Contribution to Knowledge

**Topic:** Research on Chest X-rays to deduct various respiratory infections

To reduce salt and pepper and other noise we have so many filters to reduce but in those filters I am going to test with different filters, so that we can have scope to tune image without any noise on it.

**Mean Filter:**

We can use linear filtering to remove certain types of noise. Certain filters, such as averaging or Gaussian filters, are appropriate for this purpose. For example, an averaging filter is useful for removing grain noise from a photograph. Because each pixel gets set to the average of the pixels in its neighbourhood, local variations caused by grain are reduced. Conventionally linear filtering Algorithms were applied for image processing. The Mean Filter is a linear filter which uses a mask over each pixel in the signal. Each of the components of the pixels which fall under the mask are averaged together to form a single pixel. This filter is also called as average filter. The Mean Filter is poor in edge preserving.

The fundamental and the simplest of these algorithms is the Mean Filter as defined in [1].

**Median Filter:**

Median filter is very widely used in digital image processing because under certain conditions, it preserves edges whilst removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. Median filters are widely used as smoothers for image processing, as well as in signal processing and time series processing.

A major advantage of the median filter over linear filters is that the median filter can eliminate the effect of input noise values with extremely large magnitudes. (In contrast, linear filters are sensitive to this type of noise - that is, the output may be degraded severely by even by a small fraction of anomalous noise values) [1].

**Crimmins Speckle Removal:**

The Crimmins complementary culling algorithm is used to remove speckle noise and smooth the edges. It also reduces the intensity of salt and pepper noise. The algorithm compares the intensity of a pixel in an image with the intensities of its 8 neighbours. The algorithm considers 4 sets of neighbours (N-S, E-W, NW-SE, NE-SW.)

Speckle model seems to be too simplistic in the case of medical ultrasound images for different reasons. Speckle is not necessarily fully developed and there exist a pronounced spatial correlation. Moreover, the ultrasound devices themselves usually perform a pre-processing of the raw data including even a logarithmic compression. Thus in the displayed medical ultra-sound images the noise differs significantly from the often assumed multiplicative model [2].

**Unsharp Filter:**

The unsharp masking filter (UMF) is one of the representative algorithm frequently adopted for image processing applications and satisfactory results are obtained. The application of this filter for image enhancement is attractive for its simplicity of implementation. In this process with a given image first we will convert it into a gray or monochrome image, processed using unsharp masking filter and then re-converted back to the original. Filter details were explained completely [3].

The Unsharp filter can be used to enhance the edges of an image. The ImageFilter.Unsharpmask function from the PIL package applies an unsharp filter to an image (the image first needs to be converted to a PIL Image object.) The ImageFilter.Unsharpmask function has three parameters. The ‘radius’ parameter specifies how many neighbouring pixels around edges get affected. The ‘percentage’ parameter specifies how much darker or lighter the edges become. The third parameter ‘threshold’ defines how far apart adjacent tonal values have to be before the filter does anything.

**Conservative Filter:**

The conservative filter is used to remove salt and pepper noise. Determines the minimum intensity and maximum intensity within a neighbourhood of a pixel. If the intensity of the centre pixel is greater than the maximum value it is replaced by the maximum value. If it is less than the minimum value than it is replaced by the minimum value. The conservative filter preserves edges but does not remove speckle noise [4].

**Severity of the Disease:**

The model to check the severity of the disease for example negative and positive case x-rays if we take based on the disease the model will identify if its positive case it will define the severity of that disease inside other model. Here severity can be taken from RALO (Radiographic Assessment of Lung Opacity) dataset in which Radiological scoring was performed by three blinded experts: two chest radiologists (each with at least 20 years of experience) and a radiology resident. They staged disease severity using a score system, based on two types of scores (parameters): extent of lung involvement and degree of opacity [6].

Extent of lung:

0 = no involvement

1 = <25% involvement

2 = 25%-50% involvement

3 = 50%-75% involvement

4 = >75% involvement.

Degree of Opacity:

0 = no opacity

1 = ground glass opacity

2 = consolidation

3 = mix of consolidation and ground glass opacity (>50% consolidation)

4 = white-out

The total opacity score ranged from 0 to 8 (right lung and left lung together).

**Research Papers:**

[1]. James C. Church, Yixin Chen, and Stephen V. Rice Department of Computer and Information Science, University of Mississippi, “A Spatial Median Filter for Noise Removal in Digital Images”, IEEE, page(s): 618- 623, 2008.

[2]. J. S. Lee,L. Jurkevich,P. Dewaele,P. Wambacq &A. Oosterlinck “Speckle filtering of synthetic aperture radar images” Published online: 19 Oct 2009

[3]. S.C.F. Lina, C.Y. Wonga, G. Jianga, M.A. Rahmana, T.R. Rena, Ngaiming Kwoka,d,∗, Haiyan Shi b, Ying-Hao Yuc, Tonghai Wud “Intensity and edge based adaptive unsharp masking filter for color image enhancement”

[4].D. Surya Prabha; J. Satheesh Kumar “Performance Analysis of Image Smoothing Methods for Low Level of Distortion”

[5]. Alexander Wong, Zhong Qiu Lin, Linda Wang, Audrey G. Chung, Beiyi Shen, Almas Abbasi, Mahsa Hoshmand-Kochi, Timothy Q. Duong “Towards computer-aided severity assessment via training and validation of deep neural networks for geographic extent and opacity extent scoring of chest X-rays for SARS-CoV-2 lung disease severity”

[6]. Joseph Paul Cohen Stanford University; Beiyi Shen; Almas Abbasi; Mahsa Hoshmand-Kochi; Samantha Glass; Haifang Li; Matthew P Lungren; Akshay Chaudhari; Tim Q Duong ” Stonybrook Radiographic Assessment of Lung Opacity (RALO) dataset is here: Pneumonia severity scores for 2373 images” <https://zenodo.org/record/4634000#.YX2YGp7MJPY>