EE 367 PROJECT PROPOSAL (WINTER 2016)

EYE GAZE BASED FOCAL STACK SLICE SELECTION AND DISPLAY

Kushagr Gupta (kushagr@stanford.edu), Suleman Kazi (sbkazi@stanford.edu)

MOTIVATION:

Virtual Reality (VR) has gained popularity amongst both research and commercial communities and improving the immersiveness of VR is an active area of research. In natural viewing our eyes verge and accommodate on a certain region or distance which appears to be in focus as compared to other regions which remain blurred (out of focus). Blur in images can create the sensation of depth because it emulates the limited depth of field created in the human eye. This is one of the existing problems being tackled by researchers to increase the realism of scenes displayed on the Head Mounted Displays (HMDs). Various approaches have been tried to increase the realism of scene ranging from retinal blur to foveated rendering to choosing a focal plane from a focal stack. We plan on following the focal stack approach but instead of a HMD, we shall be using a LCD (2D) monitor display for this project.

OVERVIEW:

In this project we aim to perform eye gaze based focal stack slice selection on depth images. If we can acquire real time information about the gaze location of the viewer, we can recreate the blur generated by the depth of field effect in the eye. Objects in the same plane as the object being looked at will be sharp, while other objects will be blurred. We plan to acquire images using a light field camera such as the Lytro Illum which can give us a depth map of the image along with the light field. Using an eye gaze tracker we can then find the point that the user's gaze is fixated on, and since we have the depth map we can then select the focal stack slice corresponding to that depth and display it to the user thus creating a depth of field effect similar to what the human eye experiences in real life.

TIMELINE / MILESTONES:

1. Get familiar with the eye tracker API and Lytro depth map and image pipeline.
2. Create an app to enable the display and dynamic selection of the depth plane based on user's eye gaze. Following variations will be tried in sequential order and as time permits:
    a. Implementing the idea on mono images from the light field camera.
    b. Extending it to stereo images and displaying on a computer screen with the user wearing anaglyph glasses.
    c. Extending the idea to display videos with the depth plane selection feature.

RELATED WORK:

Work has been done in studying of depth of field based gaze-contingent content display [5]. [1] reports that depth of field increases perceived realism and depth and can contribute to the perception of distance between objects in an image. It mentions that when stereo images are displayed on flat screen to provide depth cues it results in visual fatigue due to conflicts with other depth cues like vergence or accommodation. In [3] they degrade the resolution of peripheral image regions (not in fixation) to help in real time transmission of data as well as improve realism of displayed content.

REFERENCES:

[1] Mauderer, Michael, et al. "Depth perception with gaze-contingent depth of field." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, 2014.

[2] Jacobs, David E., Jongmin Baek, and Marc Levoy. "Focal stack compositing for depth of field control." Stanford Computer Graphics Laboratory Technical Report 1 (2012): 2012.

[3] “Duchowski, Andrew T., Nathan Cournia, and Hunter Murphy. "Gaze-contingent displays: A review." CyberPsychology & Behavior 7.6 (2004): 621-634.

[4] Reingold, Eyal M., et al. "Gaze-contingent multiresolutional displays: An integrative review." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 45.2 (2003): 307-328.

[5] Mauderer, Michael, et al. "Depth perception with gaze-contingent depth of field." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2014.