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Image Retrieval Process Based on Relevance Feedback and Ontology Using Decision Tree

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Abstract

In this paper, another strategy for immediate features based image recovery is proposed. Image database is developed with low level texture features got from Gray Level Co-Occurrence Matrix (GLCM) and measurable techniques for Tamura. Semantic level inquiries from the user mapped to the low level peculiarities at recovery time to recover the required images. Images with more than one moderate features can be recovered by utilizing intersection of images recovered by each of the queried feature. Artificial Neural Network (ANN) is utilized as a part of the following steps in the wake of accepting user inputs. In spite of the fact that semantics are utilized as search key as a part of the beginning steps, low level features are utilized as a part of the ANN based searching in later steps. Back propagation Algorithm is utilized as a part of learning step. This ANN based relevance feedback technique enhances accuracy of immediate feature based image retrieval method. Decision tree (DT) can likewise be connected in relevance feedback stage. Decision tree is framed in training stage and images will be tested by of the decision tree. Relation storing ontology related information is utilized as a part of every phase of retrieval procedure to evacuate ambiguities identified with synonyms and hypernym-homonym sets.

Keywords: *Semantic Based Image Retrieval, intermediate feature, Neural network based image retrieval, Decision Tree based image retrieval, SQL based image retrieval, relevance feedback based image retrieval, Ontology in image retrieval*

1. Introduction

Content based image retrieval (CBIR) retrieves images in view of illustration image. Low level features of illustration image are ascertained and contrasted with low level features of accessible images utilizing diverse strategies. There are numerous methodologies of computing low level textures, color and features. Prior methodologies were principally on the improvement of low level features retrieval techniques. Yet now the pattern of image retrieval has been changed from low level image representation to more elevated amount semantic concepts. Semantic based image retrieval (SBIR) utilizes semantics to retrieve images from image database. There are diverse SBIR techniques like semantic color based retrieval, heuristic feature based retrieval, and intermediate texture feature based retrieval. 'High contrast', 'Low homogeneity' and so forth are examples of

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intermediate texture features. Intermediate texture based searching could be possible utilizing aggregate functions of SQL. Anyway result won't be dependably completely great. The reason is the semantic gap between the types of images user needs and the semantics he utilized for the query. For instance, user is looking for “low contrast brick images”. In any case he needs “low contrast, high coarse and horizontally directed brick images”. Subsequently user feedback is needed. As per significance of user feedback the output will be altered. This is called relevance feedback method. This is totally unique in rule based methodology where the system is prepared offline by experts before it answers the questions of the users. Artificial Neural Network can be connected in the relevance feedback phase. This system utilizes the low level texture features of the images as input pattern of ANN. Decision tree can likewise be applied in the relevance feedback stage. For every stage ontology mapping is needed for synonym and hepernym-hyponym related issues. There ought to be divided ontology file or relation for this reason.

2. Related Work

Low level texture features are for the most part utilized for content based image retrieval. Gray level co-occurrence matrix or GLCM of Haralick [1] is one famous technique for calculating low level texture features. Each element (i,j) in the normalized Gray Level Co-occurrence Matrix is the joint probability occurrence of pixel sets with a characterized spatial relationship having gray level values i and j in the image. A portion of the imperative features calculated from GLCM as follows:

$$\text{Contrast}=\sum_{i=1}^{N}\sum_{j=1}^{N}(i-j)^2 p(i,j) \tag{1}$$

$$\text{Energy}=\sum_{i=1}^{N}\sum_{j=1}^{N}(p(i,j))^2 \tag{2}$$

$$\text{Entropy}=\sum_{i=1}^{N}\sum_{j=1}^{N}p(i,j)\log(p(i,j)) \tag{3}$$

$$\text{Homogeneity}=\sum_{i=1}^{N}\sum_{j=1}^{N}p(i,j)/(1+(i-j)^2) \tag{4}$$

Where p(i, j) speaks to the $(i,j)^{th}$ component of GLCM and N is number of gray levels. Statistical Methods of Tamura [2] likewise used to figure some other vital texture features coarseness, line-likeness and so on.

Heuristics and intermediate features are likewise utilized as a part of image retrieval process. Heuristics and Intermediate feature based image retrieval [3] extracted and stored heuristics, semantic colors and low level texture features in the image database and later queried to get the right reply. Zhang, Liu, and Hou [4] extracted heuristics and Intermediate feature of images to use as indexes and intermediate images through structure query language. There is likewise proposition of applying relevance feedback for a couple times to enhance the retrieval precision. The essential thought of relevance feedback [5] is to move the load of discovering the right query plan from the user to the system. It is an intuitive method for enhancing list items by system utilizing user's feedback. Relevance feedback connects the semantic gap between low level features and high level concepts in content based image retrieval. Classification and Regression Tree (CART) algorithm used for decision tree [6] development can be utilized as a part of importance feedback stage. The algorithm uses class histogram and gini index for decision tree development. A class histogram keeps the frequency distribution of class value for every feature. Class histogram is index of <class, frequency>. While the Gini (T) for an data set contains n classes is characterized as

$$\text{Gini(T)=1-}\sum p_i^2 \quad (5)$$

Where pi is the relative frequency of class i in T. In the event that the part separate T in T1 and T2, then index of isolated information is given by

$$\text{Ginisplit(T) = (n1/n)*Gini(T1)+(n2/n)*Gini(T2)} \quad (6)$$

n is the aggregate information, n1 is number of data sets in class T1 and n2 is number of data sets in class T2. The best splitter is resolved as the characteristic which has smallest Gini value. Restricted of utilizing relevance feedback is by applying Neural Network. Neural Network [7-8] is an interconnected gathering of simulated neurons that uses a scientific model of information processing. Neural Network is versatile framework that progressions its structure taking into account include and yield information. Content based image retrieval by neural network [9] recovers images by separation metric learning furthermore by neural system. The single layer perceptron can be utilized for characterizing for both binary and consistent values. Multi-layer perceptrons are neural network systems with one or more layers of nodes in the middle of input and output nodes. Multi-layer perceptrons with back propagation network is applied in various applications. A feed forward back-propagation neural network (FFBP) [10,13] can be utilized to accomplish the Content based image retrieval usefulness. FFBP goes before both in forward and backward ways. The feed forward stage processes output from the weighted aggregate inputs to every neuron unit utilizing activation function. In the back propagation stage error is engendered from output to include registering incremental weight at every layer of the network. Object ontology [11] can be considered a set of idea definitions for categorizing items. It is important to remove ambiguities created synonym, hypernym-hyponym pair and so on. Separate ontology files give fitting reactions to query that require synonym or hypernym-hyponym pair.

3. Proposed System

From the beginning, Image is fragmented into diverse regions. For every image portion low level features have been figured and stored in the database. At the time of recovery at first SQL based retrieval is utilized. In the following stages relevance feedback from user is connected to modify the outcome. Relevance feedback can be executed by utilizing neural network or decision tree. At every stage a connection keeping metaphysics is utilized.

3.1. Low Level Texture Features' Extraction and Storage

Contrast, homogeneity, energy, entropy, coarseness, directionality are some vital texture features. These can be ascertained by Gray Level Co-occurrence Matrix (GLCM) by Haralick and Statistical Methods proposed by Tamura. The numerical estimations of the above features for every image segment extracted and stored into the database. This will be later needed for intermediate texture feature based recovery.

3.2. Image Retrieval by SQL

Despite the fact that numerical values are stored into the image database, the query will be on the basis of intermediate level text features of an image. We have not stored the intermediate values 'high', medium' or "low" for features like complexity, homogeneity and so forth. The intermediate level features can be effectively recovered by the relative position of low level feature values from the whole scope of that texture value. For instance, 'high contrast' implies the images with contrast value closer to the greatest contrast of every last one of image of that heuristic sort. Thus, 'low contrast' implies the pictures with contrast value closer to the base contrast and 'medium contrast' implies the images with contrast closer to the normal differentiation of every last one of image of that heuristic sort. For this sort of query aggregate functions of SQL are being utilized.

Assume user needs images of more than one type of intermediate text features like 'high coarseness and low contrast'. Images will be retrieved by convergence of both types of images. Let the set of aggregate images I. The set of images with feature f1 will be F1, set of images with features f2 will be F2 and set of pictures with features fn will be FN, then F is images recovered by SQL.

$$F= F1 \cap F2 \cap .... \cap FN \tag{7}$$

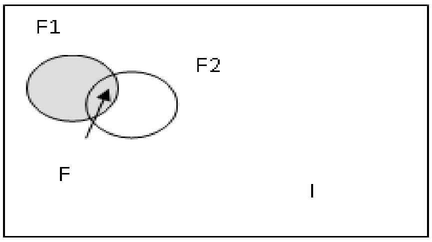

Figure 1. Initial Image Retrieval by More than One Feature

3.3. Relevance Feedback for Image Retrieval

An Artificial neuron is a system with numerous inputs and one output. The neuron has two modes of operation, Training and Testing. In Training mode, the neuron is trained with initial input. During Training stage, neural network system associate output with input patterns. In testing stage, neural network system finds input patterns which are practically like that taught input pattern.

In proposed framework, User's input will be considered as output, while low level features of all images retrieved by initial query as input patterns. Assume, if number of images retrieved by the initial query is n., then if user considers all n images retrieved by initial query are applicable then no further step is needed. Generally assume r images out of n images are important and i images are insignificant. At that point r + i = n. All the n images will be trained. Input pattern will be low level features (rather than middle features) of those images. Output for relevant r pictures will be 1, while output for unessential i images will be 0. All image segments with same heuristics will be tried against the trained images utilizing ANN demonstrated to the user. If user fulfills with result, images seeking stops, generally same methodology is rehashed.

We need to apply multi-layer feed forward back propagation network system for the above methodology. Additionally we can likewise utilize single perceptron based classification for the relevance feedback stage. Anyhow if user needs images with more than one feature this strategy won't be helpful.

We can likewise utilize decision tree as a part of relevance feedback stage. CART algorithm can be utilized for decision tree development. CART Algorithm utilizes gini index for feature determination. Feature will be sorted by numerical values. Midpoint of two relating values will be considered as spitting worth and from that class histogram and gini index will be figured. Decision tree will be structured utilizing gini index from relevance feedback of image features. This is the training stage. The image with same heuristics will be tested by principles of decision tree. Also relevant images will be shown to the user. Again relevance feedback will be given by the user. In view of the relevance feedback a new decision tree will be constructed automatically and images with same heuristics will be tested by principles of decision tree. This procedure is rehashed a few times until user is fulfilled.

3.4. Image Retrieval using Ontology Mapping

Ontology mapping is utilized as a part of every phase of image retrieval for evacuating synonym or hypernym-hyponym issues. Ontology idea is changed over to taking after relation R in proposed system.

R{ HeuristicId, Heuristic, ParentId }

HeuristicId of synonymous heuristics will be same, while ParentId of a hyponym heuristic is same as HeuristicId of hypernym heuristic. This relation is joined with fundamental relation where heuristic is the joining characteristic at the time of retrieval to get precise output.

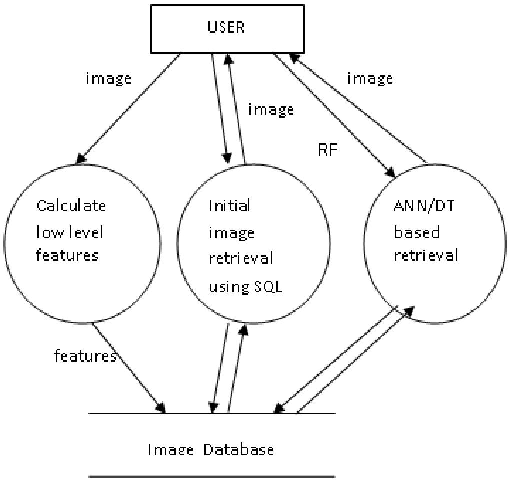

Figure 2. Data Flow Diagram of Proposed System

4. Results

Images are downloaded from the Brodatz picture database [12] with distinctive sorts of texture features. There are six heuristics classes of textures utilized as a part of our test like bark, brick, grass, sand, water and wood. Image database that stores intermediate features is shown in Table1 though image database that stores low level features is shown in Table 2.

Table 1. Storing Intermediate Features

ImageName	Heuristic	Contrast	Coarseness
Brick4.tiff	Brick	Low	High
Brick5.tiff	Brick	High	High
Grass1.tiff	Grass	Low	Low

Table 2. Storing Low Level Features

ImageName	Heuristic	Contrast	Coarseness
Brick4.tiff	Brick	15.45	6873.88
Brick5.tiff	Brick	71.23	6894.14
Grass1.tiff	Grass	26.51	4492.47

There are two possible cases for intermediate feature based image retrieval.

Case I: Domain specialists need to point out scopes of low level features relating to intermediate features like high, medium, low and *etc.* At that point for every image, low level feature will be calculated, intermediate texture features will be computed from low level features and put stored in image database shown in Table 1. At the time of retrieval, image can be retrieved.

Case II: For every image, low level features are computed and stored in image database as shown in Table 2. At the time of retrieval, intermediate feature value will be mapped to low level features existing in the database. This takes less time for computation and storing intermediate features as shown in Table1. Likewise for this situation if database volume is expanded, low level feature qualities are unaltered; however we get more precise intermediate texture values. Likewise these low level features will be utilized as input pattern for neural network relevance feedback stage.

Let p be the number of images with dimension each is [m n], number of intensity levels of GLCM is L and number of intermediate texture features is f. Table 3 gives time complexity comparison quality examination of proposed system with the existing system. Proposed technique obliges less time for feature calculation and storage on the grounds that just low level texture features are calculated, not the intermediate texture features.

Single perceptron based methodology is helpful when image is queried in view of single feature queried by the users are overlapping. At the same time if features are disjoint then single perceptron based methodology does not yield great result. In those cases multi-layer perceptron based methodology is very helpful, in light of the fact that single layer perceptron takes care of linearly separable problem. But multi-layer perceptrons can take care of the issues which are not additionally linearly separable.

Table 3. Correlation of Proposed Method with Previous Method for Intermediate Texture Based Storage and Retrieval. (Before Relevance Feedback Stage)

	GLCM Calculation	Texture Feature Calculation	Features Retrieval
Previous Method	O(mnp)	$O(L^2f)$	O(p)
Proposed Method	O(mnp)	$O(L^2)$	O(p)

Both Decision tree and neural network can be termed as supervised leaning where classification rules are produced from training data set (from relevance feedback) and these principles utilized classify future data. Ontology relation is checked, self-joined with itself and equi-joined with primary relation in every phase of retrieval procedure. Table4 is an example of the ontology relation. Sky, water are the hyponym of the nature, on the grounds that ParentId of sky and water is 1, *i.e.* same as HeuristicId of Nature. So also river, ocean, sea are hyponym of water and cloudy sky and clear sky are hyponym of sky. HeuristicId of ocean and sea is same *i.e.* 7. It signifies that both are synonymous to one another.

Table. 4. Instance of Ontology Relation

HeuristicId	Heuristic	ParentId
1	Nature	-
2	Sky	1
3	Water	1
4	Clear Sky	2
5	Cloudy Sky	2
6	River	3
7	Sea	3
7	Ocean	3

5. Conclusion

In this paper a framework is developed for intermediate texture based image retrieval. Structure Query Language is utilized as a part of initial stage and Artificial Neural Network is connected in the relevance feedback stage of the framework. We can apply different routines like decision tree based approach rather than ANN in relevance feedback stage. Speed and Accuracy of every last one of routines can be analyzed and best technique ought to be adopted. On the off chance that we can apply more accurate low level texture based image retrieval system, the accuracy of intermediate level texture based image retrieval is additionally progressed. Ontology relation made and utilized as a part of every phase of image retrieval to uproot synonym and hypernym-hyponym issues. Ontology relation can likewise be connected in the event of semantic color based image retrieval. Further works ought to be required in the field ontology enhance image retrieval process.

References

[1] Haralick R. M., Shanmugam K. and Dinstein I., "Textural Features for Image Classification", IEEE Transaction on Systems, man and Cybernetics, vol. SMC-3, **(1973)**, pp. 610-621.
[2] Tamura H., Mori S. and Yamawaki T, "Textural Features Corresponding to Visual Perception", IEEE Transaction on Systems, man and Cybernetics, vol. 8, no. 6, **(1978)**, pp. 460-473.
[3] D. Hazra, D. Bhattacharyya and K. Shin, "Heuristics and Intermediate Feature based image retrieval", Contemporary Engineering Sciences, vol. 7, no. 32, **(2014)**, pp. 1731-1738.
[4] Zhang D., Liu Y. and Hou J, "Digital Image Retrieval using Intermediate Semantic Feature and multistep search", Digital Image Computing: Techniques and Applications (DICTA), **(2008)**.
[5] P. B. Patil. And M. B. Kokare, "Relevance Feedback in Content Based Image Retrieval: A Review", Journal of Applied Computer Science & Mathematics, vol. 10, no. 5, **(2011)**.
[6] A. K. Pujari, "Data Mining Techniques", University Press, **(2010)**.
[7] Baldi P. F. and Homik K, "Learning in linear neural networks: A Survey", IEEE Trans. Neural Networks, vol.6, July **(1995)**, pp. 837-858.
[8] Lippmann R. P., "Neutral nets for computing", International Conference on Acoustics, Speech, and Signal Processing, 1988. ICASSP-88, IEEE, **(1998)**, pp. 1-6.
[9] Vrushali, Y. Erande., Badadapure P. R, "Content Based Image Retrieval using Neural Network", International Journal of Scientific & Engineering Research, vol. 4, no. 8, August **(2013)**, pp. 571-575.
[10] A. Nagathan., Manimozhi., J. Mungara, "Content-Based Image Retrieval System using Feed-Forward Back propagation Neural Network", IJCSNS International Journal of Computer Science and Network Security, vol. 14, no. 6, June **(2014)**, pp. 70-77.
[11] Parekh R. and Sharda N, "Abstractions in Intelligent Multimedia Databases: Application of Layered Architecture and Visual Keywords for Intelligent Search", L. Yan, Z. Ma (eds.). Intelligent Multimedia Databases and Information Retrieval: Advancing Applications and Technologies. Chapter 12, IGI Global, **(2011)**, pp.195-220.
[12] Brodatz P, "Textures: A Photographic Album for Artists and Designers", Dover, New York, **(1966)**.
[13] V. N. Mandhala., D. Bhattacharyya. And T. H. Kim, "Hybrid Face Recognition using Image Feature Extraction: A Review", International Journal of Bio-Science and Bio-Technology, IJBSBT, vol. 6, no. 4, August **(2014)**, pp.223-234.