ABSTRACT

Recent years have seen significant advances in the field of health care, especially for rural communities, through telemedicine. In telemedicine, medical images acquired from imaging modalities such as Magnetic Resonance Imaging (MRI), Computerized Tomography (CT), Ultrasound (US), Electrocardiogram (ECG) and Positron Emission Tomography (PET) need to be conveniently transmitted over the network for diagnosis. Especially, MRI suited for soft tissue evaluation (e.g. ligament injury, spinal cord injury, brain tumors etc.) and CT scan suited for bone injuries are widely used in telemedicine.

Developments in telecommunication technologies afford great opportunities to improve the quality of health care services by providing excellent access to medical data. However, the transmission of medical information through telemedicine remains challenging due to security, network infrastructure, remote monitoring of patients, high storage cost of medical images and automated decision support systems.

Since the volume of medical images generated increases, the transmission of huge amount of medical data with relatively low bandwidth is a critical demand in telemedicine. Moreover, the cost of storage devices remains expensive with the increasing demand for storage. In this regard, the development of efficient compression methods that results in better consumption of bandwidth and less
storage requirement is one of the important challenges to be addressed in telemedicine. Besides preserving the critical information in the medical images, high compression ratio and less computational time to compress the images are the major concerns in medical image compression.

Several state-of-the-art image compression methods have been proposed in order to meet the increasing demands for medical images. Among the proposed medical image compression methods, much interest has been focused on attaining the desirable characteristics such as high compression ratio, and little work has been done on improving the compression performance by efficient representation of edges in medical images and utilizing less computational time to compress the medical images.

Grounded on this motivation, this thesis proposes and analyzes efficient medical image compression methods, particularly suitable for telemedicine applications. The main objective of the research work is to analyze the performances of the proposed methods for a set of MRI and CT images for different compression evaluation parameters. These methods are proposed to achieve high compression performance without compromising the quality of the input medical images.

In this thesis, four transform based image compression methods are proposed and analyzed for the compression of MRI and CT images. Medical image
compression using ripplet transform has been proposed and analyzed for efficient representation of edges in MRI and CT images. Exhaustive experimentations on the proposed compression method have been performed and adequate results are taken to prove the efficiency of the proposed method in terms of Peak Signal to Noise Ratio (PSNR), Structural Similarity Index Measure (SSIM), compression ratio and computational time.

To improve the performance of image compression method by integrating geometric regularity in image representation, a novel medical image compression using bandelet transform has been proposed and analyzed. This method has been introduced for sparse representation of images using geometric regularity of image structure. Adequate analysis has been performed and the experimental results obtained for the proposed method have been compared with the existing conventional and state-of-the-art image compression methods. Experimental results prove that the proposed method is efficient for the compression of medical images.

In order to achieve efficient compression with less computational time, suitable for telemedicine environment, an efficient medical image compression using radon transform has been proposed and analyzed. Detailed analysis has been performed on the proposed compression method using radon transform and the experimental results demonstrate the efficiency of the proposed method.
Medical image compression using geometric transform has been developed that helps the medical practitioner to locate the region of interest at different scales and angles. Performances of the proposed method have been evaluated based on scaling factor, compression ratio, PSNR and computational time. Experimental results show the effectiveness of the proposed method using geometric transform.

Subjective evaluations on the diagnostic quality of compressed images have also been performed for all the proposed compression methods. The results of subjective assessment indicate that all the proposed methods preserve the diagnostic quality of images efficiently. Most of the images are rated as excellent and not a single image has failed the test of acceptability.