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Video Enhancement in Video Surveillance System

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Abstract - **Digital video has become an integral part of everyday life. It is well -known that video enhancement as an active topic in computer vision has received much attention in recent years. The aim is to improve the visual appearance of the video or to provide a "better" transform representation for future automated video processing such as analysis, detection and segmentation. Moreover, it helps analyses background information that is essential to understand object behaviour without requiring expensive human visual inspection. Therefore, in this paper, we aim at a novel approach to an algorithm for video enhancement.**

I. INTRODUCTION

Over the several decades, there have been notable capability improvements in Digital cameras including resolution and sensitivity. Despite these improvements, however, modern digital cameras are still limited in capturing high dynamic range images in low-light conditions. These cameras often rely on automatic exposure control to capture image of high dynamic range, but the longer exposure time often results motion blur. There are numerous applications where digital video is acquired, processed and used such as surveillance, general identity verification, traffic signals, criminal justice systems, healthcare, civilian or military video processing. As video surveillance equipments and mobile devices such as digital cameras, smart phones are increasingly widely deployed at many large stores, super markets, departmental stores, hospitals, public transport stations and various other public places, these are expected to acquire, record and sometimes compress and transmit video content in all lighting conditions. . However, the majority of cameras are not specifically designed to be all-purpose and weather-proof, rendering the video footage unusable for critical applications under many circumstances. Therefore, it is necessary to have a better video surveillance system. There are number of challenges in this approach like low contrast, signal to noise ratio, inter-frame coherence, thermal imaging, infrared illumination, etc. Many approaches are developed for enhancing low light video however most of them consider video from moderately dark conditions. In this paper, a new algorithm is proposed in which the illuminated area of the night time image is enhanced to highlight the foreground and then it is fused with the original image to get an enhanced night time image.

II. RELATED WORK

Image enhancement can broadly be seen under two categories. One of which is self-enhancement and another is context-based fusion video enhancement. Self enhancement is the traditional method of video enhancement which enhances the low quality video within itself and they do not add any information from the external source such as tone mapping, histogram equalization and power law transform. Another means is the „Image fusion" method which is also used to enhance the night time video feature by obtaining the information from high quality daytime video. It is a process of combining the relevant information from a set of images into a single image where the resultant fused image will be more informative and complete than any of the input images. Minjae Kim, Student Member, IEEE, Dubok Park, David K. Han, and Hanseok Ko1 [1] proposed a novel framework for enhancement of very low-light video. The image fusion idea was first invented by Marey and Murbridge in 19th century [5], but the main work was done in 2002 by UK ministry of defence to guide the pilots in the night. The first algorithm developed, processes the basic source image which reduces the contrast of the final image. Then emerged the pyramid transform which has the advantage of providing sharp contrast and also the spatial and spectral information of the pixel is retained [3]. But the problem that arised with this transform is its inability to work on real time. After that, wavelet transforms were emerged such as discrete wavelet transform (DWT), and discrete cosine transform (DCT). Their basic limitations include the poor ability to simultaneously enhance all parts of the image. When wavelet transform is used alone it does not provide good results, however, with Intensity Hue Saturation (IHS) transform the results become smoother [8], but Principle Component Analysis (PCA), filter fusion techniques does not give good results. In 2004, Ramesh

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Raskar et al. [5] presented a class of image fusion techniques, which automatically combines images of a scene which is captured under different illumination. A gradient domain technique is also used that preserves the important features while avoiding the problems like aliasing, ghosting and haloing. A linear combination of intensity gradients is used, hence a smooth blend of input images and preservation of important features is achieved. In 2006, Yinghao Cai et al. [7] delivered a novel method of automatically combining images of a scene at different time intervals using Retinex algorithm theory. In 2008, Akito Yamasaki et al. [9], had given a new algorithm called Denighting which uses the illumination ratios of the day-time background and night-time background videos to enhance the night-time videos. In 2011, Jagpal Singh Ubhi et al. [3], gave a new algorithm called FSB (Frame Subtraction Based) image fusion technique. In the given method, the images are fused by taking the difference of all the images in order to detect the changes occurring in them, followed by binarization of images by a filter which is used to remove the noise. Jing Li et al. has described a novel approach of bidirectional extraction which has the ability to extract and maintain the meaningful information like highlighting area or moving objects with low contrast in the enhanced image in addition to recover the surrounding scene information by fusing the daytime background image.

III. PROPOSED ALGORITHM

Night time images provide very less information due to low illumination. So, all the important information of the original low quality night time images are combined with the context from a high quality enhanced image of the same. Thus, the stationary parts in the poor-context night image can be replaced with better quality image context from a high-contrast image. There are two basic processes which are common in almost every algorithm i.e. Foreground extraction and Background fusion. Many algorithms proposed till now give maximum importance to the foreground extraction which is a tedious process. Hence, the the foreground of a poor quality night time image, rather, it enhances the night time picture on the basis of luminance. The image obtained after fusion contains all the features of the input Night time image along with those features which were lost due to poor illumination. The proposed algorithm has following steps- Step I - First of all the input night time image to be enhanced is taken. Step II - Then luminance of the whole image is obtained from the pixel values of the three channels (R,G,B) taken individually. Step III - Then the value of luminance is divided into different frequency levels and value of alpha α is deduced from these levels and luminance. Step IV - If the value of α is greater then the pixel values are replaced by this

Ir = r*(1- α);
Ig = g *(1- α); and
Ib = b *(1- α);

Step V - If the value of α is less than or equal to the individual color pixel value then the pixel values are replaced by this

Ir = r* α;
Ig = g * α;
and Ib = b * α;

Step VI – Next, we perform the fusion between the original image and the image obtained after
Step V.
Step VI- As a result, an enhanced night time image is obtained.

The purpose of calculating luminance and then dividing it into various luminance levels helps in calculating the value of alpha α. Every color channel pixel in the new image is updated according to the value of alpha. If the value of α is less than 1 then that particular color pixel value is multiplied with α in the enhanced image. Otherwise, the pixel value is multiplied with a value one less than alpha. Enhancement of the pixels of the original image is done in order to highly illuminate the important area i.e. the illuminant area of the night time image. After this pixel values are updated accordingly in the enhanced image. Then this image is fused and an enhanced image is obtained having the visible dark areas which were lost in the input night time image and also the illuminant areas are preserved in the fused image.

IV. RESULTS

In the algorithm described, we are enhancing the night time image(we took a night time video and extracted frames from it)by improving the value of RGB pixels of the image with the help of alpha factor. The proposed algorithm provides best and cost effective results based on the quality metrics. Also, the quantity metrics of this method gives better results in terms of Standard deviation, Mean square error and Peak to signal noise ratio. The fused image contains both visible dark areas and the illuminant area of the input night time image. In future, various filters can be applied to further enhance the poor quality images and the values of luminance can also be adjusted in order to get improved results.

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Fig 1: Original Night Image

Fig 2: Enhanced Night Image

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