

Image Inpainting Based on the Fast Marching Method

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Introduction


- Introduction of Image Inpainting
 - Problem Statement
 - Proposed Solution
 - Implementaion Details
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Image Inpainting

Image inpainting is the technique of reconstructing small damaged portions of an image

Image inpainting is usually used in

- removing text and logos from images
- reconstructing scans of deteriorated images by removing scratches or stains
- creating artistic effects



Problem Statement

Input:

- "Damaged" image: covered by some texts or stains.
- Same size mask: shows the portions to be inpainted.

Output:

- Inpainted result: image which removed the texts or stains.

Problem Statement.cont



TEST
MASK

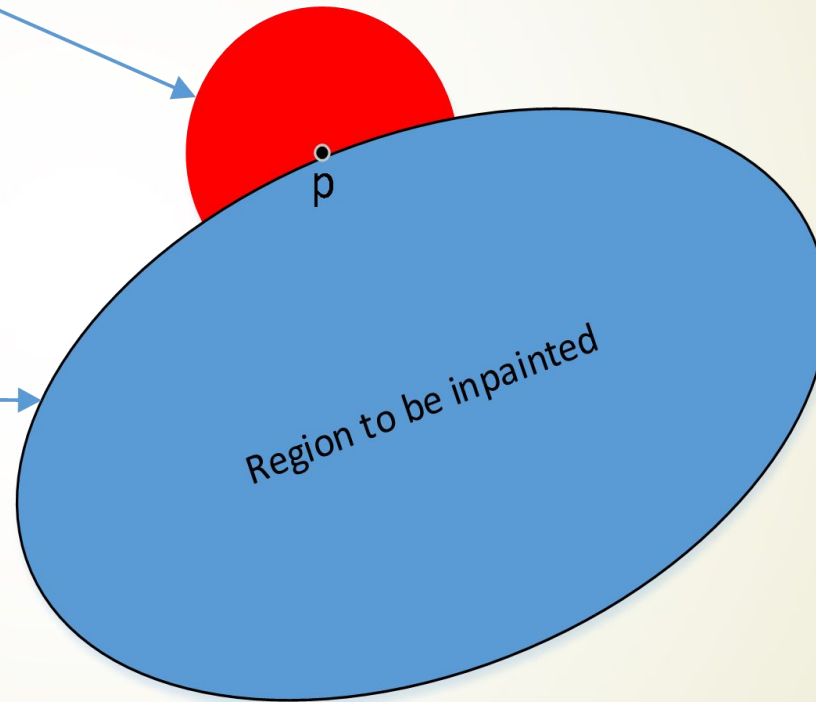
Proposed Solution

Known neighborhood of p

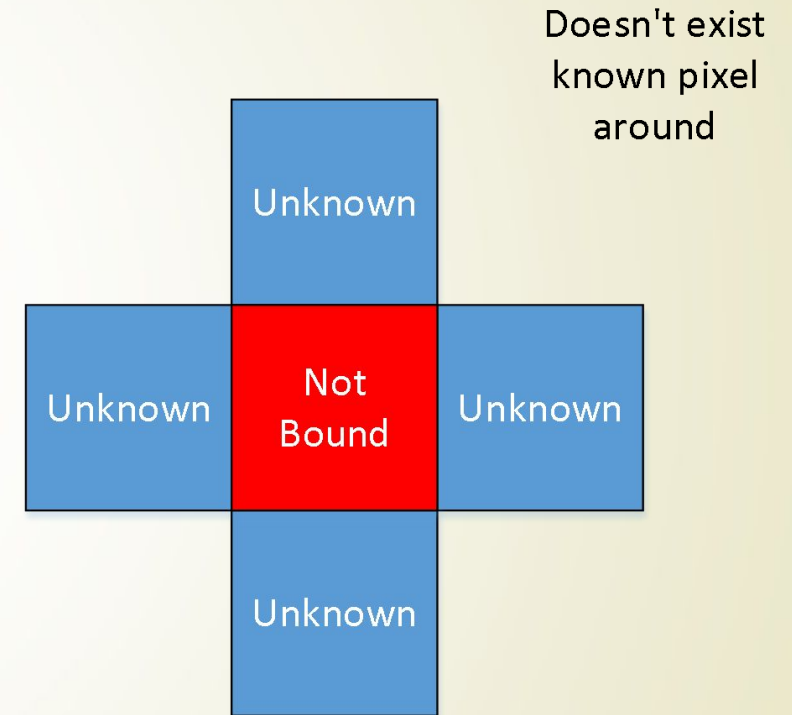
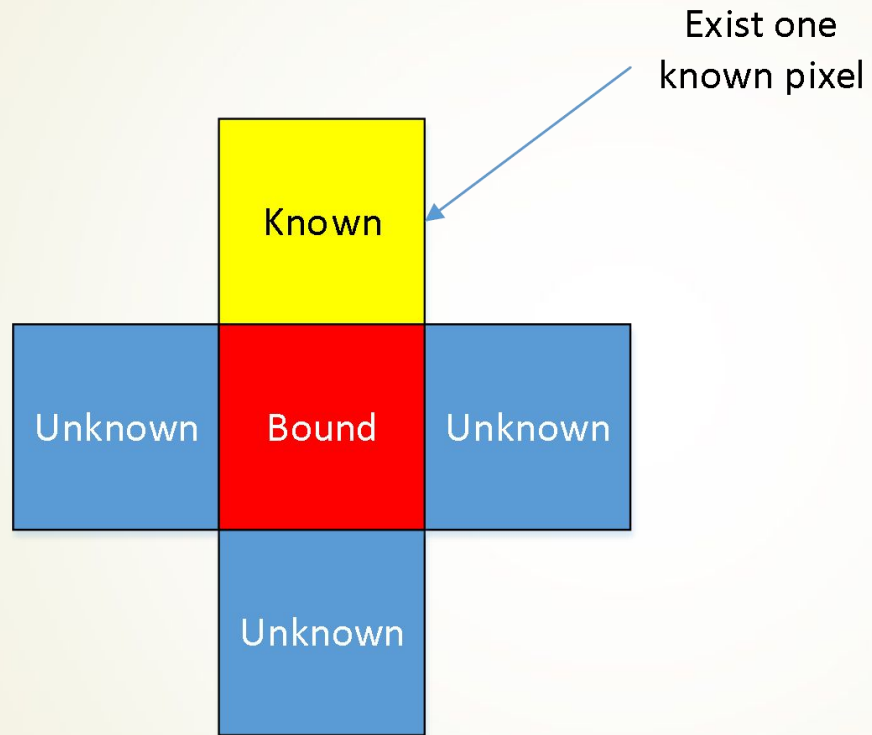
Known image

boundary

Region to be inpainted



Determination of the Bound





Determination of the Inpainting Order

We use the Fast Marching Method (FMM) to specify which pixel is the next pixel to inpaint.

The FMM will:

- calculate priority values (T) of bound pixels we found
- maintains a heap which stores the bound pixels based on their priority values(T)



Fast Marching Method

- ▶ Step 1: Initialize the T to 0 for known parts and bound.
Initialize the T to 10^6 for inside parts.
- ▶ Step 2: Insert the all bound pixels into the heap,
and extract the bound pixels with the smallest T.
- ▶ Step 3: Inpaint the pixel we get and this pixel will be known.

Fast Marching Method

- Step 4: Calculate the T for the inside pixels (k,l) which are the neighbors of the new known pixel (i,j) by solving the equation below.

$$\max(D^{-x}T, -D^{+x}T, 0)^2 + \max(D^{-y}T, -D^{+y}T, 0)^2 = 1$$

$$D^{-x}T(i, j) = T(i, j) - T(i-1, j)$$

$$D^{+x}T(i, j) = T(i+1, j) - T(i, j)$$

$$D^{-y}T(i, j) = T(i, j) - T(i, j-1)$$

$$D^{+y}T(i, j) = T(i, j+1) - T(i, j)$$

- Step 5: Insert these pixels into heap with new T and change them to be bound.



Implementation Details

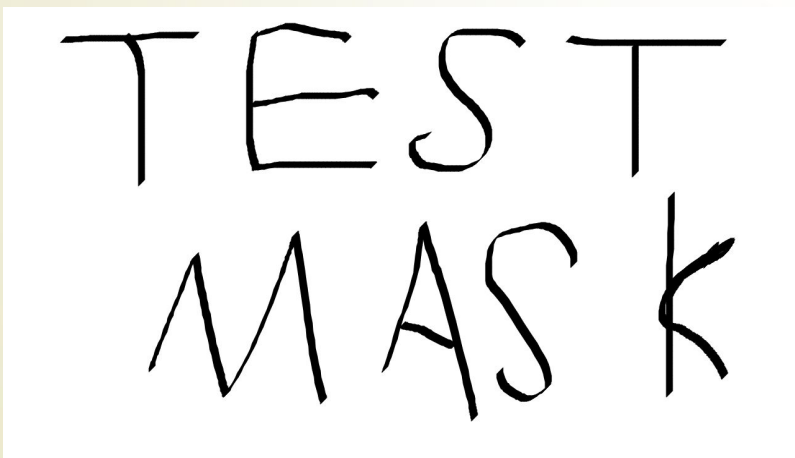
- Step 1: Change the mask to binary image.
- Step 2: Separate the known area, unknown area and the bound of the unknown area.
- Step 3: Calculate the priority value of each bound pixel.
- Step 4: Insert bound pixels in a heap sorted in the ascending order of their priority values.



Implementation Details.cont

- ▶ Step 5: Extract the bound pixels with the smallest priority. Inpaint that pixel using its adjacent known pixels' data.
- ▶ Step 6: Change that pixel to the known part and remove it from the heap. Then change its adjacent unknown pixel(s) to the bound pixel(s) and calculate the priority.
- ▶ Step 7: Insert new bound pixels into the heap.
- ▶ Step 8: Repeat step 5, 6 and 7 until the heap becomes empty. Inpainting of the damaged image is completed.

Result



Result

Pride and Prejudice is a novel by Jane Austen, first published in 1813. The story follows the main character Elizabeth Bennet as she deals with issues of manners, upbringing, morality, education, and marriage in the society of the landed gentry of early 19th-century England. Elizabeth is the second of five daughters of a country gentleman living near the fictional town of Meryton in Hertfordshire, near London. Though the story is set at the turn of the 19th century, it retains a fascination for modern readers, continuing near the top of lists of "most loved books" such as The Big Read. It has become one of the most popular novels in English literature and receives considerable attention from literary scholars. Modern interest in the book has resulted in a number of dramatic adaptations and an abundance of novels and stories imitating Austen's memorable characters or themes. To date, the book has sold some 20 million copies worldwide.

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Result

