A Survey of Image Inpainting Techniques

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ABSTRACT

When an object is removed from photograph, missing portion is created. The most challenging task is to fill such missing regions by maintaining its structure and texture of whole image. The unwanted object can be text, headings. The older photographs contain damaged portion which should be fill by satisfying its spatial coherence. The goal of the inpainting technique is to modify the damaged region in an image or video in such a way that the inpainted region is undetectable to an observer. The most efficient image inpainting technique is the one which should be capable of filling the missing portion accurately and reconstruct the texture and structure. Image interpolation is the technique of filling in the missing regions of an image using information from surrounding area. In this paper, we have surveyed the efficient image inpainting techniques.

Keyword : - *Image interpolation, Texture, Structure, Damaged region*.

1. INTRODUCTION

Instead of many lines of text, one image is sufficient to give more information. In old days images are only used for capturing memories. But now images have changed their face. Images may be two-dimensional, or three-dimensional. They may be captured by optical devices such as cameras, mirrors, and lenses. Today, for encryption, processing, authentication, sharing etc. purpose images can be used. But the main aim of image is still being preserve i.e. to store the memories. Due to extra part or distortion in image sometimes useful images get discarded or deleted. While capturing images some unwanted objects like headings, shadows, titles, captions come in image. On removal of such unwanted objects, missing portion is created by them. Such missing portion should be filled such that it should preserve the texture and structure of the whole image. There may be blur due to motion of camera. Some text in a image may contain valuable information. Although texts provide additional information, not all of them are important. They should be removed with preserving texture and structure of image. Hence, there should be a way to erase the unwanted objects from the image. This arises the need of an automatic approach to remove unwanted objects from images by using surrounding information of image.

While completing such missing areas, texture and structure of the image should be preserved by maintaining spatial and temporal coherence. Hence in the process of filling the interpolation technique used plays an important role. The inpainting technique should be capable of filling missing portion without producing any other artefacts in the image. The portion should be completed such that it should not be visible to common observer. The missing portion is completed either by patch-based or pixel-based inpainting. The missing portion is completed such that it should not be identifiable to normal observer. The texture of surrounding should be matched with portion which is being inpainted.

In this paper, we have surveyed the various techniques of image inpainting. The techniques are Fragment-based image inpainting, Multiresolution image inpainting, Wavelet-based image inpainting, Exemplar-based image inpainting.

2. IMAGE INPAINTING TECHNIQUES

2.1 Fragment-based image inpainting

In this technique to complete the image we have to remove the background and foreground elements from the image. The parts of the image which are seen with the naked eye can be used as spare parts to repair the image. In this method the first step is to select the region which we want to inpaint for that iterative process is used which selects the region approximately. After that we have to use composite image fragments to complete the image. To select the patch ,values of inverse matte is used which gives the high confidence pixels to complete the image and a level is set that provides the incremental approach to travel into the unknown region of image from high to low confidence. In each step we have to select the image fragment from frequently appearing examples. it processed to complete the image with this technique, the image fragments which is composited their probability rise with mean confidence of image.[1] The Image completed with this approach composition of similar fragment is used which iteratively fills the missing regions. We can apply any method like scaling, transformation to composite the fragment. The limitation of this technique is that it has direct proportion with examples available from the global image. If we reach in availability of fragments then we can able to complete the image. The building blocks are required to complete the image from unknown regions to the known regions.

2.2 Wavelet-based image inpainting

Wavelet transform has been used as a good image representation and analysis tool mainly due to its multiresolution analysis, data separability, compaction and sparsity features in addition to statistical properties. In this paper, we propose a wavelet-based approach for image inpainting. Multi-resolution analysis of wavelet transform can be helpful to predict coarse-to-fine image structure. Separable data into low frequency scaling coefficients and high frequency wavelet coefficients make it possible to analyze both structure and texture. Considering both global and local structure is necessary. Also it is important to analyze texture and detailed patterns for natural images. Wavelet is capable of treating these elements altogether.[2]

Inpainting process is performed in the wavelet domain by predicting both scaling and wavelet coefficients from coarse to fine scales in the unknown regions. Each coefficient in the wavelet domain is dependent on neighboring coefficients in the same subband and corresponding coefficients located in the other subbands. Therefore, it is important to consider both inter and intra-scale dependency. On the other hand, if the dependency of these coefficients is not considered, it would be difficult to estimate visually meaningful coefficients. Wavelet is a decent mathematical tool for estimating global structure of image and texture analysis thanks to its multi-scale analysis and separability features. The proposed method takes advantages of wavelet by utilizing inter- and intra-scale dependency for maintaining image structure and texture quality.

2.3 Multiresolution Image Inpainting

In the multiresoultion approach the damaged image block is divided into equal number of blocks of equal size. After dividing the image, the three threshold values were consider first for the threshold of variance of pixel colors, second and third- for the threshold of percentage. Variance of color pixels has strong indication of containing the details of the image.[3] By using this value we can able to rebuild the image. While rebuilding the image the percentage of damaged pixel was consider. In case the damaged pixel percentage is high, then to inPaint the image we have to consider the global average color. If the percentage is low, in that case we have to consider the information available from the image. After completition of image it evaluates the image with the help of PSNR value. They have used the multilevel PSNR for measuring the quality of the inpainted image. This multilevel PSNR value decides how good the image is inpainted.[3] The Single Resolution approach produces the blurred result that overcome by this approach. It also covers the different level of details. The issue with this technique is that there is no friendly environment is provided to mark the region which we have to rebuild.

2.4 Multiscale Image Modeling

If we consider the nonseparable filter banks and direction based filter banks then we have to think differently because for this purpose it is not good idea to fully resemble on wavelet transform. To extend and to add this detail we have to consider the contourlet transform [4]. It can efficiently take control over the edges of image along with small number coefficient one dimensional contour because of its multiscale and directional properties. Contourlet coefficients are highly non-Gaussian and show Markovian dependencies in the form of local clustering and persistence across scales. The Detail study of contourlet coefficient makes clear idea about non-Gaussian trivial statics and strong dependencies. Contourlet coefficient is calculated about the Gaussian by considering the difficulty of neighboring coefficient magnitude. Technique is applied on the images which are affected by noise and the image where we have to retrieve the texture. While recovering the texture it shows too much improvement and additional things than wavelet transform and performance is also better.

2.5 Exemplar-based image inpainting

To recover the old techniques of texture synthesis algorithm and inpainting algorithm used to fill the image gaps, the technique is designed to combined advantages of the two approaches. Exemplar based technique contains the method for reinstalling the both texture and structure. This algorithm divided into the few steps. First step is consisting of finding the source region, target region and finally the patch. In first step we have to find the patch, after finding the patch we have to decide the priorities of that patch because it may be the case that we can found the more patch for the same region with maximum accuracy. In this case we have to calculate the product of the confidence term and the data term. The result of this product will give us the more promising patch and that patch can found the close resemblance with the original image. By finding the patch with maximum priority we have to propagate the structure and texture information. The patch we found it can also called as exemplar means the copy of image. The patch we found has a maximum confidence pixel which minimizes the difference between the original image and the image which is result of the exemplar based technique.[5]

This approach is not only helpful to remove the objects from small scale images but this can be applied with the large scale image also. This approach by combining the two techniques provides us the better results.

3. COMPARISON OF IMAGE INPAINTNG TECHNIQUES

The various image inpainting techniques like fragment-based image inpainting, wavelet-based image inpainting, multiresolution image inpainting, multiscale image modeling, exemplar-based image inpainting are presented here. The limitation of fragment-based image inpainting technique is that it has direct proportion with examples available from the global image. If we reach in availability of fragments then we can able to complete the image. The building blocks are required to complete the image from unknown regions to the known regions. The issue with multiresolution image inpainting is that there is no friendly environment is provided to mark the region which we have to rebuild. The main drawback of wavelet transform is that there is a problem of filling missing data. In contourlet transform the image improvement cannot capture the geometric information of images and be liable to amplify noises when they are applied to noisy images also that they cannot distinguish noises from weak edges. The entire drawback is overcome by the Exemplar-based image inpainting algorithm. In order to determine the effectiveness of the techniques, experiments were carried and evaluated based on the PSNR value and MSE.

4. CONCLUSIONS

In this paper, a various image Inpainting techniques such as fragment-based image inpainting, wavelet-based image inpainting, multiresolution image inpainting, multiscale image modeling, exemplar-based image inpainting techniques are studied. The analysis proved that the exemplar based image Inpainting will produce better results for Inpainting of the huge missing region. Also these algorithms can inpaint both the formation and textured image efficiently. But it will work well only if the missing region contains only simple structure and texture. Future study includes development of efficient algorithm to reduce computational cost and to reduce the time required for Inpainting.

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