CANCER CELL DETECTION USING DISTRIBUTED CANNY EDGE DETECTOR

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Abstract - *Edge detection has various applications such as in medical field, automated driving, on large oil and sand ore etc. This paper describes cancer cell detection using edge detection technique. Its an example for the application of edge detection technique in medical field. First part describes the steps to detect cancer cells from an ultrasound image. Which contains filtering, segmentation, morphological operator and distributed canny edge detection technique as the steps to detect abnormalities in the ultrasound image. The major step involved in cancer cell detection is edge detection. Edges are the significant local changes of intensity in an image. Various features of an image can be detected using edge detection. Canny edge detection is the most widely used edge detection technique because of its superior performance. Compared to normal canny edge detection the main difference is that it uses an adaptive threshold selection algorithm; here threshold selection is based on block type and it allows parallel processing of image. In distributed canny edge detection images are divided into blocks and edges are determined based on block type and local distribution of gradients in image blocks .In addition it uses a non uniform gradient magnitude histogram to compute block base hysteresis threshold. Distributed canny edge detection has a reduced latency & it is a fast edge detection technique. Hence it can be used for better and fast detection of cancer cells. All algorithms were developed in MATLAB environment. These algorithms are implemented using a 32 computing engine architecture and synthesized on a Spartan 3E FPGA.*

Key Words: Canny edge detector; Parallel processing; FPGA; Ultrasound image

1. INTRODUCTION

Edges are the significant local changes of intensity in an image various properties of an image can be extracted from edges of an image. various edge detection techniques are available among these canny edge detection is most widely used because of its better performance it computes both high and low threshold values. Along with these advantages it has some disadvantages such as computationally complex& requires high computation time, here threshold value selection is done manually. In the proposed distributed canny edge detection algorithm memory requirements are reduced, decrease latency and increase throughput. Here a new threshold selection algorithm based on distribution of pixel gradients in a block is used. it reduces the dependency between each block hence pipelining is possible in this case. Edge detection has various applications in medical field, automated driving, On large oil and sand ore etc. Here application of distributed canny edge detection in medical field is proposed. It detects abnormal growth in internal organs from an ultrasound image. Which mainly consist of ROI selection, Speckle reduction, Contrast Enhancement, Segmentation , Morphological operation, And Edge detection. Algorithms were developed in MATLAB and these algorithms are mapped onto a Xilinx Spartan 3E FPGA.

1.1 canny edge detection algorithm

Canny edge detection is the most widely used edge detection technique due to it's high performance. It compute both high and low threshold. Canny edge detection has the following steps: 1) Calculating the horizontal & vertical gradient.2) Determining Gradient magnitude and Gradient direction.3) Applying Non maximal suppression.4) Computing high and low thresholds.5) Performing hysteresis thresholding.

In the first step a Gaussian filter is applied to reduce noise content in an image. Gradient calculation is performed by using Finite Impulse Response gradient mask. After that intensity magnitude and direction of each pixel is determined(Step 2). Gradient magnitude of each pixel is compared with neighbor pixels and pixel with low gradient will be suppressed in the next step(Step 3).In Step 4 computing high and low thresholds based on histogram of the gradient magnitude of the entire image.

In canny edge detection algorithm high and low thresholds are calculated based on entire image statistics this makes them computationally complex compared to Roberts and Sobel algorithm. Canny edge detection also has high latency so it's difficult to employed in real time application.

2. CANCER CELL DETECTION

Edge detection can be used in many field such as in medical field, automated driving, on large oil and sand ore. Application of distributed canny edge detection for Ovarian Abnormality detection system is presented here. Fig. 4 shows block diagram for abnormality detection system. The process involves six phases. Reading an image from file (conversion of 2D matrix into 1D vector),RGB to Gray conversion, Filtering, Enhancement, Segmentation, Final extraction of object (Conversion of 1D to 2D matrix, adaptive thresholding, morphological operators, feature extraction and classification)
Ultrasound lung image is first converted from 24bit RGB format to 8 bit intensity image.ROI(Region OF Interest) image is cropped in the next step. Then Cropped ROI image is Filtered by using Speckle Reduction Filter it uses a bilateral filtering algorithm. Enhancement technology is used to provide good contrast between ROI & Background. Then ROI Image is segmented. By this ROI Image &background is separated adaptive thresolding ,global thresholding are used. Morphological operators like filling ,closing, dilation& erosion are used to separate ROI image from complex background. In the Final stage distributed canny edge detection is applied it will detect abnormality in an image.

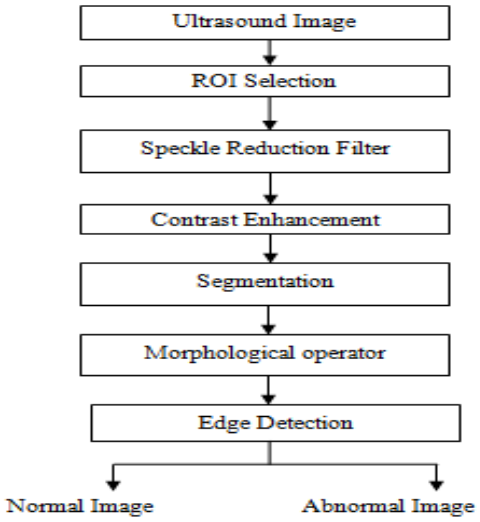

Fig-1:Proposed cancer cell detection system

2.1 Distributed canny edge detection algorithm

Canny edge detection performs on the entire image hence it's latency depends on size of the image. Here distributed canny edge detection is proposed which removes the dependency between blocks and allow parallel processing. Distributed canny edge detection algorithm is similar to normal canny edge detection algorithm they only differ in threshold calculation method. Diagram of proposed algorithm is shown in Fig .2 .In the first step image is classified into blocks and canny edge detection can be applied to each block. But directly applying normal canny edge detection leads to excessive edges in the smooth regions and loss of edges in high detailed regions. In this paper an adaptive threshold selection algorithm is proposed. Here edge detection is based on type of block and gradient distribution of each block. Which allow simultaneous processing of each block hence reduces latency. Pipelining is also allowed in this case it increases the throughput.

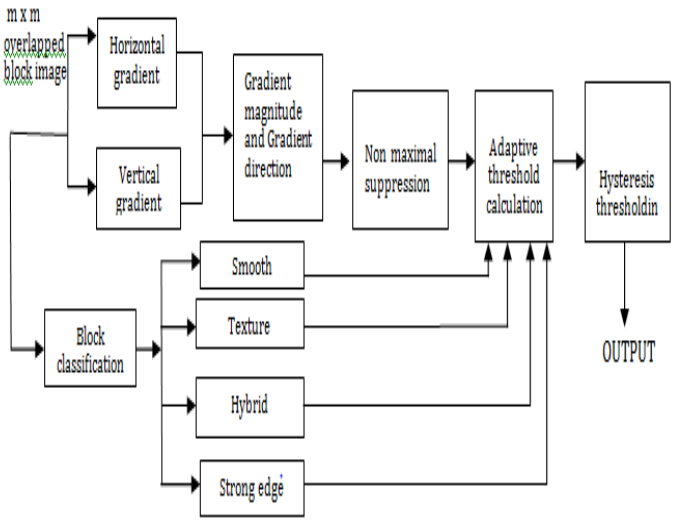

Fig-1:Proposed distributed canny edge detection algorithm.

In the proposed edge detection algorithm the input image is first divided into m x m overlapping blocks, these blocks can be processed simultaneously. For an L x L gradient mask, input image is first divides into n x n non overlapping blocks and then extending each block by (L+1) /2 pixels along the left , right, top and bottom to get m x m overlapping block with m = n + L + 1.Edge artifacts and loss of edges at block boundaries n x n non overlapping blocks should be extended because NMS operation at boundary pixel require gradient value of the neighboring pixels of the considered pixel.Fig.3. shows an example of non-overlapping block and its extended overlapping version when 3 x 3 gradient mask is used.
Proposed distributed canny edge detector can be implemented on a Xilinx Spartan 3E FPGA.FPGA based hardware implementation mainly consist of an embedded micro controller, a system bus, peripherals & peripheral controllers, external static RAM & memory controllers, an intellectual property design for the proposed system.

3. CONCLUSIONS

In order to reduce the latency and increase the throughput a distributed canny edge detection is proposed. Which allow block level threshold calculation and parallel processing of

each block. This edge detection has various applications. One of its application in medical field is presented here. Abnormality in lungs can be determined by using the abnormality detection system which contains distributed edge detection technique. it's the simplest and less time consuming process. implementation of the algorithm is done on a Xilinx Spartan 3E FPGA

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BIOGRAPHY

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