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AN IMPROVED HAZE REMOVAL METHOD FOR THE APPLICATION OF GEO-GRAPHICAL DATA ANALYSIS

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ABSTRACT

The images taken in ghastly climatic conditions is a lot tainted owing to the occurrence of haze. It may also affect heavily, such images used in the ground of computer visualization, object recognition etc. As an aim to resolve this problem in this paper a better image enhancement as well as classification method is employed. The projected work takes benefit of SVD as this solo value allow us to characterize the picture with a minimal set of value that shrink storage space and progress the quality. For a superior quality and feature improvement a rate-based alteration is completed with the help of gaussian filter. The eventual dehazed image is then classified using an improved knn as part of geographical data analysis.

Keywords: *Gradient, Artifacts, Hazy image, Halo effects.*

1. INTRODUCTION

Effective haze removal has grown to become a highly demanded area in the field of image recognition. This work proposes a novel approach that deal with foggy image enhancement and classification in a sophisticated way and generate a better efficient output than all the presented system so far.

2. EXISTING METHODS FOR HAZY IMAGE ENHANCEMENT

Existing hazy image enhancement method includes single image approaches as well as multiple image approaches. Some approaches (Kopf et al., 2008) are not apt for real world due to some controls imposed on the acquisition of scene depth information.

Multiple image approaches (Schechner et al., 2003) took additional images of the same sight, which are captured with the help of special hardware devices, like polarizing filter, to build up the scene depth information of foggy images. But, the use of these multiple image approaches usually requires either unnecessary hardware expense or extra special devices.

In the recent years only, studies started focus on single-image approaches. Tan (2009) came up a with a method that restore foggy imagery through single-key image by maximizing the local disparity of the image. After comparing the clear image with the foggy image (Tan, 2009) enhanced the image by maximizing the local contrast of the restored image.

Rannan Fattal, (2008) then came up with the estimation of scene radiance and from that obtained the transmission image. But this method could not process gray level images as it lacks color information.

Xu et al., (2012) also employed dark channel prior method but it used fast bilateral filter to get maximum efficiency. It is obtained by replacing the time-consuming soft matting part.

Kaiming and Jian, (2011) proposes an advanced guided filter method to improve the efficiency when working with video. In the fattal's,2008 method an image deprivation model is designed which is able to handle smallest input image. Tarel and Hautiere, (2009) came up with a new algorithm which is able to handle gray level and colour but it proved to be complicated dealing with real images.

He, Sun and Tang, (2011) introduced a new image enhancement technique using dark channel prior. In this method there exist no surface shading in the key image and the output image is free of halos Tan, 2009). It can analyze the thickness of haze, but it may not work for some particular images like images having sun rays present.

Ancuti's (2013) method first introduced the decomposition method where image is decomposed into 2 parts where the most significant features resides in one layer.

Li (2012) idea of gradient enhancement first introduced where the method of dynamic range compression caused the enhanced image becoming dark.

In this method, Zetian (2016) had employed a multi-scale gradient domain contrast enhancement method. A proper edge-protecting decomposition is employed to crumble the key image into a foundation layer and two left over detail layers. Throughout all the existing system there is no project done on both haze removal and classification.

2.1 EXISTING METHODS FOR DEHAZING-DRAWBACKS

Zetian (2016) clearly stated that manipulating or enhancing the gradient makes low-dynamic range image into high-dynamic range**.** After restoration the image becomes shadowy or over exposure so that it diminishes and affects the quality of the entire image. As a remedy a simple linear dynamic range compression is used but will slightly blur part of the details as well as the quality of the image. Zetian also suggested an improved color correction method so that an optimal quality wise enhanced dehazed image can be obtained. So in the proposed work an improved hazy image enhancement is used for edge preservation and tone mapping in HDR images (Zetian, 2016).

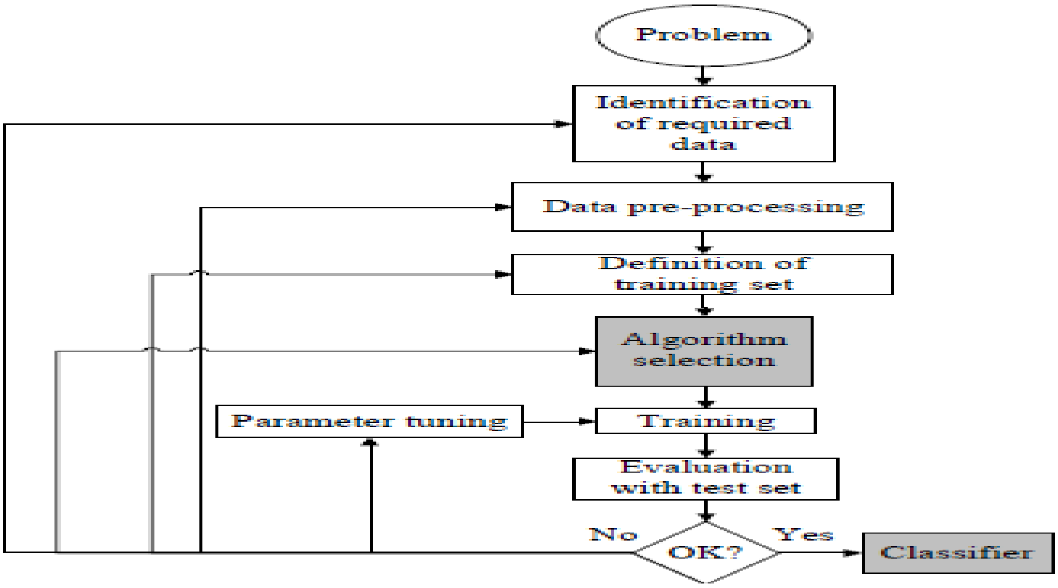

Fig 1: Steps in classification

2.2 EXISTING METHODS FOR CLASSIFICATION DRAWBACKS: There are many existing methods which works well on image classification including supervised as well as unsupervised method. In the unsupervised classification the classification is done without the help of a trained data set. But in the case of supervised classification trained data set is used for finding out in which class it belongs and when compared supervised classification yields better result. Such a type of supervised classification step is depicted in fig 1.

The first and foremost step in any image classification is the data acquisition. After that the collected data is filtered, pre-processed or enhanced. Then it is trained by feature extraction. From the trained data set by giving an input we can find out in which class it belongs to.

K-nearest Neighbor rule (KNN) has been one of the most well-known supervised learning algorithms in pattern classification, since it was first introduced (Fix,1951). The Nearest Neighbor rule (NN) is the simplest form of KNN when *k*=1. KNN has several advantages: simplicity, usefulness, intuitiveness and competitive classification performance in many domains. However, the number of available samples in real applications is usually too small to obtain a good asymptotic performance, which often leads to dramatic degradation of the classification accuracy, especially in the small sample size cases with the curse dimensionality (Fernandez, 2008) and existing outliers (Fukunaga, 1990). If *k* is very small, the local estimate tends to be very poor owing to the data sparseness and the noisy, ambiguous or mislabeled points. In order to further smooth the estimate, we can increase *k* and take into account a large region around the query. Unfortunately, a large value of *k* easily makes the estimate over smoothing and the classification performance degrades with the introduction of the outliers from other classes. To deal with the problem, the related research works have been done to improve the classification performance of KNN.

3. PROPOSED SYSTEM: We are adopting a better enhancement method that enhances the quality of the image produced as a result of WLS decomposition done in (Zetian, 2016). By doing all the decomposition and gradient enhancement (Zetian, 2016) the resultant image turns low dynamic range to high HDR images which slightly blurs part of the details as well as quality of the image. So in order to get rid of this a better enhancement technique which employs a novel compression and color correction is adopted in the proposed work.As shown in Fig.2 the modules included in the proposed work are 1) image dehazing 2) image enhancement 3) classification

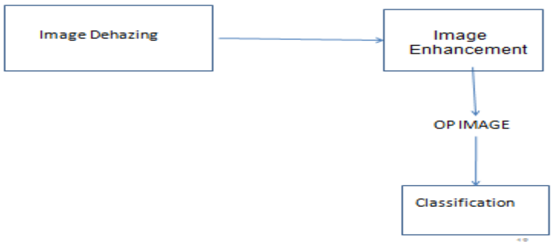

Fig 2: Work Flow of proposed system

3.1 IMAGE DEHAZING: Image dehazing is done like the method mentioned in (Zetian, 2016). The original hazy image is converted into a CIE-LAB color space. By using weighted least square filtering (WLS) decompose the input image into one detail and two base layers. Enhance the contrast of two detail layers in gradient domain. Reconstruct the detail layers in gradient domain and synthesize the two reconstructed detail layers and gamma corrected base layer. The resultant is a dehazed image.

3.2 IMAGE ENHANCEMENT: Image enhancement includes two main techniques. 1. Abetter compression suggested in Zetian, (2016) and an improved color correction technique. Here in the reconstructed dehazed image in order to reduce over enhancement a lossy compression is applied. In general, a singular value decomposition method which is applied can alter matrix A into product USV transpose, which allows refactoring a digital image into three matrices. This will help in representing the image with a minimal set of values and also reduces noise, storage, improves quality and conserve valuable features of the original image.

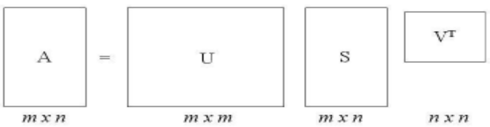

Fig 3: Representation of SVD

Where U=orthogonal matrix whose columns are left singular vectors, S=crosswise matrix with singular values crosswise and V=orthogonal matrix whose columns are left singular vectors.

As part of value-based color correction we are employing a color correction method using Gaussian filter which is highly used for detail enhancement and tone mapping in HDR images (Chang, 2016). After applying the Gaussian filter Gradient is considered. According to the gradient or directional change the reflectance as well as illuminence are updated with the help of 2D fourier transform and beta-gamma value correction respect tively.

3.3. CLASSIFICATION: As mentioned by Fukunaga (1990) if *k* is very small, the local estimate tends to be very poor owing to the data sparseness and become noisy. To deal with this, the related research works have been done to improve the classification performance of KNN Inorder to overcome the disadvantages we have introduced a weighted voting scheme for KNN, called the weighted *k*-nearest neighbor rule (WKNN). In WK-NN, the closer neighbors are weighted more heavily than the farther ones, using the distance-weighted function. The weight *wi* for *i*-th nearest neighbor of the query *x′* is defined as follows:

$$w_i' = \begin{cases} \frac{d(x',x_k^{NN})-d(x',x_i^{NN})}{d(x',x_k^{NN})-d(x',x_1^{NN})} & , \text{ if } d(x',x_k^{NN}) \neq d(x',x_1^{NN}), \\ 1 & , \text{ if } d(x',x_k^{NN}) = d(x',x_1^{NN}). \end{cases}$$

Then, the classification result of the query is made by the majority weighted voting.

4. RESULTS

Test image 1: mountain

Test image 2:forest

Fig 4: Test input 1 a) Hazy image b) Dehazed image c) improved image

Fig 5: Classification result of dehazed image

4.1 COMPARISON WITH PREVIOUS WORKS: Quality analysis is done with the help of 3 main descriptors. e= rate of new visible edges (%), $\bar{r}$=mean ratio of the gradient at observable edges or quality of contrast renovation, σ =% of saturated pixels. For a high-quality image high values of e and $\bar{r}$ and low values of σ are anticipated.

Table 1: Indicators computed on the image

	RESULT OF IMAGE 1			RESULT OF IMAGE 2		
	e(RATE)	σ(%)	$\bar{r}$(RATIO)	e(RATE)	σ(%)	$\bar{r}$(RATIO)
Fattal [9]	0.04	0.01	1.3	0.07	0.79	1.95
Tareal & Harutiere [10]	0.02	0	2.09	0.13	0.01	1.97
He et al., [11]	0.08	0.01	1.33	0.14	0.01	1.12
Ancuti & Ancuti [12]	0.07	0.01	1.19	0.01	0.03	1.07
Li et al., [13]	0.04	0	0.77	0.28	0	0.85
Zetian [1]	0.08	0.02	1.43	0.08	0.02	1.34
Ours	0.12	0.0009	1.16	0.24	0.0016	0.8

Quality evaluation ensures that the plan of the improvement technology is to enhance the contrast with no oversaturation and trailing much image information. The indicator e computed by our method maintains a comparatively higher value in the 2 test input images that is shown in Table 1.Single value decomposition works as an algorithm which prevent over saturation and Gaussian filter enabled color correction helps in boundary protect smoothing and as a outcome more edges becomes visible(high value for e).All the measured technique together with our's (except Fattal's,2008) in forest image yield small values close to zero for σ descriptor. The descriptor produces a small value like other method (Tarel and Hautiere, 2009), while this sightless judgment did not take specious boundaries and artifact into report. For ratio of contrast restoration a value higher than 2 was obtained only in Tarel and Hautiere, (2009) but it performs poor in obtaining e value (rate of new visible edges).From the descriptor values in Table 1 it is clearly evident that our proposed work yields a good result especially in terms of e value.

4.2 **MODEL EVALUATION USING CONFUSION MATRIX:** In order to analyze the performance of a training data set we are using confusion matrix. For the evaluation training data set of 274 hazy images are taken. Hardware requirements include Processor: Intel core i5 7200U CPU, Clock speed:2.50 Ghz, 16 GB RAM. Categories for classification are 1) Tree-fog 2) Mountain/ Grassland 3) Rail-road 4) Building. As depicted in fig 5 performance evaluation is done using confusion matrix. From the values obtained, it is clear that classification was done in a better way after dehazing ie more categories are classified correctly.

	Tree-fog	Mountain/ Grassland	Rail/Road	Building	Total
Tree-fog	30	10	2	1	43
Mountain/ Grassland	12	43	5	5	65
Rail-Road	6	7	33	8	54
Building	3	4	8	20	35

Fig 5: a) Confusion matrix before dehazing

	Tree-fog	Mountain/ Grassland	Rail/Road	Building	Total
Tree-fog	33	7	2	1	43
Mountain/ Grassland	10	48	4	3	65
Rail-Road	6	6	36	6	54
Building	3	4	7	21	35

b) Confusion matrix after dehazing

5. CONCLUSION AND FUTURE WORK

In this thesis we have presented an improved image dehazing & traffic information mining system as a purpose of metropolitan computing. When compared to the recent methods in single image dehazing we have introduced an advanced image dehazing technique. We also defined an advanced color correction method using gaussian filter that shares the nice property of edge-preserve smoothing by removing almost all the block artifacts. In this paper, we present a new distance-weighted *k*-nearest neighbor rule. In our approach, we concentrate on dealing with the sensitivity of different choices of *k*, with the goal of improving the classification performance. As an upcoming work filter applied for pre-processing as well as edge protection can replace with a superior one having minimal time utilization.

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