Group 14
Digital Image Inpainting

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Relevant links:

Research Paper Link: Fast Digital Image Inpainting

Github Repository Link: Digital Inpainting in OpenCV (C++)

Google Doc Link (for group project notes): CSL 461: Group 14

What is Image Inpainting?

- Modifying an image in a non-detectable form.
- Useful in:
  - Special Effects
  - Scratch Removal
  - Image Compression

Fast Digital Inpainting Algorithm:

- Used for reconstruction of small missing and damaged portions of images.
- Two to Three times faster than polynomial-time inpainting techniques, while producing similar results.
- Ω: Small region to be inpainted.
- ∂Ω: Boundary of region to be inpainted.
- Inpainting is approximated by an isotropic diffusion process that propagates information from ∂Ω into Ω.
- Image is convolved by using a gaussian kernel.

Test Case #1:

Input

Output

Test Case #2

Input

Output

Test Case #3

Input

Output

Test Case #3(a)

(Gaussian Filter is not optimal)

a = 0.01, b = 0.05

a = 1, b = 1

Approach used in code:

- Region to be inpainted is initialised by clearing its color information.
- The desired region is repeatedly convolved with the gaussian kernel, defined by the user.
- The value of gaussian kernel is manually defined by the user by hit and trial method.
- The user can specify number of iterations.
- Diffusion barrier is added so as to avoid blurred spots at high-contrast edges.

Observations:

- Regions to be inpainted using this algorithm must be locally small.
- The simple diffusion based algorithm produces blurred spots at the intersection between masked and high-contrast region. Diffusion barriers could be used to prevent this phenomena.
- This algorithm requires a step of manual masking.
- The output depends on the gaussian kernel used, optimal value of kernel could be found out using hit and trial method.

Alternative Approach:

PatchMatch Algorithm:

- Finds correspondence between small square regions of an image.
- Used for object removal and reshuffling contents of an image.
- Algorithm is based on Nearest-Neighbor Field function.

Inferences from this exercise:

- Problems like image inpainting, which seem to be easy to implement first, can turn out to be quite tricky!
- Fast digital image inpainting is a naive approach to solve such a complex problem, it is mainly used in images having fine-line like errors.
- For images having major issues, more advanced algorithms, which are a blend of machine learning and image processing are applied.

Thank You!