ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

AN EFFICIENT ALGORITHM FOR THE EXEMPLAR BASED IMAGE INPAINTING

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ABSTRACT

Image inpainting is the procedure by which we can fill the lost regions of an image. To renovate the lost regions in a visually probable manner is the main goal of image inpainting methods. There are lots of algorithms are offered by the researchers in the literature for the same. Here, in this paper we introduce a literature review of some modern exemplar based image inpainting techniques and we provide their advantages and disadvantages. An overview of image inpainting is also given at the beginning. We have also proposed a novel exemplar based image inpainting method. The proposed method will remove complete object from an image or a part of the object & it will produce high quality results.

INTRODUCTION

In the field of image processing, image inpainting is very significant research area whose main aim is to eliminate the defined objects or reestablish the lost regions in a given image in a manner that viewers cannot notice the defect. There are lots of applications of image inpainting techniques for example- photo editing, image compression, video editing, and image transmission etc. In general, image inpainting techniques can be classified into two methodologies- Exemplar-based techniques and diffusion-based techniques. The diffusion-based technique is the very important category, in which the knowledge/information diffuses from identified region into absent region. This type of problem is generally handled with the help of Partial Differential Equation (PDE), thus, this technique is also known as PDE-based technique. Diffusion-based technique is more suitable for the images in which the lost region must be lesser and diluter as compared to the bounded object, this type of image is known as non-texture image. This technique is not more suitable and produces unclear results for the images which having large missing region or having texture [1].

The Exemplar-based technique is first introduced by A. Efros and T. Leung in [2] in the form of Exemplar-based texture synthesis. In that research work, by utilizing the best similar patch from the identified region the synthesis of texture is done. As we know that a natural image contains both structures as well as textures, so, direct utilization of exemplar based texture synthesis on image inpainting problems may not offer agreeable outcomes. A technique offered by Bertalmio [3], in which an image is decompose into textural image and structural image, after decomposition of images both images are handled with the help of different techniques. For the structural image they utilized diffusion- based inpainting technique and for the textural image they used texture synthesis technique separately. The result produced by combining the features of both techniques is better than the results offered by the diffusion-based inpainting technique or texture synthesis technique in alone. A patch priority based technique is demonstrated in [4] by Criminisi et al, to find the fill-in order for exemplar based texture synthesis technique, and this patch priority is decided by utilizing isophote direction and identified region in the target patch. Exemplar-based inpainting technique offers better results as compared to diffusion based inpainting technique, also in the case of large lost region [1].

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LITERATURE SURVEY

At present there are limited numbers of tools and technologies are available that are fully capable of doing work of image inpainting. It is very emerging field and lots of research needs to be carried out to meet the demand of growth in this technology. A technique called restore inpaint is presented in [5], which enable us to detect and correct cracks without any supervision from scratched images, also this technique is an open source library. Software by Hanov solutions called Photo-Wipe is mentioned in [6] which carried out the same task mentioned above, it also offers tools to choose the region which needs to be inpainted, and also it enables us to inpaint with various time and quality using options provided in software.

The algorithm infect conflict the observer to be a de-noising algorithm use for modifying individual pixels of the images but in reality it is an inpainting algorithm used to correct the large area of damaged pictures. The prime difference between inpainting and de-noising is that inpainting doesn't required the image information while modifying the damaged image area on the other hand de-noising depends upon the image information into the infected pixels along with noise information [7]. In general the noise removal technique is not suitable for filling the big lost regions in an image.

Generally, the image inpainting techniques work as follows: initially, user chooses the region which wants to be inpainted; this is done with the help of other image processing tools because it is separate process then inpainting. Then the process of image renovation is done automatically. An image inpainting technique required generating a visually feasible renovation for this purpose it required making an effort towards the efficient renovation of isophotes and furthermore it disseminate 2-dimensional textures. Various image inpainting techniques are categorized into three categories according to the above two needs, which are as follows.

The first category of techniques is generally utilized for reestablishing the films or videos, in this technique we have less amount of information to inpaint the image on the other hand film inpainting extract the information from the frames, so this category of techniques generally not utilized for the purpose of image inpainting. The second category of techniques is normally utilized for renovation of textures from the given image [8]. For the purpose of reestablishment of an image these techniques use the samples from the target area. We can reestablish maximum part of the texture of a given image with the help of these techniques. The third category of techniques gave efforts towards the renovation of structural characteristic of the image like- object contours, edges etc. The pioneering work presented in [7] has utilized the third category techniques. This technique is suitable for elimination of structural characteristics of a given image, but it is not suitable in the case of large regions. The authors of [9] have offered a technique which utilizes mask to attain the image inpainting. The process of picking mask involves the user involvement and interactivity. With the help of this technique, we can choose the mask whose centre element value is zero in the mask, means that with the help of its personal value we can't excerpt the knowledge about the pixel. Instead of this we can utilize the values of its nearby pixels to find out the values. This technique is too suitable for small size regions, but not in the case of large regions.

One more technique is offered in [10] that utilized Cellular Neural Networks to eliminate the small regions as well as noise in a given image with very high noise ratio. On the basis of different levels of neighboring information the noise in the cell are inpainted with their different sizes. It did de-noising of an image with very high accuracy by utilizing inpainting methods. This technique offers good results but it also not suitable in the case of large regions.

The authors of [11] have demonstrated a technique to inpaint the gray-scale images by utilizing Cahn Hilliard fourth order reaction equation. The authors of [3] proposed a technique which utilize the technique offered in [11] by incorporating total variation flow for given images.

A technique for holes filling in the overlying texture and image synthesis of cartoon has offered by M. Elad et al in [8]. This technique directly utilizes morphological component analysis and the main purpose of this technique is to isolate the linearly mutual texture and cartoon. The main difference between this technique and the technique offered by

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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the authors of [7] is that they reassumed decomposition of image and filling in holes are two different phases but here in [8], assumed that both are as single phase.

There are some techniques offered in literature, which takes benefits of both the inpainting techniques texture synthesis techniques as well as structure renovation techniques. Criminisi et al [4] have offered a technique called pioneer which takes benefits of both the inpainting techniques texture synthesis techniques as well as structure renovation techniques. The order of filling is very important factor for image inpainting and the efficiency of this technique is commonly relying on this factor. The authors of [12] have offered a technique called the traditional concentric layer filling (onion-peel), which is utilized for describing the filling order for region but it is unsuccessful when renovate the structural features.

T. Shih et al [13] have offered a technique which is utilizes for video inpainting and this is done by means of placing the objects from further frames, also they have offered an exemplar based inpainting technique for the same purpose. One more technique for the same purpose is proposed by the authors of [14] to accomplish the task of image inpainting by interpolation depends upon the information of nearby frames. The work done in [15] presents a technique for video inpainting that utilizes exemplar based image inpainting technique. They have mainly concentrated on the elimination of scratches and renovation of old movies. This technique broadens the idea of block dependent exemplar based inpainting technique with the help of motion estimations.

OBJECTIVES

Following are the objectives of the proposed inpainting technique:

1. It will utilize for renovating the old images.
2. It will utilize for deletion of complete object or a portion of the object from a given image.
3. It will generate high quality of outcomes.

Solution Domain

In this section, we will describe the offered technique by which we can gain our proposed objectives. The outline of the planned technique is as follows:

1. Selection of target region: Initially, user chooses the region which wants to be inpainted; this is done with the help of other image processing tools because it is separate process then inpainting. In general, for the choice of the target region, we utilize a specific color for example-green. In addition to this, there must be no loss of generality.
2. Locate all the borders of the target region: After the selection of the region which wants to be inpainted; we locate all the boundaries/borders of the target area and this is done with the help of other image processing tools, because our aim is just to renovate the given image.
3. In the target area, choose a patch which is to be in-painted: Now, in the target region, we choose a patch which is to be in-painted. The patch size is generally chosen in such a way that it should be large than the biggest distinguishable region of the image. In our method, the default patch size we have utilized is 9 * 9. It can be changed. Also the patch is indicated by PTCH.
4. Find out the similar patch in the image: Now we can search the similar patch in the image. We utilize the Mean Squared Error to discover the best similar patch.

$$\mathbf{MSE} = \sum \frac{(f_{x,y} - g_{x,y})^2}{N}.$$

5. Inpaint the image: Now we can inpaint the image with the help of patch discovered in the previous step.

Figure- 1 shows the outline of the proposed model for image inpainting.

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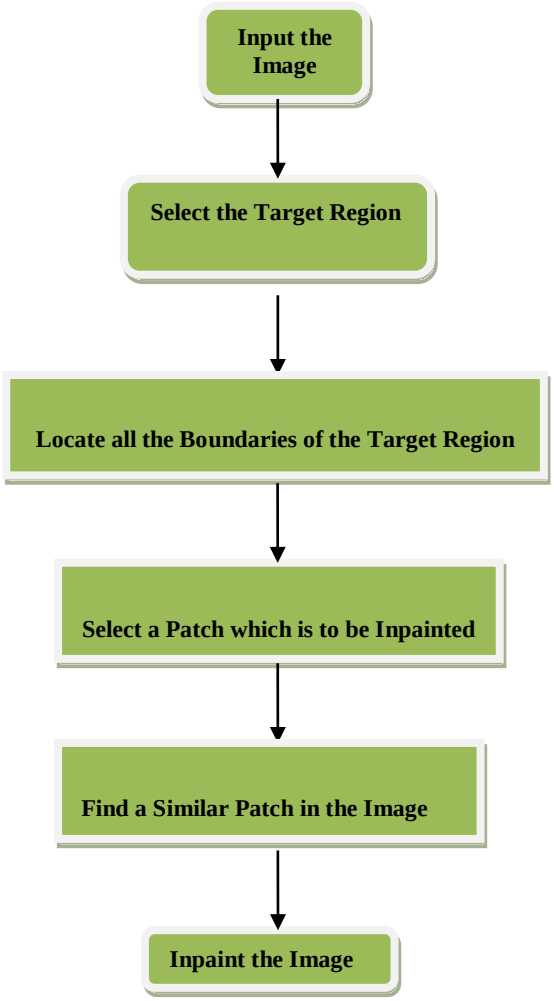

Fig- 1: Outline of Proposed Model for Image Inpainting

CONCLUSION

In this paper, we have offered a novel exemplar based technique for the image inpainting. It will utilize for renovating the old images, for deletion of complete object or a portion of the object from a given image. It will also capable of generating high quality of outcomes. In this paper, we also introduced a literature review of some modern image inpainting techniques with their advantages and disadvantages. An overview of image inpainting is also given at the beginning. The common problems of modern image inpainting techniques have been identified.

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ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
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