HAZE REMOVAL USING NON-DOMINATED SERACH BASED GENETIC ALGORITH (NSGA-III) BASED DARK CHANNEL PRIOR

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Abstract: Digital images captured in outdoor environment are easily polluted by haze, which will de-grade the conveyed information. Haze detection as well as elimination is actually a challenging job for enhancing the quality of digital images. In general, these pictures are clicked at a long distance from the visual sensor to given scene. The algorithm used here will modify the dark channel prior using existing techniques which have neglected the use of optimized selection of restoration level, so Non-Dominated Search Based Genetic Algorithm (NSGA-III) is utilized to monitor and locate the best optimized value for restoration. Adaptive brightness preserving histogram equalization is also used to remove the uneven illuminate problem of the Haze removal. Extensive experiments reveal that the proposed technique has the ability to remove the limitations of existing techniques.

Keywords: Haze, Dehazing, NON-DOMINATED SERACH BASED GENETIC ALGORITH (NSGA-III), Dark Channel Prio.,

I. INTRODUCTION

Poor visibility degrades image quality as well as the performance of the computer vision algorithms such as surveillance, object detection, tracking and segmentation. Poor visibility is due to occurrence of atmospheric substances which absorbed light in between the camera and the object. [1] They can be the water droplets that are there in the air. These droplets are very small in size and they continuously float in the air and leads to the filths of the image when clicked in the bad weather conditions such as fog, haze and smog etc. When there is fog, smog, rain and other bad weather conditions, a number of deterioration will occur in the image obtained by the camera, which reduces the purpose of the outdoor monitoring system and causes difficulty for the extraction of image features [2].

When there is fog, smog, rain and other bad weather conditions, a number of deterioration will occur in the image obtained by the camera, which reduces the purpose of the outdoor monitoring system and causes difficulty for the extraction of image features [3]. But the image defogging tools can effectively remove the weather effects of the image, it is important in the restoring of the image contrast. The natural images to fog algorithm has become the hotspot in the computer vision system and image processing field.

The current fog removal method can be divided into two categories: image enhancement and image restoration. Image enhancement excludes the reasons of fog corrupting the image quality. This method is applicable to a broader scope; it can improve the contrast of haze image, but can also lead to the loss of information in the image. On the other hand, image restoration first studied the physical features of the image and the model for the degradation of the fog is applied to it.In computer vision, the optical model, this is widely used to approximate the image formation in bad weather.

II. RELATED WORK

Bi, Guoling, et al. (201-7)[1] Proposed dehazing that plays a dominant role in many image processing applications. Bad field of vision due to atmospheric phenomena brings failing within image processing applications. Haze leads to failure of much computer vision. This approach provide a quick idea about several dehazing procedures and in addition gives information about advanced colour attenuation prior dependent dehazing methods.. **Chen, C, et al. (2017) [2]** explained that Outside view and pictures reduce the quality under poor weather conditions, and produce Hazy images. The scientific study is done on various proposed techniques to improve the visibility of hazy image, which mainly worked on saturation and brightness. Because of haze the colors, edges and texture of picture get disturbed, so there are some technique which restore edge losses and color impacts. It has also utilized a polarization and RETINEX based approach which makes dehazing simpler. **Shruti P, et al. (2017) [3]** hown that the histogram equalization methods which could be used for contrast improvement purpose. It works on reduction in no. of gray levels. Contrast improving by mean of histogram equalization methods. That evaluate numerous HE process utilize in preserving picture brightness. The main aim is to use image segmentation.
Park, et al. (2016) [4] proven that the actual scattering happened boost the whiteness in pictures as well as cut down the contrast. Haze elimination algorithms will be essential in several vision applications. **Yang, et al. (2015) [5]** discussed the dehazing process. So, there is need to overcome the error of inverse problem caused by physical degradation model so that DCP come into consideration. The DCP can be calculated by characteristic of simple outside taken images with intensity value of single colored channel along a local window close to zero. The complex solution for ill-posed inverse problem few steps of dehazing used. **B. H. Chen, et al. (2015) [6]** explain the visualize and quality of an image is highly required in the fields of surveillance and avionics. Because of turbid medium in atmosphere the pictures get vague and required processing for haze free pictures. Dark Channel Prior works very well for dehazing because with his method there is big scope for improvements. **L. Bai, et al. (2014) [7]** described that the Image improvement enhanced by increasing the information details. Here PSO having hue preserving color picture improvement process is carried out. The algorithm will be tested on different colour pictures and results will also be compared with other famous picture enhancement method.

III. GAPS IN LITERATURE

Haze elimination algorithms get more essential for number of vision applications. It has been cleared that every active research or study has mistreated many subjects. There are numerous researches gaps which concluded utilizing the literature survey are as follow:-
Haze removal algorithms become more beneficial for numerous vision applications. It has been originated that the most of the existing research have mistreated numerous subjects. Following are the various research gaps concluded using the literature survey:-

- The presented methods have neglected the evolutionary techniques i.e. Ant colony optimization, Non-dominated serach based genetic algorith (NSGA-III) or fuzzy logic kind of techniques to improve the quality of the Haze removal algorithms.
- The restoration levelt^0 has taken statically i.e. 0.1 in most of existing techniques.
- The particle swarm optimization suffers from poor convergence speed.

IV. METHODOLOGY

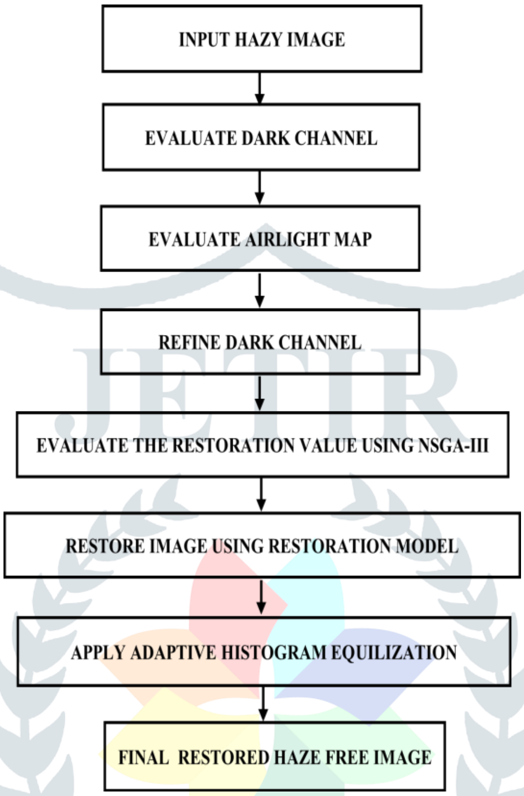

Figure 1. Proposed technique

Subsequent algorithm defines the mathematical formulation of the proposed technique.

Algorithm: Input: Hazy image (I)

Step 1: Evaluate size of hazy image

$[h, w, c] = size(I);$

Step 2: Apply aging particle swarm optimization

$h = fix(sqrt(h));$
$max\_it = 1000;$
$min\_flag = 1; \%$
$F\_index = 1; \%$
$[Gbest, Pg, AVG\_BST, MED\_BST, sol]$
$= AGING\_PSO(F\_index, N, max\_it, min\_flag);$

Step 3: Evaluate dark channel prior of I

$mask = 4;$
$for\ i = 1{:}h$
$\quad for\ j = 1{:}w$
$\qquad DC\_extend(i + mask, j + mask) = min(I(i, j, :));$
$\quad end$
end

Step 4: Evaluate airlight from Refined dark channel.

$for\ i = 1 + mask{:}h + mask$
$\quad for\ j = 1 + mask{:}w + mask$

$A = DC\_extend(i - mask{:}\, i + mask, j - mask{:}\, j + mask);$
$DC\_ori(i - mask, j - mask) = min(min(A));$
end
end

Step 5: Evaluate transmission map from Refined dark channel.
$A = 220/255;$
$w\_1 = 0.95;$
$t = 1 - w\_1 * DC\_ori/A;$
$t = max(min(t, 1), 0);$
$DC\_ori1 = min(min(min(I(:,:,:))));$
$DC\_max1 = zeros(w, h);$
$for\ i = 1{:}\, h$
$for\ j = 1{:}\, w$
$DC\_max1(i, j) = min(I(i, j, :));$
end
end

Step 6: Evaluate coarse estimated atmospheric veil from Refined dark channel.
$for\ i = 1{:}\, h$
$for\ j = 1{:}\, w$
$t1(i, j) = (DC\_max - DC\_ori1) * (A - min(I(i, j, :)));$
$t2(i, j) = (DC\_max - DC\_ori1) * A - (min(I(i, j, :)) - DC\_ori1) * min(I(i, j, :));$
$t(i, j) = t1(i, j)/t2(i, j);$
end
end

Step 7: Apply NSGA-III based image restoration model
$t0 = 0.1;\ \%Lower\ bound$
$for\ i = 1{:}\, c$
$for\ j = 1{:}\, h$
$for\ l = 1{:}\, w$
$rs(j, l, i) = (I(j, l, i) - A)/max(t(j, l), t0) + A;$
end
end
end

Step 8: Apply dynamic histogram equalization technique
$dynamic = sqrt(sol)/(M * N);$
$restoration\_val = stretchlim(rs, dynamic);$
$rs = imadjust(rs, restoration\_val, []);$

Return: Restored image (rs) with performance metrics

V. RESULTS AND DISCUSSIONS

Figure 2: Visual analysis of the existing and the proposed dehazing techniques

Table 1 shows comparative analysis of the Peak Signal to Noise Ratio (PSNR). As PSNR should to be maximum, so the main target is to increase the PSNR as much as possible. Table 1 has clearly shown that the PSNR is maximum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the existing method.

Table 1: Peak Signal to Noise Ratio Evaluation

Image name	Existing	Proposed
Image 1	61.0322	63.4264
Image 2	60.7104	65.3953
Image3	59.4213	64.2781
Image4	62.0459	63.2687
Image5	56.5984	62.4234
Image6	58.6316	62.8594
Image7	62.8617	64.9648
Image8	62.3424	62.5926
Image9	60.2135	62.7457
Image10	60.2109	65.6780
Image11	62.2676	63.1069
Image12	55.0079	69.7744
Image13	56.7929	61.5189
Image14	59.6343	61.1244
Image15	56.5002	61.4049

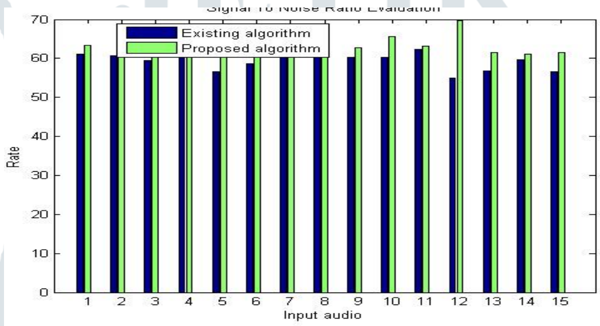

Figure 3: PSNR analyses between the existing and the proposed method

Figure 3 is showing the analysis of the peak signal to noise ratio of different images using existing dark channel prior method(pink color) and the proposed method(blue Color).It is very clear from the plot that there is increase in PSNR value of images with the use of proposed method over other methods.

Table 2 shows comparative analysis of the contrast gain. As contrast gain should to be maximum, so the main target is to increase the contrast gain as much as possible. Table 2 has clearly demonstrated that the contrast gain is maximum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the existing method.

Table 2: Contrast gain analyses

Image name	Existing	Proposed
Image1	1.9983	1.9989
Image2	1.9877	1.9922
Image3	1.9907	1.9941
Image4	1.9931	1.9964
Image5	1.9991	1.9993
Image6	1.9958	1.9976
Image7	1.9994	1.9991
Image8	1.9795	1.9876
Image9	1.9977	1.9987
Image10	1.9937	1.9953
Image11	1.9991	1.9993
Image12	1.9958	1.9976
Image13	1.9994	1.9991
Image14	1.9795	1.9876
Image15	1.9994	1.9991

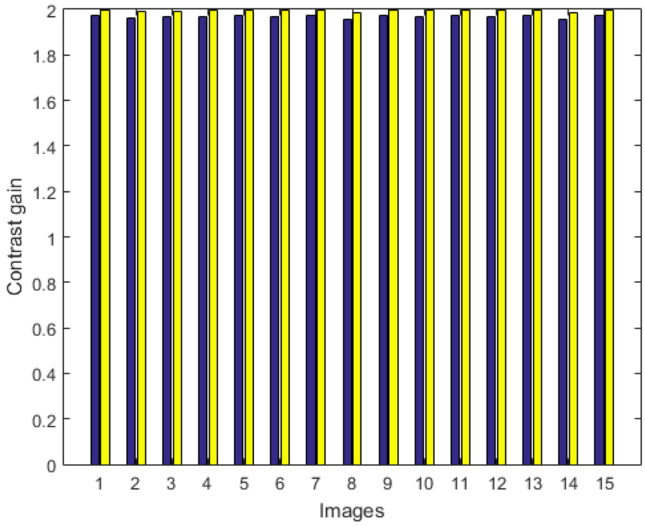

Figure 4: Contrast gain analyses between the existing and the proposed method

Figure 4 is showing the analysis of the contrast gain of different images using existing dark channel prior method(pink color) and the proposed method(blue Color).It is very clear from the plot that there is increase in contrast gain value of images with the use of proposed method over other methods.

Table 3 shows comparative analysis of the saturated pixels. As saturated pixels should to be minimum, so the main target is to decrease the contrast gain as much as possible. Table 3 has clearly demonstrated that the contrast gain value is minimum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the existing method.

Table 3: Percentage of saturated pixels analyses

Image name	Existing	Proposal
Image1	0.10218	0.08656
Image2	0.22869	0.19366
Image3	0.20533	0.17834
Image4	0.15886	0.14116
Image5	0.08696	0.07996
Image6	0.14593	0.12511
Image7	0.07560	0.08091
Image8	0.26431	0.22848
Image9	0.12194	0.09829
Image10	0.18239	0.16264
Image11	0.12469	0.13646
Image12	0.14104	0.13062
Image13	0.19678	0.18458
Image14	0.17384	0.14871
Image15	0.23838	0.20413

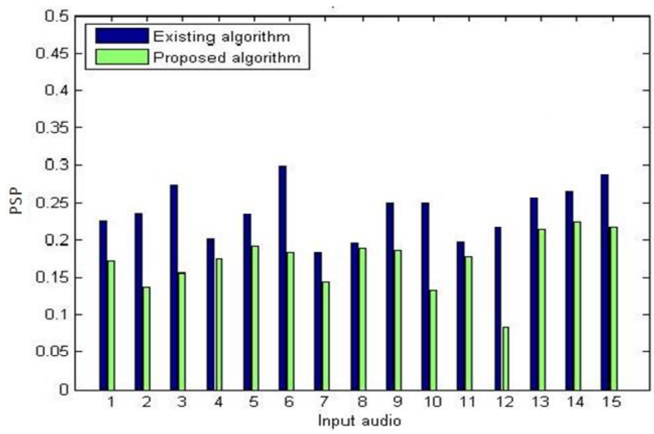

Figure 5: Percentage of saturated pixels analyses between the existing and the proposed method

Figure 5 is showing the analysis of the percentage of saturated pixels of different images using existing dark channel prior method(pink color) and the proposed method(blue Color).It is very clear from the plot that there is decrease in percentage of saturated pixels values of images with the use of proposed method over other methods.

VI. CONCLUSION

Haze removal algorithms become more useful for many vision applications. It is found that most of the existing researchers have neglected many issues; i.e. no technique is accurate for different kind of circumstances. To overcome the problems of existing research a new integrated algorithm will be proposed. New algorithm will modify the dark channel prior using:-

The existing techniques has neglected the use of the optimized selection of restoration level, so NSGA-III has been utilized to monitor and locate the best optimized value for restoration. Adaptive brightness preserving histogram equalization has been used to remove the uneven illuminate problem of the Haze removal. Thus, the proposed technique has the ability to remove the limitations of existing techniques. The MATLAB tool will be used to design and implement proposed technique with the help of image processing toolbox. Different kind of quality metrics will also be used to evaluate the effectiveness of the proposed technique over the existing one.

This paper provides comparison between existing and proposed haze removal techniques on the basis of parameters like contrast and entropy. So, the proposed technique of haze removal gives better results as compared to the existing technique.

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