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Improved Thresholding Technique for Spatial Error Concealment

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Abstract— One problem with communication system is that information is altered and lost due to noise in the channel. Impact of the data and information loss is disastrous for transmission of video and image signal as the harm to compressed bit stream leads to subjective and visual distortion at the decoder end. Further due to the real time needs which do not include the employment of certain error-recovery techniques for some of the process. The paper proposes the method for concealing error in the images and further improving the quality of images. The method of directional interpolation has been employed on images using thresholding technique and then the PSNR (peak signal to noise ratio) of image has been improved with image enhancement technique.

Index Terms- DCT, Directional interpolation, PSNR, SEC.

1.INTRODUCTION

Spatial error concealment is a technique in which the errors which are transmitted or encoded signal are replaced by a practically evaluated synthetic content. When images are transmitted specially through wireless networks they tend to lose some part of information either due to channel noise or passing through various involved components like router, switches etc. there the need arises of error concealment. Transmission of image signal on through error prone channels tends to have packet and bit loss. The Error concealment is actually an extent of exactly received portions of the images signals to regions damaged by errors occurred during transmission.
The compression of the input video is done at the source encoder to achieve the desired bit rate. The function of transport coder is to perform channel coding, modulation and packetization. The transport protocols are used for transport-level control. Then this transport coder converts the whole bit packet output from source coder back to data units which are very much convenient for transmission. Further at the point of reception that is receiver side, opposite operations are performed to get and regenerate video signal for displaying.
The source coder is classified among entropy coder and waveform coder. The Waveform coder performs as a lossy device which decreases the bit rate by using the original video signal by using transformed variables and then by applying quantization. Wavelet and Discrete cosine transform (DCT) are examples of waveform coders is transform coding whereas on the other side, entropy coder is acts as a lossless device that actually generate output out of waveform coder to binary words as per the distribution of the symbols to be coded. The arithmetic and Huffman coding are examples of entropy-coding strategies.
Though the waveform coder uses one of the video-coding methods, our focus is which coder uses motion-compensated prediction and DCT. DCT proved to be very much useful for various applications and used among all video-coding technique. Transport coder is different for various types of applications. Generally, to assist error concealment at the decoder end, a certain redundancy is added at the entropy, waveform, or transport-coder. It is assumed that the bit rate is fixed for source and channel coding.
Transmission errors are classified into two parts: erasure errors and random bit errors. The Random bit errors occurdue to the imperfections of physical channels, which lead to, bit insertion, bit deletion and inversion. Further on the basis of coding schemes and the present information, the effect random bit errors vary from very less to objectionable extend. When fixed-length coding is used, a random bit error affects one code word, and the harm in the information is mostly acceptable. when variable length coding (VLC) such as Huffman coding is used, random errors they effect the synchroniztion the encoded information such that many bits does get decoded till the next synchronization code word comes. In some cases, if synchronization is achieved, the information decoded can still be meaningless since there is no method to find which temporal and spatial locations which correspond to the decoded message. Whereas errors happen due to loss of packet in packet networks and burst errors in storage media due to physical deformities, and system failures for small interval of time.

Figure 1 shows the block diagram of video communication

Earlier error control and recovery method for data communications has further increased for video transmission.All these techniques have motive of lossless recovery. The random bit errors will causes erasure errors as one bit error cause many following bits being undecodable and useless. Result of erasure errors which occurs due to random bit errors is far bad than random bit errors as the loss of a continuous number of bits. As most of the video compression techniques use VLC in there is not any requirement to treat erasure errors and random bit errors differently.

Examples of such schemes include forward error correction (FEC), and automatic retransmission request (ARQ). Whereas signal-reconstruction and error-concealment techniques are designed so as to get approximatly same value as of the initial signal ans so as to have the output signal very less objectionable to human eyes. Different from data transmission, where error free delivery is needed human eyes can accept a precise amount of damage in video and image signals.

In earlier years, several methods have been defined and explained for error concealment. An approximation of the missing area is achieved by error reduction through certain basis functions. The reconstruction of images from coefficients in block transform coder has been described in maximally smooth recovery is in [1] and the use of inter layer correlation is described in projection onto convex sets [2]. Interpolation has also been calculated in the transform domain included in [3] to improve the quality of image the efficient algo has been described. The signal extrapolation is performed by increasing the strength of signal from a small limited number of known samples into areas beyond the samples. A finite set of orthogonal basis function is used and the known part of the signal projected on to them [4]. The algorithm generates a generic, complex valued model of the signal to be extrapolated as weighted superposition of Fourier basis function where in [2]-[4], the exactly received areas is represented as a combination of the basic functions in the transform domain. some other methods perform error concealment in spatial domain. Weighted averaging has been described in [6] which is an easy and quick procedure for images that has been used in H.264/AVC reference model [7]. most of the described methods ignore the edge information andtherefore lack to [8]-[9] is applied as edge related information and further various simulation has been done for concealing errors in image.

2. SPATIAL ERROR CONCEALMENT (SEC)

In signal and image processing spatial error concealment is a technique in which errors in transmitted signal are replaced by evaluated values of pixels from its neighbors. The Spatial Error Concealment is a technique in which we interpolate the lost region from its spatially nearby available pixels or coefficients.

A.THRESHOLDING

It is a simplest approach for image segmentation. It changes a gray scale image into binary by assigning two levels to pixels that are below and above the specified threshold value. There are various methods available for thresholding like any hypothetical value from image pixels or approximation of histogram of an image pixels or adaptive thresholding. In this paper adaptive thresholding technique is used.

B.PIXEL INTERPOLATION

A digital image actually is not an exact snapshot of reality; it is only an approximation of discrete values The resolution of an image is actually defined as the number of pixels, but the effective resolution is a harder quantity to define as it dependent on the subjective human perception and judgment.the digital image has large number of elements which has its own location and value. The need for processing image includes these two principles. One is improving pictorial information for human interpretation and perception. Secondly developing or manipulating of image data for good storage and presentation, two steps are involved for pixel value magnification firstly creation of new pixels and further assigning pixel values to these pixels. The simplest method proposed is pixel interpolation.

3.PROPOSED METHOD

A new method is used for determining the threshold value has been described. The value has been evaluated by determining the mean and the standard deviation to get the threshold value and then this value is used for spatial error concealment further PSNR has been evaluated for the original image and the regenerated image. The threshold value is determined with the formula

$$T = b + c * d \text{..}(i)$$

Where T is the threshold value, b and d is the mean and standard deviation respectively of image pixels. Parameter c is a normalizing factor used to evaluate as follows. The constant c is evaluated as follows:

$$c = 1 - \left(\frac{1}{\log 2\,(n)} * \left(a_i \log\left(\frac{1}{a_i}\right) \right) \right) \dots\dots \qquad (ii)$$

where a_i is the sum of pixel and n is quantization level used. After the threshold value has been determined then this value is used for spatial error concealment.

For the image then we apply the determined threshold value to evaluate the gradients(*iv*) and angle(*v*) further we find the direction of the pixel values and then pixel interpolation is done to obtain the new error concealed image. The PSNR has been evaluated further image enhancement technique is employed to improve the quality of image given by the formula in (*vi*) and then again PSNR has been evaluated for these images. The flowchart for SEC has been described in fig 2.

S_{hl} =[-1 0 1; -2 0 2;-1 0 1]
S_{vl} = [-1 -2 -1; 0 0 0; 1 2 1]................................ (*iii*)

$$G_{vl} = S_{vl} \otimes p(x,y)$$
$$G_{hl} = S_{hl} \otimes p(x,y) \text{..................................}(iv)$$

$$\theta = -\tan^{-1}((G_{vl})/(G_{hl}) \text{........................}(v)$$

J=IMADJUST(I,[LOW_IN;HIGH_IN],
[LOW_OUT;HIGH_OUT])...............(*vi*)

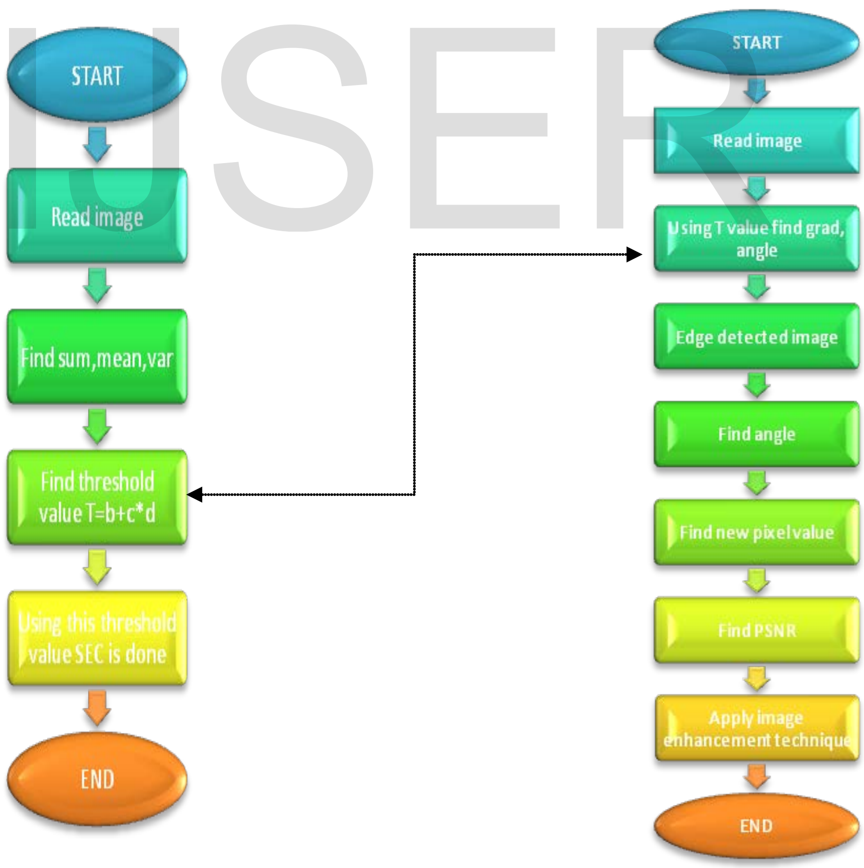

Fig 2: spatial error concealment using improved thresholding technique and enhancement technique

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4. SIMULATION RESULTS

Simulation has been done firstly by applying SEC on the test image and then PSNR has been calculated. Further SEC is done using improved thresholding and again PSNR is calculated. Next, Image enhancement technique is applied to the error concealed image to obtain better quality of image and then PSNR is calculated for the same.

TABLE1: PSNR ESTIMATION

Image	PSNR(without threshold) [10]	PSNR(with threshold) [10]	PSNR(with enhance-hancement) proposed
Lady	38.17	45.54	51.19
Public	30.74	31.38	50.53
Heart	38.71	40.51	51.50
Car	39.88	40.54	50.83
Boy	39.08	41.91	52.53

5.CONCLUSION

In this, a novel method for improving the quality of image has been described. The paper proposes a method for concealing the errors in image using improved thresholding technique and further increasing the quality of image using image enhancement technique. It has been observed that higher degree of PSNR is obtained by applying the directional interpolation and with application of improved threshold value and image enhancement technique. Various images have been taken as test images of different sizes and then there PSNR has been evaluated for all these images. the evaluated results for the above described method shows far better results than simply calculating the PSNR for spatially concealed image. In future more methods can be applied to improve the quality of image and to achieve higher PSNR.

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