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IMPLEMENTATION OF THE MODERN PACS SYSTEM AT THE INSTITUTE OF ONCOLOGY AND RADIOLOGY OF SERBIA

UVOĐENJE SAVREMENOG PACS SISTEMA U INSTITUTU ZA ONKOLOGIJU I RADIOLOGIJU SRBIJE

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Ključne reči
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Abstract
Communication systems based on existing DICOM (Digital Imaging and Communications in Medicine) servers at the Institute of Oncology and Radiology of Serbia were not able to follow the growing challenges and demands of the Institute. The introduction of modern solution of PACS (Picture Archiving and Communication System) was found necessary. With a view to resolving problems and increasing demands, the company Data Control offered their PACS solution. ASTREOS PACS server system represents dedicated software and hardware solutions for archiving, searching, analyzing and routing medical images. The main role of ASTREOS PACS system is to assure centralized archive for all medical images. System also represents connecting point for all diagnostic machines and devices. Thanks to the integrated HL7 (Health Level seven) server ASTREOS PACS system can be used for connection to the other hospital and radiological information systems. This system also facilitates telemedical services between Institute of Oncology and Radiology of Serbia and the other health care institutions. The main objective of introducing the system is to reduce unnecessary costs in health care service, especially in filming.

1. INTRODUCTION

Modern medical diagnosis can not be imagined without the use of computers in acquisition and processing of images. IT technologies have led to several revolutions in this field, and they also enabled early and simply diagnostics and therapy. Progress has led to the development of new modalities for treatment and storage of huge amounts of records and data obtained by new generation devices[1].

Institute of Oncology and Radiology of Serbia is tertiary level health care institution which performs highly specialized, specialist-consultative and stationary health activities in the field of oncology and radiology. One of the main tasks of the institute is to become actively involved in raising awareness about the importance of oncology and in the fight against cancer. Institute boasts a range of diagnostic and therapeutic equipment of different manufacturers as are General Electric (CT simulator), Siemens (CT, MR), Nucletron, Varian and Elekta accelerators[2]

Institute also has a few DICOM servers, but they are insufficient because of an increasing number of patients and additional requirements for analyzing and processing. It was necessary to introduce a powerful PACS (Picture Archiving and Communication System) solution that will be able to respond to the challenges and demands of the Institute. Company Data Control implemented ASTREOS PACS server system that aims to solve these problems.

A Picture Archiving and Communication System provides for storing and retrieving, viewing, communication and managing of medical digital images and related information, such as patient demographic information, diagnostic reports or clinical history [3]

2. MATERIAL AND METHODS

ASTREOS PACS server system is a modular software and hardware solution for archiving, searching, analyzing and routing medical images. ASTREOS PACS archives medical images with all kinds of modalities: ultrasound, CT, MRI, PET scanner, mammography, digital x-ray.

Also, ASTREOS PACS supports both types of images from angiography, nuclear medicine, endoscopy, and radiotherapy. All the images are transferred and stored in the DICOM standard or format. The Digital Imaging and Communications in Medicine (DICOM) standard is widely adopted standard for medical image and data handling. It is designed to ensure the interoperability of systems used to produce, store, display, process, send, retrieve, query and/or print the medical images and derived structured documents in a standardized way, independent from the equipment manufacturer, as well as to manage related workflow [3].

ASTREOS PACS has the support and connection with hospital information system, and thus represents a connection point for all medical information in one place.

2.1. ASTREOS PACS software system components

2.1.1. Hardware components

Basis of ASTREOS PACS server system is composed of specially selected (custom-made) of sophisticated components, which are organized into several levels. ASTREOS PACS consists of four servers: DICOM Gateway, Kaspersky Antivirus server and two DICOM server clusters.

Figure 1.

DICOM gateway server, is intended to partial segments of the PACS network, and serves as a safety link for secure transfer of images to DICOM archive server cluster. Images from specific network segments come first on the DICOM Gateway server, which scans all the pictures for viruses, and after completing the scan, automatically transfers the image on the cluster servers which are permanently stored. After a certain time images from DICOM Gateway server is automatically deleted.

More than 50 workstations are controlled by Kaspersky antivirus server. All workstations at the Institute are connected to the Kaspersky server, which has a role to perform automatic updates of the workstations and to scan for viruses. In this way we secured the safe operation of all workstation and provided the latest antivirus definitions update for all workstations. The last levels of ASTREOS PACS server system are two DICOM archive server clusters. Archival cluster servers are connected to dual redundant cluster configuration, where in case of failure of one of them, the system automatically continues to run smoothly. It is also provided the triple bond of 3 Gbit / s throughput, which further ensures a safe and rapid response of the system. The servers are connected in RAID0 (mirroring) and RAID6 array, which allows cancellation up to two drives simultaneously. When two disk failures, the system continues to operate without interruption. In the server system it was implemented WDT (Watch Dog Timer) system, which provides independent control of safety systems following the failures of archive cluster servers and assure replacement of the server in the event of abnormal operation. The complete system has a continuous power supply, with the necessary autonomy to avoid the violent fire, and damage to the system and automatically start the entire system of power upon its return. It was also introduced ALIX iBox firewall / VPN router wich provides telemedicine service though SSH connections .

Figure 2

2.1.2. Software components

System software is based on open code software, used by a the well known medical institutions, including universities in Washington, Maryland, St. Lewis, Leipzig and others. Software support is based on the Linux operating system Centos 5.5 and provides development support in one of the strongest open source community to develop DICOM software solutions. ASTREOS PACS system also has a DICOM Viewer, which allows doctors to access and view archived medical images. DICOM Viewer, provides the tools for contrast, measuring, zoom images, read DICOM headers (DICOM tags within the image) and DICOM CINE Mode. CINE Mode allows fusion of the picture frames in video film. For example, a CT study that includes approximately 500 images, may be released as a movie, and thus allows the doctor to have better access to the recordings, and thus can make better and better professional decisions.

Figure 3

2.1.3. Web based solution

The great advantage of this system is that the software is web based. Software and DICOM Viewer are the Web-based Application solutions that make the doctors easier operation. In addition there is an advantage in savings. Client workstations do not require additional software installation, so the Web browser (eg Internet Explorer, Mozilla Firefox ...) is sufficient and thus avoids the installation and purchase licenses for each workstation. Also, to analyze the medical records do not need expensive client computers, because the Web browser is the only tool needed for doctors. Doctors use a Web browser to access PACS to analyze the patients who are on the server.

ASTREOS PACS server system includes the following features:

- DICOM Storage – activation of all types of DICOM objects
- DICOM Query&Retrieve - Query the archive for DICOM objects, and retrieve them.
- WADO and RID - Web access to the archived content.
- MPPS, GPWL, MWL working lists
- HL7 server - an integrated HL7 server
- IHE Services
- XDS Services
- Log auditing
- Integrated DICOM Viewer
- Support for CD/DVD archiving
- DICOM Routing

2.2. ASTREOS PACS in telemedicine

Introduction of ASTREOS PACS server system also enable the support for telemedicine services. The system protected by security and VPN connection, provides a direct connection to any remote health institutions in Serbia and abroad. This kind of communication can contribute to quality health care for patients.

3. BENEFITS OF ASTREOS PACS SERVER SYSTEM

Introduction of ASTREOS PACS server system provides the powerful and modern DICOM server system (cluster), high processing power, storage capacity, high resistance to failure, with a high degree of data protection (computer cluster, a hardware watch-dog timer, hot swap drives, redundant communication, continuous power supply, virus protection, access control - tunneling ...) that provides easier management of traffic in radiological network. Modern features DICOM server with support for HL7 family of protocols are also provided, allowing the exchange and processing of medical data from hospital, radiology, laboratory and other information systems. There is a quick interaction and interoperability among existing DICOM server. Thanks to the new system also were improved and the capacity to store images, and solved the problem of long-term archiving of images. The most significant benefit of introducing ASTREOS PACS system is the savings, which is reflected in several segments, especially in saving a set of filming. Using PACS solutions, reduces the need for filming, because all the images and patient data are electronically in the system. Nevertheless, in the day-to-day radiology workflow, film is becoming increasingly rare; this was the sole purpose of the PACS revolution. Digital media are far more DICOM-compatible than film. CDs, DVDs, and flash drives offer more compact storage with more options to implement security as well. It's not surprising, therefore, to see why many hospitals and healthcare organizations now require using CD/DVD image exchange instead of films [4].

For the three months of use ASTREOS PACS system at the Institute for Oncology and Radiology of Serbia, has archived over 1000 patients, 2000 Study and 40,000 images

4. CONCLUSIONS

ASTREOS PACS server system provides and complies internationally accepted standards of DICOM and HL7, and as such represents a functional and standardized solution for any healthcare institution. Thanks to Web-oriented architecture, it provides easy manipulation of images as well as facilitate system administration. It also brings big savings on client workstations, because additional installation and licensing of software are not needed . Providing telemedicine services, ASTREOS PACS brings our ability to communicate with foreign experts, and those in rural areas. Simply, ASTREOS PACS, and a favorable long-term investment in public health institutions or in private.

Apstrakt

Komunikacioni sistemi bazirani na postojećim DICOM (Digital Imaging and Communications in Medicine) serverima u Institutu za Onkologiju i Radiologiju Srbije, nisu bili u stanju da prate sve veće izazove i zahteve Instituta, i bilo je potrebno uvesti novo i savremeno PACS (Picture Archiving and Communication System) rešenje. U cilju reševanja problema i sve većih zahteva, kompanija Data Control ponudila je svoje PACS rešenje.

ASTREOS PACS serverski sistem, predstavlja namensko softversko i hardversko rešenje za arhiviranje, pretraživanje, analiziranje i rutiranje medicinskih slika. Glavna uloga ASTREOS PACS sistema je da obezbedi centralizovanu arhivu svih medicinskih slika. Sistem predstavlja tačku povezivanja svih dijagnostičkih uređaja na jednom mestu. Zahvaljujući integrisanom HL7 (Health Level Seven) serveru, ASTREOS PACS sistem, može da se koristi za povezivanje sa bolničkim, radiološkim i drugim informacionim sistemima. Takođe, sistem obezbeđuje i telemedicinske servise, tako da je moguće povezivanje Instituta za Onkologiju i Radiologiju Srbije sa drugim zdravstvenim institucijama. Cilj uvođenja PACS sistema, treba da vodi ka smanjenju svih nepotrebnih troškova u zdravstvenim institucijama, pogotovo u filmovanju.

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