A MODIFIED CONVOLUTION BASED IMAGE INPAINTING

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Abstract

Digital **Image Inpainting** is a method wherein the scratched or damaged portion of the **image** is restored **by using** the pixel data of the undamaged portion. The modified convolution based image inpainting uses a kernel function which have the data of nearby pixels to reconstruct the damaged pixel by convolution. The adaptive kernel used gives weightage to pixel values in such a way that the edges are always preserved. This method of reconstruction is easy to implement and faster than other proposed algorithms.

Keywords- Digital **Image Inpainting** , adaptive kernel, convolution.

1.Introduction

As we are living in a digital world where every information is stored either in images, films or videos digital image processing has become an important part of daily life. Defining a new topic of image inpainting in the world of image processing, we have opened our ways towards many new application like video restoration, image reconstruction, object and text removal etc.

There are different types of algorithms for image inpainting-

- Exemplar and search based image inpainting
- PDE(Partial differential equation)based image inpainting
- Texture synthesis based image inpainting
- Hybrid image inpainting
- Convolution filter based image inpainting

1.1 The purpose of choosing image inpainting –

We store memories as well as information in the form of images and videos, and if those videos and images has some missing things or some extra parts that we want to remove ,in all these scenarios image inpainting would be the perfect solution. Well, photo-editing is also an option but, why go through such a time consuming process, whereas with image inpainting the work can be done by the kernels when you keep watching it.

1.2 Tools of signals and system that we are using are-

- Convolution
- Edge preservation
- Gradient of pixels
- Smoothing kernel

Using these tools we are going to remove the scratch or damaged pixel from our input images and make them look like they were never damaged.

2.Methodology

Modified Image inpainting- The whole aim is to use an adaptive kernel to convolve a small window of N*N around the missed pixels.The weights of adaptive kernel are computed by using a kernel function. The kernel function use the gradient value of pixels in the neighbourhood of missed pixels. The kernel function is designed in such a way that the pixel at the edges are given less weightage than pixels in smooth region so that in the process the edges remain sharp.We are using a 3*3 window here in our project.

2.1 Step wise algorithm

- Take input(original image).Change all the pixel with value '0' to '1'.
- Create a mask,it has damaged part as '255' and other part as '1'.
- Mask and image are compared.The points having pixel value greater than 250 equal to 255 in mask are replaced by value 0 in original image.
- Region to be inpainted is contained in mask function where 1 is damaged pixel and 0 is undamaged pixel.
- The colored image is decomposed into its corresponding RGB components and the gradients of the pixel in near neighborhood are found.
- The weight of kernel and damaged pixel is found.
- Using the values of estimated pixels of RGB, the image is reconstructed.

2.2 Functions used:

Weight function for convolution mask $w(k)=1/nF(xk)$; n= number of known pixels in neighbourhood.

$F(xk) = (1-[x/\alpha]^2)$; If $x \leq \alpha/2$

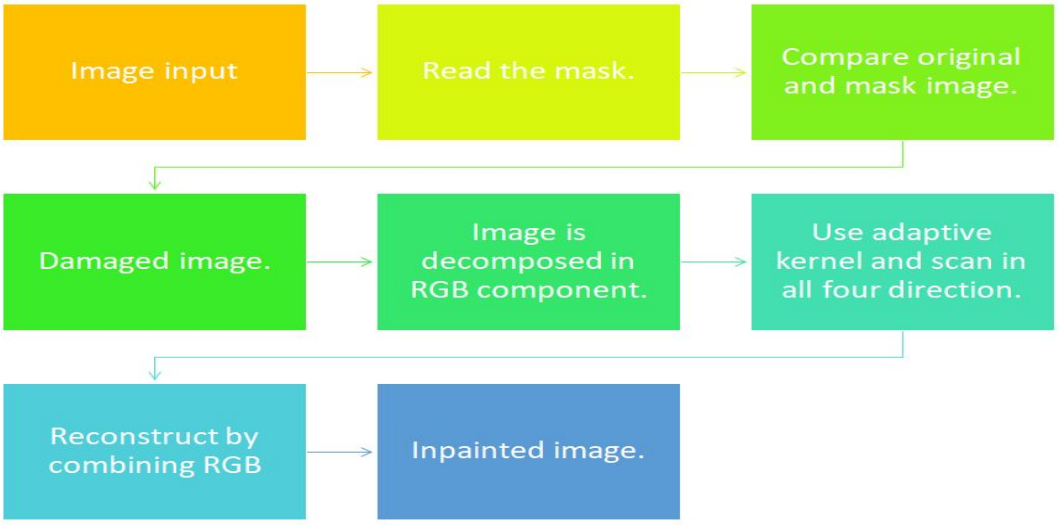
$F(xk) = ([x/\alpha]-1)^2$; if $\alpha/2 \leq x \leq \alpha$

$F(xk) = 0$; if $x \geq \alpha$

Function for estimating damaged pixel $f'(p) = (1-\sum_{k=1}^{k=n} w(k))f(p) + \sum_{k=1}^{k=n} w(k)$

Where, x = gradient value , α = It is a parameter which gives an estimation of the missed pixel gradient and it also control the softness of propagation , k= position of the pixel, f'(p)= estimated value of damaged pixel.

2.3 Block Diagram



3. Results and Observations

3.1 Observations

In Inpainting, the original image is not reconstructed but it fills the parts having lost or unwanted objects to have the final image a close resemblance with the original image.In Image Inpainting the lost or the corrupted part carries absolutely no information.This algorithm is fast, iterative, with simple implementation and provides similar results as of structure algorithms. With a single iteration without blur and removes large object with symmetric background.

3.2 Results

We tested the discussed algorithm on a variety of images to check the performance of Inpainting.The original images are clean images, and these images are damaged by drawing random lines on them. The random lines are drawn using black color by using application like Paint. Lines can also be drawn by using any other color by changing the preprocessing algorithm. These damaged images are then inpainted.If the number of damaged pixel in the image is more, the time required for reconstruction will be more.

3.3 Figure

Figure A: Damaged Image

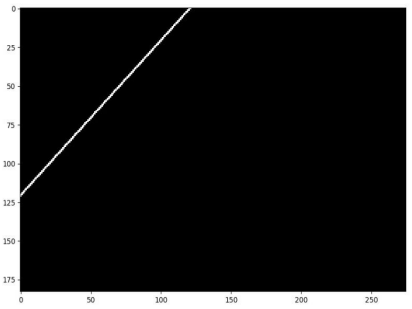


Figure B: Mask

Figure C: Restored Image

3.4 Comparison with another algorithm

Modified convolution vs Exemplar and search based inpainting

Exemplar and search based inpainting : This algorithm works on patch{container of pixels in large form} level and fills the larger areas properly but fails in restoring the definite shapes.

Its main focus is on the texture of image and hence the structure remains damaged.It involves three steps: firstly we find the order of patch level, next the patch which matches the best is searched and finally the unknown pixel values are found from the patch which matches the most.Correlation coefficient is used for the template matching purpose.

Modified convolution : a fast image inpainting algorithm which uses convolution operation. It restores structure as well as texture of the image.
It is less complex and more accurate as it restores texture as well as structure of the image.

4.Conclusion and Limitations

4.1 Conclusions:This report contains the results of modified convolution image inpainting. Modified convolution algorithm of digital image inpainting takes very less time for reconstruction and filling and generates a very good quality of image.

4.2 Limitations : This algorithm does not obtain good and accurate results while removing large objects in natural images.

4.3 Future scope: Since this algorithm takes more time when the damage is more, we can modify the algorithm so that the time taken by it to reconstruct the image is independent if the amount of damage.

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