Hybrid Coherent Image Retrieval Using Visual Indexing

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Abstract- *The rapidly increasing number of images on the internet has further increased the need for efficient indexing for digital image searching of large image datasets. The design of a cloud service that provides high efficiency but compact image indexing remains challenging, partly due to the well-known semantic gap between user queries and the rich semantics of large-scale datasets. A novel joint semantic-visual space by leveraging visual descriptors and semantic attributes, which narrows the semantic gap by combining both attributes and indexing into a single framework. Such a joint space embraces the flexibility of Coherent Semantic visual Indexing (CSI), which employs binary codes to boost retrieval speed while maintaining accuracy. Moreover, the project performs dimensionality reduction of image features avoiding the "dimensionality curse" problem. The proposed method improves the precision of the query results indicating that proposed model can be successfully employed to perform continuous feature selection in image databases.*

Keywords- Indexing, Semantics, Mining, Edge Detection, Spectral Hashing.

I. INTRODUCTION

Feature selection can significantly improve the precision of content-based queries in image databases by removing noisy features or by bursting the most relevant ones. Continuous feature selection techniques assign continuous weights to each feature according to their relevance. In this project, a supervised method for continuous feature selection is proposed. The Computer Industry has seen a large growth in technology – access, storage and processing fields. This combined with the fact that there are a lot of data to be processed has paved the way for analyzing and mining data to derive potentially useful information. Various fields ranging from Commercial to Military want to analyze data in an efficient and fast manner. Particularly in the area of Multimedia data, images have the stronghold. However there is a general agreement that sufficient tools are not available for analysis of images. One of the issues is the effective identification of features in the images and the other one is extracting them. One of the difficult tasks is knowing the image domain and obtaining a priori knowledge of what information is required from the image. This is one of the reasons the Image Mining process cannot be completely automated. A current technique in image retrieval and classification (two of the dominant tasks in Image Mining) concentrates on content-based techniques. Due to the recent wide spread of digital imaging devices, we can easily obtain digital images of various kinds of real world scenes, so that demand for image recognition of various kinds of real world images becomes greater. It is, however, hard to apply conventional image recognition methods to such generic recognition, because most of their applicable targets are restricted. Henceforth, semantic processing of images such as automatic attaching keywords to images, classification and search in terms of semantic contents of images are desired.

II. LITERATURE REVIEW

A. FAST SIMILARITY SEARCH FOR LEARNED METRICS (2009)

Brian Kulis ; Prateek Jain ; Kristen Grauman

It introduces a method that enables scalable similarity search for learned metrics. Given pairwise similarity and dissimilarity constraints between some examples, it learns a Mahalanobis distance function that captures the examples' underlying relationships well. To allow sub linear time similarity search under the learned metric, here it shows how to encode the learned metric parameterization into randomized locality-sensitive hash functions. It further formulate an indirect solution that enables metric learning and hashing for vector spaces whose high dimensionality makes it infeasible to learn an explicit transformation over the feature dimensions. It demonstrates the approach applied to a variety of image data sets, as well as a systems data set. The learned metrics improve accuracy relative to commonly used metric baselines, while our hashing construction enables efficient indexing with learned distances and very large databases.

B. MULTIDIMENSIONAL SPECTRAL HASHING (2012)

Yair Weiss, Rob Fergus, Antonio Torralba

With the growing availability of very large image databases, there has been a surge of interest in methods based on “semantic hashing”, i.e. compact binary codes of data-points so that the Hamming distance between codewords correlates with similarity. In reviewing and comparing existing methods, it show that their relative performance can change drastically depending on the definition of ground-truth neighbors. Motivated by this finding, here it proposes a new formulation for learning binary codes which seeks to reconstruct the affinity between datapoints, rather than their distances. It shows that this criterion is intractable to solve exactly, but a spectral relaxation gives an algorithm where the bits correspond to threshold eigenvectors of the affinity matrix, and as the number of datapoints goes to infinity these eigenvectors converge to eigenfunctions of Laplace-Beltrami operators, similar to the recently proposed Spectral Hashing (SH) method. Unlike SH whose performance may degrade as the number of bits increases, the optimal code using our formulation is guaranteed to faithfully reproduce the affinities as the number of bits increases. It shows that the number of eigenfunctions needed may increase exponentially with dimension, but introduce a “kernel trick” to allow us to compute with an exponentially large number of bits but using only memory and computation that grows linearly with dimension. Experiments shows that MDSH outperforms the state-of-the art, especially in the challenging regime of small distance thresholds.

C. ITERATIVE QUANTIZATION: A PROCRUSTEAN APPROACH TO LEARNING BINARY CODES FOR LARGE-SCALE IMAGE RETRIEVAL (2013)

YunchaoGong, Svetlana Lazebnik, Albert Gordo, FlorentPerronnin

Here the paper addresses the problem of learning similarity-preserving binary codes for efficient similarity search in large-scale image collections. It formulate this problem in terms of finding a rotation of zero-centered data so as to minimize the quantization error of mapping this data to the vertices of a zero-centered binary hypercube, and propose a simple and efficient alternating minimization algorithm to accomplish this task. This algorithm, dubbed iterative quantization (ITQ), has connections to multiclass spectral clustering and to the orthogonal Procreates problem, and it can be used both with unsupervised data embedded such as PCA and supervised embedded such as canonical correlation analysis (CCA). The resulting binary codes significantly outperform several other state-of-the-art methods. It also shows that further performance improvements can result from transforming the data with a nonlinear kernel mapping prior to PCA or CCA. Finally, it demonstrates an application of ITQ to learning binary attributes or "class names" on the Image Net data set.

D. NEAR-OPTIMAL HASHING ALGORITHMS FOR APPROXIMATE NEAREST NEIGHBOR IN HIGH DIMENSIONS (2008)

AlexandrAndoni, PiotrIndyk

It present an algorithm for the c-approximate nearest neighbor problem in a d-dimensional Euclidean space, achieving query time of O(dn 1c2/+o(1)) and space O(dn + n1+1c2/+o(1)). This almost matches the lower bound for hashing-based algorithm recently obtained in (R. Motwani et al., 2006). It also obtain a space-efficient version of the algorithm, which uses dn+nlogO(1) n space, with a query time of dnO(1/c2). Finally, it discusses practical variants of the algorithms that utilize fast bounded-distance decoders for the Leech lattice.

E. LEARNING TO HASH WITH BINARY RECONSTRUCTIVE EMBEDDED (2009)

Brian Kulis, Trevor Darrell

Fast retrieval methods are increasingly critical for many large-scale analysis tasks, and there have been several recent methods that attempt to learn hash functions for fast and accurate nearest neighbor searches. It develops an algorithm for learning hash functions based on explicitly minimizing the reconstruction error between the original distances and the Hamming distances of the corresponding binary embedded. It develop a scalable coordinate-descent algorithm for our proposed hashing objective that is able to efficiently learn hash functions in a variety of settings. Unlike existing methods such as semantic hashing and spectral hashing, our method is easily kernelled and does not require restrictive assumptions about the underlying distribution of the data. It present results over several domains to demonstrate that our method outperforms existing state-of-the-art techniques.

F. KERNELLED LOCALITY-SENSITIVE HASHING FOR SCALABLE IMAGE SEARCH (2009)

Brian Kulis, Kristen Grauman

Fast retrieval methods are critical for large-scale and data-driven vision applications. Recent work has explored ways to embed high-dimensional features or complex distance functions into a low-dimensional Hamming space where items can be efficiently searched. However, existing methods do not apply for high-dimensional kernelled data when the underlying feature embedding for the kernel is unknown. It show how to generalize locality-sensitive hashing to accommodate arbitrary kernel functions, making it possible to preserve the algorithm's sub-linear time similarity search guarantees for a wide class of useful similarity functions. Since a number of successful image-based kernels have unknown or incomputable embedded, this is especially valuable for image retrieval tasks. It validate our technique on several large-scale datasets, and show that it enables accurate and fast performance for example-based object classification, feature matching, and content-based retrieval.

G. GAME THEORETIC RESOURCE ALLOCATION IN MEDIA CLOUD USING MOBILE SOCIAL USERS (2016)

Zhou Su, QichaoXu, MinruiFei, Mianxiong Dong

Due to the rapid increases in both the population of mobile social users and the demand for quality of experience (QoE), providing mobile social users with satisfied multimedia services has become an important issue. Media cloud has been shown to be an efficient solution to resolve the above issue, by allowing mobile social users to connect to it through a group of distributed brokers. However, as the resource in media cloud is limited, how to allocate resource among media cloud, brokers, and mobile social users becomes a new challenge. Therefore, in this paper, it propose a game theoretic resource allocation scheme for media cloud to allocate resource to mobile social users through brokers. First, a framework of resource allocation among media cloud, brokers, and mobile social users is presented. Media cloud can dynamically determine the price of the resource and allocate its resource to brokers. A mobile social user can select his broker to connect to the media cloud by adjusting the strategy to achieve the maximum revenue, based on the social features in the community. Next, it formulate the interactions among media cloud, brokers, and mobile social users by a four-stage Stackelberg game. In addition, through the backward induction method, it proposes an iterative algorithm to implement the proposed scheme and obtain the Stackelberg equilibrium. Finally, simulation results show that each player in the game can obtain the optimal strategy where the Stackelberg equilibrium exists stably.

DevOps as an emerging paradigm aims to tightly integrate developers with operations personnel. This enables fast and frequent releases in the sense of continuously delivering new iterations of a particular application. Users and customers of today's Web applications and mobile apps running in the Cloud expect fast feedback to problems and feature requests. Thus, it is a critical competitive advantage to be able to respond quickly. Besides cultural and organizational changes that are necessary to apply DevOps in practice, tooling is required to implement end-to-end automation of deployment processes. Automation is the key to efficient collaboration and tight integration between development and operations. The DevOps community is constantly pushing new approaches, tools, and open-source artifacts to implement such automated processes. However, as all these proprietary and heterogeneous DevOps automation approaches differ from each other, it is hard to integrate and combine them to deploy applications in the Cloud using an automated deployment process. In this paper it present a systematic classification of DevOps artifacts and show how different kinds of artifacts can be discovered and transformed toward TOSCA, which is an emerging standard. Here it present an integrated modeling and runtime framework to enable the seamless and interoperable integration of different approaches to model and deploy application topologies. The framework is implemented by an open-source, end-to-end tool chain. Moreover, it validates and evaluate the presented approach to show its practical feasibility based on a detailed case study, in particular considering the performance of the transformation toward TOSCA.

H. MAPREDUCE BASED DISTRIBUTED LEARNING ALGORITHM FOR RESTRICTED BOLTZMANN MACHINE (2013)

Chun-YangZhang, C.L. PhilipChen, DewangChen, Kin TekNG

Deep learning is recently regarded as the closest artificial intelligence model to human brain. It is about learning multiple levels of representation and abstraction that help to make sense of data such as images, sound, and text. One deep model often consists of a hierarchical architecture that has the capability to model super non-linear and stochastic problems. Restricted Boltzmann Machine (RBM) is the main constructing block of current deep networks, as most of deep architectures are built with it. Based on Map Reduce framework and Hadoop distributed file system, this paper proposes a distributed algorithm for training the RBM model. Its implementation and performance are evaluated on Big Data platform-Hadoop. The main contribution of the new learning algorithm is that it solves the scalability problem that limits the development of deep learning. The intelligence growing process of human brain requires learning from Big Data. The distributed learning mechanism for RBM makes it possible to abstract sophisticated and informative features from Big Data to achieve high-level intelligence. The evaluations of the proposed learning algorithm are carried out on image inpainting and classification problems based on the BAS dataset and MNIST hand-written digits dataset.

I. BATCH-ORTHOGONAL LOCALITY-SENSITIVE HASHING FOR ANGULAR SIMILARITY (2014)

JianqiuJi, Shuicheng Yan, Jianmin Li, GuangyuGao, Qi Tian, Bo Zhang

Sign-random-projection locality-sensitive hashing (SRP-LSH) is a widely used hashing method, which provides an unbiased estimate of pairwise angular similarity, yet may suffer from its large estimation variance. It proposes in this work batch-orthogonal locality-sensitive hashing (BOLSH), as a significant improvement of SRP-LSH. Instead of independent random projections, BOLSH makes use of batch-orthogonalized random projections, i.e., it divide random projection vectors into several batches and orthogonalized the vectors in each batch respectively.

These batch-orthogonalized random projections partition the data space into regular regions, and thus provide a more accurate estimator.

It proves theoretically that BOLSH still provides an unbiased estimate of pairwise angular similarity, with a smaller variance for any angle in $(0, \pi)$, compared with SRP-LSH. Furthermore, we give a lower bound on the reduction of variance.

The extensive experiments on real data well validate that with the same length of binary code, BOLSH may achieve significant mean squared error reduction in estimating pairwise angular similarity. Moreover, BOLSH shows the superiority in extensive approximate nearest neighbor (ANN) retrieval experiments.

III. SYSTEM IMPLEMENTATION

1. PROBLEM DEFINITION

Feature selection can significantly improve the precision of content-based queries in image databases. Continuous feature selection techniques assign continuous weights to each feature according to their relevance. It performs dimensionality reduction of image features avoiding the “dimensionality curse” problem.

2. SYSTEM DESCRIPTION

The method applies statistical association rules to find patterns relating low-level image features to high-level knowledge about the images, and it uses the patterns mined to determine the weight of the features.

The feature weighting through the statistical association rules reduces the semantic gap that exists between low-level features and the high-level user interpretation of images, improving the precision of the content-based queries.

Moreover, the proposed method performs dimensionality reduction of image features avoiding the “dimensionality curse” problem. Experiments show that the proposed method improves the precision of the query results up to 38%, indicating that statistical association rules can be successfully employed to perform continuous feature selection in medical image databases.

The number of combinations of a target object and non-target objects is the large, we think that we can deal with this largeness by gathering a large amount of image from the image datasets and by using them for learning. Here, we do not set up "reject", and then all test images are classified into any class.

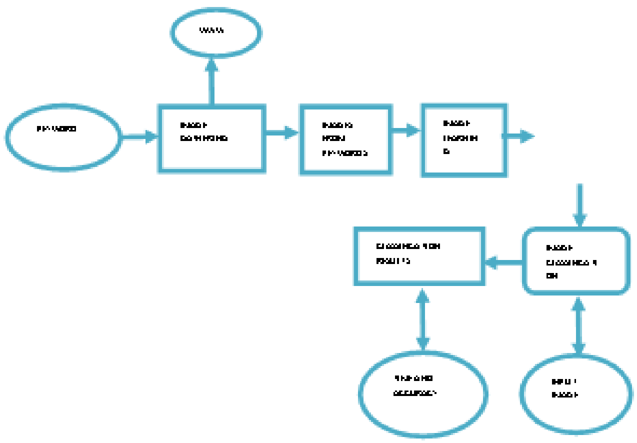

Fig 1. Proposed System

III. MODULES

3.1. IMAGE DATA SET LOADING

In this module the image data sets are uploaded into the system as files. The datasets are regular standard datasets. One of the issues is the effective identification of features in the images and the other one is extracting them. One of the difficult tasks is knowing the image domain and obtaining a priori knowledge of what information is required from the image. This is one of the reasons the Image Mining process cannot be completely automated. Current techniques in image retrieval and classification (two of the dominant tasks in Image Mining) concentrates on content-based techniques.

3.2. FEATURE DESCRIPTORS

The processing in our system consists of three steps. In the gathering stage, the system automatically gathers images related to given class keywords from the Web. In the learning stage, it extracts image features from gathered images and associates them with each class. At first, in the gathering stage, an image-gathering module gathers features from the images related to the class. Note that our image-gathering module is not called image ``search'' but image ``feature gathering'', since it has the following properties, It searches for images over the whole dataset directly, It makes an index of the Web images in advance, and It makes use of search results of commercial keyword-based search engines for the class keywords.

3.3. BUILDING INDEXING

Visual descriptors or image descriptors are descriptions of the visual features of the contents in images, videos, or algorithms or applications that produce such descriptions. They describe elementary characteristics such as the shape, the color, the texture or the motion, among others. The audio-visual descriptors are in charge of the contents description. These descriptors have a good knowledge of the objects and events found in a video, image or audio and they allow the quick and efficient searches of the audio-visual content. This system can be compared to the search engines for textual contents. Although it is certain, that it is relatively easy to find text with a computer, is much more difficult to find concrete audio and video parts. For instance, imagine somebody searching a scene of a happy person. The happiness is a feeling and it is not evident its shape, color and texture description in images. The description of the audio-visual content is not a superficial task and it is essential for the effective use of this type of archives.

Descriptors are the first step to find out the connection between pixels contained in a digital image and what humans recall after having observed an image or a group of images after some minutes.

Visual descriptors are divided in two main groups:

General information descriptors: they contain low level descriptors which give a description about color, shape, regions, textures and motion.

Specific domain information descriptors: they give information about objects and events in the scene. A concrete example would be face recognition.

3.3.3.1. GENERAL INFORMATION DESCRIPTORS

General information descriptors consist of a set of descriptors that covers different basic and elementary features like: color, texture, shape, motion, location and others. This description is automatically generated by means of signal processing.

3.3.3.1.1. COLOR:

The most basic quality of visual content. Five tools are defined to describe color. The three first tools represent the color distribution and the last ones describe the color relation between sequences or group of images:

Dominant Color Descriptor (DCD)
Scalable Color Descriptor (SCD)
Color Structure Descriptor (CSD)
Color Layout Descriptor (CLD)
Group of frame (GoF) or Group-of-pictures (GoP)

3.3.3.1.2. TEXTURE:

An important quality in order to describe an image. The texture descriptors characterize image textures or regions. They observe the region homogeneity and the histograms of these region borders. The set of descriptors is formed by:

Homogeneous Texture Descriptor (HTD)
Texture Browsing Descriptor (TBD)
Edge Histogram Descriptor (EHD)

3.3.3.1.3. SHAPE:

It contains important semantic information due to human’s ability to recognize objects through their shape. However, this information can only be extracted by means of a segmentation similar to the one that the human visual system implements. Nowadays, such a segmentation system is not available yet, however there exists a serial of algorithms which are considered to be a good approximation. These descriptors describe regions, contours and shapes for 2D images and for 3D volumes. The shape descriptors are the following ones:

Region-based Shape Descriptor (RSD)
Contour-based Shape Descriptor (CSD)
3-D Shape Descriptor (3-D SD)

3.3.3.1.4. LOCATION:

The elements location in the image is used to describe elements in the spatial domain. In addition, elements can also be located in the temporal domain:

Region Locator Descriptor (RLD)
Spatial Temporal Locator Descriptor (STLD)

In the system, image classification is performed by image-feature-based search. First, in the learning stage, an image-learning module extracts image features from gathered images and associates image features with the classes represented by the class keywords. Next, in the classification stage, we classify an unknown image into one of the classes by comparing image features.

3.4. QUERY OUTPUT VISUAL INDEX

In the proposed method of image classification, image features of not only a target object but also non-target objects such as the background are used as a clue of classification, since non-target objects usually have strong relation to a target object. Although the number of combinations of a target object and non-target objects is large, we think that we can deal with this largeness by gathering a large amount of image from the Web and by using them for learning. Here, we do not set up "reject", and then all test images are classified into any class. We made six kinds of classification experiments from no.1 to no.6 for 10 kinds of gathered images, 10 kinds of gathered images with only correct ones (selected by hand), 10 kinds of images selected from the commercial image database (Corel Image Gallery), 20 kinds of gathered images, 20 kinds of images with only correct ones, and 50 kinds of images, respectively.

CSI consistently outperformed other state-of-the-art. In the experiment gathered images from the image dataset for 10 kinds of class keywords related to animals shown. The total number of gathered image was 4582, and the precision (pre) by subjective evaluation was 68.2%, which is defined to be NOK/(NOK+NNG), where NOK, NNG are the number of relevant images and the number of irrelevant images to their keywords.

Efficient image retrieval by contents from database requires that selective access methods are provided to prune out uninteresting items during the search process. Image indexing based on visual features is particularly challenging, owing to the difficulty to derive a representation of the shapes that closely models the visual appearance perceived by humans. A novel approach for indexing planar and closed curves, on the basis on their visual appearance. A hierarchical model of the curve is derived from its multi-scale analysis, and it is used to provide a description of the curve which is able to distinguish between its structural parts and its details. To cope with the inherent uncertainty of shape appearance, fuzzy sets are used to represent the visual attributes of the shapes.

IV. COHERENT SEMANTIC VISUAL INDEXING

The rapidly increasing number of images on the internet has further increased the need for efficient indexing for digital image searching of large databases. The design of a cloud service that provides high efficiency but compact image indexing remains challenging, partly due to the well-known semantic gap between user queries and the rich semantics of large-scale datasets. In this paper, we construct a novel joint semantic-visual space by leveraging visual descriptors and semantic attributes, which narrows the semantic gap by combining both attributes and indexing into a single framework. Such a joint space embraces the flexibility of Coherent Semantic visual Indexing (CSI), which employs binary codes to boost retrieval speed while maintaining accuracy. To solve the proposed model, we make the following contributions. First, we propose an interactive optimization method to find the joint semantic and visual descriptor space. Second, we prove convergence of our optimization algorithm, which guarantees a good solution after a certain number of iterations. Third, we integrate the semantic visual joint space system with spectral hashing, which finds an efficient solution to search up to billion-scale datasets. Finally, we design an online cloud service to provide a more efficient online multimedia service.

With the advent of mobile cameras and fast internet visual internet images has increased rapidly. The viewer's request for images has also increased manifold. This leads to indexing of the images from the storage for faster retrieval. Lots of tags and attributes or meaning words for the images are also uploaded along with the images. For a single image there may be many descriptions called semantics. It is using these semantics images are indexed. When a user queries the image database using the semantics, the index is accessed and the corresponding images are taken and displayed to the user. This project aims to improve by using a Novel joint semantic-visual space for web image indexing. An iterative optimization algorithm is based on two constraints on predicted attributes and redundant features.

A spectral hashing algorithm is used which works on learning binary codes of the images. The images are converted into hashes i.e. spectral hashing The proposed approach relies on spectral hashing to convert features into binary codes This is called Coherent Semantic Visual Indexing – CSI which directly increases the retrieval performance.

A. SCOPE

The scope involves the query to be generated for the image using visual index process of spectral hashing which is accurate and reduces time and very accurate than earlier models.

1. IMAGE DATA SET LOADING

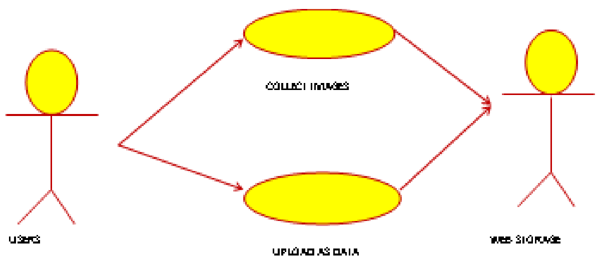

Figure 2. Image Data Set Loading

The users of the system collect and upload the images which are stored into the data store. In this module the image data sets are uploaded into the system as files. The datasets are regular standard datasets. The tags for the various images are also serialized for which the data stores govern the items in the database.

Table 1. Image dataset loading

Use case name	Image Data sets loading
Image Collects	User collects images from the user
Upload to Web Store	Uploads the image data to the web stores
Receive Data	Store the image data to Storage Node.
Reference	Fig 2

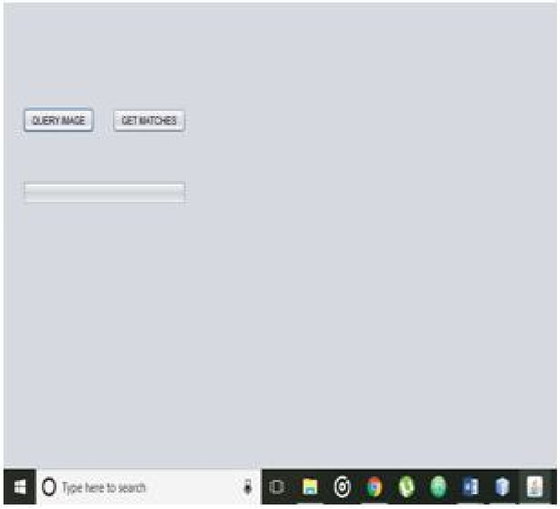

Figure 2.1. Image dataset loading

2. FEATURE DESCRIPTORS

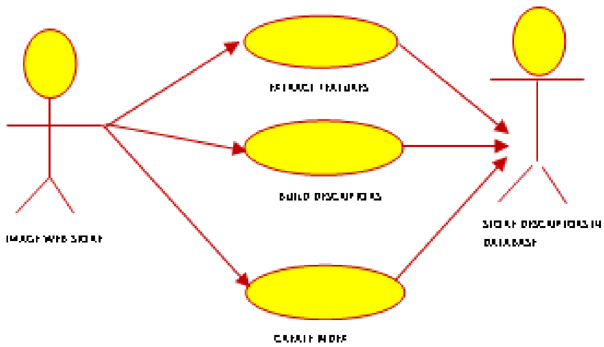

Figure 2.2 Feature descriptors

The loaded images features are extracted using visual semantic building techniques and the generated feature descriptors are stored into the data store. Based on the generated features a description index is created and this is also stored into the data store.

. Table 2. Feature Descriptors

Use case name	FEATURE DESCRIPTOR
Extract Features	Extract Features for the Images
Build Features	Build Features for the received images
Store Into the Database	Stored the extracted features data into the database.
Send Data	Send queried result to particular sink node.
DB	Store all encrypted data and create the index.
Reference	Fig 2.2

4. VISUAL INDEX BUILDING

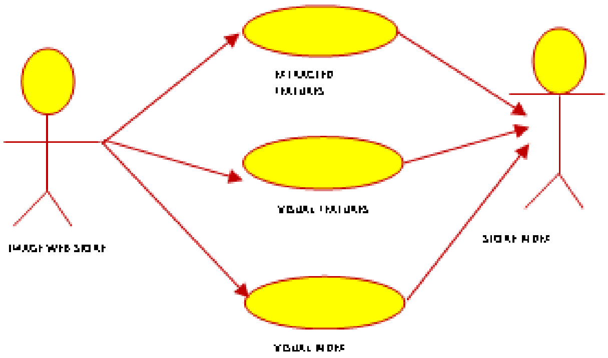

Figure 2.3. Visual Index Building

The descriptors features are extracted using visual techniques like spectral hashing using which a visual index is generated for the images and this is also stored into the data store. Based on this visual index only the results may be queried.

Table 2. Visual Index Building

Use case name	Visual Index Building
Extracted Features	The extracted features are stored into the database.
Visual features	From the extracted features spectral hashing is applied
Visual Index	The visual index is generated from this and stored into the database
Reference	Fig 2.3

5. IMAGE QUERY

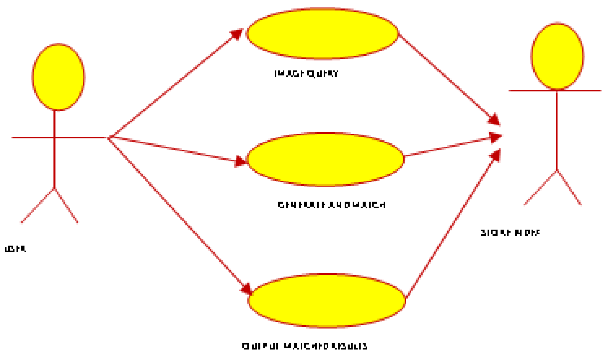

Figure 2.4. Image Query

The user finally queries the data store with an input image, with which the extracted visual query is matched and then the matched results are output using the constructed visual index. The matched results are then viewed by the user.

Table 2. Image Query

Use case name	IMAGE QUERY PROCESS
Send Query	User Queries With an Image
Features Matching	Features are Matched with the database of visual index
Results	The images matched with the visual index are retrieved and displayed
Reference	Fig 2.4

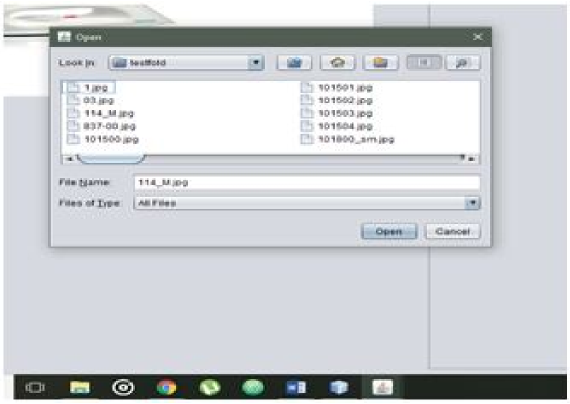

Figure 2.5. Select Query Image from Database

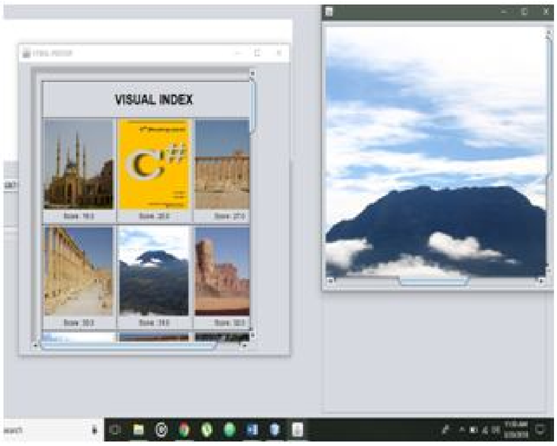

Figure 2.6. Indexed Images

V. CONCLUSION

The proposed method employs statistical association rules to reduce the semantic gap inherent in the image retrieval systems and increase the accuracy in the image. The approach can also be employed to perform dimensionality reduction, minimizing the “dimensionality curse” problem. The experiments performed show that the proposed method improves the precision of the query results up to 38%, always outperforming the precision obtained by the original features, while decreasing the memory and processing costs. These results testify that statistical association rules can be successfully employed to perform continuous feature selection in medical image databases, weighting the features in similarity query executions.

VI. FUTURE ENHANCEMENT

Future work includes to verify the results of applying our technique using other distance functions and incorporating other mining techniques. In future we have an idea of deploying the application in cloud as software as a service.

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