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Skin Tone Based RGB Channel Image Steganography Technique

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Abstract — Image based Steganography utilize the image as cover media to hide the secret data.To provide an imperceptible stego-image for human vision, Skin Tone based RGB Channel based Steganography technique is proposed. For additional security, DES Algorithm is used to encrypt and decrypt the data. Instead of hiding the data in the whole image, data will be hidden in selected regions of the image.RGB image selected region has R channel G channel and B channel. Selected region and Cipher text is divided into 8 chunks. Each cipher block is allocated to be embedded in each selected region of image block by user defined key. Out of three channels in each pixel of the image, one channel is used as indicator channel; other two channels are used for embedding the cipher text blocks in 4 least significant bits. The last 2 LSB indicators tell whether the cipher text is embedded in one channel or two channels, so that retrieving can be done accordingly at the receiver. This technique is implemented and result shows that very good PSNR (Peak Signal to Noise Ratio) is obtained.

Keywords Steganography, RGB, HSV, YCBCR, Pixel Indicator, DES

I. INTRODUCTION

Nowadays Internet is important communication in the world and Information Technology has grown rapidly. Conversation between two users is normal. But conversation over the internet is facing more problems such as data security all over the world. So we need secure communication method to transmit the data over by networks. Cryptography is one of the methods in which message is encrypted by a key and decrypted by same key or different key depending on the algorithm was used. Steganography is another method in which message is hidden in multimedia objects such as audio, video, image etc. The preliminary steps in skin detection are the representation of image pixels in color spaces, suitable distribution of skin and non skin pixels followed by skin color modeling. The skin color pixels can be detected based on color space and skin color model. Hence it is difficult to detect accurately the skin color, because there exists many differences based on skin color space distribution. Numerous techniques are presented in literature for skin detection using color.

The most commonly used color space in digital images is the RGB color space .HSV is one of the perceptual color space. This color space has three components namely Hue, Saturation and Value. HSV color spaces are the deformation of RGB color space. YCBCR color space is another technique for detecting skin regions which has mapped to non linear transformation in RGB color space. The proposed RGB intensity based steganography technique consists of following advantages:

A. RGB is the most ordinary and simplest model.
B. This technique is more secured. Third party cannot easily detect the presence of hidden data.
C. Capacity is one of its main advantages, because it embeds large amount of data as compared to previous techniques.
There are also techniques used in embedding the information inside a cover message with little to no degradation of the cover-object. Steganography and Watermarking both are branches of data hiding but they are used for different purposes

II. RELATED WORK

Typically, skin tone based RGB technique contains the following methods: color spaces, RGB color spaces, pixel indicator and LSB method. Even though, the aim of this process is to detect the skin tone region.

A. Color Spaces

Some of the color spaces that are used in literature include RGB, normalized RGB, HSI, HSV, YCBCR, YES, YUV, CIE Lab. between skin and non skin pixels. The performance of any skin detector and its sensitivity to changes in illumination conditions is affected by the selection of the color sapce [5]. The proposed algorithm is based on skin color model in YCBCR chrominance space and HSV color space. HSV and YCBCR color spaces help to a greater extent in handling intensity variations related to human color perception. The skin in channel H and S is categorized based on the range 0 to 50(H) and 0.23 to 0.68(S) for Asian and Caucasian

ethnics [4].

B. RGB Color Space and Skin Detection

RGB color space is the one of the most commonly used color space. It encodes colors as an additive combination of three primary colors: red(R), green (G) and blue (B). RGB Color space is often visualized as a 3D cube where R, G and B are the three verticular axes. Simplicity is the main advantage of RGB space. Luminance and chrominance cannot be separated by the RGB color space, and the R, G, and B components are highly correlated. The luminance of a given RGB pixel is a linear mixture of the R, G, and B values. Hence, changing the luminance of a given skin patch affects all the R, G, and B components. The location of a given skin patch in the RGB color cube will change based on the power of the illumination under which such scrap was imaged. This results in a much stretched skin color cluster in the RGB color cube.

C. HSV Color Space

Perceptual color HSV have also been popular in skin detection. These color spaces separates three components: the hue (H), the saturation (S) and the brightness (V). Basically, HSV-type color spaces are deformations of the RGB color cube and a nonlinear conversion can be applied to map the RGB color space to HSV. One of the advantages of these color spaces in skin detection is that they permit users to physically denote the boundary of the skin color class in terms of the hue and saturation. The illumination dependency of skin color is reduced by dropping V as it gives the brightness information.

D. LSB Method

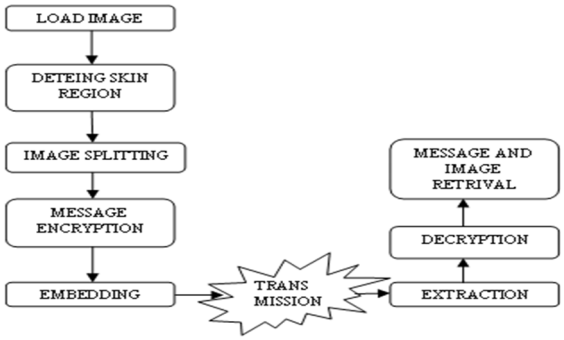
LSB algorithm still occupies an important position in information hiding [12]. This is a simple steganographic technique that embeds the bits of the secret message directly into the least significant bit (LSB) plane of the cover image [3].Each image pixel has 8 bits. Out of this 8 bits right most bits are least significant bits which are used for embedding the data. Normally 4 bit LSB is used for embedding the data [1].

E. Pixel Indicator

The pixel indicator technique is used in this work for steganography utilizing RGB images as cover media. The technique uses at least two important bits of one of the channels Red, Green or Blue as an marker of secret data existence in the other two channels. The marker channel is chosen in a sequence from R, G and B, i.e. RGB, RBG, GBR, GRB, BRG and BGR. Thus the indicator LSB bits are obviously accessible random, based on image profile and its properties [6]. We have selected the indicators in a sequence, if the first indicator selection is the Red channel in the pixel, the second is Green and the third is Blue i.e. the sequence is RGB.

III. SYSTEM DESIGN

This section involves detailed design of proposed methodology. Embedding and extraction process will be as follows,



System design

IV. PROPOSED METHODOLOGY

This section involves the proposed methodology used for detecting skin region.

A. RGB Values Detection

The input image is separated into pixels. Each pixel has red, blue and green values. RGB Color space is one of the important mechanisms for finding colors. RGB is a representation that is easily obtained from the RGB values by using a simple normalization procedure,

r =R / R+G+B equation (1)
g =G / R+G+B
b =B / R+G+B

The sum of the normalized components is known (r+g+b =1).

B. YCBCR Values Detection

YCBCR color space is effective for skin color modeling. The YCBCR color space is one of the most accepted option for skin detection, the equation for RGB conversion to YCBCR can be seen below,

Y=0.257*R+0.504*G+0.098*B+16
Cr = 0.439*R -0.321*G - 0.162*B+128
Cb = - 0.136*R - 0.524*G + 0.4129*B+128
equation (2)

Gained YCBCR values are again converted into Red, Blue and Green values for creating image. The equation for converting YCBCR to RGB can be seen below,

R= Y + 1.40200 * (Cr - 0x80) equation (3)
G=Y-0.34414*(Cb-0x80)-0.71414*(Cr- 0x80)
B= Y + 1.77200 * (Cb - 0x80).

C. HSV Values Detection

Hue is the most dominant color of an area. Saturation indicates proportion to its brightness. Value indicates the color luminance. The skin region can be detected by separating chrominance and luminance

D. The Algorithm At The Sender

1) After loading the image, image is converted into HSV color space and YCBCR color space.
2) Detect the skin region by combining RGB, HSV and YCBCR values. Divide the region to be detected into 8 blocks. Encrypt the message by using DES algorithm.
3) Divide the cipher text into 8 chunks. Keep together the first bit of all bytes, and form message block M0. Repeat the same process for all cipher chunks.
4) Provide the sub key 1; this sub key is used to allocate the message chunks to image blocks for embedding. This is a string of length 8.Likewise, each message chunk is allocated for each image block.
5) Enter the second sub key 2, which tells about the indicator of all the 8 different image blocks. From each block one indicator channel is calculated. One of red, blue, green channels will be the indicator channel. A sampe key would be as RGGBBBRG. Here R, G, B corresponds to 0, 1, 2 respectively.
6) Take the next image pixel of the image block. Take 4 bits of the cipher block. Compare 4 LSBs of channel1 with 4 bits of cipher text. If the difference is less than 7 then embed these 4 bits at those 4 LSBs of channel1.Otherwise the bits are not embedded in first channel, where the same procedure is followed in second channel.
7) For a pixel if embedding is done only in first channel, the indicator LSB will be set to 00.If embedding is done in second channel the indicator LSB will be set 01.If embedding is done in both the channels LSB will be set to 10. Else the indicator LSB will be set as 11.
8) The Data Encryption Standard is a block cipher technique, where a cryptographic key and algorithm are applied to a block of data concurrently rather than one bit at a time.
9) Encryption can be done by grouping the plaintext message, into 64-bit blocks. Each block is transformed into a 64-bit cipher text using the secret key by means of permutation and substitution.
10) Encryption process mainly consists of 16 rounds and can run in four different modes, encrypting blocks individually or making each cipher block reliant on all the previous blocks.
11) Decryption is entirely the reverse process of encryption, where the same steps will be followed but the only difference is that the order in which the keys are applied will be reversed.
12) PSNR is the most commonly used measure of quality of modernization of lossy compression codecs (e.g., for image compression).
13) The indicator in this case is the original data, and the error introduced by compression results as a noise.

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14) When evaluating compression codecs it is used as estimation to human perception of reconstruction quality, closer to the original than another.
15) Skin Tone based RGB Channel steganography enhance the feature in encrypting the information hide behind the image which is more secure.

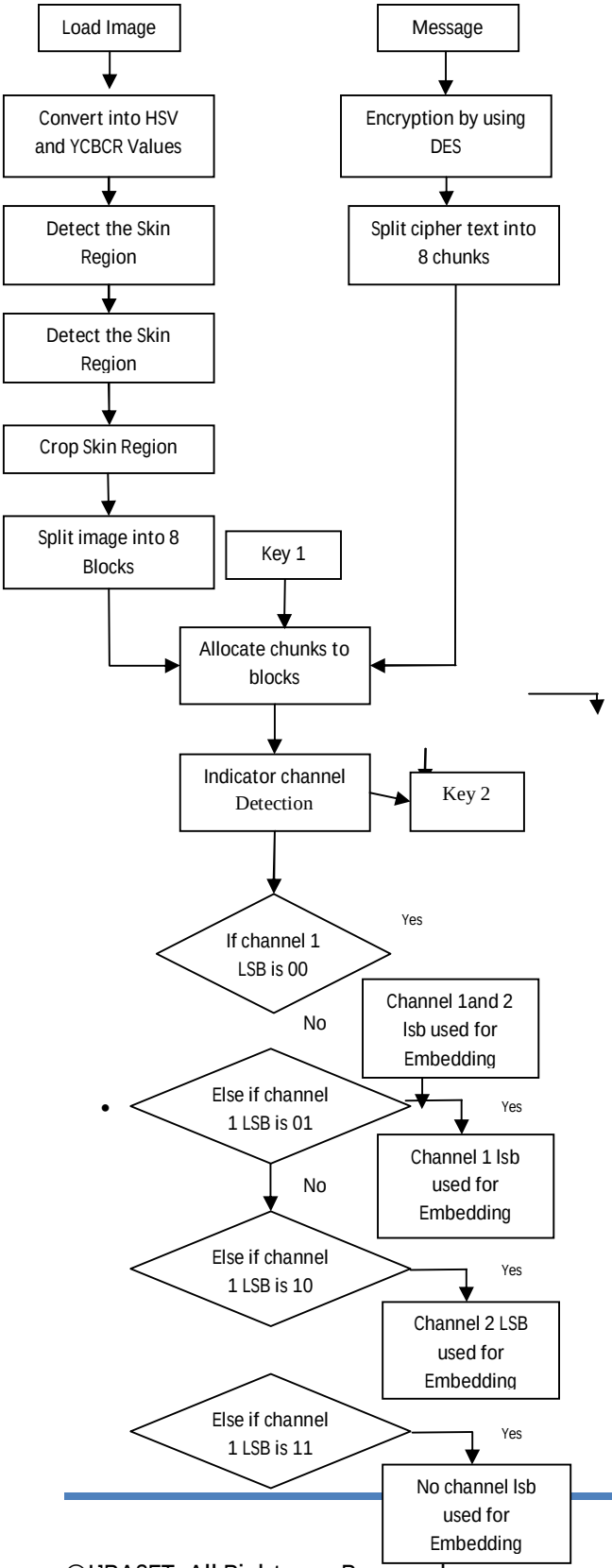

Fig 2 Architecture design

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E. The Algorithm At The Receiver

1) Retrieve the sub key1, sub key2 length from the non skinned region image.
2) Identify the indicator channel for each block by using the sub key2.
3) Take the image block. Start from the first pixel. Continue till the number of bits extracted is equal to the message block length. Read the indicator channel for each block.
4) If the last two bits of indicator are 00, then retrieve the 4 LSBs of channel1.If the last two bit of indicator is 01, retrieve the 4 LSBs of channel2. If the last two bits of indicator are 10 retrieve the 4 LSBs of channel2 and channel2. If the last two bit of indicator is 11, neither retrieve from channel1 nor channel3 of the pixel.
5) Apply DES decryption to cipher text to get plain text.
6) End the algorithm.

V. RESULT ANALYSIS

In this section ,detailed exprimental results has been presented.Each algorithm has been implemented in java.We have tested different kind of images and results are plotted.

A. Baby Face


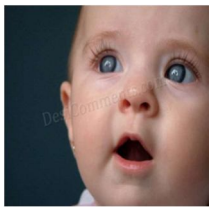

Fig 2.a. baby face b. stego image of baby face

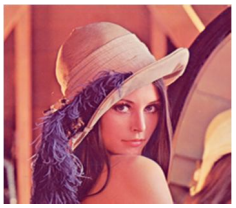
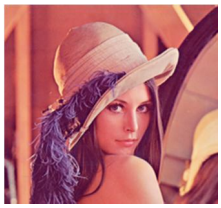

Fig3. c.Lenna d.stego image of Lenna


Fig 4. e. Argentina fb team f. stego image of Argentina

The quality of modernization of lossy com Compression codecs is measured by PSNR (e.g., for image compression). The input signal that will be provided for PSNR will be the original data, and error introduced by compression results in PSNR noise. This will be used as an approximation for comparing compression codecs to human perception of modernization quality, therefore in some cases one modernization may appear to be nearer to the original than another, even though it has a lesser PSNR (an upper PSNR would usually indicate that the restoration is of upper quality). One has to be particularly cautious with the range of strength of this metric; it is only finally valid when it is used to compare the similar codec image and the similar codec content.

MSE

It is most easily defined via the mean squared error (MSE) which for two M×N monochrome images.

MSE=

equation (4)

PSNR=$10\log_{10}(MAX\text{^}2/MSE)$

equation (5)

Here, MAXI is the maximum possible pixel value of the image.

Table I

PSNR and MSR values

IMAGE	MSR	PSNR
Argentina Football Team	0.00265	73.941
Lena	0.0233	64.454
Baby	0.00584	70.469
Beckham	0.00339	72.825

VI. CONCLUSION

The proposed method mainly focuses on information security. In this method Skin tone based Steganography is presented that uses skin region of images in RGB pixel indicator technique for embedding data. The HSV, RGB and YCBCR values are detected. The message is encrypted by DES and the encrypted message is embedded into detect skin region. Two levels of security are used. The results are analyzed and the result gives good PSNR ratio. Future work. focus on how to achieve Steganography in non skinned images and greater embedding capacity while providing an enchanced security.

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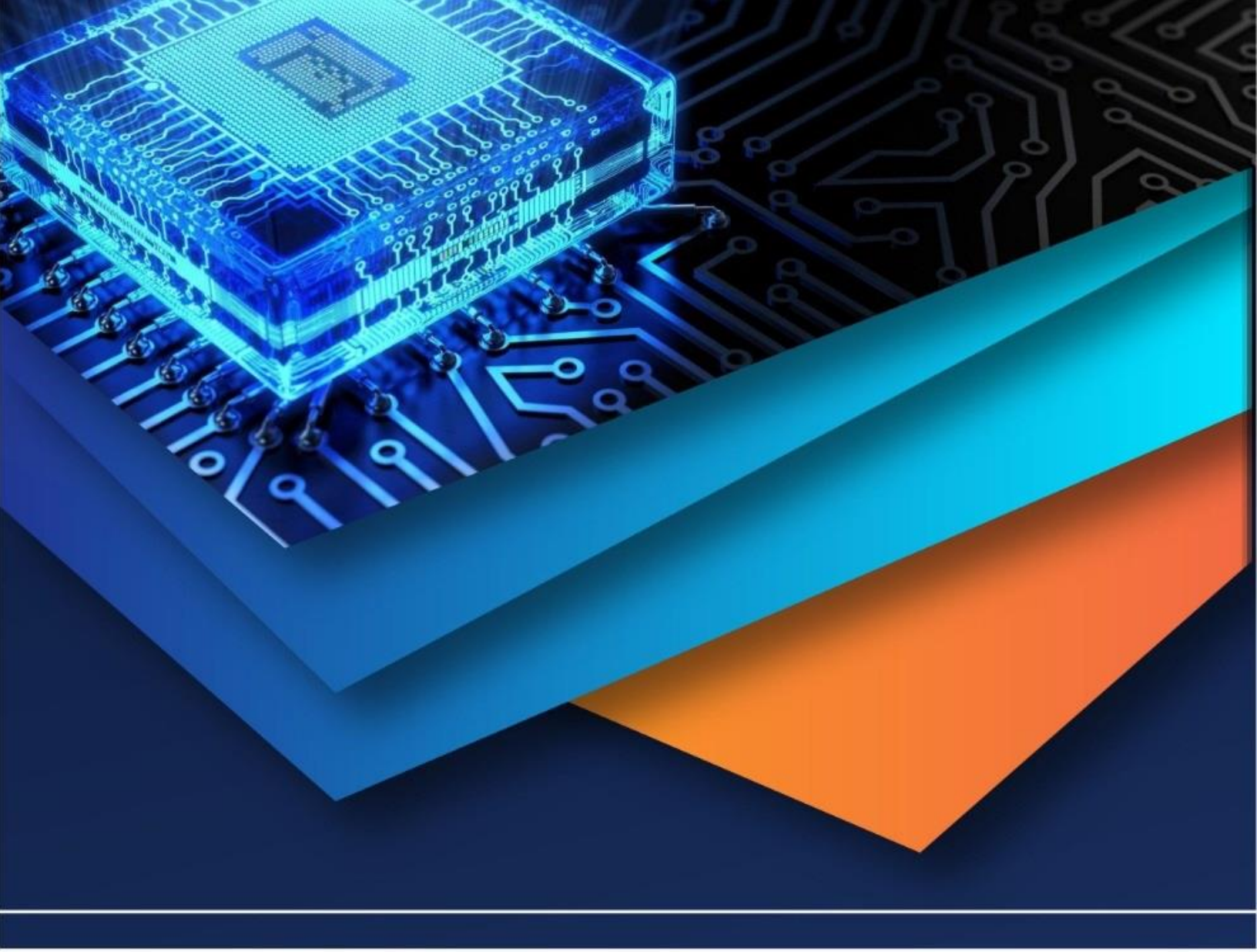

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