



Performance Estimation of Bilinear Color Interpolation in MATLAB & VLSI

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ABSTRACT: In our day to day life Digital Image Processing (DIP) applications have become common. For the real time applications the exploitation of digital image processing systems require efficient computing techniques, the algorithm which is proposed to this system indeed works on very large scale integration focuses mainly on chip based design and its implementation for DIP applications where its real time image processing works better. In the agricultural fields the farmers uses fertilizers for the growth of crops & farmers purchase these crops without any knowledge, all the fertilizers are made by usage of chemicals which are harmful to human health to avoid these problems and to identify the pest affected crops or not affected crops we are using VLSI method of Implementation. Designed system with high computational speed with research work proposed in this method will help to customers as well as farmers. With portable equipment to measure the results quickly and display in very short time. Using High Quality Interpolation Algorithm, Edge Detection, Filtering Methods, and Matching Edge Algorithm in Mathematical Laboratory (MATLAB) and VLSI implementation in Xilinx software. For hardware implementation cyclone III kit using Field Programmable Gate Array (FPGA).

KEYWORDS: exploitation; filtering; crops; Xilinx; FPGA;

I.INTRODUCTION

Now a day's Human beings very much get affected with Hazardous diseases which destroys the human life and couldn't be diagnosed. Pest affected Crops and leaves may harm to pets as well as human life which couldn't be found of manually. For the growth of crops farmers use the fertilizers which made up of strong chemicals and these chemicals only affect the human health. These crops and fertilizers purchase the farmers and customers without any knowledge which cause the health problem for human as we pets. To overcome these hazardous diseases of crops we had an implementation based on Digital Image Processing (DIP) which is time consuming process. So it then proposed with high speed and accuracy using very large scale integration (VLSI) technology. A technology with rapid progress and a digital era, traditional cameras are been used which are made up of a complementary metal oxide semiconductor and charge-coupled device a still digital cameras uses the sensor into it, sensors will effect for the light intensity. When capturing the images sensor must be occupied with the color filter and it will be responsible for the color differences. Red, Green and Blue are the three main principle colors in color filtering. Red, Green and Blue, and are set before three sensors, so that the RGB values caught individually by the three sensors can be joined to frame a full-shading picture. Nonetheless, considering the high cost of utilizing three sensors and the vast space they take up, a shading channel cluster is normally made out of standout sensor. Accordingly, every pixel just obtains the power (splendor) of one of the three-shading components R, G and B while losing the other two shading components. Subsequently, an interjection must be performed on the outcome acquired through the Color Filter Array (CFA), in order to remake the missing shading components in every pixel. The procedure of remaking the missing shading components is called demosaicking or CFA addition. In the blink of an eye, the most widely recognized CFA in advanced still cameras utilizes a shading game plan in view of the Bayer design. Bayer CFA involves 25% of R channels, half of G channels and 25% of B channels, wherein columns of then again arranged R and G channels and lines of on the other hand arranged B and G channels are on the other hand orchestrated, so that the R, G and B channels are consistently appropriated in all aspects of the CFA. It merits saying that there are more G channels in a Bayer CFA than the other two shading channels on the grounds that the human eye can perceive a more extensive scope of green than the other two essential hues. What's more, with this shading course of action, more force changes and points of interest can be recorded to encourage more exact



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picture remaking. This projects works al about working on matlab to process the digital image and then VLSI coding is done to match the results of both. For compression we need to estimate the following edge detection, Gaussian filtration, conversion to grayscale; overall the procedures to perform and plot the result we use VLSI coding where it gives us the PSNR value.

II. RELATED WORK

Presently people have no idea about the healthy leaves and non healthy leaves, to know about exact healthiness of the crops we move to this proposed system. Farmers use the fertilizers at what content? In farms and also by knowing growth the crops the fertilizers are used appropriately by R. W. Schafer [4]. Bilinear interpolation is one of the easiest methods to define the pixels using the RGB colours where it notes that these are Three main principle colour to define about the color interpolation. These images may be blurred or distorted, so avoid this B. K. Guntur [4] proposed a model called weighted array for fixed image. The color interpolation quality must be high enough. Research work on SR primarily concentrated for knowledge gaining about the interpolation [8]. Using the discrete wavelet transform (DWT) image hallucination constructed for algorithm based on discrete format and the it is been transformed to protect the image from the noisy effects so as to remove the Gaussian filter is altered [10]. In bi-cubic interpolation technique the image flow is generated using LR or HR latching techniques. Most of research works are performed construction and proceed where it take Gaussian and back projection [12]. To determine the chemical content level into the fertilizers or pest affected leafs a PH level chemical test is carried out.

Demosaicking method produces high quality of the colour interpolation, in this interpolation method the 3 main colours known as the principle colour in colour interpolation are RED, GREEN and BLUE (RGB) [11] by using the mosaic sensors we can optimize these characteristics from the interpolation information by filtration. X. Li and M. Orchard [7] is co-founder of the technique local zoom discovered in the year 2002. This method runs on gradient based computations likewise having controlled gradient for it, without executing the preliminary gradient test we can speed up the adaptive process. The scientist Chang proposed a technique called vector quantization with this technique we can interpolate the unknown pixels into the enlarged image by codebook 2hich extracts the local information about the interpolated image. Among these all technique we observed that only bilinear and the vector quantization schemes gives better results for zooming the image. A raw form image is also known as greyscale image which indeed needed for colour interpolation. Colour Image Quantization (CIQ) is the technique used for only the colour indexed images to compress the resolution of the image and this is the popular technique in multimedia.CIQ [13] technique has 3 procedures, 1. Designing Palette, image encodes and decode. In image encoding for every pixel in colour palette is searched for each closest colour and then it is recorded to compress the image in CIQ using the Red, Blue and Green colour. When the images are in raw format we can directly attach them for zooming operation. For the indexed colour images we aim to design the good quality images for the enlarged images. Suppose in foggy area the images will not clear ones so to deduce this problem there is another fog removal method for outdoor surveillance systems. The quality of the image has to be maintained to result it for interpolation.

Fog removal methods are: physical model based, in this during the poor visibility physical model improves the visibility to achieve a good quality resolution for better color interpolation. Depth segmentation is to follow the apparent visibility of the image; Red, Green and Blue, and are set before three sensors, so that the RGB values caught individually by the three sensors can be joined to frame a full-shading picture. Nonetheless, considering the high cost of utilizing three sensors and the vast space they take up, a shading channel cluster is normally made out of standout sensor. 3dimensional structure is to extract the quality of the image; and for clear scene colours we require the interpolated image. Chromatic atmospheric scattering is the geometric work to get satisfactory results. Haze removals are responsible for the polarization. Scattering model exploits several results for the images like fog colour, a different fogs involved to recognize it we define for colour; The differences in the images may define the different characteristics of images, a leaf is image as we click on digital camera and process it for run in Matlab else VLSI it most hard to defect its significant so as follow this we first go for the input images collection of the contrast images and stored in so as it will then define all the qualities of the image in better for real time input images.

III. PROPOSED SYSTEM

In the agricultural fields farmers uses the fertilizers without any knowledge but it may tend to cause the diseases to the leafs of the crops it then results into pest affection on to the leafs of the plants which farmers grows into the fields, so

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that the fertilizers which they use in the farm it has chemical contents involved into that and that with over dosage result to pests to the crops. To determine the chemical content level into the fertilizers or pest affected leafs a PH level chemical test is carried out. As we know the insects or pest affected crops are very harmful to human health, these results in cancer diseases or nervous system problem. Color interpolation is one main factor in this project so to identify that we use the low pass filter of the Gaussian which is based on gradient scale. To enhance the demosaicking method for state of art in image spatial correlation and spectral correlation scheme which is based on the wavelet classified one. Demosaicking method produces high quality of the color interpolation, in this interpolation method the 3 main color known as the principle color in color interpolation are RED, GREEN and BLUE (RGB) by using the mosaic sensors we can optimize these characteristics from the interpolation information by filtration. The filtering is carried out to enhance the characteristics of intensity, chrominance and luminance. The detection of edge is done by calculating the variances of the colors accommodated in colors. to carry out this we use iteration method for performance of color interpolation, this is done to improve the schemes used for the demosaicking images for obtaining the better quality images. There another technique called CFA [1] which is used to define the high quality images which intern result for better color interpolation With low power and chip area consumed a model was designed to perform the color interpolation based VLSI design which takes 30 image frames per second for real time progress. Although the design is bilinear color interpolation technique is one of the simplest and fine technique of the interpolation [2]. So the image taken may contain several known and several unknown pixel values in picture to determine its linearity it encircles the unknown pixels from the image and filter out. In bilinear technique the result fir RGB is always unsatisfactory because this technique doesn't receive the relation between RGB and it also do not care for the edge characteristics of the image. The color ratios are different for different colors but they add a fixed common proportion while they are calculated, the adjacent areas of the principle are variable in nature but these variations are minute. Mathematically for the green pixel simplifies the results for the color interpolation as an advantage in maintaining the quality of the image. Now the architecture is designed for coding in MATLAB and VLSI, where it shows the color interpolation for different crops. In light of this substitute game plan, the Bayer CFA is regularly called a mosaic, and the addition procedure to restore the three essential hues is called demosaicking. It merits saying that there are more G channels in a Bayer CFA than the other two shading channels on the grounds that the human eye can perceive a more extensive scope of green than the other two essential hues. What's more, with this shading course of action, more force changes and points of interest can be recorded to encourage more exact picture remaking. This projects works al about working on MATLAB to process the digital image and then VLSI coding is done to match the results of both. For compression we need to estimate the following edge detection, Gaussian filtration, conversion to grayscale; overall the procedures to perform and plot the result we use VLSI coding where it gives us the PSNR value.

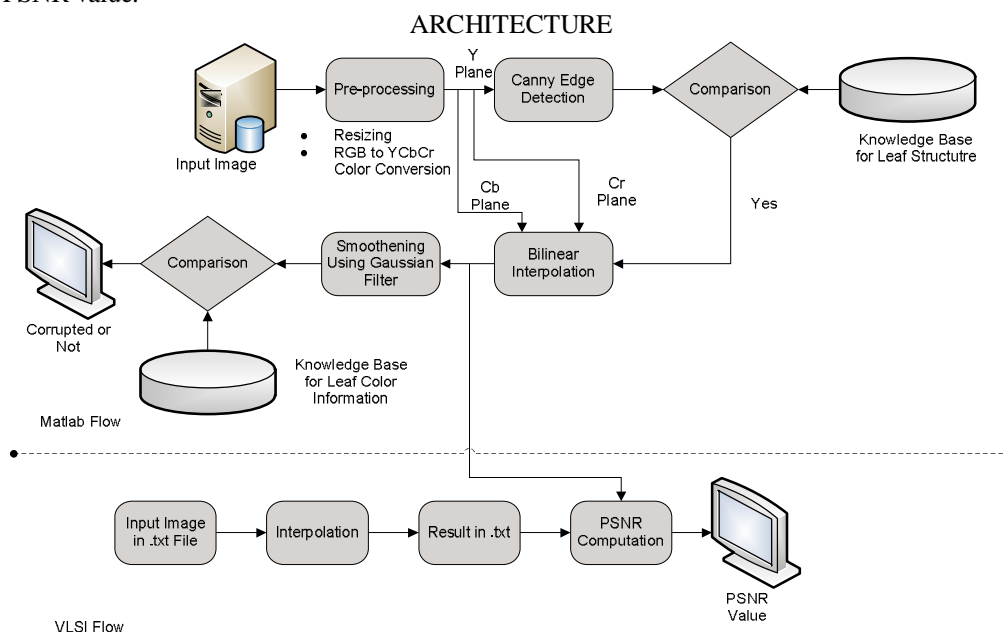


Figure 1: Block Diagram of VLSI Implementation for Color Interpolation



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MATLAB Flow:

A. Input image:

It is fed as crop image or leaves by clicking with a good DSLR camera to avoid high-low resolutions by keeping the position of the camera in constant resolution the images of the crops are been taken and fed to this input image as shown in figure 1.

B. Pre-processing Unit:

This block consists of mapping operations like resizing the image by matrix method because all the images are been clicked may be same in resolution but not in size so we need to resize the every input image in the fixed format so as we design a resizing the image. The three main principle colours are RGB which exploits to produce thousands of colours from these we get intensity and luminance of the image defined as in Ycbr where Y is for the intensity or luminance, cr and cb for the chrominance for red and chrominance for blue. As shown in figure 1 this block another procedure is done that is color conversion the colored image shows the brightness of all the colours so we unable to get exact structure of the image so for we are converting the colored image into gray scale image which gives the structure of the input image in gray scale.

C. Canny Edge Detection:

This is also known as optimal edge detection where the gray image properties will take the each value from one pixel to next and delete all other useless information from the picture. It detects for strong edge intensity differences and filters it for getting the edges then filters out unwanted edges from the image. Then it use for gradients to remove the noisy characteristics from the image so as to smoothening the image.

D. Comparison & Knowledge Base:

Comparison is done for the input image and knowledge base image, in knowledge base it consists the data of several stored leaves into it so as per its knowledge it calculated and compare to define the input image healthy as per it knowledge or not!! It compares and passes the result of comparison to bilinear interpolation block.

E. Bilinear Interpolation:

Here in figure 1, the Ycbr planes are been converted into bilinear interpolation block with Ycbr the compared result of knowledge basement from above blocks are fed. In this block the image zooming is one the basic function operation in DIP is carried out, where digitally interpolation is applied to multimedia application. By this kind of application we pass the control to check out the image with low resolution and image with high resolution (i.e. non enlarged image and enlarged image) by zooming operation we define the image quality i.e. image having the high resolution or low resolution, infect we take high resolution image to process in bilinear interpolation [2].

$$P_{Rp} = Q_n - S'n = \left(\frac{(Q_n - 1)}{(2(S(n - 2) + S(n + 4)))} \right) \dots \dots \dots (1)$$

In above equation it is clear picture that it is interpolation difference. Two conditions occur in this case i.e. image with fixed zooming and image with adaptive zooming, in fixed image zooming we see to that it has pixel length zooming or bi-cubic zooming by doing so we can filter out the unwanted pixels from the image and we obtain the better quality image for processing. Later on in this technique blocking facts called as artifact arrives which are been scaled down and smoothen the image for processing. Besides the technique called adaptive one, in this technique the quantization operation is carried to remove the high and very low artifacts [4] occurring into the image, which result in interpolation. As compare to fix zooming the adaptive zooming is better one. As a result it gives one powered ratio value which is been compared with the VLSI flow and displayed the crop efficiency.

F. Smoothening Using Gaussian filter technique:

While processing through the bilinear interpolation some noise will be added, before this noisy factor is been removed using the Canny Edge Detection to obtain the better edges for gray scale imaging, using the Gaussian filter we remove the unwanted factors from the image as well as noise. It is then compared again with the original database of the images and result is displayed.

VLSI Flow

G. Input image:

In bottom part of figure 1 similar input as that of MATLAB but instead .jpeg we take it as .text file as input because VLSI can't understand the images files in other formats instead .text; for this flow a Xilinx and Modelsim software's are used to perform the operation.

H. Xilinx:

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This software is most suitable for FPGA [7] kit for dumping the code on hardware implementation, initially I file with new project is created and code is assigned in comfortable language i.e. HDL or Verilog OR combination of both, an digital circuitry is designed using this Xilinx module.

I. Modelsim:

Designed code must be simulated using this software, simulation results are viewed by giving the inputs to waveforms and verification is done, to compile the code run simulation and debug the errors occurred and verify the output.

J. Interpolation:

To get the high quality image interpolation, design functionality is made such that image with high resolution is fed into system with .text image file and as results it has to give the results above mentioned for matlab flow. A code in verilog burned for this operation.

$$K_{i,j}^H = \left(\frac{K_{i,j-1} - K_{i,j}^H}{2} \right) + \left(\frac{K_{i,j+1} - K_{i,j}^H}{2} \right) + K_{i,j}^H \dots \dots \dots (2)$$

Where K represents the pixel values and K^H is the tentative pixel value of K.

K. Result:

The results will be obtained into the .txt file only; these are plotted using the high end simulation technique.

L. PSNR:

PSNR power signal to noise ratio gives one fractional value for both MATLAB as well as for VLSI, for different images it results the contrast values, hence following results are noted and a plot a common graph window which shows the result of PSNR.

FLOWCHART:

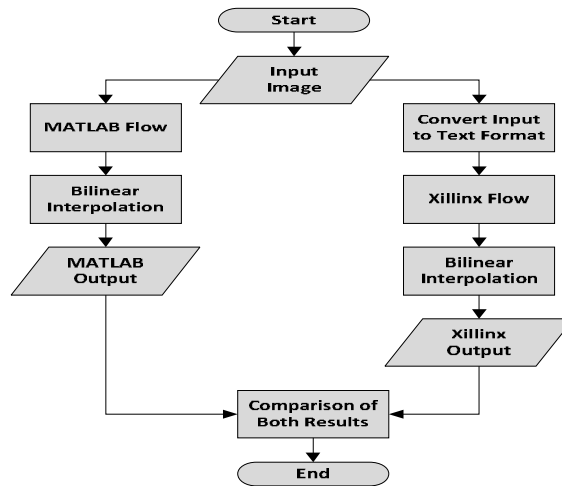


Figure 2: System flow graph

Figure 2 explains about the flow of the system, where it takes the input image which will be always a colored, majorly it is been defined in three colors Red, Green, Blue; next it fed to the MATLAB flow in this the images are processed to obtain the characteristics of input fed. For this we design the matlab in such way that we need to perform coding so we can extract all its characteristics like to get gray scale information edge detection is must be done we use canny edge detection in this system, for removing the unwanted materials from the edge detected image we need filter so we use Gaussian filter. Bilinear interpolation as explained in figure 2. Then a matlab output is obtained.

Processing for VLSI This software is most suitable for FPGA kit for dumping the code on hardware implementation, initially I file with new project is created and code is assigned in comfortable language i.e. HDL or Verilog OR combination of both, an digital circuitry is designed using this Xilinx module. The results will be obtained into the .txt file only, these are plotted using the high end simulation technique .To get the high quality image interpolation, design functionality is made such that image with high resolution is fed into system with .text image file and as results it has to give the results above mentioned for matlab flow. A code in verilog burned for this operation. Designed code must be simulated using this software, simulation results are viewed by giving the inputs to waveforms and verification is done,

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to compile the code run simulation and debug the errors occurred and verify the output. Then both results are verified and result is displayed.

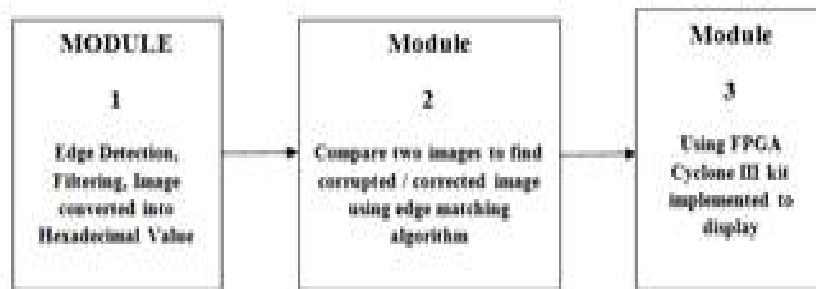


Figure 3: General block diagram to represent and verify the pest affected crops.

The interpolation algorithm is implemented such that it has low complexity with edge detection, RGB color interpolation techniques. Different methodologies are used for color interpolation; each color is interpolated with each other color like $g(i, j)$ is interpolated with red and blue colours. Three types of modules are prepared for color interpolation is shown in figure 3.

A. Module1:

Defines the edge detection, filtering, conversion of image and so on; the edges are been detected by using the Canny's Edge Detection technique, in this technique the colored image is converted into the gray scale image because the in colored image the edges are very difficult to define, so we convert that image to gray scale image to obtain the exact outline of the image. Some noise creation factors will get added during this phenomenon to remove those noisy factors we use the low pass Gaussian filter, which removes the unwanted noise from the image and prepares that image for good quality. In figure 3 digital image processing the colored image is always includes with decimated value but processors does not understand the decimal values so we convert it into the hexadecimal values.

B. Module 2:

Using the canny edge detection algorithm we obtain the edges of image where the image luminance and chrominance factors were added to it then it follows the procedure to define the correction and non correction of the leaves. The module1 and module2 are fall under MATLAB tool. This is also known as optimal edge detection where the gray image properties will take the each value from one pixel to next and delete all other useless information from the picture. It detects for strong edge intensity differences and filters it for getting the edges then filters out unwanted edges from the image. Then it use for gradients to remove the noisy characteristics from the image so as to smoothening the image shown in figure 3. comparison is done for the input image and knowledge base image, in knowledge base it consists the data of several stored leaves into it so as per its knowledge it calculated and compare to define the input image healthy as per it knowledge or not!! It compares and passes the result of comparison to Bilinear interpolation block.

C. Module 3:

This fall under the VLSI , where the field programmable gateway array with cyclone 3 kit is used to dump the entire VLSI code on to that kit to show the practical readings. Using the tool MATLAB and MODELSIM the result is displayed i.e. image is corrupted or not. Using division and the multiplication operation in matlab and compression, low power consumption, complexity and required memory the image result is obtained. As in figure 3 Initially a DSLR camera is connected with the RS232 cable and connected then to system; an image is taken, then processed to FPGA kit by dumping it on kit we conclude the result that crop is corrupted or not.

IV. RESULTS

It is fed as crop image or leaves by clicking with a good DSLR camera to avoid high-low resolutions by keeping the position of the camera in constant resolution the images of the crops are been taken and fed to this input image. As shown in figure 4 below we see the input image, about this image we are not knowing that image is healthy or unhealthy (corrupted or non-corrupted) by processing this image in we get figure 4.

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Figure 4: Colored input image.

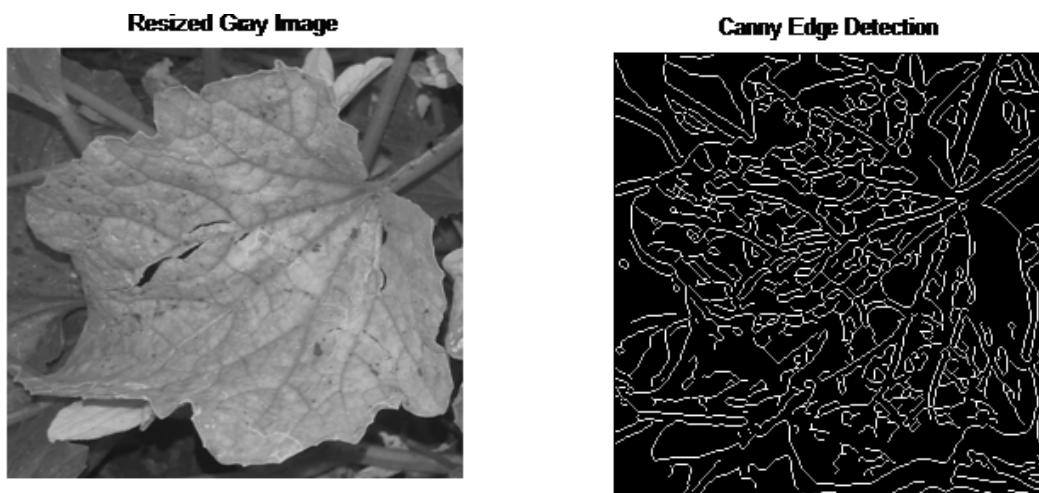


Figure 5: A) Resized Gray image.; B) Canny Edge Detection

In figure 5A, a multiplication and division operation is done to get colored image to gray image. Due to more intensity in colored image we unable to detect the edges of the leaf so we converted that colored image to gray image. To view the edges and rough outline of the gray image is designed by which we get the leaf information about the pests and it also tells that tiny and short edges are scanned.

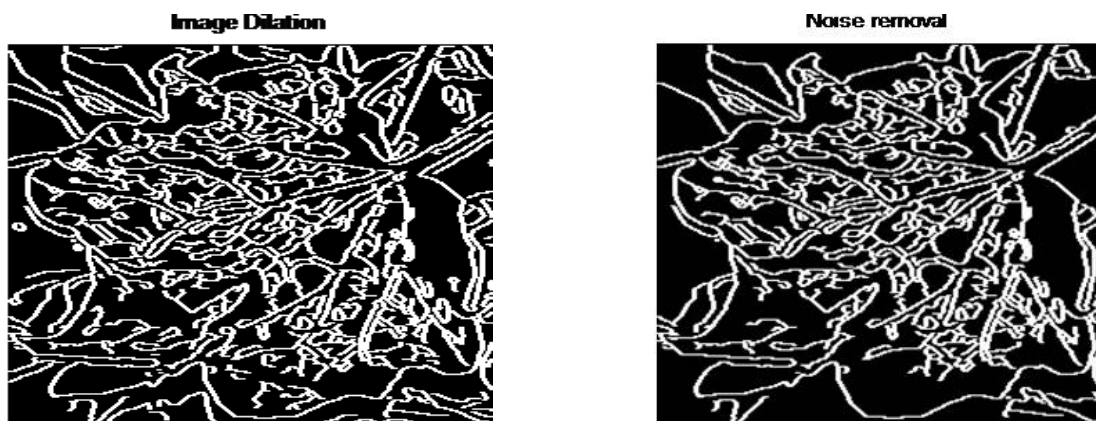


Figure 6: A) Dilated image; B) Noise removal

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To remove the blur from the image or when the image is clicked in hot sunny or in dark fogs the resolution will not respond to detection so we dilate the image so that it removes the all floating part from image and sharpen the edge which have been detected and then it makes the edge thicker as viewed in figure 6A. On the other hand, to extract the exact structure of the leaf and store in the system as shown in figure 6B, unwanted noise from the dilated image should be removed to form the excellent quality form. So that when data is been kept into the software when some input is fed of different image if it's not getting match then it will result it as unhealthy.

Interpolated Image

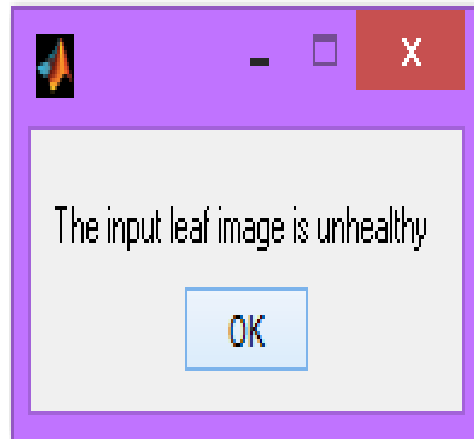


Figure 7: A) Interpolated image; B) Result of Unhealthy image

From figure 7A and 7B, we conclude that the input image is corrupted one and has pest affection on it, may contain diseases which are harmful for both human as well as pets. In figure 8 A & B we see that the crops are healthy.

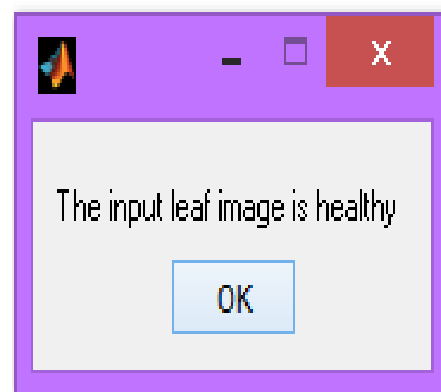


Figure 8: A) Input Healthy image; B) Result for healthy image

Now results for VLSI implementation is plated which are taken from Xilinx and Modelsim simulation. The codes are designed and bilinear schematic diagram is drawn as show below.

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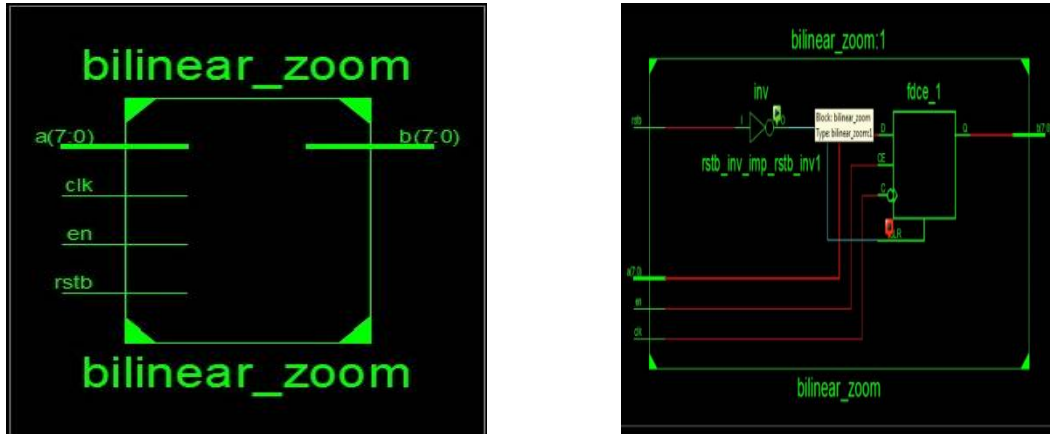


Figure 9: A) Schematic representation of bilinear zoom; B) Internal structure of bilinear zoom.

In figure 9A seven inputs are given i.e. a7, and similar no. of output is taken i.e. b7. A clock pulse (clk) is given to synchronise the process, input enable (en) should kept high until the process is done, after the output; reset bit (rstb) is switched to reset the enable for next input. In figure 9B represents the internal structure where the sample block is with not gate input for reset bit (rstb) it is then given for a kind of flip –flop block and operation carried out and b7 out is obtained, this is for zooming the image to determine the characteristics of the image and its quality.

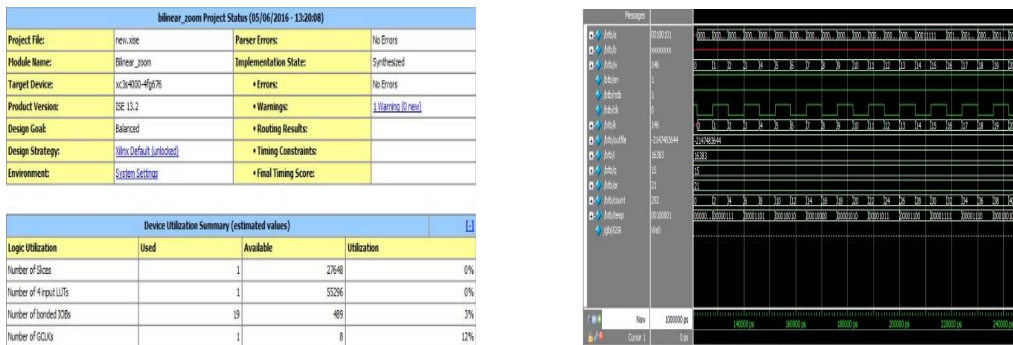


Figure 10: A) status of bilinear zoom for errors and warnings; B) simulation of bilinear Xilinx code.

From above in figure 10 A and B we deduce that no errors occurrence hence output simulation results are verified for different inputs.

V. CONCLUSION

Using the Gaussian filter technique, Edge detection technique in the base comparison of MATLAB flow the input image which fed for processing by examine the different characteristics of the image using several techniques a final result occurred as high quality color interpolation. The pest affected crops are distinguished by testing their leaves structure and its healthy characteristics are calculated. Similarly for VLSI the result is concluded for both and PSNR value is obtained as threshold, results shows the leaves are corrupted or not.

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