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Efficiency Enhancement of Image Filtering Algorithms in Parallel Environments through Multicore Architecture Optimization

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ABSTRACT: Digital image processing possesses one of the major concerns in the images which is Noise. As such kind of images are considered to be the basis for different kind of purposes either technical or non-technical but the presence of noise inside them could considerably leads to inaccurate results. For the resolution of the same many of the researchers and scholars have proposed techniques to eliminate or perish noise from images completely. The first basic step towards the same thing is the proposal of some filters which were given by some research workers in the same field. But unfortunately, a very high density of the noise among these filters lead to failure of such filters. This dissertation has focused on removing the high-density Salt and Pepper noise from color and grey scale images along with the evaluation of the performance of different median based filters. This thesis work has considered traditional median, relaxed median, PSMF filters for the removal of noise from the images. We have also implemented these algorithms in the parallel environment thereby reducing the execution time of their implementation. By making the use of image processing toolbox all the experiments have been done by implementing the above-mentioned filters in the MATLAB. After the implementation of the three filters, it has been shown that Modified Progressive Switch Median Filter is far better as compared to the traditional filters in the terms of the certain parameters like Mean Square error, Peak Signal to Noise Ratio, Mean Difference and Maximum Difference. Also the comparison has been done in terms of the parallel implementation of the algorithms.

I. INTRODUCTION

1.1 Image Processing

To enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-to-day life for various applications the technique of Image Processing is used. During the last four to five decades various techniques have been developed in the field of Image Processing. Majority of them are developed for enhancing images obtained from military reconnaissance flights, unmanned spacecrafts and space probes. Powerful personnel computers, large size memory devices, graphics software etc. and their easy availability are the major factors behind the popularity of Image Processing systems. Some of the common steps in image processing are interpretation, image scanning, storing and enhancing. Following are some specific areas where image processing is required. [20]

- Various Optical imaging (cameras, microscopes),
- Imaging in the Medical Field (CT, MRI, ultrasound, diffuse optical, advanced microscopes)
- Different Astronomical imaging (telescopes)
- Hyper spectral imaging and Radar (surveillance and remote sensing)
- Printing (color, dot matrix)
- Video and Imaging Compression (JPEG, MPEG, HDTV)
- Computer vision (robots, license, tracking human motion)
- In the field of Computer graphics specifically rendering and shading, representation
- Commercial software (Photoshop)
- Hardware (FPGA, DSP, cell processor implementation of compute intensive algorithms)
- Security and Digital Rights Management (watermarking, biometrics)
- Automatic Visual Inspection System
- Biomedical Imaging techniques
- Defence surveillance
- Moving object tracking
- Intelligent Transportation Systems

1.2 Parallel Computing

Parallel computing is the simultaneous use of multiple compute resources to solve a computational problem:

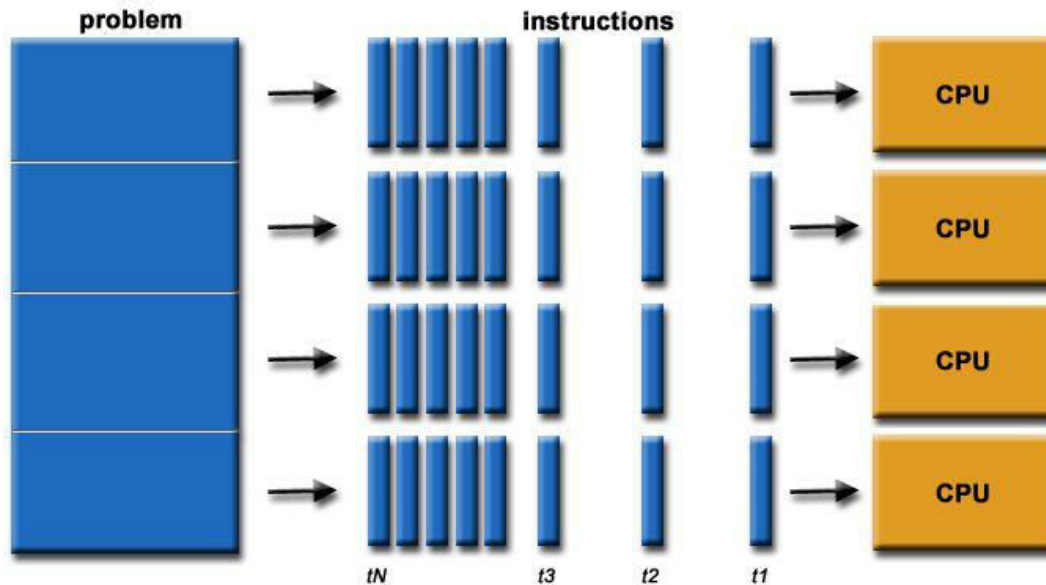


Fig 1.17-Diagrammatic representation of parallel computing

- A problem is broken into discrete parts that can be solved concurrently
- To be run using multiple processors
- Each part is further conked out down to a series of instructions
- Instructions from each part execute at the same time on dissimilar processors
- An overall control/coordination mechanism is engaged

II. LITERATURE SURVEY

Arpit Singhal et al (2021) [26] presented a technique for removal of speckle noise presented in images and then to obtain the useful edges in the output image obtained after noise removed using mathematical morphology. Mathematical morphology is a new subject established based on rigorous mathematical theories. In the basis of set theory, mathematical morphology is used for image processing, analyzing and comprehending. In the MM theory, images are treated as sets and morphological transformations which derived from Minkowski addition and subtraction are defined to extract features in images. Mathematical morphology is one of the structures for designing the nonlinear filters Morphological filters are nonlinear signal transformations that an image is probed by a structuring element which interacts with the image in order to extract useful information about the geometrical structure of the image and achieve the goal of preserving thin features while removing noise. It is a powerful tool in the geometric morphological analysis and description. This technique is used even for the purpose of edge detection to find the discontinuities in the depth. Various mathematical morphological operations are used for edge detection and enhancement. On the basis of experimental results, the author has proved that as compared to other existing techniques the peak signal to noise ratio is more while the root mean square error of the proposed technique is less.

Ayushi Jaiswal et al (2019) [1] invented a technique in which the image denoising is performed using thresholding methods which means find appropriate value which separates noise values to actual image values without affecting the significant features of the image. In this technique first poison noise is removed by median filter; and then removed by wiener filter, second noisy image is denoised with the help of wavelet-based techniques using thresholding, third thresholding is applied on the result of first and second simultaneously for image denoising and fourth various parameters are calculated for checking out the performance. In this technique filtering is performed on noisy image than soft and hard thresholding is performed and found the best threshold then finally we combine the result of filtering method and hard thresholding. The author has shown that during examining several techniquesweiner filtering method

and wavelet thresholding technique jointly gives good agreement of peak signal to noise ratio and mean square error than other..

Chandra Sekhar Panda et al. (2020) [18] suggested different low pass filtering schemes for restoring the gray scale image corrupted by Salt & Pepper noise. The filtering methods with different window sizes were applied to corrupted images with varying strengths and different noise probability. The author has proposed both subjective and objective methods to evaluate the performance of different filtering techniques for noise removal with an aim to find an efficient filter which will be suitable for real time image restoration applications. Subjective methods have been performed by visually comparing the different restoration characteristics in the output image. The mean square error, signal to noise ratio, peak signal to noise ratio and signal to noise ratio improvement have been used for objective evaluation of the different filtering schemes. The subjective evaluation of restoration performance show that median filter with 3X3 window and rank order filter with 5X5 window exhibit better cleaning of noise along with high image restored quality from corrupted image as compared to the average filter with 5X5 window. The o evaluation has shown that the mean square error for median and rank order filter is very low as compared to average and outlier filter. For median and rank order filter the SNR, SNRI, and PSNR values are very high as compared to average and outlier filter. [8]

DENG Xiuqin et al. (2020) [7] has presented anew adaptive weighted median filtering algorithm which intended at the excellence and inadequacy of the conventional median filtering algorithm. The author has shown the advantage of large window filtering and small window filtering as well as center weighted median filtering algorithm first determines noise points in image through noise detection, then adjusts the size of filtering window adaptively according to number of noise points in window, the pixel points in the filtering window are grouped adaptively by certain rules and gives corresponding weight to each group of pixel points according to some similarity, Finally the noise detected are filtering-treated by means of weighted median filtering algorithm. The result of computer simulation experiment indicates that the new algorithm can not only filter off noise effectively, but also favorably reserve image details. The contradiction between noise depression and detail preserving to a big degree has alleviated because of the approach to self-adjust the size of the filtering window and give

III. PROBLEM DESCRIPTION

As we know the importance of the Digital image processing in our daily lives especially when we make the use of various images for the technical or non-technical fields and different medical diagnostics. So the clarity of such kind of images is the utmost priority. These images get corrupted due to the presence of noises in them. Various techniques have been proposed in the same field. The survey has shown that the traditional filters has shown very effective for low density of noise but fails for high density of noises This dissertation has focused on evaluating the performance of different median and mean based filters for removing the high-density Salt and Pepper noise from color and grey scale images. Traditional filters are very effective for low density of noise but fails for high density of noises. Various filters have been proposed so far for removal the high density of noise. This dissertation has evaluated the performance of different filters for removing the high-density Salt and Pepper noise from color and grey scale images. This work has considered traditional median, relaxed median, PSMF filters. Experiments have been done by designing the given filters in MATLAB using image processing toolbox. Comparative analysis among the selected filters has shown that the PSMF is quite effective among others. Different performance parameters will also be considered to enhance the results further.

3.1 Objectives: -

1. Implementing the three existing techniques on a particular image for removing the noise and thus increasing the image quality.
2. The overall objective is to reduce the computational time taken by the three techniques for performing the image filtering.
3. MATLAB tool will used to design and implement the proposed work by using image processing toolbox.
4. The comparison among existing median filter techniques will also be drawn by taking some image performance parameters like PSNR, MSE, Mean Difference etc.

3.2 Proposed Methodology: -

Following is the step by step methodology that would be followed to implement multi core processors on sequential image filtering algorithms:

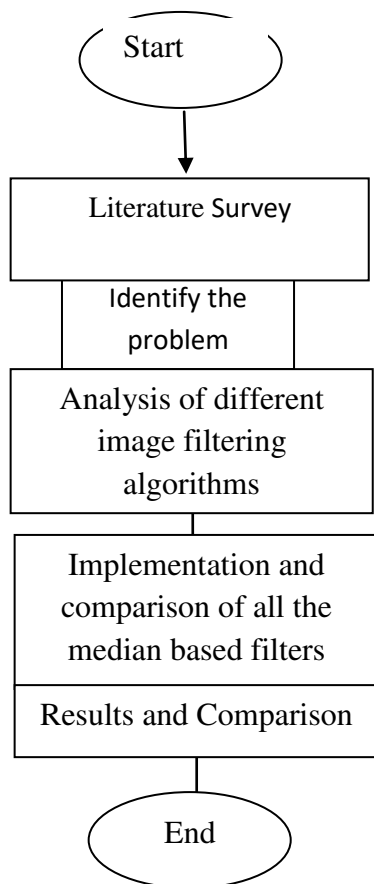


Fig 3.1: - Flowchart of methodology

IV. PERFORMANCE ANALYSIS

4.1.4.1 MEAN SQUARE ERROR

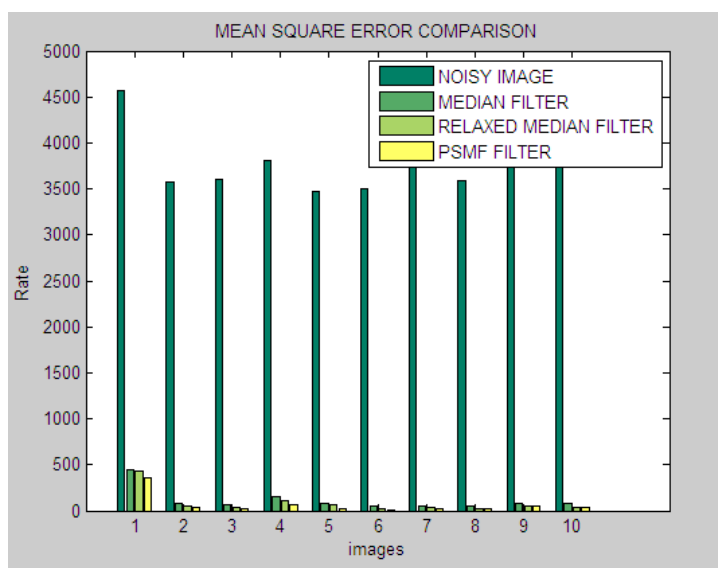


Fig 4.1:- Mean Square Error Evaluation

4.1.4.2 PSNR COMPARISON

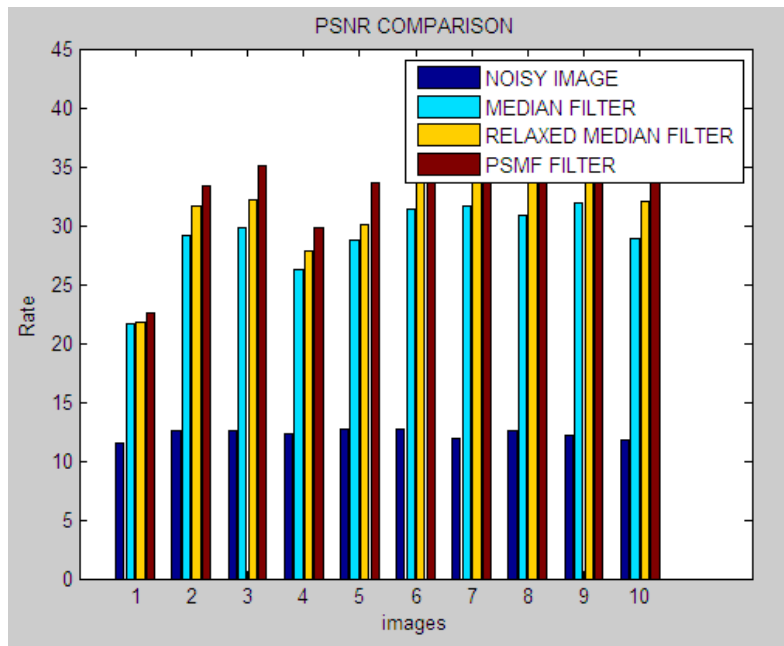


Fig 4.2:- PSNR evaluation

4.1.4.3 MAXIMUM DIFFERENCE EVALUATION

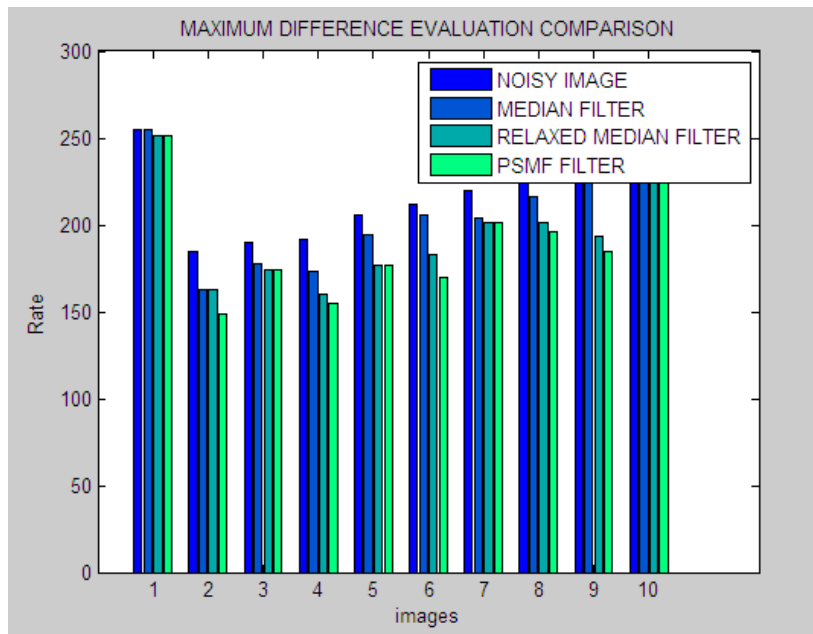
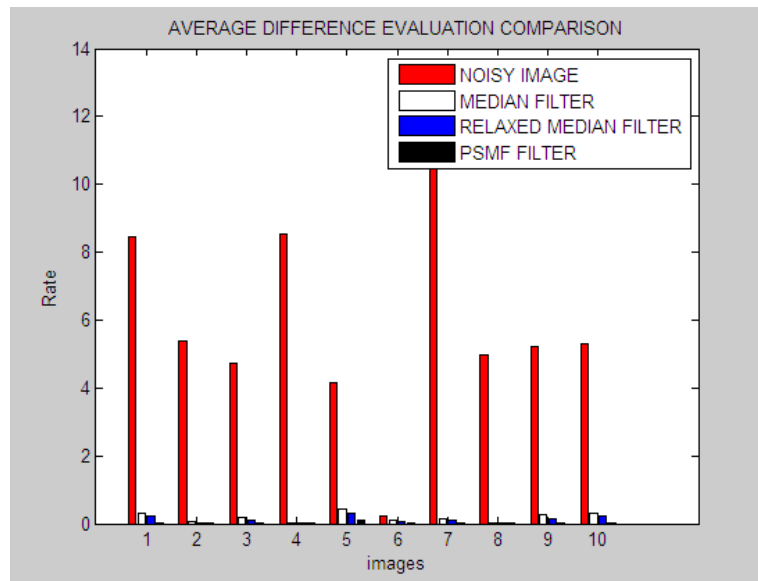


Fig 4.3:- Maximum Difference Evaluation

1.1.4.4 AVERAGE DIFFERENCE EVALUATION



V. CONCLUSION AND FUTURE WORK

When we try to remove the noise from any image so as to remain close to the original image then that process is called as Digital Image processing. The implantation of this process is mandatory because we need to stick to the ground truth image. The noise is an eminent deprivation influence that is restrained as unsolicited/unrelated material existing in the digital image. Numerous median based filters have been projected for the filtering of the noisy images polluted by salt and pepper noise. In case of high noise density the progressive switching median filter based algorithm eliminates impulse noise even and produce better results over available filters but it does not preserve edges or boundaries of the digital images. This work has considered traditional median, relaxed median, PSMF filters. Experiments have been done by designing the given filters in MATLAB using image processing toolbox. By comparing the three filters PSMF filter is found to be the most effective filter but yet in certain parameters relaxed median filter give better results. Further the computational time taken by these algorithms is improved upto a great extent by running them on the parallel platform using MATLAB image processing tool. In near future we will modify PSMF based filtering technique further by using fuzzy set theory to evaluate the best alternative to replace the noisy pixel value.

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