A Survey Paper Based On Contrast Enhancement of Gray Image Using Fuzzy Based Contrast Intensification Operator

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Abstract :- In this recent period, the image processing plays a key function in different fields of engineering and Research. Perhaps to increase the effectiveness of this field, quality of an image should be enhanced to support the human sensitivity or machine visualization. The contrast of an image is defined as difference of gray levels presented in the image. There are a number of conventional methods available for image contrast enhancement, like Gamma Correction, Power law transformation, histogram equalization etc. they all are based on the crisp logic. In this paper a novel approach for gray image contrast enhancement is proposed using the fuzzy logic based contrast intensification operator. The proposed method treats with the fuzzy logic based method because, fuzzy logic is a strong tool to handle vagueness, uncertainty and since images are vague in terms of pixel values fuzzy logic .After following proposed algorithm it is expected that efficient contrast improvement than the conventional techniques such as histogram equalization and adaptive histogram equalization will be achieved.What we do is to give different labels for our object we know.

Index Terms
Image contrast enhancement, soft computing, fuzzy logic, uncertainty, histogram equalization

I .INTRODUCTION

Image enhancement processes is the collection of techniques that seeks to improve the visual appearance of an image, or to convert the image into a human perception form. Mostly it is observed that an image acquire suffers from the poor contrast problem; in that case it is not possible to extract required information from the images. Therefore image contrast enhancement is the critical field in the image processing. In the past conventional technique histogram equalization (HE) and adaptive histogram equalization (AHE) has been used to increase the contrast level of the poor contrast image. After an experimental work done, in this paper it has been observed that HE and AHE techniques sometimes provide poor contrast enhancement or over contrast enhancement. In addition to this also observed that both the techniques produce rectangular artifacts in the output. The proposed research work seek to address this problem by make use of the advantage of fuzzy logic, so that a capable contrast enhancement can be attained. The basic suggestion is to utilize hazy and blemish condition management capacity of fuzzy logic based soft computing.

Because Fuzzy logic has a good facility of interpretability and can also incorporate expert's knowledge. In proposed research work, the objective is to develop single channel image enhancement technique using fuzzy logic based soft computing.

II.LITERATURE SURVEY

Image enhancement refers to those image processing function that advance the quality of input image in order to conquer the fault of the human visual system [6], [7]. There is no general theory of image

enhancement. When an image is processed for visual interpretation, the observer is the ultimate judge of how well a particular method works. After literature survey some image enhancement techniques has been concluded. There is so numerous research works has been achieved on image enhancement of gray images, which are follows:

- Spatial domain methods, which work directly on pixels.
- Frequency domain methods, which work on the Fourier transform of an image.
- Fuzzy domain methods, which engage the use of knowledge-base systems that are able of mimicking the behavior of a human expert.

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 [1], [8].

IV. PROBLEM IDENTIFICATION

In literature survey part some problems are identified. There are so many area presents in contrast image enhancement using histogram & adaptative histogram equalization such as:

- Amorphous ridges & valley of image
- Low contrast
- Rectangular artifacts
- Undefined boundaries between the ridges
- Under enhancement
- Over enhancement
- Noise removal
- hazy

III. METHODOLOGY

The descriptions of the basic steps of fuzzy image processing are follows:

3.1 Data Collection

Data collection is nothing but collecting those data which will be the input of research process. Data should be collected from real place. In this study the images have been collected from open source .

3.2 Image Acquisition

Image acquisition in image processing can be mostly defined as the accomplishment of retrieving an image from some source. Performing image acquisition in image processing is always the first step in the workflow progression because, without an image, no processing is possible. The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it. In fuzzy image processing, a computer must take the input from the source and provide it in a visible form for the user, a form of processing. The series can also perform activities like improve contrast, remove hazy of the image for added contrast and visibility.

3.3 Fuzzy Image Processing

It is a collection of different fuzzy approaches to image processing. It 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 [3], [4]. The proposed method uses the fuzzy contrast intensification operator to reduce the

fuzziness of the image that results in an increase of image contrast.

Fuzzy image processing has three main stages: image Fuzzification, modification of membership values, and image Defuzzification.

3.3.1 fuzzyfication:

The coding of image data in which image data are transformed from gray-level plane to the membership plane.

I. Set the parameters F_e, F_d and calculate X_{max} .

$$F_e = 2, \quad F_d = \frac{X_{max} - X_{mid}}{0.5^{\frac{-1}{F_e}} - 1}$$

Where F_e, F_d are constants for image Fuzzification, and
X_{max} = Maximum gray value of input image.
X_{mid} = Mid gray value of input image.

3.3.2 modification of membership values :

The main rule of fuzzy image processing is in the middle step, appropriate fuzzy techniques modify the membership values [16]. This can be a fuzzy clustering, a fuzzy rule based approach, and a fuzzy integration approach and so on.

II. Define the membership function for image Fuzzification.

$$\mu_{mn} = G(X_{mn}) = \left[1 + \frac{X_{max} - X_{mn}}{F_d}\right]^{-F_e}$$

Where μ_{mn} is membership function

III. Modify the membership values using contrast intensification operator on fuzzy sets [9].

$$\mu'_{mn} = \begin{cases} 2[\mu_{mn}]^2, & 0 \le \mu_{mn} \le 0.5 \\ 1 - 2[1 - \mu_{mn}]^2, & 0.5 \le \mu_{mn} \le 1 \end{cases} \quad (1)$$

3.3.3 defuzzyfication:

The defuzzyfication is defined as decoding of resulting image after modification of membership values to obtain the output image for clear human perception .

IV. Generate new gray levels by Defuzzification for the generation of Contrast intensified output image.

$$g'_{mn} = G^{-1}(\mu'_{mn}) = X_{max} - F_d\left((\mu'_{mn})^{\frac{-1}{F_e}}\right) + F_d \quad (2)$$

In this research firstly contrast of an image has been decreased for experiment of find out good quality image, for this fuzzy based contrast intensification operator is used. The resulting images are shown below:

Fig 3(a): Input image

Fig 3.(b): fuzzy contrast intensified image

Fig 3.(c) contrast intensified image using histogram equalization technique

3.4 Fuzzy logic based contrast intensification operator

A large part of mathematical models are based on a recent extension of the ordinary set theory, namely, the so-called Fuzzy Sets (FSs). FSs were introduced by Lotfi A Zadeh in 1965. Later on, fuzzy linguistic variables find very important place in the area of real life applications. The advantage is crisp variables can be made into fuzzy variables, meaning that problems that are dominated by uncertainty and impreciseness could also be completed using this FSs. Starting from 1985, this theory was further generalized into many-valued logic with the efforts of Lukaiwicz, Gottwald, Post, Godel and so on [8].

The operator contrast intensification, as its name implies, reduces the fuzziness of a fuzzy set A by increasing those of $\mu_A(x)$ which are above 0.5, and deceasing those which are below it. Its definitions on FSs, first and second type fuzzy sets are given in this section.

Definition 5.1 [6]

Let X be a non empty set. A fuzzy set A in X is characterized by its membership function $\mu_A : X \rightarrow [0, 1]$ and $\mu_A(x)$ is interpreted as the degree of membership of element x in fuzzy set A for each $x \in X$. That is, $A = \{(x, \mu_A(x)) | x \in X\}$.

Definition 5.2 [4]

Let *X* be a nonempty set. An fuzzy set (FS) in *X* is defined as an object of the form $A = \{\langle x, \mu_A(x), Y_A(x)\rangle : x \in X\}$, where the fuzzy sets $\mu_A : X \rightarrow [0,1]$ and $\Upsilon_A : X \rightarrow [0,1]$ denote the membership and non-membership functions of *A* respectively, and $0 \leq \mu_A(x) + \Upsilon_A(x) \leq 1$ for each $x \in X$.

Definition 5.3[8]

Let *X* be a nonempty set. A second type IFS *A* in X is defined as an object of the form $A = \{\langle x, \mu_A(x), Y_A(x)\rangle : x \in X\}$, Where the fuzzy sets $\mu_A : X \rightarrow [0,1]$ and $\Upsilon_A : X \rightarrow [0,1]$ denote the membership and non-membership functions of *A* respectively, and $0 \leq \mu_A(x)^2 + \Upsilon_A(x)^2 \leq 1$ for each $x \in X$.

Definition 5.4 [8]

The contrast intensification operator on a first type FS *A* of the Universe *X*, denoted by INTEN(A), is defined as

$INTEN(A) = \{\langle x, \mu_{INTEN\,1}(x), Y_{INTEN\,1}(x)\rangle : x \in X\}$, (3)

where

$$\mu_{INTEN\,1}(x) = 1 - (1 - \mu_A(x)^2)^2 \quad (4)$$

and $$\gamma_{INTEN}(x) = [1 - (1 - \mu_A(x))^2]^2. \quad (5)$$

V.CONCLUSION

The main focus of this paper was the research of fuzzy soft computing based image contrast enhancement technique for efficient image enhancement. While the conventional image enhancement techniques can capable to give image enhancement up to some level but they are not able to provide a good quality improvement due to the vagueness and ambiguity present in images. This problem can be capably handled by fuzzy logic because, fuzzy techniques can deal with the vagueness and ambiguity well, and it has been establish that fuzzy techniques are powerful tools for knowledge representation and processing.

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