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CBIR: A REVIEW ON ITS NEW TRENDS IN CURRENT ERA

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ABSTRACT

There is a technique used for searching and retrieving images which is based on their visual content is called content based image retrieval (CBIR). The process involves extracting visual features from images and then comparing them with features of other images to find the best match. Convolutional Neural Networks (CNNs) have become a popular choice for extracting features from images because of its ability to automatically learn relevant features. CBIR systems that utilize CNNs have shown to outperform traditional methods in accuracy and efficiency. By combining the power of CNNs with CBIR, image search and retrieval systems can provide highly relevant results. It has a wide range of uses, which includes medical diagnosis, surveillance, and e-commerce.

In this literature review we have tried to cover every possible techniques we can use for quick image retrieval based on traditional methods and new current age method. We have also discussed use of new technology for making an accurate CBIR system based on advantage technology called Deep Learning. For effective image retrieval from a database, we need to consider different techniques. Extensive research has been conducted in this area, and new techniques for CBIR systems are currently being developed.

Keywords: CBIR, Feature Extraction, Similarity Measure, Deep Learning, Convolutional Neural Network.

I. INTRODUCTION

CBIR (Content-Based Image Retrieval) is an innovative technique for searching big datasets for digital images. It is also known as Query by Image Content (QBIC), and it has become increasingly popular due to the exponential growth of digital images in recent years. Images are indexed in CBIR based on visual attributes retrieved from picture data such as colour, texture, and form(shapes). The user then inputs a queried image, and the system fetch images with similar visual features from the database. CBIR has various applications, including in medical diagnosis, satellite imagery, art collections, and forensic investigation.

The main advantage of CBIR is that it is based on the visual content of images rather than text or metadata, thus making it appropriate for searching large databases of images without the need for manual annotation. It provides a more efficient and accurate search than traditional text-based search methods, which rely on manual keyword annotation. CBIR systems use a combination of low-level features and high-level features for extracting the visual content of an images. Colour, texture, and form(shapes) are examples of low-level features, whereas object recognition, scene recognition, and picture categorization are examples of high-level features.

The process of CBIR involves three main stages: feature extraction, indexing, and retrieval. In feature extraction, the visual features of an image are extracted using various techniques, such as color histograms, Gabor filters, and wavelet transforms. In indexing, the features are organized and stored in a database using various indexing methods, such as vector quantization, clustering, and tree-based indexing. In retrieval, the user inputs an image, and the system fetch all the images from the database based on their similarity score to the queried image.

One of the biggest problems in the CBIR System is the linguistics(semantics) gaps, which refers to the distinction between high level semantic concepts and low level visual feature. Colour and textures also know as low-level features may not always correspond to high-level concepts, such as object recognition or scene recognition. This makes it difficult to retrieve images based on semantic content. To overcome this challenge, researchers have developed various techniques, such as relevance feedback, ontology-based retrieval, and deep learning based retrieval of images.

The main objective of the CBIR system is used to get pictures that are similar to the queried image, and this can be achieved by using ML(machine learning) algorithms, such as CNN(Convolutional Neural Network). CNN are network architecture in deep learning algorithm that has revolutionized the field of computer vision. They are

widely used in CBIR systems due to their ability to learn complex features from images. CNNs consist of multiple layers that learn different features of an image, starting with low-level features like edges and corners and moving up to the high-level features like objects and shapes. CNN have been shown to outperform traditional machine learning algorithms in a various extent of tasks related to computer vision, such as segmentation, object detection, and image classification.

CBIR systems that use CNNs typically includes two main components: a) Feature Extractor and b) Similarity Measure(distance measure). A feature extractor is a CNN that learns a set of features from images. These features can be extracted from the last layer of the CNN or from an intermediate layer. The similarity measure compares the combines the features of the query image with those of all of the images in the database, returning an image that mostly matches the query image.

With the use of CNNs in CBIR system has several advantages. First, CNNs can learn high-level features that are more representative of the content of an image, compared to hand-crafted features that are used in traditional CBIR systems. Second, CNNs can handle a wide range of image variations, such as different lighting conditions, orientations, and backgrounds. Third, CNNs can be fine-tuned on specific image datasets, which improves their performance on a particular task.

The performance of CNN-based CBIR systems depends on several factors, such as the choice of CNN architecture, the size of the training dataset, and the similarity measure used. Recent studies have shown that using larger and deeper CNNs, such as ResNet and Inception, can improve the performance of CBIR systems. In addition, using transfer learning, which involves using pre-trained CNNs as feature extractors, can reduce the amount of training data required and improve the performance of CBIR systems.

To summarize, CBIR is a powerful technology that enables the retrieval of images based on their visual content. The use of CNNs in CBIR systems has significantly improved their performance, by enabling the learning of high-level features from images and handling a wide range of image variations. CNN-based CBIR frameworks have a great many applications, including picture web crawlers, clinical conclusion, and surveillance systems, and their performance is expected to improve further with the development of new CNN architectures.

CNNs are also used for feature extraction in CBIR systems. Convolutional layers in CNNs automatically learn and extract features from images, such as edges, lines, and patterns. These learned features can be used to represent images in a lower-dimensional space, which facilitates efficient retrieval. Feature extraction using CNNs involves passing the images through the convolutional layer and obtaining the end product of the final layer of convolution as the feature representation of the image. This feature representation can be used to compare and retrieve similar images using various distance metrics like euclidean distance, cosine similarity, correlation coefficient.

In conclusion, content based image retrieval is a powerful technique(method) that is in use for searching digital images in big database based on their visual content. It has various applications in different fields, and it provides a more efficient and accurate search than traditional text-based search methods. The main challenges in CBIR are the semantic gap and the large size of image databases. Researchers have developed various techniques to overcome these challenges, including relevance feedback, ontology-based retrieval, and deep learning-based retrieval. With further advancements in computer vision and machine learning, CBIR is anticipated to play a growingly important act in image search perhaps retrieval in a future. CBIR occurs as an important application of computer vision, which has various real-world applications such as medical diagnosis, surveillance, and image retrieval. Deep learning CNNs have revolutionized the field of CBIR by enabling automatic feature extraction, efficient representation learning, and accurate retrieval. The use of CNNs in CBIR has led to significant improvements in retrieval accuracy and has opened up new possibilities for research in this field.

II. LITERATURE REVIEW

With the introduction of new techniques by different authors every time the performance of CBIR system had increased efficiently which is good. The main steps of an CBIR system is image representation, feature extraction, similarity measurement. To start with the key image representation techniques, like color histograms, textures analysis, also shape analysis then only the process of the feature extraction techniques

used in CBIR systems, such as edge detection, texture analysis, and region-based methods and lastly various similarity measurement techniques used in CBIR systems, including Euclidean distance, cosine similarity, and Mahalanobis distance. [1] With the need above techniques there has to be an metrics that can evaluate the performance of the techniques used. To do that in [2] the author has revealed the used of precision, recall and F1 Score in keeping track of performance of the techniques used.Apart from these there are various techniques for features for feature extraction which is mentioned in[3] the author here defines a hybrid method which include different feature extraction and feature similarity that are used for further processing while some CBIR algo's use the shapes feature extraction from the shapes of the objects also is categorized having higher accuracy similar to the standard feature like textures and colour.

Component extraction strategies are variety correlogram, variety minutes, HSV Variety Space, Fixed wavelet transform(SWT), gabor wavelet change, binarized factual picture highlights (BSIF), variety and edge directivity Descriptor where auto-correlogram uses RGB histograms as the features and mainly beacause of it easy to compute ability and which express the stored image's color changes are spatially correlated with distance, the color moments are the measures that are in used as the difference images based on their features of color, HSV histogram has three stage:

1. Conversion of the color space,
2. Quantization of the color and,
3. Computation of the histogram.

The first stage is RGB images is modified in to the colour space of HSV. Colours are differentiated by the hue, a percentage of the white light which is called saturation and to perceive light intensity means value, SWT decomposes images in multiple relative frequency bands which allows the frequency isolation into multiple sub-points. Using filters, it separate the high frequency and low frequency parts in the signal, A statistically based image descriptor known as Binary Statistical Image Feature (BSIF) uses thresholding to produce a binary code string. The independent vector are extracted from sample training data using ICA or Independent component analysis, CEDD utilizes variety and surface data into single histogram canister decreasing the element size. Another yet most important problem in the CBIR System's in which queried image is compared to the database image. Various similarity metrics are I. Euclidean Distance, II. City-block Distance, III. Minkowski Distance and IV. Mahalanobis Distance. The most widely used is ED or Euclidean distance because of its efficiency that measure distance between two feature vector in a tableby processing square foundation of amount of square outright contrast (I.e., by computing square root of sum of square absolute difference), city block metrics calculates path between pixels based on 4 connected neighbourhood. Also known as Manhattan distance., Minkowski distance is a generalization of both Euclidean and Manhattan metrics and mahalanobis distance is proportion of distance between point P and conveyance(distribution) D. Finally a precision are calculated for the hybrid method used for feature extraction. This is not the end towards CBIR apart from these the CBIR, also contains feature matching, and sub-space selection techniques introduced in [4]. It has been meticulously crafted to surpass the constraints imposed by current image retrieval systems, ensuring unparalleled accuracy and efficiency.

It consists of three main components: feature extraction, feature matching, and sub-space selection. In the feature extraction stage, a set of the feature is extracted from each images using the scale invariant feature transforms (SIFT) algorithms. In the property(the feature) matching stage, the take out (extracted) features is then matched by contrasting the queried image with the images stored in the database using Fast Approximate Nearest Neighbor (FANN) algorithm. In the sub-space selection stage, a sub-space is selected from the feature space to enhance the accuracy of the retrieval system also we get to know how well various distance measures[5] work in content-based image retrieval (CBIR). Using CBIR, images can be retrieved from a database which is based on the color, texture, and form(shape). Because of their use I.e., to calculate the similarity between query and database images, distance measures play an important role in CBIR System. There are eight distance measures, including Euclidean distance, Manhattan distance, cosine distance, relationship distance, Chi-squared distance, Bhattacharyya distance, convergence distance, and Hellinger distance. And as per the study the distance metrics and everything in the system is solely depends on the type of work and dataset which is mentioned in [6]. There are various machine learning algorithm that we can use[7] as

discussed by the author like SVM (Support Vector Machine), KNN (K-nearest Neighbour), RF (Random Forest), DT (Decision trees), etc. Also the author revealed use of CNN in CBIR systems. In CNN the performance is only influenced by similarity measures and features representation. Through this process once a hyper plane is trained using SVM that separate likely and dis likely pairs to large degree. For better results the use of CNN proves to be very effective. Euclidean factor is used for finds relationship among stored image and queried image. Also an evaluation metric called precision is used for evaluating performance of the CBIR system. There is also a classification method like KNN [8] for different feature extraction algorithm for good accuracy and image retrieval process. The color moments will extract color features, Connected Region will extract Shape feature and Discrete Wavelet Transform will extract texture feature. The work of the KNN algorithm is to classify query images into classes before starting the retrieval process. The proposed method uses 3 different color spaces RGB, HSV and Grayscale Color Space. A measurement that distinguishes each image based on its color features is the Color moments. Connected region selects the most dominant shape feature present within all the image. To extract texture detail from images, the Discrete Wavelet Transform (DWT) decomposes image sub-bands using low pass filters and high pass filters at every level of decay(decomposition's). And most important the KNN Classification Algorithm is used classify the category of queried image according to its comparison measures with the database image. After all the evaluation the results of those with KNN has better accuracy value and which were used previously in the existence has low accuracy.

In case of large scale dataset in [9] The author starts with an overview of the historical development of image retrieval, tracing its roots from the early days of information retrieval to the more recent developments in multimedia information retrieval.

The paper discusses the important components of retrieval of image I.e., systems, including image visualization, indexing, and similarity measurement that explores different approaches to each of these components. Various image feature extraction techniques are presented, including color, texture, shape, and edge-based features. The author also discusses different indexing structures and search strategies that can be used to efficiently retrieve images from large datasets.

The paper further examines different approaches to measuring similarity between images, including distance-based measures, model-based measures, and learning-based measures. The author highlights the importance of incorporating human perception into similarity measurement, and discusses the use of relevance feedback and user interaction in improving retrieval performance.

Finally, the paper concluded with a communication of ongoing(current) trends and coming(future) directions in image retrieval system, including the use of deep learning techniques, the incorporation of multimodal information, and the need for more effective evaluation methodologies. Overall, the paper provides a extensive overview of the field of the image retrieval system, also highlight the various challenges & opportunities that exist in this exciting and rapidly evolving area of research. [9]

Content-Based Image Retrieval (CBIR) and its significance in the present are the subject of the paper. The authors begin by outlining the fundamentals of CBIR, which include feature extraction, indexing, and similarity matching, among other things. In addition, they talk about the advantages and disadvantages of CBIR in comparison to other methods for retrieving images.

The color-based, texture-based, shape-based, and hybrid features extractions technique that are used in CBIR sustems are then discussed in depth in the following section. The creators give an outline of every procedure, alongside their benefits and constraints. In addition, they talk about recent developments in feature extraction methods like deep learning-based feature extraction.

The indexing methods used in CBIR, such as signature-based indexing, tree-based indexing, and hashing-based indexing, are then discussed by the authors. They give an overview of each method, outlining its benefits and drawbacks. They also talk about recent developments in indexing methods like distributed indexing and scalable indexing.

The distance-based, model-based, and semantic matching similarity matching methods utilized in CBIR are further discussed in the paper. Each method is discussed in detail, along with its benefits and drawbacks, by the authors. In addition, they talk about recent developments in similarity matching methods like deep learning-based similarity matching.

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The authors conclude by highlighting the significance of CBIR in today's world, particularly in healthcare, surveillance, and social media. They emphasize the necessity of developing more robust and accurate CBIR systems as well as the various difficulties and limitations of CBIR. The paper ends with a communication of challenges also adding future directions in the field also the potential research areas. And an in-depth analysis of CBIR and its components, including their benefits, drawbacks, and most recent developments. In addition, the authors highlight the current significance of CBIR and suggest potential areas for research.[10]. There is need to know the color model relevance of colour information in CBIR and the requirement for effective colour representation was innovated by the authors in the opening paragraphs. After that, they give a brief review of the many colour models that are utilised in CBIR, including RGB, HSV, HSL, YUV, CIE Lab*, and CIE Luv*. The contrast, sharpness, saturation and more proves to be very important for proper prediction.

The authors next contrast how well different colour models perform in a variety of image retrieval tasks, including color-based picture retrieval.[11]

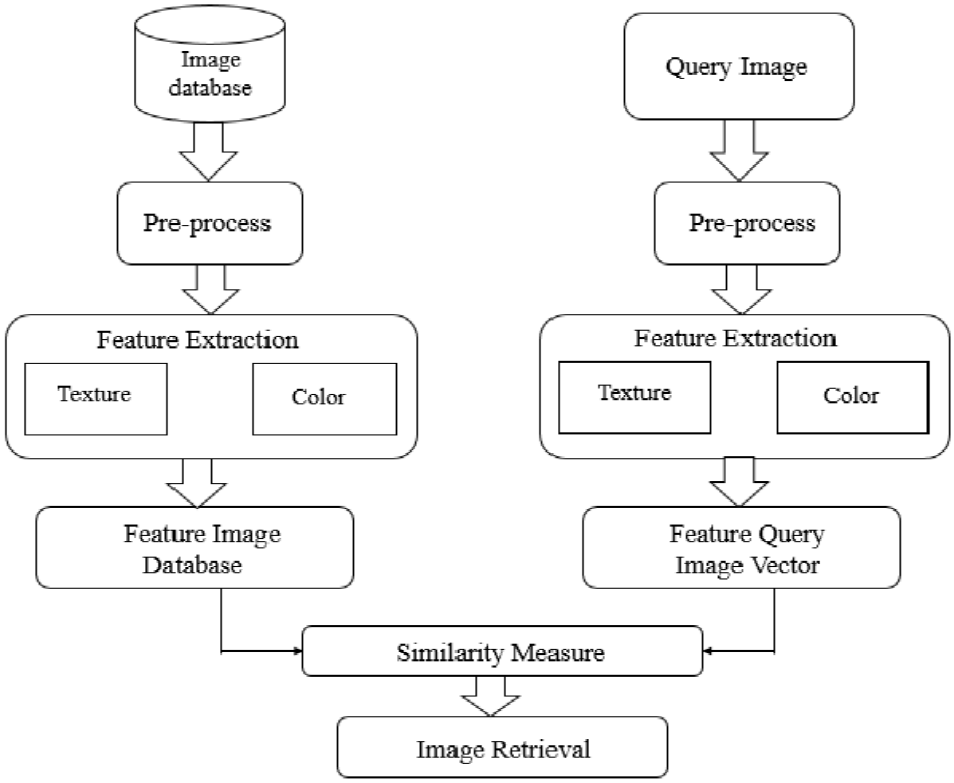

Figure 1: Traditional CBIR Model

To overcome all the problems or issues of the author [12] has revealed the use of Convolutional Brain Organisations (CNNs) for feature extraction and picture classification are then addressed.

There are various use case the author is discussing is in the medical care field, CBIR is utilized for clinical conclusion, therapy arranging, and illness observing in medical imaging, like radiology and mammography.

In the security field, CBIR is utilized for reconnaissance, scientific examination, and distinguishing proof errands. Face recognition and fingerprint analysis are two examples of CBIR systems used in law enforcement. Also Content recommendation, video summarization, and image categorization are all applications of CBIR in the entertainment industry. CBIR systems used in movie and video recommendation systems [13] In the training field, CBIR is utilized for e-learning, picture comment, and visual learning undertakings. And the need for large-scale datasets, the limitations of image features, and the limitations of current retrieval algorithms are just a few of the challenges and limitations of CBIR. In general, the author highlights the potential of CBIR in addressing various challenges in these fields and provides a comprehensive overview of the applications of CBIR in various fields. The paper is valuable for scientists and professionals in the field of PC vision and picture recovery who are keen on the different utilizations of CBIR.

With the advancement there are also some cases where the data some time gets lost so to overcome this the author in [14] start by talking about the significance of clinical picture recovery and its applications in clinical practice, exploration, and schooling. They emphasize the drawbacks of conventional text-based image retrieval techniques, such as the subjectivity of human interpretation and the inconsistent and inaccurate annotations.

A three-stage CBIR framework for medical image retrieval is proposed in the paper: highlight extraction, include choice, and similitude coordinating. To represent the images and extract features, the authors make use of texture-based features like the GLCM (Gray Level Co-occurrence Matrix) and the LBP (Local Binary Pattern). They likewise utilize highlight choice strategies, like Head Part Examination (PCA) and Straight Discriminant Investigation (LDA), to lessen the dimensionality of the component space and further develop recovery productivity.

The creators assess the proposed strategy on a dataset of mammography pictures and contrast it and other best in class techniques for clinical picture recovery. The proposed method's efficacy is evaluated using a variety of performance metrics like Precision, Recall, and F1-Score. According to the findings, the proposed method performs better than other approaches in the term of retrieval efficiency with its accuracy. Additionally, the paper discusses the proposed solution's drawbacks. method, such as the difficulty of dealing with variations in image quality and size and the requirement for expert knowledge of feature selection methods. Incorporating semantic information and utilizing deep learning techniques for feature extraction and classification are two examples of potential future research avenues that are outlined by the authors.

A content based retrieval of image strategy of product images via Convolutional Neural Network (CNN) and Score Fusion is proposed in an article titled Product Image Retrieval Method Based on CNN and Score Fusion. The authors first discuss the drawbacks of traditional text-based search strategies and the importance of product image search for e-commerce. To capture the visual content of common images, they propose a CNN-based feature extraction approach. Extract elements from images using prebuilt CNN models such as VGG16 and ResNet50.

Scores from multiple CNN models can be combined in a score fusion technique also proposed in the paper to improve search accuracy. To combine scores, the authors employ different score fusion strategies, including total fusion, maximum fusion, and average fusion. The proposed approach is evaluated against a dataset of generic images and contrasted with other state of the art approach by acquiring generic image. The potency for the work evaluated by utilizing various performance measurement like precision, recall and mean precision (MAP). The final answer in the paper showed that the proposed technique outperformed various strategies in terms of recovery quality.

The paper also discussed the limit of the proposed work, such as the difficulty of dealing with variations in image quality and size, and the need for a large amount of training data. Authors suggest potential headlines for future research. B. Use of CNN models based on integration and consideration of explicit area information. Overall, this paper demonstrates the effectiveness of a new method for obtaining product images using CNN and score fusion of product image datasets.[15] The authors share insights on the advantages and limitations of their methodologies and suggest potential areas for future research in this area. Researchers and practitioners of e-commerce and image retrieval interested in the potential of CNN-based methods for commodity image retrieval tasks will find this document helpful. With all of that discussed above there are ways like use of hybrid approach [16] content based image retrieval system utilizing a collection of SIFT (Scale Invariant Feature Transform) and CNN (convolutional neural network). SIFT is used to extract feature descriptors from images. These descriptors are used to query the database for similar images. CNNs are used to train classification models on image data sets that are used to improve the relevance of acquired image. The Proposed system was well-tried on a data-set of flower image, and the result showed that the combination of SIFT and CNN improves the accuracy of the search system compared to using SIFT alone. Although all these finding is will never be just enough there will be more new techniques coming every time which will help in betterment of performance as well as accuracy of the CBIR system.

III. CONCLUSION

We did all the efforts to make this review most informative as possible keeping in mind the current development in this field of study. We get to know different techniques for feature extraction and similarity measures for building an effective CBIR system which is the most crucial part in the CBIR.

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