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Simulation of Colour Image Processing Techniques on VHDL

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ABSTRACT- This paper deals with color image processing technique. The different parameters of image are controlled by various mathematical functions. The processing using verilog has an advantage of speed and reconfigurability over system processing, specifically required for image filtering operation. The aim is to process image by using Threshold operation, Brightness operation and Invert operation. Fast operations and efficient simulation will be considered while designing the algorithm. The simulation is carried out by establishing a link between MATLAB and Hardware Descriptive Language (HDL).

Key words: *Color image processing, Verilog HDL, MATLAB.*

1. INTRODUCTION

Recognition applications have become more and more popular in many fields, including image filtering, person or object detection. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too. Image processing basically includes the following three steps:

- Importing the image via image acquisition tools.
- Analyzing and manipulating the image.
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing is used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data must undergo while using digital technique are pre-processing, enhancement, and display information extraction. The common steps in image processing are image scanning, storing, enhancing and interpretation. The digital image processing deals with developing a digital system that perform operation on a digital image. Digital cameras generally include specialized digital image processing hardware.

2. LITERATURE SURVEY

Iuiana Chiuchisan and Marius Cerlinca and Alin-Dan potorac and Adrian Graur have explained hardware architecture of matched filter design for image recognition applications, especially for larger number of taps. By using odd-phase and even-phase processing, it can extremely reduce the number of complex multipliers and complex adders utilized. As for a practical design implementation with TSMC 40- nm CMOS technology, a 64-tap matched filter circuit operates up to a clock frequency of 500MHz and only occupies a synthesis area of 0.059 mm^2. It totally saves the design area by a saving ratio of 70.29% compared to a typical transposed form circuit [1].

C. Thirumarai Selvi and J. Amudha have explained a novel technique to assist the physically challenged people to cross the road near the traffic signal or in the pedestrian crossing with the help of automatic video surveillance. Methods analysis: As per the Indian roadway corporation it is decided to minimum 1.8m (width) 2.2m (height) is allocated for walking zone. 1800mm width is reserved for wheel chair movement in pedestrian. Detection of moving objects in a stable place needs the high security level. Findings: Image processing segmentation algorithm plays an important role to track the moving object in the fixed pedestrian crossing which can assist the physically challenged people or the elderly person. Various morphological filtering operations enhance the quality of segmenting the moving person in the video. This methodology employs histogram of Gaussian detection and object detection is done. The proposed work improves it results by 0.71% accuracy. Improvements: This work helps the physically challenged to cross the pedestrian in a safe manner and helps for autonomous vehicles [2].

R. Ravikumar and Dr V. Arulmozhi have explained image is one of the evident sources in image processing applications. Image processing will dramatically change the human computer interaction in future. A large number of image processing applications, tools and techniques helps to extract complex features of an image. While today image processing works beyond multidimensional and see what actually in the image. Several technologies playing on images in real time but image processing is the real core. This paper discusses the overview of an image processing applications, tools and techniques [3].

Shaheen Khan and Radhika Kharade and Vrushali Lavange have explained brain is most vital and vitals of the anatomy. The tumor is made by the uncontrolled multiplication of cellular division. Several techniques were developed to discover and section the neoplasm exploitation many segmentation formulas like watershed algorithm, k-means bunch, Fuzzy c-means bunch is disbursed. This is the effective formula wherever segmentation of tumor is disbursed and its options like center of mass, perimeter and area are calculated from the segmented tumor. To identify the neoplasm, scanned MRI images are given as the input. The work concerned here helps in medical field to discover tumor and its options helps in giving the treatment strategy to the patient [4].

U. Karthikeyan and Dr. M. Vanitha have explained text recognition is a technique that recognizes text from the paper document in the desired format (such as .doc or .txt). The text recognition process involves several steps, including pre-processing, segmentation, feature extraction, classification, and post-processing. The preprocessing is performed as a binarized image to convert a grayscale image, and noise is reduced on the input image of the basic operation performed by removing the noise of the image signal. The segmentation phase is used to segment the image given online and segment each character of the segmentation line. Feature extraction is to compute the characteristics of the image document. This document describes techniques for converting the textual content of a paper document into a machine-readable format. This paper analyzes and compares the technical challenges, methods, and performance of text detection and recognition studies in color images. It summarizes the basic issues and lists the factors that should be considered when addressing them. The prior art is classified as step-by-step or integrated and highlights sub-problems including text localization, verification, segmentation and identification of text. This survey provides a basic comparison and analysis of the scope and challenges in the field of text recognition [5].

S. R. Dixit has explained edges of image characterize the boundaries. It reduces amount of data and filters out useless information. It preserves structural properties of an image. Edge detection is useful for segmentation of objects, its registration and identification. So, image processing algorithms are defined. Early state detection of image has been tried using VLSI architecture. A normal image and disease affected image are compared and percentage of disease has been tried to find out. Edge detection operators such as Sobel, Prewitt, Canny Edge Detector are used. Filtering of images include the elimination of noise, enhancing the edges and contours. Fast operations and efficient implementation will be considered while designing the algorithm [6].

Sabyasachi Deyy and Bhargab B. Bhattacharya, and Malay K. Kundu have explained Euler number is a fundamental topological feature of an image. A novel algorithm for computing the Euler number of a binary image based on divide-and-conquer paradigm, is proposed, which outperforms significantly the conventional techniques used in image processing tools. The algorithm can be easily parallelized for computing the Euler number of an N_N image in O(N) time, with O(N) processors. Using a simple architecture, the proposed method can be implemented as a special purpose VLSI chip [7].

Yun Yang has explained in this paper, new RAM/ROM synthesis system with reconfigurable memory architecture for three-dimensional (3D) image processing VLSI system. To enable flexible image data operation, suitable input/output data control is critical for high performance image processing system. Fast speed 3D VLSI system also requires effective pipeline data control. New RAM/ROM codesign synthesis architecture is realized by specific arrangement with RAM, ROM, pin and interconnection. Flip-Flop control, clock buffer insertion and critical signal route] have been improved to enhance whole system speed. The reconfigurable memory system is also proposed to enable fast operation speed and raise chip system robustness. 3D image processing VLSI system can also be improved by suitable data storage and pipeline control flow in reconfigurable RAM/ROM synthesis system. Chip simulation experiments show efficient results with 247.728mW power consumption and 50MHz operation frequency. Practical chip test confirms that new RAM/ROM system can successfully realize chip inner fetch function and data flow control to improve 3D reconfigurable system efficiency. Better system flexibility can also realize by specific reconfigurable control operation and precise 3D stacking layer design [8].

Yu Zhang and Su-ying Yao and Na Zhang and Jiang-tao Xu have explained automatic white balance and color filter array interpolation are two important function of image signal processor for CMOS image sensor. This paper describes the designs and implementations of new automatic white balance method and color interpolation method on FPGA. This white balance method can effectively get the better of the defects of gray world and gray world-retinex methods by calculating the average deviation values of Cr and Cb. This color interpolation method can greatly reduce the artifacts causing by interpolating across edges with comparing the differences of neighboring pixels with the predefined thresholds. These two methods have been realized on Altera's FPGA EPlCl2Q240C8. Experimental results show that the white balance method can obtain better image quality than gray world and gray world-retinex methods, and the color interpolation method can get high PSNR value. They can be good candidate for VLSI implementation [9].

Iuiana Chiuchisan and Marius Cerlinca and Alin-Dan Potorac and Adrian Graur have explained the Hardware Description Languages (HDLs) larger availability allows the designers to not only logically describe circuit functionality but to simulate and evaluate the processing performances using appropriate development and test environments. While the simulation is generating the logical results, a

natural step consists in extending the use of the hardware simulators into the field of signal processing. Given the importance of digital image processing based on hardware implementations in order to achieve higher performance, this paper discusses basic image enhancement techniques with their implementation and results using a hardware description language, Verilog. The use of HDLs to provide signal processing results is a quite new technique replacing the classical simulations and offering a direct connection to hardware VLSI implementations. This paper is providing an innovative method for simulation followed by immediate implementation possibility. The present HDL approach is applied to image processing and accordingly an overview of underlying principle and concepts, along with common algorithms usually used for image enhancement are described. The paper focuses on image enhancement in the spatial domain, with particular reference to point processing methods like: contrast manipulation, brightness manipulation, inverting images, threshold operation [10].

Hirak Kumar Maitya and Santi P. Maityb have explained that in Reversible Contrast Mapping (RCM) and its various modified versions are used extensively in reversible watermarking (RW) to embed secret information into the digital contents. RCM based RW accomplishes a simple integer transform applied on pair of pixels and their least significant bits (LSB) are used for data embedding. It is perfectly invertible even if the LSBs of the transformed pixels are lost during data embedding. RCM offers high embedding rate at relatively low visual distortion (embedding distortion). Moreover, low computation cost and ease of hardware realization make it attractive for real-time impel-mentation. This paper proposes a field programmable gate array (FPGA) based very largescale integration (VLSI) architecture of RCM-RW algorithm for digital images that can serve the per-pose of media authentication in real-time environment. Two architectures, one for block size (8 8) and the other one for (32 32) block are developed. The proposed architecture allows a 6-stage pipelining technique to speed up the circuit operation. For a cover image of block size (32 32), the proposed architecture requires 9881 slices, 9347 slice flip-flops, 11291 number 4-input LUTs, 3 BRAMs and a data rate of 1.0395 Mbps at an operating frequency as high as 98.76 MHz [11].

Dinu Coltuc and Jean-Marc Chassery have explained that RCM is a simple integer transform that applies to pairs of pixels. For some pairs of pixels, RCM is invertible, even if the least significant bits (LSBs) of the transformed pixels are lost. The data space occupied by the LSBs is suitable for data hiding. The embedded information bit-rates of the proposed spatial domain reversible watermarking scheme are close to the highest bit-rates reported so far. The scheme does not need additional data compression, and, in terms of mathematical complexity, it appears to be the lowest complexity one proposed up to now. A very fast lookup table implementation is proposed. Robustness against cropping can be ensured as well [12].

N. Nithiya and R. Imtiaz. M.E have explained the concept of an image processing system developed to work on an FPGA (Field Programmable Gate Array). FPGAs have the advantages of speed and reconfigurability over DSP, specifically required for video processing applications. The research work done on color image processing techniques using FPGA is limited. The aim of this research is to simulate and implement color image processing techniques namely pseudo color processing, smoothing filter, median filtering and edge detection using sobel edge detection and fuzzy logic. This simulation is carried out by establishing a link between MATLAB and a Hardware Description Language (HDL) [13].

A. Boscaro and S. Jacquir and K. Sanchez and P. Perdu and S. Binczak have explained internal electrical measurements are key steps to solve design debug issues and to perform failure analysis. Due to multiple metal layers, active areas of the chip are only accessible from the backside of the die. The ability of optical contactless techniques to operate through the silicon substrate and the few sample preparations required have widely contributed to promote them as unavoidable tools of the defect localization workflow. Timing issue or unusual consumption can be detected by static and dynamic photon emission analysis and Electro Optical Probing. The identification of the emission spots is an essential step of the process. Due to scaling, more and more emission nodes are located within the acquisition area so that large variations of emission intensity can exist and it is difficult to recover a signal with a good Signal to Noise Ratio (SNR). In this paper, automated techniques are reported to locate spots in these complex areas and to recover electrical waveforms with a good SNR. underline the challenge and define applications boundaries of these techniques. These techniques give some perspectives for probing applications and allows FA community to use signal processing methods instead of expensive devices [14].

Hui Juan Huang and Yuan Yu Yu and Jiu Jiang Wang and Wang Meng and Sio Hang Pun and Peng Un Mak and Mang I Vai have explained Synthetic aperture (SA) imaging algorithm, which combines sub-aperture elements to form high resolution image, can improve image quality in vivo ultrasound image. However, large computation resource is generally required for the implementation of SA. In this paper, a parallel structural design for SA imaging algorithm that can be realized in Field Programmable Gate Array (FPGA), so that light weight and miniaturized design can be achieved. The proposed design has been validated by MATLAB and was employed to construct a high-resolution ultrasound imaging from the raw data of 128 array transducer elements. The processing time is about 2.6ms theoretically, which should be alright for usage [15].

Iuliana Chiuchisan and Oana Geman have explained the use of hardware description languages to provide digital image processing results is a recent technique that offers a direct connection to reconfigurable hardware implementation. This paper presents a real time system for

digital image processing using Verilog hardware description language that can be followed by immediate hardware implementation possibility. The image enhancement algorithms included in the described system were applied to an ultrasound image. The paper focuses on image enhancement methods such as contrast and brightness transformation, inverting and pseudo coloring images, described and simulated using verilog hardware description language [16].

3. OBJECTIVES

The number of image processing techniques, in addition to enhancement techniques, can be applied to improve the data usefulness. Techniques include convolution edge detection, filters, noise removal, and image analysis. The image processing techniques are:

- Brightness operation.
- Threshold operation.
- Invert operation.

3.1 Brightness operation

Figure 1 shows the brightness change of image. Brightness and Contrast Adjustments. An image must have the proper brightness and contrast for easy viewing. Brightness refers to the overall lightness or darkness of the image. Contrast is the difference in brightness between objects or regions.

Brightness of an image is defined by the higher grey-scale values. Such as, if an image has grey-scale values like 175,200,255 etc., it can be said that brightness of the image is high. That is, the higher the grey-scale value the higher the brightness of an image. Thus, brightness of an image is the higher values of the grey-scale levels

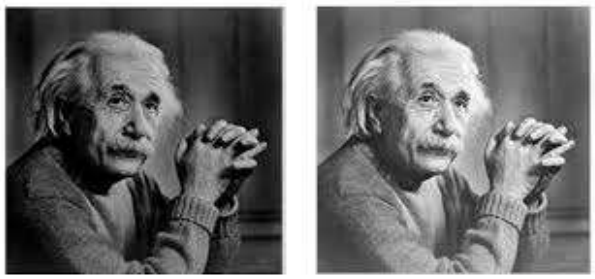

Fig- 1: Brightness operation

3.2 Threshold operation

Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images.

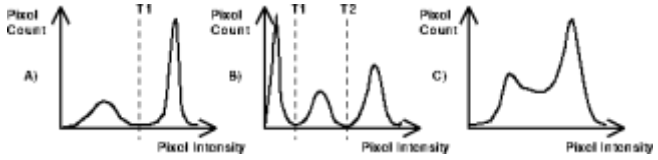

Fig- 2: Histogram equitization in threshold operation

Figure 2 shows the histogram equalization of image. Histogram Equalization is a computer image processing technique used to improve contrast in images. It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image. This method usually increases the global contrast of images when its usable data is represented by close contrast values. This allows for areas of lower local contrast to gain a higher contrast. In many vision applications, it is useful to be able to separate out the regions of the image corresponding to objects in which we are interested, from the regions of the image that correspond to background. Thresholding often provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colours in the foreground and background regions of an image. In addition, it is often useful to be able to see what areas of an image consist of pixels whose values lie within a specified range, or band of intensities. Thresholding can be used for this as well.

Fig- 3: Threshold operation

Figure 3 shows the threshold operation. The left side image is an original image and the right-side image show the threshold operation on original image.

3.3 Invert operation

An image in which up and down, as well as left and right, are interchanged; that is, an image that results from rotating the object 180 about a line from the object to the observer; such images are formed by most astronomical telescopes. Also known as reversed image. Each pixel in the input image having a logical 1 (often referred to as foreground) has a logical 0 (associated with the background in the output image and vice versa. Hence, applying logical NOT to a binary image changes its polarity. The logical NOT can also be used for a grey level image being stored in byte pixel format by applying it in a bitwise fashion. The resulting value for each pixel is the input value subtracted from *255.*

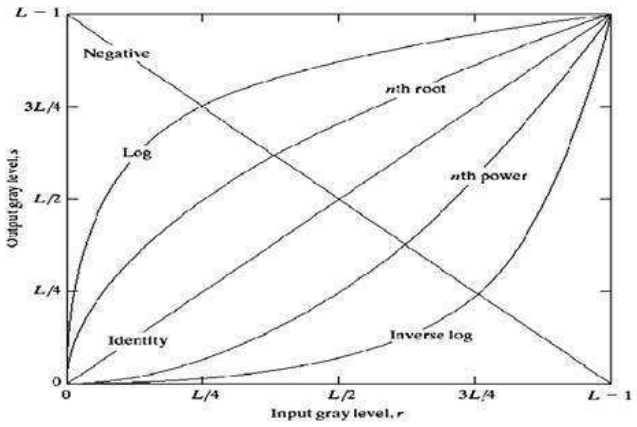

Fig- 4: Grey level transformation

Figure 4 shows the gray level transform by using log transform. The Log transformation first compresses the dynamic range and then upscales the image to a dynamic range of the display device. In this way, lower values are enhanced and thus the image shows significantly more details.

4. METHODOLOGY

Figure 5 shows the block diagram of overall working. The image is converted into the bitmap (.bmp) file and this image is given to the MATLAB to convert the bitmap(.bmp) file to the hexadecimal values of the image. This hexadecimal code is given to the VIVADO simulation tool. It is the actual part to convert the image into a different form. According to the application the contrast, brightness, image negative is done.

For the conversion of image, they should write in MATLAB after conversion of code the hexadecimal values of the image is displayed on the command window. These values are change according to the pixel values (for 8 bit it is 0-255) the hexadecimal values of the image are changes. These hexadecimal values are given to the VIVADO for the further calculations.

In VIVADO the code is such that when the brightness is set then only the brightness of the image should change. And for the change in contrast and image negative set the simulation parameter according to it. After all the steps the new image is obtained in which the parameter of the image is changes.

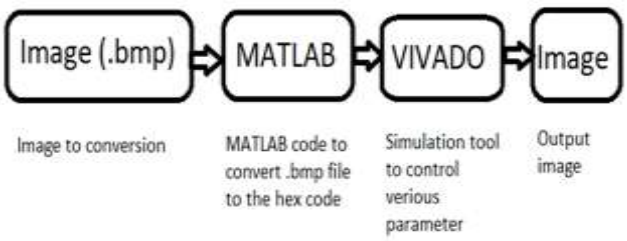

Fig-5: Block diagram

5. Result and discussion

The original image is in the JPG format, this JPG format is need to convert into a bitmap file(.bmp). This bitmap file is given to the MATLAB to convert into the proper hexadecimal code.

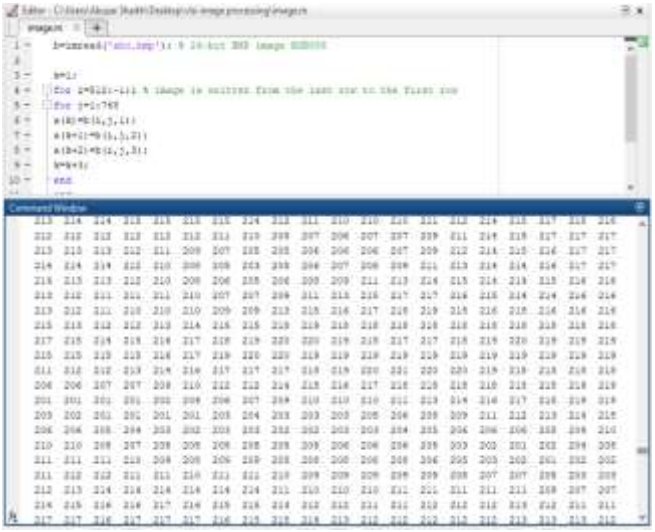

Fig- 6: Hexadecimal values

Figure 6 shows the hexadecimal values of an original image. These hexadecimal values are given to the VIVADO to do the further operation.

- Flow chart

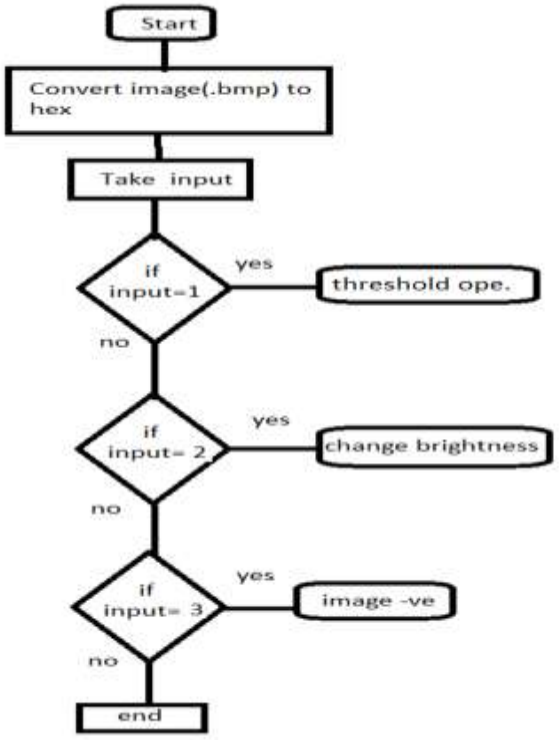

Fig- 7: Flow chart

Figure 7 shows the flow chart of the project. In the flow chart first the original image is converted into a bit map file (64-bit color image). In the MATLAB code the image(bitmap) is converted into a hexadecimal code. There is an input to select which operation is need to carry out. After selection of the operation the task is perform. The data is stored as an output image to the given location. The flow chart shows the overall operation of project.

6. CONCLUSION

The digital image processing techniques implies spatial sampling and luminance quantization. The algorithms associated has developed in VIVADO. The processing of image is faster and more cost effective. One needs less time for processing as well as less film and other photographing equipment. No processing or fixing chemical are needed to take and process digital image. Displayed result shows the accuracy of the image Brightness, Threshold and Invert operation.

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