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Title

IMPLEMENTATION OF IMAGE STEGANOGRAPHY USING LEAST SIGNIFICANT BIT INSERTION TECHNIQUE.

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Abstract:

Transferring information on internet or on any public network is very common now-a-days. However I is not a secure mean of transformation for transmitting any important information. Anyone can hack, peek or copy the information. Therefore one would not prefer to transmit important information without any protection in public network. Cryptography and steganography are two techniques to protect your message. Cryptography leads your text to be meaningless random codes. Steganography is new and exciting field; it involves embedding data into a medium in a way which is not easily detectable. This paper implements the steganography by converting the original data in to BCD code and then embedding the coded data in to digital grayscale images to get stego image. Image steganography in this paper is implemented using least significant bit insertion with BCD codes.

Keyword: Steganography, Least Significant bit, BCD codes, Encryption, grayscale images.

INTRODUCTION:

Steganography is the art and science of invisible communication. This is accomplished through hiding information in other information, thus hiding the existence of the communicated information. The word steganography is derived from the Greek words "stegos" meaning "cover" and "grafia" meaning "writing"[1] defining it as "covered writing". In image steganography the information is hidden exclusively in images. Steganography differs from cryptography in the sense that where cryptography focuses on keeping the contents of a message secret, steganography focuses on keeping the existence of a message secret [2].steganography goal is to hide the fact that communication is taking place. This is often achieved by using a (rather large) cover file and embedding the (rather short) secret message into this file. The result is an innocuous looking file (the stego file) that contains the secret message. Almost all digital file formats can be used for steganography, but the formats that are more suitable are those with a high degree of redundancy. The redundant bits of an object are those bits that can be altered without the alteration being detected easily [3]. Image and audio files especially comply with this requirement. The technique implemented in this paper first converts message into encrypted form using different BCD codes and then embeds one message bit of one character into one pixel.

STEGANOGRAPHY:

Various kinds of digital images can be use for steganography but of all types of digital images, the grayscale images is one of the most suitable kinds of images for steganography because of their great hiding capacity and high stego image quality. By using this proposed algorithm we can hide our text in an image. We can then send this image via attachments in email or in hard drives or we can even share with anyone through a web site. Anyone with knowledge that this file contains a secret hidden text can extract the hidden message and then generate the text after applying a decryption algorithm. The stego image should resemble the actual cover image under casual inspection and analysis. During transmission, the stego image can be monitored by unintended viewers who will notice only the transmittal of the innocuous image without discovering the existence of the hidden message.

LEAST SIGNIICANT BIT INSERTION OF ENCRYPTED DATA:

A very easy and direct way is to hide data is to hide one bit of information in one pixel of the host image. Least significant bit substitution is a common way to do this.[5] When applying LSB technique to each bytes of a 8-bit pixel image, one bit can be encoded to each pixel. Any changes in the pixel will be invisible to the human eye. The major advantage of achieving steganography using LSB technique is its simplicity[4]. Another main advantage of LSB coding method is his high bit rate of hidden bits and low complexity of the algorithm. Care should be taken while choosing a cover image so that any changes to the cover image are invisible to the human eye.

Here is an example showing how letter A can be hidden inside 8 pixels of the grayscale image with pixel values.

(00011101 00100010 00000011 11001100 10101010 01011001 01100100 11111111)

The binary value A is 10000011.

(00011101 00100010 00000010 11001100 10101010 01011000 01100101 11111111)

The underlined bits are the only bits that are actually changed. You will notice that actually only 3 bits have been changed.

Methodology:

Encryption

This method is proposed to convert the each code to its equivalent BCD code. Firstly the character is converted into its ASCII code (K) then the ASCII code K is converted into its equivalent BCD code with bits k_0, k_1…k_7.

Decryption

BCD code k_0, k_1,...k_7, divide them into groups such as group I_1 contains $k_0k_1k_2k_3$ and group I_2 contains $k_4k_5k_6k_7$. Convert I_1, I_2 into decimal number. I_1*10+I_2 = ASCII number equivalent to K i.e. the ASCII character.

ALGORITHM:

Embed a secret message in an image.

1. Read data character wise.
2. Convert each character into its equivalent ASCII code.
3. Using above described encryption technique generate BCD code.
4. Embed 1 bit of the encrypted bits into LSB of 1 pixel of the image and get the stego image.

Extract the message from the image

1. Extract LSB of the pixels of stego image.
2. Combine the 8 LSB bits of 8 pixels to get 8 bits of BCD code.
3. Decrypt the 8 bit BCD code data into the ASCII decimal equivalent and then generate the equivalent ASCII character using the above described decryption technique.

PROPOSED WORK:

For grabbing pixels of the image:

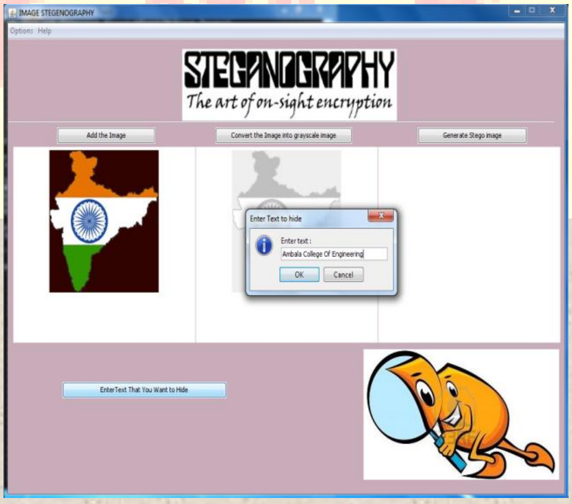
```
public int[] handlepixels(Image img, int x, int y, int w, int h)
{
int[] intens = new int[w * h];
PixelGrabber pg = new PixelGrabber(img,x,y,w,h,intens,0,w);
try{
 pg.grabPixels();
}catch (InterruptedException e)
{e.printStackTrace();}
```

For extracting RGB values of a pixel

```
int red   = (pixel >> 16) & 0xff;
int green = (pixel >>  8) & 0xff;
int blue  = (pixel      ) & 0xff;
```

For conversion of coloured pixel to grayscale pixel

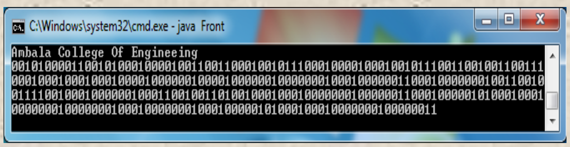
```
int intensity=(int)((red+green+blue)/3);
```



Enter text : Ambala College Of Engineering

Fig (1)

Fig (1) shows the conversion of a coloured image to a grayscale image and a prompt that ask you to insert the text that you want to hide in the image.



```
Ambala College Of Engineeing
00101000011001010001000010011001100010010111000100001000100101110011001001100111
00010001000100010000100000010000100000010000000100010000001100010000000100110010
01111001000100000010001100100110100100010001000000010000001100010000010100010001
0000000100000001000100000001000100000101000100010000000100000011
```

Fig (2)

Fig (2) shows the conversion of the text after encryption i.e. the BCD code.

For inserting BCD code to a pixel value

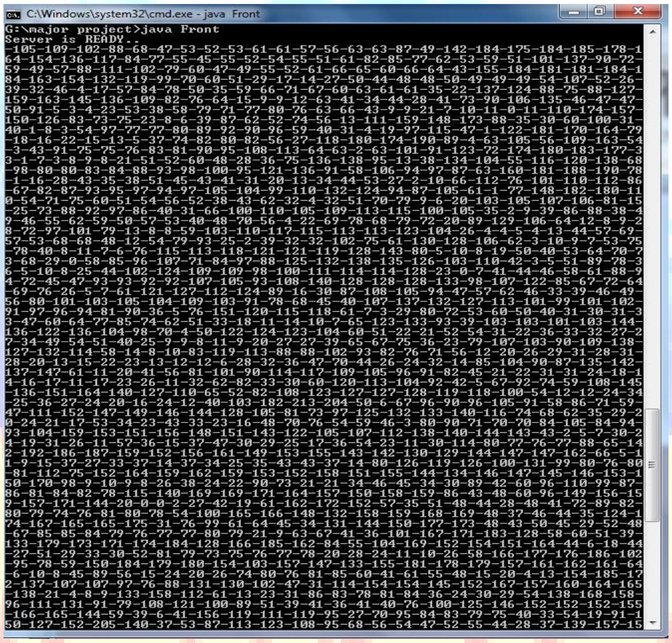
Final code is the BCD code generated.

ii shows a single caracter of the BCD code i.e. either 1 or 0.

```
 if(k<finalcode.length())
{
Character bcd=finalcode.charAt(k);
String s = bcd.toString();
ii = Integer.parseInt(s);
}
if((ii==1)&&(pixels%2==0))
{
pixels=pixels+1;
}
if((ii==0)&&(pixels%2!=0))
{
pixels=pixels-1;
}
```

For reconstruction of stego image from modified pixel array values:

```
pixels=pixels <<24 |(pixels << 16) |(pixels << 8) | ( pixels );

grayimg[j*width+i]=pixels;

MemoryImageSource m=new MemoryImageSource(w, h , finalimage, 0, w);

img1 = createImage(m);

i3=new ImageIcon(img1);

lb3.setIcon(i3);
```



```
G:\major project>java Front
Server is READY..
-105-109-102-88-68-47-53-52-53-61-61-57-56-63-63-87-49-142-184-175-184-185-178-1
64-154-136-117-84-77-55-45-55-52-54-55-51-61-82-85-77-62-53-59-51-101-137-90-72-
59-49-57-88-111-102-79-60-47-49-55-52-61-66-65-60-66-64-43-155-184-181-181-184-1
84-163-154-132-119-99-70-60-51-29-17-14-27-50-44-48-48-50-49-49-49-54-107-52-26-
39-32-46-4-17-57-84-78-50-35-59-66-71-67-60-63-61-61-35-22-137-124-88-75-88-127-
159-163-145-136-109-82-76-64-15-9-9-12-63-41-34-44-28-41-73-90-106-135-46-47-47-
50-91-5-3-4-23-53-38-58-79-71-77-80-76-63-66-43-9-9-21-7-10-11-0-11-110-174-157-
150-126-83-73-75-23-8-6-39-87-62-52-74-56-13-111-159-148-173-88-35-30-60-100-31-
40-1-8-3-54-97-77-77-80-89-92-90-96-59-40-31-4-19-97-115-47-1-122-181-170-164-79
-18-16-22-15-13-5-37-74-82-80-82-56-27-118-180-174-190-89-4-63-105-56-109-163-54
-3-43-91-75-75-76-83-81-90-95-108-113-64-63-2-63-101-91-123-72-174-180-183-177-3
3-1-7-3-8-9-8-21-51-52-60-48-28-36-75-136-138-95-13-38-134-104-55-116-120-138-68
-98-80-80-83-84-88-93-98-100-95-121-136-91-58-106-94-97-87-63-160-181-188-190-78
-1-16-28-43-35-38-51-45-43-41-31-20-13-34-44-53-27-2-10-66-112-76-101-110-112-86
-67-82-87-93-95-97-94-97-105-104-99-110-132-124-94-87-105-61-1-77-148-182-180-11
0-54-71-75-60-51-54-56-52-38-43-62-32-4-32-51-70-79-9-6-20-103-105-107-106-81-15
-25-73-88-92-97-86-40-31-66-100-110-105-109-113-115-100-105-35-2-9-39-86-88-38-4
9-46-55-62-59-50-57-53-40-48-70-56-4-22-69-78-68-79-72-20-89-129-106-64-12-8-9-2
8-72-97-101-79-13-8-8-59-103-110-117-115-113-113-123-104-26-4-4-5-4-13-44-57-69-
57-53-68-68-48-12-54-79-93-25-2-39-32-32-102-75-61-130-128-106-62-3-10-9-7-53-75
-78-40-8-11-7-6-76-115-113-118-121-121-119-128-143-80-5-10-8-19-50-40-53-64-70-7
3-68-29-0-58-85-96-107-71-84-97-88-125-132-138-135-126-103-110-42-3-5-51-89-78-3
6-5-10-8-25-44-102-124-109-109-98-100-111-114-114-128-23-0-7-41-44-46-58-61-88-9
4-72-45-47-93-93-92-92-107-105-93-108-140-128-128-128-133-98-107-122-85-67-72-64
-69-76-26-5-7-61-121-127-112-124-89-16-30-87-108-105-94-47-57-62-46-33-39-46-49-
56-80-101-103-105-104-109-103-91-78-68-45-40-107-137-132-127-113-101-99-101-102-
91-97-96-94-81-90-36-5-76-151-120-115-118-61-7-3-29-80-72-53-60-50-40-31-30-31-3
3-47-60-64-77-85-74-62-51-33-18-11-14-10-7-65-123-133-93-39-103-103-101-103-144-
136-122-136-104-98-70-4-50-122-124-123-104-60-51-22-21-52-54-31-22-36-33-32-27-2
7-34-49-54-51-40-25-9-9-8-11-9-20-27-27-39-65-67-75-36-23-79-107-103-90-109-138-
127-132-114-58-14-8-10-83-119-113-88-88-102-93-82-76-71-56-12-20-26-29-31-28-31-
28-20-13-15-22-23-13-12-12-6-28-32-36-47-70-44-26-24-32-14-85-104-90-87-135-142-
137-147-61-11-20-41-56-81-101-90-114-117-109-105-96-91-82-45-21-22-31-31-24-18-1
4-16-17-11-17-23-26-11-32-62-82-33-30-60-120-113-104-92-42-5-67-92-74-59-108-145
-136-151-164-140-127-110-65-52-82-108-123-127-127-128-119-118-100-54-12-12-24-34
-25-36-27-24-20-16-24-12-40-103-182-213-204-50-6-67-96-90-96-105-91-58-86-71-59-
47-111-152-147-149-146-144-128-105-81-73-97-125-132-133-140-116-74-68-62-35-29-2
0-24-21-17-53-34-23-43-33-23-16-48-70-76-54-59-46-3-80-90-71-70-70-84-105-84-94-
93-104-159-153-151-156-148-151-143-122-105-107-112-138-140-144-143-43-2-5-7-30-2
4-19-31-26-11-57-36-15-37-47-30-29-25-17-36-54-23-11-30-114-80-77-76-77-88-65-14
2-192-186-187-159-152-156-161-149-153-155-143-142-130-129-144-147-147-162-66-5-1
1-9-15-37-27-33-37-14-37-34-25-35-43-43-37-14-80-126-119-126-100-131-99-80-76-80
-81-112-75-152-164-159-162-159-153-152-158-151-155-144-134-146-147-145-146-153-1
50-170-98-9-10-9-8-26-38-24-22-90-73-21-21-34-46-45-34-30-89-42-60-96-110-99-87-
86-81-84-82-78-115-140-169-169-171-164-157-150-158-159-86-43-48-60-96-149-156-15
9-157-171-144-20-0-0-2-27-42-19-61-162-172-152-57-35-51-48-44-28-48-41-72-89-82-
80-79-74-76-81-80-78-54-100-165-166-148-132-158-159-168-169-48-37-46-44-35-124-1
74-167-165-165-175-31-76-99-61-64-45-34-131-144-150-177-173-48-43-50-45-29-52-48
-67-85-85-84-79-76-77-77-80-79-21-9-63-67-41-36-101-167-171-183-128-58-60-51-39-
133-179-173-171-174-184-128-166-185-162-84-55-104-169-152-154-151-164-44-6-18-44
-27-51-29-33-30-52-81-79-73-75-76-77-78-20-28-24-11-10-26-58-166-177-176-186-102
-95-78-59-150-184-179-180-154-103-157-147-133-155-181-178-179-157-161-162-161-64
-6-10-8-45-89-56-15-24-20-26-74-80-76-81-85-60-41-61-55-48-15-20-4-13-154-185-17
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-138-21-4-8-9-133-158-112-61-13-23-31-86-83-78-81-84-36-24-30-29-54-138-168-158-
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-166-165-144-59-39-6-41-156-119-111-119-95-27-70-95-84-83-79-75-40-33-54-19-91-1
50-127-152-205-140-37-53-87-113-123-108-95-68-56-54-47-52-55-44-28-37-139-157-15
```
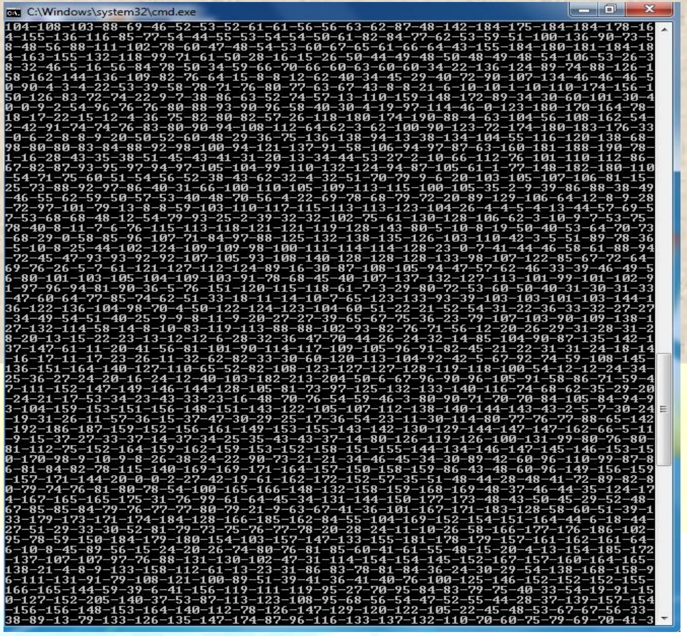

Fig (3)

Fig(3) and Fig(4) shows the value of the pixels of the image before and after steganography.



```
C:\Windows\system32\cmd.exe
104-108-103-88-69-46-52-53-52-61-61-56-56-63-62-87-48-142-184-175-184-184-178-16
4-155-136-116-85-77-54-44-55-53-54-54-50-61-82-84-77-62-53-59-51-100-136-90-73-5
8-48-56-88-111-102-78-60-47-48-54-53-60-67-65-61-66-64-43-155-184-180-181-184-18
4-163-155-132-118-99-71-61-50-28-16-15-26-50-44-49-48-50-48-49-48-54-106-53-26-3
8-32-46-5-16-56-84-78-50-34-59-66-70-66-60-63-60-60-34-22-136-124-89-74-88-126-1
58-162-144-136-109-82-76-64-15-8-8-12-62-40-34-45-29-40-72-90-107-134-46-46-46-5
0-90-4-3-4-22-53-39-58-78-71-76-80-77-63-67-43-8-8-21-6-10-10-1-10-110-174-156-1
50-126-83-72-74-22-9-7-38-86-63-52-74-57-13-110-159-148-172-89-34-30-60-101-30-4
0-0-9-2-54-96-76-76-80-88-93-90-96-58-40-30-4-19-97-114-46-0-123-180-170-164-78-
18-17-22-15-12-4-36-75-82-80-82-57-26-118-180-174-190-88-4-63-104-56-108-162-54-
2-42-91-74-74-76-83-80-90-94-108-112-64-62-3-62-100-90-123-72-174-180-183-176-33
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-54-71-75-60-51-54-56-52-38-43-62-32-4-32-51-70-79-9-6-20-103-105-107-106-81-15-
25-73-88-92-97-86-40-31-66-100-110-105-109-113-115-100-105-35-2-9-39-86-88-38-49
-46-55-62-59-50-57-53-40-48-70-56-4-22-69-78-68-79-72-20-89-129-106-64-12-8-9-28
-72-97-101-79-13-8-8-59-103-110-117-115-113-113-123-104-26-4-4-5-4-13-44-57-69-5
7-53-68-68-48-12-54-79-93-25-2-39-32-32-102-75-61-130-128-106-62-3-10-9-7-53-75-
78-40-8-11-7-6-76-115-113-118-121-121-119-128-143-80-5-10-8-19-50-40-53-64-70-73
-68-29-0-58-85-96-107-71-84-97-88-125-132-138-135-126-103-110-42-3-5-51-89-78-36
-5-10-8-25-44-102-124-109-109-98-100-111-114-114-128-23-0-7-41-44-46-58-61-88-94
-72-45-47-93-93-92-92-107-105-93-108-140-128-128-128-133-98-107-122-85-67-72-64-
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1-97-96-94-81-90-36-5-76-151-120-115-118-61-7-3-29-80-72-53-60-50-40-31-30-31-33
-47-60-64-77-85-74-62-51-33-18-11-14-10-7-65-123-133-93-39-103-103-101-103-144-1
36-122-136-104-98-70-4-50-122-124-123-104-60-51-22-21-52-54-31-22-36-33-32-27-27
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37-147-61-11-20-41-56-81-101-90-114-117-109-105-96-91-82-45-21-22-31-31-24-18-14
-16-17-11-17-23-26-11-32-62-82-33-30-60-120-113-104-92-42-5-67-92-74-59-108-145-
136-151-164-140-127-110-65-52-82-108-123-127-127-128-119-118-100-54-12-12-24-34-
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7-111-152-147-149-146-144-128-105-81-73-97-125-132-133-140-116-74-68-62-35-29-20
-24-21-17-53-34-23-43-33-23-16-48-70-76-54-59-46-3-80-90-71-70-70-84-105-84-94-9
3-104-159-153-151-156-148-151-143-122-105-107-112-138-140-144-143-43-2-5-7-30-24
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-9-15-37-27-33-37-14-37-34-25-35-43-43-37-14-80-126-119-126-100-131-99-80-76-80-
81-112-75-152-164-159-162-159-153-152-158-151-155-144-134-146-147-145-146-153-15
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-157-171-144-20-0-0-2-27-42-19-61-162-172-152-57-35-51-48-44-28-48-41-72-89-82-8
0-79-74-76-81-80-78-54-100-165-166-148-132-158-159-168-169-48-37-46-44-35-124-17
4-167-165-165-175-31-76-99-61-64-45-34-131-144-150-177-173-48-43-50-45-29-52-48-
67-85-85-84-79-76-77-77-80-79-21-9-63-67-41-36-101-167-171-183-128-58-60-51-39-1
33-179-173-171-174-184-128-166-185-162-84-55-104-169-152-154-151-164-44-6-18-44-
27-51-29-33-30-52-81-79-73-75-76-77-78-20-28-24-11-10-26-58-166-177-176-186-102-
95-78-59-150-184-179-180-154-103-157-147-133-155-181-178-179-157-161-162-161-64-
6-10-8-45-89-56-15-24-20-26-74-80-76-81-85-60-41-61-55-48-15-20-4-13-154-185-172
-137-107-107-97-76-88-131-130-102-47-31-114-154-154-145-152-167-157-160-164-165-
138-21-4-8-9-133-158-112-61-13-23-31-86-83-78-81-84-36-24-30-29-54-138-168-158-9
6-111-131-91-79-108-121-100-89-51-39-41-36-41-40-76-100-125-146-152-152-152-155-
166-165-144-59-39-6-41-156-119-111-119-95-27-70-95-84-83-79-75-40-33-54-19-91-15
0-127-152-205-140-37-53-87-113-123-108-95-68-56-54-47-52-55-44-28-37-139-157-154
-156-156-148-153-164-140-112-78-126-147-129-120-122-105-22-45-48-53-67-67-56-33-
38-89-13-79-133-126-135-147-174-87-96-116-133-137-132-110-70-60-75-79-69-70-41-3
```

Fig (4)

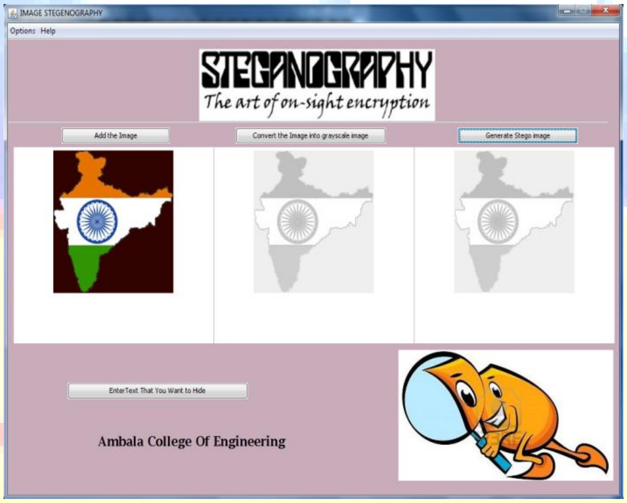


IMAGE STEGENOGRAPHY
Options Help
STEGANOGRAPHY
The art of on-sight encryption
Add the Image
Convert the Image into grayscale image
Generate Stego image
EnterText That You Want to Hide
Ambala College Of Engineering

Fig(5)

Fig (5) shows the 3 images: colored image, the grayscale image before steganography and the stego image after steganography. It also shows the text that is been hidden in the stego image.

This grayscale image is thene sent through any public medium or can we can share with anyone over a website. To any intruder the change in the images in invisible.

For extracting LSB's of stego image

```
for (int i = 0; i < width; i++)
{
int pixels = processed[j*width+i];
int bitvalue=calculatelsb(pixels);
}
public int calculatelsb(int pixel)
{
        if(pixel%2==0)
        {
                return 0;
        }
        else
        {
                return 1;
        }
}
```

Calculatelsb is a function that returns the LSB's of pixel values.these LSB's are then concatenated to generate the BCD code that we have to decrypt to generate the hidden text.

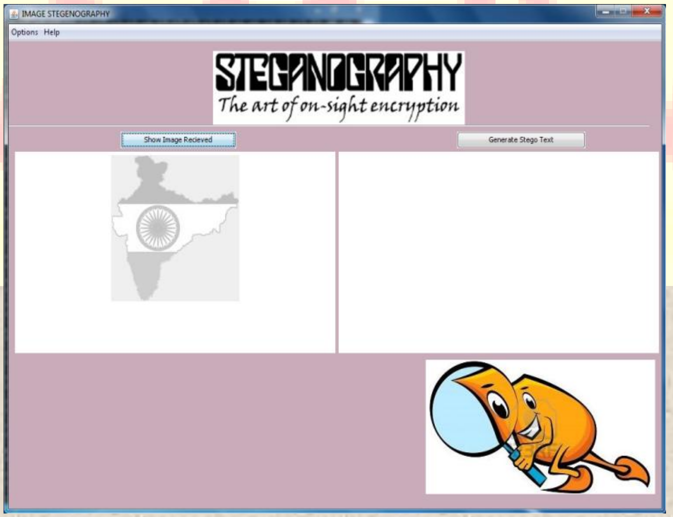


Fig (6)

Fig (6) shows the stego image at the client end where we want to generate the text from the image.

For generating stego text or decryption of the BCD code generated above

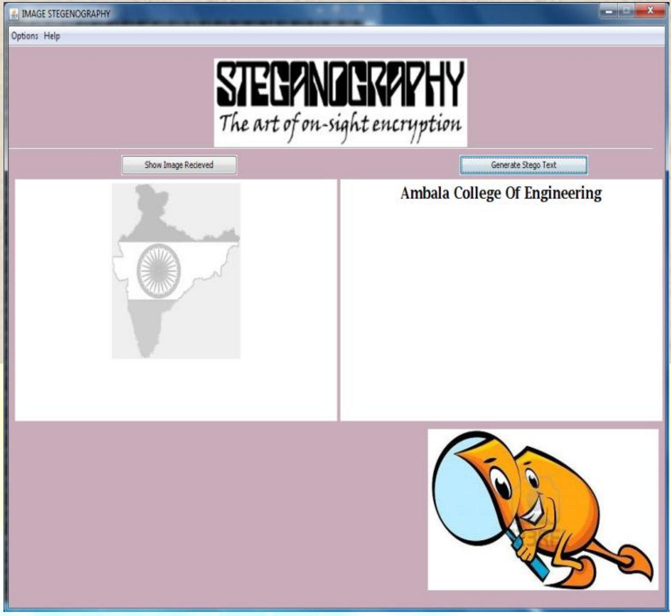
```
String strr = generateStegoText(length,code);

public String generateStegoText(int len,String finalcode)

{

        int len2=2;

        String stegoText="";

for(int i=0;i<len;i++)

{

for(int j=0;j<len2;j++)

{

int one1=Integer.parseInt(code);

String temp2=getValue2(one1);

sttmain=sttmain+temp2;

one=Integer.parseInt(temp2);

int xxx=Integer.parseInt(sttmain);

stegoText=stegoText+(char)xxx;

}

}
```

getValue2(one1) returns the decimal value for a 4 digit BCD code ranging from 0-9.

sttmain signifies the string generated from two decimal values for the BCD codes for example 9 and 7 concatenates to 97.

stegoText is the final stegoText generated from the above decimal value.

Fig (7) shows the stego text generated from the stego image.



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Fig(7)

CONCLUSION:

This paper implements the steganography using Least Significant bit insertion in grayscale images. We obtain a successful stego-image i.e. for any intruder the changes are invisible which makes it difficult to identify that whether something is hidden inside this image or not. However one of the biggest drawback is we can hide only one bit in a single pixel which demands a large size cover image. Another biggest drawback is that this technique can only be implemented on grayscale images which are not least common now days.

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