

Denoising and Development of very Low-light Video

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ABSTRACT: Video quality improvement could be a long standing area of research. Noise is dominant issue that degrades image quality. Video denoising could be a difficult topic in image processing; its main aim is to realize an efficient, adaptive and high quality video. In color image information, the color property is restored and demosaicing of raw RGB input data is performed at the same time with the noise reduction. A general methodology for noise reduction and contrast enhancement in very noisy image information with low dynamic range is given. Video footage recorded in very dim light is especially targeted. The projected technique invokes twice, within the 1st and therefore the third stages, the well-known fast fuzzy c means clustering and hierarchal merge tree and mean filter technique for spatial and temporal denoising.

KEYWORDS: Noise reduction, Video signal processing, Very low light video, Non-local means, Tone mapping, Noise reduction, Video filtering, video denoising, video deblocking, video enhancement.

I. INTRODUCTION

Since different sorts of interferences in formation and transmission, image quality is liable to decline. The purpose of image improvement is to enhance subjective visual quality and to ensure additional image processing. Despite these enhancements, quality of videos in low light conditions continues to be limited. Firstly, low light videos have poor dynamic vary. To capture pictures of high dynamic range, most consumer cameras usually suppose automatic exposure control, however longer exposure time results motion blur. Two major characteristics of low light video is high level of noise and low dynamic vary. Motion compensation could also be used to avoid ghosting artifacts once blending to-gather pixels from many frames. Spatial Temporal video de-noising strategies use a mix of spatial and temporal denoising. Typically often named as 3D denoising. Video denoising strategies are designed and tuned for specific styles of noise. A number of the earliest strategies of denoising are easy averaging filters like mean, median, Gaussian smoothing filters, and bilateral filters. Numerous factor such as noise blur, jamming, buzzing, and further accomplishment or compression relic, usually impair digital video sequences. However, cost constraints limit large scale applications of such systems, thus inexpensive sensors are usually employed. Clean, high-definition photos captured by camera systems give higher evidence for well-informed course of action. Video improvement problem are often developed as follows: given an input low quality video and also the output top quality video for specific applications. Digital video has turn out to be an significant module of everyday life. It's well-known that video enhancement as an active topic in computer vision has received a lot of attention in recent years. Digital video has become an integral a part of daily life. It's well-known that video enhancement as an active topic in pc vision has received a lot of attention in recent years. The aim is to enhance the visual appearance of the video, or to supply a "better" transform representation for future automated video process, like analysis, detection, segmentation, and recognition [1-5]. Moreover, it helps analyses background information that's essential to know object behavior while not requiring expensive human visual inspection [6]. There are varied applications wherever digital video is acquired, processed and used, like surveillance, general biometric identification, traffic, criminal justice systems, civilian or military video processing. The following figure shows the overall framework for extremely low light video. Noise in

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images arises due to a variety of reasons and based on the statistical properties of each type of noise, they are modeled using several probability distributions. Commonly occurring noise types and models are described in this section. Noise caused due to any of the above reasons will affect some number of pixels in the image as opposed to corrupting each pixel value in the image. Pixels in an image are affected by overheated or faulty pixels in camera sensors, errors in digitization process and bit errors in data transmission. In a gray scale image, affected pixels appear as randomly occurring white and black dots and thus this kind of noise is named as salt and pepper noise. This noise is modeled as impulse distribution typically with spikes at maximum and minimum values of the image. In such noise, the signal strength of noise is much larger than the image and thus affected pixels tend to take extreme values from the allowed range of image intensity. So generally, affected pixels appear very different from their surroundings. Basic low pass filters such as mean filter or Gaussian smoothing fail on impulsive noise because the corrupted pixel affects the mean significantly and thus mean can deviate by large amounts from the original value. Median filtering is effective in removing impulsive noise and preserving edges.

II. THEORY

A. Denoising

Denoising aims at effectively removing noise (acquired during capturing and transmission) from the corrupted image and recovering the original clean image. In general, no algorithm can make this decision 100% accurately. So, there is always a trade-off between amount of noise removed and fine image detail that is preserved. Naive approaches for denoising or algorithms designed for aggressive noise removal generally smooth out fine details and blur the edges. The performance of any denoising algorithm depends on its effectiveness in differentiating noise from original image data. The better its differentiating capability, the better would be the performance of the algorithm. Some algorithms separate the image into chroma and luminance components and perform more noise reduction on the chroma component due to the following two reasons: most of the image detail is concentrated in the luminance component and there is not much of important detail present in the chroma component. So, there is lower loss of information by performing more noise reduction on chroma component; generally, people find chroma noise more objectionable than luminance noise. Some of the fundamental techniques for image denoising are linear and nonlinear filters in spatial domain, anisotropic filtering [3] [4], frequency domain filtering etc.

B. Image Processing Objective

Modern digital cameras still rely on a single exposure time and on imaging sensors that possess photo elements of uniform sensitivity. This often results in underexposed dark areas in the obtained images. The problem is especially pronounced in video cameras where the exposure time is limited to prevent motion blur. Most people have probably experienced this problem when shooting a movie either indoors or within a scene where the intensities vary by several orders of magnitude.

To reduce the noise significantly we apply adaptive spatio-temporal intensity smoothing. For every pixel in the image sequence a specific summation kernel is constructed which adapts to the local spatio-temporal intensity structure. This kernel is then used to calculate a weighted mean in the neighborhood of the current pixel. Instead of applying a combination of pure spatial and pure temporal summation, as in the model of Warrant, we view the three dimensional spatio-temporal space symmetrically and shape and direct the kernels according to 3D intensity structure. By doing this, we find an optimal way of smoothing the intensities, while preserving, and even enhancing, important object contours and preventing motion blur.

After the noise has been efficiently reduced, the intensities are transformed using tone mapping, implemented by a contrast limited version of histogram equalization, in order to spread out the intensities more uniformly and widen the dynamic range of the darker areas....

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III. MOTIVATION

Good quality images and videos are key to critical automated and human-level decision-making for tasks ranging from security applications, military missions, path planning to medical diagnostics and commercial recommender systems. Clean, high-definition pictures captured by camera systems provide better evidence for well-informed course of action. However, cost constraints limit large scale applications of such systems, thus inexpensive sensors are usually employed. Insufficient lighting, in addition to low sensor quality, produce image noise that may inhibit Intelligence, Surveillance & Reconnaissance (ISR) missions and commercial industries. These applications stand to benefit from improvements in image enhancement algorithms.

IV. VIDEO ENHANCEMENT CATEGORIES

According to previous studies if enhanced video embed high quality background information, the existing techniques of video enhancement can be classified into two broad categories: Self-enhancement and frame-based fusion enhancement. Traditional methods of video enhancement are to enhance the low quality video itself. It doesn't embed any high quality background information. Such as contrast enhancement method, HDR-based video enhancement, compressed-based video enhancement, and wavelet-based transform video enhancement. These approaches are uniformly called self-enhancement of low quality video. It don't enough luminous of low quality video. The reason is that in the dark video, some areas are so dark that all the information is already lost in those regions. No matter how much illumination enhancement you apply, it will not be able to bring back lost information. Frame-based fusion enhancement refers to low quality video, which fuse illumination information in different time video. The approach is that it is by extracting high quality background information to embed low quality video. Fig.1 shows the more detail categories of video enhancement.

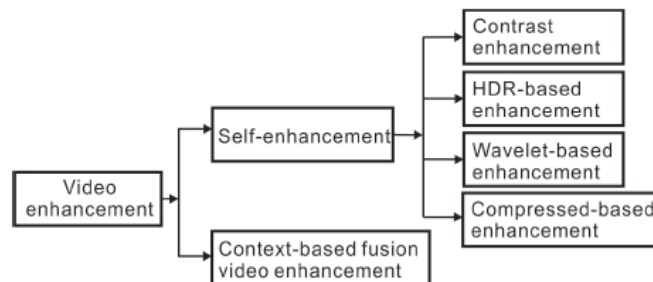


Fig.1 block diagram of video enhancement categories

V. METHOD

Main aim of image/video processing is often to improve the visual quality, typically for a human observer and throughout this report some concepts from this field will arise time and time again and we need to familiarize ourselves with them. In this chapter we will start with the basics and describe the fundamentals of images and videos in a digital form, we will cover the basics of contrast and illumination enhancement and, after that, what we mean by digital noise and a few different ways of getting rid of it.

The ability to process image and video signals is therefore an incredibly important skill to master for engineering/science students, software developers, and practicing scientists. Digital image and video processing continues to enable the multimedia technology revolution we are experiencing today. Some important examples of image and video processing include the removal of degradations images suffer during acquisition (e.g., removing blur from a picture of a fast moving car), and the compression and transmission of images and videos (if you watch videos online, or share photos via a social media website, you use this everyday!), for economical storage and efficient transmission

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The video enhancement is still an active area of research by many experts. There are still many problems of video enhancement, such as false background problem, color shift problem etc. Video enhancement is one of the most important and difficult component of video security surveillance system. The increasing use of night operations requires more details and integrated information from the enhanced image. However, low quality video of most surveillance cameras is not satisfied and difficult to understand because they lack surrounding scene context due to poor illumination. So one of key problems is image/frame fusion problem to ensure better image reconstruction and color assignment. A large number of techniques have been proposed to address this problem. In this we focus on the existing techniques of video enhancement, which can be made better in poor visibility light condition. Desired outcome of the project is to enhance video. The steps to get desired outcome is as shown in fig.2.

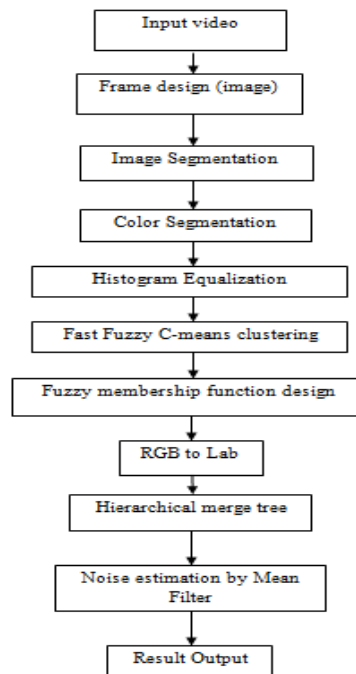


Fig.2 Flow to get enhance video

VI. RESULT

The proposed hierarchical merge tree algorithm is carried out on a color image. Segmentation of color image is done on the basis of color intensity values of the selected portion. The original color image consists of RGB components.

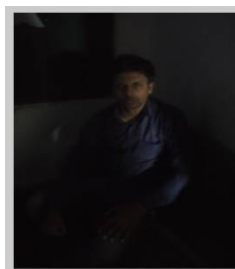


Fig.3 Original color image.

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An area of interest is selected from the given input color image to segment it successfully. A color portion of image is selected from the given input RGB color image.



Fig.4 Selected portion of color image

The RGB color image is converted to gray image for better segmentation. Figure 5 show the Image segmentation component of color pixels of entire image.



Fig.5 Image segmentation

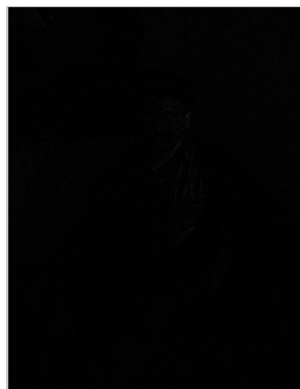


Fig.6 fast fuzzy c-means clustering image

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Figure 6 show Clustering component of the image. It should be taken out by the applying of fast fuzzy c-means.



Fig.7 image with noise

Figure 7 shows image which contains noise which is totally blurred form from the given input image.



Fig.8 Identify Objects in the Image

Figure 8 shows identified object from the input image.

Table.1 Performance Evaluation of Proposed Work

S.No.	Parameters	Previous Method	Proposed method
1.	PSNR	16.5	27.12
2.	SSIM	0.59	0.65
3.	Processing time	6.807	6.57

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VII. CONCLUSION

This work proposes enhancement of videos taken in extremely low light conditions. A brief study about the types of noises present in a low light video is also provided. The proposed work is based on hierarchical tree and fast fuzzy c-means. In this paper proposed algorithm optimizes video quality. In this work we get value of psnr is 27.12 and ssim is 0.65. In future, the video enhancement process will measure the intensity level of individual pixels channels and decide the best enhancement.

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