A SURVEY ON DIFFERENT TECHNIQUES OF IMAGE MOSAICING AND IMAGE INPAINTING

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Abstract - Mosaic means a picture produced by arranging different pieces of tile together to get a large or complete view. It is based on the idea of capturing panoramic images also named as image stitching. Image mosaicing is a technique for getting a larger view of the single picture by re-arranging set of separate or overlapped sub frames which gives a larger and better to visualize view of the image taken from different angles that allow the user to view the surrounding scene with the real image. Image inpainting is the art of reconstructing the missing portion of image in order to restore its unity by utilizing the spatial information of its neighboring region in an image. The main goal of the inpainting is to modify the damaged portion in an image in such a way that modified or inpainted region is undetectable to the observers who are not familiar with the original image. In this paper many different techniques described used for image mosaicing and image inpainting which shows filling different missing regions or object removal or patch replacement for panoramic images. This paper also guides researchers who are willing to work in the field both of image mosaicing and image inpainting.

Index Terms — Image Mosaicing,Image Inpainting, Patch replacement,Object removal, Panoramic Image, Image stitching

I. INTRODUCTION

Image mosaicing have been practicing since long years and every year continuous improvement have been doing in this field from the researcher point view. Images acquired from top of the hill or a building or to get the image of a big hall, it becomes impossible to get the larger view of the image in one image so images are portioned in different sets of images in order to display the perfect larger view of the image. It is a composition generated from sequence of images and this composition can be obtained by some mathematical and geometric calculations performed on the sets of images so that overlapped regions of different sets of images are merged together to get an in differentiable image from a single large image that covers the whole scene.[1]

It is based on the idea of capturing panoramic images also named as image stitching. Image mosaicing is a technique for getting a larger view of the single picture by re-arranging set of separate or overlapped sub frames which gives a larger and better to visualize view of the image taken from different angles that allow the user to view the surrounding scene with the real image

Image mosaicing is applicable in scenarios like:

- Constructing high resolution image that gives a better to visualize view
- To make a significant impact in video processing by combining different frames
- For generating panaromic image of nature

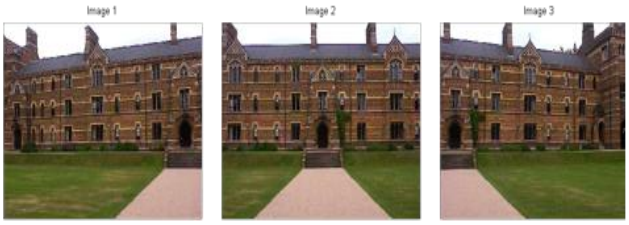


Fig.1: Three images acquired by a camera.

Fig.2: Images stitched to a mosaic

The another area to be focused is image inpainting which is most popular as it restores the damages image either by object removal or by patch restoring or filling the cracks or any missing region. Image inpainting is the art of reconstructing the missing portion of image in order to restore its unity by utilizing the spatial information of its neighboring region in an image. The main goal of the inpainting is to modify the damaged portion in an image in such a way that modified or inpainted region is undetectable to the observers who are not familiar with the original image [6].

The application of image inpainting includes removal of scratches from Photographs, removal of text from images, removal of objects that makes the image vulnerable, restoration of missing regions or dark patches. So when user identifies the original image and restored image it may not be easily distinguishable. The regions in which repairing is done are called inpainted region and region whose information is used for repairing are called source region [6].

Fig.3: Images inpainted

The paper is summarized as follows. Section 2 describes the related algorithms for both the areas. Section 3 gives the comparative study of the observed algorithms and finally Section 4 gives the conclusion and future work.

II. RELATED WORK

Image Mosaicing has many algorithms for mosaicing or stitching of images so that user cannot make out the difference between original and the mosaic image. Similarly image inpainting also has many different algorithms for filling the missing region or removing the unwanted region or recovering from dark patches. In this paper we have mainly concentrated on the survey of diferent techniques used for image mosaicing as well as image inpainting so the hybridization can be done using the best technique among them for real time images. To do so here are some main algorithms described as follows.

Image mosaicing is based on two methods: Direct method and Feature based method. Direct method are used for images which require less detailing since it is purely based on pixel intensities. In this each pixel of an image is compared to pixel of another image so it is complex and not invariant to rotation and scaling as it maximizes the pixel similarity. [2]

Feature based method works on detecting and extracting features and then matching the images from their features by establishing correspondence between points, lines, corners, edges, etc. They can be Invariant to noise, rotation, scaling and transformation [2]. There are many techniques for feature based detection technique like SIFT (Scale Invariant Feature Transformation) [4], SURF (Speeded up robust features), Harris corner detector, ORB technique, FAST (Feature from accelerated Segment Test).

A. SIFT

Scale Invariant Feature Transform (SIFT) is an efficient feature extraction technique. These features are invariant to scaling, rotation, transformation. Many works were carried out using SIFT features for stitching the images [4]. Since it gives good accuracy in terms of performance and time as it generates thousands of features for one image so matching can be done easily for generating an overlapped image. SIFT is better in terms of color invariance to gray level. The figure.1 describes the result of SIFT Algorithm.

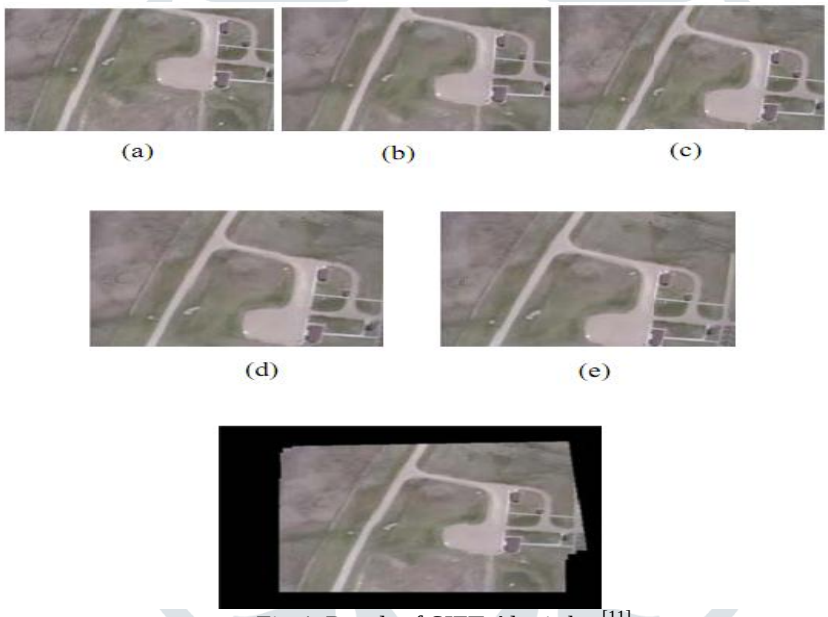


Fig.4: Result of SIFT Algoirthm[11]

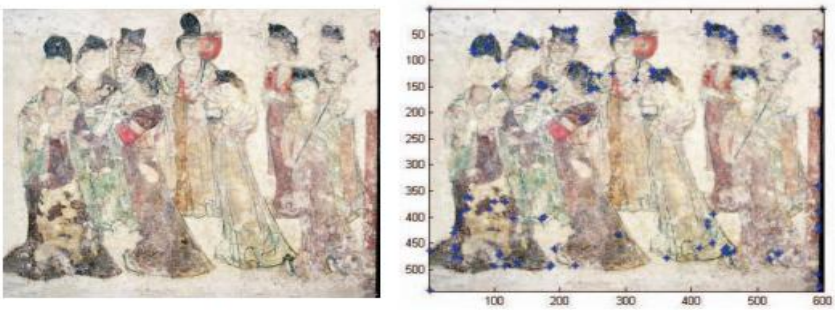
B. SURF

Speeded-Up Robust Features (SURF) is another efficient invariant feature extraction techniques that generates results same as SIFT. It provides a good balance between feature complexity and robustness to scaling and rotation. It claims that SIFT is stable against rotation and scale. SURF works on three steps: detection, description and matching. Surf speeds up its computation in terms of performance and faster technique[5].

Fig.5: Result of SURF using two images.[5]

C. HARRIS CORNER DETECTION

Harris corner is a point feature extracting algorithm which detects corners in an image based on Harris an Stephens. To find the corners in a image Harris detector checks for the intensity in all region. If the region is flat or edge region then no intensity change will occur, similarly if corner region is found then there will be change in intensity on checking at every area of image. It also detects edge, flat region, corner in an image.[3]



(a) Original image (b) Harris corner extraction Figure

Fig.6: Harris corner extraction is shown[12]

D. FAST

FAST(Feature from accelerated Segment Test) is high speed feature detector algorithm. It is better in terms of performance compared to harris corner detector. It is also feature extracting technique and has invariance to rotation and scaling. It detects less feature compared to SIFT and SURF.

In Image Inpainting the main focus for the user is selection of the target region which needs to be inpainted by a techniques which improves the quality of image in terms of computational time and performance. Several Inpainting approaches for filling the missing regions can be described as:

A. Partial Differentiation Equation (PDE) based method
B. Exemplar Based Method
C. Texture Synthesis Based Method
D. Patch Sparsity based Method

A. Partial Differentiation Equation (PDE) based method

It is diffusion based method proposed by Marcelo Bertalmioet.al in which target area which is to be inpainted is filled by diffusing the known information from the source area which depicts the original region from which inpainting is to be done into specific area of target at the pixel level. In PDE method target hole is inpainted by propagating information from the along the line with all the point having same gray value[8] i.e. we can able to find the line of equal gray scale values which contains more satisfactory information and used this to complete our image within less time. This technique will produce good result if the missing regions that need to be inpainted are small. The main disadvantage of this approach is blurring effects may be produced and if used with larger region the result will not be user satisfaction and time computation increases[7].

Inspired by this work Chan and Shen proposed TV (Total Variation Model) and an extended version of TV model which is CDD (Curvature driven diffusion)model.

The TV model uses a Euler_Langrange Equation which was designed for smaller regions inpainting but its main disadvantage is it does not connect broken edges and for resolving this connectivity issue of edges is CDD model was proposed which can inpaint larger damaged region and can be applied to non-texture images[9].

Fig 7: PDE based image inpainting

B. Exemplar Based Technique

Exemplar Based Approach is an effective class of inpainting algorithms. This algorithm presented in mainly consist two basic steps: in the first step the priority assignment is done and in second step, selection of best matching patch is done. This approach samples the best matching patch from known region whose similarity is measured by certain metrics, and pastes into target patches in the missing region. Exemplar based approach iteratively synthesizes the unknown region. This method fills structure in missing region using spatial information of neighboring regions. This method is very efficient for filling large target regions as well as regions having highly textured background. It can also remove superimposed texts like dates, subtitles etc. or even entire object from the image like. This method is proved to be very effective. The challenge includes handling of curved structures.

This method fills in the missing region by using the spatial information from the neighboring region i.e. target region is filled by most similar patches of source region [6-7]. Compare to PDE based this method is more suitable for filling larger area with reasonable time computations.

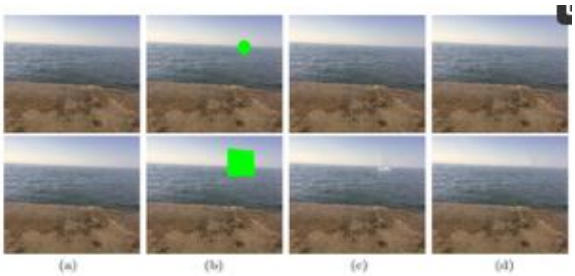


Fig.8: patch restoration using Exemplar Based Inpainting

C. Texture Synthesis Based Method

To fill in larger region based on pure textures texture synthesis based method is used. This aims at texture image as an input and goal is to extract more from that texture. The solution to accomplish this is by tiling the texture in form of rectangular grid and reproducing the target region with all its feature of texture. This techniques faces problem with natural images and images besides from texture completion [7]. Texture synthesis can be described as Pixel based scheme in which patches are inpainted by pixel wise but it is slow in computation. And the second one is patch based scheme in which target region is inpainted by blocks of pixels which is a fast process compared to pixel based but during inpainting flaws between neighboring patches remains which creates unsatisfactory result[6].

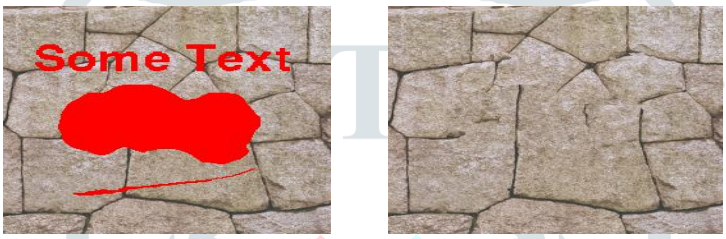


Fig.8: Texture Synthesis image inpainting

D. Patch Sparsity based Method

Image sparse representation can also be taken for inpainting based on exemplar based image inpainting. In this XU and Sun Sparsely represented the missing region using multiple candidate patches from known region to target region based on the consistency of candidate patches. In this an image is presented by sparse combination of set transformations(wavelet, DCT) and then missing pixels are inpainted by sparse representation of known region. It fail to produces smoothing effects like PDE and fail to repair stuructes[6][8] and edges in the filled region are not connected properly. Texture synthesis is not practical since the inpainting domain is surrounded by lots of differently textured areas.

It can be achieved by two ways: Firstly by Patch structure in which sparsity is designed to measure the confidence of a patch located at the image structure (e.g., the edge or corner) by the sparseness of its nonzero similarities to the neighboring patches (means broken area are set to some pixel value and all other values are set to zero).Then the masked image is inapainted by original image by candidate patches. The patch with larger structure sparsity will be assigned higher priority for further inpainting. Secondly by patch filling in which patches to be filled can be represented by sparse linear combination of candidate patches based on local patch consistency[10].

III. COMPARATIVE STUDY

We have studied some recent research papers in detail and found many issues and challenges in proposed approaches that should be carried out by researchers in future. Comparison of different methods of mosaicing and inpainting are described in tables

Table 1: Comparison of Image Mosaicing Methods

Methods	***Merits***	***Demerits***
SIFT	Features are invariant to scaling, rotation, transformation and it gives good accuracy in terms of performance. SIFT is better in terms of color invariance to gray level.	It takes large time since large number of feature are detected.
SURF	Surf speeds up its computation in terms of performance and generates results same as SIFT	Feature detection are less compared to sift
Harris Corner Detection	detects corners in an image.	It produces not satisfactory result for the flat and edged region
FAST	It is better in terms of performance compared to harris corner detector	It detects less feature compared to SIFT and SURF.

Table 2: Comparison of Image Inpainting Methods

Methods	***Merits***	***Demerits***
Partial Differentiation Equation (PDE) based method	It produces better results if there are smaller regions to be filled	If regions to be filled are large then algorithm takes more time to compute and achieves poor result.
Texture Synthesis Based Method	Produces satisfactory results in textures	Not appropriate for large natural objects
Exemplar Based Inpainting	Gives impressive results and preserves all structural and textural information and produces better result with large target region.	Gives unsatisfactory results if the corrupted area is too long and takes large time.
Patch Sparsity based Method	missing pixels are inpainted by sparse representation of known region	It fail to produces smoothing effects and fail to repair structures and edges in the filled region which are not connected properly

IV. CONCLUSION AND FUTURE WORK

Here we have surveyed the literature related to Image Mosaicing and Image Inpainting .In brief overview of image mosaicing and image inpainting we have described some of the methods used for mosaicing of images and inpainting algorithms with their advantages and disadvantages. Further based on comparisons and by theoretical analysis among algorithms we concluded that SIFT algorithm for image mosaicing and Exemplar based image inpainting technique for image inpainitng produces better result compared to other.

Since Exemplar based image inpainting can also inpaint the large missing region and also these algorithm can inpaint both structured and textured image as well.

After analyzing these different techniques we have highlighted some of the possible areas in which the future investigation can be done. It includes, inpainting for high resolution images for better quality of images. More efficient algorithms are required to be developed for reducing the computational cost and inpainting time. Thus developing the algorithm that overcomes this disadvantage remains our future work.

V. REFERENCE

[1] Jain, Parul M., and Vijaya K. Shandliya. "A review paper on various approaches for image mosaicing." International Journal of Computational Engineering Research 3.4 (2013).

[2] Arya, Shikha. "A Review On Image Stitching and its Different Methods." International Journal of Advanced Research in Computer Science and Software Engineering 5.5 (2015).

[3] Adel, Ebtsam, Mohammed Elmogy, and Hazem Elbakry. "Real time image mosaicing system based on feature extraction techniques." Computer Engineering & Systems (ICCES), 2014 9th International Conference on. IEEE, 2014.

[4] Oh-Seol Kwon and Yeong-Ho Ha, "Panoramic Video using Scale-Invariant Feature Transform with Embedded Color-Invariant Values ", IEEE Transactions on Consumer Electronics, vol. 56, May 2010.

[5] R.Karthik, A.AnnisFathima, V. Vaidehi, "Panoramic View Creation using Invariant Momentsand SURF Features", IEEE International Conference on Recent Trends in Information Technology (ICRTIT), pp. 376- 382, July 2013.

[6] Hesabi, Somayeh, and Nezam Mahdavi-Amiri. "A modified patch propagation-based image inpainting using patch sparsity." Artificial Intelligence and Signal Processing (AISP), 2012 16th CSI International Symposium on. IEEE, 2012.

[7] Vadhel, Bhavini, and Bhailal Limbasiya. "Survey on Different Techniques for Image Inpainting." (2016).

[8] Desai, Krishna B., Salman R. Bombaywala, and Chirag N. Paunwala. "Sparsity based image inpainting using optimisation techniques." TENCON 2015-2015 IEEE Region 10 Conference. IEEE, 2015.

[9] Li, Mengxin, and Yan Wen. "A New Image Inpainting Method Based on TV Model." Physics Procedia 33 (2012): 712-717.

[10] Z. Xu and 1. Sun, "Image inpainting by patch propagation using patch sparsity," Image Processing, IEEE Transactions on, vol. 19, pp. 1153-1165,2010.

[11] Ghosh, Debabrata, et al. "Quantitative evaluation of image mosaicing in multiple scene categories." Electro/Information Technology (EIT), 2012 IEEE International Conference on. IEEE, 2012

[12] Sen, Liu. "The Research and Improvement of Image Mosaicing Algorithm and Its Application in Frescoes." Intelligent Computation Technology and Automation (ICICTA), 2014 7th International Conference on. IEEE, 2014.