Review Paper On Image Inpainting Techniques

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Abstract— The process of reimposing the missing pixels from the flawed image and remove unwanted object is referred as Image inpainting. The most prominent purpose of the inpainting algorithm is to put back distorted and unpleasant regions and fill holes using natural method. Some common application of this technique includes remove unwanted object, restoring photos, photo retouching, or remove unwanted text, logo, stamps, copyright from the images. Based on the background information, image inpainting restore the damage part of the image by filling missing or corrupted data in the image. The restored image, which is produced as the result of applying inpainting technique will provide more realistic and more pleasant than compared to the original image. The attempt of recovering scene details blocked by visible parts is called disocclusion, which is viewed as an important part in image and depth inpainting. Holes are the occluded and impaired parts which is to be restored in an image. Hierarchical super-resolution-based, diffusion based, hybrid inpainting, texture synthesis based and exemplar-based method are used for inpainting. This paper gives brief review of the existing image inpainting approaches. This paper presents a brief survey of different image inpainting techniques and provides a relative comparison between these techniques for inpainting.

Keywords—ImageInpainting,RegionFilling,ObjectFilling,Holes

I.   INTRODUCTION

For more than 10 years image inpainting has been remained an active zone for researchers. It can be defined as the process of reconstructing missing parts or damaged parts of an image. It also reconstructs the damaged photograph and remove or replaces selected objects. The restored image is more realistic and more pleasant than compared to the original image. There may be various reason which causes damage to the image which may include scratches, environmental factors, chemical processing, moisture, improper storage etc. There may be techniques which replaces or removes the unwanted region or damaged region. The main objective is to replace the undesired object or to fill the missing region or hole in a natural way. The main intension of these inpainting algorithms are to fill the missing regions with the available information from their neighbors and detach the unwanted region. The main objective is to reconstruct the damaged parts or missing region which may not be identified by a casual observer. The two major types of inpainting approaches i.e. 2D image inpainting and depth map inpainting [16]. By applying textural and structural, or both the techniques simultaneously, the blemished and disfigured can be retrieved.. To improve ,3 Dimensional visualization effect by upgrading the depth map linked with the scene, mainly we use depth inpainting.

Figure 1. An example of image inpainting for object removal
(a) original image,   (b)inpainted image

There are many application for inpainting and some of the common application are-Inpainting removes the undesired object in an image and reconstructs them based on the spatial information of the neighbouring pixels i.e. filling the target region by using the information extracted from the surrounding region of the same image [11].Restoring Images: Through inpainting the decay in images can be redeemed which occurred with sweep of time. Using the above method [15] the impairment in images can also be retrieved which is caused by improper handling. Photo Retouching: This is one of the most commonly used application in media industry where images of models, actresses and actors, are changed using some operation such as to remove any undesirable features of face to give them a better look there by making their pictures more

attractive. Text Removal: Utilizing image inpainting methods, many undesirable logos of copyrights, stamps, text etc can be removed.

II. LITERATURE SURVEY

The process of reconstructing the lost parts or corrupted parts of an image is called image inpainting. It also reconstructs the damaged photograph and remove or replaces selected objects. The goal of image inpainting is not only to recover the image, but also to generate few images that have closely similar with the original image[12]. There are numbers of image inpainting techniques discussed in literature, some of them are: exemplar based inpainting, diffusion based inpainting, hybrid inpainting. texture synthesis based inpainting.

Diffusion based inpainting [1] is an inpainting technique which fill the missing region or target region by diffusing the image information from unknown region. In this technique, lost region is filled, which is known as hole. The missing region is infused at the pixel level which is evenly spread from borders to the center of hole. The drawback of diffusion- based technique is that introduces blur effect while filling the large region. Fundamentally, diffusion algorithms are based on variational method and Partial Differential equation (PDE). Ever PDE based technique [2] are well suitable for filling small and non-textured region . PDE based technique as many variants such as linear, nonlinear, isotropic (diffusion is same in every direction) and anisotropic (diffusion varies with direction).
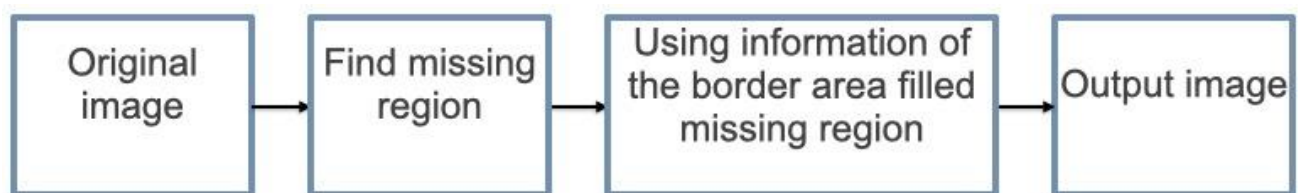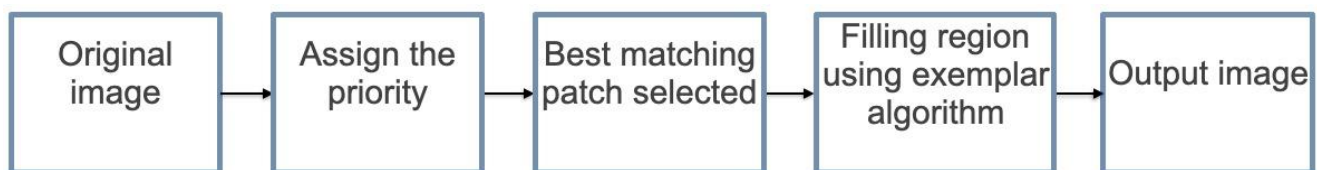

Fig2(a). Diffusion based inpainting

Figure 2(b).Exemplar based Inpainting

There are many methods that have been suggested for finding exemplar-based inpainting, but for the finding of diffusion based inpainting still no fruitful method exist[10]. In diffusion based inpainting, blurring effect can be introduced in the inpainted region. The blurring artifacts can help to expose diffusion-based inpainting,but the blurring effect or the artifact may not be visible when the inpainted region is small,it may not be easily visible from the human eye.. In order to differentiate the inpainted regions from the untouched region , we need to examine the blurring artifacts left over by the diffusion process and examine how such artifacts differ from those in the untouched regions. In this method,we first examine the diffusion process, and then notice the difference occured in the image Laplacian. Image Laplacians will remain constant in the directions of the isophote. And also it will not held in the untouched regions, leads to the blurring artifacts in the inpainted regions.After differentiating between inpainted and untouched regions, for localization, we extract feature set and perform classification.And then we finally apply two effective post processing operation to improve localization.

Texture synthesis-based inpainting algorithm [3] is one of image inpainting technique which is used to complete the missing areas by utilizing similar neighborhoods of the damaged pixels. To create the new image pixels the texture

synthesis algorithms, use an initial seed and replace the damaged pixel using the similar neighborhood to complete the missing region. Here texture is synthesized pixel by pixel. Texture synthesis method is not good enough for huge objects. Even though it yields good results, it is slow as filling in is done pixel by pixel.
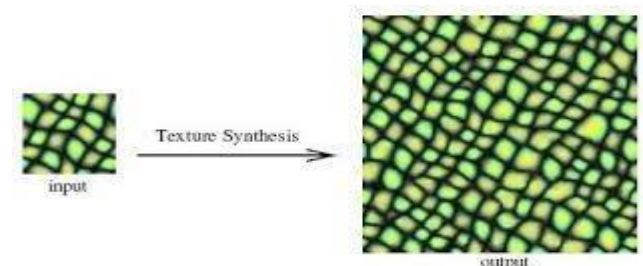

Figure 3. Texture synthesis

The Exemplar-based inpainting techniques is an important category of inpainting algorithm. Many of the ideas which was introduced in texture-based synthesis led to the development of exemplar based inpainting technique. Exemplar based inpainting are used to fill large target region which is based on two steps:

    i.   Priority assignment is done
    ii.   Choose the best matching patch

The exemplar helps in choosing the best matching patch from the source region (i.e. the region that are nearer to the target region) and the filling order is based on priority, for distinguishing structure from texture for each patch [4,5,6]. Pixel with the highest priority is chosen as target pixel to reconstruct. Priority of pixel is determined by computing the similarity which is determined by certain metrices. After computing the filling order, it searches for the most similar patch in the nearby region and copies the pixel from the most similar patch and fills it to the target region based on the decreasing order of priority. When compared to PDE-based inpainting methods, Exemplar-based inpainting algorithms perform better in restoring large regions at the cost of high computation cost.

An algorithm is introduced that combined the use of texture synthesis and an exemplar based inpainting [5] to remove the large object from the image and replace with the background information. The region filling order is determined by priority-based mechanism. This algorithm removes large objects from images and replace them with the help of background information.

Another Inpainting technique is developed using a non-local means through weighted similarity function [7]. Instead of using a single source patch to reconstruct the target patch, here several patches are used by the function. It mainly focuses on the concept of exemplar-based technique. Many traditional techniques diffuse local information to fill the missing region but the main issue is that it is restricted of using local information as a prior. Here they considered non local information from multiple samples within the image which helps in improving the visual quality while using the local information may not characterize the missing information.

Exemplar-based image inpainting algorithm can also be done using angle-aware patch matching[17] which is used to recover missing regions which consist of textural and structural components. In this method we use surface fitting technique to set up all unidentified pixels in the missing area and then we find out the filling order of pixel at the border by calculating the priority function and then select the target patch which is to be filled. After selecting the target patch, we use rotation strategy for searching multiple matching patches which is most similar features to the target patch from the source region and find optimal source path.

Even though the exemplar based inpainting are most widely used technique, but still there exist number of problems such as filling order, patch size. Hierarchical Super Resolution Based Inpainting [8] technique is introduced in which the input image is first undergo with exemplar based inpainting and then hierarchical super resolution based inpainting. Inpainting is performed several times on low resolution and the results are combined efficiently and are converted into a single image based on the super-resolution algorithm. The high-resolution details are efficiently reconstructed using this algorithm. The algorithm is proposed which inpaint the missing region with simultaneous structure as well as texture [9]. The hybrid approaches combine both structure and texture Inpainting. The main idea behind these approaches is to decompose the main image into two images, one containing the image structure and other containing image texture. Both of these images are inpainted using their respective algorithm and the result is the combination of these two processed images. And the idea of using both structural and textural inpainting simultaneously is extended by [13]. Patch-based methods are much accepted in the field of inpainting as they are used in filling missing areas patch by patch by finding for the well matched replacement patches, that is the candidate patches, in the unimpaired region of the photo and pasting after copying to the corresponding regions. One such approach is context-aware global MRF-based inpainting method [14]. To enhance the inpainting process and to speedup search for the well matching patches, contextual descriptors are employed by this technique. To improve the efficiency, it uses Markov random field model to search the patches of the image.

III.   COMPARISION

Table 1

PAPER	TECHNIQUES	INFERENCE
C. Guillemot and O. Le Meur, "Image inpainting: Overview and recent advances," IEEE Signal Process. Mag., vol. 31, no. 1, pp. 127144, Jan. 2014	Diffusion based inpainting	• Produces blur effect • Not suitable for large region
A. Criminisi, P. Prez, and K. Toyama, "Region filling and object removal by exemplar- based image inpainting," IEEE Trans. Image Process., vol. 13, no. 9, pp. 12001212, Sep. 2004.	Texture synthesis and Exemplar-based image inpainting	• Similar patch doesn't exist while synthesizing regions • Not designed to handle curved structures
A. Wong and J. Orchard, "A nonlocal-means approach to exemplarbased inpainting," in Proc. 15th IEEE Int. Conf. Image Process. (ICIP), Oct. 2008, pp. 26002603	Exemplar-basedimage inpainting	• By utilizing image information from multiple samples helps in improving visual quality
O. Le Meur, M. Ebdelli, and C. Guillemot, "Hierarchical superresolutionbased inpainting," IEEE Trans. Image Process., vol. 22, no. 10, pp. 37793790, Oct. 2013	Hierarchical super-resolution algorithm	• easier to inpaint low- resolution pictures than high resolution ones

IV.   PROPOSED SYSTEM

Image inpainting is an approach used for reimposing missing or corrupted image area. Diffusion-based and exemplar-based technique are two main classification of image inpainting technique. There are many artifacts which are produced by applying these method. So in order to reduce the artifact caused due to these method, we propose diffusion based inpainting with dilation operation and can also introduce depth inpainting. As the obtained depth edges doesn't align around the blockage boundaries well, the region is dilated by 5 pixels. This technique helps to decrease artifacts in inpainted parts.
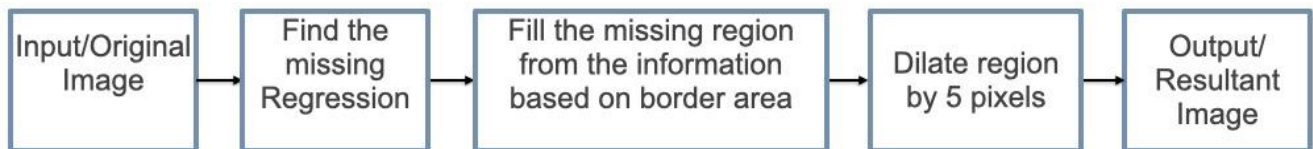
.

Input/Original Image → Find the missing Regression → Fill the missing region from the information based on border area → Dilate region by 5 pixels → Output/ Resultant Image

Figure 4. Proposed Method

V.   DISCUSSION AND CONCLUSION

The art of reproducing missing or degraded portions of an image is called as Inpainting. It has wide range of application in Digital Image Processing such as photo retouching, removing unwanted objects, restoring images etc. .Inpainting is still a challenging task in image processing field. In this paper various Image Inpainting techniques are studied. A detailed explanation is given for each technique for filling the missing region and how to reduce the artifact that occurred after inpainting in order to improve the resolution is also discussed. All the above techniques which has been discussed has its own pros and cons. The limitations in each technique is highlighted in this survey. This paper, putforth a detailed study analysis on some recent research works in the area of inpainting.

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