Build an Effective Video Noise Removal Method using Combination of Intraframe Filters

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Abstract - Video preprocessing is the most important field of Digital Video processing. Video preprocessing maps the raw input video into an output video for better vision. Video preprocessing field is classified in two, video contrast enhancement and video denoising. These two parts are further divided based on the techniques and structure. This paper basically deals with second part of video preprocessing ie video denoising. Video denoising replaces or modifies the corrupted pixel value of all the video frame based on the algorithm. In the past lots of work have been done by the researchers for making algorithms to remove noise presented on the videos. The techniques available for the video denoising mostly developed for some specific types of noises, hence the area is still open for the development of a robust and efficient video noise removal technique which can able to remove different types of noises from video frame

Hence to overcome this problem, this paper deals with the development and implementation of a highly robust and efficient gray scale video denoising technique using hybrid MW intraframe algorithms in MATLAB. The proposed hybrid MW intraframe denoising technique is basically fusion of median and wiener filter to utilize a hybrid structure for addressing different types of noise removal problems. The comparative analysis is performed based on the two parameters Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR). For the comparative analysis three types of noises salt and pepper noise, Gaussian noise and speckle noise have been considered. The result shows that the proposed technique is efficient to remove all the three types of noises considered for the comparison.

Key Words: Video denoising; Intraframe denoising; median filter; wiener filter; MSE; PSNR.

1. INTRODUCTION

Video denoising is the process of removing noise from a video signal Video denoising is still a challenge . Different algorithms are used depending on the noise model. Noise Models are basically divided into two: Additive and multiplicative noise model. Most of the natural video frames are assumed to have additive random noise which is modeled as a Gaussian. There are some other noise models are also modeled which greatly degrade the video frames like Salt & Pepper noise, Poisson Noise and Speckle noise. This paper mainly concentrates on first implementation of available intraframe video denoising techniques and then building of a technique for robust and efficient video denoising.

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2. INTRAFRAME VIDEO DENOISING TECHNIQUES

Median Filtering

The median filter is basically a nonlinear digital filtering technique used to remove noise from a video.It removes the noise improves the result .The median filter replaces every entry with the median value of its neighbor pixel including itself. Neighbour patterns are called windows.

For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median

The median filter is also a sliding-window spatial filter, but it replaces the center value in the window with the median of all the pixel values in the window. As for the mean filter, the kernel is usually square but can be any shape. An example of median filtering of a single 3x3 window of values is shown below.

unfiltered values		
6	2	0
3	97	4
19	3	10

in order:
0, 2, 3, 3, 4, 6, 10, 15, 97

median filtered		
*	*	*
*	4	*
*	*	*

Center value (previously 97) is replaced by the median of all nine values (4).

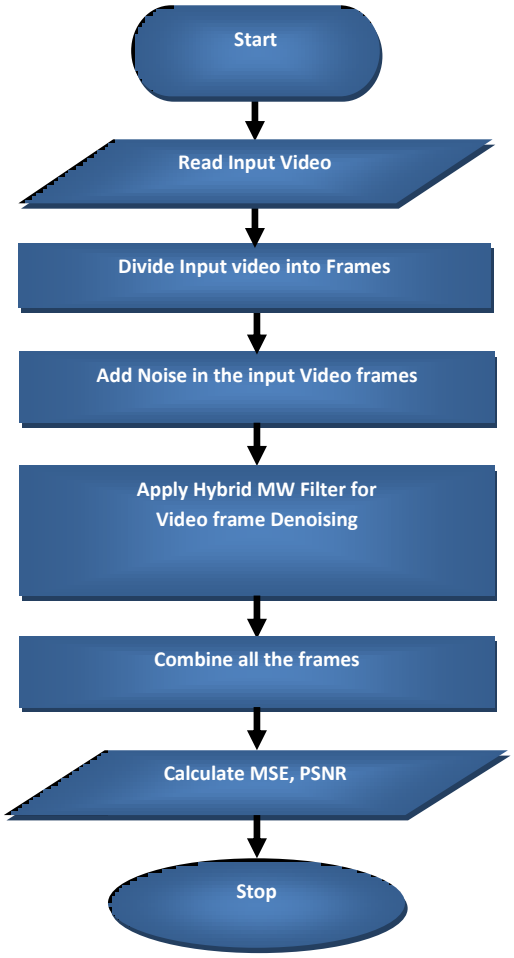
Wiener Filtering

Wiener filter is used to reduce noise from a corrupted signal . wiener filter works on the two methods: one is deconvolution, i.e., when the image is blurred , it is recovered by inverse filtering , and second is blurring. It is very effective for the additive noise and also blurs the image parallely.

The Wiener filtering gives lowest value of mean square error. It reduces the mean square error during inverse filtering and blurring.

3. METHODOLOGY

The proposed method of the paper involves development of combination of filters by the fusion of median filter and wiener filter for gray video denoising. This project work brought forward a novel hybrid filter structure for robust and efficient video denoising technique. The proposed hybrid filter is basically a cascade combination of median and wiener filters. The proposed method is shown in fig. 3.1 with the help of flow chart.



4. CONCLUSIONS

The proposed technique has been successfully implemented in MATLAB. This section deals with the results obtained after denoising using various filters in addition with discussions. For the complete analysis of the proposed work with conventional filters, this work utilizes a standard video from MATLAB. The input video is "xylophone.mpg", consists 141 frames. Fig. shows 10th of the first input video.

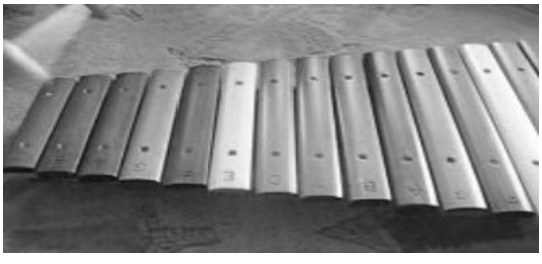


Fig. 10th frame of first input video.

Salt and Pepper noise filtering from Input video using Proposed Hybrid MW filter.

After denoising using proposed hybrid filter the denoised video frames .For the complete comparative analysis table-1 contains all MSE and PSNR

Input Video (xylophone.mpg)												
S. No.	Frame no.	Type of Noise	MSE of Average Filter	PSNR of Average Filter	MSE of Median Filter	PSNR of Median Filter	MSE of Gaussian Filter	PSNR of Gaussian Filter	MSE of Wiener Filter	PSNR of Wiener Filter	MSE of Proposed Hybrid Filter	PSNR of Proposed Hybrid Filter
1	10	Salt and Pepper Noise	18.58	35.44	6.47	40.02	13.96	36.68	9.12	38.53	3.64	42.52
2	20		19.10	35.32	6.62	39.92	14.60	36.49	9.15	38.52	3.85	42.28
3	30		19.63	35.20	7.39	39.45	14.68	36.46	9.91	38.17	4.32	41.77
4	40		19.20	35.30	7.00	39.68	13.92	36.69	9.46	38.37	3.94	42.17
5	50		19.53	35.22	7.33	39.48	14.48	36.52	9.64	38.29	4.22	41.88
6	60		18.03	35.57	6.00	40.35	13.50	36.83	8.70	38.73	3.34	42.89
7	70		19.34	35.27	7.04	39.65	14.01	36.67	9.49	38.36	3.99	42.12
8	80		18.98	35.35	7.14	39.59	13.86	36.71	9.50	38.35	4.03	42.08
9	90		18.13	35.55	6.31	40.13	13.76	36.74	8.62	38.78	3.45	42.76
10	100		19.53	35.22	7.18	39.57	14.08	36.65	9.77	38.23	4.03	42.07
11	110		19.65	35.20	7.49	39.39	14.11	36.64	9.71	38.26	4.24	41.86
12	120		17.23	35.77	5.64	40.62	13.62	36.79	8.18	39.01	3.07	43.27
13	130		18.43	35.48	6.67	39.89	13.70	36.76	9.03	38.57	3.78	42.36
14	140		17.61	35.67	5.87	40.44	13.56	36.81	8.31	38.94	3.28	42.97

TABLE I. MSE AND PSNR VALUES OBTAINED AFTER SALT & PEPPER NOISE DENOISING OF INPUT GRAY VIDEO USING ALL THE FILTERS

Gaussian noise filtering from first Input video

Let us consider input video "xylophone.mpg", consists 141 frames corrupted by 60% Gaussian noise .

Input Video (xylophone.mpg)												
S. No.	Frame no.	Type of Noise	MSE of Average Filter	PSNR of Average Filter	MSE of Median Filter	PSNR of Median Filter	MSE of Gaussian Filter	PSNR of Gaussian Filter	MSE of Wiener Filter	PSNR of Wiener Filter	MSE of Proposed Hybrid Filter	PSNR of Proposed Hybrid Filter
1	10	Gaussian Noise	2.70	33.75	0.16	56.15	1.69	45.85	1.07	47.85	0.03	64.00
2	20		2.70	33.59	0.14	56.68	1.65	45.95	1.07	47.85	0.02	64.92
3	30		2.80	33.56	0.16	56.20	1.71	45.81	1.11	47.68	0.02	64.71
4	40		2.74	33.63	0.14	56.56	1.72	45.77	1.04	47.98	0.03	64.07
5	50		2.78	33.60	0.15	56.23	1.71	45.80	1.02	48.07	0.03	64.08
6	60		2.61	33.74	0.13	56.85	1.63	46.01	1.03	47.99	0.02	66.00
7	70		2.76	33.58	0.14	56.63	1.72	45.78	1.05	47.91	0.02	64.26
8	80		2.73	33.60	0.15	56.41	1.69	45.84	1.05	47.92	0.03	64.12
9	90		2.70	33.77	0.16	56.10	1.69	46.16	1.07	48.09	0.03	63.82
10	100		2.70	33.59	0.14	55.84	1.65	45.93	1.07	47.86	0.02	63.82
11	110		2.80	33.61	0.16	56.15	1.71	45.77	1.11	47.90	0.02	64.31
12	120		2.74	33.88	0.14	57.62	1.72	46.13	1.04	48.30	0.03	67.79
13	130		2.78	33.66	0.15	56.25	1.71	45.75	1.02	48.08	0.03	64.83
14	140		2.61	33.72	0.13	56.14	1.63	46.09	1.03	48.17	0.02	64.85

TABLE II. MSE AND PSNR VALUES OBTAINED AFTER GAUSSIAN NOISE DENOISING OF INPUT GRAY VIDEO USING ALL THE FILTERS

Speckle noise filtering from first Input video

Let us consider first input video "xylophone.mpg", consists 141 frames corrupted by 50% Speckle noise .

Input Video (xylophone.mpg)												
S. No.	Frame no.	Type of Noise	MSE of Average Filter	PSNR of Average Filter	MSE of Median Filter	PSNR of Median Filter	MSE of Gaussian Filter	PSNR of Gaussian Filter	MSE of Wiener Filter	PSNR of Wiener Filter	MSE of Proposed Hybrid Filter	PSNR of Proposed Hybrid Filter
1	10	Speckle Noise	16.15	36.05	8.39	38.89	11.28	37.61	1.07	39.51	5.43	40.78
2	20		16.64	35.92	8.57	38.80	11.56	37.50	1.07	39.32	5.69	40.58
3	30		17.53	35.69	9.15	38.52	11.79	37.42	1.11	38.94	6.18	40.22
4	40		16.93	35.84	8.79	38.69	11.41	37.56	1.04	39.23	5.85	40.46
5	50		17.07	35.81	9.26	38.47	11.48	37.53	1.02	39.05	6.08	40.29
6	60		15.64	36.19	7.96	39.12	10.84	37.78	1.03	39.85	5.23	40.95
7	70		16.99	35.83	9.03	38.57	11.40	37.56	1.05	39.22	5.77	40.52
8	80		16.83	35.87	8.92	38.62	11.20	37.64	1.05	39.19	5.86	40.45
9	90		15.81	36.14	8.13	39.03	10.73	37.82	1.07	39.84	5.25	40.93
10	100		17.01	35.82	8.96	38.61	11.19	37.64	1.07	39.29	5.78	40.51
11	110		17.19	35.78	9.29	38.45	11.33	37.59	1.11	39.17	6.00	40.35
12	120		14.85	36.41	7.36	39.46	10.67	37.85	1.04	40.21	4.83	41.29
13	130		16.33	36.00	8.44	38.87	11.05	37.70	1.02	39.49	5.62	40.64
14	140		15.52	36.22	7.79	39.22	10.68	37.84	1.03	39.98	5.06	41.09

TABLE III. MSE AND PSNR VALUES OBTAINED AFTER SPECKLE NOISE DENOISING OF INPUT GRAY VIDEO USING ALL THE FILTERS

CONCLUSION:

The developed hybrid filter is basically a cascade combination of median and wiener filters. In the results section resultant graphs and tables clearly indicates that individual conventional filters are only able to filter some specific type of noise, but the hybrid filter is not only able to provide smallest MSE for all the three types of noises as well as also able to keep important video frame characteristics.

In addition to this, the hybrid filter developed in this work also provides highest PSNR values among all the testing filters. Hence in terms of parameters, it provides minimum MSE and highest PSNR as compare to available intraframe denoising techniques.

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