MOTION DETECTION FOR VIDEO DENOISING – THE STATE OF ART AND THE CHALLENGES

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ABSTRACT

This paper provide a detailed state of art of motion detection for video denoising. Most of the video denoising algorithms are done through the motion detection technique. The main goal is to give a survey of various moving object detection techniques. Object detection is the first level of video denoising. In this paper I have explained about the frame differencing technique for video denoising. The proposed video denoising technique uses three frames such as past frame, current frame and future frame.

Keywords: Motion Detection, frame differencing, video denoising.

I INTRODUCTION OF VIDEO DENOISING

Video Denoising is the process of removing noise from the video, where image noise reduction can be done through the frame individually and between the frames. Video denoising is used widely in traffic management, medical imaging and TV broadcasting applications. Denoising is an image restoration problem in which it attempts to recover image from a degraded image. Various denoising techniques make various assumptions, depending on the type as well as goal of image. [1] Explained about motion detection in Real time video streams using moved frame background. Here the author considered first frame as background frame and comparing this frame with the current frame to get the difference. Moving object detection is the first step of video denoising as well as object tracking. This technique uses segmentation of moving objects from stationary background objects [2]. This focuses on higher level processing and decreases
computation time. Due to environmental conditions like illumination changes, shadow object segmentation becomes difficult and significant problem.

II MOTION DETECTION – A SURVEY

Motion detection is the process of change in position of an object with respect to its background. Subtraction of consecutive frames in a motion sequence, on a pixel by pixel basis is called frame difference. A large difference shows the change between frames due to either motion or changes in illumination but noise in images can give high differences where there is no motion. Compare the neighborhoods frames instead of pixels. Background subtraction is very important in the case of motion detection. [34] In the proposed technique other than moving objects are considered as stationary background and the moving objects are considered as foreground. Most common method for object detection is to use information in a single frame. But some other object detection methods make use of the temporary information computed from a sequence of frames to reduce the number of false detections [3]. This temporary information is usually in the form of frame differencing, which shows regions that changes dynamically in consecutive frames. This section reviews three moving object detection methods that are background subtraction with alpha parameter, temporal difference and statistical methods, Eigen Background Subtraction. The following are the main steps to find the moving objects from the video frame: Background model, Foreground detection, Pixel level processing, Connected region, Region level processing.

1.1 Background Detection

Background detection is very important in the case of motion detection. In the proposed technique other than moving objects are considered as stationary background and the moving objects are considered as foreground. The first step is the initialization of the background. There are various techniques used to fix the background. Now the background related parts of the system is isolated and its coupling with other steps is kept minimum to let the whole detection system to work flexibly with any one of the background technique [4].

1.2 Foreground Detection

Next step is to find the foreground. Foreground is related to the background. Foreground is the difference between the two consecutive frames, which is shown in figure.1.1, 1.2. and 1.3
Figure 1.1. past frame

Figure 1.2. current frame/future frame

Figure 1.3. difference between two consecutive frames(foreground)
From the foreground a number of object features like area, bounding box, perimeter of the regions corresponding to objects are extracted from current image.

1.3 Pixel Level Processing

The after effect of foreground detection contains noise. Regularly, it affects by various noise factors. To overcome this noise, pixel level processing is required. There are various factors that cause the noise in foreground detection such as: camera, reflectance and guassian noises. A Gaussian filters smoothes an image by calculating weighted averages in a filter co-efficient [5]. Gaussian filter modifies the input signal by convolution with a Gaussian function.

1.4 Connected Region

The Next step is to detect the connected region. The above filtered foreground pixels are grouped into connected regions. After finding individual regions that correspond to objects, the bounding boxes of these regions are calculated.

1.5 Region Level Processing

Because of bad segmentation some artificial small regions remain .To remove these regions from the foreground pixel map detect the regions that have smaller sizes than a pre-defined threshold. Once segmenting regions are finds, we can extract features of the corresponding objects from the current image.

The main features are size, centroid and bounded area of the connected component. These are used for object tracking and the motion detection. Once the motion is detected, apply spatial filtering for video denoising.

III MOTION DETECTION FOR VIDEO DENOISING

Spatial (2-D) and spatio-temporal (3-D) filters [6-11] have been proposed in the literature to remove video noise. Spatial filters take only spatial information into account and as an effect can cause spatial blurring at high noise levels. This blurring effect can be reduced using both temporal and spatial information and the filtering performance can be improved at low noise levels also in this way. A wavelet domain spatial filter whose coefficients are manipulated using a Markov Random Field (MRF) image model has been proposed in [6].

In [7], a Wiener filter is utilized in the wavelet domain in order to remove image noise. A fuzzy logic based image noise filter that takes directional deviations into account has been proposed in [8]. In [9], a recursive estimator structure has been proposed to estimate the clean image from the film-grain noisy image. Noise is considered to be related to exposure time in the form of non-Gaussian and multiplicative structure in [9]. A pixel based spatio-temporal adaptive filter that calculates new pixel values adaptively using the weighted mean of pixels over motion compensated frames has been proposed in [10]. In [11], an edge preserving spatio-temporal video noise filter that combines 2D Wiener and Kalman filters has been presented.
A non-linear video noise filter which calculates new pixel values using a 3D window has been proposed in [12]. This method arranges pixels in the form of a 3D window according to their difference with respect to related pixel values and averages the pixels in the window after weighting them according to their sorting order. This method gives good results in case of no- or slow local motion, but deforms image regions in cases of abrupt local motion. Video denoising using 2D and 3D dual-tree complex wavelet transforms has been proposed in [13]. In the case of local motion, the 3D filtering performance of the method is highly reduced. In order to increase the 3D filtering performance of the method proposed in [13], 2D wavelet based filtering and temporal mean filtering that uses pixel based motion detection has been proposed in [14].

A wavelet transform based video filtering technique that uses spatial and temporal redundancy has been proposed in [15]. In [16], a content adaptive video denoising filter has been proposed recently. This method filters both impulsive and non-impulsive noise but the filtering performance is highly reduced in case of Gaussian noise with high variance. In this work, a new pixel based spatio-temporal video noise filter that takes motion changes and spatial standard deviations into account is proposed. The main objective is to suppress noise in archive video, and it is shown that the proposed method provides a successful visual quality for archive videos.[17] propose hidden markov tree modeling for wavelet coefficient and provide high CPSNR, good quality and removes color artifacts while preserving edges. In [18] spatio-temporal filtering is used for film restoration, which provides good PSNR and Visual results.

The paper [19] proposes efficient and accurate wavelet based noise estimation method for white Gaussian noise in video sequences. In [20] instead of motion estimation step, the surfacelet transform provides a motion selective subband decomposition for video signals and it is low redundancy. [21] proposes spatio-temporal predictive search block matching which provide reasonable computational cost and subjective visual quality. The paper [22] uses effective improvement on the OSA method in both 2 and 3D. Super resolution algorithm which does not rely on explicit motion estimation [23], provides artifacts free and high quality images. [24] is obtained based on an efficient quad tree decomposition of the learned dictionary and overlapping image patches.

Comparison between DWT and Dual Tree complex wavelet transform are shown in [25]. Author developed decomposition structure (greedy basis selection algorithm) for ADDWP, which has lower computational complexity [26] as well as boundary extension method can be used to improve the quality of the first and last served frames. In [27] Bilateral filtering can be decomposed into a number of constant time spatial filters. The main advantages are higher PSNR, Faster (because of parallel implementation), and small memory footprint (2% of memory). In this paper [28] video sequences are considered as volume rather than a sequence of frames and not require any motion estimation. Inpainting provides filling in the missing part of the video with the most appropriate data it is flexible but time consuming. Removing serious mixed noise from the video data (Gaussian + impulse noise) [29].

The proposed technique [30] is a low complexity method because reusing motion estimation resources from the video coding module for video denoising. [31] Provide data parallel, deeply multithreaded cores and high memory bandwidth. Video’s can be denoised by the use of motion compensation that is without detecting the motion [32], which can be done through the
correlation of neighboring frames that means selective block matching technique is used. In this paper white Gaussian noise is considered. So complexity is reduced but the quality of the image is normal. [33] Describes the motion estimation technique can be done through optical flow method and which is integrated with nonlocal means frame work with noise level estimation. In this paper, [34] present a new patch-based video denoising algorithm capable of removing serious mixed noise from the video data. By grouping similar patches in both spatial and temporal domain, formulate the problem of removing mixed noise as a low-rank matrix completion problem, which leads to a denoising scheme without strong assumptions on the statistical properties of noise. The resulting nuclear norm related minimization problem can be efficiently solved by many recent developed methods. The robustness and effectiveness of our proposed denoising algorithm on removing mixed noise, e.g. heavy Gaussian noise mixed with impulsive noise.

The ability to process a sequence in real time is dependent on three key factors: The speed of the algorithm, the frame rate required and the number of pixels. While considering all the above factors the real time video denoising can be done.

IV CONCLUSION

To analyze images and extract high level information, image segmentation, motion detection and video denoising researches have been studied. In this paper, we have studied and presented different methods and challenges of video denoising. This article gives valuable insight into this important research topic and encourages the new research in the area of Real time Video Denoising.

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