

Assignment 4

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Part 1: Creating stereograms

Approach:

When we are using the glasses, each eye can only see parts of 3 channels of the image. Pixels in the red channel won't be visible to the right eye and the left eye can't see the image in the green and blue channels. When the right and left eye are seeing two different but very similar images, our brain can create an illusion of 3D. So, for the image, we keep the green and blue channels as the same to before, but we will shift the red channel of image based on its corresponding disparity map. Then we will combine these three channels together as one image. The image may seem to be blur, but when we are using the glasses, it will show a 3D image for us.

Usage:-

- Run the makefile using make command
- `./render input_image disparity_image`

Output:

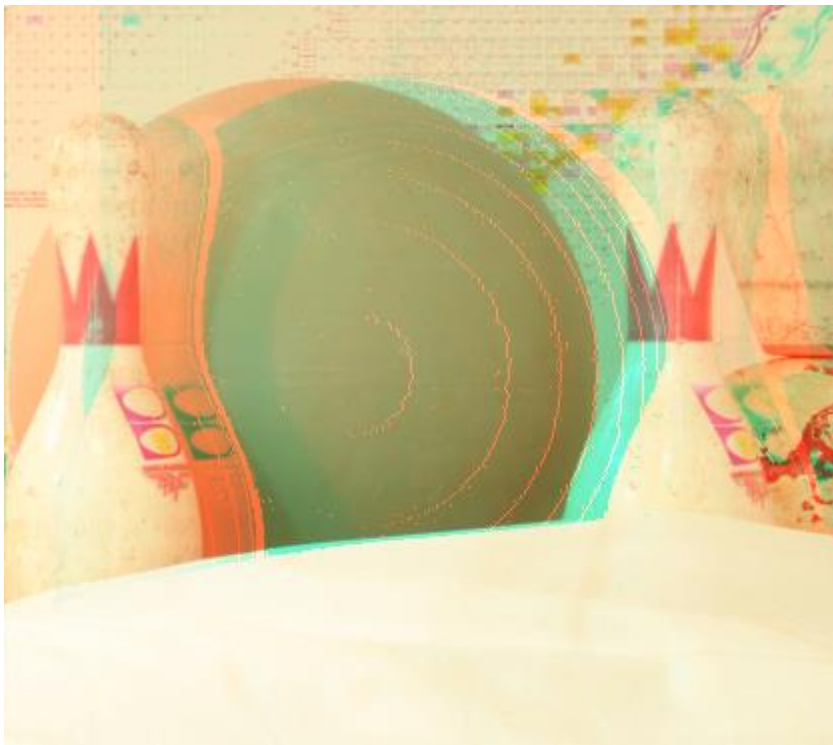
A single stereogram image named `input_image+'-stereogram.png'`

Sample Images:

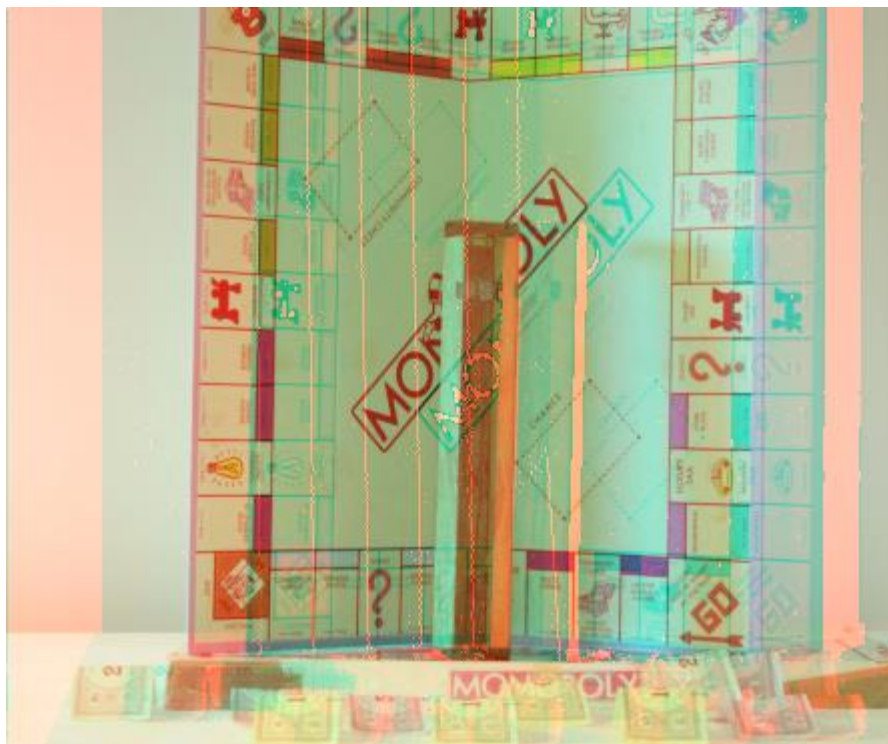
Birds



Bowling



Monopoly



Part 2: Background- Foreground segmentation

Approach:

Naïve Segmentation:-

1. Generate mean and variance of the Gaussian distribution using the pixels given in the seeds image.
2. Assign value 1 to foreground and 0 to background pixels as given in the seed image.
3. For each pixel in input image not in seed image, calculate the cost using the distribution calculated in step 1.
4. If, cost is greater than the threshold assign 1 else assign 0.

MRF Segmentation:-

1. Generate mean and variance of the Gaussian distribution using the pixels given in the seeds image.
2. Initialize prior and relative costs for each pixel depending on if it is background in seed file, foreground in seed file or not in seed file (use threshold value and cost function used in first part).
3. Start loopy belief propagation to minimize the total cost/energy associated with the image.
4. Run the loop for max_loop number of times. (currently 20)

Images produced from MRF based segmentation are much smoother than the ones produced from naïve method.

Usage:-

- Make command
- ./segment input_file seeds_file

Output:-

4 images which are explained as follows

1. Input_image+'-mrf_segment_result_fg' : Segmented Foreground of input_image using MRF.
2. Input_image+'-mrf_segment_result_bg' : Segmented Background of input_image using MRF.
3. Input_image+'-naive_segment_result_fg' : Segmented Foreground of input_image using Naïve Method.
4. Input_image+'-naive_segment_result_bg' : Segmented Background of input_image using Naïve Method.

Sample Images

Cardinal



Nara



Parakeet



Part 3: Inferring depth from stereo

Approach:

Instead of just using the unary cost, MRF will also use the information between neighbor pixels, the binary cost. We tried three different kinds of binary cost functions.

- Used a very naive cost function that if two pixels want to have different states, we will add one to the cost. We did this because we want to make the image to be smooth. Adjacent pixels probably have the same states. But this cost function didn't change too much comparing to the naive result because the cost we add are too small.
- The second one is quadratic cost function based on normal distribution. The score of the result do decrease, but it also blurs the image. So, we don't consider this is a very good result. After that,
- Linear cost function. It calculates the absolute value of two disparities. Please see the attach images for results.

Usage:

- Make command
- `./stereo input_file1 input_file2 Ground_Truth(optional)`

Output:

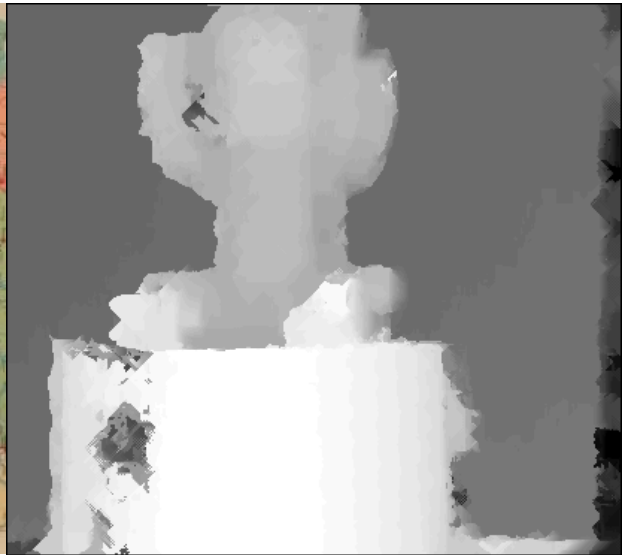
The program gives two output depth maps, one with naïve method previously implemented and one with loopy belief propagation. If ran with ground truth file as input then the console also outputs mean errors from ground truth for both methods.

Samples:

Aloe



Baby



Flower Pots



Problems Faced:-

- Setting threshold values is not easy. A good threshold for one image might not be a good one for another.
- Setting a parameter for how long should the MRF algorithm run.

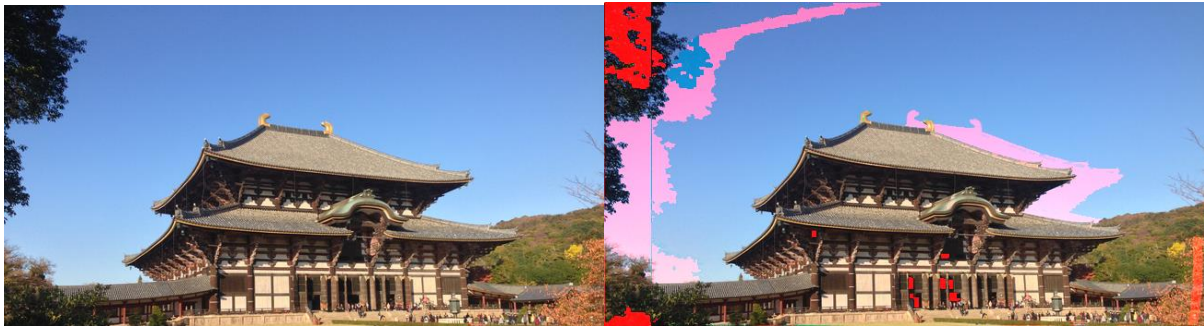
Experiments:-

Running stereograms for outputs in Part 2.

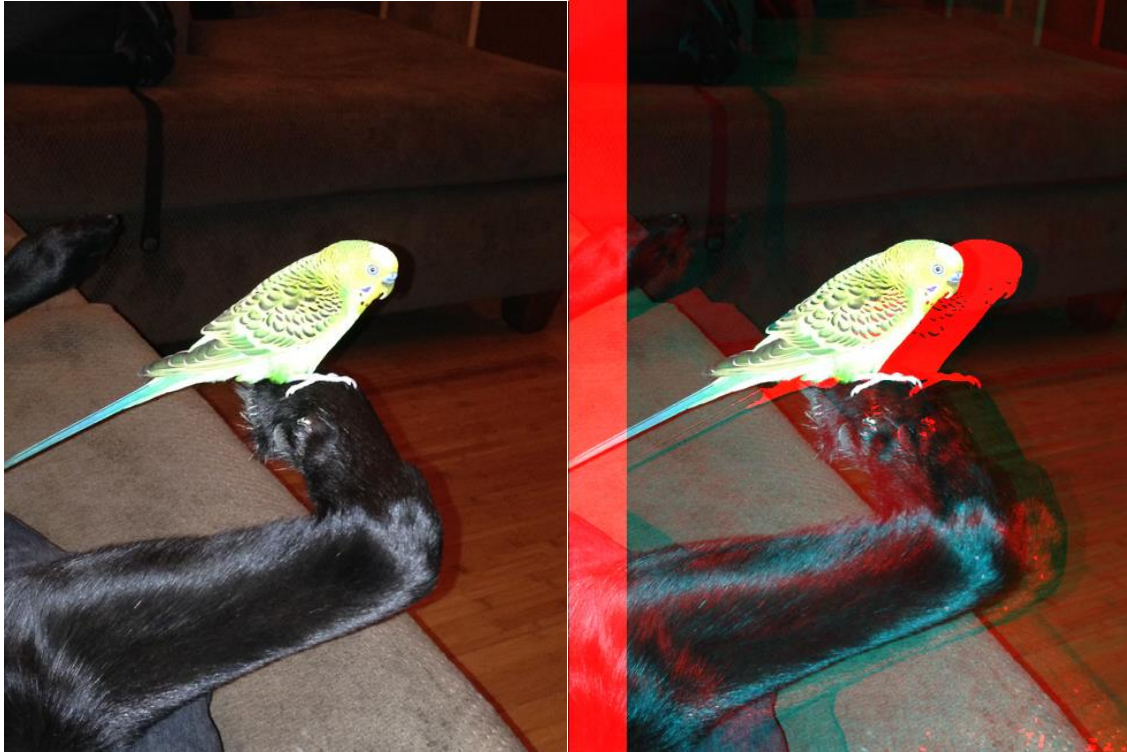
Cardinal



Nara



Parakeet



Woodpecker



Running stereograms for outputs in Part 3.

Aloe



Baby



Flower Pots

