Chapter 3.43
3G Mobile Medical Image Viewing

Eric T. T. Wong
The Hong Kong Polytechnic University, Hong Kong

Carrison K. S. Tong
Pamela Youde Nethersole Eastern Hospital, Hong Kong

ABSTRACT

Teleradiology is the technology of remote medical consultation using X-ray, Computed Tomographic or Magnetic Resonance images. It was commonly accepted by clinicians for its effectiveness of making diagnosis for patients at critical situations. Since the huge size of data volume involved in teleradiology [American College of Radiology et al., 2003], clinicians are not satisfied with the relatively slow data transfer rate. It limits the technology to fixed-line communication between the doctor's home and his office. In this project, a mobile high speed wireless medical image viewing system using 3G Wireless Network [Collins et al., 2001], Virtual Private Network and One-Time Two-Factor Authentication (OTTFA) technologies is presented. Using this system, teleradiology can be achieved by using a 3G PDA phone to query, retrieve and review the patient's record at anytime and anywhere in a secure environment. Using this technology, the patient-data availability can be improved significantly, which is crucial to timely diagnosis of patients at critical situations.

INTRODUCTION

Teleradiology is the technology of remote medical consultation using X-ray, Computed Tomographic (CT), or Magnetic Resonance (MR) images. This technique is commonly accepted by clinicians for its effectiveness of making diagnosis for patients at critical situations. For effective implementation of teleradiology, many technical problems including data integrity, accessibility, size of data volume, compression method and bandwidth of linkage should be considered. Hitherto, due to the huge size of data volume involved, clinicians are not satisfied with the slow data transfer rate. It limits the use of the technology to fixed line communication between a doctor's office and

his/her home. In this project, a mobile high speed wireless medical image viewing system using Third Generation (3G) mobile, Virtual Private Network (VPN), Common Gateway Interfacing (CGI), dynamic JPEG compression, WEB, Structural Query Language (SQL) [DuBois et al., 2002], Digital Imaging and Communication in Medicine (DICOM) [NEMA et al., 2004], and One-Time Two-Factors Authentication (OTTFA) technologies was developed. Using this system, teleradiology has been enhanced to a large extent – image data query and retrieval can be transferred from a hospital data centre to any notebook Personal Computer (PC), or to any 3G Personal Digital Assistant (PDA) phone at anytime and anywhere in a secure environment. Hence, the patient-data availability can be improved significantly, which is quite important for patients at critical situations.

BACKGROUND

Teleradiology involves the process of sending radiographic images from one point to another through digital, standard telephone lines, wide area network (WAN), or over a local area network (LAN). The radiographic images can be acquired either by a video capture board such as a frame grabber or the console of a medical imaging modality. After acquisition, the images were digitally stored in a teleradiology workstation in which the images were ready to be sent to a remote site over a network such as ethernet.

In the field of medical imaging, most of the images were stored in Digital Imaging and Communications in Medicine (DICOM) formation. DICOM is a standard that is a framework for medical-imaging communication. It was developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) [Bidgood et al., 1992] with input from various vendors, academia, and industry groups. It is referred to as "version 3.0" because it replaces versions 1.0 and 2.0 of the standard previously issued by ACR and NEMA, which was called the "ACR-NEMA" standard. It provides standardized formats for images, a common information model, application service definitions, and protocols for communication. Based upon the Open System Interconnect (OSI) reference model, which defines a 7-layer protocol, DICOM is an application-level standard, which means it exists inside layer 7 (the uppermost layer).

Today most teleradiology systems run over standard telephone [Oguchi et al., 2001] and ISDN (Integrated Services Digital Network) lines which are available in most parts of the world. Other high-speed lines, including T1 line and SMDS (Shared Multi-megabit Data Services) will also become more popular as their prices continue to drop. Over the next couple of years, we should see a substantial migration to wireless network such as IEEE 802.11x wireless and 3G (Third Generation) [Collins et al., 2001] networks, which offer higher flexibility than fixed line networks.

Digital images, whether viewed on a computer monitor, transmitted over a phone line [Reponen et al., 2000], or stored on a hard disk or archival medium, are pictures that have a certain spatial resolution. The spatial resolution, or size, of a digital image is defined as a matrix with a certain number of pixels (information dots) across the width of the image and down the length of the image. The more the number of pixels, the better is the image resolution. This matrix also has depth. This depth is usually measured in bits and is commonly known as shades of grey: a 6-bit image contains 64 shades of grey; 7-bit, 128 shades; 8-bit, 256 shades; and 12-bit, 4096 shades. The size of a particular image is referenced by the number of horizontal pixels "by" (or "times") the number of vertical pixels, and then by indicating the number of bits in the shades of grey as the depth. For example, an image might have a resolution of 640 x 480 and 256 shades of grey, or 8 bits deep. The number of bits in the data set can be calculated by the product of 640 x