Chapter 4.4
Implementation of an Error-Coding Scheme for Teleradiology System

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ABSTRACT

Teleradiology, sending of x-rays, is the most common application of telemedicine in use today. Mobile telemedicine is the latest area of research where the patient can be monitored remotely by a doctor. In this paper, we propose a teleradiology system whereby the communication is established via cellular networks and cell phones. Since the data is sent over a wireless channel, it is more prone to data loss due to the mobile environment. To prevent data from getting lost due to noise in the wireless channel, an error-coding scheme is applied. Turbo code is a powerful error coding technique employed nowadays in communication systems. In this paper we apply turbo codes to an x-ray image and an ECG image and simulate the transmission system by adding Gaussian noise to the image. The performance of Turbo codes, in terms of bit error rate is better than other error coding schemes even in the region where the signal strength is very low. The Quality of the image is retained in the receiving end by proper design of the error-coding scheme. An analysis has been done on various parameters considered in the design of turbo codes. The images obtained

after decoding are found to be suitable for recognition and diagnosis by the doctors in their mobile phones. This novel technology will enhance the health care in rural area where the opinion of a specialized doctor is not available.

INTRODUCTION

Mobile telemedicine is a new research area that takes advantage of the cellular technology to provide highly flexible medical services that are not possible with standard telephony. Conventional telemedicine systems using public switched telephone network (PSTN) land lines are already available to enable a doctor to monitor a patient remotely for home care or emergency applications as mentioned by the authors Rezazadeh and Evans (1990), Patel and Babbs (1992), Clarke, Fragos, Jones, and Lioupis (2001), Coyle, Brown and Boydell (1995). Systems using satellite communications are dealt by the authors Pierucci and Del Re (2000); Murakami, Shimizu, & Yamamoto (1994). Teleradiology is the term used when any digital image is moved outside the local environment. Teleradiology involves the transmission of digitized radiological signals to a remote site for medical diagnosis. The transmission site is a hospital. The remote site is the location of the specialized doctor. Since the doctor may not be available at all times in a hospital, it becomes difficult to attend to trauma patients. With teleradiology, the territory of a doctor is expanded by being able to receive the images over his cellular phone. The doctor will make an initial diagnosis and communicate to the hospital. For further diagnosis, the doctor will attend to the patient at his own convenience. The global system for mobile communications (GSM) has been applied along with signal processing for transmission of ECG signals by Woodward, Istepanian, and Richards (2001). In GSM, the error-coding scheme used is Convolutional coding. The limited bandwidth of GSM (9.6kbps) restricts potential mobile telemedical services. Turbo coding is the error-coding scheme used nowadays in wireless transmission since it almost reaches Shannon limit. In this article, the images are coded using Turbo encoder and decoded using the Turbo decoder. The noise signal is simulated and added to the image after encoding the data. While decoding, the algorithm efficiently removes the noise and the image quality is analysed. These images will be made available in the cellular phones. The doctor can diagnose based on that image or can download the image into a computer to do a detailed analysis. The QoS (Quality of Service) parameters of Turbo coding are modified to make the transmission of images more efficient with better quality. The paper is organized as follows. In section 1, the existing Teleradiology system is discussed and the proposed system is explained with a diagram. The second section explains the operation of the Error coding scheme .The optimal design of the QoS parameters used in Turbo coding for this application is discussed in detail in the third section. The fourth section gives the simulation results. Conclusion and future work is given in the fifth section.

TELERADIOLOGY SYSTEM

Teleradiology system is a system used for sending raw data from a complete patient study to a remote location for a radiologist to make a final decision. A teleradiology system consists of an image acquisition system, an image server to compress, and a telecommunication network to transmit the images. The network could be a Local Area Network (LAN) or a broadband internet connection. LAN cannot be applied for far distances. Broadband internet connections are not easily accessible in all areas. In this paper, we propose a system by means of which the images could be sent over the easily available cellular network, which is very economical. The system consists of two segments, one for sending, and