

RESTORATION OF PREHISTORIC IMAGES USING PATCH MATCHING TECHNIQUE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electronics and Communication Engineering

by

LAVANYA V (37130217)

PRIYATHASHNI K (37130326)



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION
ENGINEERING
SCHOOL OF ELECTRONICS AND COMMUNICATION
ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

MARCH 2021



DEPARTMENT OF ELECTRONICS AND COMMUNICATIONENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **LAVANYA V** (Reg. No. 37130217) and **PRIYATHASHNI** (Reg. No. 37130326) who carried out the project entitled "**RESTORATION OF PREHISTORIC IMAGES USING PATCH MATCHING TECHNIQUE**" under our supervision from December 2020 to March 2021.

Internal Guide

(Mrs. VIJAYASHREE T M.E., (PhD)

Dr. T. RAVI, M.E., Ph.D.,

Head of the Department

Submitted for Viva voce Examination held on

Internal Examiner

External Examine

DECLARATION

We **LAVANYA V** (37130217) and **PRIYATHASHNI K** (37130326) hereby declare that the Project Report entitled “**RESTORATION OF PREHISTORIC IMAGES USING PATCH MATCHING TECHNIQUE**” done by us under the guidance of **Mrs. VIJAYASHREE T M.E.,(Phd)** at Sathyabama Institute of Science and Technology, **Chennai- 600119** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

1.

2.

DATE:

PLACE:

SIGNATURE OF THE CANDIDATES

ACKNOLEGEEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. N. M. Nandhita, Dean, School of Electrical and Electronics Engineering** and **Dr. T. RAVI, Head of the Department, Dept. of Electrical and Electronics Engineering** for providing us necessary support and details at the right time during the progressive reviews.

We would also like to express our sincere and deep sense of gratitude to our internal guide **Mrs. VIJAYASHREE T M.E.,(PhD)** for her valuable guidance and suggestions during the progressive reviews for our project.

ABSTRACT

Indian paintings are mostly inspired from Indian mythology depicting religious deities and kings. The earliest Indian painting was rock painting. Tanjore painting is an important South-Indian painting which started around an early 9th century. These are centuries old which are portrayed on the walls and ceiling of the temples, that illustrates the stories of the people, their culture and religion. Poor maintenance, climatic conditions, and rituals followed in the temple, have a great impact on the loss of the paintings and murals. These paintings represent the rich cultural heritage of India. Preserving these paintings and murals are essential in order to protect the heritage. This paper focuses towards the nondestructive restoration methodologies adopted in preserving the ancient paintings.

Our experiments illustrate the restoration performance of the proposed method by using ancient paintings. Moreover, we also provide discussion on the future research topics about automatic damage detection and image inpainting using patch matching technique in MATLAB.

Our main aim: Damage detection; digital restoration; Patch matching technique.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE
	ABSTRACT	V
	LIST OF FIGURES	X
	LIST OF TABLES	XI
	LIST OF ABBREVIATIONS	XI
1	INTRODUCTION	1
	1.1 IMAGE PROCESSING	1
	1.1.1 ST EPS OF IMAGE PROCESSING	1
	1.2 TYPES OF IMAGE PROCESSING	1
	1.2.1 ANALOGUE IMAGE PROCESSING	2
	1.2.2 DIGITAL IMAGE PROCESSING	2
	1.3 IMAGE RESTORATION	2
2	LITERATURE SURVEY	5
3	AIM AND SCOPE OF THE PROJECT	9
	3.1 AIM OF THE PROJECT	9
4	EXPERIMENTAL SETUP AND IMPLEMENTATION	11
	OF THE PROJECT	
	4.1 MATLAB	11
	4.1.1 PROFESSIONALLY BUILT	11
	4.1.2 WITH INTERACTIVE APPS	11
	4.1.3 ABILITY TO SCALE	12
	4.1.4 USAGE OF MATLAB	12
	4.2 DATABASE COLLECTIONS	12
	4.3 PREPROCESSING	14

	4.4 FILTERING PROCESS	15
CHAPTER NO.	TITLE	PAGE
	4.5 WEINER FILTER	16
	4.6 GAUSSIAN FILTER	17
	4.7 MEDIAN FILTER	19
	4.8 SEGMENTATION	20
	4.9 INPAINTING	23
	4.9.1 DIGITAL INPAINTING	23
	4.9.2 MAIN GROUPS OF 2D IMAGE	24
	INPAINTING ALGORITHMS	
	4.9.2.1 STRUCTURAL	25
	4.9.2.2 TEXTURAL	25
	4.9.2.3 COMBINED STRUCTURAL	25
	AND TEXTURAL	
5	RESULTS AND CONCLUSION	27
	5.1 PSNR RESULT	27
	5.2 INPAINT EXEMPLER METHOD	28
	5.3 MASKING METHODOLOGY	29
6	SUMMARY AND CONCLUSION	33
	6.1 CONCLUSION	33

LIST OF FIGURES

FIGURE NO	TITLE	PAGE
1.1	IMAGE RESTORATION	3
4.1	IMAGE 1	13
4.2	IMAGE 2	13
4.3	IMAGE 3	13
4.4	IMAGE 4	13
4.5	IMAGE 5	13
4.6	IMAGE 6	13
4.7	PREPROCESSING	15
4.8	FILTERING	16
4.9	ORIGINAL IMAGE 1	17
4.10	WEINER FILTERED IMAGE 1	17
4.11	ORIGINAL IMAGE 2	17
4.12	WEINER FILTERED IMAGE 2	17
4.13	ORIGINAL IMAGE 3	17
4.14	WEINER FILTERED IMAGE 3	17
4.15	ORIGINAL IMAGE 1	18
4.16	GUASSIAN FILTERED IMAGE 1	18

4.17	ORIGINAL IMAGE 2	18
4.18	GUASSIAN FILTERED IMAGE 2	18
FIGURE NO	TITLE	PAGE
4.19	ORIGINAL IMAGE 3	19
4.20	GUASSIAN FILTERED IMAGE 3	19
4.21	ORIGINAL IMAGE 1	19
4.22	MEDIAN FILTERED IMAGE 1	19
4.23	ORIGINAL IMAGE 2	20
4.24	MEDIAN FILTERED IMAGE 2	20
4.25	ORIGINAL IMAGE 3	20
4.26	MEDIAN FILTERED IMAGE 3	20
4.27	SEGMENTATION	21
4.28	WEINER FILTERED IMAGE 1	22
4.29	SEGMENTED IMAGE 1	22
4.30	WEINER FILTERED IMAGE 2	22
4.31	SEGMENTED IMAGE 2	22
4.32	WEINER FILTERED IMAGE 3	22
4.33	SEGMENTED IMAGE 3	22
5.1	WEINER FILTERED IMAGE 1	30
5.2	MASKED IMAGE 1	30
5.3	INPAINTED IMAGE 1	30

5.4	WEINER FILTERED IMAGE 1	31
5.5	MASKED IMAGE 35	31

FIGURE NO	TITLE	PAGE NO
5.6	INPAINTED MAGE 36	31
5.7	WEINER FILTERED IMAGE 1	32
5.8	MASKED IMAGE 38	32
5.9	INPAINTED IMAGE 39	32

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
5.1	PSNR RESULT	27

LIST OF ABBREVIATIONS

SYMBOLS	ABBREVIATIONS
PSF	POINT SPREAD FUNCTION
MATLAB	MATRIX LABORATORY
PSNR	PULSE SIGNAL TO NOISE RATIO

CHAPTER 1

INTRODUCTION

1.1 IMAGE PROCESSING:

Image processing is a method of enhancing data obtained from sensors installed at various stages of life for a variety of purposes. When examining the results, there is a significant improvement in clarity, since the features are more apparent than they were when the shot was first captured. In the image processing that depicts images, there are several steps involved.

Image processing is a method of enhancing an image or extracting valuable information from it by performing operations on it. Picture processing is a method of signal processing in which the input is an image and the output is an image or image-related characteristics. Picture production is a burgeoning industry these days. It serves as a foundation for the rest of the building.

1.1.1 STEPS INVOLVED IN IMAGE POCESSING

Image processing has 3 steps:

- Importing the image from image acquisition tools.
- Analysing and manipulation of image.
- Output will be an altered image or report based on the analysis.

1.2 TYPES OF IMAGE PROCESSING:

1. Analogue image processing

2. Digital image processing

1.2.1 1. ANALOGUE IMAGE PROCESSING:

In computer science and electrical engineering, analogue image processing is a process which is performed on two-dimensional analog signals. Analogue image processing is opposite of digital image processing. The pictorial representation of a data in which it is represented as an analog waveform is called as analog image. In older days television broadcasting through dish antenna system is a example of analog image processing.

1.2.2 2. DIGITAL IMAGE PROCESSING:

Digital image processing is a process of digital images using digital computers through an algorithm. Storing the data in digital form is called as digital image processing. Digital image processing offers more benefits than analogue image processing in the area of digital signal processing. When an input image is provided, a variety of algorithms may be applied to it. Build-up noise and distortion can be minimized as a result of this. In image processing since the images are two-dimensioned digital image processing can be modeled in the form of multidimensional systems. Due to development of computers and development of math digital image processing can be affected. The demand has increased for a wide range of applications in environment, agriculture, military, industry and medical science. Example image data is stored in digital logic circuits.

1.3 IMAGE RESTORATION:

The method of replacing or reducing the damage that occurs during the acquisition of an image is known as image restoration. For example, Noise, pixel value errors, out of focus blurring or camera motion blurring using prior knowledge of the degradation phenomenon. To reconstruct the image, it deals with the modelling of degradation and then the process is applied. The image restoration has got a wide scope of usage.

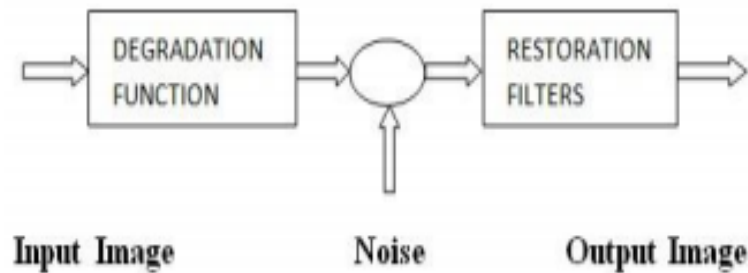


Fig 1.1 IMAGE RESTORATION

The goal of image processing is to compensate for image defects. Motion blur, noise, and camera misfocus are all examples of degradation. In motion blur instances, it is possible to restore the original image by estimating the real blurring feature and “undoing” the blur methods. In certain situations, such as when the picture is distorted by noise, compensating the image is the best option. We will integrate and apply many image restoration techniques used in the image processing field in this project.

Image restoration refers to the method of calculating a new, original image from a corrupted/noisy image. Image corruptions include things like motion blur, noise, and video mis-focus. Reversing the blurring process involves imaging a point source and using the point source image, also known as the Point Spread Function (PSF), to recover the image information lost during the blurring process.

Image restoration differs from image enhancement in that the latter is intended to highlight aspects of an image that make it more appealing to the observer, rather than simply producing realistic data from a scientific standpoint. Imaging packages have no a priori m for image enhancement techniques (such as contrast stretching or de-blurring using a nearest neighbor procedure).

Image enhancement can be used to efficiently eliminate noise in some applications by sacrificing some resolution. Resolution in the z-direction is still poor in a fluorescence microscope. The object must be recovered using more sophisticated image processing techniques.

The aim of image restoration techniques is to reduce noise and recover resolution. The frequency domain or the image domain are used to perform image processing techniques. Deconvolution is the most basic and widely used technique for image restoration. After calculating the Fourier transform of both the image and the PSF, it is done in the frequency domain to undo the resolution loss incurred by the blurring factors. This deconvolution technique amplifies noise and produces an incomplete deblurred image due to the direct inversion of the PSF, which usually has a low matrix condition number. The blurring method is always thought to shift-invariant in the traditional sense. As a result, more sophisticated techniques have been developed, such as regularized deblurring, to provide robust recovery under noise of different kinds and blurring functions. It is of 3 types: 1. Geometric correction 2. radiometric correction 3. noise removal.

CHAPTER 2

LITERATURE SURVEY

Yuan Zeng, Yi Gong [1] Most ancient artworks have structure damage problems, such as tears, flakes and cracks. This work gives an initial study of digital restoration of damaged ancient Chinese paintings via nearest neighbouring method, which is an effective non-parameter machine learning algorithm. We first present a damage detection method to estimate the mask, and then a patch-based image inpainting algorithm is performed to reconstruct the damaged paintings. Using ancient Chinese paintings, we demonstrate the reconstruction success of the proposed process. Furthermore, we explore potential research topics such as automated harm detection and image inpainting using deep learning algorithms.

Nikolaos Karianakis, Petros Maragos [2] We introduce a machine vision device that can replace or supplement the work of an expert in the reconstruction of prehistoric Tehran wall paintings. Local inpainting techniques are insufficient for adequate preservation in the case of major knowledge loss on certain areas of murals. Our method involves detecting a related field of semantics, geometry, and colour in another part of the wall paintings, which is then stitched into the missing area using a smooth image stitching algorithm. The broken and missed areas detector is a vital aspect of our automated reconstruction scheme. In the non-local inpainting mechanism, it is used in conjunction with complete variance inpainting to remove and restore missing areas first, and then to eliminate small defects on the recovered portion. We present a morphological algorithm for rough detection, which we strengthen by adding edge knowledge. We improve the identification of missing areas with complicated borders by using iterated graph cuts. Prehistoric wall drawings, digital reproduction are all terms that come up in the index.

Ioannis Giakoumis, Nikos Nikolaidis, Ioannis Pitas [3] This paper presents an integrated technique for detecting and removing cracks on digitised paintings. By thresholding the contribution of the morphological top-hat transform, cracks are

observed. After that, either a median radial basis feature neural network on hue and saturation data or a semi-automatic technique dependent on area rising was used to delete the thin dark brush strokes that were misidentified as cracks. Finally, order statistics filters or directed anisotropic diffusion are used to fill cracks. On digitized paintings with cracks, the technique has proven to be very effective.

Mauro Barni, Franco Bartolini, and Vito Capellini [4] We introduce two digital image processing applications for restoring artworks in this article. The first is an example of computer-guided restoration techniques, while the second is a simulated artwork restoration example. Cleaning dirty paintings is the first example. We define a technique that, by cleaning a small patch of a canvas, can predict the final outcome when the same cleaning approach is applied to the whole piece of art. It may be used by restorers by applying a variety of cleaning methods to very small patches of the artwork. They will then use the virtual cleaning app to figure out which cleaning technique is best for them.

Song Wei, Hangzhou [5] This paper uses a hierarchy-based approach to define a new paradigm for Chinese painting reconstruction. The framework is split into three stages: layering, in which the artwork is divided into two layers: foreground and background; hierarchy restoration, in which the foreground and background layers are restored separately using different image restoration algorithms; and composition, in which the two restored layers are combined to create a new painting.

Ayman M. T. Ahmed [6] In the last ten years, colour reproduction of old photographs, prints, slides, documentaries, and paintings has gotten a lot of press. The real motivation for creating successful colour restoration techniques is the importance of these old paintings and images. Two colour regeneration methods are discussed in this article. The first method employs a hybrid of standard deviation-weighted grey world and Combined Gray World and Retinex (CGWR) strategies. The second method is based on certain tweaks to the MSR principle. These tweaks were made to mimic the human eye's reaction to nearby pixels. The CGWR algorithm receives the output of the modified MSR. Experimental findings are presented in this article, which compare the two proposed colour restoration methods to certain basic techniques.

Ioana Cortea, Luminița Ghervase, Maria Dumbrăvicean [7] An observational characterization of mural painting samples from a 14th century Romanian monastery was carried out in this article. Nondestructive spectroscopic techniques were used, including X-Ray Fluorescence (XRF) with a handheld energy-dispersive XRF analyzer and Fourier Transform Infrared Spectroscopy (FT-IR) in Attenuated Total Reflectance (ATR) geometry. The XRF results, which were backed up by FTIR data, allowed for a full material characterization in terms of elemental composition and molecular structure. Green earth, azurite, cinnabar, lead white, zinc white, ochre, and emerald green were known as mineral pigments; and the presence of organic binders such as vegetable wax or linseed oil in some of the studied regions. Previous restoration interventions were also demonstrated by the presence of barium sulphate, which we presume came from a filler, since barium sulphate is commonly found in the chemical composition of industrial painting products.

Shrinivas D Desai, Kavita V. Horadi, Navaneet P, Niriksha B, Siddeshvar V [8] This paper proposes a user intervention-based advanced methodology for detecting and eliminating cracks in digitised paintings and pictures. Cracks usually degrade the appearance of a painting, and the value of the painting is called into question. Cracks are observed using the suggested approach by thresholding the results of morphological top-hat transforms. Misidentified cracks are often observed, either manually or by a semi-automated process based on the area expanding technique. Finally, order statistics filters are used to perform crack interpolation, also known as crack filling, in order to restore the cracked image. The true positive rate and false positive rate was used to assess the proposed technique's effectiveness. For testing purposes, we gathered 2000 paintings and photographs from an online digital art archive that were graded as cracked and uncracked. At a rate of 0.1 false positive per picture, the result indicates a true positive rate of about 98.3 percent. This is due to the fact that during the module detecting misidentified holes, the user will intervene.

CHAPTER 3

AIM AND SCOPE OF THE PROJECT

Image repair aims to compensate for or reverse effects. The image restoration techniques are geared toward modelling degradations like blur and noise, which entails the use of different filters to approximate the original scene.

Images are often degraded during the data acquisition process. Blurring, information loss due to sampling, quantization effects, and multiple sources of noise are also examples of decay. Image reconstruction is the process of estimating the original image from corrupted data. Medical imaging, astronomical imaging, forensic science, and other applications are all possible. The advantages of enhancing image consistency to the greatest degree possible frequently overshadow the expense and sophistication of the restoration algorithms involved.

3.1 AIM OF THE PROJECT:

The main aim of our project is to recover the original images. In this project our first step is data base collection. We have collected the images which are degraded due to ageing factor. And then for the images which we have collected are filtered using filtering process.

After this step segmentation is done for these images. Splitting the images into many blocks to find the damaged part is called segmentation. After finding the damages in the images we are going to fill the part with an appropriate color of the original picture. Filling color to the images can be done by inpainting method.

The Cyber Physical System (CPS) can plainly see the subtleties of the collaboration among information and terminals. CPS information joining and insightful terminals can empower start to finish gadgets to speak with one another in an intricate climate, facilitate execution and offer data. As of now, the interest for brilliant terminal innovation in college libraries and the National Cultural Museum is additionally expanding. Nonetheless, the information utilized for the advancement of shrewd terminal shows and administration sharing is confronting unique information issues that are hard to gather and the picture is inadequate and hard to fix. To show antiquated books on savvy terminals, we have built up a picture rebuilding model for top to bottom perusing. In this article, we have built up a savvy show answer for keep up the impact of advanced assurance for fragmented character pictures. Then, we propose a model dependent on the Conative Generative Adversarial Network (CGAN) to tackle the issue of fixing inadequate slug pictures. We are stacking this model into a PC module and sending it to the brilliant terminal cloud stage. What's more, we have made a manually written picture informational index for Yi characters in the cloud. To approve the CGAN computation model, we assembled and developed two quality testing tests. Test outcomes show that CGAN picture rebuilding quality is superior to conventional picture reclamation strategies. As far as the testing and assessment measure, we tracked down that the CGAN estimation model is vital in old style drawings and calligraphy.

CHAPTER 4

EXPERIMENTAL SETUP AND IMPLEMENTATION OF PROJECT

The Software component required in the proposed method is MATLAB.

4.1 MATLAB:

Millions of engineers and scientists use MATLAB to analyze data, develop algorithms, and create models. MATLAB is tailored to your thinking style and work habits.

MATLAB combines a desktop environment optimized for iterative analysis and design with a programming language that directly expresses matrix and array mathematics. It comes with the Live Editor, which allows you to write scripts that merge JavaScript, output, and structured text into an executable notebook.

4.1.1 PROFESSIONALLY BUILT:

Professionally developed, thoroughly tested, and fully documented MATLAB toolboxes.

4.1.2 WITH INTERACTIVE APPS:

You can see how various algorithms interact with your data using MATLAB software. Iterate until you achieve the desired results, then create a MATLAB programme to automate or repeat your work.

4.1.3 ABILITY TO SCALE:

Just small code adjustments are needed to scale the analyses to clusters, GPUs, and clouds. There's no need to rewrite your coding or learn new skills like big data programming or out-of-memory techniques.

4.1.4 USED FOR:

Engineers and scientists use MATLAB to analyse and design systems and products that change the world. The programme is built on the MATLAB language, a matrix-based language that allows for the most natural expression of computational mathematics.

4.2 DATA BASE COLLECTIONS:

Database collection is known as collection of data. In this project our first step is collecting original images. We have collected the original images from BRIHADISHWARA temple and some images directly from the internet. The images which we have collected are showed below. The images are in the form of cracks, tears and degraded due to some aging factors. Our main aim in this project is to remove these degradations in the image and filling the approximate colour in it. This can be done by using inpainting technique.



Fig 4.1 IMAGE 1



Fig 4.2 IMAGE 2



Fig 4.3 IMAGE 3



Fig 4.4 IMAGE 4



Fig 4.5 IMAGE 5



Fig 4.6 IMAGE 6

4.3 PREPROCESSING:

Pre-processing is a typical name for tasks with pictures at the most minimal degree of deliberations both info and yield are force pictures. These notorious pictures are of a similar kind as the first information caught by the sensor, with a force picture typically addressed by a grid of picture work esteems (brightness's). The point of pre-handling is an improvement of the picture information that suppresses undesirable bends or upgrades some picture highlights significant for additional preparing albeit mathematical changes of pictures (for example pivot, scaling, interpretation) are ordered among pre-handling strategies here since comparable procedures are utilized.

Picture pre-handling may have emotional beneficial outcomes on the nature of highlight extraction and the consequences of picture examination. Picture pre-handling is comparable to the numerical standardization of an informational index, which is a typical advance in many element descriptor techniques. Or on the other hand to make a melodic similarity, consider picture pre-processing as a sound framework with a scope of controls, for example, crude sound with no volume controls; volume control with a basic tone handle; volume control in addition to high pitch, bass, and mid; or volume control in addition to a full design's equalizer, impacts handling, and extraordinary speakers in an acoustically unrivaled room. In that manner, this section advances picture pre-handling by portraying a mix of rectifications and improvements that are a fundamental piece of a PC vision pipeline.

Picture pre-processing strategies utilize the significant excess in pictures. Adjoining pixels relating to one item in genuine pictures have basically something similar or comparative brilliance esteem, so if a mutilated pixel can be chosen from the picture, it can for the most part be reestablished as a normal benefit of adjoining pixels.

Picture pre-processing techniques are characterized into four classes as indicated by the size of the pixel neighborhood that is utilized for the count of another pixel splendor. Which are manages pixel brilliance transformations, describes mathematical changes, considers preprocessing strategies that utilization a nearby neighborhood of the handled pixel and momentarily portrays picture rebuilding that requires information about the whole picture.

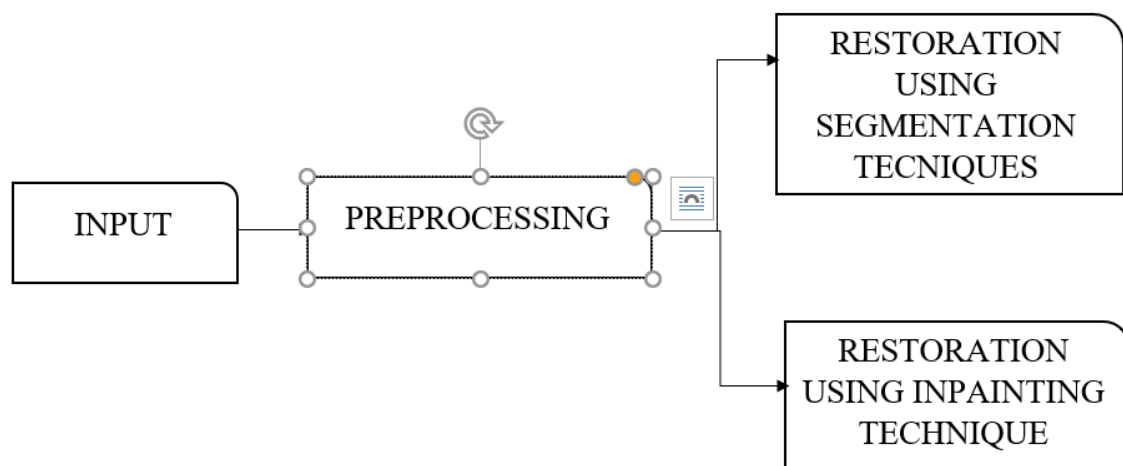


Fig 4.7 PREPROCESSING

4.4 FILTERING PROCESS:

To reestablish a picture from straight debasement different channels are utilized like opposite, pseudo reverse, wiener channel and visually impaired de-convolution are utilized in different methods. Picture rebuilding is the activity of taking an adulterated or loud picture and gauge the clean of the first picture.

Sifting is a strategy for changing or upgrading a picture. For instance, you can channel a picture to stress certain highlights or eliminate different highlights. Picture preparing activities carried out with separating incorporate smoothing, honing, and edge upgrade.

In picture preparing channels are essentially used to stifle either the high frequencies in the picture, i.e., smoothing the picture, or the low frequencies, i.e., improving or distinguishing edges in the picture. A picture can be separated either in the recurrence or in the spatial area.

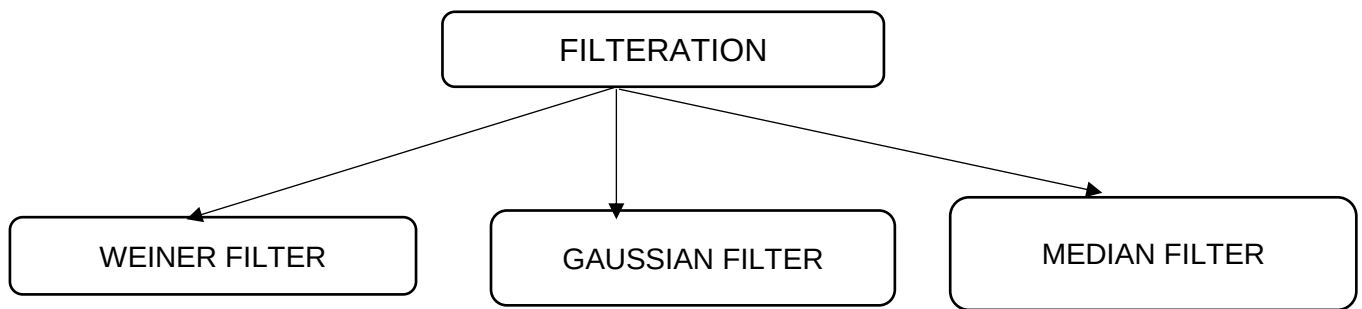


Fig 4.8 FILTERING

4.5 WEINER FILTER:

In signal preparing, the Wiener channel is a channel used to deliver a gauge of an ideal or target irregular cycle by straight time-invariant (LTI) separating of a noticed boisterous interaction, expecting to be known fixed sign and commotion spectra, and added substance clamor.

Wiener channel is utilized principally in the sign preparing gadgets, to deliver an expected or target irregular cycle by the direct time-invariant sifting techniques for any noticed boisterous methodology.

The Wiener separating executes an ideal tradeoff between converse sifting and commotion smoothing. It eliminates the added substance commotion and modifies the obscuring at the same time. The Wiener sifting is ideal regarding the mean square blunder.



Fig 4.9 ORIGINAL IMAGE 1

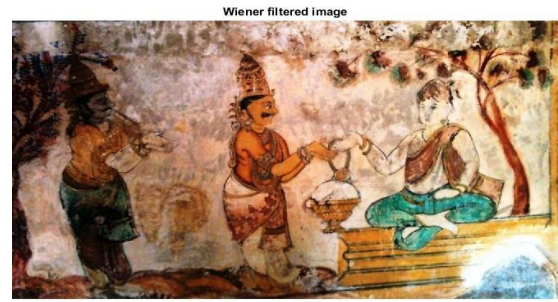


Fig 4.10 WEINER FILTERED IMAGE 1



Fig 4.11 ORIGINAL IMAGE 2



Fig 4.12 WEINER FILTERED IMAGE 2

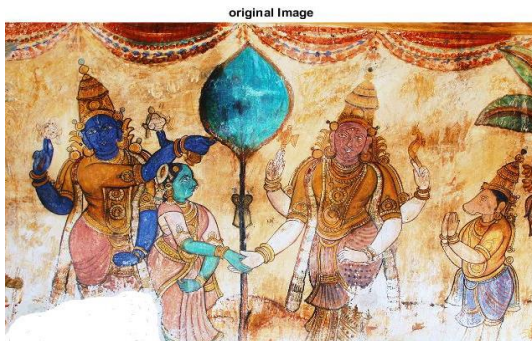


Fig 4.13 ORIGINAL IMAGE 3

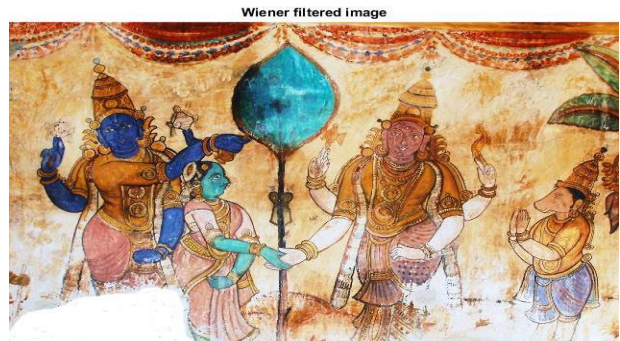


Fig 4.14WEINER FILTERED IMAGE 3

4.6 GAUSSIAN FILTER:

A Gaussian filter may be a linear filter. it's always accustomed blur the image or to scale back noise. The Gaussian filter alone can blur edges and scale back distinction. The Median filter may be a non-linear filter that's most typically used as an easy thanks to scale back noise in a picture.

Gaussian filtering is employed to get rid of noise and detail it's not Gaussian filtering is employed to get rid of noise and detail. it's not notably effective at removing salt and pepper noise. Compare the results below with those achieved by the median filter. Gaussian filtering is simpler at smoothing pictures.

The result of Gaussian smoothing is to blur a picture, in an exceedingly similar fashion to the mean filter. The Gaussian outputs a weighted average of every pixel's neighborhood, with the typical weighted a lot of towards the worth of the central pixels. this can be in distinction to the mean filter's uniformly weighted average.



Fig 4.15 ORIGINAL IMAGE 1

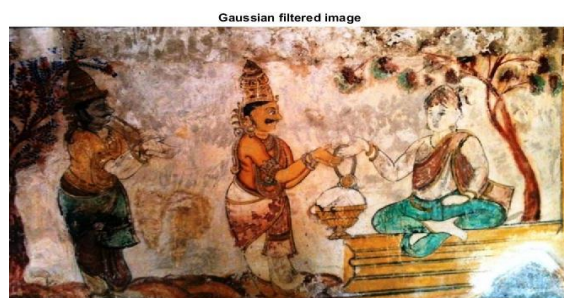


Fig GAUSSIAN FILTERED IMAGE 1



Fig 4.17 ORIGINAL IMAGE 2

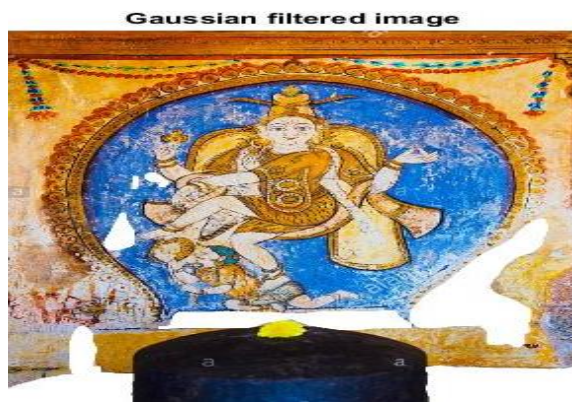


Fig 4.18 GAUSSIAN FILTERED IMAGE 2

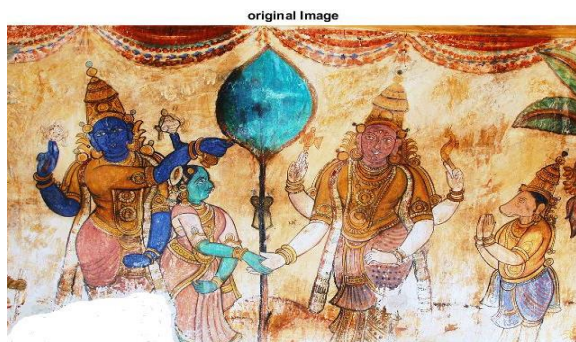


Fig 4.19 ORIGINAL IMAGE 3

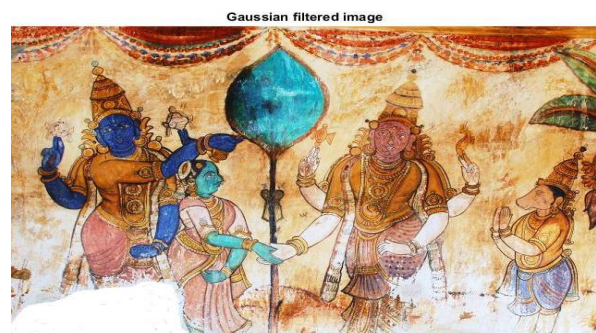


Fig 4.20 GAUSSIAN FILTERED IMAGE 3

4.7 MEDIAN FILTER:

The median filter may be a non-linear digital filtering technique, usually want to take away noise from a picture or signal. Such noise reduction may be a typical pre-processing step to boost the results of later process (for example, edge detection on AN image) The median filter is generally wont to cut back noise in a picture, somewhat just like the mean filter. However, it usually will a higher job than the mean filter of conserving helpful detail within the image.

Filters information among ROI by taking norm among a user outlined window for every information. The output is within the memory. Median filtering may be a non-

linear filtering technique that is usually helpful because it will preserve sharp options (e.g. lines) in a picture while filtering noise.



Fig 4.21 ORIGINAL IMAGE 1



Fig 4.22 MEDIAN FILTERED IMAGE 1



Fig 4.23 ORIGINAL IMAGE 2



Fig 4.24 MEDIAN FILTERED IMAGE 2

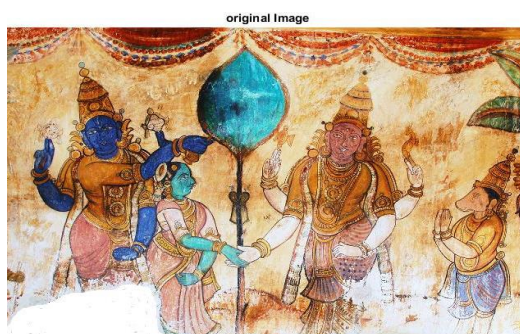


Fig 4.25 ORIGINAL IMAGE 3

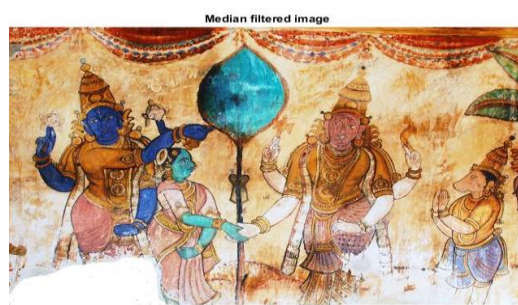


Fig 4.26 MEDIAN FILTERED IMAGE 3

4.8 SEGMENTATION:

The main piece of picture preparing is picture division. Current division approaches are audited with an accentuation put on uncovering the benefits and detriments of these strategies for clinical imaging applications. Manual division of clinical picture by the radiologist isn't just a drawn-out and tedious cycle, yet additionally not precise particularly with the expanding clinical imaging modalities and unmanageable number of clinical pictures that should be inspected. It turns out to be consequently important to audit current techniques of picture division utilizing computerized calculations that are precise and need as little client collaboration as conceivable particularly for clinical pictures.

In digital image processing and laptop vision, image segmentation is that the method of partitioning a digital image into multiple segments (sets of pixels, additionally called image objects). The goal of segmentation is to modify and/or modification the illustration of a picture into one thing that's a lot of meaty and easier to research. Image segmentation is often accustomed find objects and bounds (lines, curves, etc.) in pictures. a lot of exactly, image segmentation is that the method of assignment a label to each constituent in a picture specified pixel with constant label share sure characteristics.

The consequence of picture division is a bunch of sections that all things considered cover the whole picture, or a bunch of forms separated from the picture (see edge discovery). Every one of the pixels in a locale are comparable regarding some trademark or processed property, like tone, power, or surface. Nearby areas are essentially unique as for the equivalent characteristic(s). At the point when applied to a pile of pictures, normal in clinical imaging the subsequent shapes after picture division can be utilized to make 3D reproductions with the assistance of addition calculations like walking 3D squares.

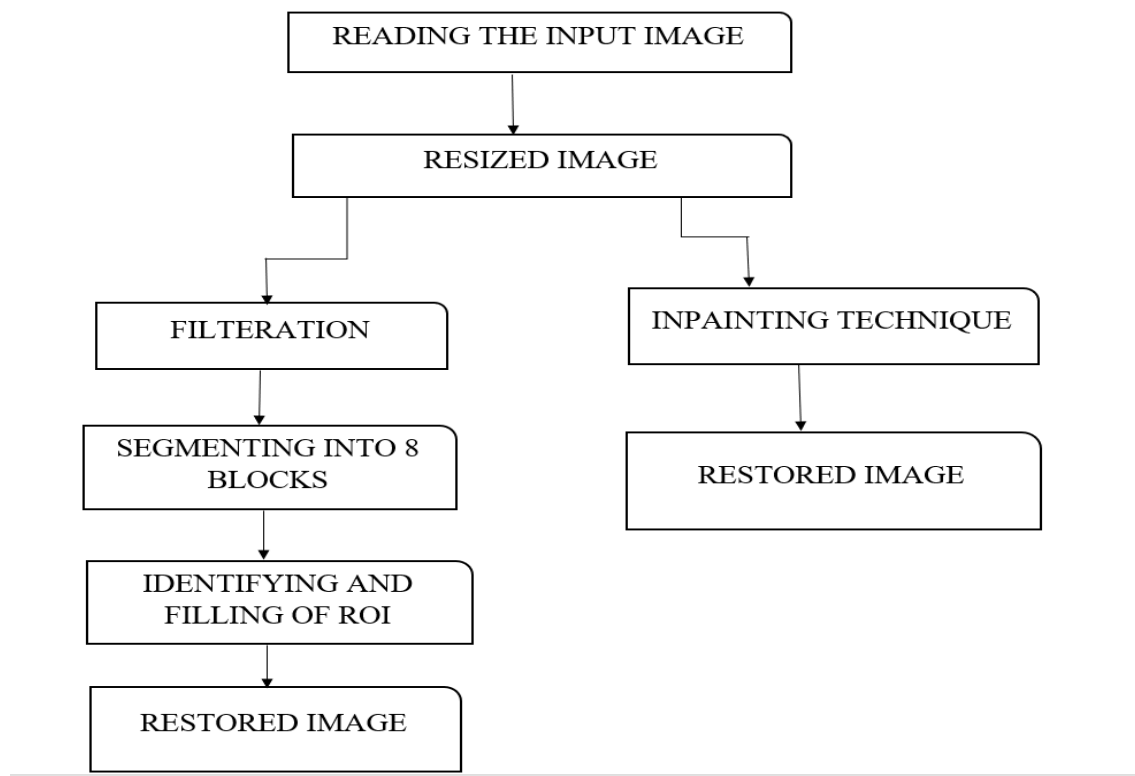


Fig 4.27 SEGMENTATION



Fig 4.28 WEINER FILTERED IMAGE 1



Fig 4.29 SEGMENTED IMAGE 1



Fig 4.30 WEINER FILTERED IMAGE 2



Fig 4.31 SEGMENTED IMAGE 2



Fig 4.32 WEINER FILTERED IMAGE 3



Fig 4.33 SEGMENTED IMAGE 3

4.9 INPAINTING:

Image inpainting is one among the image restoration technique used for reconstruction of lost or broken region in a picture. pictures might contain distorted and unwanted regions that is to be removed. the most objective of the inpainting algorithmic rule is to exchange these regions and extra service the holes in a very natural manner. The strategies used for inpainting includes diffusion based mostly, exemplar-based, graded super-resolution based and abstraction patch mixing strategies. This paper aims at scrutiny the assorted techniques used for inpainting. These techniques are aimed at filling in gaps and avoiding artefacts such as texture garbage, blur effects, and disconnected edges.

Inpainting could be a conservation method wherever broken, deteriorating, or missing elements of AN design art crammed in to gift a whole image. This method is often applied to each physical and digital art medium like oil or acrylic paintings, chemical photography prints, 3-dimentional sculptures or digital pictures and video.

4.9.1 DIGITAL INPAINTING:

There are at present numerous projects being used that can reproduce absent or harmed zones of computerized photos and recordings. Most broadly known for use with advanced pictures is Adobe photoshop. Since the advanced records can be copied, any therapeutic modifications ought to be made to the copy document, while keeping up the first records in a file. Given the different capacities of the computerized camera and the digitization of old photographs, inpainting has become a programmed interaction that can be performed on advanced pictures. More than simple scratch expulsion, the inpainting procedures can likewise be applied to protest evacuation, text evacuation, and other programmed changes of pictures and recordings. Besides, they can likewise be seen in applications like picture pressure and super goal.

In photography and film, it is utilized for film reclamation to opposite, fix, or relieve crumbling (for example actual harm like breaks in photos or scratches and residue spots in film or synthetic harm bringing about picture misfortune; see infrared cleaning). It can likewise be utilized for eliminating red-eye, the stepped date from photos, and eliminating objects for imaginative impact.

There square measure presently several programs in use that square measure able to reconstruct missing or broken areas of digital images and videos. most generally famous to be used with digital pictures is Adobe photo shop. Since the digital files square measure able to be duplicated, any restorative alterations ought to be created to the duplicate file, whereas maintaining the first files in AN archive. Given the assorted talents of the camera and also the conversion of previous photos, inpainting has become AN automatic method which will be performed on digital images and videos. Most generally famous to be used with digital pictures is Adobe photo shop. Since the digital files square measure able to be duplicated, any restorative alterations ought to be created to the duplicate file, whereas maintaining the first files in AN archive. Given the assorted talents of the camera and also the conversion of previous photos, inpainting has become AN automatic method which will be performed on digital pictures. quite mere scratch removal, the inpainting techniques may also be applied to object removal, text removal, and different automatic modifications of

pictures and videos. Moreover, they'll even be determined in applications like compression and super resolution.

In photography and cinema, it's used for film restoration to reverse, repair, or mitigate deterioration (e.g., physical injury like cracks in images or scratches and mud spots in film or chemical injury leading to image loss; see infrared cleaning). It may also be used for removing fly, the sealed initiate images, and removing objects for inventive result.

4.9.2 MAIN GROUPS OF 2D IMAGE INPAINTING ALGORITHMS:

- Structural
- Textural
- Combined structural and textural

4.9.2.1 STRUCTURAL:

Structural or geometric inpainting is employed for sleek pictures that have sturdy, outlined borders. There square measure many alternative approaches to geometric inpainting, however all of them stem from constant concept that pure mathematics may be recovered from similar areas or domains. Bertalmio devised a structural inpainting method that is similar to how conservators approach art reconstruction. Bertalmio proposed that the void could be filled by moving identical data from the boundaries of an inpainting domain inwards.

4.9.2.2 TEXTURAL:

While structural/geometric inpainting works to repair sleek pictures, textural inpainting works best with pictures that square measure heavily unsmooth. Texture encompasses a repetitive pattern which suggests that a missing portion can not be reconditioned by continued the extent lines into the gap: level lines offer a whole, stable illustration of a picture.] To repair texture in a picture, one will mix frequency and abstraction domain info to fill in a very elite space with a desired texture. This

technique, whereas the foremost straightforward and extremely effective, works well once choosing a texture to be in-painted. For a texture that covers a wider space or a bigger frame one would ought to bear the image segmenting the square measures to be in-painted and choosing the corresponding textures from throughout the image; there are programs that may facilitate realize the corresponding areas that employment in a very similar manner as find and replace works in a very application.

4.9.2.3 COMBINED STRUCTURAL AND TEXTURAL:

While structural/geometric inpainting works to repair sleek pictures, textural inpainting works best with pictures that are heavily rough. Texture incorporates a repetitive pattern which suggests that we missing portion cannot be remodeled by continued the amount lines into the gap: level lines offer an entire, stable illustration of a picture.] To repair texture in a picture, one will mix frequency and abstraction domain info to fill in an exceedingly chosen space with a desired texture. This methodology, whereas the foremost easy and really effective, works well once choosing a texture to be in-painted. For a texture that covers a wider space or a bigger frame one would have to be compelled to undergo the image segmenting the areas to be in-painted and choosing the corresponding textures from throughout the image; there are programs that may facilitate notice the corresponding areas that job in an exceedingly similar method as find and replace works in an exceedingly application program.

CHAPTER 5

RESULTS AND DISCUSSION:

5.1 PSNR RESULT:

The peak signal to noise ratio (PSNR) is a term that describes the relationship between a signal's highest potential value and the influence of distorting noise that affects its representation quality.

Considering the images which are collected from brihadishwara temple and from the internet. These images are fed into the filtering process. After more analyzation we have selected the most approximate filters which is suitable for this type of restoration process. Those filters are weiner filter, gaussian filter and median filter. The input images after the filtering process gives us some PSNR value. The PSNR results are showed below.

	MEDIAN FILTER	GAUSSIAN FILTER	WIENER FILTER
IMAGE 1	29.8519	27.2518	32.8692
IMAGE 2	27.6623	25.0841	31.4653
IMAGE 3	26.4446	24.9976	30.9505
IMAGE 4	20.6034	20.1719	25.4653
IMAGE 5	18.5369	18.5913	22.7869

TABLE 5.1 PSNR RESULT

By considering the PSNR result, wiener filter gives us the more effective result. Wiener filter is very much used for edge detecting process. Therefore, wiener filtered images from the original images are taken to the next process.

The next process is segmentation. Splitting the images into many blocks to find the damaged part is called segmentation. After finding the damages in the images we are going to fill the part with an appropriate color of the original picture. Filling color to the images can be done by inpainting method. The final output of this process is done using in paint- exemplar method.

5.2 INPAINT EXEMPLAR METHOD:

For image inpainting, exemplar-based algorithms are a common technique. They primarily consist of two phases: determining the filling-in order and choosing suitable exemplars. Traditional exemplar-based algorithms look for appropriate patches from source regions to fill in the gaps, but they run into a problem: incorrect exemplar range. In this paper, we investigate the process of patch propagation to implement an independent strategy to improve the problem. To spread geometry, we first define a new segregated priority description, and then in addition, for the new separated priority concept, an automated algorithm is being developed to estimate levels. In contrast to some competing methods, the current priority concept is capable of restoring image geometry and textures effectively.

Exemplar-based techniques are a really efficient inpainting method for giant target regions. they have a tendency to fill within The picture textures are well preserved in the target regions by directly copying and pasting patches from the source regions. For image/video applications, more exemplar-based approaches have been proposed recently. Barnes et al. introduce Patch Match, a completely new image editing algorithm for finding approximate nearest-neighbor patches from image patches. The algorithm's motivation is based on the following especially, this interactive technique has been employed by Adobe photoshop. In, Korman et al. propose coherency sensitive hashing (CSH) that extends locality sensitivity hashing and Patch Match introduced in to seek out matching patches between two images.

CSH is capable of obtaining reliable findings at a rapid pace. To compute nearest-neighbor fields, He et al. use propagation-assisted KD-trees. The proposed algorithm outperforms the CSH and Patch Match methods in terms of time. Newson et al. create an automated video inpainting algorithm that expands the Patch Match

process in their paper. in to the spatial-temporal case. This algorithm is fast and may affect complex scenes for the video. Wexler et al. in propose a framework to finish the missing information within the video. The completion is regarded as a global optimization problem that is solved using a proposed substitution algorithm. For exemplar-based image inpainting, Liu et al. apply a multiscale graph cuts algorithm. To reduce computation time, the authors introduce a global energy optimization model for exemplar-based inpainting, which they then solve on a low-resolution scale using a proposed multi simulation algorithm.

5.3 MASKING METHODOLOGY:

Masking method is a process in which the small piece of image can be taken and its used to modify it into larger image. Masking method is used in image processing which includes edge detection, motion detection and noise reduction. In this project the filtered image is first converted into binary image to find the missing degraded parts in it. After finding the degraded empty parts by using inpaint-exemplar the approximate color will be filled.

Wiener filtered image



Fig 5.1WEINER FILTERED IMAGE 1

Masked Image



Fig 5.2 MASKED IMAGE 1

Inpainted Image



Fig 5.3 INPAINTED IMAGE 1



Fig 5.4 WEINER FILTERED IMAGE 2



Fig 5.5 MASKED IMAGE 2



Fig 5.6 INPAINED IMAGE 2

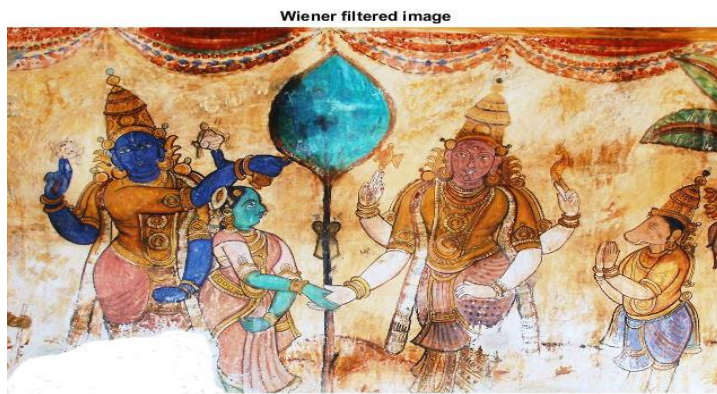


Fig 5.7 WEINER FILTERED IMAGE 3



Fig 5.8 MASKED IMAGE 3

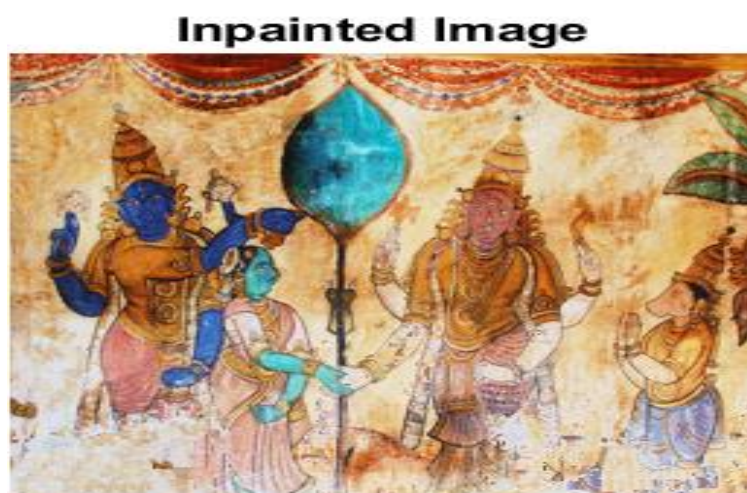


Fig 5.9 INPAINTED IMAGE 3

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 CONCLUSION:

In light of the incorporation of CPS and brilliant terminals, we made a CGAN count model for fragmented pictures of Yishu and Old Books. From that point onward, by utilizing deficient pictures as extra data dependent on CGAN, we can acquire better test outcomes. In the examination of the outcomes, this strategy is in accordance with the application field of characters in old books, and has higher exactness than different techniques. This CPS information model for cross-stage and continuous organization cross-cutting isn't just a mix of virtual and physical, yet additionally the acknowledgment of information driven information administrations. Also, the clever terminal framework development arrangement gave in this article has added to the keen advancement of the library. The shrewd terminal innovation is a stage that unmistakably shows the advanced assurance of the library. This field can be incorporated with picture rebuilding innovation applications. The objective of this action isn't just to incorporate profound learning with CPS, yet in addition to acknowledge clever administrations, innovation sharing and data sharing. For researchers of old writing, this is especially significant. The computerized assurance of Yiwen's antiquated books is a long haul and significant errand. We should utilize existing assets to build up a total computerized data set of antiquated Chinese characters and make commitments to the social legacy of the Chinese country.

REFERENCES

- [1] J. Lucas, Ian T. van Vliet, and W. Piet, “Recursive gaussian derivative filters,” in Proc. ICPR, 1998, pp. 509–514.
- [2] S. Pei, Y. Zeng, and C. Chang, “Virtual restoration of ancient chinese paintings using color contrast enhancement and lacuna texture synthesis,” IEEE Transactions on Image Processing, vol. 13, no. 3, pp. 416–429, March 2004.
- [3] A. Criminisi, P. Perez, and K. Toyama, “Region filling and object removal by exemplar-based image inpainting,” Trans. Img. Proc., vol. 13, no. 9, pp. 1200–1212, Sept. 2004.
- [4] B. Cornelis, T. Ruzic, E. Gezels, A. Doms, A. Pizurica, L. Platasa, J. Cornelis, M. Martens, M. De Mey, and I. Daubechies, “Crack detection and inpainting for virtual restoration of paintings: The case of the ghent altarpiece,” Signal Processing, vol. 93, no. 3, pp. 605 – 619, 2013, Image Processing for Digital Art Work.
- [5] H. Noh, S. Hong, and B. Han, “Learning deconvolution network for semantic segmentation,” in Proceedings of the 2015 IEEE International Conference on Computer Vision (ICCV), Washington, DC, USA, 2015, ICCV ’15, pp. 1520–1528, IEEE Computer Society.
- [6] D. Pathak, P. Krahenbuhl, J. Donahue, T. Darrell, and A. Efros, “Context encoders: Feature learning by inpainting,” 2016.
- [7] Y. Zeng, J. Tang, J. van der Lubbe, and M. Loog, “Learning algorithms for digital reconstruction of van gogh’s drawings,” in 6th International Conference, EuroMed 2016, Cyprus, 2016, vol. 10058, pp. 322–333.
- [8] E. Shelhamer, J. Long, and T. Darrell, “Fully convolutional networks for semantic segmentation,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 39, no. 4, pp. 640–651, Apr. 2017.
- [9] C. Yang, X. Lu, Z. Lin, E. Shechtman, O. Wang, and H. Li, “Highresolution image inpainting using multi-scale neural patch synthesis,” in The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), July 2017.