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Implementation of Inpainting via Super-resolution

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ABSTRACT: Image inpainting is the art of filling in the missing portion of the image . The purpose of the inpainting is to reconstruct missing region in visually acceptable manner so that it seems reasonable to human eye . The inpainted of the coarse version of the input image allows to reduce the complexity and to be less sensitive to noise. On a low resolution inpainted image , a super-resolution algorithm is applied to recover the details of the missing areas and convert it into high resolution. In this paper we present an algorithm that improves and extends a previously proposed algorithm and provides faster inpainting . The basic idea behind this approach is to find example (i.e. patches) from the image and replace the lost data with it . This technique can be used for restoring photographs .We can obtain good quality results quickly using this approach.

KEYWORDS*:* Inpainting; Object removal; Reconstruct; Restore; Super-resolution .

I. INTRODUCTION

Inpainting is the art of restoring lost parts of an image and reconstructing them based on the background information . This has to be done in an undetectable way. The term inpainting is derived from the ancient art of restoring image by professional image restores in museums etc. Digital image inpainting tries to imitate this process and perform the inpainting automatically .The algorithm automatically does this in a way that it looks reasonable to the human eye[1]. Currently there are very few accepted technologies or tools for carrying out the work of image inpainting . It is still in the beginning stage and the lots of researches are being carried out to explore this area . There are , however , a few software products and libraries existing for this purpose . Example "restoreInpaint" [2] is an open source library which provide functionalities to detect an automatically restore cracks etc from damaged photographs. It provides tools for selecting the region to be inpainted and depending on the size of the image to carry out the inpainting process with varying time and quality.

Super-resolution refers to the process of creating one enhanced resolution image from one or multiple input low resolution input 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 .The SR problem is ill-posed since multiple high resolution images can produce the same resolution image. Solving the problem hence require introducing some prior information .The prior information can also take the form of example images or corresponding LR-HR (Low Resolution-High Resolution) pairs of patches learnt from a set of unrelated training images in an external database or from the input LR image itself .

Existing method can be classified into two main categories :
The first category concerns diffusion based approaches which propagate linear structures or level line (so called isophotes) via diffusion based on partial differential equations and variational methods . Unfortunately, the diffusion based method tend to introduce some blur when the hole to be filled is in large.

The second category of approaches concerns exemplar based methods which sample and copy best matching texture patches from the known image neighborhood the methods have been inspired from texture synthesis , technique and are

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known to work well in case of regular or repeatable textures . The two type of methods(diffusion and exemplar based) can be combined efficiently[3-6].

In the past years on inpainting, difficulties remain when a hole to be filled is large and another critical aspect is the high computational time in general required . 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 exemplar based method . Correspondences between the K-NN low resolution and high resolution patches are first learned from the input image and stored in 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. The proposed method thus builds upon earlier work on exemplar based inpainting in particular on the approach as well as upon earlier work on single image exemplar based super-resolution. In proposed system two main components are the inpainting and super-resolution.

II. ALGORITHM OVERVIEW

Image completion of large missing regions is a challenging task . As presented in the previous proposed method, there are a number of solutions to tackle the inpainting problem . In this paper we propose a new inpainting method using a single image SR algorithm . In that , we briefly present the main idea of this paper and the reasons why the proposed method is new and innovative . Most of the inpainting methods work as follows , the user selects the region to be inpainted. This is usually done as a separate process and may require the use of separate image processing tools . The image restoration is then carried out automatically . In order to produce a visually plausible reconstruction, an inpainting technique must try to reconstruct the isophotes as smoothly as possible and also propagate two dimensional texture [7] . Principle:

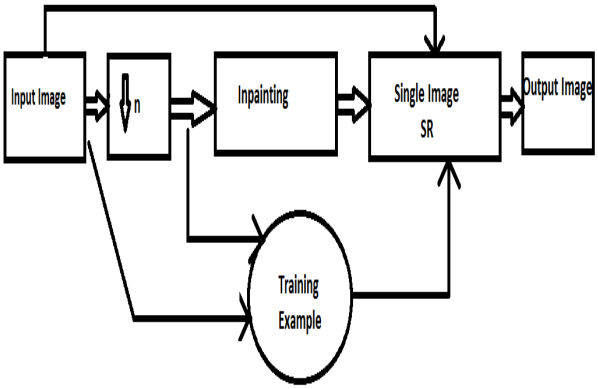

Fig. 1. Framework of proposed method

The two main components are inpainting and Super-resolution algorithm . 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 low resolution picture .

3.The quality of the inpainted regions is improved by using a Single Image SR method.

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A. Super-resolution Algorithm :

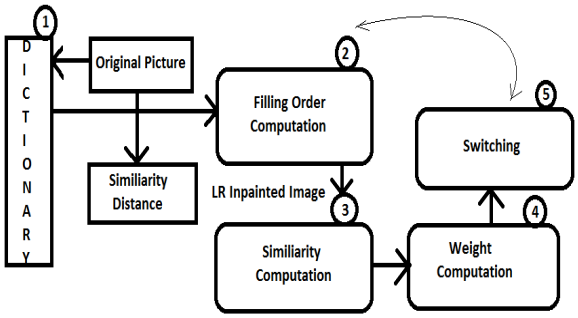

Fig. 2. Flowchart of super-resolution algorithm

1. Dictionary Building : It consist of the correspondences between low and high resolution image patches . The unique constraint is that the high resolution patches have to be valid . In the proposed approach , high resolution and valid patches are evenly extracted from the known part of the image. Those of LR patches are simply deduced.

2. Filling order of the HR picture: It is computed on the HR picture with the sparsity-based method. The filling process starts with the patch having the highest priority. This improves the quality of the image.

3.For the LR patches corresponding to the HR patch having the highest priority, its K-NN in the inpainted images of lower resolution is sought.

4.Weights of the image are calculated to perform a linear combination of these neighbors. The similarity distance used to compute the weights is composed of two terms: the first one is classical since this is the LR patch and its LR neighbors. The second term is the distance between the known parts of the HR patch and the HR patches corresponding to the LR neighbors.

5.A HR pixel is finally deduced using a linear combination of HR patches.

6.Stitching: the patch is then pasted into the missing areas.The stitching algorithm is only used when all pixel values in the overlapping region are known or already synthesized. Otherwise, stitching is disabled.

III. EXPERIMENTAL RESULTS

For this work we have utilized various images , we can enter an image with some specific file formats like jpg ,jpeg , png , bmp and gif proposed system does not allow an image other than these file formats. Figure shows example of input image . According to the proposed technique initially we input the image . After the selection of input image we select the target region and locate all the boundaries/border of target area .Now with the help of proposed technique we choose a patch which is to be inpainted and find out the similar patch in the image . Now we can inpaint the image with the super resoluted inpainted patches. The experimental results are shown in snapshots 3,4,5 and 5.

The snapshot-1 shows the front page with control menu for inpainting , like file menu (open image ,save , save as, edit menu(undo , redo) , inpaint (run the algorithm). Snapshot-2 shows the input image which is to be renovated .Snapshot-3 shows the selection of the unwanted object which is to be removed . Snapshot-4 shows the result of the renovated image.

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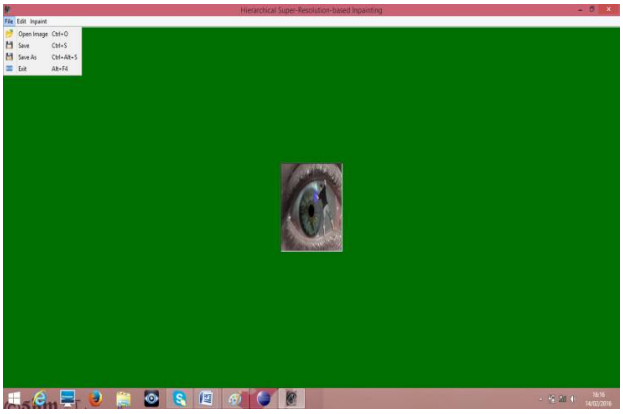

Fig. 3. Snapshot-1

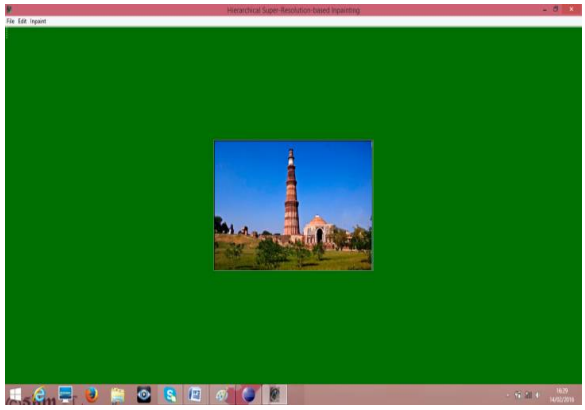

Fig. 4. Snapshot-2

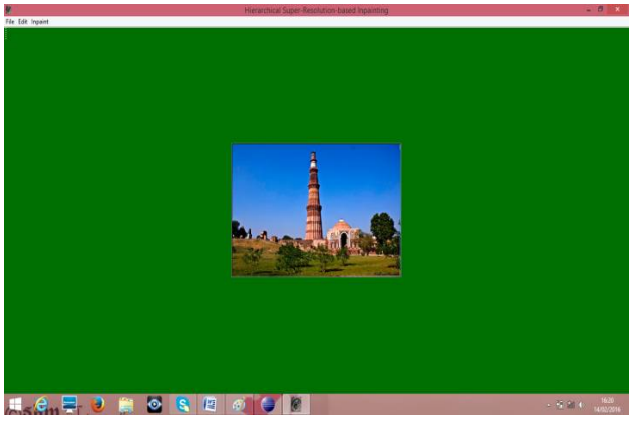

Fig. 5. Snapshot-3

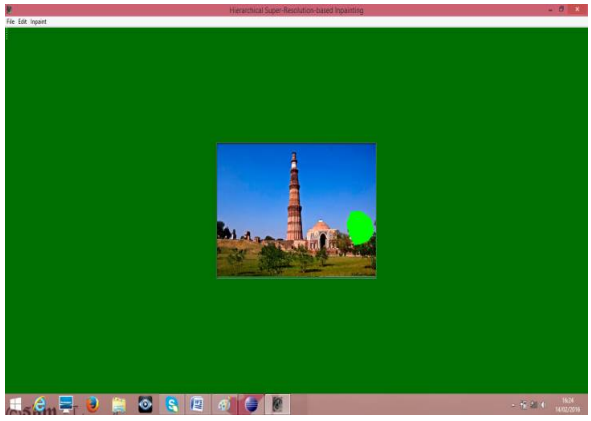

Fig. 6. Snapshot-4

IV. ADVANTAGES

- Our inpainting technique converts the high resolution image into low resolution image which makes it easier to fill damaged portion and inpaint low resolution image than high resolution one.
- Computation complexity and visual quality can be enhanced using this technique.
- Low resolution image can be inpainted several times with different configuration.
- Satellite imaging - whenever we click the picture from satellite it may happen that it can give blurred image due to movement of satellite a low quality camera. So, this technique can increase the resolution from low to high.
- Medical Science- It is quite difficult to use high definition camera in medical field using this technique low resoluted image can be converted into high resoluted image for better diagnosis.

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V. CONCLUSION

Recently, image inpainting technique have achieved high reputation in the area of Digital Image processing . The techniques that are utilized for repairing the lost part of a picture are known as image inpainting technique .In this paper we have suggested an innovative Super-resolution image inpainting technique . The suggested technique will remove whole object from a given image or a portion of the object and it offers high resolution inpainted image . The inpainted images are sharp without any color artifacts . The examples shown suggest a wide range of applications like restoration of old photographs and damaged film , removal of objects. The results can either be adopted as a final restoration or be used to provide an initial point for manual restoration , thereby reducing the total restoration time.

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