

# Digital Inpainting on the Basis of Exemplar Based Method

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**Abstract**— Digital image inpainting refers to a technique used for filling in the missing or corrupted regions of an image using information from the surrounding area. Inpainting techniques have found widespread use in applications that include, but are not limited to error recovery, red-eye removal, multimedia editing. This paper will discuss inpainting techniques in the context of digital artwork restoration. Notwithstanding the potentially different approaches, the goal of any digital image inpainting algorithm is to reconstruct the missing or damaged regions in a visually plausible way.

**Keywords**— Exemplar based inpainting, Object removal, missing areas.

## I. INTRODUCTION

Recently, it has become common to employ digital special effects in making movies and video products. For example, some common digital special effects are composition of graphic objects, removal of unnecessary objects, and insertion of virtual objects to a video sequence. In making a movie, these tasks are mostly done by using special graphic software after complete video sequences are recorded. Therefore, they are called 'post-processing'. Conventional special effects have been widely used in film industry for a long period. They invariably use a great deal of manual intervention. Nowadays, however, many digital special effects (DFX) are introduced due to the advance of computer graphics and computer vision techniques. Especially, object removal is one of the key techniques in post-processing. If a foreground object is captured in a video sequence accident or if the object is decided to be unnecessary, we need to erase the object from the sequence. Therefore, an object removal technique should remove the object and replace it with appropriate background objects. This can be extended in filling in the moving foreground occluded objects and video foreground objects separation.

Inpainting, the technique as in [1] of modifying an image in an undetectable form, is as ancient art itself. The goals and applications of inpainting are numerous, from the restoration of damaged paintings and photographs to the removal/replacement of selected objects. The algorithm automatically fills-in target regions with information surrounding them. Applications of this technique include the restoration of old photographs and damaged film; removal of superimposed text like dates, subtitles, or publicity; and the removal of entire objects from the image like microphones or wires in special effects.

## II. LITERATURE SURVEY

This study surveys various previous and current trends/methods in image inpainting. The major theme covered by the study include different approaches for inpainting.

### A. Diffusion based Inpainting

Diffusion based Inpainting was the first digital Inpainting approach. In this approach missing region is filled by diffusing the image information from the known region into the missing region at the pixel level. Basically these algorithms are based on theory of variational method and Partial Differential equation (PDE).

### B. Texture Synthesis Based Inpainting

Texture synthesis based algorithms as in [3] are one of the earliest methods of image Inpainting. And these algorithms are used to complete the missing regions using similar neighbourhoods of the damaged pixels. The texture synthesis algorithms synthesize the new image pixels from an initial seed. And then strives to preserve the local structure of the image. All the earlier Inpainting techniques utilized these methods to fill the missing region by sampling and copying pixels from the neighbouring area.

### C. PDE based Inpainting

This algorithm is the iterative algorithm. The main idea behind this algorithm is to continue geometric and photometric information that arrives at the border of the occluded area into area itself as in [1]. This is done by propagating the information in the direction of minimal change using isophote lines. This algorithm will produce good results if missed regions are small one. But when the missed regions are large this algorithm will take so long time and it will not produce good results.

### D. Exemplar based Inpainting

The exemplar based approach is an important class of inpainting algorithms. And they have proved to be very effective. Basically it consists of two basic steps: in the first step priority assignment is done and the second step consists of the selection of the best matching patch. The exemplar based approach samples the best matching patches from the known region, whose similarity is measured by certain metrics, and pastes into the target patches in the missing region. Exemplar- based Inpainting iteratively synthesizes the unknown region i. e. target region, by the most similar patch in the source region.

According to the filling order, the method fills structures in the missing regions using spatial information of neighboring regions. This method is an efficient approach for reconstructing large target regions.

### III. PROPOSED WORK

Fundamentals: Given an input image  $I$  with a missing or unknown region  $\Omega$  and its contour/fill front is denoted as  $d\Omega$ . The task of image completion is as follows:

1. The global picture determines how to fill in the gap, the purpose of inpainting being to restore the unity of the work;
2. The structure of the area surrounding  $\Omega$  is continued into the gap, contour lines are drawn via the prolongation of those arriving at  $d\Omega$ .
3. The different regions inside  $\Omega$ , as defined by the contour lines, are filled with colour, matching those of  $d\Omega$ .

The  $\Omega$  is progressively shrunk by propagating structure and texture information from the contour  $d\Omega$  as in [13]. Target/missing region  $\Omega$  is filled up patch wise with the similar patches from source region  $F$ . Next, the size of patch to be filled on fill front is defined, assuming the probability distribution of brightness values for a pixel given the brightness values of its spatial neighbourhood is independent of the rest of the image. The neighbourhood of a pixel is modelled as a square window around that pixel. More specifically, if the texture is presumed to be mainly regular at high spatial frequencies and mainly stochastic at low spatial frequencies, the size of the window should be on the scale of the biggest regular feature i.e., slightly larger than the largest distinguishable texture element in the source region  $F$ .

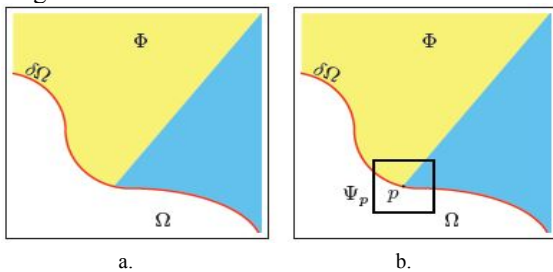


Fig. 1 (a). Original image with target region  $\Omega$  and its boundary  $\partial\Omega$  and source region  $\phi$ .(b)  $\psi_p$  marks the area which we want to remove.

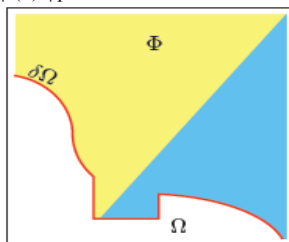


Fig. 2. Copied data from nearby region of the image.

#### A. Overview of region filling algorithm

1. Taking an input for the inpainting
  - Image
  - Video
2. Calculating the number of rows, number of columns and number of frame (if the input is video).
3. Selecting the region/object which is to be removed.
  - Calculate no. of rows of selected region

- Calculate no. of columns of selected region
4. On the values of rows and columns, we will get the number of total count.
    - Total count: gives last point of processing.
  5. Repeat until done the following steps:
    - check for pixel which needs to be inpainted
    - If found, Check pixel in previous column, previous row, next Column and next row for replacing the matched pixel.
    - If not found , increases the window length.
    - Replacing the current pixels with the found pixel.

#### B. Results of image inpainting



Fig. 2. Result of proposed approach for variety of pictures (a) Original picture (b) Inpainted picture

Thus we have successfully removed the patches (likes in first image pimple on face, in second image girl and in third image a boll) in respective images using exemplar based method of inpainting.

### IV. CONCLUSIONS

This paper proposed a simple and fast inpainting algorithm based on an exemplar based method for scratch or text removal, object removal and missing block completion and proposed a method for completion of holes in images and videos. Successfully removed the foreground object and completed the background. Finally, we believe that the proposed framework will be appropriate for video completion. This application is indeed very time-consuming. The use of the proposed framework could dramatically reduce the computational time.

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