# E-Health

# Lab 1: PACS & Visualization


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## 1. Introduction

PACS (Picture archiving and communication system) is a medical imaging technology used in healthcare organizations to securely store and digitally transmit electronic images and clinically-relevant reports [1]. So, in simple words PACS can be defied as image display, data archiving and data management components.Fig.1 shown a typical structure of PACS Servers and workstations.

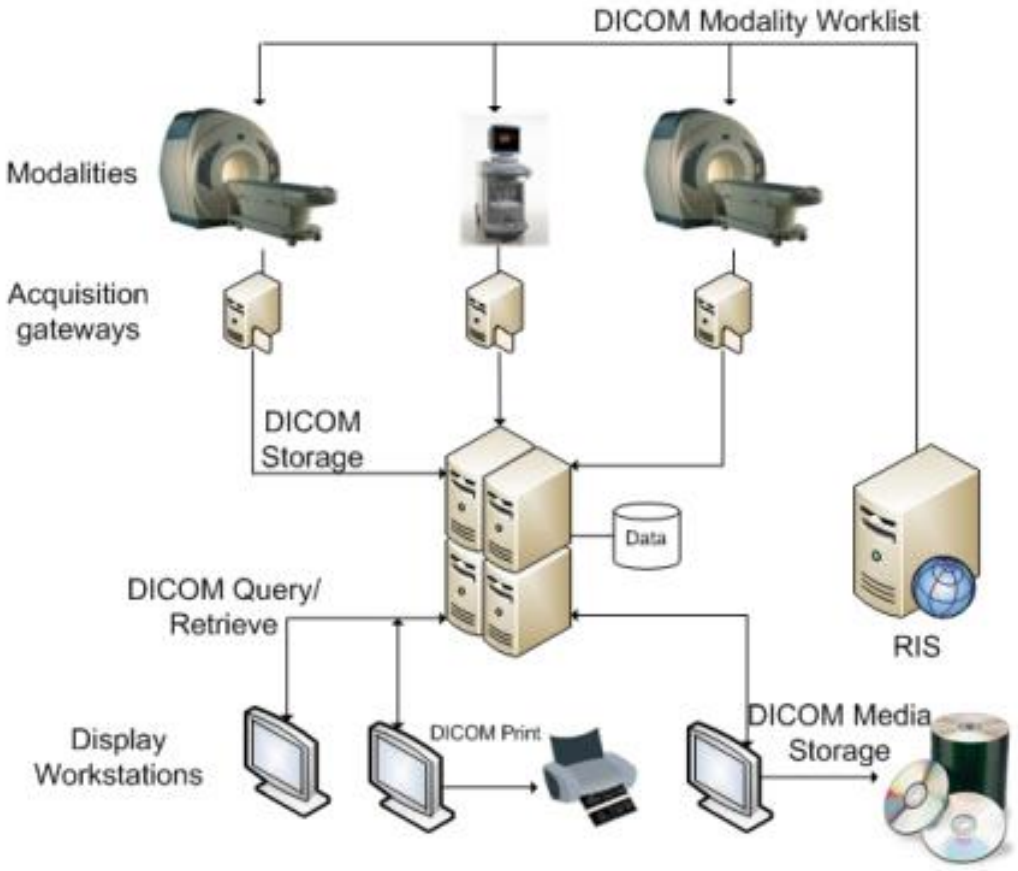



Fig.1: PACS servers and Workstations [1].

Through this lab our aim to get introduced with the PACS servers and accomplished the following goals shown below using two publicly available free software called Orthanc (Free PACS Server) and Ginkgo CADx (data viewer)

**Objectives:**

I. To understand the components of PACS Servers.
II. Install and connect a PACS system using Orthanc free PACS server.
III. C-Echo: Set connecting between two devices using Orthanc PACS servers.
IV. C-Store: Send Images from one device to another device using Orthanc PACS servers.
V. C-Find: Search for data using Orthanc PACS servers from the other device
VI. C-Move: Retrieve desired data from the other device (remote device)

## 2. Experimental Setup

To perform the tasks of this lab two software called and two computer devises were need. The experimental setup and the configuration of the devises shown below.

I. Orthanc: Free PACS Server. Version: Win64-17.7.0.
II. Ginkgo CADX: Visualization tool. Version: 3.7.1.1572.41 32 bits
III. Device-1: Windows10, Core-i5.
IV. Device-2: Windows10, Core-i5.

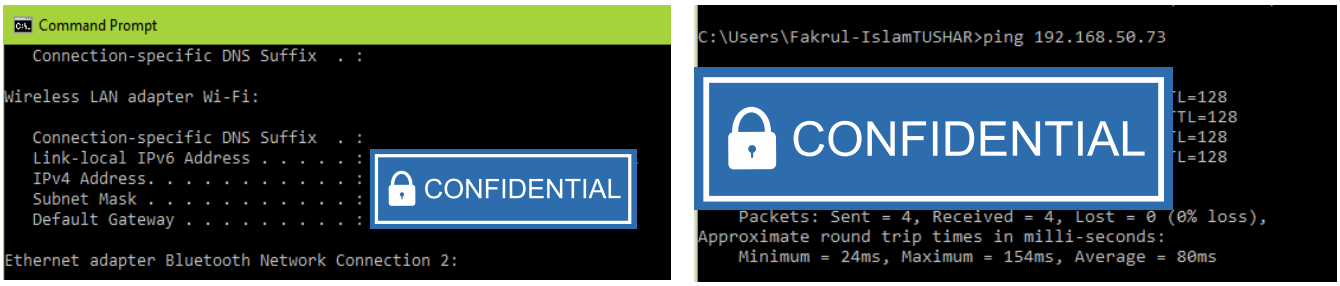
## 3. Experimental procedure

### 3.1 C-Echo step

In this step we need to test the connectivity between two devices using the Orthanc free PACS server to do thing we need go through following steps and perform few edits in the "Orthanc.json" file in Orthanc server.

I. Open Command Prompt of windows in both the devices and write "ipconfig" to get the IPv4 address for both the devices.
   - ❖ Device-1 IP Address: CONFIDENTIAL
   - ❖ Device-2 IP Address:

II. Afterward to check the IP address are correct or not we used to "ping 192.168.50.89" in Command Prompt seeing the connectivity is ok.



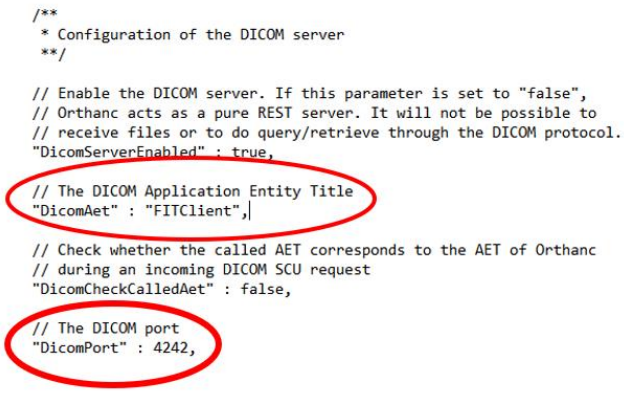

a) IP address b) Checking connecting

Fig.2: Getting IP address.

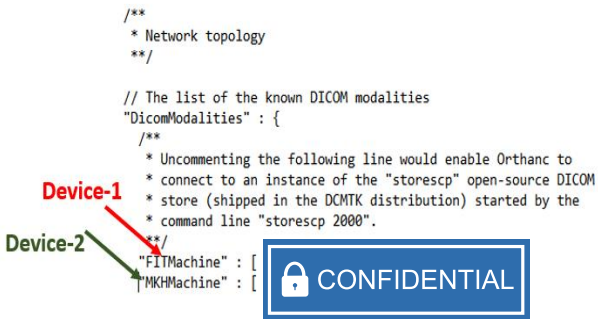
III. Now "Orthanc.json" need to edit to connect the two devices using Orthanc PACS server. Destination folder: "**C:\Program Files\Orthanc Server\Configuration**"
IV. Three things we need to edit in "**Orthanc.json**" file. In Section "Configuration of the DICOM server" 2 edits and 3rd edit in "**Network topology**" section

**1st edit:** Application Entity Title (AET) need to be edited which will be the unique device ID. **For device-1 we set AET "FITClient" and for device-2 "MKHServer".**

**2nd edit:** We need to define the Port through which Orthanc server will communicate, it's been kept default **4242.** Fig.3(a) shown the above two edits.




a) 1st edit and 2nd edit.




b) 3rd edit.

Fig.3: Edit in "**Orthanc.json**" file for **C-Echo.**

**3rd edit:** In **"DicomModalities**" part both devices AET, IP Address and Port number need to be added. Which a device name (it doesn't matter, you can give any name.). Fig.3(b) shown the performed edit.

The edited file was saved and the Orthanc was restarted from the service manager of the windows.

V. Than the application "Open Orthanc Explorer" was open. That direct to the Orthanc server. The server name for the second device was set and using the Test-Echo the connection was tasted. Fig. 4 shown the process.

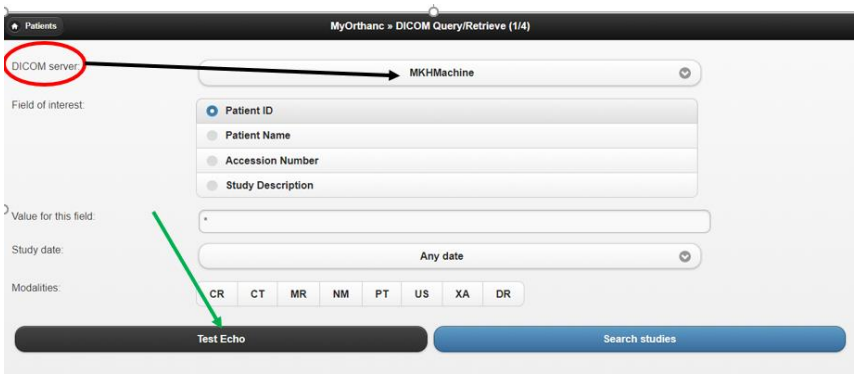


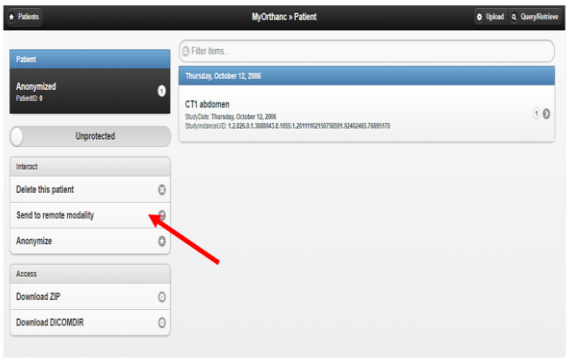

Fig.4: Shown the C-Echo Step.

### 3.2 C-Store:

In this step the data need to be upload in PACS server and send it to remote server.

I. Using the "**Upload" button on Orthanc PACS server of device-1 select all the dicom slices of the given "CT1 abdomen" data was drag and drop.**
II. Press **"Start the upload" will start the uploading.**
III. When the uploading is done it will show done.

IV. When the data is upload, in “Patient” we can get the uploaded data. Then from **“Send to remote modality”** the device-2 called “**MKHServer**” is selected and when the sending is done, device-2 got the data in the patient section as well.



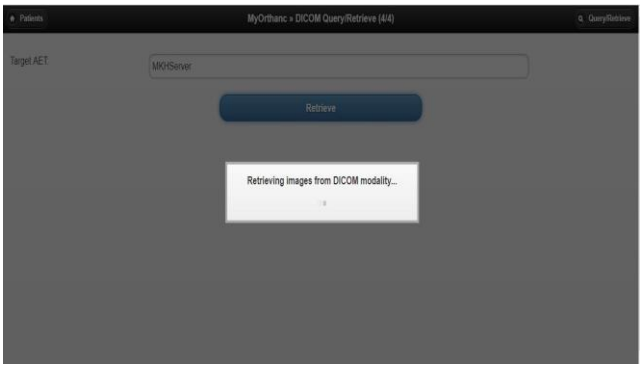




Fig.5: Sending data to remote device using Orthanc PACS server.

### 3.3 C-Find:

In this step using the Orthanc PACS server desired data can be searched in the remove device.

I. In this step, first we need to open the **Orthanc Explorer**. Go to **MyOrthanc » DICOM Query/Retrieve (1/4).** Need to select the name of Desired remote device in the **“DICOM server”.**

II. In our case, we are using now the Device-2 for run the query of the data and use device-1 (**FITMachine**) as remove device. For this we used a different dicom files which has the Patient name “**CTAKHQ**” we also used the “**CT1 abdomen**” data.

III. Field of interest was set to “**Patient Name**” and name of the patient was put on the “**Value for the field**” section.

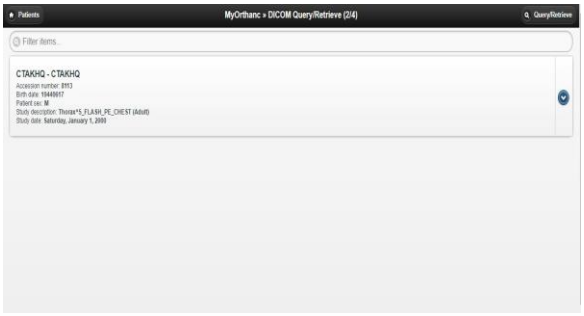
IV. Modalities was selected “CT” (as our data is CT)

V. “**Search studies**” Executed. Afterward the desired data is shown In MyOrthanc. Shown on Fig.6(b).

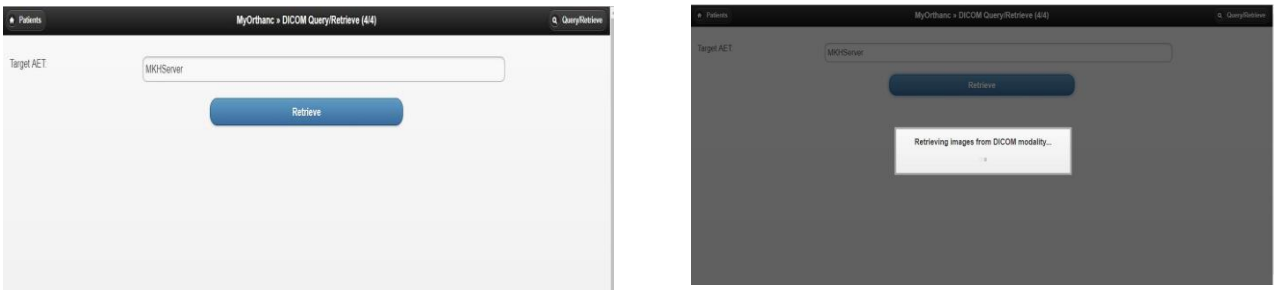
### 3.4 C-Move

**This step is a continuation of C-Find.**

VI. Click on the data (continuation of the C-Find). Put the name of **Target AET** as the target remote server where want to save. In our case, device-2 (MKHServer) was selected. “**Retrieve”** was pressed. The data was saved in the target server.

a) b)



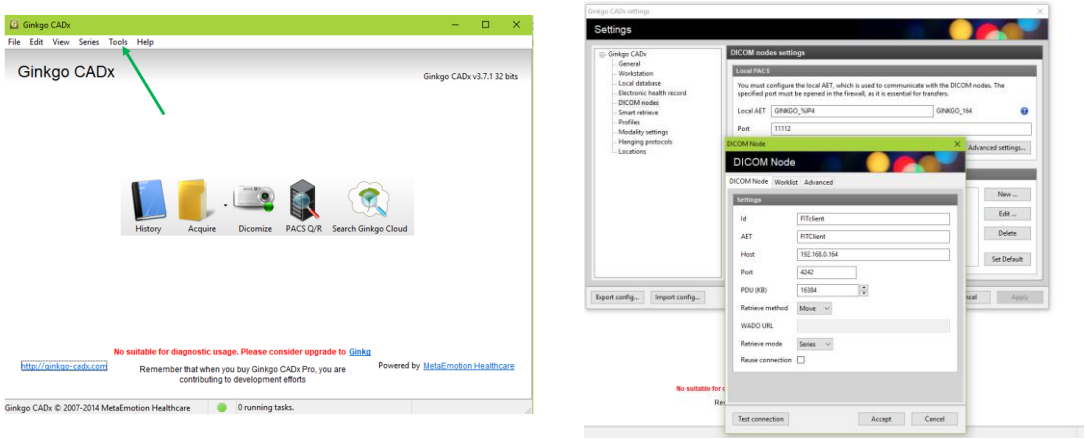

c) d)

Fig.6: Data retrieving from remote device.

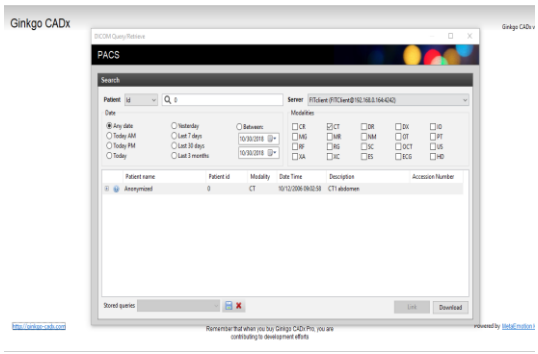
### 3.5 Visualization and Measurements:

For visualization Ginkgo CADx was used. Ginkgo CADx also has Dicom server configuration. To visualize using the Ginkgo CADx Following steps need to be performed.

I. This part is been done using a different Wi-Fi connection.
II. So, IP Address is been found out using the steps mentioned earlier.
III. New IP address is 192.168.0.163. the device-1 is been used for this part.
IV. Then open **Ginkgo CADx Application. Press on Tools.**
V. Under "Dicom Nodes" add new server was selected. The device-1 AET, IP and Port was added.
VI. After that we had to edit the "**Orthanc.json**" file. In Section "**Network topology**" section the Ginkgo's Local AET, IP address and Port number added. Shown in Fig.7 (b)
VII. Then we can search and retrieve the data from the PACS QR. Server was set as "FITClient", Patient id was set 0 and search was executed (Shown in Fig.7 (c)). Then the data was download.
VIII. When the data was downloaded the data was opened, shown in Fig.7 (d)




a) b)




c)

d)

Fig.7: Visualization of data using Ginkgo CADx.

Now, after visualization the next step was to measure the major axes of vertebrae and rid, additionally realization of these measurement in terms of pixel size and number of pixels.

Using the rule option of the Ginkgo CADx visualizer the major axes of the of vertebrae and rids were measured. Shown in Fig.8.

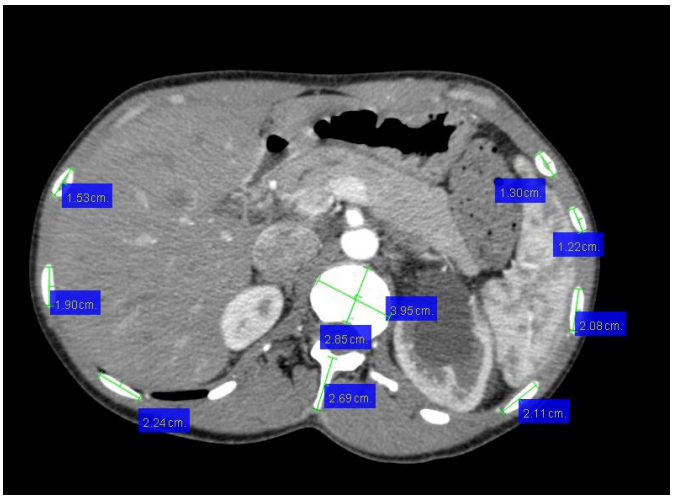



Fig.8: Measurement of the major axes of the of vertebrae and rids.

To relate this measurement which is in Centimeter (cm) with the pixel size and number of pixels we need to find out the pixel spacing of the data from the dicom header.

In Ginkgo CADx using “Show DICOM Inspector” we can get the dicom header. In Dicom header 0028|0030 shows the Pixel Spacing. In case of given data,

Pixel Spacing Along x-axis= Pixel Spacing Along y-axis=0.58984375 mm (Millimeter)

Now if we want to find out the number of pixels in the measurement we can do it use the formula below

$$Number\ of\ Pixek = \frac{Measurement\ along\ a\ axis(in\ cm\ ) \times 10}{Pixel\ Spacing\ along\ a\ axix(in\ mm)}$$

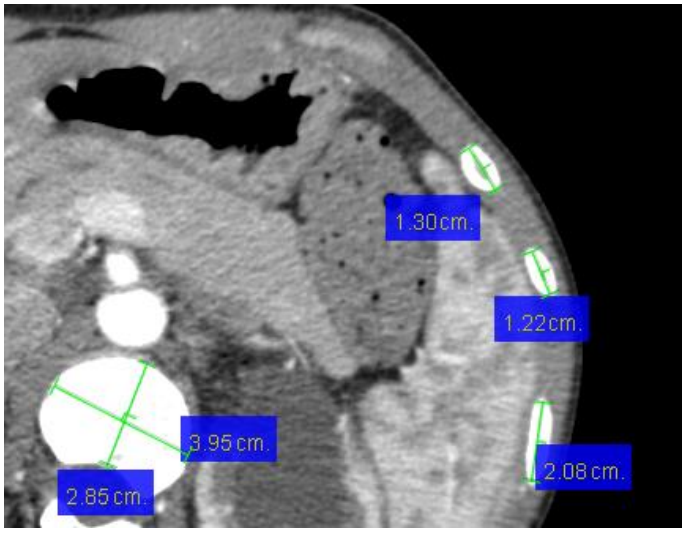



Fig.9: Measurement of the major axes of the of vertebrae and rids

- First Vertebra major axis= 3.95 cm, 66 pixels
- Second Vertebra major axis= 2.85 cm, 48 pixels
- First rids axis=1.20 cm,22 pixels
- Second rids axis=1.22 cm,20 pixels
- Third rid axis=2.08 cm, 35 pixels

## 4. Problem Encountered

During performing this lab, we faced a bit numbers of difficulties.

I. Firstly, we face problem during lab session, using the Udg Wi-Fi we could connect to the Orthanc PACS server (as PACS server was blocked by the firewall of the university). Using our or data connection / Wi-Fi we solved this issue.

II. Secondly after editing the "Orthanc.json" file we face problem to save the file. After investigating the issue, we realize that is due to some update issue in windows. We Tackle this issue by doing some minor change in administrator option and logged in as administrator when while editing and saving.

Reference

[1]Frederico Valente, Carlos Costa and Augusto Silva (2013). Content Based Retrieval Systems in a Clinical Context, Medical Imaging in Clinical Practice, Dr. Okechukwu Felix Erondu (Ed.), InTech, DOI: 10.5772/53027. Available from: http://www.intechopen.com/books/medical-imaging-in-clinicalpractice/content-based-retrieval-systems-in-a-clinical-context.