Supervised and Unsupervised Image Categorization

Pinki[1] Girdhar Gopal[2]
[1]Research Scholar [2]Assistant Professor
[1,2]Department of Computer Science and Applications
[1,2]K.U., Kurukshetra

Abstract— Categorization of images is a way of grouping images according to their similarity. Images categorization uses various features of images like texture, color component, shape, edge, etc. Categorization process has various steps like image pre-processing, object detection, object segmentation, feature extraction and object classification. There are basically two methods of categorization-Supervised and Unsupervised. There are various algorithms that are used to categorize image data such as K-means, ISODATA, Artificial Neural Network (ANN), Decision Tree (DT), Support Vector Machine (SVM) and Fuzzy Classification and K-Nearest Neighbor (KNN). In this paper supervised and unsupervised techniques for image categorization are discussed.

Key words: Image categorization, supervised classification, unsupervised categorization

I. INTRODUCTION

Nowadays the development of computers and information technology is at their peak, every piece of information is available at the finger tips and amount of data is very big. It has also created challenges in the storing, organizing and searching of that data. As Images are also an integral part of that information so to classify, organize and access images using an easy, faster and efficient way categorization is used. Categorization is an information processing task in which images are categorized into several groups [1]. It achieves higher image accuracy within less execution time. Image categorization is an important part of the remote sensing, image analysis and pattern recognition [2]. Categorization is done to identify patterns in the data and to add meaning to the data. Application of pattern recognition techniques has been found useful in image Retrieval, where it has been helpful in managing image repositories. Pattern recognition enables the learning of important patterns and trends, which can be used in the indexing of the images in a repository [3]. Image categorization is used in various application domains like biomedical imaging, biometrics, video surveillance, vehicle navigation, industrial visual inspection, robot navigation, and remote sensing.

II. IMAGE CATEGORIZATION METHODS

Basically two categorization methods are used: Supervised and Unsupervised categorization.

A. Unsupervised Categorization

In this technique image categorization is done without providing training samples by the user. This categorization has the ability to support classification without the use of training samples. This is computer automated techniques to determine which pixels are related and groups them into classes. In this method at every pass of the algorithm each pixel is tagged to an unknown cluster center based upon some similarity parameters such as Euclidean distance or absolute distance etc. of intensity. The cluster centers are then re-calculated based on these hard assignments of centers. With each successive pass, a pixel can switch from one cluster center to another until the convergence criteria are met or till none of the cluster assignment change. It has been identified as a means of improving visualization and retrieval efficiency in image retrieval. It has also been identified as a means of matching low-level features to high-level semantics especially in learning based applications. These qualities make unsupervised image categorization a likely solution for bridging the semantic gap in image retrieval [3]. The user can only designate the number of output class desired and which algorithm the software will use but otherwise does not assist in the image categorization process. Examples of unsupervised categorization algorithms are: K-means, Expectation-Maximization and Hierarchical clustering. The step by step procedure to do unsupervised categorization of images is shown in the figure 1 below. In this figure it is also shown that there is no need of previous knowledge of the region.

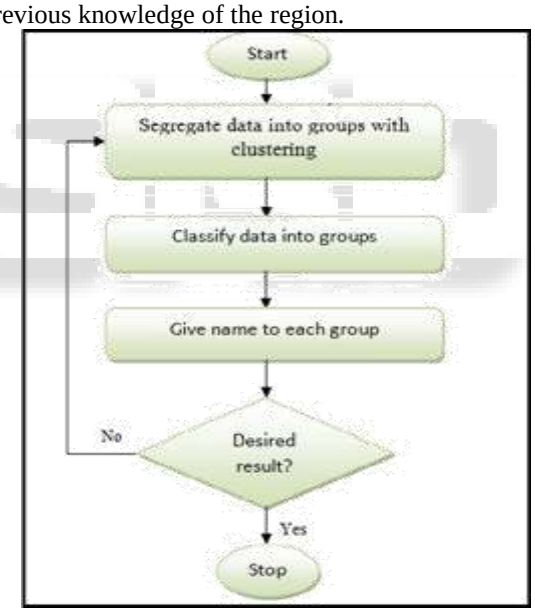

Fig. 1: Unsupervised Categorization

B. Supervised Categorization

In this technique categorization is done by providing training samples by the user. This categorization does not have the ability to support classification without the use of training samples. Training samples are selected based on the prior knowledge of the user. The training sites are used as a reference for classification of all other pixels in the image. This technique is based on the idea that from the images of data a user can choose training sites and then statistical descriptors are calculated. If desired results are found then the data is classified into predefined category else this process is repeated. The number of classes into which data is classified is also decided by the user. The user also sets the bounds for how similar other pixels must be to group them

together. The supervised classification of images based on patterns learnt from a set of training images has often been treated as a pre-processing step for speeding-up image retrieval in large databases for improving accuracy. This training data is manually selected and annotated, which is expensive to obtain and may introduce bias information into the training stage retrieval [3]. Commonly used supervised classification approaches are parallelepiped, minimum distance to mean and maximum likelihood [1]. The motivating criteria for constructing training classes in supervised classification are:

1) First, a change in the description of one training class should not change the value of another.
2) Second, different image features should have significantly different descriptions.
3) Third, all image features within a training group should share the common definitive descriptions of that group. The step by step procedure of a typical supervised image classification process is shown in Figure 2.

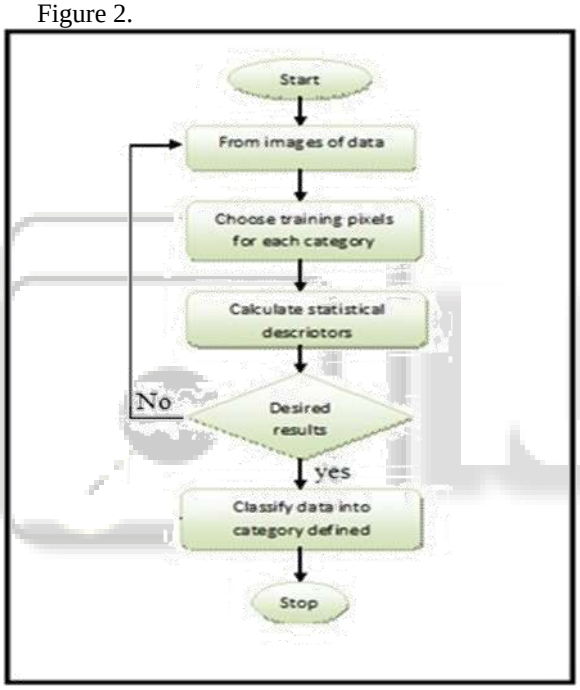

Fig. 2: Supervised Categorization

Examples of supervised classification classifiers are Decision Tree (DT), Random forests; K-Nearest Neighbor (KNN) and Vector Machine (SVM), artificial neural network (ANN).

III. LITERATURE REVIEW

In this section, we look into the review of image classification which is a growing area of interest in image processing as well as in computer vision. It describes the previous work which has been done in image classification.

Fei-Fei *et al*. [4], proposed a new approach to classify events into static images by integrating scene and object categorization. The technique used to categorize scene and object is an integrative model. By using this model they are extracting local features from the image and then categories object and after categorizing object they recognize the scene and then by integrating both scene and object recognition events are classified.

Jun Yu et al. [5], proposed an adaptive hyper graph learning method for transductive image classification. In this method hyper edges are generated by linking images and their nearest neighbors.

Jiang *et al*. [6], proposed a scene oriented hierarchical classification of blurry and noisy images. Three strategic approaches used are global pathway for essential capture, local pathway for highlight detection and thirdly hierarchical classification.

Noridayu *et al*. [7], proposed a new approach for improving performance of object class recognition by combining different features with local features. Two features thus obtained are combined and then concatenating those features in a new single feature vector by using features fusion approach. Then features are classified by using SVM.

Yasuo *et al*. [8], suggested a method to increase the performance of global features by using local feature correlation and then classifying scene. First local features are extracting from the image. It involves two steps, key point detection based on grid and feature description using SIFT descriptor. Next classification of scene is based on Linear Discriminant Analysis (LDA).

Shanmugam *et al*. [9], proposed classifying war scene from the natural scene by extracting wavelet features. By using after extracting wavelet features they are classified by using Artificial Neural Network and then Support Vector Machines (SVM).

Vogel *et al*. [10], proposed a novel image representation to access natural scenes by local semantic description. They use a spatial grid layout which split the images into regular sub-regions.

Ponce *et al*. [11], proposed a spatial pyramid matching for recognizing natural scene categories. This technique works by repeatedly subdividing the image and computing histograms of local features at increasingly fine resolution and taking a weighted sum of number of matches that occur at each level of resolution (L).

IV. COMPARISON

There are various differences and similarities in these two techniques. For some applications supervised categorization perform better but for some applications unsupervised categorization performs better. For example in mining image similarities directly from the image collection, hence can identify inherent image categories naturally from the image set. Unsupervised learning has been identified as a means of improving visualization and retrieval efficiency in image retrieval. These qualities make unsupervised image categorization a likely solution for bridging the semantic gap in image retrieval. Table I shows differences between these techniques.

Supervised Categorization	Unsupervised Categorization
Prior knowledge of the region is required and it needs trained database.	No prior knowledge of the region is required and no need of trained database.
Human annotations are required.	Human annotations are not required.
A person who is doing the classification can detect errors and often corrects them.	As user can specify only the number of output classes desired so user cannot detect errors and correct them.

Training the data can be time consuming and time costly.	No need of training the data so it is less time consuming.
Supervised classification is prone to human error.	Except initial stage of specifying the number of classes, it is less prone to human errors.
Examples of supervised classification are KNN, SVM, NN, DT, random forests.	Examples of unsupervised classification are K-means, expectation maximization.

Table 1: Difference between supervised and unsupervised classification

V. SIMILARITIES

(i) In both classifications new and unwanted classes may be created.
(ii) In both cases pixels that do not 'fit' may be absorbed.
(iii) User can specify the number of output classes desired.
(iv) In both cases initially selected data may not characterize conditions faced throughout the image.

Table 2: Similarities between supervised and unsupervised classification

VI. CONCLUSION

In this paper, we discussed supervised and unsupervised categorization techniques. We also discussed differences and similarities between supervised and unsupervised categorization. Despite the long time spent developing the classification techniques, new problems and new user demands have been gathered to the existing ones. Huge amount of data demand new approaches. Now there is need to move from basic classification methods to some advanced classification methods.

REFERENCES

[1] Jipsa Kurian, V.Karunakaran, "A Survey on Image Classification Methods," proc. International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), ISSN: 2278 – 909X, Volume 1, Issue 4, October 2012.
[2] Ms. Chandrakala. M and Mrs. R.Amsaveni, "Classification of Remote Sensing Image Areas Using Surf Features and Latent Dirichlet Allocation," proc. International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277 128X, Volume 3, Issue 9, September 2013.
[3] Abass Olaode, Golshah Naghdy & Catherine Todd, "Unsupervised Classification of Images: A Review," proc. International Journal of Image Processing (IJIP), Volume (8), Issue (5), 2014.
[4] L. J. Li and L. Fei-Fei, "What, where and who? Classifying event by scene and object recognition," IEEE Int. Conf. Comput. Vis., pp. 1–8, Feb.2007.
[5] Jun Yu,Dacheng Tao, Meng Wang "Adaptive Hyper graph Learning and its Application in Image Classification," Image Processing, IEEE Transactions on (ISSN:1057-7149, Volume:21 Issue: 7 , 6 march 2012) Biometrics, Compendium, IEEE.
[6] Le Dong and Jiang Su, "Scene - Oriented Hierarchical Classification of Blurry and Noisy Images," IEEE Trans, vol. 21, no. 5, pp. 712–727, May.2012. [7].
[7] Noridayu Manshor and Dhanesh Ramachandram, "Feature Fusion in Improving Object Class Recognition," Journal Computer Sci., 2012.
[8] Hideki Nakayama, Tatsuya Harada and Yasuo Kuniyoshi, "Scene Classification using Generalized Local Correlation," IAPR Conference on Machine Vision Applications, May 20-22, 2009.
[9] S. Daniel Madan Raja, Dr.A. Shanmugam, "ANN and SVM Based War Scene Classification using Wavelet Features: A Comparative Study," Journal of Computational Information Systems, pp. 1402-1411–86, 2011.
[10] J. Vogel and B. Schiele, "Semantic modeling of Natural scenes for content- based image retrieval," Int. J.Comput.Vis.
[11] S. Lazebnik, C. Schmid, and J. Ponce, "Beyond bags of features: Spatial pyramid matching for recognizing natural scene categories," IEEE Conf. Comput. Vis. Pattern Recognition, vol. 2, pp. 2169–2178, March. 2006.

