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Review Article

IMPLEMENTATION OF PATCH-BASED INPAINTING METHOD

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ABSTRACT

In this paper, presenting a new approach algorithm which makes the exemplar approach will be little faster than previous algorithms using patch-based concept. Different algorithms are proposed for this image inpainting to get quality in image and also time taking to process the inpainting technique. Exemplar-based inpainting is one which has got more popularized algorithm. Different approaches had applied to get reduce the time complexities in achieving the realistic appearance of the image. Inpainting is an emerging field in image processing research area. Inpainting is the retouching process which is used to remove or change the deteriorated/destroyed parts of an image and make the image real visualization to the human eye in a plausible way.

Keywords: Inpainting, Exemplar-based, Digital photography, Algorithms, Image processing.

INTRODUCTION

There is need to recover the damaged photographs, ancient paints, etc. Damage may occur due to several causes such as overlaid text, scratches, and scaled image to recover the image from such cases and providing a good looking photograph using a technique called inpainting. This term inpainting is also called as the observer does not know the original image. This inpainting has been done by professional artists. However, we did not get the pure accuracy and quality if it was done by manually and also more time-consuming process.

Inpainting is one of the arts for restoring the lost or destroyed parts of an image and also remove the unnecessary objects depending on the background of that image. This should be done in an undetectable way. Previously, in olden days, the artists used to paint by their own manually of the damaged paints. As the technology is improving day to day, this image inpainting processes the inpainting automatically. The algorithm automatically does this in a way that it looks reasonable to the human eye [1].

Currently, the image inpainting technology is an emerging trend in the digital image processing, and also it has many applications in computer graphics, renovation of old films, object elimination in digital photos, red eye alteration, super-resolution, compression, image coding, and transmission [2]. To carry out the work of image inpainting, there is only less technologies, tools, and libraries. As technology getting advanced, there is lots of growth in this area.

For example “restoreInpaint” [3], it is an open source library for providing different functionalities to detect an automatically restore breakages and damaged parts of the photographs or films. Restore inpaint provides some tools to be inpainted and also mainly depends on the size of the image to processes the inpainting along with the time varying and without disturbing the image quality.

The image inpainting technique is developed using the different algorithms written in Java or Matlab code. However, by these inpainting methods, we cannot acquire pure quality of the image. So, to overcome this, along with the inpainting, a super-resolution algorithms is also applying to acquire the good result in terms of quality in the image for visualization. Super-resolution is applicable the low-resolution pixels of the input image.

Super-resolution is a super technique for converting the low-resolution image into high-resolution image. These algorithms are mostly portrayed in movies and photography typical movie scene showing a computer operator repeatedly zoom in on a person’s face or a license plate where the missing high-resolution detail magically appears on the computer screen after each successive zoom.

Super-resolution also can be used to enhance for close observations to the videos to more accurately identify objects in the scene/image. Clearly, this is pure fiction; after all, there are an infinite number of higher-resolution images that could form the original low-resolution image. Super-resolution is classified as: Single Frame and Multi Frame [4-5].

Multi-frame super-resolution uses multiple low-resolution images of the same image from different areas to generate high-resolution output [6]. Single frame super-resolution on the contrast, to produce high-resolution image uses single low-resolution image [6].

In both cases, the problem is of estimating high-frequency details which are missing in the input image. The SR problem is multiple high-resolution images can produce the same resolution image [7]. Solving the problem hence require introducing some required information. This information is also be taken the form of example images or corresponding low resolution-high resolution pairs of patches learned from a set of unrelated training images in an external database or from the input LR image itself [7].

The challenge is that the viewer seeing the inpainted image should not be able to estimate that the image had been damaged or unauthorized alterations in it. Different inpainting techniques/methods are available in the literature.

Those techniques are partial differential equations about the diffusion based. However, it provides poor result because of its blur when the hole to be filled of large (pixel sizes) [8] on the damaged part of the image; this method is not much more popular. Another technique is the statistical-based technique which also gave the poor results.

Moreover, another one is exemplar-based technique, in which it takes some samples and considers the best matching texture patches from texture synthesis. The two types of methods (diffusion and exemplar-based) can be combined efficiently [8-10], which can give better results for removing of objects from the image. Due to this, for the better correctness of inpainting, in this advancement period want to increase the focus on exemplar-based method for image inpainting.

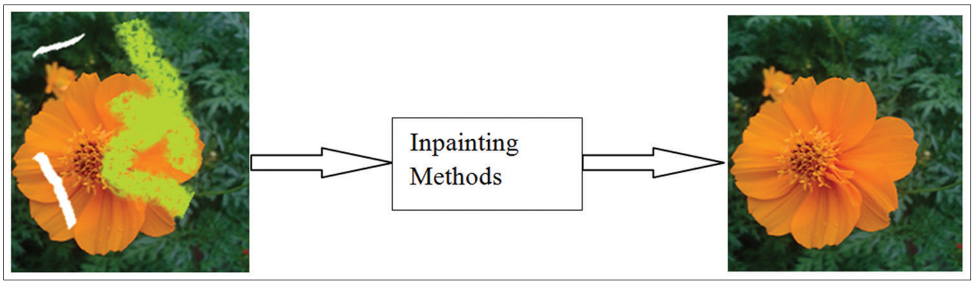

Fig. 1: Process of inpainting methods

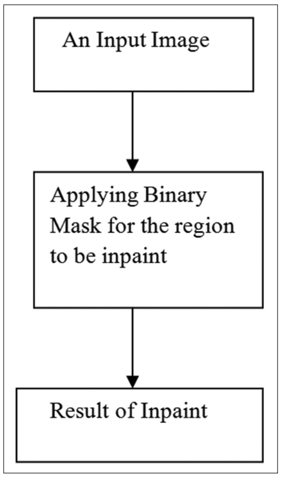

Fig. 2: Sample flow chart of algorithm

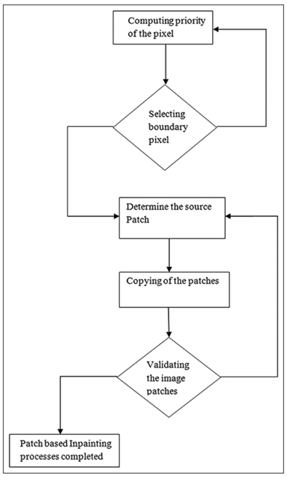

Fig. 3: Flow of greedy-patch based algorithm

In this paper, we propose a method for layering or padding holes in an image by taking the patches from other parts of the image. These will be a smooth formation for the filling part of the surroundings.

Many ideas were implemented in this work from the algorithm described in "object removal by exemplar-based inpainting" by Criminisi *et al.*

Concepts are too often obscured by complex notation, so we will refrain from using such notation as much as possible; here, we giving some information

- The target region is the portion of the image that is known at the beginning or has been already filled.
- The hole is the target region which has to be filled.
- An isophote is a gradient vector rotated by 90° of an image. It indicates the direction rather than the direction of maximum difference, as the gradient indicates.

Fig. 4: Image to be filled. The region to be filled is shown as in bright green

Fig. 5: The conceal part of the region to inpaint

PROPOSED METHOD

A simple view of the algorithm is as follows. The input for the algorithm is consists of an image and a binary mask that is the same size as the image. The mask in which it indicates a region of the image of non-zero pixels that is considered as the hole to inpaint/complete/fill.

ALGORITHM OVERVIEW

This algorithm will first read an image and a binary mask. Non-zero pixels in the mask indicate there is a hole to fill. Set the size of the

Fig. 6: The result of the inpainting

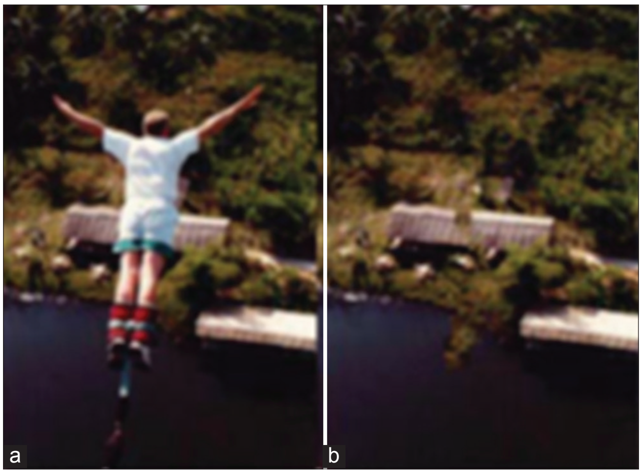

Fig. 7: (a and b) the result of inpainting by other methods

patches that will be copied. Determining a good patch size is a huge experimental process. If the patch size is decided, then we have to locate all the patches of the image that are completely inside the image and entirely in the source region.

- Computes the priority of every pixel on the whole boundary.
- With the highest priority firstly determine the boundary pixel. We can call this as the target pixel. The region centered at the target pixel and the size of the patches is called the target patch.
- Determines which source patch to copy into the target patch.
- Copies the corresponding portion of the source patch into the target region of the target patch.
- Updates the mask/hole to reflect the copied patch.
- Determines which image patches are newly fully valid and add them to the list of source patches.
- Repeats until the target region consists of zero pixels.

DETAILS OF THE ALGORITHM

There are two parts of this algorithm to discuss:

- How do we choose which boundary pixel has the highest priority?
- How do we decide which source patch to copy into a specified target patch?

Onion-peel priority

Filling in pieces near the edge of the hole should intuitively be easier than filling in pieces deep within the hole. This class encapsulates the idea that the outside of the hole should be preferred over boundary pixels that are now deep inside of the original hole. This technique gets its name because with a regularly shaped hole; the algorithm will chew away at the entire outside of the hole before moving further inside, an order that resembles peeling an onion. To enforce this behavior, a confidence image is maintained. Initially, the confidence outside of the whole is 1 (very sure) and the confidence inside of the hole is 0 (totally unsure). You can think of confidence as a measure of the amount of reliable information surrounding the pixel. In Criminisi's method, the confidence of a pixel is defined as:

$$C\,(p) = \sum \frac{\text{Confidences of the patch pixels} \in \text{source region}}{\text{Area of the patch}}$$

When a patch is filled, Criminisi updates all pixels in the hole region of the target patch in the confidence image with the confidence value of the target pixel.

Criminisi priority

Criminisi noted that continuing/filling linear structures first is very important in making the result look believable. Therefore, a data term is computed as:

$$D\,(p) = \frac{\text{isophote, boundary normal}}{\alpha}$$

This function encourages first filling target pixels that have strong isophotes in a similar direction to the hole boundary normal.

The priority P (p) of a pixel p is then given by the product

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

Alpha is a normalization factor that should be set to 255 for grayscale images but that value also seems to work well for RGB images. In fact, in Criminisi's priority term, alpha is a scalar multiple of a term that is only used once minimized; the value of alpha is actually irrelevant. No initialization is necessary to compute this priority term because it is not recursive. That is, it can be computed from the image hole information directly at each iteration.

RESULTS

In this example, the bungee jump person wants to be inpaint. First, select the region to be inpaint.

DISCUSSIONS

This patch-based exemplar method gives good results than previous approaches. The below bungee jump image shows some blur after the removal of an object by previous algorithms as shown.

CONCLUSION

In this paper, we provided a small approach for filling image holes in a patch-based method. We also provided the overview of the algorithm which will be used for future experiments and also in the research area.

REFERENCES

1. Fadili MJ, Starck JL, Murtagh F. Inpainting and zooming using sparse representation. Comput J 2009;52(1):64-79.
2. Dewangan A, Sahu I. Survey on examplar-based super-resolution based inpainting. Int J Adv Res Electr Electron Instrum Eng 2014;3(2):7559-62.
3. Restore Inpaint. Available from: http://www.restoreinpaint.sourceforge.net/.
4. Muthukumar S, Krishnan N, Pasupathi P, Deepa S. Analysis of image inpainting techniques with exemplar, poisson, successive elimination and 8 pixel neighbourhood methods. Int J Comput Appl ;9(11):15-8.
5. Glasner D, Bagon S, Irani M. Super- Resolution from a Single Image. Department of Computer Science and Applied Mathematics. Israel: The Weizmann Institute of Science; 1981.
6. Min-Chun Y, Yu-Chiang FW. A self-learning approach to single image

super- Resolution. IEEE Trans Multimed ;15(3):498-508.
7. Malpe K, Dandge S, Mamulkar V, Bharadwaj S, Gotmare R, Burde K. Implementation of inpainting via super-resolution. Int J Innov Res Comput Commun Eng 2016;4(2):2700-3.
8. Criminisi A, Pérez P, Toyama K. Region filling and object removal by exemplar-based image inpainting. IEEE Trans Image Process 2004;13(9):1200-12.
9. Drori I, Cohen-Or D, Yeshurun H. Fragment-based image completion. ACM Trans. Graph 2003;22:303-12.
10. Hrrison P. A Non-Hierarchical Procedure for Re Synthesis of Complex Texture. In: Proceedings International Conference Central Europe Comp Graphics. Visual and Computer Vision; 2009..