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Automated Monitoring and Detection System of Strep Throat using FPGA

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Abstract - *Tonsillitis is a disease occurring mostly in child and adults as this disease may take to the other effects. An automatic tonsillitis monitoring and detection system aims for personal use and requires mobility, a compact size, and a light weight with reliable functionality. This paper proposes the design and implementation of automatic tonsillitis monitoring and detection system using image processing and FPGA. Image processing is one of the emerging methods in communication. In the image processing edge detection is the first step in many computer vision applications. Edge detection of image significantly reduces the amount of data and filters out unwanted or insignificant information and gives the significant information in an image. This information is used in image processing to detect objects in which there are some problems like false edge detection, missing of low contrast boundaries, problems due to noise etc. In this paper Canny Edge Detection algorithm is implemented. Canny Edge Detection algorithm for stored image is implemented on Field Programmable Gate Array (FPGA),and the image is segmented for final analysis.*

***Key Words*: Tonsillitis, Image processing , Canny edge detection , FPGA**

1. INTRODUCTION

Tonsillitis is a viral disease that can lead to ischemic heart disease, chronic obstructive pulmonary disease (COPD), and kidney disease, which rank as the top 1, 5, and 10 causes of death, respectively . Due to the shortage of medical doctors, especially in the countryside and within an aging society, it is inconvenient to periodically consult doctors; therefore, an automated tonsillitis monitoring and detection system is needed. To be practical, the automated system should be compact and portable with low power consumption. Edge detection is a low level operation used in image processing and computer vision applications. The main goal of edge detection is to locate and identify sharp discontinuities from an image. The Canny filter is a multi-stage edge detector. It uses a filter based on the derivative of a Gaussian in order to compute the intensity of the gradients. The Gaussian reduces the effect of noise present in the image.

The equation for a Gaussian filter kernel of size $(2k+1)\times(2k+1)$ is given by:

$$H_{ij} = \frac{1}{2\pi\sigma^2}\exp\left(-\frac{(i-(k+1))^2+(j-(k+1))^2}{2\sigma^2}\right); 1 \le i,j \le (2k+1)$$

Then, potential edges are thinned down to 1-pixel curves by removing non-maximum pixels of the gradient magnitude.

The equation for a gradient sobel operator is given by:

$$M(n,n) = \sqrt{g_m^2(m,n) + g_n^2(m,n)}$$

Finally, edge pixels are kept or removed using hysteresis thresholding on the gradient magnitude.

$$M_T(m,n) = \begin{cases} M(m,n) & \text{if } M(m,n) > T \\ 0 & \text{otherwise} \end{cases}$$

The Canny has three adjustable parameters: the width of the Gaussian (the noisier the image, the greater the width), and the low and high threshold for the hysteresis thresholding. Software implementation using MATLAB, Xilinx System Generator (XSG) is objective of paper.

1.1 LITERATURE SURVEY

In related research Abdullah. D, Alotaibi [1] reviewed to tonsillitis diagnostic and treatment measurement for children's. Chandrashekar N.S., Dr. K.R. Nataraj implemented canny algorithm [2] onto a Xilinx Virtex-4 FPGA platform and tested using ModelSim. The design development is done in VHDL and simulates the results in modelsim 6.3 using Xilinx 12.2. Horio et al. [3] proposed the study of a Mucous Membrane Diagnosis Support System using probabilistic relaxation. Using intraoral images, they studied the shapes of patches of vitiligo and judged them to be lacy or non-lacy with high accuracy. They extracted the vitiligo are as using a dynamic threshold and found they were adequately extracted even when the lighting condition and angles changed in the diagnosis support system for mucous membrane disease in the oral cavity. In a study of computer aided diagnosis of tonsillitis using size and color. Mohammed Alareqi, M. Tarhda, K. Mateur, A.R. Elgouri [4] proposed to design the real time hardware enhancement spatial domain techniques for biomedical applications on FPGA and explained the several techniques of enhancement are like control of brightness, threshold segmentation, contrast stretching and operations of inverting the images. T. Pasupathi, A. Arockia Bazil Raj, J. Arputha Vijayaselvi [5] proposed the concept of spiking neuron for image recognition.

1.2 EXISTED SYSTEM

The software based tonsillitis monitoring system is designed to diagnosis the tonsillitis by the size and color. Local processing technique is start by converting the input image into the gray scale image then it convert into sobel operator for gradient magnitude then it transformed into the watershed transform to enhance the image edges. Based on sobel method edge detection, the drawback of the method is time complexity, tracking data and output image pix are configured into some fixed sizes. As a result, sobel operator suffers as the magnitude of the edges decreases. Overall sobel method cannot produce accurate edge detection with thin and smooth edge.

Fig. 1. Tonsillitis Image

Fig. 2. Sobel Edge detected I mage

2. PROPOSED METHOD

Canny edge detector is an edge detection operator developed by John F. Canny in 1986. This detector uses a multi-stage algorithm to detect a wide range of edges in images.

Advantages:

1. The presence of Gaussian filter allows removing of any noise in an image.

2. The signal can be enhanced with respect to the noise ratio by non-maxima suppression method which results in one pixel wide ridges as the output.

3. Detects the edges in a noisy state by applying the thresholding method.

4. The effectiveness can be adjusted by using parameters.

5. It gives a good localization, response and is immune to a noisy environment.

Canny built up a way to deal with determine an ideal edge locator dependent on three criteria identified with the discovery execution. The model depended on a stage edge defiled by added substance white Gaussian noise.

A block diagram of the canny edge detection algorithm is shown:

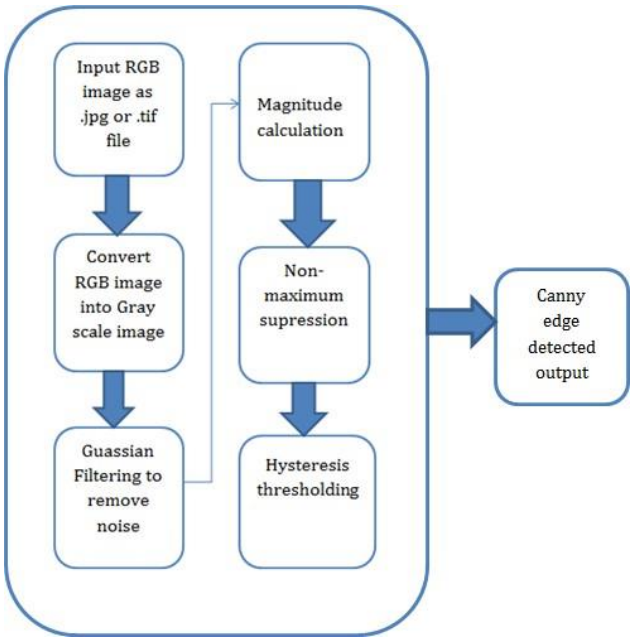

Fig. 3. : Block Diagram of the Canny Edge Detection Algorithm

Fig. 4. Tonsillitis Image

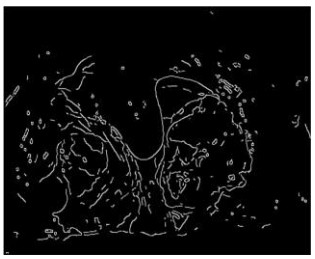

Fig. 5. Canny Edge detected Image

FPGA IMPLEMENTATION

The hardware implementation on FPGA requires raw pixel information. Therefore we have to convert a standard image format (such as JPEG, PNG, and BMP) to a raw image. In this format, we use 8 bits to represent a pixel, i.e., 00000000 represents a pixel which is completely black, while 11111111 represents a pixel which is completely white.

The extracted image is represented as a 2-dimensional array of integer values ranging from 0 to 255 corresponding to the individual pixels of the image. For color images the raw data requires three 8-bit data corresponding to each of the primary colors Red, Green and Blue and will have to be processed one by one in the FPGA.

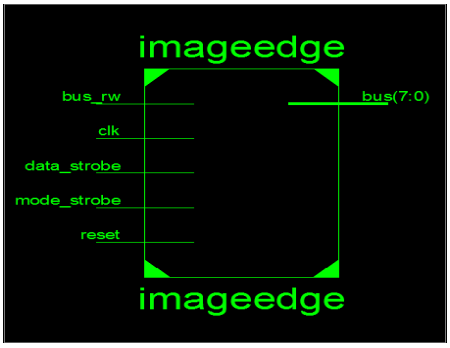

Fig -6: RTL Schematic

Device Utilization Summary (estimated values)			
Logic Utilization	Used	Available	Utilization
Number of Slice Registers	838	54576	1%
Number of Slice LUTs	4495	27288	16%
Number of fully used LUT-FF pairs	327	5006	6%
Number of bonded IOBs	13	218	5%
Number of BUFG/BUFGCTRLs	1	16	6%

Fig -7: Synthesis Report

Before implementation on FPGA, we are going to remove noise in image .The major reason that noise can occur during the image capture and transmission.

The performance parameter of noise values of sobel and canny are listed below.

ALGORITHM	Sobel method	Canny method
MSE value	82.0086008 dB	95.2494986 dB
SNR value	13.9049	11.6948
PSNR value	29.0262053 dB	28.3761723 dB

Atlast, Color image segmentation that is based on the color feature of image pixels assumes that homogeneous colors in the image correspond to separate clusters and hence meaningful objects in the image. In other words, each cluster defines a class of pixels that share similar color properties.

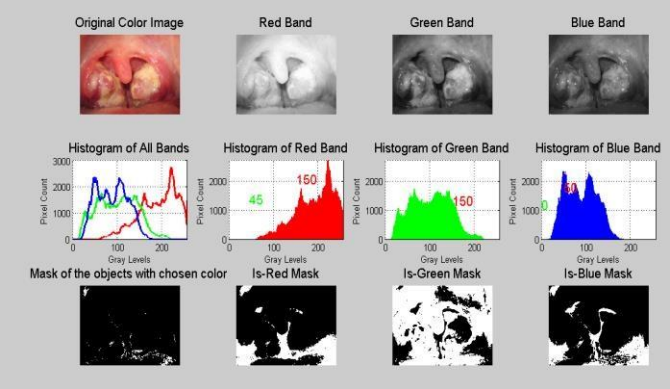

Fig -8: Color based segmentation

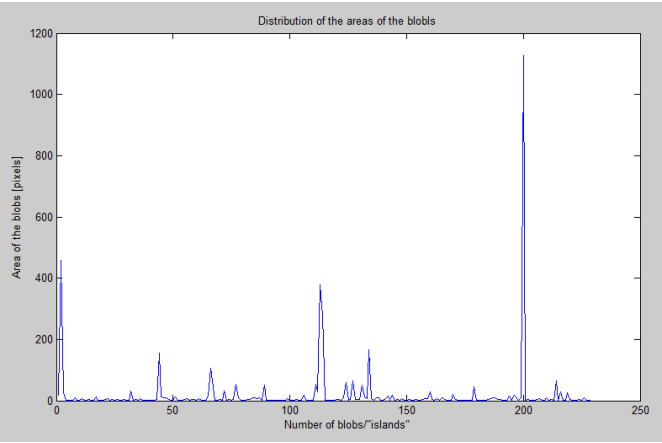

Fig -9: The Histogram plot of segmented image

3. CONCLUSIONS

From results observation, it's concluded that, Sobel edges are not clear. Sobel is the combination of log & original images. Canny detector has given very clear edges, canny edge detection is a best technique to extract useful structural information from different vision objects and reduce the amount of data to be processed. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible 1. The edge point detected from the operator should accurately localize on the center of the edge. 2. A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

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