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Ways to Increase the Efficiency of Steganographic Use of Fractal Image Compression Algorithm

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ABSTRACT

The state of the art in fractal picture compression algorithms is investigated. The primary directions for improving compression algorithms are discussed. In terms of classification efficiency and picture processing speed, the methods are among the most effective. The concept of steganographic use of the fractal algorithm is discussed. The differences between the advanced compression algorithm and the classic compression algorithm are evaluated to accomplish so. The differences discovered are used to define ways to improve the efficiency of the stego algorithm. The development of digital image compression technology was spurred by the necessity for speedy communication and "live" digital image information over the internet. Time has passed, and many tactics exist now to reduce the compression ratio and increase the usability of speedy computation, but because we are limited by certain constraints, there are many inventive ways to overcome these limitations. Today's environment is heavily reliant on digital media storage, necessitating the creation of more effective image or data compression algorithms. Images must be compressed and soft-encoded before being used in the transmission phase due to limited bandwidth and power. This paper discusses the

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differences between Lossy and Lossless compression methods as they apply to image processing.

1. Introduction

The current state of development of fractal image compression methods is analysed. The main directions of improvement of compression algorithms are determined. Approaches are described as one of the most effective in terms of classification efficiency and increase image processing speed. The idea of steganographic use of the fractal algorithm is specified. To do this, the differences between the advanced compression algorithm and the classical one is evaluated. Ways to increase the efficiency of the stego algorithm are described, which consider the identified differences (Balaji, Rajkumar, & Ibrahim, 2019).

The problem with designing effective data embedding methods is uncertainty about both the transformations used for embedding and the transformations that should hide them. In some cases, the latter somewhat limits the former so that the choice is obvious. This is often facilitated by a small number of common steganographic transformations. Focusing on steganography, which uses digital images as a cover, allows us to clarify an important feature inherent in the majority and, obviously, almost one of the mandatories among promising modern methods. Loss resistance, which is a common operation performed on images, should have a stego algorithm. There are modifications of steganographic methods, which did not provide for any further transformations in the initial version but have successfully adapted to common image compression algorithms. However, greater advantages are guaranteed by developing a method that uses the features of the generation of a particular algorithm of compressed image code and its main operations as a region of transformations. In this case, the choice of compression algorithm indicates the idea of embedding data (Cierniak & Rutkowski, 2000; Deshlahra, 2013; Niu et al., 2010; Saroya & Kaur, 2014).

2. Effectiveness of the designed steganographic method

The effectiveness of the designed steganographic method depends on the degree of effectiveness of the compression method (Mohammed, 2021). The most effective

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compression methods are used more often. The popularity of the method will guarantee a wide selection of containers and the versatility of the data embedding algorithm.

The fractal image compression algorithm is promising in terms of steganographic use because it demonstrates high efficiency: experts interpret the relationship between the compression ratio and the quality of the restored image as one of the best (Dhawan, 2011; Mainberger, Schmaltz, Berg, Weickert, & Backes, 2012; Sai Virali Tummala, 2017).

Recently, fractal image compression algorithms have developed rapidly. Despite the existence of data embedding methods that use fractal features of images, a steganographic approach has not yet been developed, which fully takes into account the trends of fractal compression and algorithms that implement it [3]. This is due to the lack of uniform standards in fractal image compression algorithms and rapid changes in this area. But several successful inventions and improvements that determine the current state and indicate the directions of development of these methods allow us to define the possibilities of steganographic use clearly.

The existing methods perform operations only in the field of images, which encourages developing a fundamentally new stego algorithm that will embed the data directly into the fractal code. During the design, it is necessary to consider all the features of the compression algorithm to create an effective method of hiding data devoid of unmasking features. Such features are determined not only by the choice of compression algorithm but also by improvements designed to increase its efficiency. The effectiveness of fractal image compression methods depends on how the two parameters are minimized, subject to limitations that guarantee the required playback quality. These parameters are the size of the compressed image and the time spent on compression. Some methods and their modifications allow success in both parameters. But in general, the solution of the time problem is preferred, which is sometimes characterized by a slight decrease in the compression ratio (A. A. J. S. Altaay, Shahrin Bin Zamani, Mazdak, 2012; Din, Mahmuddin, Qasim, & Technology, 2019; Din, Qasim, & Informatics, 2019; Qasim, Din, Alyousuf, & Informatics, 2020).

Considering the main trends in the development of modern fractal image compression algorithms, we can identify fragments, borrowing which will optimize time. Such fragments can be classified based on the steganographic significance of the operations performed, which will allow the development of an adapted stego method.

Many modern, efficient compression algorithms use the idea of highlighting features for further classification. This allows you to increase performance by limiting the search for matches only within the class. The limitation somehow affects the quality of the compressed image: it has more differences from the original than the image obtained by a complete search of blocks. But this shortcoming can be compensated by using a classification scheme with a soft adjustment of parameters.

3. The new method of embedding secret data proposed

In (Vasyura AS, 2006), a method of embedding secret data was proposed, which performs steganographic manipulations during compression by a fractal algorithm. Developing the idea presented there, it is expedient to investigate in more detail the features of the compression algorithm used as a cover to prevent disclosure due to neglect of important unmasking features. The strategy to increase the efficiency of the method proposed in (Vasyura AS, 2006) is also to improve the recognition of subsets of domain blocks of the primary image in the restored, which requires the development of a suitably adapted apparatus.

Methods of accelerating the fractal compression algorithm should be considered in accordance with the stages of image processing. Such stages are the division of the image into fragments and the search for correspondences between these fragments. Partitioning involves determining the function of belonging of each of the pixels of the image to any indexed fragment. The search for matches is usually limited to some set formed from a set of fragments. The rules of forming such sets are determined by means of admissible isometric transformations performed on each element of some subset of the set of fragments. Thus, we obtain sets of domain and rank blocks. The amount of computing resources spent on matching between blocks depends on their number and the type of isometric transformations. Fewer blocks require fewer resources, but in most cases, they negatively affect the quality of the compressed image. The correspondence between rank and domain blocks in relation to some criterion implies the possibility of several suitable domain blocks. In terms of criteria, the choice of any of them is equal. This feature determines the nature of the manipulation to embed data. But the need to accelerate fractal compression stimulates the creation of modifications of algorithms that significantly limit the possibilities (A. A. J. Altaay, Sahib, & Zamani, 2012; QASSIM & SUDHAKAR, 2015; Roshidi Din, 2018; Tayel, Shawky, & Hafez, 2012; Zaidan, Zaidan, Taqa, & Othman, 2009).

4. Steganographic efficiency

Steganographic efficiency depends on the number of domain blocks. The attempt to improve the stego method, which uses the features of the compression algorithm, causes a sharp contradiction (Vasyura AS, 2006). Modern modifications of the fractal algorithm involve the use of the so-called quad-tree scheme. Its essence is to gradually reduce the size (respectively, increase the number) of rank and domain blocks if there are rank blocks for which no suitable domains have been found. This approach saves computing resources and does not degrade the quality of the restored image (Miran & Kadir, 2019). However, the probability of matching for large blocks is small. Criterion checking for such blocks requires more resources. Therefore, the use of a complete quad-tree scheme is not always justified. An incomplete variant is more often used, which assumes the largest size of rank blocks 8×8 or (less often) 16×16 pixels. This limitation weakens the effect of the randomness factor and makes the time required to compress images of specific sizes a more predictable value (less variance). On the other hand, increasing the number of blocks helps to improve the steganographic qualities of the method.

The described method of partitioning the image using a quad-tree determines the square shape of the rank and domain blocks. The most common way to orient blocks is when the boundaries of the block always remain parallel to the edges of the image. Despite the suggestions of other ways of orienting square blocks, this remains the most convenient (saving computing resources) in further calculations. Accordingly, the largest number of isometric transformations is eight. However, not all possible transformations are always used. There are modifications in which the isometry of domain blocks is not used. A smaller step of image quantization provides the necessary variety of domains in this case. But further classification to accelerate justifies using an isometric structure: most classification models assume the existence of simplified mathematical transformations to organize the isometric set of the image fragment.

The possibility of fractal compression of images is not limited to division into square fragments. Some modifications use fragments of rectangular and even arbitrary shape. In some cases, this provides more suitable domain blocks that can be coded rankings and a higher compression ratio. The efficiency of data embedding methods based on such modifications may be higher. However, such approaches have a significant disadvantage - great computational complexity. Their research and optimization with respect to the time component is a promising direction in developing the fractal theory of image compression. Still, its current state determines the Quadro structure as the most adapted to the needs of practical use.

The next stage of the algorithm is more responsible for the compression time and quality of the restored image, although due to the previous one. Modern modifications of the fractal image compression algorithm provide a number of sequential actions at the stage of matching (Semenov, Voloshyn, & Ahmed, 2019). They aim to reduce image processing time. From the point of view of the compression idea described, it is unnecessary to involve all blocks in the matching process. Deprivation of blocks that, in principle, cannot provide the necessary variety (same type) guarantees the acceleration of the algorithm. The simplest way to determine the same type of blocks is to classify them by statistical characteristics. Blocks in which the variance of pixel intensity values does not exceed a certain threshold can be represented by an average value. It is advisable to skip such blocks at the stage of matching. This approach weakens the steganographic potential but increases the efficiency of compression.

Searching by full search, even if you ignore homogeneous blocks, takes a long time. To reduce this indicator, a multilevel classification of blocks is used. At the heart of all classification, approaches are the principle of quantifying some features. The purpose of classification is to extend the qualitative characteristics obtained from one or more

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features to other properties, the direct definition of which is difficult. Such a general assumption, not supported by the axiomatic evidence of being, leads to inaccuracies and errors in assessment. But intuitive-practical activity occurs due to classification schemes, which in many cases guarantees high efficiency of their use.

A feature of the classification models used to accelerate the fractal image compression algorithm is the independence from the variations of the components of brightness and/or contrast. Compliance involves calculating the values of the above parameters. There is no correlation between them and the degree of correspondence of the blocks. Therefore, the classification scheme should be insensitive to at least one of the parameters (preferably brightness): the undesirable effect of another parameter can usually be normalized. The narrow boundaries of the classes and, accordingly, their large number contribute to the reduction of the time required for verification within it. However, in many cases, this leads to an increase in the complexity of the calculations required to fill these classes and an increase in the share of rank blocks for which there is. Still, no correspondence is established among the domains due to classification inadequacy. Therefore, it is advisable to apply several different classification models to approach a set of suitable blocks gradually. The main requirement is the gain in time, which must be provided by the computational complexity of the models.

The classification method can have a fixed or variable number of classes. For example, vector methods that operate on a set of artificial features of the block as a vector divide the vector space into areas containing a point with the coordinates of only one vector that characterizes the rank block. Such methods require much more computing resources than methods with a fixed number of classes, although they have several advantages. The most important among them is the accuracy of establishing compliance and the practical absence of unnecessary blocks in the final class. This minimizes the verification process to a minimum, which reduces image processing time. But increasing the dimensionality of the vector-characteristic leads to a sharp increase in the share of resources allocated for classification. By applying the previous classification scheme with a fixed number of classes, you can reduce the required elementary operations. Limiting the vector dimension will also facilitate simplification and acceleration, although it will increase the proportion of mismatch

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errors. To determine the vector, you can use any artificial quantitative features insensitive to changes in brightness and/or contrast but provided that their number is limited. It is justified to use DCT coefficients to carry the most information about the image. Direct DC conversion is defined as

$$E[u,v] = \frac{1}{4}\sum_{i=0}^{n-1}\sum_{j=0}^{n-1} C\,(i,u)C(i,v)\,e_{i,j}\ , \qquad (1)$$

Where,

$$C\,(i,u) = A(u)cos\left(\frac{(2i+1)u\,\pi}{2n}\right) and \quad A(u) = \begin{cases} \frac{1}{\sqrt{2}} & u = 0; \\ 1 & u = 0. \end{cases}$$

The use of DCT coefficients in vector classification simplifies the calculation of characteristics. Blocks that are isometrically modified relative to those for which these coefficients have already been calculated. A simplified model for determining the DCT coefficients for the case of eight affine transformations can be described using the following expressions (Deshlahra, 2013; Vasyura AS, 2006):

$$E_{e_{n-1-j,i}}[u,v] = (-1)^u\,E_{e_{j,i}}\,[u,v]\,;\ E_{e_{i,n-1-j}}[u,v] = (-1)^v\,E_{e_{j,i}}\,[u,v]\,;\ E_{e_{i,j}}\,[u,v] \qquad (2)$$

$$= E_{e_{j,i}}\,[v,u].$$

As a preliminary classification model, it is advisable to use the polar coordinate of the angle of position of the interpreted center of gravity of the set of intensities-masses of the pixels of the block. This model allows you to vary the total number of classes. Its positive quality is the independence of the block size: the classification of rank blocks of a certain level of detail can be used at lower levels, where they are domain(Deshlahra, 2013; Vasyura AS, 2006). Isometric transformations require simple calculations that involve adding a certain angle. However, the main disadvantage is the one-dimensionality of the angular characteristic of a two-dimensional object. The use of a double angular characteristic, where the second value corresponds to the position of the dispersion center, partially compensates for this shortcoming. Mathematical description of the classification model is represented by the expressions:

$$M = \sum_{i=1}^{N} \sum_{J=1}^{N} e_{i.j} \; ; \qquad (3)$$

$$X_1 = \frac{1}{M} \sum_{i=1}^{N} \sum_{J=1}^{N} i \, e_{i.j} - \frac{N}{2} \; ; \; Y_1 = \frac{1}{M} \sum_{i=1}^{N} \sum_{J=1}^{N} j \, e_{i.j} - \frac{N}{2} \; ; \qquad (4)$$

$$M = \sum_{i=1}^{N} \sum_{J=1}^{N} \left(e_{i.j} - \frac{M}{N^2} \right)^2 \qquad (5)$$

$$X_2 = \frac{1}{M'} \sum_{i=1}^{N} \sum_{J=1}^{N} i \left(e_{i.j} - \frac{M}{N^2} \right)^2 - \frac{N}{2} \; ; \; Y_2 = \frac{1}{M'} \sum_{i=1}^{N} \sum_{J=1}^{N} j \left(e_{i.j} - \frac{M}{N^2} \right)^2 - \frac{N}{2} \; ;$$

$$\theta_1 = arctg\left(\frac{Y_1}{X_1}\right) \; ; \; \theta_2 = arctg\left(\frac{Y_2}{X_2}\right) . \qquad (7)$$

Comparing with the variety of domain blocks used by the full search method, one can notice a feature related to the imperfection of the classification approach. For rank blocks whose center of mass approaches the geometric center, the number of possible (permissible under the classification method) corresponding domain blocks will be much smaller than.

The second stage of classification, represented by the vector method, is a modified Zapped method that uses a heuristic approach to the definition of hyperplanes. Its essence is to gradually determine the characteristics of the feature space to establish a one-to-one correspondence between possible combinations of them and the blocks that have these features. This is done by dividing the k - measurable space of artificial features (k - 1) dimensional hyperplanes. The heuristic approach is guided by the statement that the weighted center of a subset belongs to the hyperplane that

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separates it. This modification requires (6) less computational resources than the classical method of vector classification. It is also a significant simplification to determine the characteristics of the feature space only based on data on rank blocks. The classification algorithm can be described in detail as follows (Hmood, Jalab, Kasirun, Zaidan, & Zaidan, 2010; Holub & Fridrich, 2013; Valenzise, Tagliasacchi, Tubaro, Cancelli, & Barni, 2009; Zeki, Ibrahim, & Manaf, 2012).

Let $\{\mu_i \in \Re^k : i = 1 \dots N_R\}$ and $\{v_i \in \Re^k : i = 1 \dots N_D\}$ Vectors of rank and domain blocks, respectively.

In the first iterative step, the coordinates of the weighted center are calculated:

$$g = \frac{1}{N_R} \sum_{i=1}^{N_R} \mu_i \, .$$

For each value of i ∈ $1 \dots N_R$, the normalized vector is calculated $S_i = \frac{\mu_i - g}{\|\mu_i - g\|}$. A hyperplane that divides a set $\bigcup_{i=1}^{N_R} \mu_i$ by two subsets, will pass through the point g perpendicular to the vector $W = \sum_{i=1}^{N_R} S_i$.

All steps of the algorithm are repeated for each of the subsets formed during its operation if the number of elements in them is greater than one. There may be a situation when for some subset w = 0. Then as w, you can take any vector of dimension k.

For each rank block, it is necessary to store all the w and g that define the hyperplanes that divide the subsets to which the point with the coordinates of the feature vector of this block belongs. To simplify the general algorithm for matching, it is advisable to keep the relationship between values (w, g) and (w, μ_i) for each of the subsets. This additional data will reduce the number of necessary calculations.

Preliminary classification allows you to limit the number of comparisons between rank and domain blocks. Only those blocks that belong to the same class are compared. This process takes place using the vector classification of only rank blocks. The coordinates of the feature vectors of all domain blocks involved in the comparison are calculated to do this. Next, within one class of the previous classification, the relationship (a sign of difference) between (w, g) and (w, v_i) if it is the same as between (w, g) and (w, μ_i), then the transition to foot subset. The rank and domain block are considered identical according to the proposed two-level classification algorithm. The last subset of the comparison contains only one point with the coordinates of the rank vector of features and the transition condition for the domain.

5. disadvantage of vector classification

The disadvantage of vector classification is the excessive restriction of the feature area corresponding to the rank block so that it cannot contain all suitable domain blocks. The last division of the region, which contains the characteristic points of only two rank blocks, is random and not always optimal. On the other hand, it is challenging to synthesize an adequate criterion for stopping the division process due to the difficulty of establishing a correspondence between the distances in the space of features, *DCT* coefficients, and the real (pixel) distances between blocks. Therefore, the peculiarity of the last stage of classification is that a certain domain block can be used to replace only one (or several if they are identical) ranking among all ranking blocks of the image (Jain & Uludag, 2002; Khare, Kunari, & Khare, 2010; Memon, 2014).

Establishing a correspondence between rank and domain blocks using the classification approach involves further verification in accordance with the criterion that will guarantee the level of quality of the recovered image, which is determined by the value of e.

Matching between rank and domain blocks using the classification approach involves further verification according to the criterion that will guarantee the level of quality of the recoverable image, determined by the value of e—execution of inequality.

$$d(\mu_i, N_1(v_i) \leq e \qquad (8)$$

Execution of inequality is a confirmation of the correspondence between the i-M rank and j-M domain blocks provided by Nl.

((19))

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$$S_1 = \sum_m \sum_n \left(e_{m,n}^{G(v_j)} - \overline{v_j}\right)\left(e_{m,n}^{\mu_i} - \overline{\mu_i}\right) \Big/ \sum_m \sum_n \left(e_{m,n}^{G(v_j)} - \overline{v_j}\right)^2$$

$$O_I = \overline{\mu_i} - S\,\overline{v_j}\,.$$

The steganographic use of the described image compression algorithm depends on the number of matches found and their distribution (Vasyura AS, 2006). The classification approach limits the number of matches. Given the peculiarities of the described methods, it can be assumed that the fractal code of the image compressed by the algorithm, which uses these methods to speed up the process of finding matches, compared with the code obtained by the conventional algorithm, will behave the following characteristic differences: first, much fewer blocks of the restored image will have a center of mass of the pixel intensity of the block, which coincides with its geometric center; secondly, the repeating blocks will practically disappear in the restored image; thirdly, the size of the code itself will increase due to the fragmentation of rank blocks due to the impossibility of establishing compliance with the domain, due to the peculiarities of classification. The last point is related to the first two and encourages the further improvement of methods to speed up the search for matches. However, the described imperfection, which leads to an increase in the number of rank blocks, increases the bandwidth of the secret channel and can be interpreted as an advantage of steganographic use. Variation of the value of e within certain permissible limits also allows controlling the parameters of the stego system.

Improving the efficiency of the steganographic method involves optimizing (maximizing) its bandwidth under the constraints imposed by the transformations that eliminate the identified unmasking features. There are no approaches to identify all possible unmasking signs. Some patterns violated during the embedding of data are so difficult to study that their establishment and interpretation is a matter of the distant future. However, some optimization aspects are unlikely to address future limitations. This aspect can be considered the optimization of recognizing subsets of domain blocks, which is directly related to the efficiency of reading hidden data. Data embedding occurs by selecting one element from an ordered subset according to a

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fragment of secret data. When reading the embedded data, it is necessary to correctly determine this subset and the sequence number of the element in it. Keep in mind that image compression and the embedding process itself introduce distortions that interfere with recognition. Restricting distortion will improve recognition. Such restrictions are designed to maintain the image quality at a sufficiently high level, which ensures the preservation of many features of the original. Considering the distribution of domain blocks between subgroups as a certain stable feature, we can try to interpret it by means of certain transformations into a system of rules that allow to unambiguously resolve the question of belonging of a block to any subgroup. The sequence of such transformations will be combined into a classification algorithm. However, the stability of the features of the image fragments (domain blocks) cannot be absolute. Their characteristics change during compression and due to data embedding. Ensuring classification stability with variable characteristics of the elements requires consideration of the structure in determining the classes. The last remark converts the classification algorithm into a clustering algorithm.

Among the modern variety of clustering methods, it is necessary to choose one that meets the following requirements: allows you to select clusters from the data set without any additional information about their number, shape, volume; is effective from the point of view of some adequate observer or expert, which allows keeping the composition of the clusters practically unchanged under the condition of permissible deviations of the elements due to losses during compression; allows you to configure the internal parameters of clustering when used on different data sets, like satisfies the requirements of universality; the computational costs of the method must be acceptable.

An important point in improving the efficiency of recognition of subsets of blocks is choosing the method of setting characteristic features, which allows you to translate fragments of the image into points-characteristics in the feature space while maintaining all-important features inherent in real blocks. A requirement for specifying features is a much smaller (compared to the number of pixels in the block) dimension of the vector-characteristic. The process of converting blocks into the feature space should not require high computational costs(Al-Yousuf, Din, & Science, 2020; Qasim, Din, Alyousuf, & Informatics, 2020).

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Thus, increasing the efficiency of the stego algorithm proposed in (Vasyura AS, 2006) involves simultaneous improvement in two areas: the development of a method of embedding data taking into account all the features of the fractal algorithm and preventing the formation of unmasking features, and optimizing the process of recognizing subsets of blocks similarity criterion) of the original image only based on data on the restored image. Can see the advantages and disadvantages of data compression in table .1.

Table .1. advantages and disadvantages of data compression

Advantages	Disadvantages
Less disk space (more data in reality)	Added complication
Faster writing and reading	Effect of errors in transmission
Faster file transfer	Slower for sophisticated methods (but simple methods can be faster for writing to disk.)
Variable dynamic range	Unknown'' byte / pixel relationship
Byte order independent	Need to decompress all previous data

6. Conclusion

The current state of development of fractal image compression methods is analyzed. The main directions of improvement of compression algorithms are determined. The approaches that are one of the most effective in terms of classification efficiency and help to increase the speed of image processing are described. The idea of steganographic use of a fractal algorithm specified proposed in (Vasyura AS, 2006) prevents unmasking signs. To do this, the differences between the advanced compression algorithm and the classical one is evaluated. Ways to increase the efficiency of the stego algorithm are described, which consider the identified differences. Emphasis is also placed on optimizing the process of recognizing subsets of image blocks formed by the similarity criterion. All this gives grounds to consider the steganographic algorithm presented in (Vasyura AS, 2006), which allows modification taking into account certain features and the resulting improved algorithm - ready for practical use.

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ڕێگاکانی بەکارهاتوو بۆ زیادکردنی کاریگەریەتی بە کارهێنانی هێلکاری تیشکی خەوازرمیەتی پەستانی وێنەی شکاوە

پـوختـه:

پشکنی بارۆدۆخی ئێستای تەکنیکەکانی پاستانی وێنەی کەرتیەکان ، و باسکردنی لایەنە سەرەکیەکانی بۆ چاککردنی خەوازرمیەکانی وێنە . پێناسەی ئەو جۆرە شێوازانە ئەوەیە کە توانردارترین ڕێگان لە لایەنی تواناداری ولێهاتووی پۆلین کردن وە خێرایی چارەسەرکردنی وێنەٍ. روونکراوەتەوە کە چەمکی بەکارهێنانی خەوازرمیەتی کەرتەکان بۆ مەبەستی شاردنەوەیداتاکان.بۆ ئەنجام دانی ئەوە هەلسەنگاندنی جیاوازییەکان لە نێوان خەوارزمیەکانی پەستانی پێشکەوتوو وە خەوارزمیەکانی کلاسیکی ئەنجام دەدریت، ، ڕێگاکان دیاری دەکرێت بۆ چاکردنی لێهاتویەتی خەوارزمی (Stego) لەگەل رەچاووکردنی ئەو جیاوازیانەی کە هەن .پێویستی پیوەندی خێرا وە داتای وێنەی دیجیتال "زیندوو" لە ڕێگای ئنترنێت ، پێشخستنی تەکنیکی وێنەی دیجیتای سەپاند .لە

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رۆژگاری ئێستادا ژمارەیەك ستراتیجی هەن بۆ کەم کردنەوە ڕێژەی پەستان وە باش کردنی توانای بەکار هێنانی کۆمپیوتەری خێرا، بەلام لە بەرئەوەی ئێمە بەرستیمان هەیە بە کۆت و بەربەستی دیاری کراو. ژمارەیەك رێگای داهێنەرانە هەن بۆ چارەسەرکردنی ئەم کۆت و بەرەبستانە.ژینەگەی رۆژگارمان بە شێوەیەکی مەزن متمانە دەکاتە سەر ئەمبارکردن لە ئامراز و هۆکارەکانی دیجیتالی، کە بۆتە پیویستی دورست کردنی وێنەیەکی کاریگەر تر یان خەوارزمیەکانی پەستانی داتاکان. وێنەکان دەبێت بپەستێنرێت وە پاسوویردی ئەلکترۆتی هەبێت بەر لەوەی بەکار بهێنرێن لە قۆناغی گواستنەوەی بەهۆی سنورداریەتی فراوانی چەپکی لەرینەوە و هێزەکەی . ئەو توێژینەوە باسی جیاوازیەکان دەکات لە نێوان رێگاکانی پەستان ،گە زرەرەو زیانی (لەدەستدان)، هەبێت یان نەیبێت لە بەرئەوەی ئەوان جێبەجێ دەکرێن بۆ پرۆسەی چاسەری وێنە.

طرق لزيادة كفاءة استخدام التخطيط الشعاعي لخوارزميات ضغط الصورالكسورية (كتلة الصور)

الملخص:

فحص الحالة الحالية لتقنيات ضغط الصور الكسرية. وصف الابعاد الرئيسية لتحسين خوارزمية الضغط.. تعريف تلك الأساليب على أنها من أكثر الأساليب قدرة من حيث كفاءة التصنيف وسرعة معالجة الصور. تم وصف مفهوم استخدام الخوارزمية الكسرية لأغراض إخفاء المعلومات. للقيام بذلك، يتم تقييم الاختلافات بين خوارزمية الضغط المتطورة وخوارزمية الضغط التقليدية. يتم تحديد طرق لتحسين كفاءة خوارزمية stego، مع مراعاة الاختلافات الموجودة. ان الحاجة إلى الاتصال السريع ومعلومات الصور الرقمية "الحية" عبر الإنترنت فرض تطوير تقنية ضغط الصور الرقمية. وبمرور الوقت، وتوجد الآن العديد من الاستراتيجيات لتقليل نسبة الضغط وتحسين قابلية استخدام الحاسوب السريع، ولكن نظرًا لأننا مقيدون بقيود معينة، فهناك العديد من الطرق الإبداعية لحل تلك القيود. ان بيئة اليوم بشكل كبير تعتمد على تخزين في الوسائط الرقمية ، مما يستلزم إنشاء صور أكثر فعالية أو خوارزميات ضغط البيانات. يجب ضغط الصور وتشفيرها الكترونيا قبل استخدامها في مرحلة الإرسال بسبب محدودية اتساع النطاق الترددي والطاقة. تناقش هذه الورقة الاختلافات بين طرق الضغط بالخسائر وبدون خسائر لأنها تطبق على معالجة الصور.

الكلمات الرئيسية: معالجة الصور، الضغط غير المنقوص، ضغط الصور الرقمي، خوارزمية Stego.