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Restoration of Image Using KNN Algorithm

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Abstract: - This paper analyzes coding algorithm of JPEG image and proposes a K-Nearest Neighbor (KNN) approach to perform in painting in the DCT Coefficients to get a more optimized compression ratio. The proposed methodology is expected to outperform the compression ratio of the Baseline JPEG Algorithm dealing with images having cracks and distortions. The reason behind this is plain and simple. Images having distortions will have anomalies in the distorted parts which will contribute to the size of the image. If those distortions are removed before compression, the output will be more optimized.

Keywords: *DCT, JPEG, KNN, PSNR, SSIM (Structural Similarity Index Measurement)*

Introduction

Image restoration is based on the attempt to improve the quality of an image through knowledge of the physical process which led to its formation. The purpose of image restoration is to "compensate for" or "undo" defects which degrade an image. Degradation comes in many forms such as motion blur, noise, and camera misfocus. In cases like motion blur, it is possible to come up with a very good estimate of the actual blurring function and "undo" the blur to restore the original image. In cases where the image is corrupted by noise, the best we may hope to do is to compensate for the degradation it caused. Image restoration differs from image enhancement in that the latter is concerned more with accentuation or extraction of image features rather than restoration of degradations. Image restoration problems can be quantified precisely, whereas enhancement criteria are difficult to represent mathematically.

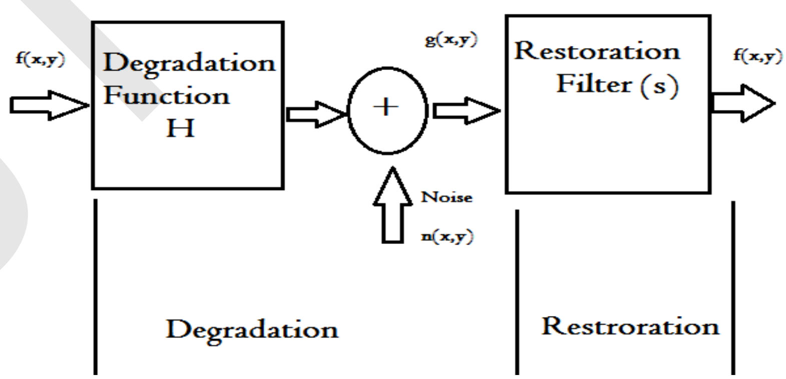


Fig.1. Degradation/Restoration Model

Image restoration uses a priori knowledge of the degradation. It models the degradation and applies inverse process. It formulates and evaluates the objective criteria of goodness. The distortion can be modelled as noise or a degradation function. To restore an image from a noise model, different filters like median filter, homomorphic filters are used.

Overview of Restoration

- A categorization according to the degradation model (noise, blur or both)
- Another possible categorization:
    - Spatial domain techniques

Characteristics/Techniques	**Huffman Coding**	**Run-Length Coding**	**Arithmetic Coding**
Task	Replaces fixed length code by variable length.	Replaces runs of two characters single Code.	Use occurrence and cumulate-ive to represent the source image
Compression Ratio	Average	Good	Very Good
Compression Speed	Very Fast	Fast	Slow
Complexity	Simple	Very Simple	Complex
Decompression Speed	Fast	Fast	Slow

Table 1 Comparison of encoding Techniques

- Bayesian techniques – make use of a priori knowledge about the unknown, undegraded image statistical image modeling
- Total variation – involves regularization –
- Penalization of not-desired local image structures Statistical image modeling.
- Modeling marginal statistics (image histograms)

Compression Algorithm
As stated above, Image compression Algorithms can be partitioned into: Lossy and Lossless. Decompression after lossless compression yields the same input image. Lossy compression brings about loss of information and the decompressed image is not precisely the same as the first.

- Lossy Algorithm
- Lossless Algorithm
- Joint Photographic Experts Group (JPEG)
- 8X8 FDCT and IDCT
- Quantization

Literature Survey
Vahid Bastani (2010) proposed an algorithm for image compression focused around an image inpainting [29] system. Initially the image regions that can be precisely recuperated are located. At that point, to lessen the information, data of such locales is evacuated. The remaining information other than essential details for recovering the removed regions are encoded to

deliver output data. At the decoder, an inpainting method is applied to retrieve removed regions using information extracted at the encoder. The image inpainting technique utilized partial differential equations (PDEs) for recovering data. It is intended to accomplish superior performance in terms of image compression criteria. This algorithm was analyzed for different images. A high compression ratio of 1:40 was achieved at an acceptable quality. Trial results demonstrated achievable obvious quality improvement at a high compression ratio compared with JPEG. The PSNR and SSIM of the sample images demonstrated that the proposed technique outperformed JPEG at high compression ratios, for example, 1:40 (0.2 bpp) and were more outstandingin low structured and low textured pictures.

Qiang LI (2014), proposed a novel algorithm that uses compressed sensing (CS) [30] in the frequency domain rather than most existing algorithms which are pixel based, to recreate corrupted images. With a specific end goal to reconstruct image, the authors first disintegrated the picture into two functions with diverse basic characteristics - structure component and textual component. They looked for a meager representation for the functions and utilized the DCT coefficients of this representation to produce an over-complete word dictionary. Experimental results on real world datasets showed the adequacy of their method in image inpainting. The method is contrasted with three state-of-the-art inpainting algorithms and it showed favorable circumstances regarding both quantitative and qualitative aspects. The proposed system can viably repair images contrasted with three other pixel-based image inpainting systems referred in the paper, particularly when the image is met with a large destroyed region. The method ensured good image quality with the structure being decently restored, and the PSNR is generally high. Likewise, there is a much better advantage in terms of time spent.

Christine Guillemot (2013), depicted an examplar-based picture inpainting algorithm locally linear neighbor embedding technique with low-dimensional neighborhood representation (LLE-LDNR). The inpainting algorithm first searches the K nearest neighbors (K-NN) of the input patch to be filled-in and linearly combine them with LLE-LDNR to synthesize the missing pixels. Linear regression is then introduced for enhancing the K-NN search. The performance of the LLELDNR with the enhanced K-NN search method is surveyed for two applications: loss concealment and object removal. Instead of using a similarity kernel, the weights are processed utilizing locally linear embedding with low-dimensional neighborhood representation (called LLELDNR in the sequel). The technique is a variation of locally linear embedding (LLE) where the weights are computed on in LLE . The algorithm searches for an approximation of the known pixels of the input patch from its K-NN. This principle is known as neighbor embedding (NE). The paper considers linear regression for enhancing the K-NN search as well as for estimating unknown pixels. Experimental in two applications (loss concealment and object removal) show superior performances of the LLE-LDNR solution over other neighbor embedding solutions. Although, only comparisons with NLM and LLE are given here, tests have indicated better performance over with Non-Negative Matrix Factorization too. The results likewise demonstrated further gains when utilizing the proposed improved K-NN search utilizing linear subspace mappings in the context of inpainting.

Li Zhiqiang (2013) disintegrated the coding algorithm of JPEG [23], advances the JPEG encoder and decoder control processes. They showed the encryption and decryption of image by using Logistic sequence. Results demonstrated that this method not just save storage space for other helpful data additionally enhanced the transmission efficiency and security in the transmission process. The article combines JPEG compression algorithm with chaotic encryption algorithm, which can viably save the storage space for image and guarantees the secure transmission of image information. In this paper, the actual characteristics of DSP hardware platform were taken into consideration. They utilized the static image compression algorithm to compress image. Since DCT transform is the most lengthy part in the image processing, this article is planned the FDCT transform and FIDCT transform systems

Mitchell A. Golner (2012) proposed a region based variable quantization scheme [24], where the quantization granularity in diverse preselected regions of the image is varied at the discretion of the user. The techniques developed in this work are compatible with the popular JPEG Still Image Standard for compression of continuous-tone grey-scale and color images. Further, region selection techniques and algorithms that complement variable quantization techniques are introduced. The paper introduced three masks: step, linear interpolated, and raised cosine interpolated, that control the transition in the quantization granularity between regions of diverse compression ratios in an image.
incorporates a point by point discussion of simulation results utilizing the proposed methodology. At the point when the strategies recommended were used, the subjective visual quality significantly enhances for comparable compression ratios of standard JPEG implementation, or proportionately, a higher compression ratio is accomplished for the same subjective visual quality. Likewise, in conjunction with the variable quantization technique, they introduced step, linear interpolated, and raised cosine interpolated masks that control the quantization granularity in transitions between regions of different compression ratios.

Image In painting/Restoration KNN Algorithm
K-NN is utilized for regression or classification. Here we are going to do classification. To do restoration, the closest neighbors of a pixel are considered. Here, K>1 is considered, i.e. an aggregate of k neighbors of every pixel can be considered in a closed window of 8x8. In the 2d matrix of image components, every component has a certain correlation with its closest components.

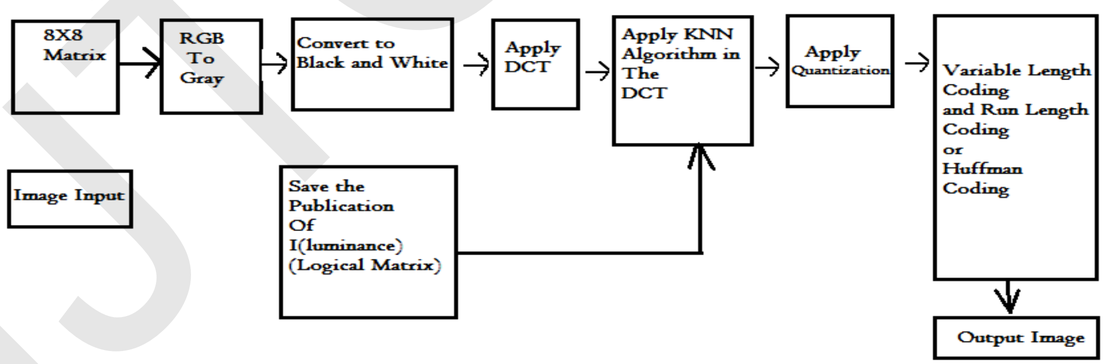


Fig 2: KNN Algorithm

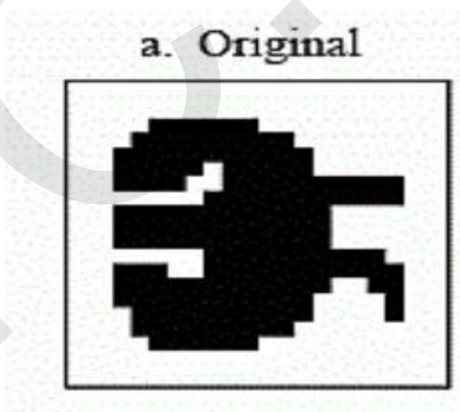
We can write algorithms by considering this property, and use the mean of all the closest neighbors to replace a damaged pixel. Hence a decent level of restoration is guaranteed by this method. The algorithm proposed will complete an iterative methodology wherein the mean intensity is discovered and further substitution The computation of the likelihood of event of each one of noisy pixel is carried out. Consider an input picture Pi, given us a chance to characterize a pixel at a position (q,r) in the info picture. Neighbor of Pi(q,r) is performed first. The mean worth is acquired by utilizing the accompanying representation Eq. 1, for a sum of k neighbors in that window.

$$M = \sum X_i P(X_i)$$

Eq. 1 gives the mean of all neighboring points of a specific pixel. This gives a value what we call as a "good pixel value". Hence the good pixel value replaces the central corrupt pixel. This guarantees the removal of the tainted pixels and restoration of the given image.

Following are the steps for the algorithm

1) Obtain image (having cracks and minor distortions).
2) Divide it into 8x8 matrix components.
3) Converts to Grayscale.
4) Convert to Black and White (logical class) and save the positions of 1(luminance) from the matrix.
5) Apply DCT to the matrix obtained from step 3.
6) Apply KNN Algorithm to the positions obtained from step 4, in the DCT Coefficients.



`Fig 3 (a) : Input image

7) Apply Quantization to compress the data.

8) Apply Variable Length Coding which includes Zigzag filtering and Run-Length Encoding or Huffman Encoding.

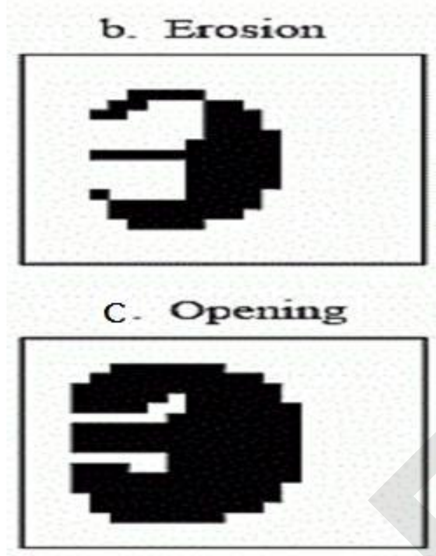


Fig 3 (b and c) : Input image

The image is converted into Black and White to retrieve the positions of cracks/distortions. In this, only luminance is shown with 1(the cracks and distortions) in the matrix. Rest every chroma component is 0. This is known as logical class.

Conclusion

The proposed methodology is expected to give a good PSNR value compared to the output of JPEG Baseline Algorithm. The output image from the system is expected to be visually more attractive to the Human eyes because of the removal of noise that were present before compressing the image.

Reference

[1] Wallace, G. (Feb 1992). The JPEG Still Picture Compression Standard. *Consumer Electronics, IEEE Transactions,* xviii - xxxiv .

[2] N. Ahmed, T. N. (Jan 1974). Discrete Cosine Transform. *IEEE Trans. Commun. 23,* 90–93.

[3] M. Bertalmio, A. B. (2001). Navier-stokes, fluid dynamics, and image and video inpainting. *Proceedings of the 2001 IEEE Computer Society Conference on (Volume:1)* (pp. I-355 - I-362 vol.1). IEEE.

[4] Telea, A. (2004). An image inpainting technique based on the fast marching method. *J. Graphics Tools, vol. 9, no. 1* , pp. 25–36.

[5] Tschumperle, D. (2006, March 01). Fast anisotropic smoothing of multi-valued images using curvature-preserving pde's. *Springer* , pp. 65-82.

[6] Shen, T. C. (2002). Mathematical Models for Local Nontexture Inpaintings. *SIAM J. Appl.Math, vol. 62, no. 3* , pp. 1019–1043.

[7] Leung, A. E. (1999). Texture synthesis by non-parametric sampling. *Computer Vision, 1999. The Proceedings of the Seventh IEEE International Conference on (Volume:2)* (pp. 1033 - 1038 vol.2). Kerkyra: IEEE.

[8] A. Criminisi, P. P. (Sept 2004). Region filling and object removal by examplar-based inpainting. *IEEE Trans. on Image Processing, vol. 13, no. 9,* 1200 – 1212.