Exemplar-Based Inpainting

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"Object Removal by Exemplar-Based Inpainting"
A. Criminisi, P.Perez. CVPR, 2003.

Objective: This project reproduces the algorithm for removing large objects from digital images, in a way that the result looks quite reasonable for our eyes.

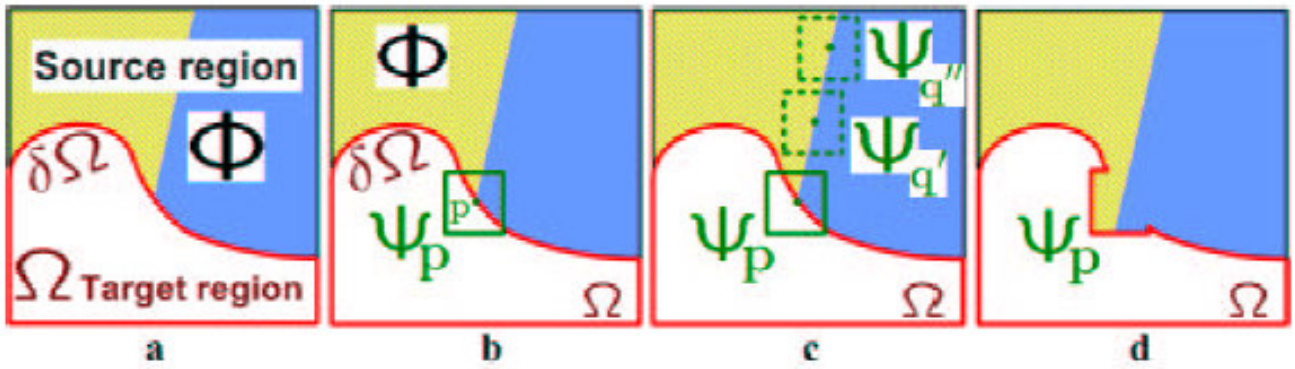
Objective

Inpainting algorithm notes:

- the target area is filled with linear structures sampled in the source region;

- the exemplar-based texture synthesis is done choosing the best-match sample from the source region;

• if the patch Ψ_p lies on the continuation of an image edge, the most likely best matches will lie along the same (or a similarly coloured) edge.



Technique

The algorithm is divided in 3 steps:

- Compute patch priorities;
- Propagate texture and structure information;
- Update confidence values.

STEP 1: Compute patch priorities

• create a filling order where the propagation of structures and textures depends entirely on the priority values of each patch on the fill front (*Onion Peel* method)

$$P(p) = C(p)D(p)$$

• this priority is computed for every border patch in the boundary of target region, where C(p) is the confidence term and D(p) is the data term, defined as

$$C(p) = \sum_{q \in \Psi_p \cap \bar{\Omega}} C(q) \qquad D(p) = \frac{\left| \nabla I_p^{\perp} \cdot n_p \right|}{\alpha}$$

STEP 2: Propagate texture and structure information

- the patch with highest priority is filled with data extracted from the source region;

- search in the source region for that patch Ψ_q which is most similar to Ψ_p;

- if the source exemplar is Ψ_q, the value of each pixel-to-be-filled is copied from its corresponding position inside Ψ_q.

$$\Psi_q = \arg\min_{\Psi_q \in \Phi} d(\Psi_p, \Psi_q)$$

STEP 3: Update confidence values

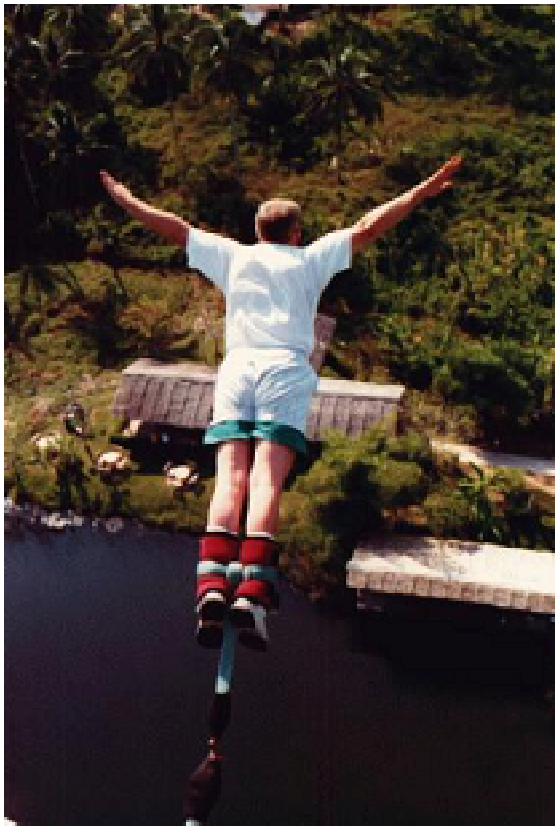
After the patch Ψ_p has been filled with new pixel values, the confidence C(p) is updated in the area delimited by Ψ_p as follows:

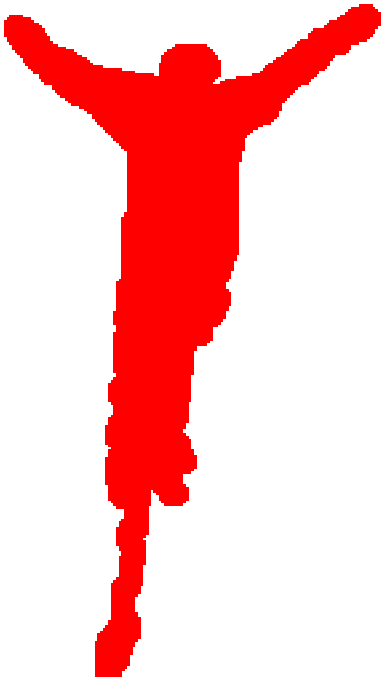
$$C(q) = C(p) \qquad \forall q \in \Psi_p \cap \Omega$$

This simple update rule allows us to measure the relative confidence of patches on the fill front, without image specific parameters.

Note: As filling proceeds, confidence values decay, indicating that we are less sure of the colour values of pixels near the centre of the target region

Results





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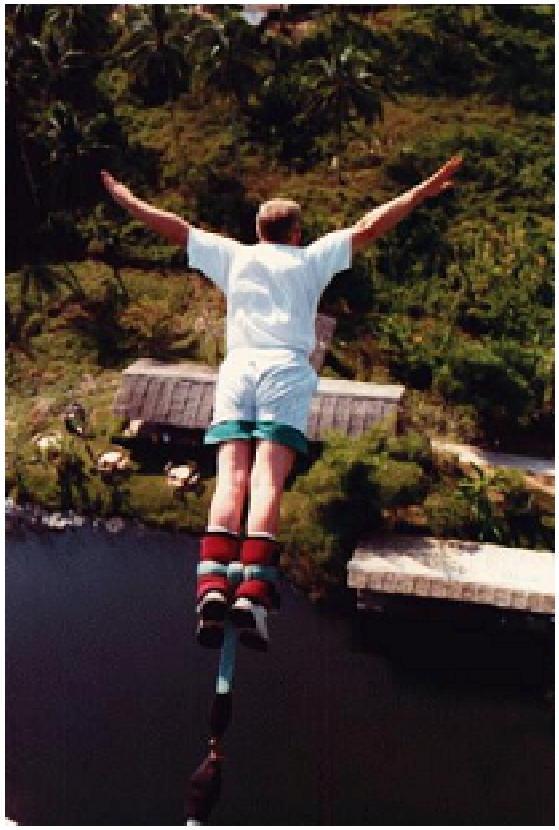

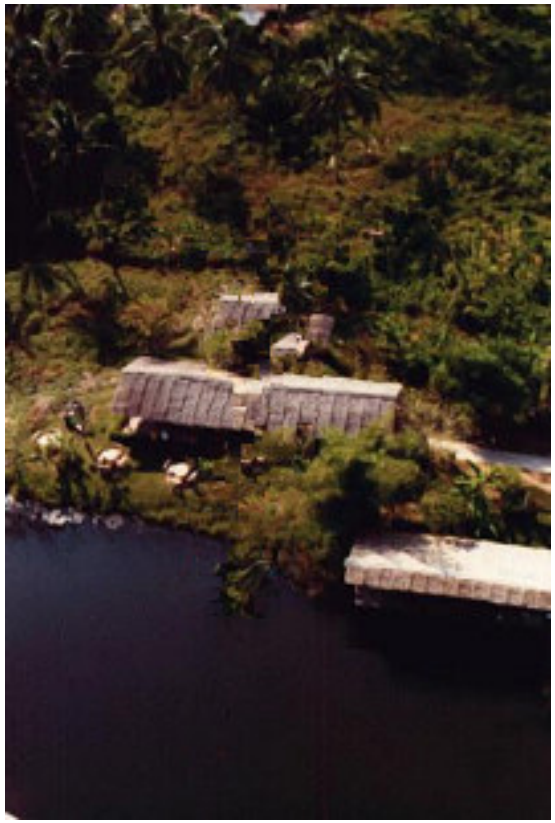

Results

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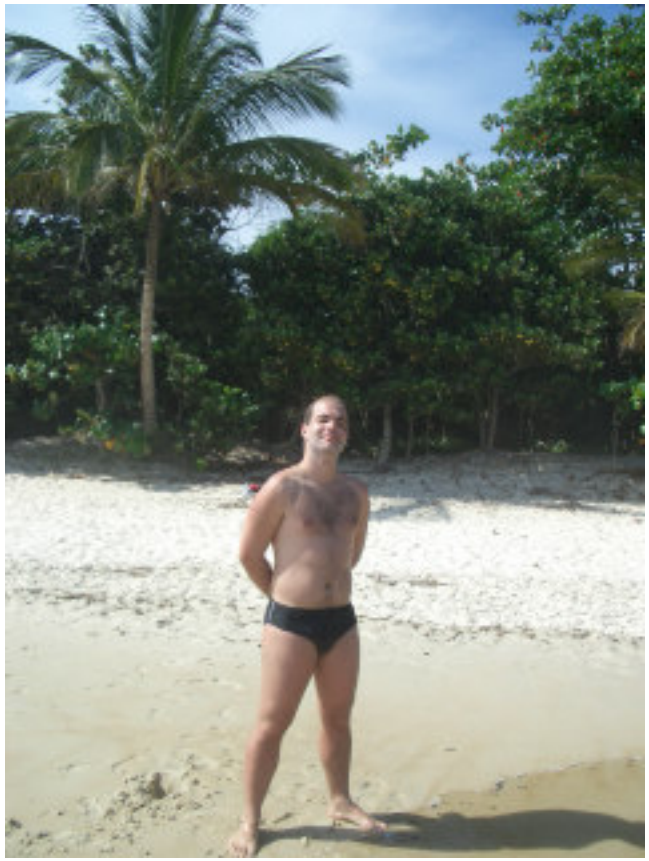
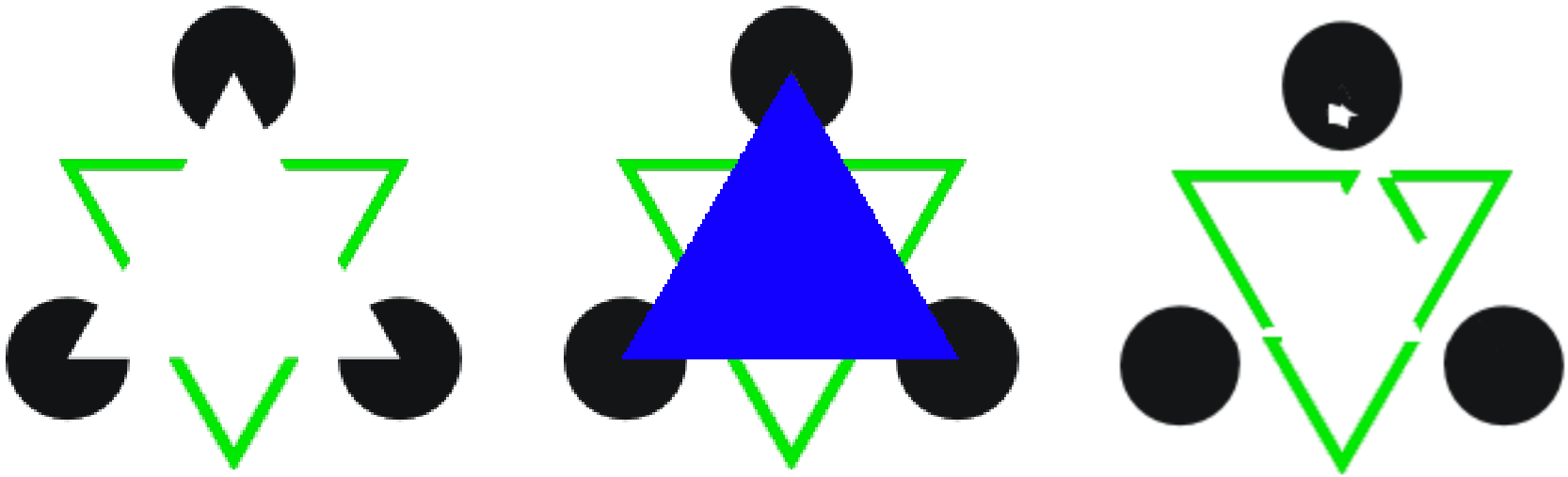
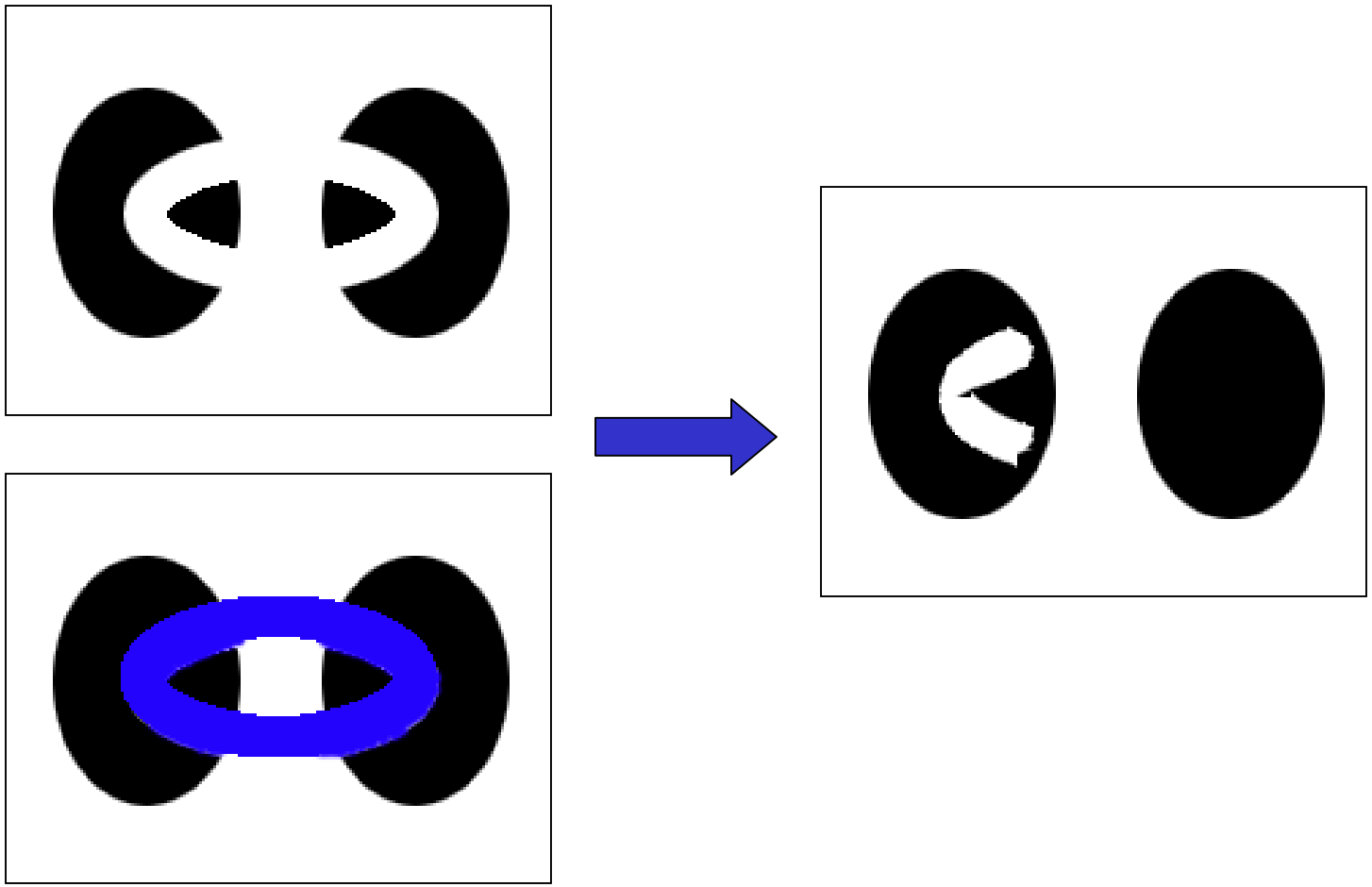


Stippling

Results



Results



Results