A Performance Enhancement of Image in Painting Technique using Texture Analysis

Priya Bundele
M.E. Student IT (final year)
Medicaps Institute of Tech. & Mgt., Pigdambar,
Rau, Indore (MP.), India-452001

C.S. Satsangi
Professor IT
Medicaps Institute of Tech. & Mgt., Pigdambar,
Rau, Indore (MP.), India-452001

ABSTRACT
Images are a kind of real world data representation using a mathematical model. Images include the object definitions by storing the color values in an image matrix. During the image capturing, storage and transmission some of the information can be corrupted. Therefore image inpainting methods are utilized to recover the actual information which corrupted. This paper presents different approaches that are frequently used for color image inpainting. In addition of that a new approach for enhancing the traditional approach is also presented. The implementation of traditional approach of image inpainting is performed using the MATLAB simulation and their results are reported. According to the obtained results the performance of the proposed image inpainting technique is found optimum and efficient in terms of computational cost.

Keywords— Digital Image, Color Image, Inpainting, Restoration, Implementation

1. INTRODUCTION
Image processing is a trick of enhancing the quality of images and removal of the noise and errors from images. Therefore that is a broad domain of investigation and research. Among them image inpainting is a process of restructuring lost or destroyed parts of images data. In real world painting, this work is carried out by a skilled artist. On the other hand in computer applications inpainting refers to the implementation of classy algorithms to substitute lost or corrupted parts of image data.

The process of Inpainting is a technique for filling the missing or damaged information. This process includes the identification and removal of scratches in a photograph or repairing damaged areas in old paintings [1]. That also denoted to satisfying in missing or damaged regions like cracks or scars in images.

In fine art museums, degraded paintings are traditionally restored by professional artists and that is very time consuming additionally risky for completely destroying a ancient painting due to direct retouching. The term Inpainting is derived from image restorers in museums paintings. Digital Image Inpainting makes efforts to reproduce the image pixels automatically [2]. Traditionally, inpainting has been done by professional restorers. The fundamental process of restoration of traditional paintings is as follows:

- From the picture required to determine how to fill the regions which are corrupted. The key of inpainting is to restore the entire damaged regions.
- Finding the structures and the gaps to be continued into filling.
- The different sections on a gap in image, such as the contour lines, color matching and its boundary.
- The small details are also required to painted, i.e. “texture”.

This section provides the overview of inpainting of images in traditional as well as digital manner. In further sections the different available techniques and proposed inpainting technique is described in detail.

2. FREQUENTLY USED TECHNIQUES
There a number of different approaches are available for inpainting of digital images. Among them two frequently used methodology are discussed in this section.

2.1 Patch based images inpainting
In patch based inpainting inputs of the algorithm consist of an image and a binary mask that is the same size as the input image. Now the non-zero pixels in mask indicate region of image that is considered as hole to inpaint/complete/fill. In this context the image consists of a black region and a gray region (bottom). This simple example is used for testing because the result to expect - the dividing line between the black region and gray region should continue smooth.

The limitation of this technique is the result will never be good for the real world images. The next image we show is an example of completing a real image. This result shows the typical quality of inpainting that the algorithm produces.

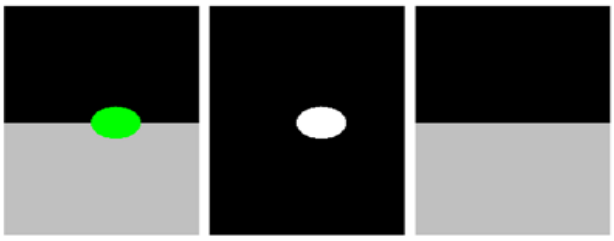

Figure 1 patch based image inpaint

Figure 2 patch based image inpaint

2.2 Examplar based image inpainting

The exemplar based image inpainting is an accurate category of algorithms. The exemplar based image inpainting is an efficient technique of restoration of large target regions. This inpainting technique is consists two phase of correction:

1. First priority assignment is estimated and then
2. Selection of the best matching patches.

The exemplar based image inpainting selects the best matching patches from the well-known area in image, whose similarity is determined by definite metrics. These selected values are inserted into the target patches in the missing area. According to the filling order, the technique fills structures in the missing regions using spatial information of neighbouring regions [3]. The exemplar based image inpainting includes the following steps:

1) **Initializing the Target Region:** In this step first missing areas are filled and characterized using suitable data structures.

2) **Computing Filling Priorities:** In this phase a pre-described priority function is utilized to compute filling order. The filling order is defined for all unoccupied pixels starting from each filling regions.

3) **Searching Example and Compositing:** In this step most analogous pattern is recovered from target area of image to embed the evaluated patches that better define on the given pixel.

4) **Updating Image Information:** In this phase the boundary of the target area and the necessary information for computing filling priorities are incorporated on image.

There are a numbers of algorithms are created for the exemplar based image Inpainting. Exemplar-based inpainting is suitable for regular textures, where missing information can be re-filled by computed patches from image area. If a unique non-repetitive structure is damaged and where no patches in the neighbourhood that is not results good. It is possible to recover these regions by increase the number and variety of patches by their photometrical or geometrical alteration. The source patch can be rotated, scaled, flipped, can be used to adjusted or to find better match the tar-get patch.

This section provides the overview of the frequently used image inpainting technique and in next section the recent research work and contributions are discussed.

3. BACKGROUND

This section described the different applications and recent contributions in the domain of image inpainting.

This paper ***A. Criminisi et al [4]*** presents a new and efficient technique that incorporates the advantages of both approaches. They first provide exemplar-based texture synthesis contains the essential process required to replicate both texture and structure. The success of structure propagation, that is highly dependent on the order in which the filling proceeds. They propose a best-first algorithm in which the confidence in the synthesized pixel values is propagated in a manner similar to the propagation of information in inpainting. The actual colour values are computed using exemplar-based synthesis.

In this paper ***Jaspreet Kaur Chhabra et al [5]*** propose image inpainting to fill the missing area in image. There are different types of image inpainting techniques such as- exemplar based image inpainting, texture synthesis based image inpainting, PDE based image inpainting, hybrid inpainting and Semi-automatic and Fast Inpainting. In this paper authors provide a detailed survey on Exemplar based image inpainting and their available variants.

In this paper ***Mrs. B. A. Ahire et at [6]*** propos a method for 3D volume of video, which is converted into 2D slices for maintaining spatial and temporal reliabilities. In this process Background removal technique is utilized for object detection and observation. Then a modified exampler based image inpainting algorithm is applied for results improvements. After combination of completed patches sequences of virtual contours are developed to find most relevant postures among the available one. Key posture selection and indexing are performed to minimize complexity of posture sequence retrieval. Therefore Synthetic posture generation technique is utilized to increase the number of posture generation.

In this paper, ***Nirali Pandya et al [7]*** provide a review of different techniques used of image Inpainting. Additionally they discuss texture synthesis technique and inpaint of image using masking approaches.

In this paper ***Ruzic T et al [8]*** first provide a general concept for context-aware patch-based image inpainting, where textural descriptors are utilized to direct and speed up search for accurately-matched patches. Additionally a novel top-down splitting approach convert the image into different size blocks according to their context and use. This process forcing the search for nearest patches to nonlocal image regions this approach can be employed to improve the speed and performance of any patch-based inpainting method.

In this paper ***Anamandra Sai Hareesh et al [9]*** propose a fast and simple technique based on a novel gradient function and its generalization via fractional derivatives to evaluate the filling order arrangement. Results validate higher and robust performance over all the recent improvements in the field of exemplar-based approaches mentioned in the literature.

This paper, ***Shivali Tyagi et al [10]*** discusses removing objects from digital images and fills the holes that are found after removal of object. They present a novel and effective algorithm that combines the advantages of two different approaches. First exemplar-based texture synthesis contains the essential process is applied to replicate both texture and structure. After successfully extraction of structure propagation a highly dependent order in which the filling proceeds is prepared. The existing algorithms are combined to improve the efficiency for finding the line association in selected regions. Thus main focus is on data term and confidence term to find association in selected region which is to be inpainted. The region filling is done from a line associated to other section in selected region of image.

This section reports the different recent development in inpainting technique in further the proposed concept is provided which improves the quality of image inpainting and pixel based modification.

4. PROPOSED WORK

Among the various inpainting and restoration techniques, Tijana Ruzic et al [11] have made significant contributions in image inpainting. They have created a global markov random field along with context- aware label selection

method. Texture and color feature of the fixed image region has been determined with the limited candidate patches. Moreover optimization has been applied to prioritize belief propagation framework, this further reduces the impainting candidates. Therefore good and efficient results of inpainting are obtained. Further this approach provides an accelerated global optimization.

This technique only includes the color distributions for image restorations. In order to improve the restoration accuracy the traditional approach is optimized using the LBP (local binary pattern) texture analysis technique. This method promises to estimate the more accurate pixel values in less number of iterations. The proposed algorithm steps for improving the image inpainting is reported as:

1. Input target image
2. Create damage area on target image
3. Convert image into grid
4. Evaluate Color movement by gird color movement
5. Extract the shape features using Gabor wavelet analysis
6. Compute image texture using LBP (local binary pattern) analysis
7. For i=1 to i<= number of iterations
8. If (damaged area features = neighbor features)
9. Return
10. End if
11. Combine features to compute pixels
12. Fill pixel values to damaged area
13. End for

In order to provide the justification of the proposed work the proposed approach is.

5. RESULTS ANALYSIS

During algorithms execution of the given algorithms the system required time and memory resources. This section provides the understanding of the implemented techniques complexity in terms of memory and time.

5.1 Time complexity

The time complexity of the system is also called the time consumption of the system. That can be calculated using the following formula.

$$time\ complexity = T_{end} - T_{start}$$

Where theT_{end} denotes the end time of algorithm execution and T_{start}shows the time when the algorithm start execution. The given figure 1 shows the time consumption of the proposed system and traditionally available technique, for demonstrating the performance of both the systems the blue line shows the performance of the proposed method and the red line shows the performance of the traditional method. Additionally the X axis shows the different experiments performed using the system and the Y axis shows the performance in terms of seconds consumed for inpainting. According to the evaluated results the performance of the proposed system is much better than the traditional system in terms of time consumption of the system.

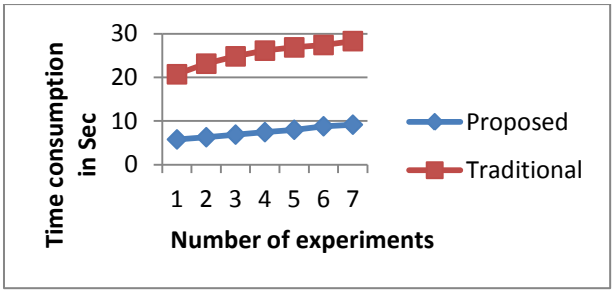

Figure 5.1 time complexity

5.2 MSE (Mean Squire Error)

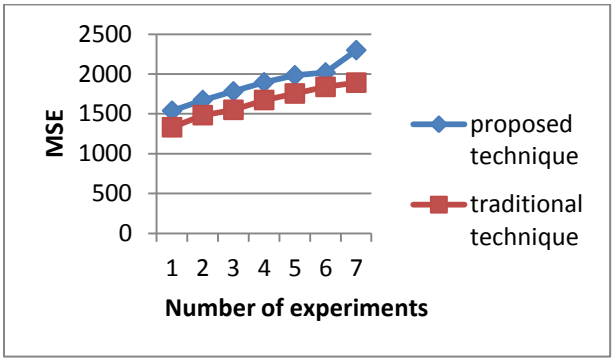

Figure 5.2 MSE

The difference occurs because of randomness or because the estimator doesn't account for information that could produce a more accurate estimate. The estimated MSE of both the implemented systems are given in figure 2. In this diagram the estimated error is given using Y axis and X axis demonstrate the number of experiments performed with the system. According to the results the amount of error in the proposed technique is much efficient than the traditional method available.

5.3 PSNR

The PSNR measures the peak signal-to-noise ratio between two images. This ratio is often used as a quality measurement between the original and a compressed image. Higher the PSNR means better the quality of the compressed or reconstructed image. The PSNR value can be calculated as:

$$PSNR = 10log_{10}\left(\frac{R^2}{MSE}\right)$$

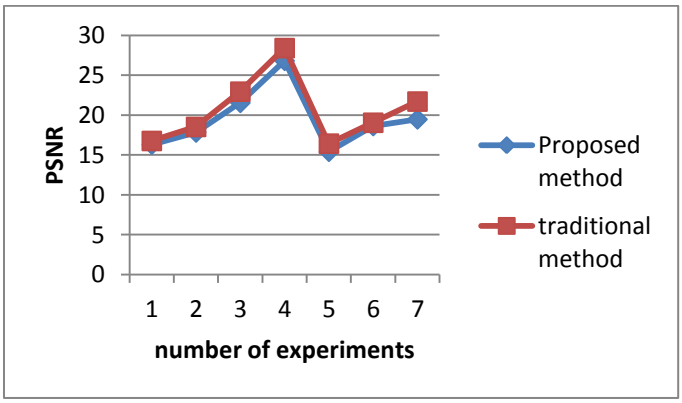

Figure 5.3 PSNR values

The given figure 5.3 shows the peak signal to noise ratio where the X axis demonstrate the different experiments and the Y axis shows the relative performance in terms of PNSR values obtained. According to the different experimentation results the proposed method provides the efficient results as compared to the traditional method.

6. CONCLUSION

Image inpainting is a technique of recovering the corrupted regions of image or damaged area of the images. There are a number of techniques are available for image inpainting but two of them are frequently used for image inpainting namely patch based method and second the exemplar based technique. Among them an effective technique is observed in [1] that provides the efficient as well as more accurate image restoration which is further extended with the texture analysis for improving the accuracy of pixel estimation. The implementations of both the techniques are performed using the MATLAB simulation environment and the performance in terms of time complexity and error basis estimated. After results evaluation the proposed technique found optimum and efficient. In near future the Examplar based techniques are studied and new solutions are discovered.

7. REFERENCES

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