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A Approach to Image Inpainting using an Examplar- based method

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***Abstract*: In this paper we propose a new framework for inapainting of an image using an examplar based approach. Compared to existing approaches, some improvements have been done. In order to make the process to be less sensitive to noise and to work with dominant orientations of image structures, we initially convert image into its coarse version and then applied the method. To enhance the quality of inpainting region, Super resolution based algorithm is applied. Experimental results on natural images and texture synthesis demonstrate the effectiveness of the proposed method.**

***Keywords*: Examplar-based inpainting, K-NN.**

I. INTRODUCTION

Image inpainting refers to methods which consist in filling-in missing regions (holes) in an image [1]. Existing methods can be classified into two main categories.

The first category concerns diffusion-based approaches which propagate linear structures or level lines (so-called isophotes) via diffusion based on partial differential equations [1, 2] and variation methods [3]. Unfortunately, the diffusion-based methods tend to introduce some blur when the hole to be filled-in is large.

The second family of approaches concerns exemplar-based methods which sample and copy best matching texture patches from the known image neighborhood [4–7]. These methods have been inspired from texture synthesis techniques and are known to work well in cases of regular or repeatable textures.

II. RELATED WORK

Criminisi et al. [4] proposed to guide the filling process with a priority term based on edge strength. Diffusion-based methods propagate the structures into missing regions[2]. PatchMatch method[7] is a fast algorithm for computing dense approximate nearest-neighbour correspondences between patches of two image regions. This algorithm is available in Adobe Photoshop CS5 and works well.

The first attempt to use exemplar-based techniques for object removal has been reported in [6]. Authors in [5] improve the search for similar patches by introducing an a priori rough estimate of the inpainted values using a multi-scale approach which then results in an iterative approximation of the missing regions from coarse to fine levels.

The two types of methods (diffusion- and exemplar-based) can be combined efficiently e.g. by using structure tensors to compute the priority of the patches to be filled as in [8].

Although tremendous progress has been made in the past years on inpainting, difficulties remain when the hole to be filled is large and another critical aspect is the high computational time in general required.

III. METHODOLOGY

These two problems are here addressed by considering a hierarchical approach in which a lower resolution of the input image is first computed and inpainted using a K-NN (K Nearest Neighbours) examplar-based method.

Correspondences between the K-NN low-resolution and high-resolution patches are first learnt from the input image and stored in a dictionary. These correspondences are then used to find the missing pixels at the higher resolution following some principles used in single image super-resolution methods.

Super-Resolution (SR) refers to the process of creating one enhanced resolution image from one or multiple input low resolution images. The two corresponding problems are then referred to as single or multiple images SR, respectively. In both cases, the problem is of estimating high frequency details which are missing in the input image(s). The proposed SR-aided inpainting method falls within the context of single-image SR on which we thus focus in this section.

The proposed method thus builds upon earlier work on examplar-based inpainting in particular on the approach proposed in [4]

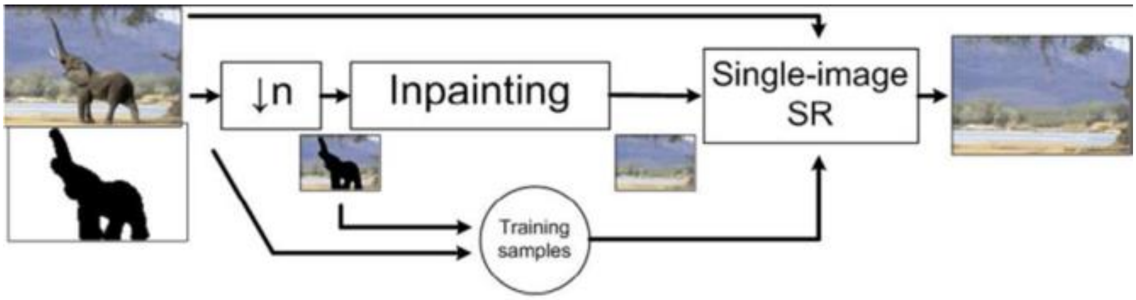

Fig 1. Framework of proposed method

Figure 1 illustrates the main concept underlying the proposed method. The two main components are the inpainting and the super-resolution algorithms. More specifically, the following steps are performed:

1. a low-resolution image is first built from the original picture;
2. an inpainting algorithm is applied to fill-in the holes of the low-resolution picture;
3. the quality of the inpainted regions is improved by using a single-image SR method.

The filling order computation defines a measure of priority for each patch in order to distinguish the structures from the textures. Classically, a high priority indicates the presence of structure. The priority of a patch centered on p is just given by a data term (the confidence term proposed in [4] is not used here since it does not bring about any improvement). So we used here Sparsity-based priority term.

The sparsity-based priority is more robust and visually improves the final result compared to the gradient and tensor-based priority. In the following, we adopt this method to compute the filling order. The filling process starts with the patch having the highest priority. Two sets of candidates are used to fill in the unknown part of the current patch. A first set is composed of the K most similar patches located in a local neighborhood centered on the current patch.

A major problem of local neighbourhood search is its tendency to get stuck at a particular place in the sample image and to produce verbatim copying. This kind of regions is often called garbage region. This problem can be addressed by introducing idea is based on the fact that patches that are neighbours in the input image should be also neighbours in the output image.

The below figure shows how we can apply super resolution algorithm to enhance the resolution of inpainted region. Flowchart of the super-resolution algorithm. The missing parts of the red block is filled by a linear combination of K HR-candidates (green arrows). The weights are computed using the similarity distance between LR and HR patches (green and red arrows, respectively). The top image represents the original image with the missing areas whereas the bottom one is the result of the low-resolution inpainting.

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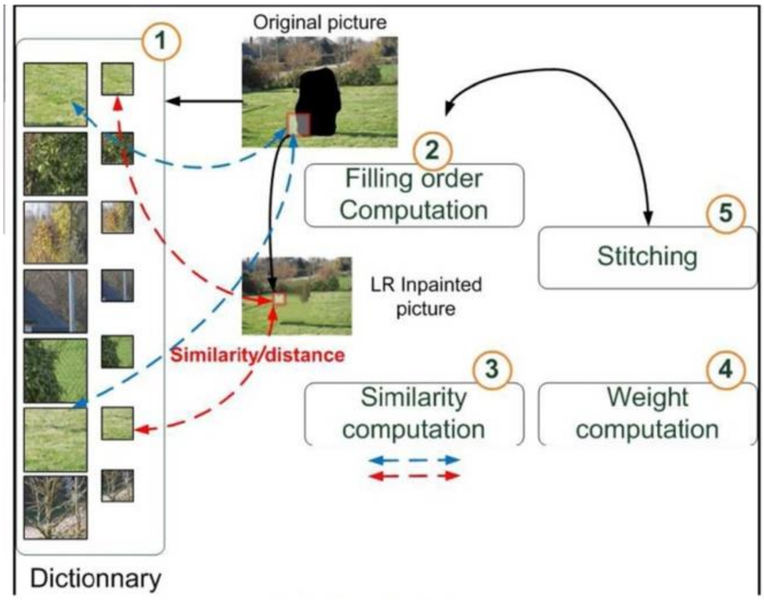


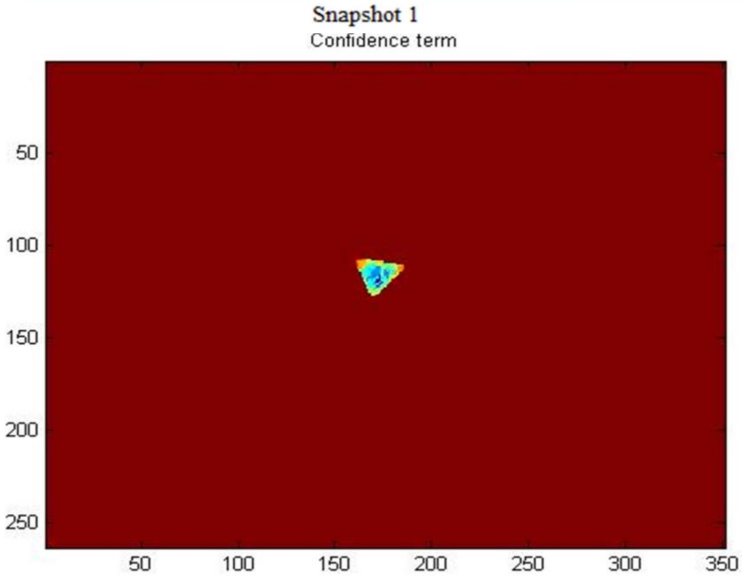
Fig 2 Super-Resolution based algorithm

IV. EXPERIMENTS AND RESULTS

With a normal PC configuration and using MATLAB-11, we conducted experiments. When compared with the previous methods when the region to be filled is large it performs very well and the results show improvements in terms of computational time in computing confident terms.

Our experiment results snapshots are as follow.

Snapshot 1



Snapshot 2

Snapshot 3

Final Output Image

V. CONCLUSION

This paper introduces a new frame work which combines best of the existing methods for image inpainting and is so generalized. We first propose an extension of a well-known examplar-based method (sparsity-based priority, K-NN). Also we used super-resolution based algorithm to enhance the resulting inpainting process. So it shows more improvement in terms of computational time when the region to be filled is large and hence it is a novel approach. In future we can use same framework with different types of priority terms.

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