ARAB ACADEMY FOR SCIENCE, TECHNOLOGY
AND MARITIME TRANSPORT
(AASTMT)

College of Engineering and Technology

Department of Computer Engineering

DISTRIBUTED IMAGE COMPRESSION INTEGRATING SET PARTITIONING HIERARCHICAL TREES AND VECTOR CODEBOOK ENCODING SCHEMES

By

Noura Samir Mohammed Khalil

A thesis submitted to AASTMT in partial

Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

COMPUTER ENGINEERING

Supervisors

Prof. Dr. Sherin M. Youssef
Computer Engineering Department
Arab Academy for Science, Technology
and Maritime Transport

Dr. Ahmed Abou El-Farg
Computer Engineering Department
Arab Academy for Science, Technology
and Maritime Transport

Feb 2015

ABSTRACT

With the advent of multimedia computing, the demand for processing, storing and transmitting images has increased exponentially considerable amount of research to be devoted in the last two decades to tackle the problem of image compression. The objective of image compression is to reduce the redundancy of the image and to store or transmit data in an efficient form. Image compression used in many applications such as health industry, federal government agencies, security industry, museums and galleries. It is used also in wireless sensor networks (WSNs) applications. Efficient compression and transmission of images in WSNs is considered, since the problem of constraint resources in WSNs such as memory limitations, restricted computational energy, and narrow bandwidth. These resource constraints form serious difficulties for the design wireless sensor networks. An efficient distributed image compression and data transmission model (DICT) is proposed as a mean to overcome the computation energy limitation of wireless sensor nodes by distributing the workload of task to many groups of nodes along the route from the source to the destination to avoid dead nodes, maximize network lifetime, minimize energy consumption, minimize response time beside optimizing peak signal to noise ratio, mean square error, compression ratio and bit per pixel. In this thesis, a new hybrid model that integrates wavelet sub-band decomposition with set partitioning hierarchical trees and vector codebook encoding scheme introduced. The proposed model includes the following phases: first, the image is partitioned into segments and each segment is decomposed into several subbands using wavelet transform. Wavelet transform have the advantage of being able to separate the important details in images, and compress or de-noise data (image) without appreciable degradation. Second, encoding phase using Set Partitioning Hierarchical Trees (SPIHT) encoding technique with the advantages of high image quality, low computation load, and high coding speed. Third, codebook (CB) generation phase with the advantage of minimizing distortion between a given training set, reduces storage space and hence storage cost, reduces time to retrieve and transmit images, reduces energy to retrieve and transmit images. Finally transmission phase. Experiments have been carried out to validate the efficiency of the proposed model. Experiments are applied on various benchmark test datasets with

different properties, and evaluation measures are recorded. Experimental results showed that improving the network lifetime, reduces energy consumption, minimize reasonable response time comparable to centralized image compression, getting higher peak signal to noise ratio and lower distortion rates. Experimental has been applied on resource-constrained WSNs with different settings. Our system model has been evaluated against Linde et al (1980) algorithm and showed 46% improvement in PSNR. Also, the system model has been tested in opposition to Kekre et al (2010) algorithm and showed 34% improvement in PSNR. Kekre et al (2009) algorithm demonstrated that our model has 42% better PSNR. The proposed model confirmed that it gives 28% enhanced PSNR than Two-Level Kekre's Proportionate Error (KPE) Kekre et al. (2010) model. Also, the system has been tested in opposition to Chandan et al. (SOFM + SPIHT) (2009) model and showed 14% of improvement in PSNR. Results showed revealed promising results in terms of peak signal to noise ratio (PSNR) and mean-square-error (MSE).

ACKNOWLEDGMENT

I humbly grab this opportunity to acknowledge reverentially, many people who deserve special mentions for their varied contributions in assorted ways that helped me during my research and the making of this thesis. I could never have embarked and finished the same without their kind support and encouragements.

First of all, I thank ALLAH the most merciful and compassionate for giving me the power and the desire to finish this thesis.

I would like to express my deepest sense of gratitude to my supervisor Prof. Dr. Sherin Youssef for being an outstanding advisor and excellent professor. Her constant encouragement, patient guidance, support in various ways, invaluable suggestions whenever I was in need throughout all the stages of this thesis made this work successful.

Additionally, I am indebted to my second supervisor Dr. Ahmed Abou El-Farg whose help, support, stimulating suggestions and encouragement helped me in the time of research and writing of this thesis.

I would like to thank my family. The constant inspiration and guidance kept me focused and motivated. I am grateful to my dad for giving me the life I ever dreamed. I can't express my gratitude for my mom in words, whose unconditional love has been my greatest strength.

The constant love and support of my sisters and my brother is sincerely acknowledged. Finally, I would like to express my deepest appreciation for my family and friends especially Yasmine, Nihal, Sara, Dalia and Sahar for believing in me and supporting me with all possible means all these years.