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IMPROVED PICTURE ARCHIVING AND COMMUNICATION MODEL FOR MEDICAL IMAGE MANAGEMENT

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Abstract: Picture Archiving and Communication Systems (PACS) is a technology employed in collection, storage, processing and retrieval of medical imaging data within the medical world like hospitals and medical diagnostic facilities across separate geographic locations. PACS breaks down the physical and time barriers associated with traditional film-based image retrieval, distribution and display. Added features may include compression of the captured images: without losing its functionality and hence enhance speed of transfer and time of communication, reduced storage space and memory usage. This feature is observed to be absent in the present model and implementation of picture archiving and communication system. Furthermore, images are store away with little description of the features and observation of practitioners on the image so stored; this has made PACS very limited in its uses in telediagnosis and distance teaching (education) of young radiologist. With the identified limitations with the existing model of PACS, an improved model for PACS was developed. This work developed an improved model for PACS with the incorporation of new features into the existing model. Its objectives were achieved implementing multimedia PACS; a reduction in transmission time and storage space requirements of radiological images was noticeable when compared with the existing model of PACS.

Keywords: medical images; teleradiology; Computed Tomography (CT); telediagnosis; work stations

INTRODUCTION

Picture Archiving and Communications System, abbreviated as PACS, enables medical images from imaging modalities such as x-rays and scans to be stored electronically and viewed on screens, so that medical practitioners and other health professionals can access the information. In th past, film has been almost the only medium for capturing, storing, and displaying radiological images. Film is a fixed medium with usually only one set of images available.

Electronic images and reports are transmitted digitally via PACS; this eliminates the need to manually file, retrieve or transport film jackets (Wagner, Morrison, Carrino, Schweitzer and Nothnagel, 2002). The medical images are stored in independent formats such as AVI, portable document file (PDF) and DICOM. The most common format for image storage is DICOM (Digital Imaging and Communications in Medicine).

In the past, film has been almost the only medium for capturing, storing, and displaying radiological images. Film is a fixed medium with usually only one set of images available. A PACS consists of four major components: the imaging modalities such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), a secured network for the transmission of patient information, workstations for interpreting and reviewing images, and long and short term archives for the storage and retrieval of images and reports.

BACKGROUND

The principles of PACS were first discussed at meetings of radiologists in 1982. Various people are credited with the coinage of the term PACS. Cardiovascular radiologist Dr Andre Duerinckx reported in 1983 that he had first used the term in 1981. Dr Samuel Dwyer, though, credits Dr Judith M. Prewitt for introducing the term. Dr Harold Glass, a medical physicist working in London in the early 1990s secured UK Government funding and managed the project over many years which transformed Hammersmith Hospital in London as the first filmless hospital in the United Kingdom. Dr Glass died a few months after the project came live but is credited with being one of the pioneers of PACS (Bauman, Gell and Dwyer, 1996).

METHODOLOGY

— Architecture

Essentially, a PACS network consists of a central server which stores a database containing the images as shown in figure 1. This server is connected to one or more clients via a LAN or a WAN that provide or utilize the images. Web-based PACS is becoming more and more common: these systems utilize the Internet as their means of communication (Taira, Breant, Chan, Huang, and Valentino, 1996).

The software (thin or smart client) is loaded via ActiveX, Java, or .NET Framework. PACS workstations offer means of manipulating the images (crop, rotate, zoom, brightness, contrast and others). Modern radiology equipment, modalities, feed patient images directly to the PACS in digital form. For backwards compatibility, most hospital imaging departments and radiology practices employ a film digitizer.

The medical images are stored in an independent format. The most common format for image storage is DICOM (Rosslyn, 2001). (Digital Imaging and Communications in Medicine), a NEMA standard (Hori, 1996). As shown in the figure below, we have a central database which stores the images for a short or long time as the case may be, the database is populated by

different imaging modalities through the database gate way and acquisition gateway, the flow of data is controlled by the PACS controller and archive server, the users or client can then log on to use the stored images and data for the purpose of research or consultation or teaching of students as the case may be. This is achieved via a webserver and application software installed for such purposes.

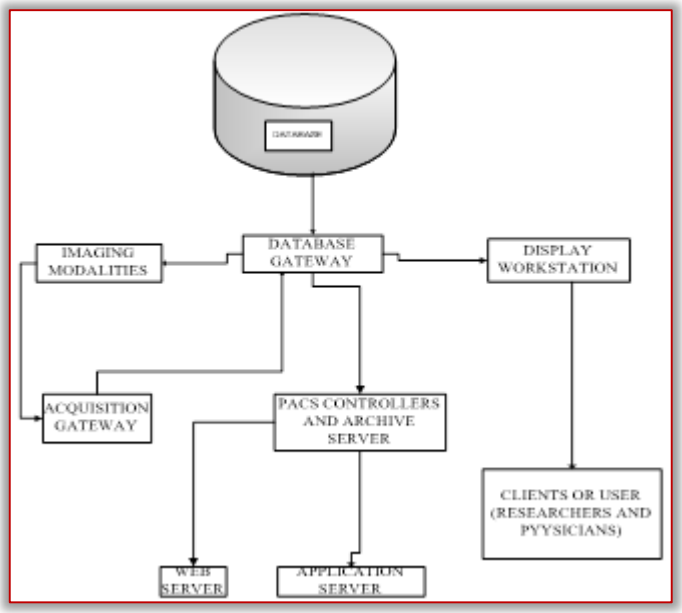

Figure 1: Basic Architecture of a PACS (Rosslyn, 2001)

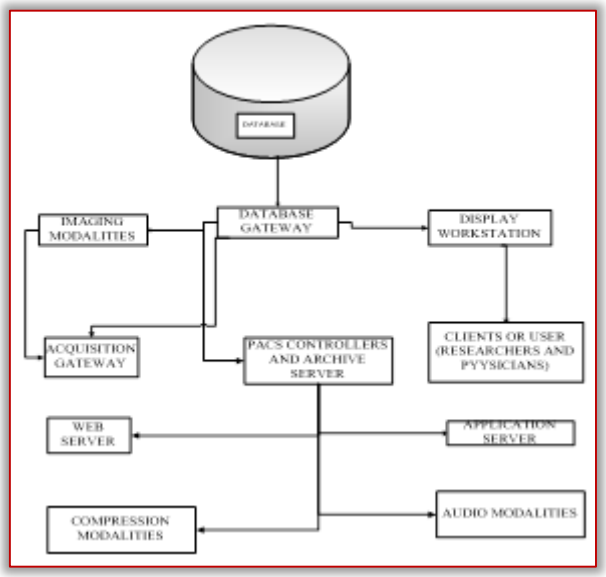

Figure 2: Proposed research framework

— Model Formulation

An evaluation of the model of the PACS led to the development of a robust model. An improved model was proposed and implemented to verify the assumptions acquired from the analysis of the scheme. During this stage, a further comparison of existing schemes and their architectures, and the new proposed solution were compared to extract similarity on the design and the improvement by this work. Analysis of selected cases was achieved from intensive study of related cases or examples of past activities.

WORKINGS OF THE PROPOSED MODEL

The physical layout of PACS as shown in figure 3 is the physical representation of how several modalities interacts to form the Picture Archiving and Communication System. The input modality comprises of the scanners, digitizers, CT scan, MIR scan and other means of capturing images. The images are captured from any of the clients or server and are stored on a dedicated database. Any user at a remote area can have access to these images wirelessly.

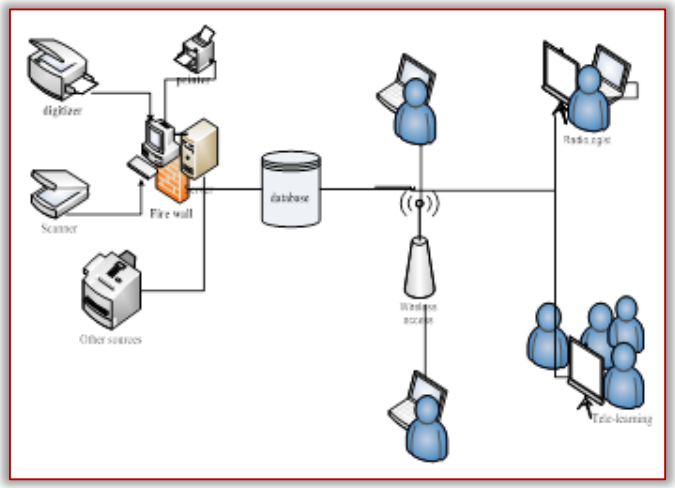

Figure 3: Physical layout of PACS (Alamu. 2011)

The conceptual frame work of PACS depicts the abstraction of the whole interaction of individual component of PACS as shown in figure 4. Abstraction is the ability of a researcher to bring to light what he thinks in his mind to tangible representation. In figure 4, all the modalities are grouped into sections like the, imaging modalities which includes the CT, MIR and Ultra Sound scanning machines, remote hospital which is made up of the local server, local client and gadgets for effective communication, central image archives which serves as a coordinating points for all the entry and exit of images in to the PACS. It contains the storage server clusters and routers to send images to the correct locations. Another section is the Image display and hard copy printing, this serves to display the images so stored on the database, and on extreme situation a print of the image may be ordered. All these functional parts and their communication is depicted in Figure 4.

The flow of work in the Picture Archiving and Communication System is depicted in figure 5, the imaging modalities are used for capturing the images and are stored in the database of PACS, the doctors and radiologist input their comment on the image and diagnosis is done based on the comment of the medical practitioners. If the image captured is to be frequently used (i.e. by an unstable patient that is it is frequently used for consultation), then the image is stored in a nearline storage device else it is stored permanently. From the nearline storage, the images can be used for referrals or

for teaching purposes during ward round, the referrals are done on a secured network.

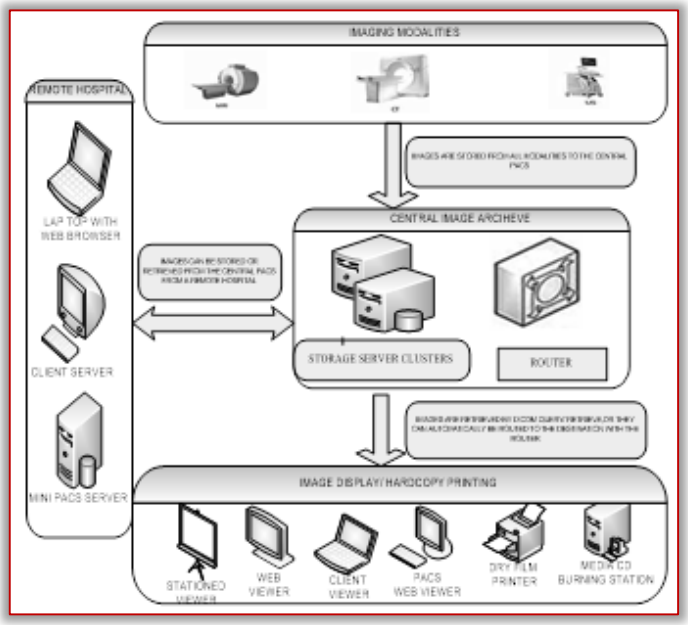

Figure 4: Conceptual frame work of PACS

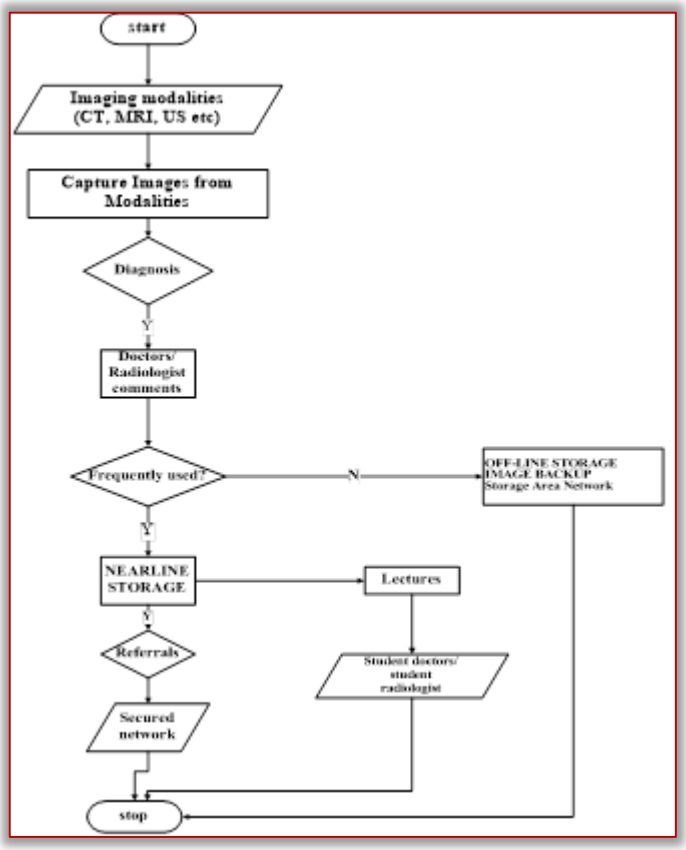

Figure 5: Flow chart of the operation of PACS

CONCLUSIONS

Picture archiving and communication systems (PACS) are responsible for solving the problem of acquiring, transmitting, and displaying radiologic images. The major benefit of PACS resides in its ability to communicate images and reports to referring physicians in a timely and reliable fashion.

The technical evolution toward more integrated systems and the shift toward Web-based technology are rapidly merging the two concepts of PACS and teleradiology in global image management and communication systems. PACS has been of tremendous help by helping to show patients their radiology images, by reducing the time spent finding images for review, by reducing the time spent finding radiology reports, by making consultations more time efficient. For clinicians whose practice is heavily dependent on radiology images, such as orthopedic surgeons and respiratory physicians, the advent of MPACS has made a substantial difference to the conduct of their clinics. PACS has made tremendous changes on the conduct of ward rounds.

References

[1] Alamu F. O. (2011). Development of a Robust Model for Picture Archiving and Communication System (M. Tech Thesis)," Submitted to Department of Computer Science and Engineering, Faculty of Engineering and Technology, Ladoke Akintola University of Technology Ogbomoso, Nigeria.

[2] Bauman R.A, Gell G, & Dwyer S.J. (1996). Large picture archiving and communication systems of the world Part 2. J Digit Imaging, 9, 172–7.

[3] Hori S.C., (1996), Image acquisition," Sites, technologies, and approaches". Radiol Clin North Am. 34, 469–94.

[4] Rosslyn (2001), "Digital Imaging and Communications in Medicine (DICOM)," National Electrical Manufacturers Association, PS 3.1-2001, pp iii–iv, 4–12.

[5] Taira R.K., Breant C.M., Chan H.M., Huang L., & Valentino D.J., (1996). Architectural design and tools to support the transparent access to hospital information systems, radiology information systems, and picture archiving and communication systems. J Digit Imaging, 9, 1-10.

[6] Wagner S.C., Morrison W.B., Carrino J.A., Schweitzer M.E. & Nothnagel H (2002). Picture archiving and communication system: Effect on reporting of incidental findings. Radiology, 225, 500–5.

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