Double Resolution Inpainitng

Christo Joy Varghese[1] Edwin Lazar[2] Francis T P[3] Dany Varghese[4]
[1,2,3,4]Department of Computer Science & Engineering
[1,2,3,4]Jyothi Engineering College, Thrissur, Kerala, India

Abstract— Image processing is processing of images using mathematical operations for which the input can be an image, a series of images, or a video and the output may be either an image or a set of characteristics or parameters related to the image. Inpainting is the process of removing particular areas and filling those missing areas. It is an art of reconstructing the missing regions of an image in order to make it more legible and to restore its unity. There are several inpainting methods. In ancient times, Image inpainting was done manually for removing defect from paintings and photographs. It is an ancient art and is a research topic in image processing. It rejuvenates the corrupted and the lost data in an undetectable manner. Here in this study, we have reviewed on some latest inpainting and super resolution techniques and tried to derive a mechanism for inpainting by combining early inpainting methods and super resolution methods. It finds numerous applications such as glaucoma detection, restoration of old damaged films.

Key words: Image Inpainting, Exemplar, Gaussian, Super Resolution

I. INTRODUCTION

It is required to remove the unwanted objects and/or scratches from an image. The unwanted object can be a text, subtitles etc. The unwanted objects and/or scratches cannot be easily erased, as erasing leaves a white patch behind in that area. By using the neighboring pixel or patch information, the space formed while removing unwanted objects are filled. This methodology is referred to as Image Inpainting.

Inpainting refers to the application of sophisticated algorithms to replace lost or corrupted parts of the image data (mainly small regions or to remove small defects). Simply, we can define inpainting as a process of reconstructing deteriorated parts of an image. The application of inpainting include film restoration in photography and also in military, aerospace and medical fields.

Super resolution method is class of techniques which exploits information from successive image frames and/or training images to enhance the resolution of input images. In a simple way we can define super-resolution as enhancing the resolution or quality of an image. The application of super resolution includes video/image enhancement, image printing, video surveillance etc.

The proposed method thus builds upon earlier work on exemplar-based inpainting, as well as upon earlier work on super-resolution based on Gaussian process. Here, we are introducing a new framework which is a combination of two main techniques: image inpainting and Gaussian process.

II. PROPOSED SYSTEM

Images are modified in a way that is non-detectable for an observer who does not know the original image is a practice as old as artistic creation itself. The use of computer algorithms to perform image processing on digital images is known as Digital image processing. Digital image processing allows the use of much more complex algorithms, and hence, can offer much better satisfying images. Image processing basically includes the following three steps:

1) Importing the image via image acquisition tools
2) Analyzing and manipulating the image
3) Output in which result can be altered image or report that is based on image analysis

There are different techniques which are used in digital image processing. Here we use two methods for the processing of an image to obtain a output image which is free from unwanted objects without any loss in resolution.

Here we use super resolution method for two time and the inpainting used for once. This method is used for the enhancement of the resolution of an imaging system. In most digital imaging applications, Images or videos with high resolution are usually desired for later image processing and the analysis. The desire for the high image resolution stems from the two principal application areas: Pictorial information for human interpretation improvement; and helping representation for the automatic machine perception. Image resolution describes the details contained in an image, the higher the resolution, and the more image details. Here we use super-resolution before and after inpainting.

Inpainting technique which modifying an image in an undetectable form, is as old as art itself. The goals and applications of inpainting are numerous, from the restoration of damaged paintings and photographs to the removal/replacement of selected objects. It is the reconstructing lost or deteriorated parts of images and videos. Since the wide applications of digital camera and old photos digitalization, inpainting has become an automatic process that is performed on digital images. More than scratch removing, the inpainting techniques are applied to object removal, text removal and the other automatic modifications of images and videos. Here we use inpainting for removing selected images from the input image.

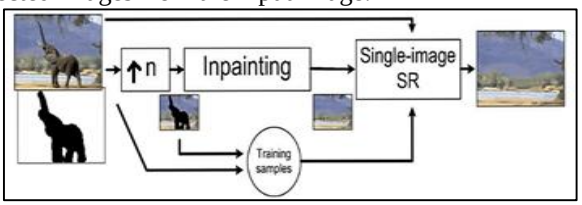

Fig. 1: The framework of the proposed method

In our proposed system we are using a combination of two methods: Inpainting and Super-resolution. Inpainting is the process of removing unwanted objects and filling the missing areas. It consists of performing inpainting on a coarse version of input image. By applying exemplar technique and super resolution algorithm the unwanted objects can be removed and the missing areas are filled. Super resolution algorithm is a technique used to enhance the resolution of an imaging system. By using this technique old photos and damaged film can be restored and are also used to remove superimposed text like dates and subtitles. This technique reduces the computational complexity and improves the visual quality.

The following steps are used to implement:

1) A high-resolution image is first built from the original picture.
2) An inpainting algorithm is applied to fill in the holes of the high-resolution picture. Different settings are used and inpainted pictures are combined.
3) Then super-resolution algorithm based on Gaussian process is applied to the inpainted image.

Most of the existing systems applies inpainting on low resolution images[1]. Thus, this is our main advantage of inpainting on a high resolution image. So, that most of the area get filled. And the accuracy is high.

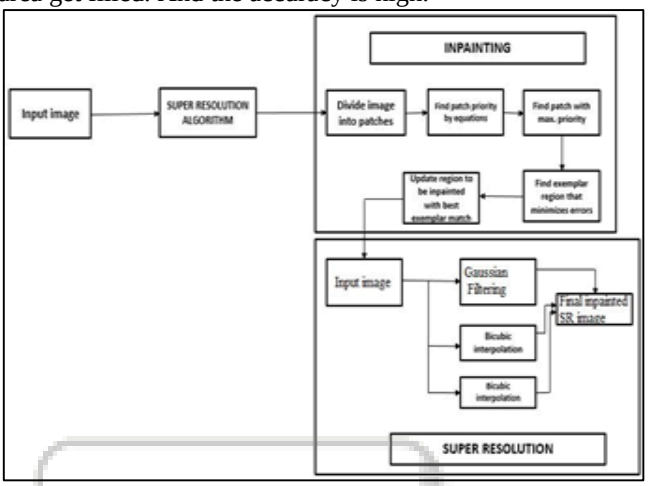

Fig. 2: Architectural diagram of proposed system

Algorithm: SRGPR(L)
  $\tilde{H} \leftarrow \texttt{Upsample}(L)$
  $\tilde{L} \leftarrow \tilde{H} \downarrow^{d}$ (Blur and downsample)
  $H \leftarrow \texttt{Deblur}(\tilde{H}, L, \tilde{L})$
  return H
Function: Upsample (L)
  Bicubic interpolation: $H_b \leftarrow L \uparrow^{d}$
  Partition L into n overlapped patches $P_1, ..., P_n$
  for $p_L = P_1, ..., P_n$ **do**
    Sample pixels in p_L to obtain the target vector $\mathbf{y}$
    Put the eight neighbors of each element of $\mathbf{y}$ in X_{NL} as a row vector for training
    Train a GPR model M using $\{\mathbf{y}, X_{NL}\}$
    Put the eight neighbors of each pixel of H_b in X_{NH_b} as a row vector for prediction
    $p_{\tilde{H}} \leftarrow M(X_{NH_b})$
  end
  return $\tilde{H}$ constructed from $p_{\tilde{H}}$
Function: Deblur ($\tilde{H}, L, \tilde{L}$)
  Partition $\tilde{L}$ into n overlapped patches $P_1, ..., P_n$ corresponding to those in L
  for $p_{\tilde{L}} = P_1, ..., P_n$ **do**
    Obtain the same target vector $\mathbf{y}$ in p_L
    Put the eight neighbors in $p_{\tilde{L}}$ of each element of $\mathbf{y}$ in $X_{N\tilde{L}}$ as a row vector for training
    Train a GPR model M using $\{\mathbf{y}, X_{N\tilde{L}}\}$
    Put the eight neighbors of each pixel of $\tilde{H}$ in $X_{N\tilde{H}}$ as a row vector for prediction
    $p_H \leftarrow M(X_{N\tilde{H}})$
  end
  return H constructed from p_H

Fig. 3: Algorithm for Gaussian Process Regression

The output is an image with high resolution is obtained after this step.

A. Inpainting

Image inpainting refers to the methods which consist of filling-in missing regions identified in an image [3]. Existing methods can be classified into two main approaches. The first category deals with diffusion-based approaches which propagate linear structures or level lines through diffusion based on partial differential equations [3, 4] and variation methods [5]. Unfortunately, the diffusion-based methods tend to introduce some blurring effect when the hole in the image to be filled-in is large. The second family of approaches deals with exemplar-based methods which sample and copy best matching texture patches from the known image neighbourhood.

Although tremendous progress has been made in the past many years on inpainting, difficulties remains when the hole to be filled is large. These problems are here addressed by considering a hierarchical approach in which a higher resolution of the input image is first computed and inpainted using exemplar-based method [6, 7]. Exemplar based image inpainting is a com-bine effect of texture and structure synthesis. Texture synthesis technique is used to repair texture and the structure synthesis is used to reconstruct structure component to reconstruct structure component.

The output from the previous stage or super-resolution stage is the input to the inpainting stage i.e. high resolution image is inpainted Inpainting is done by following steps:

- Divide the input image i.e. output from the super resolution stage into patches.
- Calculate the patch priority.
- Find the patch with maximum priority.
- Find the exemplar region which has error.
- Replace/update the region to be inpainted with the best exemplar match.

Finally, the output from inpainting stage is again fed into super-resolution stage for better visual quality and accuracy.

III. CONCLUSION

In this paper, we introduce a new method to refill the missing parts of an image. We are using the efficient technique for inpainting and super resolution. i. e. exemplar technique and single image super resolution. Exemplar technique is used for inpainting and Gaussian process super-resolution is used for super resolution. Since we are applying super resolution algorithm two times the output will be highly efficient inpainted image. The accuracy of inpainting will be increased since we are applying single image super resolution two times. Our implemented method has many applications in military for investigation purpose, in medical field such as for glaucoma detection, in aerospace etc. In aerospace sometimes the images of moon etc. will not be clear by inpainting we can receive the original environment.

IV. FUTURE WORKS

The proposed work in this paper deals with image inpainting. In future, the processing powers of computer systems will be higher. So we plan to extend our work to video inpainting.

REFERENCES

[1] M. Bertalmio, G. Sapiro, V. Caselles, and C. Ballester, "Imageinpainting," 27th Annu.Conf.Comput. Graph. Interact. Tech., p. 417U″ 424, 2000.

[2] O. L. Meur and C. Guillemot, "Hierarchical super-résolution - based inpainting," IEEE transactions on image processing, vol. 99, 2013.
[3] D. Tschumperle and R. Deriche, "Vector-valued image regularization with pdes: A common framework for different applications," IEEE Trans. Pattern Anal. Mach. Intell. , vol. 27, p. 506U″ 517, Apr.2005.
[4] T. Chan and J. Shen, "Variation restoration of non-flat image features: Models and algorithms," SIAM J. Appl. Math, vol. 61, p. 1338U″ 1361, 2001.
[5] S. dixit and S. singh, "Exemplar-based image inpainting technique using image partitioning (search region prior) method," IJSTE international journal of science technology & engineering, Oct.2014.
[6] R.Martinez-noriega, A.Roumy, and G.Blanchard, "exemplar based image inpainting: fast priority and coherent nearest neighbour search," IEEE international workshop, 2012.
[7] D. glasner, shai bagon, and M. irani, "super-resolution from a single image," IEEE transactions on image processing, 2009.

