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An Enchanced Area Optimized Image Edge Detection Based On Sobel Operator

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Abstract Edge Feature Extraction is a basic and important subject in computer vision. In recent years edge detection technique has gradually been widely used because it filter out useless data from the image. Sobel edge detection is one of the classic edge detection operator, used to detect the edge pixels in a image and property of less deterioration in high level of noise. This method exploits the change in intensity with respect to neighboring pixels. The gradient edge detection is chosen in order to optimize the area which is essential feature. The Sobel edge detection is implemented in VDHL and simulation and synthesis will be done using Xilinx and XSG. Comparison Sobel edge detection results have been done, simulation and synthesis are verified by Xilinx and XSG.

Keywords—: *Red Green Blue**(RGB),** Xilinx system generator**(XSG),** Field Programmable Gate Array **(FPGA)**.*

1. INTRODUCTION

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Edges define the boundaries between regions in an image, which helps with segmentation and object recognition. They can show where shadows fall in an image or any other distinct change in the intensity of an image. Edge detection is a fundamental of low-level image processing and good edges are necessary for higher level processing. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in an exceedingly scene. Since the edges of a picture are thought-about to be most important image attributes that offer valuable info to user, the sting detection is one in every of the key stages in image/video processing, object recognition and tracking. The goal of a edge detection algorithm is to locate the sharp changes within the image brightness. There are many ways to perform edge detection. However, the majority of various ways might be grouped into two, Gradient primarily based edge detection that detects the sides by trying for the utmost and minimum in the first derivative of the image and Laplacian primarily based edge detection that detects edges with zero crossings in the second order derivative of the image. [1], [2]. The second order derivative is very sensitive to noise gift in the image and hence second order derivative operators are not usually used for edge detection operation [3].

Consequently, over the history of Digital image Processing a variety of edge detectors have been devised which differ in their purpose (i.e., the photometrical and geometrical properties of edges which they can able to extract) and their mathematical and algorithmic properties.

This paper is organized as follows; Section 2 explains the existing model of the Sobel Edge Detection and section 3 explains the proposed model of Optimization in terms of Area of Sobel Edge Detection. Simulation & comparison of analyzed Results are in the section 4, Section 5 with the conclusion.

2. SOBEL EDGE DETECTION

The Sobel operator is far and wide or broadly used for edge detection in image processing. It has advantage of simple gradient operator over the remaining gradient operator in image processing because of its property to counteract the noise sensitivity. The operator is mainly based on computing a ballpark figure of the gradient of the image intensity utility. It principally uses two 3x3 spatial masks (Gx and Gy), which are

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convolved with the original image to gauge the ballpark figure of the gradient utility. The Sobel operator mainly uses two filter masks they are has below

Gx =

-1	0	+1
-2	0	+2
-1	0	+1

Gy =

+1	+2	+1
0	0	0
-1	-2	-1

Fig.1 Convolution Kernels

These masks compute the middling gradient components across the neighboring lines or columns respectively. The local edge potency is defined as the gradient magnitude prearranged by

$$G = \sqrt{G_X^2 \quad + G_Y^2}$$

The precision of the Sobel operator used for edge detection is fairly low because it uses two masks which detect the edges nearby in horizontal and vertical directions only.

Fig 1 shows the basic block echelon data flow diagram for working out of the Sobel edge detector. It consists of essentially four stages. In the first stage, the homeward bound pixel data is stored in buffer memory. Four gradients along poles apart directions are computed in the second stage. The utmost gradient is selected, and final edge map is computed by comparing the maximum gradient value with a threshold in the third and fourth stages, respectively.

The Sobel Edge Detector consists of chiefly 3 blocks are:

1. Memory module
2. Gradient calculation
3. Binary segmentation

MEMORY MODULE: In the Sobel compass operator [3X3], the masks are used to work out gradient values along poles apart directions over an input image. Consequently, it is obligatory to store at slightest two rows of input image data in FPGA on-chip memory before the handing out begins. To achieve this, we have used elegant buffer-based memory structural design which utilizes a set of registers in order to shift the image data into computing. The length of the shift register depends on input image width [10].

GRADIENT CALCULATION: By using these kernels we can reckon the gradient values. From these masks we can effortlessly use the subsequent equations

G_x=(P3-P1)+2(P6-P4)+(P9-P7)
G_y=(P7-P1)+2(P8-P2)+(P9-P3)
G_{dr}= (P8-P2)+2(P9-P1)+(P6-P4)
G_{dl}=(P2-P8)+2(P3-P7)+(P6-P8)
Gradient=G=$|G_x|+|G_y|+|G_{dr}|+|G_{dl}|$

By using the gradient the complete combinational logic is split keen on quite a few multiple level [6].

BINARY SEGMENTATION: The representation of binary segmentation module is shown in Fig 2 input is the gradient value and then it compares with the given threshold value [4] and either of two values one will correspond edges can be detected in this section.

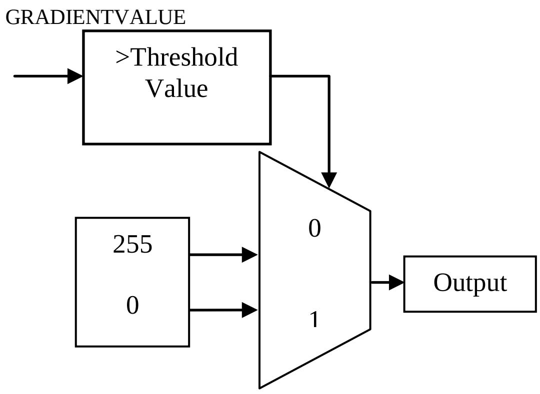

Fig 2 Binary Segmentation

3. PROPOSED ARCHITECTURE

Here the Proposed architecture using Xilinx consists of input pixels from the image and that pixels are given as the input. These pixels are stored in buffer memory and for that pixels values Sobel edge detection have been used to find out edge as well as filter out useless information. Gradient operation has to be used. From that gradient values the maximum value will comes as the output. And from that we can tell that whether the edge present in the given input pixels values of the image. So, in order to reduce the power the memory module has been design with RS

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flip flop with two separate clock pluses and for that we proposed to use the ring counter. For the buffer memory the color edge detection separates the basic components and that is applied to the Sobel edge operator in which it generally detects the edges. And now the color edge map is calculated by merging the edges of each basic color channel.

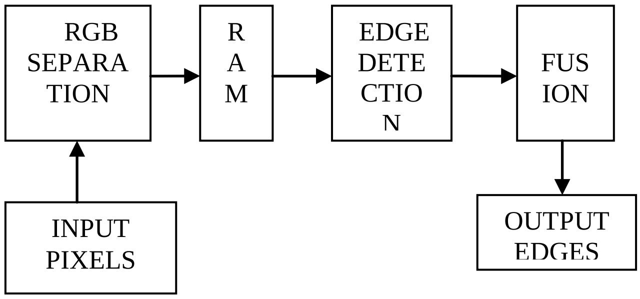

Fig 3 Proposed Architecture using Xilinx

The Sobel edge detection architecture used for three basic color channels for gradient calculation is shown in Fig 3. It determines horizontal and vertical gradients for each channel. The combined gradient for each channel is computed by adding the absolute values of both gradients values to find out the edges. The edge map is calculated by comparing the gradient value with threshold of our edges requirements. And from the figure the Sobel operator module is same on RBG components [5]. The only change is in the input pixels applied to each Sobel operator module

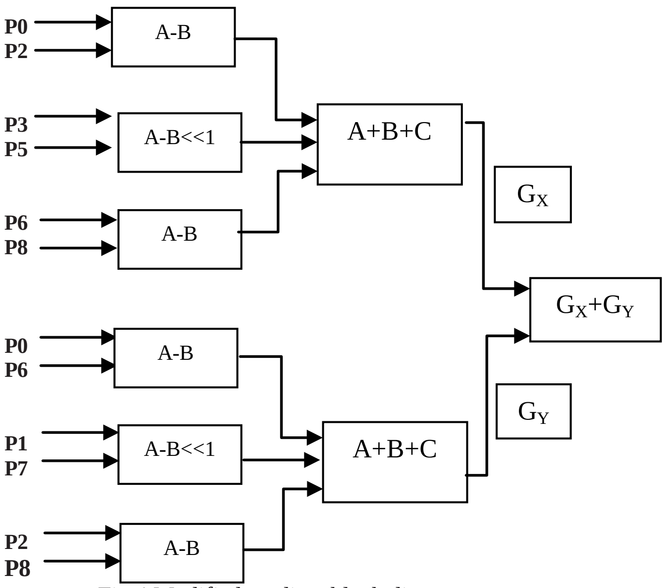

Fig.4 Modified gradient block diagram.

Here the Proposed architecture using Xilinx system generator is shown in Fig 5. It mainly consists pre-processing which is used for median filtering, background subtraction, gamma correction, histogram stretching, adjustment of hue, color balance and saturation is used to enhance the edges in images. Later the obtain image is partitioned into dyadic squares which means dividing the image into small blocks. The square blocks of the image is given to Sobel operator in order to find the edges of the image and to remove useless data present in the in image. The edges obtained have been checked out with the threshold value whether the edges lies within the specified range or not. So in that checking it will discard the unqualified pixels values i.e. the pixels values which are having more threshold then what we required. Further enhance the extracted linear features such as discontinuities, which exist in the image after further analyzed using post-processing

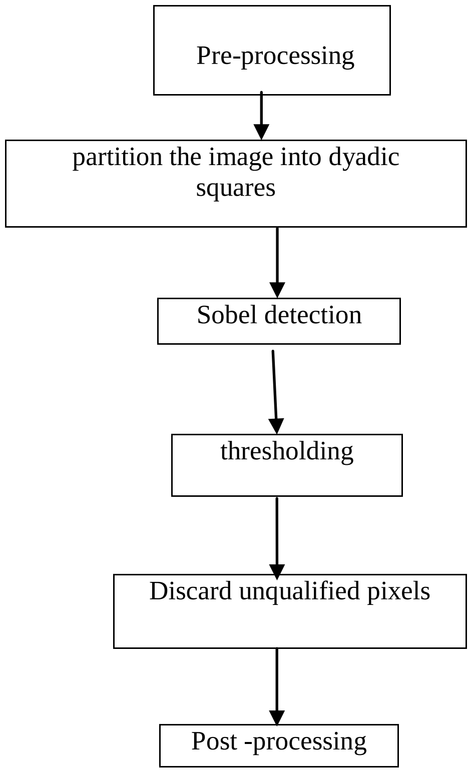

Fig.5 Proposed architecture by Xilinx system generator

4. SIMULATION RESULTS

The Propose of Sobel edge detection algorithm is described in VHDL. Fig. 6 depicts edge detected image using XSG, Design and testing of individual module has been carried out. the final output consists of only basic components of the image Fig 7 depicts the simulation results when there is no edge in the image and Fig 8 depicts simulation results when the edges present in the image. Fig 9, 10 depicts the simulation results of binary segmentation module as gradient value is compared with the user defined threshold value. Fig. 11, 12 shows RTL and technological schematic of top module. Table 1,2 shows design of Xilinx and XSG.

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Fig.6 edge detected image using XSG

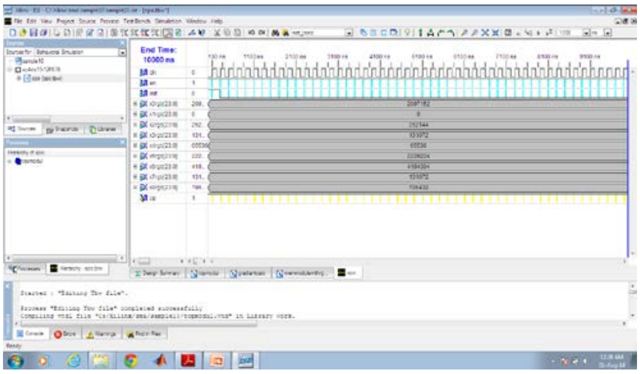

Fig7. Simulation result for sobel edge detection when edges absent.

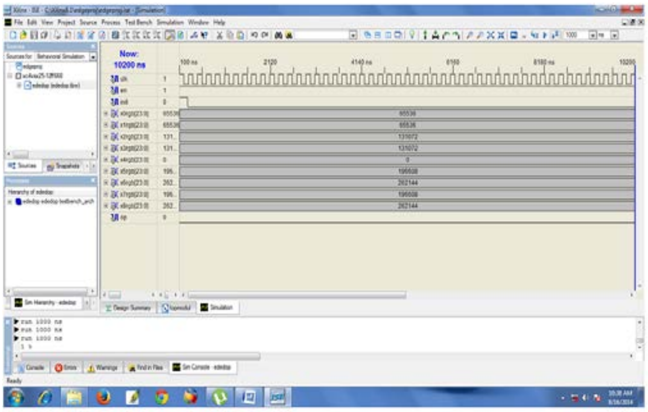

Fig8. Simulation result for sobel edge detection when edges present.

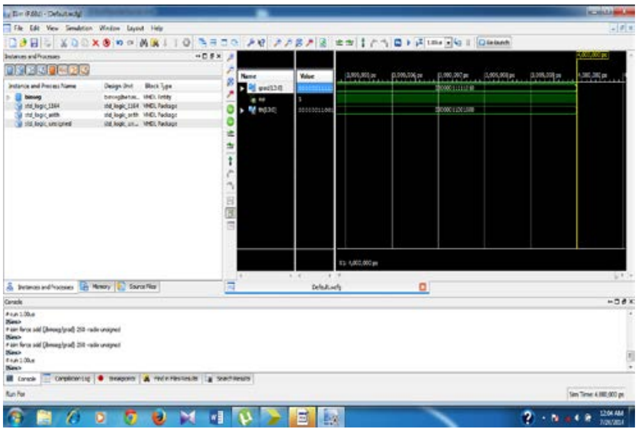

Fig9. Simulation result for binary segmentation below threshold value.

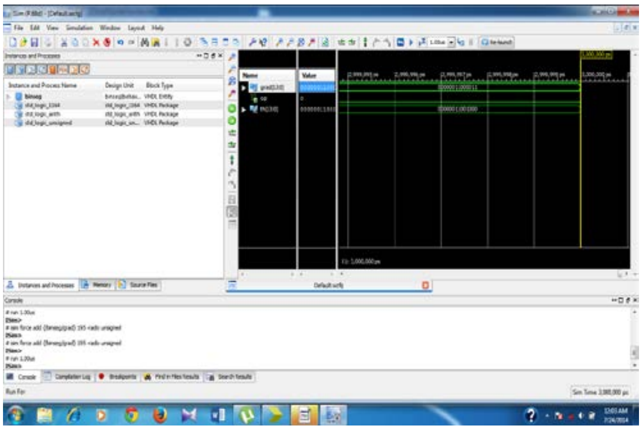

Fig10. Simulation result for binary segmentation above threshold value.

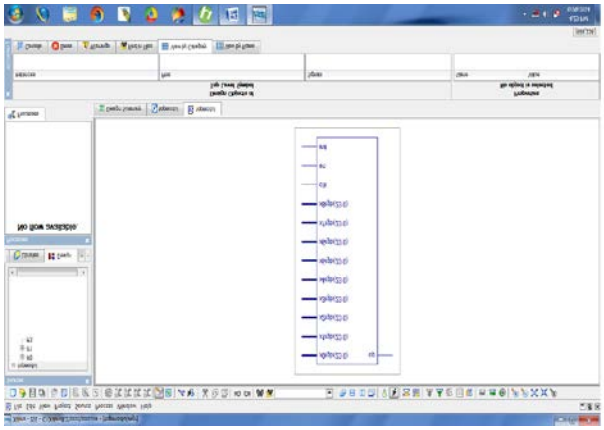

Fig11. Top module of RTL schematic.

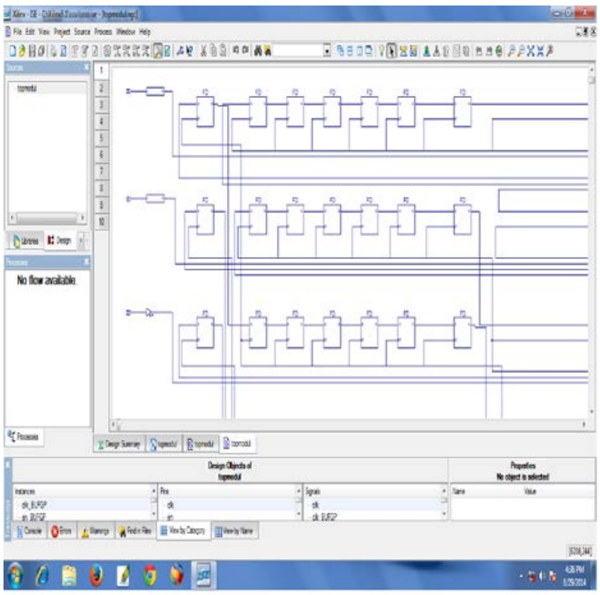

Fig12. Technological schematic view of the Top module.

Device Utilization Summary			
Logic Utilization	**Used**	**Available**	**Utilization**
Number of Slices	10240	11289	91%
Number of Slice Flip Flops	13636	20480	66%
Number of 4 input LUTs	9466	20480	46%
Number of bonded IOBs	68	320	21%
Number of GCLKs	2	32	6%

Table 1 Design Summary of Xilinx

Device Utilization Summary			
Logic Utilization	**Used**	**Available**	**Utilization**
Number of Slices	2910	122880	2%
Number of Slice Flip Flops	2910	122880	2%
Number of 4 input LUTs	1032	122880	0%
Number of bonded IOBs	153	960	15%

Table 2 Design summary of XSG

5. CONCLUSION

Sobel edge detection operator is insensitive to noise and the masks of sobel operator is relatively small as compare to the other edge detection operator (theoretically studied) that's why Sobel edge detection operator is used. From that the area is optimized with gradient calculation and the memory module. And the resource of FPGA area has been reduced. For more accurate results we can use the four convolutions to detect the edges of the images. Comparison of the area optimized results are obtained. For more accurate results we can use the four convolutions to detect the edges of the images.

REFERENCES

[1] Sanjay singh ,Chandra sekhar "Area optimized FPGA implementation of color edge detection"2013 international conference on advanced electronics systems(ICAES)

[2] D. Ziou and S. Tabbone, "Edge detection techniques - an overview," International Journal of Pattern Recognition and Image Analysis, vol. 8, pp. 537–559, 1998.

[3] Raman Maini, Dr. Himanshu Aggarwal, "Study and Comparison of Various Image Edge Detection Techniques", International Journal of Image Processing (IJIP), Volume 3.

[4] M.B. Ahmad and T.S. Choi, "Local Threshold and Boolean Function Based Edge Detection," IEEE Trans. Consumer Electronics, vol. 45, no.3, pp. 674-679, 1999.

[5] A. Koschan and M. Abidi, "Detection and Classification of Edges in Color Images," IEEE Signal Processing Magazine, vol. 22, no. 1, pp. 64-73, 2005

[6] S. Singh, A.K. Saini, R. Saini, AS Mandal, C. Shekhar, A. Vohra, "A Novel Area Efficient Implementation of Sobel Operator based Edge Detection using FPGAs," Under Review in International Journal.

[7] A. Nosrat and Y. S. Kavian, "Hardware description of multi-directional fast sobel edge detection processor by VHDL for implementing on FPGA," International Journal of Computer Applications, vol. 47, no. 25, pp. 1–7, 2012.

[8] K. C. Sudeep and J. Majumdar, "A novel architecture for real time implementation of edge detectors on FPGA," International Journal of Computer Science Issues, vol. 8, no. 1, pp. 193–202, 2011.

[9] W. Burger and M. J. Burge, Digital Image Processing: An Algorithmic Introduction Using Java, Springer, New York, NY, USA, 2008.

[10] C. Moore, H. Devos, and D. Stroobandt, "Optimizing the FPGA memory design for a sobel edge detector," in Proceedings of the 20th Annual Workshop on Circuits, Systems and Signal Processing, 2009.