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Image Enhancement Techniques Using Verilog HDL And Simulation on HDL Simulator

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Abstract- Image enhancement is the process by which the characteristics of an image can be enhanced or improved by actually working on the image. Image enhancement includes eliminating the blurredness as well as noise from the image in order to improve its quality and modify it accordingly. Hence the aim is to design the algorithm to improve the quality of encoded or compressed image and simulate it on simulator and find some results that how enhancement techniques works on simulation window. The paper focuses on image enhancement in the spatial domain, with particular reference to point processing methods like: contrast operation and brightness adjustment. This paper will provide an innovative approach for simulation the HDL code by which we can easily see the brightness and contrast operation in form of digital waveform.

I. INTRODUCTION

In this paper we will discuss those techniques which are used for enhanced the image quality to remove the artifacts and blurredness of an image.There are basic techniques by which we can enhance the quality of image, and those are Brightness control, Contrast adjustment, filtration of noise like deblocking filter used for compressed image. In this we will design a HDL code for Brightness control and contrast adjustment and find some useful result. To reached this aim we will use Xilinx 14.1 and ModelSim (Simulator) [1].

Field Programmable Gate Arrays have specially designed by hardware designers using Hardware Design Languages (HDLs)[4]. There are already few such languages available which provides different levels of abstraction but the most important ones are Verilog HDL (Verilog) and Very High Speed Integrated Circuits (VHSIC) HDL (VHDL)[3].

First discuss some basic concept of brightness operation and contrast operation in digital image processing. Brightness control It is the process of improving gray level of each pixel value by adding a constant value to the image pixels value which have poor brightness. If the digital image is of poor brightness, the objects in the image will not be visible clearly. This is due to image is captured under low light conditions. The brightness of a dark image can easily be increased by adding a constant to gray value of each pixel value. This addition operation will shift the histogram towards brighter side with a constant factor[1][6].

Contrast operation It is the process to increase the contrast range by assigning the darkest pixel value to black, the brightest value to white, and each of the others to linearly interpolated shades of gray makes good use of the display and enhances the visibility of features in the image [1][6].

II. BASIC ENHANCEMENT OPERATION

The basic color of an image are Red, Green and Blue[4], for perform this operation on Xilinx 14.1 we take input in form of basic color pixels. Each color should have its each pixel value for apply the contrast operation we have to fix a threshold value[1], so this threshold value will be work as a respective value. For an example if each color is described in 8 bits means each color can have maximum 256 pixel value[5]. If a color have 256 pixel value its mean that it will be pure white color or if a color have 0 pixel value its mean that the color will be pue black. Threshold value will be the half of maximum pixel value of each color[9].

Threshold value (Th) $>= 2\char`\^n/2$[9]

n= no of bits used to define each color

Threshold value decides that if (color pixel value < Th) means image is going towards darker side and if (color pixel value > Th) means image is going towards brighter side[9].

A. Contrast manipulation

To design the code for contrast operation first we define the threshold value, according to no of bits threshold value will be 127. When input will apply, simulator will check the pixel value of each color of each macro block of an image, if value of color is greater than threshold value means a constant value will be add in the value, by which bright color will become more brighter and the other way if pixel value of color is less then threshold value then a constant value will subtract from the value, by which dark

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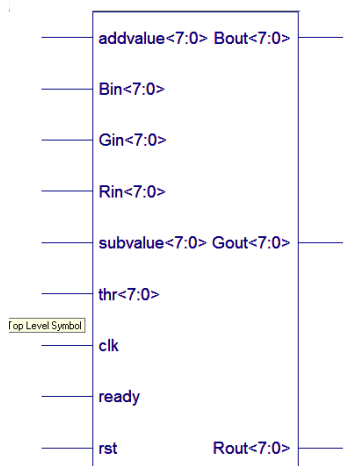color will become more darker. By using this approach contrast operation will performed.

Fig 2.1 basic block of contrast operation

Algorithm for Contrast addition

if tempR > threshold then
tempR = Rin + Addvalue
(up to 255 maximum)
If tempR >=256 then
Rout =255
else
Rout = addition of (Rin , Addvalue)
tempG = Gin + Addvalue
(up to 255 maximum)

if tempG >=256 then
Gout = 255
else
Gout = addition of (Gin ,Addvalue)
tempB = Bin + Addvalue
(up to 255 maximum)

if tempB >= 256 then
Bout = 255
else
Bout = addition of (Bin ,Addvalue)
end

Algorithm for Contrast subtraction

If tempR < threshold then
tempR = Rin – Substractvalue
if tempR[8] equal to 1 then
Rout = 0
else
Rout = Rin – Subtractvalue
tempG = Gin – Subtractvalue
if tempG[8] equal to 1 then
Gout = 0
else
Gout = Gin - Subtractvalue
tempB = Bin – Substractvalue
if tempB[8] equal to 1 then
Bout = 0
else
Bout = Bin -Subtractvalue;
end

B. Brightness Operation

In brightness operation a sign signal will be used if sign=1 then brightness operation will be perform but if sign=0 then brightness will be decrease and a constant value will subtract from each color uniformly. In brightness operation there is no need of threshold voltage. If operation is performing than a constant value will be added uniformly in each color pixel value, by which pixel value of each color will be increase so result will be more brighter than previous image.

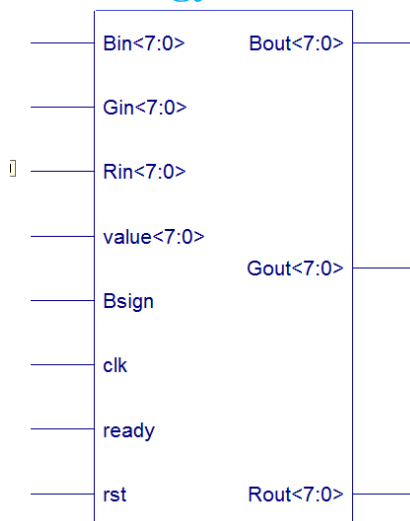# International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig 2.2 basic block diagram of Brightness operation

Algorithm for Brightness Addition

If Bsign =0 then
       tempR = Rin – Constant value
(a constant value will be subtract, Result brightness will decrease)

if tempR[8] equal to 1 then
Rout = 0;
else
Rout = Rin - Constant value
       tempG = Gin - Constant value
if tempG[8] equal to 1 then
Gout = 0
else
Gout = Gin - Constant value
tempB = Bin - Constant value
if tempB_b[8] equal to 1 then
Bout = 0;
else
Bout = Bin - Constant value;
end

Algorithm for Brightness Subtraction

If Bsign = 1 then
tempR = Rin + Constant value //
(a constant value will be add, Result brightness will increase)
if tempR >= 256 then
Rout = 255 (maximum value)
else
Rout = Rin + Constant value
tempG = Gin + Constant value
if tempG > 256 then
Gout = 255 (maximum value)
else
Gout = Gin + Constant value;
tempB = Bin + Constant value;
if tempB >= 256 then
Bout = 255 (maximum value)
else
Bout = Bin + Constant value
end

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III. RESULT AND SIMULATION OF CODE ON XILINX 14.1 AND MODEL SIMULATOR

When we synthesis the code on Xilinx 14.1 then RTL will be generate which can be implemented on FPGA kit. Fig shows the complete RTL design of given algorithm.
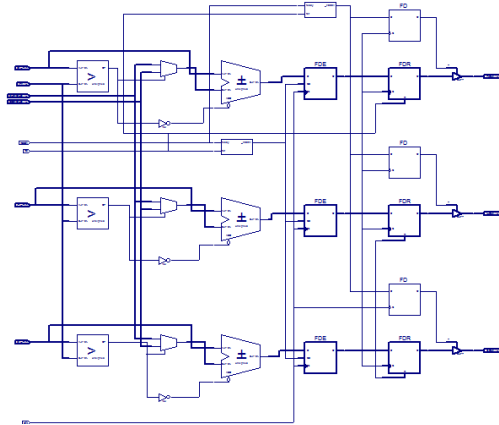

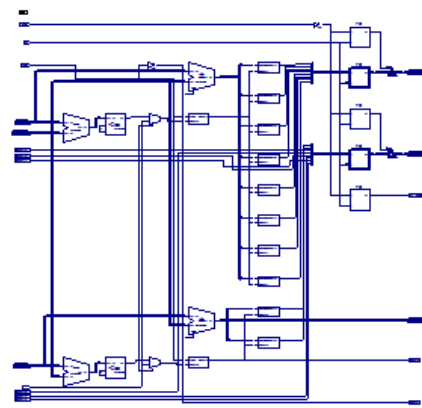Fig 3.1 RTL view of Contrast operation designed on Xilinx 14.1

Fig 3.2 RTL view of Brightness operation designed on Xilinx 14.1

Fig 3.3 shows the simulation of contrast operation in which threshold value is 127, Rin=177 Gin=122 Bin=132 and value to be add is 34 and value to be subtract is 15. When clock is high and reset is '0' and ready signal is high then operation will be performed and the result will be based on algorithm which is previously described.
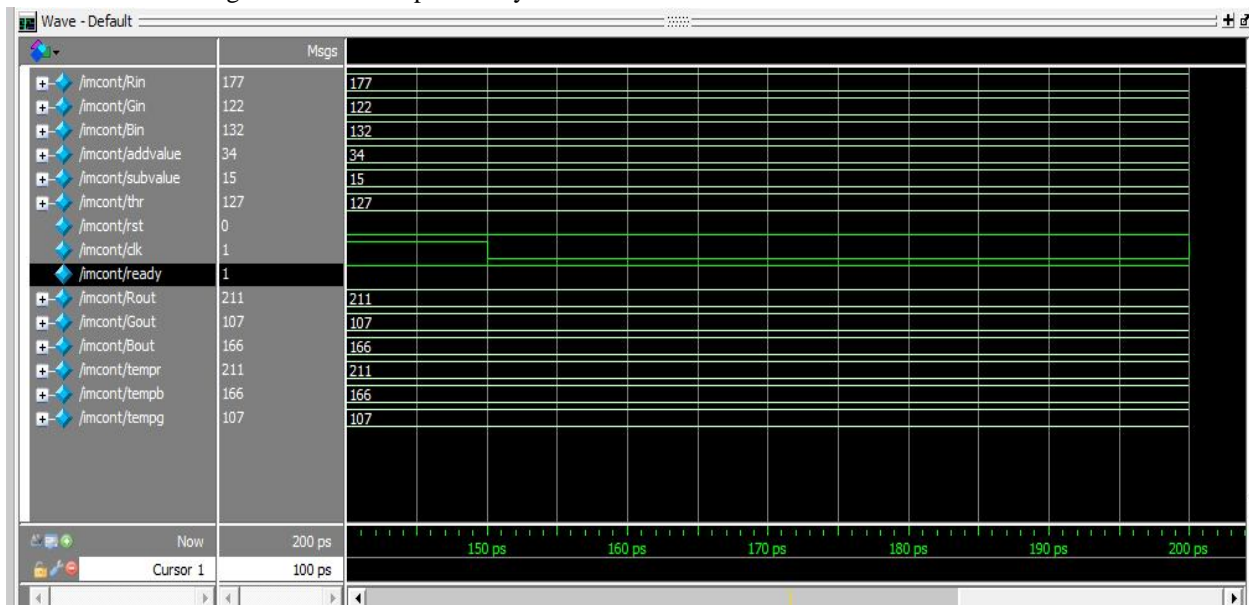

Fig 3.3 simulation of contrast operation on Model simulator

Similarly fig 3.4 shows the brightness operation performed on simulator in which values are Rin=184 Gin=103 Bin=139 and a constant value to be add is 62. When clock is high, reset is '0' , bsign is high and ready signal is set to '1' then brightness addition operation will be performed as previously described. Similarly when bsign is low then brightness subtraction operation will be performed. Fig 3.5 shows the brightness subtraction operation.

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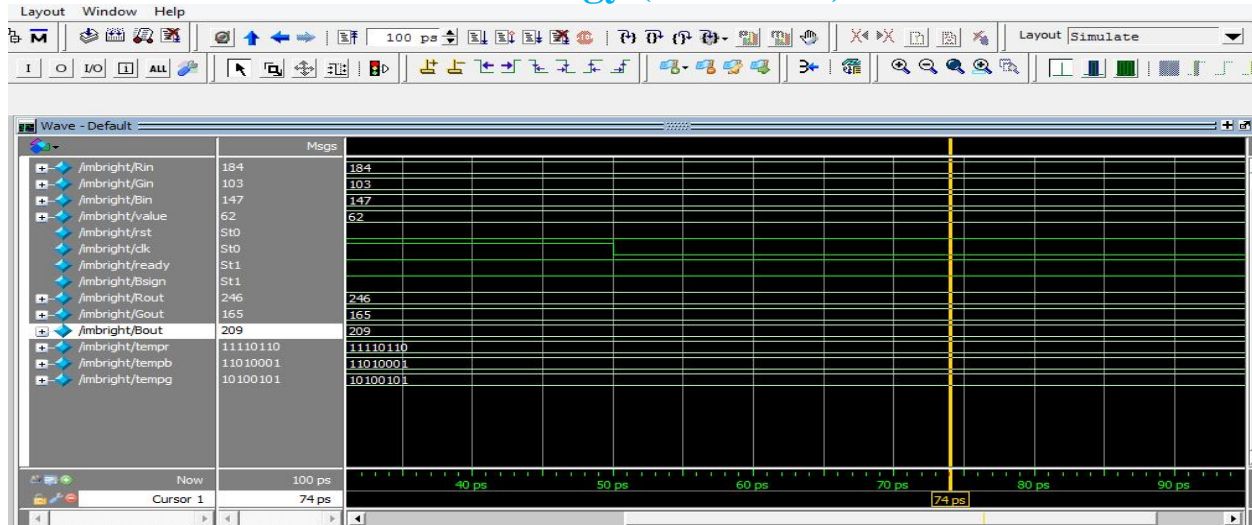

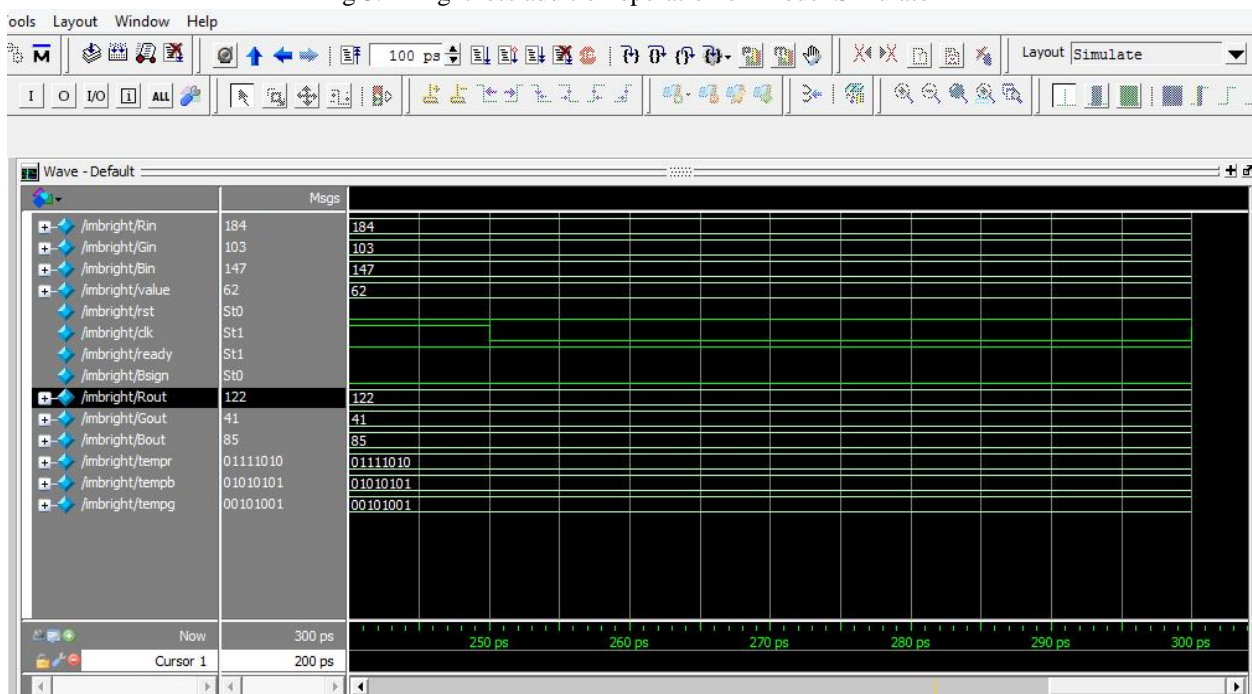Fig 3.4 Brightness addition operation on Model Simulator

Fig 3.5 Brightness subtraction operation on Model Simulator

IV. CONCLUSION

Digital Image processing is technique in which image is converted in pixel format means we extract the all image in to number form and can apply some mathematically operation to improve the quality of image. So this is our basic purpose to perform some mathematically operation on extracted data. The aim to use HDL technique which is explained in this paper is increasing the use of hardware description languages in signal processing simulations area[11]. Other hardware based simulations are to be studied as future work in order to examine and prove the advantage of this quite new approach. For performing these operation we are using the concept of verilog HDL coding HDL technique is quite new method which is generally used in digital image processing. The approach of design is too easy and user friendly, we also can check our result in mathematical format in the form of digital waveforms. So it is the easiest way to design some enhancement techniques for digital image processing.

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