A Web Based Medical Image Data processing and Management System

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Abstract

Medical services in current-time rely heavily on digital imaging technology due to image modalities utilized in medical field such as the computer tomography and magnetic resonance imaging. These techniques require image-processing tools and digital management that has been the primary reason for development of Picture Archiving and Communication Systems (PACS). The limitation to PACS is that the system architecture limits itself to be only used in the local area network, which at times causes inconvenience towards physicians requiring the system in the outside environment.

With the rapid advances in the network speed, computer processing capabilities, and the support for online software development, the potential to bridge the gap between the hospital and outside environment to share and work in conjunction may be realized.

In this paper, we present an application of database and functional imaging that runs through the Internet network (WWW) and Internet browser that has similar ability to the PACS yet having the advantages of being an online system.

Keywords: World Wide Web (WWW), PACS, Java Applet, Medical Image, and Image Processing.

1 Introduction

Recent advances in imaging technology allow evaluation of medical images in depth, which are now the requirement when studying and diagnosing an image. This depth in medical imaging is the image processing, manipulating the image to transform, enhance, and restore information, an improvement for human interpretation and processing of scene data for autonomous machine perception.

Until recently the possibility of studying and diagnosing of medical images beyond the dedicated workstations within the department has not been fully exposed that restricted the usage and convenience. Current network and computer technology allows for image processing and data retrieval efficiently, reliably, and economically. Past researches in the field of online imaging has shown great potential and functionality with the ability to retrieve medical data and basic image processing on the Internet. Allowance of such ability to be accessible online with the usage of standard Internet network and browser can be of a great beneficial towards medical imaging.

Medical imaging plays a significant role in the study and understanding of patient’s diagnostic examinations. The demand for online medical imaging systems that allow visualization and processing has increased significantly. These systems allow the tools for visualization and image processing to be accessible outside the working environment of the physicians and also accessible at all times and in any location.

The aim of this research was to explore the potential of the Internet and the browser technology, and to maximize the use of the browser to eliminate the requirement of the dedicated workstation in the field of medical imaging while still maintaining the image processing functions and imaging tools. Incorporated with this aim for the research has been the goal to ensure that the system being developed will actually be usable and functional to the potential user audience of the system.

This study attempts to address the above issues and provide a solution, which is the construction of the application ‘Functional Imaging Web’ (FIWeb).

2 System Architecture and Functionality

The system architecture shown in Figure 1 comprises of five components. There are two advantages with this architecture. The database structure is flexible as the system can be used with any type of database setup such as the SQL, XML or the text-based system. Also the system is designed to be extensible so that new component may be added to the system to enhance and customize the system.

The **Graphical User Interface** (GUI) is the component that allows the interaction of the users to the system.

The **Database** component is web-based database using JavaScript, Python script, and HTML that can be used online with any Internet browser that supports scripting language. It uses **python (ver. 6.1)** script language on the server side to execute all the user commands including login service, account creation and data search using key words. The security of the users is assured by using the 16-bit **rotor** encryption. Four access levels exist that are the **Administrator** – maintaining the database system, **Staff** – having access to all the patient information, **Patient** – ability to view their own records, and **Guest** – guest user to evaluate the system.

Component **Region of Interest (ROI)** is to select a region of an image and study that segment further. The user makes the selection by drawing a shape on the image. The process of ROI maintains all of the image’s attributes. Once the region is selected, it maybe cropped and scaled.

**Image analysis** is a requirement when studying to extract details such as pixel count, mean pixel, standard deviation, and histogram.

**Imaging tools** contain: Cine player, sequence of image displayed at variable frame rate. Comment tool for allowing users to note down study results that can be loaded and appended. Compare operator which is used to visually compare two images by fusing two images using methods such as **XOR, OR, AND, and SUBTRACT**.

**Image processing** component include common medical imaging enhancements such as interactive colour table manipulation, Blur/Sharp, Colour filter, Upper/Lower bound and Median (3x3, 5x5, and 7x7 kernel) filtering. Transformation methods are also present with the ability to Scale, Rotate and Translate.

![Figure 2. Displaying the features of the FIWeb.](image)

3 Discussion

Overall design of the system is present in Fig.2. The implementation of the GUI is the result of extracting designs from commercial image processing applications and feedback from potential user audiences.

The proposed system to access and diagnose medical images requires no software on the viewing site, thus being cost-effective and no installation. This also means that the system can be used outside the hospital and at all times. Also with medical imaging, there are the requirements of image processing to extract information that cannot be satisfied by traditional format such as printed/film media copies but possible with the FIWeb.

Java programming language is selected over others due to its Applet technology that allows online development. Also there are extensive library classes within java for Image processing and GUI building. The use of python scripting language for the database is primarily due to the database being object-oriented and file-based, which Python scripting languages are best suited.

The evaluation of network to be used for the system has produced positive results with only 56K dial-up modem having slight delays. With the rapid growth in networking and the introduction of broad bandwidth, the FIWeb system becomes very accessible.

4 Conclusion

In this paper, we have presented the potential of archiving on-line PACS system that is both efficient and functional. We addresses a broad range of issues relating to online medical imaging such as the storage and retrieval of medical data in a well-structured and manageable database to the ability of online image processing and imaging tools. The creation of FIWeb is to provide real users with the ability to perform above conditions through an easy and practical experience.

The area of research of this paper is new and exciting, with constant improvement in computer performance allowing the realization of new concepts and technology. Several new features are planned for development that will make the system more complete and powerful such as the inclusion of integrated database to the FIWeb allowing query to be done within the FIWeb system. Also with the strong growth in the 3-D imaging such as the volume representation, the support for such technique will be added.

This paper can be viewed as archiving one step closer towards total online medical imaging system and online imaging in general. It is hoped that the application developed will provoke more interest in the enormous potential of being online and the exponential growth of power in computers to improve the field of medical imaging.

5 References


