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A REVIEW ON OBJECT REMOVAL USING EXAMPLER BASED IMAGE IMPAINTING TECHNIQUE

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ABSTRACT

Image inpainting was historically done manually by painters for removing defect from paintings and photographs. Fill the region of missing information from a signal using surrounding information and re-form signal is the basic work of inpainting algorithms. Here in this paper we have studied and reviewed many different algorithms present for doing Object Removal and explain their approach. We have briefly explain some algorithms for video inpainting applications. This paper contain work done in the field of Object Removal and guide newcomers who are willing to work in Object Removal field.

KEYWORDS: Object Removal, Texture Synthesis, PDE.

INTRODUCTION

Object Removal is the research area in the field of image processing whose goal is to remove some objects or restore the damaged regions in a way that observers cannot notice the flaw. There are many applications of Object Removal such as photo editing, video editing, image compression and image transmission. Generally Object Removal techniques can be categorized into two approaches; Diffusion-based and Exemplar-based approaches. Diffusion-based approach is the fundamental approach in which information diffuses from known region into missing region. The problem is usually modeled by Partial Differential Equation (PDE), so sometimes it is called a PDE-based approach. Diffusion-based approach works well for non-texture image, in which the missing region must be small and thinner than the surrounding object. In the case that the missing region is large or containing texture, this approach gives a blurry result.

Exemplar-based approach is originated from the Exemplar- based texture synthesis in [1]. In that work, the texture is synthesized by copying the best match patch from the known region. However, as there are both structures and textures in natural images, directly applying Exemplar-based texture synthesis to Object Removal problem may not provide satisfactory result. Bertalmio [2] proposed to decompose the image into structural and textural images, then apply Diffusion- based inpainting to the structural image and texture synthesis to the textural image separately. The result of combining restored structural and textural image is better than restoration by only Diffusion-based inpainting or texture synthesis alone. For Exemplar-based texture synthesis to determine the fill-in order Criminisi et al. [3] introduced patch priority, which is defined by isophote direction and the known region in the target patch, Comparing with Diffusion-based inpainting, Exemplar- based approach gives a better result even in the large missing region case.

LITERATURE SURVEY

At present there are very few accepted technologies for carrying out the work of Object Removal. This is still in the beginning stage and a lot of researches are being carried out to explore this area. The restoreInpaint [12] is an open source library which provides functionalities to detect and automatically restore cracks from damaged photographs. The Software currently available for this task is named Photo-Wipe [11] by Hanov Solutions. Also provides tools for selecting the region to be inpainted and then provides several options to carry out the inpainting process with varying time and quality.

Algorithm at first sight may seem to be something similar to noise removal from images. The De-noising is focused towards modifying individual pixels whereas inpainting aims at modifying larger regions from the image. The

Denoising also differs from inpainting in the way that in inpainting there is no information about the image in the region to be inpainted as opposed to noise removal where pixels may contain information about both the real data and noise [1]. The noise removal will in general not work for filling-in large missing portions in an image.

The most of the inpainting methods work as follows: user selects the region to be inpainted. It is usually done as a separate process and may require the use of separate image processing tools. Image restoration is then carried out automatically. To produce a visually plausible reconstruction, an inpainting technique must try to reconstruct the isophotes as smoothly as possible and also propagate two dimensional textures. On the basis of these two requirements, all the inpainting algorithms are classified as in the following way.

Mainly there are three classes of algorithms employed for inpainting. The first class of algorithms is for restoring films or videos, but it is not very useful for Object Removal as there is limited information for inpainting images as opposed to film inpainting where the information may be extracted from various frames. Second class of algorithms deals with the reconstruction of textures from the image [4]. Algorithms utilize samples from the source region to rebuild the image. By using this approach, the most of the texture of the image can be rebuilt. Third class of algorithms tries to rebuild the structural features such as edges and object contours etc. Authors of paper [1] presented a pioneering work in this respect. This was able to recover most of the structural features from the image but failed while recovering very large regions. One more algorithm proposed in paper [10] involved the use of mask to achieve inpainting. Mask that they choose for inpainting is decided interactively and requires user intervention. Method prepare the mask such that the centre element in the mask is zero. It means that no information about a pixel is extracted using its own value. Algorithm uses the values of its neighboring pixels to determine its value. It also works only for small regions and cannot inpaint large regions in the image. One more algorithm for recovering small regions and noise in an image is proposed in paper [5]. This can inpaint images with very high noise ratio. Method uses Cellular Neural Networks for the same. The noises inside the cell with different sizes are inpainted with different levels of surrounding information. This method achieved a high accuracy in the field of de-noising using inpainting techniques. Mehod provides results that show that an almost blurred image can be recovered with visually good effect. It is not suitable for the larger regions. The [13] propose an algorithm using Cahn-Hilliard fourth order reaction equation to achieve inpainting in gray-scale images. This paper [2] extends the earlier mentioned paper [13] by introducing a total-variation flow for images. Method in [4] proposed an inpainting algorithm to fill in holes in overlapping texture and/or cartoon image synthesis. This algorithm is a direct extension of morphological component analysis that is designed to separate linearly combined texture and cartoon. The approach differs from the one proposed by Bertalmio et al. [1]. Bertalmio considered decomposition and filling-in stage as two blocks. On the other hand, their approach [4] considers these as one unified task. A very few algorithms that utilize the advantages of both the Object Removal methods i.e. the structure recreation and texture synthesis algorithms. One such algorithm was proposed in the paper by Criminisi et al. [3]. Authors proposed a pioneering approach in this field that combined structural reconstruction approach with the texture synthesis approach in one algorithm by combining the advantages of both approaches. Method used the fact that the result of inpainting process depends (in general) on the order of filling-in the hole. Traditional concentric-layer filling (onion-peel) algorithm [15] for defining the region filling order failed to reconstruct structural features. The work done in [14] proposed an algorithm for video inpainting by implanting objects from other frames. The improved exemplar based algorithms for the same. Another approach for video inpainting employs information from adjacent frames and performs interpolation based on those frames to achieve inpainting [7]. The work done in [6] present an algorithm to inpaint videos using the exemplar based approach. Authors focus their research towards the restoration of old movies and particularly scratch removal. Method use the block based exemplar based approach and extend it using motion estimation.

EXISTING TECHNIQUES

Object Removal algorithms can be classified into different categories like texture synthesis based Object Removal, Exemplar and search based Object Removal, PDE (Partial Differential Equation) based inpainting, Fast semi-automatic inpainting and hybrid inpainting. Here in this section we have explained all of these inpainting methods.

TEXTURE SYNTHESIS BASED OBJECT REMOVAL

In this method, holes are filled by sampling and copying neighboring pixels[2,7,9]. Main difference between different texture based algorithms is how they maintain continuity between hole's pixel and original image pixels. This method is only work for selected number of images, not with all. Yamauchi et.al presented algorithm which generate texture under different brightness condition and work for multi resolution [11].Bergen proposed algorithm where matching

texture is synthesized from target texture [7].Fast synthesizing algorithm presented in [2], uses image quilting (stitching small patches of existing images).

All texture based methods are different in terms of their capacity to generate texture with different color , intensity, gradient and statistical characteristics. Texture synthesis based inpainting method not perform well for natural images. These methods not handle edges and boundaries well. In some cases user need to enter which texture to replace with which texture. So these methods are used for small area of inpainting.

EXEMPLAR AND SEARCH BASED OBJECT REMOVAL

This method is very effective and use Isophote driven Inpainting and texture synthesis proposed by Criminisi et.al [1]. In this algorithm priority based mechanism is used to determine order of region filling. This method work very good for large number of images. It uses good texture and structure replication. Problems with this method is, curved structure are not handle properly and biasing in due to incorrect selection of patches.

In [6] Fang et.al presented one algorithm by combining direction measure with texture synthesis based technique presented in [4]. In algorithm presented by drori etal[12] to find unknown region, iterative approximation used. Till now to fill the hole in image one use same image pixels only but hays et.al [14] gives the concept of using millions of images as the database for filling hole. The nearest and perfect match for the image is obtain by database searching. Below we have shown figure adopted from [14] which given an idea how searching technique work. Position blending process can also be used with searching technique to fill hole.

PDE BASED INPAINTING

First PDE base approach given by Bertalmio et.al [2,1]. It uses the concept of isophotes (linear edges of surrounding area) and diffusion process. Main problem with this method is that due to blurring effect of diffusion process replication of large texture is not perform well. Pixels on edges are also not handled properly. TV (Total Vibrational) model is proposed by Chan and Shen which uses anisotropic diffusion and Euler-Lagrange equation. From TV model, another algorithm presented based on CDD (Curvature Driven Diffusion model) which include curvature information of the isophotes. Another PDE based technique known as vector valued regularization under anisotropic diffusion framework presented by Tschumperle et.al [8].

FAST SEMI-AUTOMATIC OBJECT REMOVAL

A two step process is proposed by Jian etal[15] called Object Removal with Structure propagation. A fast Object Removal method is proposed by Oliviera etal[2] which do Object Removal using iterative convolving Object Removal region with diffusion kernel. Another method which uses FMM (Fast Marching Method) for image information propagation. This method is not suitable for images with large size holes as for edge region no specific method used.

HYBRID OBJECT REMOVAL

In this method, PDE and texture synthesis based Object Removal methods are combined for filling holes. Here main goal is to decompose image into texture and structure region. Then corresponding regions are filled by texture synthesis and edge propagating algorithms respectively [12]. It require more computational time for large holes. Structure completion through segmentation based Object Removal technique is found in [16]. Segmentation algorithm used in this method is presented in

CONCLUSION AND FUTURE SCOPE

Object Removal is recently very important research area in the field of image processing. Still many work on images and on videos can be done. The applications as we have listed are many of removal algorithms. In future we would like to implement all recent algorithm presented by us and would like to compare them. We would like to improve those algorithm if possible and would like to propose our new object removal algorithm.

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