Transmission and Retrieval of Information from Scanned Images using Medical Informatics Model

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Abstract: - The existing infrastructure in medical imaging is being improvised with new technologies which has revolutionised medical industry. The main reason for its predominant use is the interrelatedness of the various departments. Sharing and transmission of patient data has become a great challenge. At present paper based patient records are replaced by electronic patient records. This documentation can be transmitted across a network, thereby improving the performance by making the system secure and reliable. In this paper we focus on a new paradigm which unifies the methods to extract information from images combined with implementing a new doctor's portal with enhanced features and security. We suggest a new system for efficient management, storage, retrieval and transmission of data over a distributed environment. Doctors across the globe can jointly collaborate for quick diagnostics and treatment. The combination of various techniques incorporated in our model not only improves the quality of healthcare but also focuses on minimising the medical errors and cost.

Index Terms: DICOM, CORBA, Digital Image Processing, MIS, PACS.

I. INTRODUCTION

Digital Image Processing in the field of medicine is used to extract useful information from images, such as MRI scans for better diagnostics. This way of diagnosing increases the reliability, decreases the cost and is flexible for information sharing [5].Even today, complete automation in diagnosis has not been achieved, as it still requires some human intervention as well.

The primary usage of digital imaging in medical field is to render clear images received from many medical devices such as MRI, X-rays, and CT scan [4]. Further operations include extraction of useful information from images, sending it over a distributed network from source to destination. New ideas like integrating a portal for doctors to interact globally with their counterparts, helps in better diagnostics, thereby reducing medical errors which in turn saves patient's life.

With the advancement of imaging technology, the diagnosis of diseases became more easy and accurate. The X-ray imaging was taken over by CT scanner, ultrasound and MRI, which changed the whole perspective of imaging in medical field. MRI scanners are widely used in hospitals for medical diagnosis, which uses strong magnetic fields and radio waves to form images of the body.

The progress in computer and communication technology has led to the development of advanced applications for higher performance in medical imaging systems. The various independent technologies led to the evolution of a universal medical imaging system (MIS) structure, which was to be followed by the medical industry [5]. This structure provided various functions for the management of high level image consults, with suitable protocols and interfaces. This led to the computerization of information systems in hospitals which stored the patient database.

2. EXISTING SYSTEM

The substantial growth of medical imaging field in recent years has developed various methods and tools for analysing, managing and sharing of medical image data.

Image database (IDB) systems can be implemented by making use of the following considerations:-

- Image Extraction and Representation
- Organisation of stored data
- Search and retrieval techniques
- Use interface design

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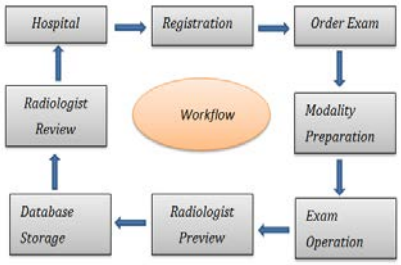

Figure 1: Workflow diagram for the existing system

The complete process from patient registration to doctor's treatment is illustrated in Figure1. The process starts with the patient registration, where the patient is given a unique id through which he can access his medical reports. Then the patient is advised to undergo the necessary treatment.

The object oriented approach is used in designing IDB systems. This approach provides a structural skeleton that encapsulates entities (Image data) and operations (Image access mechanism). These entities and operations could be represented as objects which can be grouped into classes.

Picture Archiving and Communication System (PACS) is an evolving health care technology used for image processing in medical field. It is increasingly used as an essential part of Radiology. Figure2 describes the various components and functionalities of the PACS architecture. The use of PACS acts as a replacement to the hard-copy based means of managing medical images. An electronic platform is provided by PACS for processing of radiology images and interfacing with other medical automation systems. PACS provides instant access to images and is cost effective.

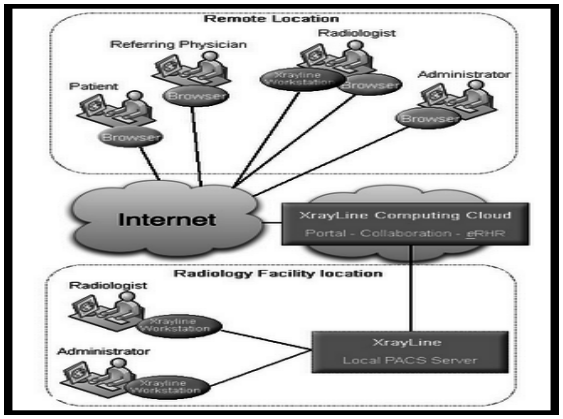

Figure 2: Sample PACS Architecture

A PACS consists of four major components: the imaging modalities such as CT and MRI, a secure network to transmit patient information, work stations for interpreting and reviewing images, and long- and short-term archives to store and retrieve images and reports. Combined with available and emerging web technology, PACS can deliver timely and efficient access to images, interpretations and related data.

The existing system is based on distributed object computing system. It provides various object services and an interactive client application. These object services manage the information for the clients. The goal of the existing system is to build a single architecture where hardware and software components coexist. This architecture was accomplished by classifying information into services and transmitting them via interfaces.

3. PROPOSED SYSTEM

The new approach combines the features of previous technologies along with some of the important added features and functionalities.

The user interface is made more interactive for physicians. The new interface combines all the necessary features of informatics stored in the hospital server, along with a new doctor's portal and information extraction from image. The proposed system is designed using object

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oriented language for flexibility and performance.

The proposed system uses the existing technology in order to track (generate) the images for the DICOM. It is also possible to brighten up the image and enhance the visibility.

The highlights of the proposed system are as follows:-

1. The inclusion of multiple images from various scans like MRI which are in DICOM format can be analysed and useful information about the patient can be accessed [2,3]. This method is made secure by making it password protective. The individual scanned images can be sent from radiology, oncology or any other department to the concerned doctor over the network.

2. Doctors within the hospital can access all the patient records related to their department for a comparative study. Another new feature is that doctors can interact with their counterparts located across the globe for exchanging of opinions and possible suggestions, for efficient diagnosis reducing any negligence or misobservation.

Figure3 gives an overview of the integrated proposed system. The scans and other reports from various medical devices are stored collectively in a database with the aid of database server. With the use of World Wide Web, these reports can be accessed by various potential users [12]. For example, doctors and other specialists can track various patient records from the web server and use it for the further analysis of the on-going treatment. The above described proposed system can be implemented with the inclusion of doctor's portal as well.

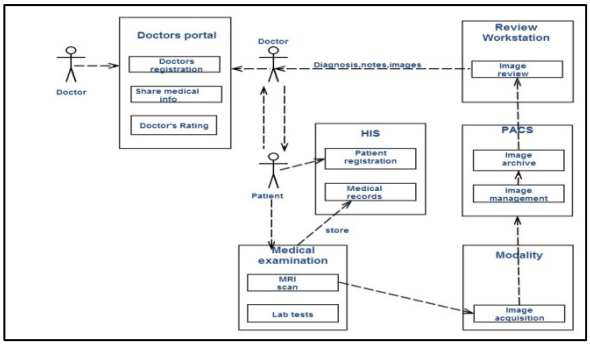

Figure 3: An overview of the proposed system

Example scenario: - Our model deals with interaction among doctors regarding various dreadful diseases like cancer, diabetes etc. A patient diagnosed with any of these diseases is subjected to thorough analysis. An allopathic doctor treating a cancer patient can take opinions from an Ayurveda doctor or a homeopathic doctor across the globe regarding the same case. These doctors can collaborate over the network and can access similar patient details in various other hospitals for efficient diagnosis. The transmission and sharing of data over the network is made secure. Only authorised personnel can access data. This way of joint collaboration helps in massive eradication in medical errors, which saves millions of lives in the world.

4. ANALYSIS

Digital Imaging and Communications in Medicine (DICOM) 3.0 is a new standard for imaging in medical field which supports distribution and viewing of medical images from sources like MRI, CT scan etc. [2,3]. DICOM standard was developed by DICOM standard committee, National Electrical Manufacturers Association (NEMA) that holds the copy rights. It is an extension of older NEMA standard.

The application could be developed using an object oriented based model. The programming objects from a common application can be shared by end users (client and server applications) [7].

The present computing system demands an infrastructure that is distributed and heterogeneous in nature [6]. This infrastructure supports three-tier computing architecture like Common Object Request Broker Architecture (CORBA) [7, 11].

Figure4 shows the general format of DICOM file used in our system consists of a header and related image data. The header is an important field which includes details like the patient's name, dimensions of image, types of scan and other diagnostic data. The DICOM image can also be compressed using certain lossless compression algorithms.

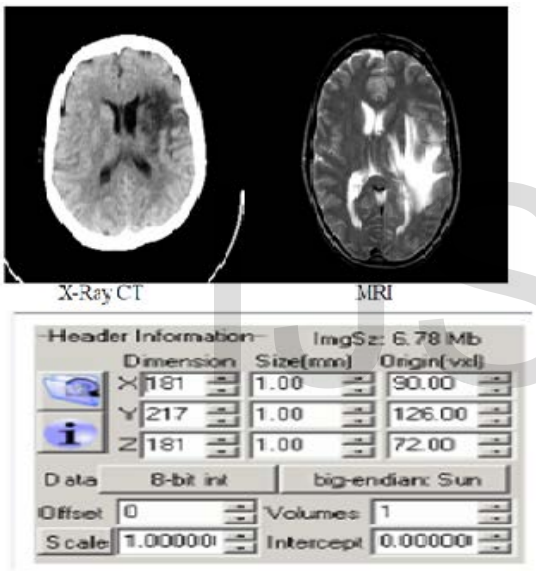

Figure 4: DICOM Header format

The policies associated with the selection of appropriate compression parameters (e.g. compression ratio) for JPEG lossy compression is beyond the scope of this standard. This facilitates the interoperability of implementations conforming to the DICOM Standard, which uses one or more of the Transfer Syntaxes for JPEG Image Compression.

The use of the DICOM Encapsulated Format to support JPEG Compressed Pixel Data requires that the Data Elements which are related to the Pixel Data encoding (e.g. Photometric Interpretation, Samples per Pixel, Planar Configuration, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values which are consistent with the characteristics of the compressed data stream. The Pixel Data characteristics included in the JPEG Interchange Format shall be used to decode the compressed data stream.

4.1 DICOM file architecture

The various modules in DICOM architecture are:

1. Images from various medical devices are obtained and compressed to a fixed size using efficient algorithms using an image renderer.

2. By using data dictionary, the image and the patient details are encoded to get the encapsulated format of data.

3. Different transformations (scaling, rotation etc.) can be applied to the files which are stored in the database.

4. Image and patient details from the DICOM files can be loaded with the help of user interface.

5. The image and the details of the patient can be decoded with the help of a DICOM decoder.

6. A separate database is maintained for storing the DICOM files and the patient details.

5. IMPLEMENTATION

The Implementation in general should contain an interactive user interface consisting of patient details, Patient medical history, various scan reports, doctor's portal etc.

In this application, doctors can request for a particular record and view it. We can use multiple windows to display different patient details, to retrieve

DICOM images, for doctor's interaction etc. [3].

Some of the requests that can be made in this system are as follows:-

1. The doctor as a client can access all the patient information related to his department.

2. The hospital server responds to the doctor's request through authorization and displays all the patient records from the database.

3. The doctor's portal can be implemented as follows:-

a. A doctor in one hospital can send a request via the portal to another doctor located in a different region for suggestions regarding a case.

b. The doctor at the receiving end can either accept or reject the sender's request. Upon acceptance both the doctors can interact about a particular case. They can even share patient records. This helps in faster diagnosis and reduces medical errors, thereby making the system efficient. Also, a doctor can give rating for another doctor based on the satisfaction level that he has experienced while discussing a patient case with his counterparts.

The following are some of the screenshots of the system.

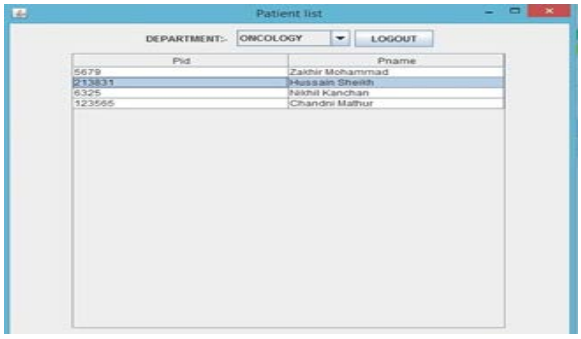

Figure 5: Patient list according to department chosen

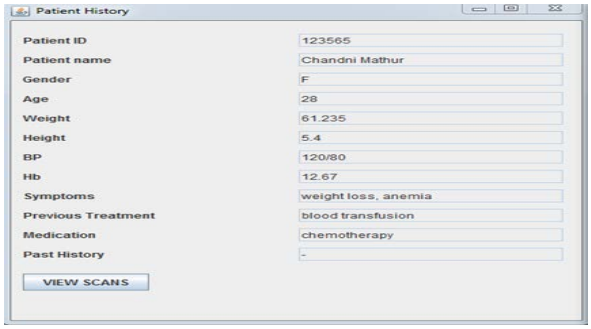

Figure 6: Patient history panel

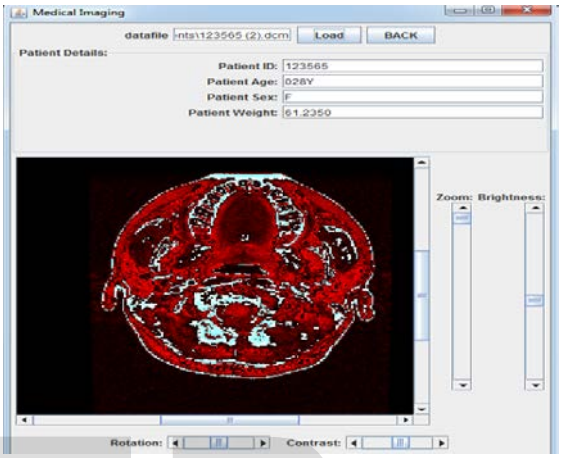

Figure 7: Retrieval of patient info from MRI scan

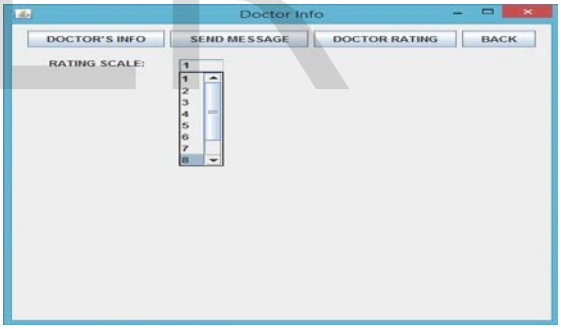

Figure 8: Doctor Rating Window

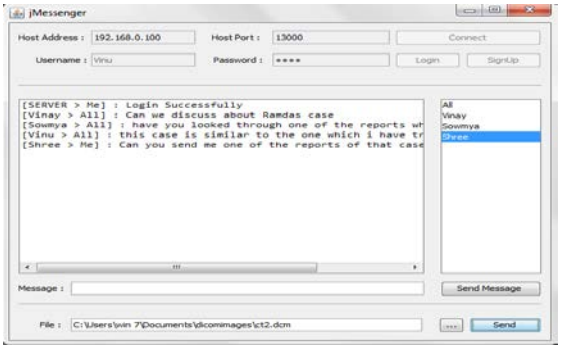

Figure 9: Attaching and uploading the file

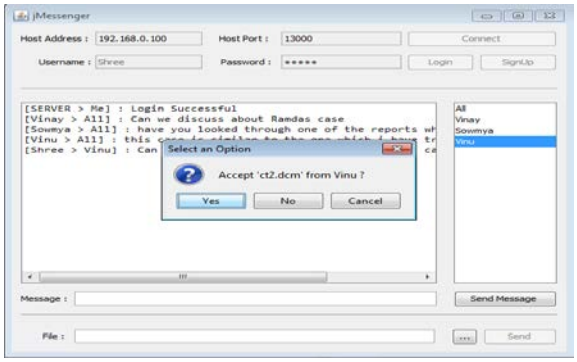

Figure 10: Accepting a file request

Figure 10 shows how the doctor responds to the file request sent by another doctor.

6. CONCLUSION

The distributed approach in trying to incorporate all of the imaging and informatics into a single unified model results in better efficiency and maintenance. We conclude that by improving the existing system with the proposed features, the cost of diagnosis can be significantly reduced. This provides a lot of options for the patient as well as the doctors in providing improvised healthcare techniques. Overall impact of the model can result in faster diagnosis and recovery of a patient. Inclusion of many optimization algorithms for both data and image handling helps in achieving better performance.

7. FUTURE WORK

1. Development of a new platform makes it possible to integrate and correlate microscopic and macroscopic imaging data.
2. Good results can be harnessed if the proposed system is deployed as an android application. This way the application can reach millions of users.
3. The collective database from various hospitals across the globe can be integrated on a secure cloud and can be made available to different drug dealers for manufacturing of improved medicines used to cure dreadful diseases.

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