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Web Based Medical Image Storage and Retrieval Using Irma

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ABSTRACT

Medical informatics deals with the resources, devices, and methods required for optimizing the acquisition, storage, retrieval, and use of information in health and biomedicine. Engineers and scientists are trying to find efficient ways of storage and retrieval of medical images and have ended up with widely accepted results. Standards such as DICOM and HL7 provide us with standard conventions of how to store medical data in a standard format. But there is no standard naming convention for medical images. The DICOM standard names images based on UID for a specific country but there are ambiguities in naming because of redundancy of names and there is no universal naming convention for medical images. Each hospital has equipments manufactured by different manufacturers and follow naming conventions compatible with a single hospital or health care group. However, these tags are rather roughly structured, ambiguous, and often optional. IRMA (Image Retrieval in Medical Applications) code is an excellent solution for the ambiguity produced due to non-structured naming. Be that as it may, the IRMA framework needs data about the variations from the norm for which indicative tests are completed. The proposed coding plan is a mono progressive code for different inconsistencies that are analyzed from restorative test systems. Each indicative picture is coded in light of the variation from the norm code such that recovery is made simple by determining the specialized methodology of imaging. This code can be joined with the IRMA code for productive stockpiling and recovery of medicinal records and information. The aforementioned codes alongside one of a kind id are utilized to name the restorative pictures which makes seeking simple and effective since every one of the catchphrases required for picture hunt is accessible in the filename itself. The proposed seeking system incorporates essential and propelled hunt alternatives. The essential inquiry alternative includes information seek in light of patient name, age, sex and area. The propelled pursuit alternative incorporates inquiry in view of directional data, positional data, anatomical data, methodology data, irregularity data, date and time of recording. The framework is productive for specialists since it recovers pictures that are significant to the pursuit inquiries thus there is no excess.

KEY WORDS: Medical Image, IRMA, DICOM.

1. INTRODUCTION

The doctors all over the world are dependent on technology to find the disease or abnormality of a patient. Each and every big hospital is using a separate code for the classification of patient data and images and there is no inter compatibility or connectivity between the data. This resulted in major ambiguities and complexities in storage and retrieval of images and data. This drawback was eliminated by the formulation of IRMA code which was a mono hierarchical code with 4 axes viz. the technical code (T) that describes the imaging modality, the directional code (D) models body orientations, the anatomical code (A) which refers to the body region examined and the biological code (B) describes the biological system examined. This code can be used to classify the medical images but it lacked information about abnormalities. The proposed coding scheme assigns a mono hierarchical code for the classification of images based on the anomalies.

2. MATERIALS AND METHODS

The proposed system includes a web based medical informatics system with authenticated interfaces for doctors, patients, technicians and hospital users as shown in Fig. 1. This system reduces the complexity of image search by searching images with priority to abnormality codes in addition to the IRMA codes. The naming convention of the image storage in the database introduces a new revolution by including the abnormality information in the name of the image which increases the credibility of storage and it also facilities the easy retrieval of images. The abnormality code is also developed based on the IRMA code with digits from 1 to 9 representing the modalities and digit 0 stands for unspecified category. The abnormality code is based on the facts from Diagnosis Pro and is a practical approach to classify images based on abnormalities rather than a semantic representation of images. The proposed system has a central server which contains the database of IRMA and abnormality codes stored as linked tables so that retrieval is made possible by linked chain codes of programming.

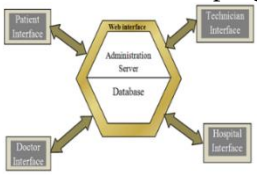

Figure.1. System Architecture that shows the relationships between the various interfaces with the administration server and database

The database also contains the images uploaded by the doctors and the technicians. The naming of the image is based on the following convention as shown in the Table.1.

Table.1. Image storage naming convention with bits allocated for each field

Fields	No. of bits
U-id	34
IRMA code	13
Abnormality Code	5
Date of scan	8
Time of scan	4

The U-id of the patient is the combination of name, gender, date of birth, time of birth, address, country code and zip code and is 34 bits wide as shown in Table.2.

Table.2. Various Fields in Unique Id Bits Allocated For Each Field

Fields	No. of
First Name (First 4 characters)	4
Middle Name (First 4	4
Last Name (First 4character)	4
Gender	1
Date of Birth	8
Time of Birth	4
Country code	3
ZIP Code of Place	6

The IRMA code is a combination of technical code that specifies the modality, directional code which specifies the orientation in which the body is positioned, anatomical code for the boy region examined and biological code of the system as shown in Table.3.

Table.3. Formation of Irma Code with 4 Axes

Code	No. of bits
Technical Code	4 bits
Directional Code	3 bits
Anatomical Code	3 bits
Biological Code	3 bits

A sample coding for pelvic calcification is as shown in Fig. 2.

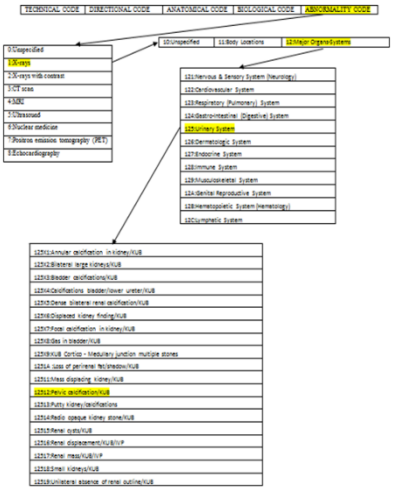

Figure.2. A sample abnormality code classification for Pelvic Calcification

The abnormality code is a 5 bit code which is based on the classification as shown in the Table 4.

Table.4. Formation of Abnormality Code with Explanation of Each Bit

Code	No. of bits
Imaging Modality	1
Location/Organ system	1
Sub system	1
Specific Abnormality	2

The DICOM storage format has image storage as two parts. The first part contains the header which has128 unused bytes followed by the letters ‘D’, ‘I’, ‘C’, ‘M’ followed by a user defined preamble which contains the

information about the images such as patient name, modality of imaging, equipment manufacturers name, referred physicians name, UID, etc. The second part contains the original image. If the image has many slices, then it is stored as a stack. The complete DICOM image with proposed naming convention is shown in the Fig. 3. If this DICOM image is named as per the naming conventions provided in the proposal then we can achieve a universal storage and retrieval method based on the content.

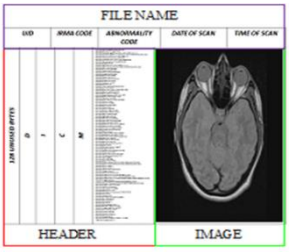

Figure.3. Representation of a DICOM image with the proposed naming conventions

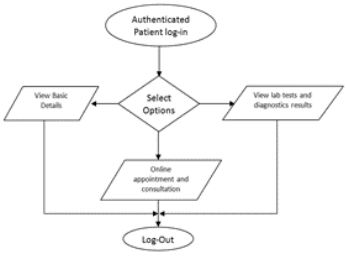

Figure.4. Patient interface with various options.

The patient interface contains the following links as shown in Fig. 4.

Basic View: This link shows the basic medical details of the patient including the recent treatments and test results and link for online appointment and primary screening.

Advanced View: This link includes a generic and advanced patient centric search engine to view specific test results and diagnostic results.

Online appointment and consultation: This link includes options for online appointment fixation with doctors and online consultation and primary screening.

The doctor interface consists of the links as shown in Fig.5.

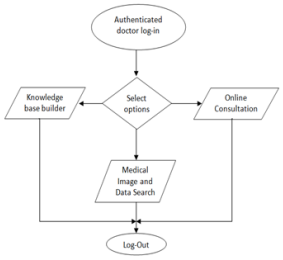

Figure.5. Doctor Interface with various options.

Knowledge base builder: The doctor can build the disease and symptoms and criteria for primary online screening by using this link which is used for primary screening.

Online consultation: It contains the queries received from the patient regarding appointments and less critical medical problems that can be solved by oral or written communication of remedies

Advanced Medical image and data search: The doctor can search the required patient and data information for the grid with basic and advanced search functionalities.

The technician interface consists of a link to upload images of patients combined with, abnormality code, IRMA code, date and time of diagnosis. The image name is unique so that search can be made at ease. The name of the image stored in the database is generated as per Fig. 6.

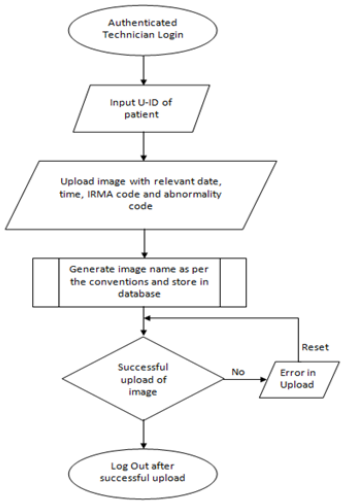

Figure.6. Technician Interface with image naming procedure.

The hospital interface includes links to retrieve patients' medical history and link to upload the in-patient and out-patient medical records after successful treatment. The process flow for a hospital user is as in Fig. 7.

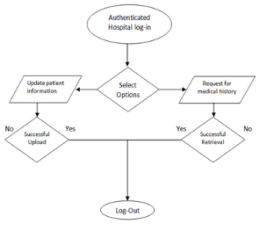

Figure.7. Hospital Interface with various options

The image and data retrieval system for doctors provides the following functionalities as shown in Fig.8.

Basic search: The basic search module incorporates patient images and data search based on patient id, gender etc.

Advanced search: The advanced search module includes more specific searches like abnormality based search, anatomical position based search, technical modality based search, directional code based search, age based search etc.

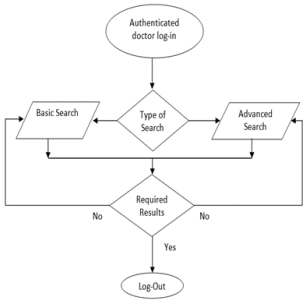

Figure.8. Search interface with basic and advanced search options.

3. RESULTS AND DISCUSSION

The therapeutic picture database frames the foundation of the looking office since it contains tables that contain IRMA codes and variation from the norm codes connected with the relating name in English as appeared in Fig. 9.This database is created using MS access for the sake of easy usage by doctors.

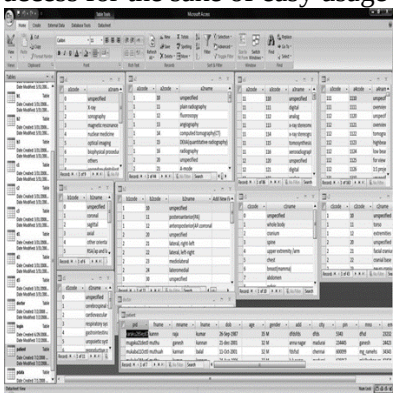

Figure.9. Medical Image Database with separate tables for all the credentials.

The registration page gets all the basic details of the patient from the user for the registration process and stores in the database when submitted successfully and generates a u-id for the patient as shown in Fig. 10.

Figure.10. Patient registration page with required input fields.

The Patient image upload page contains fields to input the patient image along with u-id, irma code, abnormality code, date and time of scan, additional scan details as shown in Fig.11.

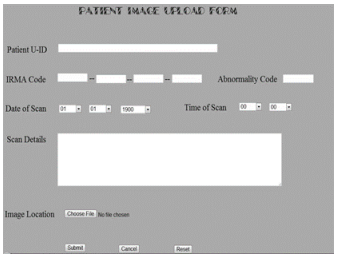

Figure.11. Patient image upload page with required input fields.

Fig.12, shows the page that provides the most important facilities that are required from a doctor's point of view. The doctor can retrieve any image he/she wants just by selecting the query options and then by entering the keywords based on the content. This search is divided into basic search and advanced search depending upon the key words used for search.

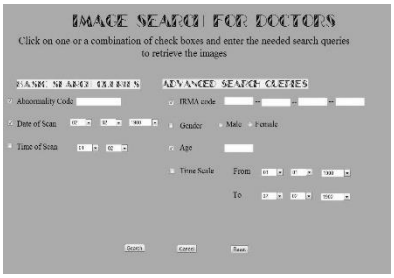

Figure.12. Medical image query page with basic and advanced search options.

The queried image is returned by the server in the format as shown in Fig.13.

Figure.13. Medical image result page with irma search query

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