

Web-based Multimedia collaboration system for Medical images Analysis and Diagnosis

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Abstract

Development of Telemedicine technologies are generating great impact in the field of health care services to overcome geographical displacement economically and efficiently. Previous researches about collaborative telemedicine have introduced many concepts to generate fundamental groundwork such as providing concrete image display, identical information sharing and distributed data management. The efficiency and effectiveness of telemedicine according to collaborative group work and consultation are needed to be considered for maximizing use of the system. We proposed the web based multimedia collaboration system for medical image analysis, diagnosis and report according to the concept of CSCW. The web based system can provide easy access to the user using Internet and also operating system independent. The efficiency of collaboration and consultation could be increased by providing video and audio data that user could aware the presence of other participants. The system network structure is server supported peer-to-peer system for efficient transmission of video and audio simultaneously. Proposed system can effectively provides a tool for collaboration and discussion about medical images.

Keywords: Telemedicine, CSCW, JAVA, WWW

1 Introduction

The rapid development of computer and network technology has lead a new era of digital multimedia. Medical health care is the one good application area of multimedia technologies to provide an efficient and economical health care. A web-based multimedia collaborative system for Medical image analysis and diagnosis uses the Computer and network technology is proposed to provide and support healthcare over separate distance.

There have been many researches carried out about Picture Archive and Communication System (PACS) but mainly for hospital network (Huang 1999). Also most of PACS systems require dedicated workstation and software that are expensive and it lacks in real time communication so that it could not provide effective collaboration or consultation sessions using the system. On the other hand, in the area of researches on information system used in telemedicine mainly focused on effective distribution of medical information such as transmission, storage and management and researches on collaboration oriented telemedicine mainly about providing concrete

image display, identical information sharing and distributed data management (Sigeji et al. 2001). However to make communication system be more effective, psychological aspect of collaboration should be concerned such as presence awareness. (Bentley, Horstmann & Trevor 1997).

The system uses the Computer and network technologies to provide and support health-care to reduce the inefficient and uneconomical for example, firstly there are often time delays between generation of medical images and analysis of it among medical staffs which requires multiple visits for patient to hospital, secondly sometimes it is required to get experts advice from different medical institute which requires long distance travel.

The main improvements web based health care communication system rises are the improving care efficiencies between medical image provider, examiner and patient, increasing the quality of clinical communication, providing better consultation especially the hard-to-diagnosis which medical experts from different regions can discuss and thus give better treatment on the patients and improving the continuity of care. The core design concept of this system is the usefulness in the aspect of image processing as well as communication. The experts knowledge can be shared regardless of geographical displacement and more options for caring of patients.

This system developed in Java such that it could be run in any popular web browser in the commercial market using virtual machine technology regardless of its operating system. This can provide cost-effective internet based health care system that has familiar interface of users using popular web-browser. In the CSCW view, an exchange of data and information is important as well as the efficient communication. Providing user awareness is the current trend of CSCW application which is important for identify, presence, truthfulness and so on (Benford, Bower & Fahl 1995). By using the concept of CSCW to the medical imaging area, the effective medical image collaboration can be achieved for medical practice and education (Bentley et al. 1997). The medical images can be analyzed and diagnosed between groups of people, such that people can discuss about image using communication system while sharing visual image information in their terminal. The analyzed image could be reported to patient from medical experts with easiness of using Internet that home and hospital can be connected. The efficiency of work is enhanced through audio and video data by providing the presence awareness that maximize the effectiveness of system in group work and communication. The network structure of system is using server supported peer to peer communication that normally video and audio data requires large bandwidth. The specific detail of the system will be described in the next.

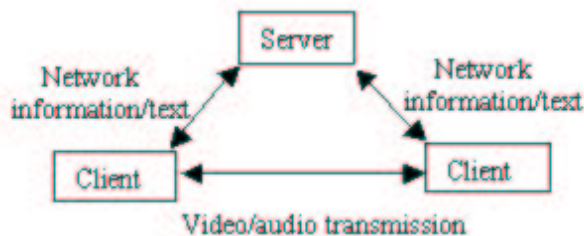


Figure 1: Server supported peer to peer communication network model.

2 Method

In this study, we present a server supported peer-to-peer communication system consists of 4 components that are text chat, voice chat, video transmission and image manipulation. The programming language used in the development is Java since the effectiveness of using Java for development of web-based application is well acknowledged by researchers that there are many papers provide results on it (Slomka et al. 2000). Especially JMF is a media-developing tool that provides easy-to-use APIs to manipulate media stream that enabled the system equipped with efficient video and acoustic data transmission.

2.1 Server supported peer-to-peer communication system

The combination of client-server model and newly emerged peer-to-peer (P2P) network is used in this application (Barkai 2002). The conventional client-server model requires a server to handle all the communication transactions between clients which may cause heavy workload and network congestion while in peer-to-peer communication, each participants' computer initiate connection each other along with server connection Figure 1. Initially Java based Applet need to be downloaded from server to activate system on participants' machine then each participants establish connections between each other with support from server that provide network information of each clients. Simple text based network information like IP is retrieved from server to participants' computer. The different tasks are assigned in difference connections such that; video and audio data are transmitted between participants' computer that enables faster transmission from one computer to the other bypassing the central server since the size of video and audio, which requires certain level of network bandwidth and server process speed, is big compared to text based messages. To ensure the identical information sharing and synchronization of data, the any manipulation made to image are stored in each participants' computer and server with sequence number and time stamp and server frequently compare its change with each participants' data in every time interval set for synchronization of distributed data.

A video conferencing and chat system are communication tools with a image manipulation tool. The video conferencing system has a Transmitter and Receiver. The Transmitter is to establish a video conferencing session by sending audio and video streams via a RTP multicast or unicast IP address with port number. The Receiver can join the session by set up a RTP session with that address. After successfully joining the session, the receivers are able to receive the incoming stream and play them back. The chat system is used as a assistant tool when there is a network problem between peers. Once those connection

has established, participants can use this system as communication tools as well as image manipulation tool.

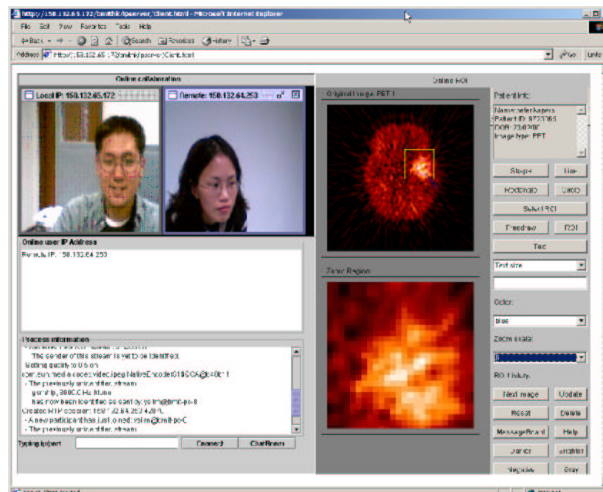


Figure 2: Overall interface of system consists of video of participants, audio and network information and image manipulation tool.

2.2 Presence awareness

There are several aspects to be considered to provide good work tool for group collaboration. The first aspect is providing presence of awareness (Bentley et al. 1997). 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. In CSCW, providing sufficient information to overcome participants is not facing each other is major concern. One of the best approaches would be providing visual and acoustic information of participants. Especially it is important in medical collaboration system since it deals with information about human so that any misunderstandings between participants are avoided. Those misunderstandings can be reduced by providing visual and acoustic contact in this system and hence communication become more effective since each user can see other participants body language such as face expression that has a better understanding and also enhance other kinds of benefits (Steve et al. 1995).

3 Results

The proposed web-based and real-time collaborative medical system consists of 4 components: video and audio chat system, text chat system, image manipulation system. This system provides a tool for user to manipulate the digitised medical images such as CT, MRI, PET and renowned image formats. User can use various methods of drawing object such as free draw, line, rectangle, circle to draw those objects on top of medical image by pointing out a specific region (Region of Interest). Several Image filters are also provided in this system so as to have a better image examination tool. Those filters are Negative filter, Gray filter, brighter filter and dark filter. User can point out the interested region on a image which can be chose by using image selector and zoom it to a appreciate size and discuss through the video/audio system which provide visual communication or text chat system. The above functions are provided such that medical specialists can use this system to hold real-time discussion on digitised medical images. An

overall interface can be found in Figure 2, a chatbox in Figure 3, and an image selection bar in Figure 4.

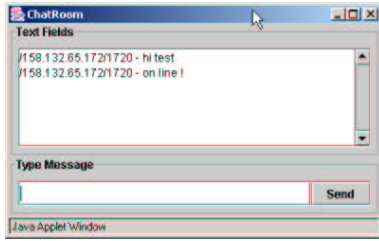


Figure 3: Chatbox is used for feed back for audio communication

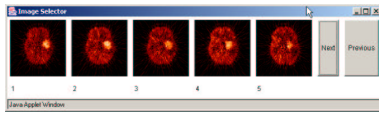


Figure 4: Image Selection bar provide each participants are able to change image from provided sets of images and make sure of displaying a same image

4 Discussion

The system has several advantages. No software is required on participants' terminals, thus images can be made easily and cost-effectively available to external participants such as referring physicians, patients and experts in long distance. The advantage of using Java would be the fact that execution of applets on remote computers without specific software configuration or other requirements, using standard web browsers. In addition, Java is available on all major computer platforms and is non-proprietary. For the experiments, the server, which is using Windows Professional 2000 Server, is being set up to test the system but it is designed to be system independent so it would run on Linux, Solaris Unix platforms with Java runtime environment. The performance of system over local area network was acceptable to understand different parties messages; there was approximate time delay of 0.3 second in video and audio transmission which solely depends on network bandwidth.

5 Conclusion

This research project set out to discover a way to support health care industries using latest Java based technologies by providing collaboration system using Internet. The system has demonstrated that our server supported peer to peer network model was appropriate for broadband Internet connection. The system was carefully designed according to concept of CSCW to make it efficient. The web based multimedia collaboration system is affordable, usable, reliable and efficient since it uses readily available web based technology and also getting all the benefits of using it.

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