

An Internet and Intranet Based Real Time Medical Imaging System

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Abstracts –Today computer is an essential part of our life. The computer database is used for medical decision making. Doctors basically used to take decision on particular diseases on the help of old and current history of the patients or same diseases procured by other patients. This paper describe a tool developed in java/j2EE which enables the doctors to retrieved old record of same diseases treatment using internet and even allow them view medical image of blood slides, ECG, CT-scan, X-Ray etc. even allow them to mark and/or zoom important area of the image. It is secure and multi party medical image database consultant system.

Keywords– Server side programming, Servlet; Medical image processing, Client-server;

I. INTRODUCTION

Now a day Medical image processing plays a very important role in decision making diagnosis of diseases. Computerized medical data base used to take good decision on particular diseases treatment. Electronic medical consultation between doctors would become more meaningful if a tool is available that not only supports verbal communication but displays medical images at their consoles with enriched features such as marking, text annotating, zooming etc [1]. Creating, developing and implementing this type of a tool over the web server is a very challenging task as it involves transfer of different type of large volume of data between the clients. The exchange of data is also threatened with the problems of data security over the network. We propose “An Internet and Intranet Based Real Time Medical Imaging System”, named as Web based Medical Image Communicator (WBMIC), which basically uses the Internet as the communication infrastructure. WBMIC proposed in this paper provides a tool for Electronic medical consultation among doctors in a web based telemedicine system to facilitate discussion over medical images of the patients. We first up all look into the **requirements** of this system and its role in the diagnosis of various diseases. A description of the system is then presented high-lighting its different features from users perspective. Finally, the paper concludes with a discussion on the scope of future development.

II. PREVIOUS RELATED WORK

a) Although not many systems have been reported in the literature providing aforementioned features over internet, contributions made by a group of researchers in Sydney [1] and in Taiwan [2,3,4] have similar objectives. The system described in [1] used HTTP protocol to deal with online consultation of a patient’s image over the Internet.

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b) However, it mentioned the use of JAI that often adds an extra overhead to the client machines. Whether more than one image can be handled simultaneously was also not clearly mentioned. The system proposed in this paper deals with tele-consultation among doctors examining medical images and other information related to a patient. When a doctor refers a case to another doctor for consultation, it would be necessary to share relevant medical images [8]. The system described in [2] used ftp as a means of communication to transfer images of a patient to the client’s local machine. It has three disadvantages:

c) It used ftp for file uploading and downloading which is often blocked because of security considerations.

d) It stored the image at the client site. Hence a suitable client tool needs to be installed for local storage management. In addition, retrieval of files and relevant image data from server as well as its storage on client side involves additional IO operations thereby increasing response time.

e) It functioned on a peer to peer basis. Peer-to-peer communication has the disadvantage that most proxies in today’s environment do not allow a client to directly connect to the outside world to avoid security breaches.

III. SYSTEM DESCRIPTION

The proposed An Internet and Intranet Based Real Time Medical Imaging System (WBMIC) provides an environment and platform for doctors who are at different places, they are connected using Internet and intranet and they like to participate in an online session. During such a session, they can open patients’ various medical images and perform various operations on it and if any other assistance needed then they can open the other patient report who already procured by same disease. This is implemented using a Java Servlet that work as client-server architecture.

IV. FEATURES

The system proposed in this paper deals with Tele consultation among doctors examining medical images and other information related to a patient. When a doctor refers a case to another doctor for consultation, it would be necessary to share relevant medical images. To undertake such sharing the following options are made available:

- To send images and medical records beforehand to all participating sites where the relevant data are saved.
- To send commands from client sites to fetch relevant image/record during a consultation.

Since both these approaches tend to store the data in a stable storage (disk), additional disk access time would be involved. The proposed system addresses the data fetching and display of data in a slightly different manner. When a user (doctor/consultant) logs into the

system, he/she is presented with thumbnails of relevant images. The relevant full image is fetched online, loaded into the memory directly and opened when the thumbnail is clicked. This avoids storage of image/data in the local stable storage. Images are fetched from the server to the client on-demand. Moreover, all images of the patients need not be downloaded to the client beforehand. In order to protect internal machines and databases from Internet based threats, most organizations use proxies/firewalls that implement Network Address Translation (NAT) and allow only HTTP/HTTPS traffic because of security considerations. In view of this, WBMIC has been developed and tested in a secured network where only HTTP and HTTPS are allowed and everything else is blocked. It is assumed that images and patient records are maintained at a central web server and a client sends HTTP requests to the web server for fetching data. Images and/or messages are received as HTTP responses. The client need not install any additional software patch. WBMIC makes HTTP requests from the clients to web server only if permitted by the client. A self-signed certificate is sent to the client for its verification. Since WBMIC has been designed to help doctors who want to consult and discuss with images related to a patient, such images should not only be readable but must be presented in a user friendly manner. WBMIC enables a doctor to open any image or patient record which is also simultaneously displayed on the other terminals of the consulting parties. If a doctor writes a text on an already opened image, it is simultaneously displayed on other windows of individual machines where this image is being viewed. Besides image chatting, WBMIC supports text based chatting to start a normal discussion before actually starting a conference related to a particular patient. Some of the important functionalities of WBMIC are listed below:

1. Open an image online during discussion.
2. Mark on the important specified regions of the image.
3. Zoom a whole image.
4. Zoom selected areas in the image.
5. Write text on the image.
6. Write text on the zoomed image.
7. Open specialized canvas for displaying skin patches or the different organs of the body.
8. Write text for text-based chatting.
9. Display the doctor's status.
10. Perform certain mathematical operation on an image portion and display the result to other participating doctors.
11. View any image with any resolution. If the image is very large, resize it to fit into the screen. If the image is too small in resolution, the zooming facility can be used to see an enlarged image. WBMIC does not impose any restrictions on the number of users of the system, or on the number of users in a group. The number of concurrent connections would not be limited by the capabilities of the web server as we are using servlet technology. There is cross platform compatibility as it is developed in Java. The application is very scalable, optimized and robust owing to the features of Java Servlet. Since the communicator uses HTTP requests to send and receive data over the Internet, this mode of communication enables any client to access the server irrespective of their underlying network links such as leased lines, ISDN, DSL, PSTN etc.

V. SYSTEM DESIGN AND ARCHITECTURE

WBMIC is a tool of Telemedicine Server **An Internet and Intranet Based Real Time Medical Imaging System** (WBMIC), developed at IET, Alwar, India. **Web Based Real Time System for Medical Image Consultation (WBMIC)** is designed for Windows platform. It is a portal built with an intention to provide access to quality healthcare services to the remotest regions through innovative and state-of-the-art technologies. The system entitled "**An Internet and Intranet Based Real Time Medical Imaging System (WBMIC)**" is developed with an objective of providing a secure telemedicine platform over the Internet. A brief description of the system is being provided in the next section.

VI. THE PROPOSED SYSTEM

The **An Internet and Intranet Based Real Time Medical Imaging System (WBMIC)** is built on a four layered architecture (shown in Figure 1). The different layers of the system are the following:

A. Database Layer

The Clinical Database forms the lowest layer of the application. It contains all the medical records of the patients as well as personal details of the users. The database has different logins for different types of users and the application server connects to the database using the appropriate login for the current role of the user. The database server is accessible only from the application server.

B. Application Layer

The Application Layer or the Business Logic Layer is the core of the application. It is responsible for all communications with the database. This layer intercepts all data requests from the presentation layer. If the current user is authorized to access the requested data, it fetches the data from the database, runs application logic on the fetched data and returns the final output to the presentation layer. Similarly data insertion and other user requests are also handled by the Application Layer.

C. Presentation Layer

This layer resides between the Application Layer and the Web Proxy Layer in the demilitarized zone (DMZ). It is the segment of the application which is responsible for organizing the data fetched by the Application Layer into a user friendly format. In the **A Server Based Real Time System for Medical Image processing support** system, the Presentation Layer formats the data into html format for external communication.

D. Proxy Layer [6, 7]

The Web Proxy Layer is the only portion of the software that resides in the DMZ. This is the publicly accessible portion of the application which communicates with the client. Whenever a request comes from a client, this layer verifies the user and then passes the request to the Presentation Layer. After being received the output for the request it is forwarded to the same client. Apart from the Proxy Layer, all the other layers are hidden by firewalls. All the client requests and responses are captured by the proxy layer to ensure that the internal layers are not directly accessible from a public network.

VII. AN INTERNET AND INTRANET BASED REAL TIME MEDICAL IMAGING SYSTEM (WBMIC)

Web Services are components accessible by Internet users through common Internet technologies and standards such as XML, SOAP, WSDL and HTTP. Any service which is being offered by a Web Server, first of all should be registered through a registry service such as in UDDI registry so that the same can be exposed to users.

An Internet and Intranet Based Real Time Medical Imaging System (WBMIC) server handles critical data of patients with different diseases and problems. In An Internet and Intranet Based Real Time Medical Imaging System (WBMIC) environment, Web Services are offered through Web proxy Layer which in turn uses HTTPS to communicate with other layers to ensure adequate security. The interlayer communication is handled following SOAP standard. Being an integral part of An Internet and Intranet Based Real Time Medical Imaging System (WBMIC), WBMIC at present is implemented as a component of the presentation layer and is not directly exposed as Web Services but it can be invoked through the Web proxy layer.

VIII. INTEGRATION OF WBMIC WITH WEB BASED REAL TIME SYSTEM FOR MEDICAL IMAGE CONSULTATION

WBMIC is a Java Servlet, embedded in a web page. In the paper entitled “An Internet and Intranet Based Real Time Medical Imaging System”, WBMIC architecture (See Figure 1), it resides as a tool in the Presentation Layer. When a request arrives, it is loaded on the server’s memory (only for the first time request) and executed by Java Virtual Machine (JVM) of the server and then the response (results) sent to the client to be shown on browser window. Once is loaded, it communicates with WBMIC server using the HTTP protocol.

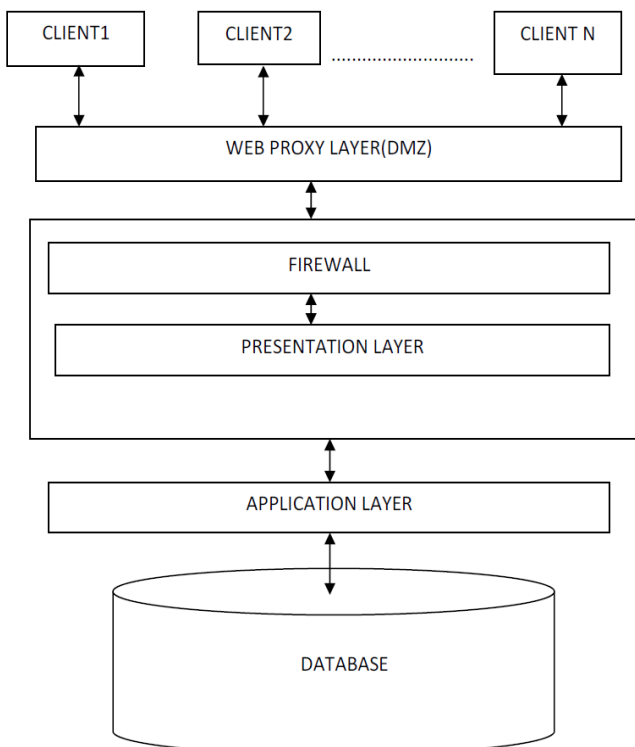


Figure 1. Architecture of WBMIC based on Internet

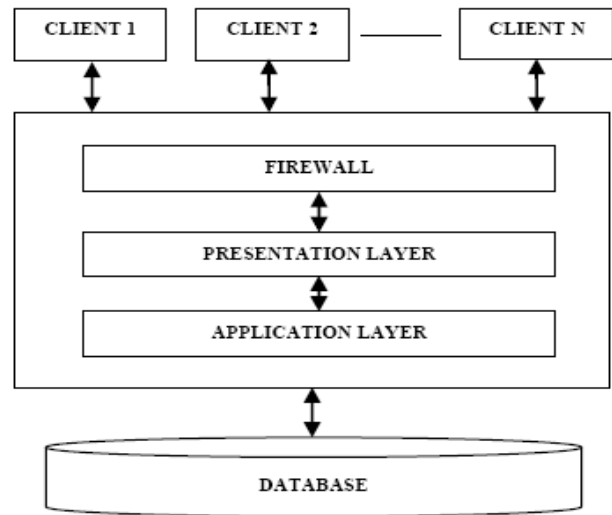


Figure 2. Architecture of WBMIC based on Intranet

The advantages of using the servlet technology are many fold including platform independency, scalability, security, robustness and built-in multithreading etc. It establishes an HTTP connection to the WBMIC server [6, 7] and then posts HTTP requests to it when any event such as annotating or drawing a circle is activated by a user. The HTTP requests are received and forwarded by the proxy layer to the presentation layer. At the presentation layer, the request is processed and then an HTTP request is made to the application layer which fetches the required information from the database layers.

IX. COMPONENTS OF WBMIC

The Web Based Real Time System for Medical Image Consultation [6, 7] server hosts database and ASPX9 pages for interaction with the database tables. The overall message flow between the clients and WBMIC is shown in Figure 2. The following three tables are installed for storing data in the system:

- a) User Table: This table contains data of logged-in users. When a doctor logs-in, a message is posted to the server, and the table is updated. In the Figure 2, this message flow is represented by point 1.
- b) Patient Table: It contains a list of patients assigned to individual doctors. This table is not updated by the communicator who can only fetch data from it. This is populated by the Web Based Real Time System for Medical Image Consultation server. In the Figure 2, this message flow is represented by point 2.
- c) Message Table: The message table is populated whenever an event is generated at the client end. In the Figure 3, this message flow is represented by point 3.

The client also checks for any new messages that are intended for it. This flow is represented by point 4 in Figure 3. Message Flow between Users and online Graphics communicator:

1. Login, Authenticate and Append.
2. Get assigned patients. Select patients, Get other doctor assigned.
3. Send message and update message table.
4. Check for any new message.

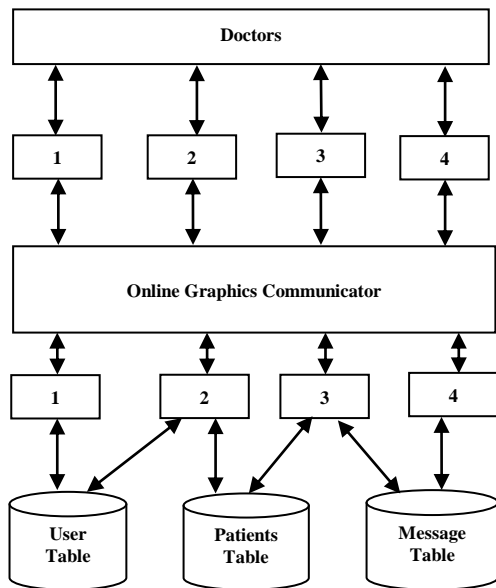


Figure 3. Message flow between clients and Server

X. WBMIC COMPRISES THE FOLLOWING TWO MAJOR BLOCKS

GetMessage Thread: GetMessage thread polls (request for new data from) the server at regular intervals to check for any new messages and on receipt of a new message, the thread updates its state as per the message.

Event Generator: When there is an event created by the connected user, a message for other clients is created and posted immediately. For example, if a user draws a line on the canvas, the message to draw the line is generated and subsequently the HTTP message is created and posted to the Web Based Real Time System for Medical Image Consultation server. WBMIC has been developed in Java10 environment without using any extra/third party APIs. It is based on event driven mechanism. For every specific event, a suitable HTTP message is generated. It is then posted to the Web Based Real Time System for Medical Image Consultation server where the message is extracted and queued up for further processing. This system, however, does not function on push technology¹². Hence the client polls the server at regular intervals to see if it has any message to process. Upon receipt of message the same is decoded and then the system is updated accordingly. Since the system works based on polling strategy, updating would occur periodically based on the polling frequency.

XI. CONCLUSIONS

The An Internet and Intranet Based Real Time Medical Imaging System (WBMIC) presented here reflects our research work.

We are in the process of developing a clean framework to implement such systems. The system design choices we have proposed will improve the efficiency and ease of programming such techniques.

XII. FUTURE WORK

This paper is based on our ongoing research of designing a new Web Based Real Time System for Medical Image Consultation. Since the research is going on, we have not included the implementation of system based on .Net. We are

working on a new peer to peer system for the medical profession.

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