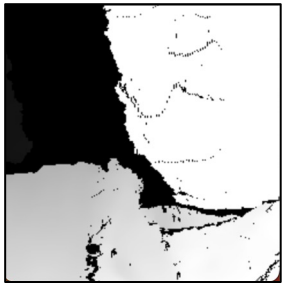
CSE 493V: Occlusion Handling in Augmented Reality ~ Devesh Sarda and Neel Jog

The Problem

Unlike Virtual Reality, Augmented Reality applications involves overlaying the real environment and the virtual environment which leads to scenarios in which an object in the real world needs to occlude a virtual object to ensure a coherent and seamless AR experience for the user. Incorrect / inaccurate occlusion handling can lead to a skewed perception of depth which can negatively impact user experience. Simply using a depth sensor is also inadequate given the extreme noise in the depth data.

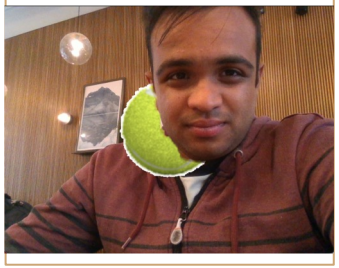
The Solution

Use color information to improve the initial foreground-background segmentation that was computed with raw depth data, leading to better classification of a pixel as foreground or background.



Classify each pixel in the color image into foreground and background.
Compute a color histogram separately for foreground and background and use it to compute pixel probabilities for the pixels in the overlapping region.
Generate per-pixel costs using a cost function using color/depth.

Final Result



Get sensor data → Distance image → Histograms & Probabilities → Cost Function → Threshold & Filter → Generate Trimap → Alpha Matting

Collect color and depth info from the sensor.
Create an image which represents the depth in the scene by comparing the visual depth and the real depth detected by the RGB-D sensor.

Threshold the cost image to produce a binary image.
Filter the noise out of the binary image.
Generate a trimap to sort out the pixels on the edge of the foreground and the background and use alpha matting to stitch the regions.

References

Primary:
Simona Gugliermo. "Occlusion handling in Augmented Reality Context"

Secondary:
D.R. Walton and A. Steed. “Accurate real-time occlusion for mixed reality”
T. W. Ridler and S. Calvard. “Picture thresholding using an iterative selection method”
E. S. L. Gastal and M. M. Oliveira. “Adaptive manifolds for real-time high-dimensional Itering”