ROBUST SECURE COLOR IMAGE WATERMARKING USING 4D HYPERCHAOTIC SYSTEM, DWT, HBD AND SVD BASED ON IMPROVED FOA ALGORITHM

BY

1. SHIVANI CHAUDHARY (1809131144)
2. TRISHA SINGH (1809131161)
3. VINEET KUMAR SINGH (1809131176)

Under the Guidance of

Dr. Sangeeta Mangesh

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JSS ACADEMY OF TECHNICAL EDUCATION

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Project Report

On

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SHIVANI CHAUDHARY (1809131144)
TRISHA SINGH (1809131161)
VINEET KUMAR SINGH (1809131176)

Under the Guidance of

Dr. Sangeeta Mangesh

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Dr. A.P.J. Abdul Kalam Technical University, Lucknow

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DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

1. Shivani Chaudhary

Roll No: 1809131144

2. Trisha Singh

Roll No: 1809131161

3. Vineet Kumar Singh

Roll No: 1809131176

CERTIFICATE

This is to certify that Project Report entitled "**ROBUST SECURE COLOR IMAGE WATERMARKING USING 4D HYPERCHAOTIC SYSTEM, DWT, HBD AND SVD**" which is submitted by **Shivani Chaudhary, Trisha Singh, Vineet Kumar Singh** partial fulfilment of the requirement for the award of B. Tech degree in Electronics and Communication Engineering of **Dr. A.P.J Abdul Kalam Technical University, Lucknow** is a record of the candidate's own work carried out by him under my supervision. The matter embodied in this thesis is original and has not been submitted for the award of any other degree.

Dr Sangeeta Mangesh

Date:

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Signature
Name Shivani Chaudhary
Roll No. 1809131144
Date

Signature
Name Trisha Singh
Roll No. 1809131161
Date

Signature
Name Vineet Kumar Singh
Roll No. 1809131176
Date

ABSTRACT

The processing of multimedia data has become much easier because to the rapid expansion of internet and network technologies, and many individuals now share their belongings. Because multimedia statistics can be easily duplicated and modified, the demand for copyright protection is growing. It is the undetectable labeling of multimedia content records to brand ownership Copyright protection has been proposed via digital watermarking multimedia records are protected. Copyright statistics are discreetly embedded in digital watermarking into multi-media content As a result, digital watermarking has been employed to protect copyright. Fingerprinting, reproduction protection, and broadcast tracking are all options. Typical types images, song clips, and virtual video are examples of indicators to watermark. The use of digital technology is where watermarking on photographs is concentrated.

The most significant technical problem is to develop a robust digital watermarking system that discourages copyright infringement by making watermark removal time-consuming and expensive. The ability to add numerous watermarks to the same image could open up a world of possibilities, including multimedia record tracing, records utilization tracking, and multiple property management. Developing an optimal and robust watermarking approach paired with a 4D hyperchaoutic structure and examining its performance, building on and distinguishing earlier work. To determine which picture technique is the best to use, to carry out all of the attacks, and to compare the results to the original data. Reduce the size of encrypted data and increase storage efficiency. To increase robustness by HbD coefficient adjustment

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LIST OF SYMBOLS

[xn]	number of complex numbers
=	equal
m*n	matrix
U	orthogonal eigen matrix
VT	transpose of n*n matrix
W	n*n diagonal matrix
P^(H)	conjugate transpose

LIST OF ABBREVIATIONS

DCT	Discrete Cosine Transform
DFT	Discrete Fourier Transform
DWT	Discrete Wavelet Transform
FFT	Fast Fourier Transform
HbD	Hessenberg Decomposition
HPF	High Pass Filter
LPF	Low Pass Filter
PIL	Pillow
SVD	Singular Value Decomposition

CHAPTER 1

INTRODUCTION

1.1. DIGITAL IMAGE PROCESSING

Digital image processing is using a digital computer to process virtual images through a set of rules. As a subcategory or discipline of digital signal processing, digital image processing has many benefits over analog image processing. It lets in a miles wider variety of algorithms to be applied to the enter data and may keep away from issues inclusive of the build-up of noise and distortion all through processing. For the reason that pics are described over two dimensions (perhaps extra) virtual photograph processing can be modled inside the form of multidimensional structures. The era and development of virtual image processing are particularly stricken by 3 factors: first, the improvement of computer systems; second, the development of mathematics (specifically the advent and improvement of discrete arithmetic theory); third, the call for a extensive variety of applications in surroundings, agriculture, military, enterprise and clinical technological know-how has extended.

1.2. HOW DIP WORKS

Digital image Processing (DIP) deals with manipulation of virtual images through a digital computer. it is a subfield of indicators and structures but cognizance especially on images.

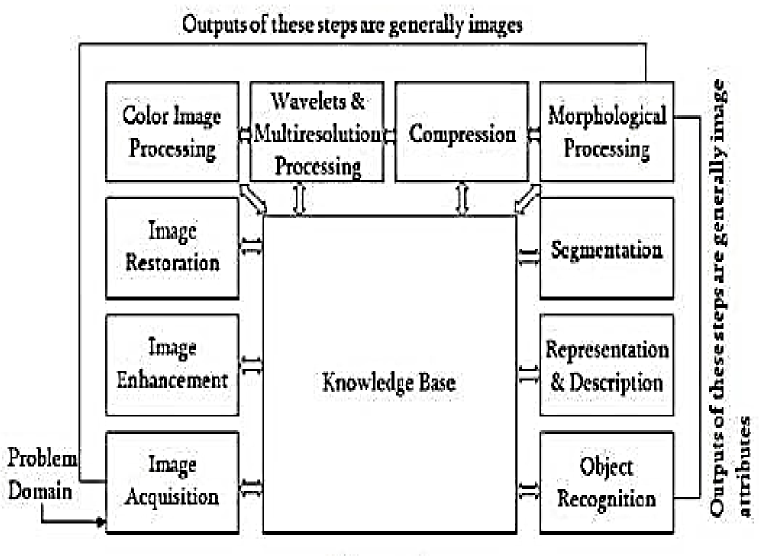


Fig 1.1 Digital Image Processing Components

DIP specializes in growing a computer device that is capable of carry out processing on an image. The input of that machine is a virtual image and the machine technique that image the usage of efficient algorithms, and gives an image as an output. The most common example is Adobe Photoshop. it's far one of the extensively used utility for processing digital images.

1.3.INTRODUCTION TO SIGNAL PROCESSING

Signal processing is the field of electrical engineering and mathematics that analyzes and processes analog and digital signals to store, filter, and perform other operations. These signals include transmit signals, audio or video signals, image signals, and other signals. Moreover, it can be divided into analog image processing and digital image processing.

Analog Image Processing - Analog image processing is performed on analog signals. This includes 2D analog signal processing. In this type of processing, images are manipulated using power tools and altering the electrical signal. A well-known example is the television image.

Digital Image Processing – Digital image processing has dominated analog image processing over time due to its wider range of applications. Digital Image Processing: Digital image processing involves the development of a digital system that performs operations on a digital image.

1.4. WHAT IS AN IMAGE?

The image is just a two-dimensional signal. It is defined by the mathematical function f(x,y), where x and y are two coordinates, horizontal and vertical. The value of f(x,y) at any point gives the value of the pixel at that point in the image.

Fig 1.2 Image

A digital image currently displayed on a computer screen is shown in the diagram above. This image, however, is a two-dimensional array of numbers ranging from 0 to 255.

1.5. RELATIONSHIP BETWEEN A SIGNAL AND IMAGE

Signal - A signal is any quantity that may be measured in the physical world through a higher dimension of space or time. A signal is an information-carrying mathematical function. One-dimensional, two-dimensional, and higher-dimensional signals are all possible. A signal that is measured throughout time is called a one-dimensional signal. Audio notifications are a common example. Signals that are measured across another physical quantity are called two-dimensional signals. The digital image is an example of a two-dimensional signal.

Relationship - The transmission is something that transmit signals or a phrase between two basic observers. Symbols use words (human voices) or visuals. Our voices become sound waves/signals as we speak, and they alter depending on the time we're talking to the person we're talking to. Furthermore, due to the way digital cameras work, a digital camera must convey a signal from one part of the system to another in order to obtain a picture.

1.6 HOW A DIGITAL IMAGE IS FORMED

The act of taking a photograph using a camera is a physical one. The sun is used as a source of energy. Images are captured using a sensor array. The sensor monitors the amount of light reflected from the object when sunlight shines on it and provides a DC voltage signal based on the amount of data detected. This data must be transformed into a digital format in order to create a digital image. Sampling and quantification are included. A two-dimensional array or matrix of numbers, which is nothing more than a collection of numbers, is the outcome of sampling and quantization.

1.7 WHY DIGITAL IMAGE PROCESSING REQUIRED?

More digital data and information is sent over the Internet than ever before. Digital media has become popular due to the availability and effectiveness of worldwide computer networks for providing digital information and data. As a result, information security is more critical for communication and information transfer between people. To secure information from illegal access, various approaches are utilized, including symmetric and asymmetric encryption systems.

Traditionally, many encryption methods have been used to safeguard digital data. However, encryption by itself is not a realistic solution because it simply ensures that content is delivered securely. After decryption, the content is no longer protected and can be pirated or copied without restriction. As a result, in the age of the internet and computers, hacking is a major issue. Digital watermarking technology beats other known solutions in combating media data piracy and counterfeiting. As a result, interest in tattooing techniques has grown in recent decades.

1.8 WHAT IS DIGITAL WATERMARKING?

Watermarks employ a type of identifier that's also secretly placed in digital data such as music, video, and images to identify the source and copyright holder. This method is used to detect copyright infringement on social media and to determine the authenticity of banknotes in the banking system.

1.9 WHY IS DIGITAL WATERMARKING IMPORTANT?

Digital watermarking is a methodology by embedding identifying information in a data carrier in a scarcely noticeable manner that does not prevent the data from being used. Multimedia data, databases, and text files are frequently protected using this technology.

Watermarking your assets is essential for protecting your work and claiming ownership. Your important digital assets could be vulnerable to content theft or illegal usage if you don't utilize a watermark.

The following are the three primary advantages of tattooing:

A) Brand Stability: Watermarking secures your assets and helps to keep your brand safe by reducing the possibility of misappropriation. When items should be viewed but not shared, watermarks can be useful.

B) Ownership Protection - Watermarks are used to protect photographs and visual files from theft, as well as from being used or altered without the owner's consent.

C) Increased ROI – By safeguarding and maintaining preparedness, secure distribution, updates, and usage changes, watermarking improves the return on investment of this precious investment.

1.10 WHAT IS THE PURPOSE OF WATERMARKING?

Watermarks can be used to protect the privacy and prove the legal document's legitimacy. To prevent counterfeiting, you will additionally watermark any paper notes in use.

1.11 TYPES OF WATERMARKS

1. Visible Watermarks – Watermarks that are visible
2. Invisible Watermarks – These watermarks use steganography and are incorporated in the media. It can't be seen with the naked eye.
3. Public Watermarks – Anyone who utilizes a specific algorithm can decipher and alter it. They have no idea.
4. Fragile Watermarks – Data tampering destroys these watermarks. If fragile watermarks are to be utilized, a system that can detect changes in the data must be in place.

1.12 DIGITAL WATERMARKING PROCESS (LIFECYCLE)

The medium should have information incorporated in it. Digital watermarks are built-in signal host signs and information. This procedure is divided into three sections.
Built-in - This component includes a digital sign with a digital watermark.
When the transmitted media is modified, it constitutes a threat and is referred to as an attack on the watermark system.

Watermark detection in noisy communications that have been manipulated for security Protection is defined as JPEG compression, rotation, cropping, and noise addition.

Digital watermarking has applications, advantages, disadvantages, and characteristics. The following are some examples.

1.12.1 APPLICATIONS

1. Forensics makes use of watermarks. In forensics, evidence modification is prohibited, although images with watermarks are permitted.
2. The brand uses it. Watermarks on digital files are intended to be authoritative. The digital media is unharmed.
3. Data can't be replicated with a digital watermark.
4. Watermarks are used in video editing software to entice users to purchase the complete version.

5. It's utilized for video verification. Videos from various agencies are frequently shown on news networks.

1.12.2 ADVANTAGES

1. Copyright infringement in digital content is detected with this tool.
2. Watermarking is a highly secure method of data encryption. A key is used to embed a watermark, and anyone who want to remove it must do so knowingly. When embedding, share keys.
3. The combined copy of the file is also digital, making it simple to transfer and use. When used as watermarked media, no changes in file format ensure no issues or problems.

1.12.3 DISADVANTAGES

1. The visible watermarks can easily be removed or replaced with others.
2. More effective photo watermarking solutions are still needed. Watermarks can be trimmed and images with watermarks can be readily resized.
3. The watermark can be readily removed by the owner. This means you can easily edit the image and change the watermark anytime someone hits the owner on this page.

1.12.4 CHARACTERISTICS

1. When watermarks degrade the quality of the content, it's difficult to notice. It should not be noticeable.
2. Watermarks should be stronger than standard conversions in general. Lossy compression, signal distortion, and D/A and A/D conversion Watermarks in photos and videos must prevent geometric distortions such as translation, resizing, and cropping, among other things.
3. Watermark Detector can determine whether the watermark is still there in the data after the alteration. You should also consider the powerful embed function.

CHAPTER 2
LITERATURE SURVEY

2.1 HISTORY OF WATERMARKING

The term "digital Watermark" was coined by Andrew Tirkel and Charles Osborne in December 1992. [1], [2]The primary successful embedding and extraction of a steganographic spread spectrum watermark changed into demonstrated in 1993 via Andrew Tirkel, Charles Osborne and Gerard Rankin[3].

Watermarks are identity marks produced in the course of the paper making procedure. The first watermarks seemed in Italy in the course of the thirteenth century, however their use rapidly unfold across Europe. [2], [4]They were used as a way to perceive the paper maker or the exchange guild that manufactured the paper. The marks frequently were created by a twine sewn onto the paper mildew. Watermarks stay used nowadays as manufacturer's marks and to prevent forgery[3], [5].

Virtual watermarks, like traditional endogenous watermarks, are frequently more evident in specific settings. Following the use of numerous algorithms. Because of its origin, a digital watermark that affects the provider's signal in a readily visible way can be considered significantly less effective. Virtual watermarks can be put on music, photo, video, text, or a 3D model, whereas traditional watermarks can be implemented on visible media such as photographs or video. At the same time, the signal can provide multiple distinct watermarks.

An example of a watermark cover for an image. In the centre is the Wikipedia logo representing the owner[1]–[3].

The digital watermark no longer switches the size of the service signal, unlike the metadata provided to the carrier label. The default watermark's attributes are determined by the application case in which it is used. To add copyright statistics to multimedia materials, the digital watermark must be powerful enough to change the media label. If security is required, on the other hand, a fragile watermark can be used.

Digital watermarks and steganography explain steganographic techniques for inserting secret recordings of audio signals. Although the goal of steganography is to make something invisible to the naked eye, the digital watermark prioritizes stability.

The digital watermark is more of a passive protection method because the digital copy of the information is comparable to the original. Even if it can no longer degrade or enter data, it merely marks records.

Supply monitoring software is virtual watermarking software. At each distribution point, a watermark is inserted in a digital sign. If a copy of the work is discovered later, the watermark can be extracted from the replication and the distribution supply estimated. This method was apparently used to detect the distribution of illegally duplicated films.

2.2 RELATED WORKS

There is multiple research literature available describing image securing techniques. One of them is the research on the design of embedded colour watermarks and extraction schemes[7], [9], [13]–[15]. Undetectable and robust digital watermark schemes could be a potential solution for the privacy and security of sensitive information such as electronic patient records (EPRs). To this end, a combination of fast curve change and SVD inserted a watermark (EPR) after encoding a healthy and sick scan of the patient's optical coherence tomography (OCT) [16]–[19]; this scheme shows a high level of anonymity, robustness and security of the EPR compared to existing watermark schemes.

The digital watermark protocol proposed in [18], [20] solves a false positive problem using a chaotic Kbest gravitational search algorithm in two domains, i.e. SVD and DCT. An effective watermark scheme in terms of invisibility, security and robustness proposed in inserted the watermark into Charlier - Meixner's Fractional Moments. .the proposed method according to achieves strength against geometric and filtering attacks and shows a better compromise between strength and deformation than the most modern techniques[8], [16]. The proposed

watermark scheme in [1], [12], [16] uses a double encryption method based on fractional Fourier transform and DCT in the hybrid wavelet domain. .the author of this scheme uses multi parameter particle swarm optimization (MP-PSO) to obtain optimized embedded factors and reveal high security and invisibility and resistance to geometric attacks.

A robust and secure watermark method for improving medical image management is described in [16]–[18]. In this design, invisible and zero watermark techniques prevent loosening between medical images and EPR and provide reliability for patient identification. Another digital watermark scheme consists of six modules (level shift, mixed modulation, mark correlation, orthonormal recovery, distortion compensation, and iterative control) that highlight the shortcomings of existing SVD-based watermark schemes while improving robustness and invisibility [1], [8], [9], [11], [14], [15], [20]–[22]. To ensure the protection of copyright and digital data ownership, the authors [25] present a customizable and robust watermark scheme that includes color hosts and watermark images of the same size - the scramble Arnold's Chaotic Map.

CHAPTER 3
IMPLEMENTED TASK

3.1 PROPOSED WATERMARKING TECHNIQUE WITH OPENCV

The method for utilizing opencv to place a watermark using a transparent overlay is discussed below. You'll need two photos to make a seamless cover:

a) The primary photograph.
b) An picture (watermark) containing the information you want to "overlay" on the first image using alpha transparency.

This watermark is a PNG picture with four channels: red, green, blue, and an alpha channel that controls the transparency of each pixel in the image.

The values in our alpha channel can vary from [0, 255], with 255 being completely opaque (i.e. not transparent at all) and 0 being completely transparent.

After we've watermarked our image, the watermark turns semi-transparent, allowing us to view the source's backdrop (partially).

```
import cv2

img = cv2.imread('images/deer.JPG')
```

3.2 PROPOSED WATERMARKING TECHNIQUE WITH PILLOW

We can add watermarks to our images using the Pillow package. The "Image", "ImageDraw", and "ImageFont" modules from the Pad package are required to add a watermark to our image. The ImageDraw module allows you to draw 2D graphics on top of fresh or existing images.

```
#import required Image library

From PIL import Image, ImageDraw, Image Font
```

PYTHON PILLOW - CREATING A WATERMARK

In this lesson, we'll look at how to make a watermark in Python using the pad package. Pillow is a Python image library (PIL) for manipulating and working with various picture Jpeg, png, gif, tiff, and other image formats There are numerous image processing applications available. Resize photographs, add watermarks, rotate them, mix them with other photos, blur them, and more. The image is displayed on the image display by PIL.

Installation: Run the following command at the command prompt to install the library: pip install pip python -m Watermarks are divided into two categories.

Watermark for text

Watermarking an image

3.2.1.1Text Watermark - It is an approach to copyright protection of textual documents. Images allow you to place simple custom text on images in a variety of fonts and formats.

Step 1-Import all image processing libraries.

Step 2-Use Image.open() to open the image and image.show() to open the photo viewer.

Step 3-Open the image in the IDE with plt.imshow().

Step 4-Copy the image to create a watermark image.

Step 5-Make the image editable using ImageDraw.

Step 6-Use ImageFont to specify the font and font size.

Step 7-Create a drawing method for the ImageDraw module and pass the image as a parameter to the function.

Step 8- We need two parameters ("font", size), so use the ImageFont module function truetype () to create the font.

Step 9-Next, I used the drawing object's text () function to pass four parameters (starting text, "sample text", Color, ImageFont object).

Step10: plt.Imshow (watermark_image) on each output.

3.2.1.2Image Watermark

This is the method used to paste one image onto another. Both parameters require one. You have to paste the image and the other paste where you want the image to be pasted.

Step 1: Enter all libraries for image processing.

Step 2: Use Open () to open the image and Show () to open the photo
view.

Step 3 - (plt.imshow) is used to open the image in the IDE.

Step 4 - Use the copy() module to copy the image to crop_image.

Step 5 - Crop_image.thumbnail - The thumbnail is used to keep the aspect ratio intact.

Step 6 - copy_image = image1.copy() is used to create the basis for the image we are in It will paste the image.

Step 7 - Paste() is used to paste the image into copy_image using two parameters (crop_image and paste position).

Step 8 - plt.imshow() to show the image

3.3 PROPOSED WAVELET TRANSFORMS IN PYTHON

The wavelet analysis is among the most essential signal analysis techniques. In science and technology, they are commonly utilized. Data compression, gait analysis, signal/image noise reduction, digital communication, and other applications are examples.

3.3.1 WAVELETS IN PYTHON

Wavelet transformations are supported by a number of Python libraries. Let me give you a few examples. PyWavelets is one of Python's most comprehensive wavelet support programs. Both discrete and continuous waves are supported. 2D discrete wavelets and 2D dual tree complex wavelets are supported by pytorch-Wavelets. Continuous wavelet transforms are supported natively by switch scipy. PyWavelet is the most established library available. Excellent performance and coverage.

The majority of the library, however, is written in C. Retarget the GPU implementation as a result. Hardware is not available. One of the reasons people turn to new implementations is because of this. For instance, in addition to PyTorch, which includes GPU support.

WAVELET TRANSFORMS

Wavelets, wavelet analysis, and wavelet transforms are mathematical concepts that represent a signal as a finite-length or rapidly decreasing oscillating waveform (called mopa). To match the input signal, this waveform is scaled and modified.

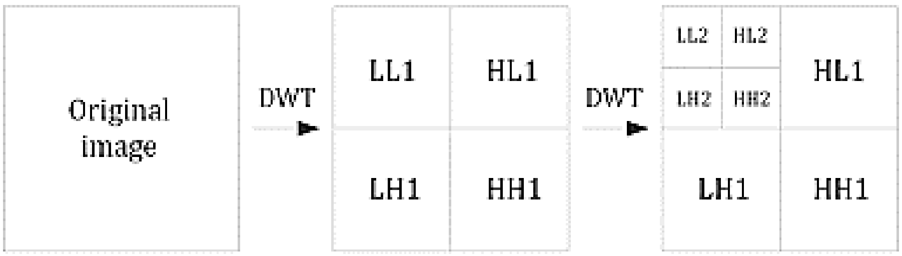
What is a wavelet?

Wavelet is a time-bound wave oscillation, as demonstrated in the example below. Scale and location are the two most basic features of wavelets. The term "scaling" (or "dilation") refers to how much a wavelet is "stretched" or "squished." This feature corresponds to the frequency property, which is defined for waves. The location specifies where in time the wavelet is located (or space).

A) DISCRETE WAVELET TRANSFORM

A wavelet decomposition that samples wavelets at distinct intervals is known as the discrete wavelet transform. DWT simultaneously gives spatial and frequency domain information for the image. Images can be studied and assessed using cross manipulation and a mix of filter banks surgery.

The discrete wavelet transform (DWT) is a signal decomposition technique. Each set represents evolution as a time series of coefficients. Signals in the appropriate frequency range.



B) DISCRETE FOURIER TRANSFORM

The discrete Fourier transform (DFT) is a computational method for converting a finite succession into a continuous sequence of function samples at equal distances into a finite sequence of equal distances. A complex frequency-evaluated function called the discrete-time Fourier transform (DTFT).

The sampling interval for the DTFT is proportional to the input time order. The DFT is a common discrete transform used in Fourier analysis practical applications. The purpose in digital signal processing is to sample any number as a signal that varies over time, such as sound wave pressure, radio signal, or daily temperature data, in a limited time interval (usually defined by a window function). The discrete Fourier transform is used to transform a sequence of N complex numbers.

{xn} := xo, x1,......, xn-1 into another series of complex numbers,

{Xk} := Xo, X1,......,Xn-1 expressed as

$$\begin{aligned} X_k &= \sum_{n=0}^{N-1} x_n \cdot e^{-\frac{i2\pi}{N}kn} \\ &= \sum_{n=0}^{N-1} x_n \cdot \left[\cos\left(\frac{2\pi}{N}kn\right) - i \cdot \sin\left(\frac{2\pi}{N}kn\right)\right], \end{aligned}$$

<u>C) FAST FOURIER TRANSFORM</u>

The DFT of a sequence is computed using the FFT. The DFT could even be used to convert specific styles of function sequences into other types of representations on our own due to its clarity. The discrete Fourier transform is a method for converting the structure of a waveform's cycle into sine components.

In a variety of signal processing applications, a quick fourier series is used.. It should be beneficial for reading components such as sound waves, as well as any picture processing technology. A fast Fourier transform is also used to solve a variety of problems.

$$x[k] = \sum_{n=0}^{N-1} x[n] e^{\frac{-j2\pi kn}{N}}$$

<u>D) DISCRETE COSINE TRANSFORM</u>

Because of its quick energy density, the DCT is utilized in lossy picture distortion because a significant the quantity of data is stored at extremely low frequencies in the signal component and the rest with a frequency with a little amount of data is stored using a small number of bits (usually a maximum of 2 or 3 bits).

To conduct a DCT transformation on a picture, we must first extract the data from the image file (pixel values in integers ranging from 0 to 255), split it by the 8 X 8 block matrix, and then apply a discrete cosine transform to this block of data.

We can see that more than 90% of the data can be entered into the low frequency component after applying the discrete cosine transform. To watch the output, we take an 8 × 8 matrix with all values set to 255 (because the image is completely white) and do a 2-D discrete change in the cosine.

$$X_k = \sum_{n=0}^{N-1} x_n \cos\left[\frac{\pi}{N}\left(n+\frac{1}{2}\right)k\right] \qquad \text{for } k = 0, \ \ldots \ N-1 \ .$$

3.4 PROPOSED TECHNIQUE USING SINGULAR VALUE DECOMPOSITION

The operator matrix for that matrix is singular-value decomposition (SVD). The three criteria have intriguing algebraic features and provide useful geometric and theoretical information on alterations that are continuous.

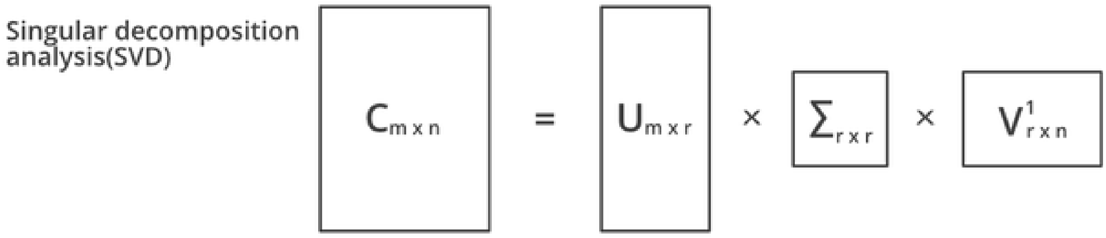
This has crucial Data Knowledge engineering. We'll seek to describe the reasoning skills behind SVD, including geometrical interpretation and algebra, throughout this page.

The mxn A matrix is calculated using the following formula: A = UWV^{T}

where: U: U is the mxn matrix of AA^{T} orthonormal eigenvectors.

VT: the orthonormal eigenvectors of AT are transposed in a nxn matrix of A.

W: a nxn diagonal matrix of singular values that are the square roots of A^{T}A eigenvalues.



3.5 PROPOSED TECHNIQUE USING HESSENBERG DECOMPOSITION

Hessenberg's disintegration

The conversion of an array A into a unit array P and a Hessenberg array H is known as the Hessenberg dissection.

PHP (H) = A, with P (H) denoting conjugated transposition.

Tungsten implements Hessenberg decomposition as Hessenberg decomposition [m]. The first phase in the demolition of Schur is to demolish Hessenberg. The decomposition of a matrix by Hessenberg involves 14n 3/3 arithmetic operations.

3.6 PROPOSED TECHNIQUE FOR IMAGE USING 4D HYPERCHAOTIC SYSTEM

Hyperchaotic attraction is typically characterized as chaotic conduct that has at least two positive aspects. Lyapunov supporters.

The lowest dimension for a (continued) hyperchaotic system is 4 when combined with a zero flow exponent and a negative exponent that guarantees solution limits.

This system is made up of a three-dimensional space continuous autonomous turbulence system with nonlinear control. He looked at the spectrum of Lyapunov exponents and the accompanying bifurcation diagram in a hyperchaotic system.

For varied values and control parameters, the system exhibits turbulent, periodic, hyperchaotic behavior. The following is a description of a hyperchaotic system with exponential expression:

$$x1' = a(x2 - x1) + x4,$$

$$x2' = bx1 + x2 - x1x3, \quad (1)$$

$$x3' = -cx3 + e\ x1x2\ ,$$

$$x4' = dx2x3,$$

where $(x1, x2, x3, x4) \in \Omega \subset R4$, The phase is characterised by a, b, c, and d, which are static variables. Evidently, there is a remedy to system (1).

3. 7 PROPOSED TECHNIQUES FOR IMAGE USING ATTACKS

3.7.1. ATTACKS ON WATERMARKS

Some alteration of the watermark image is likely, while some are deliberate. Cropping, filtering, and other techniques are used in audio compression and transmission.

Lossy Compression: An Overview summarizes them. Many compression schemes, such as JPEG and MPEG, can cause irreversible data loss, which can harm data quality.

Geometric Deformations: Geometric deformations are procedures that are specialized to photos and video and include rotation, panning, scaling, and cropping. This is how it is defined.

1. ROTATION - Image rotation is a widely used image processing method with applications in comparison, debugging, and other image-based algorithms. The picture, the rotation angle, and the place where rotation is completed are the inputs to the image rotation routine.

2. SCALING – The action of extending or shrinking a captured file is known as image scalability; dimensioning shrinks the image while scaling enlarges it. When you scale the same grid graphs and vector graphics, you get different results.

3. CROPPING - Crop can mean "cut" or "cutting." Around the outer edges of digital image, most image editing tools use the crop tool. Cropping can be used to reduce the image's size (in pixels) and/or adjust the aspect ratio (length to width).

The examples of digital baseband processing techniques.

- Compression
- Brightness

- BGR color change
- Linear filtering such as high pass and low pass filtering
- Color reduction
- Kernel attacking such as sepia, sharpen, emboss
- Addition of Gaussian noise
- Poisson noise
- Speckle noise
- Blurring
- Edge Filtering
- Image Enhancement
- Fast Deniosing
- ORB Detection
- Grayscaling
- Slicing of image
- Average Filter
- Laplacian Filter
- Mean Filter
- Median Filter
- Unsharp Filter
- Wiener Filter
- Gaussian Filter
- Salt & Pepper Noise
- Histogram Equalization

The following processing operations are described as follows.

1. COMPRESSION - The concept of reducing the quantity of bytes in a graphics file without affecting image quality is known as feature compressing. To reduce file size, more images can be saved to a specified amount of storage or memory. Photo compression is the process of encoding or modifying a picture file so that it takes up less space than the original.

2. BRIGHTNESS – Bright light is a visual sense in which the source of light is seen and is reflected. Light is a perceived subjective quality of an object. Light is an ideal concept that is distinct from light. The RGB system (red, green, and blue) is used to create the color

screen, which uses three colors. The screen is divided into three sections based on the size of the red, green, and blue pixels. The color appears dull when the brightness is reduced, and clearer when the brightness is increased.

3. BGR COLOR - BGR is a 24-bit representation, with the lowest section approaching 8 bits blue, the middle part approaching 8 bits green, and the top part approaching 8 bits red. RGB values are usually written as RGB (r, g, b), with r, g, and b values ranging from 0 to 255, or as #rrggbb, with rr, gg, and bb being 8-bit hexadecimal values. The color order is BGR when using the OpenCV imread () function to load the picture file (blue, green, red). The color palette in Unlan, on the other hand, is considered RGB (red, green, blue).

4. HPF AND LPF - The RF filter is likely to keep the image's RF information while lowering it to low frequency. The upper pass's main goal is to boost the brightness of the center pixel in comparison to nearby pixels. Low pass filtration is the foundation of most filtering technologies.

5. COLOR REDUCTION - The process of reducing color is straightforward: every color in the original image is replaced with a color from the limited palette available. Unfortunately, the image that results may be discolored and less appealing.

6. KERNEL - A core, a convolution matrix, and a mask instead of a tiny matrix are used in image processing for blur, sharpness, embossing, edge detection, and other functions. This is accomplished by convolutioning the kernel and the picture.

7. GAUSSIAN NOISE - The function of Gaussian Noise is the same as the normal distribution, often known as the Gaussian distribution. Gaussian Random To make this sound, the function is used with the photo function. Because it emerges in amplifiers or detectors, this is also known as electronic sound.

8. SPECKLE NOISE - Spot noise is a sound that affects the pixels in a grayscale image and is common in low-brightness images like Synthetic Aperture. Images from radar (SAR) and magnetic resonance imaging (MRI). Spot noise is noise produced by the image sensor due to ambient circumstances during image capture.

9. POISSON NOISE - These sites have images with unpredictable oscillations. The resulting image is random in both space and time. This is also known as a shot sound or a quantum

(photon) sound. Shot noise, often known as Poisson noise, is a sound that can be used to simulate the Poisson process.

10. BLURRING - Generally general, blurring an image reduces its sharpness. Smoothing the color transition between pixels is one way to achieve this. To accomplish this, we must use a kernel nut to apply a convolution operation using a specific matrix to the image. Blur is used in digital image processing to create a smooth image with no visible borders.

11. EDGE FILTERING – An image component is a significant change in picture intensity that is frequently related with a discontinuity in image intensity or the initial image intensity origin. Edge Detection class filters are intended to detect image area boundaries. feature large brightness differences and disclose additional aspects of image texture These unmixed filters primarily accentuate the image's edges in great contrast.

12. IMAGE ENHANCEMENT - Image enhancement is a technique for improving the quality and substance of the raw data to be processed. The goal of picture enhancement is to increase information interpretation and comprehension. People can see the photographs, or they can contribute "better" input for other automated image processing systems.

13. FAST DENOISING - The removal of sound from an audible image by reinstating the right image is known as noise reduction. However, because sound, edge, and texture are high-frequency components, identifying them in the noise and noise reduction process is difficult. Images will always lose some detail. Random sound, set pattern sound, and band sound are the three basic types of image sound.

14. ORB DETECTION - ORB (Oriented FAST and Rotated BRIEF) is a faster local function detector, first introduced by Ethan Ruble et al. in 2011, that will be available on your computer for applications like object recognition and 3D reconstruction. Once the sphere has formed a pyramid, it employs a fast algorithm to locate the image's important spots.

The most significant points are around the eyes, mouth, and nose, as we can see. We can generate a numerical function called a function descriptor using the key point and the pixels' surrounding area. The BRIEF algorithm is used by ORB.

15. GRAYSCALE - A gray scale in digital photographs means that only the light intensity information of each pixel is displayed. Such images are typically only visible in the darkest

black to the brightest white. In other words, the image only has black, white, and gray hues, each of which has multiple levels of gray.

16. SLICING - Cropping an image divides it into numerous smaller images that can be saved in various formats and with various levels of optimization. It is optimized because It may take less time to download photos than it does to download a large image; but, your website may take longer to load.

17. AVERAGE FILTER - Average filtration is a method of "smoothing" images by reducing the luminosity variation among data points. of A standard system worked by shifting the pixel using a pixel to set the position of each nearby pixel, including itself.

18. LAPLACIAN FILTER - The Laplacian filter is a partial detector that measures the rate of change of the first derivatives and is used to calculate seconds derivatives. It determines whether the change in the contents of neighboring pixels on the page is a one-time or ongoing process.

19. MEAN FILTER - The filter's purpose is to reduce the number of intensity changes between once pixels and so on, which is a basic, obvious, and easy to implement image

20. MEDIAN FILTER - The proposed technique is a nonlinear digital filtration method for removing sound out of an image or input. It is a typical pre-processing approach for enhancing the impact of future processing.

21. UNSHARP FILTER - The blurred filter is a smoother and better operator that extracts a fuzzy or smooth image model source photo. It gets its name from the fact that it improves the edges (and a few high-frequency elements in the picture).

22. WIENER FILTER – This filter is required to construct a preferred or objective random method estimation utilizing linear time invariant (LTI) filtering the perceived sound process, which is supposed to have recognized stop signals, sound spectrum, and increased noise when processing a signal.

23. GAUSSIAN FILTER –A Gaussian filter is a filter that responds to the Gaussian function in electronics and signal processing. Gaussian filters have the property of having no overshoot of the step's input behavior while limiting time increase and decrease.

24. SALT & PEPPER NOISE - Salt and pepper can be heard. The sound of salt and pepper, often known as the impulse sound, can occasionally be heard in digital photographs. Sharp and sudden video signal faults might create this noise. It appears as a mixture of white and black pixels.

25. HISTOGRAM EQUALIZATION - Histogram equalization is a computing approach that improves visual contrast by using a processing mechanism. It accomplishes this by propagating the most common intensity distribution effectively, i.e. extending the intensity range in the image.

3. 8 DEFINING THE IMAGE PROCESSING TERMS

Firstly we will define all the terms of image processing for which tabulation is performed.

3.8.1 MEAN SQUARE ERROR (MSE)

The MSE is a metric which tells how close the line is to the data points. Take the perpendicular distance from each point in the data to the appropriate value of y to interpolate the curve (incorrectly) and exponentiate the value. MSE is not a good investment.

Simply expressed, a lower value is preferable, and 0 indicates that the model is ideal. MSE is a quality indicator for estimates. If calculated using a square Euclidean distance, the result is always positive and decreases as the error approaches zero.

3.8.2 STRUCTURAL SIMILARITY INDEX MEASURE (SSIM)

SSIM, on the other hand, is a consciousness framework that considers picture decay as a reputation in contextual features, as well as other important perception phenomena such as illumination and color suppression. These approaches evaluate absolute errors in comparison to other techniques such as MSE or PSNR.

Pixels show substantial interdependencies, especially when they are spatially close together, according to structural information. These dependencies provide crucial information about the visual scene's structure items. Brightness masking is a phenomenon in which an image is warped (in this context) and is likely less noticeable in the bright area, similar to how contrast masking occurs when high activity or "texture" occurs in the picture.

3.8.3 PEAK SIGNAL TO NOISE RATIO (PSNR)

The peak signal-to-noise ratio (PSNR) is a technical phrase that relates to the proportion of maximum signal strength to destructive sound power, which can degrade fidelity representation. Because many signals have a large dynamic range, PSNR is simply expressed as a nonlinear statistic with a psychrometric chart. PSNR is widely used to calculate the quality of reconstruction before exposing pictures and video that have lost compression. The peak signal-to-noise ratio (PSNR) is a measure of the relationship between the signal's maximum possible value (power) and the degree of the noise distortion that affects its quality of representation.

3.8.4 SCALING FACTOR (ALPHA)

In arithmetic, a scaling factor is the ratio of comparable object measurements to a representation of that item. The copy will be larger if the scaling factor is a whole number. Its copy will be smaller if the scaling factor is a fraction. The activity of enlarging a document is known as sizing digital image in graphics and digital imaging. Up scaling or resolution improvement are terms used in video technology to describe the amplification of digital content. Scaling reduces the size of an image by compressing it (for example, by duplicating pixels). Although the new size is different, the content has remained virtually unchanged.

3.8.5 COMPRESSION RATIO

The compressive stress, also known as the data compression ratio, is a relative measure of how small the data representation generated by the data compression process is. It's commonly represented as a percentage of the uncompressed size divided by the compressed size. As a result a file with compression ratio of 10/2 = 5 has a file store removal of megabytes to 2 MB, also termed as the apparent proportion (5:1) or the implicitly proportion (5/1). This formula also pertains to reduction, in which the inflated size is greater than the source, and dilatation, in which the deflated size is equal to the replica size.

3.9 TABULATION OF IMAGE PROCESSING TERMS

ORIGINAL IMAGE VALUES

MEAN SQUARE ERROR (MSE)	STRUCTURAL SIMILARITY INDEX MEASURE (SSIM)	PEAK SIGNAL TO NOISE RATIO (PSNR)
0	1	48.13

TABLE 3.9 a) ORIGINAL IMAGE VALUES

FILTER ATTACKS

ATTACKS	MEAN SQUARE ERROR (MSE)	STRUCTURAL SIMILARITY INDEX MEASURE (SSIM)	PEAK SIGNAL TO NOISE RATIO (PSNR)	SCALING FACTOR (ALPHA)	COMPRESSION RATIO
1. Average Filter	1075.99	0.77	17.82	1.50	1.00
2. Edge Filter	20542.96	0.05	5.01	1.39	1.23
3. Emboss Filter	21705.92	0.01	4.77	1.02	0.80
4. Gaussian Filter	192.72	0.70	35.19	0.87	0.48
5. Laplacian Filter	4089.44	0.05	12.02	0.77	1.45
6. Mean Filter	318.66	0.65	23.1	0.92	0.73
7. Median Filter	207.87	0.66	24.96	0.88	0.56
8. Sepia Filter	10945.90	0.45	7.74	0.71	0.96
9. Sharpen Filter	1758.95	0.29	15.68	0.72	0.62

10. Unsharp Filter	5413.61	0.28	10.8	0.76	0.73
11. Weiner Filter	223.79	0.56	24.6	0.99	0.78

TABLE 3.9 b) FILTER ATTACKS VALUES

NOISE ATTACKS					
ATTACKS	MEAN SQUARE ERROR (MSE)	STRUCTURAL SIMILARITY INDEX MEASURE (SSIM)	PEAK SIGNAL TO NOISE RATIO (PSNR)	SCALING FACTOR (ALPHA)	COMPRESSION RATIO
1. Gaussian Noise	650.31	0.28	20	0.96	0.64
2. Speckle Noise	2584.66	0.12	14.01	0.94	0.68
3. Poisson Noise	2676.16	0.14	13.86	0.91	0.80
4. Salt & Pepper Noise	1964.90	0.13	15.2	0.95	0.82

TABLE 3.9 c) NOISE ATTACKS VALUES

IMAGE ATTACKS					
ATTACKS	MEAN SQUARE ERROR (MSE)	STRUCTURAL SIMILARITY INDEX MEASURE (SSIM)	PEAK SIGNAL TO NOISE RATIO (PSNR)	SCALING FACTOR (ALPHA)	COMPRESSION RATIO
1. Contrast	169.37	0.94	25.85	0.92	1.54
2. Sharpness	4.85	0.99	41.28	0.95	1.39
3. Color	2.27	0.99	44.57	1	1.38
4. Brightness	4294.13	0.84	11.81	0.99	1.42
5. Merging & Splitting of Bands	70.64	0.96	29.64	0.86	1.36
6. Image Watermark	318.79	0.98	23.1	0.77	1.35
7. Text Watermark	678.52	0.74	19.82	0.47	1.21
8. Grayscale Image	667.32	0.64	19.89	1.08	0.75
9. Background Check	1361.46	0.38	16.79	0.85	0.66
10. Gaussian Blur	279.32	0.58	23.67	0.48	1.02
11. Compressed Image	256.02	0.68	24.05	1.00	1.45
12. Decrypted Image	0.19	1.00	55.34	0.50	1.08
13. Flipping	1588.25	0.38	16.13	0.93	1.53
14. Modified Image	1938.30	0.38	15.26	0.94	1.28
15. R- Band	667.32	0.64	19.89	0.80	0.81
16. ORB detection	927.16	0.44	18.46	1.08	0.37
17. Rotation	12037.20	0.13	7.33	0.67	0.75
18. Slicing of Image	1705.62	0.35	15.82	1.02	0.81
19. Histogram Equalization	2012.44	0.61	15.1	0.99	0.95

TABLE 3.9 d) IMAGE ATTCAKS VALUES

CHAPTER 4

RESULTS AND ANALYSIS

Fig 4.1 ORIGINAL IMAGE

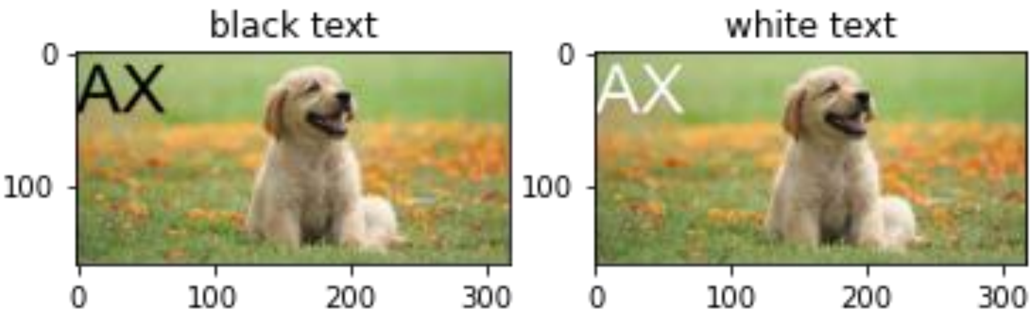


Fig 4.2 TEXT WATERMARKED IMAGE

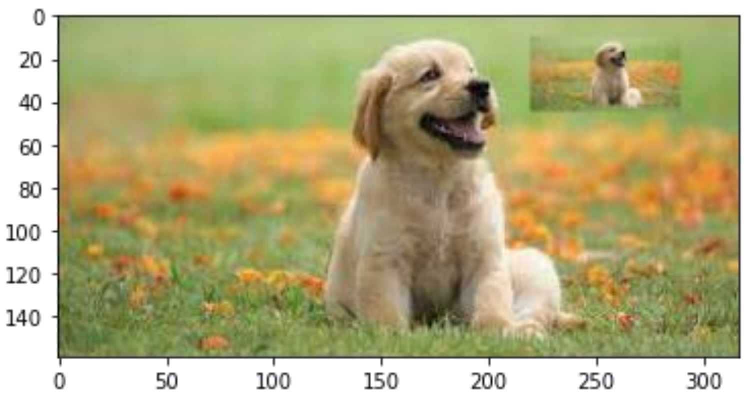


Fig 4.3 IMAGE WATERMARKED

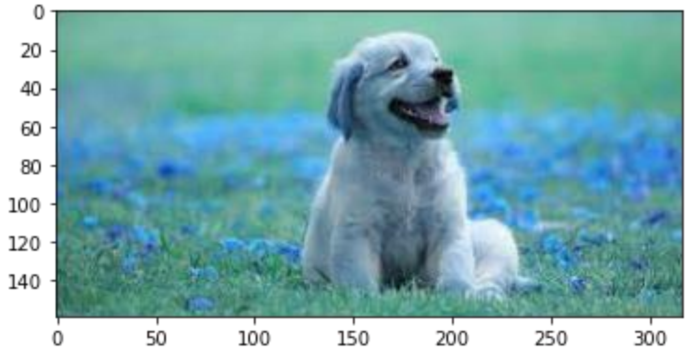


Fig 4.4 BGR COLOR

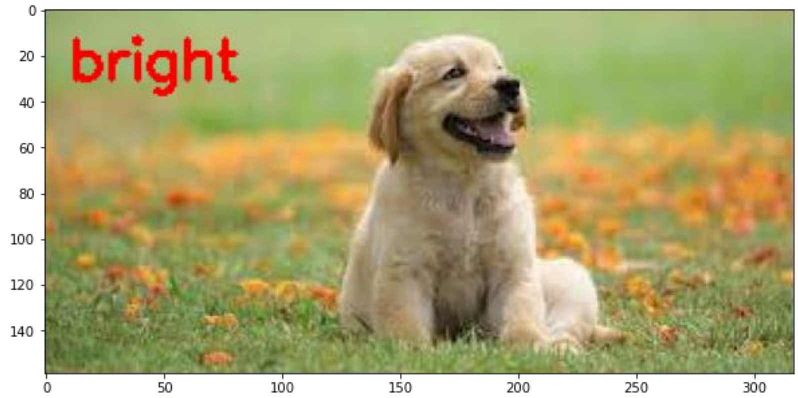


Fig 4.5 FINDING THE BACKGROUND COLOR

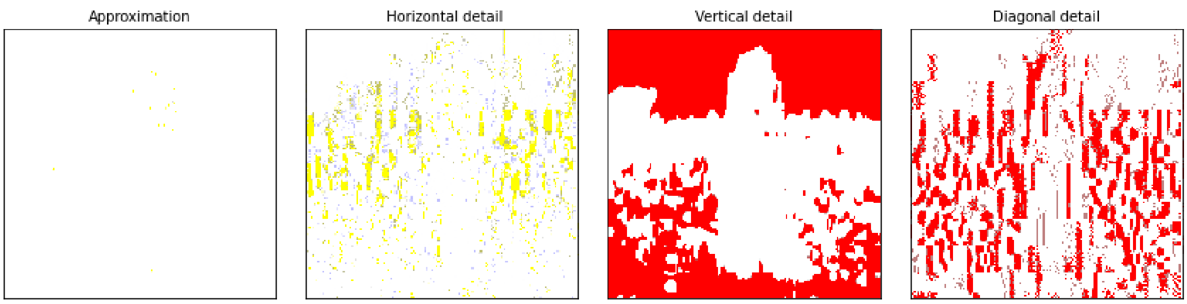


Fig 4.6 DWT TECHNIQUE

Fig 4.7 DCT TECHNIQUE

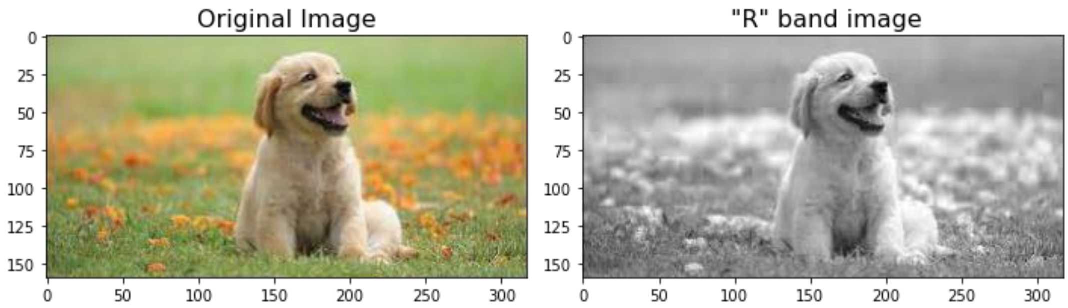


Fig 4.8 R BAND TECHNIQUE

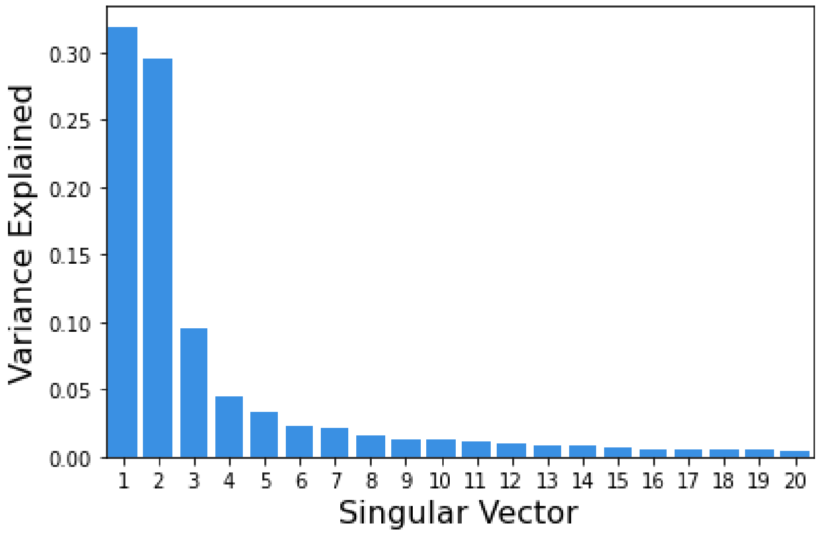


Fig 4.9 SVD GRAPH

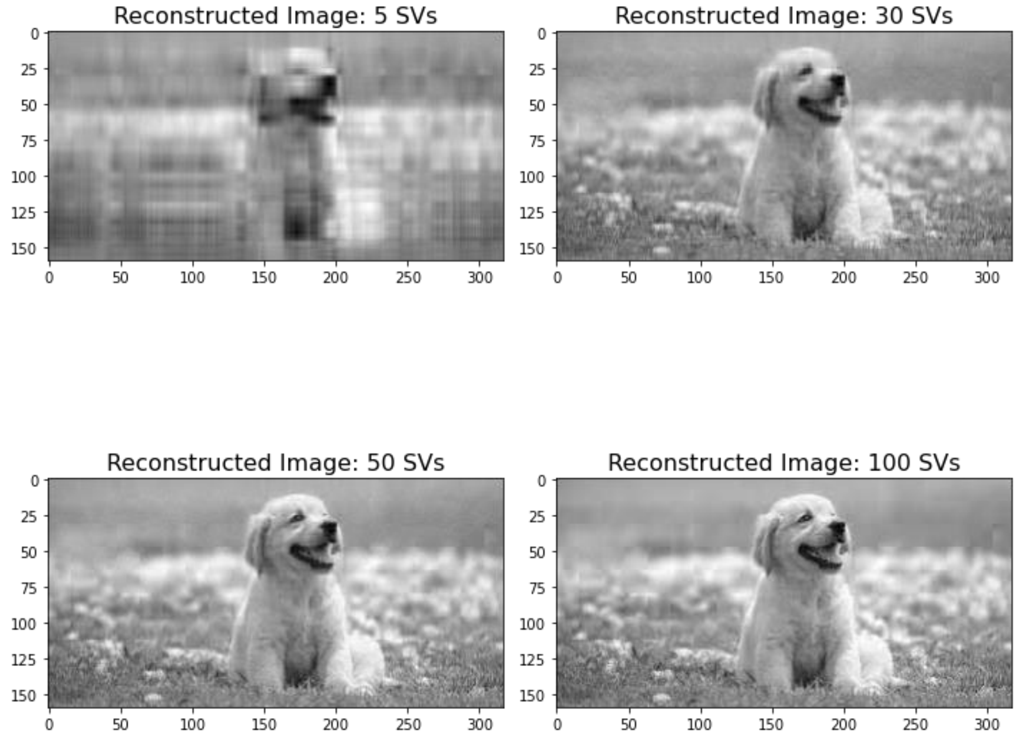


Fig 4.10 SVD TECHNIQUE

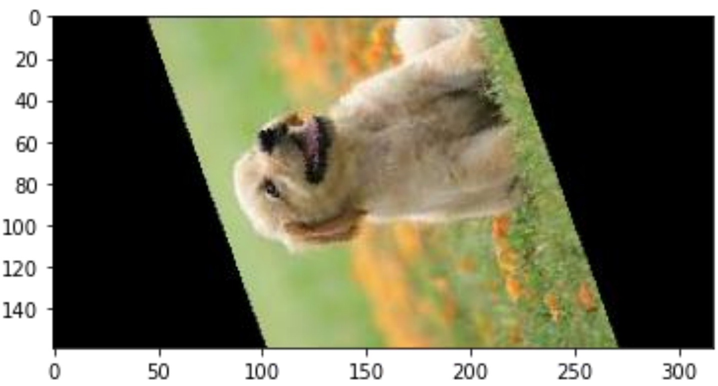


Fig 4.11 ROTATION

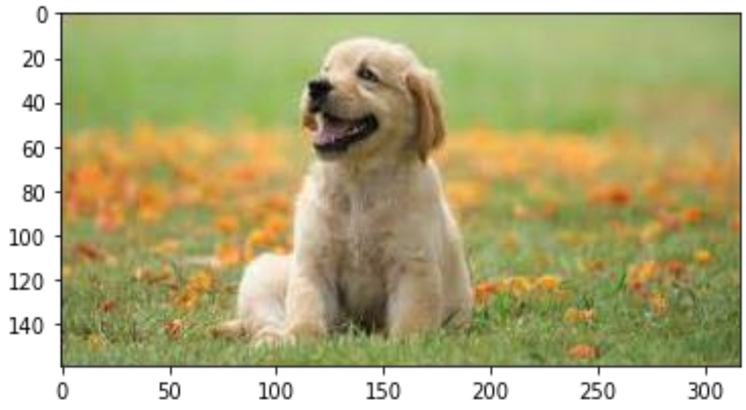


Fig 4.12 FLIPPING

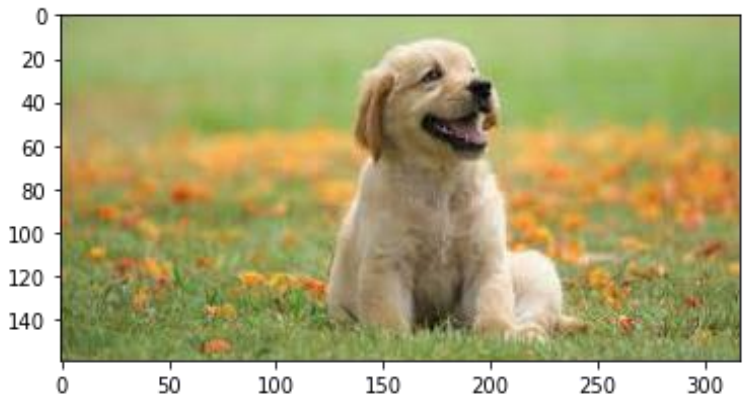


Fig 4.13 IMAGE ENHANCEMENT

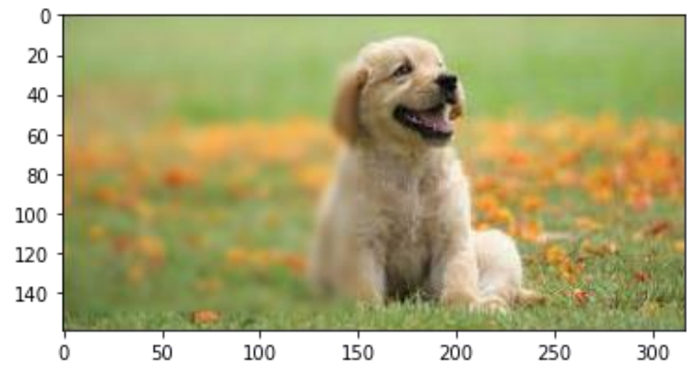


Fig 4.14 HALF SECTION BLUR

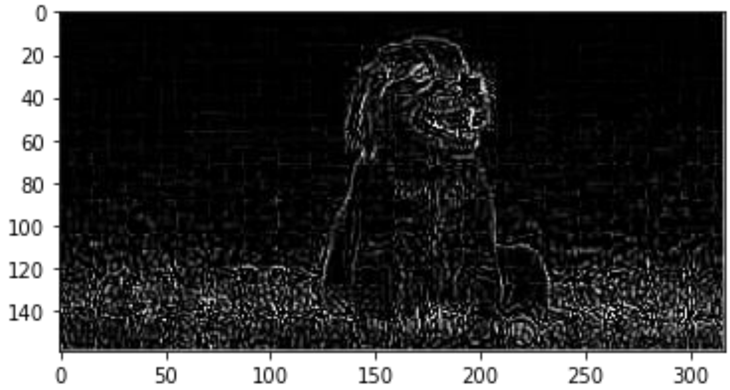


Fig 4.15 IMAGE EDGE FILTER

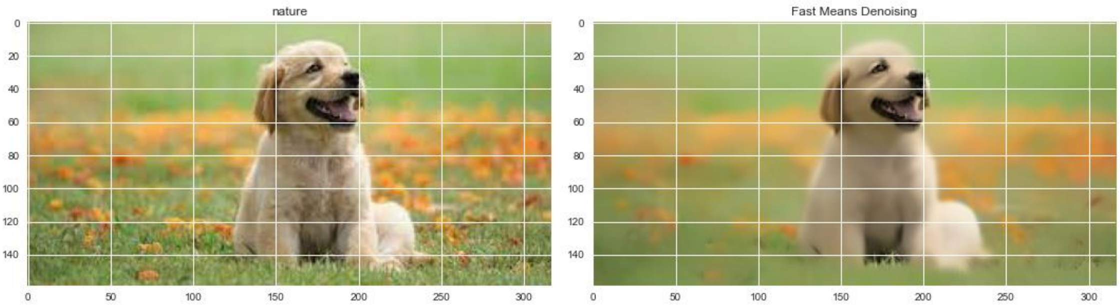


Fig 4.16 FAST DENOISING

Fig 4.17 EMBOSS FILTER

Fig 4.18 SHARPEN FILTER

Fig 4.19 SEPIA FILTER

Fig 4.20 BLUR EFFECT

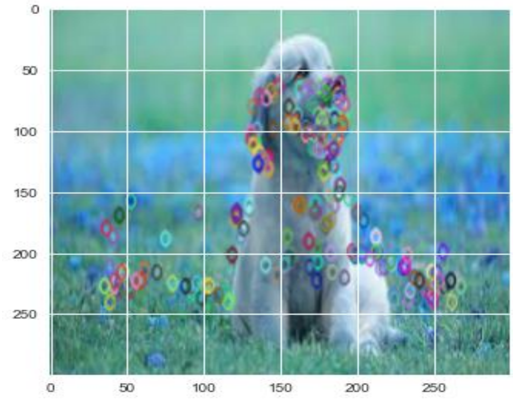


Fig 4.21 ORB DETECTION

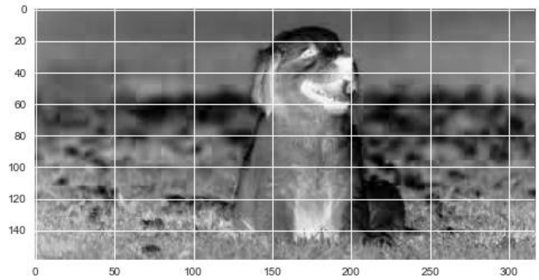


Fig 4.22 GRAYSCALE

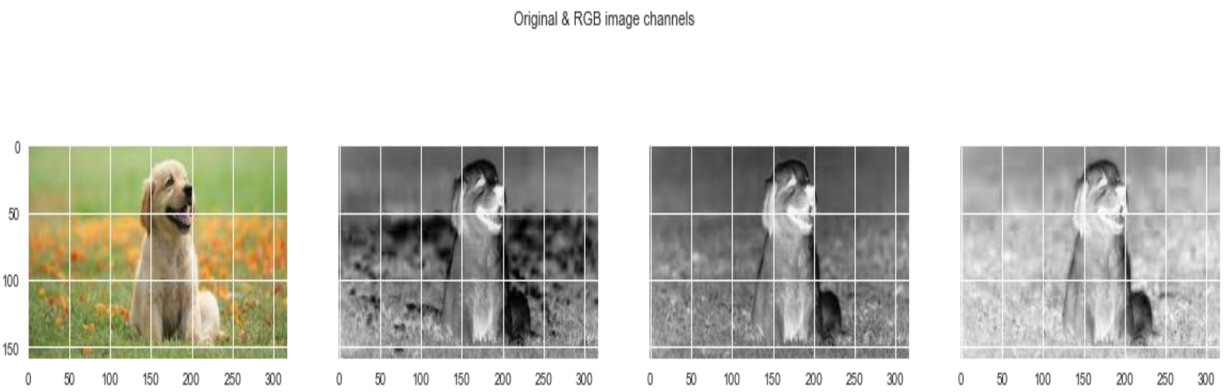


Fig 4.23 RGB IMAGE CHANNELS

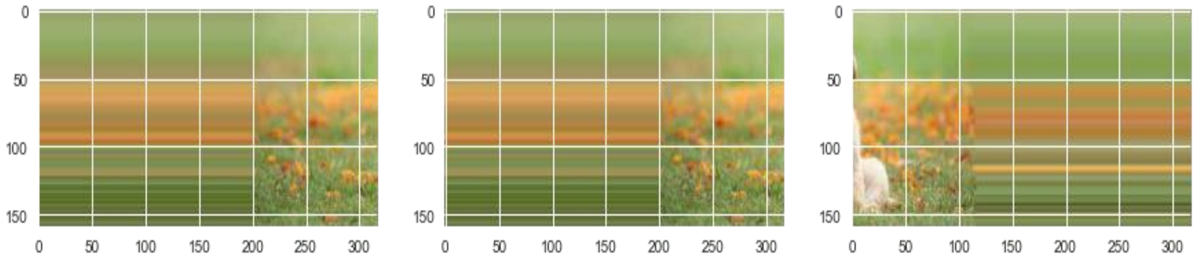


Fig 4.24 KERAS IMAGE PREPROCESSING

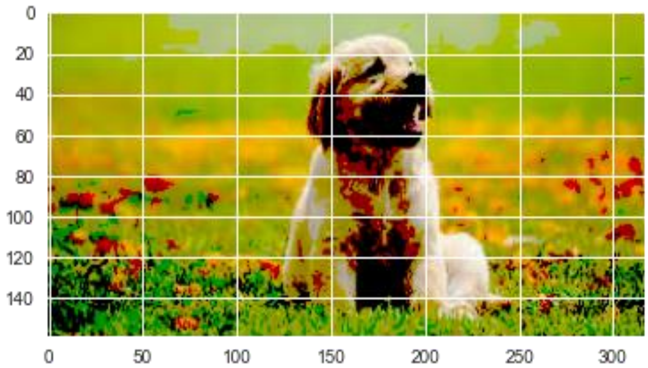


Fig 4.25 MODIFIED IMAGE

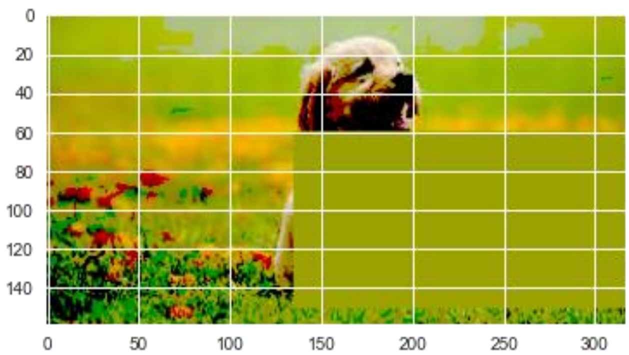


Fig 4.26 SLICING OF IMAGE

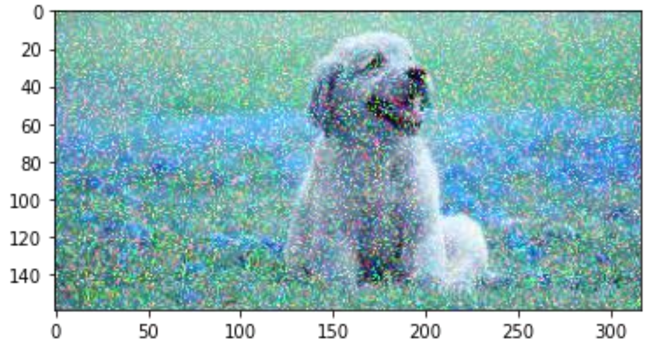


Fig 4.27 GAUSSIAN NOISE

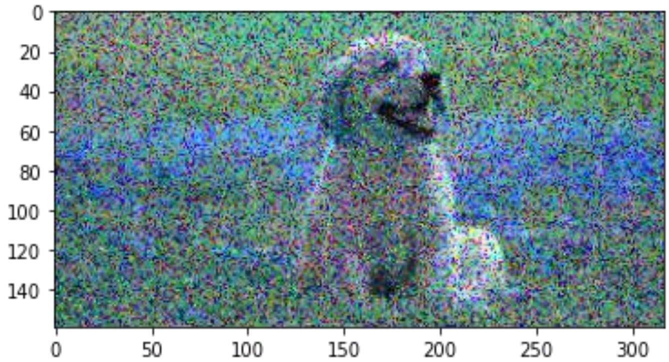


Fig 4.28 SPECKLE NOISE

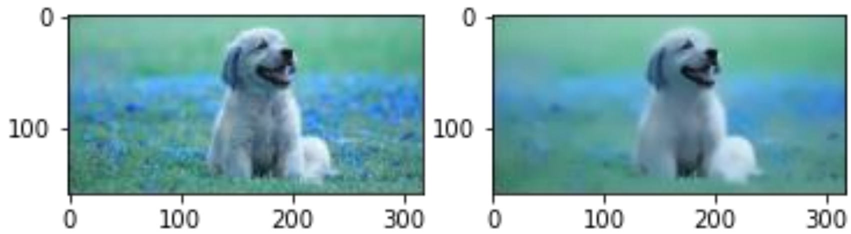


Fig 4.29 DENOISING

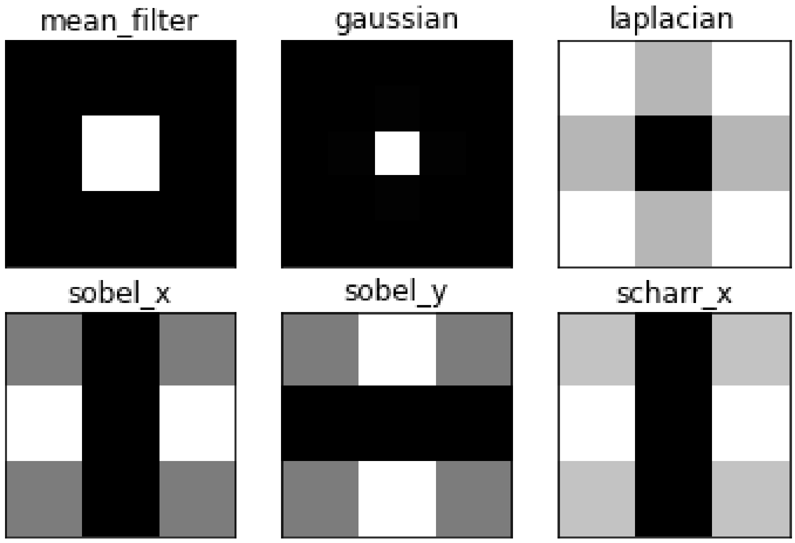


Fig 4.31 FFT FILTERS

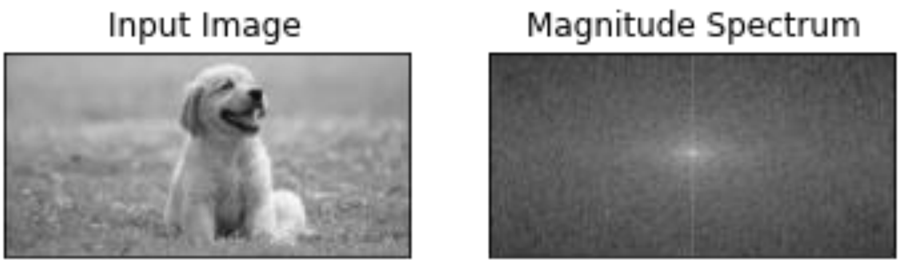


Fig 4.32 DFT TECHNIQUE

Fig 4.33 HYPER CHAOTIC TECHNIQUE

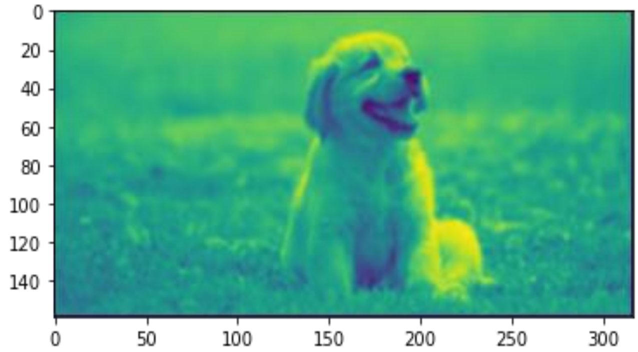


Fig 4.34 AVERAGE FILTER

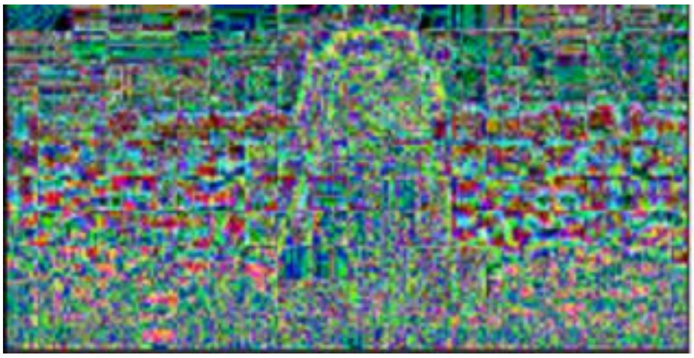


Fig 4.35 LAPLACIAN FILTER

Fig 4.35 MEAN FILTER

Fig 4.36 MEDIAN FILTER

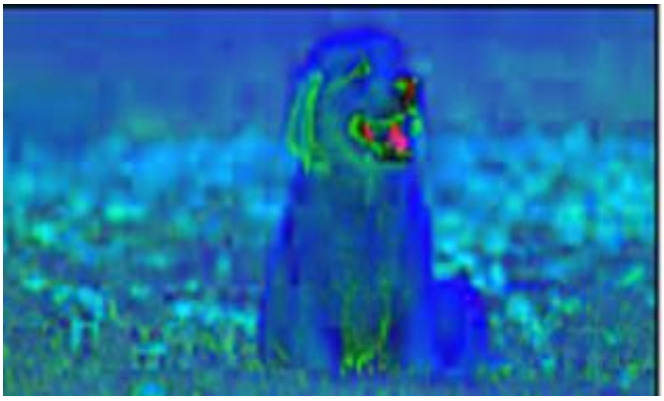


Fig 4.37 UNSHARP FILTER

Fig 4.38 WEINER FILTER

Fig 4.39 GAUSSIAN FILTER

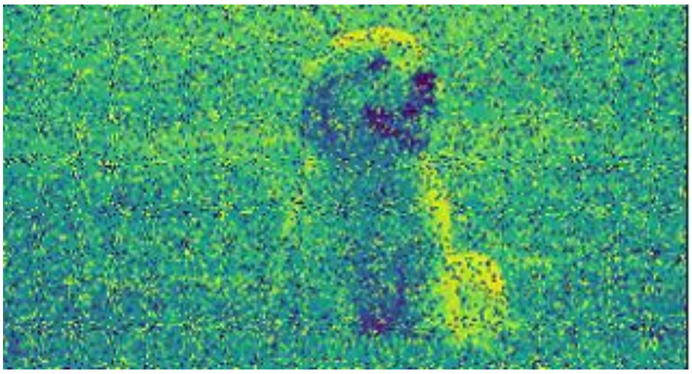


Fig 4.40 SALT & PEPPER NOISE

Fig 4.41 HISTOGRAM EQUALIZATION

CHAPTER 5

CONCLUSION AND FUTUTE SCOPE

The watermark system's ultimate purpose is to embed powerful concealed watermarks into digital files. Watermarking is a new computer, encryption, signal processing, and communications technology. I described the watermarking and dehydration algorithms as part of the project. Watermark study is much more fascinating because, in addition to human visual psychoanalysis, multimedia, and computer graphics, it demands collaborative thinking from all disciplines. Watermarks can be displayed or hidden, and each has its unique purpose.

It should be incorporated in a random range of watermark signals in a randomly selected area to preserve watermark security. This makes removing the watermark tough.

The attacks for photographs have been successfully completed. Singular Value Decomposition (SVD), Hessenberg Decomposition (HbD), and Hyper Chaotic Technique operations have all been completed. We learned about digital watermarking and how it works. The image processing metrics like Mean Square Error (MSE), Structural Similarity Index (SSIM), Peak Signal To Noise Ratio (PSNR), Scaling Factor (Alpha), and Compression Ratio are also given for all the assaults performed on the images. Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) have all been thoroughly investigated.

• FUTURE SCOPE -

Every technology has advantages and disadvantages. One can customize the app even further, as well as the website. In comparison to the present site, this one is far more appealing and convenient. We intend to keep extending our offerings. One must initiate to improve the effectiveness of the strongest attacks versus weaker ones. We'll also apply this method to other frequency conversions. Dimensional with an excessively high similarity. A system for batch processing that is extremely efficient.

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