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The Project of
Image Compression Using Run Length Encoding Algorithim

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بسم الله الرحمن الرحيم

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

سوره البقره

الايه 32

شكر وتقدير

لابد لنا ونحن نخطوا خطواتنا الاخيره في الحياه الجامعيه
من وقفه نعود فيها الى اعوام قضيناها في رحاب الجامعه
مع أساتذتنا الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا
كبيره في بناء جيل الغد لتبعث الامه من جديد .....
وقبل ان نمضي نقدم اسمى أيات الشكر والامتنان والتقدير
والمحبه الى الذين حملوا أقدس رساله في الحياه .....
الى الذين مهدوا لنا طريق العلم والمعرفه الى اساتذتنا
الافاضل نقدم لهم كل الشكر والتقدير.

الاهداء

إلى من يسعد قلبي بلقياها

إلى روضة الحب التي تنبت أزكى الأزهار

أمي

إلى رمز الرجولة والتضحية

إلى من دفعني إلى العلم وبه ازداد افتخار

أبي

إلى من هم اقرب أليّ من روحي

إلى من شاركني حضن ألام وبهم استمد عزتي

وإصراري

اخوتي

إلى من آنسني في دراستي وشاركني همومي

تذكاراً وتقديراً

أصدقائي

Abstract

The main aim : The main aim of image compression is to represent an image in the fewest number of bits without losing the essential information content within an original image.

Techniques of compression : There are various techniques that can be used to compress images. these compression techniques can be lossy or lossless**.**

Project techniques **:** this project studies image compession with run length encoding algorithm.

Output : The output encoded image had yielded comparably better results than standard lossless image compression techniques. The proposed method had been tested on a series of continuous and discreet tone standard test images.

Conclusion :

1.Run Length Encoding (RLE) is a simplest compression technique which is most commonly used.

2. RLE achieves best results with images containing large areas of contiguous colour, and especially monochrome images.

3. is very.It useful in case of repetitive data.

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CHAPTE ONE

Image Compression

1.1 Introduction to Image

An image is essentially a 2-D signal processed by the human visual system. The signals representing images are usually in analog form. However, for processing, storage and transmission by computer applications, they are converted from analog to digital form. A digital image is basically a 2- Dimensional array of pixels. Images form the significant part of data, particularly in remote sensing, biomedical and video conferencing applications. The use of and dependence on information and computers continue to grow, so too does our need for efficient ways of storing and transmitting large amounts of data.

1.2 Image types :

The image types we will consider are:

1.2.1 Binary Image

Binary images are images whose pixels have only two possible intensity values. They are normally displayed as black and white. Numerically, the two values are often 0 for black, and either 1 or 255 for white.

Figure (1.1) Binary Images.

1.2.2 Gray Scale Image

Gray _scale images are referred to as monochrome, or one-color image. They contain brightness information only , no color information. The number of different brightness level available. The typical image contains 8 bit/ pixel (data, which allows us to have (0-255) different brightness (gray) levels. The 8 bit representation is typically due to the fact that the byte, which corresponds to 8-bit of data, is the standard small unit in the world of digital computer**.**
we can convert color image to gray image by equation:

gray image = red * 0.3 + green * 0.59 + blue * 0.11

Figure (1.2): gray image

1.2.3 Color Image

It is possible to construct (almost) all visible colors by combining the three primary colors red, green and blue, because the human eye has only three different color receptors, each of them sensible to one of the three colors. Different combinations in the stimulation of the receptors enable the human eye to distinguish approximately *350000* colors. A RGB color image is a multi-spectral image with one band for each color red, green and blue, thus producing a weighted combination of the three primary colors for each pixel.

A full 24-bit color image contains one 8-bit value for each color, thus being able to display $2^{24} = 16777216$ different colors.

Figure (1.3) : Color Images.

1.3 Different formats of images

Digital images can be stored in different formats:

1.JPEG is a form developed by the Joint Photographic Expert Group. Images in this form compressed to a high degree. JPEG's purpose is to achieve high compression ratio with images containing large number of colors.

2.Graphics Interchange Format (GIF) is an 8-bit p er pixel format. It supp orts animas well. GIF images are compressed using lossless LZW data compression technique.

3.Network Graphics (PNG) is another lossless data compression which is close to GIF but supp orts 24-bit color palette. It can be seen that JPEG can be used whenever the size is a critical.

1.4 Image Compression

Image compression addresses the problem of reducing the amount of information required to represent a digital image. It is a process intended to yield a compact representation of an image, thereby reducing the image storage transmission requirements. Every image will have redundant data. Redundancy means the duplication of data in the image. Either it may be repeating pixel across the image or pattern, which is repeated more

frequently in the image.The image compression occurs by taking benefit of redundant information of in the image. Reduction of redundancy provides helps to achieve a saving of storage space of an image. Image compression is achieved when one or more of these redundancies are reduced or eliminated. In image compression, three basic data redundancies can be identified and exploited. Compression is achieved by the removal of one or more of the three basic data redundancies:

1.4.1 Coding Redundancy:

Consists in using variable length code words selected as to match the statistics of the original source, in this case, the image itself or a processed version of its pixel values. This type of coding is always reversible and usually implemented using lookup tables (LUTs). Examples of image coding schemes that explore coding redundancy are the Huffman codes and the arithmetic coding technique.

1.4.2 Inter pixel Redundancy:

In image neighbouring pixels are not statistically independent. It is due to the correlation between the neighboring pixels of an image. This type of redundancy is called Inter-pixel redundancy. This type of redundancy is sometime also called spatial redundancy. This redundancy can be explored in several ways, one of which is by predicting a pixel value based on the values of its neighboring pixels. In order to do so, the original 2-D array of pixels is usually mapped into a different format, e.g., an array of differences between adjacent pixels. If the original image [20] pixels can be reconstructed from the transformed data set the mapping is said to be reversible.

1.4.3 Psycho-visual Redundancy:

Many experiments on the psycho physical aspects of human vision have proven that the human eye does not respond with equal sensitivity to all incoming visual information; some pieces of information are more important than others. Most of the image coding algorithms in use today exploit this type of redundancy, such as the Discrete Cosine Transform (DCT) based algorithm at the heart of the JPEG encoding standar .

Image compression is an application of data compression that encodes the original image with fewer bits. The objective of image compression is to

reduce the redundancy of the image and to store or transmit data in an efficient form. The compression ratio is defined as follows:

compression ratio: uncompression file / compression file

a. Image before compress (92) KB

b. Image after compression (6.59)KB

Figure (1.4): Image Compression.

1.5 Decompression

The compressed file is firstly decompressed and then used.There are many softwares used to decompress and it depends upon which type of file is compressed. For example WinZip software is use to decompress zip file An inverse process called decompression(decoding) is applied to the compressed data to get the reconstructed image. The objective of compression is to reduce the number of bits as much as possible, while keeping the resolution and the visual quality of the reconstructed image as close to the original image as possible. Image compression systems are composed of two distinct structural blocks : an encoder and a decoder .

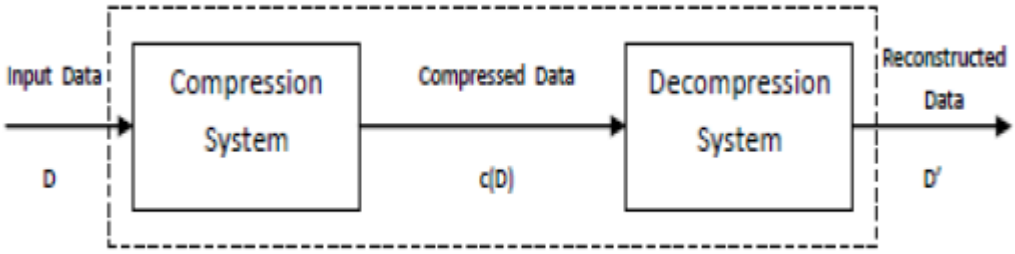

Figure (1.5) Block diagram of Compression and Decompression of image

1.6 Benefits of Compression

1. It provides a believable cost savings involved with sending less data over the switched telephone network where the cost of the call is really usually based upon its duration.
2. It not only reduces storage requirements but also overall execution time.
3. It reduces the probability of transmission errors since fewer bits are transferred.
4. It provides a level of security against unlawful monitoring.

CHAPTER TWO

Compression Techniques

2.1 Compression Technique

There are two categories of image compression i.e. lossless and lossy compression. lossless compression is used in artificial images. Basically it uses low bit rate. In the Lossy compression techniques, there is the possibility of losing some information during this process. While lossless compression is basically preferred in medical images and military images, owing to the lesser possibility of loss of information. The explanation of these methods is as follow:

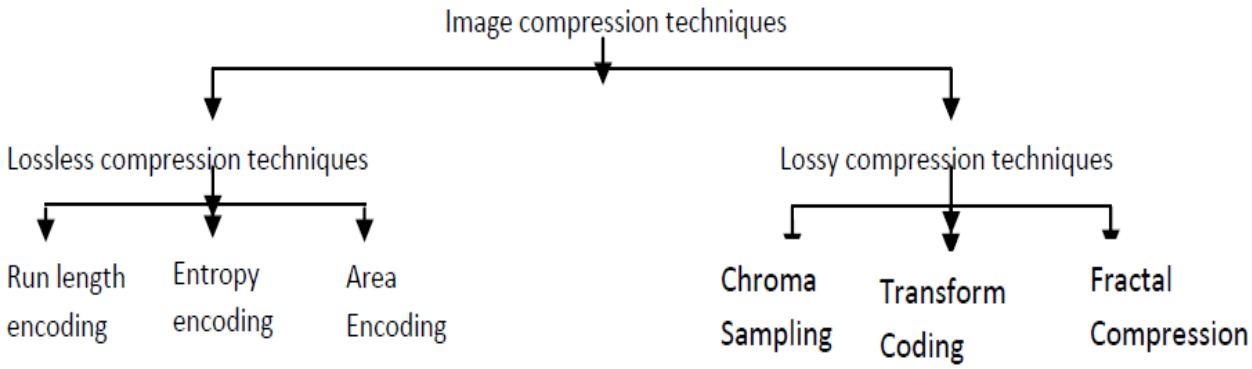

Figure (2.1) Compression Technique

2.1.1 Lossless compression technique

In lossless compression techniques,the original image can be perfectly recovered form the compressed (encoded) image. These are also called noiseless since they do not add noise to the signal(image). It is also known as entropy coding since it use statistics/decomposition techniques to eliminate/minimize redundancy. Lossless compression is used only for a few applications with stringent requirements such as medical imaging. Following techniques are included in lossless compression:

1. Run length encoding:

we discuss this techniqe in chapter three.

2.Constant Area Encoding:

This method is an enhanced form of run length encoding method. There is some significant advantage of using this technique over other lossless methods .In constant area coding special code words are used to identify

large areas of contiguous 1's and 0's.Here the image is segmented in to blocks and then the segments are classified as blocks which only contains black or white pixels or blocks with mixed intensity. Another variant of constant area coding is to use an iterative approach in which the binary image is decomposed into successively smaller and smaller block .A hierarchical tree is built from these blocks. The section stops when the block reaches certain predefined size or when all pixels of the block have the same value. The nodes of thistree are then coded.

3.Entropy encoding:

Entropy encoding is another lossless compression technique. It works independent of the specific characteristics of medium. Beside using it as a compression technique it can be also used to measure the similarity in data streams. This method works as follows. It will create a unique prefix code and assign this code to unique symbol in the input. Unlike RLE entropy encoders works by compressing data by replacing the fixed length output with a prefix code word. This is of varying size after creating the prefix code. This will be similar to the negative logarithm of probability. There are many entropy coding methods. The most common techniques are Huffman coding and arithmetic coding.

2.1.2 Lossy compression technique

Lossy schemes provide much higher compression ratios than lossless schemes. By this scheme, the decompressed image is not identical to the original image, but reasonably close to it. But this scheme is widely used. Lossy methods are especially suitable for natural images such as photographs in applications where minor loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences may be called visually lossless. The following methods are used in lossy compression.

1. Chroma subsampling

This takes advantage of the fact that the human eye perceives spatial changes of brightness more sharply than those of color, by averaging or dropping some of the chrominance information in the image.It works by taking advantage of the human visual system's lower acuity for color differences than for it is mainly used in video encoding,jpeg encoding etc. Chroma subsampling is a method that stores color information at lower resolution than intensity information. The overwhelming majority of

graphics programs perform 2x2 chroma subsampling, which breaks the image into 2x2 pixel blocks and only stores the average color information for each 2x2 pixel group. This process introduces two kinds of errors.

2.Transform coding

It is a type of compression for natural data like photographic images.It will result a low quality output of original image.It is a core technique recommended by jpeg. Transform coding is used to convert spatial image pixel values to transform coefficient values. Since this is a linear process and no information is lost, the number of coefficients produced is equal to the number of pixels transformed. Many types of transforms have been tried for picture coding, including for example Fourier, Karhonen-Loeve, Walsh-Hadamard, lapped orthogonal, discrete cosine (DCT), and recently, wavelets.

3.Fractal Compression

It is one of the lossy compression technique used in digital images.As the name indicates it mainly based on the fractals.This approach is good for natural images and textures. It works on the fact that parts of an image often resemble other parts of the same image.This mehod converts these parts into mathematical data. These data are called “fractal codes”.Which are used to recreate the encoded image.

CHAPTER THREE

Run Length Encoding Algorithm

3.1 Introduction

run length encoding is most useful on data that contains many such runs: for example, simple graphic images such as icons, line drawings, and animations. It is not useful with files that don't have many runs as it could greatly increase the file size.Run-length encoding performs lossless data compressionand is well suited to palette-based iconic images. It does not work well at all on continuous-tone images such as photographs although JPEG uses it quite effectively on the coefficients that remain after transforming and quantizing image blocks.

3.2_Run Length Encoding Algorithm

Run Length Encoding (RLE) is a simplest compression technique which is most commonly used. This algorithm searches for runs of bits, bytes, or pixels of the same value, and encodes the length and value of the run. RLE achieves best results with images containing large areas of contiguous colour, and especially monochrome images, For example The string is aaaaaaaabbbbbcc would have representation as (a; 8)(b; 5)(c; 3) Then compress each(char; length) as a unit using, say, Huffman coding. Clearly, this technique works best when the characters repeat often.

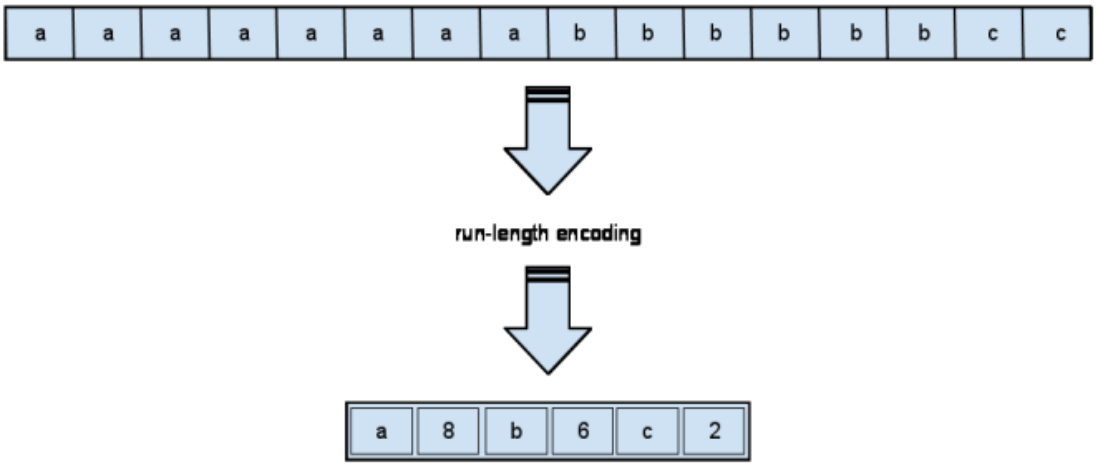

Fig 3.1 Example of Run length encoding.

82	82	82	82	82	89	89	89	89	90	90

{82,5}	{89,4}	{90,2}

Fig 3.2 Example of Run length encoding.

3.3Applications

Common formats for run-length encoded data include Truevision TGA, PackBits, PCX and ILBM. Run-length encoding is used in fax machines (combined with other techniques into Modified Huffman coding). It is relatively efficient because most faxed documents are mostly white space, with occasional interruptions of black.
Data that have long sequential runs of bytes (such as lower-quality sound samples) can be RLE compressed after applying a predictive filter such as delta encoding.

3.4 Run length encoding algorithm

Steps of algorithm for RLE are as follows:

Step 1: read the image.

Step 2: convert image to pixel.

Step 3: creat a file.

Step 4: put size of image in file.

Step 5: compute order repetition and put in file.

3.5 decoding algorithm

Steps of algorithm for decoding are as follows:

Step 1: read the file.

Step 2: get the size of image from file .

Step 3:get pixel and repetition from file.

Step 4: create image.

Step 5: assign pixle in image from file .

3.6 Advantages and disadvantages of run length encoding

This algorithm is very easy to implement and does not require much CPU horsepower. RLE compression is only efficient with files that contain lots of repetitive data. These can be text files if they contain lots of spaces for indenting but line-art images that contain large white or black areas are far more suitable. Computer-generated color images (e.g. architectural drawings) can also give fair compression ratios.

Table 1. Summarizing the advantages and disadvantages of Run length encoding algorithm.

Techniques	Advantages	Disadvantages
1.Runlength Encoding	This algorithm is easy to implement and does not require much CPU horsepower ,[13].	RLE compression is only efficient with files that contain lots of repetitive data .[13] White or black areas are more suitable then colored image. Jindal V. et al.[[14].

3.7 Project design and implementation

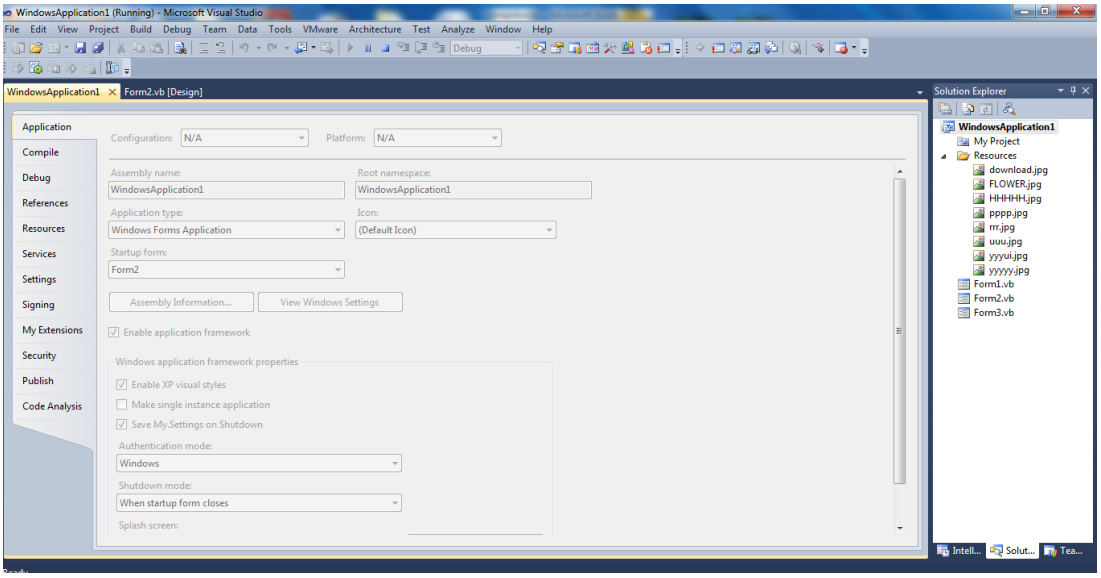

Figure 3.3 window of Microsoft Visual Studio 2010

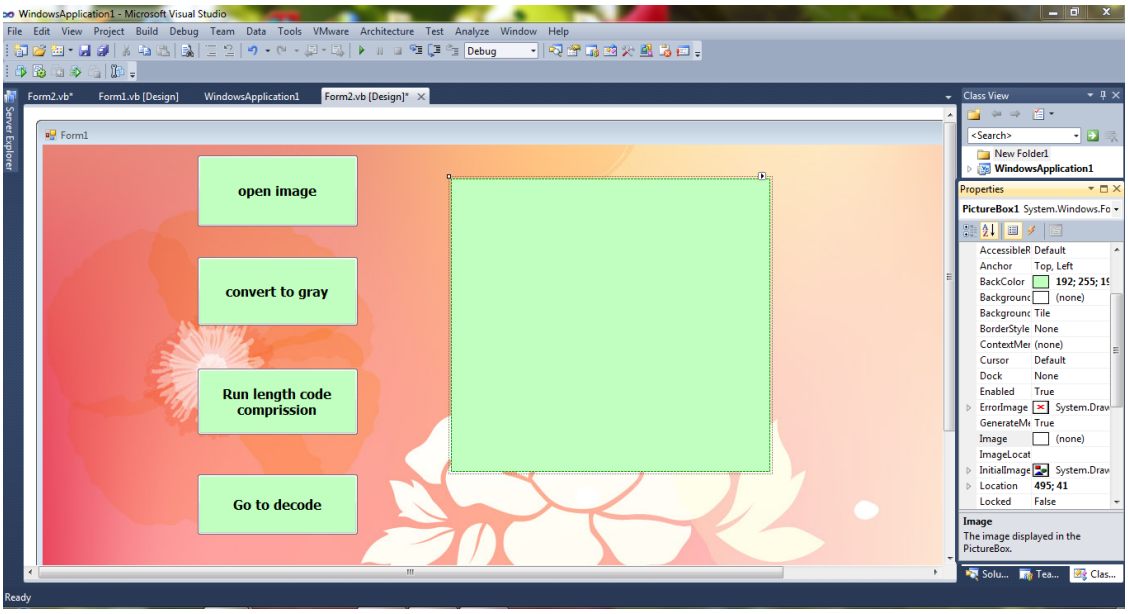

Fig 3.4 window of project

There are severl things in project design:

1. The First Window : Contains four basic command:

a. Open Image:

this command use to load picture to display on screen and apply compression on it .

b. Convert to gray:

this command use to covert color image to gray image and the algorithm to convert is :

Steps of algorithm for convert to gray are as follows:

Step 1: read the image.

Step 2: convert image to pixel value .

Step 3: get red,green,blue from pixel.

Step 4: put size of image in file.

Step 5: perform this equation **:** gray image = red * 0.3 + green * 0.59 +

blue * 0.11

c. Run length encoding algorithm :

this command apply compression on the load image from command open image after convert to gray by compute the repeated values in each row . this command use text to store the value of image after convert it to array and store the number of repeated value in each row and store the .

4. Go to decode :

this command use to go to decode window.

Fig 3.5 open color image

Fig 3.6 convert color image to gray

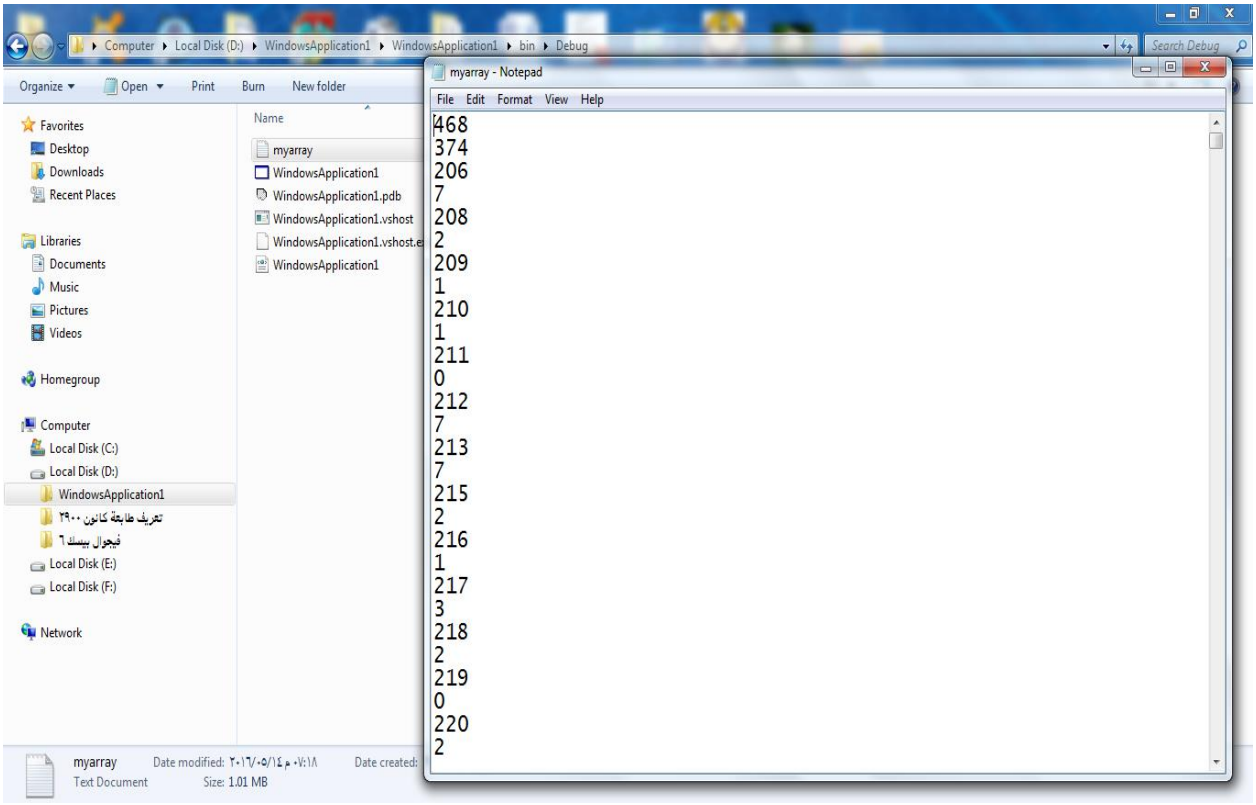

Fig 3.7 window of text after apply compression on image

3. The Second Window :

consist of two command:

1. Decode: this command take the value from text and Implemented decompression

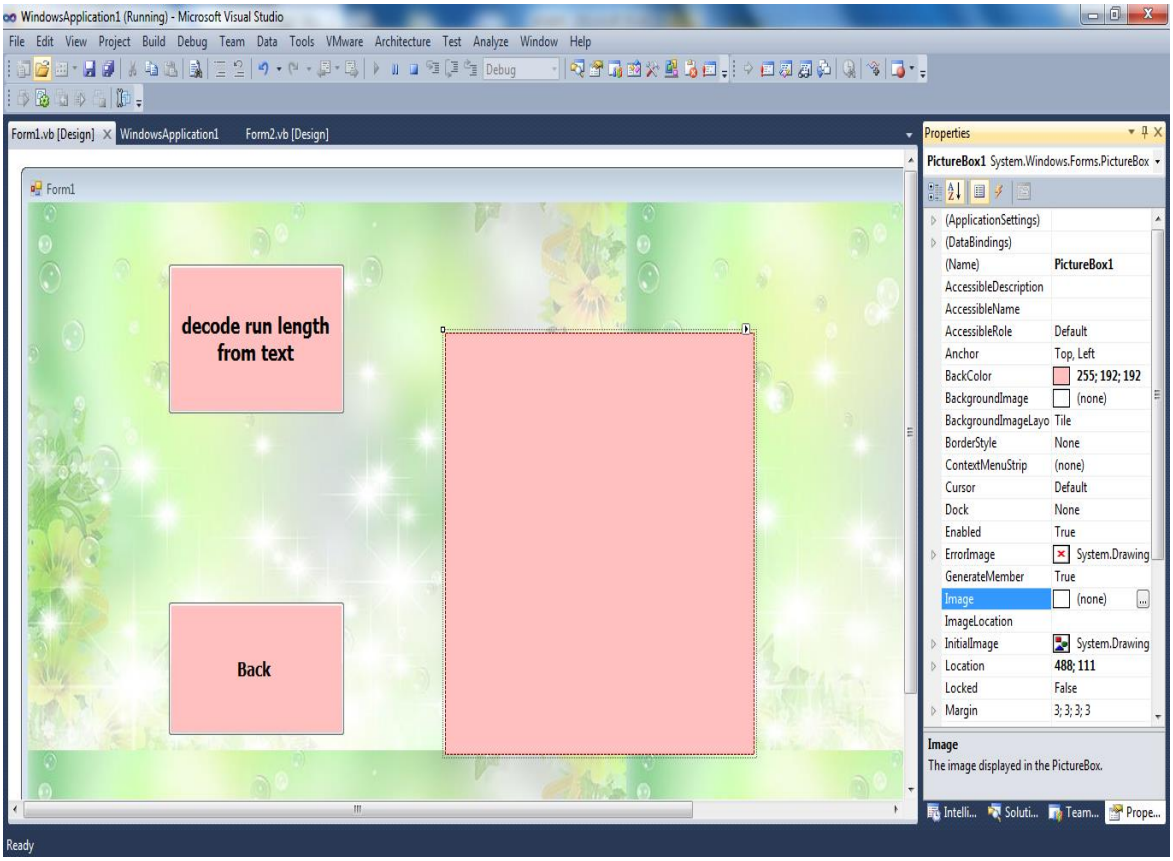

Figure 3.8 before decompression on image

Figure 3.9 after decompression on gray image

CHAPTER FOUR

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