International Journal of Computer Trends and Technology
ISSN: 2231-2803 / https://doi.org/10.14445/22312803/IJCTT-V68I3P120

Volume 68 Issue 3, 99-102, March 2020

Original Article

Real Time Dehazing System for Automobiles

Basil Eldho, Shruti Manmadhan, Susan Jacob, Joby George

Department of Computer Science and Engineering, Mar Athanasius College of Engineering, Ernakulam, India

Received Date: 22 February 2020
Revised Date: 07 April 2020
Accepted Date: 09 April 2020

Abstract *- Cars have been a common mode of transport ever since their innovation. Fog, smoke and heavy rains pose huge hindrances of sight for people when they drive. This has led to many dangerous accidents especially when it comes to driving at high altitudes or narrow roads. Hence, we propose a real-time image de-hazing system using machine learning and convolutional neural networking concepts. It captures the path in front of the car as video which is then converted to frames and removes all the factors that reduce the clarity of the image. To do so, the loss per pixel is calculated. Here, training sets are utilized in order to obtain better outcomes. Hazed and dehazed images are analyzed and compared and then converted back to dehazed video. It requires a huge refresh rate to make it real time and finally achieve the output.*

Keywords *- Convolutional neural networks, machine learning, digital image processing, training data set, layers, dehaze.*

I. INTRODUCTION

The invention of the wheel was a great turning point in the history of mankind. Automobiles have tremendously influenced our life since then. Even during changing environmental conditions- be it rain, dust and smoke, pollution etc, these vehicles have come to the rescue. But, the issues like road visibility, traffic rule obedience and many more still need to be overcomed. Also, during driving dust, rain, fog, mist etc reduce the visibility drastically and makes it nearly impossible to drive. This can lead to many accidents. In recent times, there are various cases that have been registered under the same circumstances.

Visibility is not restricted only to the road being clear to drive on. The objects on the road have to be equally identified by the driver. These objects could be another vehicle, humans, trees on the sides or holes and so on. Only if these conditions are met, one can drive easily and safely. But, with the changing weather conditions, it has become difficult and is a great threat to both the living and nonliving. Even modern cars do not provide any measures to survive such adverse conditions.

The solution that we propose is a real time image dehazing system which captures the hazed front view of the driver and provides a dehazed output to him so that he can drive with the enhanced visibility of his path. In order to do so, the live video is captured, converted into frames, each of which are individually dehazed. This output is converted back to a video and provided to the driver. The processing involves the use of convolutional neural networks and with a training dataset we train the system to identify the loss per pixel. The further implementation details can be seen in the coming sections.

II. LITERATURE REVIEW

A. Machine Learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. It mainly focuses on the development of computer programs that can access data and then use it to learn for themselves. The entire process of learning includes observations or data, such as examples, direct experience, or instruction, thereby looking for patterns in data and making better decisions in the future based on the examples that are provided. The primary goal is to allow the machine to learn automatically without human intervention or assistance and adjust its actions accordingly. Machine learning algorithms are often categorized as supervised or unsupervised.

- Supervised machine learning algorithms are applying what has been learned in the past to new data using preset examples to predict future events. Beginning from the analysis of a known training dataset, the machine learning algorithm produces an inferred function to make predictions about the output values. Thus, the system is able to provide targets for any new input after sufficient training. The algorithm used for learning can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

- Unsupervised machine learning in contrast, deals with how machines can infer a function to describe a hidden structure from unlabeled data. These are used when the

information used to train is neither classified nor labeled. The machine doesn't figure out the right output, but it explores the data and draws inferences from datasets to describe hidden structures from unlabeled data.

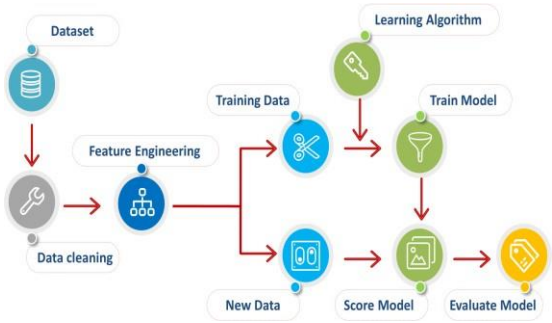

Fig. 1 Machine learning

B. Convolutional Neural Network

The study of design of algorithms that can learn is the branch of computer science called deep learning and machine learning. Deep learning is a subfield of machine learning that is inspired by artificial neural networks, which in turn are inspiredby biological neural networks.

The convolutional network, which is commonly referred to as CNN or ConvNet is a specific kind of deep neural network. It's a deep, feed-forward artificial neural network. Feed- forward neural networks are also called multi-layer perceptrons(MLPs), which are the quintessential deep learning models. There are no feedback connections in which outputs of the model are fed back into itself. The models are called "feed- forward" because information flows right through the model.

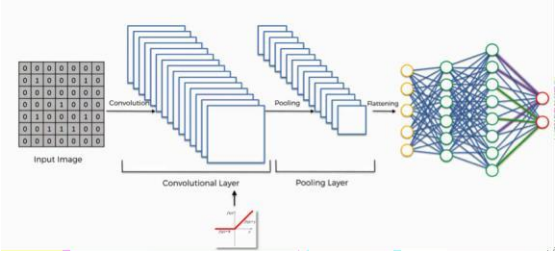

Fig. 2 Convolutional Neural Network

C. Dehazing

As compared to the general object detection problem, the task of adapting the detectors to adverse weather conditions is relatively less explored. One approach to solve this issue is to undothe effects of weather conditions by pre-processing the images using existing methods like image dehazing and deraining. However, these approaches usually involve complicated networks and need to be trained separately with pixel-level supervision. Images captured under weather conditions (such as haze and rain) can be mathematically modeled.

For example, a hazy image is modeled by a superposition of a clean image (attenuated by transmission map) and atmospheric light. Similarly, a rainy image is modeled as a superposition of a clean image and rain residue. The effect of haze on images has been extensively studied. Most existing image dehazing methods rely on the atmospheric scattering model for representing image degradations under hazy conditions. The aim of hazeremoval is to remove or lower hindrances caused by haze with dehazing approaches which intends to generate adequate visual properties and obtain profitable information.

III. DESIGN

A. Phase 1. Single Image Dehazing

Single image dehazing is done using python. The inbuilt torch module of python provides two high-level features:- Tensor computation with strong GPU acceleration and Deep Neural Networks built on a tape-based autograd system. Torch.nn library provides the functions regarding neural networks. A data set consisting of both hazy and clear images are used to train the neural networks. The neural network consists of five layers.

Fig. 3 Dehazing

90% of the entire data set is randomly selected as the training set and the remaining is used as validation set. The network is trained for multiple epochs and for each epoch, loss in the hazy images are calculated. These are then used to update the weights of the network. Once all the epochs are completed, the network will be fully trained to dehaze images.

Now, images with haze in them can be given as input to the network. The network will process it and output an approximation of the image without haze with maximum possible accuracy. Multiple images can also be processed at the same time.

B. Phase 2. Video Processing

Opencv module of python is used for videoprocessing. It provides a library of functions aimed at computer vision,

real time and otherwise. The idea is to convert the video to multiple frames, i.e., images and dehaze them individually. Theindividual frames can be fed into the previously trained neural network to dehaze them. Once de- hazed, the frames can be merged together and converted to video format. In addition to opencv, pillow (PIL) library is also required to convert images back to video.

C. Phase 3. Real time dehazing

Opencv also provides functions to manipulate videos in real time. A digital camera canbe used to capture the video in front of the car whiledriving through a haze filled path. Every second of the footage normally consists of 24 frames. Each frame can then be fed to the neural network to dehaze them. The frames after dehazing can then beplayed back as live footage on a screen visible to the drivers, to help them see the way. An embeddedsystem must be set up in the car to implement this.

IV. IMPLEMENTATION DETAILS

A 5-layered convolutional neural network is setup.

- A set of 27457 images is used to train thenetwork.
- Each individual image is fed to the trainednetwork to clean them up.
- Dehazed images are converted back to videoformat for output.
- Whole process is implemented using CNN.
- Input captured as video will be processed in realtime.

Algorithm: Training Neural Networks

- Create the convolutional neural network with 5 layers.
- Initialize the weights of the network.
- Load the training and validation datasets.
- For each epoch of training, do:
- Clean_image = dehaze_net(img_haze)
- Loss = criterion (clean_image, img_orig)
- Save the state of the dehaze network at regular intervals.
- Input hazy images from validation set to validate the network.
- The network will be trained to accurately dehaze images

Algorithm: Dehazing Video Input

- Get the video as input.
- Convert the input into frames, i.e., images.
- For every frame of the video, do:
- Clean_image = dehaze_net (image)
- Save the dehazed image as output.
- Convert the output images back to video.
- The output video will be the dehazed version of the input video.

V. RESULTS

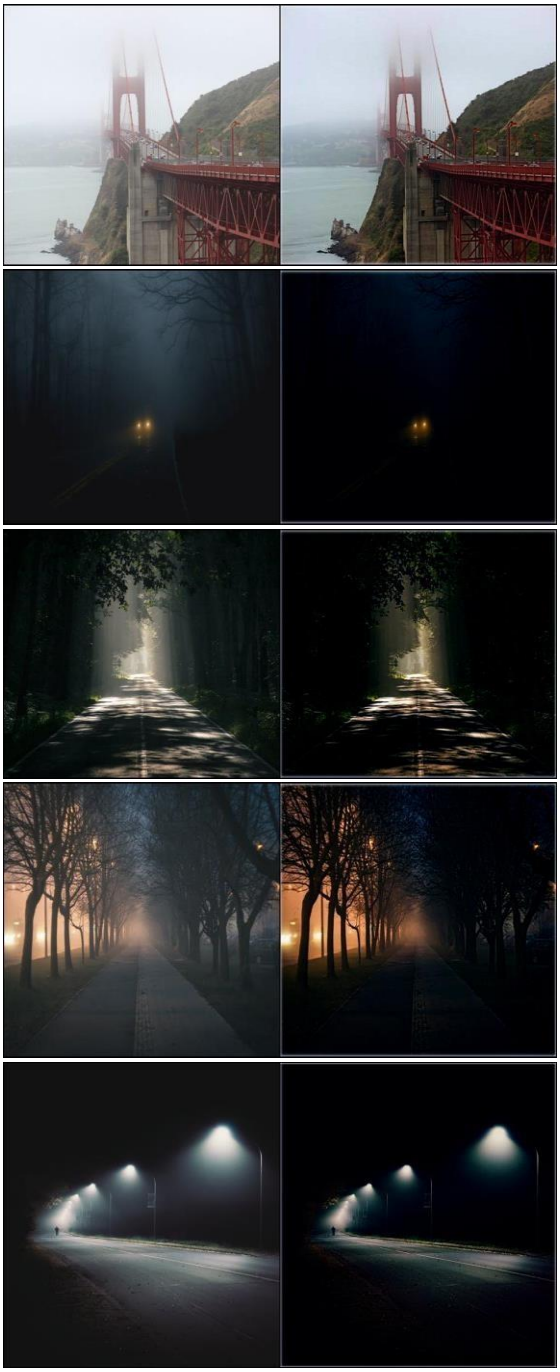

Fig. 4 Hazed to clear images

VI. CONCLUSION

Fog, smoke, rain and other adverse climatic conditions affect automobiles on a regular basis. Theaim of the paper was to develop a system that wouldhelp vehicles navigate through such dire situations. Hence, we developed a system based on convolutional neural networks that are specifically trained to clean or dehaze images polluted by fog, smoke and water. This system was further modified to accommodate moving images. Thus, a dehazing system that can take real time or recorded video input was put together. This can be embedded to anautomobile system and can be used by the drivers when they are bothered by severe atmospheric conditions.

REFERENCES

[1] Wajahat Akhtar, Sergio Roa-Ovalle, Florian Baumann, Real Time Single Image and Soil Removal Using CNNs, Computer Science in Cars Symposium.

[2] Cameron Hodges, Mohammed Bennamoun, Hossein Rahmani, Single image dehazing using deep neural networks, Pattern Recognition Letters.

[3] Alona Golts, Daniel Freedman, Michael Elad, Unsupervised Single Image Dehazing Using Dark Channel Prior Loss, IEEE Transactions on Image Processing.

[4] A. Alajarmeh, R.A. Salam, K. Abdulrahim, M.F. Marhusin, A.A. Zaidan, B.B. Zaidan, Real-time Framework for Image Dehazing Based on Linear Transmission and Constant-time Airlight Estimation, Information Sciences.

[5] Wenqi Ren, Jingang Zhang, Xiangyu Xu, Lin Ma, Xiaochun Cao, Gaofeng Meng, Wei Liu, Deep Video Dehazing With Semantic, Segmentation, IEEE Transactions on Image Processing.

[6] Wencheng Wang, Xiaohui Yuan, Xiaojin Wu, Yunlong Liu, Fast Image Dehazing Method Based on Linear Transformation, IEEE Transactions on Multimedia.

[7] Chongyi Li, Jichang Guo, Fatih Porikli, Huazhu Fu, Yanwei Pang, A Cascaded Convolutional Neural Network for Single Image Dehazing, IEEE Access

[8] Faming Fang, Tingting Wang, Yang Wang, Tieyong Zeng, Guixu Zhang, Variational Single Image Dehazing for Enhanced Visualization, IEEE Transactions on Multimedia.

[9] Venkateswaran S, Devisri R, Karthika C, Karthika U, Video Dehazing Approach Using Structure Features Prior, International Journal of Computer Trends and Technology.