

A Survey on Restoring Images using Various Inpainting Techniques

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Abstract—Image inpainting refers to the process of restoring missing or damaged areas in an image. Image inpainting is process to perform operation on image for improvement of image quality or to eliminate object from image inpainting, the technique of modifying an image in an invisible form, it is art which is used from the early year. Image Inpainting is used to filling the misplaced or smashed region in an image make use of spatial information of its neighboring region. The main objective of inpainting is to reinstallation of damaged pixel value and elimination of selected object from image. Image inpainting technique is used to remove scratches from old photographs, Now a days, It is the key tool for video and 3D cinema post production. This survey includes different Inpainting techniques and relative study of these techniques along with their advantages and Disadvantages.

Keywords—Inpainting, Exemplar based, Image restoring, Reconstruct;

I. INTRODUCTION

Digital Image Inpainting is process of filling the missing regions of an image from the surrounding parts [2]. The digital Image In-painting has various applications such as restoration of damaged old printing and old photographs, error recovery of images and videos, multimedia editing (computer assisted), transmission loss and replacing large regions in an image or video for privacy protection. The concept of image inpainting existed very long years back and from the birth of computer vision, researchers are looking for a way to carry out this process automatically. Image Inpainting restructure the damaged region or mislaid parts in an image utilizing spatial information of neighboring region.[17]

Image inpainting is process to perform operation on image for improvement of image quality or to eliminate object from image. Based on the background information, image inpainting try to fill the corrupted/missing data in the image. Some technique take care about structural inpainting and some technique take care about texture inpainting. [9] So the selection of proper technique according to our requirement is important. Generally image inpainting techniques can be categorized into two approaches; Diffusion-based and Exemplar-based approaches. Diffusion-based approach works well for non-texture image[5]. Exemplar-based approach is originated from the Exemplar- based texture synthesis[4]. Comparing with Diffusion-based inpainting, Exemplar- based approach gives a better result even in the large missing region case.

In this paper, different types of image inpainting techniques presented. Section 2 discuss about classification

of inpainting techniques. Inferences of the existing works are discussed in section 3 describe related work on survey of techniques of inpainting. Section 4 discuss about the conclusion and future work.

II. CLASSIFICATION OF INPAINTING APPROACH

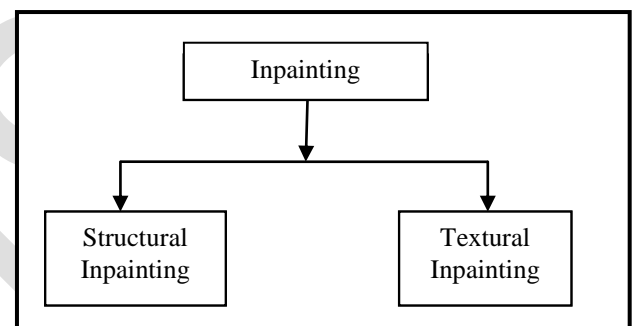


Fig-1 Traditional Approach of Inpainting

III. DIFFERENT TECHNIQUES FOR INPAINTING IMAGE

Some technique take care about structural inpainting and some technique take care about texture inpainting, So selection of proper technique according to our requirement is important. The performance of different techniques is compared based on the area to be inpainted. The following groups of Various Image Inpainting Techniques:-

- A. Partial Differential Equation (PDE) based inpainting
- B. Texture synthesis based inpainting
- C. Exemplar and search based inpainting
- D. Wavelet Transform based inpainting
- E. Semi-automatic and Fast inpainting.

IV. RELATED RESEARCH AND USE

In paper [1] Priyanka Wagh and D.R .Patel presented mainly two steps in this approach ,first is to detect text from image and second is to remove text using inpainting method. For detecting text ,text localization and text extraction is used for fill the holes in image. Smoothing is used on selected patches for making visual quality better. The result

is generally carried out on English text image. The PSNR (Peak Signal Noise Ratio) values for images with smoothing are greater than images without smoothing. Here, using smoothing for inpaint the image gives good visual quality as a result. This approach can also apply on video frame.

Object removal [2] is the recovery of missing parts in image with given region. It can be accomplished by image inpainting methods. This paper introduces an exemplar based image inpainting approach in two parts: first compute the filling priority of patches in missing region and second search for the best match patch. The improvement in original method is a regularized factor for adjust the patch priority function. This improved method gives the effective visual quality for real life photos and testing of large objects. For finding best match patch use SSD (Sum of Squared Distance) and extract the best patch use NCC (Normalized Cross Correlation). This method is also generalized for video editing.

In [3] a new image inpainting approach is used that cartoon-based metric used to compute the filling order and pixel similarity and dynamic sampling mechanisms that combines texture synthesis, diffusion and transport equation mechanism is efficient for image inpainting process. The given method generates the more accurate result for filling the region, structural objects are missing, avoid blurring effects and deal with highlight textured images. Optimizing those parameters and unsatisfactory results is an issue in future work can be obtained when inpainting non-textured images with color variation.

In this [4] presented compares different types of image inpainting algorithms and apply the different application area. Inpainting has various applications such as reconstruct of damaged old printing and old photos, error recovery of images and videos, multimedia editing, replacing large or small region or object in images or videos. Each method and algorithm have good restoration capability and advantages and limitations. The area to be inpainted is selected based on color, shape, region select by user or missing area. When the area is uniform interpolation based methods work well. Texture synthesis methods work well for large unknown area but result in blur. The exemplar based inpainting algorithm is capable of propagating both linear structure and 2D texture. PDE based algorithm has a problem of restore the curved structure in occlusion. The success of inpainting approach is based on how well the information, color, shape and structure are propagated for unknown area.

A novel approach introduced by N. Neelima and M. Arulvani [5] in order to remove large objects from digital photograph and to fill in the hole that is left behind in a visually way. Using a best-first algorithm in which the confidence in the synthesized pixel values is propagated same manner as in inpainting. The exemplar-based synthesis used for compute the actual color values and texture synthesis is sufficient for propagate linear structure. Block based method is used for compute efficiency in result. It is used in real image with large objects to remove.

In this paper [6], an efficient approach is to improve the image inpainting in a more nature quality with high performance to incorporate the exemplar-based image of inpainting method and the minimum error boundary of cut technique and also improves the time consuming issue. This approach is based on Particle Swarm Optimization to reasonably inpaint the damaged area in high priority. Past searching for the similar blocks is a time-consuming procedure, and that can be overcome through the particle swarm algorithm.

A patch based approach has proposed by Shilpa and Nisha Sharma [7] where in to repair cracked images or old paintings. It repairs or reconstructs the cracks in images without losing quality. The approach is divided in two stages, first is the crack area will be detected and second is image will be repaired. First to first identifies the cracks and then fills them by the using patch based approach and then performs the smoothing. Here we have defined an efficient patch based work to remove the scratches for the cracks from the images for old paintings. Basically the proposed method is used to remove smaller non linear objects, cracks for other patched from the image. The proposed work is efficient than other image restoration processes because it works for all types of images including JPEG, GIF and BMP. This approach can be extended for retrieve large objects from video.

In paper [8] present fast exemplar based inpainting approach for compute the efficiency in predictable time. This scheme is work in mainly two phases, first reduce the source region and second modified scheme to update fill front updating rule. The given FEII approach takes 2 second to finish filling the region and pioneer exemplar based approach takes 24 second. So it is faster than past approach for good efficiency. FEII is 3.5 time faster than original exemplar based method. It is used for very large filling the missing region in images.

In [9] for restoring the image using Exemplar based inpainting method using Curvature Driven Diffusion (CDD) and TV (Total Variation) approach with super resolution. This concept basically used in reconstruct the edge and damaged images and films, also object and text removal for special effects. This approach can be applied to gray scale and RGB images. The CDD approach improves the effectiveness and linear structure propagation and TV based approach inpaints complex structure and texture of damaged area.

Image inpainting with multiresolution approach [10] overcome the problem of computational complexity, blurring and false edges especially in large regions. In multiresolution approach first the image pyramid is established after that inpainting is chosen low resolution image in the pyramid and then information in this repaired low resolution image is propagated through each higher resolution image until the original highest resolution image is inpainted. The result and comparison with other methods, gives ease of filling large areas with better results and faster speed with human vision process. This method used for

specific object removal, missing block completion and scratch removal.

Mengxim Li and Yan Wen [11] Proposed a PDE based Total Variational (TV) inpainting model used a Euler Lagrange equation and it was designed for inpainting small regions and good for removing noise, which did not connect broken edges. The time for running this work is short than other filling algorithm. The area should be filled with structure and texture information and selection of area will fill automatically. It is also good used for removing noise in image.

In paper [12] gives a good and better review for selecting the inpainting method for video editing. This represents the different inpainting methods applied to video like PDE based, patch –based, texture synthesis and object based approach. The selection of method for inpainting based on the area for editing the video frame. As a result, many researchers have focused on object-based approaches, which usually generate high-quality visual results. The goal is to

repair the missing pixels in the holes in damage region or removal of selected objects is difficult in some application such as video repairing, movie post production, etc.

Ahire and Neeta gives [13] the approach for video inpainting using modified patch based image inpainting algorithm. The given method, 3D volume of video is sampled into 2D spatio-temporal slices. This method consists of four modules: Background subtraction method is used for Object detection and tracking, virtual contour construction, Key posture selection and synthetic posture generation and exemplar-based inpainting used to fulfill damaged object region in 2D slice. The proposed method removes objects consistent in good quality in terms of and temporal motion continuity. Also works with the non-linearity of the occluded object and avoids over smoothing.

Appendix A summarizes above approaches providing addition knowledge about positive aspects and limitations of each approach.

APPENDIX A :

TABLE I : A SURVEY ON IMAGE INPAINTING

Sr No	Title	Publication/Year	Method	Positive Aspects	Limitations
1	Text Detection and Removal from Image using Inpainting with Smoothing conferece	IEEE/2015	-Text Localization -Text Extraction -Text Remove using inpainting	-Text detection and inpainting results improved using smoothing -Using smoothing gives good visual qulity	-Extend for text inpainting in video frame by frame detection -Not working with other language rather English.
2	Robust object removal with an exemplar-based image inpainting	ELSEVIER /2014	- Improved Exemplar based approach using regularized factor	-Gives best matching patch and good output for filling large target region	-It is not enhance the good quality of filling priority in video editing
3	Combining anisotropic diffusion, transport equation and texture synthesis for textured images	ELS-EVIER, 2014	-Cartoon driven for filling order -Dynamic sampling for inpaint -Copy-Paste block based	- Very accurate and computational cost -Efficient for real and synthetic images contains different complexity level texture and structural objects	-Issue for some parameters that are needed -Not good output for non-textured with color variation image
4	Image In-Painting Techniques - A Survey and Analysis	IEEE/2013	-Texture synthesis -PDE based -Exampler-based -Pixel based	-Texture synthesis method work well for large area -Exampler based inpainting is best for linear and 2D sturcture -PDE based have all structure information	-Anisotropic diffusion based method not produce better output -Exampler-based not handle curved structure - PDE based display blur.
5	Object Removal by Region Based Filling Inpainting	IEEE/2013	-Best first algorithm for pixel value prapogate -Exampler based texture synthesis	-The result gives efficient and qualitative performance -Pixel maintain a confidence value	-The diffusion based method gives result in blur - Not Propagate more accurate result for curved structure

6	A New Approach of Image Inpainting Based on PSO Algorithm	IEEE/2013	-Exemplar based method using Particle Swarm Optimization(PSO)	-Inpaint the damaged area in high priority -Gives high-dimensional solution	-Efficiency for restore and repairing images improves time consuming problem
7	Inpainting approach to repair cracked images	IJAEM/2012	-Patch based approach for remove crack	-It work for all images like JPEG,GIF,BMP -Given approach is efficient other than restoring method -Used for remove smaller non-linear object and cracks	-Object identification also in video -In image work well for large objects,patches and cracks .
9	Image Restoration using Inpainting	IJARCS M/2012	-Curvature Driven Diffusion (CDD) method -TV(Total Variation)based texture inpaint with super resolution	-Done inpainting structure and texture simultaneously -Produce good result with texture for complex structure	-Time taken by large image is long
10	Multi-resolution Image Inpainting	IEEE/2012	-Multiresolution based approach	-Filling large areas is easy with better result, faster speed and good information -Human visual perception quality more accurate	-Need to store location of target patch and filling patches with weight coefficient
11	A New Image Inpainting Method Based on TV Model	ELSEVIER/2012	- PDE based TV model	-shorter time consuming to inpainting -Possible connecting the object	-Combine with texture synthesis for repair lost coefficient
12	A review on Video inpainting techniques	IJCET/2013	-PDE based -Texture synthesis -Patch based -Object based methods	-Dealing with videos recorded on stationary camera -Object based approach gives high visual quality	-Large number of pixels inpaint and more searching space -Generate the errors
13	Video In - painting of Objects using Modified Patch based Image Inpainting algo.	IEEE/2014	-Object based video inpainting -Modified patch based method	- Removes objects with better quality -Avoids over smoothing -Work with non-linear object	-Not deal good with it lighting is not uniform in video frame

V. CONCLUSION AND FUTURE WORK

Recently, image inpainting is very significant area for researchers in image processing. The image restoration problem is concerned with recovering an original image from various forms of degradation. The degradation depends on the

application; It can be text overlay or scratches in digital photography and digital cinema. Numerous and different types of inpainting approaches proposed with various applicability in restoration, small or large object removal, or in texture synthesis .[20]

In this paper different types of inpainting techniques are studied and analyzed for removing objects and in-paint damaged photos. We have show that the images for different environmental conditions used for filling an occlusion making use of images or video. PDE based method is good if filling area is small but if filling area is large then this

method take so long time and it will not produce good result. Texture synthesis based algorithm have difficulties in handling natural images as they are composed of structure in form of edges. So these methods address only small area of inpainting issues and these methods are not suitable for a large object. Semi-automatic and fast inpainting method is give result fast but not suitable when filling area is in form of large hole as they lack explicit methods to in paint edge regions. Exemplar based methods are capable of propagating both linear structures and two dimensional textures into the target region. This method is applicable to fill small scratches in the image/photos as well as to remove larger objects from them.[18][19]

The limited direct applications for video inpainting, which remains an open problem ,despite of preliminary solution make assumption in terms of moving object camera motion. Tracking moving objects in a video and apply inpainting approach is difficult problem. So, we will extend the work for video apply inpainting techniques which will give better efficiency.[4][13]

REFERENCES

- [1]. Priyanka Deelip Wagh and D. R. Patil “ Text Detection and Removal from Image using Inpainting with Smoothing” Conference of IEEE,2015
- [2]. Jing Wang a,d, KeLuan, DaruPan a, NingHe b, Bing-kunBao ,” Robust object removal with an exemplar-based image inpainting approach”, Elsevier ,2014.
- [3]. Wallace Casaca, Maurílio Boaventura , Marcos Proença de Almeida and Luis Gustavo Nonato “Combining anisotropic diffusion, transport equation and texture synthesis for inpainting textured images”, Elsevier 2014.
- [4]. S. Ravi, P .Pasupathi, Muthukumar. S and N. Krishnan “Image In-Painting Techniques - A Survey and Analysis “. IEEE Transaction on , IIT.131569709761,2014.
- [5]. N.Neelimal , M.Arulvan, “Object Removal by Region Based Filling Inpainting”, IEEE on 2013.
- [6]. Shu-Chiang Chung, Ta-Wen Kuan, Chuan-Pin Lu, Hsin-Yi Lin , “A New Approach of Image Inpainting Based on PSO Algorithm” ,IEEE Transaction 2013.
- [7]. SHILPA AND NISHA SHARMA,” INPAINTING APPROACH TO REPAIR CRACKED IMAGES” , IJAEM Volume 1, Issue 2, October 2012
- [8]. Qin w ang1, Qing cheni, Cheng-hsiung Hsieh2 and peng yul , ” Fast exemplar-based image inpainting approach”,IEEE, july,2012.
- [9]. Chaitali P Sathe and Dr.Shubhalaxmi P.,” Image Restoration using Inpainting ” ,IJARCSM,ISSN,vol-2,issue-1,February,2014.
- [10]. Lili Wang and Yi Wan , “Multiresolution Image Inpainting”, IEEE,2012 .
- [11]. Mengxin Li, Yan Wen ,” A New Image Inpainting Method Based on TV Model”, ELSEVIER,2012.
- [12]. Mrs.B.A.Ahire*1, Prof.Neeta A. Deshpande, “A REVIEW ON VIDEO INPAINTING TECHNIQUES”, IJCET, Volume 4, Issue 1, January- February (2013).
- [13]. Mrs.B.A.Ahire*1, Prof.Neeta A. Deshpande, “A REVIEW ON VIDEO INPAINTING TECHNIQUES”, IJCET, Volume 4, Issue 1, January- February (2013).
- [14]. B. A. Ahirel, Neeta A. Deshpande,” Video Inpainting of Objects using Modified Patch based Image Inpainting Algorithm” ,IEEE,2014.
- [15]. B. A. Ahirel, Neeta A. Deshpande,” Video Inpainting of Objects using Modified Patch based Image Inpainting Algorithm” ,IEEE,2014.
- [16]. Rajul Suthar, Mr. Krunal R. Patel,” A Survey on Various Image Inpainting Techniques to Restore Image”. ISSN : 2248-9622, Vol. 4, Issue 2(Version 1), February 2014.
- [17]. Prof. Mrs Anupama Sanjay Awati and Prof. Dr. Mrs. Meenakshi R. Patil,” Review Of Digital Image Inpainting Algorithms”, IJLTET-2013.
- [18]. Jaspreet Kaur Chhabra and Mr. Vijay Birchha, ” Detailed Survey on Exemplar Based Image Inpainting Techniques”, (IJCSIT) , Vol. 5 (5) , 2014.
- [19]. Pooja Jain, 2Aditya Mishra ,” A Review of ImageInpainting Techniques”,IJARCSEM- ISSN,vol-3,2014
- [20]. Christine Guillemot and Olivier Le Meur,”Inpainting Review and Analysis”,January,2014.