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An Intelligence System for Image Enhancement with Local and Global Enhancement for Dark Images: A Survey

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Abstract—**Image enhancement plays an important role in computer vision. The degraded image, blurred image and noised image effect the medical diagnosis of image data, satellite image for information retrieval. Various authors and researcher propose a method of image enhancement such as histogram equalization, multi-point histogram equalization and some method based on neural network. The purpose of image contrast enhancement is to improve the features of an image. However, contrast enhancement may not be necessary for all images as processing of high contrast images costs time and computations. Hence, an automatic algorithm is required to classify the images as low contrast and high contrast to improve the quality of the images.**

The quality of images is often influenced by external factors such as illumination, equipment and so on in the process of image acquisition and transmission. Image enhancement is an image processing technology which processes images through methods such as adjusting tone to improve images" contrast and enhance details in dark areas.Image enhancement method; Global image contrast enhancement is one of the most commonly used techniques to enhance the quality of an image, local details of an image are very important for diagnosing a particular ailment. When either local contrast enhancement or global contrast enhancement is used alone, there is loss of brightness of the image. , a new method is presented uses both local and global enhancement methods with ANN on the same image. The use of neural network in image enhancement gives a better performance in compression of all conventional enhancement technique.

Index Terms—Imageenhancement, Dark Image,ANN, Image Contract, Image Quality

I. Introduction

Digital image processing is the use of computer algorithms to perform image processing on digital images. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. One of the first applications of digital images was in the newspaper industry, when pictures where first sent by submarine cable between London and New York. An image is two dimensional picture that gives appearance to a subject usually a physical object or a person. It is digitally represented by a rectangular matrix of dots arranged in rows and columns. Digital images are often corrupted by noises during acquisition, transmission and storage processes. Such noises will severely affect image processing such as image segmentation, edge detection, and object recognition. The principal objective of enhancement technique is to process an image so that the result is more suitable than the original image for a specific application (very much problem-oriented) or to bring out specific features of an image or to highlight certain characteristics of an image. Therefore, many well-known digital noise filters have been presented in the past years for all kinds of image processing systems, such as average filter, Wiener filter, Median filter, Discrete Fourier transform, Discrete cosine transform, Discrete wavelet transform and so on. For example, as a typical linear filtering, the Wiener filtering can smooth Gaussian noise effectively but it makes image blurry and has little effect on removing other noises such as impulse noises and Salt & Pepper noises. Nonlinear filter, like Median filtering, due to its good effect on processing impulse noise and Salt & Pepper noise, has been often used in image processing. Two major classifications of image enhancement techniques can be defined: (i) Spatial domain enhancement (ii) Transform domain enhancement. Image enhancement attempts to emphasize details or edges. As a commonly used technique, mask convolution is hard to selectively enhance details at different scales in the spatial domain. Of course, applying different mask techniques may yield different enhancement results in the spatial domain. Transform domain enhancement techniques involve mapping the image intensity data into a given transform domain by using transforms such as the 2-D discrete cosine transform (DCT), Fourier transform [1] etc. The basic idea in using this technique is to enhance the image by manipulating the transform coefficients. Recently, many transform-based enhancement techniques have been proposed.

Enhancement of these images provides more flexibility in handling the images. In the case of poor visual images poor contrast and brightness images make more difficult to review the particular part of the image. Enhancement of images provides more flexibility in handling the images. Enhancement techniques are widely used in real time applications such as consumer electronics, medical image and disease analysis, cloud image analysis, space image analysis, defect detection in the processing industries, biometric [2] security authentications and various other applications.

The local information of an image are very important if the image is of medical or astronomical applications for analyzing and extracting the information of that image and proper diagnosing of the ailments based upon the image of a cell. So with the advancement of science and technology, especially in the field of signal processing, the quality of an image can be enhanced so that it gives clear and detailed information about the image. [3] The global method of contrast stretching is very common in image enhancement, it gives a satisfactorily good quality of an image for viewing purpose but it lacks the local details of the image as it mainly focused on the global details of the image that is overall information of the image and neglects the local details of an image. The local method enhances the local details of the image that is the slight variation of the image is addressed and provides the minute details of the image. It lacks from the overall information of the image pixel enhancement. In this

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combined algorithm, one's discrepancy is addressed by another. The minute details of the image are addressed by the local method which is not addressed in the global method. The equalization of the histogram of an image for enhancement of the image is very common and effective. Histogram equalization based contrast enhancement techniques was presented in [4] for preserving brightness. In [5], each and every peak of the histogram is equalized separately. It is a technique of spatial domain of an image. Spatial domain means processing of image is done directly on the image pixel, not on the other transformed domain. One single technique cannot be used as a universal technique that can be applied to all types of images.

Enhancement of images provides more flexibility in handling the images. Enhancement techniques are widely used in real time applications such as consumer electronics, medical image and disease analysis, cloud image analysis, space image analysis, defect detection in the processing industries, biometric security authentications and various other applications.Artificial neural network play important role in image enhancement and for preserving brightness and contrast of digital image. The nature of neural network is adaptive and variant; this nature sustained a pervious value of image pixel and set the desired target for enhancement of image. Some enhancement approaches utilize single layer and some other are used multilayer of artificial neural networks. Such as ART network for binary image enhancement [6]. A general approach for implementation of morphological image operations by a modi1ed feed-forward ANN using shunting mechanisms, i.e., neurons acting as switches.

II. Literature Review

Literature survey interprets old information and generates a combination of new information with old information. So, in this section there is a brief description of various research papers and occurrence of summary and synthesis of research papers.

MdtyhBrendel and TantcisRoskaentilted "Adaptive image sensing and enhancement using the Adaptive Cellular Neural Network Universal Machine" a method for image enhance using pixel equalization and neural network [7]. The method can be used for the adaptive control of image sensing and for subsequent image enhancement. The algorithm uses intensity and contrast content as well. The method is completely executable on the Adaptive Cellular Neural Network Universal Machine (ACNNUM) architecture. Both methods use basically the same technique for equalization as they apply the intensity and contrast information of the basic image. The equalization masks are computed by using the diffusion template via the CNN-UM. The algorithm is ideal for the ACNN-UM the most time consuming task is the diffusion. Accordingly, the use of the currently available CNN-UM chip speeds up the process significantly. On the other hand, the presented methods are of acceptable quality as this is shown by the sample images. In the algorithms the radius of the adaptation can be controlled by the time or gain of diffusion, thus all intermediate cases between full global and local equalization are dynamically available.

Her-Chang Pu, Chin-Teng Lin, Sheng-Fu Liang and Nimit Kumar entitled[8] "A Novel Neural-Network-Based Image Resolution Enhancement" a novel HVS-directed neural network based adaptive interpolation scheme for natural image is proposed. A fuzzy decision system built from the characteristics of the human visual system (HVS) is proposed to classify pixels of the input image into human perception non-sensitive class and sensitive class High-resolution digital images along with supervised learning algorithms are used to automatically train the proposed neural network. Simulation results demonstrate that the proposed new resolution enhancement algorithm can produce higher visual quality of the interpolated image than the conventional interpolation methods. The fuzzy decision rules inspired by human visual system (HVS) are proposed to analyze the sensitivity of human eyes to the image for interpolation. According to the experiment results, the proposed HVS-directed neural-network-based interpolation is superior to conventional methods such as the bilinear and bi-cubic interpolations in some aspects of visual quality such as the clarity and the smoothness in edge regions as well as the visual quality of the interpolated images. In addition, the proposed fuzzy decision rules combined with the neural network can balance the trade-off between speed and quality for different applications by just adjusting a threshold parameter.

S. Chitwong, T. Boonmee, and F. Cheevasuvit entitled [9]"Local area histogram equalization based multispectral image enhancement from clustering using competitive hop-field neural network" problem of clustering or segmenting in image enhancement is discussed . One of important issues for enhancing image based on local area histogram equalization (HE) is a clustering or segmenting technique. That is, the more the accuracy of separating image into specified classes is needed, the better the performance of enhancement is. As mentioned objective, in this paper, the competitive Hopfield neural network (CHhW) is then proposed for clustering 10 the LHE based image enhancement. By using simulated image, standard image and multispectral image from Landsat 7 satellite, experimental results are shown in both accuracy of clustering and variance of the enhanced image. The criteria for a good enhancement algorithm are that if can give high variance in detail area, low variance in smooth and edge areas. Also comparing the variance of the enhanced image by both LHE and global area histogram equalization (GHE) methods shows that one from LHE outperforms. In addirion, the enlarged image fiam small area is shown clearly by visualization. Equalizing histogram from the local area classified by such the clustering methods, CHNN show that not only the accuracy of clustering is clearly better exact in the simulated image but also the performance enhancement outperforms when comparing with FCM in all clusters for standard image. For TM image, not only in detail area the variance of FCM is more than that of CHNN, but also in the smooth and edge areas it is still higher. Thus, CHNN bas better trended as mentioned reasons.

Adin Ramirez Rivera, ByungyongRyu," Content-Aware Dark Image Enhancement Through Channel Division"[10], The current contrast enhancement algorithms occasionally result in artifacts, overenhancement, and unnatural effects in the processed images. These drawbacks increase for images taken under poor illumination conditions. They propose a content-aware algorithm that enhances dark images, sharpens edges, reveals details in textured regions, and preserves the smoothness of flat regions. The algorithm produces an ad hoc transformation for each image, adapting the mapping functions to each image's characteristics to produce the maximum enhancement. We analyze the contrast of the image in the boundary and textured regions, and group the information with common characteristics. These groups model the relations within the image, from which we extract the transformation functions. The results are then adaptively mixed, by considering the human vision system characteristics, to boost the details in the image. Results show that the algorithm can automatically process a wide range of images—e.g., mixed shadow and bright areas, outdoor and indoor lighting, and face images—without introducing artifacts, which is an improvement over many existing methods.

III. Local Enhancement of the Image

The local enhancement is employed to get the minute details of an image. It enhances the local details in terms of the gradient of the image which gives useful information to the analyzer of the image. It addresses those pixels which would be ignored by the global method. The local enhancement method employed here is un-sharp masking [8]. In this method the image is sharpened by subtracting an un-sharp image that is a blurred or smoothed from the original image, so the name Un-sharp masking is derived. In this method the following steps are involved:

1. Blurring of the image.
2. Subtracting the blurred image from the original image to make the mask.
3. Adding the mask to the original image.

If the blurred image is denoted as b (i,j) and the image as p (i,j) then the mask m (i,j) is given according to equation (1).

$$m(i, j) = p(i, j) - b(i, j) \qquad (1)$$

The weighted portion of the mask is added to the original image to get the sharpened images (i,j) given by equation (2).

$$s(i, j) = p(i, j) + w * m(i, j) \qquad (2)$$

Where 'w' is the weight, generally greater than zero. When the weight is equal to 1, it is the un-sharp masking and when greater than 1 then it is called high boost filtering. This sharpened image is given as input to the global contrast enhancement process for further improvement in the image quality or to improve the visual quality of the image.

IV. Global Enhancement of the Image

The global enhancement of the image is used to increase the contrast of the image. In this process each pixel of the image is adjusted so that it gives a better visualization of the image. In spatial contrast enhancement, the operation is performed directly on the pixel. The pixels are arranged in such a way that it is distributed throughout the range of desired intensity level. Global contrast stretching method is used as global method of enhancing the image. There are many global techniques like histogram equalization (HE), contrast limited adaptive histogram equalization and many other transformation methods like discrete cosine transform (DCT), discrete shearlet transform (DST), adaptive inverse hyperbolic tangent function transformation, etc. Among these, HE is the one used widely as global method [8].

Any of the method can be used to enhance the image globally. In all the global methods they did not consider the local details of the image and look for the global information of the image. So we first apply the local enhancement in order to verify the algorithm, the simple HE is used. It is not mandatory to use only this method; different methods can be used to improve the image quality. For the discrete image, the probabilities of the pixel value are taken in HE. To take the probabilities, first the corresponding number of pixels should have particular pixel intensity value; it is calculated and divided by the total number of the pixels present in the image. The probability of occurrence of pixel intensity level 'k' in the digital image is stated by equation (2).

$$p(r_k) = \frac{n_k}{N*M} \qquad (3)$$

Where N*M is the total number of pixels in the image and n_k is the total number of pixels having intensity level"k". The pixels are transformed according to the following transformation equation in discrete form [8].

$$t_k = L(r_k) = (G-1)\sum_{i=1}^{k} p(r_i) = \frac{G-1}{N*M}\sum_{i=0}^{k} n_i \qquad (4)$$

Where 'G' is the highest intensity level or value, L (r_k) is the transform function and k = 0, 1, 2, 3, ..., G-1. So the output image pixel is obtained by mapping each input pixel r_i to the new transformed value tk. The processed output value may have fractional value so a rounding function to the nearest integer value is needed. While doing so some of the image pixels may go to the new value and some of the intensity pixel values may not be present in the transformed image.

V. Artificial Neural Network (ANN)

Artificial neural networks (ANNs) proved to be capable of finding internal representations of interdependencies within raw data not explicitly given or even known by human system. Its special characteristic together with the simplicity of building and training ANNs and their very short response time encouraged their application to the task of image enhancement. Because of their inherent nonlinearity, ANNs are able to deal with the complex interactions between variables that affect image pixels [1]. There is no need for complex functional models to describe the relationships between the input variables and the input image. Recently the ANNs technology has been proposed as a substitute for statistical approaches for classification and image denoising problems [3].

The advantages of ANNs over statistical methods include robustness to probability distribution assumptions, the ability to classify in the presence of nonlinear relationships, and the ability to perform reasonably well using incomplete data bases [6]. Comparison results between ANNs and statistical techniques indicated that neural nets offer an accurate alternative to other classical methods such as histogram equalization or autoregressive models In this dissertation cascaded ANNs are used for image enhancement and bright contrast preserving. The ANNs are trained with the back-propagation algorithm, which is a gradient-decent technique that is easily applied to networks whose neurons have smooth, monotonic differentiable transfer functions such as sigmoid and hyperbolic tangent.

VI. CONCLUSION

In this paper we review the image enhancement technique based on neural network application.Neural network also play important role in image enhancement.

The locally enhanced image is given to the input of global enhancement for better visual perceptions and increases the brightness to a level which gives pleasant sensation to the human eye. The different local and globalimage enhancement methods with ANN have been used and tested their effectiveness of the different combinations of the local and global methods.Image Enhancement entails the processing of an image for improving its visualization for one of kind applications. Process involves processing the image by its structural features like contrast and resolution.

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