network of Crete. In this context, a web-based environment that allows healthcare personnel to collaborate with their peers regardless of their actual geographic location has been developed. Healthcare related collaboration will be facilitated through a number of integrated web-based services such as electronic mail, *I²Cnet* postings, annotations, and on-line collaboration.

Keywords: regional healthcare networks, medical collaboration, computer supported cooperative work

1. INTRODUCTION

A regional network provides healthcare professionals with the necessary infrastructure to collaborate with their peers, share opinions, exchange clinical data, and access regional information. Since its first appearance in 1993, the world-wide web (WWW) has created a new paradigm for information access and delivery.

In the regional healthcare network of Crete, a web-based environment allows medical specialists to collaborate regardless of their actual geographic location. Furthermore, the Image Indexing by Content network, (*I²Cnet*)[1], provides content-based access to medical image collections and related data, contributing to a collection of integrated services that will promote medical collaboration. The forms of medical collaboration initially available to the users of the regional network of Crete through integrated services are shared workspaces, e-mail, *I²Cnet* postings, authoring of annotations, and on-line collaboration.

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2. INTEGRATED COLLABORATION SERVICES

In an intranet framework, integrated services such as image processing, content- and annotation-based search for images and annotations, authoring of annotations and image descriptions, and user collaboration are provided to authorized users through an unmodified web browser. Services are integrated in the sense that both asynchronous collaboration through e-mail, postings, and shared workspaces, as well as synchronous collaboration through an on-line collaboration forum are facilitated. Furthermore, the presence of an Internet gateway leads to other regional networks and the Internet.

This environment, initially created for the collection and annotation of image collections will gradually integrate patient record data that will allow the discussion of medical cases and promote remote opinion request and tele-consultation. The gradual integration of patient record data will take into account data, presentation, control, and functional integration aspects [2]. A domain specific framework for the integration of distributed patient record segments maintained by heterogeneous autonomous systems, which form the logical components of the patient record, will be adapted for that purpose [3].

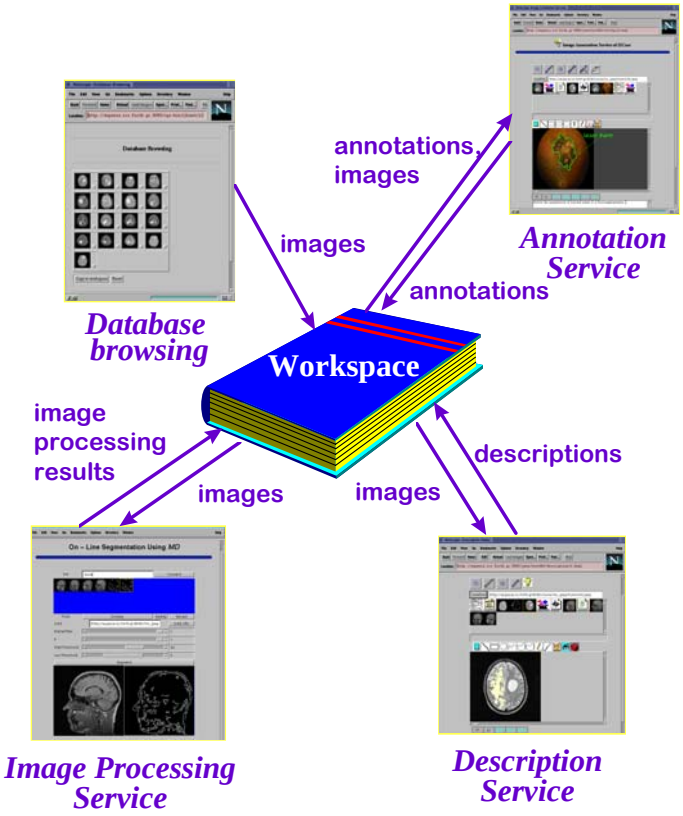

Figure 1: Shared workspaces facilitate the integration of web-based medical services by providing transparent access to multimedia data.

2.1 Shared Workspaces

Shared workspaces support the cooperation of authorized users and service integration by providing secure and transparent access to a heterogeneous data collection anytime and anywhere browser software and a network connection are available. This data collection includes service results and multimedia data objects (images, voice, video, patient exams, annotations, etc.) that were inserted by the users sharing the workspace (fig. 1). Thus, multiple users may collaborate over a workspace, sharing material of common interest.

Workspaces persist between user sessions, among services, and among users. All users connected to a specific workspace are notified of any workspace updates as they occur and may inspect the property sheet of a workspace object which includes its author, the date it was last updated, and a brief description. Furthermore, all services have workspace access, making the transfer of data from one service to another seamless and transparent irrespective of the actual network location of the data object.

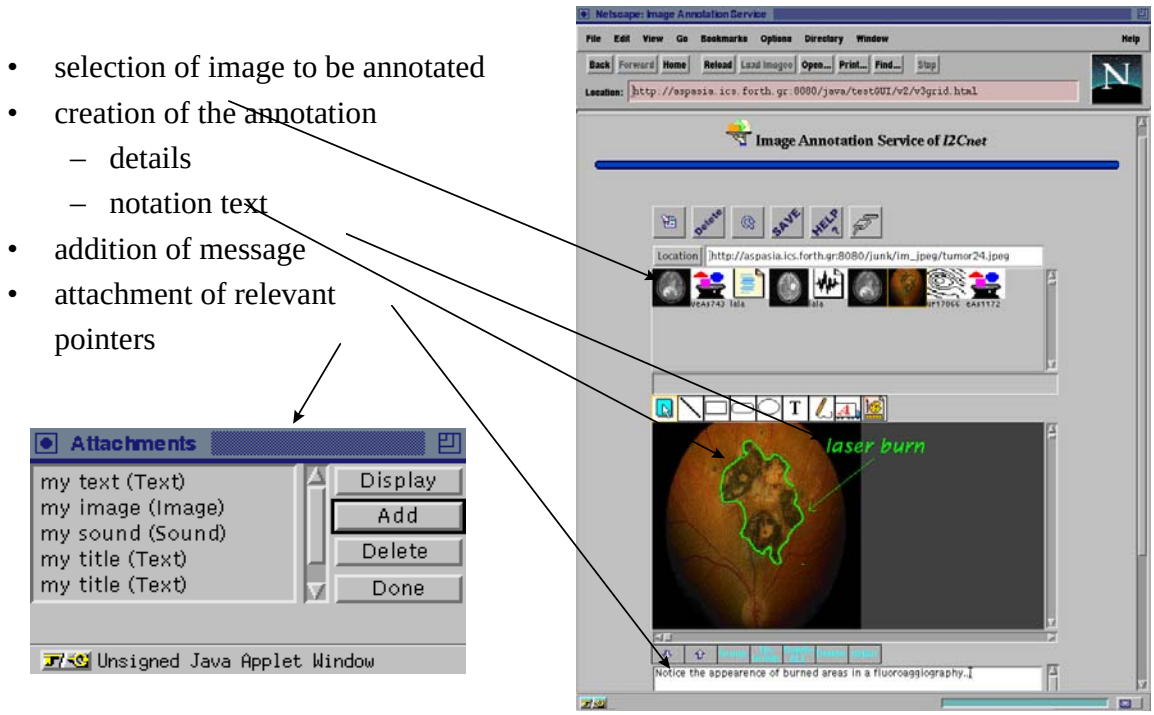

Figure 2: The annotation service facilitates the interaction of healthcare professionals with diagnostic images and patient record data.

2.2 *I²Cnet* postings

In the regional network of Crete, autonomous information repositories that provide in addition to site specific information, local services as well as interesting medical images and related patient data, will involve. Thus, besides using a shared workspace, users may collaborate through postings to appropriate regional bulletin boards. They may post their comments, views, opinions, or propose revisions and updates on the contents of an information repository. *I²Cnet* postings are moderated by medical specialists who serve as

administrators/moderators of the various sites. Classes of medical images corresponding to the special needs, interests, and expertise of particular sites may be created and enriched with material which has been collected locally or has been contributed by remote users. Consequently, healthcare professionals may browse through medical images and related patient data guided by different notions of image similarity, thus sharing experience and information regardless of their physical location.

2.3 E-mail

Using the built-in e-mail support of any advanced web browser, healthcare professionals may mail to each other any data object present in an accessible workspace or network location. Workspace objects may be e-mailed in a native format, i.e. annotation format, or be converted into an image format like GIF or JPEG.

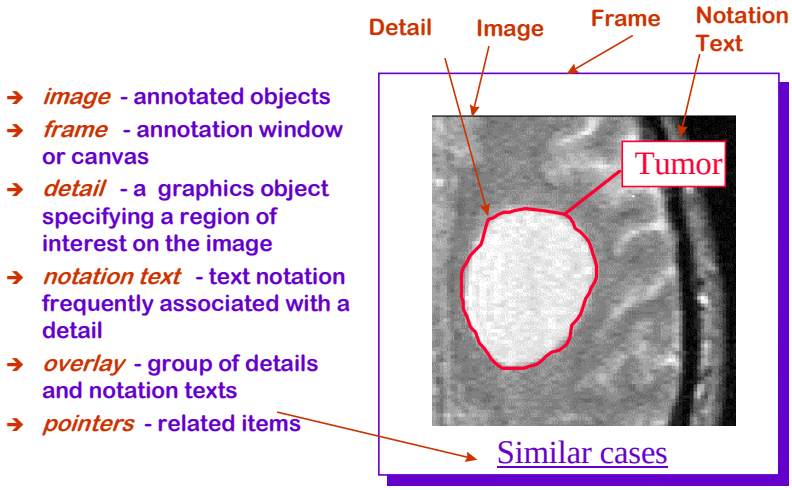

Figure 3: The native annotation format promotes the expression of different forms of annotation: comment, refutation, confirmation, correction, and illustration to name a few.

2.4 Annotation Service

The objective of the annotation service (fig. 2) is to provide healthcare professionals with the ability not only to access medical image collections, but also to interact with imagery, creating, viewing, and communicating notes on groups of images and related patient data. The purpose of an annotation depends on the type of information being accessed as well as on the point the author wishes to make. In its initial version, the annotation service provides a rich way for users to express a comment, a refutation, a correction, or a confirmation through a generic annotation format. An annotation may be include graphics and text grouped into multiple overlays and be associated with various media types such as images, text, sound, hypertext, video (see fig. 3).

The annotation service allows users to collaborate over groups of diagnostic images and related patient data. Hence, medical specialists may create annotations for their private collections, discuss them using e-mail, or use them in discussion fora and on-line

collaboration sessions. Furthermore, the administrator of a site may browse annotation postings, select interesting ones, and link them to selected diagnostic images.

2.5 On-line Collaboration Service

The on-line collaboration service satisfies the need for a more direct form of communication (fig. 4). Users sharing a workspace may discuss using an on-line "talk" facility and comment on various workspace objects. In the course of an on-line session, the joint annotation of a group of images may be performed.

A new instance of the collaboration server is launched, when an authorized user requests the creation of a collaboration session bound to a specific workspace. The contents of the workspace at that time constitute the conference material, and the user that requests the launching of the collaboration session controls the floor. All exchange of information passes through the server, enabling the recording of the complete collaboration session. Furthermore, snapshots of the session may be stored in the annotation format. An noteworthy feature of this service is that, once it is completed, it will allow experts to discuss on-line a wide range of data types, ranging from images to patient record segments.

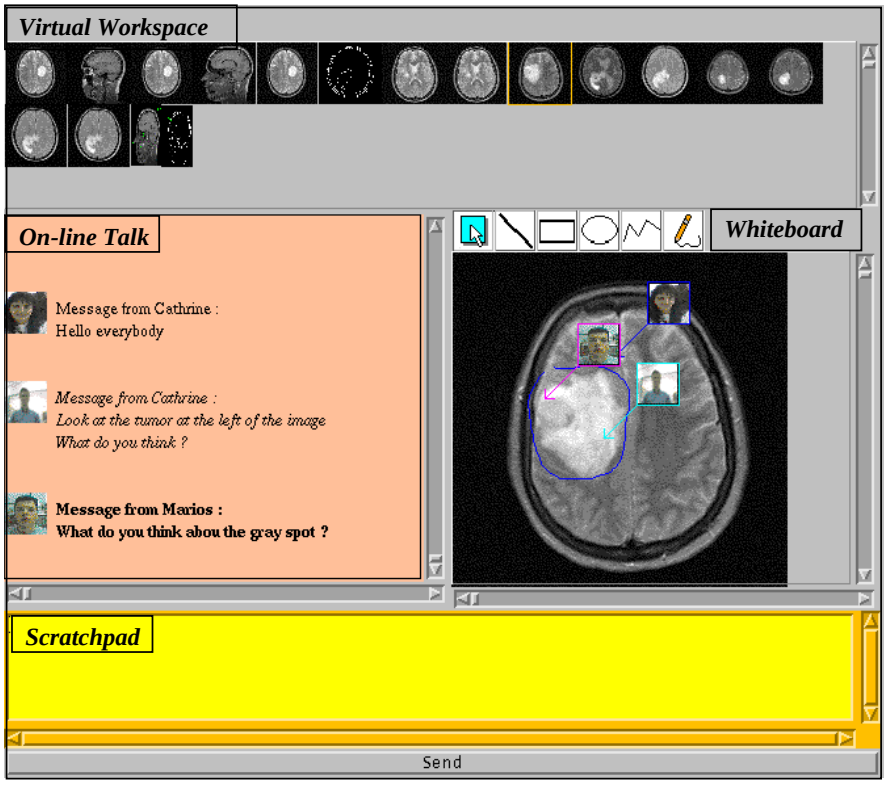

Figure 4: On-line collaboration session in progress.

3. DISCUSSION

The web-based medical services of the regional healthcare network of Crete support asynchronous user collaboration through the use of shared workspaces that maintain all relevant data and service results, as well as moderated postings, and e-mail. The annotation service allows users to interact with the content of information repositories and create annotations that may be e-mailed to any user of the regional network, be posted to various fora, or saved in a private collection or a shared workspace. The on-line collaboration service permits user interaction in pseudo-real time through the discussion of multimedia data objects ranging from electrocardiograms and diagnostic images to laboratory results. Hence, not only the interaction of a large number of users with the available information repositories is facilitated, but also the active participation of users in the evolution of the regional healthcare network is promoted.

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