An Effective Technique for Compression and Transmission of Medical Data via Wireless Ad Hoc Network

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Abstract--To collect the data of patients and to improve medical facilities, a wireless ad hoc network is deployed in a disaster area. The WANETS consists of several small nodes scattered in disaster area and also capable of sending medical data to base stations. To preserve the quality of service, an efficient approach is needed because of the limited battery power of node and huge transmission of medical data. For this issue, an optimization based medical data compression technique is proposed in which transmission errors are less. A fuzzy-logic-based route selection technique is proposed to deliver compressed data that maximizes lifetime of WANET. The technique does not use any geographical or location information. The technique is an application of telemedicine which is robust to transmission errors. The system collects medical data of patients at primary health station and transmits to community care through wireless networks. The system allows to decode correctly even in the presence of transmission errors.
Keywords-Wireless ad hoc network, health care, transmission error.

I. INTRODUCTION

A remote based primary health care system is known as remote medical monitoring system. The remote medical monitoring system collects medical data of patients in the form of audio, video and other information of patients at the primary health care station of disaster area. Medical data of patients are transmitted to community care through wireless networks. The effectively deployed network during disaster recovery is known as WANET consisting of several nodes that can communicate with each other and also with PHC station and CC center. If all nodes reach the CC center in one or more multiple hops then the WANET is said to connected. Minimization of energy consumed during the connectivity of the network, is an important factor in extending lifetime of WANETS because of batteries for the nodes will not be accessible for replacement.

In this paper the study of an energy-efficient connectivity problem in WANETS is being considered. The nodes are deployed randomly in disaster area independent of each other. The proposed system is a visually lossless compression technique for medical data of patients and fuzzy logic route selection technique is used to compress medical data of patients.

II. LITERATURE REVIEW

K.Shimzau, Et al. [1] on their work has proposed about the national crisis caused by the earthquakes and tsunamis. Japan was devastated by the Great East Japan Earthquake occurred on March 11th, 2011. Huge tsunamis swept a vast area of Tohoku causing a complete breakdown of all the infrastructures including telecommunications. Communication of emergency information was limited. It caused a serious delay in the initial rescue and medical operation. it is important to identify the number of casualties, for the emergency rescue and medical operations ,their locations and states and to dispatch doctors and rescue workers from multiple organizations. The systems were interoperable ,even though the doctors and rescue workers from multiple government organistaion have their own dedicated communication system. This work is a design concept of Emergency Temporal Information Network System designed in such a system of systems in the Acute Stage of Large-scale Disasters Damage Mitigation.

Huang et al. [2] on their work proposed that an image is divided into eight by eight blocks and then the 2-D DCT is applied to encode each block in conventional JPEG algorithm. the 2-D DCT is also orthogonal in the trapezoid and triangular blocks in addition to rectangular blocks. Instead of eight by eight blocks, generalize the JPEG algorithm and divide an image into trapezoid and triangular blocks according to the shapes of objects and can achieve higher compression ratio. The number of bytes used for encoding the edges can be less and the error caused from the high frequency component at the boundary can be avoided. The proposed method to generate the 2-D complete and orthogonal sine basis, Hartley basis, Walsh basis, and discrete polynomial basis in a trapezoid or a triangular block.

G.varaprasad et al.[3] on his work has proposed that mobile adhoc network which doesnot have a fixed infrastructure. To increase the lifetime and network in this scenario a new multicast algorithm is used. Residual battery capacity and relay capacity is considered here and multicasting is done from source to destination. It can be compared with multicast-incremental-power, lifetime-aware-multicasttree, multicast-ad-hoc-on-demand-distance-vector protocol and multiple-path-multicast-ad-hoc on-demand vector.

P.Turzca and M.Dupalga et al. [4] in their work has proposed that system consists of a custom CMOS image sensor, a dedicated image compressor, a forward error correction (FEC) encoder which protects radio transmitted data against random and burst errors, a radio data transmitter, and controller supervising operations of the system. image compressor is based on an integer version of a discrete cosine transform and a low complexity efficient, entropy encoder use of an adaptive Golomb-Rice algorithm instead of Huffman tables.

B.Fong and N.Ansari and A.C.M. Fong et al.[5] on his work proposed that prognostics approach is being used for the reliability optimization for telemedicine networks. Prognostics is bassed on analysis of the failure modes, which is based on the analysis of failure modes, detecting the early signs of wear and aging ,fault conditions, has applied to electronic components and systems as well as structural monitoring. The condition of a network can be monitored
By use of operational data related to data packets which are delivered across the network.
Prognostics are important for wireless telemedicine networks since these networks must operate reliably without abruptly changing operating conditions to support life-saving missions.

III. MEDICAL DATA COMPRESSION TECHNIQUE

Following figure illustrates the block diagram of the proposed system.

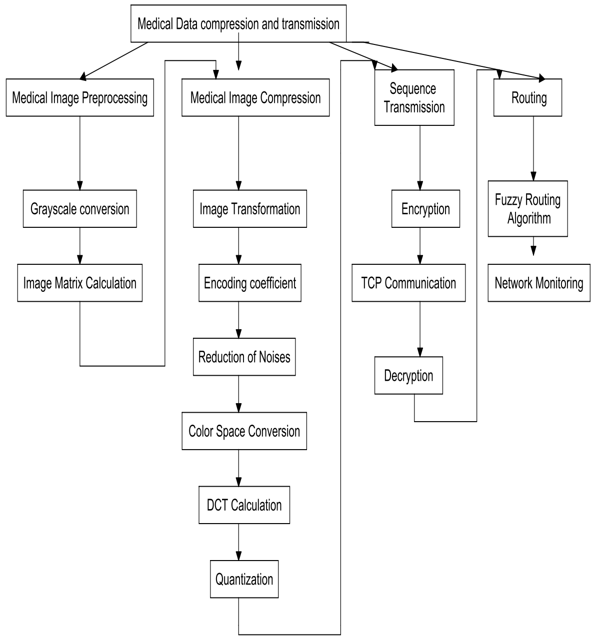


Fig 1.Block diagram

The modules are explained as follows.
Medical image Preprocessing: It is the study of processing of the medical images.
Grayscale conversion: it is to convert an image in which it carries only intensity information.
Image Matrix calculation: An image matrix is calculated.
Image Transformation: Each pixel is represented by R,G,B color planes. Adapativecolor space conversion is better than independent color conversion. The process of image transformation and quantization in steps below:
i) Color-Space Conversion: The technique performs an adaptive color space conversion of the image.
Since lossless and hardware efficient implementation required, YUV r and YCgCo-R corresponds to reverse color transform and fidelity range extension of video coding.
ii)Blockwise pixel scanning: detailed characteristics of image omitted after quantization due to high computational burden.Image is divided into non-overlapping blocks which decrease number of operations.To avoid artifacts the size of the transformed block was kept as 4x4.
iii) Transformation and Quantization: The signal dependent Karhunen-Love transform (KLT) is the efficient decorrelating transform for compressing the component planes to single spectral plane of a color image . Using 2-D integer DCT can be used for compression process to compact energy into few coefficients and also it is used instead of 2D-DCT for transformation and quantization.
The coefficients obtained from block transformation can be encoded using efficient encoder in the next section.
A.Encoding of coefficients: Encoding is done using AGR encoder with parameter k is defined as

$$G(u,k) = 11 \ldots 10 b_{k-1} b_{k-2} \ldots\ldots b_0 \qquad (1)$$

AGR encoder encodes non-negative integers only, the following mapping function used to transform DC coefficients to non-negative integers is given by

$$M_1(d) = \{2d if (d \geq 0)$$
$$= \{2|d| - 1 \text{ otherwise} \qquad (2)$$

Since AC coefficients are signed, a mapping function, denoted by M2(e),

$$M_{2(e)} = \{M_1(e) : e \in Z \neq 0 \qquad (3)$$

is used to transform a nonzero AC coefficient e to a positive integer for the AGR coding, such that
Encryption and Decryption algorithm used is rivest cipher4 algorithm to increase the security.

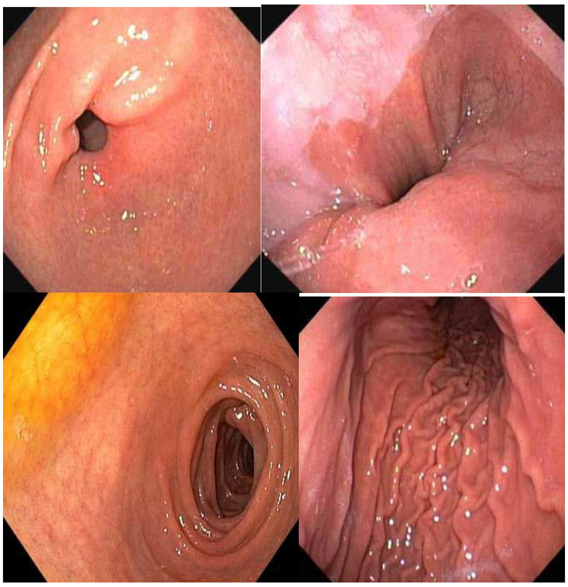
IV. MEDICAL DATA COMPRESSION ALGORITHM

The color-space conversion from *RGB* to *YCbCr* of an input image is performed to generate less correlated component planes. Each component plane is transformed and quantized
to reduce inter pixel correlation and packing pixel energy into few transform coefficients. The plane is divided into non-overlapping $N \times N$ blocks. The blocks are transformed and quantized by blocked IntDCT. The quantized coefficients of each component plane are encoded using a hardware efficient encoder. The coefficients of a block are partitioned into DC and AC coefficients. The DC coefficients are differentially encoded and mapped to non-negative integers using Eq. 2.The resultant coefficients are further encoded using AGR coding shown in Eq. 1.The AC coefficients are scanned along a zigzag order and the nonzero AC coefficients are also mapped to nonzero positive integers using Eq. 3. A pair consisting of a nonzero AC coefficient and the run-length of the succeeding zero-value AC coefficients is encoded using the AGR encoder. Each zero-value AC coefficient is assigned the value '0'.
C. Reduction of Artifacts and Noises: An adaptive edge based fuzzy filtering method to reduce blocking artifacts. It is based on the intensity of pixels close to boundary of two blocks during the time of compression at CC center.
D. Fuzzy-Logic Based Route Selection Technique
When a node d wants to find a route to destination node t, it broadcasts RREQ messages {e,u,d, Esd k , es 1 , ds 1}. If an intermediate node c receives RREQ messages for t: Node c uses the fuzzy rule set and calculates the select_routing_metric for each RREQ message. Node c selects RREQ message

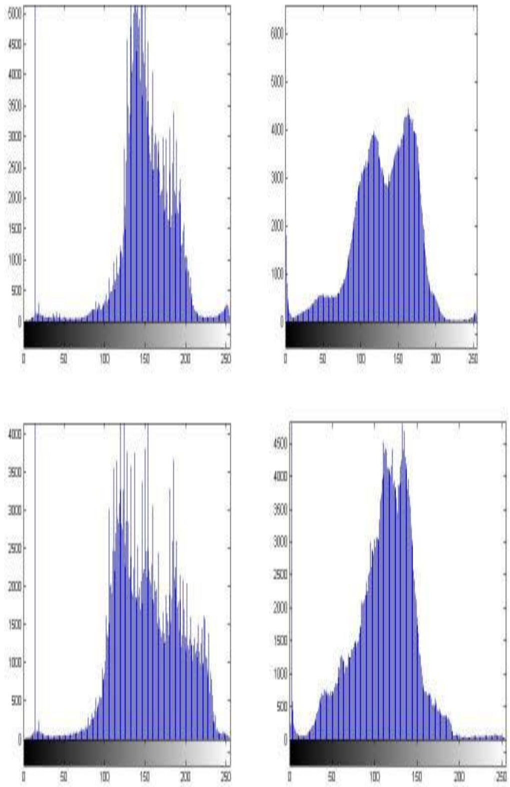
having least select_routing_metric. Node c updates its routing table and broadcasts a RREQ message. When t receives RREQ messages:

Node t uses fuzzy rule set, calculates select_routing_metric for each RREQ message, and updates its routing table. It waits for a fixed time interval to receive more route request messages. Node t unicasts a RREP message back to its neighbor from which it has received the least select_routing_metric.Each node, after receiving a RREP message, unicasts the RREP message towards source node

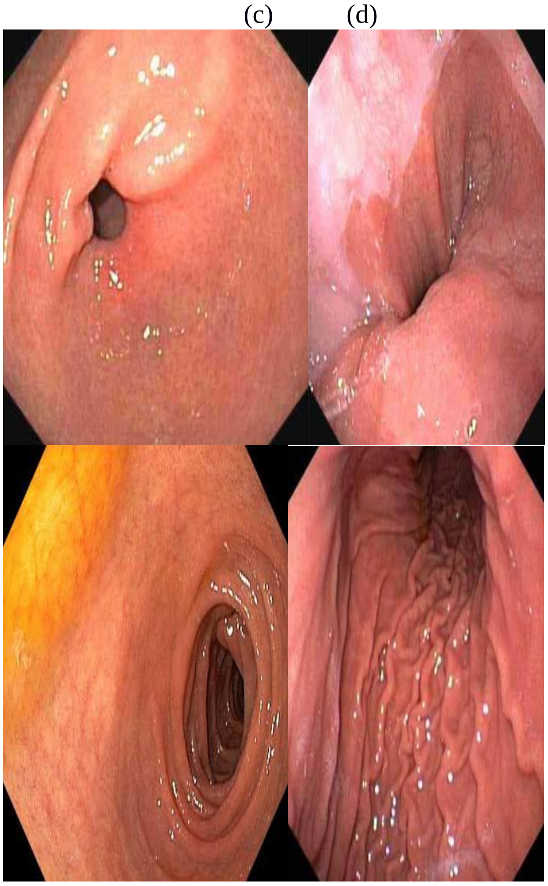
V. SIMULATION RESULTS



(a) (b)



(c) (d)



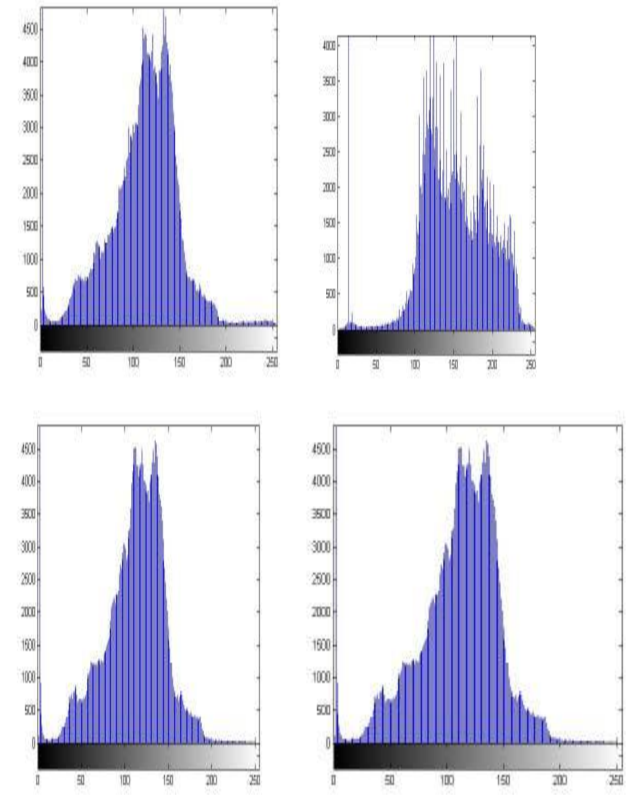


Fig 2. Original endoscopy images(first row),respective histograms (second row),their decompressed counterpart(third row),their respective decompressed histograms(last row).

The medical data compression Technique generated MDPS at the PHC station from
Endoscopicimages of patients.It is then decompressed,artifacts and noises are removed. Compressed MDPs are transmitted to CC center through WANETS.

A.Performance evaluation of the MDC

An image dataset of endoscopic images with a 512x512 used for compression and tested against transmission errors. Other images such as ecg images, mri images can also be used.

1) Visual quality of MDPs: fig.1 illustrates the degradation cannot be perceived by human visual system. The probability is for high and same for the histograms of original and decompressed images. Peak signal to noise ratio(PSNR) is used to determine quality of image reconstruction.

2)Compression ratio: It is the ration of original image to the compressed image. As it increases bit rate will decrease and can achieve highly compressed data.Blockiness effect increases in DCT based method which will increase quality of compressed images.

3)Robustness against errors: The bit error rate (BER) is the ratio of number of error bits to total number of transmitted bits during a interval.BER can be calculated as

BER=transmission errors/total number of bits.

The increase in BER is less in this case, which provides better perceptual quality of an image.

VI. CONCLUSION

In this paper, the proposed system is for the routing of medical data of patients in disaster areas. The proposed system consists of components that collects, compresses and also transmits compressed data to base station via wireless ad hoc network.It can decode correctly even in the presence of transmission errors. This system exploits attributes of quality of service. Simulation and demonstration of the system for different scenario and demonstrated lifetime of network is increased.Thus it maintains QoS of WANETS. In future hardware implementations will be made.

REFERENCES

1. K. Shimazu, M. Ito, Y. Kitsuta, and N. Kawashima, “Project concept:Design concept of ad-hoc information network system for disastermitigation,” in *Proc. ICACCI*, Aug. 2013, pp. 1436–1439.

2. J.-J. Ding, Y.-W. Huang, P.-Y. Lin, S.-C. Pei, H.-H. Chen, and Y.-H. Wang, “Two-dimensional orthogonal DCT expansion in trapezoid and triangular blocks and modified JPEG image compression,” *IEEE Trans. Image Process.*, vol. 22, no. 9, pp. 3664–3675, Sep. 2013.

3. G. Varaprasad, “High stable power aware multicast algorithm for mobile ad hoc networks,” *IEEE Sensors J.*, vol. 13, no. 5, pp. 1442–1446, May 2013.

4. P. Turcza and M. Duplaga, “Hardware-efficient low-power image processing system for wireless capsule endoscopy,” *IEEE J. Biomed. Health Inform.*, vol. 17, no. 6, pp. 1046–1056, Nov. 2013

5. B . Fong, N. Ansari, and A. C. M. Fong, “Prognostics and health management for wireless telemedicine networks,” *IEEE Wireless Commun.*, vol. 19, no. 5, pp. 83–89, Oct. 2012.