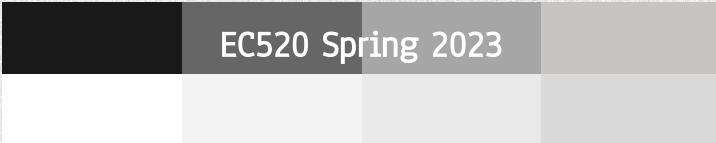

Depth-Based Blurring

&

Gradient Depth-Sweep

By Ysatis Tagle and Sally Shin



EC520 Spring 2023

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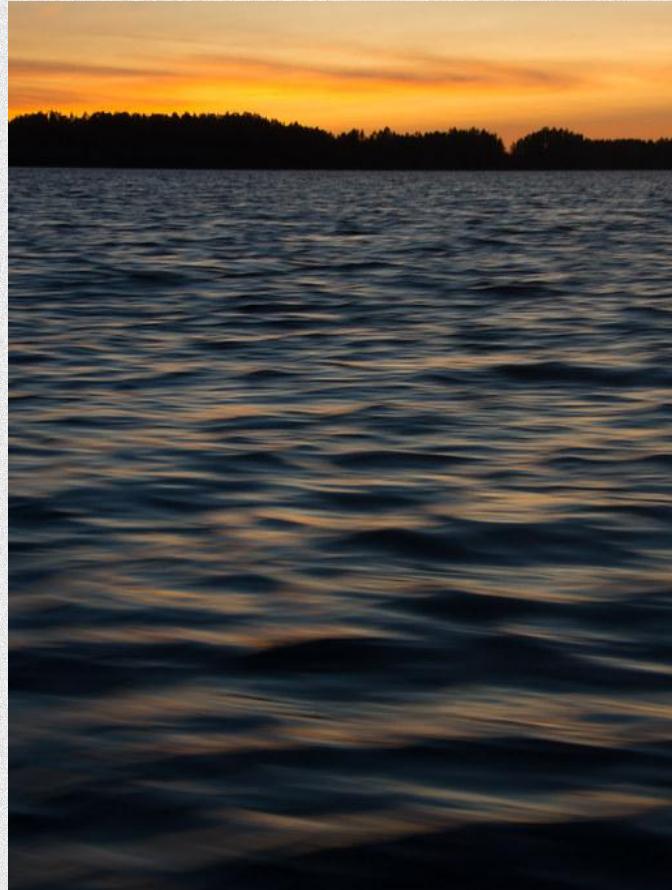
04

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INTRODUCTION

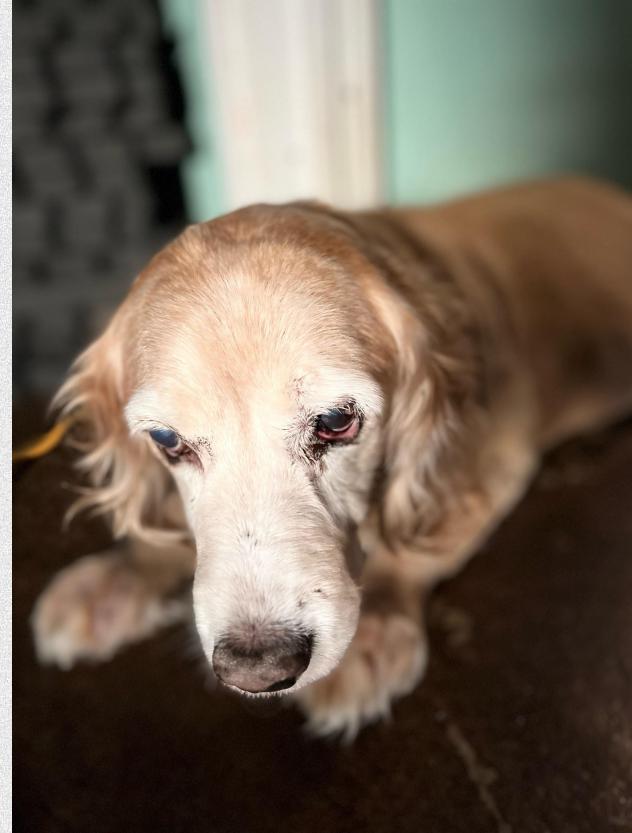
INTRO & MOTIVATIONS

Motivations

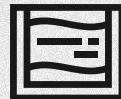
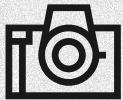
- Refocusing
 - Computational
 - Portrait Mode

Purpose

- Depth-based Blurring
- Gradient Depth
- Intel RealSense



ASSUMPTIONS



Intel RealSense

- Little user error
 - Camera settings
 - Calibration
- Right priority for depth map

Photos

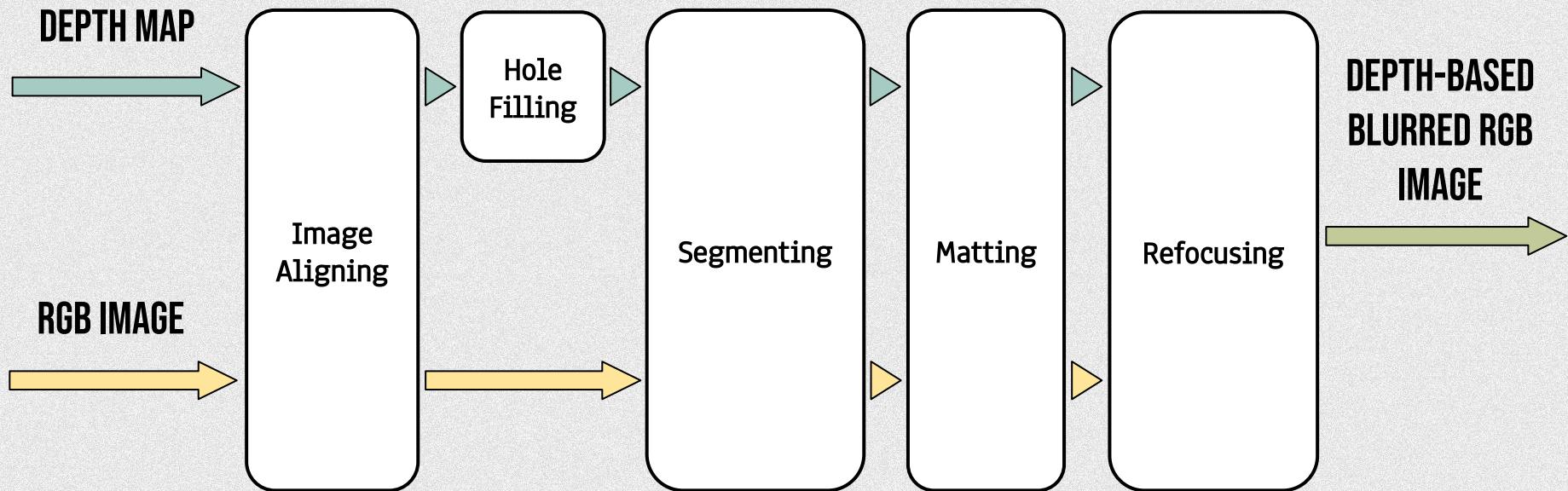
- Stationary
- Consistent features
- Same resolutions
- Similar viewpoints

Depth Map

- Known FG and BG
- No reflective materials
- Good lighting



IMPLEMENTATION PIPELINE



ORIGINAL IMAGES



RGB 480x640



Depth 480x640



IMAGE ALIGNING



IMAGE ALIGNING

Overlay of the aligned RGB and Depth images

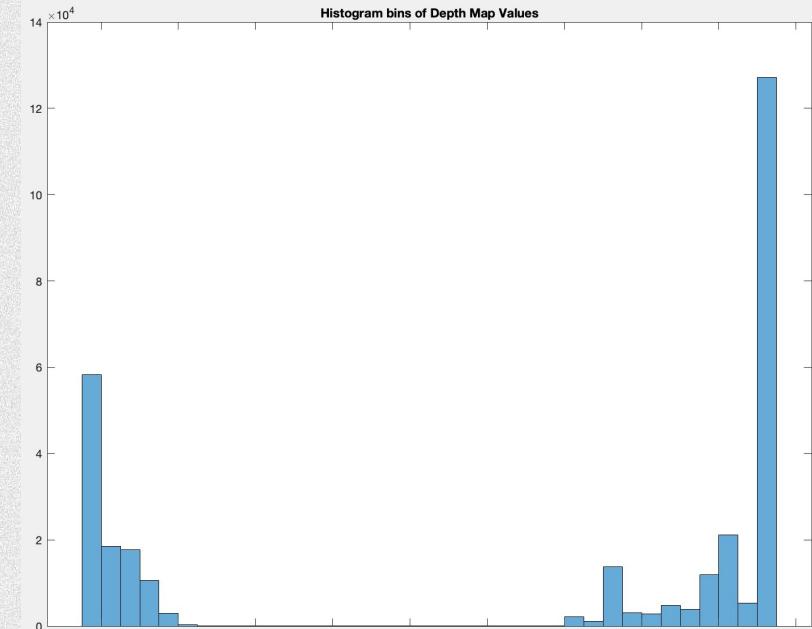
- *cpselect* to select for points of similarity
- *fitgeotform2d* to create geometric transformation to warp the images to the points of similarity



HOLE FILLING



After Hole Filling

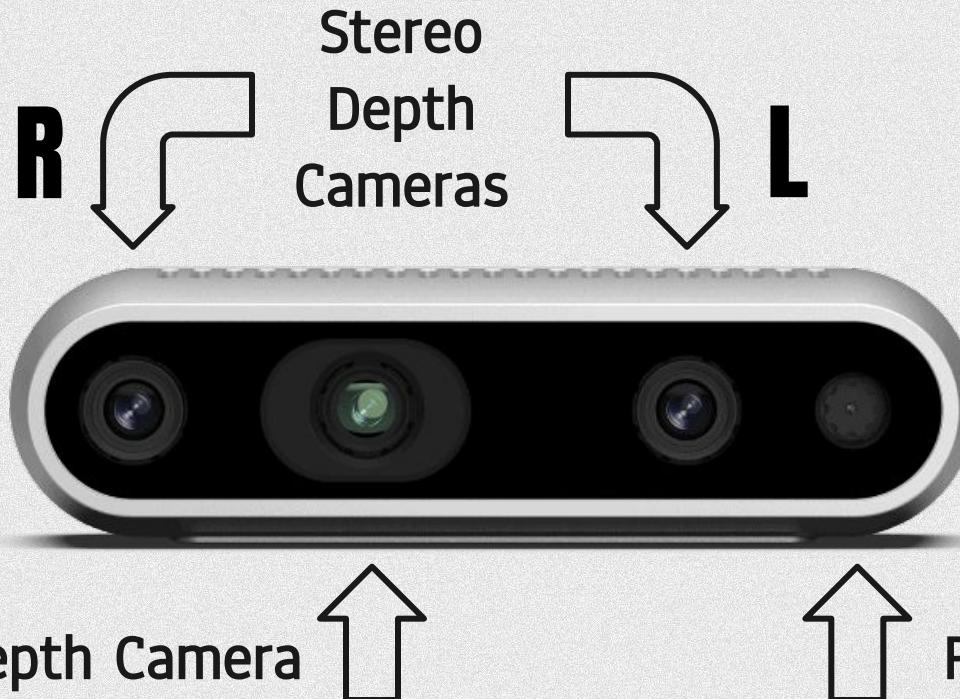


Histogram of Depth Map Values

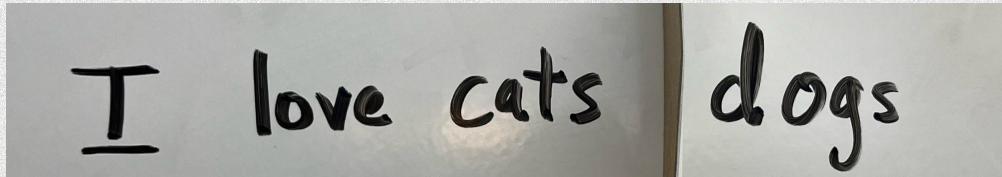


IMPLEMENTATION

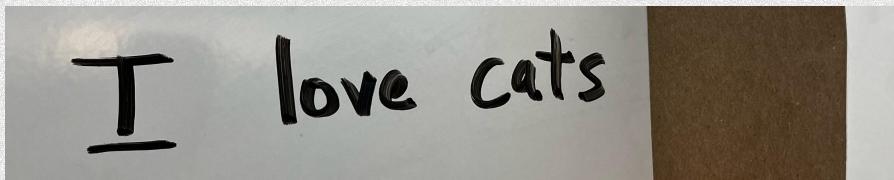
HOLE FILLING: OCCLUSION



HOLE FILLING: OCCLUSION



Reference



"Left Camera"



"Right Camera"

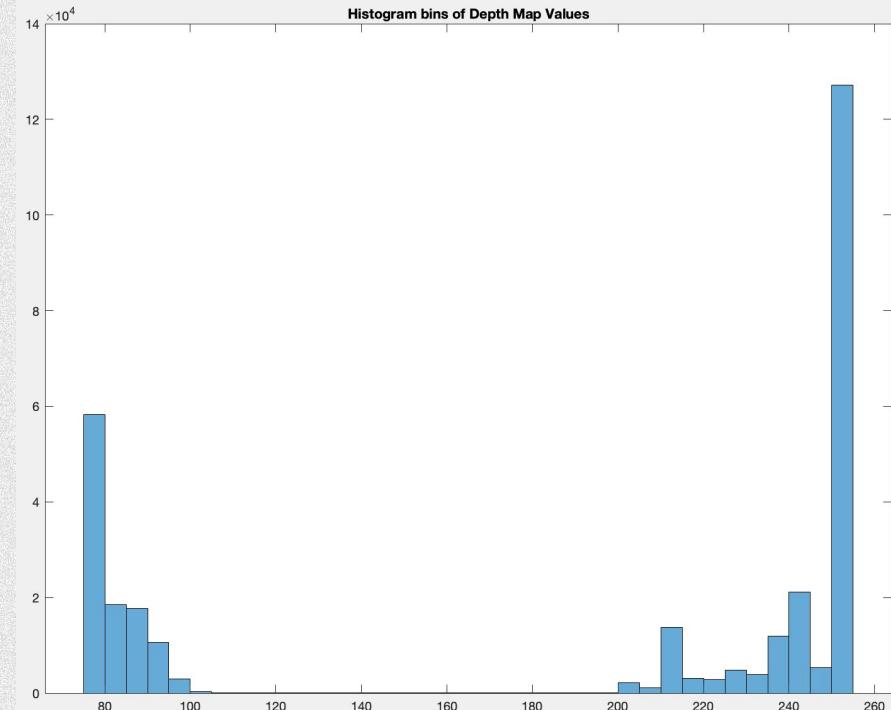
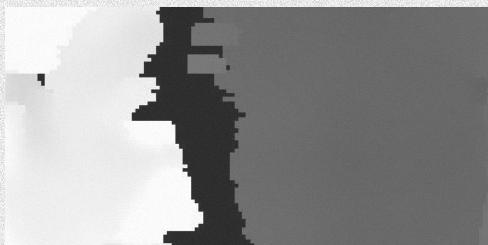
This occlusion occurs when making the depth map, where the Intel RealSense favors the right camera, so holes cover the left image.



HOLE FILLING



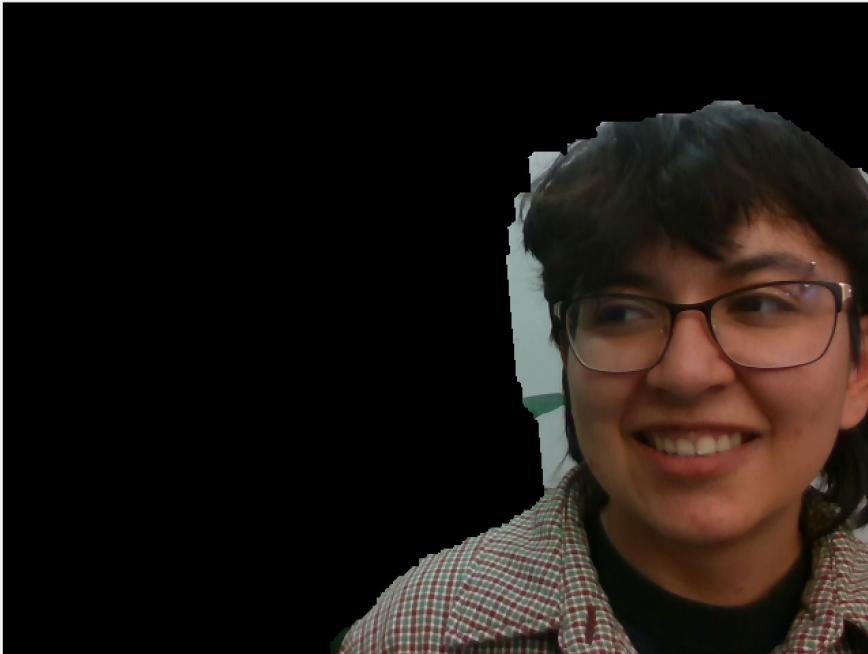
Occlusion Filled



Histogram of Depth Map Values



SEGMENTING



Foreground



Background

MATTING

Matting smooths out the boundaries of segmentation by making the blurred boundaries be a complement of each other

So when these matting images are added together, all values in the resulting matrix is 1



Background matting = $1 -$
Foreground matting

+



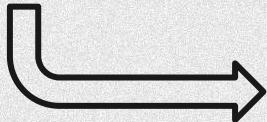
Blurred Foreground matting
image



IMPLEMENTATION

REFOCUSING

INPUTS



1. Gaussian filter
2. Mask from matting image
3. Image 1: Blur RGB and multiply by mask
4. Image 2: Multiply RGB by complement of mask
5. Add two images

BLURRED IMAGE



RESULTS: BLURRING BACKGROUND



Before



After

RESULTS: BLURRING FOREGROUND



Before



After

WHY MATTING IS IMPORTANT



Without Matting



With Matting

CONCLUSIONS

1

Image Refocusing is possible with MATLAB through this pipeline using image registration, segmentation, and matting.

2

BIGGEST **issues due to depth map** assumptions and limitations, resulting in blur boundary issues

3

Matting is a crucial stage in making depth blurring realistic.

4

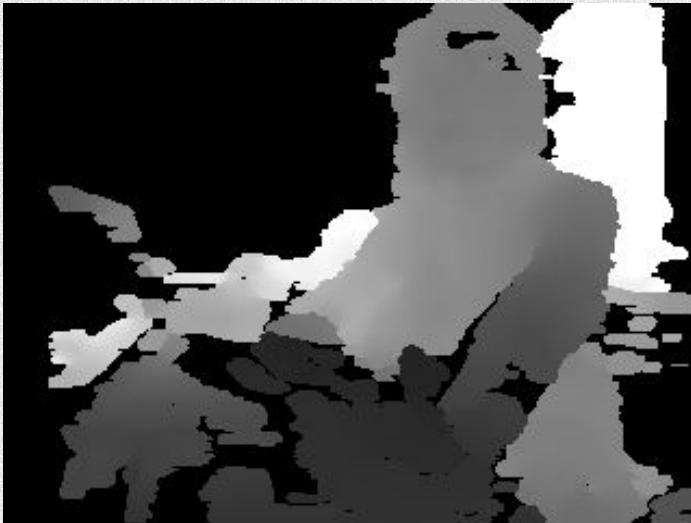
Further work includes **improving the hole filling algorithm** as well as **expanding gradient depth sweep** implementation.

THANK YOU

Questions?



USER ERROR WITH INTEL REALSENSE



Issues due to reflective surfaces and lighting