[Sreekutty* *et al.*, 6(4): April, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

FAST SINGLE IMAGE HAZE REMOVAL AND DATA HIDING SYSTEM

Sreekutty K*, Nicy K S

[1,] M.Tech Student, Computer Science and Engineering, IES College of Engineering

[2,] Assistant Professor, Computer Science and Engineering, IES College of Engineering

DOI: 10.5281/zenodo.496112

ABSTRACT

Haze brings trouble to many computer vision and computer graphics applications. Single image haze removal is a challenging problem. In order to solve this problem a simple but powerful method to remove haze from single image is proposed. It uses a color attenuation prior model for haze removal. A linear model is created for modeling the depth of the scene and using depth map we can easily estimate transmission map and outlook radiance, thus effectively removing haze from single image. In the dehazed image some confidential data like time at which photos are taken and temperature of the place from where the photos are taken can be made hidden and this secret message can be recovered whenever necessary.

KEYWORDS: Dehazing, defog, depth information, image restoration, outlook radiance

INTRODUCTION

Outdoor images taken in bad weather conditions lost color and contrast. Bad weather conditions such as haze, mist and fog degrade the quality of images .because such conditions changes the color and contrast of photos which is an annoying problem to photographers. It is a threat to many image processing applications. Poor weather conditions also degrade the quality of satellite and under water images. Effective haze removal is very broadly demanded area in computer vision and graphics applications. Concentration of haze is different from place to place. Quality of image in haze weather condition is degraded due to scattering of light. This may affect the normal working of many systems like automatic monitoring systems, transportation systems, outdoor recognition systems, and tracking systems. Scattering of light is mainly due to 2 atmospheric phenomena: air light and attenuation. Haze attenuates the reflected light from scene and some additive lights are blended. Haze removal helps to improve reflected light from mixed light. By using effective haze removal techniques stability and effectiveness of visual system can be improved.

Figure1. Input Haze Image

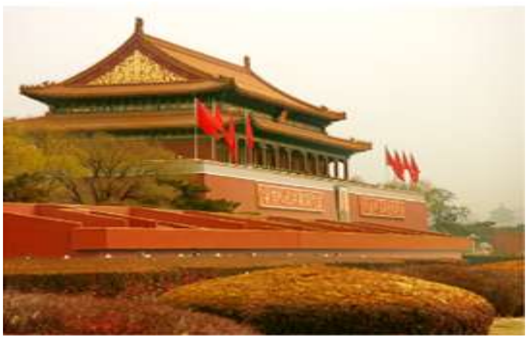

Figure2. Haze Free Image

Haze removal requires depth map and transmission map estimation. In haze removal image enhancement and image restoration techniques are used. Image dehazing using our method improve quality of hazy image and restore visibility of photos. There are haze removal techniques like polarization ,independent component analysis and dark channel prior. Initial works for haze removal use multiple images of the same scene.

RELATED WORKS

Image dehazing is considered as a challenging task because concentration of haze is varies from place to place. First researchers use traditional techniques for haze removal. Because single image can hardly provide much information later the researchers try to perform dehazing with multiple images . In [1] Narasimhan et al. propose a dehazing method with multiple images of the same scene. Significant development has been made in single image haze removal based on physical model. A novel haze removal techniques by local contrast maximization of image based on Markov Random Field is proposed by Tan [2] . Fattal [3] propose a dehazing method for color images based o independent component analysis. This method is time consuming and cannot apply for gray scale images. It have some difficulties to deal with dense haze images. He et al. [4] develop dark channel prior model based on the assumption that in most of the non sky regions, at least one color channel has low intensity at some pixels. Jing yu et al [5] proposes a physics based fast single image haze removal .it is a novel fast defogging method based on a fast bilateral filtering approach. Complexity of this method is a linear function of the number of input image pixels.

Faming fang et al. [6] introduced a single image dehazing and denoising with variational method. This method proposes a unified variational approach for image dehazing and denoising. Negative gradient descent methods is used to solve Euler-Lagrange equations. A window adaptive method on dark channel prior is used to improve estimation of transmission map. Jiao long et al. [7] develop fast haze removal for single remote sensing image using dark channel prior. It is a simple and effective method for haze removal from single remote sensing image. A low pass Gaussian filter is used to refine the coarse estimated atmospheric veil. Wang et al. [8] introduced haze removal from single image based on depth information. This algorithm uses atmospheric scattering physics-based model. Kang, et al. [9] proposed a single image based rain removal approach by formulating rain removal as an image decomposition problem based on MCA(Morphological Component Analysis).Tarel, et al. [10] Has proposed a model for improving road images by introducing an additional constraint taking in to account that a large part of the image can be assumed to be planar road. Image enhancement is based on Koschmieder's law. This law is related to the apparent contrast of an object against a sky background. Yeh, et al. [11] has introduced a pixel based dark/bright channel prior and fog density estimate method for haze removal process.

PROPOSED SYSTEM

In this paper simple and powerful color attenuation prior model is proposed. Using this prior linear model for scene depth of hazy image is created. With the help of supervised learning model parameters of liner model are learned and corresponding depth map for hazy image can built easily. Using depth map, transmission map and scene radiance can easily restored .This approach we can effectively remove haze from a single image. in the dehazed image some confidential data can be hidden and recovered whenever necessary.

Atmospheric Scattering Model

As in this heading, they should be Atmospheric scattering model can be used to describe the formation of hazy image. Hazy image can be represented as

$$I(x) = J(x)t(x)+A(1-t(x)), \qquad (1)$$

$$t(x) = e^{-\beta\, d(x)}, \qquad (2)$$

where x is the position of pixel within image, I is the hazy image, J is the scene radiance representing haze free image, t is the transmission medium , A is the atmospheric light , d is the depth of the scene and β is the scattering coefficients. β is considered as constant in homogenous atmospheric condition. If I is known, J can be restored using equation (1) and transmission medium t can be calculated using equation (2).

Color Attenuation Prior

Human brain can easily identify hazy area from natural scenery without extra information. Brightness and saturation of pixels in hazy image vary sharply along with the haze concentration changes. In haze free region saturation of the scene is high and brightness is moderate. Haze concentration increases along with the changes of depth of the scene. We can assume that scene depth is positively correlated with haze concentration and we have

$$d(x)\alpha\ c(x)\alpha\ v(x)-s(x), \qquad (3)$$

Where d is the depth of the scene , c is the concentration of haze, v is the brightness of scene and S is the saturation of pixel.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Scene Depth Restoration

Linear model can be created using the assumption that difference between brightness and saturation can approximately represent the concentration of haze as follows:

$$d(x) = \theta_0+\theta_1\, v(x)+\theta_2\, s(x)+\varepsilon(x), \qquad (4)$$

where $\theta_0,\theta_1,\theta_2$ are linear coefficients. v and s are the brightness and saturation component respectively. $\varepsilon(x)$ is the random variable representing random error.

Training Data Collection

Training data are necessary in order to learn the coefficients θ_0,θ_1 and θ_2 accurately. Training sample consist of a hazy image and its corresponding truth depth map. Depth map is very difficult to obtain and current depth cameras are not able to acquire accurate depth information. For each haze free image , a random depth map with same size is generated.

Atmospheric Light Estimation

Atmospheric light is calculated using the equation

$$A=I(x),\ x \in \{x|\forall y: d(y) \le d(x)\}, \qquad (5)$$

where A is atmospheric light and I(x) is the intensity of the pixel. To find out atmospheric light select pixels with highest intensity in hazy image among these brightest pixel as atmospheric light A.

Scene Radiance Recovery

As scene depth d and atmospheric light A are known scene radiance can be recovered using

$$J(x) = \frac{I(X)-A}{t(x)} + A = \frac{I(x)-A}{e^{-\beta d(x)}} + A \ , \qquad (6)$$

where J (x) is the haze free image. For avoiding too much noise, value of transmission medium t(x) is restricted between 0.1 and 0.9.Scattering coefficient β is considered as constant in homogenous regions. Figure 3 shows the architecture diagram of the proposed system. From a hazy image input scene radiance can be recovered using color attenuation prior model .In the haze free image some secret message can embed and recover when it is required.

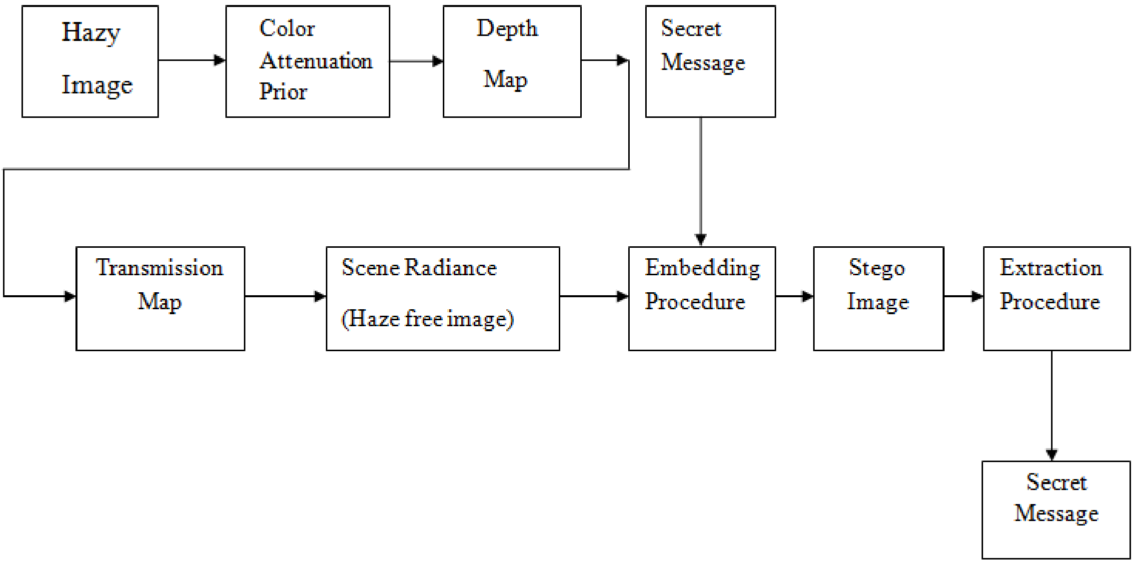

Figure 3: Proposed architecture of haze removal and data hiding system

Data Hiding and Recovery

Text information can be hidden in the dehazed image using least significant bit(LSB) technique. In an image each pixel is represented in 8 bits .Last bit in a pixel is called least significant bit. Here least significant bit of image is replaced with data bit. The reverse process is applied to recover data from image

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

CONCLUSION

In this paper a novel color attenuation prior model based on difference between brightness and saturation components of pixels within hazy image is proposed. A linear model for the scene depth is created with this color attenuation prior model. Supervised learning model is used to learn parameters of the model and depth information recovered. By using depth map obtained by proposed method, scene radiance of hazy image can easily recovered. Experimental results show that proposed approach posses high efficiency and outstanding haze removal effects. Proposed approach also allows to hide some secret message in the dehazed image. It can be very useful in many security related applications which needs data confidentiality.

REFERENCES

[1] S. K. Nair and S.G. Narasimhan,"vision in bad weather", in Proc. IEEE Int Conf. Comput. Vis. (ICCV),vol.2, pp.820-827, sep.1999

[2] R.T. Tan ,"visibility in bad weather from a single image", in Proc. IEEE conf. Comput. Vis. Pattern Recognit. (CVPR), pp. 1-8, Jun.2008

[3] R. Fattal, "Single image dehazing," ACM Trans .Graph., vol.27,no.3,p. 72,Aug. 2008

[4] He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior", IEEE Trans. Pattern Anal. Mach. Intell.,vol. 33,no. 12,pp. 2341-2353,Dec. 2011

[5] J. Yu, C. Xiao,and D.Li, "physics based fast single image fog removal", in Proc. IEEE 10th Int. Conf. Signal Process. (ICSP),pp. 1048-1052, Oct. 2010

[6] Faming Fang, Fang Li, Xiaomei Yang, Chaomin Shen, Guixu Zhang "single image dehazing and denoising with variational method", IEEE 2010

[7] Jiao Long , Zhenwei Shi, Wei Tang "fast haze removal for a single remote sensing image using dark channel prior", IEEE 2012

[8]Wang, Yan, and Bo Wu "improved single image dehazing using dark channel prior", IEEE International Conference on Intelligent Computing and Intelligent Systems. Vol.2, 2010

[9] Kang, Li-Wei, Chia-Wen Lin, *and* Yu-Hsiang Fu *"*Automatic single image based rain streaks removal via image decomposition", IEEE Transactions on image processing, 2012

[10] Tarel, J-P., et al. "vision enhancement in homogenous and heterogenous fog intelligent transportation systems" magazine IEEE, 2012

[11] Yeh, Chia-Hung, et al."Efficient image/video dehazing through haze density analysis based on pixel-based dark channel prior", International Conference on Information Security and Intelligence Control, 2012