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Extracting Deblur Image Using Fuzzy Logic Approach from Impulse Noise in Dip

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***Abstract**: Image processing is very crucial in today world because of various noises, attacks, and many more problem faced by an image from a transmitter to the receiver side. By applying various algorithms and filters we can remove such type of noises and attacks. Blur detection techniques are very helpful in real life application and are used in image segmentation, image restoration, and image enhancement. Blur detection techniques are used to remove the blur from a blurred region of an image which is due to defocus of a camera or motion of an object. Blurring is a form of bandwidth reduction of an ideal image owing to the imperfect image formation process. It can be caused by relative motion between the camera and the original scene, or by an optical system that is out of focus. Deblurring techniques are basically used to sharp an image using different methods & parameters so that we can the abundant amount of knowledge. As we know there are various types of noises occurred in an image and to remove various techniques are used. Every technique is suitable for a particular noise and we cannot apply randomly to remove a particular noise. With advancement of time old technique are replaced by advanced method and today Fuzzy Logic is much more appreciated due to simple logic function and it is fourth generation technique*

Keywords: Deblur, Digitized Image, Fuzzy Logic, Gaussian Noise, PSNR, Membership Function and MSE.

I. INTRODUCTION

A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency, slide, photograph, and chart is first digitized and stored as a matrix of binary digits in computer memory[1-2]. The digitized image can then be processed on a high-resolution television monitor. For display, the image is stored in a rapid access buffer memory which refreshes the monitor at 30 frames per second to produce a visibly continuous display.

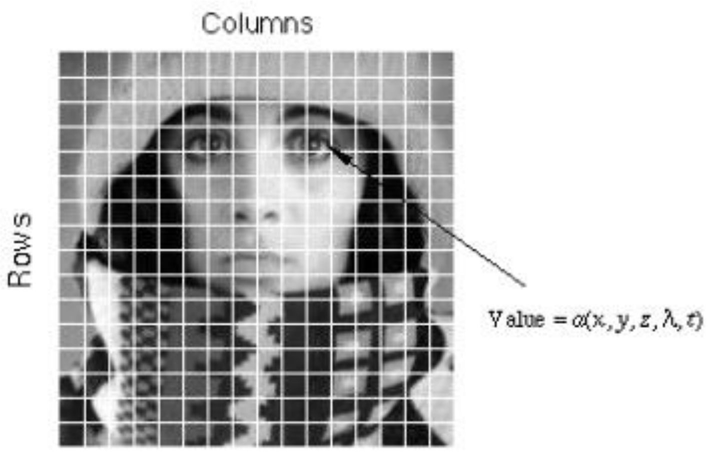

Fig.1 Digitization of a continuous image

From capturing to transmitting and finally in receiving various types of noises added with the original image and due to its lots of important information can be corrupted which would be very useful. Therefore we have a lot of challenging aspect of this problem

in which we have to design different selectively filter to extract important information, such as blur image, without losing significant features or creating false ones [5]. Many nonlinear models have been proposed for this purpose, however, when an image consists of objects of non-uniform intensity or has been degraded by noise. Our goal is to study a new model for image restoration which not only removes noise and retains sharp edges, but also avoids stair casing in what should be smooth regions
The image degradation process can be modeled by the following equation:

$$g=H.f+w$$

Where **H** represents a convolution matrix that models the blurring that many imaging systems introduce. For example, camera defocuses, motion blur, imperfections of the lenses all can be modeled by **H.** The vectors **g**, **f**, and **w** represent the observed, the original and the noise images. More specifically, **w** is a random vector that models the random errors in the observed data [17]. These errors can be due to the electronics used (thermal and shot noise) the recording medium (film grain) or the imaging process (photon noise).
Fuzzy techniques in image processing are a promising research field. Among the different topics, this project will focus on the construction and application of fuzzy filters for image processing. It is well known that fuzzy filters have a more robust performance than classical filters. For example, most classical filters that remove noise simultaneously blur the edges, while fuzzy filters have the ability to combine edge-preservation and smoothing. Compared to other non-linear techniques, fuzzy filters are able to represent knowledge in a comprehensible way [12-14]. Fuzzy techniques have already been applied in several domains of image processing and have numerous practical applications such as in industrial and medical image processing. In this project, we will focus on fuzzy techniques for image filtering.

Fig.2. Blurred and Deblurred Image

II. LITERATURE SURVEY

Fuzzy logic was first introduced in 1965 as a new way to represent vagueness in everyday life [8, 15]. The definition of fuzzy logic as a superset of conventional(Boolean) logic that has been extended to handle the concept of partial truth values between "completely true" and "completely false". By this definition, fuzzy logic departs from classical two-valued set logic. It uses soft linguistic system variables and a continuous range of true values in the interval [0, 1], rather than strict binary values. It is basically a multivalve logic that allows intermediate values to be defined between conventional evaluations like yes/no or true/false**,** etc. Notions like rather warm or pretty cold can be formulated mathematically and processed by computers."

Fuzzy logic is also a structured, model-free estimator that approximates a function through linguistic input/output associations. Fuzzy logic is powerful, yet straightforward, a problem-solving technique with widespread applicability, especially in the areas of control and decision-making [14]. Fuzzy Logic was first invented as a representation scheme and calculus for uncertain or vague notions. It allows more human-like interpretation and reasoning in machines by resolving intermediate categories between notations such as true/false, hot/cold etc used in Boolean logic In this context, Fuzzy Logic is a problem-solving control system methodology that lends itself to implementation in systems ranging from simple, small, embedded micro-controllers to large, networked, multi-channel PC or workstation-based data acquisition and control systems. It can be implemented in hardware, software, or a combination of both. FL provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. FL's approach to controlling problems mimics how a person would make decisions, only much faster. In general, fuzzy logic is most useful in handling problems not easily definable by rigorous mathematical models. FL is capable of additional benefits of Fuzzy Logic include its simplicity and its flexibility. Fuzzy Logic can handle problems with imprecise and incomplete data, and it can model nonlinear functions of arbitrary complexity. "If you don't have a good plant model, or if the system is changing, then fuzzy will produce a better solution than conventional control techniques." Fuzzy logic derives much of its power from its ability to draw conclusions and generate responses based on the vague, ambiguous, qualitative, incomplete, or imprecise information. In this respect, fuzzy-based systems have a decision reaching similar to that of humans [11-14]. In fact, the behaviour of a fuzzy system is represented in a very simple and natural way which allows quick construction of an understandable, maintainable, and robust system. In addition, a fuzzy approach generally requires much less memory and computing power than conventional methods, thereby resulting in a smaller and less expensive system [26]. Fuzzy logic has many applications such as:

1. A control system (Robotics, Automation, Tracking, and Consumer Electronics).

2. Information systems(DBMS, Information retrieval)
3. Pattern recognition (Image Processing, Machine Vision).
4. Decision support (Sensor Fusion).

FL offers several unique features that make it a particularly good choice for many control problems.

1) It is inherently robust since it does not require precise, noise-free inputs and can be programmed to fail safely if a feedback sensor quits or is destroyed. The output control is a smooth control function despite a wide range of input variations.

2) Since the FL controller processes user-defined rules governing the target control system, it can be modified and tweaked easily to improve or drastically alter system performance. New sensors can easily be incorporated into the system simply by generating appropriate governing rules.

3) FL is not limited to a few feedback inputs and one or two control outputs, nor is it necessary to measure or compute rate-of-change parameters in order for it to be implemented. Any sensor data that provides some indication of a system's actions and reactions is sufficient. This allows the sensors to be inexpensive and imprecise thus keeping the overall system cost and complexity low.

4) Because of the rule-based operation, any reasonable number of inputs can be processed (1-8 or more) and numerous outputs (1-4 or more) generated, although defining the rule base quickly becomes complex if too many inputs and outputs are chosen for a single implementation since rules defining their interrelations must also be defined. It would be better to break the control system into smaller chunks and use several smaller FL controllers distributed on the system, each with more limited responsibilities.

5) FL can control nonlinear systems that would be difficult or impossible to model mathematically. This opens doors for control systems that would normally be deemed unfeasible for automation.

III.PLANNING OF WORK/METHODOLOGY

Fuzzy logic is also a structured, model-free estimator that approximates a function through linguistic input/output associations. Fuzzy logic is powerful, yet straightforward; problem-solving technique with widespread applicability, especially in the areas of control and decision-making [24]. Fuzzy Logic was first invented as a representation scheme and calculus for uncertain or vague notions. It allows more human-like interpretation and reasoning in machines by resolving intermediate categories between notations such as true/false, hot/cold etc used in Boolean logic In this context, Fuzzy Logic is a problem-solving control system methodology that lends itself to implementation in systems ranging from simple, small, embedded micro-controllers to large, networked, multi-channel PC or workstation-based data acquisition and control systems. It can be implemented in hardware, software, or a combination of both. FL provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. FL's approach to controlling problems mimics how a person would make decisions, only much faster

Fuzzy Operation: FL requires some numerical parameters in order to operate such as what is considered significant error and significant rate-of-change-of-error, but exact values of these numbers are usually not critical unless very responsive performance is required in which case empirical tuning would determine them.

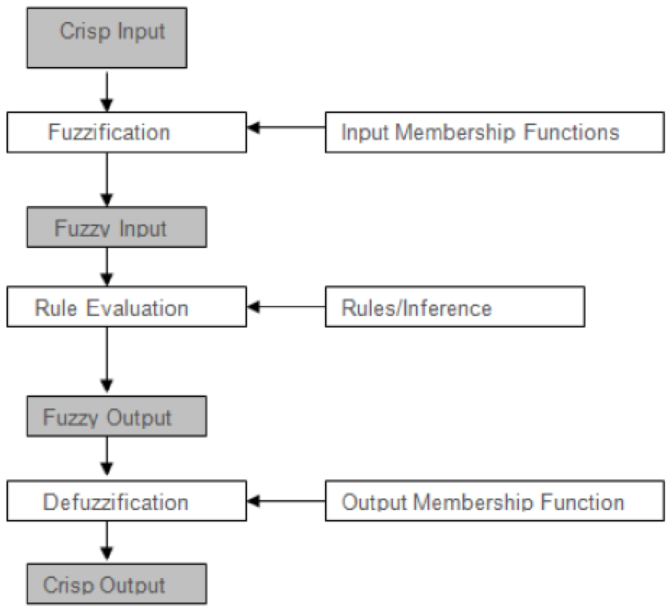

Fig3. Fuzzy Logic Operation

Membership Functions: The membership function is a graphical representation of the magnitude of participation of each input. It associates a weighting with each of the inputs that are processed, defines the functional overlap between inputs, and ultimately determines an output response. The rules use the input membership values as weighting factors to determine their influence on the fuzzy output sets of the final output conclusion. Once the functions are inferred, scaled, and combined, they are defuzzified into a crisp output which drives the system.

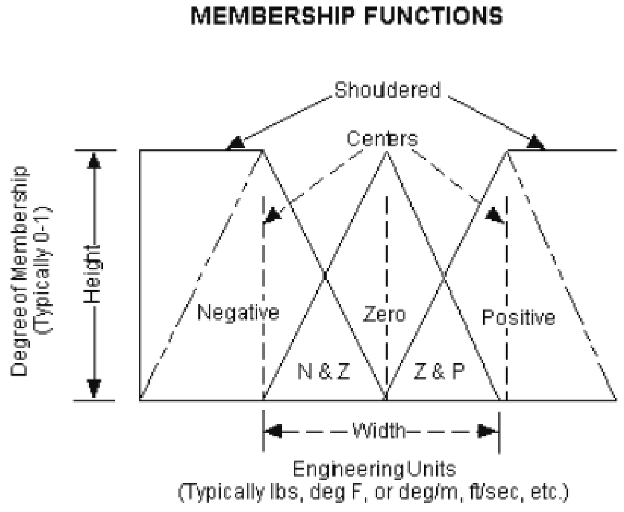

Fig.4 Membership functions (UOD versus membership grade)

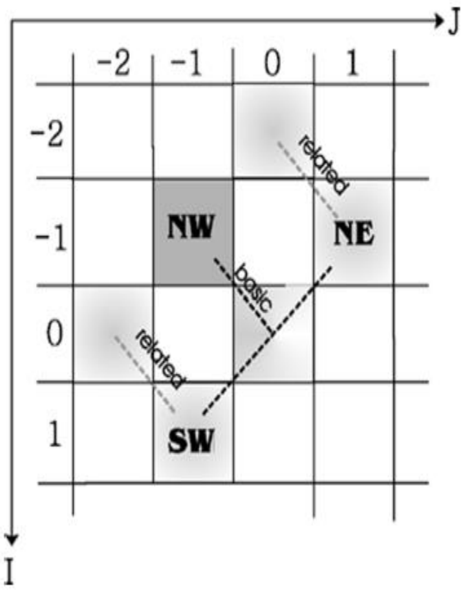

Fig.5 Involved centers for the calculation of the related gradient values in the NW direction

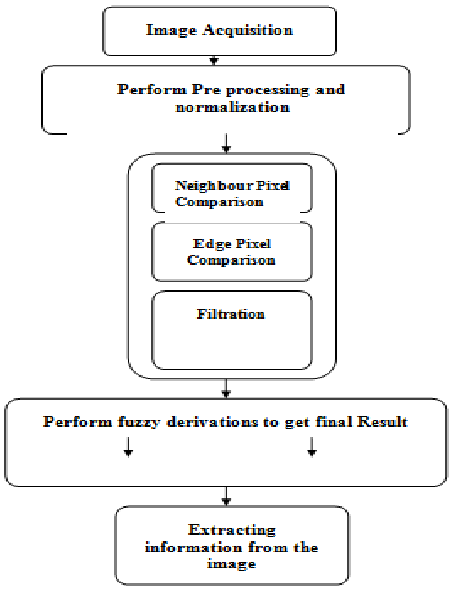

Fig. 6 Fuzzy Approach Flow Chart

IV. SOFTWARE USED AND SIMULATION RESULT

Software: MATLAB Version R2015a: It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

Using MATLAB, you can solve technical computing problems very easily and time-saving as compared to traditional programming languages, such as C, C++, and FORTRAN. The name MATLAB stands for Matrix laboratory.

In our research work simulation result are depicted below as:

Fig.7 Original image

Fig.8 Blur image

Fig.9 Deblurring with undersized PSF

Fig.10 Deblurring with oversized PSF

Fig.11 Deblurring with INITPSF

Fig.12 Deblurred Image

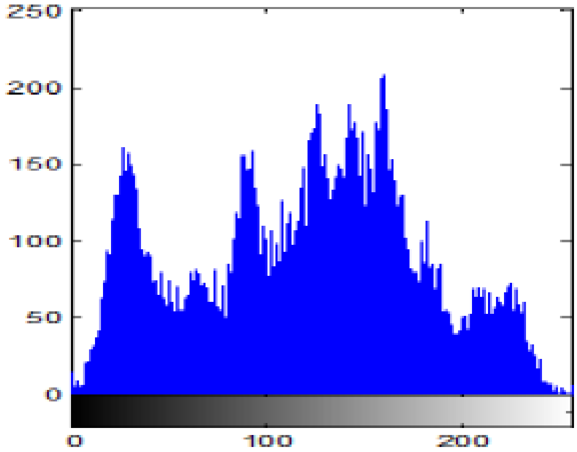

Fig. 13 Histogram of Image

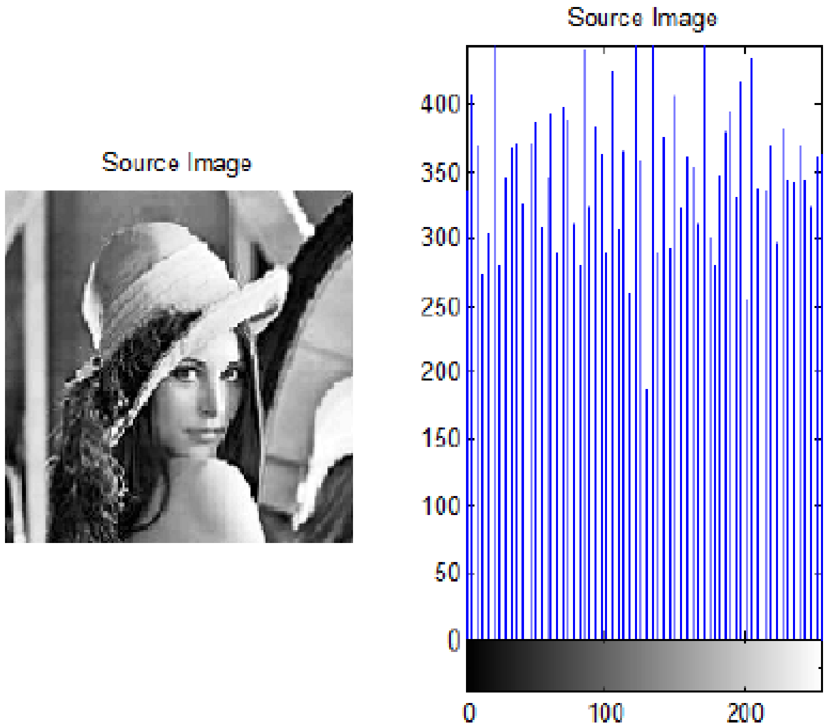

Fig. 14 Result image

PSNR	**31.67**
MSE	6.72

CONCLUSION

There are various types of images and various types of noises and when there is an exchange of information via any mode then various noises came into existence. Our researchers focused on Gaussian blur suppression from images. A new two-step filter which uses a fuzzy detection and an iterative filtering algorithm have been presented and this filter is specially developed for reducing all kinds of blur. Its main feature is that it leaves the pixels which are noise-free unchanged. Experimental results show the feasibility of the new filter. Numerical measures such as PSNR and visual observations show convincing results for grayscale images. But the filter does not give a good result for the Gaussian blur. Finally, this new method is easy to implement and has a very low execution time. To conclude this thesis, following are some points that may lead to some better and interesting results. In this thesis, blur image detection is mostly covered and for noise filtration, an iterative filtering algorithm is used. Future scope of this dissertation could lead to better and more robust filtration techniques. This technique together with the best detection technique can result in optimal restoration of the degraded image. Besides this using ANN we can also deblur noise from the image.

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