An Optimized Knowledge Associated, Storage and Retrieval of Digital X-rays Databases

Saad Razzaq, Fahad Maqbool, Ahmed Farid, Fahad Shahbaz ,Kashif Irfan & Anwar M.A.

***Abstract*— Since the start of digital X-Rays its storage and retrieval has been a challenging issue for the researchers. This paper focuses on an optimized storage of digital X-Rays and related information that consequently reduces the retrieval time. The storage module consists of different layers that are responsible for storing extracted slices of digital X-Rays along with its associated knowledge. The assembler in retrieval module takes digital X-Rays and related information from their respective extractors and displays it on the screen.**

***Index Terms*—Assembler, Data Mining, Extractor, Normalizer.**

I. Introduction

Computer science is espoused by every field of life, due to its immensity, ease of utilization, and promising solutions for problems in different fields. Computer Science is also involved in the filed of medical sciences. In this paper our focus is on the problems associated with storing and retrieval for Digital X-Rays as they are getting more popular and replacing the conventional standard photographic X-Rays in Pakistan. Digital X-Rays uses X-Rays detectors for its production while conventional X-Rays use films and chemicals for its production. Making the transition from analog to digital could bring several to X-Ray imaging [1]. Digital X-Rays are more common these days due to its features like easy storability as an image in computer, rotatable, resizable, adjustable for contrast, color coding for educational purposes, more clear and clean image then conventional X-Rays [2].

The conventional X-Rays are difficult to find and store safely both by the patient and medical personnel. Conventional X-Rays starts vanishing with passage of time but for digital X-Rays there will be no such issue. Digital X-Rays can easily be maintained by the medical personnel and by the patient. Medical personals of Pakistan can get quick opinions and response through internet by sending digital X-Rays to specialists of other countries. Medical personals can compare current X-Ray with previous X-Ray using one click environment rather than finding them from a file and, if lot of time has been elapsed then even difficulties in comparing. In this paper we propose a system which stores a digital X-Ray and associated knowledge with each X-Ray like information provided by the radiologist and description given by the doctor. The system maintains an optimized and digitized database of X-Rays of patients for efficient retrieval. The proposed system may bring a new methodology for the treatment of X-Rays related diseases in the medical field of our country by providing facility of comparing different knowledge associated X-Rays on different visits of the patient to guide for further treatment options.

Section two explains the system overview in detail, section three describes relational model. In section four we discuss the advantages and disadvantages of digital X-Rays and of our system. And in last section we conclude our work and present future research directions.

II. System Overview

Conventional X-Ray involves firing high energy X-rays through the body with a photographic plate at the other side. Dense bits of the body like bones absorb radiation. That leads to a lighter area on the developed photographic negative. In effect a shadow is cast through you onto the photograph, giving a view inside. Digital X-rays uses detectors that are sensors based not film and produce digital images rather than the standard photographic images [2]. One major draw back associated with conventional X-Rays is their storage issue; how they are maintained after production? The hospital or/and patient is responsible to maintain the X-Rays and, is also, responsible to provide it on the successive visit to the medical personnel. Whereas, in the case of digital X-Rays databases, all manual effort in maintaining and producing the X-Rays is eliminated by the use of a computer in the office of medical personnel. S/he may view the first and/or successive X-Rays just by entering the patient-ID.

Saad Razzaq, Fahad Maqbool, Ahmed Farid are with Department of Computer Sciences & IT ,University of Sargodha ,Pakistan e-mail:msaadrazzaq@yahoo.com,fahadmaqbool@yahoo.com, ahmedfarid80@yahoo.com,fahadjee@yahoo.com,kashif_irfan31@hotmail.com.Anwar M.A is with University College Yanbu, KSA e-mail:anwarma@yahoo.com.

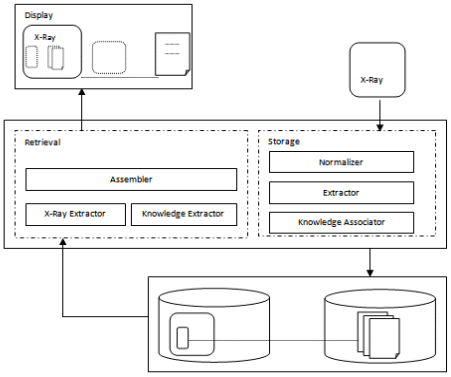

Figure 1: System Block Diagram

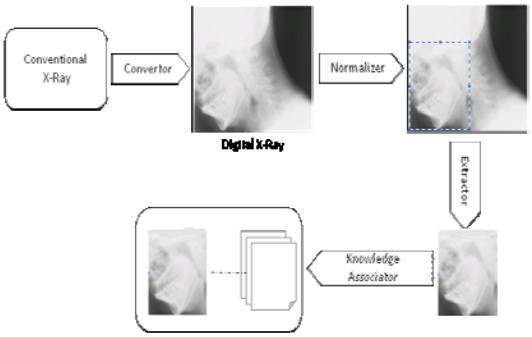

Figure 2: Slice extraction from digital x-ray and knowledge association

The proposed system comprises of three parts; storage, retrieval and display as shown in Figure 1. A digital X-Ray is given as input to the storage module which consists of normalizer, extractor, and knowledge associator. After passing through these steps an optimized X-Ray along with associated knowledge is stored in the database. The retrieval module consists of X-Ray extractor, knowledge assembler and displayer. Medical personnel can request for all the X-Rays of a patient taken in successive visits or of any particular visit. Assembler will pick the X-Ray from X-Ray extractor and take knowledge from knowledge extractor and display it on screen along with the original X-Ray. Now we briefly explain our storage and retrieval modules in detail.

A. Normalizer

Normalization is the image processing technique that is used for finding bonded rectangle [3]. A digital X-Ray is input to the normalizer. The radiologist will identify and draw a rectangle around the disease affected area on the X-Ray using mouse. The radiologist describes about the size of the rectangle around the affected part of the X-Ray and this will become a minimum bounding rectangle (MBR). Normalizer also, supports the conventional X-Rays: It will convert an X-Ray into an image using one of the available techniques and then radiologist will give it to the MBR.

B. Extractor

The extractor uses the normalized X-Ray process by the normalizer and extracts the highlighted part from the original X-Ray. This part is saves into X-Ray imagery databases. The details of the database design are explained at the end of this section.

C. Knowledge Associator

On each X-Ray radiologist or medical personnel needs to write the information about the effected area. The knowledge associator is responsible for attaching such knowledge with the slices of X-Rays on each successive visit.

D. X-Ray Extractor

This is the part of retrieval module. It extracts the stored X-Ray from X-Ray imagery databases on the basis of patient id. X-Ray extractor passes the extracted X-Ray to the assembler. X-Ray extractor facilitates medical personnel or radiologist to view whole X-Ray that is original one and all or few of the sliced X-Ray for the comparison purposes

E. Knowledge Extractor

The purpose of knowledge extractor is to retrieve information associated with the X-Rays taken on successive visits from the knowledge base and output it to the assembler.

F. Assembler

It combines both X-Ray and its associated knowledge and displays it on the screen. Medical personnel/radiologist can request for any particular date and also to view the whole summary or for some specific dates. Assembler will manage the display on the screen if the request is for the few results then it will adjust accordingly or if the request is for all previous X-Rays history then it will adjust accordingly.

III. Relational Model

Figure 3 shows a relational model for the data storage of the proposed system. The model consists of four relations; Patient, Knowledge, X-Ray, and Segment. The radiologist captures the X-Ray of a patient and stores it in the X-Ray imagery databases along with xID (X-Ray ID), pID (patient

ID) and xDate (X-Ray Date). Radiologist or medical personnel writes his comments that are stored in knowledge database. The original X-Ray is stored only once time in X-Ray imagery databases, and on the successive visits by the patient, sliced X-Rays are stored if s/he comes for the same problem.

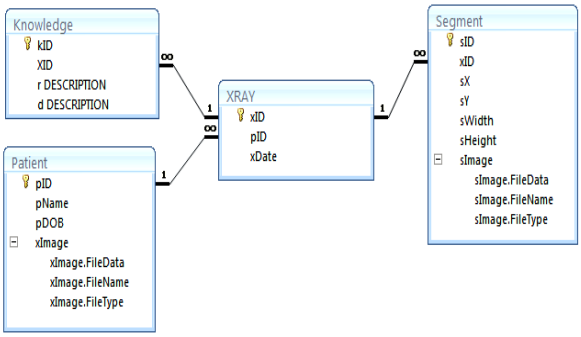

Figure 3: Relational model for data storage

IV. DISCUSSION

We haven't found much of work done related to optimized storage and retrieval of digital X-Rays for Pakistani medical personals and radiologists, that limits us to discuss our system features in detail only. Long and Thoma discusses digital X-Rays indexing using techniques from vertebral morphometry [4].

Digital X-Rays provide more ease to the patient, medical personnel or radiologist and hospital administration in capturing, maintaining, and storing of these X-Rays. These are easily retrieved and viewed by the medical personnel or radiologist on screen where in case of conventional X-Rays; it has to be either maintained by hospital administration or by the patient himself. Also the availability of X-Ray at the time of visit has to be ensured either by hospital administration or by the patient. It is also difficult for radiologist or medical personnel to view the piles of conventional X-Rays of patients opposite to that of digital X-Ray where it is one click far away to reach any particular X-Ray.

The advantages of our proposed system is that: It may helps the medical personnel or radiologist to view all the X-Rays, original and the sliced one of a person on its successive visits to check whether the patient is improving or not. Another advantage of our system is, it reduces and indeed eliminates the paper and file manipulation environment. Medical personnel or radiologist views the patient details, which includes X-Rays along with its descriptive information and the prescribed treatment suggested by him on patient previous visits. This will facilitate him to decide for changing and continuation of prescription.

Due to storing sliced X-Rays on the successive visits of a patient rather than whole X-Ray large amount of disk space is spared and consequently retrieval time is also reduced in term of I/O. As an example, we stored one hundred Digital X-Rays of ten patients of their ten visits. Each original X-Ray took 2 mega byte of space for storage results in two hundred mega bytes disk space and it took approximately 20×10^4 I/O blocks, if we consider block size of 1024 bytes. In our case storing hundred X-Rays take almost forty six mega bytes which reduces disk space by 4 times and it takes approximately 5×10^4 I/O blocks which reduce I/O's by approximately 4 times.

The radiologist has to identify the MBR around the affected area of each X-Ray manually which needs to be automated. This is the only week point which needs to be addressed, it involves image processing and pattern recognition algorithms. Digital X-Rays are having varying size so converting them to a one standard size is another major issue.

V. CONCLUSION & FUTURE WORK

Our proposed system provides a computerized solution for Digital X-Rays as they are more popular these days in medical personals and radiologist of Pakistan, due to its promising features. Our system not only facilitates the patient and medical personals or radiologist in maintaining, storing and comparing the digital X-Rays but at the same time it consumes less disk space and also reduces the I/O time, the focus of our research.

In future our focus is on automating the normailzer module so that it will work without the intervention of radiologist. Different Data mining, artificial intelligence techniques can be applied on X-Ray imagery databases to find different patterns and clusters which may help the medical personnel to understand the root or cause of diseases. Furthermore we wish to work on enhancing the system so that medical personnel of our country can discuss about an X-Ray with another specialist any where in the world online.

more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

ACKNOWLEDGMENT

Authors wish to appreciate visiting scholar program of Higher Education Communication of Pakistan and University of Sargodha, Pakistan for providing facilities and opportunity to work on the proposed system.

REFERENCES

[1] Digital X-Rays by Vikram Shah, VESIT
[2] Looking inside medicine - computer scientists in the body, Courtesy Queen Mary, University of Landon
[3] Rafael C. Gonzalex, Richard Eugene Woods, Steven L. Eddins Digital Image Procesing using Matlab, Published 2004,Pearson Prentice Hall, ISBN 0130085197
[4] L.Rodney Long, George R. Thoma, Image Query and Indexing for Digital X-rays, National Library of Medicine Bethesda, MD20894.