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Database Management System for a Digitized Medical Image

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Abstract
Medical images are critical component of the healthcare system with great impact on the society's welfare. Traditionally, medical images were stored on films in developing country, but the advances in modern imaging modalities made it possible to store them electronically. Thus, this paper gave and developed a novel framework for storing, retrieving and processing digitized medical images. Digital medical informatics and images are commonly used in hospitals today because of the interrelatedness of the radiology department and other departments, especially the intensive care unit and emergency department, the transmission and sharing of medical images has become a critical issue. This work provides vivid solution to the problem encountered and the difficulties associated with the challenges of large memory utilization attributing to storing patient's medical image information conveniently.
Keyword: Database Management System, Digitized Medical images, Memory utilization

1 Introduction

Traditionally, medical images are being stored on film but the advances in modern imaging modalities made it possible to store them electronically. Thus, there is a need for Database Management System for storing, retrieving and processing the medical images. Nowadays, medical images are generated and stored in large medical Picture Archive and Communication Systems (PACS). Medical images represent enormous amount of information and the electronic resources for processing and for intelligent indexing are in great need. For example, the total amount of storage for medical images produced by the department of radiology at a typical hospital could be in the upwards of 10 Terabytes and memory capacity of the available computer system are very limited hence there is a need to maximized the limited available memory resources to facilitate the storing of Medical images.

Database Management System

A Database Management System (DBMS) is software that controls the creation, maintenance, and the use of a database. It allows organizations to conveniently develop databases for various applications by database administrators (DBAs) and other specialists. It can also be refers to as a programs that enables the storage, modification, manipulation and extraction of information from a database. It allows different user application programs to easily access the same database. Database management systems may use in any variety of database models, such as the network model or relational model. In large systems, a Database management system allows users and other software to store and retrieve data in a structured way. When a Database Management System is used, information systems can be changed more easily as the organization's information requirements change. New categories of data can be added to the database without disruption to the existing system. A Database Management System is a single or set of computer programs that are responsible for creating, editing, deleting and generally maintaining a database or collection of data records. The type of database management system is determined by the database model. A database model is the manner in which the data collection is stored, managed and administered Codd (1970).

Over the years, the dire need for a system to manage patient records in the Hospital has created a lot of problems which the intellectuals in the field have seriously searched for a solution. This actually necessitates the need to produce a management system which accept, store and could update the data of patients in the Hospitals. Mostly, the radiological unit of many hospitals finds their work easier when software's are used to store their patient radiograph images alongside with the data so that easy accessibility could be made. The process of solving these problems was through the use of a database management system.

Medical image data are becoming an increasingly important aspect for effective patient diagnosis. There is an increasing trend of medical images being viewed and stored in digital format as opposed to the traditional film based images. On one side, imaging modalities such as MRI, CT, X-Ray and Ultrasound are technologically evolving and providing enhanced images so that physicians can qualitatively analyze a patient's problem, while on the other end, there is an increasing number in aging population in Nigeria, who demand better healthcare. Imaging procedures at hospitals are increasing at an exponential rate. For example, the number of CT procedures performed alone accounted for over 35 million in 1997 and doubled to 70 million procedures in 2007. Frost & Sullivan predicts that the CT procedures will reach 100 million by 2013. Images play the most important role in human perception. However, unlike humans, who are limited to the visual band of the electromagnetic (EM) spectrum, imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves. Thus, image processing encompasses a wide and varied field of applications Ayache *et. al*, (1996). Medical imaging is a discipline within the medical field which involves the use of technology to take images of the inside of the human body. These images are used in diagnostics, as teaching tools, and in routine healthcare for a variety of conditions. Medical imaging is sometimes referred to as diagnostic imaging, because it is frequently used to help doctors arrive at a diagnosis, and there different types of technology used in medical imaging Rosslyn (2003). Medical images are critical component of the healthcare system with great impact on the society's welfare. Traditionally medical images were stored on film but the advances in modern imaging modalities made it possible to store them electronically. Thus, this research proposes a novel framework for classifying various strategies for storing, retrieving and processing digital medical images.

Manual methods of storing images are inconvenient and not suitable for further automation. In this Paper Database Management System which incorporates the patient data in hospital with their digitized diagnostic images into the database was developed

2. Methodology

The project was implemented in three phases; the conversion phase using Matlab, The database phase using SQL database management system, and the interface result phase using C# programing Language. Figure 1gives the conceptual view of the system developed and figure 2 represents the flowchart of the system.

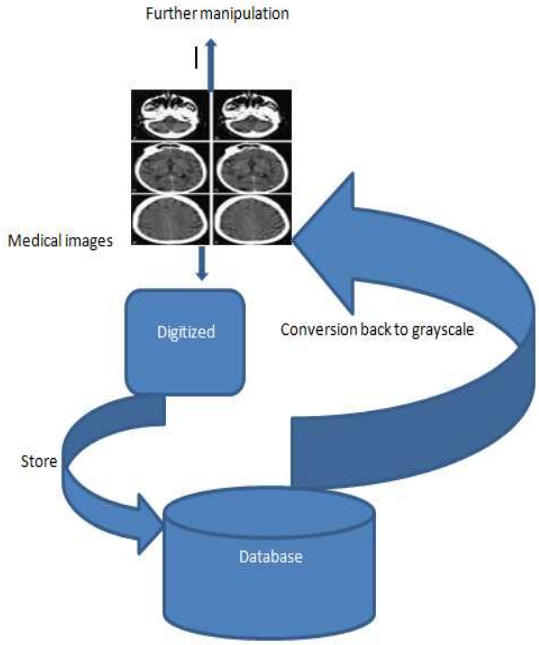

Figure 1: Conceptual view of digitized medical image for Database Management System

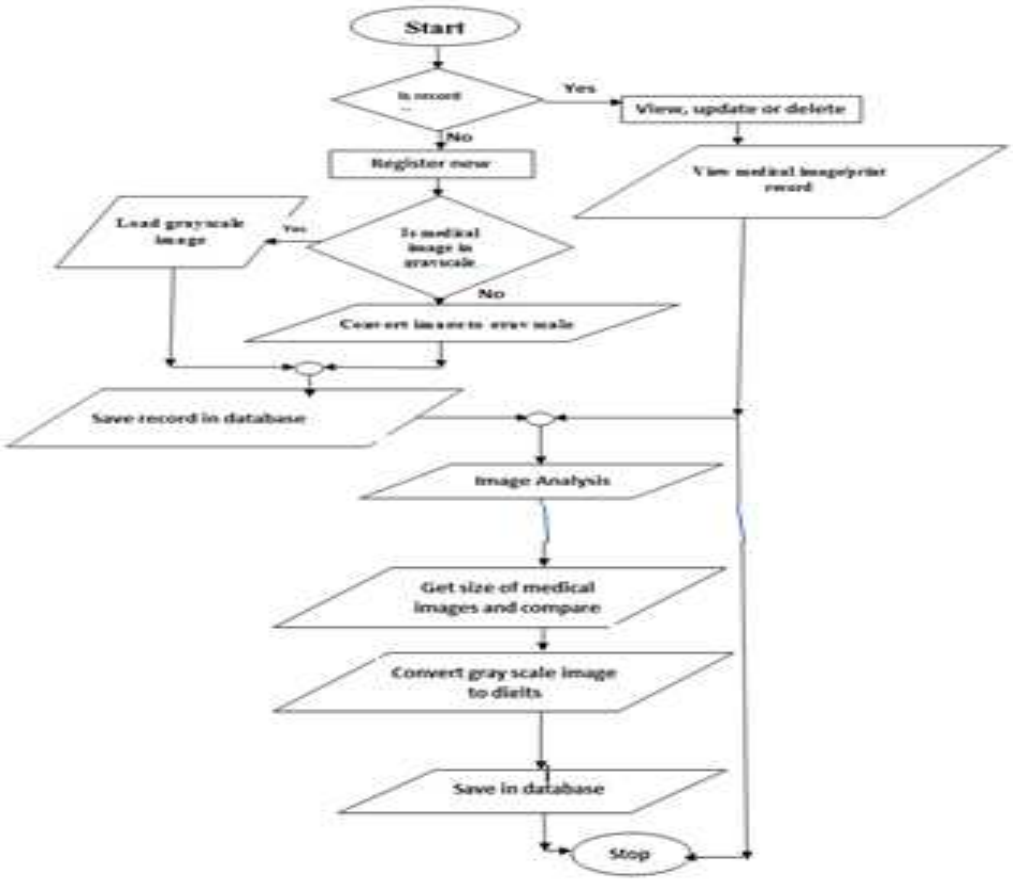

Figure 2: Flowchart of digitized medical image for Database Management System

Algorithm of Database Management System for digitized Medical images

This section describes the step by step instruction of the system developed for Database Management System used for the Digitized Medical images. It also shows the comparison between the real image and a digitized medical image.

Step 1 START
Step 2 IF record present in database
(a) preview record as table or as detailed view
(b) or update record
(c) or Delete record
(d) or print record
(e) or preview patients medical image in a maximized window
(f) or count record in database
(g) GOTO step 5
ELSE GOTO step 3
Step 3 Register new patient
(a) Supply patient's profile
(b) Load patient's photograph
(c) IF med image is in binary, load it ELSE
(d) Convert med image to binary and load it

(e) Save record in database
(f) GOTO step 4 or step 5

Step 4 Image Analysis

a) Load original medical image in full colour
b) IF gray scale equivalent is available , load it ELSE
c) Convert coloured image to gray scale and load it
d) Convert the gray scale image to binary digits
e) Compare the time taken to insert the two images into database
f) Compare the size of the two images in the database
g) Check the quality of the conversion
h) GOTO step 2 or step 5

Step 5 STOP

3 Analysis of Result

User interface

Figure 3 shows the main application window which is the first interface of the application. From here, the application user can navigate to the various part of the application. This window shows the application menus and the medical image panel to the bottom right of the window.

Figure 3: User Interface Design

Figure 4 shows the patient biodata Interface which shows how the patient data will look like showing the patient photograph and the patient medical image. After filling the biodata, press the save button to save the biodata with the picture into the database .To save the medical image into the database press reset button then it will load the medical image into the database. This shows how to search for patient stored in the database by selecting the search field it will also bring the biodata of the selected field

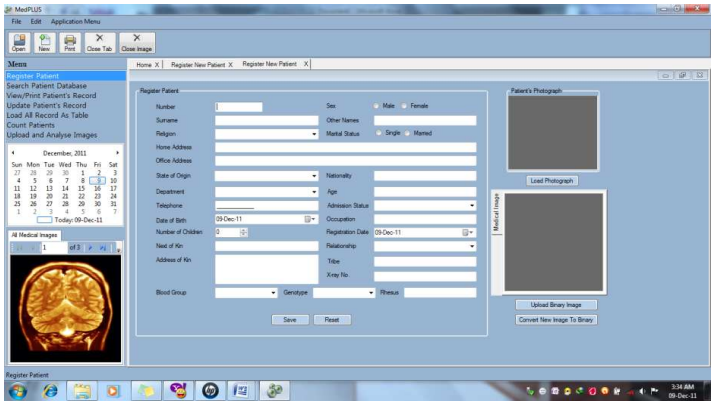

Figure 4: Patient Biodata Interface

Figure 5, 6, and 7 show view of the interfaces for various database operations e.g search operation, update operation and insert operation that can be performed on the database.

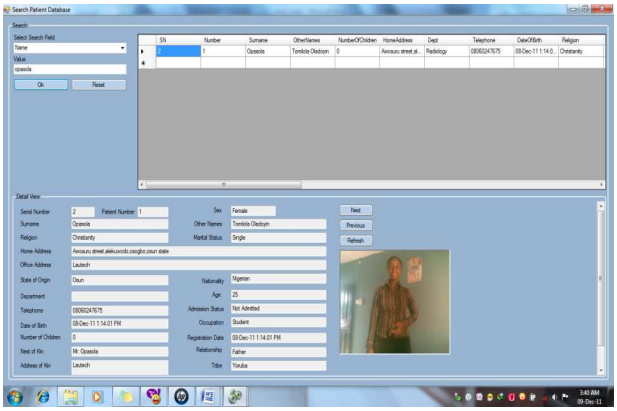

Figure 5: Search engine showing the Biodata of the Patient

Figure 6: Update patient Record

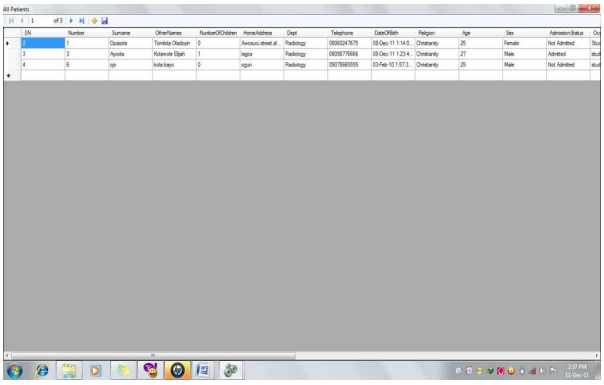

Figure 7: Table view of Record

Digitized Image Analysis

The memory utilization of the medical images and the digitized medical images was calculated. Figure 9 shows the interface for the analysis, Figure 10 shows the processing stage of the binary images and Figure 11 shows the interface that produced the digitized format of the medical images.

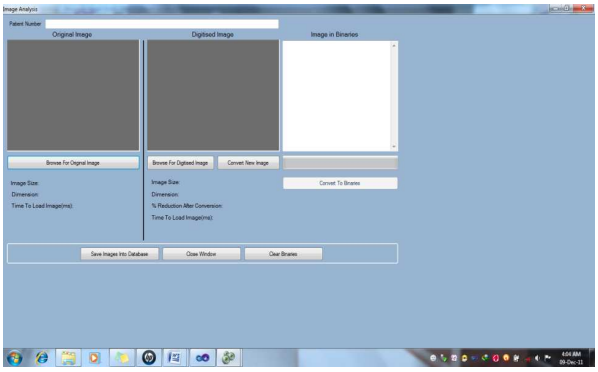

Figure 9: Image Analysis

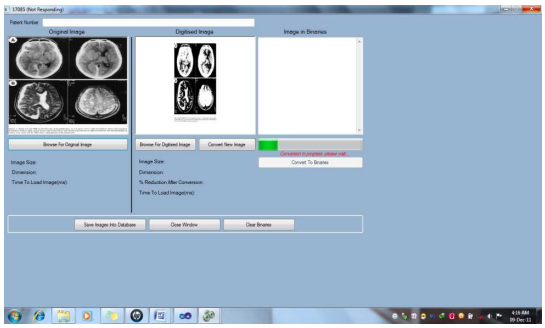

Figure 10: Processing of Binary Image

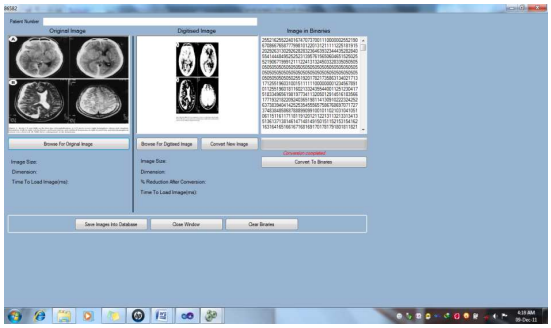

Figure 11: Processed image in Digitized format

Table 1: Result showing Memory utilization and Load time taken for undigitized medical image and Digitized medical image

	Undigitized Medical Image (Human Brain)	***Digitized Medical Image (Human Brain)***
Memory Utilization (kb)	171.08	42.35
*Load Time taken(*μs)	7.004	12.8011

Discussion on the observation of the implemented system

From the result obtained in Table 1 for the implementation of the work; solution has been provided to the problem of large memory utilization attributing to storing patient medical information conveniently. In a nutshell, the system portrayed the requirement expected of digitized medical images; some of which are highlighted below:

i. **Maintain links to data.** The database management system is responsible for establishing a physical connection to the data in the database. Users can be on another computer, in another building or even in another country. As long as the connection is maintained, the database can be manipulated from any location.

ii. **Manage access to data.** The database management system must control the flow of data to ensure that records are not accidentally garbled. Limiting access to a record to one user at a time is a key requirement. Tracking changes to data records (called transactions) is important in the case of an error or system crash. A database management system provides the ability to undo or "rollback" incomplete or erroneous transactions.

iii. **Maintain data access security.** A database management system can limit user access to data. The system can prevent unauthorized access as well as limiting the type of access users may have.

iv. **Small Memory Utilization**. To provide solution to the problem of large memory utilization attributing to storing patient medical information conveniently.

4. Conclusion

From the result gotten, it was deduced that the size of the memory utilized for storing digitized image was reduced compared to the size of memory utilized for the real medical image. The memory utilization of the undigitized image is 171.08KB with Dimension of 973*1128 for each image and the time to load the original image is 7.004μs while the memory utilization of the digitized image was 42.35KB with Dimension of 488*462 of each image and the time it takes to load the image is 12.8011 μs. Therefore, the percentage reduction after conversion is 75.25% which is the main challenges addressed by this paper.

5. References

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