

A Web-based Collaborative System for Medical Image Analysis and Diagnosis

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ABSTRACT

The overall objective of this paper is to show the development of a web-based collaborative system for medical image analysis and diagnosis that is affordable, usable, reliable and efficient for medical area. The system consists of four components that are chat system, online image manipulation system, message board and server system. To carry out the objective of the system, various method are applied such as JAVA applet which is system independent using a virtual machine technology, server and client network model, distributed data structure to manage data for multi-users and image manipulation using Java Awt Graphics library. This system was developed and tested to provide better interface for CSCW (Computer Supported Collaborative Work) in medical area. The collaborative system for medical image analysis and diagnosis being able to be used via Internet provides system independence, convenience and efficiencies.

1 INTRODUCTION

The web-based collaborative system for Medical image analysis and diagnosis uses the Computer and network technologies, the Internet to provide and support healthcare when distance separates the participants.

There have been many researches carried out to develop electronic Picture Archiving and Communications system (PACS) that is for hospital wide network. Most of systems require dedicated workstation and software that are expensive compared to Internet. The core design concept of this system is usefulness of system related to the image processing as well as communication. Development of work tools for group of people leads this system to be focused on Graphical interface intensively. This system developed in Java such that which could be run in any popular web browser in the commercial market using virtual machine technology. This can provide cost-effective PACS system that has familiar interface of users using popular web-browser.

By introducing concept of CSCW to the medical imaging area, the medical image collaboration can be achieved for

medical practice and education. The medical images can be analyzed and diagnosed between groups of people, such that people can discuss about image using chat system while sharing visual image information in their terminal.

In Australia, the level of medical service varies from places to places (Report of the New South Wales Chief Health Officer, Chapter 3.4 1999), because of unequal population density. To make it even this problem online medical image collaboration system is needed to link between low population density area and high population density area using Internet, which is rapidly expanding.

Digitized medical images are used in this system, which are acquitted from CR, CT, MRI and nuclear medicine techniques. Functional images can be powerful tool to examine disease in human body (D. Feng, D. Ho, H. Iida, and K. Chen 1997). Combing network based communication method and functional image browser can provide powerful diagnosis and analysis tool for people to deals with medical image.

2 METHOD

The system has been implemented in JAVA as a set of applets and Common Gateway Interface (CGI) scripts to establish web-based application.

2.1 Structure of Network

Multi-threaded Server and client model is used in this system that a client send information to server and server echoes back to all clients participants. Multiples clients are connected to single server. TCP/IP and Internet protocol is used to make server and clients communicate. The server application is set up in Linux machine, which runs Apache web server as this system is based on World Wide Web. The link with Linux operating system and current Apache web server allow this system to have all the benefit of Linux and Apache such as security. The client application is loaded when user accesses to the web site providing applet connecting back to server. Java's security model depends on browser-specific signing technologies such as Netscape's API capabilities and Microsoft's Authenticode technology. All the data that needs to be accessed by client are programmed using CGI. These features make this system secure from tempering and any illegal attempt to access data inside

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server. The distributed data structure was used to make multiple users share the data. Each individual participant's machine manages each data structure.

2.2 Functionality

The client system consists of chat system, image system and CGI based system. The chat system provides information about all the participants and actual messages between them. The image system consists of image selector and drawing tools. Image selector downloads medical images from server's database and display set of images. When user selects one image it creates new image object with drawing tools to handle image and network connection to the server. The main function of image system is that an authorized user could make marks or drawings on a medical image, which appears immediately on other users' screen to draw their attention to specified area called Region of Interest. The functions for image handling are region of interest, zoom, text annotation and drawing object. The user can access to database using CGI since database provide Web compatible, by submitting queries to web based database user can retrieve set of images with related text data.

2.3 CSCW

There are several aspects to be considered to provide good work tool for group of people. The first aspect is providing presence of awareness (PRASUN DEWAN 1997), since there is no visual contact between the participants in collaboration. In real world collaboration, each participant can clearly see the movement and appearance of other participants so that one can deduce the point of the focus easily. However, in a collaborative system for network, it is not possible to provide such an environment. To overcome these difficulties, the system includes many information boxes and tool for specifying different user, user action and user status. All the user name of participants is displayed in the user information box and user can select different color to differentiate his/her identity while using an image editor. Any user action such as drawing region of interest of image is displayed as text in information box.

The second aspect is usability of the system, which should be easy to learn and use. In the aspect of usability, interface was carefully designed using concepts of direct manipulation, Metaphor and color (Ian Sommerville 1998). The system is operated by mouse pointer and keyboard, which is simple and easy to use. Refer to fig.1 capture of system.

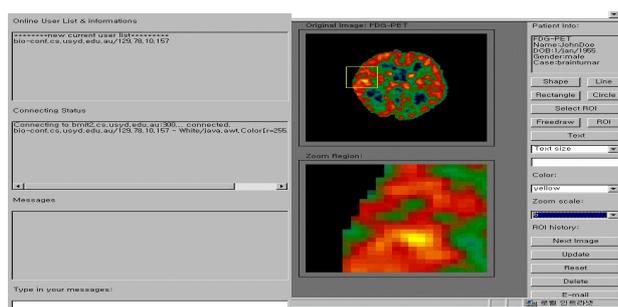


Figure 1: Overall interface of image manipulation; The

system provide direct manipulation and information boxes.

3 DISCUSSION

The Server is being set up to test the consistency and feasibility of the system. Using different platform machines such as Microsoft windows, Unix/x-windows, and Linux were tested it to check the system independence. It performed well in all kind of operating system but the performance depends on the network bandwidth. For the future work, video-capturing function could be added in future work to provide better presence of awareness.

4 CONCLUSION

The system mainly dealt with providing communication methods using Internet for medical area. Wide range of issues related to online medical image and communication were discussed, such as providing well-organized useful communication method, and establishing reliable and secure network connection using Internet.

The primary goals of development of the system are usability and online. In the aspect of usability, direct manipulation using simple mouse peripheral action and simple interface layout provide user-friendly interface. The online ability has been achieved providing text based direct communication and online image manipulation with various functions such as region of interest, zoom text annotation and drawing.

This system has achieved its intention of allowing collaboration in medical area by the usage of current browser technology and the Internet. This area of research is vital in the field of medical imaging, as communication is the core of practice.

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