

# Geometric Reconstructions in Video Inpainting

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**Abstract:** *Inpainting, is the technique to modify the images so that changes made in the particular part of an images should not be noticeable easily by an observer. This inpainting includes restoration of harmed painting, selected objects to be replaced etc. In this paper, the selected fill regions can be inpainted by using information available from the surrounding source region. The filling of the region is to be processed in such a way that the outside boundaries of the particular fill region is to be completely filled inside. Similar approach had been applied in this paper on videos for better geometric reconstructions.*

**Keywords:** Image inpainting, Video Inpainting, Video to image converter, Image to video converter

## 1. Introduction

Inpainting technology has an important value for the special effects used in film, television and used in many applications such as old films, red eye correction, compression, image coding and transmission etc. Due to time consuming and manual process inpainting is carried out by the professional artist. This technique has the main goal reconstruction of the harmed regions of an image in such a way that the damaged region that had been inpainted should not be detected by the observer. By utilizing the spatial information of the neighbouring region of a damaged image or missing parts can be reconstructed by image inpainting[6]. Using image inpainting creating the original image requires the prior knowledge of the image. Aim of the algorithm is to reconstruction of the image by creating the visual pleasing continuation of the data around the damaged part so that it is not detectable by ordinary observer.

Diffusion technique for inpainting was first approached way to fill the harmed portions of an image. Equation of Partial Differential was required to develop the algorithm for inpainting the image[5]. The non-textured or very smaller missing regions can be filled by the diffusion-based inpainting[1]. But this process has a drawback that the diffusion process introduces blur portion which is very much easily noticeable when filling larger portions.

Later K-N model was introduced in order to overcome from these issues by considering into another level in which low resolution packages of data picture was enrolled and then inpainted. Low-determination and high determination patches were learnt by the K-NN model from the data picture. Correspondences occur between both resolution patches that use to find the missing pixels. Further, image inpainting of the unwanted portion is done from the knowledge of the neighbouring region by gradient value of the particular pixels with respect to the confidence term and data term of the pixel of the fill region and the source region. Accordingly the matrix for the each and every pixel created for the fill region and the source region in order to inpaint the highest confidence term in the fill region with respect to source region.

## 2. Related Works

Harmed parts can be overcome by using the texture based synthesis algorithms by using similarly matching pixels around damaged portion. This technique performs well only for the selected number of holes of the damaged image[3]. In this, stitching technique is used for the inpainting of the small patches[1]. Parametric structure algorithm was developed by the Bergen and Heeger which synthesize the texture that is matched for the targeted texture[1]. This technique first matches the order of the statistics of the linear filter bank that matches roughly the discrimination of the texture. The texture synthesis objective was to generate texture patterns in such a way to reproduced the texture some similar to root texture[1]. Difficulty arises by handling the natural images because these images are composed with the structured edges and also the difficulty for the interaction between the texture boundaries and the structural boundaries[3].

Partial Differential Equation (PDE) algorithm is an iterative process. This process makes the continuation of information near to the border of the patch. This technique produces the good result if there are small missing regions. But for the large missing regions, it does not produce good results and this is time consuming process[8]. The Total Variational(TV) inpainting model uses the diffusion based on the isophotes strength. This process has better performance for the noise removal applications and for smaller regions. Drawback arises here because it neither works with the texture patterns nor connects with the broken edges. The CDD (Curvature Driven Diffusion) model was extension of the TV model. This model uses the information of the isophotes curving in order to have curve portion[5]. Above all the process have some problems such as process produces the blurred resulting image, large textured regions are not well reproduced and are time consuming process. The exemplar-based approach is a very crucial concept for the image inpainting. This process includes assignment of priority based technique and by choosing best matching patch. Exact appropriate patch selection is done from the known neighbouring regions, then in accordance with this region the similarity is measured on metrics and accordingly missing region gets paste with the information of the surrounding regions[4].

Exemplar-based inpainting works with the unknown regions which is the targeted region for the inpainting. Exemplar-based process includes mainly following steps: a) Initialization of the targeted region in which the extraction of the missing regions and the representation of the appropriate data structures. b) Computation of the filling region priorities in accordance with the knowledge of the damaged patch. c) After the computation, updating of the damaged region of an image is done[7]. Further, priority function improves the robustness. The function for the weight similarity was introduced which includes the various source patches which helps to reconstruct the targeted patch[8]. Curves edges that exists in any image can be inpainted very carefully by using the texture propagation[5]. Thus the damaged region can be inpainted with the help of the structure information and curve filling process.

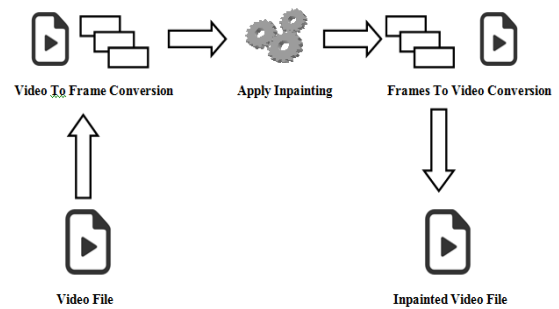
Exemplar-based process works well with the recovering the damaged part and also works well with the geometric structures as well as the texture with smaller areas[9]. Then the Criminisi developed a very good and easy approach that helps for filling the patch from the boundary of the targeted region and then use of the sum squared difference which helps for the selection of the matching patch[7]. With comparison to diffusion process, the approach of exemplar technique achieves the appropriate results to cover various textures and structures[4]. This process works well only with images that contain the simple textures and structures. But still this exemplar-based algorithms arises to some problems such as enough samples are required in order to synthesize the required picture[7]. Shortage of samples of a particular image leads to the inappropriate inpainting[9].

In neighbourhood method, by identifying pixel value that is centrally located that is surrounded by neighbourhood pixel which contains properties such as direction, variation of colour, intensity and repetition[6]. The neighbourhood of a pixel is the set of pixels that touches the damaged portion of an image. The pixels neighbouring to a targeted pixel P, is the set of surrounding pixels which share an edge and a vertex of that pixel[6]. In the existing inpainting methods includes the smoothest continuation of the local structure[6]. Inappropriate exists due to increase in size of the image which is to be inpainted results in the increase of the domain.[1] However these methods employs a little circulated area surrounding the domain of inpainting that helps to repair the unknown part. Complication occurs due to occurrences of the both texture and structure and the texture disturbs the process of inpainting, results to false edges of the repaired image [1].

### 3. Proposed System

The inpainting technique goes to the next level to the inpainting videos. At a time one video can be inpainted only. After the inpainting procedure completes the inpainted video is considered as the output. The proposed system architecture contains 3 modules in order to inpaint the video. Figure 1 shows working of the 3 modules for the video inpainting are as follows:

- (A) Video to Image Converter
- (B) Inpainting of images (frames).
- (C) Images (Frames) to Video Converter.



**Figure 1:** Proposed System Architecture for Video Inpainting.

Each block of the above system is described in detail as follows and thus the application starts working:

(A) *Video to Image Converter*: At the beginning, browse the video file and thus the location of the selected video is displayed on the screen. Then, click on the „convert“ button to convert the video into various frames. As the video is the collection of the number of images (frames) so splitting is necessary for inpainting process. Then number of frames thus generated.

(B) *Inpainting of images (frames)*: Now the second step is to browse each frame in order to do inpainting. Then select the region in order to remove from the frames. This process continuous till the inpainting is applied on all the frames. This process is done by the fast inpainting technique. *Fast inpainting* is the process where the selected fill region is to be inpainted by the neighbouring pixels with respect to the source region. Thus the highest confidence term is inpainted in the fill region with respect to the data term. Thus *Fast inpainting* is faster and have good performance with respect to the normal inpainting. In normal inpainting when the unwanted region is selected, then that region is not properly inpainted and that region can be easily detected by the ordinary observer. And in this the recovery of the damaged pixels or the removed region is not possible. So to overcome this problem *fast inpainting* technique is applied.

(C) *Images (Frames) to Video Converter*: Now, the integration of all inpainted frames are required in order to create the inpainted video as an output. Thus the required region is thus removed from the video and thus the process of the inpainting video is accomplished.

### 4. Algorithm Used

In inpainting technique, the unwanted region gets selected by clicking on the boundary of the unwanted region and thus the region is masked which is call the fill region.

In inpainting technique, the unwanted region gets selected by clicking on the boundary of the unwanted region and thus the region is masked which is call the fill region. So fill region can be inpainted by using the information of the neighbouring source region. So the inpainting is done from the boundary towards the inside of the fill region. Fill region is inpainted in such a way that the ordinary observer cannot detect the region which had been removed.

### A. Boundary Filling Algorithm:

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#### Algorithm 1: Boundary fill algorithm

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Step 1: The boundary fill procedure accepts input as the fill region and the boundary region.  
Step 2: Starting from, the procedure tests the neighbouring positions to determine whether they are boundary region.  
Step 3: If boundary region determines the neighbouring positions then the inpainting process gets started to the fill region by using the source region.  
Step 4: Thus the filling of the fill region continuous from the boundary towards inside till all the pixels of the fill region inpainted.

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### B. Video Inpainting Algorithm:

As from the images the unwanted or the damaged region or regions can be deleted similarly user can also remove the unwanted region or regions from the video by using video inpainting algorithm. Then the algorithm gives the inpainted video as an output as expected by the user.

Firstly, the video file gets selected by the user which is to be inpainted. Then that video file gets converted into the number of frames. For each and every action single frame is created. As soon as the video conversion to frame takes place, these frames get automatically save in the original drive where their libraries are saved.

These frames are the images, as we all know that the video is collection of number of actions images. Then from these frames select the region which is not required by using inpainting technique. Then after inpainting the frames, merging of the frames is necessary which possible by converting images to video. Thus the integration of inpainted frames along with all frames into video is accomplished and now inpainted video is ready to play.

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#### Algorithm 2: Video Inpainting

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**Input:** Video.

**Output:** Inpainted Video

**Method:**

Step 1: Start.

Step 2: Select the video file from the disk file.

Step 3: Convert that video into the frames.(Converted frames are store in disk:\\ffmpeg\\bin default.[ffmpeg is the library used to convert the video into frames.])

Step 4: Apply inpainting to the images (frames) and remove the region that you want to remove from the video.

Step 5: Apply the inpainting to the region selected by the user.

Step 6: Follow the step 4 and 5 to the selected images.

Step 7: Merge all the frames to the video file.

Step 8: Save the file into the disk.

Step 9: Play the video to test the applied inpainting result

Step 10: Stop

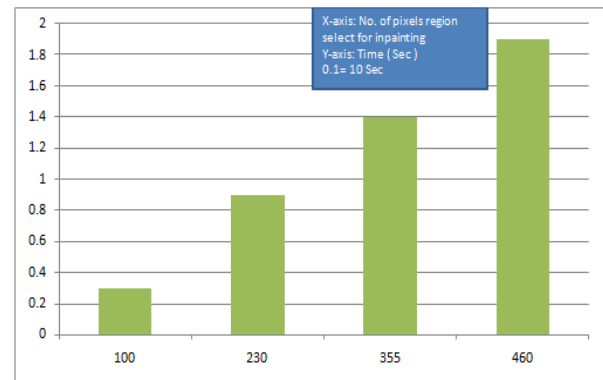
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## 5. Results

Computerised pictures are the formation of the pixels as discussed above. In this work, inpainting of the image takes

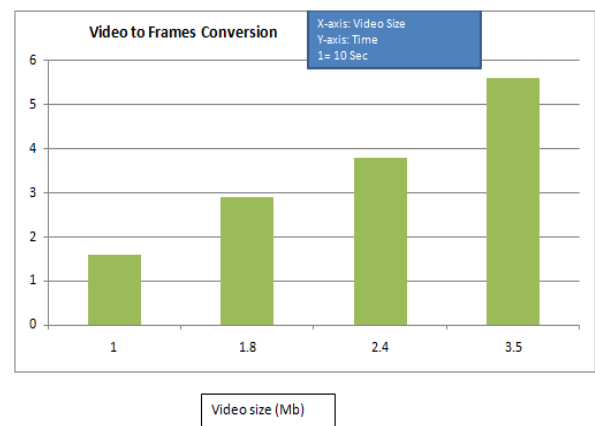
place with respect to the pixels and the time taken for the inpainting process. Thus some graphs are discussed below according to the selected region for the inpainting process. These are the results present below are after the successful execution of our work as discussed in section III.

Below graph(figure 2) describes that when the particular area is attempting for the inpainting process then X-axis represents the number of pixels gets selected for the particular region for inpainting and Y-axis represents time(seconds) taken for the inpainting process. Thus time taken for the inpainting process is in very less time.



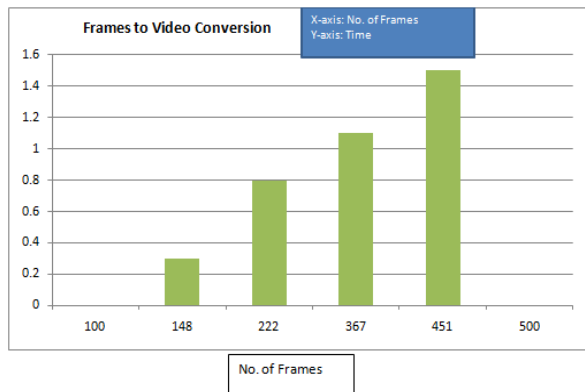
**Figure 2:** Image Inpainting graph

When the inpainting process have to perform on the video then for that, video to frames conversion is required. Thus these frames get ready for the inpainting process. Below figure 3 shows the representation on the X-axis for the size (Mb) of the video and Y-axis represents time (seconds) taken to convert the video into frames.



**Figure 3:** Video to Frames Conversion

When frames get ready for the inpainting process then the unwanted region gets remove from frames and after the successful completion inpainting on all frames then the integration of all inpainted frames get started to create the final inpainted video. Thus the above figure 4 shows the representation on X-axis shows number of inpainted frames. Y-axis shows the time (seconds) taken to integrate all number of frames in order to create the inpainted video file.



**Figure 4:** Frames to Video Conversion

## 6. Conclusion

By using the video inpainting technique the unwanted image can be removed and replaced. Here by using video inpainting algorithm, the user needs to give an area for inpainting and the further process is performed. Thus the result of inpainted videos are sharp and without blur.

## 7. Possible Future Work

Automatic selection of the damaged region from the image by using the intelligent algorithms can be a future scope. Another future work can be in real images, i.e. three dimensional images, objects that are symmetric not necessary may appear exactly same with the projection from the 3D plane to the 2D image plane. By modelling the appropriate transformation can result in an appropriate completion by optimizing the function of cost over all the projective transforms.

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