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Enhanced Content-Based Image Retrieval Using Cuckoo Search Algorithm

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Abstract— in this paper, we have presents Content-Based Image Retrieval using color and texture features. The purpose of this survey is to provide an overview of the functionality of content based image retrieval system in terms of technical aspects: querying, relevance feedback, features, matching measures, indexing data structures, and result presentation.Content-based image retrieval uses the visual contents of an image such as colour, shape, texture, and spatial layout to represent and index the image. CBIR system that can filter images based on their content would provide better indexing and give more accurate results. The processing time is often regarded as a major problem in the field of image retrieval research. We proposed content based image retrieval using cuckoo search algorithm. Cuckoo search is used to optimize the search results. In this retrieval experiments, we have used different category of images to expand the scope of experiment and test our results on different category of images. The proposed concept performances are analyzed on the basis of retrieval time. Our process is making the process of retrieval fast and efficient. The effectiveness of the optimization, classification testing, potential performance is analyzed with training feature samples of images.

Keywords— Content-Based Image Retrieval (CBIR), Query by Image Content (QBIC), Content-Based visual information retrieval, Cuckoo Search.

I. INTRODUCTION

In this time, almost all spheres of human life including commerce, government, academics, hospitals, crime prevention, surveillance, engineering, architecture, journalism, fashion and graphic design, and historical research uses images to provides better services [14]. A huge collection of images is referred to as image database. An image database is a system where image data are integrated and stored.Image data include the raw images and information extracted from images by automated or computer assisted image analysis. In a small collection of images, simple browsing can discover an image. But difficulty in case of large and varied collection of images, where the user encounters the image retrieval problem.To resolve this problem there are different techniques adopted for search and retrieval in an image database.

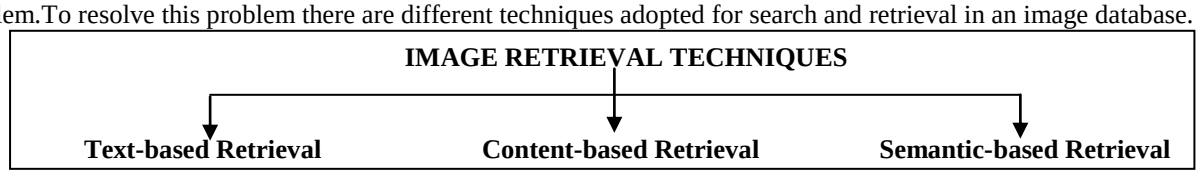

Figure 1: Image retrieval techniques.

- **Text-based Retrieval: -** in this each image has a number of keywords for describing the image and the keyword based matching is performed to retrieve relevant images**.** Text based retrieval is non-standardized because different users use different keywords for annotation. Text descriptions are sometimes subjective and incomplete because they cannot depict complicated image features very well. Textual information about images can be easily searched using existing technology, but requires humans to personally describe every image in the database.
- **Content-based Image Retrieval**: - in this various well known low-level features like colour, texture and shape are extracted for describing the image semantics. Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases. Content based image retrieval is opposed to concept based [7]. "Content-based" means that the search will analyze the actual contents of the image rather than the metadata such as keywords, tags, and/or descriptions associated with the image. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because most web based image search engines rely purely on metadata and this produces a lot of garbage in the results.
- **Semantic-based Retrieval: -** in this semantics are used to retrieve the relevant images. Semantic retrieval, where the user makes a request likes "find pictures of Abraham Lincoln". This type of open-ended task is very difficult for computers to perform - pictures of Chihuahuas and Great Danes look very different, and Lincoln may not always be facing the camera or in the same pose.

1.1 Process of Content-based Image Retrieval

The process of CBIR consists of the following stages:

- Image Acquisition
- Image Preprocessing
- Feature Extraction
- Similarity Matching

- **Image Acquisition**

  It's the process of acquire a digital image using any image capturing device and that image stored in image Database. Image database contains collection of n number of images depends on the user range and choice.

- **Image Pre-processing**

  To improve the image in ways that increases the chances for success of the other processes. The image is first processed in order to extract the features, which describe its contents. The processing involves filtering, normalization, segmentation, and object identification. Like, image segmentation is the process of dividing an image into multiple parts. The output of this stage is a set of significant regions and objects.

- **Feature Extraction**

  A feature is a characteristic that can capture a certain visual property of the image. Features such as shape, texture, colour, etc. are used to describe the content of the image. The features further can be classified as low-level and high-level features. In this step visual information is extracts from the image and saves them as features vectors in a features database .For each pixel, the image description is found in the form of feature value or a set of value called a feature vector by using the feature extraction .These feature vectors are used to compare the query with the other images and retrieval

  .

A. Colour Feature

Colour is one of low-level visual features, which is mostly used in the applications of image processing .It's one of the important features that make possible the recognition of images by humans is colour [14]. Colour is a property that depends on the reflection of light to the eye and the processing of that information by the brain. We use colour to tell the difference between objects, places, and the time of day. It has the characteristics of easy calculation and invariant in image scaling, rotation and translation. Usually colours are defined in three dimensional colour spaces. These could either be RGB (Red, Green, and Blue), HSV (Hue, Saturation, and Value) or HSB (Hue, Saturation, and Brightness).

1. HSV Histogram The HSV colour space are defined in terms of three constituent components; Hue, Saturation and Value. Hue varies from 0 to 1.0, the corresponding colours vary from red through yellow, green, cyan, blue, magenta, and back to red, so that there are actually red values both at 0 and 1.0. As saturation varies from 0 to 1.0, the corresponding colours (hues) vary from unsaturated (shades of gray) to fully saturated (no white component). As value, or brightness, varies from 0 to 1.0, the corresponding colours become increasingly brighter. The method of representing colour information of images in CBIR systems is through colour histograms. Quantization in terms of colour histograms refers to the process of reducing the number of bins by taking colours that are very similar to each other and putting them in the same bin. For the purpose of saving time when trying to compare colour histograms, one can quantize the number of bins. Obviously quantization reduces the information regarding the content of images but it is a trade-off between processing time and quality.

2. Colour Moments Colour moments are measures that can be used to differentiate images based on their features of colour. The first order (mean), the second order (variance) and the third order (skewness) colour moments have been proved to be efficient in representing colour distribution of images. Once calculated, these moments provide a measurement for colour similarity between images. These values of similarity can then be compared to the values of images indexed in a database for image retrieval. The colour histogram, colour moments and colour set only contain the colour information of each pixel in an image. In colour based search HSV histogram and colour moments are calculated for query image and other images. Both are used for image analysis. To find colour based similarity Euclidean distance is calculated on the bases of histogram and colour moments. We will use different MATLAB functions that will help in calculating the Euclidean distance like power. After finding Euclidean distance images will be sorted on the basis of shortest distance and images with shortest distance will be most similar images.

B. Texture Feature

Texture is another kind of important low-level visual features. Texture can be considered as repeating patterns of local variation of pixel intensities. It can express the relationship between the innate surface properties of an object and the surrounding environment. It contains important information about structural arrangement of a surface, such as; clouds, leaves, bricks, fabric, etc [21]. It also describes the relationship surfaces to the surrounding environment. It gives us information about nature of colour intensities in an image or selected portion of the image. In feature that describes the distinctive physical composition of a surface. The methods calculate measures of image texture such as the degree of contrast, coarseness, directionality and regularity, or periodicity, directionality and randomness.The. Wavelet transform transforms the image into a multiscale representation with both spatial and frequency characteristics. It calculates the frequency. This allows for effective multi-scale image analysis with lower computational cost. Wavelet is popular tool in

image processing and computer vision. Many applications, such as compression, detection, recognition, image retrieval have been investigated. Wavelet transform has features of space frequency localization and multires solutions.Other methods of texture analysis for image retrieval include the use of **1**. **Gabor filter** is widely adopted to extract texture features from the images for image retrieval and has been shown to be very efficient. For texture based search Gabor Wavelet function and wavelet transform are used and output of these functions are used to compare images based on texture feature. Gabor filters are group of wavelets with each wavelet capturing energy at a specific frequency and specific orientation.

Manhattan distance function computes the distance that would be travelled to get from one data point to the other in a grid like path.These functions are used on query image to calculate values and information from dataset images will be extracted using these function then to compare texture based similarity Manhattan distance is calculated, then images are sorted in smallest distance order and images with smallest distance from query image is calculate .Query image parameters and dataset images parameters are find the distance. Each image is compared with query image and a distance is calculated .Then images with lowest distance will be displayed.

- **Similarity Matching** The information about each image is stored in its feature vectors for computation process and these feature vectors are matched with the feature vectors of query image which helps in measuring the similarity. The image to be search in the image database whether the same image is present or not or how many are similar kind images are exist or not. This step involves the matching of the above stated features to yield a result that is visually similar with the use of similarity measure method called as Distance method. We are using Euclidean distance for matching colour based images. Euclidean distance measure the distance between two points. Euclidean distance is used to retrieve the needed images by finding the similarity between the query image features and the classified image features in the database based on the principle of smaller the distance and better the resemblance .Manhattan distance function computes the distance that would be travelled to get from one data point to the other in a grid like path .So, different distances method available for measuring the distance between query image and target images.
- **Resultant Retrieved Images** It searches the previously maintained information to find the matched images from database. The output will be the similar images having same or very closest features as that of the query image. User interface and feedback which governs the display of the outcomes, their ranking, the type of user interaction with possibility of refining the search through some automatic or manual preferences scheme etc.

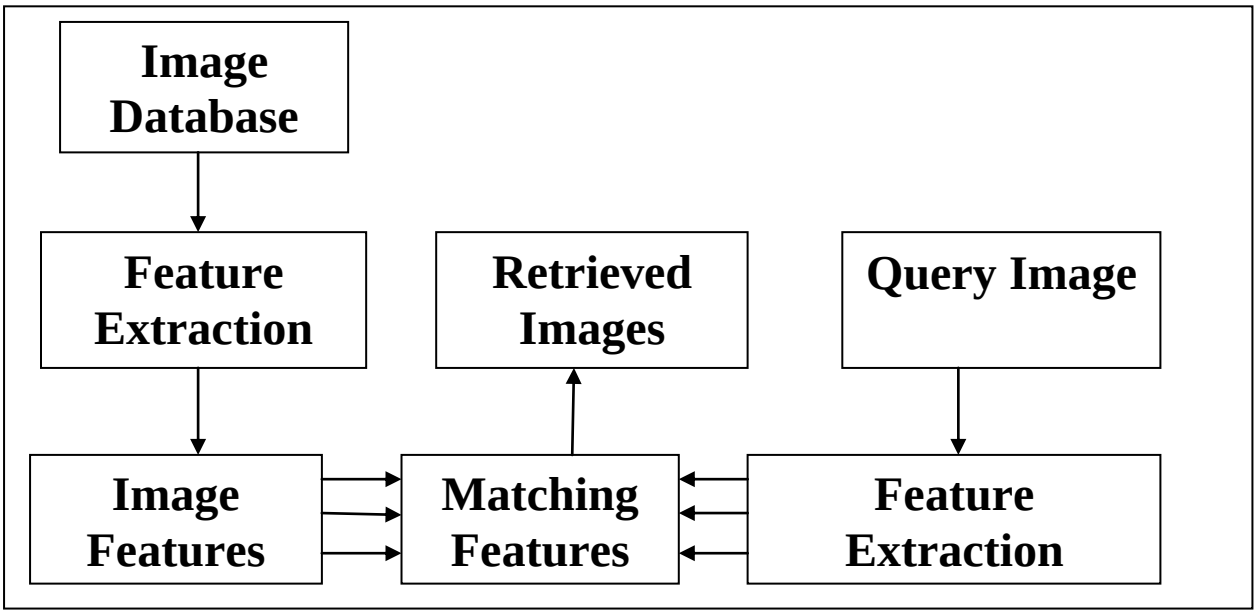

Figure1.1: Block diagram of CBIR

II. RELATED WORK

Kabir et al. (2004) describes that image retrieval using histograms of uni-color and bi-color blocks and directional changes in intensity gradient presents a new and effective image indexing technique that employs local uni-color and bi-color distributions and local directional distribution of intensity gradient. The image is divided into 4 by 4 non-overlapping blocks. Each block, based on its gradient magnitude, is classified as uniform or non-uniform. Using the average of each color component for the pixels of a uniform block, its representative color is found. Then the histogram of uni-color uniform blocks of the image, HUCUB, is constructed. To each non-uniform block, two representative colors are assigned. Then the histogram of bi-color non-uniform blocks, HBCNB, is created. To represent the shape content of the image, the histogram of directional changes in intensity gradient, HDCIG, is introduced. Experimental results on a database of 2250 images are reported [2].

Suhasini et al. (2008) suggested that Graph based segmentation in content based image retrieval traditional image retrieval systems are content based image retrieval systems which rely on low-level features for indexing and retrieval of images. Graph based segmentation is has the ability to preserve detail in low-variability image regions while ignoring

detail in high-variability regions. After segmentation the features are extracted for the segmented images, texture features using wavelet transform and colour features using histogram model and the segmented query image features are compared with the features of segmented data base images. The similarity measure used for texture features is Euclidean distance measure and for colour features Quadratic distance approach [3].

Yang et al. (2009) describes that intend to formulate a new meta-heuristic algorithm, called Cuckoo Search (CS), for solving optimization problems. This algorithm is based on the obligate brood parasitic behaviour of some cuckoo species in combination with the Levy flight behavior of some birds and fruit flies. We validate the proposed algorithm against test functions and then compare its performance with those of genetic algorithms and particle swarm optimization. Finally, we discuss the implication of the results and suggestion for further research [4].

Analoui et al. (2011) describes that content-based image retrieval using Artificial Immune System (AIS) clustering algorithms concerns an open problem in the area of Content Based Image Retrieval (CBIR) and presents an original method for noisy image data sets by applying an artificial immune system model. In this regard, appropriate feature extraction methods in addition to a beneficial similarity criterion contribute to retrieving images from a noisy data set precisely. The results show some improvement and resistance in the noise tolerance of content based image retrieval in a database of various images [5].

Sakhare et al. (2011) describes that rretrievals of images based on visual features such as colour, texture and shape have proven to have its own set of limitations under different conditions. Various techniques have been implemented using these features like fuzzy colour histogram, Tammura texture etc. In proposed a novel method with highly accurate and retrieval efficient approach which will work on large image database with varied contents and background. The dramatic rise in the sizes of images databases has stirred the development of effective and efficient retrieval systems. The application performs a simple colour-based search in an image database for an input query image, using colour, texture and shape to give the images which are similar to the input image as the output. The number of search results may vary depending on the number of similar images in the database. CBIR is still developing science. As image compression, digital image processing, and image feature extraction techniques become more developed, CBIR maintains a steady pace of development in the research field [7].

Yuan et al.(2011) suggested that progress in image retrieval by using low-level features, such as colours, textures and shapes, the performance is still unsatisfied as there are existing gaps between low-level features and high-level semantic concepts (semantic gaps). In proposed a novel image retrieval system based on bag-of-features model by integrating scale invariant feature transform (SIFT) and local binary pattern (LBP). We show that SIFT and LBP features yield complementary and substantial improvement on image retrieval even in the case of noisy background and ambiguous objects. Two new integration models are proposed: patch-based integration and image-based integration. By using a weighted K-means clustering algorithm, the image-based SIFT-LBP integration achieves the superior performance on a given benchmark problem comparing to other existing algorithms [8].

Kumar et al. (2012) suggested that content based image retrieval methods using random segmentation algorithm. In a high-level semantic retrieval process, we utilize the search engine to retrieve a large number of images using a given text-based query. The need to have a versatile and general purpose content based image retrieval (CBIR) system for a very large image database has attracted focus of many researchers of information technology-giants and leading academic institutions for development of CBIR techniques. In a high-level semantic retrieval process, we utilize the search engine to retrieve a large number of images using a given text-based query. In a low level image retrieval process, the system provides a similar image search function for the user to update the input query for image similarity characterization. The revolutionary internet and digital technologies have imposed a need to have a system to organize abundantly available digital images for easy categorization and retrieval. These techniques encompass diversified areas, viz. image segmentation, image feature extraction, representation, mapping of features to semantics, storage and indexing, image similarity distance measurement and retrieval making CBIR system development challenging task. The state of the art techniques are reviewed and future scope is cited. The experimental evaluations based on coverage ratio measure show that our scheme significantly improves the retrieval performance of existing image search engine [13].

Afifi et al.(2012) presented a content-based image retrieval using invariant color and texture features presents a new content-based image retrieval method that uses both color and texture feature. To extract the color feature from the image, the color moment will be calculated where the image will be in the HSV color space. To extract the texture feature, the image will be in gray-scale and Rank let Transform is performed on it. From the rank let images generated from the original image, the texture feature is extracted by calculating the texture moments. Experiments results show that using both color and texture feature to describe the image and use them for image retrieval is more accurate than using one of them only [14].

Rashedi et al. (2012) suggested that improving the precision of CBIR systems by feature selection using binary gravitational search algorithm feature selection using binary gravitational search algorithm is utilized to improve the precision of CBIR systems. The performance of a CBIR system is hardly depends on the features that are extracted from images. Thus, selecting most relevant features leads to higher accuracy by reducing the semantic gap between high level features and low level features. Gravitational search algorithm is one of the recent heuristic search algorithms that in this paper, its power is compared with genetic algorithm and binary particle swarm optimization in feature selection. The proposed method is examined in Corel database. Results confirm the efficiency of BGSA to increase the precision of CBIR systems [15].

Gavade et al. (2013) describes that Review on image retrieval systems reviewed and analysed different image retrieval systems. The classification techniques such as k-KNN, SVM, Decision stump, Manifold Ranking, Hash Encoding

Algorithm followed by a suitable relevant feedback model via cross domain learning , GMISVM , Laplacian Regularized Least Squares(LapRLS), Search Result Clustering(SRC)Algorithm , Biased Discriminative Euclidean embedding (BDEE) to refine the image retrieval result of consumer photos. After thorough study, this review also claims that most systems uses low level features and only few uses high level semantically meaningful features and the image retrieval results affect due to this semantic gap. The semantic gap is often regarded as a major problem in the field of image retrieval research [20].

Mohd. Danish et al. (2013) suggested that a Survey of content based image retrieval based on color, texture, shape & neuro fuzzy. In current technology the acquisition, transmission, storing, and manipulation are allowed on the large collections of images. With the increase in popularity of the network and development of multimedia technologies, users are not satisfied with the traditional information retrieval techniques. So nowadays, the content based image retrieval is becoming a source of exact and fast retrieval. Content Based Image Retrieval (CBIR) is a technique which uses visual features of image such as color, shape, texture, etc. to search user required image from large image database according to user's requests in the form of a query image. Images are retrieved on the basis of similarity in features where features of the query specification are compared with features from the image database to determine which images match similarly with given features. [21].

III. THE PROPOSED ALGORITHM

We proposed content based image retrieval using cuckoo search algorithm. Cuckoo search is a new meta-heuristic optimization algorithm. A fully implemented and the victories version of cuckoo search is given in MATLAB, which can easily extended to solve various global optimization problems efficiently. Cuckoo search (CS) is an optimization algorithm developed by Xin-she Yang and Suash Deb in 2009 [4]. Cuckoos are fascinating birds, not only because of the beautiful sounds they can make, but also because of their aggressive reproduction strategy. It was inspired by some cuckoo species egg laying behavior. Some Cuckoo birds lay their eggs in the nests of other host birds (of other species). Cuckoo search is used to optimize the search results. In this retrieval experiments, we have used different category of images to expand the scope of experiment and test our results on different category of images. The proposed concept performances are analyzed on the basis of retrieval time. Our process is making the process of retrieval fast and efficient. The effectiveness of the optimization, classification testing, potential performance is analyzed with training feature samples of images. If a host bird discovers the eggs are not their own, it will either throw these alien eggs away or simply abandon its nest and build a new nest elsewhere therefore there is always a probability that egg will be discarded. Cuckoo search idealized such breeding behavior, and thus can be applied for various optimization problems. It seems that it can outperform other meta-heuristic algorithms in applications.

3.1 Cuckoo Search Implementation

In Cuckoo search (CS), each egg in a nest represents a solution, and a cuckoo egg represents a new solution. The aim is to employ the new and potentially better solutions (cuckoos) to replace not-so-good solutions in the nests. In the simplest form, each nest has one egg. The algorithm can be extended to more complicated cases in which each nest has multiple eggs representing a set of solutions (Yang 2009; Yang 2010). The CS is based on three idealized rules:

1. Cuckoo will randomly choose a nest and will dump its egg in that nest.
2. High quality nest i.e. nest with better eggs (solution) will have higher chances to go to the next generation.
3. There are fixed numbers of available host's nests, the probability of finding the egg laid by a cuckoo in host bird's nest is represented within a range of $p_a \in (0,1)$. Discovering operates on some set of worst nests, and discovered solutions dumped from farther calculations.

For simplicity, the last assumption can be approximated by a fraction pa of the n nests being replaced by new nests, having new random solutions. For a maximization problem, the quality or fitness of a solution can simply be proportional to the objective function. Other forms of fitness can be defined in a similar way to the fitness function in genetic algorithms.

3.2 Phases in Development

To verify the effectiveness (qualities and robustness) of the proposed technique, we conduct several experiments with this procedure on several images. There are some steps of our proposed technique are given below:

Phase 1: Firstly we develop a particular GUI for this implementation. After that we develop code for the loading dataset folder in MATLAB database. After that we calculate the feature of the dataset.

Phase 2: Develop a code for the loading the Query image in the MATLAB workspace. After this apply the feature extraction on this loaded query image.

Phase 3: Develop a code for the retrieving the images from the loaded dataset. For the retrieving purpose we use two techniques based on Texture and Colour.

Phase 4: After that we implement Cuckoo Search Algorithm in our concept. In our proposed method Cuckoo Search Algorithm is used for the optimization purpose.

Phase 5: After that we develop the code for the result in the MATLAB figure window. Our results are retrieved images.

3.3 Models for present work

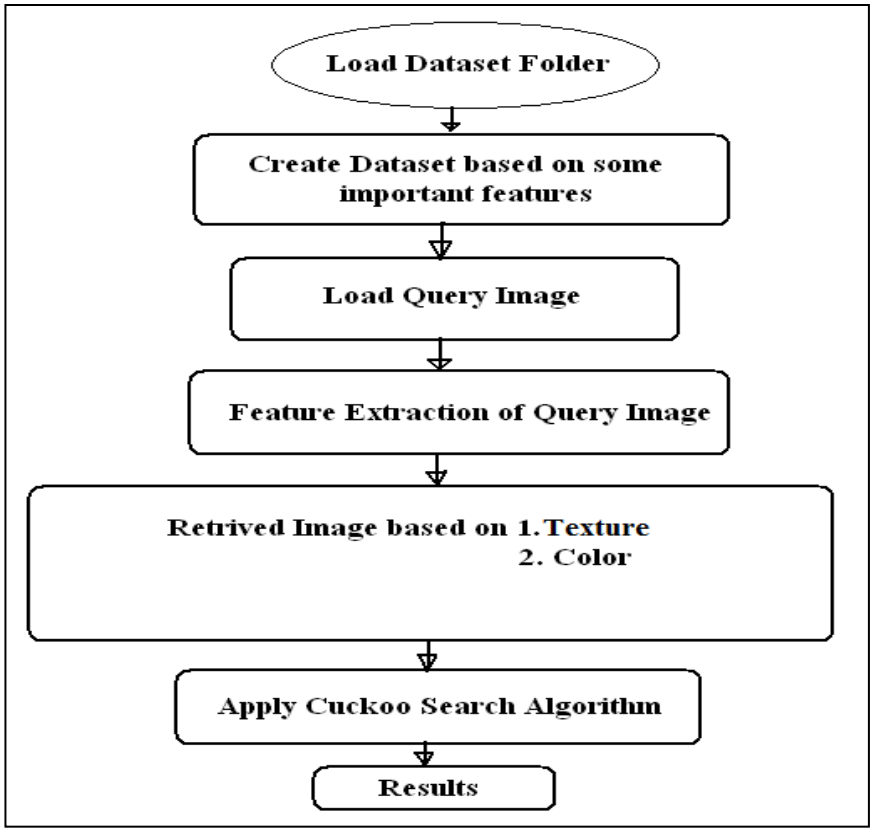

Figure 3.3: Flow chart of proposed algorithm.

3.4 Proposed Algorithm

Step1: Give query image I to the program.

Step2: Extract feature from the query image. Colour and Texture based features.

Step3: If dataset D is not available create dataset: First select directory of images.

Create dataset. Extract features of images and load in dataset during dataset creation.

Step4: Load dataset D.

If need to load new dataset:

Go to step 3.

Else:

Load available dataset.

Step5: Select a search technique.

If texture base search is selected:

Send Query image and dataset to the texture base search script. Apply Cuckoo search to find better quality images. Further apply texture search and retrieve most similar search.

Else if colour based search is selected:

Send Query image and dataset to the colour base search script. Apply Cuckoo search to find better quality images. Further apply colour based search and retrieve most similar search.

Step6: Display results to the user on the basis of colour or texture search.

Figure 3.4: Proposed Algorithm

IV. EXPERIMENTAL RESULTS

This Section provides information regarding results, interpretation of results and comparison of proposed content based image retrieval using CUCKOO search engine. We conduct several experiments with this procedure on several images.

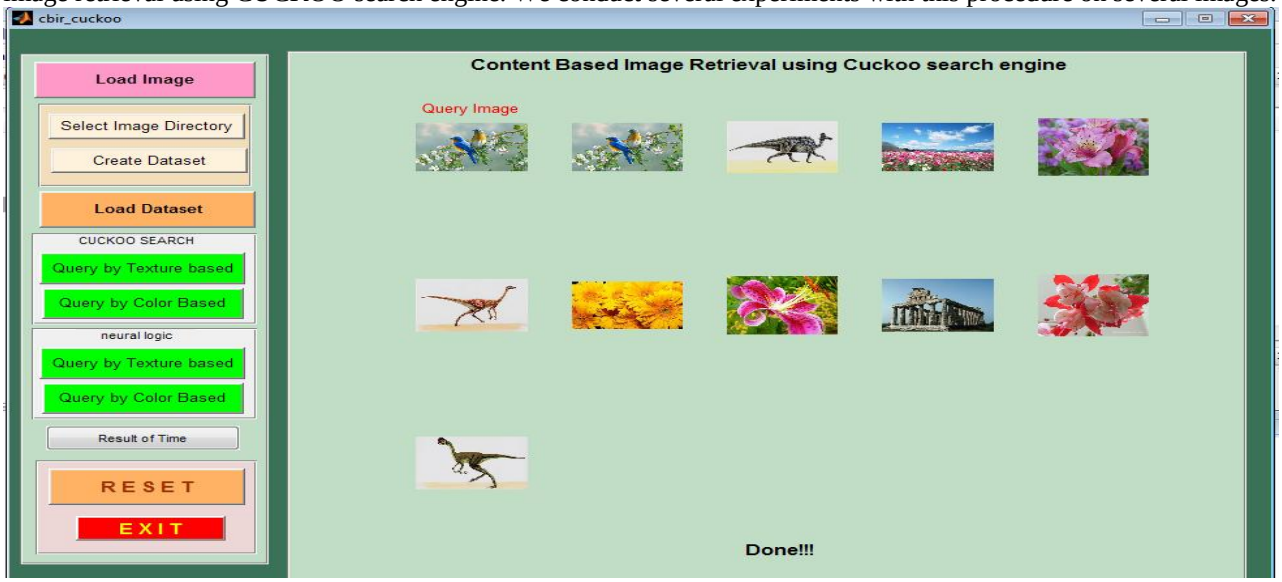

*Figure 4.1: F*igure window of texture based for CS

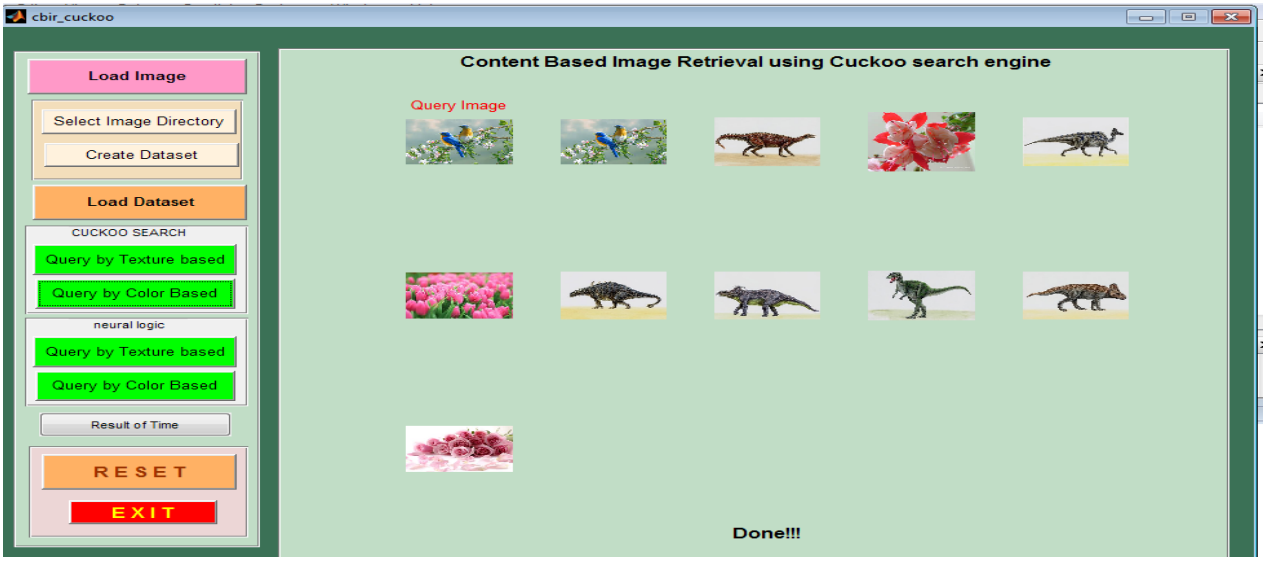

Figure 4.2: Figure window of color based for CS

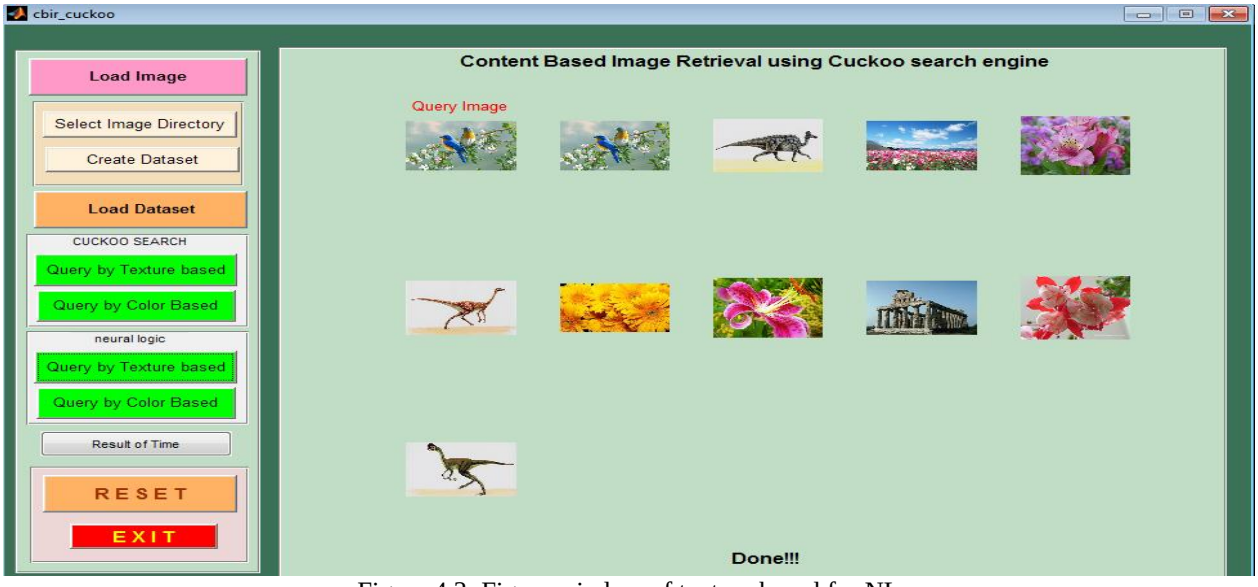

Figure 4.3: Figure window of texture based for NL

Figure 4.4: Figure window of color based for NL

4.5 Parameters of Content –based Image Retrieval

In CBIR, the most commonly used performance measures are Precision and Recall. Precision is defined as the ratio of the number of retrieved relevant images to the total number of retrieved images. We denote to the precision by P. Recall is defined as the ratio of the number of retrieved relevant images to the total number of relevant images in the database. We denote to the recall by R [10]. In CBIR, if the precision score is 1.0, this means that every image retrieved by a search is relevant, but we do not know if the search retrieves all the images relevant to the query. If the recall score is 1.0, this means that all relevant images are retrieved by the search, be we do not know the number of irrelevant images were also retrieved.

Table1. Comparison Table of CBIR Algorithms based on Parameters

Images	**CBIR using Cuckoo Search Algorithm**				**CBIR using Neural logic Algorithm**			
	Precision		**Recall**		**Precision**		**Recall**	
	Colour	**Texture**	**Colour**	**Texture**	**Colour**	**Texture**	**Colour**	**Texture**
200.jpg	*0.182*	*0.156*	*0.132*	*0.76*	*0.282*	*0.256*	*0.221*	*.123*
50.jpg	*0.234*	*0.081*	*0.134*	*0.051*	*0.234*	*0.381*	*0.145*	*0.121*
100.jpg	*0.285*	*0.192*	*0.185*	*0.75*	*.455*	*.212*	*0.211*	*0.95*
150.jpg	*0.192*	*0.145*	*0.122*	*.115*	*0.672*	*0.178*	*0.192*	*0.135*
175.jpg	*0.325*	*0.195*	*0.125*	*0.105*	*0.345*	*0.231*	*0.175*	*0.145*
25.jpg	*0.222*	*0.189*	*0.82*	*0.129*	*0.452*	*0.201*	*0.999*	*0.259*

4.6 Comparison of CUCKOO Search with Neuron Logic

The results are compared with CUCKOO Search and Neuron Logic. From the results it is clear that CUCKOO search more optimize in term of time (seconds) as compared with neuron logic. In figure 4.6 the results are compared on the basis of texture based search and colour based search. Using CUCKOO search the images are retrieved in texture based search (4.5) seconds where as in neuron logic it took 11.7 seconds to find the images from data set. Moreover, when we searched based on color based features using CUCKOO search it took 2.2 seconds but the neuron logic completes it search in 4 seconds. From the results it is clear that CUCKOO search more optimize the time as compared with neuron logic.

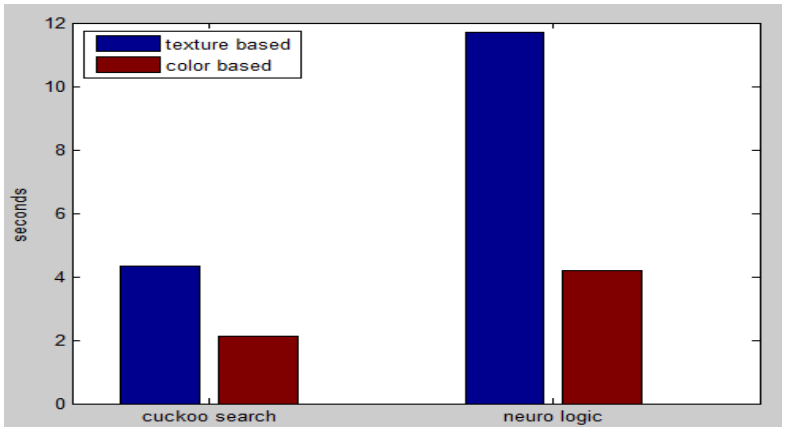

Figure 4.6: Comparison Graph based on Time in Seconds

V. CONCLUSION

In this paper, we use the cuckoo search engine for the content based image retrieval purpose. Cuckoo search idealized such breeding behavior, and thus can be applied for various optimization problems. It seems that it can outperform other meta-heuristic algorithms in applications. A new approach of Cuckoo Search (CS) is used for selection of relevant images as per the search. Cuckoo search compare with neural network technique which perform more iterations. So, results of CUCKOO search are compared with neuron logic. From the results it is clear that the CUCKOO search more optimize the searching time in seconds as compared with neuron logic. For future work, we plan to improve the content based image retrieval performance using shape feature also by using CS.

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