Encoding a Secret Message in an Image
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Introduction:

This paper will describe an algorithm used to encode a secret message into an image.
The average pixel value of an image is found (**m**=average). All pixel values of **m** are changed making the image have no pixel values equal to **m**. Now we make an alphabet out of an array with the array's index corresponding to a letter (a=0, b=1, c=2, etc) . We insert pixels with values **m** with the distance between them corresponding to a letter in the alphabet. The decoder then looks for pixels equal to **m** and uses the distance between them to decode each letter of the message.

Details Of Algorithm:

Encode:

Step 1:
We find the average pixel value of the image.

```
int image_mean( unsigned char  * image, int width, int height)
{
  int average = 0;
  int pixel;

    for( int y = 0; y < height; y++)
      {
              for(int x = 0; x < width ; x++)
                {
           pixel = image[x + y * width] ; //get the pixel value
                  average = pixel + average;
                }
      }

    average = average/(width*height);
    return average;
}
```

Step 2:

Then we find the first pixel that is equal to **m** and this pixel location will be the start of the hidden message. Then we continue looking for pixels equal to **m** and change them to **m**+1.

```
for( int y = 0; y < height; y++)
 {
        for(int x = 0; x < width ; x++)
          {
            pixel = image[x + y * width] ; //get the pixel value
           if(pixel == average)
             {
                    pixel++;
                    if( first == 1)
                      {
                        first = 0;
```

```
                    sp = x + y*width;
                  }
              }
             image[x + y * width] = pixel ;

           }
    }
```

Step 3:
We create an alphabet (a=0, b=1, c=2, etc).

```
char text[30] = {'a','b','c','d','e','f','g','h','i','j','k','l','m','n',
                 'o','p','q','r','s','t','u','v','w','x','y','z',' ','$'};
```

Step 4:
You write the secret message such as “bomb at palace”.

```
char  msg[64] = "woah secret message stuff hmmm";


int msg_len =  strlen(msg);
cout << "Msg length =  " << msg_len << endl;
```

Step 5:

At this point we have a starting point for the secret message **sp**. We take the index of each letter of the message and make the pixel at location **index+sp** equal to **m**. If the pixel value at this location is not close to **m** we keep on adding 30 (size of alphabet) until a location is found.

```
//-------------------------------------------------------------------------
int put_in_txt( unsigned char  * image, int sp, int average)
{

  while( abs(image[sp] - average) > 20)
    {
     sp += 30;
    }
  image[sp]=average;

  return sp;

}

//-------------------------------------------------------------------------
int GetIndex(char * txt, char xxxx, int n)
{
  int index = 0;

  for(int i = 0; i<n; i++)
    {
      if(txt[i] == xxxx)
              index = i;

    }

  return index+1;
}
```

```
for( int i = 0; i<msg_len; i++)
    {
            sp += GetIndex(text,msg[i],30);
            sp = put_in_txt(image,sp, average);
    }
```

Decode:

Step 1:
We find the average pixel value of the image.

```
average = image_mean(image, width, height);
```

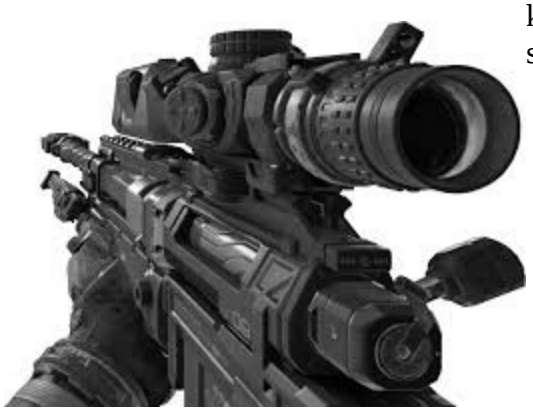
Step 2:
We find the starting point (the first pixel equal to the average).

```
//get the first starting point , look for the first average value
for(int i = 0; i < width*height; i++)
  {

        pixel = image[i];
        if(pixel == average)
          {
            sp = i;
            break;
          }
  }
```

Step 3:
We go through the rest of the image looking for pixels equal to the average. The distance between the average value pixels is used as a index to the alphabet array to decode the message.

```
for(int i = sp+1; i < width*height; i++)
  {

        pixel = image[i];
        if(pixel == average)
          {
            int distance = (i - sp)%30;
            sp = i;
            char c =  GetChar(text, distance-1);
            printf("%c", c);
          }
 }
```

Example Messages:



kcoopman > ./decode image4.jpeg
secret message is: **bomb at indoor parking lot**

kcoopman > ./decode image5.jpeg
secret message is: **i am in the whole foods come and find me**

kcoopman > ./decode image3.jpg
secret message is: **woah secret message stuff hmmm**