VIDEO DEHAZING USING AIRLIGHT ESTIMATION WITH GAUSSIAN APPROXIMATION

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Abstract— *This project presents design and implementation of video dehazing unit using Air-Light Estimation with Gaussian Approximation(ALEGA) algorithm. This algorithm provides an efficient removal of fog present in the video and provides higher resolution output video. The video is blended with fog contents when the air-light is interact with the original image, as a result the air-light is the main content of the original video from the camera. As the air-light is very bright, the air-light estimation technique directly select the bright pixels for air-light and the gaussian approximation selects the air-light in the brightest region of the input image. The color similarity estimation is also used here to refine the images. This estimation provides higher resolution in the order of 480*270 and low time complexity.*

1. INTRODUCTION

In foggy weather, visibility degradation occurs when observers perceive object light blended with air-light due to scattering caused by a medium in the atmosphere, such as small water droplets. Degraded visibility in a foggy image then affects the effect of computer vision techniques, including motion detection; face tracking, license plate recognition and so on. Hence, for multimedia devices, such as advanced driver assistance and video surveillance systems, fog removal techniques play an important role for improving the visibility of the images.

Since surveillance cameras are often installed outside and are expected to stand the test of 24/7 operation, they are frequently exposed to strong light, rain, snow, and fog. These environmental conditions have a great influence on the image quality of the surveillance camera, especially the fog. The aerosol particle containing moisture and fumes in the fog is the main cause for the degrading of the image quality. The low contrast ratio when foggy decreases the image quality so that the details of the scene can't be seen clearly. Therefore, defog technology is one of the imperative technologies for outdoor surveillance.

At present, one common approach for defogging an image is to use a specific optical component that senses more IR information in fog. One of the liabilities of this physical means is its high cost. Advancements in the development of digital technology brings about the defog image processing technology. This technology adjusts the distribution of the information captured by the image sensor, and enhances the color and details of the surveillance target to decrease the information loss during subsequent processing.

In this proposed paper we are going to implement the defogging technique by using Air-Light Estimation with Gaussian Approximation method to reduce the time complexity and reduce the complexity present in the DCP method, which uses the soft matting technique for thresholding. Instead of soft matting the proposed paper use Luma thresholding.

2. EXISTING METHOD

Currently DCP algorithm used in the defogging. This is a fast and efficient haze removal for algorithm applicable to static images. In the previous method Otsu algorithm is used, but it has more number of iterations to perform the operation. To overcome this drawback the ALEGA is used along with guided filter.

The DCP method is an effective method to find the transmission map instead of the depth map. In this algorithm, a weighted technique is employed to refine darker atmospheric light used for obtaining high contrast image which means that the components of image histogram cover a broad range of the gray scale. In addition, this existing system executes an edge-preserving transmission estimation process with a low-pass filter to reduce the halo effect on object contours. Moreover, the adjustment of atmospheric light values was considered to accommodate for the difference between videos and images.

The operating procedure of the DCP algorithm can be separated into three main parts: atmospheric light estimation, transmission map estimation, and scene recovery. First, a mixed weighting technique is proposed for determining an appropriate weighting value for different atmospheric light in bright and dark portions. Second, object contours are detected and an edge-preserving low-pass filter and dark channel are alternately applied to estimate the transmission map. Finally, the image is recovered based on the equation derived in the previous section.

A. Otsu Algorithm:

For the thresholding process the Otsu algorithm is used in the existing method. Otsu's thresholding algorithm method involves iterating through all the possible threshold values and calculating the measure of spread for the pixel levels each side of threshold, i.e. the pixels that either fall in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum.

The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread is minimal, or equivalently so that their inter-class variance is maximal.

On the basics of this threshold, the pixels of the input image were divided into bright and dark regions to form the basis for achieving an efficient atmospheric light estimation. Due to this, Otsu's algorithm requires several iterations (usually 255 iterations).

B. Disadvantages:

- This method is only suitable only for the single images for fog removal and can't be applied for the dynamic scenes.
- DCP has highest time complexity because it uses Otsu algorithm for thresholding it may take time complexity in the order of 18.95 secs.
- The number of saturated pixels (sigma) is not constant in this algorithm.

3. PROPOSED ALGORITHM

In this proposed method Atmospheric Light Estimation with Gaussian Approximation (ALEGA) is used for the removal of fog in the video. It is compute the average color from the refined candidate pixels for air-light estimation. In this method provide more accurate and less time complexity.

Finally the output will be filtered by using guided filter, to compare the original image with the guided image to provide perfect filtered image.

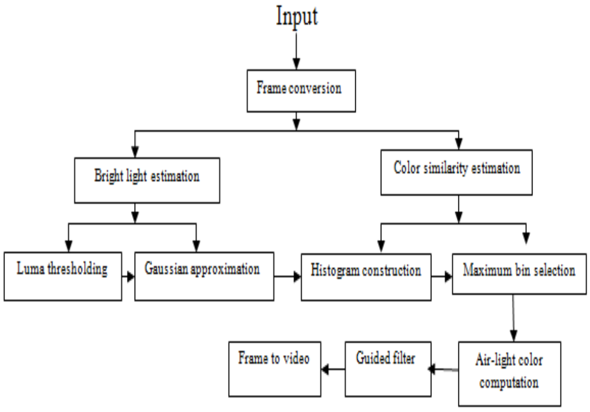


Fig.1 Block Diagram of ALEGA.

A. Air Light Estimation With Gaussian Approximation:

In general, air-light estimation can be performed by manual and automatic methods. The manual method directly defines image regions affected by air-light, but it is inapplicable for realistic application due to frequent interruption. In contrast, the automatic methods are more convenient. So, here the estimation is done automatically.

Basically, the proposed ALEGA method has two characteristics:

1. It computes the color probability to select precise candidates for air-light estimation.

2. It does not construct the dark channel before air-light estimation

B. Luma Thresholding:

The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T or a white pixel if the image intensity is greater than that constant. This is the normal thresholding process.

In Luma thresholding the whole thresholding process is carried depends on the luminescence value of the image. The luminance threshold effect generates a matte by thresholding the luminance of an image. Thresholding is a method to segment or isolate a certain zones in an image. This effect will isolate areas based on image's luminance.

This algorithm works well with bitmap images that have many shades of colors. A pure vector image with flat colors could use a color override to isolate areas.

Luma Thresholding Properties:

1.Threshold.
2.Soften Colours.
3.Gamma Correction.

C. Gaussian Approximation:

According to the three-σ-rule of Gaussian distribution, most of the values drawn from a Gaussian distribution are limited within one standard deviation away from the mean. Therefore local mean and local standard deviation of the rough candidates have to be computed to select the significant ones.

This kernel is an approximation of a Gaussian function,

$$h(u,v)=\frac{1}{2\pi\sigma^2}e^{-\frac{u^2+v^2}{\sigma^2}}$$

μ=mea σ^2=variance; σ=standard deviation.

D. Histogram Construction:

Histogram modeling techniques (e.g. histogram equalization) provide sophisticated method for modifying the dynamic range and contrast of an image by altering that image such that its intensity histogram has a desired shape.

In order to estimate the similarity of the candidate pixels, we construct a 2-D histogram that involves Luma and Chroma information.

Let image i, in which the intensity (I) at pixel with coordinates (x,y) is I(x,y) and write the histogram h, as h(i) indicating that intensity of i, appears h(i) times in the image. If let the expression have the value 1 when a=b, and 0 otherwise histogram h(i) can be written as,

$$h(i)=\sum_{x}\sum_{y} I(x,y)=i$$

Histogram determines, contrast, aperture, lighting level and scene.

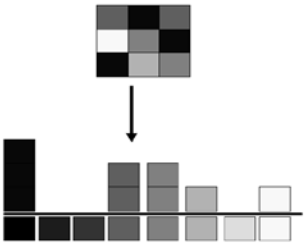


Fig.2.Histogram Diagram

E. Maximum Bin Selection:

In the selected candidates, the most representative pixels have the same color information and the highest probability densities. Hence, we select the maximum bin of H2D denoted by,

$H_{2D}^{max} = Max(H_{2D})$.

F. Air-light Estimation:

In foggy weather condition image become degraded due to the presence of Air-light, because it is generated by the scattering of light by fog particles.so air-light estimation is suitable method for remove the fog in fogged image with that back ground.

In average, the execution time of the overall dehazing is reduced by 41.3% by the fast execution of the air-light estimation when compared to that of the system based on the original method while the dehazing quality is maintained

In the air-light estimation the size and colour of the image or video is taken in to account and the sky regions brightness is fixed. The brightness of the image is increased against the sky region this is called contrast of pixels between image and sky.

Comparison to the air-light estimation scheme in the existing method, complexity can be reduced significantly because the pixels belonging to each sub region need not be sorted but rather searched for the maximiser of the dark channel intensity.

G. Guided Filter:

The guided filter computes the filtering output by considering the content of a guidance image, which can be the input image or another different image. Guided filter uses the colour images for implementation because colour guidance image can better preserves the edges that are not distinguishable in gray-scale. Guided filter simulation done using MATLAB

The guided filter performs edge preserving smoothing on an image, using the content of the second image called a guidance image, to influence the filtering.

Guided image filtering is a neighbourhood operation, like other filtering operations, but takes into account the statistics of a region in the corresponding spatial neighbourhood in the guidance image when calculating the value of the output pixel.

4. EXPERIMENTAL RESULTS AND SYSTEM ANALYSIS

The proposed system is implemented using MATLAB and it is compared with the existing method by using two different parameters. They are,

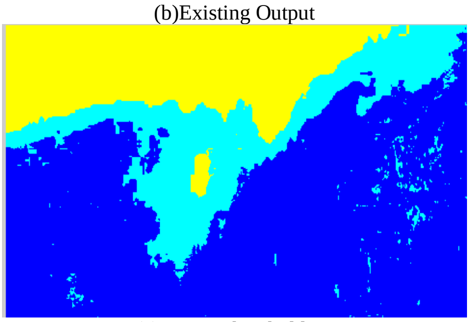
1. Resolution.
2. Time Complexity.

Table No.1 Comparison between Existing and Proposed method.

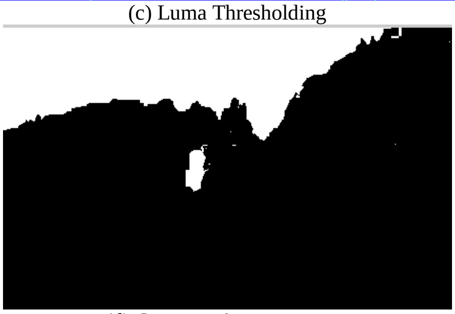
S.No.	Algorithm	Time Complexity (secs)	Resolution
1.	DCP	18.95	270*128
2.	ALEGA	8.995	480*270

(a)Input Frame

(b)Existing Output



(c) Luma Thresholding



(d) Gaussian Approximation

(e)Histogram Construction.

(f) Our Output Frame

Fig.3.Experimental Results.

The above experimental results shown our experimental results will provide better resolution compared to existing method and each process outputs of this proposed paper.

The resolution is hiked in the proposed method by eliminating soft matting technique in the DCP algorithm.

5. CONCLUSION AND FUTURE WORK

In this paper defogging method using Air-Light Estimation with Gaussian Approximation is proposed with Guided filter. The resolution and time complexity of the execution are the main thing which is considered in the image and video processing. By implementing this paper the time complexity of the existing method is reduced from 18.95 secs to 8.995 secs. The resolution of the video is increased from 240*128 to 480*270. In future work the resolution of the video will be increased by reducing the calculation of air-light estimation and improve it in the real time applications.

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