Exemplar-Based Image Inpainting Technique using Image Partitioning (Search Region Prior) Method

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Abstract

Exemplar based image inpainting is a combine effect of texture and structure syntheses. This technique can be applicable by applying Basic traditional method (Criminisi algorithm) Patch shifting scheme, Search region prior method. Criminsi'algorithm is based upon isophote-driven image sampling process, gives better image quality but require more time to inpaint damage region. Sarawut's patch shifting scheme, shift the target patch towards source region having more information related to missed region, PSNR improved but time requirement is more than criminsi's method. After analyzing, both above given method, proposed method based on K-means clustering reduced time complexity and improve image quality also

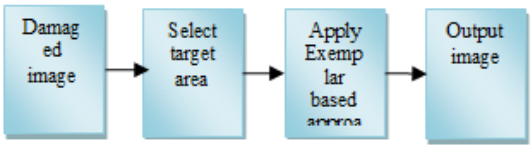
Keywords: Patch, Isophote, Source, Image Quality

I. INTRODUCTION

The purpose of digital image inpainting method is to fill given missing region that has a damage region [1, 2] in a plausible way. There are many applications of digital image inpainting such as photo editing, video editing, image compression, image transmission, red eye correction. Basically this technique can be categorized in two approaches.

Diffusion-based approach was the first digital image inpainting technique in which missing region is filled by diffusing the image data on or after identified region into the missing into the missing region at pixel level [2]. These algorithms are based on variation method and partial differential equation (PDE). This algorithm produced blur when larger region is to be filled. PDE based inpainting is appropriate for Filling small region and no- textured target region.

Exemplar–based image approach is originated from the Exemplar-based texture synthesis. In that case, the texture is synthesized by copying the best match patch from the known region. This may not provide satisfactory result [3]. This is due to, there are both structural and textures in the natural image. This method of image inpainting is an efficient approach to reconstructing the large target region. It removes the smooth effect of the diffusion based inpainting algorithm. This approach is applicable for simple and easy region filling. Exemplar-based inpainting technique has to follow these steps:



- Image for inpainting
- Selection of target part of image (missing region)
- Patch (target) is filled by making patch priorities of surrounding region
- Fill it with similar information from the related surroundings region patch that have highest patch priority
- Update the target patch after filling procedure

The remainder of this paper is as follows: in section II, literature review is presented. In section III, Exemplar based image inpainting method is described. In next section, image portioning or search region prior method is presented in detail. At last result of this and traditional approach has been compared and conclusion is made at last with future work.

II. LITERATURE REVIEW

Bertalmio et al. [1]; Chan and Shen in (2001) [2] in introduced Diffusion based approach that diffuses pixels around missing region and fills into missing region. It gives plausible results, when the missing region is small enough and texture of known region is not strong. When the edge structure of source region is not maintained these methods have problems, which may cause blur that are clearly visible errors.

Criminisi et al.in(2004) [3] proposed Exemplar based approach, search most matched patch from source region and copied pixels of the founded patch directly into the missed region. Criminisi developed simple and efficient approach to encourage filling from the boundary of the missing region where the strength of the isophote nearby was strong, and then used to sum of squared distance (SSD) to select a best matched patch from number of source patches.

Sun (J. sun L, et al.) in (2005)[4] drew main curves manually to inpaint the missing structure first and then filled the unknown information using texture propagation [4].Hung (J.C. Hung, et al.) in (2005) [5]used structure generation and Bezier curves to construct the missing edge information.

Wu (J, y, et al) in (2004)[6] considered a cross isophote exemplar based model using the cross isophote diffusion data and the local texture information which decided the dynamic size of exemplars

Fang (C.Fang, et al) (2009) [7] developed a rapid image inpainting system which consists of a multi resolution training process and a patch-based image synthesis process.

Xu Z. Xu, et al. in (2010) [8] proposed two concepts of sparsity at patch level for modeling the patch priority and patch representation.

Sarawut et al. in (2011) [9] gives a method to shift target patch toward source region. So that target patch shifting scheme helps target patch to contain more information of adjacent known region

III. EXEMPLAR-BASED INPAINTING METHOD

The Exemplar- based approach is an important class of inpainting algorithm. This method of image inpainting is an efficient approach to reconstruct the large region. Basically image inpainting is modeled as a problem of filling–in the missing region (target region)Ω, of the present image∪, and the missing region is filled by taking similar information from surrounding which is called source region Φ.this approach iteratively synthesized the target region by most similar patch in the source region. This samples the best matching patches from the known region, whose resemblance is measured by certain metrics, and pasted into target patches in the missing region. Proceedings are the some important followed in image inpainting techniques:

- Priority assignment is done.
- Best matched patch selection.
- Basically, an Exemplar-based inpainting algorithm having the following four steps:
- The initial missing area is extracted is called target region and presented with appropriate data structure.
- Computing filling priorities, in this, predetermined priority
- Function is used to compute the filling order for all unfilled pixels $p \epsilon \partial\Omega$ in the beginning of filling iteration each.
- Searching Example and compositing, in which the most resembles example is searched from the source region Φ to compose the given patch,Ψ (of size N×N pixels) that centered on the given pixel p. Updating image information, in which the boundary $\delta\Omega$ of the target region Ω and the required information for computing filling priorities are updated.

A. Image Partitioning or Search Prior Region Method

Exemplar–based basic traditional method, target region which is needed to be inpainted is completed by simply taking best match patch priority in source region. This method does not provide better visual appearance.

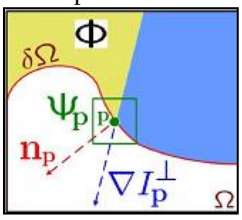


Fig. 2: Original image, with the target region Ω, its contour $\partial\Omega$ and the source region Φ

Next the patch shifting scheme for image inpainting becomes popular by shifting target patch which have less information present toward the source region having more information. This is less effective. Here, in this section, we introduce a new era of image inpainting method i.e. image partitioning or search region prior method. In this we using target patch to contain more meaningful features that represents adjacent known region, and it provide best search region with more consistent color and texture. Sarawut's patch shifting scheme [9] which is related to traditional method of inpainting. In that case target patch is shifted toward source region, and the target patch contains more number of known pixels. Hence, by increasing known pixels in the target patch does not have sufficient information to differentiate correct patch in search region.

In place of adding more information in target patch, this method provides better search region excluding any sub region with inconsistent color compared to the known pixels of target patch. Search region prior method has the following steps:

1) *Step1. Divide the given input image using:*

- Using color.
- Convert RGB into L*a*b*, where L is luminance or intensity, and a,b are color components
- A, B are the color components that are partition according to K- means, where K is the numbers of clusters.

2) *Step2. Generate region index map by setting different index to all pixels in each region as shown in figure (3).*

3) *Step3.Compute the patch priority for all patches those centers is located along the boundary of* Ω*, and then choose the patch with maximum priority value.*

4) *Step4. Next, Find the best match patch,* Ψ_q*, that has maximum sum of squared difference (SSD) with known pixel point p in the target patch, where* $\forall p \in (\Psi_p \cap \Omega)$.

$$D(\Psi_{p,\Psi_q}) = \sum_{(i,j)} |p(i,j) - I(i,j)|^2 \qquad (3.2.1)$$
$$\forall p(i,j) \in \Psi_p \text{ And } \forall q(i,j) \in \Psi_q.$$

Except following candidate patch condition. For searching best patch, search region is selected with the following valid candidate patch criterion:

$$\Psi c \text{ for } \exists q: R(p) = R(q), q \in \Psi_c, p \in (\Psi_{p \cap \Phi}) \qquad (3.2.2)$$

Where Ψc is the valid candidate patch in search region, R (p) is the region index at point (p) in known pixels of target pitch (q) is region index at point q in candidate patch. This condition implies that only candidate patch in search area which have the same region indices with target patch are considered.

suppose that target patch is chosen from right boundary of the house in figure3 (a), traditional method uses search area with fixed size in any case as shown in figure3 (b), (d) and (f).this method select search region based on region index involving in the target patch, Ψp for example, if known pixels of target patch contains region index 4 as figure3 (d), region of index 4 as in figure 3(c) is excluded from search area.

When known pixels of target patch contain more than two region indices as in figure 3(g),search area is set to sum of only candidate patch that have all corresponding indices. In this way, only

Candidate patch close to the edge is searched in figure3 (g), excluding other patches far from the edge.

5) *Step5. Search the best match patch of* $\Psi_{\hat{q}}$ *to* Ψ_p *from the source region U*Ω*, copy data from* $\Psi\hat{q}$ *to* Ψ_p *for* $\forall p \in \Psi p \cap \Omega$ *and Update C (q) for* $\forall p \in \Psi_{p \cap} \Omega$.

IV. RESULT AND DISCUSSION

For the implementation of proposed method, matlab software version R(2013)a (8.1.0.604) is used, and reconstruct some standard image like jumping bungee, texture images. Portioning method first convert RGB image into L*a*b* form by K-means clustering.

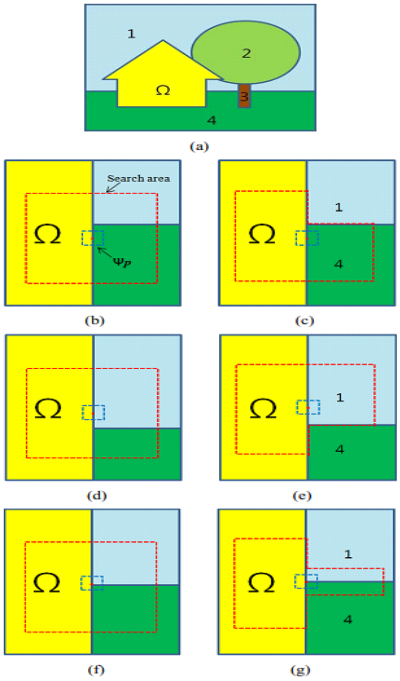


Fig. 3: selecting search area setting: (a) region index map from search region partition. (b); (d); (f) search area of traditional method. (c); (e); (g) search area of search prior region method.

Implementation of method is seen on jumping bungee mage have input image, have to remove bungee from scene for this mask is taken of patch size 9*9 then clusters are form and after that inpainted image is occurred as shown in figure 4.1 (a),(b),(c),(d)

Another example let us take texture image in this, some of text we want to remove by using our method of image partitioning or search region prior method. First of all input image is converted into L*a*b* and then by using k-means some text is removed,

Fig.4.1 (a)

Fig. 4.1(b) mask

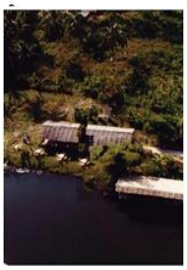


Fig. 4.1(d) output image

After that PSNR value comes of 49.0127 dB and time required of 11 minutes. This all shown in figure 4.2 next image shows the text "since when 1699, French explorers" that is target text which is needed to be removed. As shown in fig. 4.2 (b)

Fig. 4.2(a) original image

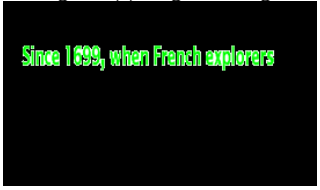


Fig.4.2 (b) Text mask

Fig.4.2 (c) cluster image

And last image shows the output of our result. As Shown in fig 4.2 (d)

V. CONCLUSION

In this paper we presented exemplar-based image inpainting with image partitioning or search region prior method. From the implementation of this method PSNR value is improved and time requirement is less hardly ten to fifteen minutes which much less than previous one.

Fig.4.2 (d) Text mask

Future work, try to increase PSNR at desirable value, to reduce time complexity and provide better clarity of image.

REFERENCES

[1] M Bertalmio L.Vese, G.Sapiro, and S. Osher, Simultaneous structure and texture image inpainting. IEEE Transactions on Image Processing, Vol.12, No.8, pp.882-889, 2001, 2003
[2] T.F Cham\n, J.H. Shen Mathematical model for local non-texture Inpainting [J]. SIAM Journal of applied Mathematics, 2001.
[3] T.F. Chan, J.H Shen. Non- texture Inpainting by curvature-driven diffusion (CDD). Journal of Visual Communication and image representation, 2001
[4] Criminisi, P.Perez, and K.Toyama. Object removal and region filling by Exemplar-based inpainting. IEEE Transactions on Image Processing, Vol.13, No.9, pp.1200-1212, 2004.
[5] Y.Wexler, E.Shechtman, M.Irani, "Space -Time Completion of Video, "IEEE Transactions and Pattern Analysis and Machine Intelligence, Vol.29, pp.463-476, 2007
[6] T.F Chan, J.H. Shen Mathematical model for local non-texture Inpainting [J]. SIAM Journal of applied Mathematics, 2001.
[7] Sarawut, Tae-o-sot, and Akinori Nishihara, "Exemplar-based image inpainting with patch shifting scheme,"2011 17th International Conference on Digital Signal Processing (DSP) pp.1-5.
[8] T.F Chan, J.H. Shen Mathematical model for local non-texture Inpainting [J]. SIAM Journal of applied Mathematics, 2001.
[9] T.F. Chan, J.H Shen. Non- texture Inpainting by curvature-driven diffusion (CDD). Journal of Visual Communication and image representation, 2007
[10] I.A. Ismail, E.A. Rakh, S.I. Zaki, M.A. Ashabrawy, M.K. Shaat, "Crack detection and filling, using steepest descent method", International Journal of Computer and Electrical Engineering, Vol. 1, No. 4, October, 2009.
[11]]Z. Xu and S. Jian, "Image inpainting by patch propagation using patch sparsity," IEEE Transactions on Image Processing, Vol. 19, pp. 1153-1165, 2010
[12] Gunamani Jena, "Restoration of Still Images using Inpainting techniques", International Journal of Computer Science & Communication, Vol. 1, No. 2, Pp. 71-74, July- December 2010.
[13] Digital Image Processing, 2nd Edition Gonzalez.