IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A SURVEY OF DIFFERENT IMAGE INPAINTING TECHNIQUES

Prof. Bijal Dalwadi, Riya Golani, Rutu Patel, Nishita

Professor,Student,Student,Student
Information Technology
Birla Vishwakarma Mahavidyalaya, Anand, Gujarat, India

Abstract: *Image inpainting is one of the image restoration techniques used for reconstruction of lost or damaged regions in an image. This image inpainting technique aims to refill the missing region of an image, which is visible to human eyes. It is done in such a way that human eyes could not identify that it has undergone some restoration. Image inpainting is applied for the restoration of old images, removing dust spots of an image, super- resolution, correction of the red-eye, object elimination in the digital photographs, creative changes by removing some objects, etc. The researchers have developed many such algorithms, each used for a certain purpose of image inpainting. This paper aims at reviewing the various techniques used for image inpainting.*

Keywords: Image Inpainting, Image restoration, texture and structure

I.INTRODUCTION

Image inpainting technology is a very searing topic in the field of image processing, computer vision and computer graphics over the past few years and it has several applications as renew of old images, removal of objects in digital photographs, super- resolution of images, compression of images, red eye correction and image coding [6]. Image Inpainting is the technique of repairing a corrupted portion or reconstructing missing parts of an image. Based on the background information, image inpainting tries to fill the corrupted and the missing data in the image. Image reinstallation consists of re-establishment of old photographs and damaged image or film by eliminating dust spots, scratches, abrasions, a superimposed text like dates, some printed text [3].Image inpainting is the process in the field of image processing to reform the missing or the deteriorated portion in the image such that the observer is unaware of this fact [4]. The necessity of image re-establishment increases from paintings to photographs and films for restoring any deterioration like cracks or scratches in paintings and photographs or to modify the image by adding or removing elements. The objective of this paper is to compare and refer different methods with its merits and demerits.The objective of this paper is to review different methods with its merits and demerits.

II. OVERVIEW OF IMAGE INPAINTING TECHNIQUES

A. Partial Differential Equation

Bertalmio et al. is the pioneer of this algorithm. PDE requires the mathematical representation of images such as a 2D matrix with numbers representing the grayscale value. The user will mark the portion of the input image that needs to be retreated, so using this user provided mask and the algorithm, the image will be taken as a combination of three different channels that are RED, GREEN and BLUE. For each of the three channels, it fills in the areas that are to be inpainted by passing the information from the outside of the masked region & along the boundary lines [3]. This algorithm is good due to Isophote driven Approach, we find the line of equal grayscale values from the matrix which contains the more reassuring information and this is used to fill the image with less time. The disadvantage of PDE based image inpainting is that this method works for each pixel and so produces a blurry output. Edges are continued in a straight manner; hence, this algorithm is not suitable for curved edges [2].

B. Texture Synthesis Based Inpainting

Texture synthesis algorithms work primarily on one pixel at a time and determine that pixel value by focusing on similar areas in the available input image data [2]. Instead of copying single pixels, it copies whole blocks and transfers into the inpainting domain, hence the resulting image connects smoothly and resembles the original image [4]. The main aim of texture synthesis based inpainting method is to produce the texture patterns, that are indistinguishable to the prearranged sample patterns, in such a way that the replicate texture retains all the statistical possessions of its source texture. The disadvantage of texture-based image inpainting is that it is difficult to handle natural images through this approach. It does not provide a good resolution image for large object removal [4]. Tiling the texture example on a rectangular grid of the required size is really simple key. Although the taster is tiled properly, the grid structure which is so large that it

can't be unnoticed the perception of the actual texture is distorted [1].

C. Semi-automatic Image Inpainting

Semi automatic inpainting is a fast Inpainting technique. It is a two-step process: Initially, important missing information is specified by the user. This is done by drawing object boundaries for the region requiring mending. Secondly, Texture is generated using patch based texture synthesis[9]. Synthesis of missing patches is performed with the help of the curves specified by the user, this is performed by expressing the problem as a global optimization problem with different structural and consistency limitations. The disadvantage of semi-automatic inpainting is that it is not applicable for inpainting large patch regions and blur effects are resulted in the final image [2].

D. Exemplar Inpainting

In Exemplar Inpainting a term known as "text redness" is used. The pixel to be filled in the target region is obtained by the level of “text redness” of the pixel's neighbourhood [6]. Linear structures that are strong yet are damaged by noise and thus the value of the extra computation is minimized. Propagating extended linear image structures is also an application of Exemplar-based texture synthesis, hence for handling isophotes separate synthesis mechanism is not required[6]. This technique is sufficient for propagating both structure and texture into the patched region with a very simple algorithm. In this technique best matching patches are selected from the familiar regions with the help of certain metrics and then inserted in the missing area. Reconstruction of huge objective regions is performed by this method[8].

E. Total Variation Inpainting

Total variation inpainting is based on the principle of locality, restoration of narrow edges and robustness to noise. All of these principles are the basic requirement of image inpainting, as locality means the image must be constructed using neighbouring pixels of the domain, restoration of narrow edges which provide most important visuality of an image must be easily reconstructed and robustness to noise dented removal of any kind of unwanted noise or object[7]. This method is best suitable when the domain region is thin [1]. TV inpainting can reduce metal artifacts both of circular metal objects in simulation phantom and clinical study in case of a bullet from gun shoot, dental filling and pedicle screws, leading to higher image quality[13].

F. Convolution Based Inpainting

Image inpainting based on convolution algorithms are well known for fast results, however in some conditions, adequate results are not obtained in sharp details like edges. This method works as follows, the gradient of the image is used to calculate the mask coefficient[8]. The neighborhood of the damaged pixels of the image to be inpainted is convolved with a proper kernel. The algorithm has following advantages: fast and iterative algorithm also it is simple to implement. Oliveira et al. presents a fast image-inpainting algorithm using convolution method[13]. In this method, initially as the related pixel in the original image is unknown, the central weight of the diffusion mask is considered zero[12]. Comparing fast convolution-based digital inpainting algorithm with oliveira algorithm, the former is faster with 1 iteration rather than 100 iteration also it removes large objects in symmetric background images. But limits or gives poor results while mending large objects in a natural image[7,8].

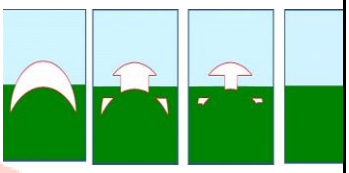
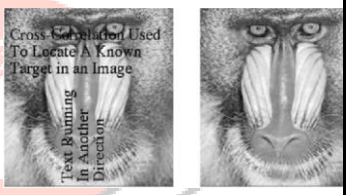
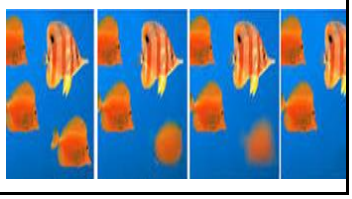
G. Hybrid Inpainting

The hybrid method is a mixture of PDE based and texture based inpainting techniques [1]. Firstly it uses a texture distribution analysis algorithm, divides the missing area into homogeneous part and inhomogeneous part, then uses PDE based inpainting method and sparse representation inpainting method to restore the missing area according to the result of texture distribution analysis [3].The inpainting result provides more precise texture information than the Sparse Representation inpainting using predefined dictionary [5]. Then related regions are loaded using algorithms such as texture synthesis and edge propagating respectively. Large holes need more time for computation. Segmentation based inpainting technique is used for structure completion in hybrid inpainting[6].

III. COMPARATIVE STUDY OF DIFFERENT METHODS

Table 1 is the representation of the various methods used for image inpainting.

Table-1: Comparing different methods of inpainting an image with merits and demerits.

Methods	Merits	Demerits	Image
PDE(Partial Differential Equation)	Uses isophote driven approach and preserves all structure information.	Work at pixel level, give a blur effect for larger regions and take a long time.	
Texture Synthesis	Performs well in approximating textures	Difficulty to handle natural images and hardly applicable for large objects.	
Exemplar	Efficient for larger target regions.	Calculation time is more.	
Total Variation	Highly applicable for handling salt-pepper noise.	Inpaints only small regions of images.	
Convolution	Produce fine results without blurring, fast, iterative, simple to implement.	When large objects are removed in natural images, vague results are produced.	
Hybrid	Smoothness is restored and structure and texture are preserved of image.	If the damaged area is large and inappropriate, blocky image is obtained.	

IV. CONCLUSION

This review paper gives ideas on different methods of image inpainting. In this report we reviewed the existing techniques of Image Inpainting. All the techniques mentioned above have a detailed explanation along with their application for removal or filling of missing regions of any image. Each technique has advantages and disadvantages which are analysed and a detailed review of which method is applicable for which type of inpainting is mentioned. Therefore, in our opinion, the developing trend should be deterministically a combination of variation methods. All the inpainting algorithms currently try to restore the holes with the image information only from the rest of the image, which is called the low-level approach.

REFERENCES

1. Bertalmio, Marcelo, Luminita Vese, Guillermo Sapiro, and Stanley Osher. "Simultaneous structure and texture image inpainting." (2002).
2. Pandya, Nirali, and Bhailal Limbasiya. "A survey on image inpainting techniques." *International Journal of Current Engineering and Technology* 3, no. 5 (2013): 1828-1831.
3. Patel, Hiral Nileshbhai. "A Survey on Different techniques for Image Inpainting." *International Research Journal of Engineering and Technology (IRJET)* (2016).
4. Liu, Yaojie, and Chang Shu. "A comparison of image inpainting techniques." In *Sixth International Conference on Graphic and Image Processing (ICGIP 2014)*, vol. 9443, p. 94431M. International Society for Optics and Photonics, 2015.
5. Suryawanshi, Shital D., and P. V. Baviskar. "Image Inpaint Using Patch Sparsity." *APTIKOM Journal on Computer Science and Information Technologies* 1, no. 3 (2016): 85-91.
6. Criminisi, Antonio, Patrick Pérez, and Kentaro Toyama. "Region filling and object removal by exemplar-based image inpainting." *IEEE Transactions on image processing* 13, no. 9 (2004): 1200-1212.
7. Getreuer, Pascal. "Total variation inpainting using split Bregman." *Image Processing On Line* 2 (2012): 147-157.
8. Chavda, Priyanka, and Lokesh Gagnani. "Survey on Image Inpainting Techniques: Texture Synthesis, Convolution and Exemplar Based Algorithms." *International Journal for Innovative Research in Science and Technology* 1, no. 7 (2015): 100-106.
9. Sangeetha, K., P. Sengottuvelan, and E. Balamurugan. "Combined structure and texture image inpainting algorithm for natural scene image completion." *Journal of Information Engineering and Applications* 1, no. 1 (2011): 7-12.
10. Li, Shutao, and Ming Zhao. "Image inpainting with salient structure completion and texture propagation." *Pattern Recognition Letters* 32, no. 9 (2011): 1256-1266.
11. Wang, Minqin. "A novel image inpainting method based on image decomposition." *Procedia Engineering* 15 (2011): 3733-3738.
12. Vadhel, Bhavini, and Bhailal Limbasiya. "Survey on Different Techniques for Image Inpainting." *International Research Journal of Engineering and Technology* (2016).
13. Kulkarni, Ketki R., Vishwas R. Takate, and Samira R. Kulkarni. "An Overview of Image Inpainting." *International Journal of Innovative Research in Computer and Communication Engineering* 5, no. 4 (2017).