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Image Compression using Vector Quantization based on MSE Approach

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Abstract : Vector Quantization is an essential and fundamental technique for lossy image compression. Codebook generation is very important influence in Vector Quantization (VQ).The objective of this research is to create a new inventive Algorithm which can be used to take input image in bits and apply Haar transform to input image to create codebook for Vector Quantization. The new system in this research is used to create codebook based on MSE of input sequences which gives the better quality of image. The codebook generated will be more efficient for low frequency image.If the image size is too large then retrieval time is more so will used Fast Search algorithm can be used to reduce time and used to obtain PSNR with less mean square error (MSE).

Keywords: Image, Image Compression, Vector Quantization, Haar, MSE,PSNR.

1. INTRODUCTION

It's well known certainty that today's world has appear as global village where communication anytime and anywhere is necessary. Internet become the key feature for every domain whether education, industry or entertainment. In every application of computer a digital image is used widely. The 2-dimentional array including large media like videos, images which required large bandwidth to get powerful and efficient transmission of data. Image compression could be one such resolution to achieve better results. Performing this we reduce the amount of data required for such transmission without obstructing the quality of transmission leading to small size image representation. The compression can be easily obtained by reducing the data redundancies in coding, interpixel and psychovisual areas. By effectively handling such redundancies the number of bits representing the image. This bit can be reduced through compression methods. The Compression of image can be splited as lossless and lossy.

The source image is gives replicas exactly in lossless compression method while only some part of the original image can be recovered in lossy compression technique. LZW coding, Huffman encoding and run length encoding are lossless image compression method on the other hand transformation coding, vector quantization belong to lossy image compression technique.

Vector quantization (VQ) includes the process of clustering. VQ compression technique consists of two phases: VQ encoder and VQ decoder. In VQ the given method the image is divided into non overlapping image blocks.The codebook consists of a collection of image blocks called code words. The VQ encoder finds a closest match codeword in the codebook for each image block and the index of the codeword is transmitted to VQ decoder. In the decoding phase, VQ decoder replaces the index values with the respective code words from the codebook and produces the quantized image, called as reconstructed image [1].

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2. LITERATURE SURVEY

2.1 New Clustering algorithm for Vector Quantization Using Hybrid Haar slant Error Vector

Sudeep Thepade and Vandana Mhaske proposed these in year 2015. In these research the error vector used to splitting the clusters in Vector Quantization. It is proposed to be prepared by using discrete Slant transform matrix and Haar matrix. The results show that proposed VQ codebook generation algorithm gives less MSE and less distortion as compared to KEVR, KEVRW which gives better image compression. Proposed algorithm has shown 4.76 % enhancement in the quality of compressed image as compared to KEVR[1].

2.2 New Clustering Algorithm for Vector Quantization using Haar Sequence

This research by Sudeep Thepade and Vandana Mhaske in year 2013.Another method is Thepade's Haar Error Vector Rotation (THEVR) method.In this algorithm two vectors are generated by adding error vector to code vector. This error vector is generated using Haar transform sequence. From the Haar transformation matrix the positive and negative values are replaced respectively with 1's and -1's to obtain the Haar error vector matrix to be used in proposed THEVR codebook generation algorithm, where each row of Haar error matrix ei for ith row will be error vector to be added and subtracted from the centroid of cluster for dividing into two. Haar sequence consists of a brief positive impulse followed of a brief negative impulse. So there is fast change in cluster orientation. This gives effective clustering [2].

2.3 Thepade's Hartley Error Vector Rotation For Codebook Generation In Vector Quantization

In this algorithm error vector is generated using Hartley sequence. Hartley error vector matrix which is to be used in proposed codebook generation algorithm Thepade's Hartley Error Vector Rotation (THtEVR), where each row of Hartley's error matrix ei for ith row will be error vector to be added and subtracted from the centroid of cluster and two vector v1 and v2 are generated. Although the DHT is defined for both real and complex sequences, its practical values arise from the way in which it takes advantage of the symmetry in DFT real sequence. The results obtained indicated that THtEVR gives less MSE and less distortion as compared to KEVR and KEVRW giving better image compression [3].

2.4 New Clustering Algorithm for Vector Quantization using Rotation of Error Vector

The paper presents new clustering algorithm. In this paper existing codebook generation algorithms i.e. Linde Buzo Gray (LBG) and Kekre's Proportionate Error (KPE). Constant error is added every time to split the clusters in LBG, resulting in formation of cluster in one direction which is 135º in 2-dimensional case. Because of this reason clustering is inefficient resulting in high MSE in LBG. To overcome this drawback of LBG proportionate error is added to change the cluster orientation in KPE. Though the cluster orientation in KPE is changed its variation is limited to ±45º over 135º. The proposed algorithm Kekre's error vector rotation(KEVR) takes care of this problem by introducing new orientation every time to split the clusters[4].

2.5 New Clustering Algorithm for Vector Quantization using Walsh Sequence

This paper aims to present an improvement to KEVR algorithm. In KEVR, only one digit of error vector changes in each iteration, which results in slowly changing cluster orientation. This drawback is removed in proposed technique-KEVRW. In KEVRW, the Walsh sequence is used to generate error vector. The Walsh sequences are symmetric in nature and half the number of digits change in successive Walsh sequences. So there is a fast change in cluster orientation. This gives effective clustering. It is observed that KPE and KEVR give far better performance as compared to LBG algorithm. However the proposed new algorithm KEVRW improves this performance. The proposed method reduces MSE by 59% to 70% for codebook size 128 to 1024 with respect to LBG, by 43% to 32% with respect to KPE and by 16% to 19% with respect to KEVR[5].

3. CODEBOOK GENERATION ALGORITHM

In this section existing codebook generation algorithms i.e. Kekre's Error Vector Rotation (KEVR) and Kekre's Error Vector Rotation Using Walsh Sequence (KEVRW) are discussed.

3.1 The KEVR Algorithm [4]

In Kekre's error vector rotation (KEVR) algorithm two vectors v1 and v2 are generated by adding and subtracting error vector to code vector. First image is divided into non overlapping blocks and each block forms training vector set. Centroid is computed for training vector set and error vector is added or subtracted from the code vector and two vector v1 and v2 are generated. The Mean square error between training vector and codeword is computed and v1 and v2 splits in two clusters. This procedure is repeated for the new clusters. This procedure is repeated till codebook of desired size is obtained. KEVR introduces new orientation every time to split the clusters. But in KEVR the error vector sequence is the binary representation of numbers starting from 0 to k-1, so only one bit of error is changed in one iteration.

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3.2 The KEVRW Algorithm [5]

In KEVRW algorithm image is divided into non overlapping blocks which forms training vector of dimension k. It is considered as one cluster and its centroid (mean) represents space first code vector. Then generate n Walsh sequences where codebook size of 2n is required by sampling Walsh function at center of interval. Then add and subtract first Walsh sequence to the first code vector to generate two codes Walsh sequence is used to generate error vector. The Walsh sequences are symmetric in nature and half the number of digits change in successive Walsh vectors. Then calculate Mean Square error between the training vectors in the cluster and the code vector to split the cluster into two. Update the cluster centroid. In the next iteration add and subtract next Walsh sequence to the cluster centroid. The procedure is repeated for each cluster till the codebook of desired size is obtained.

3.3 The Proposed Algorithm

Codebook generation acts as important role in Vector Quantization (VQ). The codebook is used to encode the image blocks for image compression.

In this proposed algorithm two vectors v1 and v2 are generated by adding error vector to code vector. This error vector is generated using Haar sequence. From the Haar transformation matrix the positive and negative values are replaced respectively with 1's and -1's to obtain the Haar error vector matrix to be used in proposed MSE based HEVR codebook generation algorithm, where each row of Haar error matrix ei for ith row will be error vector to be added and subtracted from the centroid of cluster for dividing into two. Haar sequence consists of a brief positive impulse followed of a brief negative impulse. So there is fast change in cluster orientation. This gives essential clustering. The 4x4 Haar sequence is given below.

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix}_{4x4}$$

4. IMPLEMENTATION

There are three important approaches in Vector Quantization that are codebook generation, encoder and decoder procedure. In the codebook generation method images are separated into several dimension training vectors sets. The relevant codebook generated from training vectors by using the different clustering Algorithms. In the encoding procedure, an original image is divided into various k-dimension vectors and every vector is encoded by the index of code word by a table look-up method. Which is known as index table? During the decoding procedure, the receiver user uses this same codebook to convert the index back to its corresponding code word for reassembling the image.

Pre-processing: Preprocessing images commonly involves removing low-frequency background noise. Image pre-processing can significantly increase the reliability of an optical inspection. Users are able to optimize a camera image with just a few clicks

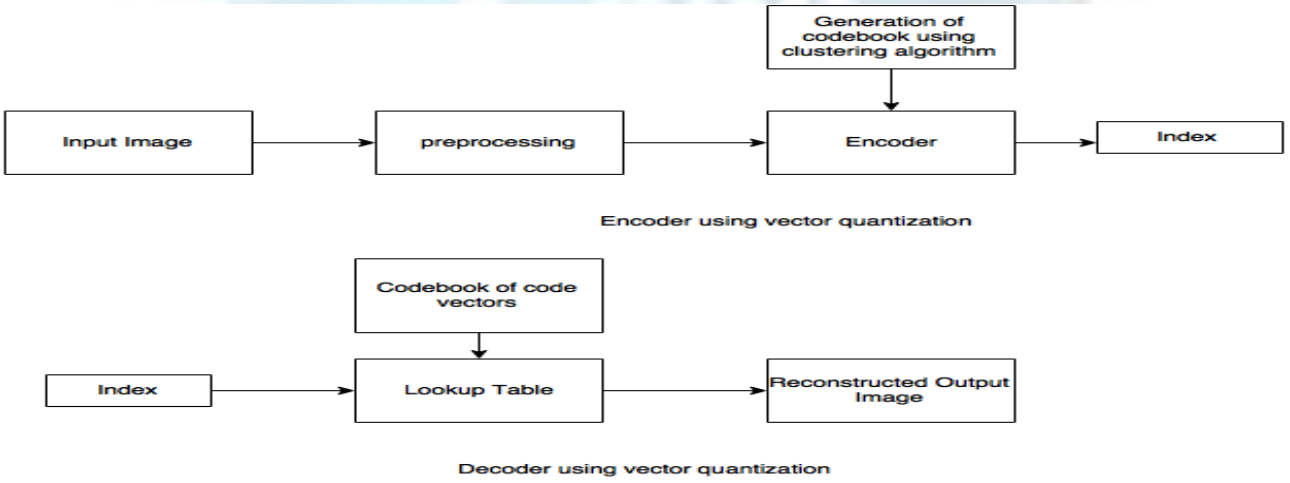

Figure 1: Architecture of Vector Quantization

4.1 The Proposed MSE based HEVR codebook generation algorithm

The algorithm for proposed system as follows:

Step 1: Image is divided into non overlapping blocks.

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Step 2: Each block is converted into training vector of dimension k. Initially all vectors are considered to be in one cluster.

Step 3: Its centroid represents first code vector.

Step 4: Generate Haar error vector.

Step 5: Then add and subtract all Haar sequence to the first code vector to generate two code vectors.

Step 6: To form the two clusters using Euclidean distance between the training vectors in the cluster and the code vectors.

Step 7: For newly generated centroids from first code vector MSE will calculated.

Step8: Centroids having minimum MSE will be considered for further processing.

Step 9: Repeat the steps from 5 to 8.

Step10:This process will continue as per the size of codebook.

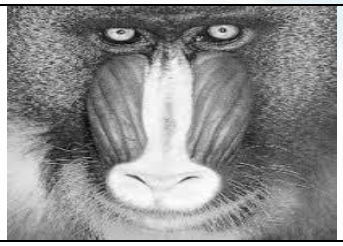
4.2 4.2 The Proposed Fast Search Algorithm

Read the input image. Arrange it into subimages of size 2*2. Find the sum of each codevector. Arrange codevectors in ascending order Find the sum of image vector. Sort for the minimum distance. Reconstruct the image by replacing the Corresponding codevector. The total time required for finding out the proper codevector was calculated. The MSE is calculated between the original image and the reconstructed image.

5 RESULTS

The proposed algorithm were implemented using Matlab 7.1 Using P-IV and MSE,PSNR were calculated. The image were used of size 256*256 and image was arrange to generate codebook size 4*16384 and the size of codebook generated was 4*256.Similarly image arranged to size 16*4096 and the size of codebook generated was 4*64.The MSE and PSNR for codebook size 64 were calculated for Following images

.

Original Image	Reconstructed Image
	
Vegetables	**MSE=65.4874** **PSNR=0.7355**
	
Baboon	**MSE=104.1031** **PSNR=0.4627**
	

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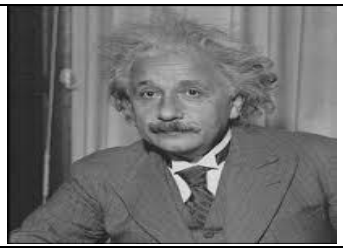
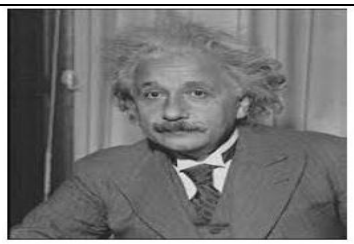
Lena	**MSE=75.0772** **PSNR=0.6415**
	
Man	**MSE=45.6117** **PSNR=1.0560**

Figure 2: Some Sample results of Proposed Algorithm From codebook size 64

6. CONCLUSION

The new algorithm MSE based Haar error vector for codebook generation is proposed and it gives better result than other algorithms. The Fast Search algorithm is apply to image for rapid reconstruction of image. The proposed algorithms gives minimum MSE and PSNR and obtained maximum compression ratio.

BIBLIOGRAPHY

[1] T. S. D and M. Vandana, "New Clustering Algorithm for Vector Quantization Using Hybrid Haar Slant Error Vector," in IEEE International Conference on Computing Communication Control and Automation, 2015.

[2] T. S. D and M. Vandana, "New Clustering Algorithm For Vector Quantization Using Haar Sequence," in IEEE International Conference on Infromation and Communication Technologies, Tamilnadu, 2013.

[3] S. D. Thepade, V. Mhaske and V. Kurhade, "Thepade's Hartley Error Vector Rotation For Codebook Generation in Vector Quantization," in IEEE Internatinal Conference WCI, Maysore, August 2013.

[4] Dr.H.B.Kekre and T. K.Sarode, "New Clustering Algotithm for Vector Quantization Using Rotation Error Vector," Internatinal Journal of Computer and Information Security, vol. 7, no. 3, 2010.

[5] Dr.H.B.Kekre, T. Sarode and J. Save, "New Clustering Algorithm for Vector Quantization Using Walsh Sequence," Internatinal Journal of Computer Application(0975-8887), vol. 39, no. 1, February 2012.

[6] S. Thepade, V. Mhaske and V. Kurhade, "New Clustering Algorithm'TCEVR' for Vector Quantization Using Cosine Transform," ELSEVIER International Journal, March 2011.

[7] A. B.Kulkarni and G. Pardesi, "Fast Search Algorithm for Vector Quantization," in International Conference on Advance in Computing,Communication and Control(ICAC3'09), January 23,2009.

[8] T.-C. Lu and C.-Y. Chang, "A Survey of VQ Codebook Generation," Journal of Information Hiding and Multimedia Signal Processing ISSN 2073-4212, vol. 1, no. 3, July 2010.

[9] T. S. Dr.H.B.Kekre, "Two-level Vector Quantization Method for Codebook Generation using Kekre's Proportionate error Algorithm," CSC International Journal of Image Processing, vol. 1, no. 3, 2010.

[10] Dr.H.B.Kekre and T. Sarode, "Fast Codevector Search Algorithm for 3-D Vector Quantized Codebook," WASET International Journal of Computer Information Science and Engineering, vol. 2, no. 4, pp. 235-239.

[11] S.Jayraman, S.Esskrajan and T.Veerkumar, Digital Image Processing, TMH,3rd Edition, 2010.

