Image Steganography

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What is Steganography ?

➢ **Art of hiding secret message** in such a way that no one, apart from sender and intended recipient suspects existence of message.

➢ Steganography is a process that involves hiding important information (**message**) inside other carrier (**cover**) data to protect the message from unauthorized users.

➢ The art and science of concealing message in the form of text, image, video or file within another text, image,video or file is called steganography . (**Not Cryptography**)

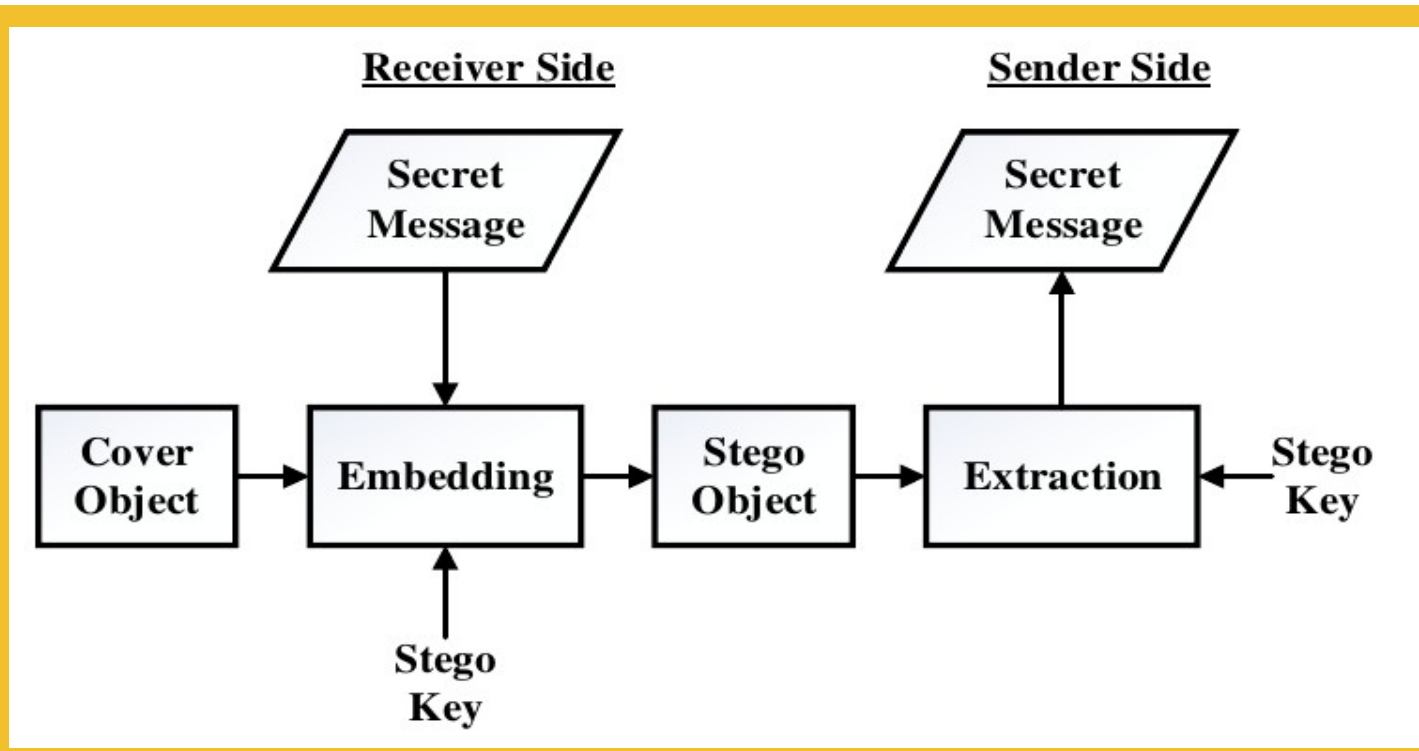➢ Two Approaches are available for Achieving Goal :-

       1. **Spatial** Domain Based   2. **Frequency** Domain Based
                                             Ex – DCT , DFT , DWT

Basic Model of Steganography

Receiver Side

Sender Side

Secret Message

Secret Message

Cover Object → Embedding → Stego Object → Extraction ← Stego Key

Stego Key

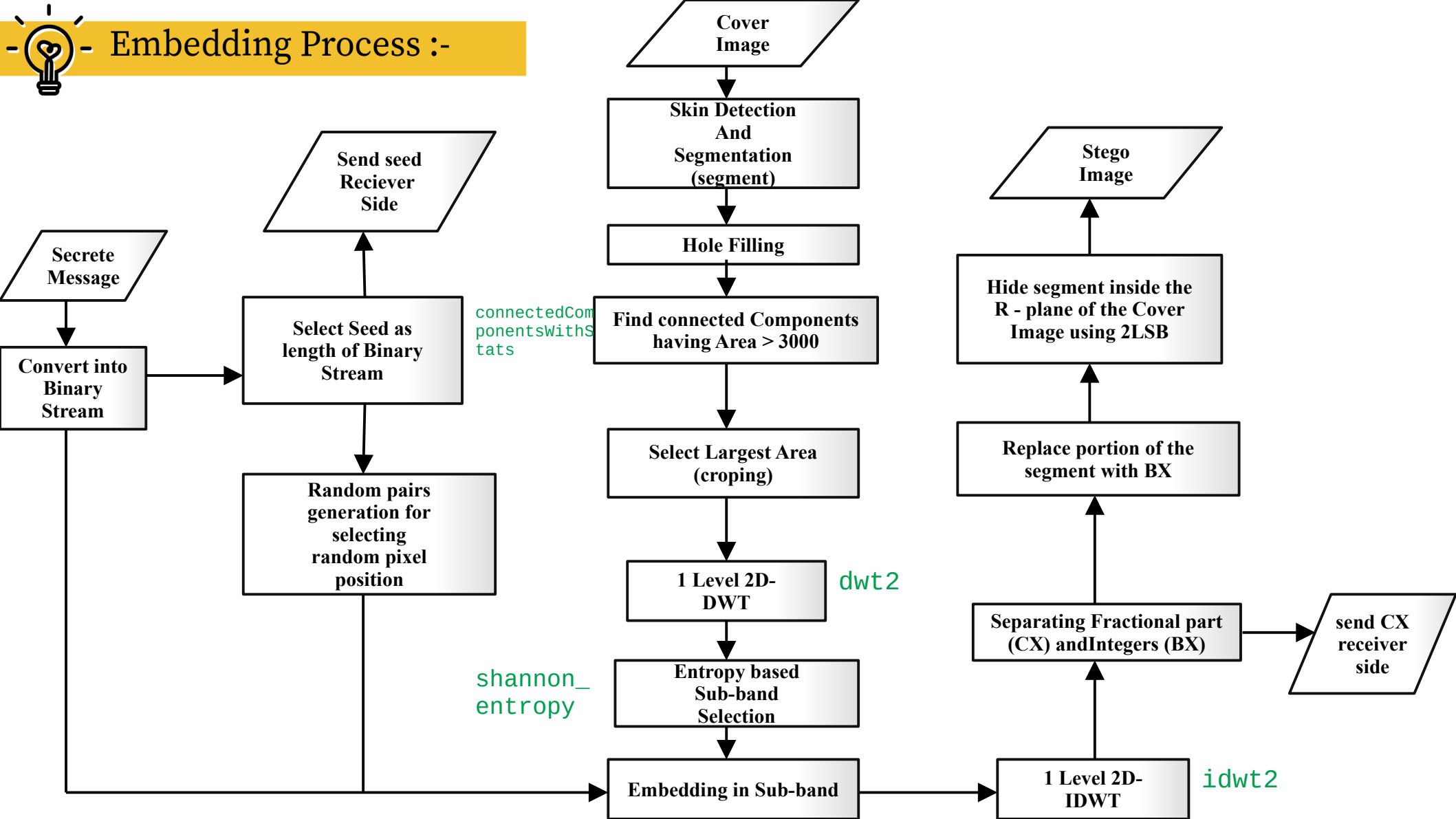# Classification & Applications of Steganography

- Based on **carrie**r : text, image, audio, video

- Based on **message** format: text, image, audio, video

- Based on **domain**: Spatial domain, Frequency domain

- Based on **methods** used:
  - ✔ **Spatial** Domain Methods (LSB, Pseudo-random LSB Encoding),
  - ✔ **Frequency** Domain Methods (DCT, DFT, DWT)
  - ✔ Spread Spectrum Method, Statistical Method, Distortion Method, Visual Cryptography, Cover Generation Method

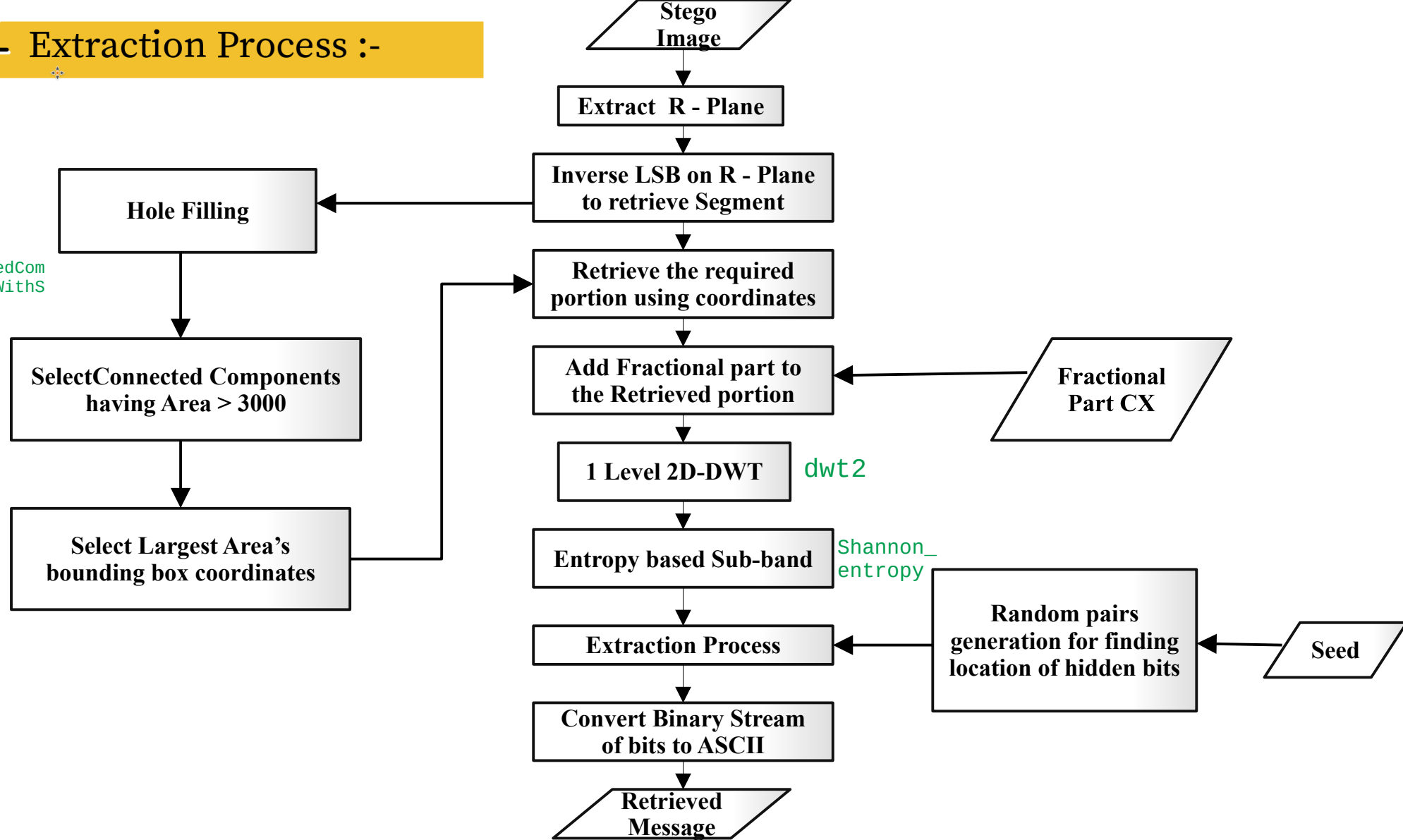- ◆ **Applications of Steganography**

Proposed Algorithm

1) Secret message is **converted into a binary stream** of bits.

2) **Skin detection** algorithm is applied on the cover in order to identify the skin areas as the regions of interest.

3) The **largest skin area** is passes through **DWT** in order to extract its frequency coefficients.

4) An **entropy based sub-band** selection method is used in order to find the most textured sub-band and embedding positions are **randomly** selected using a **seed**.

5) The process of extracting the secret message from a **particular ROI**'s **particular sub-band** and from **particular positions**.

Embedding Process :-

Secrete Message → **Convert into Binary Stream**

Cover Image → **Skin Detection And Segmentation (segment)** → **Hole Filling** → **Find connected Components having Area > 3000** `connectedComponentsWithStats` → **Select Largest Area (croping)** → **1 Level 2D-DWT** `dwt2` → **Entropy based Sub-band Selection** `shannon_entropy` → **Embedding in Sub-band**

Send seed Reciever Side ← **Select Seed as length of Binary Stream** → **Random pairs generation for selecting random pixel position**

Embedding in Sub-band → **1 Level 2D-IDWT** `idwt2` → **Separating Fractional part (CX) and Integers (BX)** → **send CX receiver side**

Separating Fractional part (CX) and Integers (BX) → **Replace portion of the segment with BX** → **Hide segment inside the R - plane of the Cover Image using 2LSB** → **Stego Image**

Stego Image

Extract R - Plane

Inverse LSB on R - Plane to retrieve Segment

Hole Filling

connectedCom
ponentsWithS
tats

SelectConnected Components having Area > 3000

Select Largest Area's bounding box coordinates

Retrieve the required portion using coordinates

Add Fractional part to the Retrieved portion

Fractional Part CX

1 Level 2D-DWT   dwt2

Entropy based Sub-band   Shannon_
entropy

Random pairs generation for finding location of hidden bits

Seed

Extraction Process

Convert Binary Stream of bits to ASCII

Retrieved Message

◆ **Technologies :-**
   Python , OpenCV , Scikit Image , PyQt , Sewer , Numpy

◆ **Tools :-**
   Visual Studio Code , Google Colab , Qt Designer

◆ **DataSet Design :-**

   ✔ **Secret Message Dataset**
      3 custom Messages of Length **128 , 310 , 3736** Characters

   ✔ **Cover Image Dataset**
      30 custom Selected Images

• Performance metrics

01

PSNR

It is measured by calculating **PSNR** and **MSE**. PSNR is a nonperceptual objective metric measuring the **difference between the original and distorted images.**

02

UIQI

It measures **distortion** that has occurred in cover object **due to embedding** process.

03

SSIM

SSIM considers **image degradation** as perceived change in structural information. Structural information is the idea that the pixels have **strong interdependencies** especially when they are **spatially close.**

04

Hidden Ratio

(Total Size of message in Bits / m x n) *100

Where, m and n are width and height of selected sub-band respectively.

CONCLUSION

➢ **Security** because of biometric feature (skin tone Region) , entropy based sub-band selection , seed that generates random locations.

➢ **Visual Quality** improvement because Features obtained from DWT coefficients are utilized so secret messages are embedded in high frequency sub-bands which are less sensitive to human eyes.

➢ **Cost :** Time - **0.63s** to **85.84s**   PSNR : **47.222617136984**   UQI = **0.994226**
SSIM : **0.995673777583**   Hidden Ratios : **6.18775, 15.40879 , 24.5557**

➢ **Future Work :**
      A) **Encryption** of Text (Hashing of Passcode)
      B) **Compress** the data (Using ZLIB)
      C) Other **wavelets** like daubechies, symlets
      D) **Video Steganography** (Multiple Frames)
      E) Utilize more bit for Data Hiding
      F) Use of **Machine Learning** to Find Skin Region

➢ **Limitations :-**

1. Cover Image size Should < **1.5MB**

2. **fixed** ranges of **HSV** and **YcbCr** color-space for finding skin.

3. If **ROI** size is **smaller** than needed for hiding secret data then we cannot proceed with embedding.

THANK YOU

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