A MORPHOLOGICAL OPERATOR BASED APPROACH TO DETECT BACKGROUND FROM DARKEN IMAGES

Priyanka*

Manoj Arora**

Abstract*: This proposal deals with the detection of background in images with poor contrast. Some morphological transformations are used to detect the background in images characterized by poor lighting. Lately, contrast image enhancement has been carried out by the application of two operators based on the Weber's law notion. The first operator employs information from block analysis, while the second transformation utilizes the opening by reconstruction, which is employed to define the multi-background notion. The objective of contrast operators consists in normalizing the grey level of the input image with the purpose of avoiding abrupt changes in intensity among the different regions. Finally, the performance of the proposed operators is illustrated through the processing of images with different backgrounds, the majority of them with poor lighting conditions. The contrast enhancement problem in digital images can be approached from various methodologies, among which is mathematical morphology (MM). Such operators consist in accordance to some proximity criterion, in selecting for each point of the analyzed image, a new grey level between two patterns (primitives).*

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*Student , ECE Deptt. JMIT Radaur

**Asstt. Prof., JMIT Radaur

I. INTRODUCTION

Contrast enhancement is an important task in image processing that is commonly used as a preprocessing step to improve the images for other tasks such as segmentation. However, some methods for contrast improvement that work well in low-contrast regions affect good contrast regions as well. This occurs due to the fact that some elements may vanish. The proposed method is based on morphological transformations by reconstruction and rational operations, which, altogether, allow a more accurate contrast enhancement resulting in regions that are in harmony with their environment. Furthermore, due to the properties of these morphological transformations, the creation of new elements on the image is avoided. As a result of the previous considerations, the proposed method keeps the natural color appearance of the image.

The contrast function enhances the contrast of an image. It creates a new gray colormap, cmap, that has an approximately equal intensity distribution. All three elements in each row are identical. cmap = contrast(X) returns a gray colormap that is the same length as the current colormap.

The two contrast enhancement operators used in the proposed methodology are:- Block Analysis and Opening by reconstruction methods. These are discussed in the following subsections.

A) Block Analysis method

It is a method in which we divide the image into various sub images and then apply operations on them for contrast improvement. In the proposed methodology, 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 parameters takes the maximum intensity levels (Mi) then (f > Ti) is the clear region, background parameters takes the minimum intensity levels (mi).

B) 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. 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).

II. LITERATURE SURVEY

I.R. Terol-Villalobos[1] 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 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.Angélica R. Jiménez-Sánchez, Jorge D. Mendiola-Santibañez[2] has described that some morphological transformations are used to detect the background in images characterized by poor lighting. Lately, contrast image enhancement has been carried out by the application of two operators based on the Weber's law notion. The first operator employs information from block analysis, while the second transformation utilizes the opening by reconstruction, which is employed to define the multibackground notion. The objective of contrast operators consists in normalizing the grey level of the input image with the purpose of avoiding abrupt changes in intensity among the different regions. Finally, the performance of the proposed operators is illustrated through the processing of images with different backgrounds, the majority of them with poor lighting conditions. I. R. Terol[3] 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.

Alexander Toet[4]: He presented a method to merge images from different sensing modalities for visual display, which produces a fused image by nonlinear recombination of the ratio of low-pass (RoLP) pyramidal decompositions of the original images. The appearance of merged images that are produced by this scheme is highly dependent on the contrast and mean gray level of the input images. That nonlinear multiplication of the successive layers of a ratio of low pass pyramid results in a contrast-enhanced image representation that is highly invariant for changes in the global ray-level characteristics of the original image is shown. Application of this nonlinear multiplication procedure in the image fusion process results in composite images that appear highly independent of changes in lighting and gray-level gradients in the input images. The method is tested by merging different degraded versions of parallel registered thermal (FLIR) and visual (CCD) images. S. Mukhopadhyay and B. Chanda[5] 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.

Jerzy Kasperek[6] 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[7] 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[8] 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 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. James Short, Josef Kittler and Kieron Messer[9] :- As an extension to prior work by the authors in the area of photometric normalisation for face verification, they apply these algorithms in a component-based framework. In particular, they investigate how the requirement for complexity of the normalisation changes when smaller image patches are used. They show that for smaller image patches, a simpler normalisation can out-perform a more complicated method. In addition, they show that a method that applies a simpler normalisation to a number of smaller face image components that are then fused, out-performs a more complicated method applied to the full face image.

III. PROPOSED WORK

Morphological operators often take a binary image and a structuring element as input and combine them using a set operator (intersection, union, inclusion, complement). They process objects in the input image based on characteristics of its shape, which are encoded in the structuring element. Usually, the structuring element is sized 3×3 and has its origin at the center pixel. It is shifted over the image and at each pixel of the image its elements are compared with the set of the underlying pixels. If the two sets of elements match the condition defined by the set operator (*e.g.* if the set of pixels in the structuring element is a subset of the underlying image pixels), the pixel underneath the origin of the structuring element is set to a pre-defined value (0 or 1 for binary images). A morphological operator is therefore defined by its structuring element and the applied set operator. For the basic morphological operators the structuring element contains only foreground pixels (*i.e.* ones) and `don't care's'. These operators, which are all a combination of erosion and dilation, are often used to select or suppress features of a certain shape, *e.g.* removing noise from images or selecting objects with a particular direction.

We will explain the methodology used for the concept proposed. The block diagram of the proposed methodology and explanation of steps is given below.

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. 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 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 functions like image sharpening etc. By doing this, finally our image will be of good contrast and free from bad lightning.

IV. RESULTS

In this, some snapshots of image enhancement process are shown here. In these snapshots, you can see the variation in graphs of different morphological operations i.e. erosion, dilation, opening and closing. You can also see the variation in contrast of original image after applying contrast enhancement operators i.e. block analysis and opening by reconstruction methods. Then you can compare the histograms of the original image and contrast improved image by seeing their results.

The original image which we call as image1 is shown as:-

Fig 1:- Original image (image1)

The histogram of this image is shown as:-

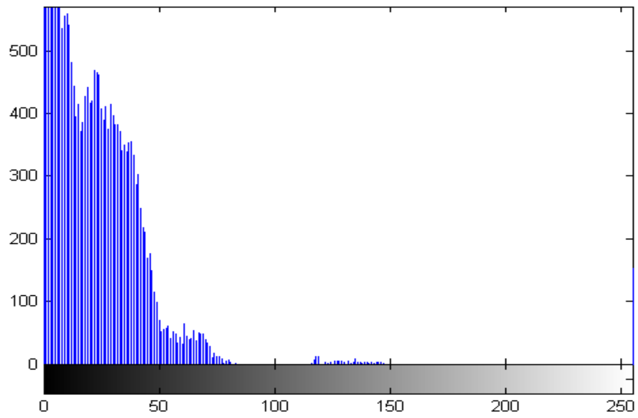

Fig 2:- Histogram of original image (image1)

The graphs of the morphological operations applied on the original image are shown as follows:-

Graph of Erosion operation applied on original image is shown as:-

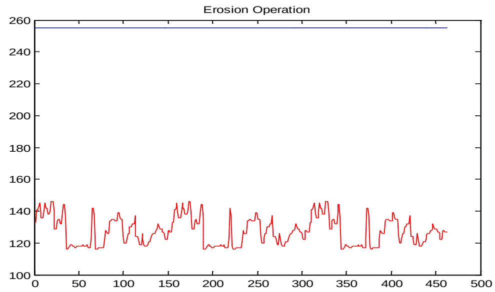

Fig 3:- Plotting of original image (image1) Vs erosion operation on original image (image1)

The result obtained from the proposed approach is shown in figure 4. As we can see we get the enhanced image from the work.

Fig 4:- Contrast improvement operation on image (image2)

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