Empirical Analysis of Denoising Techniques in Video Processing

R.Revathi[1], *M. Hemalatha*[2]

Abstract

Video broadcast plays a very vital role in traffic applications. Existence of Noise in the video frames conceals essential details. It negotiates with intensity of quality of images in the video frame. So, it is crucial to eliminate the noise from video frames. Removal of noise is one of the pre-processing tasks in several video processing techniques. Numerous researchers work on different types of filters used to remove different types of noises from video frames. There are some traditional filters, some filters derived from traditional filters and some filters are new innovations. In this proposed method we adapted the spatial video denoising methods, where noisy image are applied to each frame individually. Since there is a immense deal of eliminate noise from video content, this paper has been devoted to noise detection and filtering technology with the aspire of eradicate unwanted noise without affecting it negatively the clarity of scenes that contain necessary detail and rapid motion. In this proposed work we made a survey on different denoising filters and concluded which works better among all..

Keywords:
Image Processing, Video Processing, Denoising and Filters

1 Research Scholar, Karpagam University, Coimbatore, TamilNadu, India s.revathisenatha@gmail.com
2. Head Dept of Software Systems, Karpagam University, Coimbatore, TamilNadu, India. hema.bioinf@gmail.com

I. Introduction

Image processing is a process to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. Some type of signal allowance in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Generally Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them [1].

Image Processing forms research area in engineering and computer science disciplines too.

Image processing includes the following three steps.

Importing the image with the help of optical scanner or by digital photography[1].

Data compression and image enhancement and spotting patterns are analyzed and manipulating the image that are not to human eyes like satellite photographs [1].

Output is the last stage in which result can be altered image or report that is based on image analysis[1].

II. Purpose of Image Processing:

The purpose of image processing is divided into 5 groups. They are:

Visualization - The objects are observed which are not visible [1].

Image sharpening and restoration - To generate a better image [1].

Image retrieval - Seek for the image of interest [1].

Measurement of pattern – Measures various objects in an image [1].

Image Recognition – Distinguish the objects in an image.

Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction [1].

III. Applications

Intelligent Transportation Systems – This technique can be used in Automatic number plate recognition and Traffic sign recognition [1].

Remote Sensing – For this application, sensors capture the pictures of the earth's surface in remote sensing satellites or multi – spectral scanner which is mounted on an aircraft. These pictures are processed by transmitting it to the Earth station. Techniques used to interpret the objects and regions are used in flood control, city planning, resource mobilization, agricultural production monitoring, etc [1].

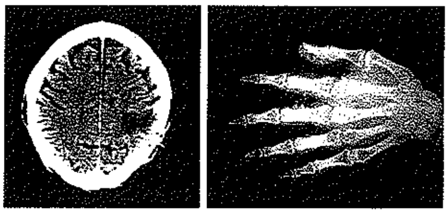
Moving object tracking – This application enables to measure motion parameters and acquire visual record of the moving object. The different types of approach to track an object are:

Motion based tracking

Recognition based tracking

Defense surveillance – Aerial surveillance methods are used to continuously keep an eye on the land and oceans. This application is also used to locate the types and formation of naval vessels of the ocean surface. The important duty is to divide the various objects present in the water body part of the image. The different parameters such as length, breadth, area, perimeter, compactness are set up to classify each of divided objects. It is important to recognize the distribution of these objects in different directions that are east, west, north, south, northeast, northwest, southeast and south west to explain all possible formations of the vessels. We can interpret the entire oceanic scenario from the spatial distribution of these objects [1].

Biomedical Imaging techniques – For medical diagnosis, different types of imaging tools such as X-ray, Ultrasound, computer aided tomography (CT) etc are used. The diagrams of X- ray, MRI, and computer aided tomography (CT) are given below.



Some of the applications of Biomedical imaging applications are as follows:

Heart disease identification– The important diagnostic features such as size of the heart and its shape are required to know in order to classify the heart diseases. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images [1].

Lung disease identification – In X- rays, the regions that appear dark contain air while region that appears lighter are solid tissues. Bones are more radio opaque than tissues. The ribs, the heart, thoracic spine, and the diaphragm that separates the chest cavity from the abdominal cavity are clearly seen on the X-ray film [1].

Digital mammograms – This is used to detect the breast tumors. Mammograms can be analyzed using Image processing techniques such as segmentation, shape analysis, contrast enhancement, feature extraction, etc [1].

Automatic Visual Inspection System – This application improves the quality and productivity of the product in the industries.

Automatic inspection of incandescent lamp filaments – This involves examination of the bulb manufacturing process. Due to no uniformity in the pitch of the wiring in the lamp, the filament of the bulb gets fused within a short duration. In this application, a binary image slice of the filament is created from which the silhouette of the filament is fabricated. Silhouettes are analyzed to recognize the non uniformity in the pitch of the wiring in the lamp. This system is being used by the General Electric Corporation[1].

Automatic surface inspection systems – In metal industries it is essential to detect the flaws on the surfaces. For instance, it is essential to detect any kind of aberration on the rolled metal surface in the hot or cold rolling mills in a steel plant. Image processing techniques such as texture identification, edge detection, fractal analysis etc are used for the detection [1].

Faulty component identification – This application identifies the faulty components in electronic or electromechanical systems. Higher amount of thermal energy is generated by these faulty components. The Infra-red images are produced from the distribution of thermal energies in the assembly. The faulty components can be identified by analyzing the Infra-red images [1].

IV. Video Processing

Video processing uses hardware, software, and combinations of the two for suppression the images and sound recorded in video files. General algorithms in the processing software and the peripheral equipment allow the user to perform editing functions using various filters. The most wanted things can be shaped by suppressed frame by frame or in larger batches.

Video files are obtained from the recording device using a universal standard bus (USB) cable or fire wire attachment. The records are then full into a computer software program or peripheral device. Most computers used personal come with software that allows the user to accumulate images and videos, change images, and create videos on a incomplete level. Storyboards allows the adding together of audio files and the alteration of chart images, transitions, and audio files, which, together, determine the overall length of the video. Videographers, electrical engineers, and computer science professionals use programs that are capable of a wider range of functions. Signal processing frequently involves applying a combination of pre filters, intra filters, and post filters [2].

Video Processing used in Research Areas:

Now-a-days many researches focuses on applying image/ video processing techniques, like recognition of pattern and various signal processing techniques, to work out definite problems in real-world applications.

In an application is the computerized age-assessment of skeletal babies development, children and young adults, using X-rays of the human hand. A mismatch of the skeletal age with the biological age indicates growth abnormalities, and thus serves as good diagnostic tool for a number of diseases. New methods for matching the patterns were developed to create algorithms for the evaluation of the skeletal age of the patient.

Though the image processing tribulations carry over to video processing, but exaggerated by the larger data sizes and the new dimension of time and motion. We have developed video segmentation techniques will open the door to some type of divide-&-conquer advance to many of the video processing problems.

V. Video Denoising:

Video denoising is the process of extracting the noise from a video signal. Video denoising methods can be divided into spatial, temporal and spatio-temporal. Spatial video denoising method is adopted in this paper. In this method image noise reduction is applied to each frame of a video individually. Images are frequently corrupted by noises. Noises occur during image capture, transmission, etc. [3] The most important process in video processing is Noise removal. In this the results of the noise removal have a strong control on the quality of the video processing technique. Various techniques for noise removal are well expanded in color image processing.

The nature of the noise removal problem depends on the kind of the noise corrupting the image. In the field of image noise reduction several linear and non linear filtering methods have been projected. Linear filters are not able to efficiently eradicate impulse noise as they have a propensity to blur the edges of an image. On the other hand non linear filters are suitable for dealing with impulse noise. Several non linear filters based on Classical and fuzzy techniques have emerged in the past few years. For example most classical filters that confiscate concurrently blur the edges, while fuzzy filters have the ability to merge edge preservation and smoothing. Evaluated to other non linear techniques, fuzzy filters are able to symbolize acquaintance in an understandable way. In this paper we present results for different filtering techniques and we evaluated the results for these technique

Image sequence restoration has been progressively achieving importance with the increasing prevalence of visual digital media. The demand for content increases the pressure on archives to automate their restoration activities for preservation of the cultural heritage that they hold. The goal of this paper is to find a pre-processing method based on noise removal.

Type of Denoising:

- Spatial video denoising methods, in this noise in image is reducing by applying to each frame individually.
- Temporal in this video denoising method the noise between frames is reduced. [4]Motion compensation may be used to avoid ghosting artifacts when blending together pixels from several frames.
- Spatial-Temporal is another video denoising methods which is a combination of spatial and temporal denoising.

TYPES OF NOISE:

- Amplifier noise (Gaussian noise)
- Salt-and-pepper Noise
- Periodic Noise

Amplifier noise (Gaussian noise): The Amplifier noise is also called as additive or Gaussian or independent at each pixel and independent of the signal intensity, caused primarily by Johnson–Nyquist noise (thermal noise), including that which comes from the reset noise of capacitors [3]. In color cameras more amplification is used in the blue color channel other than in the green or red channel, there can be more noise in the blue channel [5].

Salt-and-pepper Noise: Salt-and-pepper noise or spike noise is also called as Fat-tail distributed or "impulsive" noise. The images of salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. [4]This type of noise can be caused by the errors of analog-to-digital converter, bit errors in transmission, etc. This can be eliminated in large part by using dark frame subtraction and by interpolating around dark/bright pixels[6].

Periodic Noise: The signal-to-periodic noise ratio is the ratio in decibels, of the nominal amplitude of the luminance signal (100 IRE units) to the peak-to-peak amplitude of the noise. Different performance objectives are sometimes specified for periodic noise (single frequency) between 1 kHz and the upper limit of the video frequency band and the power supply hum, including low-order harmonics.

Types of Filters

1. **Average Filter**
2. **Median Filter**
3. **Wiener Filter**
4. **Rank Order Filter**
5. **Gaussian Filter**
6. **Non-Linear Filter**
7. **Outlier Filter**

Average filter: Mean filter or average filter is a windowed filter of linear class, which smoothens the signal (image). The filter works as low-pass one. The basic idea behind filter is for any element of the signal (image) take an average across its neighbourhood.

Median filter: Median filtering is a nonlinear process is used to reduce impulsive or salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise. Impulsive or salt-and pepper noise can occur due to a random bit error in a communication channel. In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed. For example, suppose the pixel values within a window are 5, 6, 55, 10 and 15, and the pixel being processed has a value of 55. The output of the median filter and the current pixel location is 10, which is the median of the five values [7].

Wiener Filter: A restoration technique for deconvolution is inverse filtering, i.e., when the image is blurred by a known low pass filter, it is possible to recover the image by inverse filtering or generalized inverse filtering. Additive noises are sensitive to inverse filtering. The approaches for reducing degradation for restoring the algorithms are developed for each type of degradation and simply combine them. The Wiener filtering is executed by an optimal tradeoff between inverse filtering and noise smoothing. The mean square error is optimized in wiener filtering. It minimizes the overall mean square error in the process of inverse filtering and noise smoothing [8]. The original images are linear estimated to wiener filtering. [9]The orthogonally theory of implies that the Wiener filter in Fourier domain can be expressed as follows:

$$W(f_1,f_2)=\frac{H^*(f_1,f_2)S_{xx}(f_1,f_2)}{|H(f_1,f_2)|^2 S_{xx}(f_1,f_2)+S_{nn}(f_1,f_2)}$$

Where $S_{xx}(f_1,f_2), S_{nn}(f_1,f_2)$ power spectra of the original image and the additive are respectively noise, and $H(f_1,f_2)$ is the blurring filter. The Wiener filter is easy to separate two parts, an inverse filtering part and a noise smoothing part. It not only performs the disconsolation by inverse filtering (high pass filtering) but also removes the noise with a compression operation (low pass filtering).

Rank Order Filter: Rank order filters have a certain size, but do not have any matrix values or a gain factor. A rank order filter of size 3x3 for example, examines 9 pixel values of the input map at a time, sorts the values from small to large, and selects for the output value that value which is encountered at a certain rank order number. So one value of the pixel values examined becomes the output value, without any calculation performed on the values itself. When a threshold is set, the value of the centre pixel will only be replaced with the new value if the difference between the original and new value is smaller than or equal to the threshold.

Gaussian Filter: Gaussian filter is a filter which has the impulse response is the Gaussian function. When minimizing the rise and fall time these filters are developed to overshoot. The minimum possible group delay is connected closely with the Gaussian Filter. A Gaussian filter is modified by the input signal of the convolution with a Gaussian function mathematically; this transformation is also known as the Weierstrass transform.

The one-dimensional Gaussian filter has an impulse response given by

$$g(x)=\sqrt{\frac{a}{\Pi}}.e^{-a.x^2}$$

or with the standard deviation as parameter

$$g(x)=\frac{1}{\sqrt{2.\Pi.\sigma}}.e^{-\frac{x^2}{2\sigma^2}}$$

In two dimensions, it is the product of two such Gaussians, one per direction:

$$g(x,y)=\frac{1}{2\Pi\sigma^2}e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Where x is the distance from the origin in the horizontal axis, y is the distance from the origin in the vertical axis, and σ is the standard deviation of the Gaussian distribution[10].

Non-Linear Filters: A nonlinear filter is a signal-processing device whose output is not a linear function of its input. Terminology concerning the filtering problem may refer to the time domain (state space) showing of the signal or to the frequency domain representation of the signal. When referring to filters with adjectives such as "band pass, high pass, and low pass" one has in mind the frequency domain. When resorting to terms like "additive noise", one has in mind the time domain, since the noise that is to be added to the signal is added in the state space representation of the signal. The state space representation is more general and is used for the advanced formulation of the filtering problem as a mathematical problem in probability and statistics of stochastic processes [11].

Outlier Filter: An adaptive filter is a filter that self-adjusts its transfer function according to an optimization algorithm driven by an error signal. Most adaptive filters are digital filters has more complexity of algorithms in optimizations. A non-adaptive filter has a static transfer function. An error signal that has to be refined to its transfer function to match the changing parameters is used in adaptive filters. [12]The adaptive process is involved the use of a cost function, which is also used as a criterion for optimum performance of the filter, which determines how to modify the filter algorithm to transfer its function to minimize the cost on the next iteration. Adaptive filters have become much more common and are now often used in devices such as mobile phones and other communication devices, camcorders and digital cameras, and medical monitoring equipment.

VI. Evaluation Measures for Filters

***Mean Square Error*:** In the image coding and computer vision literature, the most frequently used measures are deviations between the original and coded images of which the mean square error (MSE) or signal to noise ratio (SNR) being the most common measures. The reasons for these metrics widespread popularity are their mathematical tractability and the fact that it is often straightforward to design systems that minimize the MSE but cannot capture the artifacts like blur or blocking artifacts [13]. The effectiveness of the coder is optimized by having the minimum MSE at a particular compression [David Bethel (1997)] and MSE is computed using Eq.(2),

$$\text{MSE}= \frac{1}{MN}\sum_{i=1}^{M}\sum_{i=1}^{N}(f(i,j)-f^{'}(i,j))^2 \quad (1)$$

Peak Signal – To – Noise-Ratio: Larger SNR and PSNR indicate a smaller difference between the original (without noise) and reconstructed image. This is the most widely used objective image quality/ distortion measure. The main advantage of this measure is ease of computation but it does not reflect perceptual quality. An important property of PSNR is that a slight spatial shift of an image can cause a large numerical distortion but no visual distortion and conversely a small average distortion can result in a damaging visual artifact, if all the error is concentrated in a small important region. This metric neglects global and composite errors PSNR is calculated using Eq. (2),

$$\text{PSNR}=20\log_{10}\left(\frac{N}{RMSE}\right)dB \quad (2)$$

Average Difference: A lower value of Average Difference (AD) gives a "cleaner" image as more noise is reduced and it is computed using Eq. (3).

Average Difference (AD)

$$=\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left[f(i,j)-f^{'}(i,j)\right] \quad (3)$$

Maximum Difference: Maximum difference (MD) is calculated by using Eq. (4) and it has a good correlation with MOS for all tested compression techniques so it is preferred as a very simple measure by referring the measure of the compressed picture quality in different compression systems (Marta Mrak et al 2003).

Maximum Difference (MD) =

$$Max(|f(i,j)-f^{'}(i,j)|) \quad (4)$$

Normalized Correlation: The proximity between two digital images can also be quantified in terms of correlation function. These measures measure the similarity between two images, hence in this sense they are complementary to the difference based measures. All the correlation based measures tend to 1, as the difference between two images tend to zero. As difference measure and correlation measures complement each other, minimizing Distance measures are maximizing correlation measure [Thomas Kratochevil et al (2005)] and Normalised Correlation is given by Eq. (5)

Normalised Correlation (NK)

$$= \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}\left[f(i,j).f'(i,j)\right]}{\sum_{i=1}^{M}\sum_{j=1}^{N} f(i,j)^2} \qquad (5)$$

F. *Mean Absolute Error*:

Mean Absolute Error (MAE)

$$= \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left(\left|f(i,j)-f'(i,j)\right|\right) \qquad (6)$$

MAE is calculated used Eq. (6) and large value of MAE means that the image is of poor quality [Ratchakit Sakuldee et al (2007)].

Normalized Absolute Error

Normalised absolute error computed by Eq. (7) is a measure of how far is the decompressed image from the original image with the value of zero being the perfect fit [Harker (1987)]. Large value of NAE indicates poor quality of the image [Ratchakit Sakuldee et al (2007)].

Normalized Absolute Error (NAE)

$$= \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}\left|\left[f(i,j).f'(i,j)\right]\right|}{\sum_{i=1}^{M}\sum_{=1}^{N}\left|f(i,j)\right|} \qquad (7)$$

Structural Correlation/Content:

A recognizable concept in image processing, that estimates the likeness of the structure of two signals is Correlated,. The measure are compared with the total weight of an original signal to that of a coded or given. This measure is also called as structural content. The Structural content is given by Eq. (8) and if it is spread at 1, then the decompressed image is of better quality and large value of SC means that the image is of poor quality [Ratchakit Sakuldee et al (2007)].

Structural Correlation/Content (SC)

$$= \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}\left[f(i,j)\right]^2}{\sum_{i=1}^{M}\sum_{j=1}^{N} f'(i,j)^2} \qquad (8)$$

VII. Results and Discussions :

	Gaussian Noise						
	MSE	PSNR	MNCC	AD	SC	MD	NAE
Average Data	435.7165	21.9992	0.9616	1.8718	1.0534	161.5750	0.0962
Median Filter	256.0075	24.2621	0.9798	0.8614	1.0256	159.7333	0.0828
Wiener Filter	175.3028	25.9706	0.9798	0.8615	1.0308	85.9333	0.0678
Rank Order	202.2178	25.2960	0.9886	0.3427	1.0107	116.2333	0.0831
Gaussian Filter	226.5426	24.8181	0.9789	0.8713	1.0294	116.4417	0.0796
Non-Linear Filter	256.0075	24.2855	0.9798	0.8614	1.0256	159.7333	0.0828
Outlier Filter	345.1225	22.9543	0.9964	0.1580	0.9866	150.0750	0.1178

Table: 1 Evaluation Measures for Gaussian Noise

From the above Table: 1 for Gaussian Noise, the video for Wiener Filter out performs. The remaining filters in the video are denoising

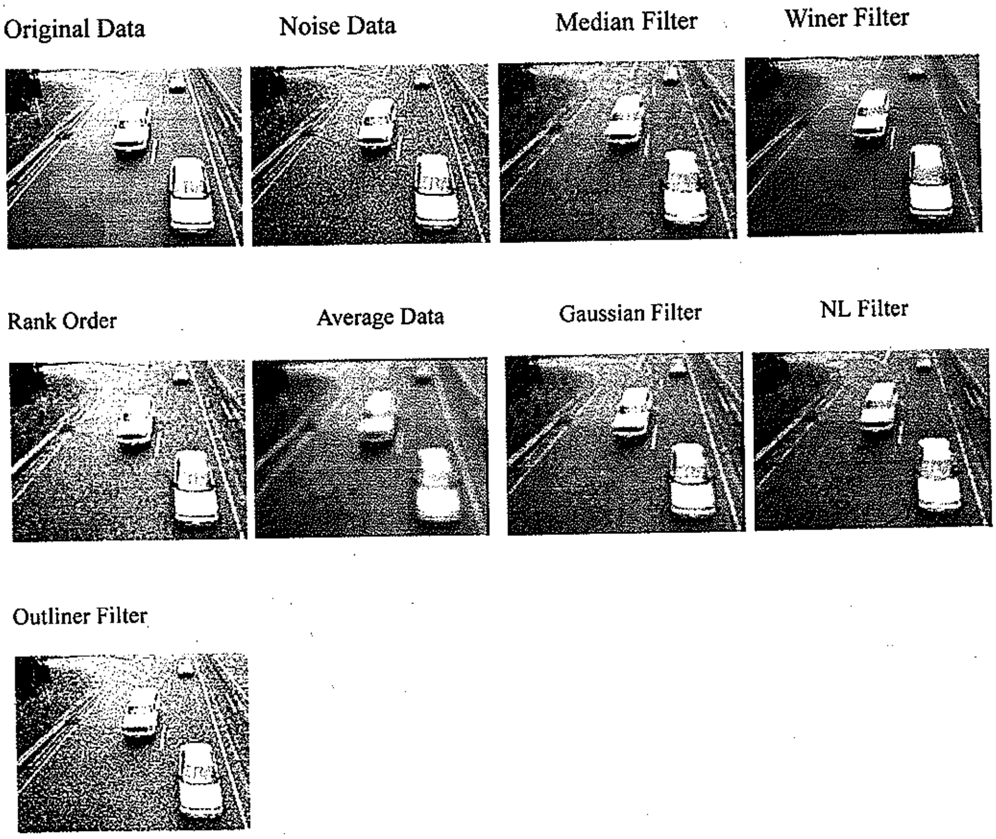


Fig: 1 Screen Shot for Gaussian Noise

Table: 2 Evaluation Measures for Salt and Pepper Noise

	Salt & Pepper Noise						
	MSE	PSNR	MNCC	AD	SC	MD	NAE
Average Data	512.6008	21.2961	0.9582	104849	1.0558	162.2667	0.1181
Median Filter	255.9669	24.0606	0.9958	0.4679	0.9930	189.8667	0.0272
Wiener Filter	421.1141	22.1408	0.9673	1.0192	1.0417	208.1167	0.1010
Rank Order	187.3607	25.6188	0.9892	0.3037	1.0104	215.5667	0.0378
Gaussian Filter	435.6573	21.9709	0.9746	0.4647	1.0253	141.7417	0.1169
Non-Linear Filter	230.6177	24.7355	0.9802	0.8514	1.0265	198.0917	0.0501
Outlier Filter	257.5257	24.2373	0.9956	0.4818	0.9933	189.3417	0.0273

From the above Table: 2 for Salt and Pepper Noise, the video for Median Filter and Rank Order Filter performs well. The remaining filters in the video are denoising.

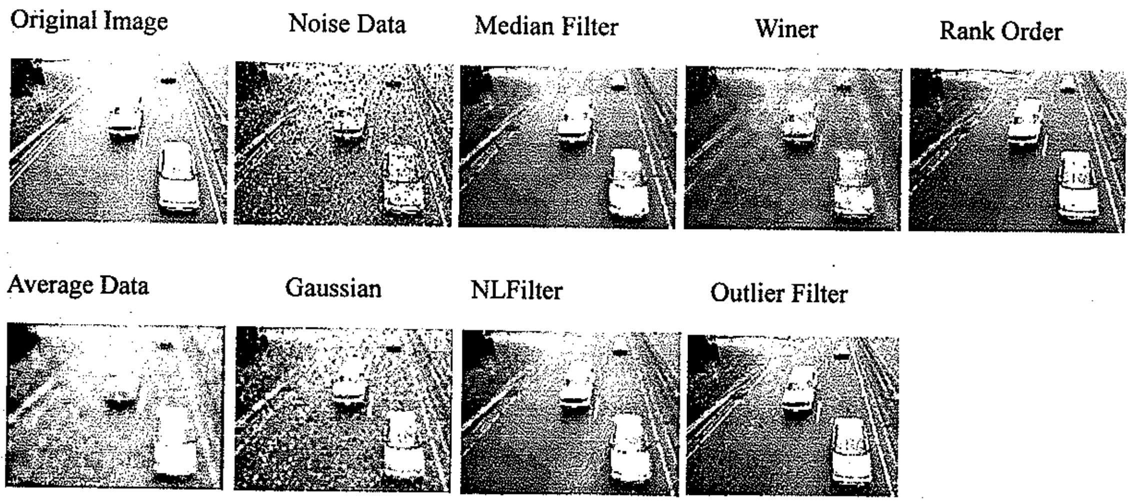


Fig: 2 Screen Shot for Salt & Pepper Noise

Table: 3 Evaluation Measures for Periodic Noise

	Periodic Noise						
	MSE	PSNR	MNCC	AD	SC	MD	NAE
Average Data	612.4158	16.7406	0.9381	0.6814	1.0452	171.7083	0.2343
2D Filter	150.0259	20.2936	0.9654	0.5665	1.0240	125.9833	0.1002
Wiener Filter	512.355	16.9289	0.9314	0.0260	1.0636	176.4833	0.2264
Rank Order	235.313	9.5164	0.9632	0.4357	0.7345	252.5833	0.5757
Gaussian Filter	356.218	17.1290	0.9486	1.6681	1.0302	172.0333	0.2260
Non-Linear Filter	235.51	14.4934	0.9622	2.5876	0.9885	249.2000	0.3010
Outlier Filter	178.86	15.6354	0.9526	0.7225	0.9917	225	0.2560

From the above Table: 3 for Periodic Noise, the video for 2D Filters performs well. The remaining filters in the video are denoising.

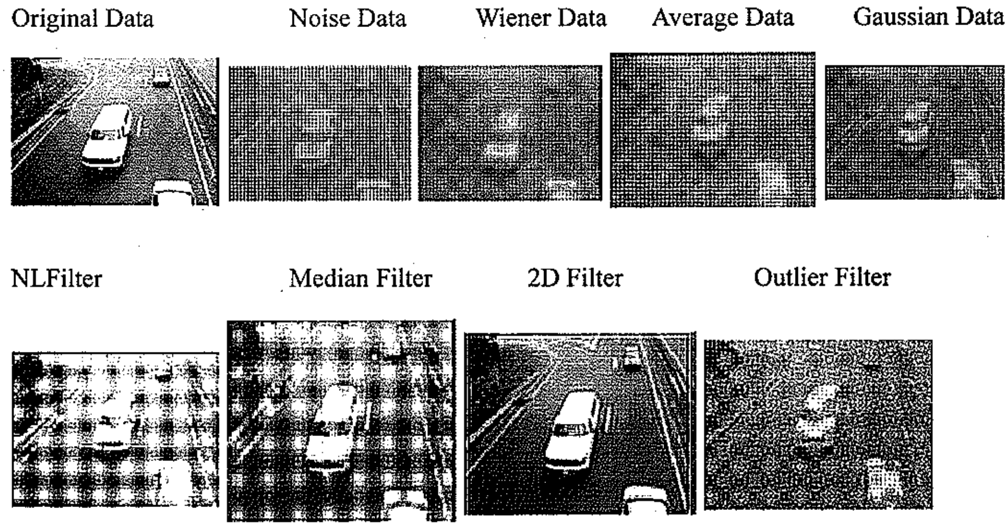


Fig: 3 Screen Shot for Periodic Noise

VIII. Conclusion

In this article, we conversed about different filtering techniques for removing noises in video. Furthermore, we presented and compared results for these filtering techniques. From the results obtained we conclude that with three different noises salt and pepper noise, Gaussian noise and periodic noise applied for denoising of the spatial video produces variant results over different filtered techniques. From the results obtained using various filtering techniques it is observed that for salt and pepper noise median and rank order filter works better than other techniques. In case of Gaussian noise Weiner and rank order filter works fine. For Periodic noise 2D filter works better than other filters.

References

[1] http://www.engineersgarage.com/articles/image-processing-tutorial-applications.

[2] http://www.wisegeek.com/what-is-video-processing.htm.

[3] C. Mythili,Dr. V. Kavitha, ."Efficient Technique for Color Image Noise Reduction", T h e R e s e a r c h B u l l e t i n o f J o r d a n A C M, V o l. I I (I I I) P a g e | 4 1-44.

[4] http://en.wikipedia.org/wiki/Video_denoising

[5] http://en.wikipedia.org/wiki/Image_noise.

[6] Amit Yerpude, Dr. Sipi Dubey, Amit Yerpude, Dr. Sipi Dubey, "Robust Method for Noisy Image Segmentation", IJCSET |February 2012| Vol 2, Issue 2,891-895.

[7] http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi_Img_Pro/chapter_8/8_16.html

[8] http://www.owlnet.rice.edu/~elec539/Projects 99/BACH/proj2/wiener.html.

[9] Disha Sharma and Gagandeep Jindal, "Computer Aided Diagnosis System for Detection of Lung Cancer in CT Scan Images", International Journal of Computer and Electrical Engineering, Vol. 3, No. 5, October 2011.

[10] http://en.wikipedia.org/wiki/Gaussian_filter.

[11] http://en.wikipedia.org/wiki/Nonlinear_filter

[12] http://en.wikipedia.org/wiki/Adaptive_filter.

[13] Sumathi Poobal, G.Ravindran," The Performance of Fractal Image Compression On Different Imaging Modalities Using Objective Quality Measures", International Journal of Engineering Science and Technology (IJEST), and Vol. 3 No. 1 Jan 2011, PP: 525-530.

Author's Biography

M. Hemalatha completed MCA MPhil., PhD in Computer Science and currently working as an Assistant Professor and Head, Department of software systems in Karpagam University. More than ten years of Experience in teaching and published more than fifty papers in International Journals and also presented seventy papers in various National conferences and one International Conferences Area of research is Data mining, Software Engineering, bioinformatics, Neural Network. She is also reviewer in several National and International journals.

R.Revathi was born and brought up Trichy She received her Bachelor of Computer Science from Bharathidasan University and Master degree in Information Technology from Bharathidhasan University. She completed her M.Phil from Bharathidasan University. Currently pursuing Ph.D., in computer science at Karpagam University under the guidance of Dr.M.Hemalatha Head, Dept of Software System, Karpagam University, and Coimbatore. Area of Interest is Image Processing and Networks. Area of Research is Image Processing.