Review on various haze removal techniques

Environment, Ecology

This paper represents that image defogging is commonly used in many outside working arrangements. The fog removal methods play significant role in various areas of vision processing. Haze detection and removal is a challenging task for improving the quality of digital images. In general, these images are captured at a huge distance from the visual sensor to given scene. Some climatic effects such as fog, smoke, dust etc. reduce the quality of the received image. The long-term objective of this paper is to show the comparison between different haze removal approaches which illustrate the better quality results.

Fog is actually a minor concealment of the bottom environment, typically brought on by small hanging molecules. To overcome haze from picture, several visibility restoration methods are placed on the image to make it better. The degradation is closely related to number of factors such as gap between object and camera, blur resulting from miss-focus associated with digital camera, relative climatic issues and some others. The quality of entire picture of outdoor scene in the foggy or hazy atmosphere is usually degraded as a consequence of scattering of sunshine prior to hitting the camera because of these large sets of hanging molecules (e. g. fog, dust or other impurities) in the environment. This dispersed condition of light is happened as a result of exhaustion and atmospheric light. When the light comes to the object to be clicked, it gets scattered as a result of haze and part of it reaches to you and results change in the picture being captured. To eliminate this color change in the graphic, different fog removal methods can be used to enhance the quality of image.

Image Defogging

Single image defogging is a term used to illustrate any approach that eliminates scattering of light (e. g., fog) from an image. When an image gets hazed, it is not seen clearly or we can say that the contrast of an image gets reduced which make the image dull. To eliminate this dullness from an image, there are several defogging algorithms that have the power to provide the image a better visual property.

Image Defogging Effect Assessment

The CNC index is a powerful defogging review sign which often is beneficial in order to slowly move the parameter adjusting procedure. With the source hazy image x and the unique equivalent fog free picture y, the CNC index is received just after undertaking these kinds of steps: Calculate the velocity e of seen tips soon after as well as previous to haze elimination. Compute the picture color naturalness index (CNI) and color colorfulness index (CCI) to measure the color naturalness of fog free image y, and merge several components e, CNI in addition to CCI in order to provide an overall defogging consequence.

$$CNC(x, y) = h(e(x, y), CNI(y), CCI(y)) \quad (1)$$

For the entire deviation trend of these three indexes, the statistical outcomes depict that the maximum value of CNI curve holds the normal outcome, but it is not inevitably the most effective fog removal impact. Nevertheless, the most effective outcome should have excellent naturalness (high CNI value). Once the picture is over-enhanced, the color is usually deformed, in addition to CNI fails swiftly. With regard to e and CCI, they have the most effective influence before getting to their particular highs. Once the picture is over-improved, the curves keep on climbing. Right after attaining the highs, these arcs begin to decrease. Hence, in event of the raising trend of e and CCI (from their total capability result issues, hence, to their arc's peaks) often results in negating the falling-trend of CNI, as well as top of CNC arc may be close to the real most effective result level. At the same time, the actual value variant associated with CNI is usually compact, this is among one of e and CCI is rather high. Hence, a result of e and CCI around the CNC catalog ought to be lessened. This CNC index among graphic x and y, i. e. the function h in (1) may be considered as: CNC(x, y) = e(x, y) 1/5 • CNI(y) + CCI(y) 1/5CNI(y)(2)As described above, a superb outcome can be tagged by the important valuation on CNC. Hence, the best outcome of the two main factors of defogging algorithm is found once the CNC index defines the greatest value.

Defogging techniques

A. Fusion Based

The main goal of image fusion is to form an image to fulfill some requirement. This goal can be attained by processing the number of images which are taken from different cameras or from the same camera based on some property. The image fusion technology can produce a new remote sensing image by processing the multiple remote sensing images of the various platforms and cameras which have same target, which contains the features and information of both input images. The latest fused image can offers more inclusive information; therefore, it provides technical support for the analysis and extraction of remote sensing information. It has become a key technology for remote sensing images.

B. Guided Image Filter

The guided image filter does edge-preserving smoothing on a picture, by utilizing the data of the alternative graphic, that is sometimes called as guidance image, used for filtering . This picture is most likely the initial graphic on its own, another type of edition of a graphic, or it can be entirely unique. Guided filter is a simpler notion above smoothing: it can switch the structures of a guidance photograph towards filtered outcome, which allows completely new filtration purposes including dehazing as well as guided feathering. Now, this has become the best edge-preserving filter system. To define the guided image filter, first, describe a general linear translation-variant filtering process, which has a guided photograph G, a source picture I, plus final image O. Each I as well as G are supplied in advance according to the request, and both are usually same. The filter output at the pixel x actually will be conveyed for a weighted mean: (3) Here x and y are usually pixel indexes. The filtration system is a method of guided image G which is separate from I actually. The filter is usually linear for I.

C. Adaptive Histogram Equalization

Adaptive histogram equalization (AHE) is basically a method to process images where it helps to enhance contrast in pictures. It differs from simple histogram equalization with respect to adaptive method that calculates number of histograms, each equivalent to the unique sector of the graphic, and utilizes them to rearrange the lightness values of the graphic. Consequently, the idea generated for strengthening a neighborhood difference along with improving the classifications involving tips within each part associated with an image. Nevertheless, AHE could over-amplify noise in comparatively identical areas of a picture. Another solution associated with histogram equalization termed as contrast limited histogram equalization (CLAHE) that inhibits this by reduction of amplification.

D. Dark Channel Prior

Dark channel prior is in reality a stats of outside photo errors removal. It is depending upon the concept that the areas nearby sections inside the haze free photos where high intensity is modest throughout several coloring channel. This information is utilized by dark channel prior to boost the standard of photograph. Accessible pixels whose strength is usually reduced, the actual thickness of particular errors may be projected and the top quality dehazed photograph could be improved. As a result of air light, a new foggy impression can be better than their fog-free edition where transmission T can be minimal. Therefore, the dark channel on the foggy graphic can have increased high intensity inside locations together with more dense fog. Thickness in the fog is undoubtedly an estimated estimation of intensity of the particular dark channel. This method provides the good quality depth map of an image.

E. Degradation model

Some sort of foggy picture produced seeing that shown within Fig. 3 is mathematically patterned the examples below [11]I(y) = J(y)+L(1-) (4)

In this, y delivers the picture coordinates, I is definitely the noticed foggy image, O is original image, L will be the world atmospheric lumination, α is definitely the scattering coefficient of environment and d is the scene depth. Listed here, is sometimes presented as transmission map and it can be written as: T(y) =(5)

F. Genetic Algorithm

Genetic Algorithms (GAs) are adaptive heuristic search algorithm. It depends upon the concept of biological evolution. It is very useful to exploit a arbitrary search that's used to solve optimization problems. The genetic algorithm iteratively changes a population of distinct results. At every step, it selects individuals at random from the present inhabitants to be ancestors and utilize them to produce the offspring for the later production. After subsequent generations, the population " evolves" towards an optimum outcome.

Related works

Guo, et al. presented a unique fog removal factor selection algorithm centered on genetic algorithm (GA). It concentrated on the approach to choose optimum constants for image defogging. This method put on two main fog removal algorithms by selecting main constants and then optimizes them using the genetic algorithm. Huimin Lu, et al. proposed an individual optimized image defogging approach that measures air- light conveniently and eliminates fog with assistance from a semi-globally adaptive filter. The improved pictures are distinguished with slight noise and great visual capability in darkened areas.

The structure and borders of the processed pictures will also be embellished considerably. Wen, et al. proposed a best defogging algorithm with fusion based method. Important steps of an algorithm are defined as: First, the initial picture of the fusion method is acquired by having a simple linear transformation. Next, a superior high-boost filtering algorithm driven by guided image filtering that is recommended to uncover the second source photograph. Third, a fairly easy fusion procedure is utilized to group the above mentioned both source pictures. The ultimate defogging solution can be attained by a quite easy white balance process.

Qingsong, et al. represented an authentic but great color attenuation prior for eliminating fog from a source image. With a linear model for modeling the intensity of scene from the foggy picture under this unusual prior in addition to learning the factors of the model utilizing a supervised learning approach, the intensity information could be restored efficiently. Utilizing the depth map of the foggy picture, we could measure the transmission and recover the scene radiance through atmospheric scattering model, hence, efficiently eliminate the fog from a picture.

Zhai, et al. represented two priors- dark channel prior and gradient prior which are integrated to estimate the unexplored scene transmission map that is converted to a TV-regularization optimization problem. Tang, et al. represented two dehazing approaches for single image dehazing. They work based on haziness analysis. The very first approach uses the brightness element picture that will be attained through retinex algorithm in addition to the depth information of the very first picture to clean out the veil layer. Aforementioned algorithm employs carefully guided photo filter to really have the slick errors transmitting in addition to detach that from the original photograph.

Fan, et al. proposed an automatic way of the dehazing procedure by an image. Detailed depth information is predicted from the multi-level estimation procedure, which will combine the depth maps with assorted shapes associated with areas by simply dark channel prior to recoup the foggy image. Markov random field (MRF) is given to look at the depth levels with adjoining area for rectifying wrong estimated regions.

Gibson, et al. proposed a fast method to remove fog from an image. It runs on the best method that refines the information regarding fog within the image by utilizing the Locally Adaptive Wiener Filter. They identified a remedy for guessing disturbance details for the filter mask.

David Pardo, et al. proposed a new variational platform for the task to eliminate haze from individual photograph. The important changes are composed of the substitution of values used by this structure towards grey-world theory by simply estimating the mean in the haze free photograph. Kim, et al. [10] proposed a straightforward adaptive algorithm for image defogging. Haze free picture possesses very low contrast than just an obscure picture; generally, they tried to recover this source picture by means of enhancing the contrast. Initially, the proposed algorithm guesses atmospheric lumination within the provided obscure graphic dependent upon the quad-tree subdivision. And then, the proposed algorithm measures the transmission map in order to enhance the contrast within the final picture.

CONCLUSION

This paper has discussed the image defogging techniques that plays significant role in various area of vision processing. Many real time applications suffer from poor contrast problem due to haze or fog. Some atmospheric effects such as haze, fog, smoke, dust etc., degrade the quality of the received image. Image fog removal techniques have taken restoration value statically, that depends upon the given set of images which limits the performance of fog removal as restoration value needs to be adaptive as effect of haze on given image varies scene to scene and atmospheric veil. The presented methods have neglected the use of multi-objective optimization techniques to improve the adaptivity of the digital haze removal algorithms. So, in future we will propose multi-objective optimization Differential Evolution for image defogging using contrast gain and percentage of saturated pixels.