International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET229263

# Mist Removal Using Fast Algorithm Based on Linear Operator

**Dr. N. Geetha Rani[1], K. Siva Lakshmi[2], G. Deepika[3], Ch. Aparna[4], B. Chitrika Naidu[5]**
[1]Associate Professor, Department of ECE, Ravindra college of Engineering for Women, Kurnool, Andhra Pradesh, India
[2,3,4 & 5]Department of ECE, Ravindra college of Engineering for Women, Kurnool, Andhra Pradesh, India

**Article Info**
Volume 9, Issue 2
Page Number : 339-347

**Publication Issue :**
March-April-2022

**Article History**
Accepted : 15 April 2022
Published: 30 April 2022

**ABSTRACT**

In hazy or foggy weather conditions image quality gets degraded which affects the performance of outdoor computer vision system. In this project a fast algorithm is proposed based on linear transformation by assuming that a linear relationship exists in the minimum channel between the hazy image and the haze-free image for dehazing single image. Firstly, the principle of linear transformation is analyzed and then the method of estimating a medium transmission map is elaborated & the weakening strategies are introduced to solve the problem of brightest areas of distortion. To accurately estimate the atmospheric light, an additional channel method is proposed based on quad-tree subdivision. In this method, average grays and gradients in the region are employed as assessment criteria. Finally, the haze-free image is obtained using the atmospheric scattering model.

**Keywords :** Markov Irregular Fields (MRFs), Closest Neighbor Fields (NNFs), ICA and Markov Irregular Field (MRF).

## I. INTRODUCTION

Exact extraction of picture highlights is a key factor that straightforwardly impacts the execution of PC vision frameworks [1]. Be that as it may, in hazy or foggy weather conditions, picture quality extremely corrupts because of light scattering by atmospheric particles, and numerous attributes of the hazy picture are secured. In this way, enhancing picture quality and upgrading framework heartiness in testing weather conditions has critical logical essentialness and wide application esteems. Its examination results can be generally utilized as a part of urban transportation [2], open air video observation [3], driver help frameworks [4], and satellite remote detecting [5]. Moreover, they give reference esteems to submerged picture investigation [6] and blustery and frigid picture preparing fields. The climate in a scene incorporates a few kinds of aerosols, for example, fog, residue, or haze. When we catch a scene photo of a scene, frequently thick aerosols diffuse light transport from the scene to the camera, bringing about a hazy photo. A murkiness free image could be reestablished in the event that we could gauge and repay the measure of scattered vitality appropriately. In any case, assessing dimness from a solitary photo is a seriously poorly postured issue because of the absence of the scene data, for example, profundity. An image processing strategy that evacuates a layer of fog and repays the weakened vitality is known as dehazing.

It can be connected to numerous outside imaging applications, for example, self-driving vehicles, reconnaissance, and satellite imaging. The general dehazing calculation comprises of two principal forms. We first need to surmised cloudiness at first by using accessible dimness pieces of information in light of a specific supposition on normal image measurements, for example, a dull channel earlier [12]. In this stage, the majority of dehazing algorithms tend to deliver a deficient transmission outline the hazy image. No widespread image measurements on normal hues can deal with the dehazing issue. In addition, the greater part of spread algorithms with a typical lattice arbitrary field regularly suffers from cloudiness seclusion curios. The measure of cloudiness in the air at every pixel is controlled by its profundity. In the event that there is an unexpected change in scene profundity, the lattice irregular field can't regularize a transmission outline sharp-edge intermittence because of wrong spread. With a specific end goal to deal with sudden changes of fog thickness, we require a scene profundity data, despite the fact that it is inaccessible in single-image dehazing. In this task, we propose a non-nearby regularization for dehazing that can spread scanty air light evaluations to yield a thick transmission delineate experiencing the commonplace detachment issue. Our regularization approach is created by consolidating Markov irregular fields (MRFs) with closest neighbor fields (NNFs) looked by Patch Match [2].

We found that the NNFs looked in a hazy image relate patches at the comparable profundity. Since no profundity data is accessible in single-image dehazing, we use the NNFs data to induce profundity signs for engendering concealed conditions of scattered light, which is exponentially corresponding to profundity [19]. To the best of our insight, this approach is the main work that joins MRFregularization with NNFs for dehazing. This proposed regularization technique can be utilized with some other dehazing algorithms to improve fog regularization.

## II. LITERATURE REVIEW

As of late, some single image dehazing techniques in light of extra priors or imperatives have been proposed. For instance, Tan proposed a viable technique in light of the earlier that the complexity in a fogless image is higher than that of a foggy image and after that understood the dehazing by expanding the neighborhood appear differently in relation to just a single image. Be that as it may, in this approach, shading can without much of a stretch progress toward becoming oversaturated in a vigorously hazy image. Fatal utilized free segment investigation (ICA) and the Markov irregular field (MRF) model to evaluate the surface albedo in view of the earlier information that no relationship exists between the protest surface shading and the transmission delineate, it might flop in situations where this presumption is invalid. Afterward, the creator exhibited another strategy in light of the shading lines pixel normality in common images with a specific end goal to determine the transmission better in segregated pixels that are deficient with regards to their own evaluations. Kratz and Nishino proposed a technique identified with the Tan arrangement. This approach can recoup a fog free image with fine edge points of interest; be that as it may, the outcomes have a tendency to be excessively upgraded and experience the ill effects of oversaturation. Afterward, they presented a novel Bayesian probabilistic strategy to appraise the scene albedo and profundity by completely utilizing their inert factual structures.

All things considered; this procedure delivers some dim antiquities in areas that approach vast profundity. Also, He et al. exhibited a viable strategy in view of the dull channel earlier (DCP). In this approach, least filtering is utilized to evaluate an unpleasant transmission delineate, delicate tangling is embraced to refine the harsh transmission guide to deliver better execution. Be that as it may, because of the delicate tangling, the calculation has high computational many-sided quality. Different methodologies, for example, two-sided filtering, middle filtering, edge-protecting filtering, and guided filtering are utilized to upgrade the transmission to improve the calculation execution. Tarel et al. presented a difference based improving way to deal with evacuate the fog impacts that was gone for being quicker than the past methodologies. It is accepted that the atmospheric shroud work changed tenderly in the nearby district, so the transmission coefficient of the medium can be assessed by pretreatment and middle filtering, which extraordinarily rearranges the dehazing procedure and enhances the

proficiency. All things considered, numerous parameters in the calculation can't be adaptively balanced. To hold the adjust of overstretched differentiate, Kim et al. advanced differentiation upgrade by augmenting the block wise differentiate, while limiting data misfortune because of pixel truncation. Besides, Meng et al. given a transmission image advancement calculation by investigating limit imperative and relevant regularization. This technique can constrict image clamor and improve some fascinating image structures. Acute et al. exhibited the utility and adequacy of a combination construct strategy for dehazing with respect to a solitary corrupted image. These contributions from a hazy image are weighted by three standardized weight maps lastly mixed in a multi-scale way that stays away from ancient rarity presentation what's more, Squeal. proposed a shading weakening preceding make a straight model for the scene profundity of a hazy image. Their approach utilizes a managed learning strategy and uses the recuperated profundity data, in this way making it simple to expel the fog from a solitary hazy image.

## III. EXISTING SYSTEMS

At present, existing image dehazing techniques can be isolated into two classes: image enhancement– based strategies and image restoration– based strategies. Image enhancement– based techniques incorporate histogram adjustment, the Retina strategy, homogeneous filtering, wavelet transformation, and others. Histogram balance upgrades the general differentiation of a hazy image by expanding the dynamic scope of the dark qualities. In any case, the worldwide histogram balance (GHE) experiences issues reestablishing the ideal incentive for every neighborhood, nearby histogram evening out (LHE) has a vast many-sided quality of calculation. The Retina strategy can successfully keep up the harmony between the shading consistency and dynamic range pressure. Be that as it may, it doesn't have an edge-safeguarding capacity, which brings about radiance marvels in some sharp limit locales. The objective of homogeneous filtering is to join recurrence filtering and grayscale transformation to enhance image quality. It can adequately hold the form data in uneven districts. In any case, its calculation load is striking. Wavelet change (WT) enhances image quality by dehazing low- recurrence locales and improving high-recurrence areas. By the by, this approach experiences issues settling over- brilliance and uneven enlightenment issues. To put it plainly, the principal reason for hazy image enhancement is to fulfill the visual impression of the human eye and give more noteworthy accommodation to PC acknowledgment without considering the corruption model.

## IV. PROPOSED SYSTEM

### A. Atmospheric Scattering Model

As per the atmospheric scattering hypothesis, the scattering of atmospheric particles is essentially partitioned into two sections: one is the constriction procedure of reflected light from the protest surface to the camera; the other is the scattering of air light achieving g the camera [39]. A schematic graph of the atmospheric scattering model is appeared in Fig.1. The strong line indicates light from the question the camera; the dabbed line speaks to air light. This sort of dehazing technique serves to evacuate the impact of atmospheric light with a specific end goal to reestablish the points of interest of the image and shading data. As appeared by Eq. (2), the primary trouble in explaining single image dehazing is the twofold questions of the murkiness free image, and the transmission outline which is extremely not well postured. Notwithstanding, if the profundity data of an image is known or on the off chance that we have some earlier learning for the single image, at that point can in any case be settled.

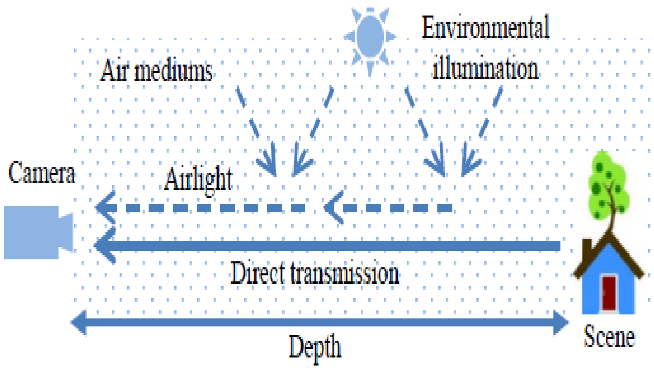


Fig.1. Atmospheric Light Scattering Model.

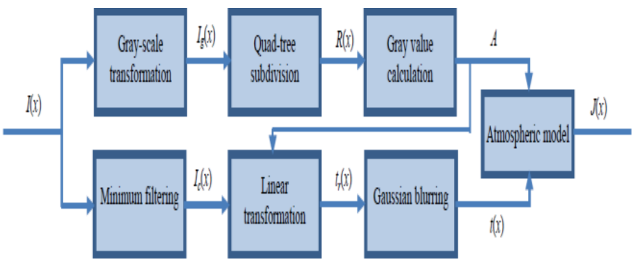


Fig.2. The flow chart of proposed method.

B. Dehazing Method based on Linear Operator

The stream diagram of the proposed strategy is appeared in Fig.2, which is isolated into three stages as indicated by the atmospheric scattering model. (1) Atmospheric light estimation is performed through grayscale transformation to discover. At that point, the quad-tree subdivision is embraced to acquire the sky locale, lastly, the atmospheric light is gotten by computing the normal dark of the sky area.

(2) A transmission outline evaluated by computing the base shading channel of to acquire. At that point, the direct transformation calculation is utilized to evaluate the harsh transmission outline, lastly, the Gaussian obscure technique is utilized to refine the unpleasant transmittance capacity to get. (3) Image restoration with parameters and is utilized to recuperate the dimness free image in view of the atmospheric scattering model.

1. Transmission Map Estimation:

Linear Transformation: The impact of atmospheric light on imaging increments as the separation from the scene to the perception point increments, and from the visual impact, the splendor of the image is bit by bit expanded as the mist thickens. To assess the medium transmission, delineate) can be changed into: The transmission rate acquired by means of the above strategy is pixel-based, which is enormously affected by its own grayscale esteem. Considering that the transmission rate changes gradually in a specific territory, it is important to do a smoothing task to enhance the visual impact. The straightforward normal filtering is clearly irrational since it doesn't consider the weight and makes the edges obscure. This implies the closer the relationship is between contiguous pixels, the higher the weights ought to be. Something else, the weight ought to be lower. Thusly, the weighted normal strategy ought to be utilized. The Gaussian obscure strategy is utilized just to supplant every pixel esteem by the weighted normal estimation of all pixels in the pixel neighborhood. It has isotropic and homogeneous properties. With the layout estimate M×N, the Gaussian capacity of components (x, y) can be communicated as: notwithstanding the above technique, different methodologies can be utilized for image smoothing.

Fig.3 demonstrates the processing comes about with the distinctive strategies, where Fig.3 is the hazy image and Fig.3 are the reestablished images whose transmission maps are handled with non-filtering, normal filtering, middle filtering, Gaussian filtering, recursive two-sided filtering, anisotropic filtering, and guided filtering, separately. As indicated by the above exploratory outcomes, the sifted transmission delineates smoother from the visual impacts, while the recouped image is more sensible. In the recuperated image, the impacts of utilizing a Gauss channel, anisotropic channel, and guided channel are superior to those from the normal channel, middle channel, and two-sided channel. The required circumstances for the above filtering strategies to address a 600 × 400-pixel image in the MATLAB condition are appeared in Table.1.

TABLE I: The Running Time Comparison with Different Filters

| Methods | Gaussian filtering | Average filtering | Recursive bilateral filtering | Anisotropic filtering | Median filtering | Guided filtering |
|---|---|---|---|---|---|---|
| Time (s) | 0.021 | 0.016 | 0.039 | 0.530 | 0.048 | 0.097 |

Kim et al. [3] chose the atmospheric light in a hazy image utilizing a various leveled seeking technique in view of the quad-tree subdivision. In this approach, an image is over and again separated into four rectangular areas. The brightest area is picked as atmospheric light as indicated by the edge. This technique is solid; nonetheless, it utilizes just the normal dim as the criteria and results in white areas. Fig. 3 are images named 'the illegal royal residence' and 'Lake,' separately. The dark locales are the last determination result in light of Kim's strategy [3]. The normal sky districts are situated on the stone and water surfaces, separately, because of the impedance of white areas.

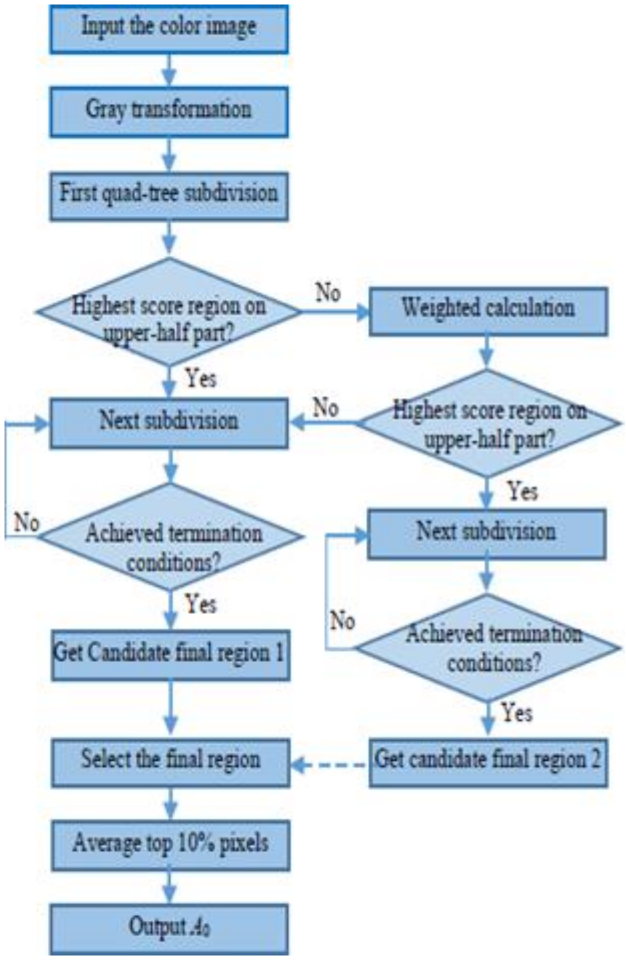


Fig.3. Flowchart of the method for estimating atmospheric light.

## V. RESULTS AND DISCUSSION

The proposed haze removal algorithm is designed, coded, implemented and simulated in the matlab environment. The simulation results of the proposed dehazing approach are presented as following Figs.4 to 15.


Fig.4. Original Image Corrupted by Haze.


Fig.5. Estimated Dark Channel.


Fig.6. Estimated Transmission Map.


Fig.7. Enhanced Transmission Map.

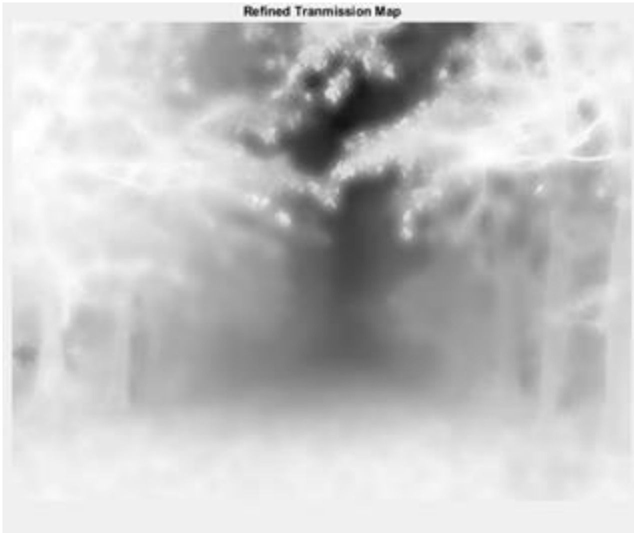


Fig.8. Refined Transmission Map.


Fig.9. Estimated Radiance Map.

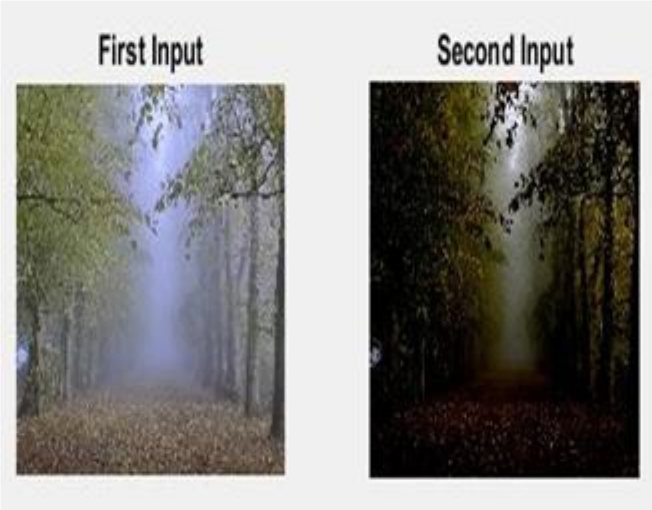


Fig.10. First input(white balanced), second input (contrast stretched).


Fig.11. Estimated weight maps.

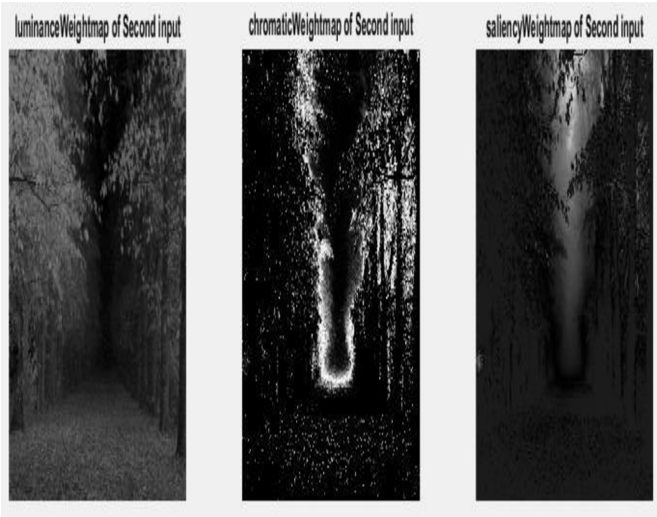


Fig.12. Normalized weight maps.

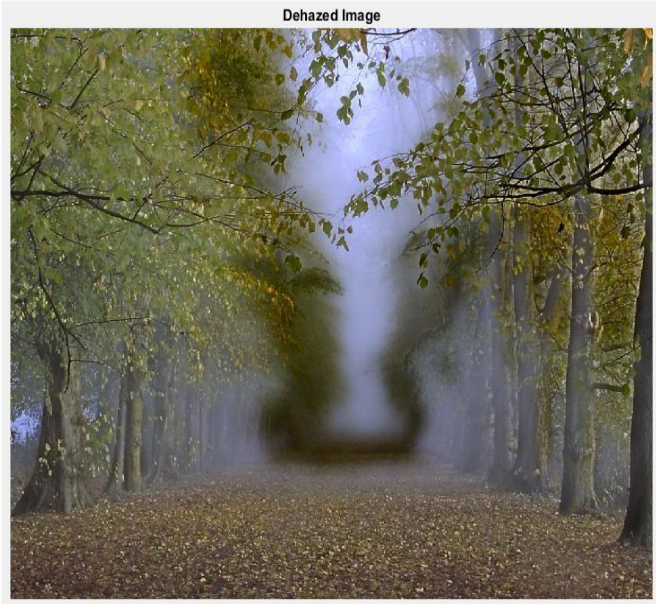


Fig.13. Channel two Dehazed Image.


Fig.14. Channel one Dehazed Image.

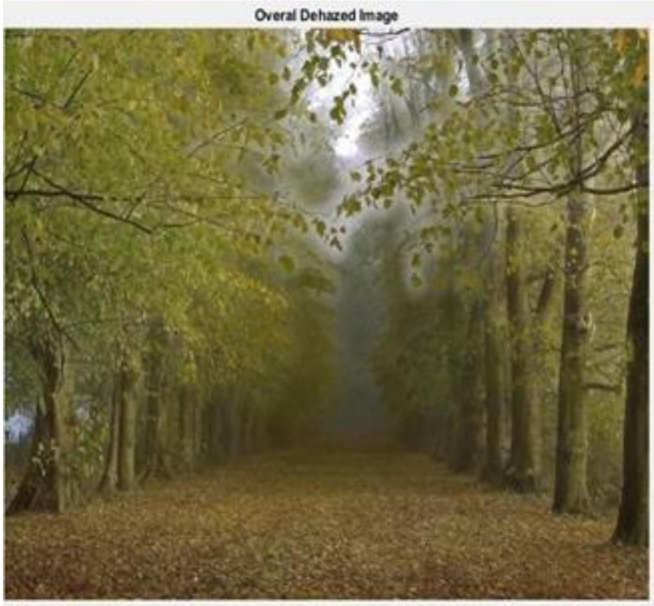


Fig.15. Final Dehazed Image.

## VI. CONCLUSION

This project proposed a dehazing algorithm based on the difference-structure-preservation prior, which can estimate the optimal transmission map and restore the actual scene. To obtain the rough transmission map, we use two basic properties in the haze model to resolve the optimal parameter at the same depth. Afterwards, we assume that an image patch can be approximated by a sparse linear combination of elements from a neighbour basis set to obtain a more accurate transmission map that can better preserve the structures of images. Experimental test results were also used to verify that the method effectively achieves accurate and true representation. In the future, this method will be studied in global air-light to improve operational efficiency and target the problem of color error, and further applications in video dehazing will be explored.

## VII. REFERENCES


[1]. K. B. Gibson, D. T. Võ, T. Q. Nguyen, An Investigation of Dehazing Effects on Image and Video Coding, IEEE Trans. Image Process, vol. 21, no. 2, pp. 662– 673, Feb. 2012.

[2]. Z. Chen, B. R. Abidi, D. L. Page, and M. A. Abidi,

[3]. Gray-level grouping (GLG): An automatic method for optimized image contrast enhancement—Part II: The variations, IEEE Trans. Image Process. Vol. 15, no. 8, pp. 2303–2314, Aug. 2006.

[4]. J. Kopf, B. Neubert, B. Chen, et al, Deep photo: Model-based photograph enhancement and viewing, ACM Trans. on Graphics, vol. 27, no. 5, pp. 32-39, Dec. 2008.

[5]. E. J. McCartney. Scattering by Molecules and Particles, in Optics of the Atmosphere, New York, John Wiley and Sons, 1976.

[6]. [5] S.G. Narasimhan and S. K. Nayar, Contrast Restoration of Weather Degraded Images, IEEE Trans. Pattern Anal. Mach. Intell, vol. 25, no. 6, pp. 713–724, June. 2003.

[7]. L. Li, W. Feng and J. W. Zhang, Contrast enhancement based single image dehazing via TV-L1 minimization, in Proc. IEEE int conf on Multimedia &Expo, Cheng Du, China, 2014, pp. 435-440.

[8]. K. Nishino, Bayesian Defogging, Int. J. Computer. Vis, vol. 98, pp. 263-278, Nov. 2012.

[9]. Qingsong Zhu, Jiaming Mai, and Ling Shao, A Fast Single Image Haze Removal Algorithm Using Color Attenuation Prior, IEEE Trans. Image Processing, vol.24, no. 11, pp. 3522–3533, Nov. 2015.

[10]. R. Tan, Visibility in bad weather from a single image, in Proc. of IEEE Conf on Computer Vis and Pattern Recognition, Anchorage, Alaska, USA, 2008, pp. 1–8.

[11]. L. Caraffa and J. P. Tarel, Markov Random Field Model for Single Image Defogging, in Proc. Of IEEE Intelligent Vehicles Symposium, Gold Coast, Australia, 2013, pp.994-999.

[12]. R. Fattal, Single image dehazing, ACM Trans. Graph, Vol. 27, no. 3, pp. 1–9, Aug. 2008.

[13]. Y. K. Wang, Single Image Defogging by Multi-scale Depth Fusion, IEEE Trans. Image Process, vol. 23, no. 11, pp. 4826–4837, Nov. 2014.

[14]. R. Fattal, Dehazing using Color line. ACM Trans. Graph, Vol. 34, no. 1, pp. 256–269, Nov. 2014.

[15]. K. 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.

[16]. K. He, J. Sun, and X. Tang, Guided image filtering, in Proc. European Conference on Computer Vision, Crete, Greece, 2010, pp. 1-14.

[17]. B. Xie, F. Guo, and Z. Cai, Improved single image dehazing using dark channel prior and multi-scale Retinex, in Proc. Int. Conf. Intell. Syst. Des. Eng. Appl, 2010, pp. 848–851.

[18]. H. Xu, J. Guo, Q. Liu, and L. Ye, Fast image dehazing using improved dark channel prior, in Proc. IEEE Int. Conf. Inf. Sci. Technol, Mar. 2012, pp. 663–667.

[19]. G. Meng, Y. Wang, J. Duan, S. Xiang, and C. Pan, Efficient image dehazing with boundary constraint and contextual regularization, in ICCV, 2013.

[20]. Y. S Lai, Y. L. Chen, and C. T. Hsu, Single Image Dehazing With Optimal Transmission Map, in Proc. Int Conf on Pattern Recognition, Tsukuba, Japan 2012, pp. 388- 391.

[21]. M. N. Do and M. Vetterli, The contourlet transform: An efficient directional multi-resolution image representation, IEEE Trans. Image Processing, vol.14, no. 12, pp. 2091–2106, Dec. 2005.

[22]. E.J. Candès and D. L. Donoho. New tight frames of curvelets and optimal representations of objects with piecewise C2 singularities. Comm. Pure Appl. Math, vol.57, pp.219-266, Nov, 2002.

[23]. M. Aharon, M. Elad, and A. M. Bruckstein, The K- SVD: An algorithm for designing of over complete dictionaries for sparse representation, IEEE Trans. Signal Processing, vol.54, no. 11, pp. 4311-4322, Nov. 2006.

[24]. M. Elad and M. Aharon, Image denoising via sparse and representations over learned dictionaries, IEEE Trans. Image Processing, vol.15, no. 12, pp. 3736-3745, Dec. 2006.

[25]. P. Chatterjee and P. Milanfar, Clustering-based denoising with locally learned dictionaries (K-LLD), IEEE Trans. Image Processing, vol.18, no.7, pp. 1438-1451, July. 2009.

[26]. P. Chatterjee and P. Milanfar, Image denoising using locally learned dictionaries, in Proc. SPIE, vol. 7246, no. 3, pp.351-357, Feb. 2009.

[27]. K. Dabov, A. Foi, V. Katkovnik, and K. O. Egiazarian, Image denoising by sparse 3D transform domain collaborative filtering, IEEE Trans. Image Process, vol.16, no.8, pp.2080-2095, Aug. 2007.

**Cite this article as :**

Dr. N. Geetha Rani, K. Siva Lakshmi, G. Deepika, Ch. Aparna, B. Chitrika Naidu, "Mist Removal Using Fast Algorithm Based on Linear Operator", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 9 Issue 2, pp. 339-347, March-April 2022. Available at doi : https://doi.org/10.32628/IJSRSET229263

Journal URL : https://ijsrset.com/IJSRSET229263