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AN EFFICIENT FRAMEWORK FOR IMAGE DATA RECOGNITION & RETRIEVAL

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ABSTRACT

Valuable information can be hidden in images, however, few research discuss data mining on them. Image retrieval means searching, browsing and retrieving images from image databases. There are two different methodologies for image retrieval i.e. text based image retrieval and content based image retrieval. Former one is obsolete. In latter one many visual features like texture, size, intensities, and frequency of pixels and color of image are extracted. In query-by-example search extracted featured are compared with stored ones. In this work an efficient for extracting image features is considered using intensity histogram of gray color image. Here in this general framework based on the decision tree for mining and processing image data. Pixel wised image features were extracted and transformed into a database-like table which allows various data mining algorithms to make explorations on it. Finally results of average gradient vectors are to be compared with previously stored one dimensional array of intensities to find similarities in image data.

INTRODUCTION

Image Extraction

Data Mining is termed as discovering hidden values in data warehouse, extracting hidden information from huge databases is a powerful new methodology which has helped many organizations nowadays to focus on significant information in their data warehouses. [1] Data mining techniques can be implemented rapidly on various platforms on high performance parallel processing computers or client/servers. Data mining tools can work with heavy databases to find answers to various business queries. [3] Many data mining operations are managed outside of data warehouse nowadays and thus require extra steps for extraction, import and to analyze preprocessed data. Also, when new things require operational data implementation, collaborations with the warehouse improves the application of outcomes from data mining. [14,23,29] The resulting analytic data warehouse can be applied to improve business processes throughout the organization, in areas such as substantial degree of relevance management, fraud detection, new product rollout, and so on.

The starting point of data mining process is a data warehouse having collaboration of its internal data with external market data from web about rival companies competing with them.[1,2] Previous raw information related to potential customers provides excellent basis for analyst software modules. An OLAP server favors more advanced flexible and fast data access to be applied when navigating data in some data mapping scheme for standardization. The data mining access server must be integrated with OLAP server and data warehouse. It is the job of data mining access server to advance process centric data that will give major data mining objectives like prospecting, promotional integration and campaign management.[3] Integration of newly arrived metadata with existing data warehouse allows operational decisions to be directly focused and tracked. As a result when data warehouse grows with newly bindings in decisions, organization can mine continuously best results to be practiced for future decision making.

Image Mining Process

Data mining is the feature detection technique of image data and the use of software based techniques for finding image patterns and bitmap regularities in sets of image data. [38,41,43] The computer program is responsible for observing the image bit patterns by elucidating the pre-defined rules and image features in the image data. Data collected from different sources like databases or flat files or any other resources like web is made to be preprocessed. Various standardization techniques of data cleaning or formatting are to be used by data warehouse or mapping schemes. [4] Further preprocessed data is made to be reviewed by data analyst who is done nowadays by computers software. In earlier days it was manually done by data analysts. After reviewing preprocessed data analyst reports are to be made which is revised or refined if something is needed with hand on information to generate finally mined or interpreted results.

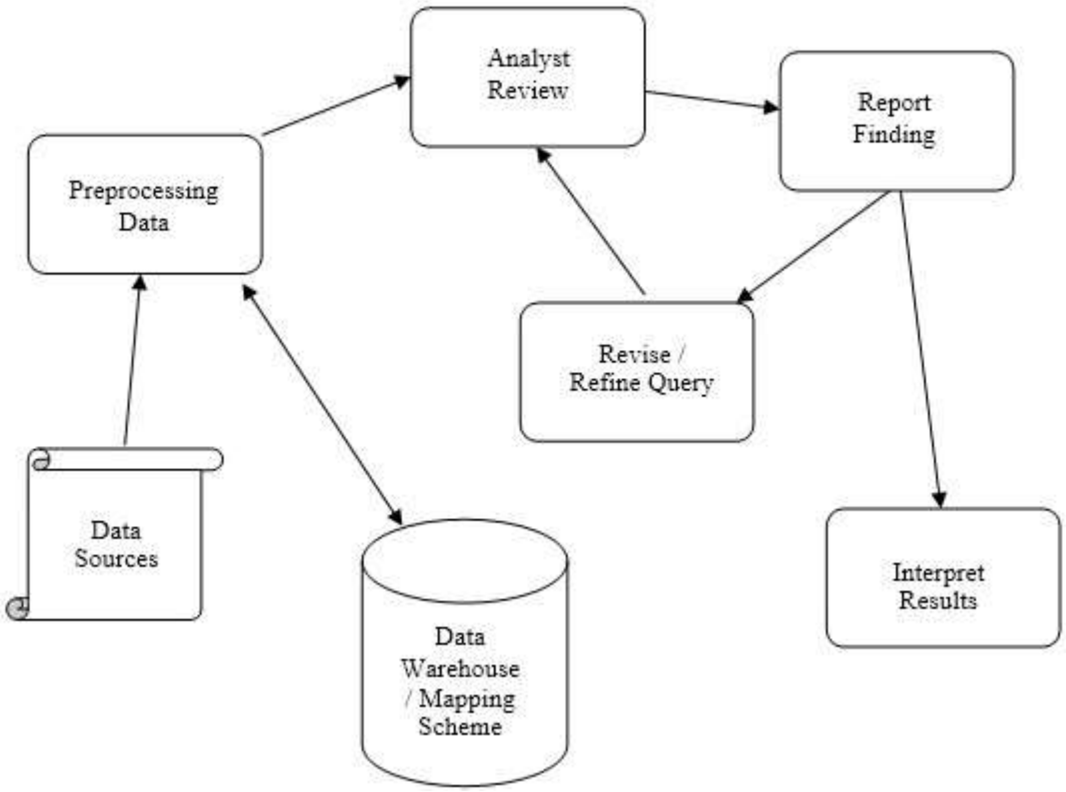

Figure 1.1: Data mining process interpreting mined results

IMAGE DATA RETRIEVAL

Recent progress of technology in hardware with large capacity of holding data from image, audio, video or textual data and/or combination of them has become more common these days. As a result the need of accessing contents of such data is growing with requirement of fast access database systems. [4] In case of conventional databases, retrieving contents of multimedia data is not enough facilitated. Because in conventional databases most of database systems are based on relational data models. [5] Following are three main reasons behind this lack in support:

a) In relational data models there is a lack of spatio-temporal relations. In linear system theory, it was in context of audition where an auditory data signal is represented as a function of single variable. [6, 19, 21, 29, 31, 39] But the same theory works on an image which is a function of two spatial dimensions x and y. also if temporal sensitivity is considered as well then a signal will be a function of three variables i.e. x, y and t which is in case of movie or sequence of images. In audition basic stimulus used in linear system theory is a sine wave grating. [7] Also temporal relation between audio and video data is a key thing that is needed to be taken care by database systems. In case when textual data is superimposed with video data which is stored separately from textual data, both temporal as well as spatial relations need to be managed in order to define relation between them.

b) Secondly semantics of data being retrieved is a crucial thing in recognition and/or data interpretation process in case of multimedia data, because representation of data and contents perceived are two different things in an image, video and audio data.

c) Third major concern in retrieving multimedia data is query representation. Retrieval of data in conventional databases is totally based on relational algebra with simple query conditions in the form of standard alphanumeric character representation. On the other hand multimedia data retrieval involves types of contents to be diverse and here query-by-example (QBE) would be better solution.

Spatial Relations

One of the most mandatory features in many multimedia documents is management of spatial coherence. Management of spatial relation of components of image data is done by considering its rectangular Cartesian coordinates. The spatial axis position of a component in object in image data is represented by rectangular coordinates and the relations between components are calculated mathematically. [9, 13, 24, 48-50] A multimedia document which is composed of images, flowcharts, and other random graphics as well as image text is another example that proves the management of spatial coordinates for layout information in an image [6]. In other applications of image processing such as geographical information system (GIS), the image pattern representation and random indexing of abstract and finite spatial relations in some regions of image is studied. A 2D stream of bits [3], [9] is an image data indexing technique for representing a spatial pattern between different components of an image; 2D stream of bits represents few patterns in position of components in neighboring regions, which is composed of horizontal and vertical ordering of image components.

Temporal Relations

A recent study depends upon bit representation and image data management of temporal relation considers video based applications of image processing such as video information databases (VID). There are two basic techniques for representing time based relationship between objects in multimedia data of a moving image: One is a point-based image data representation containing time lag of various colors in a multimedia document, and the other is an interval-based image data representation which contains intervals of data shifts from neighboring regions of data. [21, 29, 34] The point based representation contains the Cartesian position of objects by points in the image data on timeline, whereas the interval-based representation contains the cohesion of image objects by means of their intervals of the occurrences of similar intensities in neighboring regions of an image.

DATA RETRIEVAL IN CONVENTIONAL DATABASES

Earlier database systems were designed to manage and retrieve the textual data and their related keyword based retrieval techniques which are not suitable for retrieving the data which comprises of text, video and audio data. Adding to this, in earlier times lot of human effort was required for the manual annotation because as the data which was stored in binary form was of no meaning to the human. Similarity comparison techniques are considered to be the best techniques for the exact matching of the applications.

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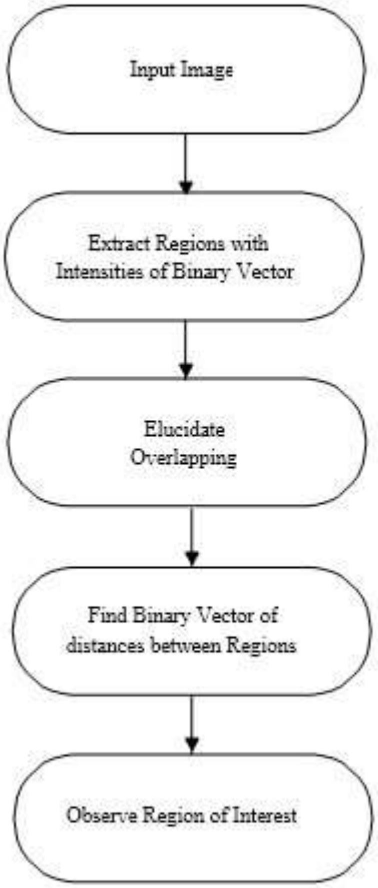

Manhattan Distance

The distance between two points measured along the axes at right angles. For example, given two points **'A'** and **'B'** in a two-dimensional plane at (x1, y1) and (x2, y2) respectively, the Manhattan distance between **'A'** and **'B'** is given by

Dist = $|x_2 - x_1| + |y_2 - y_1|$

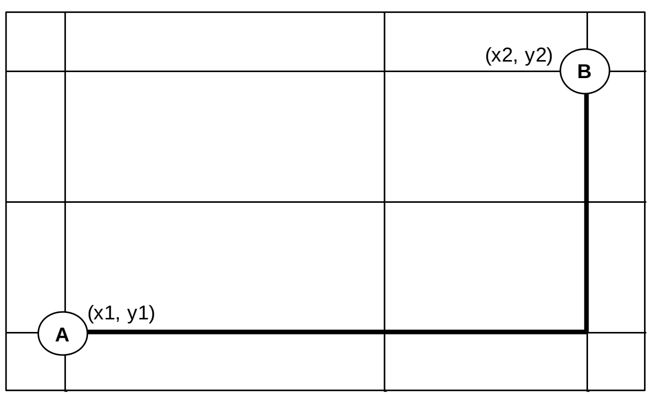

Fig.3.1 - Manhattan Distance

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OUTCOME RESULTS

Image data retrieval problem has important applications; designing an algorithm with good performance becomes necessary and important. A lot of algorithms for recognizing image data problems have been proposed in the literature since the 2000's. The early work focused on the exact algorithms. Content based image data retrieval is the branch of image processing for elucidating certain image patterns by accessing image from image data. in this thesis we create database, set parameters and fundamental aspects of image object recognition and retrieval. we implemented and tested the developed system for accurately recognition and retrieval of images. Lastly we investigate the performance of developed system using accuracy, precision, recall, sensitivity etc.

Calculation of Relevant and Irrelevant Images

Table 4.1 Number of Relevant and Irrelevant Images

Class	Image Number	No. of Relevant Images	No. of Irrelevant Images
1	11	13	7
	28	16	4
	36	15	5
2	57	18	2
	72	19	1
	89	15	5
3	118	18	2
	135	19	1
	146	19	1
4	169	13	7
	184	14	6
	197	15	5
5	215	17	3
	229	17	3
	248	19	1

The result depicted in Table 4.1 reveals that the developed system has accurately find the maximum number of relevant images. The irrelevant images retrieved by the system are less in number. So we can say that the system are efficient to find maximum relevant images.

The bar graph of relevant and irrelevant images of all the classes are shown in figure 4.9.

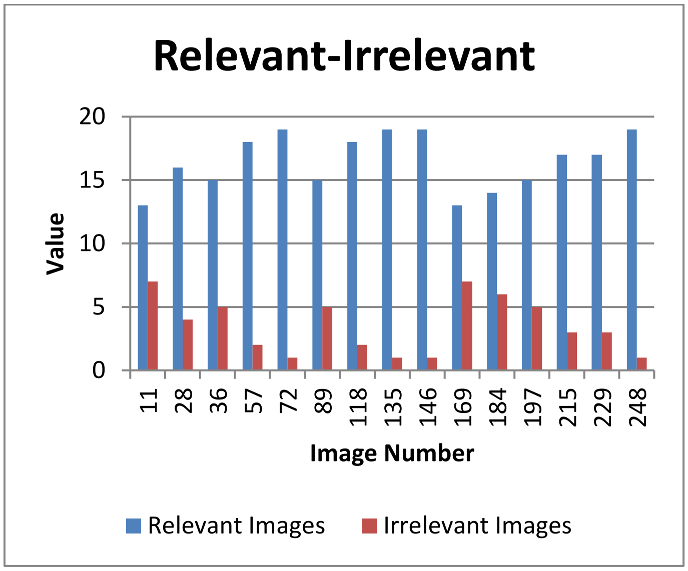

Fig. 4.9 - Bar chart of Relevant and Irrelevant Images

As shown in Figure 4.9, the number of relevant images is much higher than irrelevant images. In some cases, the irrelevant images is negligible small in number.

Table 4.2 shows the values of True Positive, False Positive, False Negative and True Negative.

Table 4.2 Various Parameters

Classes	Parameters			
	True Positive	False Positive	False Negative	True Negative
Class 1	9	5	11	25
Class 2	16	10	4	20
Class 3	16	4	4	26
Class 4	9	8	11	22
Class 5	17	7	4	22

In the above table, quality parameters are calculated of every image of each class i.e consist of 50 Images per class. The average value is computed with most similar 20 retrieved images. Table reveals that the true positive and true negative has higher values, which means the system is able to distinguish between relevant and irrelevant images. These values are used to calculate accuracy, specificity, precision and recall. Bar graph of these images is shown in figure 4.10.

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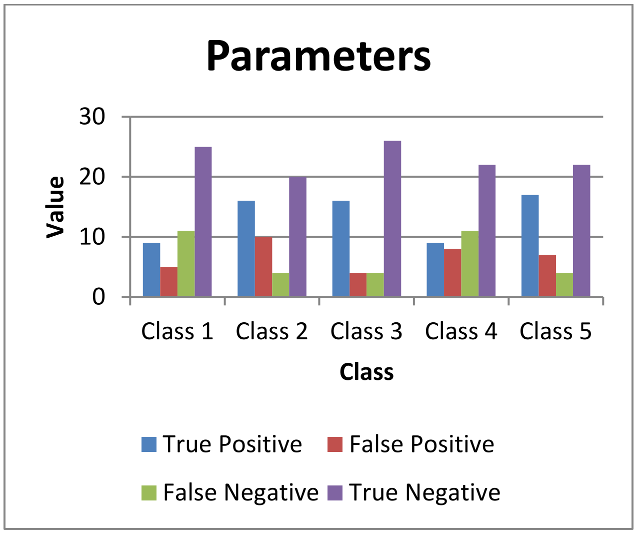

Fig. 4.10 - Bar chart of Various Parameters

Comparison between Precision and Recall

We evaluate the quality performance of developed Image Retrieval System. Table 4.3 shows the precision and recall of all the five classes.

- **Precision** is the number of True Positives divided by the number of True Positives and False Positive.
- **Recall** is the number of True Positives divided by the number of True Positives and the number of False Negatives.

Table 4.3 Comparison between Precision and Recall

Classes	Parameters	
	Precision	Recall
Class 1	0.6429	0.45
Class 2	0.6154	0.8
Class 3	0.8	0.8
Class 4	0.5294	0.45
Class 5	0.7083	0.8095

The result depicted in Table 4.3 reveals the precision and recall of the developed system.

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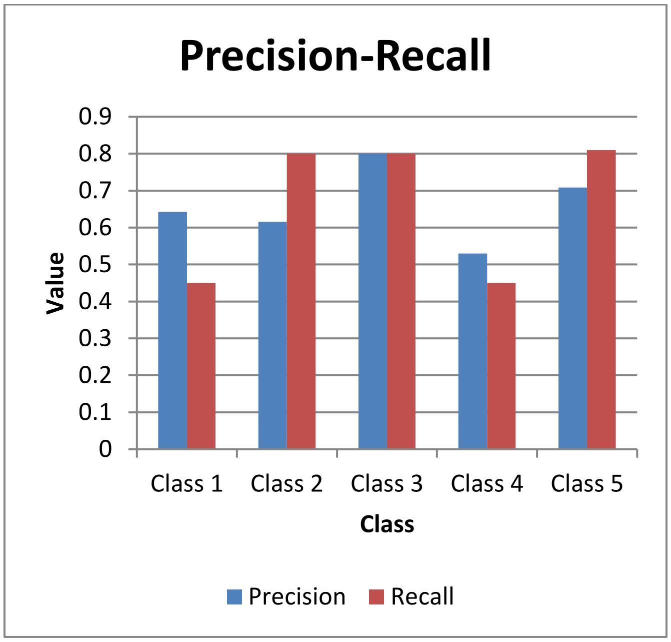

Fig. 4.11 - Bar chart of Precision and Recall

Calculating of Accuracy and Specificity

We evaluate the quality performance of developed Image Retrieval System. Table 4.3 shows the Accuracy and Specificity of all the five classes.

- **Accuracy** is the proportion of the total number of predictions that were correct.
- **Specificity** measures the proportion of negatives that are correctly identified.

Table 4.4 Calculating Accuracy and Specificity

Classes	Parameters	
	Accuracy	Specificity
Class 1	0.936	0.9783
Class 2	0.944	0.9565
Class 3	0.968	0.9826
Class 4	0.924	0.9652
Class 5	0.956	0.9694

The result depicted in Table 4.4 reveals the Accuracy and Specificity of the developed system. The accuracy and specificity is very high of the developed Image Retrieval System.

The bar graph of Accuracy and Specificity of all the classes are shown in figure 4.12

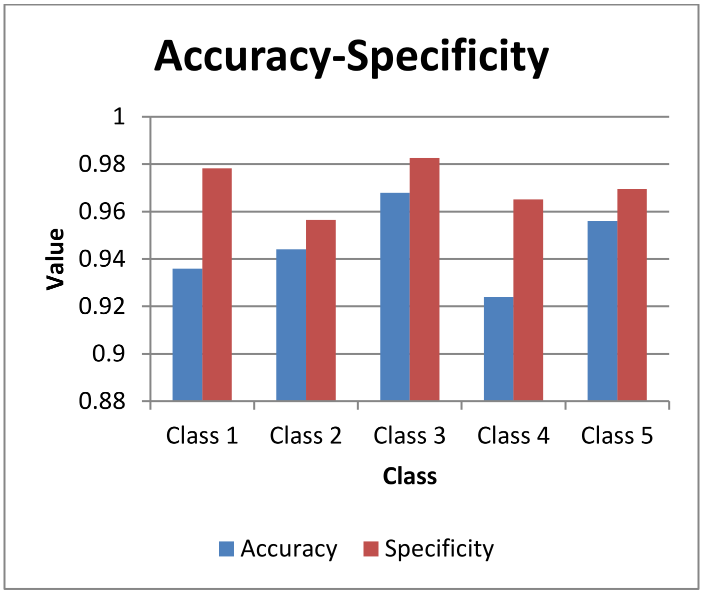

Fig. 4.12 - Bar chart between Accuracy and Specificity

CONCLUSION AND FUTURE SCOPE

Image Object Recognition and Retrieval is a vast research area and has many open questions and challenges. Designing a Image Object Recognition and Retrieval system involves choosing particular feature representation techniques, optimal dimensionality and reliable similarity functions in order to achieve best results.

We developed Image Object Recognition and Retrieval System using MATLAB R2015. From the test results, it is found that the developed image retrieval system has quite good and promising result. The developed system is not complex and easy to implement. The system will provide higher accuracy values thus facilitating the investigation of results. The experimental result shows that the developed system has an average Accuracy of 95 percent.

This report is a starting point for determining a possible set of metrics for appropriate and consistent performance evaluation. This is crucial to enable comparison between Image Object Recognition and Retrieval systems on similar grounds.

1. To further improve the performance of the retrieval system, the study of taking shape features into account during similarity distance computation can be considered.
2. To obtain better performance, the system can automatically pre-classify the database into different semantic images (such as outdoor vs. indoor, landscape vs. cityscape, texture vs. non texture images) and develop algorithms that are specific to a particular semantic image class.

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