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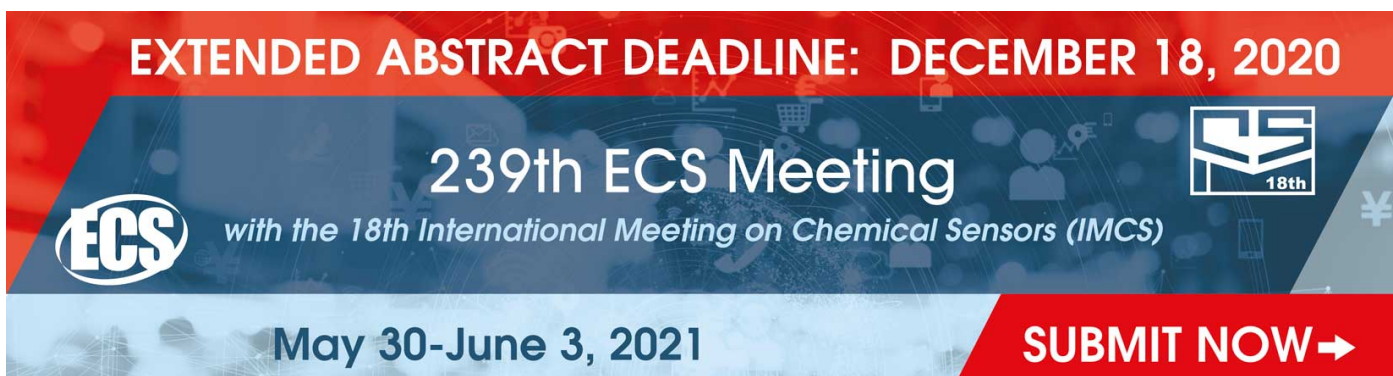
Mobile Teleradiology Simulation Using Dicom Files Reader Application on Android Smartphones

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Abstract.   The rapid development of digital technology has given birth to the industrial revolution 4.0, where every line of human life cannot be separated from the existence of smartphones. The development has spread to all fields including in the field of radiology. The development of Android-based applications that are able to open Dicom files, makes it easier for doctors to analyze patients' diseases without limited time and location. In this study mobile teleradiology simulation was carried out by sending dicom files that were archived in zip from the scanning results using mobile x-ray and DR films via email, files which were received using an android smartphone and then extracted. By activating the dicom file reader application on the smartphone an image that can be adjusted to brightness, sharpness, contrast so that it can be further analyzed by the recipient. With this simulation, it is analogous if the file sent is a scanning of a patient, and the recipient is a doctor, then the doctor can analyze the disease of the patient.
Keywords: Mobile Teleradiology, Dicom, Smartphone.

1. Introduction

The use of x-rays in the field of radiology, especially in the conventional diagnostic field, is to utilize the properties of x-rays which can blacken radiographic films. The size and density of objects traversed by x-rays will affect the intensity of x-rays that are able to penetrate the material, so that images recorded in photographic films can describe objects that are traversed by x-rays, in this case are human organs [1]. Radiographic film that is used to record images using AgBr materials that are sensitive to light, so that in film processing a room with very minimal light is needed. After processing the film, the image will be observed in the light box for diagnosis [2]. The quality of the image produced by the film is determined by several factors including density, contrast, sharpness and detail.

Along with the development of technology, recording x-ray intensity patterns that describe the patient's organs using film is no longer widely used, slowly conventional radiography is replaced with digital radiography [3] through computed radiography (CR) and Digital Radiography (DR). Both CR and DR produce digital images with files in the DCOM format so that they will be cheaper compared to conventional radiographs because they do not require the use of radiographic films [1].

Data on image capture using the CR method is stored in image reader, then scanned to get Dcom files which can then be displayed on a PC monitor screen with either Windows, iOS or Linux operating systems. By digitizing this radiographic image, teleradiology can be carried out by sending a radiological digital image diagnosis from one place to another electronically [4]. The purpose of

teleradiology is to improve the quality of care for patients, because the disease can be diagnosed more quickly by a doctor who happens to be outside the hospital where the patient is.

The Dcom file reader can only be done initially on a PC with brightness and contrast adjustment features by setting Window Width (WW) and Window Center (WC), and displaying desired slices for multiple slice images [5]. The development of an Android smartphone which is a development of the Linux operating system presents the Dcom file reader which is more mobile because it can be opened directly from the smartphone without reducing the Dcom reader feature on the PC [6]. In this study simulating teleradiology that utilizes mobile devices such as smartphones or called mobile teleradiology to further improve service to patients, because diagnosis of the disease will be done faster without limited space and time.

2. Experimental Details

This simulation uses mobile x ray to scan objects. The objects in this study were pass keys, glass bottles, styrofoam and aluminum foil debris, the scans were stored on DR cassette. Data in the cassette is read using CR image reader and images are obtained in jpg and dcom formats. This file in the Dcom format still stores complete information from the scanned object, while the file in JPG format is an image file that has been extracted. Dcom files are then archived in zip form and to reduce file size without reducing information from the files.

The file archiving results are then sent by email or other messaging so that it can be received on a Smartphone. After the archive file is received on the smartphone the DCOM file is then extracted, and can be opened using the DroidRender application. By using the DroidRender application, the image in the dcom format can be adjusted to the brightness and contrast of the image to get the maximum image. If the dcom file stores 3D information or multiple slices then the droid rendering can also display organ slices as desired. All settings, both brightness, contrast, sharpness and slices can be arranged using swipe and pinch on the analyzed image

3. Result and Discussion

When scanning, all objects placed on the cassette are then radiated with mobile x ray as shown in Figure 1. After irradiating, the information stored on the scanned object will be stored on the cassette. The tape is then read using CR image reader to get dcom and jpg files. By the operator dcom files are placed in a folder and burned into a Compact Disc (CD).

Figure 1. Image capture process

The mobile teleradiology simulation process is carried out on the Universitas Kristen Indonesia campus, by archiving folders from Dcom files using WinRAR on a PC, then storing them in zip format. The zip file is then sent to a smartphone that has installed DroidRender using email. By using DroidRender the images obtained can be adjusted so that the optimal image is obtained. The optimal image obtained in WW 2170 and WC 2833, which is when most object information can be clearly described. In these settings can display Styrofoam, while for the other value of WW and WC,

Styrofoam images are not clearly displayed, while the aluminum foil debris cannot be displayed because it is too thin, so the reduction in the intensity of x-rays that penetrate aluminum foil is not too significant [6]. Figure 2 shows a comparison between the appearance of the default dcom file or before optimization with after optimization.


(a)   (b)
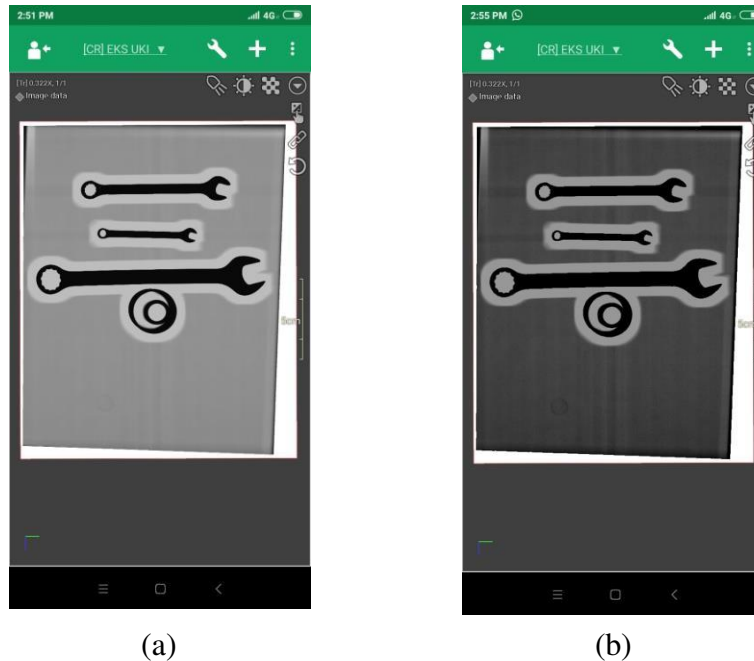
Figure 2. Comparison of Dcom imagery before (a) and (b) after optimization

In DroidRender, an example file is also provided as a tutorial for using the application. Dcom file consisting of multiple slices images, the droid rendering can display 3-dimensional images and display slices of organs. In the example of Dcom the head scanning results in 21 slices and spine in 36 slices, can display 3 dimensions, sagittal slices, transverse and coronal slices of the head and as seen in Figure 3.

In the service of patients in the hospital, after the patient has been scanned either with CT scan, MRI or PET CT, to be able to apply mobile teleradiology, a radiographer will get an additional task by archiving the file into a zip, and sending the zip file to the doctor by email or other messaging. In addition, usually in hospitals, PCs used for scans are not connected to an internet connection, but are only connected locally to the area network so that a radiographer needs to copy the archived files to another computer that connected to internet access.

After obtaining a dcom file from the radiographer, the doctor will be able to see and diagnose the patient's disease wherever he is, because it can be accessed with the android smartphone he has. Diagnosis can be done more effectively because in the DroinRender application there are settings and image optimization features of the patient. Thus service to patients will be faster and on target.

(a)   (b)
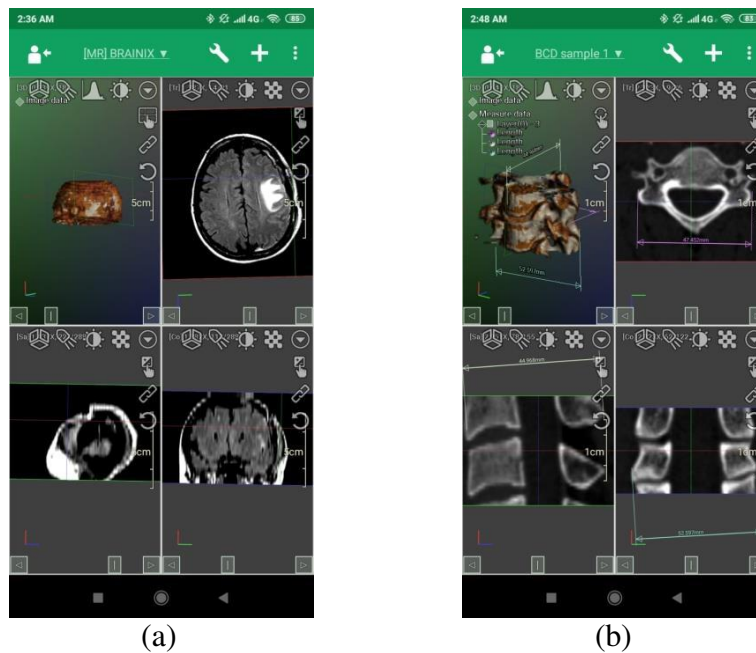
Figure 3. Dcom image example of droid render application, multi slice image (a) Head (b) Spine

4. Conclusion

This mobile teleradiology simulation is done by using a dicom file that has been archived to zip format sent via email and the recipient opens the Dcom file by using the DroidRender application on the Android Smartphone. In practice for patient care, a radiographer is given an additional task to archive the patient's dcom and send the archived file to the doctor.

Acknowledgments

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