A Review: Fuzzy Contrast Mapping for Image Enhancement

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Abstract - Image enhancement methods referred to a collection of different techniques that search forth improvement of the photographic appearance of an image or for converting the image to a form which is better suitable for the analysis of a machine or a human. In many applications and research areas the enhancement of noisy image data is a big technical problem. Image enhancement approaches can be grouped into three extensive categories such as Frequency domain methods, which are based on the Fourier transformation of an image, spatial domain techniques, which are based on the pixels directly, and Fuzzy domain techniques, which comprise the use of knowledge-based systems that are able to imitate the activities of a human expert. The main advantages of spatial based domain techniques are the low complexity which brings the favours in real time implementations and they are conceptually simple to understand. However, these methods commonly lack in providing imperceptibility and adequate robustness requirements. Fuzzy logic is a good measured frame to handle the problem of uncertainty in the image information. In this work different fuzzy algorithm used in image enhancement have discussed with the help of literature review widely used to improves quality of image contrast very efficiently.

Keywords- Image Processing, Contrast enhancement, Fuzzy Image Processing, Fuzzy Inference System, histogram equalization, Fuzzy logic.

I. INTRODUCTION

Whenever an image is converted from one form to another, such as, digitizing, scanning, transmitting, storing, etc., some degradation occurs at the output. Hence, the output image has to undergo a process called image enhancement. Fuzzy image processing is the collection of all approaches that understand, represent and process the images, their segments and features as fuzzy sets. The representation and processing depend on the selected fuzzy technique and on the problem to be solved. The idea of fuzzy sets is simple and natural. For instance, we want to define a set of gray levels that share the property dark. In classical set theory, we have to determine a threshold, say the gray level 100. All gray levels between 0 and 100 are element of this set; the others do not belong to the set. But the darkness is a matter of degree. So, a fuzzy set can model this property much better. The basis for fuzzy logic is the basis for human communication. This observation underpins many of the other statements about fuzzy logic. Because fuzzy logic is built on the structures of qualitative description used in everyday language, fuzzy logic is easy to use. A filtering system needs to be capable of reasoning with vague and uncertain information; this suggests the use of fuzzy logic.

A. Digital Image Processing

An image may be defined as a two-dimensional function $f(x, y)$, where x and y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a digital image. The field of digital image processing refers to processing digital images by means of a digital computer. Note that a digital image is composed of a finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, image elements, pels, and pixels. Pixel is the term most widely used to denote the elements of a digital image.

B. Image Enhancement

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 (IE) transforms images to provide better representation of the subtle details. It is an indispensable tool for researchers in a wide variety of fields including (but not limited to) medical imaging, art studies, forensics and atmospheric sciences. It is application specific: an IE technique suitable for one problem might be inadequate for another. For example forensic images or videos employ techniques that resolve the problem of low resolution and motion blur while medical imaging benefits more from increased contrast and sharpness. To cater for such an ever increasing demand of digital imaging, software companies have released commercial softwares for users who want to edit and visually enhance the images refer to Figure 1.1.
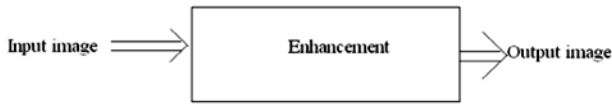
Figure 1.1 Operation of Image Enhancement.

C. Image Enhancement Techniques

The Image enhancement techniques can be divided into three 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.

3. Fuzzy domain, 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 is most appropriate.

II.   FUZZY IMAGE ENHACEMENT SYSTEM

Fuzzy image enhancement is based on gray level mapping into a fuzzy plane, using a membership transformation function. The aim is to generate an image of higher contrast than the original image by giving a larger weight to the gray levels that are closer to the mean gray level of the image than to those that are farther from the mean. An image I of size M x N and L gray level scan be considered as an array of fuzzy singletons, each having a value of membership denoting its degree of brightness relative to some brightness levels.

Figure 2.1 The main principles of Fuzzy Image Enhancement.

Image enhancement procedures comprise of a gathering of strategies that try to enhance the visual presence of a picture or to change over the picture to a structure more qualified for examination by a machine or a human. The rule goal of picture upgrade improvement strategies is to process a picture so that the outcome is more suitable than the first picture for a particular application. It is regularly used to build the complexity in pictures that are considerably dull or light. Picture upgrade involves operations that enhance the appearance to a human viewer, or operations to change over a picture to an organization more qualified to machine preparing. Picture upgrade alludes to those picture handling operations that enhance the nature of information picture with a specific end goal to beat the shortcoming of the human visual framework.

Fuzzy frameworks are made of a learning base and thinking component called fluffy deduction framework. A fluffy surmising framework (FIS) comprises of four practical squares as indicated in Figure.2.2.
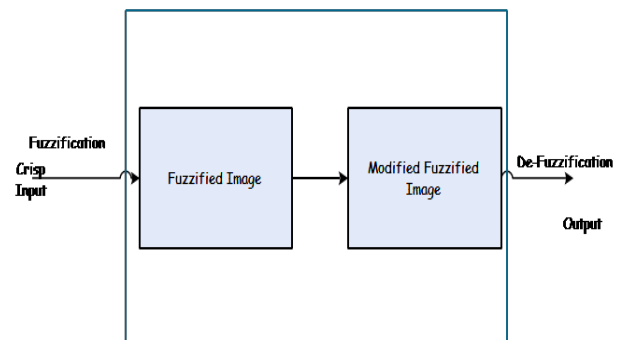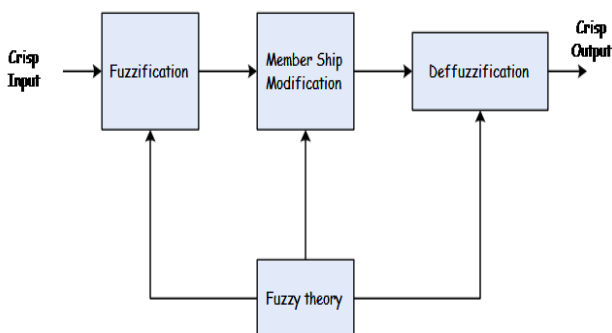
Figure 2.3 Membership Function Modifications.

- Fuzzificantio: Changes the crisp inputs into degrees of match with phonetic qualities. Converse procedure of defuzzification.
- Knowledge Base: Consists of a tenet base and a database. A tenet base contains various fluffy if-then guidelines. A database characterizes the enrollment capacity of the sets utilized as a part of the fluffy guidelines.
- Fuzzy Inference Engine: Fuzzy Inference engine achieves the implication operations on the instructions.

Figure 2.2 Fuzzy Inference Systems.

- Defuzzification: This change of fuzzy set to particular crisp value is called defuzzification.

III. LITERATURE REVIEW

SR. NO.	TITLE	AUTHOR	YEAR	APPROACH
1	Fuzzy contrast mapping for image enhancement,	A. Thakur and D. Mishra,	2015	The application of fuzzy theory to improve contrast of low contrast image is area of recent interest
2	Image enhancement for hand sign detection,	J. W. Wang, T. H. Chen and T. Y. Chen,	2014	devised an image enhancement technique based on singular value decomposition to remove dark backgrounds by reserving the skin color pixels of a hand image
3	Quality enhancement technique for gray level immunohistochemistry images,	P. Smitha, L. Shajy and P. Marichami,	2014	In IHC technique it detects the specific type of proteins from sample tissue sections.
4	Enhancement of sputum cytology images through recursive mean separate histogram equalization and SVM classification,	L. Shajy, P. Smitha and P. Marichami	2014	various HE methods for the enhancement of sputum cytology images
5	Image enhancement using fuzzy c-means clustering based on local population balance modeling,	N. Duran, M. Çatak and M. E. Özbek,	2013	a novel approach is presented for image enhancement based on population balance modeling concertedly fuzzy c-means clustering
6	Image contrast enhancement for outdoor machine vision applications,"	M. H. A. Wahab, N. Zakaria, R. Latip and R. A. Salam,	2013	the art of image enhancement techniques used to adjust the contrast of an outdoor image degrade by fog, haze, and rain

A. Thakur and D. Mishra,[1] Human visual system appeases by a good contrast Images. Image enhancement techniques are best solution for improving the visual appearance of images to a human viewer. It also preserves the structure features of the image. Enhancement of the noisy image data without losing any significant information is very challenging. There are many uncertainties involved while capturing image and the performance of image enhancement varies with subject. It is well established that Fuzzy logic and fuzzy sets are very good at handling many uncertainties. The application of fuzzy theory to improve contrast of low contrast image is area of recent interest. To investigate and establish the application of fuzzy theory for enhancing a low contrast image, we propose a fuzzy based contrast enhancement of gray level images. Our experiment asserts that the proposed method has better performance than conventional methods. The image quality of the system has been evaluated based on visual appearance, peak signal to noise ratio and entropy.

J. W. Wang, T. H. Chen and T. Y. Chen, [2] This exploration proposes compact hand extraction to assist in computerized handshape recognition. We devised an image enhancement technique based on singular value decomposition to remove dark backgrounds by reserving the skin color pixels of a hand image. The polynomial approximation YCbCr color model was then used to extract the hand. After alignment, we applied illumination compensation to the adaptable singular value decomposition. Experimental results for images from our database showed that our method functioned more efficiently than conventional ones that do not use compact hand extraction against complex scenes.

P. Smitha, L. Shajy and P. Marichami,[3] Study of breast cancer through Immunohistochemistry (IHC) images are focused in this exploration. In IHC technique it detects the specific type of proteins from sample tissue sections. The qualitative analysis of tissue is done through the visual inspection and manual staining method. The perception of pathologist is a considering factor in this case. The differences in staining methods may provide various results by different pathologist. So an enhancement technique, suitable to improve the quality of the images is a major challenge in cytopathology. In this exploration we discus different enhancement techniques suitable to enhance the IHC images. Segmentation can be done

properly with an efficient enhancement technique. The features can easily be extracted from properly enhanced and segmented image. Better feature leads to efficient grading of malignant cells.

L. Shajy, P. Smitha and P. Marichami,[4] Contrast enhancement is one of the important steps in image processing. Enhancement process has a vital role in medical image processing. Histogram Equalization (HE) plays the major role in enhancement process. HE is simple and effective method in contrast enhancement. The conventional HE enhancement process outputted an excessive contrast result. Which leads to poor classification result, especially in medical image processing. In this exploration we discussed about various HE methods for the enhancement of sputum cytology images. Our ultimate aim is, to develop an efficient algorithm to detect lung cancer at early stage. The challenging problem, we faced, in this work is to find out a proper algorithm for the enhancement of sputum cytology images. Here we consider some famous HE algorithm for the enhancement of sputum cytology images. The Recursive Mean Separate Histogram Equalization Method (RMSHE) gives better result in sputum cytology image enhancement.

N. Duran, M. Çatak and M. E. Özbek,[5] In this exploration, a novel approach is presented for image enhancement. Conventional image enhancement methods suffer from blurring effects while they obtain good level of peak signal to noise ratio (PSNR). We propose a new algorithm based on population balance modeling concertedly fuzzy c-means clustering aiming to image enhancement while keeping the image sharpness at a good level. To test the developed algorithm well-known four images have been used. According to results, the proposed algorithm supplies fair enough level of PSNR in addition to stop losing the sharpness level of the test images.

M. H. A. Wahab, N. Zakaria, R. Latip and R. A. Salam,[6] Outdoor machine vision is getting a concern nowadays. Ranging from surveillance and monitoring system to automotive system such as driver assistance system require vision application or artificial eye to keep monitoring the situations. However, most of these applications works very well during clear weather and degrade during bad weather due to the atmospheric particles mitigate the quality of vision system. This exploration discuss the state of the art of image enhancement techniques used to adjust the contrast of an outdoor image degrade by fog, haze, and rain. A brief overview of bad weather will be discussed and several recent techniques on removing fog, haze and rain are discussed.

PROBLEM STATEMENT

Whenever an image is converted from one form to another such as, digitizing, scanning, transmitting, storing, etc., some of the degradation occurs at the output. Hence, the output image has to undergo a process called image enhancement which consists of a collection of techniques that seek to improve the visual appearance of an image. In the image if the local region is somewhat smooth, then the new value of the pixel can be determined by averaging neighboring pixel values. On the other hand, if the local region contains edges a different type of enhancement method should be used. However, it is extremely hard, if not impossible, to set the conditions under which a certain enhancement method should be selected, since the local conditions can be evaluated only vaguely in some portions of an image, therefore, an enhance method needs to be capable of reasoning with vague and uncertain information; this suggests the use of fuzzy logic.

IV.   CONCLUSION

In today's world many techniques are used for image enhancement. But fuzzy is the most popular and modern technology for image enhancement. An image that contain high differentiation and all around characterized edges and valleys are called as great quality picture, while a low quality picture is stamped by low complexity and poorly characterized limits between the edges. The focal objective of the work is to review image enhancement procedure based on fuzzy approach. In literature survey there are numerous methods used for contrast enhancement has discussed. The existed methods are able to enhance gray scale images. The fuzzy image processing is one of the significant application parts of fuzzy logic. This fuzzy algorithm is able to get good contrast image which increases the brightness of the under exposed contrasted images.

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