Images Enhancemcut By using the Histogram

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الخلاصة
المنحنى المكراري للصورة هو عبارة عن رسم يبين توزيع الكثافة الضوئية في الصورة، ودالة المنحنى المكراري تشى خريطة بحيث تحدد عدد من الصفات الحيزية كل واحدة منها تمت قياس قيمة عبر من البيانات الموجودة في الصورة. ومن ثم تقوم بحساب عدد النقاط الموجودة ضمن كل قيمة.

تحسين الصور الذي يقوم بتعديل عناصر الصورة هو طريقة تقليدية لتعديل الصفات المرئية في الصورة. هناك عدد من طرق تحسين الصور الرقمية التي تستخدم للوصول إلى أفضل تحسين ممكن ملموس ويستخدم في التطبيقات البصرية والصناعية من خلال المنحنى المكراري. جميع هذه الطرق تحاول تحسين البيان في الصور بدون
Abstract

An image histogram is a chart that shows the distribution of intensities in an image. The image histogram function creates plot by making \( n \) equally spaced bins each representing a range of data values, and then calculates the number of pixels within each range.

Image enhancement that modifying the value of picture elements is a classical method for improving the visual perception. Many digital enhancement techniques have been used in order to optimize the visual quality of image for human or machine vision through histogram modifications. All these methods try to enhance the contrast of the input image without measuring the contrast itself. In this paper two histogram modification methods are introduced the first one (histogram stretching) depending on the maximum and minimum brightness value in the image, while the second one (histogram...
equalization) depend on the re-arrange the brightness values in the image. The experimental results indicate that the images more brightness after applying the two enhancement methods and the quality of the processed images is measured subjectively.

Keywords:-
Image Enhancement using Histogram, Image Equalization, and Image Stretching

1 - Introduction

A histogram shows the distribution of an image, for gray scale image it shows how many times a particular pixel intensity occurred in the image. It gives a good sense of how much contrast in an image (the contrast is basically the difference in pixel intensity from light to dark parts of an image), a histogram with a small spread has low contrast, and a histogram with wide spread has high contrast. The desirable information in an image often occupies only a small portion of the available contrast range. Thus, certain objects may not be distinguishable because their gray level values are too near the same. Computer contrast enhancement techniques are often used to increase the perceptibility of this low detail information. [1]
Image enhancement is a major area of image processing. Its principal objective is to process an image so that the result is more suitable than the original image for a specific application. Possible applications are the enhancement of x-ray images, images transmitted by a space probe orbiting a planet or weather images from a weather satellite. Knowing the application is important, so it become a very popular topic in the image processing areas.

2 - **Histogram stretching**

Contrast stretching is a simple image enhancement technique that attempts to improve the contrast in an image by 'stretching' the range of intensity values. It contains to span a desired range of values - e.g. the full range of pixel values that the image type concerned allows.

Before the stretching can be performed it is necessary to specify the upper and lower pixel value limits over which the image is to be normalized. Often these limits will just be the minimum and maximum pixel values that the image type concerned allows. e.g. for 8-bit grey level images the lower and upper limits might be 0 and 255. Call the lower and the upper limit (a) and (b) respectively. The simplest sort of normalization then scans the image to find the
lowest and highest pixel values currently present in the image, call these (c) and (d). Then each pixel $P$ is scaled using the following function:[2]

$$P_{new} = (P_{in} - C)(\frac{b - a}{d - c}) + a \hspace{2cm} (1)$$

The problem with this is that a single outlying pixel with either a very high or very low value can severely affect the value of (c) or (d) and this could lead to very unrepresentative scaling. Therefore a more robust approach is to first take a histogram of the image, and then select $c$ and $d$ at, say, the 5th and 95th percentile in the histogram. (i.e. 5% of the pixel in the histogram will have values lower than $c$, and 95% of the pixels will have values higher than $d$). This prevents outliers affecting the scaling so much.

Another common technique for dealing with outliers is to use the intensity histogram to find the most popular intensity level in an image (i.e. the histogram peak) and then define a cutoff fraction which is the minimum fraction of this peak magnitude below which data will be ignored. In other words, all intensity levels with histogram counts below this cutoff fraction will be discarded (driven to intensity value 0) and the remaining range of intensities will be expanded to fill out the full range of the image type under consideration.[2]
Another method for enhanced the image using histogram stretching by using the following equation:

\[
\text{Stretch}(I_{(r,c)}) = \left[ \frac{I_{(r,c)} - I_{(r,c)\text{MIN}}}{I_{\text{MAX}} - I_{(r,c)\text{MIN}}} \right] [\text{MAX} - \text{MIN}] + \text{MIN} \quad \text{(2)}
\]

Where

\(I_{(r,c)\text{MAX}}\) is the largest gray-level value in the image \(I_{(r,c)}\)

\(I_{(r,c)\text{MIN}}\) is the smallest gray-level value in \(I_{(r,c)}\)

\(\text{MAX}\) and \(\text{MIN}\) correspond to the maximum and minimum gray level values possible (for a 8-bit image these are 0 and 255). This equation will take an image and stretch the histogram across the entire gray-level range, which has the effect of increasing the contrast of allow contrast image. If a stretch is desired over a smaller range, different \(\text{MAX}\) and \(\text{MIN}\) values can be specified. If most of the pixel values in an image fall within a small range but a few outliers force the histogram to span the entire range, a pure histogram stretch will not improve the image and in this case it is useful to allow a small
percentage of the pixel values to be clipped at the low and high end of the range (for an 8-bit image this means truncating at 0 and 255). [3]

3 - Histogram equalization

Histogram equalization provides a sophisticated method for modifying the dynamic range and contrast of an image by altering that image such that its intensity histogram has a desired shape. Histogram equalization employs a monotonic, non-linear mapping which re-assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. This technique is used in image comparison processes because of its effectiveness in detail enhancement and in the correction of non-linear effects introduced by, say, a digitizer or display system. [4]

Histogram equalization is a popular technique for improving the appearance of a poor image. However its function is similar to that of a histogram stretch since its provides more visually pleasing results across a wider range of images HOWWER ITS. The theoretical basis for histogram equalization involves probability theory, where we treat the histogram as the probability distribution of the gray levels. This is reasonable since the histogram is the distribution of the gray levels for a particular image. [3]
The equalization functions use the following steps:- [3]

1- Calculation of the histogram of the source image.

2- Calculate the sum of the histogram. This is also a 256- element array, defined in the following way: element 0 contains histogram element 0, element 1 contains the sum of histogram element 0 and histogram element 1. Element 2 contains the sum of histogram element 0, 1, and 2, and so on, down to Element 255. This contains the sum of histogram elements 0, 1, 2, ..., 255.

3- Normalize the histogram sum array by multiplying each of its elements by the quotient 255 / (the total number of pixels in the image) (round to the nearest integer).

4- The normalized histogram sum is a LUT. Use it as mapping to transform the source image. The result is the destination image.

4 - The Experimental Results

This section is devoted to illustrate the experimental results of applying the histogram modification techniques (histogram stretching and histogram equalization) on selected images. Figure 1 shows the original image, the histogram of the original image, the histogram stretching, and in the end, the image after applying the histogram stretching. Figure 2 also shows the original
images with their histogram and the histogram and the results images after applying the histogram equalization.

From the results in figures 1 and 2, both techniques allow to display the images with a pleasing range of brightness. Also the results show that the histogram stretching technique differs from the histogram equalization in that it apply a linear scaling function to the image pixels value, as a result the enhancement is less harsh, while histogram equalization employ non-linear mapping which re-assigns the intensity values of pixels in the input image such that the output image contains a flat histogram.
Fig. (1) The results of applying the histogram stretching on test images
Fig. (2) The results of applying the histogram equalization on test images
5 - Conclusions

From the results of applying the histogram modifications techniques on test images, some of conclusions can derive:

1 - Both techniques (stretching and equalization) produce images with suitable brightness.

2 - The stretching technique is a linear function while the equalization technique is a non-linear function therefore the second one produce an image more brightness.

References


