Volume 4, Issue 4, April 2014 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Process of Blurring and Noise Removal using Fuzzy Technique

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Abstract—The main cause of blurring in digital images occurs during image acquisition (digitization) or transmission. When we acquire images with a camera, the light levels and sensor temperature affects the amount of blurring in images. Images are also corrupted during transmission due to interference in the channel. For example, when we transmitted an image using a wireless network might be corrupted as a result of light level or other atmospheric disturbance. Blur was implemented by first creating a point-spread function (PSF) filter using in MatLab which is approximate to linear motion blur. This PSF was involved with the original image to produce the blurred image. Convolution is a mathematical process to find the resulting signal, in the case the image filtering. The amount of blur added in original image depended on two parameters of the PSF such as length of blur (in pixels), and the angle of the blur (in pixels). This Paper work is providing a new, faster, and more efficient noise removal method for images corrupted with blur. This new filter has two phases: first one is detection phase and second one is the filtering phase. The first phase uses fuzzy rules to found whether an image is blurred or not. If blurry image is detected then we use fuzzy filtering technique on the blurred pixels.

Keywords— Image processing, fuzzy logic, impulse noise, noise reduction method.

I. INTRODUCTION

The process of receiving and analyzing visual information by digital computer is called digital image processing. The first applications of digital images were in the newspaper industry, when pictures were sent for first time via submarine cables from London to New York. A digital image is a collection of real or complex numbers denoted by a finite number of bits. The term digital image processing refers to processing of a two dimensional picture or data by a digital computer. The main source of noise and blurring in digital images occurred during image acquisition or transmission. The image performance is affected by a variety of factors, such as the environmental condition and checking the quality of the sensing elements themselves during image acquisition. During image acquisition using a camera, light levels and sensor temperature are major factors affecting the amount of blur and noise in an image.

II. DETECTION AND FILTERING ANALYSIS

Noise is quantified by the percentage of corrupted pixels within images. These corrupted pixels are either set to be maximum value or set to single bits flipped over image. In some cases, single pixel is set either zero or maximum value. This filter has two phases: first one is detection and second is filtering phase. The detection phase uses set of fuzzy rules to decide whether a pixel is corrupted with impulse noise (salt and pepper noise) or not. When impulse noise is detected, some parameters will be determined which will be passed to the second (filtering) phase. After this detection, the fuzzy filtering method focuses only on the real noisy pixels.

A digital image discussed in a 2D discrete space which is derived from 2D analog image through a sampling process that is referred to as digitization. This analog image a(x, y) is divided into numbers of rows and columns. The pixel values represents the intersection of row and a column in image is which is assigned for integer coordinates [m, a(x, y)n] with {m=0,1,2,...,M-1} and {n=0,1,2,...,N-1} is image a[m, n]. Most of the cases a(x, y) which we might considered as the physical signal that impinges on the face of a 2D sensor is actually a function of many variables including depth (z), color (λ), and time (t). In the case of rectangular sampling, some of the most common neighborhoods are the case of rectangular sampling use 4-connected neighborhood and the 8-connected neighborhood and the case of hexagonal sampling use 6-connected neighborhoods. In Image representation one is concerned with the characterization of the quantity that each picture element represents. Sampling and quantization is the fundamental requirement of digital image processing.

III. BACKGROUND OF FUZZY LOGIC

Fuzzy logic was first introduced by Lotfi Zadeh in the 1965, as a new way to represent vagueness in everyday life. The fuzzy logic is a superset of conventional logic that has been extended to handle the concept of partial truth values between true and false. It uses soft system variables and a continuous range of true values between [0, 1], rather than strict binary values. The intermediate values to be defined between conventional evaluations like yes/no or true/false are allowed through fuzzy logic is a multi-value logic. Fuzzy logic is also a structured, straight forward, problem solving technique with wide spread applicability. Fuzzy Logic was first invented as a representation scheme and calculus for uncertain or vague notions. Fuzzy Logic is a problem-solving control system methodology, itself to implementation in

systems ranging from simple, small, networked, multi-channel PC or workstation-based data acquisition and control systems methodology. It can be implemented in both, hardware and software. Fuzzy Logic provides a very simple and definite conclusion based system which are vague, ambiguous, noisy, or missing input information. In general fuzzy logic is an approach use to control problems and take decisions much faster like a human being.

Fuzzy logic is very simple and flexible technique. The behavior of a fuzzy system is represented in a very simple and natural way which allows quick construction of robust and maintainable system. Fuzzy approach requires much less memory and computing power than conventional methods, so resulting in a smaller and less expensive system. Now a day fuzzy logic has many applications such as *Control system* (Robotics, Tracking and Consumer Electronics etc), *Information systems* (DBMS and Information retrieval) and *Pattern recognition* (Image Processing and Machine Vision).

IV. FUZZY FILTERING OF BLURRED IMAGES

After the detection of blurred image traditional tactics the filtering is done, otherwise the image is left unchanged. For this there is need to calculate some parameters which are used to construct the fuzzy set more or less impulse noise. After that the iteration is done for the filtering stage on the basis of membership functions that represents the fuzzy set. To get membership functions are a simplification of the obtained noise histogram. If the membership value higher than threshold value then the image is blurred. For the extreme large value cause wide membership function that results some kind of blurring of the image.

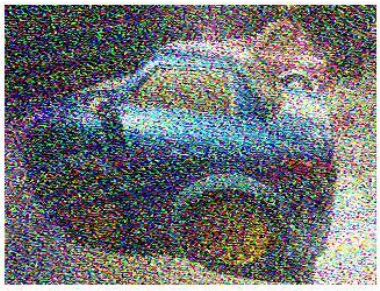
The filtering method is based on the membership function. This is used a 3x3 window around the filtered pixel. If output image is the similar as input image then the filter method is called recursive, otherwise non-recursive.

Algorithm for fuzzy filtering:

(1) First read the noisy image and take membership degree more or less impulse noise for the fuzzy set.
(2) Perform comparison with neighbor pixel in 3x3 windows.
(3) If the blur detected in image, perform the fuzzy filtration
(4) Replace the pixel in window by the fuzzy derived pixels
(5) If there is no blur detected by neighbor comparison then
    a) Perform the edge based comparison within window
    b) If it satisfies then perform fuzzy filtration
    c) Replace the pixel by new fuzzy derived pixels

Fig 1: Original image

Fig 2: Simulate blurred and noise image



(a)

(b)

Fig 3: (a) Restoration of Blurred, Noisy Image Using Estimated NSR, (b) Result after fuzzy filtering

In the filtering step of first iteration is given in the algorithm, based on the membership function. The pixels which are the part of the fuzzy set are blurred have to be filtered, otherwise leave pixels unchanged. A 3x3 window around the

filtered pixel is used to found result. If the output image is the same as the input image then the filter method is called recursive, otherwise non-recursive.

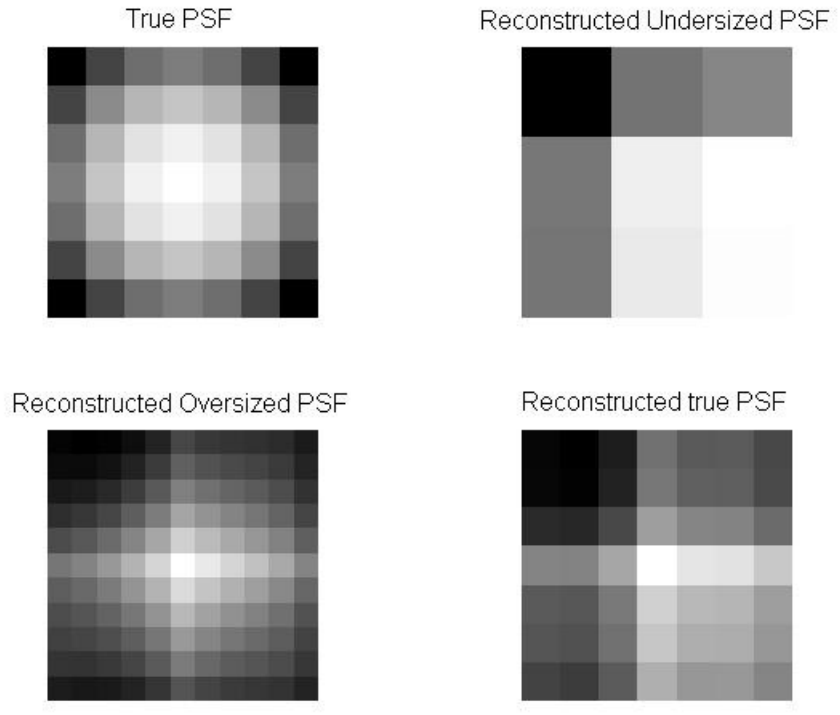


Fig 4: Analyzing the Restored PSF, then maximum values are at the center (white) and minimum at the borders (black).

V. CONCLUSION & FUTURE WORK

In this paper we have successfully shown the process of blurring and noise removal using fuzzy technique. It mainly focuses on impulsive & Gaussian noise suppression from images. These two step filter technique uses fuzzy detection and filtering algorithm for images. This filter is especially developed for reducing all kinds of impulse noise. Its main feature is that it leaves the pixels unchanged which are noise-free. The result of this technique shows the feasibility of new filter. This filter is not efficient for the Gaussian noise. This filter method is easy to implement and has a very low execution time. In this paper we have used fuzzy logic algorithm for noise detection. Further investigation will be carried out to use neural network for detection of noisy pixels in the image and fuzzy logic to remove the detected noise from the image.

ACKNOWLEDGMENT

I would like to thanks all my respected faculties for their assistance and support for writing this paper. Also I would like to thanks the resource provider department for proving different facilities in writing my research work.

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