



International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

Automatic Object Removal Using Exemplar Based Image Inpainting Algorithm and Survey.

Saraswati¹, Prof. A S. Awati²

P.G. Student, Department of Electronics and Communication Engineering, Gogte Institute of Technology, Belagavi, Karnataka, India¹

Assistant Professor, Department of Electronics and Communication Engineering, Gogte Institute of Technology, Belagavi, Karnataka, India²

ABSTRACT: Image Inpainting is a method for modifying an image based on background of the image in image processing, that is not recognizable by an ordinary viewer. It is patch based algorithm that repeats some small areas across the image with no visual differences between original image and reconstructed image. The main aim of image Inpainting is to fill the missing area or removal of object and the output image should look like original image. Many different types of image Inpainting techniques are- exemplar based image Inpainting, texture synthesis based image Inpainting, PDE based image Inpainting, hybrid Inpainting and Semi-automatic and Fast Inpainting. This paper provides a survey on Exemplar based image Inpainting.

KEYWORDS: Inpainting; missing area; exemplar based Image Inpainting

I. INTRODUCTION

Nowadays, image Inpainting is very important technique in image processing to remove undesired object in an Image. it is also called as image completion. the viewer cannot find the image is recovered by Inpainting method. Inpainting procedure is based on surrounding area of the image that gives better result with no visual differences between original image and Inpainted image. it has several applications such as restoration of an image, removing unwanted objects from image, image compression, filling missed region. many different types of image Inpainting techniques are texture synthesis based image Inpainting[13] algorithm is the earliest techniques of image Inpainting in image processing. To recover the missing areas texture synthesis based algorithms utilize similar neighbourhoods of the damaged pixels in the image. most of earlier Inpainting techniques make use of texture synthesis methods to fill the missing area by sampling and copying pixels from the neighbouring region. PDE based image Inpainting[13] the main goal of partial differential equation (PDE) algorithm is to fill the missing area of an image partial differential equation algorithms outputs are good if missing area are small but when it comes to big missing areas partial differential equation algorithms will take huge amount of time and output will not be good. hybrid Inpainting technique is combination of both earlier algorithm texture synthesis and partial differential equation based Inpainting for reconstructing the missing areas. The process of hybrid Inpainting technique is that it divides the image into two separate parts, texture region and structure region. Semi-automatic image Inpainting technique needs user in the form of guide line for Inpainting procedure with Structure propagation. in this technique there are two-steps, In the first stage a user draws missing area by using sketching object boundaries from the known area to the unknown area and then a patch based texture synthesis is used to produce the texture. Semi-automatic image Inpainting technique may take much time to Inpaint that depends on the size of the missing area to Inpaint. The fast Inpainting techniques are not applicable for filling the large missing areas and blurry effect in the output image [13]. The exemplar based image Inpainting method is based on the mask selected by the user. Exemplar based Inpainting consists of two steps first is,



International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

selection of mask to Inpaint by user second is, Inpainting technique to get original image. The main purpose of exemplar based Inpainting is to repair the mask portion of an image selected by the user and fill the missing area of an image by the priority order of patches [1]. This algorithm iteratively synthesizes the target region filling starts in missing area by using nearest neighbouring regions. The advantage of Exemplar based method algorithm is suitable for large selected area by the user to Inpaint. So in this paper the proposed method is based on exemplar based image Inpainting method.

II. LITERATURE SURVEY

In paper [1], author enhanced the method of exemplar based Inpainting method based on fast global optimal searching. It includes four steps in the framework; first, the initialization is carried out layer by layer in a fast way. Second, use Patch-Match algorithm to search the approximate patch for patches in the missing region. Third, a weighted mean based image reconstruction method is implemented iteratively. Forth, use Poisson editing to handle the illumination of missing region to get real looking image. This paper shows the results that effectively maintain the texture and structure characteristics of the missing region. to solve problem using Inpainting is to fill the missing area using the pixel from known region or source region. This method shows the result becomes better and more visually pleasant due to the global optimal searching.

In paper [2], author enhanced a method is for the object removal using exemplar-based image inpainting. In this technique, the image is normalized in to column wise and then the priorities of each pixel are calculated. The pixel is then replaced with the pixel which has maximum priority. This process is continued until all the patches of the desired object are removed. The image is Inpainted for which part of image is masked by user and copy the highest priority patch from source region. Priorities are calculated by using the formula that is a product of confidence term and data term. And this exemplar method minimizes the error or patch in the image and patch is updated by removing the area which is masked. This proposed method suitable for images that contain linear patterns, complete selected objects and all textures surrounding the object to be removed.

In paper [3], author enhanced a Inpainting method using image structure tensors algorithm to guess the lost parts of the targeted image by using the remaining area of the image . in this paper lost parts are called as holes the hole in the image is created by user one of the most well-known algorithms in Inpainting algorithm has been proposed by Criminisi. Criminisi's algorithm is fast, simple and makes effort to propagate both image textures and structures, it fails for convoluted structures. To solve this problem Image structure tensors have been employed. To get the most effective structures a combination of image structure tensors and image gradients have been used and Image structures is strengthened. This algorithm gives us better results in the quality of an image compared to Criminisi algorithm. The structure tensor also called as second moment matrix for the orientation and image structure analysis. It gives the information about gradients directions and their coherence. The Eigen values provides the information about image structure and this proposed method gives better results compared to the Criminisi algorithm using image structure tensors. The combination of the image structure tensors and gradients are for detecting the salient image structure and slighter image structures.

In paper[4], the exemplar based image Inpainting algorithm is implemented to solve error repair accumulation, high time complexity in Criminisi's method. by introducing the structure tensor theory and patch priority this algorithm improves the results in visual effect and set the priority in to sum form instead of multiplication form to avoid error repair in Inpainting procedure and structure tensor is used to construct a structure control function and Eigen values of the structure reduces random matching block, it improves the matching accuracy. Structure tensor Eigen values can represent different image partitions [5]. Criminisi algorithm searches the optimal patch with highest priority. Whereas this method search for match patch in known region that corresponds to the target region.

In paper [5], traditional exemplar method the match patch method is used to Inpaint the undesired area and the priority patches are searched in the known region of the image in a fixed size. It may cause the clearness of texture when it increases the time. To solve this two steps are proposed, first it is proposed an algorithm that is adaptive sample algorithm based on patch sparsity. The size of the sample patch is very important in Inpainting process. A large size patch may gives the detail texture but causes low matching rate, and it reduces the time, for smaller size patch gives the detail about edges but lost the texture. So deciding of patch size is very important in this process. an adaptive function



International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

is introduced to decide the size that is patch sparsity. The value of patch sparsity represents the location of patch that is based on whether the value is large (edge) or small (texture). Second it proposed a candidate patch system to improve the patch match rate, it selects several candidate patches rather than most similar patch and then selects three most similar patches and calculates the difference among them, if it is small the patches location are nearly same and can select most similar patch to Inpaint. This proposed method can give better result that is match more significant patches compared to traditional method and also better texture effect and it suites for the image with large selected area.

In paper [6], author enhanced a method that is advanced exemplar based inpainting algorithm to solve the problem such as computational complexes, noise and image reconstruction. This method includes image gradient function and extra similarity metric for measuring how image is altering. The traditional method can occur blurry effect while filling bigger holes so this proposed method can easily fill the bigger holes.

In paper [7], proposed a method that combines advantages both texture and structure. In traditional Inpainting method pixel value is propagated via diffusion and this tends to image smoothing which results blurry effect for large regions to Inpaint. For this reason the proposed method is based on image texture by direct sampling of the source region to search the patch which is most similar to highest priority patch. This is enough to achieve the propagation of both structure and texture information from the source region to the target region so this technique is capable of propagating both linear structure and two dimensional texture in to the target region.

In paper [8], the traditional exemplar method Inpainting is done by taking best match priority from source region but this method does not provide better visual appearance. In this paper a proposed method is image partitioning or search region prior method. First generate region index map by assigning different index to all pixels then compute the patch priority for all patches located in the boundary and choose highest priority value next search the best match patch that has maximum sum of squared difference with known pixel point in the target region. In this method target patch contain more meaningful features that represents adjacent known region, and it provide best search region with more consistent colour and texture.

In paper[9], the proposed method improves and extends traditional method instead of searching the entire image for ,patch the proposed method has reduced search region by searching the nearby pixels since in most cases the similar information patch lies nearby pixels this algorithm reduces time to complete Inpainting. The search area should be near to the pixel. This algorithm starts filling target region automatically so user does not specify where to search the information of patch filling procedure starts with highest priority pixel. Inpainting procedure completes in less time compared to the traditional method. for the patch with MSE calculates the mean and variance for two patches to Inpaint and this reduces the search region.

In paper [10], Introduced new exemplar based Image Inpainting this includes salient structure completion and texture propagation. In salient structure completion incomplete salient structures are completed by using content based image retrieval method. In the texture propagation step synthesizes texture information of completed salient structures from content based image retrieval method. Then the texture information is propagated into remaining missing areas by patch based Inpainting method. In the traditional method diffusion results blurry effect for large holes so in this paper a proposed method is introduces a method image texture by direct sampling of the source region from the source region search for a patch with highest priority patch. This method gives better PSNR compared to the traditional method and more accurate and less blurry effect and requires less time to complete Inpainting.

In paper [11], the proposed method has an additional parameter that the entropy of the patches be similar it is a good measure of an edge content. To solve the problem of false edge propagation that is occurred by minor mismatch between the source patch and best matching patch entropy of a patch is used [12]. if the source patch is smooth and the matching patch should also be smooth then entropy is good. If the patch has an edge then entropy will be high so the data is not uniform. Instead of minimizing the distance between the patches this method has entropy that patches should be similar entropy and similar color. This method is proposed to avoid false edge propagation and helps in smoothness of the inpainted image. PSNR of the image gives better results than the other methods.

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

III. EXEMPLAR BASED IMAGE INPAINTING ALGORITHM

The main goal of an Exemplar based Image Inpainting method is to remove undesired objects in the image by creating a mask for the damaged region that is known as target region and then selecting pixels from the boundary of the damaged region and search for highest priority matching patch from the surrounding region that is known as source region. After finding match patch copy and update it in the target region. Exemplar based Image Inpainting algorithm includes four main steps:

Step1: COMPUTING THE TARGET REGION:

Inpainting algorithm starts from this step, to remove undesired object or area from the damaged image select the undesired area by using mask this is done by user. In matlab, creating mask is done by using a tool called imfreehand

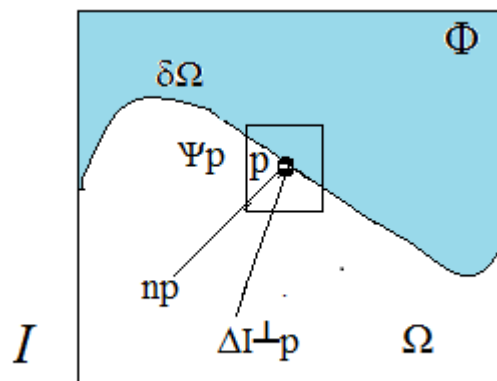


Fig1: Notation diagram. Given the patch $p \Psi$, n_p is the normal to the contour $\delta\Omega$ of the target region and $\nabla I p_{\perp}$ is the isophote (direction and intensity) at point p . The entire image is denoted with I while Φ to be the undamaged area and Ω to be the damaged area.

Step2: COMPUTING THE PRIORITIES:

To recover the masked region in the image calculate the priority $P(p)$ of each pixel on the boundary of damaged region.

Priority is defined by the product of two terms

$$P(p) = C(p) * D(p)$$

Where $C(p)$ – confidence term,
 $D(p)$ - data term

$$C(p) = \frac{\sum_{q \in \Psi_p \cap \Omega} C(q)}{|\Psi_p|}$$

$C(p) = 0$ for target region
 $C(p) = 1$ for source region

$$D(p) = \frac{|\Delta I_{\perp p} \cdot n_p|}{\alpha}$$

$\Delta I_{\perp p}$ – gradient of the pixel p

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

n_p - unit vector orthogonal to the edge $\partial\Omega$

Step3: SEARCHING FOR THE BEST MATCHING PATCH:

To choose highest priority patch compare the calculated priority of each pixel and find out the best matching patch compared with target region throughout the whole known region or source region. This process is defined as the follows

$$\Psi_q^- = \arg \min_{\Psi_p^-} d(\Psi_p^-, \Psi_q^-)$$

The $d(x,y)$ is the sum of squared differences of the already known pixels in the two patches

Step4: UPDATING THE BEST MATCHING PATCH:

After finding highest priority matching patch in the source region copy and update the patch to the target region. Repeat the above steps until the masked image is fully restored.

IV. RESULTS

In order to evaluate the performance of the exemplar based image Inpainting method. we are taking a original image as input to Inpaint that shown below in fig. for the original image user can be selected the unwanted portion that is shown as Inpainting portion image, and finally object removed by using exemplar based image Inpainting method that is shown in final output image.

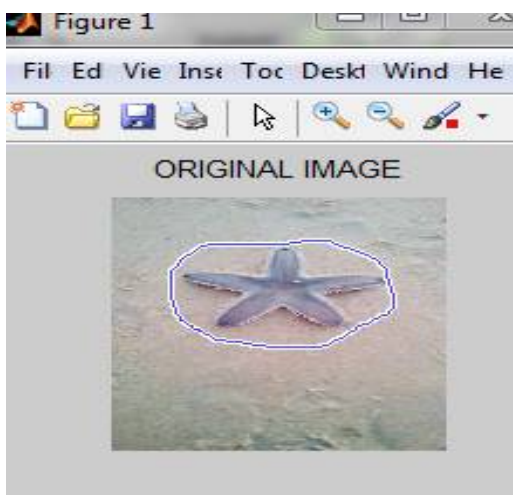


Fig2: original image,input to the inpainting algorithm

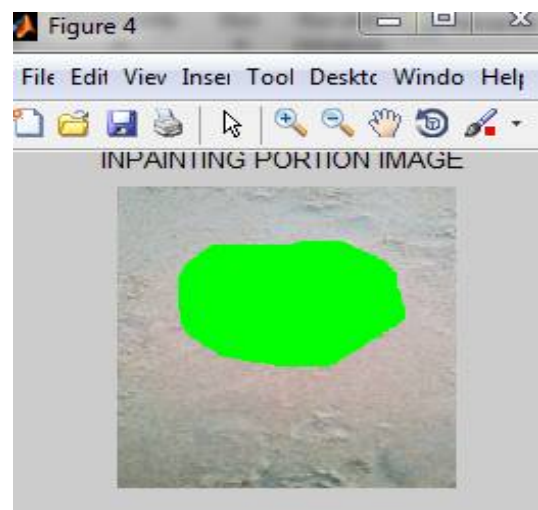


Fig3: Inpainting portion image marked as a target region shown in green color

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijirccce.com

Vol. 6, Issue 2, February 2018

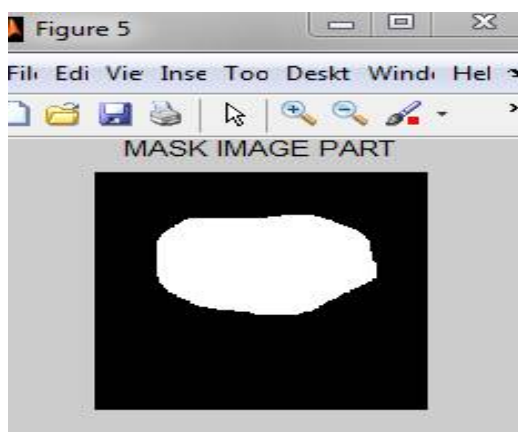


Fig4: mask image part, binary image of Inpainting portion Image

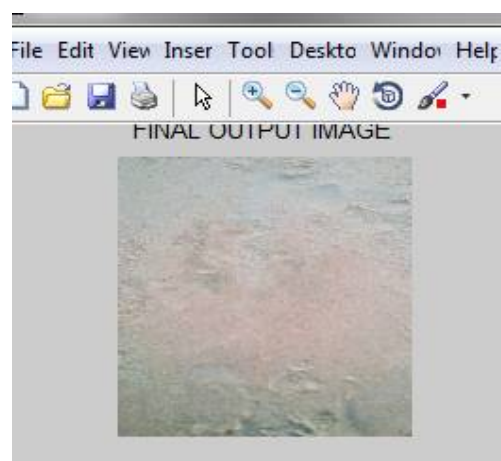


Fig5: Final Inpainted image, object is removed

V. CONCLUSION

Image inpainting method plays a major role in image processing. It is a method of unwanted object removal based on its structural methods, in this paper the exemplar based image inpainting has been proposed. This exemplar based algorithm gives better results compared with other inpainting methods and it is suitable for large objects

REFERENCES

- [1] Yu, Bing, and Youdong Ding. "Exemplar-based Image Inpainting via Fast Global Optimal Searching." IEEE 2017
- [2] Krishnamurthy, Vidya, and Senthilkumar Mathi. "An enhanced method for object removal using exemplar-based image inpainting." Computer Communication and Informatics (ICCCI), 2017 International Conference on. IEEE, 2017.
- [3] Siadati, S. Zahra, Farzin Yaghmaee, and Peyman Mahdavi. "A new exemplar-based image inpainting algorithm using image structure tensors." Electrical Engineering (ICEE), 2016 24th Iranian Conference on. IEEE, 2016.
- [4] Liu, Ying, et al. "A Novel Exemplar-Based Image Inpainting Algorithm." Intelligent Networking and Collaborative Inpainting." IEEE Transactions on image processing 13.9 (2004): 1200-1212. Systems (INCOS), 2015 International Conference on. IEEE, 2015.
- [5] Qian, Fan, Zhang Lifeng, and Hu Xuelong. "Exemplar-based image inpainting algorithm using adaptive sample and candidate patch system." Electronic Measurement & instruments (ICEMI), 2015 12th IEEE International Conference on. Vol. 3. IEEE, 2015.
- [6] Patel, Kaushikkumar R., and Lalit Jain. "A novel approach to exemplar based image inpainting." Communication and Signal Processing (ICCSP), 2016 International Conference on. IEEE, 2016.
- [7] Criminisi, Antonio, Patrick Pérez, and Kentaro Toyama. "Region filling and object removal by exemplar-based image
- [8] Dixit, Seema, and Saranjeet Singh. "Exemplar-Based Image Inpainting Technique using Image Partitioning (Search Region Prior) Method." IJSTE-International Journal of Science Technology & Engineering 1.(2014).
- [9] Patel, Jayesh, and Tanuja K. Sarode. "Exemplar based image inpainting with reduced search region." International Journal of Computer Applications 92.12 (2014).
- [10] Bhangale, Miss SC, and Asst Prof PR Thorat. "Image Inpainting Using Modified Exemplar-Based Method." (2016).
- [11] Vantigodi, Suraj, and R. Venkatesh Babu. "Entropy constrained exemplar-based image inpainting." Signal Processing and Communications (SPCOM), 2014 International Conference on. IEEE, 2014.
- [12] Salman, R. Bombaywala Md, and Chirag N. Paunwala. "Semi automatic image inpainting using partial JSEG segmentation." Inventive Systems and Control (ICISC), 2017 International Conference on. IEEE, 2017.
- [13] Chhabra, Jaspreet Kaur, and Mr Vijay Birchha. "Detailed survey on exemplar based image inpainting techniques." International Journal of Computer Science and Information Technologies 5.5 (2014): 6350-635.