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Global Image Segmentation Process for Noise Reduction by Using Median Filter

Ankit Kandpal [1] Vishal Ramola [2]
M.Tech. Student [1], Assistant Professor [2]
VLSI Design Department
Faculty of Technology, University Campus
Uttarakhand Technical University
Dehradun - India

ABSTRACT

This paper presents a novel architecture for noise reduction by using median filter based on global segmentation process. This paper also deals with a method for computing more median value in an image, and an average median value for an image matrix. By using average median value one can easily decides the threshold value of an image. The importance of this threshold value is set the image brightness and darkness according to user application. All simulation work is done in XILINX tool by using VHDL language.

Keywords:- Image segmentation, Salt-and-Pepper noise, Multilayer sorting, Image enhancement, VHDL.

I. INTRODUCTION

The objective of image segmentation is to partition an image into meaningful parts that are relatively homogenous in a certain sense. We can broadly classified image segmentation into two types: (1) local segmentation, (2) global segmentation. Local segmentation deals with segmentation sub-images which are small windows/masks on a whole image whereas global segmentation is concerned with segmenting a whole image. Global segmentation deals mostly with segments consisting of relatively large number of pixels or masks in whole image.

Basically in an image processing many analyses happens, i.e. image segmentation, image enhancement, image compression, image restoration, object recognition and many more process. The main objectives of these all analyses are to improve the visual standard of viewers.

Mainly an image is a combination of pixels. And many types noise such as additive noise, multiplicative noise, salt-and-pepper noise disturbs the visual standard. For removing these types noise we use various types filtering schemes. Basically the most commonly used filtering techniques are (1) linear filtering, (2) averaging filtering, and (3) median filtering. In case of linear filters they smooth the noisy signals but also the sharp edges. In addition, the impulsive noise components cannot be suppressed sufficiently by linear filtering, and there digital implementation can be bulky and slow. In case of averaging filters they have some desirable features like outlier points that distort the filtered signal, and edge information loss. The median filters have proved to be good alternatives because they have some very interesting properties: 1) they can smooth the transient changes in signal intensity (e.g., noise); 2) they are very effective tool for removing the impulsive noise from the signals; 3) they can preserve the edge information in the filtered signal; and 4) they can be implemented by using very simple digital nonlinear operations. Because of these properties of the median filters, they are frequently used in various signal and image processing applications, such as seismic signal processing, speech processing, computerized tomography, medical imaging, robotic vision, pattern recognition, peak detection, coding, and communication [1].

This paper presents a new architecture for computing more median values in an image, and with the help of median values we get one average median most value for deciding the threshold of an image. For this purpose we use a 9×9 image matrix, and also we used partitioning process in an image.

The paper is organized as follows: in Section II, concept of median filter is reviewed. Subsequently, in section III, the proposed design of global image segmentation process for noise reduction by using median filter is presented. In section IV, the simulation results are given and discussed. Finally a conclusion will be made in the last section.

II. MEDIAN FILTER

Median filter is an effective tool for removing salt-and-pepper noise or impulsive noise. Here, salt corresponds to the maximum gray pixel value (white) and pepper corresponds to the minimum gray pixel value (black). Random occurrence of black and white pixels in an image is generally called 'salt-and-pepper' noise. We can see this effect in fig. 1. With the help of median filters we minimize salt-and-pepper noise. Median filters perform these following tasks to find each pixel values in the processed images at first all pixels in the neighborhood of the pixel in the original image which are identified by the mask are sorted in ascending (or) descending order after that the median of the sorted value is computed and is chosen as the pixel value for the processed image.

There are various methods and approaches for implementing hardware model of median filter [2-7]. We used multilayer sorting structure [2] for our work. Multilayer implementation method has been proposed based on removing non-median pixels. Fig. 2 shows the structure of multilayer sorting. With the help of this structure we get the median value of an image.

Figure 1-Salt-and-Pepper noise in an image

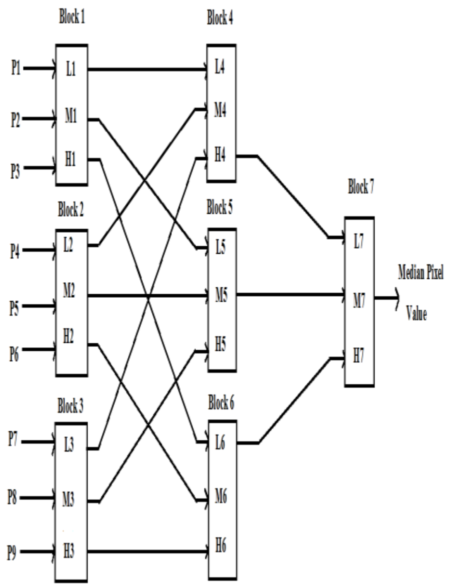


Figure 2-Multilayer sorting of pixels [2]

Fig. 2 contains 7 blocks and each block is assigned with three inputs. For block 1, the inputs are P1, P2, and P3. Now this block compares the inputs and gives low, medium and high value as output. For block 1, the outputs are L1, M1, and H1. The functionality of all the blocks is same. For block 2 and 3 the outputs are L2, M2, H2 and L3, M3, H3 respectively.

Block 4 feeds the low value of all the three previous blocks (B1, B2, and B3), compares them and drives the output as L4, M4, and H4. Block 5 feeds the medium value of three previous blocks (B1, B2, and B3), compares them and gives output as L5, M5, and H5. Block 6 feeds the high value of three previous blocks (B1, B2, and B3), compares them and drives output as L6, M6, and H6. The final block, block 7 is fed by three input i.e. high value of block 4 (H4), medium value of block 5 (M5) and low value of block 6 (L6). This block compares all of these values and extract out median value among them among all inputs applied.

Each of the sorting blocks in fig. 2 is constructed from 3 comparators, as shown in fig. 3 [3].

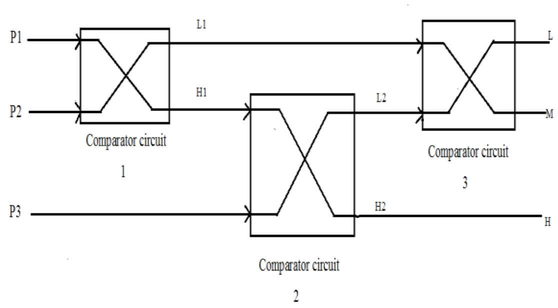


Figure 3 Structure of a 3 pixel sorting block [3]

Fig. 3 consists of three comparators which are interacted to each other. The three input nodes P1, P2, and P3 are carrying different values. At first P1 and P2 serves as an input to comparator 1, which gives low and high value corresponding to the input applied i.e. L1 and H1. H1 is then applied to comparator 2 along with P3 which gives low and high value L2 and H2 with respect to the applied input. The high value of comparator 2 is above all i.e. the highest one. Now, comparator 2 lowest value (L2) and lowest value of comparator 1 are feed to comparator 3 which gives lowest value and median value among all the applied values. Hence with the help of fig. 3 module structure we have computed the lowest, medium and highest value with respect to the applied inputs P1, P2 and P3.

III. PROPOSED ARCHITECTURE

Many kind of segmentation process described previously [8-12]. They are based on theoretical analysis. In this paper we proposed a new structure based on global segmentation process for noise reduction by using median filter. This approach is also a type of an image segmentation practical analysis. The phenomenon of this approach is discussed as: let we have a 9×9 pixel matrix which is shown in fig. 4, and if we want to compute more median values of this image matrix so with the help of global segmentation process we compute more medians of this image matrix. Now the point is why global segmentation? The reason behind that is the basic theory of global segmentation deals mostly with segments consisting of a large number of pixels. We use region approach for this work because this approach deals with a fix region or mask of an image. We mentioned here algorithm steps for this problem:-

Step 1: Read an input image.
Step 2: To compute medians for this image, apply segmentation or partitioning process.
Step 3: With the help of multilayer sorting structure, compute medians.
Step 4: To compute an average median value or median most value or threshold value, feeds above medians in new multiyear sorting block.
Step 5: With the help of new multilayer sorting block, compute an average median value.

1 (P1)	2 (P2)	3 (P3)	28 (P28)	29 (P29)	30 (P30)	55 (P55)	56 (P56)	57 (P57)
4 (P4)	5 (P5)	6 (P6)	31 (P31)	32 (P32)	33 (P33)	58 (P58)	59 (P59)	60 (P60)
7 (P7)	8 (P8)	9 (P9)	34 (P34)	35 (P35)	36 (P36)	61 (P61)	62 (P62)	63 (P63)
10 (P10)	11 (P11)	12 (P12)	37 (P37)	38 (P38)	39 (P39)	64 (P64)	65 (P65)	66 (P66)
13 (P13)	14 (P14)	15 (P15)	40 (P40)	41 (P41)	42 (P42)	67 (P67)	68 (P68)	69 (P69)
16 (P16)	17 (P17)	18 (P18)	43 (P43)	44 (P44)	45 (P45)	70 (P70)	71 (P71)	72 (P72)
19 (P19)	20 (P20)	21 (P21)	46 (P46)	47 (P47)	48 (P48)	73 (P73)	74 (P74)	75 (P75)
22 (P22)	23 (P23)	24 (P24)	49 (P49)	50 (P50)	51 (P51)	76 (P76)	77 (P77)	78 (P78)
25 (P25)	26 P26)	27 (P27)	52 (P52)	53 (P53)	54 (P54)	79 (P79)	80 (P80)	81 (P81)

Figure 4- 9×9 image matrix

Fig.4 consist a problem matrix. Here P1-P81 shows pixel counting number and we take data in simple form 1-81. So for the computation of more median value of this image we split this image in form of 3×3 masks. The mask formation is shown in fig. 5.

(3×3) Mask 1	(3×3) Mask 4	(3×3) Mask 7
(3×3) Mask 2	(3×3) Mask 5	(3×3) Mask 8
(3×3) Mask 3	(3×3) Mask 6	(3×3) Mask 9

Figure 5- 9×9 image matrix mask formation

Fig. 5 contains nine 3×3 masks. Each mask contains nine pixel values. After that we apply all masks in our proposed structure which is shown in fig. 6.

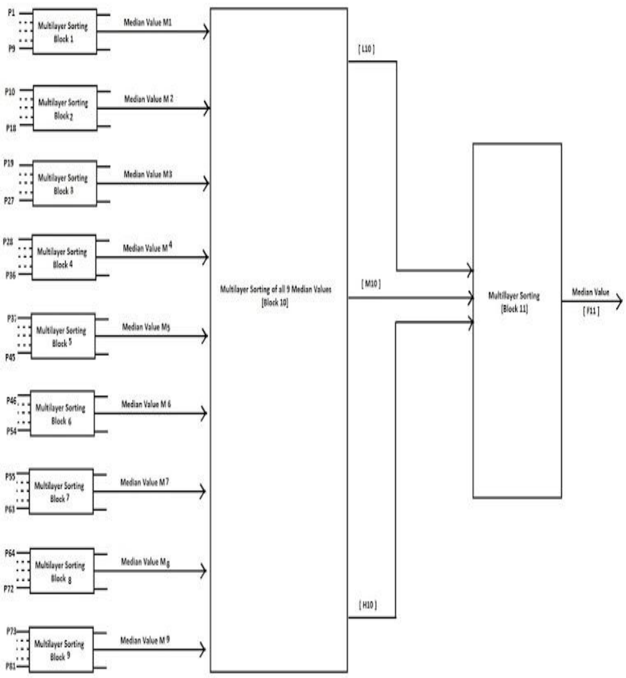


Figure 6- 9×9 Proposed architecture

Fig. 10 shows our proposed structure. We feed all masks in this structure and this structure provides us nine median values with the help of multilayer sorting structure. Nine median value image matrix is shown in fig. 7.

1 (P1)	2 (P2)	3 (P3)	28 (P28)	29 (P29)	30 (P30)	55 (P55)	56 (P56)	57 (P57)
4 (P4)	5 (P5)	6 (P6)	31 (P31)	32 (P32)	33 (P33)	58 (P58)	59 (P59)	60 (P60)
7 (P7)	8 (P8)	9 (P9)	34 (P34)	35 (P35)	36 (P36)	61 (P61)	62 (P62)	63 (P63)
10 (P10)	11 (P11)	12 (P12)	37 (P37)	38 (P38)	39 (P39)	64 (P64)	65 (P65)	66 (P66)
13 (P13)	14 (P14)	15 (P15)	40 (P40)	41 (P41)	42 (P42)	67 (P67)	68 (P68)	69 (P69)
16 (P16)	17 (P17)	18 (P18)	43 (P43)	44 (P44)	45 (P45)	70 (P70)	71 (P71)	72 (P72)
19 (P19)	20 (P20)	21 (P21)	46 (P46)	47 (P47)	48 (P48)	73 (P73)	74 (P74)	75 (P75)
22 (P22)	23 (P23)	24 (P24)	49 (P49)	50 (P50)	51 (P51)	76 (P76)	77 (P77)	78 (P78)
25 (P25)	26 (P26)	27 (P27)	52 (P52)	53 (P53)	54 (P54)	79 (P79)	80 (P80)	81 (P81)

Figure 10- 9×9 image matrix with 9 medians

Right now we have 9 median pixels, with the help of segmentation process in an image. User can directly apply these medians in an image for removing salt-and-pepper noise in an image or with the help of our proposed structure [fig.9] feed all median values in next multilayer sorting block and at the end compute one median most value. This is shown in fig.11.

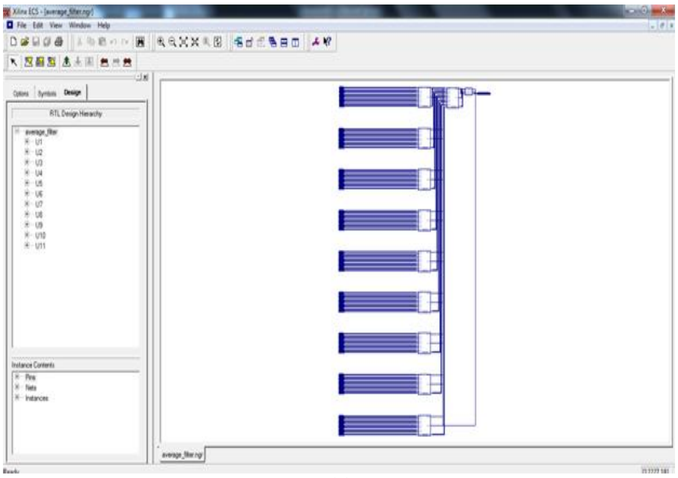
1 (P1)	2 (P2)	3 (P3)	28 (P28)	29 (P29)	30 (P30)	55 (P55)	56 (P56)	57 (P57)
4 (P4)	5 (P5)	6 (P6)	31 (P31)	32 (P32)	33 (P33)	58 (P58)	59 (P59)	60 (P60)
7 (P7)	8 (P8)	9 (P9)	34 (P34)	35 (P35)	36 (P36)	61 (P61)	62 (P62)	63 (P63)
10 (P10)	11 (P11)	12 (P12)	37 (P37)	38 (P38)	39 (P39)	64 (P64)	65 (P65)	66 (P66)
13 (P13)	14 (P14)	15 (P15)	40 (P40)	41 (P41)	42 (P42)	67 (P67)	68 (P68)	69 (P69)
16 (P16)	17 (P17)	18 (P18)	43 (P43)	44 (P44)	45 (P45)	70 (P70)	71 (P71)	72 (P72)
19 (P19)	20 (P20)	21 (P21)	46 (P46)	47 (P47)	48 (P48)	73 (P73)	74 (P74)	75 (P75)
22 (P22)	23 (P23)	24 (P24)	49 (P49)	50 (P50)	51 (P51)	76 (P76)	77 (P77)	78 (P78)
25 (P25)	26 (P26)	27 (P27)	52 (P52)	53 (P53)	54 (P54)	79 (P79)	80 (P80)	81 (P81)

Figure 11- 9×9 image matrix with average median value

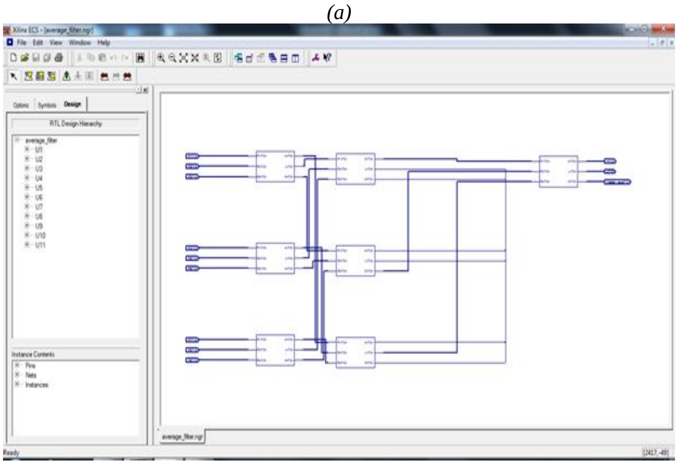
The main advantage of our proposed structure is that user can set a threshold value by using medians. The threshold value expresses image brightness and darkness. This threshold value plays vital role in image processing application. With the help of this value one can change the vision of an image.

IV. EXPERIMENTAL RESULTS

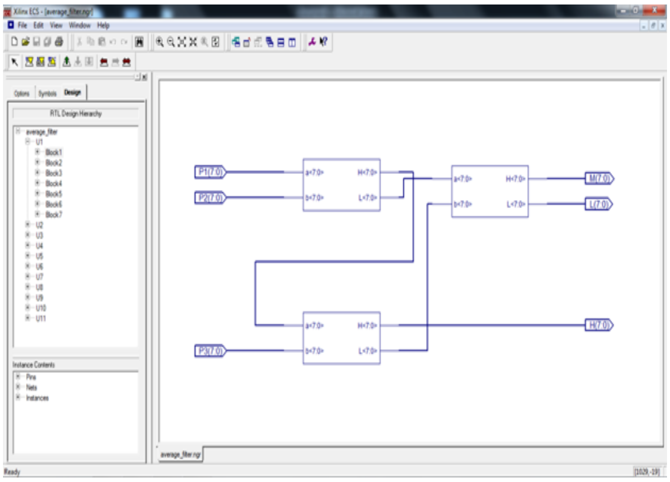
In this paper we proposed a new segmentation based structure for computing more median values and average median value. We also describe algorithmic steps for this process. This algorithm exhibits suitability and simplicity for VLSI implementation due to regular architecture. The RTL design hierarchy and simulation environment is summarized below:-



(a)



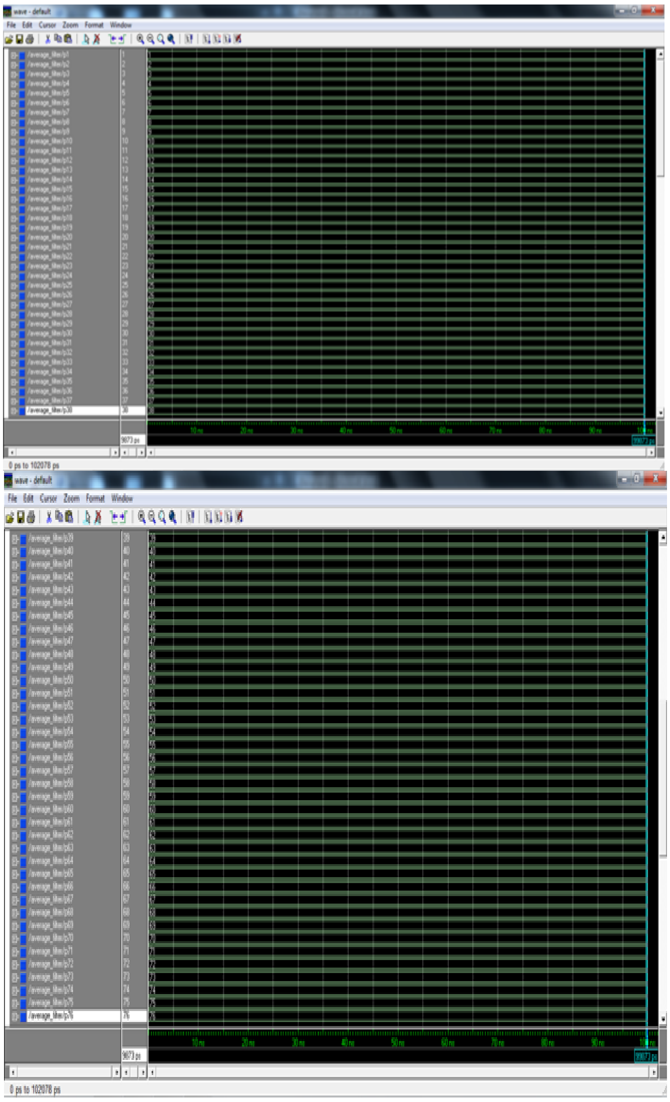
(b)



(c)

Figure 12- RTL Design hierarchy, (a)RTL for proposed structure, (b) RTL for multilayer sorting structure, (c) RTL for 3 pixel comparator module.

The simulation result for average median value is shown in fig. 13.



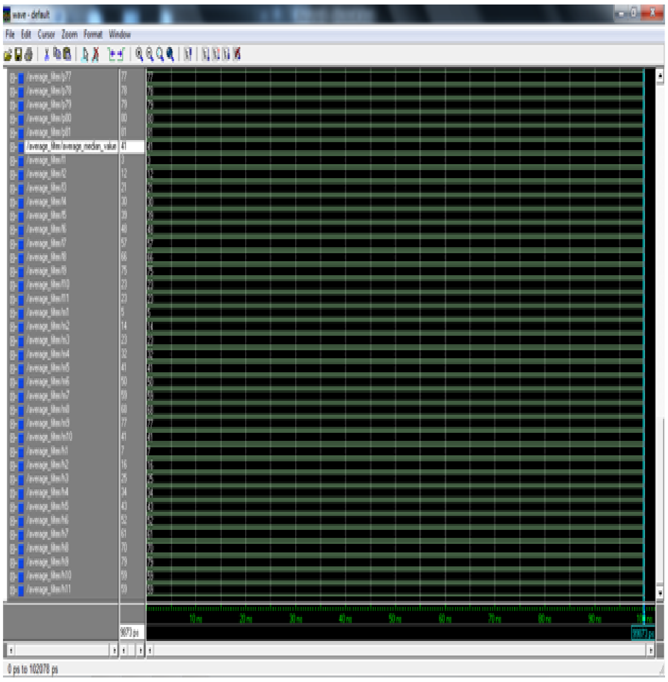


Figure 13- Simulation result (we shows here three screenshot because data matrix is very lengthy in last screenshot average median value is shown and also 9 median comparison present in this screenshot.)

V. CONCLUSION

In this paper we propose a novel architecture for computing more median values in an image, and also an average median value by using all medians. This whole process is based on segmentation process. So we can say that this is a practical analysis of an image segmentation method for removing noise in an image by using median filter. Our proposed structure includes two image processing methods one is image segmentation and second image enhancement. Because median filters provides us median values and by using medians, one can enhance an image very easily. Our proposed structure is very effective for computing average median value. With the help of this average median value one can easily decides the threshold value of an image. The threshold value expresses image brightness and darkness. The concept of threshold value plays vital role in image processing application.

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AUTHOR'S PROFILE

Ankit Kandpal was born in June, 22, 1992 at Bageshwar, in India. He received his B.Tech. degree in Electronic and Communication Engineering from Uttarakhand Technical University, Dehradun (India) in 2012. He is currently pursuing M. Tech. (VLSI design) degree from Faculty of Technology, University Campus at the same university. His area of interests includes VLSI design, Advance digital signal processing, Digital image processing, and Nano scale device & circuit design.

Vishal Ramola working as an Assistant Professor and Head of Department in M.Tech. Department of VLSI design Faculty of Technology, University campus, Uttarakhand Technical University, Dehradun. He has more than fifteen year of teaching experience and has published many research papers in various International Journals. His area of interests includes VLSI design, Advance VLSI Technology, and Nano scale circuit design. He is presently guiding a number of M. Tech. students in the same area.