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FPGA Implementation of Reconfigurable Processor for Image Processing Application

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Abstract

In this research I have proposed the method of FPGA implementation of reconfigurable processor for image processing for medical, Photoshop and satellite application purpose. Field Programmable Gate Array (FPGA) technology has become a viable target for the implementation of real time algorithms suited to video and image processing applications.In this project we are using the image processing application like Median filter, Erosion and dilation. Here the digital image is taken as the input that image is converted into gray scale image and creating header file with the help of Matlab. Header file mean that gray scale image is converted into pixel. After we are writing C code for median filter, erosion and dilation. For the embedding the header file and the C code we have used the Xilinx Platform Studio(XPS),after dumping into the FPGA kit with the help of JTAG and RS232 cable. The purpose of JTAG is at the time we can send data parallel into kit. The purpose of RS232 cable is at a time we can show data serially. The main purpose of this project is we are using Medical, Photoshop and Satellite application processes. Programmable Array Logic (FPGA) board had used to increase the capacity. we have selected the Spartan3EDK tool for the implementation purpose.

Keywords : MATLab, field programmable gate array(FPGA), xilinx plat form studio 10.1, Spartan 3EDK, visual basic window

1. INTRODUCTION

Image processing methods comes from two application area. One is information about human interpretation another one is storage image data and transmission. The term image processing mean refers to the processing of images by digital computer. In that digital images have finite number of elements each elements have particular value and locations. Image processing application widely used in industries. One of the first application of images was in the newspaper industries. Image processing have many applications all the applications we are using anyone image processing technique then we can get output with the help of MATLAB. All the image processing concept depending upon only software. So there are many disadvantages of the hardware. It will be show output on separate window. Time and speed operation will be high.

Now I have proposed FPGA implementation of image processing using reconfigurable processor. Here we are using both hardware and software. Reconfigurable means once we dumping a code with hardware it is not constant. After again we dumping another code in that kit previous code will be erased. So this process will be continuously using it is called reconfigurable processor. Here I will introduced FPGA SPARTAN 3EDK kit. If we are using hardware it will be show output on single window only that window is called visual basic window(VB) and also speed time will be less compared to MATLAB.

In existing paper we are using Reconfigurable Binary processor for image processing. A Binary image is a digital image that has only two possible values for each pixel. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. Two colors are used for a binary image are black and white though any two colors can be used. Binary images are also called bi-level or two-level. Each pixel is stored as a single bit i.e. a 0 or 1. The Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering. For a binary image, black pixels denote background while, white pixels are normally taken to represent foreground regions. The set of coordinates corresponding to that image is simply the set of two-dimensional Euclidean coordinates of all the foreground pixels in the image, with an origin normally taken in one of the corners so that all coordinates have positive elements.

In existing system Morphological image used in VHDL (verilog hardware description language). So the output derived by simulation part only.

In the proposed system, Xilinx Platform Studio based on the Xilinx FPGA Spartan 3 has been used to implement a low-cost image processing system for real time applications with educational purposes.

MATLAB graphical user interface allows the designer to open the image to be processed, setup the communication parameters, specify the required processing, send the input image, and receive the corresponding result after the process.

The main project is classified into two parts as. The steps are as follows

1. At first digital image is converted into grayscale image and then the header file is created. Then the embedding process of header file and C code is done by using Xilinx platform studio.
2. After that, by using Xilinx platform studio (Spartan3EDK tool) we have to implement the project.

Advantages:

1. The main advantages of this project is we can take real time video that video is converted into 15 frames. In those 15 frames we can select only one frame as our input image.
2. Wide application range: As processor is reconfigurable we can use same processor for different image processing application.
3. Less expensive: As we are using only one reconfigurable processor the whole system becomes less expensive.
4. Simple structure: As the process of all the applications is same only we are changing the c code for the structure of the system is simple.

The remaining paper is organized as follows. Description of morphological application like median filter, erosion, dilation is given in section 2.Block diagram is given in section 3. In the section 4 there are implementation and the results are given. Conclusion, acknowledgment and the references are given the section 5, 6 and 7.

2. DESCRIPTION OF IMAGE PROCESSING APPLICATION

2.1 Median Filter

The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing. Median filter taking the median value instead of the average or weighted average of pixels in the window Sort all the pixels in an increasing order, take the middle one. The window shape does not need to be a square. Special shapes can preserve line structures.

2.2 Erosion

Erosion is one of two fundamental operations in morphological image processing from which all other morphological operations are based. It was originally defined for binary images, later being extended to grayscale images, and subsequently to complete lattices.

2.3 Dilation

Dilation is one of the basic operations in mathematical morphology. Originally developed for binary images, it has been expanded first to gray scale images, and then to complete lattices. The dilation operation usually uses a structuring element for probing and expanding the shapes contained in the input image.

3. BLOCK DIAGRAM

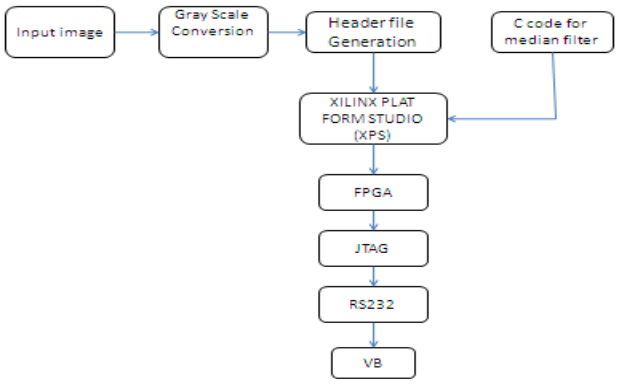

Figure 1:. Median filter block diagram

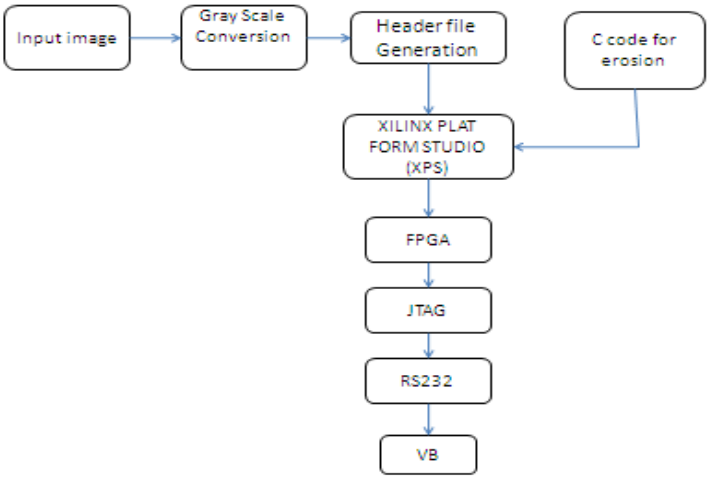

Figure 2: Erosion block diagram

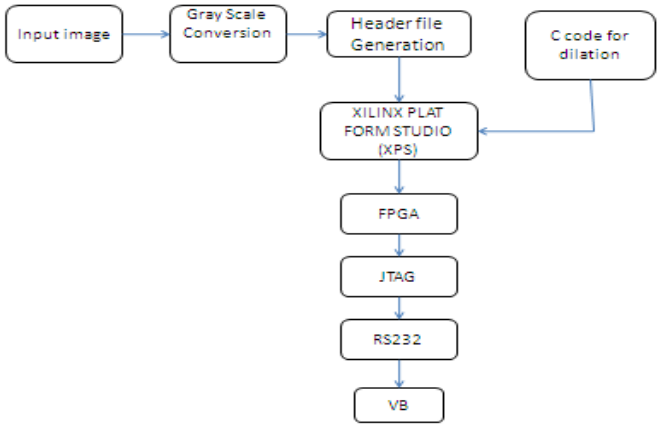

Figure 3: Dilation block diagram

4. IMPLEMENTATION AND RESULTS

The images shown in figure 4 is the how to create GUI file with the help of MATLAB,figure 5 is the input image, figure 6 is the header file creation, figure 7 is the header file.

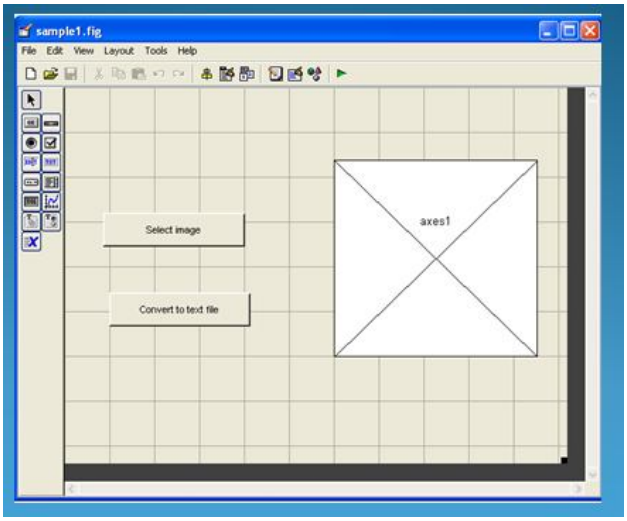

Figure 4 : GUI file

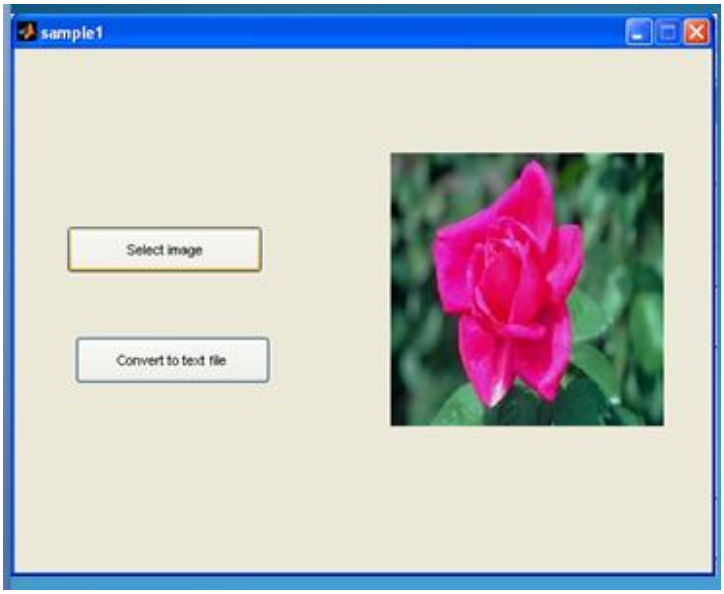

Figure 5: select input image from MATLAB

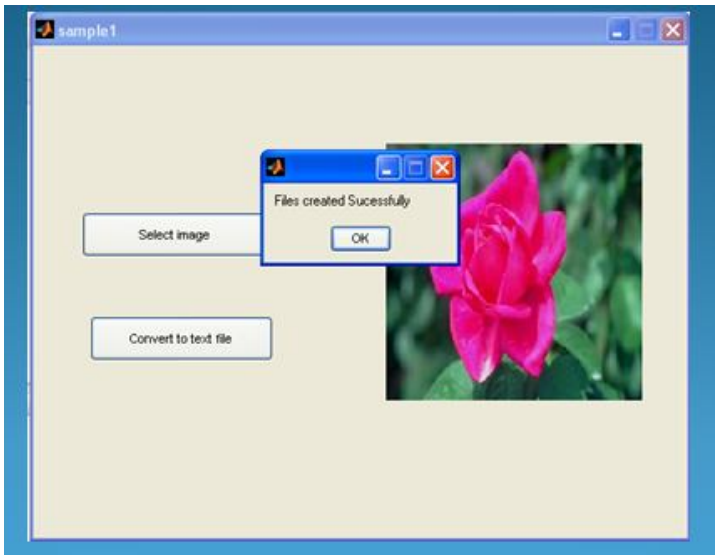

Figure 6: Header file creation

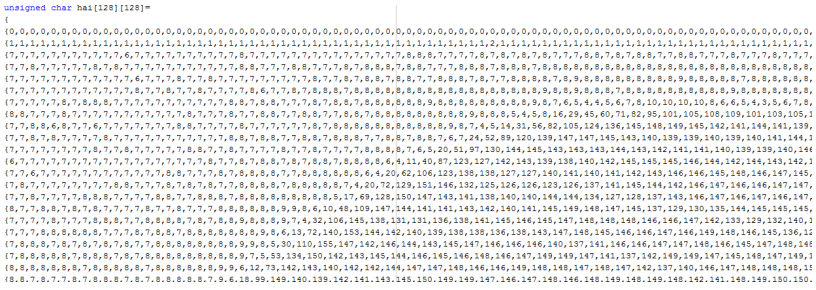

Figure 7: Header file

In this section results of various morphological application techniques are compared. Figure (8) is the original input image for median filter. Figure (9) is the output image for median filter. Figure (10) is the input image for erosion. Figure (11) is the output image for the erosion. Figure (12) is the input image for dilation. Figure (13) is the output image for dilation.

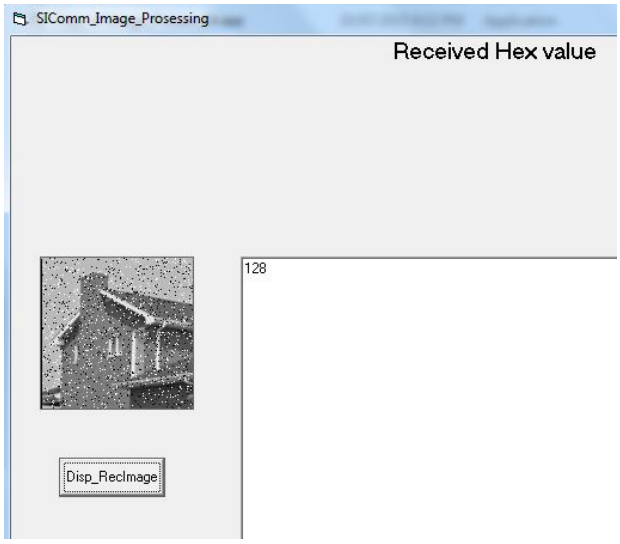

Figure 8: original input image for median filter

Figure 9: output image for median filter

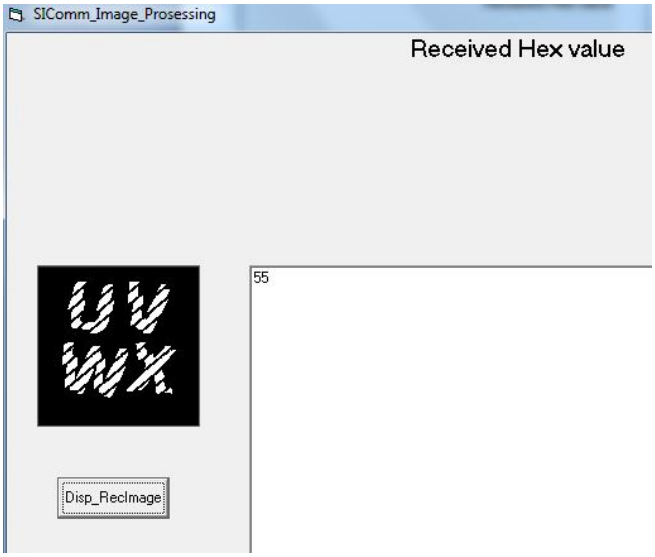

Figure10: Input image for erosion

Figure11: Output image for erosion

Figure12: Input image for dilation

Figure13: Output image for dilation

5. CONCLUSION

Image processing operations namely median filter, erosion, dilation are useful tools in medical, satellite, Photoshop application. In this paper a variety of application of morphological operations in additional with several of existing cases are presented to demonstrate their usability and capability.

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