Vision based Vehicle Detection with Fog Removal Algorithm

Divya Sahgal, A. Ramesh

Abstract*: *The present study proposes a vision-based technique for Vehicle Detection in foggy weather condition. The methodology used in this approach is based on image processing. MATLAB is used to execute algorithm with image processing toolbox. Gabor wavelets technique has been used to extract features from images. This paper aims to improve the visibility of degraded images due to foggy weather condition, which can be used for the vehicle detection at traffic intersection for traffic control and management. It proposes an improved technique with fog removal option for the restoration of low-density image, which is damaged by reducing the contrast of the picture due to foggy weather. The proposed methodology combines the CLAHE method and adaptive gamma modification to achieve the purpose of this research work. This algorithm works effectively in different weather situations to ensure efficient vehicle detection at the traffic intersection.

Index Terms*: *MATLAB, Vision-Based; Intelligent Transportation Systems; Applications; Vehicle-to-vehicle; Vehicle detection; Fog Removal; Image Processing

I. INTRODUCTION

Vision based techniques have been applied to transportation for many purposes including traffic monitoring, estimation of traffic speed, traffic light state detection and accident detection[1-3]. Growing urban population and increased disposable income have resulted in an increased vehicle count on the road. This has led to problems such as traffic congestion, prolonged travel time, increased fuel consumption and traffic delays. While systems such as fixed light traffic control systems, vehicle actuated systems, inductive loops, magnetic loops, etc. use real time data and have been proposed and tested for traffic control, these systems have been found to suffer from drawbacks such as limited coverage and higher cost of implementation and maintenance [5]. Vision based traffic control techniques (e.g. image sensors) may provide a cost effective solution to the aforementioned problems while overcoming the limitations of conventional methods. The technique proposed in the article is for removal of fog from the video frames captured at the traffic intersection, which can be used as an cost efficient alternative for vehicle detection at traffic intersection to control the traffic. Adverse weather conditions like fog affects feature detection into the images, segmentation, object tracking and recognition. If any disturbances are found in the environment due to the weather, the vehicles can not be identified clearly. The atmospheric particles such as fog, mist, etc. that cause poor climate may significantly damage the information present in the image. As well as reducing the visibility of the color picture of the traffic scene at the intersection. For this purpose, various methods have been proposed earlier to improve the visibility in bad weather. The first method is using polarizing filters in which the number of images are determined and the ex- tension of this such as polarization with two different degrees of precision (DOP) are used. In all these methods, eyesight, bad weather reduced visibility of object, the size and the presence of large particles are inevitable. Unfortunately, these methods do not always give accurate results for the visibility of the fog degraded image. In this study, Median and Wiener filter are used as the image filtering techniques for cleaning the fog from the image and clear visibility, for detecting the vehicles at traffic intersection. Brightness of objects scattered by the particles are absorbed from the existing corrupt picture to enhance the visibility. Wiener approach using two filters is used to achieve the purpose of this re- search. It is the image filtering and cleaning technique used for the foggy images[9] . Following the promotion process (i) the appropriate attenuated particles reflect the light, and (ii) a change of the camera straight to the spread of the beam of the outside entity. This effect reduces the haziness of the picture by increasing the object visibility within the foggy environment. The present study proposes an intelligent vision based vehicle detection approach that utilizes video data to detect vehicles at an urban traffic inter-section. Matlab software has been used as an image-processing tool in the present study. A brief overview of how the system functions is given below:

1) Real time image acquisition by using image-sensor.
2) RGB to gray scale image transformation.
3) Image enhancement.
4) Morphological operations.

First, installing a camera at the intersection to capture a video footage of the road. The video comprises consecutive frames, each frame can be compared to the previous one.

For feature extraction, this study uses Gabor Wavelet technique, which has not been used for foggy weather condition before.

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The Gabor Wavelet technique is superior to other techniques in terms of detecting size and pose of vehicles. Another advantage of this technique is that environmental noise and lack of visibility or illumination do not affect its results. Thus, the results obtained through this technique are more credible and reliable. Various studies have been carried out in the past for vehicle detection. Object recognition in the field of computer vision focuses on the task of identifying or locating a set of objects in an image or video sequence. Computer vision literature mentions many approaches to solve the object recognition problem, which are used in diverse fields. Under the worst climatic conditions, the bright-ness of the image is the spread by camera. Reduced visibility due to environmental disturbances and image quality degrades perceptual algorithms such as when the computer monitor, track, and steering presentation. Therefore, it is particularly essential to strengthen the construction of the vision algorithm in climate change. Schedule based on optical effects, in the form of bad cli- mate conditions broadly into two categories, permanent and robust. The image histogram equalization to enhance the general scheme has been identified. However, the global histogram equalization is still easy and fast, not so appropriate because of the fog result in the image captured by the camera. The present study adopts an appearance–based approach for vehicle identification at the intersection. It employs multi-scale Gabor wavelet representation of objects using only a small set of object models and sensor model along with a flexible matching mechanism for vehicle detection at the urban traffic intersection in real-world situations.

In this paper section II describes the problem specification. Methodology is explained in section III. Experimental setup is given in Section IV. Section V contains the concluding remarks.

II. PROBLEM STATEMENT

The rapid growth of traffic on roads today has created serious problems, especially in urban areas. Existing automatic time based traffic control systems at intersection are becoming increasingly inefficient for the reason that such systems are unable to make intelligent decisions to ensure efficient flow of traffic and reduce vehicular congestion[7]. This results in unnecessary waiting until the pre-set signal time elapses, or multiple rounds of traffic light turns before the waiting traffic can move. The present study pro- poses a vision based vehicle detection at urban intersection with fog removal algorithm, which collects real time data and on the basis of such data, decides traffic light state to show. The proposed algorithm works effectively in different situations including foggy weather to ensure efficient flow of traffic at the intersection. Feature extraction is done using Gabor wavelet. Return images that are suitable compensation model with the image degradation model to calculate the difference. They offer superior picture version of the image. According to the climate conditions of fog, under the spacing and color of the character image is destroyed seriously. There are clear differences between the resulted images over the foggy image. Therefore, in contrast to the fog scene, algorithm should be improved. Resolution Enhancement foggy and chrominance image recovery to maintain the integrity of the color of a image due to the complex weather is a challenge. During foggy image enhancement, remember that it leads to the enhancement of saturation on the pixel values . So, to avoid saturation image enhancement should be surrounded by some of the limitations and appropriate to protect the integrity of the color. In contrast to the end in sight, and the exponential molder crosses inside the depth of the point of sight is changed. Therefore, image processing techniques have changed enough to break away from the image of the normal climate is to take effect. Here is a color image, RGB path used for the purposes of a charge of beating the air, the light mist of a vague image of a simple alteration of the recommended method for estimation will command. However, it is estimated the figure to be consistent light wind. This is to make the existing system, as it is still valid in the light wind did not finish sharing the pictures are developed.

III. METHODOLOGY

If M. Zanin et al. addressed a method for vehicle queue detection[4]. This scheme is based on movement analysis in which background information is needed therefore it is not well suited for congested scenes like intersection. J. Kato et al. proposed a segmentation methodology which is based on HMM-based for classifying the objects in traffic images as foreground, background objects or shadows[6]. We did not use the approach which rely on motion analysis, in fact it can work well in the congested traffic situation also. Another difference is the vehicle detection is done inside the blocks. It eliminates the requirement of vehicle segmentation and to measure the vehicle queue length, the blocks containing the vehicles are counted. We used a well known model based approach - “Gabor wavelet transform” - to extract features. The main reason behind selecting Gabor wavelets was its multi-resolution, multi- orientation properties. Also, it is more efficient and accurate as compared to traditional approaches; saves neighborhood relation- ships between pixels; is easy to update; possesses fast recognition; and has low computational cost . Initially the live video is captured by a stationary camera installed at an intersection, which is known as image acquisition process. After that frames are extracted continuously from this live input video. Then, we crop the image to select the region of interest. Here, the area where the vehicles are present is retained and unnecessary surrounding information is filtered out. Next, presence of objects is enhanced by binarization of image differencing.

A. Image Representation

The basic requirement of digital image processing is that the images be sampled and quantized. We can represent image in analog or digital format. In this system digital image representation is used, in which images can be represented in gray-scale or colour format. The gray- level images are represented as 8-bits which allow 256(0- 255) possible gray colour.

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B. Image Analysis

The steps involved in image processing are as follows:

- Video capturing via camera
- Converting video input to frames of images
- RGB to gray-scale conversion on images
- Image enhancement
- ROI selection
- Feature extraction using Gabor Wavelet

When the outside weather condition like fog, which reduces the quality of the image captured by reducing the contrast of the object does not exist. This paper gives improvement and the option of a fog or a low-density image used for the restoration of visibility. The proposed algorithm is applied to mix the former path, CLAHE and adaptive gamma modification to achieve the purpose of this research work.

C. Fog degraded Image Enhancement

Fog, adversely affect the quality of the obtained images. As a result, in contrast to the distortion of the image frame shows hazy mist. This type of vision is based on the environment than the normal surveillance system causes poor performance. We estimate the depth of the images using the relative time difference by incorporating a contrast enhancement. Representative experimental results prove that the fog-degraded image contrast enhancement algorithm is effective.

Also, a dark channel is used for prior single image. This ghostly special effects showed a good performance. However, using multiple images using a single detail can provide more information. We offer an effective model for estimation and depth and contrast enhancement appears to be using it for. Experimental results indicate that the proposed depth estimation models produced satisfactory defogging performance.

D. Image filtering Approach

Foggy, hazy weather conditions degrades the quality of the images, in the sense of charge and mist extraction. The proposed algorithm improves the visibility of gray or color images into visibility capability of the air. In the haze, fog, and mist there may be difference between the amount of spaces. Visibility poverty and the spread of the beam is in the interest of particles inside the impression. Mostly a spectator visibility with the object since the scattering of the particles, the sun began to disperse the particle beam and a witness at the scene streak to relax the atmosphere, thus reducing the difference between the entity and the background of the picture.

The median filter is similar to that test by a large impressive mask with improved low-touch, even through the haze level should be achieved and maintained the power to change. With dark channel prior, normal broadcast and fogless coefficient is calculated for the image. As a result, the projected image algorithm increases the transparency and the appropriate medium. In addition, it can look like the high-tech methods, and that they result in a higher level. Improving the visibility of the image outside of the immersion method are two main categories. The first non-model-based methods such as histogram equalization, the premise of the retina. The second is wavelet Transform. However, the shortcoming of this approach is the development of low-set to maintain the color and shape. There are three steps to improve the quality of fog degraded image frames:

1. CLAHE Method:-

Adaptive histogram equalization is a form of partial CLAHE comparison. Hazed image processing method for the forecast weather data is not required. First, foggy conditions as RGB image is transformed inside the camera (red, green, and blue) color space lab to change the color of the gap[14]. A Lab color space by a color used for precision measurements with the opponent to be gaps (a, b) the shade intended for the size of the opponent, the base of the CIE XYZ color space as determined nonlinearly inserted.

2. Dark Channel Prior: -

Dark channel dehazed to the impressive figure of the beam can be used to calculate more accurate results. This technique is mostly non-air patch used for the smallest quantity of pixels of a single color, as on the way there is extremely little power[19-20]. Because the brightness of the image to be met, the image with bad channel will be shaded. Mist (light wind) to appropriate, without fog image will be brighter than its image. So we see ghostly fog higher resolution image of the dark channels in the region would not be able to have high strength. Thus, the amount of fog in the channel width of shady visually robust estimates.

3. Adaptive Gamma Correction:-

Video or image in the rest of the system is a nonlinear process and decode the code. Gamma alteration defined by the power law expression:

$$V_{out} = A\, V_{In}^{\gamma}$$

Where the value of an effort to produce a stable, non- negative real value; A = 1 common container in the classic series between the input and output of 0 - 1. A gamma value $\gamma < 1$ times the compressive power-law nonlinearity of the training methods of training with a call gamma, gamma density to be called; Equally a gamma value> 1 with a decoding gamma-friendly power- law nonlinearity of the request be referred to the development of gamma-called γ.

E. Proposed Algorithm

Step I. Capture real-time video via camera and convert this video input to frames of images.

Step II. Input the degraded foggy image frame INPUT(x,y) be of size M*N, Select Region of Interest(ROI) to extract the features by Gabor wavelet.

Step III. Convert the input image to HIS space and take the intensity component of this image as I(x,y) and pixels in a block B(x,y) mask of size m*n.

Step IV. Apply CLAHE method on L*a*b colour gap operation to set equilibrium in the outcome of the brightness and colours of the video frames. Take the output image as OUTPUT(x,y). Initialize two matrices of size M*N named as SUM and COUNT by zero. Where SUM stores the sum of changed value of pixels at location(x,y) at each time the mask passes through it due to overlapping. And COUNT stores the frequency of filter mask passing through a pixel location(x,y).

Step V. Calculate the Dark channel to resolve the consequence of fog from digital vedio frames by finding the pixel of highest gray level in the input component.
PIXEL=MAX(I(x,y))

Step VI. Adaptive gamma improvement is applied as a post dispensation operation to enhance the brightness of the frames by getting the higher region of the image.
Higher Region= PIXEL-Threshold
IF 220<PIXEL< 225, THEN Threshold=25 ELSEIF 150< PIXEL<220, THEN Threshold =15 ELSE Threshold=10

Step VII. Get a block of pixels named as BLOCK, with x=A and y=B from the I(x,y).

Step VIII. Find the minimum intensity value in the block
L= MIN(BLOCK(x,y))
Then apply the contrast enhancement accordingly

Step IX. Repeat step 4 to 8 for the whole image.

Step X. Take the average of the values changed at location(x,y) to get the enhanced output image.
OUTPUT(x,y)= SUM(x,y)/COUNT(x,y)
After the application of the proposed algorithm, we got a lot of recovery in the images. The size of each image will be changed.

IV. SIMULATION AND RESULT

After In order to execute algorithm, MATLAB is used with Image Processing Toolbox. Inside the command to cross the support of the implementation of the strategy also contains non-linear enhancement. Such changes to the image, and the image of the beam pattern has been changed. Fig (1-6) shows the changes for each image is set to recover, used in this study.

After applying the algorithm, results are found for video frames and it has been seen that images are free from fog. We have analyzed the optical effects for evaluation of the new findings. While comparing the results, the benefits of this approach are shown. We have to improve visibility as a single misty image using low- rank average filtering techniques. We estimate the depth of the images using the relative time difference by incorporating a contrast enhancement method propose to fall into the fog. Experimental results show (fig. 1-6) the future development of algorithms for the gap in the fog-degraded image.

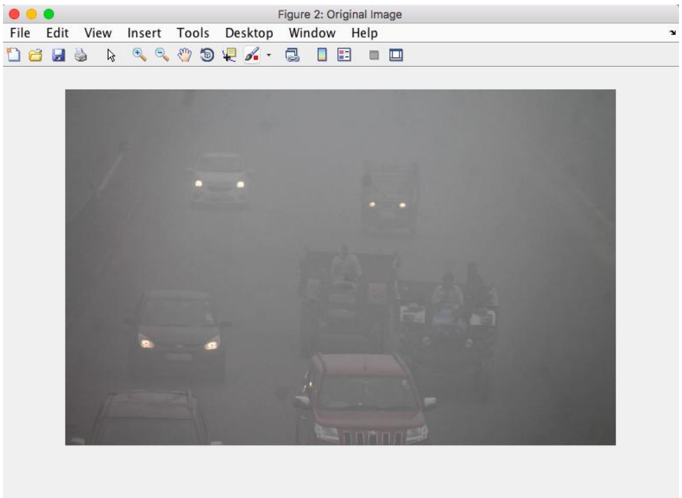

Fig. 1. Original Image degraded by Fog

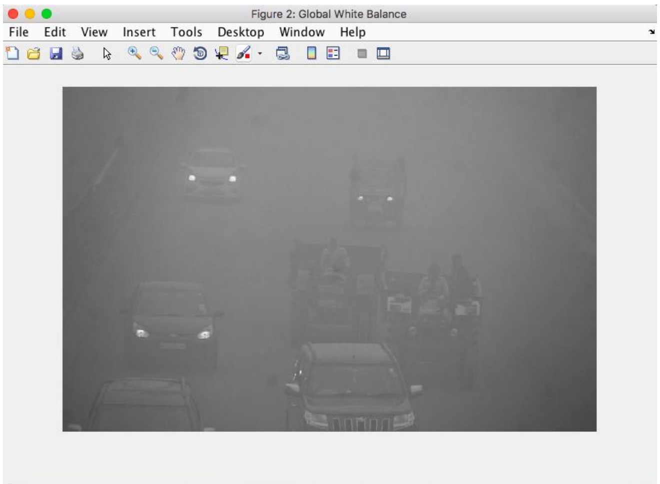

Fig. 2. Global White Balance Image

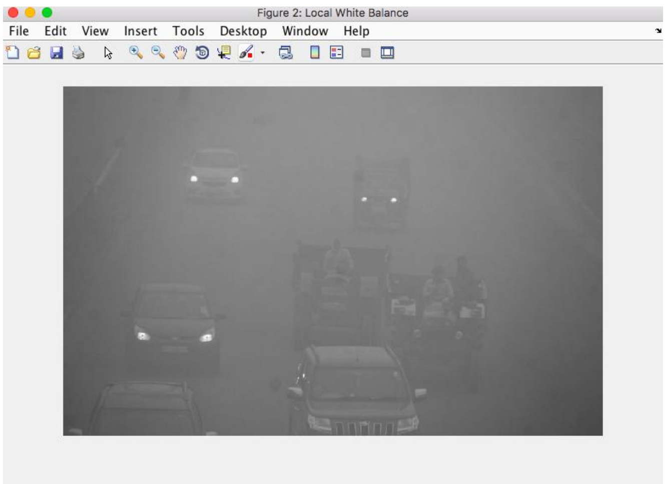

Fig. 3. Local White Balance Image

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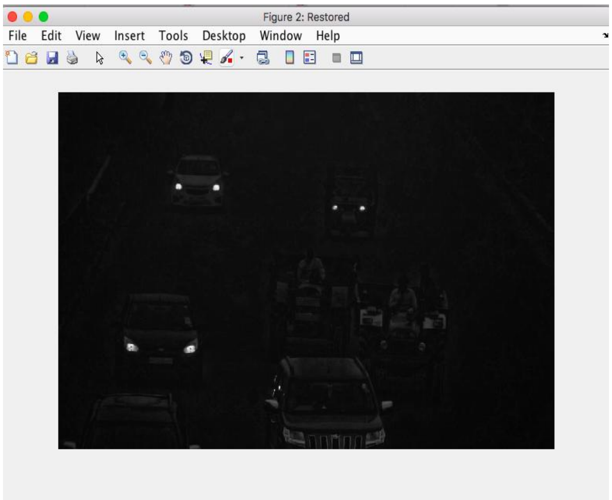

Fig. 4. Restored Image

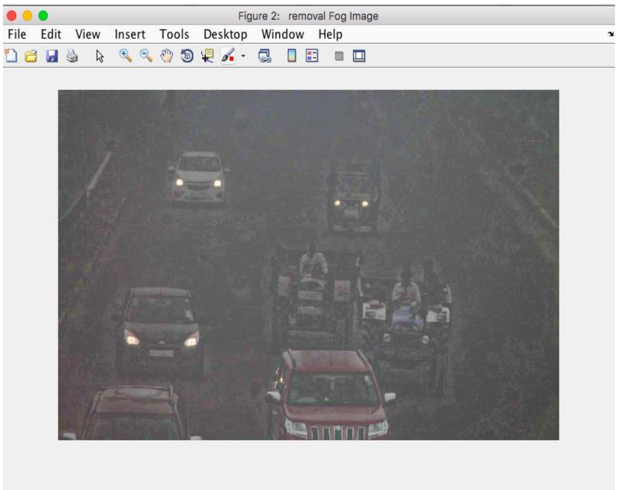

Fig. 5.Final Image after Fog Removal

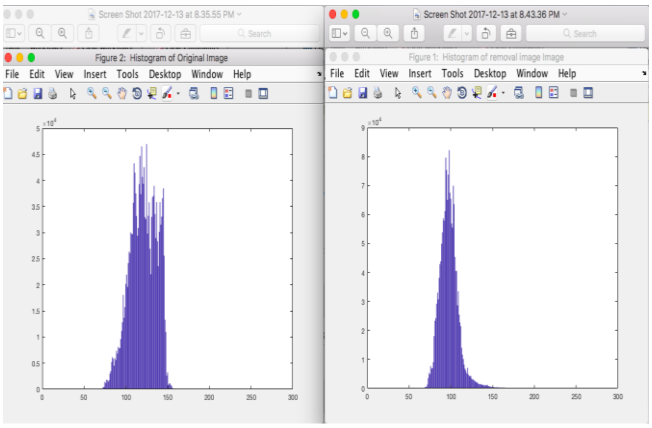

Fig. 6.Histogram Of Original Image And after Fog Removal

From results(see fig 1-6), we can see the visibility enhancement in the foggy weather condition. Vehicle can be identified more clearly with a significant improvement in the image quality. Finally we can calculate the traffic density in the particular region of the image frame by simply counting the total vehicles. The greater the vehicular traffic on road, the greater will be the covered area and therefore more will be the green light time assigned to that particular road, so that the traffic may move for a greater amount of time to clear the road.

V. CONCLUSION

The present study proposes an intelligent vision based technique that utilizes real time video data to detect vehicles at an intersection in foggy weather condition and on the basis of these data, decisions can be made on traffic green light splits. The data gathered by the system can also be used for vehicle tracking, counting and classification in the future. The method may reduce traffic congestion and time wasted when waiting for a green light on an empty road. While simulations show that the proposed algorithm works well on the live feed considered in the study, further studies need to be conducted in different geographical areas with different traffic densities at distinct times to determine the efficacy of the system in general.

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