

Image Inpainting Technique to Restore Image: A Study

Manoj S Ishi

Assistant Professor

RCPIT, Shirpur, India

Abstract— Lost parts of recovery of image and reconstructing of image is an art performed with image inpainting technique. This information is collected from background element and done in such way that common observer is unknown of that changes. Unwanted data, object, microphones, ropes, unwanted persons, logos, stamped dates and text are removed with the help of image inpainting algorithm. It is also used to create special effect. It removes the unwanted portion from the image using masking method. First that portion is mask and then new texture is generated using color value and pixel available from source image. Exemplar method used to remove large object from the image and texture synthesis is used to recover small size images. In this paper numbers of algorithms are discussed like fast march method, neural patch synthesis, low rank and linear model, image segmentation, wavelet decomposition etc. are discussed.

Key words: Fast Marching Method, Wavelet, Segmentation

I. INTRODUCTION

In this paper inpainting techniques are discussed to restore image on the basis of background information. Details which are completely hidden by object need to recover in such way that it is undetectable to common observer. The main objective of image inpainting to create image which is in close resemblance with original image. When image is transfer over network some part of image missing. These parts are recovered with image inpainting. Stains and undesired objects are present in image which covers significant portion of image. Regions are completed from remaining area of image. Image coding, image transmission and image restoration are very important while filling missing information. Removing object from image is known as image manipulation technique. Quality improvement of image is main focus along with recovery of image. Image inpainting art starts from masking desired object of image, finding term to fill the area. Then the image is filled with graphical technique. Graphical technique mostly classified into texture synthesis and inpainting to recover image. It try to get all details right. Exemplar based algorithm generates new texture by sampling and copying color values from source image in easy manner. Image compression is used to fit large amount of data with narrow bandwidth of communication channel to keep visual quality acceptable to common observer. If removal is done manually then it is tedious task. Erasing is not enough to recover image because it lefts white patch in image. Neighboring information is collected to fill the missing region or damaged portion of image. Computer graphic is one of the important advantages of image inpainting to maintain historical heritage. Numbers of techniques are provided like Total Variation model, Curvature- Driven Diffusion, Partial Differential Equation to recover image using mathematical model. These models are used to propagate color information into image. Mostly 3X3 filter used to recover image and fill the missing pixel of

image. The problem of isophote estimation and information propagation is subject of numerical diffusion. So to avoid this number of techniques on the basis of exemplar technique is proposed to effectively remove damaged portion of image with maximum accuracy. Figure 1 shows example of image inpainting to recover image.

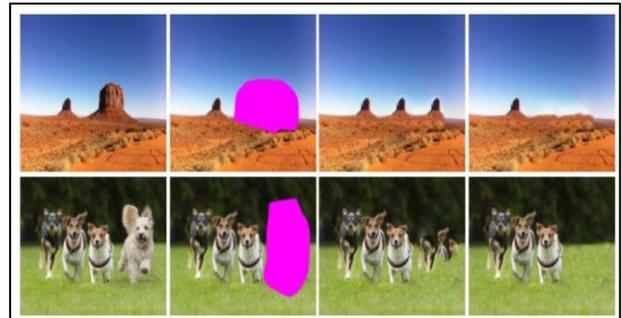


Fig. 1: Example of image Inpainting

II. LITERATURE SURVEY

A. Image Inpainting using Exemplar based and FMM Algorithm [1]

Fast marching method and Exemplar based algorithm are provided here for repairing of image. In exemplar based algorithm neighborhood area is searched to find the damage region of image. In this algorithm focused is provided on image smoothness rather than known neighborhood of pixel to inpaint. Level set of image is created which consist of missing region of image. Fast marching method is used to propagate the image information. It works efficiently on 800X600 size image. It can easily customize with different inpainting strategies. FMM technique is used to remove scathes from image.

- Advantage: Simple to implement and faster that other inpainting method.
- Disadvantage: Image distortion is more while repairing image.

B. High-Resolution Image Inpainting using Multi-Scale Neural Patch Synthesis [2]

In this author proposed approach where Multi-scale neural patch synthesis approach is used based on texture constraint and joint optimization of image content, to produce high frequency detail image by checking and acquiring patches with similar feature correlation mid layer in deep classification network to preserve contextual structure. This approach produces more coherent result and sharp image as compared to other methods. It consists of following steps:

It provides joint optimization framework which create illusion for missing region of image by considering global content constraint and local texture part of image with effective neural network. Multiscale neural patch synthesis algorithm provided for high resolution image repairing on joint optimization network. Middle layer is used to extract feature from image to get real content and

texture from image. Semantic inpainting art is extended using neural patch synthesis. High frequency detail is provided by texture network. Content network provides strong priority about global and semantic texture.

- Advantage: it is used in denoising, retargeting and super resolution technique.
- Disadvantage: in some cases discontinuity is produced and speed is bottleneck of this algorithm.

C. Low-Rank and Nonlinear Model Approach to Image Inpainting [3]

Matrix rank minimization with nonlinear mapping function provided in this method. Autoregressive model is mapped with nonlinear mapped image. Image inpainting problem is defined with matrix rank minimization problem. Iterative Partial Matrix Shrinkage (IMPS) algorithm modifies inpainting algorithm for nonlinear mapping function for filling missing pixel. Nonlinear AR model is proposed and finds the missing pixel with nonlinear function and matrix rank minimization. This function is polynomial of finite degree and dimensioned of recovered part is less than the patch to recover.

- Advantage: It minimizes the problem of finding high priority patch by using rank minimization problem with fitting error term.
- Disadvantage: Complex algorithm to find priority of pixel.

D. An Improved Image Inpainting Algorithm based on Image Segmentation [4]

In the present era, sample block image inpainting algorithm is not good idea for processing of abundant information and it produce false matching error while recovering the image. Image segmentation based algorithm is provided here for recovery of image. Image segmentation is carrying out with watershed image segmentation algorithm. Image repairing is done with curvature feature in isophote direction. Details of structure is provided curvature feature to provide priority for data term. Image segmented region and pixel box matching is performed for better solution to avoid excessive extension of the texture block in restoration of image. The problem of matching texture block based on inaccurate calculation of maximum priority of target block and confidence term dropping too fast on each iteration. Reconstructed image maintains structure information. The image is divided with watershed image segmentation algorithm into key areas. Then searching begins in that reduced areas and problem of searching in complete extension is solved. Algorithm is superior as compared to other algorithm in terms of quality and efficiency.

- Advantage: larger PSNR value obtained to have better repair effect consist of abundant information.
- Disadvantage: Distinctive texture and color image is not well repair with this algorithm.

E. Image Inpainting Based on Wavelet Decomposition [5]

In image inpainting structure and texture region information simultaneous filling is difficult. Wavelet decomposition approach is presented here for missing structure and texture filling. Here image is divided into number of parts and texture parts using wavelet decomposition. Curvature-

Driven diffusion technique is used to reconstruct image by collecting missing information for structure. Texture part of image with improved texture synthesis is performed with exemplar algorithm. Then combine the result of this two method to get final inpainted image. PSNR(Peak signal to Noise Ratio and visual effect is good. This algorithm is consisting of three steps. In first step image decomposed, structure inpainting in second step and in final step texture synthesis. In wavelet decomposition image divided into four sub images. In one part structure image and remaining three parts consist of structure part. Then this two inpainted image are combined together to obtain final inpainted or reconstructed image.

- Advantage: This algorithm is quick, efficient while restoring structure and texture at same time.
- Disadvantage: Overhead of dividing image and recombining the image is more.

F. Inpainting for compressed images [6]

While compressing the image iterative framed based algorithm is provided for inpainting to recover missing coefficient or missing bits from image. Coefficient thresholding and quantization based image compression scheme is as post process to improve compression ratio to remove compression parts. Numerical experiments are performed on images to provide inpainted image, iteration is performed for the convergence and solution generated minimize the error with special function. Tight frame decomposition is key idea for image inpainting in pixel domain in bit domain or coefficient domain. After considering wide range of application the idea of bit domain provided. Unique approach is provided with bit domain to recover image with improved accuracy. Many applications can use this technique to get accuracy gain.

- Advantage: Quantization error is avoided, Visual Quality improved.
- Disadvantage: Not effective on curved portion.

G. Image Completion by Spatial-Contextual Correlation Framework [7]

Spatial contextual correlation method is used in this paper to recover image. The damaged region is selected automatically or semi automatically. Gaussian filter method is used for preprocessing of image. It eliminates the noise and distortion of image. Area is segmented using max difference growing region. Region is selected and then real image and object is compared and marked with color. Self data information and contextual correlation are used to final matting of image. Drag shaped method is used to carry out segmentation and manual input is given in this semi automatic approach. Information required to complete image is provided by correlation of omitted region and border information updating carry out toward centre.

- Advantage: Inpainting of single and multiple regions are inpainted.
- Disadvantage: Noise reduction is less.

H. An Image Inpainting approach Based on Poisson equation [8]

This paper is based on inpainting of image as texture and structure based on properties of pixel repairing is done.

Exemplar based method is used to recover texture image. Structure is repair and improved using laplacian operator. Then this laplacian image is recovered with exemplar algorithm using Poisson equation. And in last both the images are combined together to get the final image with more promising information.

- Advantage: Large area inpainted with good visual effect.
- Disadvantage: Complex algorithm to recover image.

I. Exemplar-Based Image Inpainting Using Color Distribution Analysis [9]

A new approach is provided here to give guidelines and priority for filling. Color distribution analysis is used to assign priority instead of isophote driven approach for finding the patch with maximum priority. Different method is proposed to recover image instead of traditional texture and structure recovery method. More promising pixel is found from the surrounding image to recover image.

- Advantage: It is capable to maintain consistency with respect to continuity of image and consistency of texture for better visual quality.
- Disadvantage: More time required to recover image.

J. Repairing and Inpainting Damaged Images using Diffusion Tensor [10]

Nonlinear diffusion tensor scheme is proposed to recover damaged part of image in this method. It tracks the geometry of corrupted image in the isophote curve direction and then diffusion is done. For the recovery of image coherent color completion method is used. It provides good result with respect to repairing corrupted part and discontinuities preserved.

- Advantage: It avoids the used of isotropic smoothing method.
- Disadvantage: Smoothing is not done in Efficient Manner

III. CONCLUSION

In this way different algorithm are discussed for image inpainting to recover the image in most effective way so that undetectable for common observer. All the algorithms discussed in this paper have its own advantage and disadvantage. Details which are completely hidden by object is removed with image inpainting technique. In fast marching method large size image is inpainted but image distortion is more. Neural patch synthesis used in many application but speed is problem of this algorithm. Low rank algorithm uses matrix rank optimization to find priority but it is complex technique for finding priority of algorithm. Image segmented approach is used to recover image but for color image it is not effective. Wavelet decomposition algorithm is used to recover image but overhead for diving and recombining of image is more. Compressed image is inpainted, contextual correlation framework, Poisson equation, diffusion tensor this techniques providing better solution to recover image with good visual effect and with maximum information recovered. They are also having disadvantage like more time, image smoothing, and complexity. All algorithms are tried to recover image with

maximum accuracy. So that image looks clone of original image.

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