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Survey on Intelligent Approach of Content Based Image Retrieval and Classifications

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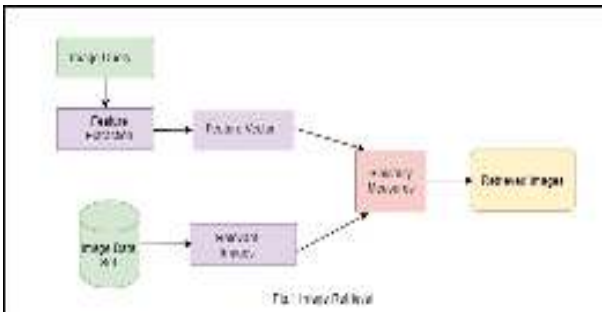
ABSTRACT

Image retrieval makes an emphasis role in this digital world. This work is a review of several references from various image retrieval methods. However, searching the digital image with its visual content is mandatory for searching and fetching images from the dataset. The Process of image retrieval becomes tough when it has to search huge number of images per seconds is very complicated than the searching fewer images. There are different efficient image retrieval techniques are available, here content- based image retrieval is the vital role with its visual contents in lesser time with more accuracy. It has proposed effective and resourceful intelligent techniques. The research work gives new dynamics of decent attention and performance of image retrieval with machine learning algorithm with balance training set and best classification of it. The large collection of images and retrieval with its semantic features of texture, shape, color, is measured. The essential reduction of semantic gap is main goal between user and CBIR system. Our research proposes the novel outlooks for various image retrieval techniques in intelligent way and its potential applications and future directions.

Keywords: Image Processing, Machine Learning, K-Nearest Neighbor, Local Neighbor Pattern, Artificial Intelligence, Support Vector machine.

1.Introduction

The process of searching an image from the large collection of image datasets and its retrieval. Since 1970[1,2] pictorial information processed by encoding and position-invariant for pattern recognition and picture segmentation and also used some management software. At present we are generating digital forms of images and it gets retrieval is good attention in the area of remote sensing, multimedia, image processing, planetary research areas, medical images, digital libraries, Location field descriptors, database applications, and other related areas. when the images of the collection grow into thousands is not an easy job for fast and effective retrieval. A query image relays to a relevant image from the collection of images which has to retrieve according to the human perception. The purpose of the image database for image storing, retrieving, and categorization for its future query which also inherits information retrieval, user query, system graphics, and database image assemblages is interconnected and gives an appreciated benefaction for the research. In [3][4] CBIR research encounters new challenging features low-level and high-level semantics of an image, so that we turn into new techniques with certain constraints of reducing the semantic gap for best results with high retrieval performances.



In early days image retrieval is not easy and efficient for searching and browsing an image which based on their visual feature. Often, they stored the images are tagged by its metadata, and it's used for searching images in the

collection of databases. Text-based image retrieval includes shapes, color, and texture of an image for supporting high performance and best accuracy in an innovative way.

Let us discuss a few intelligent techniques and their statistical performances for the intelligent image retrieval area. Section 2 is about the Literature Review of Image Retrieval, Section 3 is about machine learning Algorithms, Section 4 is about various Image Retrieval Techniques, Section 5 is about Evaluation Performance, Section 6 is about the Conclusion of this paper.

2.Literature Review

Retrieval of images by its content-based has proved some machine learning algorithm. The usage of machine learning in CBIR has an attractive factor in adaptive learning capability. Some predictable techniques for CBIR have proved with its greater performance and accuracy. Ideas and new conventional techniques of Machine learning presented are in [6-15]. The images are stored in image databases and their queries for retrieval in an application domain. Researches were performed on enormous image databases and it provides great performance and best results obtained after the inclusion of some machine learning algorithm. Let us discuss image retrieval techniques with some intelligent approaches to machine learning algorithms in a better way.

In [6] authors have proposed the Support Vector Machine (SVM) Methodology with its relevance query feedback incorporating with Region-Based Image Retrieval (RBIR) for high-performance. Image segmentation algorithm initiated by retrieving color content of a region and calculated their Earth Mover Distance for developing a generalized SVM. Feature extraction method named hybrid feature which includes shape, color, and texture converted to feature vector. Region Legendre Color Distribution Moments (RLCDM) is characterized by its color content of an image without constructing a histogram, even though accuracy compares with its full-color histogram. The proposed method provides shorter retrieval time while database growing rapid size, which also the best implementation for region-based image retrieval, and offer shorter recovery period of retrieval is compared with Earth Mover Distance (EMD) values are inaccurate.

In [7] authors have proposed a methodology of Support Vector Machine with its coupling techniques and Fuzzy clustering has used. The accuracy and retrieval time are measured with Prefiltered FCM. Image classification is done with the help of SVM-PWC with FCM for their entire database. The feature extraction method is used for extracts low-level features and it reduces dimension by Principal Component Analysis (PCA) technique, in addition to that Bhattacharyya, Mahalanobis, and Euclidean distance used for numerical computation measures of similar images. SVM-PWC techniques are giving an excellent forecast of the class category of the query images. The analysis of the result is done by Precision and Recall value. The maximum percentage for misclassified images are classified accurately with high accuracy, then the remaining percentage of images are classified with a database search in connection with decreasing time factor by Prefiltered database search. This paper's proposed work is concluded with high accuracy at the right time.

In [8] the authors have tried to compared CBIR relevant-feedback with SVM relevant-feedback with the help of user query to enhance it. CBIR uses query refinement band re-weighting which includes an imbalanced training set and limited information to the user. The semantic gap, human perception, and similarity visual feature are reduced among the user and the CBIR system. The Supervised learning techniques are used by SVM for retrieving an image according to user query by binary classification as similar images are called positive one, and dissimilar one is called a negative one. The techniques include data preprocessing, data collection, feature similarities, and applicable feedback from users to advancement the system performance. Query refinement band weighting has improved. MAP segmentation techniques used for image segmentation; Haar wavelet filter is used to extract texture features. Image similarity measures are done by Earth Mover Distance. The authors try to decrease the imbalance training set problem by the SVM-based classifier for retrieving more positive images as a similar image and also reduces the semantic gap.

In [9] authors have presented a scheme that uses the K-Nearest Neighbour Algorithm (KNN) from a large database using three attributes of shape, color, and texture. The retrieval technique of Text-based has disadvantages of efficacy, expensive task and gives some loss of information which is overcome by retrieval classifier of KNN. The color Feature Extraction method is used, which involves Color Histogram, Color Correlogram, and color moment, HSV histogram. The shape and texture are extracted by Wavelet transform. KNN classifies Image similarity measured by Relative Standard Derivation meanwhile query image to similar image from the database and it calculates the

distance between training and test vector. KNN classifier for image classification and RSD for similarity measures for CBIR performance improvement.

A huge remote sensing image data set enforces authoritative techniques of high-resolution satellite image retrieval argued in [10]. The paper recommends Scale-Invariant Features (SIFT) which also includes SVM linear classification. An anisotropic filter is used for increasing training data, empowering satellite images that were too complex when compared with other images. The SVM classifies average precision values increases by the usage of the descriptor SIFT and Cross Adaptive Luminance (CAL) for similarity distance. The SVM classifier with its filter beats the deep learning methodology with an average precision value. This paper concluded with an SVM classifier provides the best retrieval of intricate representation belongs to satellite images which inherit the color feature extraction method for high-resolution images.

In [11] authors have presented and enhance the traditional approaches of retrieval techniques by Support Vector Machine through Decision tree. This paper resolves the problem of the visual semantic gap among low-level and high-level fetures. Extraction on a color feature by color histogram and texture feature by structure composition of an object by its surrounding environment. The Canonical Correlation Analysis (CCA) gives the greater correlation between suggested similar image sets and gives better performance. The research depends on SVM with a decision tree and applies a hash function, to characterize a vector map for binary coding and to calculate Hamming distance calculated. The decision tree is constructed by an inductive learning algorithm and applied a greedy strategy for constructing a tree in a top-down manner. While classifier accuracy and speed of training are maintained by hyperplane function. The different kernel function like Gaussian kernel and Sigmoid function has made it and emphasizes the user center relevance feedback and to enhance traditional approaches of image retrieval in a shorter time and better performance.

In [12] authors have proposed image retrieval techniques with Local Neighbor Pattern (LNP) which includes some supervised machine learning techniques for better results. LNP method comprises and evaluates with the local binary pattern, local directional pattern, and wavelet-based techniques are proved shorter retrieval time improves to maximum percentage results. The supervised learning algorithm of the K-Nearest Neighbor and Support Vector Machine is compared with their different dimension like linear, medium gaussian, quadratic and cubic kernel for SVM; distance between class and number of neighborhoods calculated for KNN.

In [13] authors contended image retrieval by the combination of color, shape feature with help of Siamese Neural Networks of K similar images with N number of category repository by applied one-shot learning on query image. Convolution Neural Networks are used for feature extraction and make a good prediction in a very shorter timing. convert the image in to feature map, convolution layer for feature extraction, and corrected linear activation function is calculated for non-linearity to the system, sigmoid activation functions are used to overcoming the stepping function. Max pooling is used for the reduction of their size and thereby increase the calculation speed. An accuracy and mean average precision performance is found to be good with a maximum over the arbitrary testing of images.

In [14] authors have to present Content-Based Image Retrieval with the Convolution Neural Network method for classifying an image dataset and to calculated similarity between images by cosine similarity. Three layers are used specifically the pooling layer, convolution layer, and fully connected layer for image recognition and classification. Activation functions on CNN by the rectified linear unit (ReLu) are calculated for reducing negative values like dissimilar images and max-pooling calculated for reduces size. Retrieved images give the best results obtained maximum value by the average precision validation test accuracies.

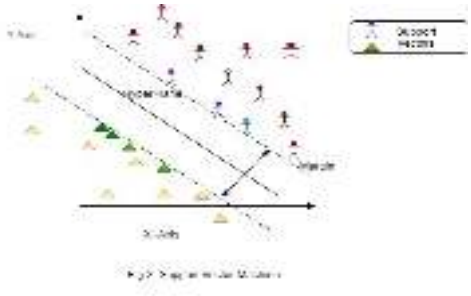
In [15] authors have proposed an Intensity Variation Descriptor (IVD) for image retrieval, to the represented image in variations of color, edges, and intensity. He highlights combines the advantage of RGB and color HSV spaces used to simulate lateral inhibition mechanism, orientations selection mechanism for optimum values. An IVD based on intensity variation serves as a bridge for extract features. He proposes IVD based on direction local binary pattern (LBP)tests texture image sets, which can effectively discriminate the texture feature and also proves higher performance than the existing one [16].

3.Machine Learning Algorithms

Machine learning algorithm learns on its procedure by giving feedback to the system and produce very optimal results that will ensure more accuracy and performances to produce a branch of conjectural technology called procedure learning theory [17].

3.1 Support Vector Machine

Support Vector Machine giving considerable good accuracy, classification for prediction given query image. SVM is supervised learning which is good for classification and regression, and it has a unique way of the ability to differentiate and categorical value of multidimensionality.



The representation of different classes using hyperplane, it's generated in an iterative manner and is reduced for errors. The images closest to the hyperplane are called support vectors, and the margin is the gap between lines which is larger is good for best performance while comparing small margins. The classifier uses the subsets of training samples.

The relevance feedback system in CBIR reduces the semantic gap among the user and the high-level and low-level features of an image. Support Vector Machine with Fuzzy C-Mean provides pairwise coupling techniques can predict query image which can predict for clustered centered Image Retrieval. SVM-Linear Classification is a modest, fastest classification and regression detection which is used for high-resolution images. Adaptive SVM with Random Decision Tree classification model gives the best characteristics of the dimension and its categories to improves the similar identification ability effectively. SVM-Local Binary Pattern Method gives better results which give more accuracy to minimize the training time samples [18].

3.2 K-Nearest Neighbors

This is one of the supervised machine learning methods smooth and effortless to implement. It classifies the data based on attributes of training objects and testing the object. K-NN uses image data and classifies the new image data based on similarity measures by Euclidean distance calculation. K-NN is classification done by choosing the nearest neighbor clustering it as similar which is done in a simple manner.

a. Let T be training samples

b. Initialize each query image, to create neighbor images as Super image

c. Calculate Euclidean distance between query image to every Super image data.

d. Assign query images to Super image as smallest Euclidean distance.

e. Put I label to relevant retrieved images

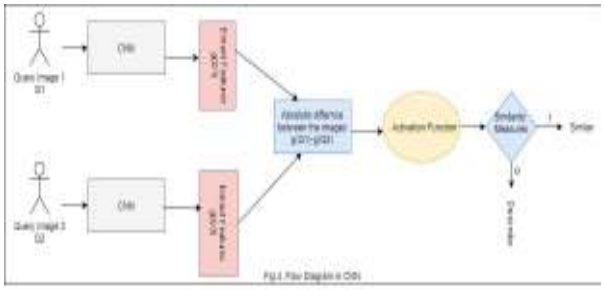
i) calculating mean for regression

ii) calculating model for classification

f. End

3.3 Convolution Neural Network

From the subset of machine learning, Deep learning supports the methodology of convolution Neural Networks. which is the subset of machine learning. The method has succeeded in image retrieval and classification with a maximum prediction rate and low preprocessing work while comparing with another algorithm. Input image recognized by extracting features and to classify dominant features by its hidden layers, filters, pooling, and fully connected layer and finally apply the activation function ReLu to decide query image similarly or not by representing binary value 0,1



The convolution Neural Networks method has speedup computations, adding different convolution layer until it satisfies similar one. Siamese Neural Networks with N-way shot learning algorithm to perform feature extraction of similar images with high precision results.

4.Retrieval Techniques

Retrieval techniques are three classes namely, low-level, mid-level, and high-level features. Here extraction of color, shape feature is low level, texture, edge feature extraction is the mid-level, solving semantic gap, and reducing human perception is the high-level features using machine learning techniques.

4.1 Low-level Features

Text-based image Retrieval offers a loss of information expensive task and time consuming which is the surface property of the object in the image, which does not depend on color and dimension feature. Query-based image Retrieval has image selected and equal to weight for ranking each image which enhances user query to the feedback method for supporting the user query-based image. selection and weight ranking of image retrieval. The color feature is mined from the color histogram and correlogram which measure the numerous colors in color space. It cannot be derived exact spatial distribution of over-all information. The shape and texture feature is extracted from the wavelet transform.

4.2 High-level Features

Content-based image Retrieval extracts high-level Features that are put to use and classify the database for similar images and dissimilar images of the visual features while applying a machine learning algorithm reduces the semantic gap. Region-based image Retrieval is effective for the color region which includes hybrid feature extraction of shape, color, and texture. The Scale-invariant features Transform which mainly focused on high-resolution satellite images that describe image matching and recognition these are invariant to translations, scaling, and rotation. SIFT Descriptors describe the local feature and calculate the feature vector of an original image by three-parameter location scale and orientation. Local Neighbor Pattern is the new feature extraction method in supervised machine learning techniques, it extracts the local feature based on the neighborhood pixel and its difference from the binary pattern of an image which improves the performance of CBIR more accuracy with minimum training time can extend the methodology for video retrieval. Intensity Variation Descriptor describes quantized edges to a specific direction by local direction detection method.It highlights HSV and RGB Color Spaces for optimal directions and spatial layout of lateral inhibition mechanism and orientation-selective mechanism for good CBIR Performance.

5. Evaluation Parameters for Retrieval Systems

CBIR Systems have some validation parameters for their retrieved image performance and accuracy. These measures are commonly depending on proposed algorithm visualization performance, user query, application domains, while it can classify the images from that, predict results in a good manner.

5.1 Precision

It is the proportion of retrieved similar images to the total amount of retrieved images which computed as

$$P = \frac{Number\ of\ Retrieved\ Relevant\ Images}{Total\ number\ of\ Retrieved\ Images}$$

5.2 Recall

The Recall is the proportion among quantity of retrieved similar images to total quantity of similar images which computed as

$$R = \frac{Number\ of\ Retrieved\ Relevant\ Images}{Total\ number\ of\ Relevant\ Images}$$

5.3 F-Measures

F-Measures gives better predictive power of hormonic mean

$$F = 2\ X\ \frac{P * R}{P+R}$$

5.4 Average Precision

Average precision $A_{avg}P$ for a single query j is obtained mean to each relevant image.

$$A_{avg}P = \sum_{j=1}^{RRI} \frac{P(j)*R(j)}{TRI}$$

RRI for similar images in the dataset, j for single input query image

5.5 Mean Average Precision

It is the mean of $A_{avg}P$ values for each query and given by,

$$MA_{avg}P = \sum_{q=1}^{W} A_{avg}P(q)/W$$

whereas W is the number set of queries.

5.6 Precision-Recall Curve

It shows first n number of most appropriate retrieved images belongs to the retrieval system represented by curve of PR values in different threshold levels.

Table1: Comparative Analysis

S.No	Limitations of Study Analysis	Performance with its description	Results
1.	Images of fuzzy feature is not considered in a Region-Based Image Retrieval [6].	Developing generalized Kernel SVM for quicker retrieval time	Image Retrieval accurate with generalized gaussian kernel.
2.	Missing or wrong input spoil the entire image representation in CBIR System [7].	Misclassified images are classified by SVM-PWC with FCM	Image accuracy is 94% .
3.	Problem with too much negative feedback of text retrieval in CBIR [8].	Enhanced relevant-feedback method	Solving the issue of imbalance training dataset

S.No	Limitations of Study Analysis	Performance with its description	Results
4.	KNN Classification time is too long [9].	K-Nearest Neighbour Algorithm	Error rate is minimized.
5.	SIFT presents its stability in most situations although its slow of satellite images [10].	Usage of SVM Classification in Scale Invariant Features.	Anisotropic data augmentation of average precision has increased
6.	In an Adaptive SVM, once a mistake is made at higher level, any subtree is wrong [11].	SVM and Random Decision Tree	Hierarchical tree structure has better search ability.
7.	Results are not support more accrue when irrelevant input feature are presented in training data [12].	LNP with supervised machine learning techniques.	Accuracy improves to 99.50%.
8.	More Hyper Parameter and fine-tuning is necessary of Siamese Neural Network [13].	One-shot learning technique of Siamese neural network.	Mean Average Precision is 98.62%.
9.	High computational cost, do not encode position and orientation of image in Convolutional Neural Networks [14].	Convolution Neural Network method with cosine similarity	Average precision retrieval is 89.6%
10.	Dataset grows, performance reduces of Intensity Variation Descriptor [15].	Intensity Variation Descriptor (IVD)	Best suited for trademark and palm print image retrieval

6. Conclusion

This paper examined different techniques and methodologies belongs to image retrieval systems. Recent advanced machine learning techniques have proved high-level semantic features while comparing low-level features in CBIR. This paper examined the Support Vector machine with a different addon decision tree, Scale-Invariant Features with SVM classification, local neighbor pattern with supervised machine learning, and methodology of K-Nearest Neighbor and Convolution Neural Network also. The CBIR enhances the learning procedure by machine learning and gives extraordinary highlights it contains. From this survey, CNN is observed to be dominant feature extraction for image retrieval and expertise in image recovery, but it has a very complex structure of implementation for recovery procedure, hence SVM has the best implementation routine in a good manner for image recovery. In the future machine learning system satisfy the semantic hole between machine observation and human judgment that lead in headlines of image recovery systems.

REFERENCES

[1]. A. Rosenfeld. “Picture processing by computer.”. ACM Computing Surveys, 1(3):147-176, 1969.
[2]. H. Tamura and S. Mori. “A data management system for manipulating large images.” In Proceedings of Workshop on Picture Data Description and Management, pages 45-54, Chicago, Illinois, USA, April 1977.
[3]. Ying Liu, Dengsheng Zhang, Guojun Lu, Wei-Ying M. “A survey of content-based image retrieval with high-level semantics”.Pattern Recognition 40 262 – 282(2007)
[4]. R.Datta, D.Joshi, J.Li, J.Z.Wang. “Image Retrieval: Ideas, In uences, and Trends of the New Age”. ACM Transactions on Computing Surveys, vol. 40, No. 2(2008)
[5]. G. Chechik, V. Sharma, U. Shalit, and S. Bengio. “Large scale online learning of image similarity through ranking”. Journal of Machine Learning Research, 11:1109–1135, 2010.
[6]. Zhiyong Zeng, Shengzhen Cai, and Shigang Liu, “A novel image representation and learning method using SVM for region-based image retrieval,” in 2010 5th IEEE Conference on Industrial Electronics and Applications, Taichung, Taiwan, Jun. 2010, pp. 1622–1626, doi: 10.1109/ICIEA.2010.5514756.

[7]. B. Celia and I. Felci Rajam, "An Efficient Content Based Image Retrieval Framework Using Machine Learning Techniques," in Data Engineering and Management, vol. 6411, R. Kannan and F. Andres, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2012, pp. 162–169.

[8]. P. Pavani and T. S. Prabha, "Content Based Image Retrieval Using Machine Learning Approach," in Proceedings of the International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2013, vol. 247, S. C. Satapathy, S. K. Udgata, and B. N. Biswal, Eds. Cham: Springer International Publishing, 2014, pp. 173–179.

[9]. P. A. Deole and R. Longadge, "Content Based Image Retrieval using Color Feature Extraction with KNN Classification," IJCSMC, Vol. 3, Issue. 5, May 2014, pg.1274 – 1280.

[10]. H. Sebai and A. Kourgli, "Improving high-resolution satellite images retrieval using Linear SVM classifier and data augmentation," in 2018 3rd International Conference on Pattern Analysis and Intelligent Systems (PAIS), Tebessa, Oct. 2018, pp. 1–7, doi: 10.1109/PAIS.2018.8598536.

[11]. X. Xie, W. Huang, H. H. Wang, and Z. Liu, "Image Retrieval with Adaptive SVM and Random Decision Tree," in 2018 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), 2018 2nd International Conference on, Palladam, India, Aug. 2018, pp. 784–787, doi: 10.1109/I-SMAC.2018.8653699.

[12]. M. Alrahhal and K. P. Supreethi, "Content-Based Image Retrieval using Local Patterns and Supervised Machine Learning Techniques," in 2019 Amity International Conference on Artificial Intelligence (AICAI), Dubai, United Arab Emirates, Feb. 2019, pp. 118–124, doi: 10.1109/AICAI.2019.8701255.

[13]. R Rajkumar, M V Sudhamani "Content based Image Retrieval System using Combination of Color and Shape Features, and Siamese Neural Network," IJITEE, vol. 9, no. 2S, pp. 71–77, Dec. 2019, doi: 10.35940/ijitee.B1053.1292S19.

[14]. Z. Rian, V. Christanti, and J. Hendryli, "Content-Based Image Retrieval using Convolutional Neural Networks," in 2019 IEEE International Conference on Signals and Systems (ICSigSys), Bandung, Indonesia, Jul. 2019, pp. 1–7, doi: 10.1109/ICSIGSYS.2019.8811089.

[15]. Z. Wei and G.-H. Liu, "Image Retrieval Using the Intensity Variation Descriptor," Mathematical Problems in Engineering, vol. 2020, pp. 1–12, Jan. 2020, doi: 10.1155/2020/6283987.

[16]. A.S. Arunachalam, T.Velmurugan. "A Survey on Educational Data Mining Techniques." International Journal of Data Mining Techniques and Applications 5.2 (2016): 167-171.

[17]. S. Perumal,T.Velmurugan, "Lung cancer detection and classification on CT scan images using enhanced artificial bee colony optimization",International Journal of Engineering & Technology,7 (2.26) (2018) 74-79.

[18]. Arunarani, S., Gobinath, R. "A relative analysis of multimodal biometric fusing face, ear and fingerprint"International Journal of Scientific and Technology Research, 2020, 9(4), pp. 1996–2002.

[19]. Arunachalam, A. S., S. Vaishnavi Sree, and K. Dharmarajan. "Malware Detection and Classification using Random Forest and Adaboost Algorithms.", International Journal of Innovative Technology and Exploring Engineering,Issue 8(10),2019,pp. 2863-2868.