ISSN 2348 – 9928
IJAICT Volume 2, Issue 8, August 2015 Doi:01.0401/ijaict.2014.03.10 Published Online 05 (08) 2015

DESIGN OF MEDIAN FILTER USING VHDL

Mr. G. V. Manoj Gowtham
PG Scholar,
VLSI Design, Department of ECE,
SNS College of Technology,
Coimbatore, Tamilnadu, India

Prof. R. Sathish Kumar
Assistant Professor,
Department of ECE,
SNS College of Technology,
Coimbatore, Tamilnadu, India

Abstract— In this paper an efficient method for removing noise as well as preserving the edge from corrupted image is presented here. In the signal transmission, the image signal can be corrupted by noise and the blurred image be the result. Impulse noise is caused by malfunctioning pixels in camera sensors, faulty memory locations in hardware, or transmission in a noisy channel. For instance two common types of impulse noise are the salt-and-pepper noise and the random-valued noise. For images corrupted by salt-and-pepper noise, the noisy pixels can take only the maximum and the minimum. The proposed idea is to run through the image pixel entry by entry and replacing each entry with the median of neighbouring entries. This Median filter has the capability to remove the noise without damaging the edges. The simulation design gives better image and it is algorithmically simple. Our scheme can remove salt-and-pepper-noise effectively.

Keywords— FPGA, Impulsive Noise, Median Filter.

I. INTRODUCTION

The FPGA and CPLD's are gaining applications in all fields of engineering because of their high speed parallel operations (unlike microprocessor which execute operations sequentially). Because of its operating speed it is especially preferred for the heavy and time critical processing tasks such as real time image processing. The digital image contains millions of bytes of data and in real time applications it is needed to be processed in very limited time (frame interval). This paper presents a fast and efficient processing architecture based on FPGA for the filtration of the impulsive noise. Traditionally, the impulse noise is removed by a median filter which is the most popular nonlinear filter. Its hardware implementation is straightforward and does not require many resources. However, the standard median filter gives a poor performance for images corrupted by impulse noise with higher intensity. A simple median utilizing 3×3 or 5×5-pixel window is sufficient only when the noise intensity is less than approx. 10-20%. When the intensity of noise is increasing, a simple median filter remains many shots unfiltered [1].

II. IMPULSE NOISE

Impulse Noise (IN) is a general term for single-pixel bright or dark spots that are not authentic imagery. This artifact can have several different causes, each with a slightly different appearance [4].

2.1 Bit-Flip Noise: Bit-Flip Noise is a specialized form of IN that causes single-pixel shifts in the data that are set powers of 2 a pixel may be 128, 64, or 32 DN higher or lower than its actual value. This artifact arises from some digital source, often a transmission error or a problem in the processing systems.

2.2 Salt and Pepper Noise: Fat-tail distributed or "impulsive" noise is sometimes called salt-and-pepper noise or spike noise [4]. An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by analog-to-digital converter errors, bit errors in transmission, etc.[5][6]. It can be mostly eliminated by using dark frame subtraction and interpolating around dark/bright pixels. If any form of impulsive noise pixels appears only in certain detectors or in fixed locations, it could be a warning of an imminent dead or flat detector problem.

2.3 Shot noise: The dominant noise in the lighter parts of an image from an image sensor is typically that caused by statistical quantum fluctuations, that is, variation in the number of photons sensed at a given exposure level. This noise is known as photon shot noise.[4] Shot noise follows a Poisson distribution, which is usually not very different from Gaussian. When noise becomes more than just shot noise, and hot pixels appear as salt-and-pepper noise.

III. MEDIAN FILTER

Median filter is a spatial filtering operation, so it uses a 2-D mask that is applied to each pixel in the input image. To apply the mask means to centre it in a pixel, evaluating the covered pixel brightness's and determining which brightness value is the median value. The median value is determined by placing the brightness's in ascending order and selecting the centre value [2]. The obtained median value will be the value for that pixel in the output image. Figure 3.1 shows an example [2].

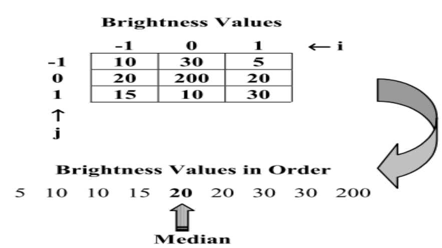

Fig 1 : Structure of the median filter

ISSN 2348 – 9928
Doi:01.0401/ijaict.2014.03.10 Published Online 05 (08) 2015

Habitually a 3x3 median filter is used, since bigger filters usually eliminate small edges. Therefore most of the image filtering algorithms are focused on the 3x3 median filter implementation.

3.1 Noisy Candidate Detection

Let the pixel to be tested for the noise candidate is at the centre [7](as shown in figure 2)

$P(i-1, j-1)$	$P(i-1, j)$	$P(i-1, j+1)$
$P(i, j-1)$	$P(i, j)$	$P(i, j+1)$
$P(i+1, j-1)$	$P(i+1, j)$	$P(i+1, j+1)$

Fig 2: Mask for Detection of Noisy Pixel

3.2 Design Process

Step 1: Adding Noise to the Image

Add the noise to the image by using the command in the MATLAB and then convert the data type into double data type. Generate the text file of the image.

Step 2: Processing of Image

In the second step removing of noise takes place. This can be done by spatial filtering. Considering the pixel and then mask the pixel. By finding the median value then the noisy pixel can be replaced by the median pixel value. Thus the error gets minimised. Step 2 is done by using MODELSIM. For masking scheme, spatial filtering is done. To go through the pixel nine conditions are taken out which can be indicated by x and y axis of the image. The presence of nine conditions in terms of x and y axis are (0,0),(0,254), (254,0), (1to254&1to254), (255,255)(255,255), (254&1to254),(1to254&254),(0,255) and (255,0)

For (0,0)

0	0	0
0	I,J	J,J+1
0	I+1,J	I+1,J+1

For (0,254)

0	0	0
I,J-1	I,J	I,J+1
I+1,J-1	I+1,J	I+1,J+1

For (254,0)

0	I-1,J	I-1,J+1
0	I,J	J,J+1
0	I+1,J	I+1,J+1

For (1 to 254 & 1 to 254)

I-1,J-1	I-1,J	0
I,J-1	I,J	0
I+1,J-1	I+1,J	0

For (255,255)

I-1,J-1	I-1,J	I-1,J+1
I,J-1	I,J	I,J+1
I+1,J-1	I+1,J	I+1,J+1

For (254 & 1 to 254)

I-1,J-1	I-1,J	I-1,J+1
I,J-1	I,J	0
I+1,J-1	I+1,J	0

For (1 to 254 & 254)

0	0	0
I,J-1	I,J	0
I+1,J-1	I+1,J	0

For (255,0)

0	I-1,J	I-1,J+1
0	I,J	J,J+1
0	0	0

Corresponding Author: Mr. G.V. Manoj Gowtham, SNS College of Technology, Coimbatore, Tamilnadu, India.

ISSN 2348 – 9928
Doi:01.0401/ijaict.2014.03.10 Published Online 05 (08) 2015

For (0,255)

I-1,J-1	I-1,J	0
I,J-1	I,J	0
0	0	0

Use the file input1.txt in the ModelSim and then by using these nine conditions the median can be taken out by arranging the values in ascending order.

Step 3: Read the Output Image

In the third step display of output image takes place. By using MATLAB, image can be displayed.

IV. RESULTS

This section demonstrates the simulation results for proposed scheme. These have been implemented using MATLAB and MODELSIM. The image which is applied to MODELSIM get processed and noise removed image is get and the output get displayed by using MATLAB. As the program is written in VHDL and so this can be implemented in hardware's like FPGA. It is suitable for many real time applications.

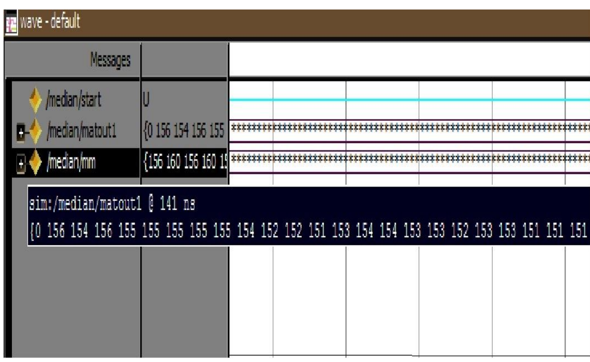

Fig 3 : Output Waveform

Fig 4 : Input Image

Fig 5 : Noisy Image

Fig 6 : Output Image

V. CONCLUSION

From the simulated results, it can be observed that by using median filter the impulse noise can be removed. The concept based on a removal of noise as been shown to be useful to design median filter. There are different filters available but the median filter is seen to be good.

References

[1] Zdenek Vasicek and Lukas Sekanina "Novel Hardware Implementation of Adaptive Median Filters", Design and Diagnostics of Electronic Circuits and Systems, 2008.

[2] Miguel A. Vega-Rodríguez, Juan M. Sánchez-Pérez and Juan A.Gómez-Pulido "An Fpga-Based Implementation for Median Filter Meeting the Real-Time Requirements of Automated Visual Inspection Systems", Proceedings of the 10th Mediterranean Conference on Control and Automation- MED2002 Lisbon, Portugal, July 9-12, 2002.

[3] Saeed V. Vaseghi "Advanced Digital Signal Processing and Noise Reduction, Second Edition", ISBNs: 0-471-62692-9.

[4] http://landsat.usgs.gov/science_an_impulsenoise.php

[5] D.Dhanasekaran and K.Boopathy Bagan "High Speed Pipelined Architecture for Adaptive Median Filter", European Journal of Scientific Research ISSN 1450-216X Vol.29 No.4 (2009), pp.454-460.

[6] Anis Boudabous, Lazhar Khriji, A. Ben Atitallah, P. Kadionik and Nouri Masmoudi "Efficient Architecture and Implementation of Vector Median Filter in Co-Design Context", Radio Engineering, VOL. 16, NO. 3, September 2007.

[7] Gonzalez and Woods, Digital image processing, 2nd edition, Prentice Hall, 2002. Chap 4 Sec 4.3, 4.4; Chap 5 Sec 5.1 – 5.3 (pages 167-184 and 220-243).

Corresponding Author: Mr. G.V. Manoj Gowtham, SNS College of Technology, Coimbatore, Tamilnadu, India.