Employing Melanoma Diagnosis Support using Ajax and Topic Maps

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Abstract: In *t*his paper a web-based information retrieval system is presented for handling dermoscopic melanoma images and associated medical data, in order to provide an effective diagnostic support tool for medical scientists in the sensitive field of melanoma cases. The proposed system is semantic web-based and is driven by exploiting the combination of AJAX framework and topic map technology. A novel client/ server architecture was developed that enables several clients (e.g. dermatologists) to interact online with the topic map based-system. This framework allows the end users to view and modify huge amounts of medical information as well as to share these data between them.

Key-words: Melanoma, Topic maps, AJAX, Semantic, Web, Dermoscopy, ABCD

1 Introduction

Melanoma is one of the most aggressive types of skin cancer [1,2]. Dermoscopy is a non invasive method for improving the early diagnosis of melanoma [3-5]. The dermoscopic diagnosis of melanoma is based on various analytic approaches and algorithms that have been set forth in the last few years [6]. The ABCD rule (A (asymmetry), B (border), C (colour), D (Diameter or Differential structures)) is a standard used in dermatoscopy analysis for classification of dermatological images to benign, suspicious or melanoma [7]. There has been a great deal on scientific research aimed to provide reliable diagnostic support to dermatologists by means of computerized means, towards early diagnosis of melanoma [5,7,8].

In response to these evolving needs, one main demand is to manage efficiently the increasing amount of produced digital melanoma images and related diagnostic data. As information technology spreads throughout the world, several research efforts focus on developing new approaches by utilising Web and Semantic Web technologies for more effective storage, access and retrieval of digital medical images [9-11]. Hence, advanced web-based image repositories can be created for diagnostic and teaching purposes.

One of the major requirements of such a system is concerning its ability to make information more accessible and interoperable by all implied users[12]. Research is turning towards assuring interoperability and reusability of images and related diagnostic knowledge. It seems to be essential to produce no stand-alone but web-based applications to support shareability of information. Furthermore, such a system should be capable of demonstrating some form of knowledge-based reasoning and decision support [13,14].

Semantic Web technologies, such as ontologies and topic maps, seem to have a great deal of potential to provide explicit representation of the semantics of data in order to achieve interoperability and reusability of data as well as reasoning support in such a system [15-18]. The Topic Map model, as a semantic ontological approach, provides the required level of knowledge representation and information management [19-21].

In view of the above, the ultimate goal of the research work that is conducted in our Laboratory is to provide an integrated semantic web-based information management and retrieval system for digital melanoma images and associative data. The main objective of this paper is to present in detail, the design and implementation of the proposed system which is driven by exploiting the combination of AJAX framework and topic map technology.

2 Using Ajax framework

In this section, a topic map based information retrieval system is presented for handling TM-encoded dermatoscopic melanoma images and

related medical data. The main aim of this research is to investigate the potential benefits of encoding medical information using ontology technology, in order to create an effective diagnostic support tool for melanoma cases.

In this background, a topic map-based information management and retrieval system (Figure 1) for possible melanoma images, have been developed during the research work that is conducted in our Laboratory [22,23,24]. The programming language used is Java and in particular the Netbeans IDE platform [25,26].
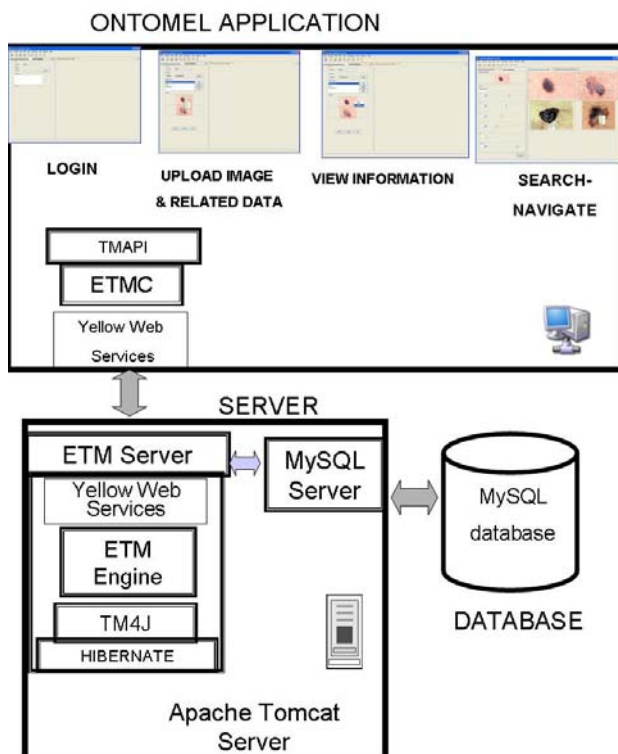

Fig. 1: Representation of TM-based system

Initial evaluation of the system shows promising results. Nevertheless, the following problems have been identified during technical evaluation of the system and are stated below.

Communication between client-server is quite slow. Uploading of images is rather time-consuming. User, in order to interact with the system and have access to server, has to install Ontomel application to his PC. This procedure seems to be rather fuzzy for users, especially if they are not familiar with computers. A viable solution could be to offer access to the system by using a simple internet browser like Internet Explorer. Finally, Netbeans environment offers many facilities to programmers to create windowing applications. Nevertheless, in practice the produced

application were rather complicated. An attempt is made to simplify the programmatic process of creating easy to use client interfaces.

Above mentioned troubleshooting could be solved and further improvement may be achieved by employing Ajax technology in order to build the proposed system for managing melanoma images using topic map standard.

The proposed system is web-based and is driven by exploiting the combination of AJAX framework and topic map (TM) technology. A novel client/ server architecture was developed that enables several clients (e.g. dermatologists) to interact online with the topic map based system. This framework allows the end users to view and modify huge amounts of medical information as well as to share these data between them.

Web applications have many benefits over desktop applications; a larger audience can be reached, they are easier to install and support, and easier to develop. However, Internet applications are not always as "rich" and user-friendly as traditional desktop applications. With AJAX, Internet applications can be made richer and more user-friendly. Ajax, shorthand for Asynchronous JavaScript and XML, is a web development technique for creating interactive web applications. AJAX approach, to building web applications, sheds a new light on the web and help closing the gap between web applications and desktop applications in terms of usability and responsiveness [27-29].

As seen, the proposed architecture is based on an AJAX web application model. This architecture enhances the interaction of the user with the user interface by introducing an intermediary (Ajax engine) between the user and the server. Briefly, instead of loading a webpage, at the start of each session, the browser loads an Ajax engine that is responsible for both rendering the user interface and communicating *asynchronously* with the backend servers[29].

In the following, the architecture of the proposed web-based topic map system is described and the most significant parts are further analyzed.

3 Architecture of the proposed web-based topic map system

In this section, the framework that was developed in order to create a web diagnostic support tool for medical purposes is presented. The core of the proposed system is the Enterprise Topic Map Server (ETMS), which has been implemented using

several java servlets (user maintenance, ontology, information storage and retrieval, etc.), and that administrates the Ontomel TM and coordinates communication issues with client application and MySQL database[22]. Communication issues and exchange of TM are established using the proposed Ajax framework via simple http protocol requests, as illustrated in Figure 2.
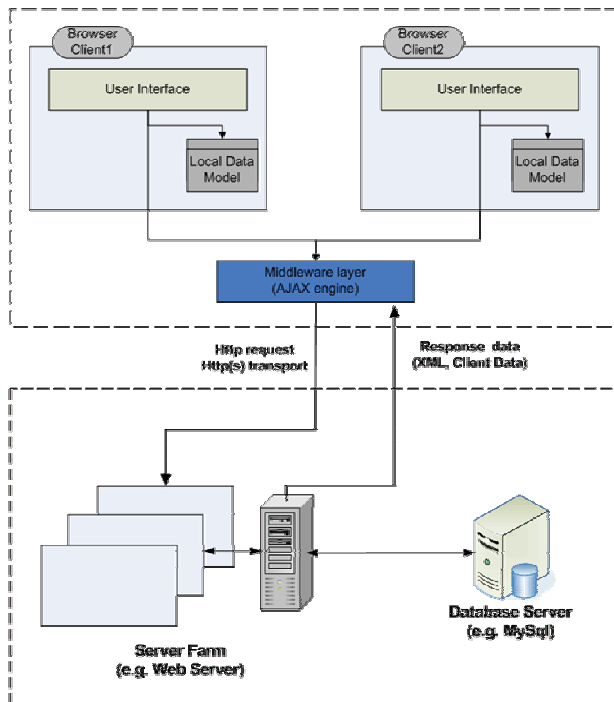

Figure 2: Client/Server architecture using AJAX framework

On the server, a software tool (Yellow-TM) is enabling authoring and visualization of TM, as well as definition of TM Schema and expression of rules and queries [24]. Yellow-TM has been to construct a knowledge repository based on the topic map model that contains melanoma images and related data [23].
The Ontomel framework is provided to the end-users using a simple web interface that just want to access the system but they don't have an implicit knowledge of topic map[22]. More specifically, simple form-based graphical user interfaces (GUIs) have been implemented using the Google web toolkit (based on Ajax framework) (Figure 3).
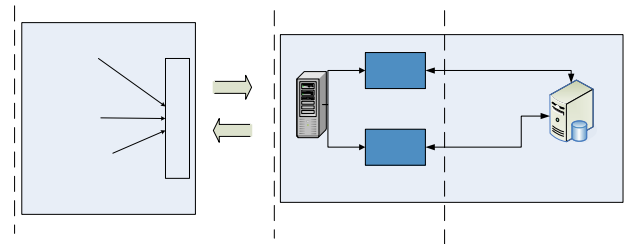

Figure 3: Representation of TM-based system using a web user interface and AJAX framework to communicate with the TM-based server

Registered users log into the system using an Internet browser anywhere, anytime and subsequently interact with it (Figure 4). User may upload a dermatological image, related data like ABCD parameters, patient's data and clinical data in a simple way. By using the Ajax engine, several calls (asynchronous) can be established with the ETMS that resides in a Tomcat server. The ETMS will encode all input data according to the correspondent TM structure and save them in the TM-based database.
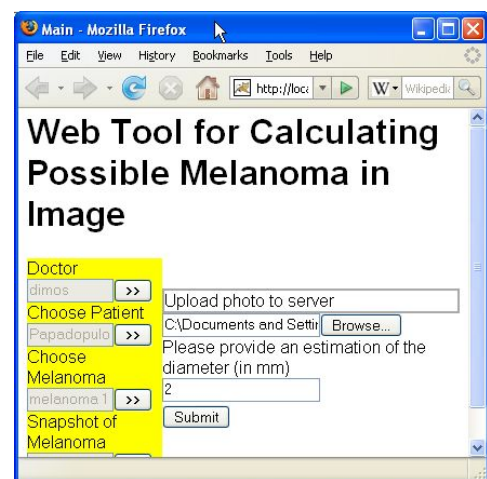

Figure 4: User uploads a new image

Moreover, enhanced navigational and retrieval functionalities are provided via GUIs that minimise user's input requirements. User can locate a patient from a predefined list and see associated melanoma images and clinical information (Figure 5). Additionally, the end-user can use the predefined rules and queries that have been established in the system, for a more sophisticated access and retrieve of information [22] i.e. to find melanoma images with similar ABCD features.
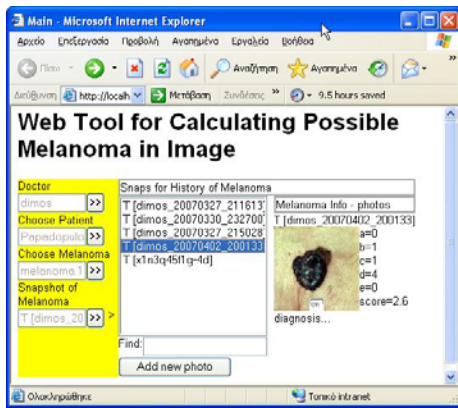
Figure 5: User retrieves information

4 Conclusions

In this paper the design and implementation of a web-based diagnostic support tool for melanoma dermatological images and related diagnostic data is presented. The proposed system incorporates Ajax and topic map technologies. User can access the system via a simple Internet browser, anywhere and anytime.

Topic map technology seems to offer the necessary framework for knowledge management to support sherability and reusability of information as well as advanced reasoning support.

On the other hand, Ajax technology offers the possibility to create web applications that resembles desktop applications in terms of usability and responsiveness.

Currently, the proposed system is in evaluation phase on a technical and functional level. A main demand that seem to be indispensable in order to offer effective diagnostic support to dermatologists is to provide automatic detection of ABCD parameters. Current work of this research effort, is to produce a calculation program for automatic detection of the ABCD parameters of uploaded images and consequently to incorporate into the implemented web-based system.

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