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Research Article

Image processing application: Overlapping of Images for faster video processing devices

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ABSTRACT
This paper mainly concentrates on the merging and impulse noise removal technique in images. Image fusion is the operation of merging a pair or more images into an individual image while maintaining the main property of each image. Five dissimilar filtering algorithms are used independently for refining the image recorded by the sensor. The filtered images are merged to get a favourable yet more standard image out of independently denoised images. In-order to get higher quality of image with noise withdrawing performance of the proposed merging technique from human's perspective, an edge detection is carried out using a canny filter to the merged image. Any value of salt and pepper noise is reduced by using these five filters. Fact-finding outcome display that this process has the ability of putting together effective outcomes of distinct images into single images. This process is algorithmically straight forward and can be used for merging any number of images and in real time applications too. Image Fusion is a top-tier procedure used in remote sensing, satellite vision, military areas, perfect for the human vision, robotics field and medical applications. In the proposed system, firstly, an image is recorded by a sensor. Secondly, the image is filtered in equivalent five different creamy filters. The denoised images are achieved from five mismatched filters are merged them at third level and in the final level, canny filter is applied to the fusion of recovered image to acquire a giant standard image free from impulse noise. MATLAB tool is used for the implementation of the proposed image fusion technique.

Key Words: Canny Filter, Edge detection, Image Fusion, Impulse Noise Reduction, MSE, PSNR, SNR.

I. Introduction

The existed techniques are the techniques used to remove the impulse noise in which only one individual filter is used at a time those filters are Median filter (MF), Vector median filter (VMF), Basic vector directional filter (BVDF), Spatial median filter (SMF), Modified spatial median filter (MSMF). Which have their utilization in specific domains and know about how they are removed noise from the digital images effectively. MF removes the noise from digital images is more effective and accurate one when any pixel is not represented then there will be no impact on the median value of that pixel. Its applications are reducing the program runtime while maintaining the image details uniformly. The VMF is a noise removal technique which preserves the correlation. It is a high speed processing technique and results in improved noise attenuation with good edge response while having applications in wind velocity fields, colour signals, remote sensing, motion vector field, communications, monitoring systems. BVDF results in being vectors approximately in collinear and preserves the colour chromaticity. Its applications are in satellite image processing, colour image processing, biomedical image processing. SMF is an algorithm of smoothing type that maintains the edges around larger shapes and also enhances or highlights the details in the image. The applications are in enhancement of a photo, in image visualization of medical and in defect detection of industrial works. MSMF is the preprocessing operation of the further processing most suitable filter for the denoising the images its applications are in signal processing and in image processing [1]-[22].

The MF cannot distinguish fine details from noise it is the significant drawback of the MF. VMF has the significant drawback is that it has the high computational complexity. BVDF allows the utilization of gray-scale techniques vastly which results in distortion of a suboptimal filtered estimate. SMF is the easily distorted filter and it is a set of mask neighbours in that it replaces the points which are not the maximum spatial depths. MSMF is the modification of the SMF which give address to the concerns of the SMF [23]-[27].

The proposed design explains about the each filter significantly and it consists of five filters which removes the impulse noise from the digital images

effectively. For these five filters the input is the single image from the sensor. The proposed design mostly describes about the image fusion technique this technique fuses the one or more images and obtain as a single image. The outputs of the five filters are given as input to image fusion and output will be a fused image of those five filtered images. In edge detection techniques, there are number of filters which detect the edges of the image among them canny filter is the most effective filter. The output of the image fusion that is the fused output is given to the canny filter which finally gives the output as the noise free image by detecting the edges of the input image [28]-[31].

The rest of the paper organizes as follows. The section II describes about how the proposed design, the new technique is been designed, section III describes about the standard existing image filtering techniques that is about the individual filters, section IV describes about the image fusion model that is about how the image fusion technique is designed , its functionality and how it is going to work, the section V describes about the experimental results of the proposed methodology is about the results of the new technique, section VI is about evaluation of the proposed image filtering techniques and section VII describes the conclusion and later the references are as follows.

II. Proposed Design for Impulse Noise Removal

In proposed system image fusion technique is used to detach the impulse noise from pictorial graphic such as a digital photograph. Image fusion technique is the process of melding the different photocopy to one photocopy without loss of data and for high quality. MF, VMF, BVDF, SMF and MSMF are refining algorithms are used for penetrating. By using these percolating algorithms, noise from the photocopy is detached. The image from a device which detects has been sent to these five filters at a time as an input and the outputs of the each of five filters are noise free images those are fused into a single image for better appraise of the image, canny filter is used and finally the output is a noise free image [32]-[40].

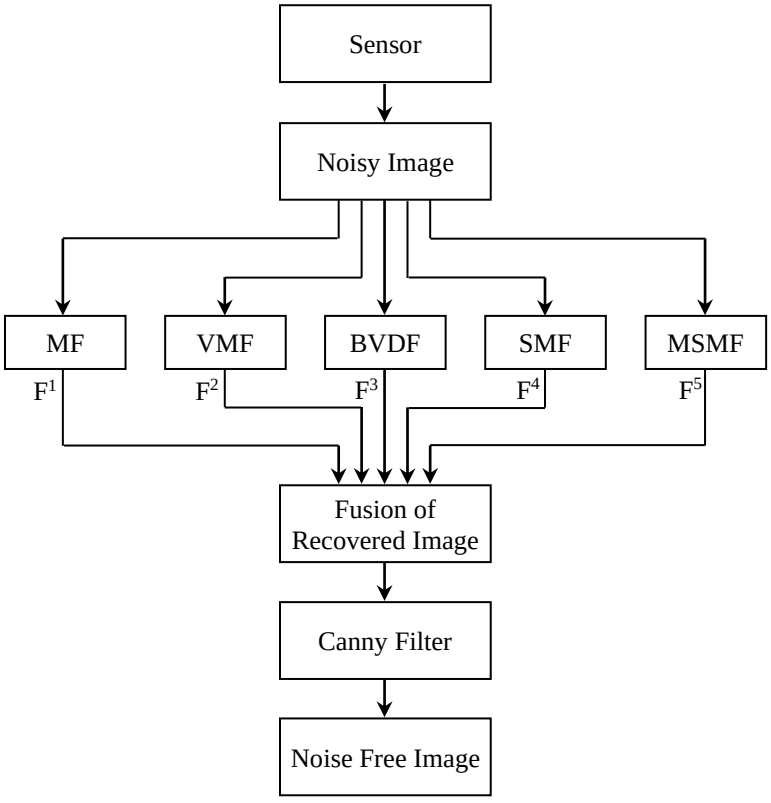


Fig. 1. Block Diagram of Image Fusion.

The image fusion technique is represented as shown in above Fig. 1 and here F^1, F^2, F^3, F^4 and F^5 are the outputs of the filters. Where F^1, F^2, F^3, F^4 and F^5 are the outcomes of MF, VMF, BVDF, SMF and MSMF, respectively.

III. Image Filtering Techniques for De-Noising

Filter is a method which detaches the undesirable components or a distinctive attribute from a wave. Various Standard Image Filtering techniques are existed. Some Filtering techniques are discussed below for the detachment of the unwanted components in a wave or signal.

a. MF

The MF is a non-linear ordered statistic digital filtering method which is normally used to eliminate noise drastically in an image. MF replaces the pixel value with the median of input values, instead of exchanging the pixel value with the mean of adjoining pixel values.

The mathematical equation of median filter is given as follows,

$$Median\ filter(x1, x2, ..., xN) = Median(x1, x2, ..., xN) \quad (1)$$

Where $x1$, $x2$, ..., xN are the values of pixels.

The MF refines the image which contains pixels and its neighbors are utilized to determine whether or not it is characteristic of its environments. The MF exchanges pixel value with the median of input values. The values of each pixel in an image are first sorted into numerical order, then the value of the pixel replaced by the median of the pixel values of an image. The region is referred to as the window. The window can have various shapes centered on the target pixel. If the neighborhood consists of an even number of pixels, the average of the two middle pixel values is the output of the median filter. The median filter is worked using a window which contains an odd number of pixels in an image under the normal circumstances.

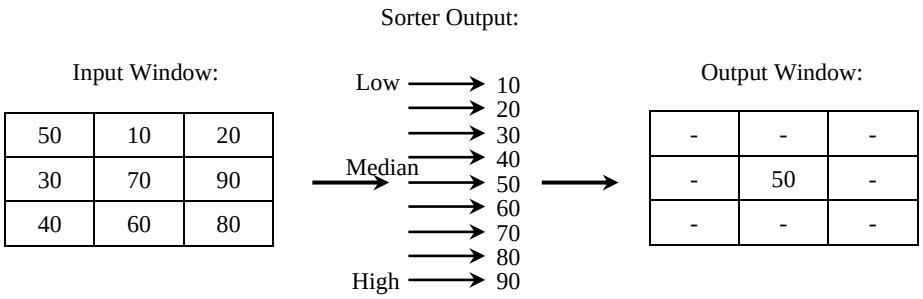


Fig. 2. Graphical depiction of the median filter operation.

The advantage of MF over other rank order filters, especially mean filter, it is an alternatively strong average than the mean value, the abnormal pixel in neighborhoods would not affected by median value.

The median value of the surrounding pixels is most likely to be the value of one of the pixels in the neighborhood within the window. When the filter is working in transition zones the MF is less likely to create new unrealistic pixel. For this cause, the median filtering technique is better than the mean filtering techniques in terms of maintaining sharp edges. It significantly reduces the program running time and also maintains, the better image details.

b. VMF

VMF is introduced for processing vector valued signals having similar properties with the operation of median filters alike zero impulse response and better smoothing ability while maintaining sharp edges in the signal. They are derived as maximum likelihood estimates from exponential distributions and are based on the theory of nonlinear order statistics. It is used in wind velocity fields, colour signals, the scanning of the earth by sunlight, motion estimation process, a system with complex valued signals in transmission, numerous-restricted controlling organizations.

The VMF output is the lowest ranked vector with minimum aggregated distance to the input picture elements present inside the window, thus picture elements which vary greatly from the data population correspond to the maximum aggregated magnitude difference. The mathematical equation of VMF is given as follows,

$$Si = \sum_{j=1}^{N} \|xi - xj\|\gamma \quad (2)$$

Where N means Natural numbers. If $x1$, $x2$, …, represent the picture elements present inside the filtering window W, the vector median is computed as For each vector element xi calculate the sum of distances to all other picture elements which are present inside the filtering window, using the Minkowski metric (either the $L1$ or $L2$ are metric that measures the difference between two vectors) and add them together to get sum of distances Si.Where γ =1 for city block distance (it is the absolute difference between the coordinates of a pair of objects) and γ =2 for Euclidean distance (it is the Straight line from one pixel to another pixel). Find a parameter $m$in such that Smin denotes the minimum Si. Corresponding to Smin, $x$min=(1) represents the vector median xVMF. Therefore $x$min=xVMF.

c. BVDF

BVDF select the vector which is centrally located, without taking magnitudes. From the information set, it results the vector that decreases the total of the intersection together with various vectors. BVDF

implementation can be parallelized with the function of VMF and it results the vector that reduces the total of the areas to the various vectors.

$$y_{BVDF}(n) = X_{(1)}(n) \quad (3)$$

Where n is the no of picture elements, $X_{(1)}(n)$ is the centrally located pixel and $y_{BVDF}(n)$ is the BVDF value of y_n. BVDF is used in the Satellite data acquisition and processing, processing of colour image, image processing of multispectral biomedical.

d. SMF

The SMF is a consistent flat design with the aim of detaching unwanted components and edges of picture element while preserving boundaries around greater configuration. The Spatial Median Refiner and Vector Median Refiner chase a homogeneous design and similar outputs they have. To enhance the best of all the outcomes of the SMF, another parameter will be into use and the laboratory information is shown indicating the quantity of improvement.

$$S_{depth}(X, x1, ..., x_N) = 1 - \frac{1}{N-1}\left\| \sum_{N-1}^{N} \frac{X - x_i}{\|X - x_i\|} \right\| \quad (4)$$

The main design for calculating the Spatial Median of a set of points x1, x2, x3, ..., xN is for every vector x, figure out S, which is a group of the total of the spatial depths from x to each other vector next step is to determine the mostest depth of spatial of this set, Smax. The Smax means the Spatial Median of the group of elements.

f. MSMF

The unfortunate drawback to using Refiner Spatial Median and Vector Median Refiner is the leveling which happens continuously among the picture. In an image, if noise is not present, the original information is detached unwantedly. Loss of data not occurs in MSMF. The MSMF is defined by

$$MSMF(T, x_1, ..., x_N) = \begin{Bmatrix} r_c & c = T \\ r_1 & c > T \end{Bmatrix} \quad (5)$$

Where r_c & r_1 are rank order. After computing the spatial depths between the each point of the mask. The center value of the mask is to be checked whether it is uncorrupted or not. If it is not corrupted then it should not modify. After computing the all the spatial depth values in the mask, those values are to be arranged in the descending order. If there is a noise existence, the point under the center point is replaced by the representative value. The points are moved forward, which are having largest spatial depths in the order set. The smallest spatial depths are being moved to the end of the list after considering the difference between the representatives value to the largest spatial depths. Observing the center point in the spatial order statistic list some smoothing can be dropped.

Let us consider "T" as a parameter (limits are 1 T size of the mask), represents the original points under the mask points which are estimated. In the list as stated earlier, the largest spatial depths are at the beginning. In signal processing the filtering is the fundamental and before further processing it is a preprocessing operation.

IV. Image Fusion Model

The image fusion model is also consist of an important concept along with the five filters and the image fusion is the canny filter which is one of the type among the edge detection filters these filters works on the principle of the edge detection. In this the concept of both canny filter and edge detection is described.

a. Canny Filter

The canny edge detector is greatly used to be the basic design to for finding the boundaries of objects within the image in the production. The image from a device which detects is been send to these five filters at a time as an input and the outputs of the each of five filters are noise free images those are fused to a single image for better appraise of the image canny filter is used and finally the output is a noise free image. Canny edge detector is processed in this way a picture can be smoothed by a Gaussian of two dimensional. One in the indication of x and another in the direction of y. In more situations the calculation of Gaussian of a two dimensional is pricey, so it is approximated by more than one, Gaussians of one dimensional. Consider the gradient of the image. It shows variations in the intensity, which shows the existence of boundaries. It gives two outcomes, x direction inclination and the y direction inclination. Non-maximal suppression: Where the gradient is maximum, edges will occur at points. Therefore, total dots not at a most should be compressed. In order to do this, calculate the weight and direction of the inclination at each picture element. Then check for every picture element if the weight of the inclination is greater at uni pictures element length away in either the negative or the positive direction inclined at right angle to the gradient. If the picture element is not bigger than both, compress it. From central gradient value interpolate gradient value at the dot from gradient values at e, g and h. Repeat in opposite direction suppress if non-maximum.

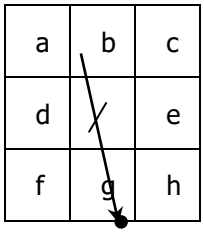


Fig. 3. Pictorial Operation of Canny Edge Detector.

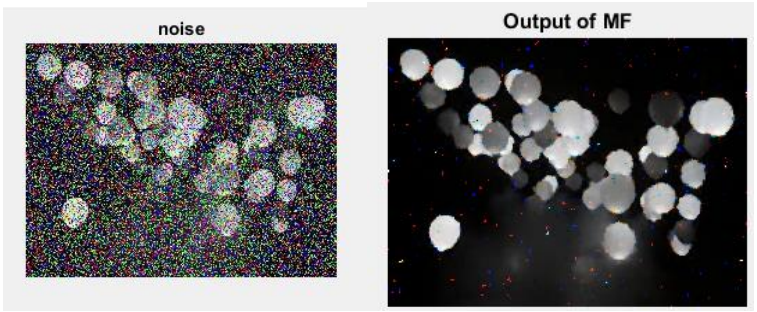
b. Edge detection

The design of edge image segmentation utilized by the Edge Detector of Canny is considered as "hysteresis." It is made to utilize both upper and lower image segmentation. If a picture element has a data crosses the lower image segmentation, it is set as a neighbor of the boundaries picture element and a picture element has a data above the upper image segmentation and is a boundary of picture element. If a picture element has a data above the lower image segmentation, but is not the neighbor of a boundary of picture element, it is not a boundary of picture element. If a picture element has a data below the lower image segmentation, it is not set as a boundary of picture element.

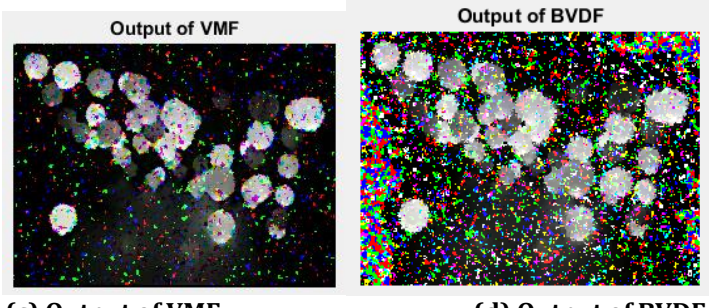
Finally, after applying the canny filter for the fused image it enhances the boundaries of the picture in a way to preserve the data present in the image and at the output end a noise free high quality image is obtained.

V. Experimental Results of the Proposed Methodology

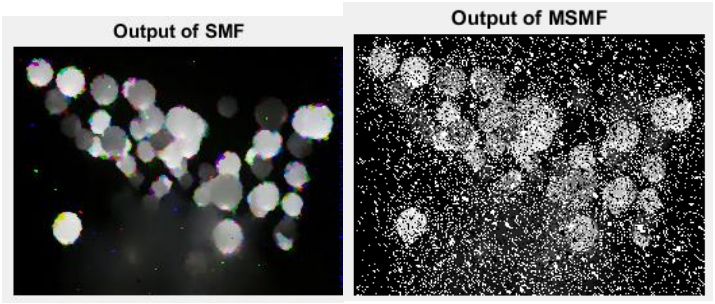
A balloon image (.jpg) is taken as input to that a salt and pepper noise by 0.4% is being added and that image shown in Fig. 5.1(a) is given as input to the MF, VMF, BVDF, SMF, MSMF and the image get processed through these filters and reduces the percentage of the noise in the digital images the outputs are shown below in Figs. 5.1(b)-(f). These five outputs are given to the image fusion it fuses the all five outputs into a single image. This single image is the output of the image fusion and further it is given to the canny filter which detects the edges of the input image.



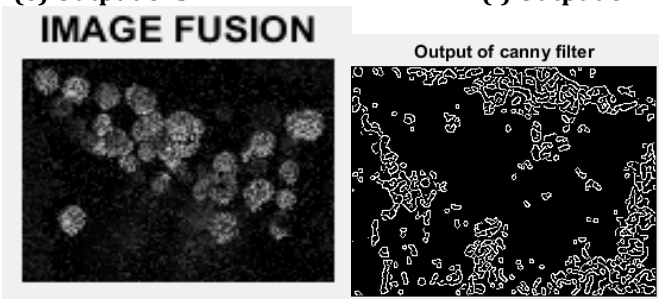
(a) Noisy input **(b) Output of MF**



(c) Output of VMF **(d) Output of BVDF**



(e) Output of SMF (f) Output of MSM



(g) Image Fusion (h) Output of canny filter

Fig. 4. Simulation results of the proposed model.

VI. Evaluation of the Proposed Image Filtering Techniques

The parameters like MSE, PSNR and SNR are being calculated for each filter along with image fusion and are compared as follows:

Table 1. Parameters of Median Filter.

Filter	Parameter		
	MSE	PSNR	SNR
MF	273.32	23.75	13.58
VMF	12845.2	7.03	1.15
BVDF	16613.73	-42.21	0.0189
SMF	11379.75	7.5695	1.6651
MSMF	18733.72	-42.726	-0.5085
IMAGE FUSION	60766.92	-47.84	-1.86

VII. Conclusion

With the exponential evolution in computations and many new technologies and sophisticated imaging techniques have been emerged. Though they prove to best techniques for removal of noise, they come with certain limitations and tend to have bounds of their own which cannot be neglected that easily. This paper aims to create a new technique that bridges the gap between the clear image and a distorted image by emphasizing the information and enhancing the distorted image breaking past the limits of those techniques by alternating and combining those techniques with other turning the disadvantages of one technique into advantages of other emulating one another giving rise to a perfect image. In this paper MF, VMF, BVDF, SMF and MSMF are used. Finally, all the outputs are fused using Image Fusion to acquire single image without information loss. Later it is further subjected to edge detection using Canny filter which preserves information at the edges of the image, and for totally cancelling out the noise from the image. Based on the simulated results provided, our paper stood out with astounding figures that would prove this process to be an excelling process to remove noise.

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