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A Review of Image Transmission using Real Time Technique over WMSN

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Abstract

Wireless multimedia sensor network is entirely different from its precursor scalar network in – characteristics and data size being transmitted, required memory resources and power consumption in every node for processing and transmitting. WMSN is useful in many applications like environmental monitoring, traffic monitoring, in medical, image and video transmission etc. Real time data transmission is very important concern in these applications, in terms of security as well as maximum usability when multimedia data is processed and transferred. This problem can be overcome by image coding. As we know image contains huge amount of redundancies because of high correlation among pixels. Countless coding algorithms have been developed for the similar. So our main concern of this survey is to study and evaluate pertinent research route as well as go through the latest image coding algorithms over WMSN. This survey outlines the pros and cons of latest efforts of these algorithms. Basically it gives an open research idea for many coding techniques and their capability to WMSN.

Keywords: Wireless multimedia sensor network, DCT, DWT, Power consumption, compression ratio (CR), mean square error (MSE), bits per pixel (BPP)

INTRODUCTION

Image is basically carrier amid the information from the surrounding environment and it is most important medium which contains information. It has pixels which are highly correlated to each other. Due to this, it consist a huge amount of redundancies which contains enormous storage space and also reduces transmission bandwidth. Image contains three types of data redundancies – Spatial, temporal and spectral redundancy. First one can be described as the unwanted repeated data in the same frame required to be removed for minimizing image size, second one required to minimize the count of the bits use to represent image, in third one correlation between differ color planes respectively.

To overcome these problems, coding must be required for least storage and less bandwidth with satisfactory visual quality of reconstructed image. Any of Lossy or lossless compression technique can be used. But to choose a compression technique completely depends on the nature and behavior of operating manifesto. One of the most suitable platforms is wireless multimedia sensor network (WMSN).

WMSN comprises many number of sensor nodes situated in region of interest and multiple base station (sink). WMSN consist of wireless nodes and video cameras, microphones which make it capable for high computation. WMSN basically use the networks to transmit real time multimedia data including video, image, sound etc. to each other or to base stations through sensors using economic hardware. In WMSN every node can obtain, compress as well as transfer the apprehended frames to base station, which is the primary network controller. WMSN's are well capable to store real time data obtained from many sensors as well as to transmit it.

Now a day's WMSN is one of the most popular platform, which has been used in N number of applications like health care services, traffic control systems, industrial process control systems, industrial process control, military, security monitoring, plant monitoring, machine failure diagnoses, surveillance systems etc.

As compared to the wired network and scalar data wireless sensor networks, WMSN faces more complications because of their complexity, restricted amenity in memory, processing and power consumption. To transmit large data over WMSN, it consumes additive power dissipation per node. So there is requiring of data compression to decrease data size.

The principal objective of this survey is to study and evaluate pertinent research route as well as go through the latest image coding algorithms over WMSN. This survey outlines the pros and cons of latest efforts of these algorithms. Basically it gives an open research idea for many coding methods and their capability to WMSN.

WMSN's can be simply analyzed in three stages- sensing, data processing and transmission. Energy related issues are handled by data processing and transmission stages. A suitable compression algorithm can improve the lifetime of sensors as well as reducing data size and power consumption. Power utilization is the most significant issue which directly induces the potential of WMSN. Therefore there is a need of a

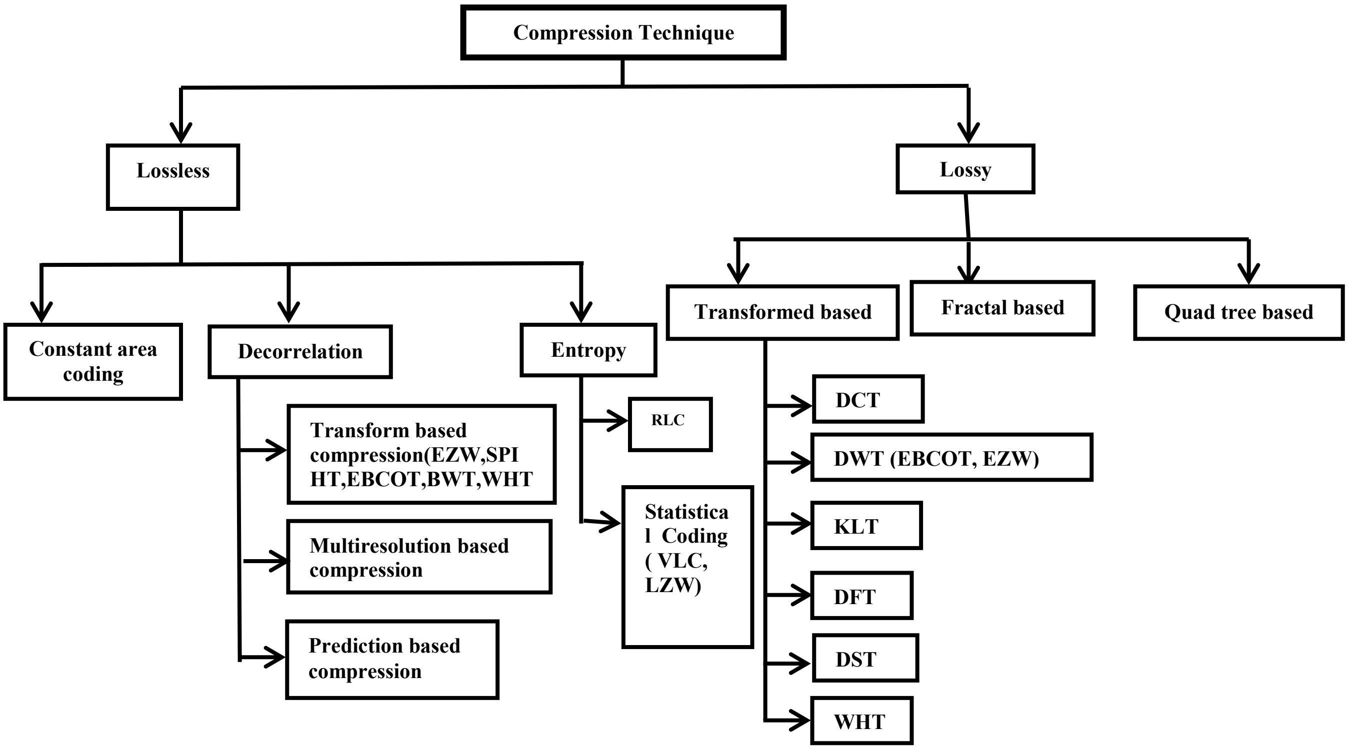

Figure 1. Image compression technique in WMSN

simple and convenient compression technique as well as maintain the image quality.

IMAGE COMPRESSION TECHNIQUES IN WMSN

WMSN's have very restricted power and bandwidth because of which, some of image compression algorithm like JPEG, JPEG2000 is not fruitful for WMSN's. Problem with such algorithms are their size, memory access and processors speed.

The basic criteria for choosing compression technique should be image quality, power consumption, compression ratio, memory resources, computational complexity etc.

The image compression can be categorized in two parts – Data loss (lossy) and without Data loss (lossless) as shown in the figure1.If the original data is perfectly reconstructed from the compressed data, without any information loss is called as lossless compression. But, if there is any information loss, it will be considered as lossy compression technique.

Lossless Image Compression Techniques

Case 1- If the data like text, documents and executable are need to be compressed, then it is necessary to reproduced it without any data loss, when decompressed it again.

Case 2- For the data like music, images etc. are needed to be compressed, it is necessary to generate exactly same. The correspondence of original image is sufficient in most of the cases, as for as the error or difference is tolerable.

There are three categories of lossless image compression

i) Decorrelation

ii) Constant area coding

iii) Entropy

Decorrelation

This technique basically removes the spatial redundancies between pixels. Decorrelation techniques can be divided in two types- Transformed based compression (Prediction based) and Multi resolution based technique.

Constant Area coding

In this technique unique code words are needed to recognize the large areas of adjoining 0's or 1's. In this technique complete image is split in block with general size m*n pixels. Blocks can have block pixels if it can have mixed intensity. Most constant category is denoted with 1 bit code word 0 & the surplus categories denoted with 2 bit codes 10 & 11. The codes denoted to mixed intensity is preferred as adjunct, is followed by mn bit pattern of block. In this way compression can be executed as the mn bits are utilized to illustrate every constant area, which are replaced by 1 bit or 2 bit code word. For compressing white text documents in easier way, White block skipping can be used for coding the solid white areas as 0 & other can be added as 1 which follows the block bit pattern. This proposal can be benefited by the predicted structural format of the image which has to be compressed.

Entropy

Entropy coding is also used for removing redundancies in two ways- Run length coding & statistical coding. Entropy is used to find out the frequent transpiring character in data string with small code words in compressed bit string. This coding can also be used with some of the lossy compression technique such as JPEG. As we know there is no loss of any data in lossless compression, due to it compression ratio is reduced which makes a complicated system for transferring over WMSN.

Brief Review of the Previous Work

S. Sathappan et al [19] proposes that color image is decorrelated into luminance and chrominance image with reversible color transform technique. The proposed scheme accomplishes better CR & PSNR value and provides efficient lossless compression of images.

Xiangrong Zhang et al [40] propose an advance spectral spatial feature learning method for hyper spectral image classification; it combines spectral & spatial information into group sparse coding by clusters. It results flexible & adaptive spatial neighborhood correlations for spectral spatial joint sparse coding, improved classification accuracy & provide exclusive classification maps.

R. Patel, V. Kumar [31] analyze Huffman coding technique, to remove the redundant bits in data by analyzing many characteristics like PSNR, MSE, BPP & CR for various input images & new method of splitting an input image into equal rows & columns & sum of all individual compressed images provide better result & make information secure.

A. Zheng et al [26] proposed to evaluate an optimal variable length context tree (VCT) Ʈ, through maximum a posterior (MAP) formulation for evaluating symbols conditional probabilities. Proposed algorithm gives excellent context based scheme for small & large training data sets, while for lossy contour coding, this algorithm results corresponding schemes in rate distortion performance.

C. Huang et al [22] proposes a lossless data hiding scheme for SMVQ compressed images based on the search order coding (SOC) algorithm. Result indicates that proposed scheme achieve high CR & also decreasing the compression bit rate.

Seishi Takamura et al [21] proposed that the value of concurrent pixel from previously decoded pixels values can be predicted by lossless image coding. Result shows 1.32 to 3.90% bit rate reduction against the pair of predictor & context modeler of a conventional method CALIC.

S. Wang, L. Jiao et al [12] presented a novel CD technique by generating the discriminative feature vectors, which are obtained by sparse coding & max pooling on the basis of nonlocal similarity blocks in difference image. Polling method fully utilizes spatial information & improves final detection accuracy

W. Yang et al [15] proposes POLSAR HPD matrices are represented as sparse linear combinations of elements from a dictionary & each element is an HPD matrix & representation loss is measured by affine invariant Riemannian metric. This results the excellent performance in classification accuracy & clustering quality compared to the competitors.

X. Peng, J. Xu et al [3] presented a hash base line by line template matching (hLTM) for lossless screen image coding, where non local redundancy presents in text & graphics parts. hLTM can significantly reduce encoding/decoding complexity by 68 & 23 times as compared with traditional TM & improve coding efficiency by up to 12.66% bits.

Caroline Conti et al [39] proposes a light field image codec solution based on HEVC & considering a bi-predicted self-similarity estimation & compensation to improve coding performance. This results justified better performance in comparison to JPEG, HEVC & previous ss- based solution.

B. Xu, Q. Yin et al [27] uses the discriminant criterion into the sparse coding process to make residual of each class have high discriminatory potential is more effective for classification. This method performs better than other sparse representation based classifiers & has a superior capability for classification.

Josep Santaló, Ian Blanes et al [38] proposes to onboard compress the multi-hyper spectral images captured by aircraft and satellites by a new technique generated by MHDC working group of consultative committee for space data systems (CCSDS). This technique depends on fast lossless adaptive linear predictive compressor.

Hanna ZainEldin et al [37] study and evaluate pertinent research route as well as go through the latest image coding algorithms over WMSN. This survey outlines the pros and cons of latest efforts of these algorithms. Basically it gives an open research idea for many coding techniques and their capability to WMSN.

Lossy compression technique

This technique decreases the bits, if distinguishing the superfluous data, the destroy it. Information pressure is to lessening the information document estimate; it can likewise term as source coding. In this loss of undesirable data is satisfactory because of which it spares the storage room. This technique have high compression ratio in comparison with the lossless technique. In this technique compressed image can vary from actual image but creates an equivalent inexact of the actual image. Due to which there is need of some distortion measures like MSE, PSNR etc.

Lossy compression technique can be categorized in three main parts

i) Transformed based technique

ii) Fractal based technique

iii) Quad tree based technique

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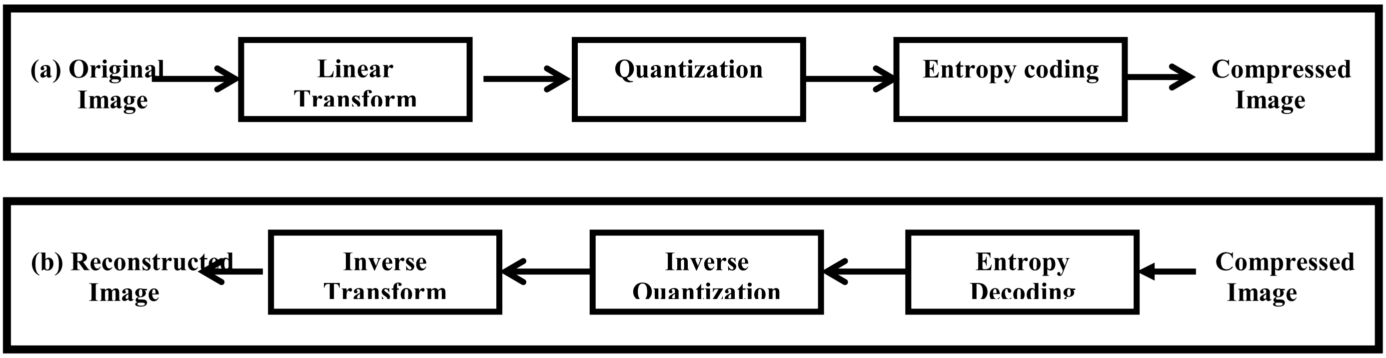

Figure 2. Block diagram of transform based image Coder

Transform coding

The basic idea behind this technique is to transform the original image from one domain (spatial or temporal) to a dissimilar kind of representation, by using any of the transform technique. This is an effective technique based deploying of inter pixel correlation. The original image is transformed to a different representation, so the average value of transformed image is lesser the original image.

Due to which compression is achieved with more correlation between images pixels, improved compression ratio can be achieved

Transmitter part in the figure is taken as encoder & receiver part is denoted as decoder. In the encoder, original image is applied to a linear transform to withdraw redundancy from data than followed by quantization, which qualifying the transform coefficients ant then followed by entropy coding to get the quantized output. This encoded image is transmitted over channel, then decoder received the encoded image & reverses all process applied in encoder in sequence & try to reconstruct the decoded image as much as possible closer to the original image.

In encoder part, the very first step (linear transform) is to transform the image from spatial to transformed domain by using some of well known transform technique like

i. Karhunen-Loeve Transform (KLT)

ii. Discrete Fourier Transform (DFT)

iii. Discrete Sine Transform (DST)

iv. WalshHadamard Transform (WHT)

v. Discrete Cosine Transform (DCT)

vi. Discrete Wavelet Transform (DWT)

Fractal based compression

To accomplish the target of pressure, the fractal picture pressure depends on the partitioned iterated function system (PIFS), which utilizes the self-similitude property in the picture. The significant downside of fractal based pressure is that it has high computational many-sided quality and it has poor recreated picture qualities if compacting any tainted pictures. Some advance fractal based technique i.e, Huber Fractal image compression (HFIC) is introduced. In case of self-similarity property every block has to encoded, to encode any image, for which it must search in very huge Zone to get the best suited match. Encoding process is complex as well as time taking process as a huge amount of evaluation is needed for the similarity checks.

In case of HFIC, to speed up the similarity measure of closely best suited match block for any given block, practical swarm optimization is used. HFIC shows

Quadtree based compression

a) Compression/Encoder b) Decompression/Decoder

Better results for vigorousness counters the outliers but doesn't show any remarkable improvement in image quality, especially for Gaussian & Laplace noises. This technique is based on simple averages &comparisons. Any Quadtree is basically a tree kind of data structure, in which every node ends on a leaf which contains some beneficial information, or on branches into four sub-branches quadtree. There is need to design a excellent algorithm on quadtree to separate the image in blocks & store then in such a way, so that the blocks can be restored again. Two heaps are required at the process of separating the original image into blocks, relies on threshold value. Then these heaps are considered as substitute of tree & separated heaps are numbered to find the blocks accurately. This is basically designed to reconstruct the compressed image is simple & quick way. This CR range is in between 0.12 to 0.68, but CR depends on threshold values, which directly affect the quality of image compression.

Brief Review of the Previous Work

H. Rekha and P. Samundiswary et al [4 using AMBTC for image compression amplified by using histogram based multilevel thresholding. AMBTC have additional features of increasing the lifetime of the sensor node by decreasing the computational time, improved image quality &high compression & suitable for WSN..

Yan Song , Xinhai Hong et al [41] proposes CNN –FVC method by re-interpreting a pre-trained CNN as the probabilistic discriminative model. It results better classification accuracy, allow simple fusion scheme to improve performance about 61.1% & 83.1% respectively.

Qiwang Chen, Lin Wang,andShaohua et al [42] proposes an image pre-processing approach for joint source channel coding(JSCC) scheme based on double photograph low-density parity check (DP-LDPC) codes. This improves the transmission efficiency & can recover the images with better quality at a very low signal to noise ratio.

R. Monteiro *et al* [32] proposes Light field imaging permits user to change the focus & objectivity after clicking a picture & also to create 3D content, between many applications. The result shows improvement over JPEG & HEVC in terms of average bit & average PSNR gains respectively.

R.Dusselaar, M.Paul et al [29] approaches spectral prediction Modeling (SPM) technique in HEVC framework to improve hyper spectral image data compression by treating each band as a video frame. It generates higher compression rate & maintain the quality of image with authentic & effective spectral prediction.

S. Li and Y. Fu et al [25] proposes an unsupervised Transfer learning approach based on low-Rank coding (UTLRC), to get the advantages of high level structural information in the targeted area & apply it to clustering visual data. It result the effectiveness of UTLRC as compared to some representative subspace clustering methods.

A. Mobinet al [24] proposed the performances of optimized 2 & 3 layered UEP schemes using 64-HQAM, which were investigated for SPIHT coded images transmitted over AWGN channel. It result that optimized 3 layered UEP scheme perform better then optimized 2 layered UEP scheme under average channel conditions, but it increases the system complexity.

A. Zaghetto, F. A. O.Nascimento et al [23] proposes an algorithm based on JPEG algorithm & utilizes the fuzzy interference system to use the normalized process of the transformed coefficients through the analysis of local characteristics of echocardiographic images. This results maximum local SNR & adapted to the characteristics of each sub-block of image, provides better compression rates.

C .Perra et al [18] presented a light field coding based on a low-complexity preprocessing approach that provides a pseudo-video sequence appropriate for standard compression using HEVC. It results better performance than JPEG achieving higher gains, especially for higher compression ratios.

S. Swamy, P. K. Kulkarni et al [20] deals with a new idea for image filtration process using dynamic block coding for de-noising the image & preserve the information. This block based coding provides best block trace order via edge tracing, results the filtration of image smoothening at the edge regions, as well as image contents.

Jani Lainema et al [17] proposed a HEIF format which offers an appropriate way to enclose HEVC coded images, image sequences & animations together with conjoined Meta data in a single file. HEVC provides around 25% bit rate reduction than the JPEG 2000, keeping the same objective picture quality.

K. Jaiswal, K. Supe et al [9] presented fuzzy block truncation coding for image feature extraction. This is used to extract features from images in different color spaces such as RGB, YCrCb, YUV, HSV & LUV. Many classifies like C4.5, naïve bayes & random forest with other preprocessing methods like fuzzy & PKIDiscretize are used. C4.5 provides better accuracy with discretize preprocessing method.

Ayshakadaikar et al [8] deals with the two block wise disparity map estimation algorithms to take benefits of a large search area, permits better forecast of the right view. This is done by selecting an appropriate disparity set & by processing the BMA with this specific set. Results confirm the advantages of this algorithm compared to the BMA in terms of bit rate distortion.

C. Senthil and L. Hui et al [11] proposes E-BTC method which is applied to each component for image compression. In case of color, compression is performed by block wise on red, green & blue image components. This shows better quality of original image & reconstructed image using quality measurement parameters such as MSE,PSNR,SNR,CR, BR & CPU time.

K. Jaiswal, K. Supeet al [10] presented a framework of deep feature hash codes for content based image retrieval system. Combining the CNN features extraction & hashing methods to improve the efficiency of CBIR system. With the decrease of feature dimension, it does not reduce the retrieval precision & also improve the retrieval accuracy, effectively improve the speed.

V. Kiani, A. Harati et al [16] Proposes planelet transform to effectively represent piecewise planar depth images. This is a geometry preserving approach to compress depth images generated by modern structured light depth sensor. It results appreciable quality by explicitly representing edges & planar patches, better approximation of planar surfaces in presence of noise.

B.-D. Choi, S.-J.Ko et al [5] presented a new bottom up based block partitioning method called split & merge. A modification of ordinary intra-prediction & transform is assigned for non-square blocks. This results in average & maximum bit rate reduction of 3.1% & 8.3& relative to HEVC intra coding based on quad tree partitioning.

G. Alves, F. Pereira et al [6] proposed a performance assessment methodology for light field image compression & outline the performance of present image coding standards while used to directly code the light field images, then provided at many aspect & focal points. This results that HEVC Intra is the most efficient codec.

COMPARATIVE STUDY BETWEEN LOSSLESS COMPRESSION TECHNIQUES AND LOSSY COMPRESSION TECHNIQUES

Lossy compression techniques are used for sound, image &

video compression. It has high compression ratios of lossy video codec's compared to the audio & still images. E.g. Audio- 10:1, Video- 300:1. This causes some loss of information. Specially used for applications that can digest difference in original and reconstructed image as well as power limited because data can't be recovered & reconstructed exactly. More data can be billeted in channel & include distortion. This technique use less encoding/decoding time.

Lossless compression techniques are used for text compression. It has less compression ratio about 3 to 4 times of original data. This involves no loss of information & original data can be recovered distortion less data completely from compressed data. So this is used in such applications that cannot accept any difference in original & reconstructed data. It has high power consumption & requires more encoding/decoding time and less data can be billeted in channel.

We can conclude that, lossless algorithms are not much suitable for transferring images through WMSN's as this technique support text data more efficiently.

CONCLUSION

In this survey, we have discussed merits & demerits of various compression techniques especially for WMSN & the factors which affect the compression performance. Performance parameters vary according to the different operating rostrum. The most essential parameters as per discussed for compression quality are image quality, power consumption, CR, compression speed etc. The transform based image compression is most elevated in real time image compression because of its low computational complexity. So there are various transform coding techniques which can best suited for the operations & selected as per priorities.

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