Watermark Algorihm for JPEG2000

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Abstract - **A lot of research work had been carried out recently in the field of copyright protection of multimedia documentation-images, videos, and audio files and etc. In this article a specific method for preventing images' copying is presented. In previous work we discussed for embedding and delectation of watermark had been done using wavelets algorithm using JPEG. Now we proposed method for watermark still images based on the JPEG2000 compression standard.**

***Keywords*: watermark, wavelets, compression, JPEG2000.**

I. INTRODUCTION

In recent years a lot had been done in the field of technologies for compression of static and dynamic images and multimedia files transmission over Internet and warless sets. The well-known standards JPEG and MPEG had undergone many changes. Two years letter ago the JPEG2000 was introduced. Modern hardware solutions, such as digital video cameras, digital photo cameras, multimedia players etc. implement to a certain degree the new standards due to the usage of smaller files' size or memory reduction possibilities. Copyrights protection in a global plan becomes more and more important due to the increased dissemination of multimedia files in the world wide web.

Until recently research activities in the field of multimedia data protection were quite a few. Nowadays they have increased a lot..New qualitative solutions are investigated, new algorithms for watermarking second and third generation are developed. In this article a method for water marking of still images is presented on the basis of an improved algorithm using JPEG and JPEG2000 standards of compression.

II. DECOMPOSITION

The submit algorithm itself is a combination of the well known algorithms of blind Dugad [7][1][14] and non blind algorithm Xie [6][1], but now we adapt to new standard and add new features. After research and a lot of experiments we chose this combination, implementing a new modification, calculating results of non-overlapping blocks when watermark is represented as a binary sequence.

The watermark length is two bytes when is binary. The length the pseudo random watermark (when generated in a copyright mode) is variable and depends on the threshold array [Tj] and images' dimensions of selected polygons. It depends upon the wavelet decomposition levels as well as upon the various sub-bands.

Initially selected coefficients are normalized by vector factor *a*. This vector is experimentally chosen and set in the range of 0.1-1(Default 0,33). As a result of using a combination of blind and non-blind methods we've got the possibility of improving results in water mark extraction and increase the stability of the algorithm against deformation, compression, cropping etc. attacks..

III. WATERMARK EMBEDDING

The modified algorithm of Dugad [***] and Xie [***] is used aiming at the least visible changes in images.

Watermarking is embedded in the JPEG2000 algorithm. Initially a 7/9 bi-orthogonal filter is used with 5 levels of decomposition. Data are fed in LH2, HL2, HH2 sub ranges at second and third decomposition wavelet level. The overall level is divided apriori into non-overlapped blocks of 32X32 elements. A combination of three cells is used (as in the Xie algorithm Fig[1]).

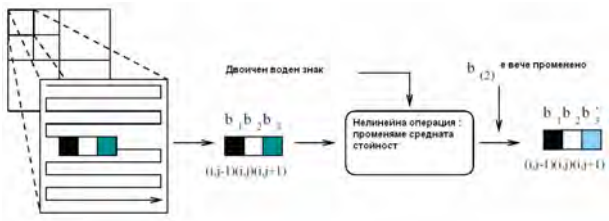

Fig. 1 Method Watermark by Xie

Where:

B1,b2,b3 was pixel 1,2,3 and second b was sorted and mark mean with formula Δ Eq(1);

$$\Delta = \frac{\alpha.(\max|bj| - \min|bi|)}{2} \qquad (1)$$

α Is scaling factor

Δ-Mean of the bj ,bi of array 3x3

The watermark is a Gauss function, generated by three Pseudo random generators. The watermark has got a variable length and it depends upon the number of selected points, having threshold values, set into an array. The values depend upon the specific image and may vary from 15 to 60. It depends of levels sub-bands. We use a technique for selection and marking, similar to the Dugad method [7], selecting groups of cells in 3 (in the frame of the Xie[6] algorithm) Fig. 2

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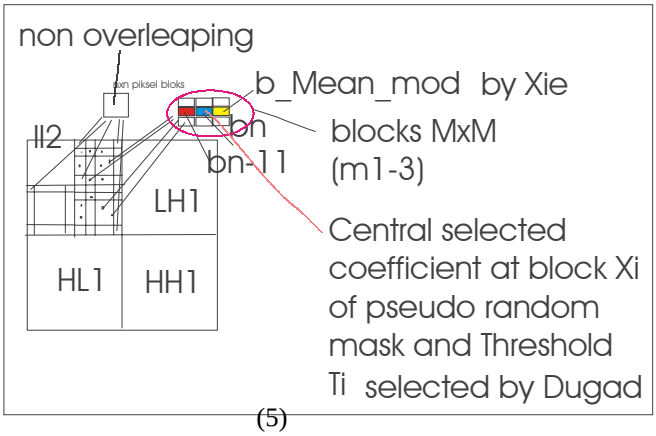

(5)

Fig.2 Blocks and coefficients located in the Wavelet levels by the modified methods

The embedding formula is shown in Eq(2), whilst the schemes of embedding are shown in Fig. 2

$$f^{'}(m,n) = f(m,n) + \alpha.\Delta(m,n).wi \tag{2}$$

Where m,n is selected coefficient by the thresholds array Ti and m,n < x,y(where x,y size of images(blocks) Defaults level is 8x8 for binary . Every blocks in this case embedded one bits of watermark sequences wi* . When images uses for copyright protection blocs was 256x256 min up to blocks K(i) where K(i) is number of array of Thresholds(i)/3

We don't need the original images in order to extract the watermark. This modified algorithm is a "blind" algorithm. After the reverse IDWT wavelet JPEG2000 transformation and extracting the colors and luminance components of the image the watermark is being extracted. First we determine non-overlapping blocks sized 16x16 (when watermark has been binary), and then we select coefficients by mask of Pseudo random sequences [-1,1] and component threshold array Tj.

$$T_i = \frac{\alpha}{S.N}\sum_{i}^{N}\left|f^{i}\right| \tag{3}$$

Where S is Standard deviation

The routine for checking the availability of watermark starts with the evaluation on the correlation between the embedded watermark wi* and the extracted one wi with formula Eq (4), setting the group coefficients 3X3

$$wi^{*} = \frac{f^{*}(m,n) - f(m,n)}{\alpha.f(m,n)} \tag{4}$$

Where m,n is the number of current selected (masking) point

The results from the separate blocks are compared to a standard correlation function – Eq [5]

$$\delta = \frac{w_i^{*} \bullet w_i}{\left\|w_i^{*}\right\| \bullet \left\|w_i\right\|} \tag{5}$$

The number of cells for watermarking may be additionally set to 1, 2x2 3x3. Extraction is shown in Fig. (4). It is similar a lot of know additive algorithms for watermarks images

As a complementary protection we foresee a change of the coefficients of the wavelet filter for image decomposition. Coefficients equal to 6, 5 and 4 are used for the one to tree levels. All experiments had been carried out at second and third levels of decomposition wavelets. Software developments are JAVA2 based, using JJ2000 [15][14]

In [1] was given others schemes for watermarking schematic connections that produced others selected coefficients by irregulars mechanism watermark

IV. Results.

Results are based on an overall number of 1000 tests. Due to the improved Dugad-Xie algorithm we get an improved exposure of watermarking in 80 % of all case studies in the event of attacks, done by StirMark[1] layout compared to other algorithms[1]. For other types of attacks, such as (still not for all Crop & Rotation) the algorithm yields very good results (very robust) on the condition that parameters of image deformation are known beforehand. Described above algorithm has been used to create a program, that embedded and detect watermark in still colors images. It s was release by Java2 and JJ2000[] coder and encoder()

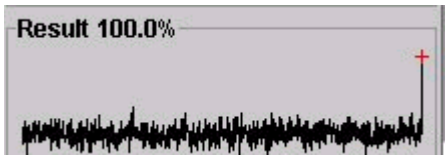

Fig. 7 Result FMLR –attack StirMark new method

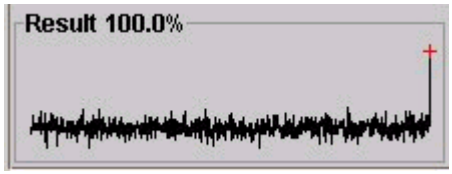

Fig. 8 Result Gaus –attack StirMark new method

Fig. 9 Result Median 4x4 –attack StirMark new method

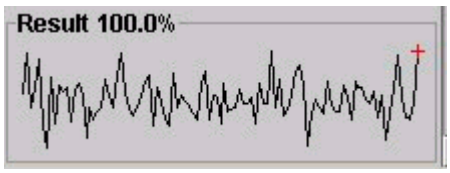

Fig. 10 Result Shearing 5x5 –attack StirMark new method

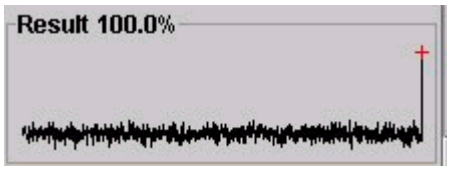

Fig. 11 Result Remuve 17 columns and 5 rows –attack

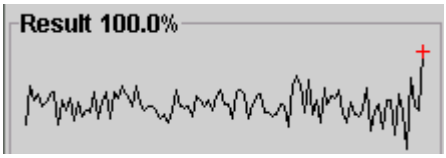

Fig. 12 Result Median 3x3–attack StirMark old method

Fig.13 Original 14 Fig. Marked jp2

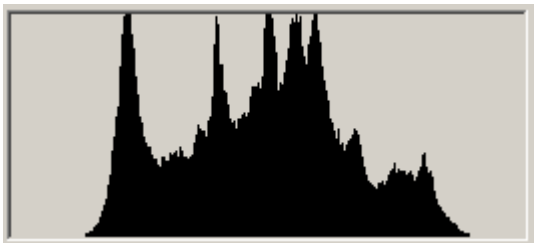

Fig. 15 Marked image Lena.jp2 Histogram fig.

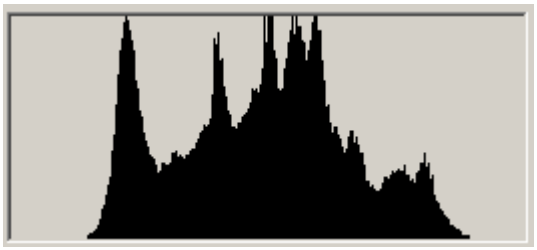

Fig. 16 Histogram Original Histogram fig.

Different images can be obtained after casual modulation of other parameters. On fig. 3 you can see the same diferenses original and marked images..

The multiple embedding of water signs in result in more stability and robustnes against geometric distortion of the selected image, cropping and compression ratio high diapason

V. Conclusion

The next step for the improvement of the algorithm should be the implementation of an algorithm for automatic recognition of applied image's attack (e.g. using feature point or some other well known algorithms for embedding reconstruction functions)[9,10,11,1,2,3,5], whose deformation can reconstruct the image after attacks) or a manual adaptive definition of the level of deformation by the software and then searching for the watermark.

The second option is too complicated and needs a lot of time and resources in processing bigger data arrays (as specified in images' database), which in its turn is not applicable for Internet applications for automatic registration and images watermarking

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