Design and Development of an Algorithm for Image Clustering In Textile Image Retrieval Using Color Descriptors

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ABSTRACT

All textile industries aim to produce competitive materials and the competition enhancement depends mainly on designs and quality of the dresses produced by each industry. Every day, a vast amount of textile images are being generated such as images of shirts, jeans, t-shirts and sarees. A principal driver of innovation is World Wide Web, unleashing publication at the scale of tens and millions of content creators. Images play an important role as a picture is worth thousand words in the field of textile design and marketing. A retrieving of images needs special concepts such as image annotation, context, and image content and image values. This research work aimed at studying the image mining process in detail and analyzes the methods for retrieval. The textile images analyze various methods for clustering the images and developing an algorithm for the same. The retrieval method considered is based on relevance feedback, scalable method, edge histogram and color layout. The image clustering algorithm is designed based on color descriptors and k-means clustering algorithm. A software prototype to prove the proposed algorithm has been developed using net beans integrated development environment and found successful.

KEYWORDS

Image Mining, Image retrieval, Relevance Feedback, Image Clustering.

1. INTRODUCTION

Image mining refers to set of tools and techniques to explore images in an automated approach to extract semantically meaningful information. The retrieval process represents a visual query to the system and extracts the images based on the user request such mechanism referred to as query-by-example and it requires the definition of an image representation a set of descriptive features and of some similarity metrics to compare query and target images. The additional mechanisms have been introduced to achieve better performance and relevance feedback proved to be a powerful tool to iteratively collect information from the user and transform it into a semantic bias in the retrieval process. RF increases the retrieval performance and it enables the system to learn what is relevant or irrelevant to the user across successive retrieval-feedback cycles. RF approaches critical issues yet unsolved. And user interaction is time consuming and tiring, and it is desirable to reduce as much as possible the number of iterations to convergence.

This is particularly difficult when only a few new images are retrieved during the first RF steps and no positive examples are available for successive retrieval.

2. IMAGE MINING

Image mining is an extension of data mining to image domain and it is an interdisciplinary endeavour that draws upon expertise in computer vision, image processing, image retrieval, data mining, machine learning, database and artificial intelligence. The development of image acquisition and storage technology have led to tremendous growth in very large and detailed image databases [10] and it can reveal useful information to the human users. Image mining deals with the extraction of implicit knowledge, image data relationship, and other patterns not explicitly stored in the images. It differs from data mining in respect of the data and the nature of the data. Image mining has led to tremendous growth in significantly large and detailed image databases. The most important areas belonging to image mining are the image knowledge extraction; content based image retrieval, video retrieval, video sequence analysis, change detection, model learning, as well as object recognition.

2.1 Image Mining Techniques

Image mining may use data from a image databases and images are stored with some description against a particular image. The images are nothing but some intensity values, which figure the image in terms of color, shape, texture etc and the mining task is based on using such information contained in the images. The image mining techniques used by image miners are image acquisition, object recognition, image indexing and retrieval, image classification and clustering, association rule mining and neural networks [3].

Image mining is incomplete without image retrieval process. Images can be retrieved based on color, texture, shape, size, the spatial location of image elements. Image indexing, retrieval, image segmentation, feature extraction are the principal tasks in image mining. They are categorized as content-based techniques. The image retrieval techniques are categorized under description based retrieval techniques [16]. A major challenge of the image mining field is to effectively relate low-level features to high-level semantics based on the human perception.

2.2 Issues in Image Mining

The increasing number of image archives has made image mining an important task because of its potential to discover useful image patterns and relationships from a large set of images. A framework for extracting knowledge from a sequence of images has been proposed by Hsu, Lee and Goh. The structure of the framework composed of image analysis and knowledge processing [7] .The applications of image mining used in Military reconnaissance, Weather forecasting, Earth resources, Medical image, Criminal investigation, Terrain & sensor data fusion, Manufacturing quality control, Broadcast content management, Remote Sensing, Security and authentication, Forensics, Video logs, Geophysics, Aerial Photogrammetric. Some of the key applications in image mining are recent phenomenon such as follows www, multimedia, healthcare, engineering and construction industry [15].

The main issues of the image mining applications comprises of [6]:

1. Image Mining for Modeling of Forest Fires from Meteosat Images
2. Stochastic methods for image mining and data quality (DAQUAL)
3. In agricultural studies, topics like precision agriculture and crop modeling will be addressed

4. In environmental studies, the topic of spatial/temporal scales is still an ongoing issue for research.
5. Health issues concern the quantitative modeling of epidemics of a various kind.
6. Hydrology focuses on model-based Geo statistics for rainfall prediction.

3. IMAGE CLUSTERING AND RETRIEVAL

Clustering is a method of grouping data objects into different groups, such that similar data objects belong to the same group and dissimilar data objects to different clusters [1,9]. Current research increasing interest in digital image searching, classification, identification, management and storage. Some common but important applications of are person identification in movie clips and festive home videos, recognition in biometric system, natural scene classification for robot vision, commercials filtering, segmentation of important topics in lectures and meetings [4]. The image clustering, an important technology for image processing, has been actively researched for a long period of time and explosive growth of the Web, image clustering has even been a critical technology to help users digest the large amount of online visual information.

3.1 Retrieval Methods and Components

The storing of image contents are complicated than textual data stored in traditional databases. The greater demand for retrieval and management tools for visual data and visual information is a more capable medium of conveying ideas and is more closely related to human percept ion of the real world. Image retrieval techniques should provide support for user queries in an effective and efficient manner and just as conventional information retrieval does for textual retrieval. The image retrieval categorization is explained below [2].

Exact Matching – This category is applicable only to static environments in which features of the images do not evolve over an extended period of time. The databases containing industrial and architectural drawings are examples of such environments.

Low-Level Similarity-Based Searching – In most cases, it is difficult to determine which images satisfy the query and different users may have different needs of images and the same user may have different preferences under different circumstances. Thus, it is desirable to return the top several similar images based on the similarity measure. The similarity measure is generally based on simple feature matching and it is quite common for the user to interact with the system and indicate the quality of each of the matches, which helps the system to the users' preferences.

High-Level Semantic-Based Searching – In this searching, the notion of similarity is not based on simple feature matching and usually results from extended user interaction with the system. This area is quite active in research and yet still in its infancy. At the coarsest level, it identifies two major components of the retrieval problem will be representation and learning. The representation establishes a computational basis for the retrieval operation, and learning relies on the representation to address the dynamic aspects of a retrieval system [2].

Representation - A representation for content based image retrieval consists of three fundamental building blocks are explained below:

Feature Transformation - A feature transformation is a mapping from the space of image observations that has better properties for the retrieval operation. The feature transformation is

the most important component of the retrieval architecture. The various image classes that compose the database should be clearly separated in feature space.

Feature Representation - Keeping track of all the feature vectors extracted from each image would pose a major difficulty to any retrieval system. The feature representation is needed for summarize the distribution of feature vectors.

Visual features - Visual feature is the basis of any content-based image retrieval technique and widely used features include color, texture, shape and spatial relationships. Multiple approaches have been introduced for each of these visual features and each of them characterizes the feature from a different perspective [2].

Color - Color is widely used visual features in current based image retrieval system and color histogram is commonly used as representation technique. It is statistically described as combined probabilistic properties of different color channels by taking hold of number of pixels having specific properties [12].

Texture - Texture measures for visual patterns in images and presented by texels which are put into a number of sets and it depends on how many textures are found out in an image [13]. These sets not only define the textures it tells location of image in the texture. Identifications of specific textures in an image by modeling texture as two dimensional gray level variations [14].

Shape - Shape does not refer to the shape of an image. It to specify region which is intended to be sought out. Shapes are often determined first by applying segmentation.

Similarity Function – The feature representation for each database image, retrieval consists of extracting a s et of feature vectors from a query image and relying on a similarity function to evaluate which feature representation best explains those features.

4. IMAGE CLUSTERING OF TEXTILE IMAGES

4.1 Problem Definition

The area of content based image retrieval (CBIR) was motivated since the early 1990s by the idea to find and retrieve images independent from metadata other than extracted from the image itself. However a satisfactory solution has not been found yet and a problem has been isolated. the researchers defined the semantic gap, which refers to the inability of a machine to fully understand and interpret images based on automatically extracted data. In current research efforts in visual information retrieval especially global features, which denote features capturing characteristics of the whole image instead of focusing for instance on segments.

Image databases enormous in size, containing millions of images. The images will be searching based on the keyword assigned to the image by the user and user may not get the accurate images while surfing the internet. The current under development is the retrieval of images based on their content called content based image retrieval. The trade off decreases as more efficient algorithm are utilized and increased computational power becomes inexpensive.

4.2 Proposed System

In the proposed system several additional mechanisms have been introduced to achieve better performance. The additional mechanism of relevance feedback (RF) proved to be a powerful tool

to iteratively collect information from the user and transform it into a semantic bias in the retrieval process. The experimental metadata based image retrieval carries different types of retrieval mechanisms are supported such as MPEG-7 descriptors color layout, scalable color and edge histogram. Algorithms of feature extraction measure are very dependent on the features used. In each feature, there would be more than one representation and histogram is the most commonly used technique to describe features.

The proposed system is an automatic process to search relevant images based on user input and it compares with images from the database and returns the results. The concurrent file system (CFS) is act as a database which is used for matching with minimum iteration, although content based methods are efficient, they cannot always match user expectation. It is an implementation of existing one; the discrete cosine transformation and K-means algorithm are used to adjust the query by user's feedback. Indexing is an interactive process to improve the retrieval accuracy by a few iterations.

4.3 Methodology

4.3.1 Image Color Selection

Color is the vital and widely used visual features in current based image retrieval system and color histogram is commonly used as representation technique. It is statistically described as combined probabilistic properties of different color channels by taking hold of number of pixels having specific properties. The computing distance measures are concerned, it is based on color similarity which can be achieved by computing a color histogram for each image that identifies the proportion of pixels within an image which has specific values & humans express it as colors. Color has been successfully applied to retrieve images, it has very strong correlations with the underlying objects in the image. Color spaces for computation of a color histogram HSV (Hue, Saturation, and Value), HLS (Hue, Lightness, and Saturation), were found to deliver better results as compared to the RGB space. Hue of color represents the relative color appearance of 'redness', 'greenness,' and so on and value indicates the darkness of the color and Saturation represents the strength of the color. The procedure is stated as follows:

Step 1. Initialize a two dimension array of the image size.
Step 2. Find a pixel which is not labeled. Label it and store its coordinates on a stack.
Do:
2.1) get a pixel from the stack;
2.2) check its neighbours to see, if they are unlabeled and close to the considered Pixel; if so, label them and store them on the stack.
Step 3. Repeat the above step until there are no more pixels on the image.

4.3.2 Text based Image Retrieval

The images are indexed and retrieved based on the descriptions such as their size, type, date and time of capture, identify of owner, keywords or some text description of the image. This is often called description based or text based image retrieval process. The text based descriptions of the images are typed manually for each image by human descriptors, because the automatic generation of keywords for the images is difficult without visual information and feature extraction. Based on these visual contents, desirable image features can be extracted and used as index or basis of search. The keyword from the dictionary of the images and on the basis of these keywords searches the required images. Image came in the form of text stores in the data dictionary and here finds the keywords are available in the data dictionary then it shows the number of particular images. The data doesn't find then it shows a message the word does not

match. The user's has given input text the images are displayed based on their relevance feedback.

Text-based search provides results with semantic similarity, the images are downloaded from goggle using the URL provided by the image collection. The content-based descriptors extracted from the images were: Color Histogram 3 × 3 × 3 using RGB color space (a 27*d* vector), Gabor Wavelet (a 48*d* vector), Efficient Color Descriptor (ECD) 8 × 1 using RGB color space (a 32*d* vector), ECD 8 × 1 using HSV color space (a 32*d* vector), and Edge Local 4 × 4 (a 80*d* vector).

4.3.3 Query Based Image Retrieval

The query image can be extracting the visual features and can be compared to find matches with the indices of the images stored in the database and these features are used to retrieve the similar images from the image database. In the comparing of two images, similarity of the visual features of the query image is measured with the features of each image. The similarities of two images are measured by computing the distance between the feature vectors of two images the retrieval system returns the k images. Several image features have been used to index images for content based image retrieval systems. Query provides the retrieval system with an image and then search is based upon search algorithms which vary according to its application; result images must all share common elements. A pre existing image may be supplied by user or taken from stored database. In the proposed approach there are three methods are available namely color layout, scalable color and edge histogram or combining any one of the methods.

5. CASE STUDY

The global textile and clothing industry occupies an important position in the total volume of merchandise trade across countries. In the developing countries account for little over two-third of world exports in textiles and clothing. Asia has been the principal sourcing region for imports of textiles and clothing by both USA and European Union. India accounts for 22 per cent of the world's installed capacity of spindles and is one of the largest exporters of yarn in international market. Indian industry contributes about 25 percent share in the world trade of cotton yarn [27].

5.1 India's share in World Textile Trade

India's textile clothing and apparels sector has opened up significantly with the dismantling of quotas. Global apparel market is gradually shifting from western countries to Asia on account of cost competitiveness. India has the added advantage of low labor cost along with other countries like Bangladesh, Indonesia and China. There are a number of factors that have contributed to a definite swell in apparel market size. India's domestic market for clothing is currently worth Euro 20,219 million in 2008. It has registered a steady compounded annual growth rate (CAGR) of 13.6% in the past 5 years. Volume wise, apparel market has grown from 4.8 billion units in 2004 to 5.9 billion units in 2008 at a CAGR of 5.3%. [11].

Table 1 show that the growth rate of manufacturing and textile sectors in India. The percentage of textile manufacturing growth rate is displayed from the year 2003 to 2010 November.

Table 1. Growth Rate of Textile Sector in India

Year	Growth rate of Manufacturing (%)	Growth rate of textiles (%)
2003-04	7.4	-1.1
2004-05	9.1	9.3
2005-06	9.1	8.2
2006-07	12.5	10.9
2007-08	9.0	5.8
2008-09	3.2	-1.2
2009-10 (April-November)	7.7	5.8

In the overall trade, India's share in the $ 685 billion world textile and clothing market and India's textile export share increased from 3.27% in 1996 to 3.96% in 2007. India's export share in clothing increased from 2.57% in 1996 to 2.79% in 2007 [8]. Table 2 shows the yearly wise textile trade production details as world export, India's export and India's share in world export during the year 1996 – 2007.

Table 2. Yearly Wise Textile Trade

	Textile			Clothing		
Year	World Export	India's Export	India's Share in World Export %	World Export	India's Export	India's Share in World Export %
1996	151.06	4.94	3.27	164.14	4.22	2.57
1997	157.73	5.24	3.32	182.28	4.34	2.38
1998	151.31	4.56	3.01	183.33	4.78	2.61
1999	147.92	5.09	3.44	186.03	5.15	2.77
2000	157.46	5.90	3.74	198.94	6.03	3.03
2001	147.00	5.38	3.66	195.03	5.48	2.81
2002	152.20	6.03	3.96	200.85	6.04	3.01
2003	169.40	6.51	3.84	225.94	6.46	2.86
2004	194.70	6.85	4.00	258.10	6.62	2.80
2005	203.00	7.85	3.90	276.00	8.29	3.00
2006	217.992	8.837	4.05	309.593	9.465	3.05
2007	238.126	9.446	3.96	345.39	9.655	2.79

5.2 Relevance Feedback

Relevance feedback is an interactive process that starts with user input query, and then the system extracts the image feature and measure the distance with images in the database. The initial retrieval list is then generated. The user can annotate the photos with free text and rate the quality of the image. The pre existing metadata like EXIF or IPTC tags inside images is loaded and converted to MPEG-7. In the second panel, the semantic description panel has displayed and it offers a tool for visual creation of MPEG-7 based semantic descriptions using a drawn directed graph. The feature extraction panel, low-level descriptors that are automatically extracted are shown. The extracted MPEG-7 descriptors are Color Layout, Scalable Color and Edge

Histogram. The shape panel allows the creation of simple shapes on the images and all shapes are stored within the MPEG-7 document.

5.3 Scalable Color

The scalable color descriptor has a color histogram extracted in *HSV* color space, and encoded for storage efficiency. The descriptor extraction starts with the computation of the color histogram with 256 bins in the *HSV* color space with hue (H) component quantized to 16 bins, and saturation (S) and value (V) quantized to 4 bins each. This initial version is then passed through a series of 1-D Haar transforms, starting with H axis, followed by S, V and H. The result is a set of 16 low-pass coefficients and up 240 high-pass coefficients. The redundancy of the original histogram, the high-pass coefficients tend to have low values. Typical application of the descriptor include similarity search in multimedia databases and browsing of large databases. Scalable color also forms the basis of the group of frames/pictures color descriptor.

5.4 Edge Histogram

The image array has divided into DCT 4x4 sub images. Each sub image has further partitioned into non-overlapping square image blocks whose size depends on the resolution of the input image. The edges in each image-block are categorized into one of the following six types: vertical, horizontal, 45± diagonal, 115± diagonal, non directional Edge and no-edge. A 5-bin edge histogram of each sub image can be obtained and each bin value is normalized by the total number of image-blocks in the sub image. The normalized bin values are nonlinearly quantized.

5.5 Color Layout

The image array has partitioned into 8x8 blocks and colors are selected and expressed in YCbCr color space. The three components (Y, Cb and Cr) are transformed by 8x8 DCT (Discrete Cosine Transform). The resulting sets of DCT coefficients are zigzag-scanned and the first few coefficients are nonlinearly quantized to form the descriptor. YCbCr and Y'CbCr are a practical approximation to color processing and perceptual uniformity, where the primary colors corresponding roughly to Red, Green and Blue are processed into perceptually meaningful information. The subsequent image/video processing, transmission and storage can do operations and introduce errors in perceptually meaningful ways.

Y'CbCr is used to separate out a luma signal (Y') that can be stored with high resolution. The transmitted at high bandwidth, and two chroma components (Cb and Cr) that can be bandwidth-reduced, sub sampled, compressed, or otherwise treated separately for improved system efficiency.

5.6 Image retrieval

An image retrieval system has a computer system for browsing, searching and retrieving images from a database of digital images. Most traditional image retrieval utilize some method of adding metadata such as captioning, keywords, that retrieval can be performed over the annotation words. Retrieval gives the ability to retrieve annotated photos. This is experimental software the retrieval mechanism is file system based and all MPEG-7 documents found by retrieval in a specified directory and in further subdirectories are searched.

There are four ways of searching for a matching image such as searching through an X-Path statement, and search options entered through textboxes with various options. Image retrieval

using the visual descriptors color layout and scalable color defined in the MPEG-7 standard, searching for a similar semantic description graph.

5.7 X-Path search

The first option used for developers and debugging of X-Path statements and all other retrieval mechanisms use X-Path as query language. The search for matching documents using X-Path requires detailed knowledge of the structure of the documents being searched. The querying documents without knowing the structure and these statements only offer minimal retrieval features.

5.7 Semantic Search

The panel offers a search mechanism for searching semantic descriptions and it allows the user to define a graph with minimum one to maximum three nodes and two possible relations and an asterisk is used as wildcard. A search graph which only contains node with a word defining node will return each MPEG-7 document wherein a semantic object containing the specified word is found. In the searching, if two nodes and two relations are used to define the search graph, the repository of MPEG-7 documents is filtered by the terms defined as objects or relations.

The retrieval engine implementation, connect to an XML database, which speedup executing the X-Path statements. In case of a content based image search each MPEG-7 document has to be loaded and the required descriptor is located using X-Path and descriptor has to be compared to the sample descriptor used as search parameter to calculate relevance. These results are put into a list ordered ascending by relevance, though a relevance of zero shows an exact match. The comparison of the descriptors has to be implemented on database side like a stored procedure, a server object or a similar mechanism, because of speed issues.

6. RESULTS AND DISCUSSIONS

The prototype developed has six modules and it aims for solving relevance feedback (RF), scalable color, edge histogram, color layout, image retrieval and semantic search respectively. The image retrieval method is based on color descriptors such as color layout, scalable color and edge histogram. These three descriptors yield three methods. The time taken to search and retrieve an from database using relevance feedback method is 0.22 seconds and color descriptor method is only 0.11 seconds. It is shown that the accuracy and efficiency of color descriptor method are higher than that of relevance feedback method.

Figure 1 shows the retrieved images using relevance feedback method based on image quality, rating, metadata description, details on creator of image and technical information about the image.

Figure 1 Retrieved Images Using Relevance Feedback Method

This panel offers a search mechanism for searching semantic descriptors and it allows the user to define a graph with minimum one to maximum three nodes and two possible relations. The retrieved images are represented in the following of a semantic object based on text, image descriptor and relations and the results are stored in MPEG-7 format. Figure 2 shows the retrieved images using color descriptor method by zooming then one can view the images.

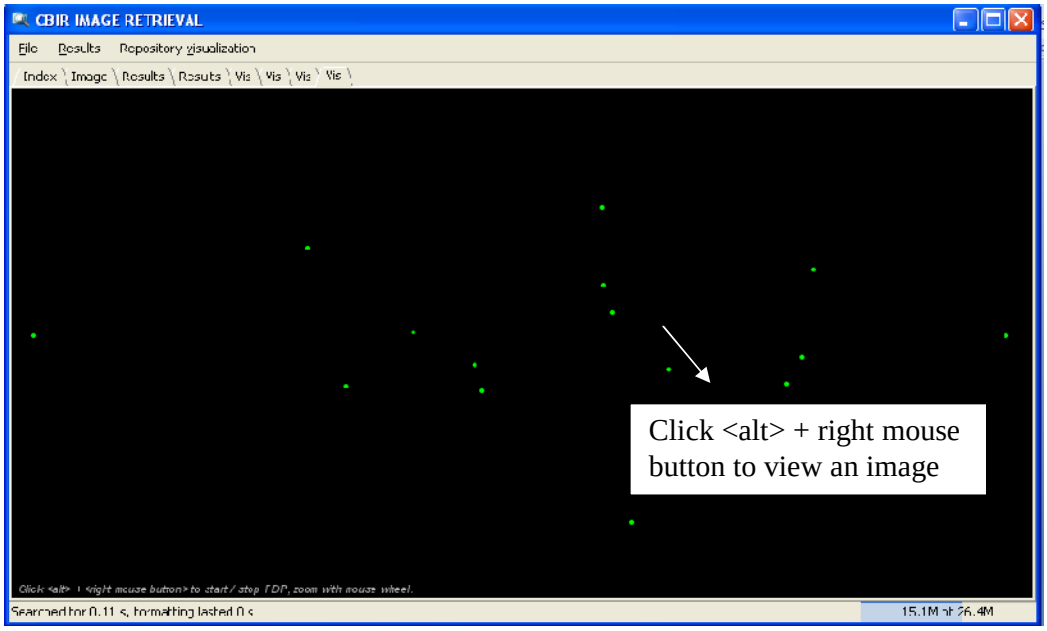

Figure 2 Retrieved Images Using Color Descriptor Method

Figure 3 Variations of Retrieval Images in Color Descriptor Method

Fig 6.3 shows the variation of the retrieved images in color descriptor method and it displays the images visually. By using "<alt> + right" button the image zooming wheel can be initiated and stopped.

7. CONCLUSIONS

This research is concerned with the study and analysis of image mining, image retrieval, image clustering of textile images. The retrieval method designed based on relevance feedback, color layout, scalable color and edge histogram. The algorithm for image clustering is designed based on k-means algorithm and the developed software prototype allows one to retrieve the images of the textile based on categories such as shirts, t-shirts, pants and sarees and color descriptors. The prototype is tested with test data and found successful.

8. FURTHER WORK

This research work can be further extended in the following directions: automation of annotation advanced formatting of images and building libraries.

Automation of Annotation – It is necessary to provide annotations for the images this can be done by identifying visually similar images, similar semantics and visual descriptors.

Advanced Formatting of Images – Currently the images are stored in jpeg format. This research work can be extended to store images in MPEG-7 format and to retrieve the same.

Building Image Libraries - Most of the companies need image repositories like clip arts collection, royalty free images for ads and flyers or photos from objects, persons and events. This research work can be further extended to build image libraries for other industries.

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