Video Enhancement to Transfer Night Vision into Day Vision for Surveillance System

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Abstract— Surveillance system plays a very important role for security purpose in real time environment. The video captured during nighttime or under dim light is difficult to monitor and identify the objects in that video. Hence enhancement of video surveillance system is needed for security purposes. The proposed method uses alpha rooting which gives better results for gray level images then applies frame difference with background subtraction using Gaussian filters for moving object detection, and applies color transfer methods such as retinex with wavelet transform to get clarity of objects for human visual perception. The effectiveness of the proposed method is shown with the practical results.
Keywords: Surveillance System, Gaussian Filters, Retinex

I. INTRODUCTION

Videos captured under low lighting conditions face serious loss of visibility. Several enhancement algorithms are proposed for enhancement of night video, these methods face lack of visual perceptual quality of video. Proposed method improves the quality of video using efficient fusion and color transfer methods. Day reference video features are captured from security surveillance system and are used for enhancing night video. Proposed method uses alpha rooting technique and it is the efficient method for enhancing dark pixel video frames. Moving objects are detected using frame difference method to extract the foreground objects. The resulting motion detection video frames and illumination background images are combined using fuzzy C means clustering fusion method. Proposed method uses effective color transfer methods namely retinex and wavelet transform to get effective results. The objective of the proposed method is to track the objects in the night video, which is important to detect a theft in a security system.

II. LITERATURE SURVEY

The surveillance security system captures video under different lighting conditions. Video enhancement plays a key part in nighttime video surveillance so that the objects or activities of interest can be clearly monitored. There is research on this problem and many methods are proposed to solve this problem. There is a simple method of pixel inversion [7] and complex method of building a color estimation model [10] for converting dark into day, but these methods do not provide effective visual perception. The reference image cannot be directly taken for color enhancement [4] due to the major colors in the reference image; it affects the visual performance of the night image [1], due to the absence of bright pixels in the dark video color transfer will reduce the visual quality, hence the illumination fusion by combining the enhanced night and day image [11] is used to get good visual perception. As the night and day images may be different but with same background, so needs to concentrate on object tracking in the night video by using second order statistics features [3] a moving object can be detected under low brightness and low contrast; by using contrast model [9] an object can be detected but it has the drawback of detecting long distance objects. Proposed method overcomes these drawbacks by using simple frame difference and advanced color enhancement methods. The goal is to overcome the limitations of existing methods and to design a robust method to get secured surveillance system where objects can be clearly identified at any time.

III. PROPOSED METHOD

First an input night video is divided into frames and enhanced to normalize the brightness and increases the contrast of an image. The Moving objects are detected using frame difference technique and enhanced using fusion for improving the sharpness of the moving objects. The proposed algorithm fuses video frames from high quality day reference background with low quality nighttime videos to improve the perceptual quality of night videos by enhancing details. The proposed method applies wavelet transform with retinex to improve the image enhancement results. The flow chart of proposed method is as follows

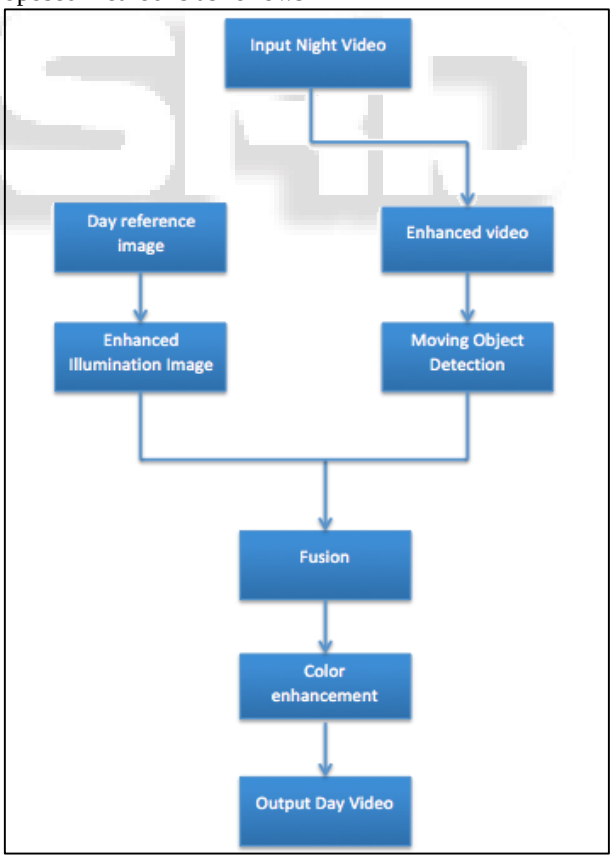

Fig. 1: Flow chart

A. *Extraction of Day Reference Image and Enhancement*

A surveillance security system captures video in different lighting conditions; a day reference background image is extracted and enhanced to nighttime background image using

illumination images. The input image I(x,y) is considered as the product of illumination L(x,y) and reflectance R(x,y).

$$I(x,y)=L(x,y)\times R(x,y) \quad (1)$$

L(x,y) represents low frequency components of an image while R(x,y) represents high frequency components in the image.

The proposed method uses weighted average image fusion algorithm to enhance nighttime background image. The proposed algorithm uses following fusion equation.

$$B(x,y)= \alpha*N(x,y)+(1- \alpha)*D(x,y) \quad (2)$$

Where B(x,y) is the resulting nighttime background image, N(x,y) is the night time illumination image and D(x,y) is the daytime illumination image. The factor α is in the range [0,1]. The proposed algorithm determines α by the mean of nighttime and daytime illumination images based on image enhancement experiments.

B. Enhancement of Night Video

In nighttime video surveillance system video enhancement plays a very important role. The goal of enhancement is to improve the visual appearance of the video. It is difficult to extract objects in the night video due to low contrast. Enhancement of night video is to facilitate extraction of moving objects. Proposed algorithm uses alpha rooting method to enhance the video frames and it is best suitable for high dynamic range image operations. Using alpha rooting method the day and night background illumination map is estimated.

C. Moving Object Detection

The objective of tracking is to establish correspondence of objects and object parts between consecutive frames of video. Object tracking is the method of detecting moving objects of interest and plotting its route by analyzing them. The object-tracking algorithm utilizes extracted object features together with a correspondence matching scheme to track objects from frame to frame. Object detection in a video sequence is the method of detecting the moving objects in the frame sequence using digital image processing techniques.

Every video consists of moving and non-moving objects. It is important to track the moving objects in the video. The proposed algorithm uses frame difference technique. Each and every frame is tracked to trace objects. The proposed methodology feature is to separate objects from the frame and identify them in that image frame. The motion blocks in the current frame are grouped as clusters. The matching information of motion blocks is compared between the current frame and the previous frame. By this comparison, moving objects present in that frame are traced.

D. Fusion

Image fusion is used for imparting all relevant and complementary details from multiple sources of image into a single composite image. Fuzzy c means clustering is an unsupervised and robust clustering algorithm, which allows one input vector into two or more cluster regions. FCM algorithm partitions a input data set x_i, where i=1,2,…N, into C fuzzy clusters by assigning membership value to a data point to various clusters. Membership values are evaluated by minimizing the given dissimilarity objective function as follows

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{C} u_{ij}^{m} \parallel x_i - C_j \parallel^2 \quad (3)$$

Where m is any real value greater than one and set to two. Fuzzy portioning is carried out by iteratively optimizing the objective function and updating membership of u_{ij} and the C_j cluster centers. Where u_{ij} denotes the degree of membership of x_i in the cluster region j. x_i is the i^{th} of d-dimensional input data. C_j is the center of the cluster region j and $\|*\|$ is any norm representing the similarity between any measured data and the center.

Proposed fusion method is based on segmented regions of source images obtained by a fuzzy-C means clustering algorithm and is the robust clustering method. Principal components are evaluated for the clustered regions of source images and average of all principal components is evaluated to get fused result as a linear combination of input images. The block diagram of the proposed method is shown in fig.2. This algorithm is applied to get fusion result with maximum average quality index.

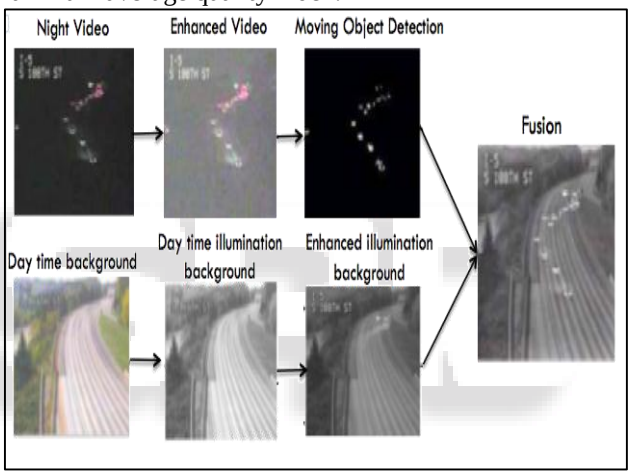

Fig. 2: Block diagram of proposed algorithm

E. Color Transfer

The novel fuzzy C means clustering based fusion method is presented and by applying color transfer methods such as retinex and wavelet transform the night video is transformed into day video. The retinex algorithm enhances the image similar to the human perception of the scene compared to other color image enhancement methods. It gives a computational human vision model to enhance the image with dynamic range compression and provides color constancy. Retinex algorithms deal with two parameters, illumination and reflectance. It is based on center algorithm; the center pixel value is compared with surrounding average pixel values to get a new pixel value.

There are different types of retinex algorithms; Single Scale Retinex (SSR), Multi Scale Retinex (MSR) and Multi Scale Retinex with Color Restoration (MSRCR) algorithm. These methods have some limitations. SSR cannot simultaneously provide dynamic range compression and tonal rendition and images are suffered from color distortion. MSR provides dynamic range compression and tonal rendition. But MSR output images violate gray world assumptions hence suffers from graying out of the image

either globally or locally. Main problem of MSRCR algorithm are the presence of halo artifacts at edges, graying out of low contrast areas and bad color rendition.

The fused night video contains the color that is transferred from the day reference image and due to the statistical property of day reference image produces an unnatural color transfer. That is modern retinex algorithms also suffer from color violation and unnatural color rendition problem. The Wavelet transforms is the very good technique for image de noising and is found to be capable of improving both global and local contrast as well as preserving color consistency. Hence effective color transfer methods retinex with wavelet transform is applied for efficient results as shown in fig.3.

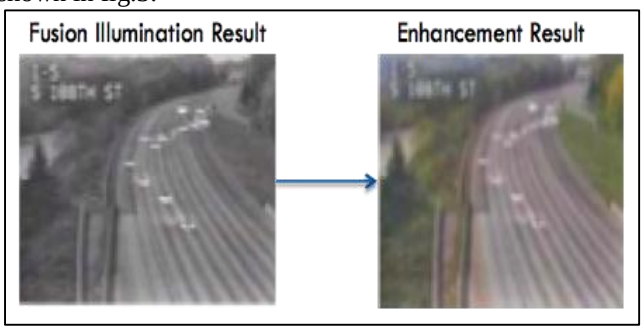

Fig. 3: Enhanced result after color transfer

IV. ALGORITHM

Algorithm: Night video enhancement using fusion and color transfer methods
Input: Night video, Day reference image
Output: Day video

1) Extract day reference image from day video and make illumination changes
2) Improve contrast of the night video by using alpha rooting enhancement
3) Identify the moving objects in the night video using combination of frame difference and background subtraction method
4) Generate the fused image with enhanced night image and day reference image by using fuzzy C means clustering technique
5) Apply color enhancement methods retinex and wavelet transform for color transfer from night video into day video

V. CONCLUSION

Enhancement of night vision into day vision using fusion and color transfer methods is proposed. The algorithm extracts day reference video and enhances to nighttime background image. The alpha rooting method is efficient to enhance dark pixels but difficult to extract parameters hence feature work is simplifying the parameter computation using the measure of enhancement. The input video is enhanced using alpha rooting and applies fuzzy C means clustering algorithm for fusion and finally applies color transfer methods to the frame fusion video. The result demonstrates that the proposed algorithm is robust method. Objective measures can be applied to evaluate the performance of proposed method.

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