Content-aware seam carving for image resizing

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Overview

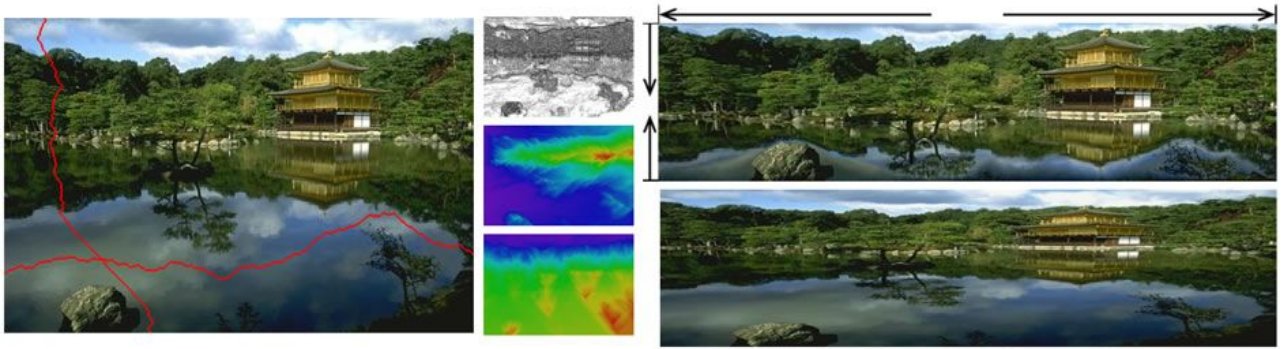
- Seam Carving
- Issues with Seam Carving
- Approach
- Preliminary Results
- Conclusion
- References

Seam Carving

- Seam Carving resizes images taking into account content
- Content is considered using an energy function
- A “seam” is an 8-connected path of minimal energy
- Removing seams allows image to shrink
- Adding interpolated pixels along seams will grow image

Simple Energy Function

$$e_1(\mathbf{I}) = \left|\frac{\partial}{\partial x}\mathbf{I}\right| + \left|\frac{\partial}{\partial y}\mathbf{I}\right|$$



Reference: [2]

Seam Carving

Image interpolation

Castle distorted

Seam carving

Issues with Seam Carving

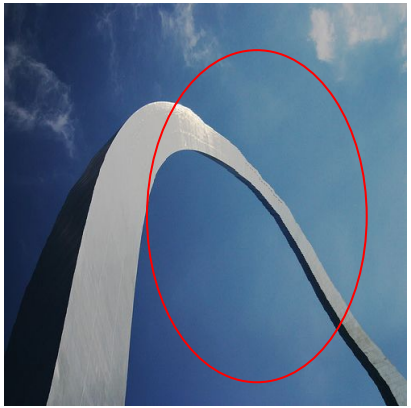
- Seam Carving is not simple scaling
- Computationally complex
- Artifacts can get generated in images
- Aspect ratio changes are susceptible to shearing

300x230 px
(Aspect Ratio 3:2.3)

360x360 px
(Aspect Ratio 1:1)

Defects

Castle distorted



Arch distorted

Approach

- Want to improve appearance of aspect ratio changed images
- A few approaches are under evaluation
  - Perform aspect ratio enlargement change, then apply scaling
  - Perform masking over edge areas to increase energy gradient through them to reduce distortion
  - Modify energy function

Preliminary Results

- Perform masking on edge areas to increase energy gradient through them to reduce distortion
- Very little noticeable difference, likely due to gradient energy function being used

Original

Seam Carved to larger size and aspect ratio

Delta Image

Seam Carved to larger aspect ratio and scaled

Preliminary Results

- Performing aspect ratio change through seam carving and then scale

Original

Seam Carved to larger size and aspect ratio

Seam Carved to larger aspect ratio and scaled

Conclusion

- We have been able to find some techniques to improve image quality when changing aspect ratio using seam carving
- Seam carving works better on images with sparse objects
- When images have objects uniformly distributed, seam carving works similarly like interpolation
- Remaining work before project due date:
    - Try some other energy functions with the edge mask
    - Fix object distortions
    - Compare different energy functions with testing images
    - Characterize performance

Questions?

References

1. http://www.cs.cmu.edu/afs/andrew/scs/cs/15-463/f07/proj2/www/wwedler/
2. Shai Avidan and Ariel Shamir. 2007. Seam carving for content-aware image resizing. ACM Trans. Graph. 26, 3, Article 10 (July 2007). DOI: https://doi-org.stanford.idm.oclc.org/10.1145/1276377.1276390
3. Dong, Weiming, et al. "Optimized image resizing using seam carving and scaling." *ACM Transactions on Graphics (TOG)*. Vol. 28. No. 5. ACM, 2009