Restoration of Digitized Vintage Films Using Video Inpainting

Ms. Kirave Vaishnavi Kiran and Prof. Thorat R. A.

M.E. (Electronics), Karmaveer Bhaurao Patil College Engg. & Poly. Satara, rvkshine@gmail.com
M. E. (Electronics), Karmaveer Bhaurao Patil College Engg. & Poly. Satara, roopa_thorat@yahoo.com
Electronics Department, KBPCE, Satara
Shivaji University

ABSTRACT

Inpainting is very advanced application of Digital Image Processing. Image inpainting or image completion is the technique that automatically restores/completes removed areas in an image. To restore videos image inpainting techniques shows some limitations. Video inpainting is an important video enhancement technique used to facilitate the repair or editing of digital videos. Now a day's transformation of cultural artifacts such as vintage videos/films into digital formats has been employed worldwide. Such videos usually have very poor quality and often contain unstable luminance and damaged content. This paper presents a video inpainting algorithm for repairing damaged content in digitized vintage films, focusing on maintaining good spatial (intra-frame) continuity. The key technique utilized so as to achieve spatial continuity is Frame completion. Frame completion repairs & restores damaged contents of frames of a video. Frame completion algorithm is one of the types of the Inpainting algorithm. This algorithm produces a visually pleasing video with good spatial continuity.

Keywords: Video Inpainting, Image Inpainting, Frame completion.

1. INTRODUCTION

Inpainting is very advanced application of Digital Image Processing. Image inpainting or image completion is the technique that automatically restores/completes removed/damaged areas in an image. To restore videos image inpainting techniques shows some limitations. To repair & restore any video, the temporal & spatial continuity among video frames needs to be taken into account. Video inpainting is an important video enhancement technique used to facilitate the repair or editing of digital videos. Now a day's transformation of cultural artifacts such as vintage videos/films into digital formats has been employed worldwide. Such videos usually have very poor quality and often contain unstable luminance and damaged content. It is found that the digitized vintage films contain some damaged information or some films may have lost some content of their information due to their age. Here presenting a Video inpainting algorithm to repair and restore such damaged vintage films. Video inpainting is one of the most challenging techniques that help users to remove undesirable objects and repair areas where content is missing or damaged [1].

This report proposes a video inpainting algorithm for repairing damaged content in digitized vintage films, focusing on maintaining good spatial continuity. The key technique utilized is Frame completion. Frame completion repairs damaged frames to produce a visually pleasing video with good spatial (intra-frame) continuity and stabilized luminance. To deal with image inpainting problems, researchers initially focused on removing or repairing small regions of an image using interpolation or smoothing techniques. In recent years, researchers have extended these well-developed image inpainting techniques to the repair of videos. An intuitive approach involves applying image inpainting techniques to each video frame so that the completed frames are visually pleasing when viewed individually [1].

Current inpainting methods can be divided into two approaches. The first approach inpaint the damaged areas of an image using only data from the same frame. The second
approach searches both the current and neighboring frames to find reference data for use in inpainting [1]. In this report a new approach is presented to inpaint the damaged content. In the presented algorithm, the required data so as to inpaint the damaged frame is collected from the next and previous frames of the current frame. Here the current frame addresses to damaged frame. Then the data is pasted onto the damaged frame.

It is found that when using existing video inpainting techniques to repair old films or remove undesirable objects, the unstable luminance and poor quality of the original film frequently cause visible defects in the resulting video. As a result, a new approach is needed to tackle the challenges presented by old films as well as by modern digital videos. To this end, a video inpainting algorithm that can address those challenges and produce visually pleasing results is being proposed here.

2. LITERATURE SURVEY

2.1 Video Inpainting On Digitized Vintage Film Via Maintaining Spatiotemporal Continuity:

The focus of this paper is to maintain good spatiotemporal continuity of a digital vintage film. To achieve, two key techniques are used: 1) Motion completion 2) Frame completion. Motion completion completes the missing motion information and maintains temporal continuity. Frame completion restores damaged content of frames of video and maintains the spatial continuity of the referenced data before it is pasted on damaged area. This algorithm is more useful when the video contain unstable motion and luminance. Visual defects may occur in the resultant video if damaged content having large area appears in every successive frame [1].

2.2 Region Filling And Object Removal By Exemplar-Based Image Inpainting:

This paper presents an algorithm to remove large objects from images. This algorithm combines the advantages of texture synthesis algorithms and Inpainting techniques. This algorithm uses Exemplar based texture synthesis which contains a process to replicate texture and structure. Inpainting techniques are used to filling small image gaps. The order of proceeding of filling the gaps decides the success of structure propagation. This algorithm is used to achieve simultaneous propagation of texture and structure information [2].

Figure 2 shows an example of this task in which foreground person is replaced by sampled data from background.

Figure 1 Visual defects generated by pasting image data into onto a missing area directly [1].

In this paper, the proposed video inpainting algorithm implements two key procedures, a motion completion procedure and a frame completion procedure, which try to inpaint, damaged video content while maintaining good temporal continuity of the inpainted video [1].

Figure 2 Removing large objects from images. (a) Original photograph. (b) The region corresponding to the foreground person (covering about 19% of the image) has been manually selected and then automatically removed [2].

Computational efficiency is achieved by a block-based sampling process. A number of examples on real and synthetic images demonstrate the effectiveness of this algorithm in
removing large occluding objects, as well as thin scratches. Robustness with respect to the shape of the manually selected target region is also demonstrated [2].

2. 3 Video Inpainting Under Constrained Camera Motion:

This algorithm inpaints the missing part of a video which is recorded with either a moving or stationary camera. The region to inpainted is general it may be still or moving, in the background or in the foreground, it may occlude one object and be occluded by some another object. The algorithm in this paper consists of simple preprocessing stage and two steps of video inpainting algorithm. Preprocessing is to roughly segment image into foreground and background. First step of video inpainting is to reconstruct moving object in foreground using a priority based scheme. The second step inpaint the remaining hole with the background. To achieve this frame aligning is used to copy data directly when possible. The remaining pixels are filled in by extending spatial texture synthesis to the spatiotemporal domain. Advantages of this algorithm are that it permits some camera motion, simple to implement, fast, does not require statistical models of background or foreground [3].

2.4 Exemplar-Based Video Inpainting Without Ghost Shadow Artifacts By Maintaining Temporal Continuity:

This paper discusses that an exemplar based image inpainting algorithm can be extended by incorporating an improved patch matching strategy for video inpainting. In this algorithm different motion segments with different temporal continuity call for different candidate patches those are used to inpaint holes after tracking and removing a selected video object. This algorithm produces very few ghost shadows in the resulting video as compared to other algorithms. Different types of videos like cartoon, video from games, video from digital camera with different camera motions can be used in this experiment [4].

2.5 Video Repairing Under Variable Illumination Using Cyclic Motions:

This article presents a complete system capable of synthesizing a large number of pixels that are missing due to occlusion or damage in an uncalibrated input video. These missing pixels may correspond to the static background or cyclic motions of the captured scene. This system employs user-assisted video layer segmentation, while the main processing in video repair is fully automatic. The input video is first decomposed into the color and illumination videos. The necessary temporal consistency is maintained by tensor voting in the spatio-temporal domain. Missing colors and illumination of the background are synthesized by applying image repairing. Finally, the occluded motions are inferred by spatio-temporal alignment of collected samples at multiple scales. This algorithm is experimented on a system with some difficult examples with variable illumination, where the capturing camera can be stationary or in motion [5].

2.6 Full-Frame Video Stabilization With Motion Inpainting:

Video stabilization is an important video enhancement technology which aims at removing annoying shaky motion from videos. This article proposes 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, this 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. The effectiveness of this method is confirmed by extensive experiments over a wide variety of videos [6].

3. RESTORATON OF DIGITIZED VINTAGE FILMS

This chapter focuses on Frame completion, proposed work and flow of execution. As mentioned earlier in the introduction
that the frame completion is used to maintain the spatial continuity of a video. Spatial continuity indicates the intra-frame continuity. It means Frame completion repairs and restores those damaged contents lying within the frame.

Frame completion repairs damaged frames to produce a visually pleasing video with good spatial continuity and stabilized luminance. It maintains the spatial continuity of the referenced content before it is pasted onto the corresponding missing area. This step is especially important when the luminance in old films is unstable [1]. The proposed process involves 3 steps: Scratch detection, masking and inpainting.

To restore the video, in this paper we are going to implement the detection, matching & pasting algorithm. The general block diagram of proposed work is given in figure 3.

Figure 3 General Block Diagram of Proposed

Figure 3 shows the general block diagram of proposed work. Patch searching and patch pasting processes units together to form the inpainting algorithm addressed in this report. This algorithm is called the frame completion algorithm which is used to maintain spatial continuity.

**Scratch detection:** This is the first step of the Frame completion algorithm. To begin scratch detection first we extract the frames of the digital input video. Each frame is scanned one by one to detect scratch. By assuming that the scratch pixels are to be pure white pixels, each frame is scanned. To achieve this RGB channels of each frame are checked to detect scratch pixels. According to this criterion pure white content of frame is marked as scratch. When the scratch is detected the frame is marked as damaged frame.

**Patch searching:** Second step of proposed work is patch searching. In this step we collect the reference data to form a best patch to be pasted on damaged frame. Reference data is collected from the reference frames. We take two reference frames to collect the reference data. These frames are: 1) next frame to damaged frame and 2) previous frame of the damaged frame. The patch is formed by averaging the reference data from both the reference frames.

**Patch pasting:** This is the third step of the proposed work. Once the patch is formed in patch searching step it is pasted on the damaged frame. This step completes the inpainting algorithm. After pasting the patch the original frame is restored.

Each detected damaged frame is repaired & restored separately. When all the frames are repaired & restored one by one video rebuild operation is executed. Video rebuild operation unites all the original & repaired frames to rebuild the original video.

**Execution flow:**

Figure 4 Execution flow

Figure 4 shows the execution flow of the proposed work. As the figure 4 shows the execution begins with browsing an input video. The input video must be digital. Then the video is processed to extract the frames. Figure 5 shows the example of
some extracted frames. All the extracted frames are stored together in a separate memory block. During execution of the program all the extracted frames can be viewed. At the end of the frame extraction process we start detection of scratch. Figure 6 shows the result of scratch detection. In this step each is scanned one by one to detect scratch as discussed previously in the description of proposed work. A supplementary is provided in this program that we can introduce scratch/scratches manually in any of the extracted frames by editing the frame in paint. This is to ensure the performance of the program. If no scratch is found in the scratch detection operation, we can introduce a scratch and continue to execute.

Figure 6 Detection of Scratch (Damaged Frame)

Figure 7 Masking of Frame

Figure 8 Inpaint frame

Masking operation can be executed after the completion of scratch detection. Masking is used to ensure that only the damaged content of the detected frame is utilized to perform the operations while remaining part is covered. Figure 7 shows example of masking. Then inpainting process can be executed. In this two operations are performed patch searching & patch pasting as discussed in the proposed in the proposed work. Figure 8 shows an example of inpainted frame. After repairing all the detected damaged frames video rebuild operation is executed. This process is the end of the execution and it produces the complete original video by uniting all the original and restored frames.

Suppose \( n \) number of frames are extracted from an input video. Out of \( n \) frames, \( m \) number of frames are found to be damaged. Then we have to repair \( m \) number of frames. The proposed algorithm does not repair all \( m \) frames at the same time. Also the frames are repaired neither in ascending nor in descending order of sequence of input video frames. A provision is given to select a frame manually to be repaired. The video rebuild operation can be executed even if only one frame out of \( m \) frames is repaired. In this case the output video will be generated with one repaired frame only. This provision will help when a frame having some pure white content is mispredicted as damaged frame. In such case, if we don’t want to inpaint the frame then we can rebuild the video without selecting that frame to repair. After repairing all the detected damaged frames video rebuild operation is executed. This process is the end of the execution and it produces the complete original video by uniting all the original and restored frames.
4. CONCLUSION
This paper presents a video inpainting algorithm for restoration of digitized vintage films. Few image inpainting algorithms are also discussed in this report. Image inpainting, image denoising, image stabilization, video inpainting, video denoising, video stabilization are the methods to repair and restore images and videos. Some of the restoration algorithms are discussed in the literature survey. Also this report presents a video inpainting algorithm to restore the damaged frames in digitized video. This video inpainting algorithm consists of three stages which are scratch detection, masking of image and inpainting. The proposed algorithm is used to maintain the spatial continuity. It is the most important video enhancement technique to indicate the repair and restoration of videos. The inpainting algorithm is divided in two steps as patch searching & patching pasting. The result of apply this inpainting algorithm is a visually pleasing output video.

The algorithm gives more accuracy in output as it uses neighboring frames to collect the reference data. It is very useful with the videos having frames with unstable luminance. When sufficient data is not available in the neighboring frames then the percentage of getting accurate result decrease slightly. In future experiments we can work with different types of scratch patterns multiple video formats for the advanced applications like image synthesis, cartoon making and fashion design.

5. REFERENCES

First Author – Ms. Kirave Vaishnavi Kiran, M.E. (Electronics), Karmaveer Bhaurao Patil College Engg. & Poly. Satara, rykshine@gmail.com