Available online @ https://jjem.jnnce.ac.in
https: www.doi.org/10.37314/JJEM.SP0245
Indexed in International Scientific Indexing (ISI)
Impact factor: 1.395 for 2021-22
Published on: 08 December 2024

Enhancing Object Detection through Image Dehazing

Vinay S [1], Sampath Kumar S [2]

Student [1], Assistant Professor [2], Department of Master of Computer Applications
JNN College of Engineering, Shimogga

vinaysvinays39@gmail.com, sampathkumar@jnnce.ac.in

Abstract

Dehazing procedure helps in utilizing a better quality of photos taken from the hazy areas. In addition to increasing smogginess of the photos that have been captured in the foggy environment, the procedure is highly significant and it may serve the objective of the proposed object detection's and it is important in preprocessing stage. This forms haze as light is diffused by debris, smoke, and globules of water which also makes the image to have less contrast. In fact, such deterioration is really a trouble for object detection systems. In particular for corresponding applications using it, like for example, remote sensing, self-driving, and surveillance systems where high accuracy of results and their reliability are critically required. In fact, to resolve this kind of problem, this study offers the whole framework to integrate not only the YOLO: The paper integrates not only You Only Look Once for Object Detection model but also the DCP dehazing method into the study. The method of atmospheric light value estimation followed by the dark channel value computation and the enhancement of the transmission map with the help of these three values do the work of calculation of haze in an efficient manner and then its removal is carried out by DCP approach. directing the screening process.

Keywords: *Haze Degree, DehazeNet, Faster RCNN, Dark Channel Prior, DCP*

1. Introduction

Due to the nature of the air particles causing diffused reflection of light, the recovery of object recognition under foggy environment is difficult. These particles, which are smoke, dust, and even water droplets, obscure the image like a thin layer of fabric in front of the picture that blurs the details and distorts colors and the contrast. The degradation and blurring typical in many real-life scenes eagerly affect standard object detection techniques that rely on a clear and detailed picture to accurately define the items' place and type. Fog and smog are particularly detrimental to object recognition due to clever algorithms concealing crucial aspects, which blur the line between objects and backgrounds and reduce the reliability and precision of perceived identification as a result Strong gradients, low contrast, and weak edges have posed these challenges; due to these, methods for making the objects in fuzzy photographs visually more appealing, a process referred to as image dehazing, have been developed. Another image clarity enhancement method which is excellent and famous is the so-called Dark channel prior (DCP). The DCP technique is based on the identification of the existence of some areas in the scene if the most areas of the photo taken with an outdoor scene without haze contain at least one pixel with extremely low intensity of each color channel. Employing this characteristic, the DCP technique determines the atmospheric light, namely, the light which manifests as an outcome of scattering by particles and the transmission map indicating the amount of haze in the image. Subsequently, extent estimations are made with these, and a haze-free image is obtained or the original scene with precise colors and contrast is restored.The dehazing step is done using the IRAW model while for the object recognition step, the network used is YOLO (You Only Look Once). Face detection algorithms are currently one of the most popular modern object detection algo- rithms, such as YOLO due to their high speed and recognition the bounding boxes once, and comes up with the bounding boxes and class probabilities of a few objects. as not only has it reduced the computational complexity in this end-to-end scheme but also improved the detection accuracy because of the first consideration of contextual infor- mation of the entire image. In the event of YOLO, the image is then divided into a grid and the algorithm predicts a number of bounding boxes, each with a confidence score attached to each of the cell in the grid. These predictions are then taken through a non-maximum suppression where repeated detections for best and accurate two boxes are eliminated are kept. Therefore, when two approaches such as YOLO and DCP- based dehazing are integrated, an efficient sys- tem to detect objects in foggy region is ob- tained. This boosts the detection accuracy of yolo by employing the enhanced image quality of dehazing and turned out to be very applicable in real-life implementation such as in remote sensing, autonomous driving, and surveillance. As a result of proposed method's capability to solve haze related problems and assure object localization, this combined method has a lot of potential for practical implementation in the various complex environmental conditions in the upcoming change.

2. Literature Survey

Kaiming et al. proposed [1], the technique known as Dark Channel Prior (DCP) for single picture haze removal is described that was pro- posed by. noted that the haze-free images do not have pixels with low value in at least one adjust- ment of the color channel of a patch thus hazy images are cleared based on this property.

Zhang et al. [2], This work elobarates how to reduce time required in the soft matting stage in the DCP. In this regard, they utilized a guided filter for a successful transition of the transmission map with a significantly reduced computational cost, as compared to the previous methodology, but with high-quality dehazing results.

Component Analysis (ICA) algorithm. It is clearly seen that as a result of two new ideas presented in Fattal's approach, the haze and scene radiance components are successfully separated, which improves image clarity and visibility.

Convolutional Neural Networks technique was used in [4], The following paper proposed by Liu et al. is related to image dehaze. A more accurate and faster dehazing algorithm was established by segmenting the images into superpixels and utilizing CNN results to estimate the transmission.

Bolun Cai et al. [5], explained the new method of dehazing named DehazeNet based on BReLU and maxout networks which mostly works based on the special characteristics of fuzzy images and gives more clear and accurate results in this sector.

This research [6], tells about the haze identification and the algorithm for estimating the degree of haze using DCP and image contrast feature are described by Chi Wei Wang et al. This problem was solved by feeding the features into a Support Vector Machine where the degree of haze was assessed.

In [7], this paper focuses on the limitations of integrating Faster RCNN with DehazeNet despite offering a quick remedy to object recognition. The longer processing time is an issue that hinders the use of WSUs in real-time applications; hence, the need to optimize it.

C. Ancuti, et al. [8], Using the IVC Dehazing Dataset, the Foggy Road Image Dataset-FRIDA and Static Images Dataset obtained from Color Hazy Images for Comparison-CHIC. The validity and reliability of haze degree and image dehazing techniques and methodologies are going to be assured by these datasets.In [9] this paper, the authors describe how Young-Sik Shin et al. implemented dehazing for underwater picture using a standard architecture neural network design to estimate ambient light and transmission map. Their method is effective in addressing those challenges especially the ones found in Submerged Space environments.

Raanan Fattal's technique is used in [10], this paper details on using physical based features in Raanan Fattal's technique to compute scene transmit. In contrast to other probabilistic models utilized in the dehazing process, Fattal's technique can be described as quite a procedural and clear-sighed method for the enhancement of image's visibility.

J. Mao et al. writing in [11], considers the method proposed for ascertaining haze through maximum and minimum pixel values of the image. From these numbers, the haze degree is determined and this can be used to quantify the level of haziness.

3. Proposed Method:

The recommended procedure for enhancing blurry photos and detecting objects in them should be systematic and well-structured. Key phases are fundamental to this system, ensuring improved functionality and efficiency.

3.1. Uploading an image

The user first chooses an ill-defined image and uploads it on the application. This is the input image that is utilized for the subsequent processes of object recognition and classification. The uploaded image is generally in RGB colors and for getting the clear visibility of the objects or getting the correct locations of the objects to be detected, there's initial haze is required to be eliminated.

3.2. The Process of Dehazing

When the process of dehazing is a multistep process, the aim is to increase the level of clarity by reducing haze.

3.2.1. Dark Channel Prior Calculation: The first of them is calculation performed in order to dehaze the picture The second is the computation of disable, as well as the alpha and beta of the dependant haze values. From here, the dark channel prior can be derived by finding out the mean of the minimum intensity value of every pixel of the RGB image. Intentionally used regarding the haze assessment, the technique enhances the segments of the picture which are impacted by light to the least.

3.2.2. Atmospheric Light Estimation: Before, the dark channel is employed to compute the light of the atmosphere in the image, like as the system suggests. To do this, only the highest value pixels corresponding to this black channel which often correspond to the intensity of ambient illumination must be looked for. It was also necessary to determine amount of ambient light in order to approximate the haze projection in the image.

3.2.3. Estimation of Transmission Map: This is followed by the estimation the transmission map of the display after the estimation of the ambient light has been carried out. The map of transmission corresponds to the part of the light that makes it to the camera without being localised . The atmospheric light and the original light picture are used as the inputs for the calculation. This map is useful in quantifying the amount of haze per pixel to be expected in an image.

3.2.4. Refinement of the Transmission Map: It should be so done since the first estimation of the transmission map is often full of noise and requires it. In the case of refinement, a guided filter is adopted to smooth out the transmission map but constructively preserving the edges by employing the image intensity structure. Thus, with this step, the transmission map is sure to capture the distribution of haze in the image as desired.

3.2.5. Image Recovery: The system removes the dehaze component from the image by employing the atmospheric light and the updated transmission map. This means that it is possible to counteract the haze by manipulating the pixel intensities in relation to the transmission map as well as the available light. In other words, while comparing the recovered image with the initial image that seems to be, blur and visibility should be better.

3.3. Image Improvement

The technique uses histogram equalization to further enhance the quality of the dehazed image. By shifting the intensity levels, this technique improves the image's contrast and produces a more balanced, eye-catching image. Object detection can now be performed on the improved, dehazed image.

3.4. Identification of Objects

Objects within the improved dehazed image are recognized and labeled during the object detection stage.

3.4.1. Load YOLO Model: The You Only Look Once (YOLO) model has been updated by the system. Modern object identification algorithms like YOLO are renowned for their quickness and precision. The configuration files and weights required for identifying a variety of objects are included in the pre-trained model.

3.4.2. Object Detection: To identify objects, the improved, dehazed image is processed by the YOLO model. The image is divided into grids, and bounding boxes are assigned to each cell and class probabilities are predicted. For items that are detected, the model produces bounding boxes, confidence scores, and class labels.

3.4.3. Draw Labels: Following object detection, the system surrounds the objects it has located with bounding boxes and labels. An easy-to-understand visual representation of the identified objects in the picture is provided by the annotation of each bounding box with the class label and confidence score.

3.5. Show Off the Outcomes

The initial fuzzy image, the dehazied image, and the dehazied image with objects recognized are the three images are shown in system. In this step, the user can examine the outcomes of object detection and assess how effective the dehazing procedure was.

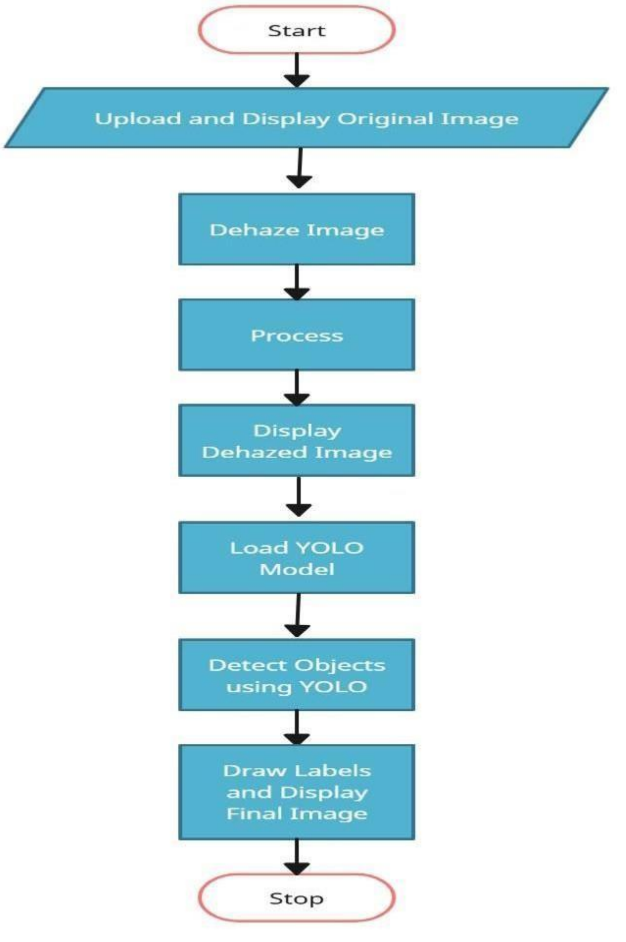

Figure 3.1: Flow chart of proposed system

The figure 3.1 shows a process to clarify a hazy image and recognize objects using a pretrained YOLO model. It starts with the user uploading and displaying a hazy image. The image undergoes dehazing, beginning with calculating the dark channel prior to find the darkest pixels. Then, the atmospheric light is estimated by identifying the brightest pixels in the dark channel. This information is used to create a transmission map, showing how much light reaches the camera without scattering, which is then refined for accuracy.

After dehazing, the clearer image is displayed. The next step involves loading the YOLO model, a real-time object detection system. The YOLO model analyses the dehazed image, detecting and identifying objects by marking them with bounding boxes and labels. The final image, now labelled with detected objects, is displayed for the user. This process ensures the image is clear enough for accurate object detection, enhancing the YOLO model's effectiveness.

4.Conclusion:

In this paper, we demonstrated an effective approach to enhance object detection in hazy images by integrating the Dark Channel Prior (DCP) dehazing technique with the YOLO object detection model. By leveraging the DCP technique, we efficiently remove haze, improving image visibility and contrast, which enhances YOLO's detection accuracy. Our results indicate that this combination significantly improves reliability in adverse weather conditions, benefiting applications like autonomous driving and surveillance. This method also offers real-time implementation feasibility due to its computational efficiency.

References

1.K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior", IEEE Transactions on Pattern Analysis and Machine Intelligence, 33(12):2341-2353, 2011.
2.H. Zhang, and L. Hu, "Fast image dehazing using improved dark channel prior", IEEE Inter-national Conference on Information Science and Technology, 189-192, 2010.
3.R. Fattal. Single image dehazing, "ACM Transactions on Graphics (TOG)", 27(3):72, 2008.
4.R. Liu, L. Ma, W. Zhang, and X. Fan, "Single image dehazing with a generic modelagnostic convolutional neural network", arXiv preprint arXiv:1510.05191, 2015.
5.B. Cai, X. Xu, K. Jia, C. Qing, and D. Tao, "DehazeNet: An end-to-end system for single image haze removal", IEEE Transactions on Image Processing, 25(11):5187-5198, 2016.
6.C. W. Wang, and H. H. Wu, "A novel single-image dehazing method using support vector regression", IEEE Transactions on Signal Processing, 60(11):5686-5697, 2012.
7.S. Ren, K. He, R. Girshick, and J. Sun, "Faster R-CNN: Towards real-time object detection with region proposal networks",Advances in Neural Information Processing Systems, 28:91-99, 2015.
8.C. Ancuti, C. O. Ancuti, C. De Vleeschouwer, and P. Bekaert,"D-HAZY: A dataset to evaluate quantitatively dehazing algorithms",IEEE International Conference on Image Processing, 2226-2230, 2012.
9.Y. S. Shin1, S. Y. Cho2, and K. M. Lee3,"Underwater image enhancement using a convolutional neural network",IEEE International Conference on Image Processing, 1-5, 2016.
10.R. Fattal,"Dehazing using color-lines", ACM Transactions on Graphics (TOG), 34(1):13, 2014.
11.J. Mao, H. Shen, and Q. Yuan, "A new method for haze removal based on the extremum of color channels",IEEE International Conference on Image Processing, 2085-2088, 2011.