Single Image Haze Removal Method Using Conditional Random Fields

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Abstract- *To enhance the visibility, saturation, contrast and reduce the noise in a foggy image. Outdoor scenes are often affected by fog, haze or smog. To capture such landscapes as fog or haze adds significant visual pull. Fog and haze degrade the quality of preview and captured image by reducing the contrast and saturation. As a result the visibility of scene or object degrades. In previous method formulated a refined image formation model that accounts for the surface shading in addition to the transmission function. Then proposed a Markov random fields-based approach which estimates depth using the contrast from the local image patches. After introduced an effective image prior, dark channel prior (DCP), to remove haze from a single input image. The prior is based on the observation that local patches in clear day images contain some pixels which have values close to the dark intensity in at least one color channel. The computationally efficient approach, however, occasionally results in blocking artifacts during refining the local patches using closed-form matting. Recent trends in single image dehazing are focused on learning-based approaches, including a random forest regressor-based approach and a convolution neural networks (CNN)-based approach.*

Keywords*-* Red,Green and Blue(RGB), Convolution natural networks(CNN), Cantrast noise ratio(CNR).

I. INTRODUCTION

Haze is caused by particulate matter from many sources including smoke, road dust, and other particles emitted directly into the atmosphere, as well as particulate matter formed when gaseous pollutants react in the atmosphere. These particles often grow in size as humidity increases, further impairing VISIBILITY. Haze pollution can be “trans boundary” if its density and extent is so great at source that it remains at measurable levels after crossing into another country’s air space. Images captured in awful climatic conditions normally lack visual vividness, and provide poor visibility of the information content of the scene, emerging from the fact that light is absorbed by the murky medium such as small molecules and water globule in the atmosphere along the line of sight. Moreover, most of the systems that usually depend on the interpretation of the input images fall short to work as usual due to the degraded images.

Natural scene images reduce its contrast, resolution and experiences color changes due to the effect of fog, smoke or haze. Although the fog or haze seems to be similar but are different in the way that the fog is thick and obscure while the haze is thin and translucent. The image quality is severely affected due to the atmospheric light that mixes with the light coming from different directions. Haze, an atmospheric phenomenon due to an aggregation of condensed water vapor and dust, is the major cause of reduced visibility. Deterioration of image quality in hazy conditions is an issue that needs to be dealt with in most outdoor vision applications such as surveillance and autonomous navigation. Haze removal from a single image has been a challenging problem because the haze transmission depends on the depth.

To enhanced image refinement technique which is based on air light calculation. The method uses multi level transmission maps using different block sizes followed by cross bilateral filtering for better noise removal and edge enhancement. The method is faster as compared to other existing techniques, real time fog and haze removal is a challenge. A Contextual Regularization de-hazing algorithm is proposed by which to dynamically repair the transmission map and thereby achieve satisfactory visibility restoration. These techniques restore the hazy images based on the estimated transmission (depth)map. Our contribution is a new contextual regularization that enables us to incorporate a filter bank into image de-hazing.

Existing dehazing methods of remote sensing imagesinclude radiative transfer based methods and imagebased methods. Radiative transfer based methods such as LOWTRAN and MODTRAN are accurate in terms of dehazing, however, it's difficult to acquire all the detailed parameters of geographic and atmospheric conditions.By contrast, image based methods require no additional information except image data, which have been widely used in dehazing .

Traditional enhancement methods like histogram equalization (HE) and retinex can be used to remove haze. Fu et al. developed a remote sensing image enhancement method combining HE with the discrete cosine transform (DCT).Wu et al. improved the remote sensing image quality using multi-scale retinex (MSR). Shen et al. proposed a method in the frequency domain based on homomorphic filter to remove haze from visible remote sensing images. Because enhancement methods do not consider the reason of image degradation, they can eliminate slight haze but fail in thickhaze, and color distortion is easily caused. With the rst physics imaging model developed in, a bunch of dehazing methods based on different imaging models are proposed and gradually become predominant in the outdoor imageeld and the remote sensing image .

These approaches improve the dehazing results notably since the model is designed based on the mechanisms of atmospheric scattering. Makarau et al.and Qi et al.restored the haze-free remote sensing image from Landsat and AVNIR-2 through subtracting its corresponding haze thickness map (HTM) which is constructed by searching dark objects locally in the image, and their dehazing effect is more signi cant than enhancement methods. Makarau's method can dehaze for multispectral bands including visible, near-infrared and shortwave infrared channels. Since visible bands are degraded by haze more easily, some dehazing methods focus on visible bands. Zhang et al.proposed a haze optimized transformation (HOT) method based on the correlation between the blue and the red bands.

II. PROPOSED SYSTEM

We propose an enhanced image refinement technique which is based on air light calculation. The method uses multi level transmission maps using different block sizes followed by cross bilateral filtering for better noise removal and edge enhancement. The proposed method is faster as compared to other existing techniques, real time fog and haze removal is a challenge. A Contextual Regularization dehazing algorithm is proposed by which to dynamically repair the transmission map and thereby achieve satisfactory visibility restoration. These techniques restore the hazy images based on the estimated transmission (depth) map. Our contribution is a new contextual regularization that enables us to incorporate a filter bank into image dehazing.

III. ARCHITECTURE

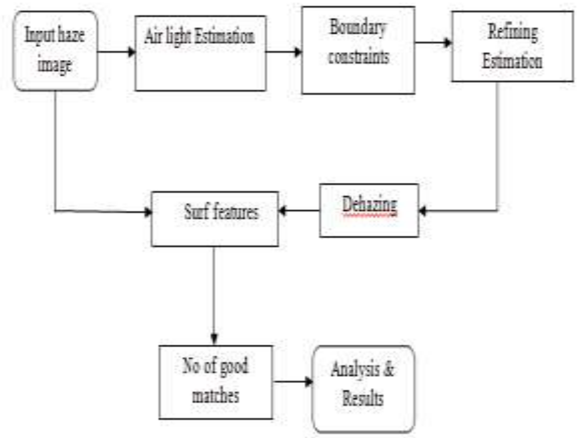

Figure 1.1

IMAGE ACQUISITION

The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. In the present scenario images have become the most suitable way to keep our past alive. Nowadays people are very busy in earning their livelihood and day to day life, even though they want to keep their golden moment alive for the rest of life. Images have touched almost all the fields like medical, sports, social networking and many more. It is the need of time to know how the images are being captured and stored into memory. To deal with images and before analyzing them the most important thing is to capture the image. This is called as Image Acquisition. Image Acquisition is achieved by suitable camera. We use different cameras for different application. In this project we get the images which is affected by environmental factors like fog,smog. This image can be acquired from that and it will interface with MATLAB.

AIR LIGHT ESTIMATION

The air light function is the multiplication of two factors: atmospheric luminance and the inverse of depth map. We can assume that a portion of the image contains pixels infinitely far away. The image points corresponding to scene points at infinity are regarded as the set of representative color vectors of atmospheric luminance and an average operation is applied to estimate the expected color vector of atmospheric luminance. To estimate A first pick up most hazy pixel in input hazy image and filter each color channel of an input image by a minimum filter with moving window. Then the maximum value of each color channel is taken as estimate of A.

CALCULATE BOUNDARY CONSTRAINTS

Here we are considering that the scene radiance J(x) of a given image is always bounded, that is,

$$C_0 \leq J(x) \leq C_1$$

where $C0$ and $C1$ are two constant vectors that are relevant to the given image.Consequently, for any x, a natural requirement is that the extrapolation of J(x) must be located in the radiance cube bounded by $C0$ and $C1$. The above requirement on J(x), in turn, imposes a boundary constraint on t(x).

CONTRAST ENHANCEMENT

In a local image patch, pixels share a similar depth value. Based on this consideration, we have derived a patch-wise transmission from the boundary constraint. But the situations where abrupt depth jumps occur, this contextual consideration often fails, and leading to significant halo artifacts in the Dehazing results. A solution to overcome this problem is to introduce a weighting function W(x, y) on the constraints. Therefore we are here using Weighted $L1$ -norm based contextual regularization. This contextual regularization enables us to incorporate a filter bank into image Dehazing. These filters help in attenuating the image noises and enhancing some interesting image structuressuch as jump edges and corners. Finally we estimate the transmission function using following formula,

$$t(x) = F^{-1}\left(\frac{\frac{\lambda}{\beta}F(\hat{t})+\sum_{j\in\omega}\overline{F(D_j)}\circ F(u_j)}{\frac{\lambda}{\beta}+\sum_{j\in\omega}\overline{F(D_j)}\circ F(D_j)}\right)$$

Finally we get the dehaze image using equation (4) by using values of estimated Air light and estimated transmission function.

Self-Organizing maps learn to cluster data based on similarity, topology, with a preference of assigning the same number of instance to each class. Self-Organizing maps are used both to cluster data and to reduce the dimensionality of data. They are inspired by the sensory and motor mappings in expectation-maximization(EM) algorithm, which also appear to automatically organizing information topologically. Discriminant analysis is aclassification method. It assumes that different classes generate data based on different Gaussian distributions. Use random subspace ensemble(subspace) to improve the accuracy of discriminant analysis(classification Discriminant). Subspace ensembles also have the advantage of using less memory than ensembles with all predictors, and can handle missing values (NaNs).

IV. EMBEDDED UNIT

The implementation of remove the haze in the images which has taken by the camera in the moving vehicle and the speed of the motor should be reduced with respect to the haze depth.Reduce the speed of the motor by using the uart,arduino,driver and motor.

BLOCK DIAGRAM

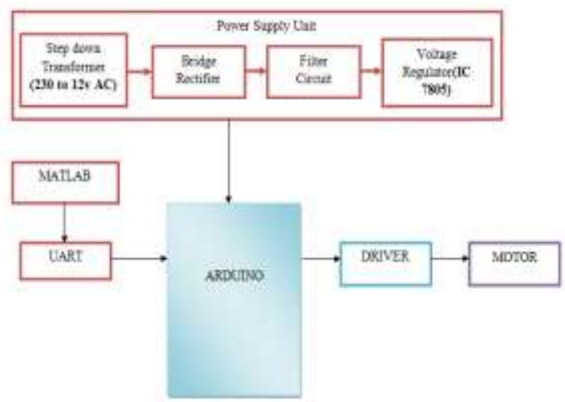

Figure 1.2

ARDUINO UNO

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. It was founded by Massimo Banzi and David Cuartielles in 2005. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

UART

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. UART is also a common integrated feature in most microcontrollers. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires.

MOTOR

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power.The most common types rely on the forces produced by magnetic fields.

MOTOR DRIVER

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction.L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC.

V. RESULT

The Outdoor scenes are often affected by fog, haze or smog. Often we like to capture as fog or haze adds significant visual pull. Fog and haze degrade the quality of preview and captured image by reducing the contrast and saturation. For remove the haze in the images which has taken by the camera in the moving vehicle and the speed of the motor should be reduced with respect to the haze depth.

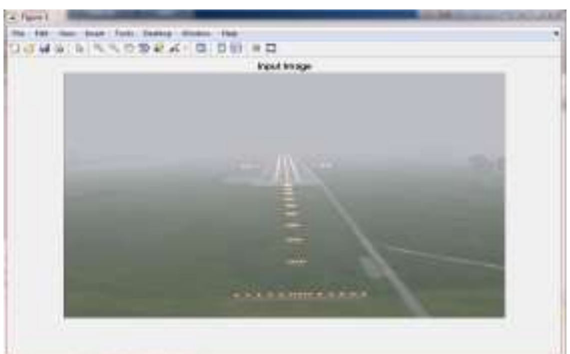

Figure 1.3

The input haze image in figure 1.3 is the image which is affected by the haze. Haze, fog, and smoke are such phenomena due to atmospheric absorption and scattering. Read the image which is taken by the camera and already stored in disk.In this figure 1.4 is the air light estimation. This is done by using the ginput function in matlab. This is getting the pixel information from the image. Ginput function is get the pixels from user by using mouse cursor

Figure 1.4

After the air light estimation done by the boundary constraints. In this figure 1.5 calculate the pixel wise boundary calculation. After this function minimum filtering also done after the boundary constraints.

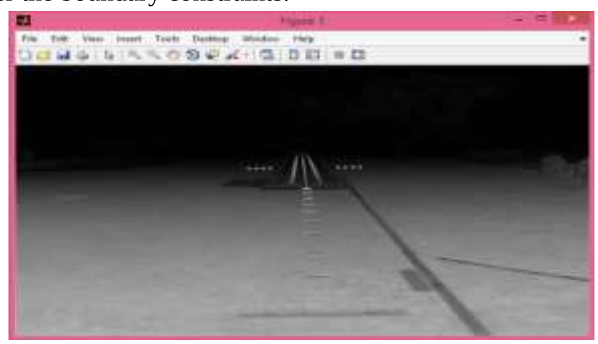

Figure 1.5

Refining Estimation done for smoothing and enhancing the image. In this figure1.6 is the color image contains 3 primary colors and that is separated and each image filtered respectively. Here use the weighting function for filter the image. By using this the image will be enhanced perfectly.

Figure 1.6

After the smoothing function we done the Dehazing. In the figure 1.7 is the Dehazing function done by the filtering of haze pixels which attained by the air light estimation function. Here remove the haze pixels with the help of the boundary constraints and refining estimated filtered images.

Figure 1.7

The dehazing result to obtain Visibility metric is calculated by using the comparing the image pixel values of haze image and dehaze image. This new visibility metric is to calculate the Contrast-to-Noise Ratio of noise image estimated by Gaussian kernel with sigma1 and sigma2 respectively.

The based on the visibility metric value is should be determine in the speed of the motor.the motor speed is increase or decrese in vibility metric value of the operation in figure 1.8.

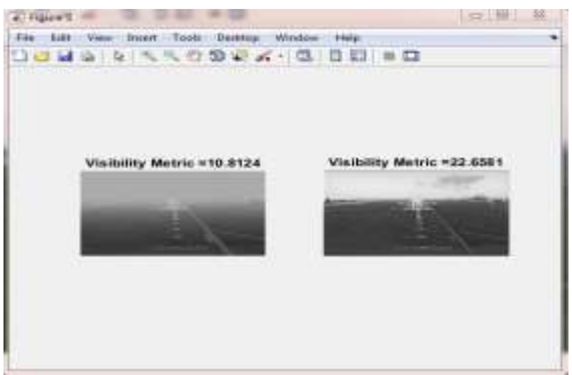

Figure 1.8

VI. CONCLUSION

The proposed method is Contextual Regularization dehazing algorithm for single image haze removal algorithm. Conventionally, counteract for Contextual Regularization dehazing algorithm require a large amount of computation. The proposed method is not requiring additional algorithm. It is simple and efficient method haze suppression. But proposed method includes color tone distortion. Future works will require an overcome the color tone distortion.

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