VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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A PROJECT SYNOPSIS

ON

"Improving fog-degraded images using CNN and DLA"

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ABSTRACT

Degraded visibility and lack of luminance in foggy weather are major threats to the safety of drivers. Nowadays many camera-based advanced driver assistance systems (ADAS) have been introduced to assist drivers and ensure their safety under various driving conditions. One of the problems faced by drivers is the faded scene visibility and lower contrast while driving in foggy conditions. These conditions increase the danger of vehicle collision which leads to a major number of cases of injuries and fatalities on roads that are covered with fog. Accumulation of fine droplets in the fog blocks and scatters the light. This leads to reduced visibility since there is less light reaching the driver's eye, and also because of the lower contrast. The color and contrast of images under such weather conditions are considered to be degraded due to the airlight and attenuation of the radiance introduced by a scene visualized by the driver. At this point, a significant fog removal approach contributes to visibility improvement, reducing road accidents in such foggy weather. Moreover, fog image dehazing and visibility improvement techniques are considered to play an anchor role in minimizing the contrast that predominantly impacts the advanced driver assistance system (ADAS) in the real world. Here in our approach, we assume that the fog in an image can be mathematically modeled by an unknown complex function. Using this function and utilizing the deep neural network to approximate the corresponding mathematical model for the fog. By doing it this way we input a foggy image and arrive at an approach to dehaze the fog to provide a clear fog-free image that can be used in real-time. Experiments on synthetic images suggest that this method can provide a very good accuracy. It also consists of an interface that makes it easily accessible on multiple devices. Hence, the goal of our approach is to provide a much faster and more clear image that significantly improves the visual and gives defogged images regardless of its uses.

DRIVING FORCE BEHIND THE IDEA:

Fog is a major factor in weather that affects most daily life activities. One of the major threats of fog is vehicle crashes. On average, 23% of crashes and 18% of all fatal crashes are weather-related, whereas crashes in foggy conditions are prone to be more severe and can involve multiple vehicles compared with clear conditions. Data from the ministry of road transport and highways shows that as many as 12,678 people lost their lives in fog-related road accidents in 2018. In 2016, as many as 9,317 people died in such accidents and the number increased to 11,090 in 2017. The ministry further said between 2014 and 2018, fatalities on roads due to fog-related crashes increased by almost 100%. Since 2017, north Indian states such as Uttar Pradesh, Bihar, Haryana, Punjab and Delhi have topped the list of states where road accidents spike during winter. In this regard, low-traffic traffic volume corridors might have more serious safety concerns.

There might also be high variability in driver behaviour on low-volume roads with various roadway geometry characteristics and relatively large headway distances at the desired speed . On low-volume highways, this behaviour can aggravate crash risk in WZs, especially during foggy conditions . Fewer traffic interactions on low-volume highways can lead to drivers being unaware of downstream conditions and imminent dangers, often resulting in multi-vehicle and severe crashes. In a recent interaction with the Delhi traffic police officials, they said that the problem is more rampant on highways and expressways around the city, and accidents caused by low visibility increase by at least 8-10% in December and January— when the visibility in the region dips to almost zero. Apart from road accidents, the possibility of pile-ups—when multiple vehicles crash with each other—also increases in the fog.

Due to the interference of fog, even travellers and photographers sometimes end up getting disappointed. It is reported that sometimes due to high density it becomes difficult for travellers to navigate in the fog and would have to wait until the fog clears. Sometimes high density of fog causes navigation issues even at ports and airlines. It is also necessary to note that fog can often result in degraded images of nature which makes it hard for photographers to capture the images clearly. Hence our motivation to take up this project is to make it safer for drivers to drive and also to enjoy the beauty of nature without any disturbance.

LITERATURE REVIEW

PROS

1. Remove haze from the input image.
2. Analysing Polarisation Filtered images has become more accurate.
3. It is used in Surveillance, highway driving aircraft take-off, landing, object tracking, object identification, and other fields.
4. Correct image density and contrast yield more precise details in the image.
5. Helps to easily store and retrieve data on the computer.
6. Images can be made available in any desired format like black and white or colorized.
7. Disturbance removal rate is high.
8. Highly trained models can provide better accuracy based on the device its being used.

CONS

1. A major problem is spatially varying reduction of contrast by stray radiance, which is scattered by the haze particles toward the camera and causes irreplaceable distortion.
2. The natural marvels which decrease the color contrast and surface color of an object with deference to the distance from the sight object .
3. Initial cost is high depending upon the system used.
4. Portability is an issue.
5. Real-time rendering of the image requires faster processing.
6. Once the system is damaged the image will be lost resulting in a complete loss of trained data.
7. Time consumption is a major issue.
8. In special events like any accident or crash the predicated image and the real image varies the possibility of loss of minor data is high.

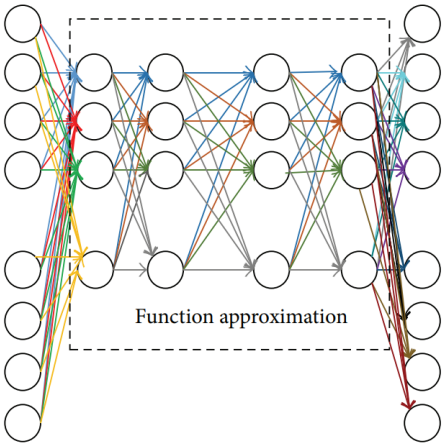
PROBLEM STATEMENT/ OBJECTIVE

Fog is a natural phenomenon that blurs the scene, reduces visibility, and changes color. It is an annoying problem for photographers because it can reduce image quality but it is a major problem for drivers as it makes the road invisible. The foggy weather, it makes it very difficult for drivers to view the road while driving. In a recent report from the Ministry of Road Transport, in 2018, 1,51,417 road crashes recorded due to unfavourable weather conditions, especially fog, killing 28,533 people. Dense fog was also recorded in Bihar, Uttar Pradesh, West Bengal. Sometimes due to high concentration of smoke and fog, there is a mixture formed called as smog. This results in a poor air quality and also in poor road visibility. This has lead to a dramatic increase of accidents at Delhi. Hence, it is necessary for us to develop a system that can produce images which are clear and free from fog disturbance. This could help in reducing the number of accidents and also provide better support for travelling.

SYSTEM DESIGN

1. ARCHITECTURE:

Foggy image



Defogged image

Simple deep neural network architecture for fog removal.

2. HARDWARE AND SOFTWARE REQUIREMENTS:

Hardware Requirements:

1. **CPU:** Intel core i5-7267U @ 3.50 GHz
2. **Memory:** 8 GB
3. **GPU:** NVIDIA A100 and upwards
4. **Network:** minimum 1 Mbps

Software Requirements:

1. **Operating system:** Windows 7 and above(64bit)
2. **CUDA:** CUDA Toolkit 7.0
3. **OpenCV:** OpenCV 3.0
4. **cuDNN:** cuDNN 8.3
5. **Python:** 3.11.0
6. **Pytorch:** 1.13.0
7. **Frontend:** React native, Html, CSS

CONCLUSION:

The present study is based on the removal of fog from natural images, which can be mainly applied to automation in self-driving vehicles. This paper addresses the issue by taking the fog depths and transforming the images into maps. The results are presented for the transmission map and the filtering methods. The comparison of filters based on the contrast gain and the color index is tabulated. The images of the lake, truck, and train have been used for this comparison and the results are compared, but the processing speed for this is much higher compared to other methods hence we implement much more testing and advanced methods where the model estimates the thickness of fog in a hazy image. Then the foggy region gets converted to a white region after this transformation. The restoration after this transformation plays a key role in understanding the actual data without fog. The deep learning model also utilized the convolutional neural network system in it so that the quality of the defogged image does not decrease and also so that the accuracy obtained is very high. Here, the defogged image is generated. The proposed method provides much higher accuracy and faster processing. Since we are using react native as an interface for uploading the images for dehazing, we can ensure that the feature can be easily accessible across various devices. Due to its minimalistic configurations, this can be implemented in real-time too. Using this method in real-time, we can facilitate the drivers, outdoor surveillance, video-guided transportation, remote sensing images, and real-time image processing.