International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.4., 2015 (July-Aug)

REVIEW ARTICLE

ISSN: 2321-7758

DIFFERENT IMAGE INPAINTING METHODS: A REVIEW

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ABSTRACT

Image Inpainting or Image bring back is technique which is used to reconstruct the damaged image and to fill up the regions which are absent in unique image in visually believable way. Inpainting is a method of modifying an image in an undetectable form, Applications of this method include reconstruction of broken photographs and films, subtraction of superimposed text, deduction of unnecessary objects, red eye correction. The main goal of the Inpainting is to change the damaged region in an image or reconstructing lost or damaged Part of images. This paper is a small effort to summarize different Inpainting technique used for reconstructing lost or damaged Part of images. Inpainting techniques like Examplar based image inpainting, PDE based image inpainting, texture synthesis based image inpainting, structural inpainting and textural inpainting.

Key Words—Image inpainting, Image Restore, Examplar, Object Removal, wavelet transformation.

I. INTRODUCTION

Inpainting is the process of reconstructing lost or deteriorated parts of an image. The process of inpainting utilizes the background information to fill the missing or target region of image [1]. Initially inpainting is used for scratch removal. The other applications include object removal, text removal and other automatic modification of images[2][3]. The idea of object removal is to remove objects from digital photographs and fill the hole with the information extracted from the surrounding area. Nowadays, the image Inpainting technology is a hotspot in computer graphics and it has important value in a heritage preservation, film and television special effects production, removing redundant objects etc. In the fine art museums, this Inpainting concept is used for degraded paintings. Conventionally Inpainting is carried out by professional artist and usually its very time consuming process because it was the annual process[4].

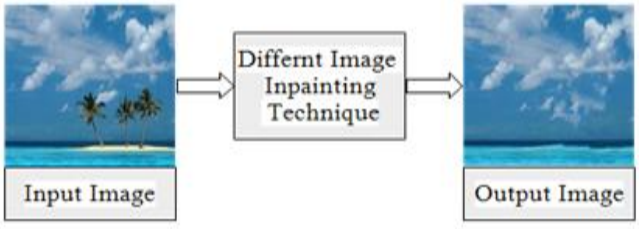

Figure 1. Image Inpainting process

The main goal of this process is to reconstruct damaged parts or missing parts of image. And this process reconstructs image in such a way that the inpainted region cannot be detected by a casual observer. Inpainting technique has found widespread use in many applications such as restoration of old films, Object removal in digital photos, red eye correction, super resolution, compression, Existing methods for the image

Inpainting can be classified into two main categories[5]. The first category concerns diffusion-based approaches which propagate linear structures or level lines (so-called isopods) via diffusion based on partial differential equations and variation methods. Unfortunately, the diffusion-based methods tend to introduce some blur when the hole to be filled-in is large. The second family of approaches concerns exampar-based methods which sample and copy best matches texture patches from the known image neighbourhood. These methods have been inspired from texture synthesis techniques and are known to work well in cases of regular or repeatable textures[6].

II. REVIEW OF IMAGE INPAINTING TECHNIQUES

A.Criminisi et. al [7] proposed that a coarse version of the input image is first inpainted by a non-parametric patch sampling. Compared to existing approaches, some improvements have been done (e.g. filling order computation, combination of K nearest neighbors). The inpainted image of a coarse version of the input image allows reducing the computational complexity to be less sensitive to noise and to work with the dominant orientations of image structures. From the low resolution inpainted image, a single image super resolution is applied to recover the details of missing areas. Experimental results on natural images and texture synthesis demonstrate the effectiveness of the method. This inpainting framework which combines non-parametric patch sampling method with a super resolution method. The extension of examplar-based method (improvements are scarcity based priority, K-coherence candidates and a similarity metric adapted from) is proposed and compare it to existing methods. Furthermore super-resolution method is used to recover a high resolution version [8, 9]. Criminisi et al [2] proposed algorithm for digital images to remove large objects. This proposed algorithm produces the merits of both texture synthesis and inpainting approach. Texture and structure information of simultaneous propagation is obtained by one efficient algorithm. Output of this method is an image in which selected object is replaced by suitable background.

Shanti K. et. al [11] presented the combining structure inpainting method and texture synthesis technique in a decomposition framework. A hybrid method for completion of images natural scenery, where the removal of a foreground object creates a hole in the image. The basic idea is to decompose the original image into a structure and a texture image. Reconstruction of each image is performed separately. The missing information in the structure component is reconstructed using a structure inpainting algorithm, while the texture component is repaired by an improved exampar based texture synthesis technique. Taking advantage of both the structure inpainting methods and texture synthesis techniques[12], they designed an effective image reconstruction method. A comparison with some existing methods on different natural images shows the merits of proposed approach in providing high quality inpainted images. This method and texture synthesis technique in a decomposition framework combination of these two powerful approaches enables us to simultaneously recover texture and structure information [13].

S. Mukherjee et. al [14] used wavelet transform for image inpainting due to its nice multi-resolution properties and decoupling characteristics. Unlike other inpainting algorithms [15]. W. Wanget. al [16]. can expect better global structure estimation of a damaged region in addition to shape and texture properties. Wavelet transform has been used for various image analysis problems due to its nice multi-resolution properties and decoupling characteristics [17]. Shanti K. et. al [18] proposes an algorithm to utilize the advantages of wavelet transforms for image inpainting. Examplar based structure synthesis contains the essential process to replicate both texture and structure [19] new image inpainting technique that emphasizes image textures and color components. Bugeau, A.et. al [21]. Proposed method that resolves high image vein defections which simple color image restoration methods would be unable to process. Empirically, the results generated by this method clearly illustrates superior image inpainting than other present image inpainting methods and techniques are unable to achieve.

Olivier Le Meur et. al [23]. Introduced a framework for examplar-based inpainting. First

input picture down sampled and several inpaintings are performed on same images. The low-resolution inpainted pictures are combined by globally minimizing an energy term. Once the combination is completed, a hierarchical single image super resolution method is applied to recover details at the native resolution. Experimental results on a wide variety of images have demonstrated the effectiveness of this method. The advantage of this approach is that it is easier to inpaint low-resolution pictures than high resolution ones [24]. Low resolution input image is inpainted several times to set the parameters for inpainting method. Loopy belief propagation and super resolution algorithm is used to combine and recover image respectively. P. Sengottuvelan et. al [26] introduced exampar based inpainting in a hierarchical framework. A hierarchical search of space refinement and hierarchical filling which increases the accuracy and handles the extra cost due to multi resolution processing in a better way. The former tries to select an exampar suitable at all resolution levels restricting the search space from the lower resolution level. The later fills the region at lower resolution level whose results are taken to the higher levels. This makes the non boundary pixels known in the higher resolution level which in turn helps in search space refinement while increasing accuracy [27]. Hierarchical approach improves the quality of reconstruction and that hierarchical filling provides a better solution. The number of levels required for proper reconstruction varies based on the image nature. Since the images are obtained by simple sub sampling process distortions occur in the reconstructed image. These distortions are prominent beyond 5 levels for natural textured images and 3 levels for images containing regular shapes. An algorithm that utilizes the nature of the image could be developed for better inpainting [28].

D. Cho et. al [29] proposed method which perform very well when the region to be reconstructed is very small, but fails in proper reconstruction as the area increases. Considering this problem Hierarchical method by which the area to be inpainted is reduced in multiple levels and Total Variation (TV) method is used to inpaint in each level. This method tries to utilize the advantage of the TV method while keeping the mask size less than a predefined value all the time. Though this method produces the gray levels better than other methods it results in some amount of blurring as the number of levels increases.

Nazarlu et. al[30] used two approaches segmentation and inpainting. Segmentation approach used to separate damaged area and inpainting is performed to recover image. Segmentation module is selected by considering the inpainting effects. The valuation of segmentation result guides system to construct Heuristic rules. Abu et. al [23] experienced a problem that hole caused by dissolution in depth image have a bad effect on stereoscopic image quality. To solve the problem hole filling method using image segmentation-based image inpainting is introduced. In this method whole filling not only gives high quality result but also possibility of general purpose method as real-time application and generate natural stereoscopic image using DIBR.

Vemulapally et. al [28] introduced a method for examplar-based inpainting. To inpaint on a rough version of the input image, a hierarchical super-resolution algorithm is used to recover the missing areas. The advantage of this approach is that it is easier to inpaint low-resolution pictures than high-resolution ones. The gain is both in terms of computational complexity and visual quality. A data term is used to improve the patch propagation. They introduced a new coefficient for propagating structure components accurately. With help of this method video can also be inpainted. The damaged video can be inpainted frame by frame.

B.Wang et. al [30]. Introduced an algorithm for image inpainting that attempts to replicate the basic techniques used by professional restorators. The basic idea is to smoothly propagate information from the surrounding areas in the isopods direction. The user needs only to provide the region to be in-painted; the rest is automatically performed by the algorithm. The in-painted images are sharp and without color artifacts. The in painted of a blur version of the input image permits to decrease the computational complexity, to be low sensitive to sound and to operate with the image structures

dominant orientations. This technique reducing the total restoration time.

Chatur et. al [31]introduced a new angle of looking towards image inpainting techniques said that applications of inpainting techniques not limited to error recovery, red-eye removal, multimedia editing. He discusses inpainting techniques in the context of digital artwork restoration. He proposed a simple and fast inpainting algorithm based on an examplar based method for scratch or text removal, object removal and missing block completion and proposed a method for completion of holes in images and videos. Successfully removed the foreground object and completed the background. His framework is appropriate for video completion. This application is indeed very time-consuming. The use of the proposed framework could dramatically reduce the computational time. Prasad et. al [26] introduced new approach for object removal using inpainting to whole world in 2014, they first removed required area with the help of hierarchical manner by combining inpainting and Super-resolution after obtained output is given as input to a super-resolution algorithm to recover details on missing areas. Exampar-based inpainting is used to remove objects that are not required. It is desirable to use a Super-resolution algorithm since inpainting produces a low resolution (LR) image. Their work consist of regularization method based on morphologic operations is used for SR image reconstruction. It is always desirable to generate a high resolution (HR) image as it shows more intricate details. Shivamurthy et. al [27] make the process to be less sensitive to noise and to work with dominant orientations of image structures. They initially convert image into its coarse version and then applied the method. To enhance the quality of inpainting region, Super resolution based algorithm is applied. Experimental results on natural images and texture synthesis demonstrate the effectiveness, super-resolution based algorithm to enhance the resulting inpainting process. It shows more improvement in computational time when the region to be filled is large.

Conclusion and Future scope

In this paper a variety of image Inpainting techniques such as texture synthesis based Inpainting, PDE based Inpainting, Exampar based Inpainting, wavelet transformation and semiautomatic and fast Inpainting techniques are studied. Image inpainting is recently very important research area in the field of image processing. The performance of different techniques is compared based on the area to be inpainted. Most of the algorithms work well for small scratch regions or small regions to be inpainted. In future we would like to implement algorithms reviewed in this paper would like to compare their performances. We would like to improve those algorithms and would like to propose a new inpainting algorithm for inpainting large regions. And includes growth of efficient algorithm to decrease the time required for Inpainting and reduce computational cost.

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