Video Inpainting Techniques with Super Resolution: A Literature Survey

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***Abstract* - Inpainting aims to restore images with partly information loss and tries to make in-painting results as these missing parts in such a way that the reconstructed the video looks natural. The key issue in video completion is to maintain the spatial temporal information. A lot of researchers have worked in the area of video inpainting. Most of the researchers try to maintain either spatial regularity or temporal stability between the frames. But none of them try to maintain both of them in the identical technique with a good quality. There exist convoluted situation where low-quality input images suffer from inadequate resolution with missing regions. Treating super resolution and inpainting simultaneously decreases noise than super resolution after inpainting**

Index Terms — Video Inpainting; Object Removal; Unwanted Object Detection; Partial differential equation; Exemplar based inpainting; patch; object based; Texture synthesis.

I. INTRODUCTION

1.1 Video Inpainting

Nowadays video has an important media of publication in the world. The method of recover lost part of image base on background information is known as inpainting [1]. Video in-painting is a process of remove object or recover missing or corrupted part present in video sequence by using spatial and temporal information from neighboring frame. Image in-painting is concluded in spatial domain where video in-painting is concluded spatial-temporal domain [2].Video in-painting is a mostly similar to image in-painting, but here we have to consider images one by one sequence. Video in-painting is a commonly useful in professional video and movie production, multimedia editing and visualization, privacy protection, video error concealment in video transmission [2].

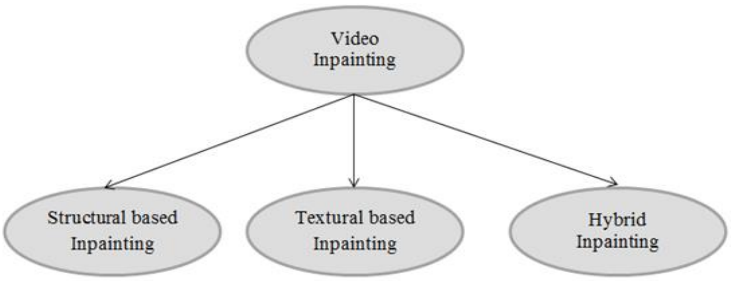

Fig.1 Types of Video Inpainting Approaches

Video inpainting method can be classified in tree types [3]. Figure 1 show that types of video in-painting. Structural based in-painting method focus on geometry approach and textural based in-painting method focus on texture. Where hybrid approach has combination of structural and textural based in-painting approach used to filling missing region of texture and geometry part of frame.

1.2 Super Resolution

Video inpainting with super resolution is a two steps process. First a coarse version of the input picture is inpainted. The second step consists in creating an enhanced resolution picture from the coarse inpainted image. The goal of Super-Resolution (SR) methods is to recover a high resolution image from one or more low resolution input images. Super-Resolution (SR) refers to the process of creating one enhanced resolution image from one or multiple input low resolution images. SR can be broadly classified into three methods: (1) The classical multi-image super-resolution, and (2) Example-Based super-resolution. In the classical multi-image SR a set of low-resolution images of the same scene are taken. Each low resolution image imposes a set of linear constraints on the unknown high resolution intensity values. If enough low-resolution images are available then the set of equations becomes determined and can be solved to recover the high-resolution image. Practically, however, this approach is numerically limited only to small increases in resolution These limitations have lead to the development of "Example-Based Super-Resolution" also

termed "image hallucination" In example-based SR, correspond dences between low and high resolution image patches are learned from a database of low and high resolution image pairs and then applied to a new low-resolution image to recover its most likely high-resolution version. Higher SR factors have of- ten been obtained by repeated applications of this process. Example-based SR has been shown to exceed the limits of classical SR. However, unlike classical SR, the high resolution details reconstructed by example- based SR are not guaranteed to provide the true high resolution details.

II. OBJECTIVE OF VIDEO IN-PAINTING WITH SUPER RESOLUTION

Goal of video in-painting is that remove unwanted object from video sequence. Figure 2 shows numbers of video frame of bicycle race. In this video person who acts as an occluding object. Apply video in-painting Algorithm result show in figure 2(B) but resolution of that frame is low after in-painting than apply super resolution approach you can see expect result Figure.2(c).

Fig.2(A) Fig.2(B) Fig.2(C)

Fig.2 Video in-painting with super resolution

III. LITERATURE REVIEW

Literature review of many papers there are many algorithms for video inpainting which can be categories can be following:

1. Exemplar based Inpainting
2. PDE based Inpainting
3. Texture synthesis based Inpainting
4. Patch based Inpainting
5. Semi-automatic and Fast Inpainting
6. Hierarchical Super-Resolution based Inpainting
7. Contour-based Video Inpainting
8. Hybrid Inpainting.

1. Exemplar based In-painting

Exemplar based method good for large frame with good texture and structure reproduction but it is difficult for handling curve structure [4].

Exemplar based In-painting algorithm perform following steps:

a. Initializing target region pointed by user.
b. Calculating priority of pointed region,
c. Searching and composting exemplar for target region in other frame
d. Updating image information repeat in which required information computing filling priorities are updated.

In this paper [5] suggested Exemplar based algorithm for removing large objects from video and it was filling hall behind in a probable manner by dividing the frame and in less time. We got good result compare to the without dividing the frame.

In this paper [6] suggested exemplar based algorithm which restore area of remove object. Gaussian Mixture Model (GMM) model is work on separate foreground and background than it reduces calculating time the optical flow patchwork which is used many video in-painting algorithm in re-procedure step. Where videos contain quite close foreground and background than this method does not perform well.

Fig.3 Exemplar based and Partial Differential Equation based In-painting

2. Partial Differential Equation based In-painting

Partial differential equation based method is working repeatedly. This algorithm lines which are appearing at the border of the region should be smoothly in-painted from outside of the border to inner region. It Produce good results if missed regions are small one and target region is non-textured, but take long time if target region is large. Some blurring effect is presented in the resultant video sequence [7]. In this paper [8] suggested Partial differential equation algorithm is focus is to fill hole spatially by extending the edges and then by a diffusion process filling hole with smoothed color information .Main drawback of this method is it not consider correlation between two consecutive frames.

3. Texture synthesis based In-painting

Texture synthesis based method used to fill the damaged region using similar neighborhoods of the missed pixels and texture is synthesised in pixel by pixel. This algorithm used only small region and can't handle natural scenes also this method very slow because filling in begging pixel by pixel [4, 14].

Texture synthesis based method works on three steps [3]:

a. Separates foreground and background layer.
b. Reconstruct moving object based on priority using moving foreground in other frames.
c. "Occluded" region in foreground inpainted. In this step does not fill all missed hall.
d. Remaining hall fill by 2nd step using spatial texture synthesis.

Paper [9] has suggested this method perform automatically text remove and reconstruction. This method applied on spatial-temporal continuity but drawback of this method is spent on bundled transform which reduces optimized implementation. Texture synthesis method speeded up but you can use Principal Component Analysis (PCA) and Vector Quantization (VQ).

Fig. 4 Texture synthesis based In-painting

4. Patch based Inpainting

Patch based method is a distinguish damage and non-damage are based on structure and texture information [4]. Patch based method work well applied to image inpainting but it difficulty to handle spatial and temporal continuity in video inpainting [10].

Paper [1] has suggested Patch priority and patch representation are two main steps of process. First step is video converted into numbers of frames. Edges to be removed by identified using edge detection method. Patch is computed from each frame using nonzero similarities to neighbouring patches which patch computes from structure sparsity. If large patch structure sparsity than it give higher priority.

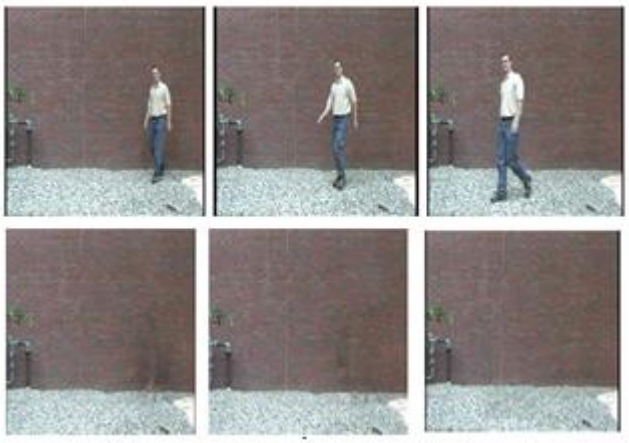

Fig. 5 Patch based Inpainting

5. Semi-automatic and Fast Inpainting

Semi-automatic and fast inpainting require user help. This method worked in two steps. In the first step user identified missing information in hole by sketching object boundaries from the known to unknown region. Second steps is patch based texture synthesis is used to develop the texture [14]. If single curve is present than simple dynamic programming can be used to derive the optimal answer otherwise optimization deal more difficult approximated answer by using belief propagation.

6. Hierarchical Super-Resolution based Inpainting

Hierarchical super-resolution based inpainting method is combination of exemplar based method and single image super resolution method. In this method first step applied with exemplar based method and then give inpainted result. In second steps check inpainted frames resolution by using single-image SR. Paper [11] has suggested a hierarchical super-resolution algorithm which is used to recover detail on the missing areas by exemplar and advantage of this method is, that it is easier to inpaint low-resolution pictures than high-resolution. It is better than state-of-the art inpainting method and work completely in less time periods.

7. Contour-Based Video Inpainting

Paper [12] has proposed Contour-Based Video Inpainting. This paper proposes an algorithm for video inpainting when an object is totally damaged. In this framework the background and foreground in the moving object are separated from each other. By using these separated moving objects, a large patchwork image is constructed then a patch-based method with the help of a contour-based method and large patches fills the holes. By settling the objects on their places in each frame, the inpainted foreground is collected. Missing regions of the stationary background are filled separately. Overlapping the inpainted foreground and the stationary background produces the inpainted video.

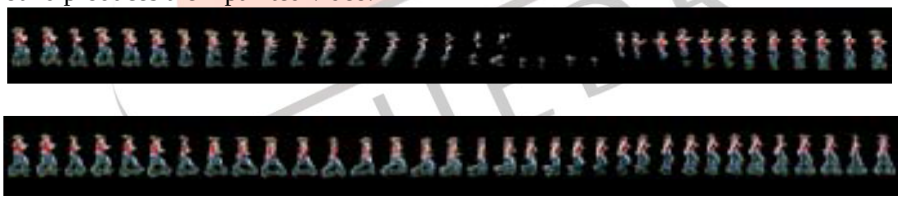

Fig. 6 Contour based Inpainting

8. Hybrid Inpainting

Hybrid inpainting is combination of both texture synthesis and PDE based Inpainting. This method allows large holes and spread both structure and texture, but computation time of this algorithm is more for large holes. This method uses a two-step approach: the first stapes is structure completion followed by texture synthesis. In the structure completion stapes, segmentation is performed based on the free and easy geometry, colour and texture information on the input and then the partitioning boundaries are extrapolated to generate a complete segmentation for the input using tensor voting. Next step consists of synthesizing texture and colour information in each segment, again using tensor voting [4].

Paper [13] has proposed combined structure and texture image inpainting algorithm for natural scene image completion. They present a hybrid method for completion of images of natural scenery, where the removal of a foreground object creates a hole in the image. The basic idea is to decompose the original image into a structure and a texture image. Recover of each image is performed separately. The missing information in the structure component is reconstructed using a structure inpainting algorithm, while the texture component is repaired by an improved exemplar based texture synthesis techniques. Taking advantage of both the structure inpainting methods and texture synthesis techniques, they designed an effective image recover method. A comparison with some existing methods on different natural images shows the merits of this approach in providing high quality inpainted images.

CONCLUSION

In this paper, different types of in-painting techniques are studied and analyzed for removing objects and in-painting in damaged videos. This analysis proved that the exemplar based image inpainting will create better results for Inpainting the huge missing region. Each algorithm has its own merits and demerits. Advance study includes growth of efficient algorithm to shrink computational cost and to reduce the time required for Inpainting. The author's future work will concentrate on extending analysis to in-painting of video/images where the challenge is to preserve visual coherency of in-painting results over time with better quality.

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