A Review on Recovery of Image with Image Inpainting Technique

Prof. Manoj S Ishi
Assistant Professor
Computer Department
RCPIT, Shirpur, India

***Abstract*—The advancement of multimedia instrument in day to day activities of human being, they are trying to click each and every moment of line. But as the time surpasses the picture get damaged. While clicking the pictures the unwanted person is also came in image, unwanted text in image. These are the some of the examples which causes the problem in image. Image inpainting is method which helps us to recover images. This modification is done so smartly which is unreadable for common user and he is unable to find any problem in image. Image inpainting is used to fill that damaged portion by gathering information related to pixel from nearby region. It searches the pixel information with maximum matching value and closely resembling with original image. The common user is not able to find any difference between damaged image and original image. In this research paper different image inpainting techniques are discussed. The advantages and disadvantages of techniques are discussed by considering time limit and efficiency parameter of image inpainting.**

***Index Terms*— Image inpainting, multimedia, pixel, time limit.**

I. INTRODUCTION

Image inpainting is ancient art which is used to do unidentifiable recovery to image. Use of image inpainting starts from the removal of object from a scene to the rebuilding of a damaged painting or photograph. For photography and film, inpainting are often accustomed to reverse deterioration (e.g., cracks in images, scratches and spots of dust in film), or to integrate or removal of elements (e.g., dates on images, "red-eye," and, infamously, political enemies) from photographs. Every time, the goal is to produce a new image in that contains inpainted region is combined with original image so seamlessly that a normal viewer is not going to recognize that any operation has occurred on image. Image inpainting is the method of predicting damaged regions of an image. The filling-in of damaged region or unneeded information is a most considerable topic of image processing. The most important work done by of image inpainting are removing of object and scratch, recovering missing areas, image repairing, etc. Mostly, an image or photograph is sometimes damaged because of aging. Because of that proper definition of inpainting is that the reconstruction of damaged images in such a way that is unidentified by the human eye. The manual work of inpainting is very time consuming process. Due to digitalization of this technique, becomes faster and automatic. After the user selects the regions to be restored, the algorithm fills these automatically regions with information available near that region. The fill-in is performed such a way that isophote lines arriving at the regions boundaries are completed inside. Advantage of this technique include the restoration of images which are old and film which is damaged; removal of text like dates, subtitles and the removal of complete objects from the image like wires or microphones with special effect which is superimposed. We should take care that image denoising method cannot apply to image inpainting, since the regions of inpainting are more in size. That is, regions consist of top to bottom scratches along film frames, large cracks in photographs, superimposed large data, and so on, are of comparatively larger size than the noise suppose to occur in common image improvement algorithms. In case of common image improvement applications, the pixels contain both information about the noise real data, while in inpainting; there is no significant data in the region to be inpainted. The information is mainly in the regions surrounding the areas to be inpainted. There are increases the need to design techniques to solve these problems. Primarily three groups of task can be found in the literature related to inpainting. The first one for restoration of films, the second one is related to pattern synthesis, and the third, for a less very influential to the work related to disocclusion. It is not technique causes for creation of new image but it try to rebuilt image which having more data containing pixels and that pixels available from the source area and by tacking help of that user create the clone image which is recovery of damaged portion and the copy of that image is such accurate that if any normal observer going to view that with no difference. In this paper in section 2 several techniques are discussed of image inpainting, advantage and disadvantage of that techniques are discussed. In section number 3 problem is identified of previous technique and discussed. In section 4 conclusion is provided about this techniques.

II. LITERATURE REVIEW

1. Criminisis Algorithm

To restore the old techniques of texture synthesis algorithm and inpainting algorithm used to fill the image gaps, the method is designed such that so that it combined advantages of the two approaches. Exemplar based technique contains the method for rebuilding both structure and texture [1]. This algorithm contains few steps. First step is consisting of finding the source are, target area and finally the patch. In first step we have to find the patch, after finding the patch priorities need to decide the reason behind that is it may be the case that we can found the more than one patch with maximum accuracy. The product of the

confidence term and the data term is calculated. The outcome of this product will give the more promising patch and that patch can found the close resemblance with the original image. By finding the patch with more priority need to propagate the structure and texture information. The patch we found it can also called copy of image i.e. exemplar. The patch we found has a maximum confidence pixel which minimizes the difference between the source image and the result image of the exemplar based technique.
Steps
Extract the manually selected initial front.
Repeat until done:
1 a. Identify the fill front.
b. Compute priorities.
2 a. Find the patch with the maximum priority.
b. Find the exemplar.
c. Copy image data from exemplar to image.
3. Update confidence value.

Advantage: This method is not only use to remove the objects from small images but this is applied with the large image also. It combines the two techniques to provide better results.

Disadvantage: This algorithm cannot work with the depth of ambiguities. If this method does not found similar patches for synthesis, user can't get desirable result.

2. Image Inpainting by Kriging Interpolation Technique

Kriging is a method that takes into account both the distance and the degree of variation between identified points when predicting values in unknown locations with geostatic interpolation. Kriging is eying to estimate unknown values at specific points in area by using pixel values from its surrounding regions [2]. Kriging yields optimal aftermaths compared with the traditional interpolation methods. It must be mentioned that, Kriging is an exact interpolator technique because it make sure that the original observed values will stay with same value, i.e. the old values will not changed by the interpolation technique. Kriging predictions are treated as linear combinations with weight of locations known to author. According to Kriging technique, the closer the input, and nearly correlated predictions. The proposed method starts with identifying the queer pixels within the k X k block from the contaminated image. The contamination may be thin scratch, thick scratch, text, bad areas generated with aging, or even unwanted item that may be removed from the original image. These affected areas will be marked according to its mask value. After that, the k X k block will be dispatched to Kriging interpolation technique to predict the contaminated areas using the accurate prediction feature of Kriging.

Advantage: The result reveal by proposed Kriging technique having high PSNR value when implemented on a variety of images.

Disadvantage: Kriging being more computationally expensive, it has been shown that it gives very sophisticated output when rebuilding digital images that have scratches or unwanted text.

3. Joint Data Hiding And Compression Scheme Based On Smvq And Image Inpainting

The data-hiding and compression scheme works jointly for digital images, this technique is carried out using the side-match vector quantization and image inpainting algorithm [3]. Data hiding and image compression are combined into single module. At sender side, the blocks in the leftmost and topmost of the image are considered as complex blocks by default and it is compressed using VQ technique and the other remaining blocks can be integrated with confidential data and simultaneously compressed using raster-scanning order with SMVQ or image inpainting method. This is performed according to the current embedding bit. The progressive compression may cause visual disturbance and error distortion. This is controlled with the help of vector quantization (VQ) for complex blocks. The indicator bit divides the image-compressed codes into a series of sections. At receiver side, receiver can extract the confidential bits and decompress the image successfully. This is performed on the basis of the index values that are available in the segmented sections. An integrated data hiding and compression scheme that uses SMVQ and image inpainting is implemented in this method. The blocks in the leftmost column and the topmost row are compressed with VQ technique. The remaining blocks are compressed using SMVQ or inpainting and the confidential bits are integrated in them. SMVQ or inpainting is used on the basis bits that are embedded. In case of complex blocks, VQ is used to control the visual disturbance and reduce the error diffusion. Compressed blocks are segmented into a series of sections. This is performed according to the indicator bits. The index values in the each section helps in the finding of the integrated bits. Finally a decompressed original image and the secret image can be restored.

Advantage: The two separate modules are combined into one to make the process of compression and hiding more secure.

Disadvantage: Because of two modules algorithm is complex to implement inpainting.

4. Digital Inpainting on the Basis of Exemplar Based Method

Digital image inpainting is a technique used for filling in the missing or damaged regions of an image using information from the neighboring area. This technique is simple and fast inpainting algorithm on the basis of an exemplar based method for scratch or text removal, object removal and competition of missing blocks and proposed an algorithm for filling of holes in images and

videos. It removes the foreground object and fills the background. The use of the proposed method could reduce the execution time. The Ω is progressively accepts integrating structure and texture information from the contour dΩ [4]. Target or missing region Ω is filled up patch wise with the matching patches from source region. Next, the size of patch to be filled on fill front is finalized; assuming the distribution of brightness values probability for a pixel given the brightness values of its neighborhoods is not defend on rest of the image. The surrounding pixel is modelled as a square window around that pixel. If the texture is assumed to be regular at high frequencies and mainly stochastic at low frequencies, the size of the window should be on the scale of the regular feature i.e., slightly larger than the largest identifiable texture element in the source region. And finally the inpainted image is obtained from this algorithm.

Advantage: The proposed method will be appropriate for video completion.

Disadvantage: This application is time-consuming.

5. Digital Image Inpainting Using Cellular Neural Network

Digital Image inpainting methods provide a way for recovering of small damaged portions of an image. Image or video are often received in poor conditions, because of noise or defects making the resources difficult to understand and read. Some algorithms are presented which used for the reconstruction of damaged or partially damaged images. Author proposes an algorithm with CNN, which can be used to inpainting digital images or video frames with high noise ratio. Noises inside the cell with different category are inpainted with different information available from surrounding. The outcome showed that blurred image or unidentifiable cell can be reconstructed with good visual effect.

Advantage: This method takes the possibility of direct implementation of CNN chip into account, in a single step, by using 3x3 dimensional linear templates [5].

Disadvantage: This method can be further used for processing motion picture with more percentage of noise.

6. A Framelet-Based Image Inpainting Algorithm

In this algorithm, author presents some preliminaries of tight framelets [6]. Author only present the univariate framelets and the framelets for two variables can be rebuilded by tensor product of univariate framelets. Tight frames in unite dimensional space derived from framelets and their matrix forms are also given. Image inpainting is a basic problem in image processing and has many works to do. Motivated by the recent tight frame based methods on image restoration in either the image or the transform domain, author proposes an iterative tight frame algorithm for image inpainting. Author considers the convergence of this framelet-based algorithm by interpreting it as iteration for minimizing a special functional. The proof is under the framework of convex analysis and optimization theory. Author also discusses the relationship of this method with other wavelet-based methods.

Advantage: Numerical experiments are used to increase the performance of the proposed algorithm.

Disadvantage: Works only for univariate framelets.

7. Data Hiding and Compression Scheme Based on Image In painting

In today's world, most digital content, especially digital images and videos are converted into the compressed forms for transmission. Due to the attack on digital images on the Internet, how to compress images and hide secret data into the compressed images efficiently. Nowadays, many schemes of data-hiding for the compressed codes have been proposed, which can be used for various compression techniques of digital images, like JPEG, JPEG2000, and vector quantization (VQ). VQ is used for some complex blocks to control the visual noise and error diffusion caused by the progressive compression. The new way is that one can match vector quantization (SMVQ) and image inpainting. The functions of data hiding and image compression can be combined into one single module. The receiver achieves the extraction of secret bits and image decompression successfully and securely, according to the index values in the divided sections. According to the secret bits for integrating, the image compression based on SMVQ is adjusted by adding the image inpainting technique. This proposed an SMVQ-based secret-hiding method using adaptive index. The weighted squared Euclidean distance (WSED) was used to improve the probability of SMVQ for a high embedding rate. In order to make the secret data imperceptible to the interceptors, data hided secret data into the SMVQ compressed codes of the image by using a partially sorted codebook. The recovering of the original SMVQ-compressed image can be achieved at the receiver side. After receiving the secret compressed and embedded codes of the image, one can extract the embedded confidential bits successfully during the image decompression. In this method, authors proposed a joint data-hiding and compression scheme by using SMVQ and image inpainting. On the receiver side, after segmenting the compressed codes into a series of sections by the indicator bits, the embedded secret bits can be easily extracted according to the index values in the segmented sections, and the decompression for all blocks can also be achieved successfully by SMVQ, and image inpainting[7].

Advantage: The results show that this method has the satisfactory performances for compression ratio, hiding capacity, and decompression quality.

Disadvantage: The proposed method integrate the two functions of data hiding and image compression into a single module, makes it time consuming.

8. An Image Inpainting Technique Based on the Fast Marching Method

Author presents here a new algorithm for digital inpainting based on the fast marching method for level set applications. This algorithm is very simple to implement, fast, and produces nearly identical results to more complex, and usually slower, known methods.

```
δΩi = boundary of region to inpaint
δΩ = δΩi
while (δΩ not empty)
{
p = pixel of δΩ closest to δΩi
inpaint p using Eqn.2
advance δΩ into Ω
}
while (NarrowBand not empty)
{
extract P(i,j) = head(NarrowBand); /* STEP 1 */
f(i,j) = KNOWN;
for (k,l) in (i1,j),(i,j1),(i+1,j),(i,j+1)
if (f(k,l)!=KNOWN)
{
if (f(k,l)==INSIDE)
{
f(k,l)=BAND; /* STEP 2 */
inpaint(k,l); /* STEP 3 */
}
T (k,l) = min(solve(k1,l,k,l1), /* STEP 4 */
solve(k+1,l,k,l1),
solve(k1,l,k,l+1),
solve(k+1,l,k,l+1));
insert(k,l) in NarrowBand; /* STEP 5 */
}
}
float solve(int i1,int j1,int i2,int j2)
{
float sol = 1.0e6;
if (f(i1,j1)==KNOWN)
if (f(i2,j2)==KNOWN)
{
float r = sqrt(2(T(i1,j1)T(i2,j2))*(T(i1,j1)T(i2,j2)));
float s = (T(i1,j1)+T(i2,j2)r)/2;
if (s>=T(i1,j1) && s>=T(i2,j2)) sol = s;
else
{ s += r; if (s>=T(i1,j1) && s>=T(i2,j2)) sol = s; }
}
else sol = 1+T(i1,j1));
else if (f(i2,j2)==KNOWN) sol = 1+T(i1,j2));
return sol;
}
```

Advantage: The presented inpainting method is simple to implement, fast, and easy to customize for different inpainting strategies.

Disadvantage: Author plan to extend the method by developing new inpainting functions that are better able to preserve the directions of isophote. One such way is to integrate anisotropic diffusion. A second extension would be to modulate the increase speed of the FMM, author work more on the high detail areas than on the smooth regions.

9. Fast and Enhanced Algorithm for Exemplar Based Image Inpainting

This technique presents an algorithm that can remove objects from the image in a way that it seems reasonable to eye of human. It can also rebuild old photographs. This method extends an exemplar based inpainting method along with a priority term that

defines the order of filling the image. In this algorithm, pixels maintain a confidence value and identification based on priority calculated using confidence and data term. The technique defines a method of differentiating between patches that have the same mean value squared with the selected patch. This approach propagates both linear structures and two dimensional textures into the damaged region. It is also efficiently works with larger images. This algorithm try to improve the algorithm so that the complexity is further improved while keep concentrating on the quality of inpainting and if possible, technique like to improve the inpainting algorithm.

Advantage: This technique can be used to fill small scratch in the image/photos as well as to remove large objects from them.

Disadvantage: The inpainting algorithm presented here is not meant to be used for inpainting videos. Author improving method to improve the algorithm to make it more perfect so that it can be used with videos.

III. Problem Discussion

The above presented methods are providing the dissent result but they are also lacking in certain things. If user considers the size of thing to recover, some of the methods are not able to produce the desired result, because some of the techniques are designed for small image size. If the image with large size is completed then complete the image will give the result but the result quality will be not good and blurring occurs there. Some of the techniques generate single resolution image output, to avoid that disadvantage multiresoultion approach need to use. Wavelet transform is overcome by the fast marching method for better result. PSNR values are used in some algorithm which measured with the help of number of parts of images author created to complete the image. The PSNR value is magnitude relation of value decomposed image to value of the whole image that is calculated at the various levels. This PSNR price is employed to satisfy the human sensory system (HVS). Once HVS is satisfy the image turn out are going to have shut similitude with original image. However this PSNR conjointly creates drawback once range of iteration are increased.

IV. Conclusion

This review consists of a variety of image inpainting techniques which are discussed here. It consist of Criminisis algorithm, Fast marching method, Digital inpainting method, Framelet based inpainting, using cellular neural network etc. For each of the method detailed discussion consists of the methodology of the inpainting techniques which are used to check out the region which need to inpaint also remove the unwanted thing. From this detailed review discussion about the advantages and disadvantage of all image inpainting techniques are done. Some works only for small image gaps which overruled by the new algorithms of inpainting. When the situation come to rebuilt image with large gaps exemplar based inpainting provides the good result, this algorithm is design in such manner user can able to restore the object from small image gaps to large image gaps. This algorithm works for pattern and synthesis of structure. But this is work fine and with maximum accuracy when regions contain simple texture and structure. Overall review tells that all technique trying to provide efficient result in terms of efficiency of output image and trying to improve the time taken by image completition algorithm.

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