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Improvement of contrast of images in Poor Light: a Research and Analysis

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Abstract

In this paper, the four morphological operator's erosion, dilation, opening and closing are used to detect the background. After the background is extracted, contrast of bad lightning image is improved by the application of operators based on Weber's law notion Two contrast enhancement operators Block Analysis method and Opening by Reconstruction method are used. These operators avoid abrupt changes in intensity among different regions .In the final step, we enhance the image by using various filtering techniques. By applying filtering techniques, our image will be of good contrast and free from bad lightning.

Keywords: *Morphological operators, Weber's law, block analysis, opening by reconstruction, image background*

I. INTRODUCTION

Image enhancement is a useful technique in image processing that permits the improvement of the visual appearance of the image or provides a transformed image that enables other image processing tasks (image segmentation, for example).Methods in image enhancement are generally classified into spatial methods and frequency domain ones. The present work is focused on the spatial methods, and in particular, to the use of morphological image transformations.

The application of mathematical morphology to image processing and analysis has initiated a new approach for solving a number of problems in the related field. This approach is based on set theoretic concepts of shape. In morphology objects present in an image are treated as sets. The identification of objects and object features through their shape makes mathematical morphology become an obvious approach for various machine vision and recognition processes.

Quite often a recorded image suffers from a common degradation like poor contrast. The range of intensity i.e. the difference between the highest and lowest intensity values in an image gives a measure of its contrast. The first work dealing with contrast theory was carried out by Meyer and Serra. There are standard techniques like histogram stretching, histogram equalization for improving the poor contrast of the degraded image.

During the histogram equalization process, grey level intensities are reordered within the image to obtain an uniform distributed histogram However, the main disadvantage of histogram equalization is that the global properties of the image cannot be properly applied in a local context , frequently producing a poor performance in detail preservation.

In this paper, firstly morphological operators to detect the background are explained. Then two methodologies to compute the image background are proposed i.e. block analysis and opening by reconstruction. Then a proposal to extract background and enhancement of contrast in case of poor lightning is proposed.

II. RELATED WORK

I.R. Terol-Villalobos has presented a multiscale image approach for contrast enhancement and segmentation based on a composition of contrast operators. The contrast operators are built by means of the opening and closing by reconstruction. The

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operator that works on bright regions uses the opening and the identity as primitives, while the one working on the dark zones uses the closing and the identity as primitives. To select the primitives, a contrast criterion given by the connected tophat transformation is proposed. This choice enables us to introduce a well-defined contrast in the output image. By applying these operators by composition according to the scale parameter, the output image not only preserves a well-defined contrast at each scale, but also increases the contrast at finer scales. Because of the use of connected transformations to build these operators, the principal edges of the input image are preserved and enhanced in the output image. Finally, these operators are improved by applying an anamorphosis to the regions verifying the criterion.

S. Mukhopadhyay and B. Chanda has presented a scheme for enhancing local contrast of raw images based on multiscale morphology. The conventional theoretical concept of local contrast enhancement has been extended in the regime of mathematical morphology. The intensity values of the scale-specific features of the image extracted using multiscale tophat transformation are modified for achieving local contrast enhancement. . Locally enhanced features are combined to reconstruct the final image. The proposed algorithm has been executed on a set of raw images for testing its efficacy and the result has been compared with that of other standard methods for getting idea about its relative performance.

I. R. Terol has also presented a paper in which the quantification of the contrast is based on the analysis of the edges, which are associated with substantial changes in luminance. Due to this, the contrast measure is used to detect the image that presents a high visual contrast when a set of output images is analyzed. The set of output images is obtained by application of morphological contrast mappings with size criteria. These contrast transformations are defined under the notion of partitions generated by the set of flat zones of the image; therefore, they are connected transformations. In addition, an application to the segmentation of white and grey matter in brain magnetic resonance images (MRI) is provided. The detection of white matter is carried out by means of a contrast mapping with specific control parameters; subsequently, white and grey matter are separated and their ratio is calculated and compared with manual segmentations. Also, an example of segmentation of white and grey matter in MRI corrupted by 5% noise is presented in order to observe the performance of the morphological transformations proposed in this work.

Jerzy Kasperek has presented a paper which describes the implementation of the real time local image contrast enhancement method. The system is based on Virtex FPGA chip and enhances the angiocardiographic data using the modified mathematical morphology multiscale TopHat transform. The morphological TopHat transform proved its effectiveness but the direct real time pipeline implementation of the multiscale version requires too many memory blocks. The author proposes a slight modification of the algorithm and presents satisfactory image contrast enhancement results and an efficient FPGA implementation. Proposed pipeline architecture uses the structural element decomposition and employs the Virtex BlockRam modules effectively. The processing kernel realises the contrast enhancement for the 512 x 512 image data with 8 bits/pixel representation in the real time in one XCV-800 Virtex chip.

P. Salembier and J. Serra have dealt with the notion of connected operators. Starting from the definition for operator acting on sets, it is shown how to extend it to operators acting on function. Typically, a connected operator acting on a function is a transformation that enlarges the partition of the space created by the flat zones of the functions. It is shown that, from any connected operator acting on sets, one can construct a connected operator for functions (however, it is not the unique way of generating connected operators for functions). Moreover, the concept of pyramid is introduced in a formal way. It is shown that, if a pyramid is based on connected operators, the flat zones of the functions increase with the level of the pyramid.

Eli Peli has presented discussed on the topic, contrast in complex images. The physical contrast of simple images such as sinusoidal gratings or a single patch of light on a uniform background is well defined and agrees with the perceived contrast, but this is not so for complex images. Most definitions assign a single contrast value to the whole image, but perceived contrast may vary greatly across the image. Human contrast sensitivity is a function of spatial frequency; therefore the spatial frequency content of an image should be considered in the definition of contrast. In this paper a definition of local band-limited contrast in images is proposed that assigns a contrast value to every point in the image as a function of the spatial frequency band. For each frequency band, the contrast is defined as the ratio of the bandpass-filtered image at that frequency to the

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lowpass image filtered to an octave below the same frequency (local luminance mean). This definition raises important implications regarding the perception of contrast in complex images and is helpful in understanding the effects of image-processing algorithms on the perceived contrast. A pyramidal image-contrast structure based on this definition is useful in simulating nonlinear, threshold characteristics of spatial vision in both normal observers and the visually impaired.

III. MORPHOLOGICAL TRANSFORMATION

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the *structuring element* used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as a dilation or an erosion.
In erosion, The value of the output pixel is the *minimum* value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to 0, the output pixel is set to 0.
In Dilation The value of the output pixel is the *maximum* value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to the value 1, the output pixel is set to 1.

.As shown in (d), opening is defined as an erosion followed by a dilation. Figure (e) shows the opposite operation of closing, defined as a dilation followed by an erosion.

As illustrated by these examples, opening removes small islands and thin filaments of object pixels. Likewise, closing removes islands and thin filaments of background pixels.
These techniques are useful for handling noisy images where some pixels have the wrong binary value. For instance, it might be known that an object cannot contain a "hole", or that the object's border must be
smooth

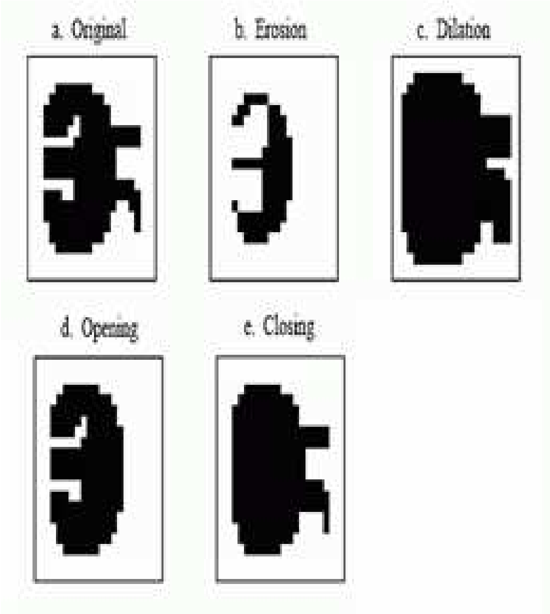

Fig. 1 Morphological operations. Four basic morphological operations are used in the processing of binary image: erosion, dilation, opening and closing.Fig (a) shows an example binary image. Fig (b) to (e) shows the result of applying these operations to the image in (a).

IV. CONTRAST ENHANCEMENT OPERATORS

Block Analysis Method

In this project, d represent the digital space under study, with d=z * z and z is the integer set. Each block is the sub image of the original image. The maximum and minimum intensity values are denoted as Mi and mi. For each analyzed block, maximum (Mi) and minimum (mi) values are used to determine the background measures. Ti is used to select the background parameters. Background parameters line between clear (f >Ti) and dark (f <=Ti) intensity levels. and dark intensity levels. Once Ti is calculated, this value is used to select the background parameter associated with the analyzed block. If (f <=Ti) is the dark region then background

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parameters takes the maximum intensity levels (Mi) then (f > Ti) is the clear region, background parameters takes the minimum intensity levels (mi).

Opening by Reconstruction method

The normal morphological opening is an erosion followed by a dilation. The erosion "shrinks" an image according to the shape of the structuring element, removing objects that are smaller than the shape. Then the dilation step "regrows" the remaining objects by the same shape. The dilation step in the opening operation restored the vertical strokes, but the other strokes of the characters are missing. How can we get the entire characters containing vertical strokes. The answer is to use morphological reconstruction. For binary images, reconstruction starts from a set of starting pixels (or "seed" pixels) and then grows in flood-fill fashion to include complete connected components. To get ready to use reconstruction, first define a "marker" image. This is the image containing the starting or seed locations.

Consider a transformation ψ acting on sets consisting, first, of measuring an increasing criterion such as the area or the Ferret's diameter of each connected component of the input sets and, second, of keeping only the connected components for which the criterion is higher than a given limit. A typical example of this filter is area opening[15].

To find the function that matches the background images without dividing the original images into blocks, and also without using erosion and dilation method. When structural element increases, morphological end generate new shapes. Erosion and dilation are used with large size to expose the background. However, in MM, there is other class of transformations that allows the filtering of the image without generating new components; these transformations are called transformations by reconstruction When considering the opening by reconstruction to detect the background, one further operation is necessary to detect the local information given by the original function (image extremes are contained in the opening by reconstruction because of its behavior).

V. PROPOSED METHODOLOGY

Steps to perform

Firstly we perform image acquisition i.e. acquire image, which has poor lightning or dull, from a specified place.

Then in second step we separate the background from the image. For this we will assume that the contrast of the image is more than the normal contrast or we can say that the threshold of the image is greater than the normal value.

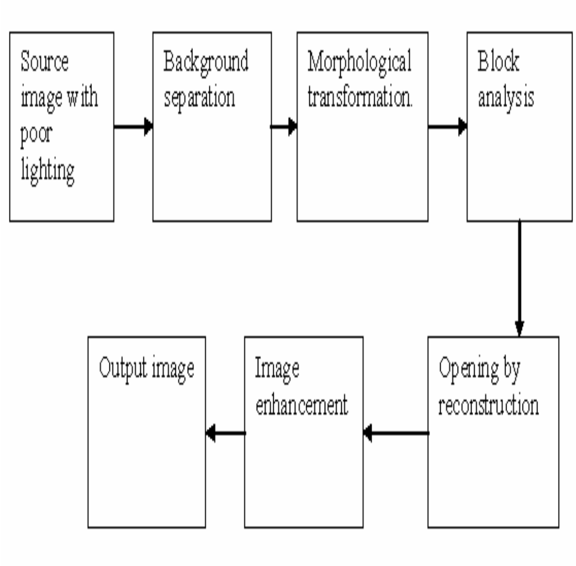

Fig 2 Proposed methodology to compute the problem

Here, the basic idea is to select a set of training images which look good perceptually, next a Gaussian mixture model for the color distribution in the face region is built, and for any given input image, a color tone mapping is performed so that the color statistics in the face region matches the training examples. In this way, even though the reported algorithms to compensate changes in lighting are varied, some are more adequate than others.

In third step, morphological operations are applied on the image such as erosion, dilation, opening and closing to see the exact location of foreground image.

Then in the next step, we segment the image into sub-images. As the source image is difficult to deal with in a general view. Thus we decompose it into simpler ways in this processing stage. The decomposed sub-images are processed by a morphological filter to emphasize the character region and suppress the small islands of noises. Finally the sub-images are united to obtain the resulting image. Image background approximation is done with the help of block analysis method.

Then the next methodology i.e. opening by reconstruction is used for mutibackground notion. It is used given its following properties: a) it passes

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through regional minima, and b) it merges components of the image without considerably modifying other structures.

In the final step, we enhance the image by various filtering techniques. Filtering is a technique for modifying or enhancing an image. Image processing operations implemented with filtering include smoothing, sharpening, and edge enhancement. In statistics and image processing, to smooth a data set is to create an approximating function that attempts to capture important patterns in the data, while leaving out noise or other fine-scale structures/rapid phenomena. Many different algorithms are used in smoothing. One of the most common algorithms is the "moving average", often used to try to capture important trends in repeated statistical surveys. In image processing and computer vision, smoothing ideas are used in scale-space representations. Sharpening is an important part of digital image processing. It restores some of the sharpness lost in the lens and image sensor. Virtually every digitized image needs to be sharpened at some point in its workflow— in the camera, the RAW conversion software, and/or the image editor. Edge enhancement is an image processing filter that enhances the edge contrast of an image or video in an attempt to improve its acutance (apparent sharpness). The filter works by identifying sharp edge boundaries in the image, such as the edge between a subject and a background of a contrasting color, and increasing the image contrast in the area immediately around the edge. By applying filtering techniques, our image will be of good contrast and free from bad lightning.

VI. CONCLUSION

In this paper, I have proposed a method to detect the image background and to enhance the contrast in grey level images with bad lighting is Firstly, a brief introduction about morphological transformation operators is given. Then, a methodology was introduced to compute an approximation to the background using blocks analysis. This proposal was subsequently extended using mathematical morphology operators. However, a difficulty was detected when the morphological erosion and dilation were employed; therefore, a new proposal to detect the image background was propounded, that is based on the use of morphological connected transformations. Also, morphological contrast enhancement transformations were introduced. Such operators are based on Weber's law notion. These contrast transformations are characterized by the normalization of grey level intensities, avoiding abrupt changes in illumination. There is a disadvantage of contrast enhancement transformations i.e. they can only be used satisfactorily in images with poor lighting; in a future work this problem will be considered.

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