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Review Paper for Different Techniques Using Image Enhancement

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Abstract

Image enhancement (IE) performs a basic position in vision purposes. Lately, plenty of work has been carried out in the discipline of IE. Many tactics have already been proposed until now for reinforcing the digital pictures. This paper has presented a comparative analysis of quite several IE methods. This paper has proven that the fuzzy logic (FL) and histogram founded tactics have fairly amazing outcome more than the obtainable systems. This paper finally ends up with suitable future recommendations to increase fuzzy founded IE extra.

Keywords: *Fuzzy logic (FL), image processing (IP), color image enhancement, histogram equalization (HE)*

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INTRODUCTION

Digital image processing (DIP) is a field characterized by way of need for significant trial work to hook up the capability of proposed options to a specified quandary. IP science is used by planetary scientists to enhance picture of Mars, Venus or different planets. One in every fraction of the IP is the IE. It is the growth of digital image (DI) value, without abilities about the supply of deterioration. IE is the device to beef up the interpretability or perception of records in photo for human viewers [1]. It is to get higher the picture best in order that the consequent photograph is superior to the unique photograph for a specific application. The main purpose of IE is to take out detail that is hidden in a picture or to enhance contrast in a low contrast image. Whenever a picture is transformed from one form to different, in such image a few form of decay occurs at output.

IE is among the easiest and most appealing areas of DIP. Clearly, the suggestion in the back of enhancement tactics is to carry out detail that is obscured. Enhancement is also used to revive a picture that has suffered some type of decay as a result of the optics, electronics and/or environment or to enhance distinct elements of a picture.

The objective of IE is dependent on the applying context, and the standards for enhancement are in general subjective or too complicated to be effortlessly transformed to useful purpose measures. IE algorithms tend to be easy, qualitative, and advert hoc. Moreover, in any given software, an IE algorithm that performs well for one class of picture won't participate in as good for other lessons. Spatial domain procedures like the logarithmic transforms, vigor legislation transforms, HE, are based on the direct manipulation of the pixels within the picture aircraft, whilst the development into area procedures are founded on the manipulation of the orthogonal transform of the picture as a substitute than the picture itself.

IMAGE ENHANCEMENT

IE is the easiest and fundamental inspiration in DIP and it can be implemented via noise elimination or distinction enhancement. The notion at the back of in IE is to fortify quality of given picture or quite simply to spotlight

the special function of the picture. A well-recognized illustration of IE. In which when we increase the visual background of an image it looks better than original image (OI). Improved image can be obtained by using different image contrast enhancement methods (ICE). Contrast is a visual difference of image that makes the object distinguishable from the background. The contrast of the picture improves it than the OI as shown the Figure 1. IE improved the contrast of the picture in terms of brightness and the actual appearance of the processing image [2].

Input image *Enhance image*

Fig. 1: *Image Enhancement.*

Applications

IE has applications in many fields like aerial imaging, satellite images, digital camera pictures, remote sensing applications, forensic labs, astrophotography, fingerprint or face detection and etc. IE is a foremost tool for highlighting areas to toughen the visual representation of the picture. It has a considerable application in medical imaging like in MRI, X-rays or ultrasound [3].

VARIOUS IMAGE ENHANCEMENT TECHNIQUES

The IE procedure consists of quite several methods that make the visual look of the given picture stronger or convert the input image into better form for better analysis by machines as well as humans. Various enhancement techniques are as follows:

1. Spatial domain methods (SDM).
2. Frequency Domain methods (FDM).
3. Fuzzy domain methods.

Spatial Domain Method

IP strategies centered on spatial ways operate straight on pixels. These techniques change the pixel values (PV) as indicated by standards relying upon unique PV i.e. local or point process. Numerous methods exist to examine or integrate the PVs with their instant or neighboring pixels. Do not forget that the usual picture f(x, y), transformation T may also be utilized to obtain the ensuing or processed picture g(x, y) as:

G(x, y)=T[f(x, y)]

Operator T is defined over neighborhood pixels of (x, y). Operator T is applied to each pixel (x, y) to obtain g output at that point. Various SDM based techniques are discussed below:

Histogram Equalization (HE)

HE is a technique based in SD using histogram of the picture. A histogram plots the frequency of grey level, at each and every pixel of the picture, varying from zero (black) to 255 (white). Histogram is a discrete performs given with the aid of:

h(rk)=(nk)/N

The place, rk and nk are depth phases of the pixels; N is the number of pixels within the photo with intensity respectively. It is a technique that transforms given histogram of the picture by way of spreading the gray-stage clusters over a dynamic range. It remaps the grey level frequency situated on a probability distribution of enter grey-level of the long-established image to histogram with close-to uniform probability density operate. This system redistributes the intensity distribution. Histogram having top and valleys can have top and valleys even after equalization; however these will probably be shifted. HE can also be labeled into two precepts classes: international and local HE. Global histogram equalization (GHE) uses entire input for transformation function of the input histogram. Even as, local histogram equalization (LHE) makes use of a sliding window that slides by method for every pixel or piece of pixels successively and gray stage mapping is performed on the middle pixel of that square handiest. Other methods based on histograms are: HS that transforms histogram of one image into the histogram of another image, and DHS that works on critical points from the input histogram.

Global Histogram Equalization

In this technique, each pixel of the image is assigned a new intensity value based on previous cumulative density function. To participate in GHE, the real histogram of the grayscale picture needs to be equalized. GHE

accounts the global know-how. The ensuing picture of GHE is more desirable in distinction. However, it is going to have unnatural looks because of over enhancement of brightness. Also, GHE technique is not adaptable to local light conditions.

Local Histogram Equalization

This technique uses sub-blocks of the enter image and use these blocks to retrieve their histograms. HE is applied to the important pixel of that block by way of creating use of cumulative density function. The process is common for each pixel till the quit-pixel is equalized. This technique results in over-superior quantities. This technique is not adaptable with partial light information. Also, computational costs are high for this technique.

Histogram Specification (HS)

Below this manner, histogram of enter picture is modified into the histogram of an additional image. This system is used at the instances whilst output is needed to shape a specific histogram through attaining highlighted grey-stage tiers. This technique enables obtaining the favored output. Creation use of this technique is bit elaborate when you consider that it is complicated to identify the output histogram as it varies for the entire pictures.

Dynamic Histogram Specification (DHS)

In these strategies, a few critical points (CPs) of the input picture are chosen. On the groundwork of CPs and other variations, a unique histogram is created dynamically. This approach enhances the image, by preserving some of the characteristics of the input image's histogram. But, it does not improve the on the whole contrast of the picture. HE techniques suffer from mean-shift problem [4]. The mean intensity value of the picture is shifted to the middle gray-level of the intensity range. Thus, HE based techniques are not useful in the cases where intensity protection is required.

Frequency Domain Technique (FDT)

FDT are founded on Fourier transform (FT). Excessive-frequency contents within the feet are dependable for edges and sharp transitions in a picture. Soft areas of picture appear due to low frequency contents of FT. Enhancement of picture f(x, y) is performed by applying frequency area based on DFT.

Fuzzy Domain

More than a few uncertainties and capabilities in IP may also be quite simply applied utilizing FL. Fuzzy founded IP is collection of various fuzzy strategies that realize, characterize and approach the picture. Fuzzy manner has three primary steps: fuzzification, amendment of club plays values, and de-fuzzification. Some steps of fuzzy reasoning may also be comparable to:

Fuzzification

Input values are evaluated with the membership function (MF) to obtain membership values for each part of image in case of IP. Change of MF values: The membership values are then combined with the outlined fuzzy set operations to get weight of each fuzzy rule.

Defuzzification

The qualified output results are combined to obtain crisp output based on the defined methods.

Law for fuzzy differencing:

If x is P1 and y is Q1, Then z is R1.

If x is P2 and y is Q2, Then z is R2.

The procedure of fuzzification and defuzzification are just the steps for encoding and decoding the picture and hence the key point is the alteration of membership value. Fuzzy based IP depends on the fuzzy inference system being used and the enter image to be processed [4].

LITRETURE SURVEY

Verma *et al*. proposed two new transformation features for the enhancement of under and over uncovered regions of the identical pictures [5]. Rectangular hyperbolic perform is used for the below-exposed areas, even as for over-exposed regions, S-operate is applied. The HSV color model is used for the enhancement purpose. The S-function allows more flexible control for the given regions. The proposed technique is efficient in terms of time required for getting best possible results.

Tamalika's paper presents a brand new process using intuitionistic fuzzy set thought for medical IE [6]. The procedure produces an intuitionistic fuzzy picture utilizing Sugeno sort fuzzy complement and the parameter in intuitionistic fuzzy picture is optimized

making make use of intuitionistic fuzzy entropy. Experimental outcome on a couple of low contrasted medical graphics exhibit that the proposed method produces higher more advantageous picture as compared to the present fuzzy and intuitionistic fuzzy manner.

Kannan *et al.* presented strategies for the enhancement of dark sports activities photographs [7]. Low contrast pictures may just occur in view of negative lightning conditions or small dynamic variety of imaging programs. The ways proposed listed here are fuzzy rule situated systems and then making use of sigmoid functions for the dark and bright inputs. The process used for enhancement is splitting the color graphics into RGB planes and making use of membership capabilities to each and every aircraft. The RGB planes are then concatenated to obtain the resultant enhanced image. Sigmoid approach is priceless, considering that it is bendy; the distinction explanations will also be adjusted except an enough influence is bought.

Enhancement of portraits over a high range is offered using FL and synthetic ant colony process [8]. The AACS is utilized to recognize the underexposed, blended and overexposed districts of a picture. The HSV color model is applied and Gaussian factor is used for the fuzzification of over and underneath-exposed regions, even as combined-uncovered areas are left uninjured. Parametric sigmoid skills are used for the enhancement. Moreover, AACS is used to optimize the visible aspect of picture and therefore ascertaining the parametric required for enhancement. The visual application is favored to generate the resulting picture human eye friendly. This manner is effective in recovering lost information from permanently degraded images.

Khairunnisa *et al*.'s paper grants the fuzzy IE for low distinction and non-uniform illumination pictures [9]. A new fuzzy depth measure is proposed to differentiate between the dark and bright regions. This measure is computed by considering the average intensity and deviation of the intensity distribution of the image. The enter image is better utilizing a power-law transformation. Implementation of the proposed algorithm on the non-uniform illumination and low distinction pix shows that the proposed algorithm outperforms the other enhancement techniques. The proposed algorithm creates extra even explanation with improvement in the details and contrasts.

Mahashwari and Asthana presented a fuzzy based method for IE [10]. The pixels of picture are classified into three classes: dark, bright and gray. On the foundation of this classification, MFs are applied by following a global approach. The resultant image obtained is modified and clear.

Hasikin *et al.* offered a parameter, named, contrast component [11]. This parameter gives info on change amongst gray-level values in local neighborhood. It splits the degraded picture into brilliant and dark area. Gaussian membership perform is utilized to the particular dark and shiny areas individually. For the dark pictures, sigmoid functions are used to increase the picture. While for colored images, HSV model is used to enhance them. This manner is best applicable for real time applications.

Shrivastava and Richhariya presented a contrast enhancement method founded on fuzzy entropy rule and fuzzy set theory for low contrast gray scale images [12]. The proposed algorithm is better contrast upgrade and also requires much less computational time. It can overcome the drawbacks of SDM of thresholding. It results in high contrast images.

Chamorro-Martínez *et al*. discussed extra few cardinalities of fuzzy units and their use in quantification [13]. The trained indicates that scalar measures are not suited for measuring cardinalities, and fuzzy numbers suit this good. A new fuzzy based procedure has been proposed to assess the quantified sentences. Linguistic histograms have outcomes in more proper technique to furnish inputs to users. The concepts of color have been definite very well using fuzzy based approach which can be efficiently used in fuzzy IP.

Preethi *et al.* presented a MF ramp used to enhance the visual form of the picture so that maximum possible information could be extracted [14].

Table 1: *Comparison Table [17].*

Sr. No.	Technique	Concept	Advantage	Disadvantage
1	Histogram Equalization	Uniform distribution of gray values over scale	Simple, effective and low complexity	Brightness of an image is changed after HE
2	Bi-histogram Equalization	Decomposition of image using mean value	Preserve the brightness of an image	Gives an artificial look to image
3	Dynamic Histogram Equalization	Decomposition of image using local minima or maxima	Enhances the images without making any loss of information	Required more computation time i.e. more complex
4	Gray scale Grouping	Formation of bin of grey values	Applicable to abroad variety of images	More complex
5	Histogram Modification	Uses specified image histogram	Simple and works well in many applications	System is sensitive to noise

The MF is modified for dark and bright regions, but is left unchanged for the middle regions. This approach can be used in medical images to create the diagnosis easy.

The most significant function of IE is to beef up the class of a picture to make its visibility better [15]. This paper gives a strength-constraint HE algorithm in YCbCr field for AMOLED the usage of. Within the proposed algorithm, the power-constraint local histogram equalization (PCLHE) is applied on the Y element. And the average HE is utilized on the Cb and Cr component individually.

In a function of which processes a picture, the process used generally CE referred as time period contrast of enhancement, is HE [16]. An algorithm for this can be without problems completed; nevertheless, it has a tendency to transfigure the picture brightness to the core point of scale of gray level. [18] This report indicates the amendment scheme of a histogram which is fundamental to care for such variety of problems as per trait of implementation. The boundary estimations which can be two in wide diversity of backing of histogram chart are found out and situated to concerning qualities, in my opinion. The likelihood density function for calculating probability of the image is then is enumerated and revised function of mapping is utilized to accomplish HE.

CONCLUSION

This paper has presented a study on various IE techniques. The review has shown that there are still many improvements required in the available procedure to handle different kinds of images. This paper has shown that no particular technique is effective for every kind of pictures or image data set. Although FL and histogram based method have shown quite significant results, but it still faces many issues. To overcome the limitations of existing method, a new procedure will be proposed in near future which will evaluate K factor of fuzzy based enhancement automatically, creation use of the ACO to search out the fine similarity value among the many given sets of values which represents the image in additional efficient method.

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