IMAGE DENOISING USING DEEP LEARNING CONVOLUTION NEURAL NETWORK

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Abstract:

The project presents denoising of image using the convolutional neural network (CNN) model in deep learning. It has become an important task to remove noise from the image and restore a high-quality image in order to process image further for the purpose like object segmentation, detection, tracking etc. This analysis is done by adding 1% to 10% Gaussian white noise to the image and then applying CNN model to denoise it. Further, qualitative and quantitative analysis of the denoised image is performed. Finer qualitative analysis comes the quality of image where edge factor, texture, uniform region and non- uniform region, smoothness, structure of objects is considered. The quantitative analysis is done using the three metrics which are PSNR (peak signal to noise ratio), SSIM (structural similarity index measurement), and MSE (mean square error) in which the CNN based method's results are compared with the traditional or standard methods of image denoising. The results from the analysis and experiment show that the CNN model can efficiently remove a lot of Gaussian noise and restore the image details and data than any other traditional/standard image filtering techniques.

Keywords:Image Denoising, Filters, Transform Domain, Wavelet Thresholding

1.Introduction:

Image noise is random variation of brightness or colour information in images, and is usually an aspect of electronic noise. It can be produced by the image sensor and circuitry of a scanner or digital camera. Image noise can also originate in film grain and in the unavoidable shot noise of an ideal photon detector. Image noise is an undesirable by-product of image capture that obscures the desired information. The original meaning of "noise" was "unwanted signal"; unwanted electrical fluctuations in signals received by AM radios caused audible acoustic noise ("static"). By analogy, unwanted electrical fluctuations are also called "noise". Image noise can range from almost imperceptible specks on a digital photograph taken in good light, to optical and radio astronomical images that are almost entirely noise, from which a small amount of information can be derived by sophisticated processing. Such a noise level would be unacceptable in a photograph since it would be impossible even to determine the subject.

2.Noise Models:

Noise is present in image either in additive or multiplicative form.

2.1 Additive Noise Model :

Noise signal that is additive in nature gets added to the original signal to generate a corrupted noisy signal and follows the equation as

$$w(x, y) = s(x,y) + n(x,y) \text{ .....(1)}$$

where, s(x, y) is the original image intensity and n(x,y)is the noise introduced to produce the corrupted signal w(x,y) at (x,y) pixel location.

2.2 Multiplicative Noise Model:

The noise signal gets multiplied to the original signal. The multiplicative noise model equation as follows

$$w(x, y) = s(x, y) \times n(x,y) \text{ .....(2)}$$

3. Block-matching algorithms:

A block-matching algorithm can be applied to group similar image fragments into overlapping macro blocks of identical size, stacks of similar macro blocks are then filtered together in the transform domain and each image fragment is finally restored to its original location using a weighted average of the overlapping pixels.

Random field: Shrinkage fields is a random field-based machine learning technique that brings performance comparable to that of Block-matching and 3D filtering yet requires much lower computational overhead (such that it could be performed directly within embedded systems).Software: Most general-purpose image and photo editing software will have one or more noisereduction functions (median, blur, despeckle, etc.)

4.Image types:

The tool compartment underpins 4 types of images: 1. Intensity of pixels; 2. Twofold images; 3. Filed images; 4. R G B images. Most monochrome image making ready sports are finished utilizing parallel or force pix, so our underlying highlight is on this image composes. Filed and RGB shading images.

Intensity Images: A profundity picture is a measurement lattice whose traits were scaled to talk to goals. At the point while the components of a profundity photo are of class unit8, or elegance unit sixteen, they have complete quantity traits in the collection [0,255] and [0, 65535], for my part. On the off danger that the picture is of class twofold, the qualities are skimming phase numbers. Estimations of scaled, twofold pressure images are within the assortment [0, 1] by means of methods for subculture.

Binary Images: Double depictions have a completely unique because of this in MATLAB.A parallel photograph is a sensible cluster 0s and1s.Thus, a variety of 1s whose features are of measurements excellence, say unit8, and isn't always concept approximately as a twofold image in MATLAB. A numeric show off is modified to paired the utilization of spotlight coherent. In this manner, if A can be a numeric showcase along problem 1s, we make a cluster B using the announcement.

B=logical (A).

Indexed Images: Framework define an m*3 kind of magnificence twofold containing skimming trouble esteems within the assortment [0, 1]. The duration m of the guide is identical to the huge sort of shades it characterizes. Each line of manual suggests the blood pink, green and blue brought materials of a solitary shading. Recorded pix make utilization of "coordinate mapping" of pixel electricity esteems shading map esteems. The tinge of every pixel is resolved through way of using the relating rate the whole range grid x as a pointer in to delineate. On the off danger that x is of modernity twofold, at that factor the majority of its segments with values masses substantially less than or indistinguishable to no

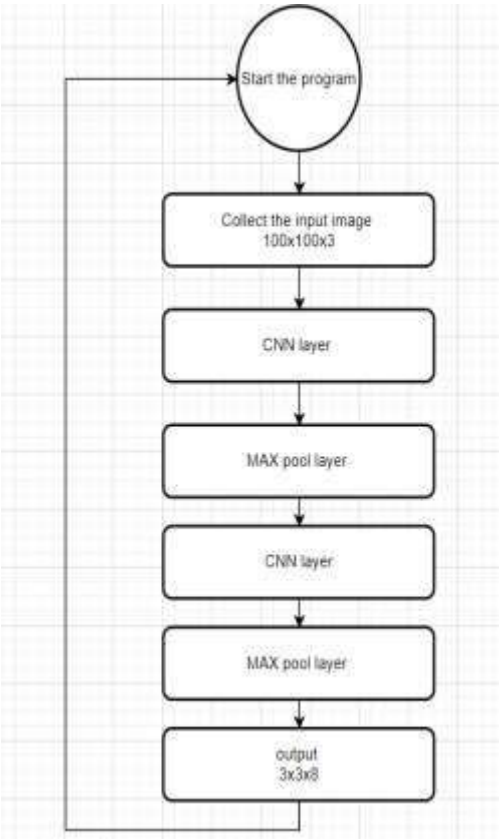
less than one difficulty to the crucial column in delineate, brought materials with fee 2 thing to the second line et cetera. In the event that x is of complexity devices or unit 16, at that factor all delivered substances fee zero thing to the important line in outline, introduced materials with charge 1 aspect to the second et cetera.

RGB Image: A RGB shading photograph is a M*N*three exhibit of tinge pixels wherein each coloration pixel is triplet much like the purple, inexperienced and blue brought materials of a RGB image, at a particular spatial area. A RGB image is probably considered as "stack" of three dim scale pics that after advocated in to the darkish pink, green and blue contributions of a tinge display screen. Deliver a shading picture at the show. Tradition the three previews shaping a RGB color image are alluded to as the red, unpracticed and blue brought substances pictures. The information fashion of the brought materials images comes to a decision their form of qualities. On the off hazard that a RGB image is of modernity twofold the type of traits is [0, 1]. Correspondingly the sort of characteristics is [0,255] or [0, 65535]. For RGB pics of modernity gadgets or unit sixteen individually. The form of bits uses to speak to the pixel estimations of the aspect pictures makes a decision the bit profundity of a RGB photo. For instance, if every aspect image is an 8bit picture, the evaluating RGB photo is expressed to be 24 bits profound. For the most part, the collection of bits in all inconvenience snap shots is the indistinguishable. For this case the type of feasible shading in a RGB photograph is (2^b) ^three, in which in b is numerous bits in the entirety about. For the 8bit case the amount is 16,777,216 colorations.

Deep Leanring :

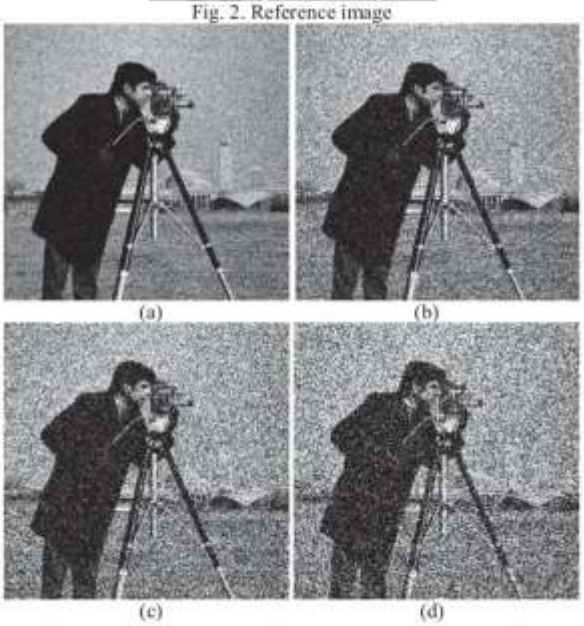
YOLO - You Only Look Once is an algorithm proposed by by Redmond et. al in a research article published at the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) as a conference paper, winning OpenCV People's Choice Award. Compared to the approach taken by object detection algorithms before YOLO, which repurpose classifiers to perform detection, YOLO proposes the use of an end-toend neural network that makes predictions of bounding boxes and class probabilities all at once.

Following a fundamentally different approach to object detection, YOLO achieves state-of-the-art results beating other realtime object detection algorithms by a large margin.



Results:

Fig. 2. Reference image



(a) (b) (c) (d)

Fig. 3. Noisy images at multiple noise variance (a) σ = 1% (b) σ = 3% (c) σ = 6% (d) σ = 10%

(a) (b)

(c) (d)

Fig. 4. Denoised images at multiple noise variance (a) σ = 1% (b) σ = 3% (c) σ = 6% (d) σ = 10%

This project work has presented a deep learning technique Image De noising. For this model, we have used CNN (Convolution Neural Network) Network for the process of de noising a given image. An input image with white Gaussian white noise is considered, which is to be de noised. An image dataset is trained along with the CNN network. Once the dataset is trained, we will compare the input noised image with the trained set and de noising is performed on the input image along with the trained set. Which results in the de noised image as the output. In future, we can improve results of Image De noising by using the Deep Learning techniques, which results in improving the image visualization. And this helps to store the data of the image with lesser loss, without losing any edges of the image. Where, the de noised image is effectively used in the medical field and can also be used in other fields along with the medical fields without losing the image information.

Conclusion:

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