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Privacy-Preserving Content-Based Image Retrieval in Cloud Computing With EMD

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Abstract:
Content based image retrieval (CBIR) system plays a vital role in real world image retrieval applications. CBIR is developed to retrieve desired featured image. CBIR is limited because it has been used widely for its computational requirements and security purposes. In this work, we develop a privacy-preserving content based image retrieval design in which the data owner is allowed to obtain the content based image which can be stored in the cloud. Earth Mover’s Distance is utilized to measure the similarity of the viewed images. EMD can be calculated by solving transportation problem and linear programming problem. The proposed design supports local-feature based CBIR with EMD such a way that the cloud can find a solution without experiencing the personal information. This proposed system provides enhanced security and efficient searching.

Keywords:_Earth mover’s distance (EMD), image retrieval, cloud computing._

I. INTRODUCTION

Nowadays the world is being experienced a vast growth and effectively utilizing the features of the images. The most important and commonly used methods in information retrieval are utilizing the data such as captioning and keywords [20, 28, 29]. In CBIR (content based image retrieval) there is a problem of searching for digital images in largerdatabase [18, 21, and 27]. The some of the CBIR engines have colour, texture, size, shape, object, etc. CBIR is an application for the computer vision techniques [17, 19, 26, and 36]. The term refers to the process of retrieving the image in large collection of database. The millions of images are contained in a particular database out of that the user might take his own matching image using CBIR technique [1, 16, 35, and 37]. Basically an image plays a critical role in many departments like medicine, advertisement, industries, education, entertainment, design, etc. Among all kind of areas, theprocess of retrieval of images is being increased in large scale image database [22,30,35]. The high level of calculation in CBIR is due to the high dimensionality of the image content [23,33,34]. Cloud computing provides anaccess for storage and security requirements, forming the image retrieval.The data owner needs not to maintain the image database, and same timethe permitted user will be able to query the cloud without interacting with data owner [24,31,32].

In this work, we have achieved the CBIR outsourcing problem and given formal practical illustrations. The techniques from cloud computing, image retrieval, security are exploited. In this work we shall discuss about EMDi.e..,to measure the probability distribution between the distances. LSH used in reducing the high

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dimensional data to low dimensional data, it has been developed to achieve search efficiency.

The rest of the paper includes as follows. Section 2introduces system architecture and preliminaries. Section 3 reflects proposed scheme and analysis. Section 4 Explains the Performance analysis. Section 5 conclusion and Future Enhancement. Finally reference is given in section 6.

II. RELATED WORKS

The [1] proposed localized CBIR that retrieve similar images by taking single query image and this is the global view of the image often depends on content of the image which is localized and not has a holistic image. It [2] has defined their work in existing difficulties in present CBIR and biometrics for the future retrieval image.

Author [3] proposed extraction of images from database by utilizing efficient multimedia content. Mpeg 7 is set to indicating multimedia content for fast and effective recoginition with large amount of applications. The semantic view defines that texture is employed for egde histogram and color is employed for color structure for retrieval of image. In other hand Mpeg-7 describes very difficult and time consuming for better implementation. Researchers [4] proposed anmining texture method and color feature of an given image to retrieve some of the most important image based on the content based image retrieval. The [5] suggested CBIR with color classes which supports query by color. In this method low frequency DCT coefficients used for the images that are scattered from YUV color space. Thus it consequently support effective retrieve of images for the user.

One of the researcher [6] suggested a private content based image retrieval (PCBIR) which helps to protect privacy but expose unencrypted images from database to the server. It helps the extraction of images from the cloud with privacy of the query image. Again it has been [7] defined content based image retrievel to support the algorithm that color and texture information is encrypted for better security.

To the begineers the best knowledge similar[3] the author[8] proposed Begineers CBIR that technique has overwhelmed the drawbacks of TBIR(text based image retrieval).Database request that images can be easily retrieved from large database of images and its effectiveness consumes low cost. The results can be utilized by the users feedback. CBIR [9] produces bitplane randomization, random projection and randomized unary encoding techniques that is these three techniques helps to calculate hamming distance in encryption and also used to calculate L1 distance in encryption projection domain. CBIR [10] similar with [9] utilize the bitplane randomization and random project to support the encryption domains to design the content based image retrieval. The authors has [11] proposed a sensitive data that to be released over encoded CBIR with water making plan that cannot be viewed as exceptionally when required.

This scheme secures the information in CBIR with privacy protection when the clients want to retrieve for better and stronger images. The privacy preserving CBIR is mainly supported for retrieval of images of global feature and local feature but it need not to complicate the perceptual similarity metric that is earth movable distance (EMD). In this project we proposed a practical scheme that supports local feature based on CBIR with EMD as similarity metric.

SYSTEM ARCHITECTURE AND PRELIMINARIES

2.1 System Architecture

The proposed system has three categories: they are data owner, data user, cloud server. The large scale image database D={d_1,d_2….d_n} are being deployed and holedby data owner. Here n number of database represents images.The explored sequence index for the image database is created by data owner. In figure1, the data owner has to encrypt the image database and provide the index. Having done this, it develops the encrypted database images and the sequenced index to the cloud server. Since this work is executed when the data is outsourced, the cloud server canable to permit the CBIR service without authorizing with the data owner. Hence need to create a special type of encrypted code to support encrypted data. The encrypted query is submitted by the authorized user to the cloud server during CBIR queries.

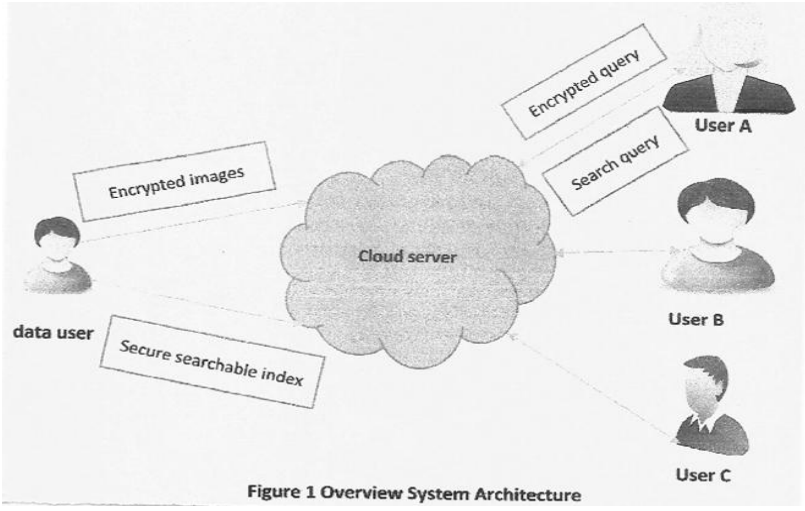

Fig.1.Overview System Architecture

Now the cloud server intimates the similarity between the images and returns the similar data to the datauser. And the received images are decrypted by the authorized user.

2.2Security Model

In this paper, we talk aboutthe semi honest cloud server, where it follows the strict accurate role andprotocol specification and analyse the interaction history thus deriving crucial information. The trusted parties are data owner and authorized users. The cloud server is prevented from knowing thecontent of image database and user's query.

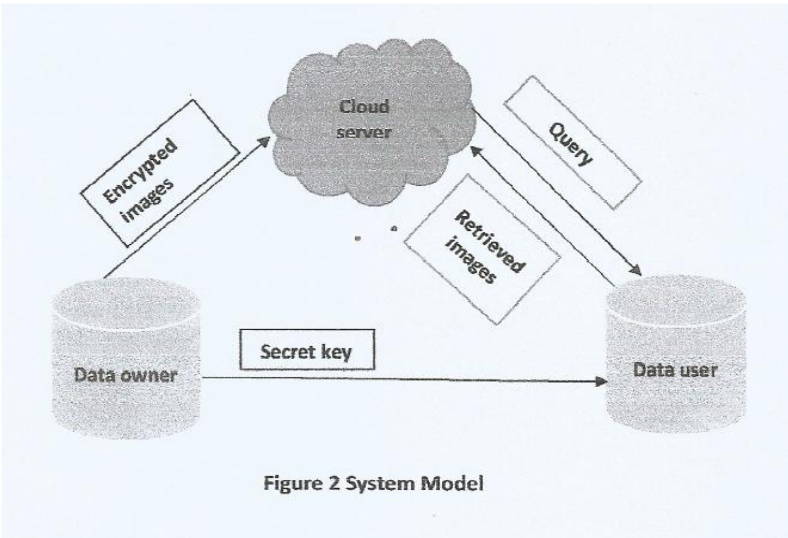

Fig.2.System Model

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2.3Bag-of-words Model

The extraction of visual features and search for similar images are involved by CBIR techniques. The feature extraction is astep to describe an image mathematically. The feature of the image is to capture entire image globally or locally with appropriate pixels. Global features such as texture features, shape features, colour histograms, etc..,.have the qualities to calculating similarity between images. To represent an imagein CBIR is too rigid however it is done between accuracy and calculation. Local features are based on typical transformation, corner points, results and analysis. Some of the popular local features t scale invariant transform and image patches. The system model is given in figure2. The local features are extracted from regions of an image. One popular CBIR using local features is computed as bag of words design. The local features are extracted from the images that are jointly clustered. In local feature, only the identifier of theclosest cluster is kept.

$$St= \{(c_1,w_1),\ldots,(c_i,w_i),\ldots,(ck_t,wk_t)\}\text{--}(1)$$

Where w_i denotes a cluster center, k_i denotes number of local features of the images that are clustered.

K_t is the total number of relevant clusters. The similarity between the images are calculated by the earth mover's distance(EMD) which is the measure of the probability distribution between the distance.

2.4 Earth Mover's Distance

The Earth movers distance is used to measure the similarity between the distributions. If there are given two distributions, the distribution with minimum weight can be seen as weight of earth. (i.e) mass which spreads on space, the distribution with maximum sum of weights can be seen as array of holes in same space. The cost of all moving earth into holes is measured by EMD.Thetransportation problem can be solved by using earth mover's distance. Two distributionsthat are having least transportation can be viewed in similar qualities.

Assume the signature U have k clusters with $P=\{(p_1,wp_1),(p_2,wp_2),\ldots(p_n,pw_n)\}$. Where pi is denoted as cluster representative and the pw_n is the weight of the clusters.Similarly for the second distribution $Q=\{(q_1,qw_1),(q_2,qw_2),\ldots(q_n,qw_n)\}$ has n clusters. Therefore the flow between the pi and qi is

The computations of EMD can be solved by transportation problem using minimum cost algorithm. For example Hungarian algorithm and simplex method.

$$EMD(0) = 0$$

$$EMD(i+1) = p_i + EMD + Q_i$$

$$\text{Total distance} = |EMD(i)|$$

The signatures can be transformed to probability distributions by normalization techniques. The EMD can be transformed to linear programming problem.

III. PROPOSED SCHEME AND ANALYSIS

In this section, the design of the privacy preserving CBIRgiven in figure3 is being discussed. Here we introduce the framework for the executed system. Some of the technologies are employed in the index construction. The entire details are presented accordingly.

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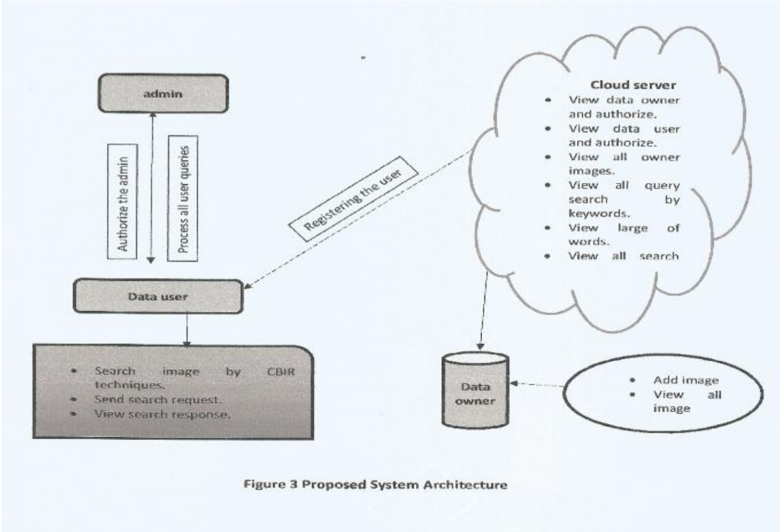

Fig.3.Proposed System Architecture

3.1 The Framework of the System

The tuple of probabilistic polynomial time algorithms are proposed in this system. For example keygen, search index, secure transactions, data encryption }. The proposed system is illustrated in figure 3.The image database ¥, the data owner €, build index (∞,£) and data enc (£,¶) then the data owner sends the authorized users to the cloud server.

An authenticated data user runs trapdoor gen to generate trapdoor to the cloud server. The encrypted signature is obtained by running Search index. The similar query images are the subset of the corresponding image subsets. Then the cloud server sends the data to the data user corresponding to image queries. Here the earth mover's distance (EMD) is enabled to view the similarity among the images. The most similar set of images are sent to encrypted query set to the data user.

3.2 Local Sensitive Hash

The time complexity is created when the calculation of EMD problem between the query and image database sets. In real world application, it is unusual with the huge number of image sets. Hence the EMD is calculated only for similar images. (i.e) we need to dismiss the dissimilar images. In this paper the local sensitive hash is employed to filter out the dissimilar images.

*Signature centroid:*The equidistant between the chord and centroid is defined as the lower bound of the EMD between two probabilistic distance. The centroid is given as

$$\P(t) = \sum_{i=1}^{K(t)} c(i)\, w(i) \quad \text{--------(2)}$$

Local sensitive hash has the feature with higher probabilities which can be a actual query vector space. Multiple hash functions are available so that the similar items map to same. The cryptographic and conventional hash functions are differ from the LSH. Data clustering and the nearest neighbour search are common in local sensitive hash. There are two divisions in hash functions they are: data independent method and data dependent method. LSH are applied in several domains, some of the domains are hierarchical clustering, image similarity identification, audio fingerprint, database management systems

3.3 LSH Algorithm

The main applications of LSH is used in nearest neighbour search algorithms.Suppose the family of LSH is denoted as £. LSH algorithm have some

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of the main parameters, one is the width parameter(¥) and the other is number of hash table(β).

In the initial level, the new family'G' is defined for hash function g obtained by the functions. (i.e){h_1,,,,,,,h_k}.

The query point 'q' is given, the hash functions 'g' iterates. For example , consider 'g' it gives the data points that are hashed into the same iterations 'q'. The iteration is stopped when the distance is found.

Given the parameters k and L, the algorithm have the performance requirements

- Space limit: O(n_l) storing data points.
- Execution time:O($n_l k_t$) for evaluating the function the time t is used.
- Query time: the algorithm exists in certain time limit for a particular query with probability atleast 1-(1-p1)L
- For the fixed probabilities the ratio c = 1+¢ and the probabilities p1 and p2 is given by

$$K = \log n/\log 1/p2 \quad \text{and } L = n_p$$

Where

$$P = \log p_1/\log p_2$$

- The above results are verified for the storing data points.
- Query time: O($np(k_t+d)$);

It not necessary for LSH to have the properties. Hence the direct transmission does not exists, so the cloud server may leak the data in the database. The one way security is enhanced to employ the functions.

3.4 Linear Programming Transformation on EMD

The information about the image content is verified or revealed by the image feature vector. For example the indication of sea and sky are probably represented in the presence of instance blue. The data server wants to calculate the power of the cloud by the EMD techniques.

The original problem is then converted into

Minimise s^Ay -c^tr'
Subject to UAy = ¢+Ur,------(3)
VAy = E+Vrfv

The cloud server solves the transformed EMD problems and uses the provided constrains to compute EMD. Then the components themselves reveal the small information. After that cloud server sorts the data and returns the encrypted images to the data user. The sum of the elements of the solutions is derived from the original EMD solutions and the transformed EMD solutions.

IV. PERFORMANCE ANALYSIS

In this section the CBIR technique scheme is verified experimentally on real world database. The performance of the scheme is measured through efficiency and precision. The scheme is performed in java language on windows server with Pentium-lV processor, RAM with minimum 4GB and 20GB hard disk. The scheme is dependent on several parameters that undergoes certain precision. Some of the parameters used here is local sensitivity hash(LSH), earth mover's distance (EMD).

4.1 Precision

In this section, the term "precision" refers to defines $P_K = K^1/K$ here k^1 number of real images in the retrieved k images. The secured images gives the problem in EMD that reflects not to influence retrieval precision. There are vast reasons to tribute the outsource. Some of thefactors are local features and the second one is local hash function.

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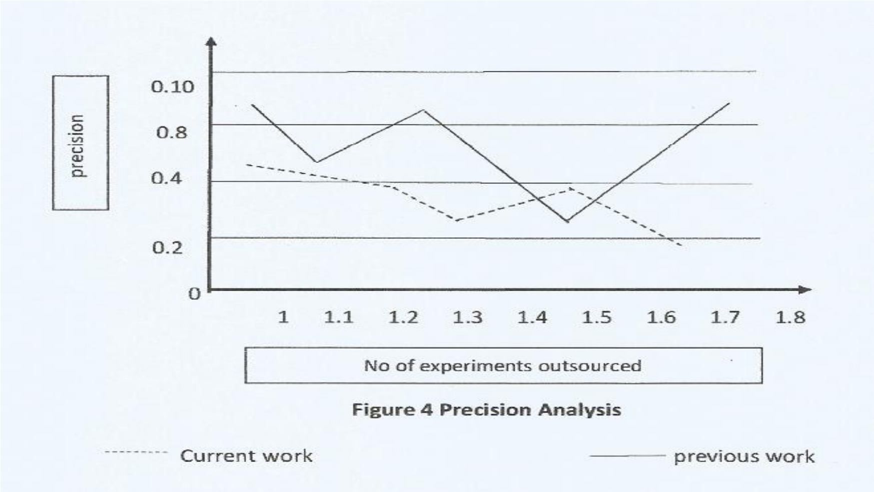

Fig.4.Precision Analysis

The proposed system can achieve normal precision and recall. The precision method is the key element in content based image retrieval system. The comparison between the system and the outsource delivers the certain retrieval proposes that it may have a certain recall techniques. In addition to it the time consumption plays a role in the index formation[1-10].

4.2 EFFICIENCY

4.2.1 Index Construction

In this paper, scaleinvariant feature transform (SIFT) is invoked to represent images. Here the clustering features and pre-processor features are used to represent a images. The image construction process requires a signature generation. The feature extraction and the clustering have less time consumption than feature extraction. The data owner offers affordable data outsourcing technique. The storage consumption of an index have the affordable cloud server.

Table 1.time consumption of index, clustering contruction, feature extraction

Table 1: time consumption of index, clustering construction ,feature extraction

Image database(in size)	200	400	600	800	1000
Feature extraction (in sec)	377	675	897	3451	249
Clustering operations (in sec)	134	234	558	234	1123
Index construction(in sec)	23	567	234	213	342

4.2.2 Time of Search Operation

By receiving the search operation the cloud server obtain the identity set in which the candidateimages are collected. The signature set is formed and transferred to the query for the decryption of the images. The cloud server, then transforms the role in which the received images are being sent to the data users [11-29].

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Fig.5.Search Index Time Consumption

Time consumption refers to the search that is similar to local sensitivity hash. The local sensitivity function does not depends on the time. The proposed system is although achieves nearby time series according to the database images. The scheme is majorly based on the security and the time complexity. LSH table increases in the expansion of the database that provides information about the images. Here the EMD drives the time complexity and the distance between the images which are from the cloud server. Data user determines the several form according to the stored data base. A cloud have the less time consumption rather than in the image database. Here the queries are derived from the text. Then the text queries are stored in the cloud. The cloud serves less amount of time in the query process.

4.3 Performance

The cloud server includes the index search and the solutions to EMD problems. During the execution the data server gives the index scheme to the role of the everyprocess according to the images stored in the cloud. The local features such as size, colour, texture, pattern derives an image. Hence the performance become generally fast accords the server based scheme. The performance can be measuredusing EMD [30-40].

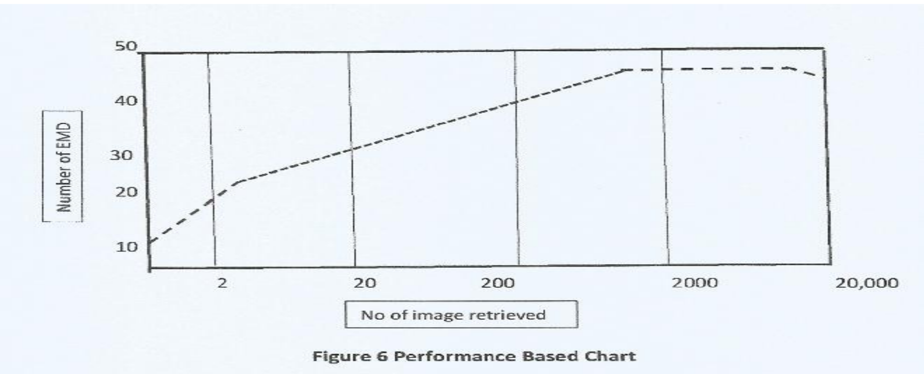

Fig.6.Performance Based Chart

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4.4 Implementation

In this work, there are four modules they are cloud server, data owner, data user, view and authorized users. Initial module is**cloud** server**--** in this module the server login by using suitable user name and password. After successful login the user can do some of the operations like view data owners and authorize, view data user and authorize, view all owner images, view bag of word, view all search request, view all image score in chart and view all keywords count in chart.

The second module is **view an authorize users**—In this module the admin can view the registered users. In which the admin can view the registered data user details such as user name, email , address and admin authorized users.The third module is **Data owner**—In this module there will be n number of data owners. Before doing the operations the data owner should register. After registration the data is stored in the database. The data owner has to login with user name and password. When the registration is successful, then add image, view all my images, operation are performed when login is completed successfully

The fourth module is **Data user---** In this there are n number of users are present. The user can perform operations after the registration. Once the user registers the data are stored in database. Once the registration is successful user should login with the user name and password. Once the login is successful the user will do certain operations like search image by CBIR techniques, send search request, view my search history, view search response [41-43].

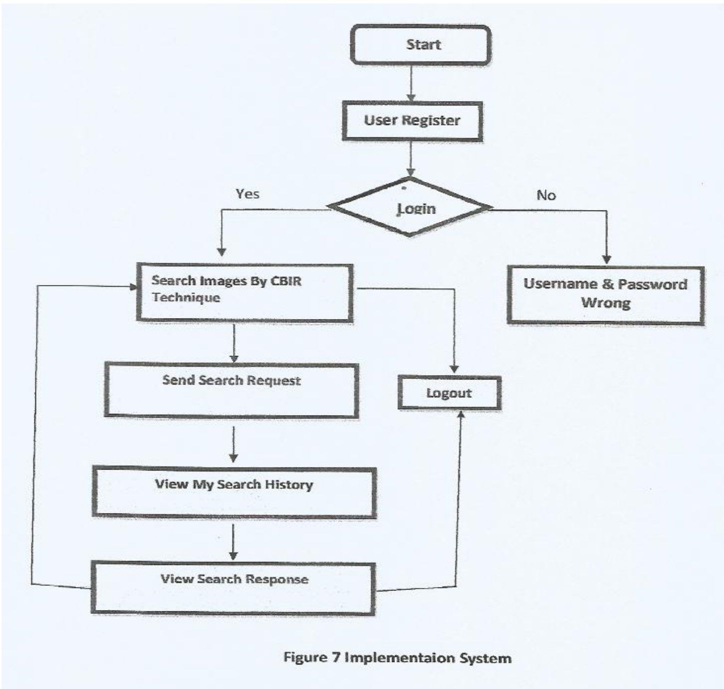

Fig.7.Implementalon System

V. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, our intention is to develop theprivacy-preserving content based image retrieval design, that helps the data owner to retrieve image database and the CBIR design to the cloud without revealing the true content to the database server. Here the EMD is involved to find the probabilistic similarity of the images. To improve the search efficiency we designed two

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levels of LSH the first stage is to filter the dissimilar images by pre-filtering tables. In the second stage the remaining images are compared by the EMD metric from search results. Having executed of above, this system delivers state-of-art security analysis and efficiency.Differ from other conventional retrieval system; the proposed method has no restrictions in using special encryption algorithms, thus makes this retrieval system more universal and user friendly as it helps to accommodate different kind of application.

This process of retrieval has been emanated through LSH & EMD, hence it is considered more unique and ubiquitous. We are sure that the developed image retrieval system would be set to meet the required security and efficiency, in general and ensure development of our society empowerment, in particular.

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