Volume 2, No. 1, Jan-Feb 2011

ISSN No. 0976-5697

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Secure and Authenticated Visual Content Transmission with Codebase Cryptosystem

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Abstract: There must exist, requirement of such scheme through which transmission of visual content will become authentic, secure, speedy, compact and remains integrated between two communicators. That's why, in this paper, complete effort have been done, in the direction to fulfill the above said requirement.

Keywords: Cryptography; McEliece public-key cryptosystem; Steganography; SEQUITUR algorithm.

I. INTRODUCTION

The necessity of authentic and secure diagnosis is vital in the medical world to save the life of world creature. Nowadays, the transmission of images is a daily routine and it is necessary to find an efficient way to transmit them over the net [3,4,5]. For image transmission, two different approaches of technologies have been developed. The first approach is based on content protection through encryption [1], [2]. In this approach, proper decryption of data requires a key. The second approach bases the protection on digital watermarking or data hiding, aimed at secretly embedding a message into the data. In the current era, the transmission of Image over internet is so much challenging over the internet. In this manner, the better way to transmit the image over internet is encryption. Using the cryptography we secure the image as well as also better utilization of the communication channel with compression technique.

Cryptography is a tool of security that aims to provide security in the ciphers of any kind of messages. Cryptographic algorithms use encryption keys, which are the elements that turn a general encryption algorithm into a specific method of encryption. The data integrity aims to verify the validity of data contained in a given document. [2]

McEliece proposed the first public-key cryptosystem (the McEliece Scheme) based on algebraic coding theory in 1978[1]. The idea behind McEliece public-key cryptosystem is based on the fact that the decoding problem of an arbitrary linear code is an NP-hard problem [2].The McEliece scheme has the advantage of high speed encryption and decryption and this system employs probabilistic encryption [1,2], which is better than other type of deterministic encryption[9] in preventing the elimination of any information leaked through public-key cryptography.

It is point of remark [9] that the security comparison is made here for classical attackers. The picture changes drastically to the advantage of the McEliece system if we consider two systems to offer the same level of security if breaking them requires quantum computers with the same number of qubits. This cryptosystem cannot be used for authentication because the encryption is not one to one and total algorithm is truly asymmetric.

In this current article, we describe SEQUITUR, an algorithm that infers a hierarchical structure from a sequence of discrete symbols. The ability to deal easily with long sequences has greatly extended the range of SEQUITUR's application. By introducing McEliece cryptosystem and SEQUITUR algorithm, an image transmission with compression and encryption can be achieved. This arrangement distributes in different phases and each phase plays an important role in manner.

Phase 1 describe the generation of blocks, Phase 2, 3 shows DCT & quantization and Phase 4, 5 define the encryption and compression process, give the complete solution of transmission. After completion of all above phases, receiver applies the reverse process of all phase and generates an actual image.

II. PRELIMINERIES

A. *McEliece Public-Key Cryptosystem[1,2]*

It is assumed that McEliece public key(P_A) is duly certified and public. It can be described by its $k \times n$ generator matrix G. With the aid of a regular $k \times k$ matrix S and an $n \times n$ permutation matrix P, a new generator matrix G' is constructed that hides the structure of G:G' = S . G . P

The public key consists of G' and the matrices S and P together with g(x) are the private key(S_A).

B. *Compression*

A compression scheme can be employed what is known as lossless compression on secrete message to increase the amount of hiding secrete data, a scheme that allows the software to exactly reconstruct the original message [6].

The transmission of numerical images often needs an important number of bits. This number is again more consequent when it concerns medical images. If we want to transmit these visual content by network, reducing the content size is important. The goal of the compression is to decrease this initial weight. This reduction strongly depends of the used compression method, as well as of the intrinsic nature of the image. Therefore the problem is the following:

1. To compress without lossy, but with low factor compression. If you want to transmit only one visual content, it is satisfactory. But in the medical area these are often sequences that the doctor waits to emit a diagnostic.
2. To compress with losses with the risk to lose information. The question that puts then is what the vital information is to preserve and those that can be neglected without altering the quality of the diagnosis. The human visual system is one of the means of appreciation, although subjective and being able to vary from an individual to another. However, this system is still important to judge the possible causes of degradation and the quality of the compression [7].

C. *SEQUITUR Algorithm*

The SEQUITUR [8] algorithm represents a finite sequence as a context free grammar whose language is the singleton set {σ}. It reads symbols one-by-one from the input sequence and restructures the rules of the grammar to maintain the following invariants:

(A) no pair of adjacent symbols appear more than once in the grammar, and

(B) every rule (except the rule defining the start symbol) is used more than once.

To intuitively understand the algorithm, we briefly describe how it works on a sequence 123123. As usual, we use capital letters to denote non-terminal symbols. After reading the first four symbols of the sequence 123123, the grammar consists of the single production rule S ➔ 1, 2, 3, 1 where S is the start symbol. On reading the fifth symbol, it becomes S ➔ 1, 2, 3, 1, 2 Since the adjacent symbols 1, 2 appear twice in this rule (violating the first invariant), SEQUITUR introduces a non-terminal A to get

S ➔ A, 3,A A ➔1, 2

Note that here the rule defining non-terminal A is used twice. Finally, on reading the last symbol of the sequence 123123 the above grammar becomes

S ➔ A, 3, A, 3 A ➔ 1, 2

This grammar needs to be restructured since the symbols A, 3 appear twice. SEQUITUR introduces another non-terminal to solve the problem. We get the rules

S ➔ B,B B ➔ A 3 A➔ 1 2

However, now the rule defining non-terminal A is used only once. So, this rule is eliminated to produce the final result.

S ➔ B, B B ➔ 1, 2, 3

Note that the above grammar accepts only the sequence 123123.

III. PROPOSED SCHEME

In our proposed scheme, we use sequitur as a compression technique and McEliece as a encryption technique, this cryptosystem cannot be used for authentication because the encryption is not one to one and total algorithm is truly asymmetric. Sequitur is a single-pass hierarchical algorithm that builds a context-free grammar for a string. The resulting grammar compactly represents the original structure and has the interesting property that the compressed format itself contains useful information about the string. The McEliece scheme has the advantage of high speed encryption and decryption and this system employs probabilistic encryption. Here we concatenate Id_A with r give us authenticity of sender without digital signature.

Input an medical image and follows these phases:

Phase 1: Generating $n \times n$ blocks:

In RGB space the image is split up into red, blue and green images. The image is then divided into 8×8 blocks of pixels and accordingly the image of $w \times h$ pixels will contain $W \times H$ blocks. Where, $W = w/8$, $H = h/8$.

Phase 2: DCT:

All values are level shifted by subtracting 128 from each value. The Forward Discrete Cosine Transform of the block is then computed. The mathematical formula for calculating the DCT is:

$$T(u,v) = \sum_{x=0}^{n} \sum_{y=0}^{n} f(x,y), g(x,y,u,v)$$

Where

$$, g(x,y,u,v) = \frac{1}{4}\alpha(u)\alpha(v)\cos\left[\frac{(2x+1)u\pi}{2n}\right]\cos\left[\frac{(2y+1)v\pi}{2n}\right]$$

Where $\alpha(u) = \begin{cases} \frac{1}{\sqrt{2}} \ldots\ldots for, u = 0 \\ 1 \ldots\ldots for, u = 1,2,\ldots\ldots N-1. \end{cases}$

Phase 3: Quantization:

Quantization is the step where the most of the compression takes place. DCT really does not compress the image, as it is almost lossless. Quantization makes use of the fact that, the high frequency components are less important than the low frequency components. The Quantization output is

$$Q_{DCT} = round\left(\frac{T(u,v)}{Z(u,v)}\right.$$

The $Z(u,v)$ matrix could be anything, but the JPEG committee suggests some matrices which work well with image compression.

Phase 4: Compression using SEQUITUR

After quantization, the scheme uses a filter to pass only the string of non-zero coefficients. By the end of this process we will have a list of non-zero tokens for each block preceded by their count.

DCT based image compression using blocks of size 8x8 is considered. After this, the quantization of DCT coefficients of image blocks is carried out. The SEQUITER compression is then applied to the quantized DCT coefficients.

Phase 5: Encryption/Decryption using **McEliece Cryptosystem**

This cryptosystem [1,12] cannot be used for authentication because the encryption is not one to one and total algorithm is truly asymmetric so we process as shown below to add authenticity without digital signature.

1.Sender send message m in the form of bitstring to which she wishes to send information.

2. Sender generates a secret pseudo q-bit random vector r.

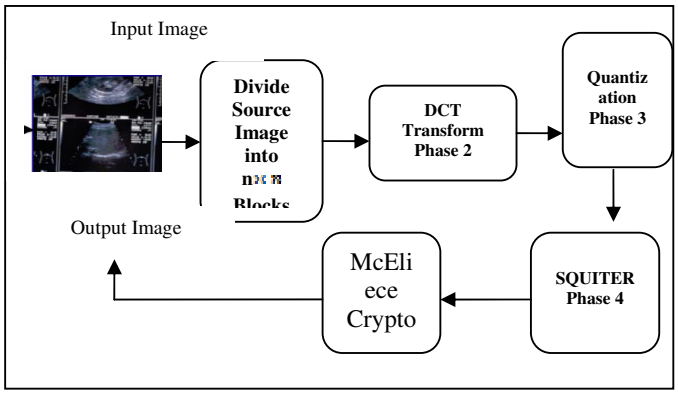
3. Sender has a identifier Id_A of p-bit random vector.

4. Sender concatenate her identifier Id_A with secret pseudo q-bit random vector r which give us a vector R= $Id_A \square r$.

Here $h(m) = mP_A$ where $h(m) \subseteq GF(2^n)$,

Encryption: $C = mP_A \oplus e$, where $e = g(R)$, here g is an invertible function which maps R in to an n-bit error vector of weight α .

Then after acceptance ,reciever decrypt the massage as first m can be recovered by using the decryption algorithm in the original scheme. In the meantime, the value $g(R)$ can also be obtained. Then the receiver computes $R = g^{-1}(g(R))$, where g^{-1} is the inverse of g .Ffinally Bob calculates $f(c')(SGP)^{-1}$ and get the message. Here Bob get the Id_A from the R to know the authenticity of the sender.



IV. CONCLUSION

Here, we explained an intelligent and authenticated transmission scheme without digital signature on an algebraic coding theory based public key cryptosystem which relay on the difficulty of decoding and proposed by McEliece in 1978. The main feature of this approach is randomness of the error vector concatenate with identifier, here identifier provide the authenticity with randomness.

The efficiency and security of McEliece cryptosystem comparatively better than the RSA cryptosystem also [9,10]. Here we use sequitur as a compression technique and Sequitur has the ability to read a stream in reverse also. So our approach is more appropriate, secure and futuristic than previous literature of medical data transmission over un-secure channel. In the new scenario the Health Insurance Portability and Accountability Act (HIPAA) [11] requires that medical providers and insurance companies implement procedures and policies to protect patient's medical information.

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