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Principle of Steganography Tool BCS (Bilevel Compression by Using Steganography)

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Abstract

In this paper we make a new approach of compression used as a tool of steganography instead of make it as obstacle (BCS). The outline of BCS compression used two steps level 1 and level 2, level 1 is a new approach of compress images which depends on the fact that every paint has a limited colors, that make it reduce the physical size of repeating pixels which is called a run like RLE compression method, but the main difference of level 1 that make it more efficient than RLE is using relative address which is classified to base address and offset. The base address for the first run is the location of the pixel value that represent this run the other runs base address for the same pixel is the last pixel in the previous run and that we call it dynamic base address (DBA). Level 2 depends on the steganography properties to reduce the fourth byte for each run in level 1 to bit and insert it as a bit in dummy image instead of a byte.

Keywords: Steganography, dummy image, information hiding, PLE, DBA, lossy, lossless, compression, BCS.

مبداء لأداة أخفاء في الصور (BCS)

الخلاصة

في هذا البحث استخدمنا طريقه ضغط جديدة تستخدم كأداة في عملية الإخفاء في الصور(steganography) بدلاً من جعلها عقبه في تقنية أخفاء الصور (BCS). الخطوط العريضة لهذه الطريقة تتكون من خطوتين هما المستوى 1 (level 1) و المستوى 2 (level 2). المستوى 1 هو طريقة ضغط جديدة للصور و التي تعتمد على حقيقة بأن جميع الرسوم تحتوي على عدد محدود من الألوان، و الذي يمكن المستوى 1 من اختزال الحجم الفيزياوي لنقط التلوين المتكررة (pixels) و المسماة السلسلة و التي تشبه طريقة الضغط (RLE). لكن الفرق الرئيسي بينهما و الذي يجعل المستوى 1 أكثر كفاءة هو استخدام العنوان ذات العلاقة (relative address) الذي يصنف إلى عنوان القاعدة (base address) و العنوان الابتدائي (offset address)، العنوان ذات القاعدة للسلسلة الأولى هو عنوان نقطة التلوين الأولى لتلك السلسلة و المستخدمة كقيمة للسلسلة، أما عناوين السلاسل الأخرى فيكون نقطة التلوين الأخيرة من السلسلة السابقة و هذا ما نسميه العنوان ذات العلاقة المرن (DBA). المستوى 2 يعتمد على خصائص تقنية الإخفاء في الصور لأختزال البايت الرابع لكل سلسلة من سلاسل المستوى 1 و إدخاله كبت بدلاً من بايت في تقنية الإخفاء في الصور.

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1-Introduction

Internet communication has become an integral part of the infrastructure of today's world. The information communicated comes in numerous forms and is used in many applications [1]. In a large number of these applications, it is desired that the communication be done in secret. Such secret communication ranges from the obvious cases of a bank transfers, corporate communications, and credit card purchases, on down to a large percentage of everyday e-mail [9]. With e-mail, many people wrongly assume that their communication is safe because it is just a small piece of an enormous amount of data being sent worldwide. After all, who is going to see it? But in reality, the Internet is not a secure medium, and there are programs "out there" which just sit and watch messages go by for interesting information.

Encryption provides an obvious approach to information security, and encryption program are readily available. However, encryption clearly marks a message as containing "interesting" information and the encrypted messages becomes subject to attack [3]. Furthermore, in many cases it is desirable to send information without any one even noticing that information has been sent. Steganography represents another approach to information security. In steganography, data is hidden inside a dummy image or container that looks like it contains only something else. A variety of dummy images are possible, such as digital images, sound clip and even executable files [5]. Using steganography has been increasing in the last years and become very important, which leads to create assistant tools for it. We invented first tool and it is a new compression method compatible with steganography by using its properties in changing information hiding to bits before insert it [8], and that mean make our compression not restrict by any unit. Bases of experiments in this paper are image hiding in image (24 bit of pixels) bitmap. BCS compression is structured by two levels (Bilevel) and uses the same approach of steganography technique with simple change for dealing with level 2 of BCS compression. The header of bitmap image will not be compressed.

2-BCS Compression

The outline of BCS compression used two steps level 1 and level 2, level 1 is a new approach of compress images and have a good ratio reached to 3:1 in Fig5. The BCS depends on the fact that every paint has a limit colors even in 24-bits pixel which the number of its colors reaches to 16,777,216(2) possible color combinations [2]. That makes BCS reduce the physical size of repeating pixels which is called a run like RLE compression method [6], but the main difference of BCS that make it more efficient than RLE is reducing the physical size of repeating runs using relative address which is classified to base address and offset [4]. The base address for the first run is the location of the pixel value that represent this run the other runs base address for the same pixel is the last pixel in the previous run and that we call it dynamic base address

(DBA). Level 2 depends on the Steganography properties to reduce the fourth byte for each run in level 1 to bit and insert it as a bit in dummy image instead of byte (fourth byte has value either 1 or 0) which indicates the pixel has run or has not. That byte is called pixel link escape (PLE).

3-Level 1

This level classifies the pixels which have runs and which have not runs (individual) by adding to each pixel one byte which has value either 0 if has no run or 1 if has run's (PLE) which is reduced to bit in level 2, for the run pixels has two PLE, the second indicates the end of runs for that pixel as shown in Fig1.

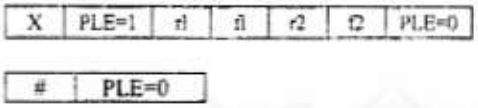

Fig1. PLE example

Where
#, X: pixel
r1, r2: run
f1, f2: offset address of run.

The base of level 1 is used DBA notation, the Fig2 explain it:

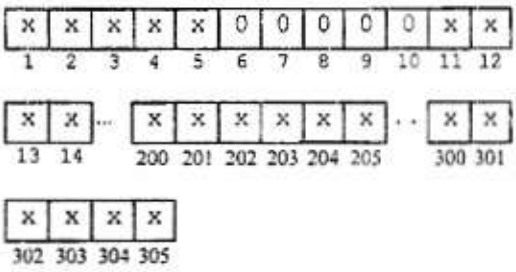

Fig2. DBA example

Assume the Fig2 is a segment of bitmap image and each symbol represent a pixel of 24-bit, how the (X) pixels will be stored in the compress file? Pixel number 1 is inserted in the compress file as a value for four runs of (X) pixels also as address for these runs. Then PLE added, followed by four groups of runs are typically each run encoded into two bytes, the first byte for pixels number in the run. In practice, an encoded run may contain 1 to 128 or 255, if the run is more than 255, then the new group of run is created, the second is the offset number for location of the recent run according to the last pixel in previous run using this pixel as DBA, the important of DBA is appear in this example, since without DBA we must put the offset of the last run =300 (that mean the distance between this run and the value pixel) for that we need two bytes to store the offset = 300, and for larger image will may be offset size equal 3 or 4 bytes. But in DBA, the offset of the last run in the segment = 95 (the distance between pixel number 300 which represent the start of last run and the pixel number 205) for that offset has no need more than one byte to store number 95. And by this maybe BCS can reach for all runs in the image of (X) pixel by offset with one byte instead of 2, 3 or 4 bytes but under condition the distance between any two run not increase than 255. The (X) pixel with its run terminates with PLE, the implementation of (X) pixel will be explained in Fig3. The size of (X) pixel and its four groups of runs = 13 bytes indicate to 63 bytes of (X) pixels in the bitmap image.

Fig.3. Size 87.9 KB Compress by level 1 to 36.8 KB.

The Fig4.a and Fig4.b represent complete algorithms of level 1 and truck run.

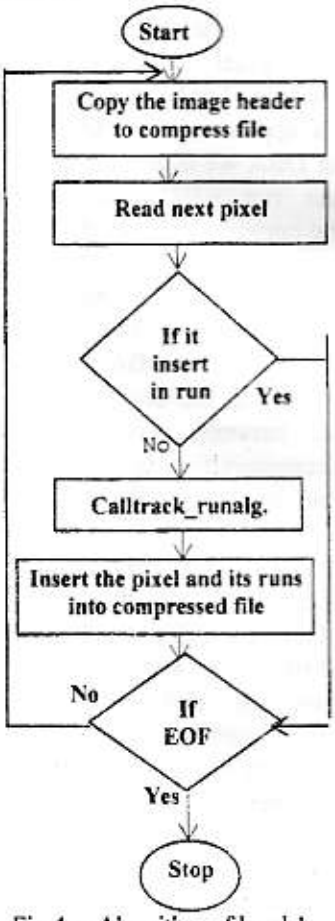

Fig.4.a. Algorithm of level 1

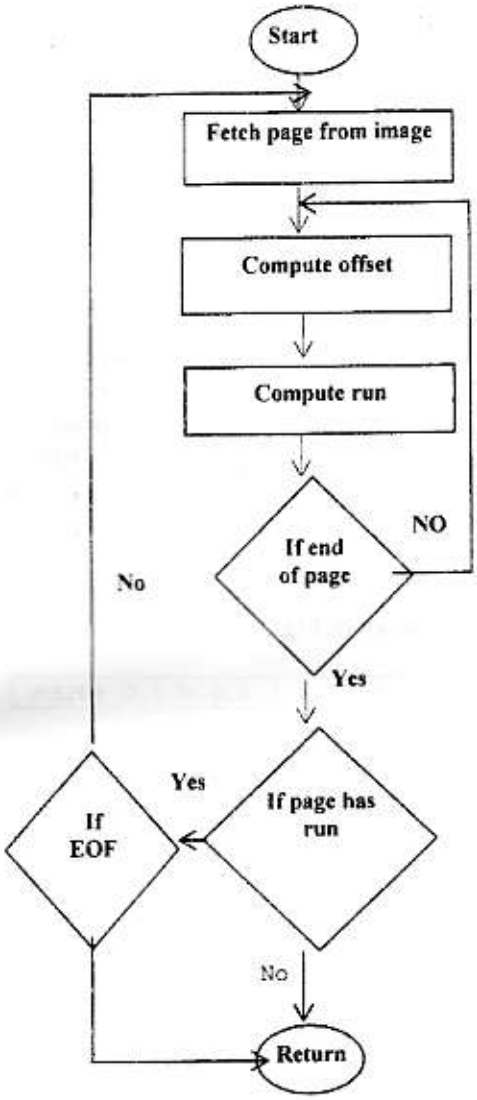

Fig.4.b. Track-run Alg.

4-Level 2

This level will guarantee that BCS will not be doubled in size (like RLE) in case the repetition of pixels is small [1], the worst thing is making BCS same size of origin, and that is achieved by reducing fourth byte (PLE). Level 2 will add extra ratio of compress to level 1.

5-Retrieving

To retrieve the image, we followed two steps, first step retrieve the compress file from the dummy image by inverse steganographyy algorithm [7]. The second step is to uncompress the file by inverse the compressed algorithm.

6-Results

We used segmented paging notation [4], to achieve the seek about repeating runs by discrete the image to different size of segments each one of it represent the beginning of the page that will scan for run in it [10]. The size of the segments depend on location of the last pixel in recent run to fetch page with fixed size equal 255 pixels to be compatible with offset has a byte size which can't track the run more than 255 pixel.

The next page will be fetched from the last pixel in the last run found in the recent page. If no run found in the page, the tracking of run will stop. For each run become after this page will be treated as a new pixel is not related with previous pixel. The largest compress ratio is done by level 1 in Fig5 and Fig6 Level 2 has small ratio depends on steganography, Fig7 will be compressed from 217 KB to 99.3 KB by level 1 Fig8 represents steganography that relate to level 2 to compress the results of level 1 and insert it in the dummy image to add extra compression ratio to level 1and reduce 459 byte from the compressed file of Fig3 (this ratio may be increased in other images). The final result of BCS is Fig9.

7-Conclusions and Future Work

The objective of this paper is to demonstrate BCS tool of steganography, which is based on a property of steganography. The most important point for this technique is that BSC compression specialized just on steganography which makes it more compatible than the other compression methods. We have discussed the following points and showed our experiments:

1. We can replace the old compression methods with BCS that nor lossy neither lossless categorize, but a new compression used as a tool of steganoraphy.
2. BCS is a bilevel compression.
3. BCS program can be customized for each user. Thus it guarantees secret Internet communication.
4. We used a DBA that can store large address just in one byte which guarantee founding any run whenever the distance between it and pixel value not increase than 255 bytes.
5. Level 2 guarantee will never BCS has a size larger than origin image.
6. We can separate level 1 and make it as a traditional lossy compression in a new approach with very large compression even without variants on it, but we must make modification on level 1.

We are very convinced that a BCS is a very strong compression technique, because of the specialized using. Future research will include the application to image other than 24 bit, and used variants on BCS, identifying and formalizing the customization parameters, and developing new applications.

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Application of BCS Compress.

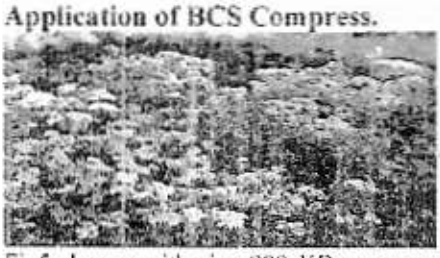

Fig5. Image with size 900 KB compressed by level1 to 336 KB.

Fig6. Image with size 87.9 KB compressed by level1 to 36.8 KB.

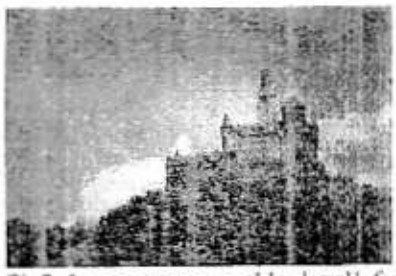

Fig7. Image compressed by level1 from 217 KB to 99.3 KB and by level 2 reduce 459 Byte from compression file.

Fig8. Image with size 900 KB before hiding Fig7 (steganography) in LSB.

Fig9. Result of BCS: compression and hiding Fig7 in LSB.