DicomPrint, an Application for Managing DICOM Images

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Abstract. Digital Imaging and Communications in Medicine (DICOM) is a standard for handling, storing, printing and transmitting information in medical imaging. It includes: the file format and the networking protocol. The image consists of a list of attributes which contains a) metadata for image like size, dimensions, resolution etc. and b) patient metadata like patient name, sex, ID, age etc. The process of reading and printing the image in itself is difficult because of the adaption between different modalities and devices.

The aim of this work is to develop an application that reads, views and prints DICOM images of a certain user, regardless of the device. The image can be printed with and without the patient metadata and has to be integrated in the DICOMRX (RxScan) software, developed by GrowIdeas Ltd which examines the patient and scans his/her inner parts. The developed application selects a DICOM image from a folder, extracts its metadata and loads these data into a form. The form is then printed according to the needs of the doctor.

Keywords: DICOM format · Metadata · Printing format

1 Introduction

Transmission of images and textual information between health care information systems has always been difficult for two reasons. First, information systems use different computer platforms, and second, images and data are generated from various imaging modalities by different manufacturers. With the emergent health care industry standards, Health Level 7 (HL7) and Digital Imaging and Communications in Medicine (DICOM) [1], it has become feasible to integrate all these heterogeneous, disparate medical images and textual data into an organized system [2]. One of the systems for digital image data management is Picture Archive and Communication System (PACS). The main components of PACS include image acquisition, data management, data transmission, image display, interfaces to printers and portable media, and communication routes to other electronic systems [3]. PACS are usually based on DICOM standards [4]. The following sessions of this paper will give a general description of the module, the logical architecture of the software, a dynamic behavior of functionalities and workflows.

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2 System Architecture

2.1 Environment Description

The environment where the application works is a medical laboratory equipped with all the necessary devices such as scanners, sensors, etc. The practitioner (referred here as Doctor), after examining the patient and scanning his/her inner parts can modify the images and apply any of the options which are part of RXScan or RXViewer. The printing option will be added in this interface and the Doctor can choose one of the following:

1. Print the image only.
2. Print the image and the metadata of the patient in landscape view.
3. Print the image and the metadata of the patient in portrait view.

As inputs will serve the events generated by the Doctor (chooses one of the options) and the output will be the printed paper of the patient data (image with/without metadata in landscape/portrait view).

2.2 Architecture Overview and Main Software Components

The main physical components of the project are a computer on which the software runs and a printer. A general picture of the system architecture workflow is shown figure 1. The Doctor examines the patient and captures images or videos with camera. The samples are transmitted to the PACS server and when the operator or doctor wants to examine them, he/she can do so via a computer where the software we have implemented runs. As hardware resources we recommend using a PC with processor over 2.5GHz, and RAM over 1GB of capacity.

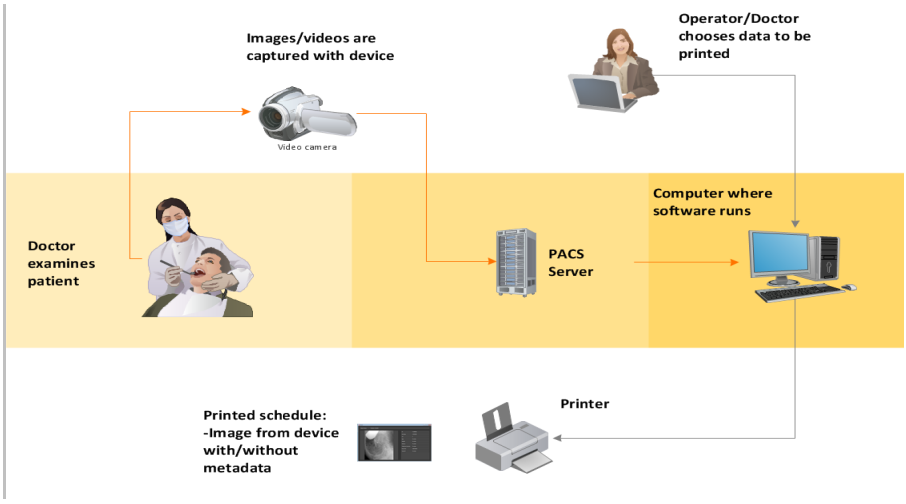

Fig. 1. System architecture workflow

The application is built in Embarcadero Delphi XE6 as a Firemonkey Desktop Application. There are 5 Units, namely: (1) Main Unit, (2) Landscape Unit, (3) Portrait Unit, (4) NoMetadata Unit, (5) PatientMetadata Unit. The relationship between units is described in the diagram in figure 2:

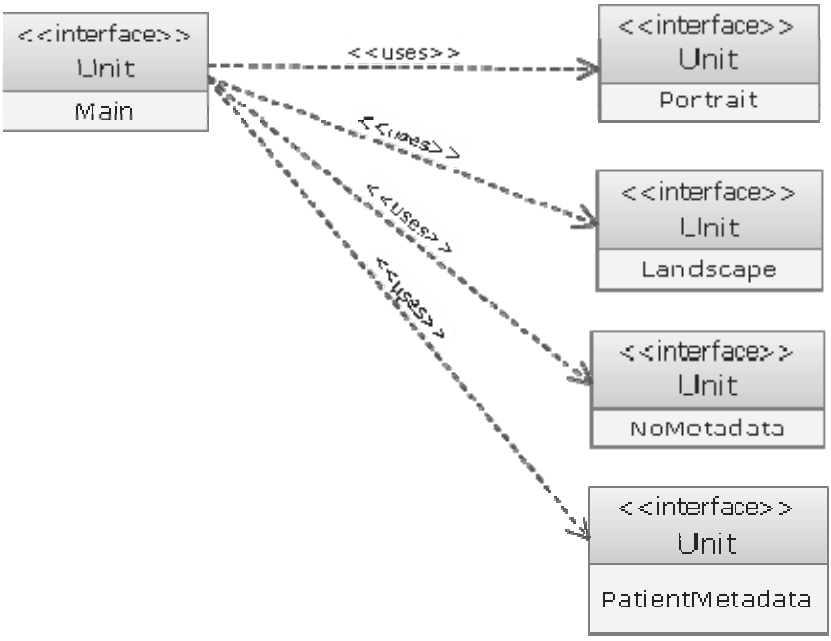

Fig. 2. Unit's relationship diagram

Main Unit Description and Functionalities

The most important unit of the application is Main Unit. It serves as the first interface that the user sees. This interface is divided into 4 components: upper bar, thumbnail bar, image content, and metadata content. The upper bar component is a panel containing:

a. "Load File" button: opens a dialog box where the user first chooses a DICOM image from a set of images stored in a folder.
b. "Include metadata" checkbox: the user chooses to add patient metadata to the image or not.
c. View panel: user has to choose between the two options, whether he/she wants to print the document in portrait or landscape view.
d. Print panel: contains two buttons for the user to set printing preferences and to preview what will be printed.
e. "Print" button: prints what the user has chosen in the previous settings.

The thumbnail viewer is a panel containing a thumbnail of the chosen image. This component is implemented for future situations where a certain user can have more than one DICOM image associated with his name. Whereas the Image content panel displays the extracted image from the DICOM format.

1. In the metadata content panel we have:

    a. Panel containing a grid where metadata are imported from the extracted text file of the DICOM image.
    b. "Show on the right" button changes the position of the metadata content from bottom (default case) to the right of the image.
    c. "Show on the bottom" button changes the position from the right to the bottom.

Landscape Unit Description and Functionalities
If the user chooses to print his patient document in landscape view, what he will see will be a static interface divided into 3 components: patient name panel, image content, and metadata content. The patient name panel contains the patient name from the extracted metadata. The image content panel contains an image viewer component which displays the extracted image from the DICOM format, and the metadata panel contains the following data from the extracted metadata file: ID, Birthdate, Sex, Age, Weight, Address, Telephone, Bodypart, Study ID.

Portrait Unit
If the user chooses to print his patient document in portrait view, what he will see will be a static interface divided into 3 components:

1. Patient name panel
2. Image content
3. Metadata content

NoMetadata Unit
If the user chooses to print his patient document without metadata, the form will be very simple. It will contain only two components:
1. Patient name panel
2. Image content

PatientMetadata Unit Description and Functionalities
If the user chooses to print his patient document with metadata, the main form will add a grid containing the patient data. This unit calls three functions, from which two are private and one is public. The public function extracts the patient metadata from a text file of metadata regardind the Dicom tags [5]. The private functions do string processing over the metadata.

3 Dynamic Behavior of Architecture

The architecture was designed to answer functional requirements. For each function of the system, we will describe the sequences / data flow that occur.

The first case is the way that the user interacts with the GUI. The flow chart is shown in figure 3.

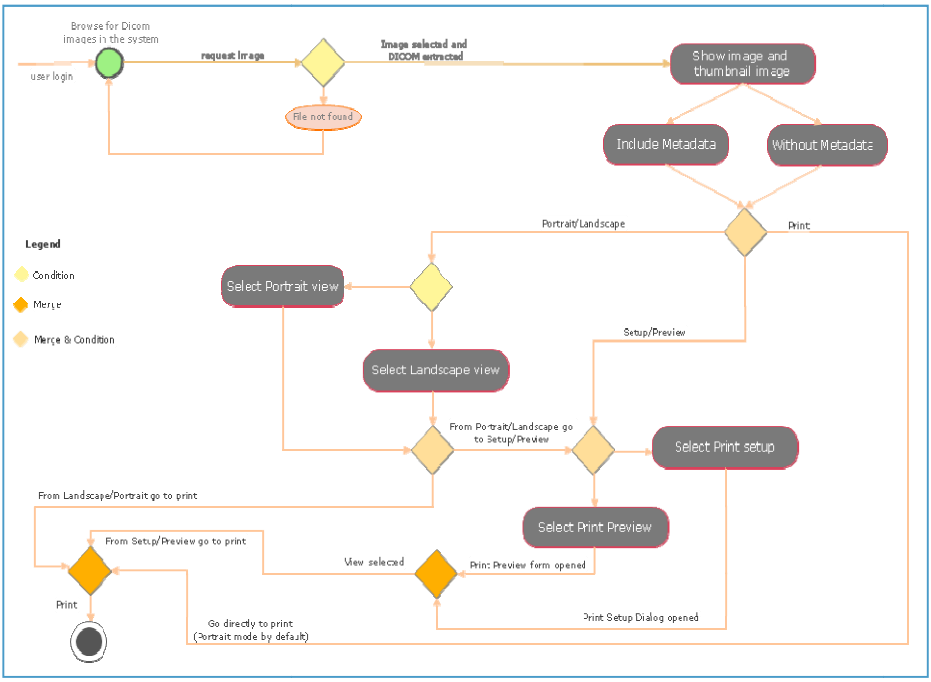

Fig. 3. Functionalities behavior flow chart

3.1 Interaction between Components and Procedures

Firstly the user (doctor) clicks on the Load File button in order to view the DICOM image. This event calls a procedure which executes the open dialog component. After the dialog component is opened the user can choose the image that he wants to view. The user selects the DICOM Image via a procedure which executes CMD in background in order to convert the DICOM image selected into a BMP image using the *dcmj2pnm* command of the preinstalled DCMTK toolkit, It also generates a text file with all the metadata of the DICOM image selected. The image is shown in the main content part and the thumbnail version of the image is also shown.

The user can check the "Include metadata" checkbox. This events makes the prefilled metadata container visible to the form, below image container. The user has the possibility to choose between portrait mode and landscape mode by clicking the Portrait radio-button or the Landscape radio-button. To preview the selected mode, the user can click on the Print Preview.

This procedure implementation controls if the user has checked the Include Metadata checkbox and the mode the user has clicked and shows another form (portrait form or landscape form) beside the main form with the attributes that the user has selected.

If the user clicks the Print Setup button, a procedure opens the Print Setup Dialog.

The user can click on the Print button in order to print the DICOM image with or without the patient data. This implementation controls if the user has checked the Include Metadata checkbox and the Portrait or Landscape radio-button selected in which the user wants the image to be printed.

According to the mode selected the Print Dialog is opened. The image and the metadata are printed in correspondence to the printer specification [6] and the print dialog box settings, maximizing the print quality and the layout for a better view.

3.2 Software Screenshots

The following figures represent the screen shots of the application. Fig. 4 shows a DICOM image in the main form of the application.

Fig. 4. Image in the main form

Figure 5 shows the DICOM image with its metadata in portrait view while figure 6 shows it in landscape view.

Fig. 5. Image with metadata in portrait view

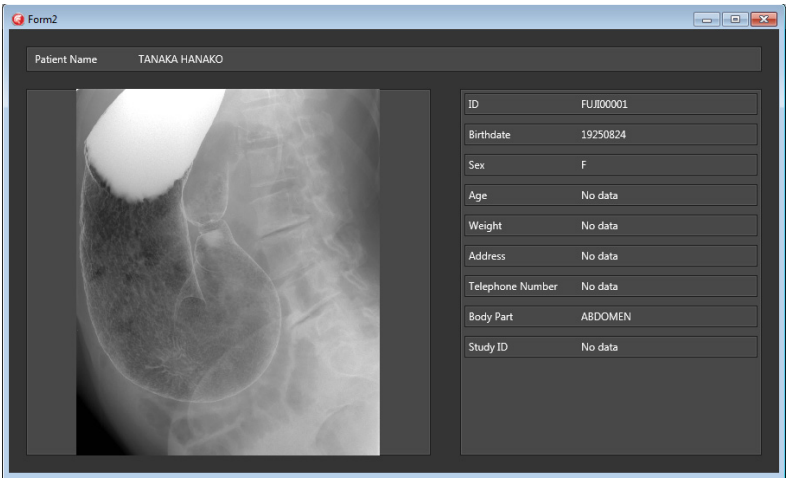

Fig. 6. Image with metadata in landscape view

4 Discussion and Further Work

DicomPrinting application will first support the dentistry clinics in managing the process of printing this image format. It is efficient and easy to use from the user's

perspective. It works in Windows and OS X operating system. This module is part of the system named RXScan and in the future GrowIdeas Albania. As a future work we will focus on the medical video management and its integration to the whole system.

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