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A study of Content Based Watermarked Image Retrieval in Clouds with Privacy Protection

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Abstract

Content Based image retrieval is one of the major substantial research area for retrieving visual information on the cloud. Image retrieval may undergo irregularity between the specified and retrieved content. Using Content-Based image retrieval system, it is possible to retrieve only the relevant images. The image owners outsource their images to cloud, but before outsourcing, there may be a chance of image leakages and they may be faked. So the retrieved faked images from cloud may be dangerous in case of sensitive fields. So here in CBIR systems, watermarking technique is combined with encryption. In this paper a Content Based Image retrieval systems are used for querying a very large watermarked image databases .This makes the image leakages as well as retrieving faked images to get reduced and provide privacy for preserving them.Thispaper demonstrates the Secure and Robust Digital Image Watermarking using Coefficient Differencing(DCT) and Chaotic Encryption.

Keywords: CBIR, watermarking, DCT, chaotic encryption

1. INTRODUCTION

Due to recent development in technology, there is an increase in the usage of digital cameras, smartphone, and Internet. The shared and stored multimedia data are growing, and to search or to retrieve a relevant image from an archive is a challenging research problem [1–3].The fundamental need of any image retrieval model is to search and arrange the images that are in a visual semantic relationship with the query given by the user. Most of the search engines on the Internet retrieve the images on the basis of text-based approaches that require captions as input [4–6].The user submits a query by entering some text or keywords that are matched with the keywords that are placed in the archive. The output is generated on the basis of matching in keywords, and this process can retrieve the images that are not relevant. Content-based image retrieval (CBIR) is a framework that can overcome the abovementioned problems as it is based on the visual analysis of contents that are part of the query image. By outsourcing CBIR services to the cloud server, the data owner is relieved from maintaining local image database and interacting with database users online. Despite the tremendous benefits, image privacy becomes the main concern with CBIR outsourcing. This paperconsiders watermarking based content image retrieval.The watermarked image extracted from the recognized image ismatched with the test image watermark for authentication.However, the data when outsourced to the cloud might be corrupted or lost due to the inevitable software bugs, hardware faults and human errors in the cloud [1]. It is aimed to develop a system, that should enable to sense about that faked images. We hope that Content-based image retrieval (CBIR) and watermarking based image security is the appropriate solution.

A. *Content Based Image Retrieval*

The central issue in CBIR is to identify a set of salient image features for indexing and similarity evaluation. Color, shape, texture and spatial relationships among segmented objects are typical features employed for image indexing. Some researches combine two or more of these features to improve retrieval performance. The main goal in CBIR system is searching and finding similar images based on their content. To accomplish this, the content should first be described in an efficient way, e.g. the so-called indexing or feature extraction and binary signatures are formed and stored as the data. When the query image is given to the system, the system will extract image features for this query. It will compare these features with that of other images in a database. Relevant results will be displayed to the user. Fast and accurate retrievals among the data collections can be done according to the content description of the query image. There are many factors to consider in the design of a CBIR systems based on the domains and purposes, choice of right features, similarity measurement criteria, indexing mechanism, and query formulation technique. The most important factors in the design process is the choice of suitable visual features and the methodologies to extract them from raw images, as it affects all other subsequent processes. By the nature of its task, the CBIR technology boils down to two intrinsic problems: (a) how to mathematically describe an image which can also be called as feature extraction.(b) how to assess the similarity between a pair of images based on their abstracted descriptions. Which can also be called as matching. [2] In typical content-based image retrieval system the visual contents of the images in the database are extracted anddescribed by multi-dimensional feature vectors. The feature vectors of the images in the database form a feature database. To retrieve images, users provide the retrieval system with example images or sketched figures. The feature vector of this query image is extracted. Then the extracted feature vector of query image is compared with the feature vector in the database. As a result of the query, similar images are retrieved according to their similarities between the feature vectors of the query example or sketch and those of the images in the database. In this paper I have proposed a content-based imageretrieval method based on an efficient combination of color, texture and neural network based ICM (Intersecting Cortical Model) features. Both color and texture features of images are extracted and stored as feature vectors in a database. Then from those features imagesignatures are derived which basically provide the no. ofwhite pixels in those 25 images and saved in the database forretrieval purposes. During the retrieval process, the color,texture and ICM feature vector of the query image iscomputed and matched against those features in the database. For image matching there are various methods such as Euclidean distance method, Canberra distance, Man Hattan distance andcity block distance method are available for color and texture features andk-means method for comparing the ICM features. Here, in this papercity block distance have been used for dis tance matching, which gives better result for CBIR.

B. Digital Watermarking

It is important to outsource data to the cloud since the information technology is improved. The security level ofdata should be enhanced when the development also increases. There are several privacy issues against which the sensitive data is to be protected and there are several techniques proposed for securing the data. Here I have chosen digital watermarking technique. For securing the original data from illegal manipulation and distribution, a label, tag or information container is added within the multimedia data through watermarking technique. Visible or Invisible Watermarking is the two different types of watermarking approaches. Depending upon the type of application in which watermarking system is applied, the properties of watermarking are developed. The effective detection of watermark is very important. It is not possible to fulfill the goal of watermarking when the watermark is detected. The watermarking approach considers the host signal quality property as an important one. The host signal is known to be affected by the watermark is embedded within watermarking. Thus, least numbers of changes must be done on the host signal. Also, when the watermark is not visible in the watermarking system, the host signal must beimperceptible. Watermark Size helps in performing owneridentification. The host signal is provided with security. It isvery important to use this watermark while transmitting thedata. Within allwatermarking systems, robustness plays a very importantrole. The watermark is degraded at the time of transmission. The transmitted data may be corrupted. Thus, to ensure the system toleration, the robustness of watermark is necessary. The user's data isensured to be safe by authenticating it.

Contribution:

The contribution of this paper can be summarized as follows:

(i)Before outsourcing the image, watermark will be embedded with the original image using DCT based digital watermark algorithm and watermark will be encrypted using Chaotic encryption.

(ii) After embedding, IDCT is applied and a robustic watermarked image will be generated. Then the Watermarked image will be outsourced to the cloud.

(iii) Based on query image, color and texture features retrieves better sets of similar images. The images retrieved will have similarity measure values between 0.0 and 1.0.

2. LITERATURE REVIEW

AbdulazizShehab, et.al (2018) proposed a novelapproach for medical applications to provide image authentication and self-recovery. The image tampering islocalized and the original image is recovered by proposing this new fragile watermarking based approach [3]. Further, the transformation of original image is identified by applying SVD with the help of inserting the traces of block wise SVDinto the LSB of image pixels. For surviving the vector quantization attack, block authentication and self-recoverybits are the two authentication bits that are applied. The Arnold transformation is applied for recovering the original image even when the tampering rate is higher for determining the insertion of self-recovery bits. There are several attacks in the presence of which the proposed mechanism is tested. It is seen through the experimental results achieved that the tamper location accuracy and PSNR of self-recovered image are enhanced to a higher level as compared to the existing approaches.

Zigang Chen, et.al (2018) proposed a new technique suchthat the image content can be protected and authenticated by applying General-NMF (General non-negative matrixfactorization) based digital watermarking technique [4]. For the factorization of a matrix into two factor matrices, a general-NMF technique is proposed initially. There is no need to meet the dimension matching constraints in this proposed mechanism. Further, on the basis of proposed General-NMF, a digital watermarking mechanism is proposed here. Here, the keys applied for digital watermarking include the generator factor of random matrix and n. Several attacks and tampering are resisted effectively

by the proposed approach as per the simulation results achieved. It is also possible to apply the proposed mechanism as digital watermarking approach dependingupon the feature matrix an transform domain since certain parts of faces and semantic features of text can be learnt by

NMF.Shuai Liu, et.al (2017) proposed a fractal encodingmethod and DCT based digital watermarking algorithm in this paper. For making enhancement in the existing DCT method, the fractal encoding and DCT methods are integrated by the proposed method such that the encryptions can be doubled [5]. In the form of first encryption, the fractal encoding is used to encode the image. Further, toperform second encryption, the encoded parameters are used within the DCT method. For encoding one private image with private scales, the fractal encoding method is applied initially. In the form of digital watermarking, the encodingparameters are applied. Further, DCT is used to reversibly add digital watermarking within the original image. Thus, along with the private encoding scales, it is possible for the author to extract private image from the carrier image. It is seen that in comparison to the traditional approaches, theperformance of proposed method in terms of robustness and PSNR is better as per the simulation results achieved.

B.Jyothi et al. (2016) [6] focused on texture components that are integrated with user feedback to improve the retrieval accuracy of the BIR system. Some complex techniques such as intensity, gradient and edge mapping techniques were used to achieve their goal. If the user is dissatisfied with the images retrieved, the system provides an interface where the user can select the most relevant image for searching again. The system analyses the relevance feedback from the user and returns better results.

RoshiChoudhary et al. (2014) [7] have described an integrated CBIR method to extract both texture and color features. A technique called color moment (CM) extracts the color features from colored images and local binary pattern (LBP) extracts the texture features from grayscale images. A feature vector is then formed by combining the color and texture features of the image. The Euclidean distance between the feature vectors of the database images and query image are computed and images in the database corresponding to the query that fall below the Euclidean Distance threshold value are returned.

Yu-Chen Wang et al. (2015) [8] They have proposed a method called biased discriminant analysis which is a subspace learning algorithm, with feature line embedding for enhancing performance in relevance feedback schemes by identifying the correlation between feature lines and samples. Relevance feedback is used for dimensionality reduction and feature line embedding is utilized to reduce the gap between abstract high-level semantic features and low-level features.

Zhi-Chun Huang et al. (2010) [9] have attempted to simplify the complexity involved in computation and improve the retrieval accuracy of relevant images by combining colour and texture features and allowing the user to specify the weights that must be assigned to these features while measuring the similarity between images. They have used HSV (Hue,Saturation,Value) colour space for colour features. Gabor texture descriptors were used for the texture feature.

3. PROPOSED WORK

A. Digital image Watermarking using DCT and Chaos Encryption

Amongthe various transform domain techniques, DCT is considered as an efficient digital watermarking algorithm due to its low cost of hardware design.DCT of a digital image is considered in three ways. It is computed either on the whole image or is computedon the blocks of the image or only the DC coefficient ofblocks of image are computed [10][15]. In all the ways embedding will be done by altering the DCT coefficients. For copyright protection, a watermark must resist on images, and is secure from image processing attacks. To achieve this embedding is done in low frequency coefficients. If the embedding is done on low frequency coefficients, then modification of these coefficients will mak a low quality watermarked image. So for authentication purpose, embed the watermark in high-frequency coefficients.

To achieve robustness embed the watermark in midfrequency coefficients [15]. Another major concern is security of watermark in digital image watermarking techniques. For that a cryptographic method called Chaotic Based encryption is preferred here which holds privacy preservation [11].Chaos based encryption algorithms, on the other hand, show highly efficientresults due to their excellent characteristics viz. initial condition sensitiveness, periodicity, pseudorandom behavior, andergodic nature. Due to these properties, the adoption ofchaotic methods has been considered widely in recent years.

B. Chaos Encryption

A chaotic based encryption algorithm is an effective methodfor data encryption. Chaos signals possess the qualities ofpseudo-randomness, irreversibility and dynamic behavior.The systems having chaotic nature possess high sensitivity toinitial parameters. The output chaotic sequence is similar towhite noise having random behavior with improved correlation and complexity and is defined as reported in [12]and given by:

$$C_{n+1} = \mu \times Cn \times (1 - Cn) \quad (1)$$

where 0< μ <4 typically μ can be set to value 3.9 in orderto achieve highest randomness and 0 <Cn<1 is the nthvalue generated from Eqn. 1. Different values of Cn could beobtained by varying the value of n from 0 to L-1. Here, L isthe maximum number of chaotic values. By setting the initialvalues of μ and C0, we can get the required chaotic signal.As it offers the joint advantage of speed and security,the use of chaotic encryption has been shown to offerincreased security [16]. The security of information can beincreased by using various encryption Thisencryption method, is two dimensional and works well inapplications for encrypting images of type N×N. The Arnoldtransformation is mathematically represented as

$$\begin{matrix} x^n \\ y^n \end{matrix} = \begin{vmatrix} 1 & 1 \\ 1 & 2 \end{vmatrix} \begin{matrix} x \\ y \end{matrix} (mod\ N) \quad (2)$$

C. System model

As shown in Figure 1, the input image 'I' is passed through the pre-processing unit which acts as a buffer for grayscale images and as a converter for color images.To carry out watermark embedding into the luminance part of the image the pre-processing unit converts the input RGB image into YCbCr image,where

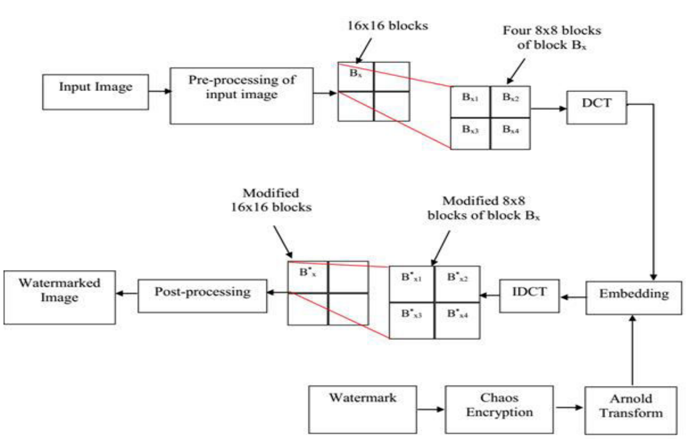

Fig:1 Digital watermark embedding using Coefficient differencing and chaotic encryption

Y stands for luminance information,Cb stands for chrominance blue information and Cr stand for chrominance redinformation of the image. The luminancepart 'Y' is put forward as cover for the watermark becausemodification of this part of the image brings less noticeable changes to actual image compared to the chrominanceinformation. On the other hand, if one wants to embed threewatermarks into an RGB image, one in each plane, thenthe pre-processing unit extracts the RGB planes and thenarranges all the three planes in a two-dimensional matrix sothat each plane could be treated by the system as a P × Qgrayscale plane, where P and Q respectively denote rowsand columns of cover image. The resulting matrix values are brought in a range of -128 to 127 by subtracting 128 fromthe matrix.

After pre-processing the resultant matrix is divided into16 × 16 blocks. For an input image of dimensions P × Q, thenumber of blocks will be P16 × 16 Q . Let an arbitrary block berepresented by Bx. The block Bx is further divided into 8 × 8blocks. The four 8 × 8 blocks of block Bx are representedby Bx1, Bx2, Bx3*;* and Bx4 as shown in Figure 1. Therefore,the total number of 8×8 blocks will be equal to 4×(16 P × 16 Q).The total number of bits that could be inserted into a hostimage is equal to the total number of 8 × 8 blocks. Theproposed technique utilizes the advantages of the

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DCT coefficient correlation of adjacent blocks.Therefore, DCT of eachblock (8 × 8) is calculated. To embed a watermark bit, the difference betweentwo preselected DCT coefficients of two neighboring blocksis calculated and is given as,

$$D= C_{xy}(i,j)- C_{xy+1}(k,l) \quad (3)$$

where (i, j) ≠ (k, l), gives the position of the selected coefficient within a sub-block and 1≤i,j,k,l≤8. x =1,2,3,4, ..., P/16×Q/16; whose value represents to which 16 × 16 pixelblock the coefficient belongs while as y = 1,2,3,4 (whosevalue represents the 8×8 DCT block to which thecoefficientbelongs). For the current work i, j, k and l are respectivelytaken as 3, 3, 3 and 2.For embedding the first watermark bit the difference between coefficientchosen from Block Cx1 and a coefficient chosen from blockCx2 is calculated. Similarly, to embed the second watermarkbit, the coefficients from the block Cx2 and the block Cx3 arechosen for the difference, for embedding third bit in blockBx the coefficients from block Cx3 and block Cx4 are chosenand for embedding fourth bit the blocks Cx4 and Cx1 aretaken for difference purpose. The difference 'D' is modulatedaccording to the information bit to be embedded and the'D' itself. The IDCT for every enhanced DCT block iscalculated once the embedding process is completed.Further, post-processing operations are performed afterIDCT. A final watermarked image is generated when thepost-processing operations are completed. This watermarked image is outsourced to the cloud.

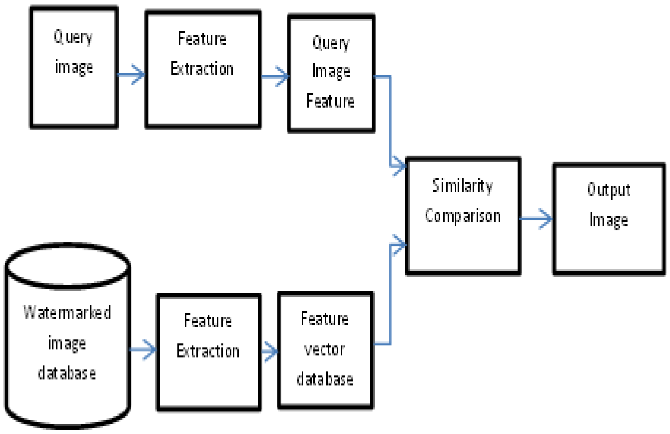
D. Image retrieval using various features

Most of the early studies on CBIR have used only asingle feature among various available features. However, itis hard to attain satisfactory retrieval results by using a singlefeature because, in general, an image contains various visualcharacteristics. Recently, active researches in image retrievalusing a combination of color and texture features have beenperformed [1]. For an advanced CBIR, it is necessaryto choose efficient features that are complementary to eachother so as to yield an improved retrieval performance and tocombine chosen features effectively withoutincrease offeature vector dimension. When an RGB query imageenters the retrieval system, it is first transformed into HSVcolor image. Then color feature is extracted and formed thecolor feature vector. Similarly the texture feature is extractedand formed the texture feature vector. After the color andtexture feature vectors are extracted, the retrieval systemcombines these feature vectors, calculates the similaritybetween the combined feature vector of the query image and that of each target image in watermarked image database, and retrievesa given number of the most similar target images.

Color Features

Several methods for retrieving images on the basis ofcolor similarity have been described in the literature [13], butmost are variations on the same basic idea. Each imageadded to the collection is analysed to compute a colourhistogram which shows the proportion of pixels of eachcolour within the image .The colour histogram for each image is then stored in

Fig:2 system architecture



thedesired proportion of each colour (75% olive green and 25%red, for example), or submit an example image from which acolour histogram is calculated. Either way, the matchingprocess then retrieves those images whose colour histogramsmatch those of the query most closely. In this paper we haveused HSV method for extracting the color feature and matched theresult by using Newdist distance method.

Texture feature

In CBIR, texture features play a very important role incomputer vision and pattern recognition, especially indescribing the content of images. Texture features typicallyconsist of contrast, uniformity, coarseness, and density.Importance of the texture feature is due to its presence inmany real world images: for example, clouds, trees, bricks,hair, fabric etc., all of which have textural characteristics.Earlier methods[16],[17] for texture image retrieval sufferfrom two main drawbacks. They are either computationallyexpensive or retrieval accuracy is poor. Here we concentrateon the problem of finding good texture features for CBIR,which are efficient both in terms of accuracy andcomputational complexity. There are two main approachesfor texture representations, statistical method and structuralmethod. Structuralmethods include morphological operators and adjacencygraphs, describe texture through the identification ofstructural primitives and their arrangement in the image, forexample, the presence of objects that areadjacent,perpendicular or parallel to one another. On the other hand,statistical methods identify texture through quantitativedistributions of image intensity and include techniques suchas Gabor, wavelet transforms, co-occurrence matrices,Fourier power spectra, Tamura feature etc. In this paper we have used Gabor technique foe identifying the texture.

ICM Feature

ICM is a biologically inspired algorithm which takes asinput an image and produces pulse images or binary imagesas output. The purpose or application of ICM is that eachpulse image contains some important feature of an imagelike edges, shape, color and many more information that canbe plotted and that plot can be used for image retrieval [ref1].The three equations of ICM are:

F [n]= f F[n-1]+S+W(Y[n-1])

Y [n] = 1, if F[n]>Θ[n-1]

0, otherwise

Θ [n]=gΘ[n-1]+hY[n] (4)

Where S is the input, F is the state of neuron, Y is theoutput, Θ is the threshold, *f*, *g* and *h* are constants, n is thenumber of iterations and W(.) is the interneuroncommunication function. If the ICM iterates *N* times andoutputs *N* pulse images *Y*, the signature will be a vector *G*with *N* elements. Each element is the number of white pixelsin the corresponding pulse image:

G[n]= Σ Y[n], n=1,2,3……..,N (5)

Since the pulse images from the ICM contain differentinformation from the image, such as form, edges and colors,the idea is that the information will be conserved in thesignature.

Distance Metrics

Distance between two images has to be calculated to findif there is any match or not. Distance will help us in findingdegree of matching for the entire data base. There aredifferent distances available and here City Block distancemethod[19] is used.Distance between X and Y is calculated using equation **D{(x1,y1),(x2,y2)}=|x1-x2|+|y1-y2|**(6)

This equation helps to find the cityblock distance between two points (x1,y1) and (x2,y2). The distance between the xcoordinates and y coordinates are found separately and the modulus vale is added to get the distance.

Algorithm

1. For each image embed watermark using DCT.
2. The embedded image is stored in cloud which is called as watermarked image database.
3. If the user gives a query image, then do as follows,
4. Extract the Red, Green and Blue elements from an imageand convert the R, G, B components to HSV color domain and store it in same image object.
6. Extract texture feature of the image using gaborfilter andstore texture feature vector in same image object.
8. Combine both the feature vectors using vectorconcatenation and store it in same image object[feature vector database].
9. Repeat Steps 4to 8 for the query image.
10. For each image in the feature vector database , compute the distances using the user-selected similaritymeasure between the feature vectorof thequery image and the corresponding feature vector of theimage in the watermarked image database
11.End For

CONCLUSION

This paper describes the watermarking technique in general and also describe the watermarking using coefficient difference and chaotic encryption. From this technique, it is clear that encryption is applied on watermark, the watermark is secured and it provides high security as compare to the images after embedding.. Many new techniques should be applied for better results in field of robustness and security.Here different methods are used for extracting color,texture as well as ICM features. And for similarity distance measurement city block distance methodis used.Here it is concluded that DWT and ICM methods givesusbetter precision and performance. The main challenge infront of the CBIR system is time complexity in retrieving secured image.

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