

Design and Simulation of SOBEL Edge Detection using MATLAB Simulink

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Abstract - Image processing is widely used in many applications and edge detection is the heart of all image processing application. Edge detection is the process which identifies and locates sharp discontinuities of image, which are abrupt changes in pixel intensity and it specifies the boundary of an object. The objective of this work is to implement an SOBEL EDGE DETECTION algorithm on image captured in which it reads the pixels of an image and then fixed mask values of SOBEL OPERATOR is applied on image. The proposed algorithm is to be coded and synthesised using MATLAB Simulink.
Key Words: SOBEL EDGE DETECTION, pixel intensity, boundary, SOBEL OPERATOR, MATLAB Simulink.

1.INTRODUCTION (Size 11 , cambria font)

Image processing is one type of signal processing where the image or information regarding the image is set as an input signal and a variety of operations are performed on it. The various operation performed on the image can be applied for various applications like Image filtering, medical imaging, image compression, computer vision, etc. Some of the most common operations on an image that comes under image processing which are Image scaling, image rotation, filtering, edge detection, colour detection.

1.1 Edge Detection

Edge detection is a major tool in image processing area which is used in many application like feature extraction and feature detection .It identifies the

points in a image where there is a sharp change in brightness. These points are alone marked in the output image with a specified colour which is usually black and rest of the image as white. So the output image only contains the edges of a range of components in input image. There are not many algorithms used for edge detection out of which sobel filter is familiar one.

This paper is based on sobel edge detection using Simulink, which is a simulation modelling and GUI based diagram environment and design tool, developed by Math Works, and is a commercial tool for modelling, simulating and analyzing multi domain dynamic systems. Its major interface is a graphical block diagramming tool and a customizable set of block libraries. It offers tight integration and the rest of the MATLAB environment can either drive MATLAB or be scripted from it. Simulink is a raised area for multi domain simulation and model-based design of dynamic system. Simulation is an interactive tool for modelling, Simulating and analyzing dynamic multi domain system. You can build a block diagram, simulate system behaviour evaluate performance and refine the design. MATLAB provides you to immediate access to an extensive range of analysis and design tool. Simulink is very efficient for processes like control system design, Digital signal processing design, communication system design simulation option . Edge detection is one of the fundamental tools used in most image processing.

2. Sobel Edge Detection

The Sobel edge detection is a very common first order edge detection operator which computes an approximation of the gradient of the image intensity function. At each part in the image the result of the Sobel operator is the corresponding norm of this gradient vector. The Sobel operator only considers the two orientations which are 0° and 90° convolution kernels as shown in Fig.(1) and Fig.(2). The advantage of Sobel operator is its simplicity in calculation but one of the disadvantage is its accuracy which is relatively low because it only used two convolution kernels to detect the edge of image.

$$H_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

Fig.1 Horizontal operator

$$H_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

Fig.2 Vertical operator

The gradient components across the neighbouring lines or columns are convoluted by these filters correspondingly. And the result of gradient magnitude defines local edge strength and the equation is given by (1).

$$GM(x,y) = \sqrt{H_x^2 + H_y^2} \dots\dots(1)$$

But square root and square operations for each and every pixel is computationally expensive for which the square and square root operations are approximated by absolute values which is given by the expression(2).

$$GM(x, y) = |H_x| + |H_y| \dots\dots(2)$$

This expression (2) can be easily processed and it helps in preserving the edges in images/video for which the above mentioned process is applied individually for each and every pixel of an image and the final edge plot is calculated by absolving the edge maps of all channels.

3. Proposed Model

The planned model for Sobel Edge Detection by using Simulink model is shown in Fig. 3. The Input and Output Image are simulink block sets where the block can read/write image from/into Matlab workspace. The Serialize block and Deserialize block

are also in simulink blocksets that transfers the image into the suitable standard for next entity. Here the Sobel Edge Detection algorithm is also designed by using blocksets of Simulink.

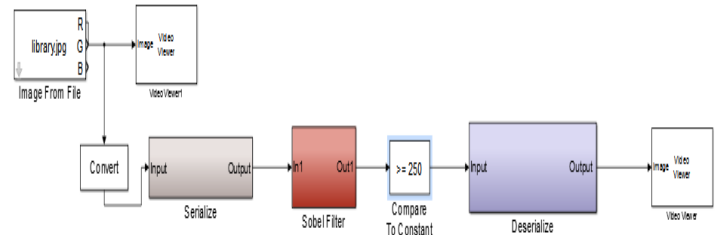


Fig: 3 Proposed Model

4. BLOCK DIAGRAM

a. Serialize Block

Serialize block is shown in Fig.4. The significance of this block is serialization of data with suitable data rate for the hardware implementation.

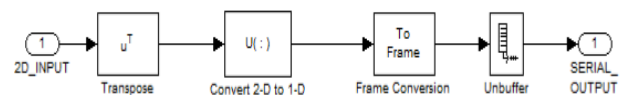


Fig: 4 Serialize block

b. Deserialize Block

Deserialize block is shown in Fig.5. The significance of this block is to make the data accessible and with suitable data rate for displaying in matlab environment.

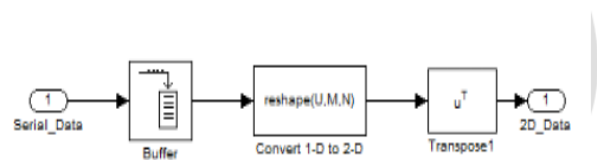


Fig: 5 Deserialize block

c. Sobel Edge Detection Block

The Sobel filter block is depicted in fig. 6. It first calculates Sobel filter response in x and y direction in Sobel kernel block, then sum their absolute values to get the final Sobel filter response and quantize the response

to Uint8 type for following display.

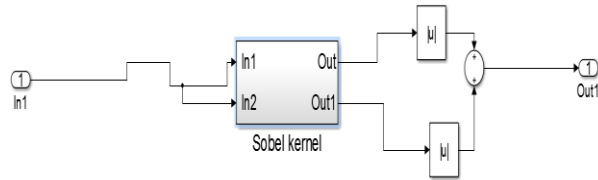


Fig.6 Sobel Filter Block



Fig.7 Sobel Kernel Block

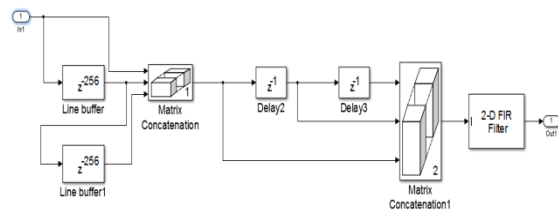


Fig.8 X/Y- Directional Block in Sobel Filter System

Fig. 7 shows the implementation of Sobel kernel block. Then the x/y directional block in fig.8 is shown .Here,in each iteration the input pixel is pushed into the current line buffer and then control logic rotates between these three buffers when it reaches the column boundary. Each buffer is followed by a shift register and data at the current column index is pushed into the shift register. At each iteration a 3x3 surrounding of pixels are formed from the pixel input, shift registers and line buffer outputs.

5. SIMULATION RESULT

The output result for Sobel edge detection technique for Matlab Simulink model shown above are given bellow. Here the input image is “library.jpg” the gradient calculated image in x and y direction is done and edge detected output is shown below.



Fig.9 Input Image



Fig.10 Sobel Edge Detected Image

6. CONCLUSION

Edge detection form a pre-processing stage to eliminate the redundant information from the input image, thus considerably reduces the amount of data to be processed while at the same time preserves the useful information about the boundaries. Here we are dealing with edge detection technique in modelling type by using the Matlab Simulink and we are concentrating only on the working of edge detection technique . The computations are complex. Further,there are also many other type of edge

detection methods are there to improve the detection of edges .

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