Project Proposal: Depth Estimation and Fog Simulation

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I. MOTIVATION

As automation and artificial intelligence become increasingly popular, so does the need for accurate computer vision and scene rendering. One of the most important aspects of computer vision is depth estimation. This problem has broad applications in areas such as robot vision, human computer interfaces, intelligent visual surveillance, 3D image acquisition, and intelligent driver assistance systems.[1] Depth estimation can also be used for artistic purposes, such as image refocus, bokeh, simulations, and special effects.

II. OVERVIEW

In our project, we will explore and implement image processing algorithms to estimate depth from two corresponding images taken by a dual camera. Once we have a method for generating a depth map of the image, we hope to extend this task further to background filtering, specifically fog simulation.

With a depth map, we will be able to realistically simulate fog, smoke, or haze in an originally clear image. Naturally, more distant objects will be more obscured by fog, which is possible once closer and more distant objects are differentiated. Furthermore, we can simulate a concentrated source of smoke, such as a chimney. It can be applied to video games, autonomous driving training and pilot training.

III. MILESTONES

1. Demosaicing, Image correction: We will process the raw image by implementing image processing pipeline. By 3.3

2. Object recognition and depth estimation: We will identify the objects in the images from dual camera. And by calibrating the displacement of objects, we will be able to get the depth information. By 3.6

3. Background effects: We can implement background rendering or refocusing based on depth map we have, for example fog simulation. Further, we will design our mask for local source of fog and apply it on images. By 3.12

IV. RELATED WORK

There are some work on depth estimation by a variety of methods:

Quiyan, et al., use a short video clip with minor camera movement to estimate depth and implement refocusing. The parallax of different frames of the video clip are used to determine the depth of each object. It uses the same principle of a dual camera system but instead using one camera over a period of time. [2]

Martinello, et al., use a dual camera to accomplish depth estimation. Their work is notable that they use a mobile camera. They also implement some denoising techniques in combining two images. [3]

Fan, et al., compare a few methods for fog simulation and apply it to images for different amounts and types of fog. [4]

The general idea is once we have a few photos from different perspective, we will be able to estimate the depth of the objects in the photo. There are a lot of publications based on this idea for other applications, which may be helpful even for fog simulation.

[1] S. Lee, N. Kim, K. Jung, M. H. Hayes, and J. Paik, in *Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on* (IEEE, 2013) pp. 2247–2251.

[2] Q. Tao, J. Li, L. Wang, and M. Zhang, in *Wireless Communications & Signal Processing (WCSP), 2015 International Conference on* (IEEE, 2015) pp. 1–5.

[3] M. Martinello, A. Wajs, S. Quan, H. Lee, C. Lim, T. Woo, W. Lee, S.-S. Kim, and D. Lee, in *Computational Photography (ICCP), 2015 IEEE International Conference on* (IEEE, 2015) pp. 1–10.

[4] F. Guo, J. Tang, and X. Xiao, International Journal of Computer Games Technology **2014**, 10 (2014).