Techniques and Issues in Image Mining: Survey

Janki Naik[1] Prof. Sagar Patel[2]
[1,2]Computer Engineering Department
[1,2] Alpha college of Engineering and Technology, Gujarat, India

Abstract— Mining image data is one essential feature in present time. Image mining is not just an extension of data mining to image domain. Analyzed images reveal useful information to the human users. Image mining manages with the extraction of knowledge, image data relationship, or other patterns which is not stored in the images. It associates techniques like computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence. In this paper, we there are some techniques in image mining, research issues in image mining and image mining framework. .

Keywords: image classification, image mining, object recognition.

I. INTRODUCTION

Image mining deals with the extraction of implicit knowledge, image data relationship, or other patterns not explicitly stored in the image databases. It utilizes methods from computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence. Rule mining has been implemented to huge image databases[1]. It is an interdisciplinary endeavour that essentially draws upon expertise in computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence [2]. Advances in image acquisition and storage technology have led to tremendous growth in significantly large and detailed image databases [3]. A large number of image data such as satellite images, medical images are generated every day. These images, if analyzed, can reveal useful information to the human users. Image mining systems that can automatically extract semantically meaningful information (knowledge) from image data are increasingly in demand. The main obstacle to rapid progress in image mining research is the lack of understanding of the research issues involved in image mining.

In this paper, first we define different image mining techniques. This will be followed by a review of what are currently happening in the field of image mining, particularly, image mining frameworks, state-of-the-art techniques and systems. The rest of the paper is organized as follows. In next section we will discuss research issues of image mining. Section 4 discusses two possible frameworks for image mining: the functionality framework versus the information-driven framework. Section 4 gives an overview of the major image mining approaches and techniques used in image mining including object recognition, image indexing and retrieval, image classification and clustering, association rules mining, and neural networks. Finally, section 5 concludes with some future research directions for image mining.

II. IMAGE MINING TECHNIQUES

Besides investigating suitable frameworks for image mining, early image miners have attempted to use existing techniques to mine for image information. The techniques frequently used include object recognition, image indexing and retrieval, image classification and clustering, association rules mining, and neural network.

A. *Object Recognition*

Object recognition has been an active research focus in field of image processing.[4] Using object models that are known a priori, an object recognition system finds objects in the real world from an image. This is one of the major tasks in the domain of image mining. Automatic machine learning and meaningful information extraction can only be realized when some objects have been identified and recognized by the machine. The object recognition problem can be referred to as a supervised labeling problem based on models of known objects. Specifically, given a target image containing one or more interesting objects and a set of labels corresponding to a set of models known to the system, what object recognition does is to assign correct labels to regions, or a set of regions, in the image. Models of known objects are usually provided by human input a priori.

In general, an object recognition module consists of four components, namely, model database, feature detector, hypothesizer and hypothesis verifier. The model database contains all the models known to the system. The models contain important features that describe the objects. The detected image primitive features in the Pixel Level are used to help the hypothesizer to assign likelihood to the objects in the image. The verifier uses the models to verify the hypothesis and refine the object likelihood. The system finally selects the object with the highest likelihood as the correct object.

B. *Image Retrieval*

Image mining requires that images be retrieved according to some requirement specifications. The requirement specifications can be classified into three levels of increasing complexity [2]:

(a) Level 1 comprises image retrieval by primitive features such as color, texture, shape or the spatial location of image elements. Examples of such queries are “Retrieve the images with long thin red objects in the top right-hand corner” and “Retrieve the images containing blue stars arranged in a ring”

(b) Level 2 comprises image retrieval by derived or logical features like objects of a given type or individual objects or persons. Examples include “Retrieve images of

All rights reserved by www.ijsrd.com

round table" and "Retrieve images of Jimmy"

(c) Level 3 comprises image retrieval by abstract attributes, involving a significant amount of

high-level reasoning about the meaning or purpose of the objects or scenes depicted. For example, we can have queries such as "Retrieve the images of football match" and "Retrieve the images depicting happiness".

[5] Three query schemas for image retrieval: Query by Associate Attributes, Query by Description, and Query by Image Content. In Query by Associate Attributes, only a slight adaptation of conventional table structure is needed to tailor it to fit the image needs. The images are appended as extra field. Image retrieval is performed based on other associated attributes within the same table. In Query by Description, the basic idea is to store image descriptions, also known as labels or keywords, along with each image so that users can locate the images of interest using the descriptions. The image descriptions are normally generated manually and assigned to each image in the image pre-processing stage. It suffers from the drawbacks of the "vocabulary problem" [5] and non-scalability. In the early 1990's, because of the emergence of large-scale image repository, the two difficulties of vocabulary problem and non-scalability faced by the manual annotation approach became more and more acute.

Content-based image retrieval is thus proposed to overcome these difficulties. There are three fundamental bases in content-based image retrieval, namely, visual information extraction, image indexing and retrieval system application [6].

C. *Image Indexing*

Image mining systems require a fast and efficient mechanism for the retrieval of image data. Conventional database systems such as relational databases facilitate indexing on primary or secondary key(s). Currently, the retrieval of most image retrieval system is, by nature, similarity-based retrieval. In this case, indexing has to be carried out in the similarity space. One promising approach is to first perform dimension reduction and then use appropriate multi-dimensional indexing techniques that support Non-Euclidean similarity measures [6].

Other proposed indexing schemes focus on specific image features. [7] presents an efficient color indexing scheme for similarity-based retrieval which has a search time that increases logarithmically with the database size. [8] proposes a multi-level R-tree index, called the nested R-trees for retrieving shapes efficiently and effectively. With the proliferation of image retrieval mechanisms, [9] give a performance evaluation of color-spatial retrieval techniques which serves as guidelines to select a suitable technique and design a new technique.

D. *Association Rule Mining*

An association rule is an implication of the form X -> Y, where X, Y $\subset$ I and X Λ Y= ϕ. I is the set of objects, also referred as items. D is a set of data cases. X is called the antecedent and Y is called the consequent of the rule. A set of items, the antecedent plus the consequent, is call an itemset. The rule X -> Y has support s in D if s% of the data case in D contains both X and Y, and the rule holds in D with confidence c if c% of the data base in D that support X also Support Y. Association rule mining generate rules that have support and confidence greater than some user specified minimum support and minimum confidence thresholds. A typical association rule mining algorithm works in two steps. The first step finds all large itemsets that meet the minimum support constraint. The second step generates rules from all the large itemsets that satisfy the minimum confidence constraint. Association rule mining is frequently used in data mining to uncover interesting trends, patterns and rules in large datasets. Recently, association rule mining has been applied to large image databases [10,1,4]. There are two main approaches. The first approach is to mine from large collections of images alone, and the second approach is to mine from a combined collection of images and associated alphanumeric data [1].

E. *Image Classification*

There are two classification methods: decision tree based methods and neural network based methods. Sethi, et al. [13] has taken database of 2100 images. They have used Access database to store the feature vectors extracted from the images. From each image they have extracted quantized global historical. For global histogram following quantization scheme was obtained based on the images in the database.

Hue: (H1, H2, H3, H4, H5, H6, H7, H8) = (0, 25, 41, 61,138, 200, 213, 241, 359)
Saturation: (S1, S2, S3, S4, S5, S6, S7, S8) = (0, 9, 16, 24, 33,42, 56, 80, 100)
Lightness: (L1, L2, L3, L4, L5, L6, L7, L8) = (0, 13, 27, 38,47, 56, 65, 78, 100)

Four classes they have considered: Sunset, Arid, Marine and Noctune. For each image they have created a feature vector with 24 components: 1 to 8 related to hue, 9 to 16 for saturation, and 17 to 24 for lightness. The decision tree was induced using the CART option from the SIPINA software package [14]. All the decision trees induction methodologies allowed by this software package were applied to this problem. Association rules were extracted from a set of decision trees induced over the set of extracted low-level features from the images. Kun-che Lu and Don-lin Yang, *et al.* [15] proposed a general framework based on the decision tree for mining and processing image data. The proposed model can be very efficient and effective for image processing and image mining.. Input data for the presented model was formatted as a set of equal sized raw and label image pairs. In image transformation part, they transformed them into database like table. In data reduction step redundant information, generated due to similar feature vector for neighboring area pixels, in the result table is removed. After that mining algorithms can be used on it. Authors have chosen the decision tree for this purpose. This decision tree classifier can be converted to if else statements which can provide useful information about the training image Mausoko, *et al.* [16] have taken 25 images of size 1024 × 768 pixels representing microscopic wax structure of leaves from trees. They have used unsupervised texture image classification algorithm using competitive neural network. Their goal is to study major problems of texture

All rights reserved by *www.ijsrd.com*

analysis, including the classification of texture and propose solution based on wavelet transformation. Neural network design algorithm implemented by MATLAB Neural Network toolbox and algorithms based on mathematical computation and empirical computation for determining the class boundary are given by the authors in their work. They have concluded that unsupervised classification of textured images has successfully adopted the neural network approach. But there are some problems which are associated with the choice of wavelets, suitable level of decompositions.

III. ISSUES IN IMAGE MINING

The most common misconception of image mining is that image mining is nothing more than just applying existing data mining algorithms on images. This is certainly not true because there are important differences between relational databases versus image databases [4].

A. *Absolute versus relative values*

In relational databases, the data values are semantically meaningful. For example, age is 35 is well understood. However, in image databases, the data values themselves may not be significant unless the context supports them. For example, a grey scale value of 46 could appear darker than a grey scale value of 87 if the surrounding context pixels values are all very bright.

B. *Independent versus dependent position*

Another important difference between relational databases and image databases is that the implicit spatial information is critical for interpretation of image contents but there is no such requirement in relational databases. As a result, image miners try to overcome this problem by extracting position-independent features from images first before attempting to mine useful patterns from the images.

C. *Unique versus multiple interpretations*

A third important difference deals with image characteristics of having multiple interpretations for the same visual patterns. The traditional data mining algorithm of associating a pattern to a class (interpretation) will not work well here. A new class of discovery algorithms is needed to cater to the special needs in mining useful patterns from images. In addition to the need for new discovery algorithms for mining patterns from image data, a number of other related research issues also need to be resolved.

IV. IMAGE MINING FRAMEWORK

There are two different frameworks of image mining have been proposed by researchers [17]: function driven framework and information driven framework.

Most of the existing image mining system architectures fall under the function driven framework. However, function driven framework is not a generalized framework. It can be application oriented or organization oriented. Mihai, et al. [17] have given function driven framework for intelligent satellite mining system. Function driven framework for the Multimedia Miner is given in [18]. The drawback of this framework is that it can organize and clarify the different tasks to be performed in image mining, but it is not able to differentiate levels of information representation which is necessary for image data to perform meaningful mining. This drawback is overcome in another information driven framework.

Information driven framework for the image mining representing different levels of information [4]. This framework has four levels of information pixel level, object level, semantic level and pattern and knowledge level. Pixel level is the lowest level in an image mining system. It deals with the raw image information such as image pixels and the primitive image features such as color, texture, and shape. It can answer the query like "Retrieve the image with red color". But it cannot answer the query like "Retrieve the image of girl". Next level is object level which can retrieve images for such queries. It deals with object information based on the primitive features in the pixel level. Object recognition assigns correct labels to a single region or set of regions. But still it cannot retrieve images for query like "Image with sad faces". The third Semantic concept level takes into consideration domain knowledge to generate high-level semantic concepts from the identified objects to answer such queries. These three levels are retrieving information for the image itself to mine it. If the user query is like "retrieve all the heart images from last one month" then it needs to consider alphanumeric data corresponding to images. It supports all the information needs within the image mining framework.

V. CONCLUSION

In this paper, we have discussed about the image mining. We have also discussed techniques that are generally used in image mining. These are namely; object recognition, image retrieval, image indexing, association rule mining and image classification. In following section, there are some research issues to be solved. We have also studied two frameworks for image mining namely function-driven and information-driven image mining frameworks.

REFERENCES

[1] C. Ordonez and E. Omiecinski (1999), "Discovering association rules based on image content," Proceedings of the IEEE Advances in Digital Libraries Conference (ADL'99).

[2] M. C. Burl et al. Mining for image content. In *Systemics, Cybernetics, and Informatics / Information ystems: Analysis and Synthesis*, (Orlando, FL), July 1999.

[3] O. Zaiane and J. Han (1998), "Mining MultiMedia Data," CASCON'98: Meeting of Minds, Toronto, Canada, pp 83-96, November.

[4] Zhang Ji, Hsu, Mong and Lee (2001), "Image Mining: Issues, Frameworks and Techniques," Proceedings of the Second International Workshop on Multimedia Data Mining (MDM/KDD'2001), in conjunction with ACM SIGKDD conference, San Francisco, USA, 26th August.

[5] R. Kazman and J. Kominek. Information organization in multimedia resources. *Proceedings of the 11th annual*

All rights reserved by *www.ijsrd.com*

international conference on Systems documentation, Pages 149 – 162,1993.

[6] Y. Rui, T. S. Huang et al. Image Retrieval: Past, Present and Future. Invited paper in *Int Symposium on Multimedia Information Processing*, Taipei, Taiwan, Dec 11-13, 1997.

[7] B. C. Ooi, K. L. Tan, C. Yu and S. Bressan Indexing the Edges - A Simple and Yet Efficient Approach to High-Dimensional Indexing, *19th ACM SIGMOD-SIGACT-SIGART Symposium on Principles of Database Systems,* pp. 166-174, Dallas, Texas, May 2000.

[8] K. L. Tan, B.C. Ooi and L. F. Thiang. Retrieving similar shapes effectively and efficiently, *Multimedia Tools and Applications*, Kluwer Academic Publishers, The Netherlands, 2001.

[9] K. L Tan, B. C. Ooi and C. Y. Yee. An Evaluation of Color-Spatial Retrieval Techniques for Large Image Databases, *Multimedia Tools and Applications*, Vol. 14, No. 1, pp. 55-78, Kluwer Academic Publishers, The Netherlands, 2001.

[10] V. Megalooikonomou, C. Davataikos and E. Herskovits (1999), "Mining lesion-deficit associations in a brain image database," KDD, San Diego, CA USA.

[11] I. Sethi, I. Coman, D. Stan, *"Mining Association Rules between Low-level Image Features and High-level Concepts"* Proc. of AeroSense 2001, Data Mining and Knowledge Discovery: Theory, Tools and Technology III, Orlando, Florida, USA, pp. 279-290, 16-20 April 2001.

[12] SIPINA for Windows. ERIC Laboratory, University of Lyon 2, http://eric.univ-lyon2.fr/ ricco/sipina.html.

[13] K. Lu and D. Yang, *"Image Processing and Image Mining using Decision Trees"* Journal of Information Science and Engineering 25, 989-1003, 2009.

[14] V. Musoko, M. Kol´ınov´a, A. Proch´azka, *"Image Classification Using Competitive Neural Networks"* 12th conference MATLAB 2004, Prague, Czech Republic, 25 November, 2004.

[15] M. Datcu and K. Seidel. *"Image information mining: exploration of image content in large archives"*, IEEE Conference on Aerospace, Vol.3, 2000.

[16] J. S. D. Bonet. Image preprocessing for rapid selection in "Pay attention mode". *MIT*, 2000.

[17] Gibson, S et al. Intelligent mining in image databases, with applications to satellite imaging and to web search, *Data Mining and Computational Intelligence*, Springer-Verlag, Berlin, 2001.

[18] Y. Rui, K. Chakrabart i, S. Mehrotra, Y. X. Zhao, and T. S. Huang. Dynamic clustering for optimal retrieval in high dimensional multimedia databases. *In TR-MARS-10-97*, 199

All rights reserved by *www.ijsrd.com*