

Image Inpainting with Improved Storage Capability using DCT

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Abstract- Nowadays, tremendous amount of digital media is generating but having grazes on it. In this paper we proposed new idea to remove the graze from image, called image inpainting where in, Exemplar based image inpainting follows discrete cosine transform. The exemplar based image inpainting is based on copy-and-paste texture synthesis for reconstructing damaged parts of an image. Based on exemplar-matching techniques performance and speed of algorithm increases but size of image is also increases so, we proposed discrete cosine transform for reducing the size of image, removing noise and ultimately provides it good quality of image.

Keywords: *Inpainting, exemplar-matching techniques, Criminisi's Algorithm, DCT, texture synthesis.*

I. INTRODUCTION

Digital format is used to store images in computer. When we consider the digital images then there is chances of corrupted images so recovery of partially damage, corrupted and modified image plays very important role in Digital Image processing. To recover damage images, technique is used is called Image Inpainting. Image Inpainting is a method for repairing damaged pictures or removing unwanted elements from pictures. It recovers the missing or corrupted parts of an image so that the reconstructed image looks natural. The main aim of inpainting is to modify the damaged region in such a way that the inpainted region is unnoticeable to the ordinary observer who is unaware of the original image. In real world, many people need a system to recover damaged photographs, designs, drawings, artworks etc. damage may be due to various reasons like scratches, covered text or graphics etc. Initially the work of restoration was carried out by skilled artists but the process was very time consuming and hence digital image inpainting was introduced. M. Bertalmio et al[1]. was first one to introduce the term inpainting in 2000 in relation to art restoration.



Figure1. Left: Damage Photograph, Right: Inpainted Image

Image Inpainting mostly used in photography and cinema such as remove cracks in photograph and dust spot in film. One more use of Image Inpainting is remove red-eye from photograph. When taking pictures in dark lighting condition, people use flash light to make object visible but flash light causes red-eye effect. Another Application of Inpainting in video is Visual story modification means sometimes it is necessary to remove some objectionable objects, gestures, in a video. Video inpainting can also be used to change the behaviours of entities within a video and undesired object removal.

A Discrete cosine transform (DCT) indicate a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important for lossy compression of images and videos. For compression only cosine function is used, since it turns exposed that fewer cosine functions that are desired to approximate a typical signal, whereas the cosines express a particular choice of boundary conditions for differential equations. DCTs[8] are similar to DFTs of roughly twice the length, operating on real data with even symmetry but some variant input and output data are shifted by half a sample. DCT have Energy compaction property.

This paper is structured as follows. In section II, Literature survey is discussed. Section III, represent proposed technique. Observation of this technique is discussed in section IV. Finally, conclude this work in section V.

II. LITERATURE SURVEY

This section gives an overview of image inpainting technique. In literature three categories of inpainting technique have been introduced. First category contain method PDE, second

category include texture synthesis. The third category includes exemplar based method.

1. Partial Differential Equation (PDE) based image Inpainting

Bertalmio et.al (2000)[1] was proposed Partial Differential Equation based algorithm. It is iterative algorithm. This algorithm will produce good results if missing regions are small, But when the missing regions are large this algorithm will take so long time and it will not give good results. Then inspired by this work, Chan and Shen[16] proposed the Total Variational (TV) Inpainting model. This algorithm is better due to isophote driven approach. Algorithm find the line of equal gray scale values which contains the more likely information and this used to complete the image with less time. The main difficulty with this algorithm is copy of large texture regions. This algorithm also unable to recover partially degraded image. To avoid this difficulty, CDD (Curvature Driven Diffusion)[2] model used in which it included the curvature information of the isophotes to handle the curved structures in a well manner. PDE based technique has been widely used in applications such as image segmentation, restoration etc.

2. Texture synthesis based image inpainting

In Texture synthesis[2] input sample of a texture is given, and the goal is to produce more texture which is similar to input sample. The main objective of texture synthesis based on inpainting is to generate texture patterns. Texture synthesis approaches (Efors et al.1999) can be categorized into three categories: first is Statistical (parametric), second is, pixel-based and last is, patch-based (non-parametric). Statistical methods are reproducing irregular textures, but usually it fails to reproduce regular textures. Other category pixel-based methods which “build” on the sample texture pixel-by-pixel instead of applying filters on it, and it provide good quality result than statistical methods, but they usually fail to grow large structured textures. Finally, patch-based methods which “build” on a sample texture patch-by-patch, it is faster method and produce more regular textures. The texture synthesis is based inpainting produce well result in approximating textures. These algorithms have problem in handling natural images as they are composed of structures in form of edges. Also they have complex interaction between structure and texture boundaries.

3. Exemplar based image Inpainting

It overcomes the drawback of partial differential equation based inpainting and it is used for reconstructing large target regions. Exemplar based image Inpainting consists of two basic steps: priority assignment is the first step and the second step is the selection of the best matching patch. The exemplar based approach find the best matching patches from the known region and pastes into the target patches in the missing region. Generally, new exemplar-based algorithms use the greedy strategy, so these algorithms going from the common problems of the greedy algorithm, so filling order is very critical. Exemplar based Inpainting will produce well results

only if the missing region consists of simple structure and texture but if there is not enough samples in image then it is impossible to synthesize the desired image. Also, it produce blur on images when image on complex texture.

III. PROPOSED SYSTEM

This algorithm is based on two principles. First, exemplar-based texture synthesis Criminisi’s Algorithm [4] and second is, Discrete Cosine Transform(DCT)[8][15].

Criminisi’s Algorithm:

The algorithm starts with a patch Ψ centered at the point p where Ω . The problem is now to fill the pixels in $\Psi \cap \Omega$. So the algorithm searches for the patch Ψ which is most similar to those parts that already filled in Ψ .

Step 1: Divide image into RGB plane.

Step 2: Detect the target region Ω from each plane.

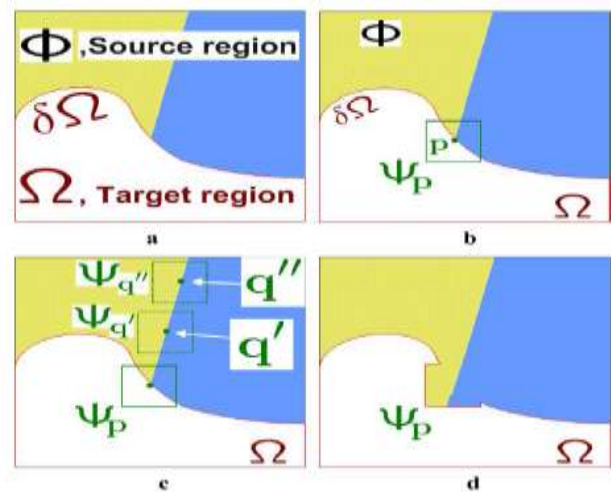


Figure 2. (a) Original image with the target region Ω , filling front $\delta\Omega$, and the source region Φ , (b) The patch Ψ centered at point p that has to be inpainted, (c) The most similar candidate patches for the source region, (d) The best matched patch has been copied into Ψ_p .

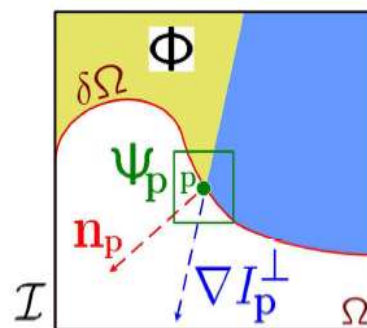


Figure 3. Notation diagram, For patch Ψ Centered at point p , is the gradient vector at point p , and n_p is a unit vector normal to the filling front $\delta\Omega$.

Step 3: if $\Omega = \emptyset$ is NO then Specify the fill front Ω^t .

Step 4: For each point $p \in \Omega^f$ define the patch Ψ_p centred at the point p and then compute its priority $P(p)$ as the product of two terms. The confidence term $C(p)$ and the data term $D(p)$.

$$P(p) = C(p) \cdot D(p) \quad \dots (1)$$

The confidence term $C(p)$ may be thought of as a measure of the amount good information surrounding of the pixel p and is defined as:

$$C(p) = \frac{\sum_{q \in \Psi_p \cap \Omega} C(q)}{|\Psi_p|} \quad \dots (2)$$

Where $|\Psi_p|$ is the number of pixels of patch Ψ_p . The Data term $D(p)$ is a function of the strength of the isophotes hitting the front $\delta\Omega$ at the each iteration. This term increases the priority of those patches that linear structures flow into them. The data term in this algorithm is defined as:

$$D(p) = \frac{|\nabla I_p \cdot n_p|}{\alpha} \quad \dots (3)$$

Where α is a normalization factor. n_p unit vector orthogonal to the front $\delta\Omega$ at the point p , and ∇I_p is the isophote vector (direction and intensity) at the point p .

Step 5: Find the patch Ψ_p^{\wedge} with the maximum priority

$$p^{\wedge} = \underset{p \in \Omega}{\operatorname{argmax}} \{P(p)\} \quad \dots (4)$$

Step 6: Search the source region Φ in order to find Ψ_q^{\wedge} that is most similar to Ψ_p^{\wedge} formally

$$\Psi_q^{\wedge} = \underset{\Psi_q \in \Phi}{\operatorname{argmin}} \{d(\Psi_p^{\wedge}, \Psi_q)\} \quad \dots (5)$$

Where, $\{d(\Psi_p^{\wedge}, \Psi_q)\}$ is the dissimilarity measure between two patches that can be defined as the sum of squared differences (SSD) of already filled pixels in two patches.

Step 7: For each pixel in $\Psi_p^{\wedge} \cap \Omega^f$ copy image data from its corresponding pixel in Ψ_q^{\wedge} to Ψ_p^{\wedge}

Step 8: Update the confidence values

$$C(p) = C(p^{\wedge}), \forall p \in \Psi_p^{\wedge} \cap \Omega^f \quad \dots (6)$$

Step 9: If $\Omega = \emptyset$ is Yes, apply DCT on each plane.

Step 10: Discard pixel value which is less than threshold value.

Step 11: Apply inverse DCT.

Step 12: Concatenate RGB plane and Finally get the inpainted image with reduced size.

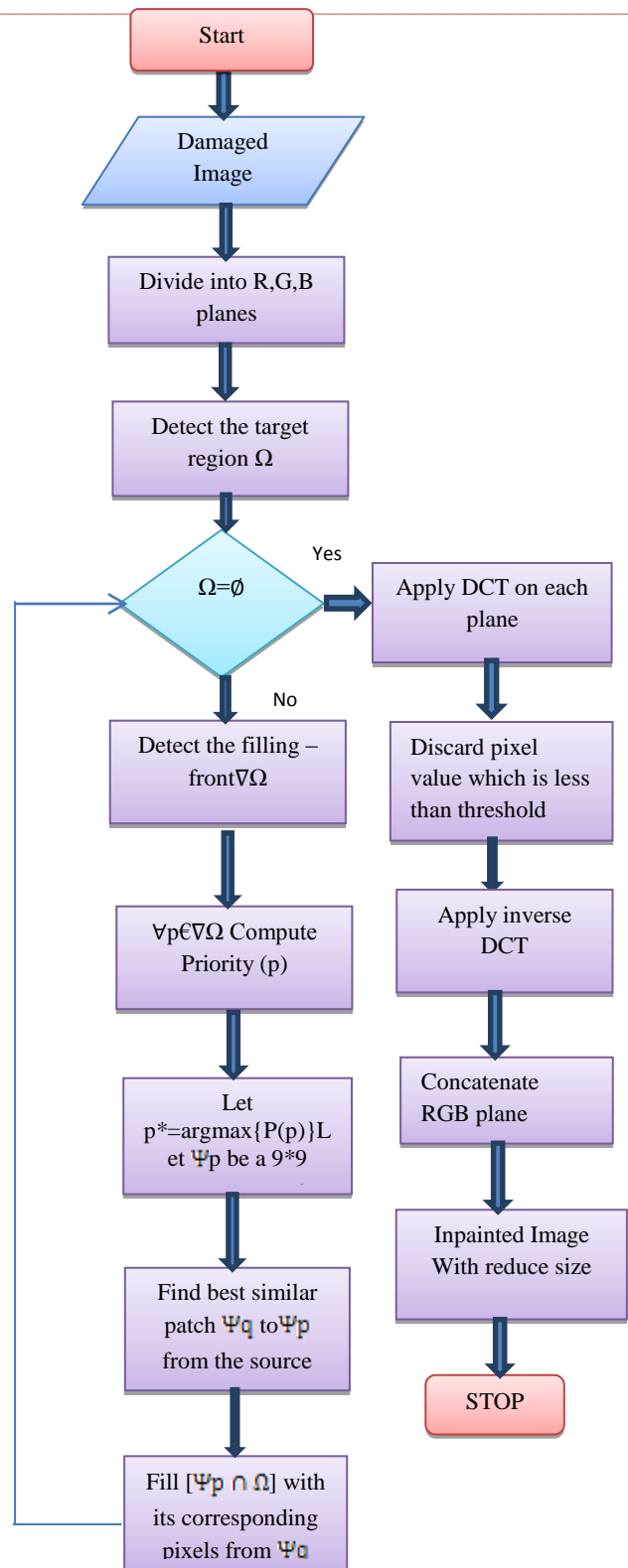


Figure 5. System Flow

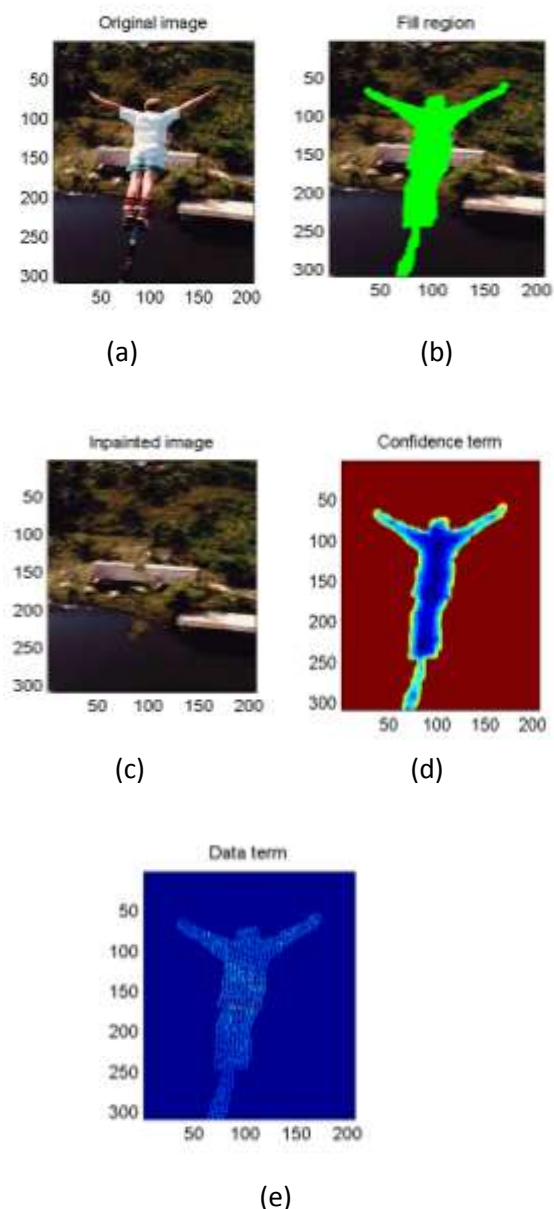


Figure 4. (a) Original Image (b)Filling Region (c) Inpainted Image (d)Confidence term (e)Data term.

IV OBSERVATION

When applying inpainting on image through, criminisi's algorithm then size of image is increased, due to this increasing size of image computational cost is increases. So, to overcome this problem use the Discrete Cosine Transform. By the use of Discrete Cosine Transform, get the image in good quality with reduced size, so that computational cost would decrease.

V. CONCLUSION

This paper has proposed a fast and simple algorithm for inpainting images with large missing region, simple texture and structural synthesis. Discrete Cosine Transform provide good quality with reduced size inpainted image.

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