A Survey on Video Inpainting

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Abstract— Video Inpainting is the technique that can automatically restore damaged or partially removed image.It is also the unique tool for filling in the missing part in a video sequence. Many algorithm have been developed so far among which some are directly extended from the image inpainting algorithms. There are numbers of method used for video inpainting. All methods have their own advantage and disadvantage. This survey various video inpainting approaches.

General Terms: Inpainting.
Key words: Repair object, Object Removal

I. INTRODUCTION

Increasingly, police and security staff rely on video surveillance systems to facilitate their work. This practice is most evident in large public transportation areas such as metro stations and airports. However, these systems remain largely labor intensive, and the personnel monitoring the video displays find it extremely difficult to be attentive to randomly occurring incidents.

Video inpainting is one of the very challenging problems in computer vision.video inpainting approach may be used for the removing an undesired object from an input video or repaired damaged part of input video

The video inpainting technique has many applications including surveillance video processing,video editing during post-production in the movie industry,removing logos and subtitles from video,etc.[7]

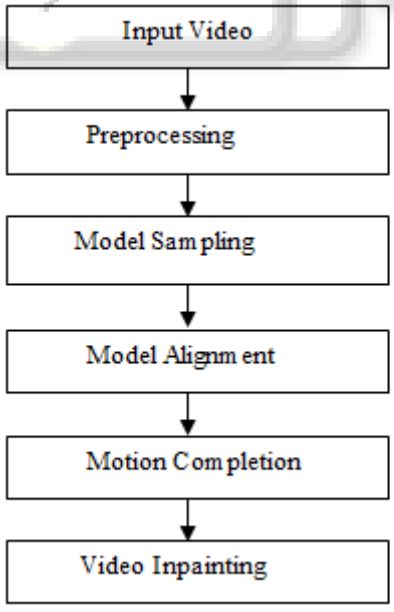

Fig. 1: Different stages for video inpainting [16]

A very straightforward approach to video inpainting is to apply image inpainting algorithm to each frame of a video sequence. Some researchers have extended the work in from image inpainting to video inpainting for restoring the objects and the technique is further improved in. But this approach is inadequate because it does not take the advantage of high temporal correlation that exists between the video frames.[7]

A straightforward extension of image inpainting algorithms to video inpainting is to treat the underlying video data as a set of distinct images and apply image inpainting algorithms to them individually. This approach to video inpainting proves inadequate as it fails to take advantage of the high temporal correlation that exists in video sequences. While recent video inpainting algorithms have addressed this issue with relative success, many technical challenges still remain. The most notable ones are their algorithmic complexity and the limited hole size they can handle.

Image inpainting focus on the removal and completion of unwanted or damaged regions in single images using surrounded information.It is not possible to extend methods from image inpainting to the field of video inpainting, because in image inpainting techniques only consider spatial information, and completely neglect the significant temporal information present in video sequences. Compared image inpainting with video inpainting has a large number of pixels to be inpainted

In **[17] Mrinmoy Ghorai, Pulak Purkait, and Bhabatosh Chanda** Proposed fast video inpainting technique to infer the unknown information in the target region by maximizing box-based selfsimilarity and coherence measure. The video inpainting is already proposed in the literature and some of them are able to produce good quality results. However, the bottleneck of those algorithms is they are painfully slow.In this method fill the texture in the target region that preserves the smooth motion of the object without inclusion of any artifacts in reasonable amount of time. This proposed method is quite efficient to synthesize unknown information in a video and comparable to the existing state-of-the-art methods

In **[15] Sanket Sonawane, Sahil Sarangdhar, Siddhi Bhatt, Divya Sharma** Video inpainting is a process of repairing the damaged areas of a video or removing any desired part of a video. Dealing with such problems requires a study image inpainting algorithm along with a regeneration technique for filling the missing parts of a video sequence recorded from a static camera. Many automatic techniques for video inpainting are available but most of them are computationally intensive and fail to repair the damaged areas. Also, from the remaining video inpainting algorithms a masked video sequence has to be provided. To overcome this problem, inpainting process is carried out by using the background registration method which is proposed in this paper. The video is first converted into distinct image frames and the first frame is registered. Second, the edges of an object to be removed are detected by comparing the registered frame with each succeeding frame of the video. Next, a masked frame is generated for each time frame. Then the inpainting process is performed separately for each and every time frame of the images.

Next, these processed image frames are displayed sequentially, so that it appears as a video

In **[14] Ankita S. Bagul, Asha S. Bhalerao, Vaishali N. Dhage** Video inpainting or completion is a vital video improvement technique used to repair or editing of digital videos. In this paper, we are proposing video inpainting algorithm for repairing damaged frames in video films, focusing on maintaining good spatiotemporal continuity. It has been used all over the world to convert cultural artifacts such as vintage videos and films into digital form. However, such types of videos are usually very poor in quality and most of the time it contain unstable luminance and damaged content. Experiment on many frames of videos show the benefits of our proposed approach which lead to natural looking videos with less annoying artifacts

In [**10] Vaishali k Gaikwad,P.V.Kulkarni** proposed an efficient algorithm using exemplar-based technique. Here, considered static camera which gives video having stationery background with moving foreground. To detect the region of moving objects we apply edge detection technique. Once object region detected priority assignment to the patches is applied. A natural image has structures and textures. Structure sparsity was measure to find similarities of the patches. The patch having higher sparseness is then selected and its priority is set which is the highest priority among the patches.

In **[8] Mrs.B.A.Ahire,Prof.Neeta A. Deshpande** An efficient moving object removal using modified exampler based inpainting algorithm is proposed in this paper. In the proposed method, 3D volume of video is converted into 2D slices for maintaining spatial and temporal consistencies. Background subtraction technique is used for object detection and tracking. Then, modified exampler-based image inpainting algorithm is applied to get the improved results. After combination of completed slices, sequences of virtual contours are formed to retrieve the most similar postures among the number of available postures. Key posture selection and indexing are used to minimize the complexity of posture sequence retrieval. Synthetic posture generation method is used to increase the number of posture generation database

In **[1] M. Bertalmio, A. L. Bertozzi, *G.* Sapiro** In this papec we introduce a class of automated methodr for digital inpainting. The approach uses ideas from classicalfluid dynamics to propagate isophote lines continuously from the exterior into the region to be inpainted. The main idea is to think of the image intensity as a 'streamfunction'for **a** two-dimensional incompressible flow. The Luplacian of the image intensity plays the role of the vorticity of the fluid; it is transported into the region to be inpainted by a vector field defined by the stream function. The resulting algorithm is designed to continue isophotes while matching gradient vectors **at** the boundary of the inpainting region. The method is directly based on the Navier-Stokes equations for fluid dynamics, which has the immediate advantage of well-developed theoretical and numerical results.

In [**2] Wei-Qi Yan, Mohan S. Kankanhalli** A video logo is usually a declaration of the video copyright. However it sometimes causes visual discomfort due to the presence of multiple logos in videos that have been filed and exchanged by different channels. In this paper, we present an approach to erase logos from video clips. Based on the histogram energy analysis of the relevant video frames, we obtain the best quality logo frame that can be easily processed in the selected region of video frames. After that, we mark the logo area in the entire sequence of frames and inpaint each frame of the video logo based on color interpolation

In **[5] Sanjeev Kumar, Mainak Biswas, Serge J. Belongie and Truong Q. NguyenIn** this paper we investigate the application of texture synthesis and image inpainting techniques for video applications.Working in the non-parametric framework, we use 3D patches for matching and copying. This ensures temporal continuity to some extent which is not possible to obtain by working with individual frames. Since, in present application, patches might contain arbitrary shaped and multiple disconnected holes, fast fourier transform (FFT) and summed area table based sum of squared difference (SSD)calculation cannot be used.

In **[6] Yasuyuki Matsushita, Eyal Ofek, Xiaoou Tang, Heung-Yeung Shum**Video stabilization is an important video enhancement technology which aims at removing annoying shaky motion from videos. We propose a practical and robust approach of video stabilization that produces full-frame stabilized videos with good visual quality. While most previous methods end up with producing smaller size stabilized videos, our completion method can produce fullframe videos by naturally filling in missing image parts by locally aligning image data of neighboring frames. To achieve this, motion inpainting is proposed to enforce spatial and temporal consistency of the completion in both static and dynamic image areas. In addition, image quality in the stabilized video is enhanced with a new practical deblurring algorithm. Instead of estimating point spread functions, our method transfers and interpolates sharper image pixels of neighboring frames to increase the sharpness of the frame.The proposed video completion and deblurring methods enabled us to develop a complete video stabilizer which can naturally keep the original image quality in the stabilized videos

Sun Xiaoming, Yu Xiaoyang, Yu Shuchun, Guan Yanxia, Meng Xiaoliang, Yu Yang, Liu YananMotion object detection has been widely used in traffic monitoring and target tracking fields. In order to solve the difficulty of building a model of the background and improving the accuracy of the update rate in the background subtraction, a new detection moving object method combining the surf algorithm and the background subtraction is proposed in this paper. Firstly, according to the continuity of motion, motion regions are labeled and filled in; Secondly, the image mosaic by surf algorithm is conducted to obtain the image with the whole background, then the whole background image mosaic is used to obtain the frame image with the whole background; Finally, frame difference method is used to obtain the foreground object, and then a morphology is processed

In **[7] Narendra Bhatewara, Prashant Kumar, Anupam Agrawal** Video inpainting is one of the very challengingproblems in computer vision. This approach may be used for removing an undesired object from an input video. In this Paper the undesired object will be removed and the texture is reconstructed in the entire video while maintaining the consistent flow of video. The technique implemented here is for the videos recorded with stationary camera. It involves the steps of preprocessing, motion

inpainting, and background filling-in. The step of preprocessing involves segmenting each frame of a video into foreground and background, detecting the foreground objects and then tracking those detected objects. The motion inpainting step will fill the holes created by the occluding object by copying information from object templates generated in preprocessing step. The last step of background filling-in will fill the remaining holes by copying corresponding background from background model

In **[9] M. Vijay Venkatesh, Sen-ching Samson Cheung and Jian Zhao** Video inpainting is the process of repairing missing regions (holes) in videos. Most automatic techniques are computationally intensive and unable to repair large holes. To tackle these challenges, a computationally-efficient algorithm that separately inpaints foreground objects and background is proposed. Using Dynamic Programming, foreground objects are holistically inpainted with object templates that minimizes a sliding-window dissimilarity cost function. Static background are inpainted by adaptive background replacement and image inpainting

In **[18]Timothy K. Shih, Nick C. Tang, Jenq-Neng Hwang** Image inpainting or image completion is the technique that automatically restores/completes removed areas in an image. When dealing with a similar problem in video, not only should a robust tracking algorithm be used, but the temporal continuity among video frames also needs to be taken into account, especially when the video has camera motions such as zooming and tilting. In this paper, we extend an exemplar-based image inpainting algorithm by incorporating an improved patch matching strategy for video inpainting. In our proposed algorithm, different motion segments with different temporal continuity call for different candidate patches, which are used to inpaint holes after a selected video object is tracked and removed. The proposed new video inpainting algorithm produces very few "ghost shadows," which were produced by most image inpainting algorithms directly applied on video. Our experiments use different types of videos, including cartoon, video from games, and video from digital camera with different camera motions..shadows," which were produced by most image inpainting algorithms directly applied on video. Our experiments use different types of videos, including cartoon, video from games, and video from digital camera with different camera motions..

In **[19] Felix Raimbault and Anil Kokaram** Video inpainting has become an important tool for rig removal but there has been little consideration of the problem in stereo. This paper presents an algorithm for stereo video inpainting that builds on existing exemplarbased video completion and also considers the issues of view consistency. Given user selected regions in the sequence which may be in the same location in several frames and in both views, the objective is to _ll in this area using all the available picture information. Existing algorithms lack temporal consistency, causing ickering and other artefacts. This paper explores the use of long-term picture information across many frames in order to achieve temporal consistency at the same time as exploiting inter-view dependencies within the same framework.

In [**20] Jan Herling, Member, Wolfgang Broll** While image inpainting has recently become widely available in image manipulation tools, existing approaches to video inpainting typically do not even achieve interactive frame rates yet as they are highly computationally expensive. Further, they either apply severe restrictions on the movement of the camera or do not provide a high-quality coherent video stream. In this paper we will present our approach to high-quality real-time capable image and video inpainting. Our PixMix approach even allows for the manipulation of live video streams,providing the basis for real Diminished Reality (DR) applications. We will show how our approach generates coherent video streams dealing with quite heterogeneous background environments and non-trivial camera movements, even applying constraints in real-time Our approach is based on a high quality image inpainting and allows for the realization of Diminished Reality applications. Our current approach was very much inspired by the randomized approaches This allows for even faster inpainting while improving the overall image quality significantly. Combined with new tracking approach and frame-to-frame coherence this provides the basis for real-time video manipulation By additionally applying a homography based approach, we can now achieve a high coherence for translational and rotational camera movements our pixel based approach to real-time image and video inpainting. We further showed how this approach enables the realization of Diminished Reality. Additionally, a real-time capable object selection and tracking algorithm has been introduced. Our inpainting approach allows for balancing between the spatial and the appearance term of the cost function in order to provide optimal inpainting results.The overall results showed fewer artifacts than other approaches, allowing for high-quality image inpainting in real-time This provided the basis for our self-contained high-quality video inpainting approach. We achieved this by extending the overall cost function by a frame-toframe coherence term and by applying a homography as a first guess for the mapping in the next frame providing a significantly better initialization. Our video inpainting approach is based on the previous and the current frame only, allowing for a high-quality manipulation of live video streams. In our future work, we are planning to extend the homography based approach to arbitrary 3D objects. Further, we intend to publish the results of a user study on the perceived quality and plausabilof our video inpainting approach. While the actual user study has already been conducted, it requires further analysis of the data obtained.

TITLE	YEAR /JOURNAL	MERITS	DEMARITS
Navier-stokes,fluiddynamics,and image and video inpainting[1].	2001/IEEE	Produce good results. There are no color or motion artifacts.	Only suitable for filling small non textured holes.

Erasing video logos based on image inpainting[2]	2002/ IEEE	The best quality logo frame that can be easily processed in the selected region of video frames.	Automatically finding and removing the logos in videos is not possible in this method.
Spatio-temporal texture synthesis and image inpainting for video Applications[5]	2005/ IEEE	High efficiency.	Search space is typically huge for video applications.
Full-Frame Video Stabilization with Motion Inpainting[6]	2006/ IEEE	This method transfers and interpolates sharper image pixels of neighboring frames to increase the sharpness of the frame. The effectiveness of our method is confirmed by extensive experiments over a wide variety of videos.	This Our method strongly relies on the result of global motion estimation which may become unstable when a moving object covers large amounts of image area.
Video Repairing under variable illumination using cyclic motions[7]	2006/ IEEE	Variable illumination&spatio-temporal consistency is preserved.	Works only for periodic motion. Cannot repair shadows of a damaged movel.
Efficient object-based video inpainting.[9]	2006/Preprint submitted to Elsevier	Can address videos from both static and moving cameras. Can handle large holes including cases where the occluded object is completely missing from several frames.	Results are unsatisfactory if number of postures is insufficient.
Video inpainting for largely occluded moving human[13]	2007/ IEEE	The proposed method can well repair the damaged video sequenceswithout introducing strong artifacts.	This method is notrepair moving humans with more complex motion.
A rank minimization approach to video inpainting[11]	2007/ IEEE	Can be used for non-periodic motion. Non-iterative and computationally attractive algorithm.	It cannot handle scaling or deformations. It causes blurring and ghost image artifacts if the objects motion is not periodic.
Video Inpainting Model for Camera Motion Based on Improved Background Subtraction Method[4]	2013/ IEEE	This can effectively avoid the occurrence of capitation moving targets.	This method has not achived high accuracy.
Intelligent Video Inpainting System for Texture Reconstruction[7]	2013/ IEEE	This method handled partially occluded objects and fully occluded objects at the same time thereby reducing the effort of segmenting the partially occluded objects and fully occluded objectsinto different groups and handle them separately.	This method only works with stationary background videos. The inter frame transitions do not appear smooth.
Exemplar based Video Inpainting for Occluded Objects[10]	2013/ International journal of computer applications 2013	Efficient algorithm This method works with only stationary background	This method not consider dynamic background

Video inpainting of objects using modified Patch based technique[8]	2013/ International journal of emerging Technologies in Computational and applied sciences	Remove objects with good subjective quality in terms of the objects spatial consistency and temporal motion continuity This method also works with the non-linearity of the occluded objects	Illumination change problem that occurs if lighting is not uniform across the scene

Table 1: A Survey on a Various Video Inpainting Approach

II. CONCLUSION

After studying some papers related to Video inpainting, it is very help full in the field of image processing. The main goal of video inpainting is to remove undesired object or repaired damaged object in input video. Each method has its own merits and demerits. We can choose our algorithm depending on our own requirement or depending on application.

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