An Examplar Based Video Inpainting using Dictionary Based Method

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Abstract:-Inpainting is a skill of rebuilding lost or selected part from the image based on relatedor available information. Reconstruction of missing parts in videos is used extensively nowadays. A method for video inpainting usingexamplar-based inpainting is introduced in the system. The examplar based inpainting samples and copies best matching texture patches using texture synthesis. Matching patches are extracted from the known part of the frames from the video.
Input frames are extracted and inpainted using examplar based method. For that dictionary is maintained which consists of legal patches. The input picture isinpainted several times with different parameters. Then it is combined and details are recovered to get the final inpainted video.

Keywords: *Examplar based inpainting, Dictionary based method, texture synthesis*

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1. INTRODUCTION

Inpainting is the skill of restoring missing parts of an image and reconstructing them based on the contextual information. Most of the harms in any image or video are often generated by noise, scanned old photo paper, dust or stains resting on the scanning glass of a scanner, scratched images or others have logos or stamps. Another point is that pictures or videos are not always captured by professionals so there may be possibility of some kinds of holes remains in the picture or video. To remove such holes from images or videos inpainting can be used. Also inpainting can be used in producing special effects by eliminating undesirable objects from the image. Undesirable objects may range from microphones, ropes, shadow, some unwanted people and logos, stamped dates and text etc. in the image. During the broadcasting of images or videos over a network, there may be some portions of an image that are not available.

These parts can then be reconstructed using image inpainting.Rebuilding of missing parts or scratches ofimages is an important field used extensively in artwork restoration.

This paper focuses on video inpainting technique based on image inpainting. It goals to remove objects or rebuild missing regions present in video by exploiting spatial as well as temporal information using neighboring picture frames. This particular approach can be applicable to videos as well as to image but there are some differences between image and video inpaintng.

The major difference is related to its size. Video inpainting deals with comparatively large region with the focus on filling in of two dimensional repeating patterns. Another difference is characteristics of the region to be inpainted. In image inpainting only spatial dimensions can be considered while in video inpainting temporal dimensions can be also applicable. So in video inpainting better outcomes can be produced.

This method gives a framework for inpainting unwanted portions of a video series using exemplar based method.Mainly all inpainting methods are based on two basic categories. The most fundamental inpainting approach is diffusion based method which relies on patial differential equation. In this method, image inpainting can be done by propagating linear structure called as isophotes via diffusion based on partial differential equation. But in this approach some distortion will be introduced when it is used in huge region. Another method of inpainting is exemplar based inpainting. In this method best matching patch will be found out and the hole will be replaced using such matching patch.
The rebuilding of image can be done by using two approaches, texture synthesis and structure recreation. Texture synthesis algorithm samples the texture from the region other than the region to be inpainted. It is used on textures repeating two dimensional patterns. Structure recreation algorithm recreates the structure like lines and object contours. This is generally used when the region to be inpainted is small in size. This focuses on linear structure which can be considered as one dimensional pattern such as lines or object boundaries. In this method combination of both these methods is used.

In this approach the video and the region to be inpainted is taken from the user. The region to be inpainted is selected by user manually. The input video is then converted into multiple picture frames and the frames which needs to inpaint are separated out from remaining frames. Then the low resolution images are first constructed from original frames. Inpainting algorithm is applied on low resolution frames also different settings are applied on it. After that quality of inpainted frames is improved by using single image super resolution method. Lastly all these frames are combined to produce output video.

2. LITERATURE SURVEY

This section discusses existing inpainting techniques with their benefits and weaknesses. Presently there are some accepted technologies for carrying out the work of inpainting. The first approach introduced is diffusion based method [2]. In this method, image inpainting can be done by

spreading linear structure called as isophotes via diffusion based on partial differential equation. This approach is suitable for small area but introduces some blur when the hole to be filled in large area. Another approach for inpainting is vector valued algorithm which uses mathematical formula based on partial differential equation to inpaint an image [3]. But this method is not efficient to represent the flows of large image distortion.Also one morediffusion based approach is variance-based diffusion method which uses Euler-Lagrange equation and inside inpainting domain employs diffusion based on isophotes [4]. A variational approach for filling-in regions of missing data in gray level and color images is introduced. It can be useful in removing noise but do not connect broken lines or edges.
The first attempt to use examplar-based technique for the removal of objects is given in non-hierarchical method for re-synthesis of textures [6]. In this algorithm, pixels are chosen for the patches which are in output image. It helps to reduce the blur remain in the diffusion based method but uses only the interaction of nearby pixels for reproducing large features. After this fragment based method is implemented and evaluated which improves the search for similar patches by introducing a priori rough estimates of inpainting values [5]. In this method confidence values can be calculated by assigning values to the pixels and visual parts are taken as training set. This results in iterative approximation of missing regions from coarse to fine levels but it has the limited training set.

Next exemplar-based approach is based on local geometry.In this paper, a novel inpainting calculation is proposed joining the benefits of PDE-based plans and examplar-based methodologies [11]. The proposed calculation depends on the utilization of structure tensors to characterize the taking care of request need and format coordinating. The structure tensors are registered in a hierarchic way while the layout coordinating depends on a K-closest neighbor calculation. The quality K is adaptively set in capacity of the nearby composition data. Contrasted with two cutting edge approaches, the proposed system gives more lucid results. The proposed method provides more coherent results than previous methods but introduces some blur due to diffusion. The exemplar-based approach is related to texture synthesis which is introduced in texture synthesis by non-parametric sampling [7]. These methods are known to work well in cases of repeating textures.

Another approach is based on quality prediction which utilizes naturally determined quest space requirements for patch source locales, which prompt enhanced composition union and semantically more conceivable results [10]. These imperatives likewise encourage execution forecast by permitting us to connect yield quality against elements of conceivable districts utilized for blend. The prescient capacity in this approach is utilized to locate an ideal harvest shape before the fulfillment is figured, possibly sparing critical measures of calculation. An advanced harvest incorporates however much of the first scene as could be expected while staying away from areas that can be less effectively filled in. But it avoids regions that can be less successfully filled in.

Next idea for image completion is related to Statistics of patch offsets which uses insights of patch counter balances [8]. It facilitates that watch that a couple of prevailing balances give dependable data to finishing the picture. This method yields generally better results and is faster than existing state-of-the-art methods but it is less suitable for synthesizing semantic textures or structures. Another method suggested for patch propagation is using patch sparsity. This gives a novel patch propagation based on examplar algorithm for scratch or text or object removal [12]. It investigates the sparsity of natural objects but at the small scale.

In earlier stages the super resolution based inpainting is introduced. A coarse form of the information picture is initially inpainted by a non-parametric patch inspecting [9]. The inpainted version of a coarse adaptation of the picture permits to diminish the computational intricacy, to be less touchy to clamor and to work with the overwhelming introductions of picture structures. From the low-determination inpainted picture, a solitary picture super-determination is connected to recuperate the subtle elements of missing regions. This method reduces the computational complexity but the quality of the low-resolution inpainted image has a critical impact on the quality at the final resolution. This approach is then advances to Hierarchical Super-Resolution-Based Inpainting [1]. It comprises in performing first the inpainting on a coarse version of information picture. A progressive super-determination calculation is then used. It is easier to inpaint low-resolution pictures than high-resolution ones. The gain is both in terms of computational complexity and visual quality.

3. PROPOSED WORK

Image completion of large missing regions is a challenging task. As presented in the previous section, there are a number of solutions to tackle the inpainting problem. In this proposed system,a new inpainting framework relying on both the combination of exemplar based inpainting algorithm and a dictionary based method. This section presents the main ideas of this paper and the reasons why the proposed method is new and innovative. The goal is to enhance the quality of picture and video after inapinting is done.

Given an input video, required frames are separated out from the video on which the examplar algorithm should be applied.

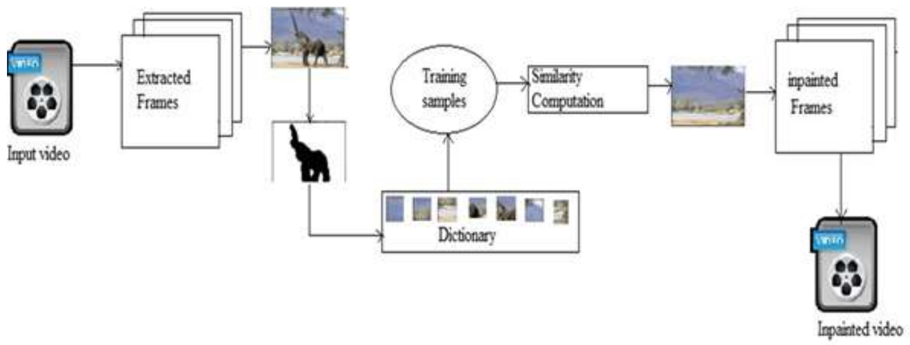

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Figure: 1 Framework of proposed method

Fig. 1 illustrates themain concept underlying the proposed method: An input frames are selected from the given video; then the object to be inpainted is selected from selected images. An inpainting algorithm is applied to fill in the holes of the selected picture. Different settings are used and inpainted pictures are combined; and the quality of the inpainted regions is improved by using a dictionary based method. Using data and confidence terms, similarity is calculated and the previous patch is replaced by highest priority patch. Finally all such frames are combined to form output inpainted video.

Patch Priority: The filling order computation defines a measure of priority for each patch in order to distinguish the structures from the textures. Classically, a high priority indicates the presence of structure. The priority of a patch centered on Px is just given by a data and confidence term.

Texture Synthesis: The filling process starts with the patch having the highest priority. To fill in the unknown part of the current patch Px , the most similar patch located in a local neighborhood W centered on the current patch is sought. A similarity metric is used for this purpose. The chosen patch maximizes the similarity between the known pixel values of the current patch to be filled Px and co-located pixel values of patches belonging to W.

4. MODULE DESCRIPTION

This method starts withpatch priority and texture synthesis methods using inpainting algorithm and combines it with the dictionary based method. Both are collectively used to fill holes as they remove unwanted features or holes in the image.

Basically it takes input video from the user. After that the user selects the region to be inpainted with a separate process. Then the video to be inpainted is converted into number of picture frames. Frames with input region are separated out from all other frames. And build low resolution image from the selected image. Then apply Examplar-based algorithm on the low resolution frames which will produce inpainted frames. Then to improve quality of inpainted regions the single image super resolution method is used. Finally output will be generated by combining all picture frames to reconstruct video.

4.1 Examplar-based algorithm:

Here, 'I' denotes the input image. 'Ω' denotes the region to be inpainted. 'Φ' denotes the region from which information is available to rebuild the image. Then, Φ = I – Ω. Also, 'δΩ' denotes the outline of the target region. Examplar based algorithm involves the following steps:

1. Set the region to be inpainted: This is performed separately from the inpainting process and additional image processing tool needs to be used. This can be done by assigning separate color to the region to be inpainted.

   Here Source region = Input region – Region to be inpainted

2. Select the outline of the region to be inpainted.
3. Find a patch ψpfrom the region to be inpainted: The patch size should be a bit larger than the largest distinguishable texture element in the image.
4. Find the patch of size N*N pixels from the image which is the best match for the selected patch or compute filling priorities (Give linear structure higher priority)

   P(p) = C(p) D(p)

   where C(p) denotes the confidence term for the patch and D(p) the data term for the patch. The confidence term C(p) is a measure of the amount of reliable information surrounding the pixel p. The intention is to fill first those patches which have more of their pixels already filled, with additional preference given to pixels that were filled early on. The data term D(p) signifies the strength of the gradient function at that point. The data term is based on the product of isophotes and a unit vector orthogonal to the front of an inpainted area. The data term gives a high priority to inpainted area which has a potential to copy structural information from the source area.

   These terms are defined as

$$\mathbf{C(p)} = \frac{\sum_{q\in\psi_p\cap\phi} C(q)}{|\psi_p|}$$

$$\mathbf{D(p)} = \frac{|\nabla I_p^{\perp}.n_p|}{\gamma}$$

   Where, |Ψp| is the area of Ψp,

C(p) is the confidence term and D(p) is the data term,

α is a normalization factor,

np is a unit vector orthogonal to the front $\partial\Omega$ in the point p and

$\perp$ denotes the orthogonal operator.

P(p) is the priority computed for every border patch, with distinct patches for each pixel on the boundary of the target region.

5. Update the image information according to the patch found in the preceding step.

4.2Dictionary-based method:

For improving quality of a picture dictionary method can be used. For dictionary based method, dictionary of various pictures is maintained. The dictionary contains legal patches required for the proper reconstruction of video. Legal patches are the part of picture whose pixels are entirely recognized. For this purpose, the patches are taken out from the known part of an image.

In this dictionary based method, the appropriate patch from the dictionary is selected and fill it at required location. To select the appropriate patch, the priorities of patches are calculated. The patch priority can be calculated based on the previous algorithm and the best matching patch is selected as replacement.

5. CONCLUSION

An advanced video inpainting technique is proposed which combines examplar based algorithm with dictionary based method. The required frames are taken out from the input video and the object to be inpainted is selected manually. The object selected is inpainted using combination of examplar based algorithm as well as dictionary based method. The exemplar algorithm works on patch priority as well as texture synthesis. The patch priority is calculated based on data and confidence terms. In addition to this, dictionary based method is added to give image enhancement which maintains legal patches of an image. These patches can be useful to replace the less resolution patches to give enhanced picture quality. These patches can be replaced based on the priority. This method can be applicable to videos and also to images.

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