ML19/20-3.13. Validate and improve Tests of Existing Algorithms: Gaussian & Mean Algorithm, Ring Projection Algorithm

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***Abstract*— In image filtering, Gaussian and mean filter is used to modify the image by removing noise and to get original images at the output and ring algorithm is used to identify the image at any orientation. Gaussian filters are implemented on images which are used to remove the noise that are present in the image while capturing or injected into the image at the time of transmission. Mean filter is mainly used to remove noise in the image, the main advantage of mean filter over Gaussian filter is that in mean filter the noise is removed while edges are kept relatively sharp. In ring- projection, the image is identified when the original image is kept at different angles. This reduces the orientation problem and identifies the image.**

Keywords—Gaussian Filter, Mean filter, Ring Projection, Blur, Orientation

I. Introduction

The Gaussian filter is extensively utilized in image processing and computer vision for long years. For the most part it works with low pass filtering. These filters have been appeared to assume a significant job in edge detection in the human visual framework, and to be to a great extent valuable as detection for edge and line recognition. Conventional linear filters, for example, Gaussian mean filter and Gaussian filter smooth noise successfully however blur edges. The Gaussian smoothing operator is a 2-D convolution administrator that is utilized to 'blur' images and evacuate detail and noise. Right now, resembles the mean filter, yet it utilizes an alternate kernel that represents to the shape of a Gaussian ('bell-shaped') hump.

The Ring Projection Algorithm is used to solve the orientation issues. In these algorithms the image can be recognized when placed in any angles. If the image is moved to 180 degree or 270 degree then these Algorithm matches with the original image and identifies it.

II. Methodology

In the concept of image processing, a Gaussian smoothing (also called as Gaussian blur) is used to blur the image by Gaussian filter. It is mostly used in graphics software, to eliminate noise in the image. The main ideology of Gaussian smoothing is to use the 2-dimensional distribution as a `point-spread' function, and this can be processed by convolution.

where **σ** is the standard deviation for Gaussian distribution.

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

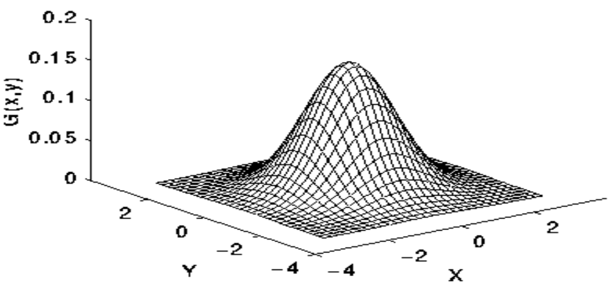

Fig 2.1: 2-D Gaussian distribution with mean (0,0) and σ =1

An integer valued 5/5 convolution kernel approximating a Gaussian with a σ of 1 is shown in fig.

$\frac{1}{273}$

1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

Fig 2.2: Gaussian Function

Gaussian filtering G is used in the equation. The Gaussian filter is also referred as non-uniform low pass filter. The kernel coefficients diminish with increasing distance from the kernel's center. Central pixels will have a high weighting than those on the periphery.
Larger values of σ gives a wider peak (more blurring).
Kernel size must increase with increasing σ to maintain the Gaussian value of the filter.
Gaussian kernel coefficients depend on the standard deviation value (σ).
At the edge of the mask, coefficients must be near 0.
The kernel is not directionally bias and is rotationally symmetric. Gaussian kernel is separable which allows fast computation 2.5. Gaussian kernel is distinct, which permits quick calculation. Gaussian filters might not preserve image brightness to blur images and remove noise and detail.

Mean Filter:
The Mean filter is also known as sliding-window spatial filter where the central element is replaced by the average of all the pixel values in the window. The window, or kernel, is generally a square but can be of any shape. The mean filtering is calculated below. Here a single 3x3 window of values are taken.

Unfiltered values
5 + 3 + 6 + 2 + 1 + 9 + 8 + 4 + 7 = 45
45 / 9 = 5

5	3	6
2	1	9
8	4	7

Fig 2.3

Mean Filtered

*	*	*
*	5	*
*	*	*

Fig 2.4

The mean filtering is used to replace each pixel value in an image with the average value of its surrounding pixels, including itself. In the mean filter the effect of removing pixel values which are not represented of their neighboring pixels. Mean filtering is also called as a convolution filter.

Ring Projection Algorithm

In ring projection suppose we have a set of M-patterns which are classified as M -classes and each class has only one pattern sample and if we have S-different sizes of each pattern and allow R different orientation. The first one is to treat them as single pattern sample classes. This means the uncertainty will increase considerably. For the above inputs we will have M x S x R classes. The second solution is that we only consider the categories of the pattern and disregard their sizes or orientation. This means the uncertainty will remain same as that of the set with M classes.

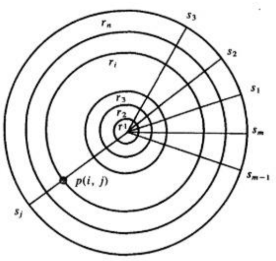

Fig 2.5: Ring-extraction panel

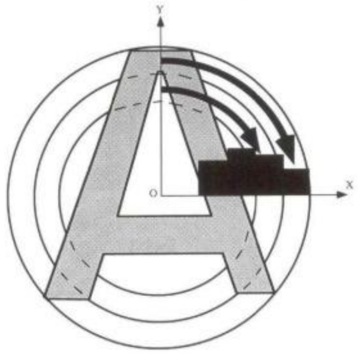

Fig 2.6: Ring projection

The ring projection Algorithm can be summarized as
Step1: Find the center of gravity and translate it to the origin of the image plane.
Step 2: Find the largest distance d.
Step 3: Skill the input image by D/d.
Step 4: Find the ring-projection vector using ring projection operation.

$$p_{r_i} = \sum_{\theta=0}^{2\pi} f^*(i, \theta), \qquad i = 1, 2, \ldots, n.$$

Step 5: Find the feature vector by accumulating the p $_{ri}$`s

$$[P_1 \quad P_2 \quad \cdots \quad P_i \quad \cdots \quad P_n]^T,$$

where,

$$P_1 = p_{r_1};$$

$$P_2 = p_{r_1} + p_{r_2};$$

$$\cdots\cdots$$

$$P_i = \sum_{k=1}^{i} p_{r_k};$$

$$\cdots\cdots$$

$$P_n = p_{r_1} + p_{r_2} + \cdots + p_{r_{n-1}} + p_{r_n}.$$

III. RESULTS

Gaussian and Mean Algorithms

In Gaussian filter the result is carried out by taking the addition of all the pixels and dividing by 16.
In Mean filter the result is carried out by taking the addition of all the pixels and dividing by 9.
In Gaussian and Mean Filter firstly, the gaussian operation is performed and on the smoothened image mean operation is performed.

Fig 3.1: Input Image

Fig 3.2: Mean Filter Output

Fig 3.3: Gaussian Filter Output

Fig 3.4: Gaussian and Mean Filter Output

Fig 3.5: Input Image

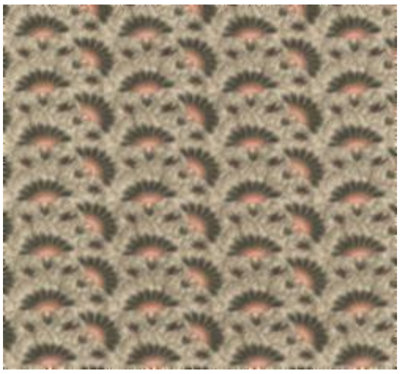

Fig 3.6: Mean Output

Fig 3.7: Gaussian Output

Fig 3.8: Gaussian and Mean Output

Ring Projection Algorithm

In Ring Projection Algorithm we have given four similar images with different orientation.
In result by algorithm calculations the radius and the corresponding value has been calculated, By comparing these values all the input images have different orientation the result comes out to be positive (i.e. original image).

Input images at different orientation:

Fig 3.9: Letter A

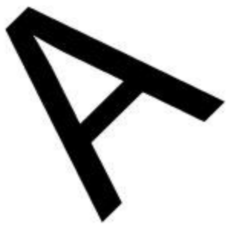

Fig 3.10: Letter A(-45degree)

Fig 3.11: Letter A(45degree)

Fig 3.12: Letter A (180 degree)

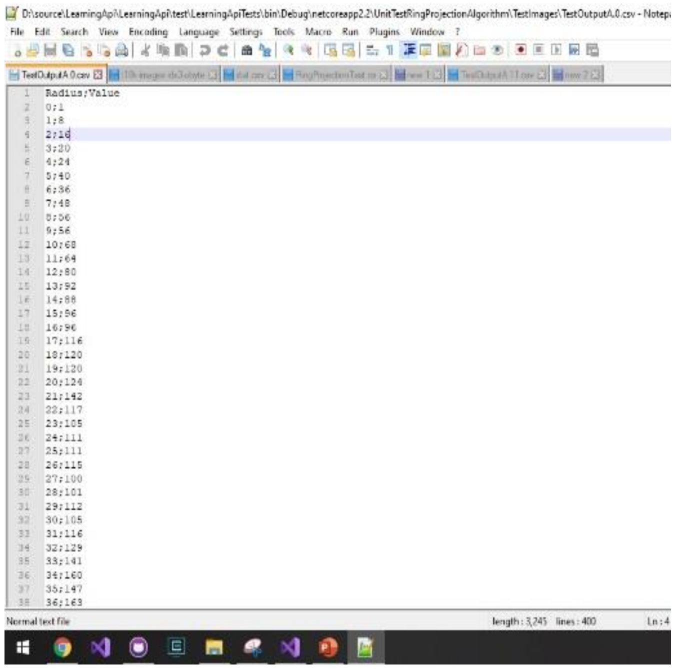

Fig 3.13 Output Image

IV. CONCLUSION

In Gaussian smoothing sigma and the window size is used and Gaussian filter blurs the image to decrease the noise from the image. Also, the Mean Filter does the same functionality and blurs the image and removes the noise. A Gaussian filter is a linear filter. It is used to blur the image or to reduce noise. If you include both of them and subtract, you can use them for "unsharp masking" (edge detection). The Gaussian filter can used to blur edges and reduce contrast. Mean filter is a non-linear filter that is mostly used as a simple way to reduce noise in an image. It claims to fame (over Gaussian for noise reduction) is that it removes noise while keeping edges relatively sharp. The Ring Projection Algorithm reduces orientation problems and it is computationally efficient, insensitive to noise, High discriminating power and scale of characters.

REFERENCS

[1] Koedkurang, K., & Rungsipanich, A. (2018, July). An Adaptive Gaussian filter for merging JICA and MOST DEM. In 2018 15th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON) (pp. 736-739). IEEE.

[2] Devapriya, W., Nelson Kennedy Babu, C. and Srihari, T. (2016) Real Time Speed Bump Detection Using Gaussian Filtering and Connected Component Approach. Circuits and Systems, 7, 2168-2175.

[3] Bunke, H., & Wang, P. S. P. (1997). Handbook of character recognition and document image analysis. World scientific.

[4] Tang, Y. Y., Li, B. F., Ma, H., & Lin, J. (1998). Ring-projection-wavelet-fractal signatures: a novel approach to feature extraction. IEEE Transactions on circuits and systems II: Analog and digital signal processing, 45(8), 1130-1134.