FPGA Based Design and Implementation of Image Edge Detection Using Xilinx System Generator

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Abstract:

Edge detection serves as a pre-processing step for many image processing algorithms such as image enhancement, image segmentation, tracking and image/video coding. The edge detection is one of the key stages in image processing and object recognition. Edge detection is a basic operation in image processing, it refers to the process identifying and locating sharp discontinuities in an image, the discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. The proposed system we use canny algorithm, in canny edge detection can produce good detection of the edge with the thin and smooth it's very useful for further study of segmentation.

Key words: pre-processing, image enhancement and segmentation, canny algorithm.

I. Introduction

The edges of image are considered to be most important image attributes that provide valuable information for human image perception. The edge detection is a terminology in image processing, particularly in the areas of feature extraction, to refer to algorithms which aim at identifying points in a digital image at which the image brightness changes sharply .The data of edge detection is very large, so the speed of image processing is a difficult problem.

The main objective of image processing is to improve the quality of the images for human interpretation or the perception of the machines independent of the images for human interpretation or the perception of the machines independently. This paper focuses in the processing pixel to pixel of an image and in the modification of pixel neighborhoods and of course the transformation can be applied to the whole image or only a partial region. The need to process the image in real time, leading to the implementation level hardware, which offers parallelism, Thus significantly reduces the processing time, which was why decided to use Xilinx System Generator, a tool with graphical interface under the Mat lab, Simulink, based blocks which makes it very easy to handle with respect to other software for hardware description. In addition to offering all the tools for easy graphical simulation level. This article presents architecture of image processing application generator, which is an extension of Simulink and consists of a bookstore called "Blocks Xilinx", which are mapped architectures, entities, signs, ports and attributes, which script file to produce synthesis in FPGAs, HDL simulation and development tools. The tool retains the hierarchy of Simulink when it is converted into VHDL.

II. Existing system

In edge detection, the Sobel operator is used commonly. The Sobel operator is a classic first order edge detection operator, computing an approximation of the gradient of the image intensity function. At each point 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. The operator uses the two

kernels which are convolved with the original image to calculate approximations of the gradient. The two convolution kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations.

The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these Gx and Gy).These can then be combined together to find the absolute magnitude of the gradient at each point. The gradient magnitude is given by:

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

Typically, an approximate magnitude is computed using:

$$|G| = |G_X| + |G_Y|$$

This is much faster to compute. The Sobel operator has the advantage of simplicity in calculation. But the accuracy is relatively low because it only used two convolution kernels to detect the edge of image.

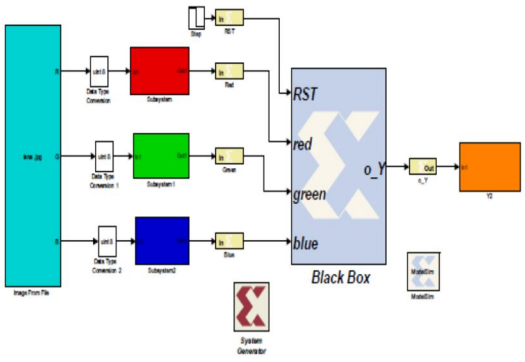
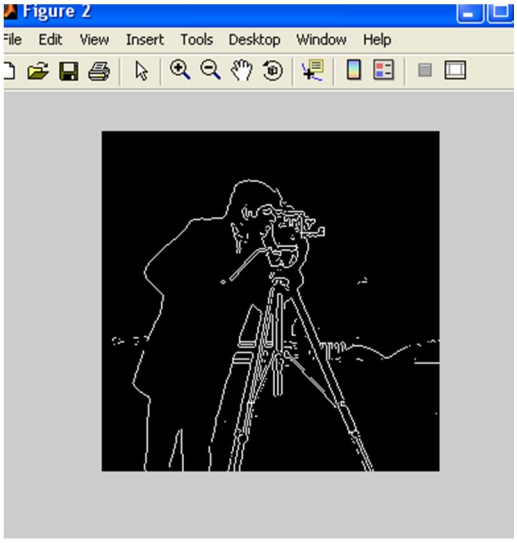


Fig1. Sobel edge detection.

(a) Input image



(b) Edge Detection Image

Fig2. Results for sobel edge detection.

Disadvantages:

The disadvantages of these cross operators are sensitivity to the noise, in the detection of the edges and their orientations. The increase in the noise to the image will eventually degrade the magnitude of the edges. The major disadvantage is the inaccuracy, as the gradient magnitude of the edges decreases. Most probably the accuracy also decreases.

II. PROPOSED SYSTEM

The Canny edge detection algorithm is known to many as the optimal edge detector.. The first and most obvious is low error rate. It is important that edges occurring in images should not be missed and that

there be NO responses to non-edges. The second criterion is that the edge points be well localized. In other words, the distance between the edge pixels as found by the detector and the actual edge is to be at a minimum. The gradient array is now further reduced by hysteresis. Hysteresis is used to track along the remaining pixels that have not been suppressed. Hysteresis uses two thresholds and if the magnitude is below the first threshold, it is set to zero. If the magnitude is above the high threshold, it is made an edge. And if the magnitude is between the 2 thresholds, then it is set to zero unless there is a path from this pixel to a pixel with a gradient.

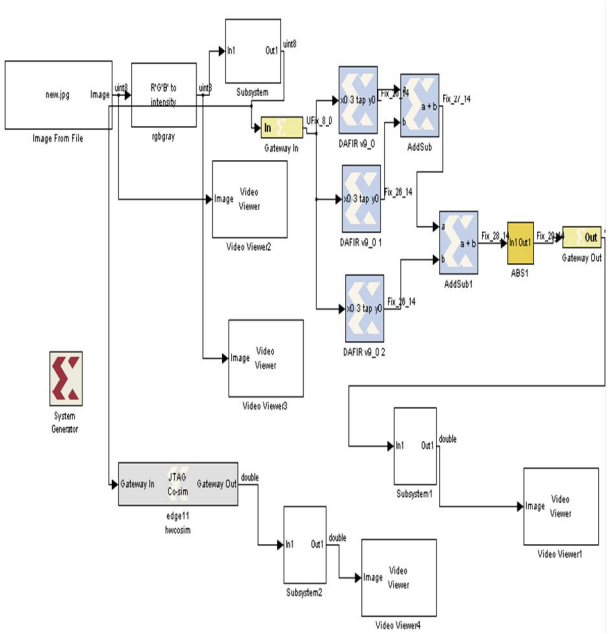


Fig3. Canny edge detection

Advantages of canny edge detection:

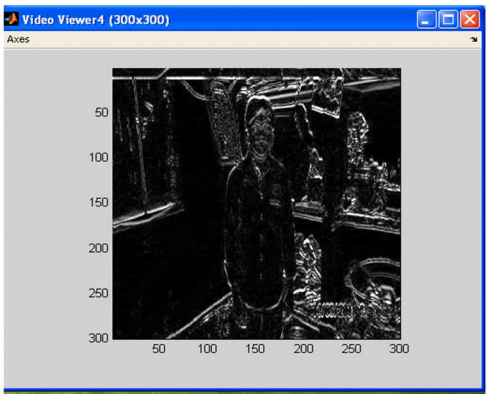
1. Using probability for finding error rate
2. Localization and response.
3. Improving signal to noise ratio.
4. Better detection specially in noise conditions

Applications of canny edge detection:

- Control the amount of detail which appears in the edge images.
- Suppress noise.
- Canny edge detector is adaptable to various environments.
- Canny edge detector has been modified in many different ways to solve specific problems.
- Robot applications.
- The brain MR image analysis in the applications of medicine.

III. Results

(a) Input image



(b) Edge Detection Image

Fig4. Results for canny edge detection.

IV. Conclusion

Xilinx system generator has a unique hardware in the loop co-simulation feature that allows designers to greatly accelerate simulation while simultaneously verifying the design in hardware.

The implemented canny edge detector architecture using low cost available Spartan 3 development system with Xilinx chip XC3S200 has 50MHz maximum frequency .it detects the noise images and which can be computed in a short, fixed amount of time for any desired amount of smoothing.

VI. REFERENCES

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