The Image Enhancement Algorithm Xilinx and Modelsim Tool Using VHDL and MAT Lab

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Abstract: Image processing modifies pictures to improve them (enhancement, restoration), extract information (analysis, recognition), and change their structure (composition, image Editing). Images can be processed by optical, photographic, and electronic means, but image processing using digital computers is the most common method because digital methods are fast, flexible, and precise. VHDL is a hardware language which is used to define the functionality of any hardware into textual form, leading to chip design and fabrication. MATLAB is used for pictorial presentation of any algorithm and scripts are used to simulate the design. I will design and simulate the image enhancement algorithms in Xilinx and Modelsim tool using VHDL and MATLAB.

Introduction

An image can be synthesized from a micrograph of various cell organelles by assigning a light intensity value to each cell organelle. The sensor signal is "digitized" converted to an array of numerical values, each value representing the light intensity of a small area of the cell. The digitized values are called picture elements, or "pixels," and are stored in computer memory as a digital image. A typical size for a digital image is an array of 512 by 512 pixels, where each pixel has value in the range of 0 to 255. The digital image is processed by a computer to achieve the desired result.

Image enhancement improves the quality (clarity) of images for human viewing. Removing blurring and noise, increasing contrast, and revealing details are examples of enhancement operations. For example, an image might be taken of an endothelial cell, which might be of low contrast and somewhat blurred. Reducing the noise and blurring and increasing the contrast range could enhance the image. The original image might have areas of very high and very low intensity, which mask details. An adaptive enhancement algorithm reveals these details. Adaptive algorithms adjust their operation based on the image information (pixels) being processed. In this case the mean intensity, contrast, and sharpness (amount of blur removal) could be adjusted based on the pixel intensity statistics in various areas of the image. Image processing technology is used by planetary scientists to enhance images of Mars, Venus, or other planets. Doctors use this technology to manipulate CAT scans and MRI images. Image processing in the laboratory can motivate students and make science relevant to student learning.

MATLAB, which stands for MATrix LABoratory, is state-of-the-art mathematical software package, which is used extensively in both academia and industry. It is an interactive program for numerical computation and data visualization, which along with its programming capabilities provides a very useful tool for almost all areas of science and engineering. Unlike other mathematical packages, such as MAPLE or MATHEMATICA, MATLAB cannot perform symbolic manipulations without the use of additional Toolboxes. The C-code can then be integrated in Matlab simulation platform and verified. However, various tools are now available to support the fixed-point functionalities **[1,2].** It remains however, one of the leading software packages for numerical computation.

As you might guess from its name, MATLAB deals mainly with matrices. A scalar is a 1-by-1 Matrix and a row vector of length say 5, is a 1-by-5 matrix. We will elaborate more on these and other features of MATLAB in the sections that follow. One of the many advantages of MATLAB is the natural notation used. It looks a lot like the notation that you encounter in a linear algebra course. This makes the use of the program especially easy and it is what makes MATLAB a natural choice for numerical computations. MATLAB is a high performance interactive software package for scientific and engineering computation. MATLAB integrates numerical analysis, matrix computation, signal processing and graphics in an easy-to-use environment where problems and solutions are expressed just as they are written mathematically **[3].**
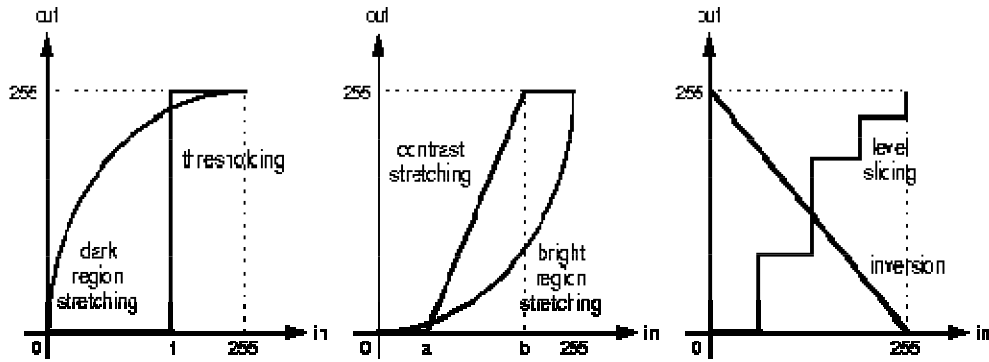
Image enhancement Categories:

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide `better' input for other automated image processing techniques.

Image enhancement techniques can be divided into two broad categories:

1. Spatial domain methods, which operate directly on pixels, and
2. Frequency domain methods, which operate on the Fourier transform of an image.
Unfortunately, there is no general theory for determining what `good' image enhancement is when it comes to human perception. If it looks good, it is good! However, when image enhancement techniques are used as pre-processing tools for other image processing techniques, then quantitative measures can determine which techniques are most appropriate.

Smoothing:

A noisy Image is taken and the noise removal is done by applying a smoothing technique. The noise

removal is achieved by using a mask which enables neighborhood pixel processing.

Image Enhancement for Face Recognition:

This paper considers procedures for enhancement of images, which are of low contrast, dark or bad lighting. Image pre-processing and normalization is significant part of face recognition systems. Changes in lighting conditions produces dramatically decrease of recognition performance. We present image enhancement procedures for face recognition, both wide spread and developed by us. [4]

Image pre-processing and normalization is significant part of face recognition systems. Changes in lighting conditions produces dramatically decrease of recognition performance. If an image is low contrast and dark, we wish to improve its contrast and brightness. The Widespread histogram equalization cannot correctly improve all parts of the image. When the original image is irregularly illuminated, some details on resulting image will remain too bright or too dark
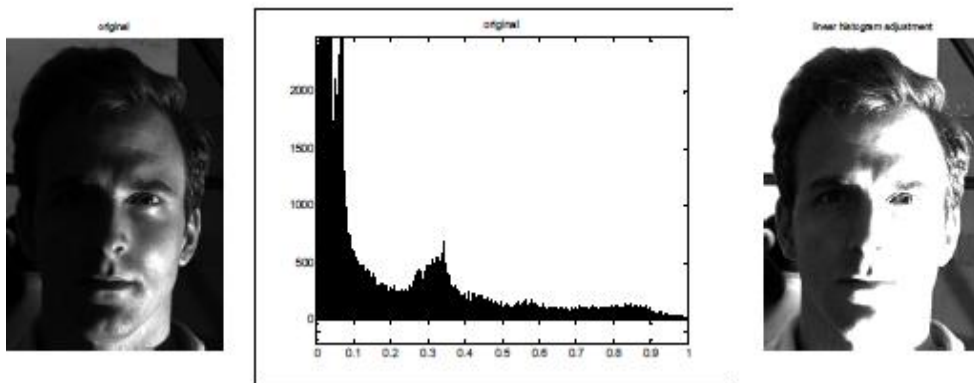

Fig.1 Histogram processing of an image

There are different techniques to enhance the image. Like Histogram Technique, Spatial domain filtering, pixel increment etc.

Adaptive contrast enhancement

The idea is to enhance contrast locally analyzing local grey differences taking into account mean grey level. First we apply local adaptive contrast enhancement. Parameters are set to amplify local features and diminish mean brightness in order to obtain more contrast resulting image. [5] After that we apply histogram equalization.
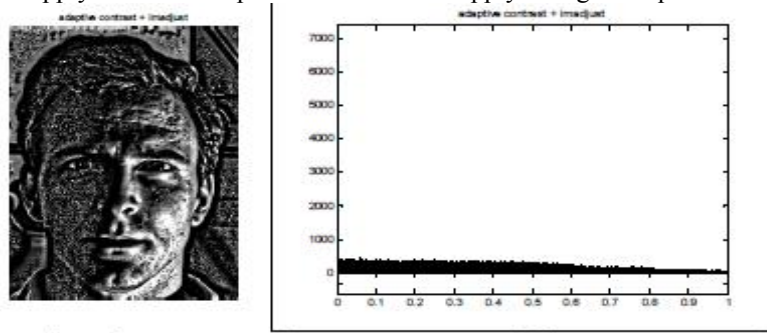

Fig 2 Adaptive Contrast Enhancement

Nonlinear histogram equalization

The main drawback of linear histogram equalization is that it is a global procedure. There is no warranty of good result. We tested non-linear histogram equalization, which performance is better under large variety of images and it did not require manual selection of parameters. The performance of nonlinear histogram equalization is not worse than performance of linear histogram equalization under carefully chosen parameters.
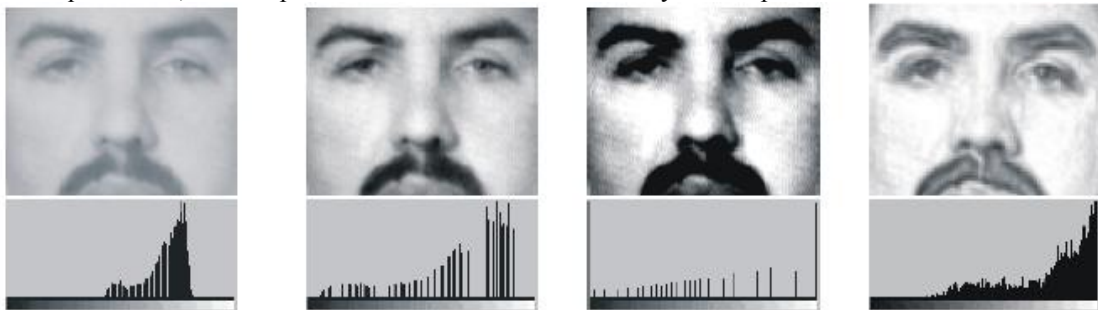

Fig 3 Nonlinear histogram equalization

High boosting

High boosting operator is another operator combining local pixel properties: gradient information and grey value. Resulting image has more contrasted edges and uniform brightness.

Local histogram equalization

The image pre-processing may be used for different goals. For example for manual or automatic image processing. So we have developed another image enhancement procedure, the local histogram equalization. The main idea is to take into account histogram distribution over local window and combine it with global histogram distribution. [6] We have used nonlinear histogram equalization for combination of local and global histogram.
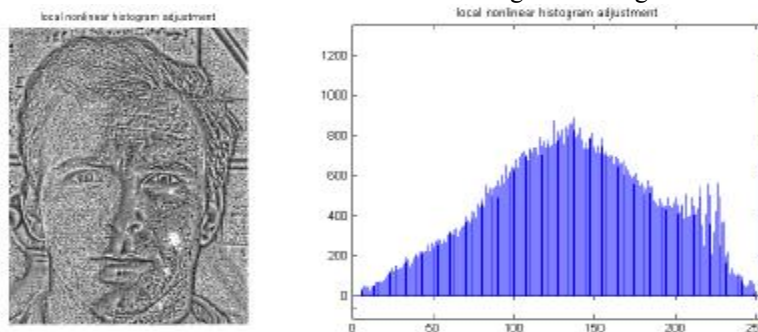

Fig 4 Local histogram equalization

As we can see, local histogram equalization produces less noise than adaptive contrast enhancement, but also image is less sharp.

Gamma correction operation performs nonlinear brightness adjustment. Brightness for darker pixels is increased, but it is almost the same for bright pixels. As result more details are visible.
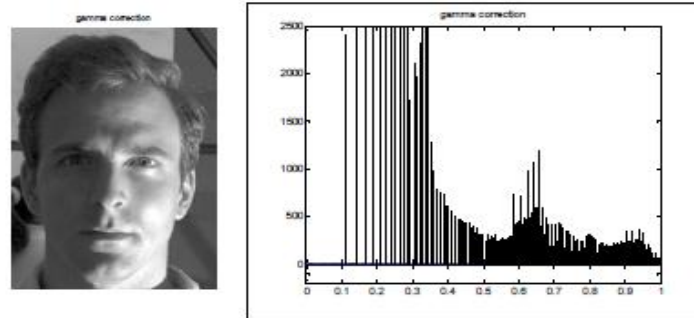
Gamma correction

Fig 5 Gamma Correction

Conclusion:

In this paper we discussed about the image recognition method with the help of MATLAB Tools and in this software we calculate the exact recognition of images. In this paper we declare many methods for correction operation performs nonlinear brightness adjustment. Brightness for darker pixels is increased.

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