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Design and Implementation of Image Enhancement Using XSG

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ABSTRACT

Image processing is a technique for improving the quality of images and extracting organized data. Image enhancement techniques are used to improve the aesthetic appeal of photographs. Enhancement can be applied to a grayscale image with a resolution of 128 * 128 pixels. Any enhancement technique's primary goal is to produce a more plausible result when compared to the structure. The requirement to handle them gradually drove them to be run in hardware. Using high-level languages to construct image processing methods necessitates a large amount of lines of code, which is inefficient and time-consuming. Another option is to use Xilinx System Generator, which is a modelling tool that captures plans by using Xilinx blocks from a library environment. Using the Xilinx System Generator, this project proposes an approach for hardware software co-simulation for image processing (XSG). This approach generates a set of Simulink blocks (models) for a number of hardware activities that may be performed on various Xilinx FPGAs.

I. INTRODUCTION

1.1 OVERVIEW

The amplitude of F at any set of directions (x,y) is known as the intensity of that picture at that point. An image is defined as a 2-dimensional function, F(x,y), where x and y are spatial directions, and the amplitude of F at any set of directions (x,y) is known as the intensity of that picture at that point. We call it a Digital image when the x,y, and amplitude values of F are constrained. In other words, Image is a two-dimensional array that is intentionally structured in rows and columns. A digital image is made up of a small number of components, each of which has a distinct value at a distinct position. Image components, picture components, and pixels are all terms used to describe these components. The term "pixel" is most commonly used to describe the elements of a digital image.

Types of an image:

1. **BINARY IMAGE–** The binary image, as its name implies, has only two pixel components: 0 and 1, where 0 denotes dark and 1 denotes white. Monochrome is another name for this image.
2. **BLACK AND WHITE IMAGE–** The picture which comprise of just high contrast tone is called BLACK AND WHITE IMAGE.

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3. **8 bit COLOR FORMAT–** The most well-known image design is this one. Grayscale Image is a type of image that has 256 different shades of colour. 0 symbolises black, 255 represents white, and 127 represents dark in this structure.
4. **16 bit COLOR FORMAT–** It's an image with a lot of different designs. It contains 65,536 different types. It's also known as High Color Format. The distribution of diversity isn't quite as even in this arrangement as it is in the Grayscale picture A 16 bit design is really partitioned into three further configurations which are Red, Green and Blue. That famous RGB design.

1.2 PROBLEM IDENTIFICATION

When digitising photographs, the impacts of poor picture quality, lack of contrast, and the existence of shading and artefacts are common. To improve picture quality, effectiveness or attractiveness augmentation is required.

1.3 METHODOLOGY

The Xilinx System Generator device is another image handling programme that provides a user-friendly processing environment since processing units are organised in blocks.

The following three phases are crucial to image processing:

- Bringing in the image using image procurement apparatuses;
- Analyzing and regulating the image;
- Output in which the outcome can be modified picture or report that is dependent on image analysis.

Analog and Digital picture management are the two types of picture handling strategies that are used. For printed copies such as printouts and images, analogue picture handling can be used. When using these visual tactics, picture examiners use a variety of essentials of translation. Using PCs, digital picture management strategies aid in the control of complex images. Pre-processing, improvement, and display, as well as data extraction, are the three general stages that a wide range of information must go through when using a computerised technique.

II. EXISTING METHOD

3.1 APPROACH

One of the most important and demanding methods in image research is picture enhancement. Picture enhancement aims to improve a picture's visual appeal or provide a "better change depiction for future Digital picture processing." Many images, including medical images, satellite images, aerial images, and, surprisingly, genuine photographs, suffer from poor effects and noise. To improve picture quality, it's critical to increase contrast and reduce noise. Image Enhancement methods, which work on the quality (clearness) of photos for human assessment, are examples of improvement tasks. Improvement actions include removing hiding and noise, increasing contrast, and showing details. From one field to the next, the augmentation approach varies depending on the goal.

3.2 DESIGN

Contrast Stretching is a picture enhancement technique that involves manipulating a photograph to make it appear more appealing to human viewers. It's usually used in post-production to alter contrast, dynamic range, or both in a photograph. The goal of the contrast enhancement method is to alter the local contrast in numerous areas of the image such that features in dark or bright areas can be seen by human viewers. Contrast enhancement is commonly used to improve the visual representation of input images by adjusting unique pixel values using a transform function of the structure such as g(x, y)=T[r(x, y)], where g(x, y) and r(x, y) are the result and input pixel values at picture position, respectively. This transformation improves differentiation by broadening the range of dim level traits to encompass an ideal range of dim level qualities. This transformation is also known as a picture power shift or standardisation. Let a, b represent f(x, ybase)'s and biggest pixel upsides, while c, d represent g's base and most extreme pixel upsides (x, y). Scaling every pixel in a unique picture as s=(r-c) (b-a)/(d-c) + a can be used to achieve standardisation. The present differentiation enhancement procedures strategies can be divided into two groups: direct and indirect techniques.

Direct procedures are used to describe a contrast measure and to try to improve it. Indirect tactics, on the other hand, focus on differentiation by utilising underutilised locations or a large reach without defining a specific differentiating term. The following groups of contrast improvement strategies can be found in this paper:

Histogram Equalization (HE), Tone Mapping, One of the most commonly used approaches for improving contrast is histogram equalisation. It makes a concerted effort to modify a picture's spatial histogram to match a uniform distribution. The major goal of this strategy is to achieve a uniformly disseminated histogram by utilising the information picture's combined thickness capacity. Because of its global treatment of the image, the HE suffers from the issue of being ineffectively appropriate for holding neighbourhood detail because subtleties that are typically associated with the small scale of the histogram are lost. The drawback is that in some applications, such as consumer electronics, where brightness preservation is required to avoid irritating artefacts, it is far from a reasonable feature. In most cases, the adjustment results in an unwelcome loss of visual information about value and force scale. Another technique for improving contrast is the histogram detail method. The state of the histogram is physically determined in this technique, and then a change work is produced in the histogram input picture at dim levels. The picture histogram is divided into partitions based on the location of neighbourhood minima and explicit dark level ranges. HE is applied to each partition after partitioning. To make the contrast enhancement of HE based even more evident, we attempted a brief assessment of existing frameworks for differentiation improvement strategies. Table 1 depicts a brief HE-based investigation.

Tone Mapping is one more methodology of contrast improvement strategies. If we want to produce a high dynamic range (HDR) image on paper or on a display, we can use this technique. We should believe the vast power range in the image to the lower range supported by the showcase in some way. This method, which is used in picture handling and computer design to plan a group of variations from one to the next, is widely used to estimate the presence of high-power reach pictures in media with a more limited unique reach. Tone planning is done in a logarithmic scale and just in the luminance divert. It is used to convert a floating point radiance map into an 8-bit representation for the purpose of delivering applications. In a low dynamic range tone planned picture, the two primary aspects of the tone planning algorithm are preserving picture details and providing appropriate absolute brightness data.

III. PROPOSED METHOD

The proposed framework generator based plan consists of three stage operation utilizing Xilinx blocks as:

- Picture pre-handling blocks
- Contrast enhancement utilizing XSG
- Picture post handling blocks

To play out the contrast enhancement in equipment, the picture should be pre-handled before fundamental architecture. In software level recreation there is no requirement for picture pre-handling stage. It will get to a picture as a two layered (2D) grid of pixels with size M x N. In any case, in equipment execution, this lattice should be considered as a variety of one layered (1D) vector, where it requires picture pre-handling.

Image pre-processing block sets:

Figure 2 depicts the framework generator-based strategy used for image pre-handling. As a contribution to the file block, input images are delivered as a variety or dim scale. The RGB (Red, Green, Blue) variety model is converted to a dim scale image using a variety space converter block. Then, for additional treatment, the 2D information must be converted entirely to 1D. The frame change block changes the output signal to approach-based data. It sends data to the unbuffer block, which converts the frame to scalar samples.

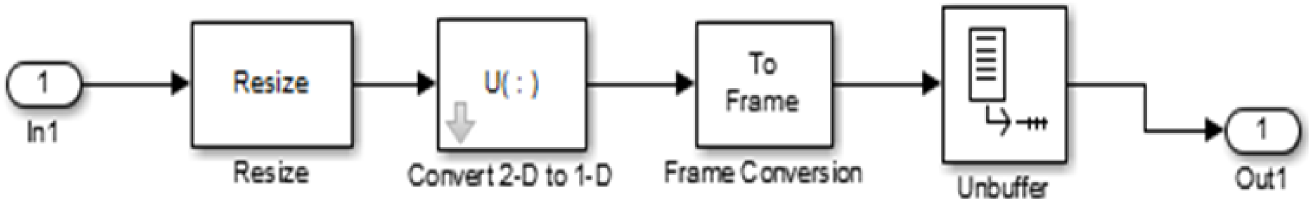

Fig 4.1 Operation with Xilinx block sets for image pre-processing

HARDWARE Modified Piecewise linear transformation:

Piece-wise Linear Transformation is type of gray Piece-wise Linear Transformation is a type of dark level adjustment that is used to improve pictures. It's a strategy for using space in a specific way. It is used to regulate a picture such that the result is more realistic than the first for a certain application.

Piecewise functions (or piecewise functions) are precisely what they sound like: a diagram with bits of varied capacities (sub-works). If you drew more than one capacity on a chart and just removed sections of the capacities where they shouldn't be (along the x's), it is the simplest way to think about them; they are described differently for distinct timespans. The obvious direct alteration in the changed work is shown in the diagram below.

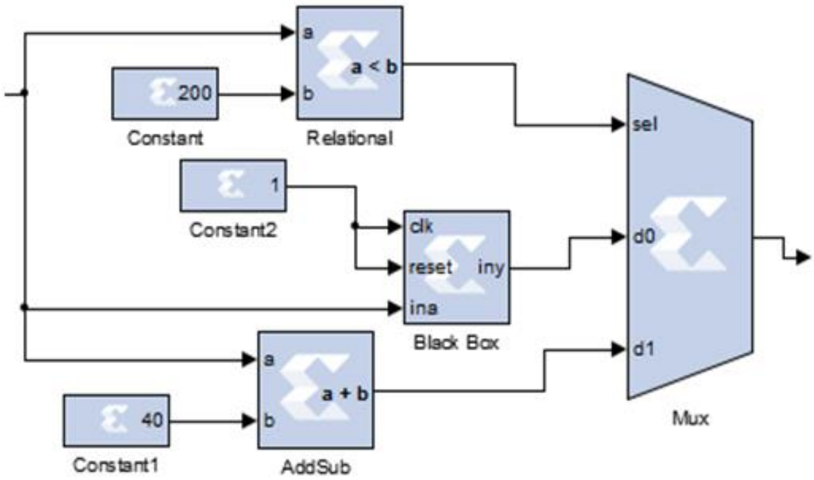

Fig 4.2 Piece by piece, modified Image post-processing block sets for linear transformation:

The picture post handling blocks are utilized to change over the picture output back to show design is displayed in below figure. Buffer block utilized in post-handling changes scalar examples over completely to approach output followed by 1D to 2D arrangement signal block. At long last a sink is utilized to show the result picture back in the presentation unit. The total architecture with the hardware and software co-simulation is displayed in below figure.

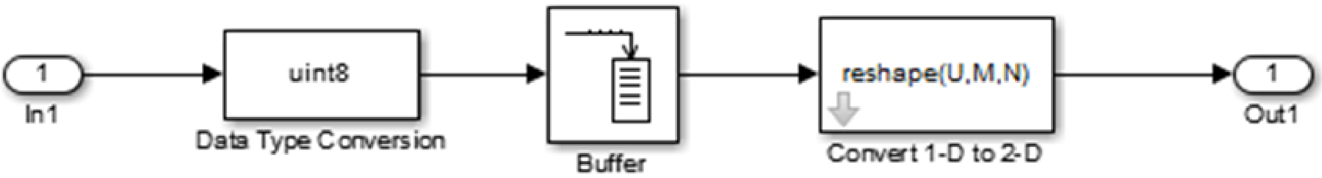

Fig 4.3Operation with Xilinx block sets for image pre-processing

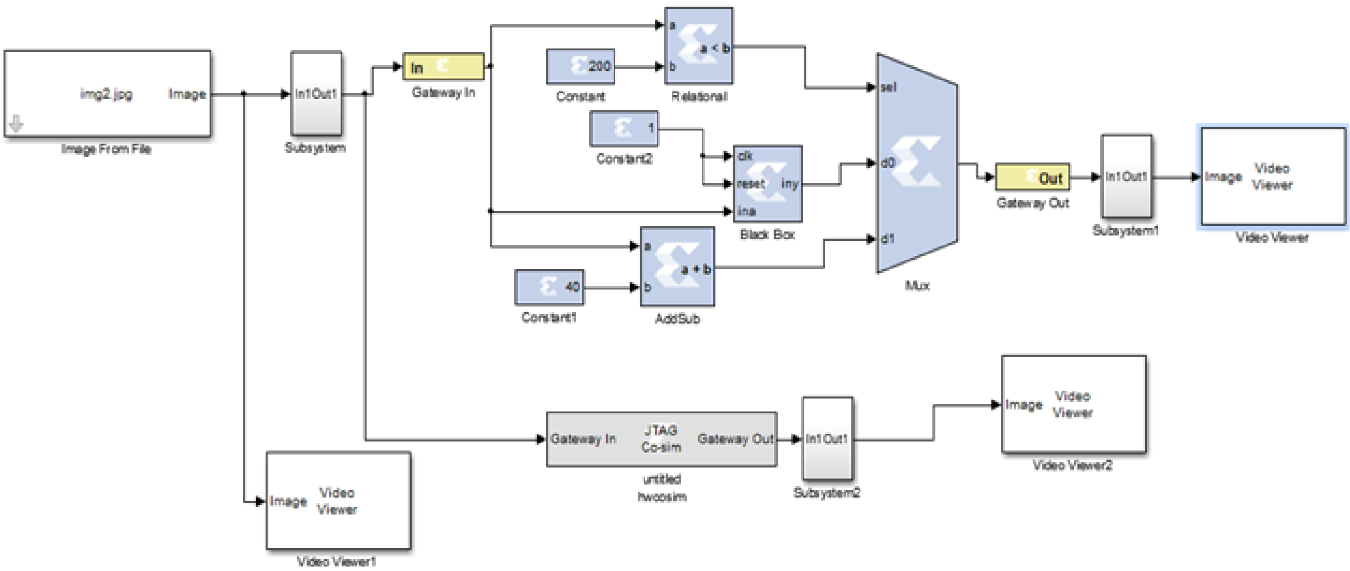

Fig 4.4 Complete hardware/software simulation design

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IV. SIMULATION RESULTS

The outcomes for the picture improve utilizing XSG is shown by below stimulate window.

It opens the module high level, which basically shows input(s) and output(s), as seen by double tapping the rectangle, it opens the realized internal logic as displayed.

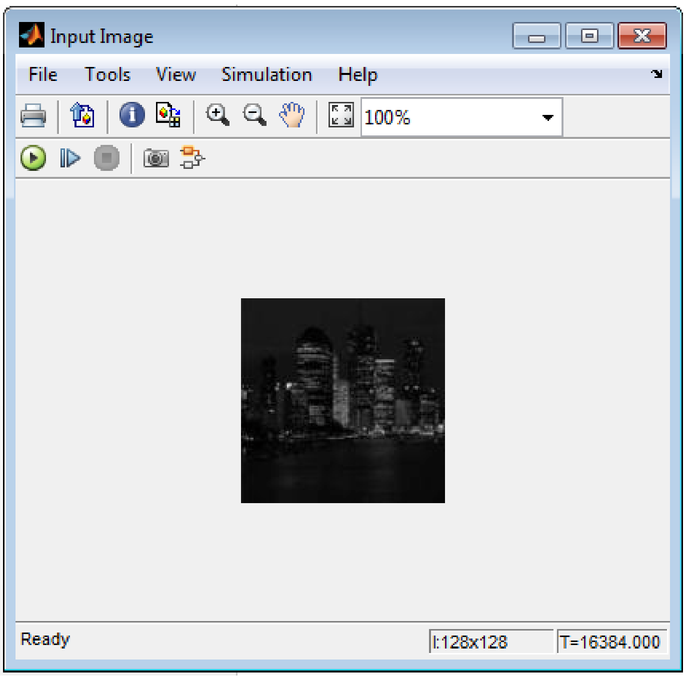

Fig 5.28: Input Image

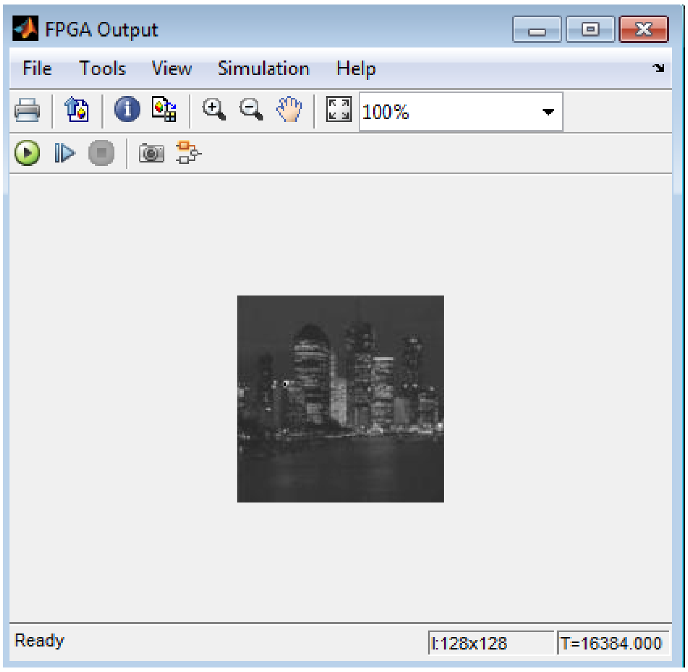

Fig 5.29 :Enhanced Image

V. COMPARISON OF HARDWARE & SOFTWARE RESULTS

Here we have determined the Simulation time (msec) of various Image Enhancement Techniques on a 256×256 picture utilizing Matlab codes on an Intel Pentium-M CPU of 1.60GHz and 1GB RAM. (O.S default processes running behind the scenes) Also we have determined the Simulation time (nsec) of various Image Enhancement Techniques on a 256×256 picture utilizing FPGA Spartan-3E xc3s500e-4fg320 by Hardware-In-Loop Verification with JTAG co-reproduction through USB design port with clock frequency= 50MHz.

SpatialFilteringTechniques												
Techniques	Averagefilter		Sobelfilter		Laplacianfilter		High Boostfilter		Order Statisticalfilter		Image Enhancement Processor	
	H/W (nsec)	S/W (msec)	H/W (nsec)	S/W (msec)	H/W (nsec)	S/W (msec)	H/W(nsec)	S/W (msec)	H/W(nsec)	S/W (msec)	H/W(nsec)	S/W (msec)
Lena	24.042	262.281	15.991	260.284	15.991	277.361	25.580	277.087	31.924	282.533	36.842	1265.759
HubbleSpace Telescope	24.042	353.462	15.991	348.417	15.991	350.933	25.580	355.660	31.924	356.965	36.842	1381.642
Cameraman	24.042	271.143	15.991	243.882	15.991	272.695	25.580	269.850	31.924	281.406	36.842	1263.734
Barbara	24.042	341.870	15.991	339.276	15.991	339.607	25.580	333.720	31.924	343.474	36.842	1291.492

VI. CONCLUSION

This improved piecewise linear transformation method technique is region proficient, and the framework generator is used for interfacing Simulink and Xilinx blocks. Piece-by-piece linear transformations are introduced in this study. The threshold strategy enhances contrast from dim or low contrast images, however the min-max technique is capable of providing enhancement images, lowering the mean square error and increasing the peak signal to noise ratio for a better output image. This formula can be used in a variety of applications, such as grayscale images.

Future research could lead to a variety of outcomes. A wide range of computations could be custom-made for execution using the proposed technique from the perspective of the calculation plan. Such application would provide more evidence to support the technique's approval, and it might even widen the current DFI restrictions. Furthermore, an all-encompassing computation could be used as a test vehicle for implementing the methodology in order to quantify savings or gains in terms of Normalized design parameters.

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