A Review Paper on 2 D Gaussian Smooth Filter for De-Noising & Its Applications

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Abstract : In present era every multimedia device are require fast and good quality image/video. Due to Internet of Things there is rapid demand of real time applications so for those applications there is need of some application specific processing unit which also make justice with batter power consumption. As we know in present stage ever one doing real time image/video transmission. Due to real time may be some time there is image quality will decrease so for improvement of those real time image there is need of De-noising approach which well known as Smooth filter. In this paper we did study about the previous existing techniques.

Index Terms— Gaussian filter, , image quality assessment, multiresolution techniques, segmentation, textured images..

I. INTRODUCTION

In imaging science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frameThe yield of picture handling might be either a picture or an arrangement of attributes or parameters identified with the picture. Most picture handling strategies include regarding the picture as a two-dimensional flag and applying standard flag preparing systems to it. Picture handling more often than not alludes to advanced picture preparing, however optical and simple picture preparing additionally are conceivable.

An image defined in the "real world" is considered to be a function of two real variables, for example, a(x,y) with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y).

The goal of this manipulation can be divided into three categories:

- Image Processing (image in to image out)
- Image Analysis (image in to measurements out)
- Image Understanding (image in to high-level description out)

A picture might be considered to contain sub-pictures once in a while alluded to as locales of-intrigue, ROIs, or just areas. This idea mirrors the way that pictures as often as possible contain accumulations of articles every one of which can be the premise for an area. In an advanced picture handling framework it ought to be conceivable to apply particular picture preparing activities to chosen areas. Therefore one a player in a picture (area) may be handled to stifle movement obscure while another part may be prepared to enhance shading interpretation. Succession of picture handling: Most as a rule, picture preparing frameworks require that the pictures be accessible in digitized shape, that is, varieties of limited length paired words. For digitization, the given Image is inspected on a discrete network and each example or pixel is quantized utilizing a limited number of bits. The digitized picture is handled by a PC. To show an advanced picture, it is first changed over into simple flag, which is examined on to a show.

In current sciences and innovations, pictures additionally increase substantially more extensive degrees because of the regularly developing significance of logical perception (of frequently vast scale complex logical/trial information). Illustrations incorporate microarray information in hereditary research, or ongoing multi-resource portfolio exchanging money. Before going to preparing a picture, it is changed over into a computerized frame. Digitization incorporates examining of picture and quantization of inspected esteems. In the wake of changing over the picture into bit data, preparing is performed. This handling procedure might be Image improvement, Image rebuilding, and Image compression.[4] Image upgrade: It alludes to highlight, or honing, of picture highlights, for example, limits, or differentiation to make a realistic show more helpful for show and investigation. This procedure does not expand the inalienable data content in information. It incorporates dim level and complexity control, clamor decrease, edge crispening and honing, sifting, introduction and amplification, pseudo shading, et cetera. Picture rebuilding: It is worried about sifting the watched picture to limit the impact of debasements. Viability of picture reclamation relies upon the degree and exactness of the learning of debasement process and also on channel plan. Picture reclamation contrasts from picture improvement in that the last is worried about more extraction or highlight of picture highlights. Picture pressure: It is worried about limiting the quantity of bits required to speak to a picture. Use of pressure are in communicated TV, remote detecting through satellite, military correspondence by means of air ship, radar, video chatting, copy transmission, for instructive and business reports, therapeutic pictures that emerge in PC tomography, attractive reverberation imaging and computerized radiology, movement, pictures, satellite pictures, climate maps, topographical studies et cetera. Picture preparing is characterized as the control of picture portrayal put away on a PC. Tasks on pictures that are viewed as a type of picture preparing incorporate zooming, changing over to dim scale, expanding or diminishing picture splendor, red-eye decrease in photos, edge and shape

recognition of a question and investigation of protest properties, for example, size and shading. These tasks normally include cycle over every single individual pixel in a picture.

In present era energy consumption has become critical issue for multimedia devices like mobile and embedded systems [1]. These devices incorporate computer graphics and image pro- cessing as their core application like security, medical science, entertainment, etc. The real time image processing suffers from noise signal which degrades the quality of the image while compression or transmission. For reduction of these noise, there is a need of smooth filter. Commercially smooth filters are available having characteristic like Averaging, Median, Mean, Gaussian Filter etc. Out of these, the mainly used filter is a 2D Gaussian Smooth Filter (2GSF), since it does not generate false edge on increasing scale [2] and provides good trade-off between localization in spatial and frequency domains. The famous edge detection algorithms like Canny [3] and MarrHildreth [4] uses 2GSF. 2GSF is also useful in many other applications like texture segmentation [5], tone mapping of high dynamic range images [6], image blurring [7] and image mosaicing [8]. 2GSF is basically based on gaussian kernel function, having a floating point coefficient. In terms of hardware complexity, floating point design requires large hardware unit and huge amount of energy. Existing approaches will make injustice with SPAA (Speed, Power, Area, Accuracy) metrics, while operating on portable devices. In order to justify SPAA metrics there is need of approximate design. The approximate designs produce almost-correct results, and offer power reductions with performance improvements in return [9]. These designs exploit a tradeoff of accuracy explained with an example, let there be two number X=223 and Y=224. Its accurate and approximate multiplication [10] will results to Z = 49952 and Z = 46847. The total and percent error difference is 3105 and 6.21% respectively. As per [11], the human eye can tolerate an error upto 10%. So we can easily apply approximation on image processing system. Through this small error there is tremendous saving in hardware complexity.

1.1 2D Gaussian Smooth Filter: In display time vitality utilization has turned out to be basic issue for sight and sound gadgets like versatile and inserted frameworks [1]. These gadgets fuse PC designs and picture preparing as their center application like security, therapeutic science, amusement, and so forth. The constant picture handling experiences commotion flag which corrupts the nature of the picture while pressure or transmission. For decrease of these clamors, there is a need of smooth channel. Industrially smooth channels are accessible having trademark like Averaging, Median, Mean, Gaussian Filter and so on. Out of these, the primarily utilized channel is a 2D Gaussian Smooth Filter (2GSF), since it doesn't produce false edge on expanding scale and gives great exchange off between restriction in spatial and recurrence areas.

1.2 Application where 2D Gaussian filter

Application where 2D Gaussian filter is used:-

1. Canny edge detection [2].
2. MarrHildreth edge detection [3].
3. Texture segmentation [4].
4. 2D to 3D conversion [5].
5. Image mosaicing [6].

2GSF is basically based on gaussian kernel function, having a floating point coefficient. In terms of hardware complexity, floating point design requires large hardware unit and huge amount of energy. Existing approaches will make injustice with ASAP (Speed, Power, Area, and Accuracy) metrics, while operating on portable devices. In order to justify ASAP metrics there is need of approximate design.

1.3 Introduction To Edge Detection

Edge recognition is the name for an arrangement of scientific techniques which go for distinguishing focuses in a computerized picture at which the picture splendor changes pointedly or, all the more formally, has discontinuities. The focuses at which picture brilliance changes forcefully are ordinarily composed into an arrangement of bended line portions named edges. A similar issue of discovering discontinuities in 1D signals is known as step location and the issue of discovering signal discontinuities after some time is known as change recognition. Edge location is a basic instrument in picture preparing, machine vision and PC vision, especially in the regions of highlight discovery cases of administrators, for example, Canny, Sobel, Kayyali,..etc. also, highlight extraction. [3,4,7]

1.4 Effects Of Noise On Edge Detection

Edge detection is susceptible to noise. This is due to the fact that the edge detectors algorithms are designed to respond to sharp changes, which can be caused by noisy pixels. Noise may occur in digital images for a number of reasons. The most commonly studied noises are white noise, “salt & pepper” noise and speckle noise. The effect of noise on edge detection

2. LITERATURE REVIEW

The fields of picture preparing and PC vision are persistently increasing expanded consideration in applications including mechanical technology, computerization, quality control, and security frameworks. Among the numerous picture handling

methods, edge identification is seen by numerous as the primary fundamental advance in a picture examination. It is utilized to isolate the picture into object(s) and foundation. The execution of an edge recognition administrator is characterized as its capacity to situate, in uproarious information, an edge that is as close as conceivable to its actual position in the picture.

- 2D Gaussian Smooth Filter:

2GSF is one of the most common filter which is used in many image processing applications. This filter is based on a fixed value of standard deviation. The equation of a Gaussian function in 2D with a standard deviation can be described by:

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

Where x & y is distance from origin of horizontal & vertical axis. When this formula is applied on 2D image, it produces a surface whose contours are concentric circles with a Gaussian distribution from the centre point. When a noisy image t is applied to gaussian filter with impulse response of g, so spatial domain of smooth image k is calculated by using of convolution.

$$k(x, y) = t(x, y) * g(x, y)$$

Similarly, frequency domain of smooth image k is calculated by using of below expression

$$K(a, b) = T(a, b) \times G(a, b)$$

Frequency domain is generated by spatial domain, which are k(x,y), t(x,y) and g(x,y). Here K(a,b), (a,b) and G(a,b) are represent frequency domain form. In equation (1) will decide amount of smoothness. For more effective smoothing large value of σ & large kernel is required for accurate representation of a function. In this paper we have proposed gaussian smooth filter of 3X3 and 5X5 kernel for _=1, which is calculated by equation (1) for given (x,y) values. For calculation of 3 X3 kernel, value of x & y lies between -1 to 1. Coefficients of a 3X3 gaussian kernel for σ= 1 are :

$$\begin{bmatrix} 0.0751 & 0.1238 & 0.0751 \\ 0.1238 & 0.2042 & 0.1238 \\ 0.0751 & 0.1238 & 0.0751 \end{bmatrix}$$

For calculation of 5 X5 kernel, value of x & y lies between -2 to 2. Coefficients of a 5X5 gaussian kernel for σ = 1 are:

$$\begin{bmatrix} 0.0030 & 0.0133 & 0.0219 & 0.0133 & 0.0030 \\ 0.0133 & 0.0596 & 0.0983 & 0.0596 & 0.0133 \\ 0.0219 & 0.0983 & 0.1621 & 0.0983 & 0.0219 \\ 0.0133 & 0.0596 & 0.0983 & 0.0596 & 0.0133 \\ 0.0030 & 0.0133 & 0.0219 & 0.0133 & 0.0030 \end{bmatrix}$$

2D gaussian smooth filter is basically based on gaussian kernel function, having a floating point coefficient. In terms of hardware complexity, floating point design requires large hardware unit and huge amount of energy. Existing approaches will make injustice with ASAP (Speed, Power, Area, Accuracy) metrics, while operating on portable devices. In order to justify ASAP metrics there is need of approximate design.

2.1 Approximation For Error Tolerant Applications: The approximate designs produce almost-correct results, and offer power reductions with performance improvements in return. This design exploits a tradeoff of accuracy in computation versus speed, power and area. Explained with an example, let there be two number X=223 and Y=224. Its accurate and approximate multiplication [8] will results to Z = 49952 and Z = 46847. The total and percent error difference is 3105 and 6.21% respectively. As per [7], the human eye can tolerate an error upto 10%. So we can easily apply approximation on image processing system. Through this small error there is tremendous saving in hardware complexity.

2.2 Approximate 2D Gaussian Smooth Filter: As we already see there is no need of accurate logic we can use approximate logic and reduce the previous existing issue. In this direction many researchers are make there 2D Gaussian system. Here am targeting some of them. According to [13] author propose a technique which is based on approximation, in this paper author change the Gaussian kernel value and try to reduce the hardware complexity. Here author use power-of-two. According to

modified[14] author propose a modified approximate technique which is used for 2D Gaussian smooth filter. Here author use the fixed point technique and modified the Gaussian kernel. According to Ankur[15] author propose a technique which is use to design fast 2D Gaussian smooth filter. According to this approach author use a diagonal technique where he reduce the input image 33 and 5X5 kernel. According to Sharda[16] author modified the [15] technique and reduce the diagonal kernel into semi diagonal kernel. This all technique are able to reduce the harward complexity specially [15] & [16] but in [15] [16] image quality is not so good.

There are many applications where we have to use 2D Gaussian smooth filter and those applications are:

1. **Aerospace Application.**
2. **Discrete Cosine Transform (Image Compression Unit).**
3. **Different DSP and DIP Filters.**
4. **Multimedia Applications.**
5. **Face Recognition**
6. **Edge Detection**
7. **Object Recognition**

3. Problems In Previous Research

As we already know there is need of multimedia application in every portable devices. Now current era everyone want realistic view so they need 3D image/Video technology as we also know for 3D generation it pass from many process so there is need of noise reduction technique like 2D Gaussian filter.. According to previous existing 2D Gaussian smooth filter algorithm some problem those issues are followings:

1. Image visual quality is not up to the mark.
2. [15],[16] are able to reduce power, area and speed metrics but for more noisy image they are suitable to make justice with quality.
3. Not applicable for many applications

4. Future Scope on Gaussian Filter

According to previous literature survey in this paper we got some issues which are still a big threat for this system. So in future research point of view these are the future scope of this area.

1. Reduce the time complexity issue in both algorithm & architecture level.
2. Make justice with ASAP metrics.
3. Image quality is most important factor. Here I will try to improve image quality as compare to [15], [16] with good improvement in ASAP metrics.

5. Conclusion

As indicated by current innovation future is completely in view of virtual world. At this moment everything depends on genuine information exchange and as we probably am aware for constant information exchange we require commotion less framework. According to this paper we did study about the previous existing 2D Gaussian filter and according to that previous existing problem which is time complexity with maintain the quality level of the generated output images. The key contribution of this paper is to provide a complete information about the previous existing approaches. Here there is lot of future scope on this area , still this area is facing lots of problems which have to solve.

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