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An Effective Image Searching Method Based on YCbCr Color Transformation and Content-Based Image Retrieval

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Abstract:

The identification or searching of any digital information from online database archives is an essential part of daily life. This growing body of knowledge is largely composed of digital images and videos. Current research challenges with processing the terabytes of unlabeled picture data generated and digitally stored in big repositories that contain data on visuals on the internet or computer systems have been solved in large part by the employment of retrieval methods based on content. These images are stored in numerous databases spread over the globe as unstructured multimedia data. To address this issue, a low complexity Histogram design matching algorithm is proposed in the work along with the feature vector design in transformation, attempting to incorporate some of the visual perception characteristics of the YCbCr transformation technique, which is frequently used in content-based image retrieval systems. The simulated results demonstrate how well the suggested strategy works with the current search techniques. With the results attained, the Wang Dataset image data base's average search algorithm accuracy comes out to be 95%.

Keywords — **Image retrieval techniques,CBIR, Feature Extraction, YCbCr, Color Transformation, etc.**

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I. INTRODUCTION

In the 1990s, CBIR (Content Based Image Retrieval) was proposed [1-3]. CBIR systems produce descriptions of an image's physical properties, such as colour, texture, shape, etc., that are machine-interpretable. There is still a significant difference between the feature-based model utilised for CBIR and the actual human perceptions model, even after generating multiple compact and effective features vector for indexing each image. This is mostly because semantic information, such as spatial organisation, context, and events, is not taken into account when designing feature vectors; instead, it is exclusively dependent on low level visual information (such as colour, texture, shape, etc.). Museum management and art galleries [8], architectural design and construction design engineering [9], law enforcement and criminal investigation [10], interior design [11], remote geo-sensing and earth resource management [11], scientific DBMS [12], weather forecasting [12], retailing [13], fashion design [14], medical imaging [14, 15], and picture processing and communication systems are some application areas where CBIR is frequently used.

The accuracy of a CBIR system primarily depends on four key elements, including (a) accurate feature vector representation of an image, (b) appropriate distance metrics for assessing similarity between images (corresponding feature vectors), (c) closing the semantic gap between the semantic meaning of an image as represented by low-level features, and (d) minimising the search space/time.

Given the aforementioned information, feature extraction is one of the main CBIR system research issues. Feature vectors that are distinctly different from one another should be used to represent the photos in the database that belong to various classes. Therefore, a hard issue in CBIR research is the requirement for establishing an appropriate feature extraction method that captures the prominent intrinsic aspects of an image from which production of an appropriate feature vector as a real representation of an image.

The second crucial step in the construction of the CBIR system is the similarity/dissimilarity metric. The distance metrix's function is to quantitatively assess how similar or unlike a query and an image are in the database's perceptual space. A significant issue, "to assess similarity," has not yet been resolved. This is because not every low-level feature representation of an image will work with every type of distance measure for comparing similarity and dissimilarity in perceptual space. Choosing the optimum mix of low level feature and distance measure is therefore crucial for getting the best results.

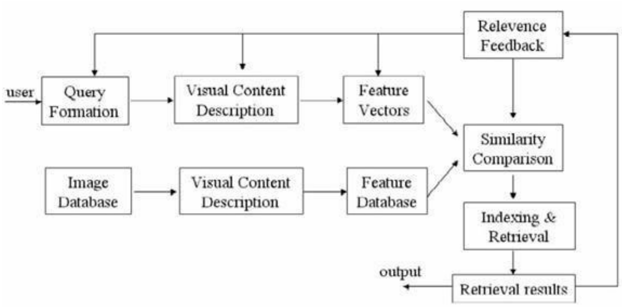

Fig 1 Standard CBIR systems

In CBIR research, "how to minimise the semantic gap" is the third key issue. The human perception system is utilised to differentiate between or equate one image to another in terms of semantics in order to obtain the significant visual information. Searching time reduction is a crucial study topic for future CBIR system development as a result of the database's steadily growing size. Pre-classifying the various photos in the database into a number of classes is one technique to limit the effective search space corresponding to a query. Due to limitations in the classifier accuracy used for pre-classifying the query, searching for each query image may be limited to a few classes to which the query Image may belong

II. RELATED WORK

The features extraction block is one of the main components of a CBIR system. A picture is declared by features in the feature extraction block, enabling the search for images that are comparable to the test image. The most frequently utilised features in these applications are colour, texture, and form. A feature is defined to retrieve a certain visual aspect of an image. There are a number of CBIR algorithms that have been created utilising only a single feature [16–18]. Multiple visual features are required for the general purpose CBIR since a single visual feature typically only describes a particular aspect of the image content [19].

Multiple visual features are used in recent study, which can significantly increase retrieval efficiency [20, 21]. Color, texture, form, and key point descriptor are the significant and prominent qualities that are detected by various multiple visual feature extraction approaches while constructing CBIR systems. Additionally, details of a few CBIR systems that are offered for purchase will be provided. Different CBIR system colour properties include: It is a crucial visual queue because of the colour signature of the backdrop and the foreground objects. The two different colour representation techniques are block/group based and point/pixel based. Color moments [26] and Color Co-occurrence Matrix (CCM) [27] are examples of pixel-based colour representations, whereas colour histogram and colour correlogram [28] are examples of block/group-based representations.

III. CONTENT BASED IMAGE RETRIEVAL

It's possible that you won't be able to find photographs that meet your expectations when looking for an image in the biggest databases in the world like Google and Bing. The majority of image matches rely on the linked text's annotations. Due to the presence of thousands of photographs that aren't related to the query image, finding an image in a huge database is a challenging operation. The second idea was for searching, called CBIR, and it first appeared in the 1990s. Several strategies have since been put forth to extract various image contents. Very few of these are in-depth:

A. General Image Search

People may want to look for images in databases maintained by businesses, on personal computers, or in major search engines online. Due to a number of restrictions, including the inability to describe the content of the desired Image, the performance of text-based Image retrieval in the first scenario is subpar. Users typically cannot utilise text in the second and third scenarios if such images are not labelled. CBIR is thus employed in these situations. For instance, we may give the system a similar image and have it search for images in my image repository. After that, we can discover pictures related to our search.

B. Medical Applications

Daily reports containing several photos from medical procedures like x-rays, ultra-sound scans, molecular imaging, and magnetic resonance imaging are produced. It would be tremendously helpful if patients and doctors could more quickly and easily access earlier reports in similar circumstances.

C. Video Search

In this sector, numerous movies, films, and advertising are produced and kept in huge archives that expand daily. As a result, when people need to access them, it is challenging to find them. A method that could retrieve them automatically based on the text would be very helpful. Videos are made up of a number of image frames, and when needed, photographs can be utilised to search for a certain video.

D. Surveillance

The photos that are recorded and taken at high-security locations every second by surveillance cameras. These data are utilised to automatically identify suspicious individuals and unexpected occurrences. In order to comprehend the scenario and the people, a content search is helpful.

E. Security

CBIR is helpful for security-related reasons. To identify suspects, it is utilised for fingerprint and facial recognition matching. They utilise these tools in private businesses to confirm their employer's identification and uphold workplace security.

F. Robotics

A machine or robot must be able to recognise circumstances and objects. The robot can recognise the thing by snapping a picture and feeding it into the system if the system has similar images.

IV. FEATURES EXTRACTION IN CBIR

CBIR approaches have been created in recent years based on colour, texture, shape, and spatial position. Segmentation, low-level feature detection and extraction, representation, high-level semantics, storage, and effective indexing challenges must still be developed and solved.

• ***Level 1:*** Retrieve images based on the basic attributes of image elements, such as colour, texture, and shape. Find pictures like these, for instance, by looking for pictures with a green background and a brown object in the foreground.

• ***Level 2:*** Object retrieval from the specified query derived features used to identify the image.

Retrieval by abstract and its properties at ***Level 3*** includes retrieval of named events or activities, among other things. Such queries include, for instance, "find photographs of an Indian new year."

Most CBIR systems, as can be seen, operate at level 1. However, by adding interactive RF mechanisms to the system, levels 2 and 3 can be reached. Even though several CBIR systems have been created for image retrieval, it might be difficult to describe an image according to its visual content for a variety of reasons. The [i]Semantic gap and [ii]Sensory gap are two important causes. The sensory gap can be further broken down into various groups, including changes in lighting, scale, viewpoint, occlusion, and rotation.

1) ***Semantic gap:*** This is the discrepancy between the high-level perception of a picture by a human being and the low-level features extracted by machines.

2) ***Sensory gap:*** The sensory gap refers to the difference between an object's or a scene's real-world characteristics and its system's representation of those characteristics, such as illumination, scale, and occlusion, derived from the recorded image.

*3) **Lighting modification:*** A photograph's appearance is significantly impacted by the lighting. Changes in illumination consequently have an impact on appearance. Creating a reliable system to recognise an object or scene in various lighting situations is a simple undertaking.

*4) **Changes in scale/size:*** An object may appear at various sizes in various photos, and its positioning may vary from one to the next. Additionally, scenic photographs can appear up close or far away, for example, a group of trees in the foreground of one image may appear behind grassland in another. These pictures can be regarded as being interchangeable.

*5) **Variations in viewpoint:*** The way the camera is positioned in respect to an object or scene can alter how it appears. This could cause the system to identify those photographs as being unique.

*6) **Occlusion:*** Occlusion can occur in a number of ways. Occlusion happens when another object obscures (occludes) the primary object in an image. Occlusion can occasionally refer to areas about which we are in the dark (part of an object).

*7) **Rotation:*** There may be instances where an object or scene in an image is viewed from a different angle. They could also be turned upside down or in the opposite direction. The system could interpret an object or scene as distinct even though it is identical other than the angle.

*8) **Other:*** truncation, background noise, and poor articulation

Contrary to CBIR systems, a person can deal with every one of these circumstances. In addition to these, there are other elements that influence performance and result in issues with inadequate query specification or inadequate image description, such as ambiguity and user viewpoint. The user's perspective and the categorisation could be completely at odds. Real user feedback is therefore useful for CBIR performance development. The classification performance can be evaluated normally using ground truth, PRF, and simulated user RF, but the assessment retrieval performance requires real users. However, the classification performance is impacted by both intra- and inter-class heterogeneity.

The system will be smart, as expected by the users, if it is effective at bridging the semantic gap and enabling the queries to be satisfied. However, as it is a difficult and complicated task, it has not yet been resolved. In order to bridge the semantic gap, it is critical to take the retrieval performance into account. It is true that people are typically unsatisfied with a slow system that takes a long time to produce results. The dimensionality and quantity of objects to search through, however, have an impact on the system search time. As a result, indexing and retrieval in a CBIR system must be effective and cost little to compute. The amount of memory and disc space needed also has an impact on the system's overall performance. The system's usefulness must also be taken into account. Therefore, it is preferable to address this problem while creating a CBIR system. The aforementioned concerns, especially semantic retrieval performance, must be addressed for a system to be successful, which is a difficult challenge.

V. PROPOSED METHODOLOGY

There are many different colour space models, however the YCbCr colour space is significantly more suited for video and human visual systems. created a codebook with chromatic and achromatic colour patterns at 64, 128 and 256. This colour scheme was described as a basic pixel block's characteristic in a colour image. Here, a 4x4 block is regarded as a small block. They produce (mxn) / 16 blocks if an image has mxn pixels.

Three components make up an image section's visual detailing. The three variables are the stimulus intensity (S), achromatic spatial pattern (P), and chromatic spatial pattern (denoted by C). P channel records the achromatic spatial pattern of the input colour image, whereas C channel records the chromatic spatial pattern. A frequency sensitive competitive learning approach was used to create codebooks for achromatic and chromatic patterns separately because it is less sensitive to the first codeword chosen and is more useful than codebooks created using other vector quantisation methods.

Histogram generation is as follows and a 64 dimensional colour histogram was generated. This research used 64 codewords; 32 Achromatic Spatial-Patterns (ASP) and 32 Chromatic Spatial-Patterns (CSP). They were combined as one single vector in our research.

– First convert Image from RGB space to

$$sc_r = \frac{1}{4S}\sum_{i=0}^{1}\sum_{j=0}^{1} c_r(2k+i, 2l+j)$$

$$sc_b = \frac{1}{4S}\sum_{i=0}^{1}\sum_{j=0}^{1} c_b(2k+i, 2l+j)$$

YCbCr.

– Then Image was subdivided into non-overlapping 4x4 size blocks.

– Strength (S) of the block (mean) was calculated. Suppose

$$Y = y(ith, jth),\ i, j = 0, 1, 2, 3$$

be the 4x4 Y Image block. Then stimulus strength (S) was calculated by equation 1.1.

$$S = \frac{1}{16}\sum_{i=1}^{3}\sum_{j=1}^{3} y(i,j)$$

Each pixel in the block was divided by the mean S to generate pattern vector.

where

$$ASP = \{asp(ith, jth),\ i, j = 0, 1, 2, 3\}$$

$$asp(i,j) = \frac{y(i,j)}{S}$$

CSP vector was constitue by sub-sampling of the two chromatic channels Cb and Cr to gain a single vector

Sub-sampled signal

$$Cb = \{cb(ith\ , jth),\ i, j = 0, 1, 2, 3\}$$

$$Cr = \{cr(ith\ , jth),\ i, j = 0, 1, 2, 3\}$$

and

$$Cb;\ SCb = \{scb(kth, lth),\ k, l = 0, 1\}$$

$$Cr;\ SCr = \{scr(kth, lth),\ k, l = 0, 1\}$$

Then the CSP vector was generated

$$CSP = \{csp(k),\ k = 0, 1, , 7\}$$

by concatenating SCb and SCr

- A related index was discovered employing 32 codewords for both pattern and colour. Pattern vector ASP and vector CSP were presented. To store values according to indices like histP and histC for pattern and colour, respectively, two 32-dimension vectors were created. In new histP and histC, the value one was added to those indices in accordance.

–Up until all of the Image blocks were finished, the aforementioned stages were repeated. For both histP and histC, the count for the nearest index value was located in each step and increased by one.

–After normalising histP and histC by dividing the vector's total value, they were concatenated to create a single vector.

– Histogram in 64 dimensions for colours was generated.

The image is then retrieved by comparing the image histogram of the test image with the already-existing images in the database to determine how similar they are, and it then retrieves the precise image that was requested

VI. SIMULATION AND RESULTS

When we use the term "multi-level," we mean that three levels of image search were conducted by choosing the proper feature order based on the type of dataset (dataset of objects, colour images, texture images or heterogeneous collection). For instance, the form feature was used to re-rank the photographs after the initial round of searching for related images. Now that we have obtained a list of photos from the shape feature, we have reranked the list using the texture feature, taking into account only a portion of the Image list from the earlier collected list. The identical Image list that the form feature to texture feature provides is used in the second level, but it is reranked. The final retrieval list is then taken and presented to the user after a subset of this list has been utilised to re-rank using the colour feature.

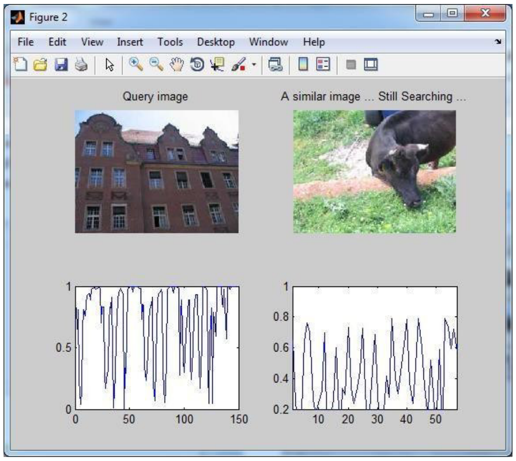

Fig 2 Similar image searching

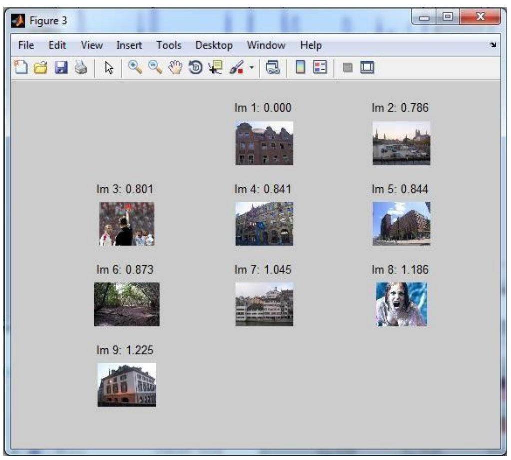

Fig 3 Similar images

The final retrieval list is then taken and presented to the user after a subset of this list has been utilised to re-rank using the colour feature. Given that we give the shape feature the most weight among the three, this example instance might be more helpful for object detection. Utilizing Image attributes in accordance with the database's importance was the goal of this. Color, texture, and shape order was the best way to search for photographs because we were using general images.

TABLE 1

COMPARATIVE TABLE BETWEEN THE INTEGRATED APPROACH AND PROPOSED WORK

	Integrated Approach	Proposed Work
Beaches	0.5	0.8
Buildings	0.7	0.91
Buses	0.98	0.99
Elephant	0.6	0.75
Flowers	0.89	0.89
Mountain	0.7	0.74
Horse	0.8	0.83
Dinosaur	1.0	1.0
Food	0.6	0.83
Overall accuracy	0.75	0.82

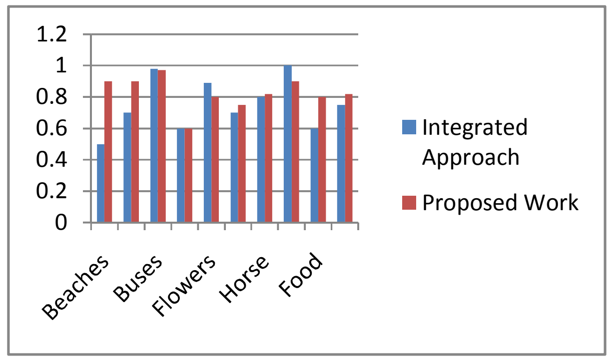

Fig 4 Precision results of Integrated approach and proposed work

VII. CONCLUSION

The algorithm that would be suggested in the following work would be based on YCbCr and content-based, and it would also incorporate the histogram of the image because it is also a key component in the field of imaging. As a result, it would search the database for images using three different criteria: text, colour, and the histogram of the requested image. The goal of the article was addressed by simulations, but the suggested method in content-based picture retrieval by YCbCr image transformation changed and proposed technique yielded better results. The average accuracy for all image categories is 95%, which is by far the greatest among the systems currently in use.

REFERENCES

[1] M. N. Munjal and S. Bhatia, "A Novel Technique for Effective Image Gallery Search using Content Based Image Retrieval System," 2019

International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon), 2019,

[2] V. A. Wankhede and P. S. Mohd, "Content-based Image retrieval from videos using CBIR and ABiR algorithm," 2019 Global Conference on Communication Technologies (GCCT), 2015, pp. 767-771, doi: 10.1109/GCCT.2015.7342767.

[3] F. -R. Andrés, R. -M. Eduardo, A. -C. Carlos and L. -S. Fidel, "Image Retrieval System based on a Binary Auto- Encoder and a Convolutional Neural Network," in IEEE Latin America Transactions, vol. 18, no. 11, pp. 1925- 1932, November 2020,

[4] Y. Yan, M. Yang, S. Zhang and Y. Zhang, "Image Retrieval Based on Block Motif Co-Occurrence Matrix," 2019 IEEE 14th International Conference on Intelligent Systems and Knowledge Engineering (ISKE), 2019, pp. 994-1000,

[5] N. K. Rout and M. Kumar Ahirwal, "A Content Based Image Retrieval System: Analysis of individual and Mixed Image Features," 2018 international Conference on Recent innovations in Electrical, Electronics & Communication Engineering (ICRIEECE), 2018.

[6] G. Rafiee, S. S. Dlay and W. L. Woo, "A review of content-based image retrieval," 2010 7th International Symposium on Communication Systems, Networks & Digital Signal Processing (CSNDSP 2010), 2010.

[7] G. Qiu, "Indexing chromatic and achromatic patterns for content-based colour image retrieval, Pattern Recognition", Volume 35, Issue 8, 2002.

[8] Xiang-Yang Wang, Hong-Ying Yang, Dong-Ming Li, "Distinctive Image Features from Scaleinvariant Keypoints," International J. Computer Vision, Vol. 60, pp. 9 1- 1 10,2016.

[9] Vipin Tyagi, "Content-Based Image Retrieval Ideas, Influences, and Current Trends", Springer 2017.

[10] Heng Chen and Zhicheng Zhao, Semantic-based visual information retrieval: IRM Press, 2017.

[11] Monika Daga, Kamlesh Lakhwani, "Image classification for content-based indexing," Image Processing, IEEE Transactions on, vol. 10, pp. 1 17- 130,2016.

[12] Peter Enser Yiannis Kompatsiaris Noel E. O ConnorAlan F. SmeatonArnold W. M. Smeulders,"Image and Video Retrieval", Third International Conference, CIVR 2004, Dublin, Ireland, July 21-23, 2004. Proceedings.

[13] Thomas Hurtut, Yann Gousseau, Francis Schmitt, "Adaptive image retrieval based on the spatial organization of colors", Computer Vision and Image Understanding, Volume 112, Issue 2, 2008.

[14] Ying TanYuhui ShiZhen Ji, "Advances in Swarm Intelligence", Third International Conference, ICSI 2012, Shenzhen, China, June 17-20, 2012.

[15] A. Preethy Byju, B. Demir and L. Bruzzone, "A Progressive Content-Based Image Retrieval in JPEG 2000 Compressed Remote Sensing Archives," in IEEE Transactions on Geoscience and Remote Sensing, vol. 58, no. 8, pp. 5739-5751, Aug. 2020

[16] K. Kumar, J. Li and Zain-Ul-Abidin, "Complementary feature extraction approach in CBIR," 2015 12th International Computer Conference on Wavelet Active Media Technology and Information Processing (ICCWAMTIP), 2015

[17] Xu, Q. Lin, J. Huang and Y. Fang, "An Improved Ensemble-learning-based CBIR Algorithm," 2020 Cross Strait Radio Science & Wireless Technology Conference (CSRSWTC), 2020

[18] Y. Huang, J. Zhang, L. Pan and Y. Xiang, "Privacy Protection in Interactive Content Based Image Retrieval," in IEEE Transactions on Dependable and Secure Computing, vol. 17, no. 3, pp. 595-607, 1 May-June 2020.

[19] W. Zhou, H. Li, J. Sun and Q. Tian, "Collaborative Index Embedding for Image Retrieval," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 40, no. 5, pp. 1154-1166, 1 May 2018.

[20] F. Peng, J. Luo, G. Wang and K. Qi, "Stereo Image Retrieval Using Height and Planar Visual Word Pairs," in IEEE Geoscience and Remote Sensing Letters, vol. 14, no. 11, pp. 2082-2086, Nov. 2017.

[21] M. Marinov, I. Valova and Y. Kalmukov, "Design and implementation of CBIR system for academic/educational purposes," 2020 International Conference Automatics and Informatics (ICAI), 2020

[22] X. Pan et al., "Content-Based Visual Summarization for Image Collections," in IEEE Transactions on Visualization and Computer Graphics, vol. 27, no. 4, pp. 2298-2312, 1 April 2021,

[23] L. K. Pavithra and T. Sree Sharmila, "An Improved Seed Point Selection-Based Unsupervised Color Clustering for Content-Based Image Retrieval Application," in The Computer Journal, vol. 63, no. 1, pp. 337-350, Jan. 2020.