A Comparative Study of Image Retrieval Algorithms for Enhancing a Content-based Image Retrieval System

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Received: 14 December 2016 Accepted: 3 January 2017 Published: 15 January 2017

Abstract

Content Based image retrieval (CBIR) is in retrieve digital images by the actual content in the image .The content are the features of the image such as color, shape, texture and other information about the image including some statistic measures of the image. In this paper Content Based Image Retrieval algorithms are discussed. The comparative study of these algorithms is done. This article covers various techniques for implementing Content Based Image Retrieval algorithms and Some Open Source examples of Content-based Image Retrieval Search Engines.

Index terms— image retrieval algorithms, content-based image retrieval system, feature detection algorithms.

1 Introduction

ith the explosive growth of the Internet, Web Search technology marked by keywords has acquired a great success in the tremendous information retrieval. As the network develops into the Web2.0 era, people no longer satisfy with merely the text-search, also want to be able to find more images from the sample image. In the future, image search engine will become the main tool of the user to retrieve images in the network [1].

The image content is more complexity than the text content to search kinds of information; images can only be expressed through their own content features. Therefore, image retrieval to be implemented is much more difficult than text retrieval.

On the other hand, people have developed many convenient development toolkits, which are capable of establishing image feature database. That makes it possible that the image search technology becomes more and more mature. As the same time, the efficiency of retrieving image becomes better than that of the past [2].

With the growth of the Internet, and the availability of image capturing devices such as digital cameras and image scanners, image databases are becoming larger and more widespread, and there is a growing need for effective and efficient image retrieval systems. There are two approaches for image retrieval: text-based and content-based. The text-based approach can be tracked back to 1970s [3]. In such systems, the images are manually annotated by text descriptors, which are then used by a database management system to perform image retrieval. There are two disadvantages with this approach, the first is that a considerable level of human effort is required for manual annotation. The second is the annotation inaccuracy due to the subjectivity of human perception. To overcome the above disadvantages in text-based retrieval system, content-based image retrieval (CBIR) was introduced in the early 1980s.

In CBIR, the image visual content is a matrix of pixel values which are summarized by low-level features such as color, texture, shapes. We describe a CBIR methodology for the retrieval of images, whereas for humans the content of an image refers to what is seen on the image, e.g." a forest, a house, a lake ". One of the research issues in content-based image retrieval is to reduce this semantic gap between the image understanding of humans and the image understanding of the computer, Humans tend to use high-level features (concepts), such as keywords, text descriptors, to interpret images and measure their similarity. While the features are automatically extracted using computer vision techniques are mostly low-level features (color, texture, shape, spatial layout, etc.). In general, there is no direct link between the high-level concepts and the low-level features.

Digital image databases and image processing techniques have developed significantly over the last few years. Today, a growing number of digital image databases are available, and are providing usable and effective access to image collections. In order to access these resources, users need reliable tools to access images. The tool that enables users to find and locate images is an image search engine Search engines that use Text-Based Image Retrieval (TBIR) are Google, Yahoo. TBIR is based on the assumption that the surrounding text describes the image. The technique relies on text surrounding the image such as filenames, captions and the "alt"-tag in HTML and paragraphs close to the image with possible relevant text. The other approach uses image annotation of the images and is often a manual task. Annotation of images lets the provider annotate the image with the text (metadata) that is considered relevant. Most text based image retrieval systems provide a text input interface that users can type keywords as a query. The query is then processed and matched against the image annotation, and a list of candidate images are returned to the users. The Drawbacks of TBIR as follows: 1. In TBIR, humans are required to personally describe every image in the database, so for a large image database the technique require too much effort and time for manual image annotation. [4]. 5. The queries are mainly conducted on the text information and consequently the performance heavily depends on the degree of matching between the images and their text description. 6. The use of synonyms would result in missed results that would otherwise be returned.

In order to overcome the drawbacks of text based image retrieval system outlined above, and to assist users in finding desired images from the expected tens of millions of images, the Content-based image retrieval (CBIR) techniques can be designed to meet this aim.

The current research will focus on Comparison of Image Retrieval Algorithms within Image search engines, to identify searchable image features, to compare them based on their features, and to analyze the possible impact of these features on retrieval for enhancing a content-based image retrieval system Most search engines rely on weak algorithms such as Color Histogram and Texture, which affects search results and images that do not match the query image. So the current research is trying to review these algorithms as an attempt to integrate them to achieve the quality of the search results.

2 II.

The Research Problem Can be Couched in the Following Questions III.

3 Objectine

This search introduces a Comparison of Image Retrieval Algorithms within image search engines on the World Wide Web based on image recognition techniques. The main objectives are summarized in the following aspects: ? Highlight image retrieval algorithms which collect images from the World Web according to its low level features (color, texture and shape). ? Forming a scalable and adaptive CBIR framework for World Wide Web (www) users and search engines platforms 2). ? Enable the user to search for the images which are similar to his/her query in the contents and returns a set of images that similar to the user's query. ? Improving the overall performance of feature extracting processing. ? To acquire reliable and accurate results to validate the approach. ? Improving the overall timing of user's query.

4 IV.

5 Image Retrival

Search for an image from a collection of images was commonly done through the description of the image. As the number of image collections and the size of each collection grow dramatically in recent years, there is also a growing needs for searching for images based on the information that can be extracted from the image themselves rather than their text description. Content Based image retrieval (CBIR) IS an approach for meeting this need .CBIR is in retrieve digital images by the actual content in the image The content are the features of the image such as color, shape, texture and other information about the image including some statistic measures of the image.

Image retrieval techniques integrate both low level Visual features addressing the more detailed perceptual aspects and high level semantic features underlying the more general conceptual aspects of visual data. supplied image. The similarity of images is determined by the values or similarity measures that are specifically defined for each feature according to their physical meaning ? High Level Semantic-Based Searching: The notion of similarity is not based simple feature matching and usually from extended user interaction with the system. At a higher semantic level that is better attuned to matching information needs. Such indexing techniques produce descriptions using a fixed vocabulary or so-called high-level features also referred to as semantic concepts.

The image retrieval systems based on the most commonly used image features following:

? The Color: it does not find the images whose colors are exactly matched. But images with similar pixel color information. This approach has been proven to be very successful in retrieving images since concepts of the color-based similarity measure is simple. And the convention algorithms are very easy to implement. Besides, this feature can resist noise and rotation variants in images. However, this feature can only used to take the global characteristics into account rather than the local one in an image. Such as the color difference between neighboring objects in an image. it is often fails to retrieve the images that are taken from the same scene in which the query example is also taken from under different time or conditions [5] ? The Shape: Natural objects are primarily recognized by their shape. A number of features characteristic of object shape are computed for every object identified within each stored image. Generally, Shape representations can be divided into two categories, boundary -based and region-based. The former uses only the outer boundary of the shape while the latter uses the entire shape region [4] ? A shape-based image retrieval stein accepts as input an image provided by the user and outputs a set of (possibly ranked) images of the system's database, each of which should contain shapes similar to the query, There are two main types of possible queries: queries by example and quay by sketch. In shape-based retrieval no isolated objects are difficult to deal with because they need to be localized in the image before in order to be compared with the query. shape localization is a non-trivial problem, since it involves high level scene segmentation capabilities how to separate interesting objects from the background is still an open and difficult research problem in computer vision .the second problem is the necessity to deal with inexact matching between a stylized sketch and a real. Possibly detailed, shape contained in the image, will be need to take into account possible differences between the two shapes when compared between of them [6] ? The Texture: texture is an important characteristic in many types of images. Despite its importance a formal definition of texture does not exist. When an image has wide variation of tonal primitives, the dominant property of that image is Texture. Texture is the spatial relationship exhibited by grey levels in a digital image. Textural measures are measures capture that spatial relationship among pixels, spatial measures, which refer to measures mostly derived from spatial statistics, have been used largely in geospatial applications for characterizing and quantifying spatial patterns and processes [7] The method of texture analysis is divided into two approaches: statistical and structural. For biological section images, the statistical approach is appropriate because the image is normally not periodical like a crystal. In the statistical approach, there are various ways to measure the features of the texture. Tested the discriminating power of various tools: spatial gray -level dependence method (SGLDM), gray -level difference method (GLDM), gray-level nun length method(GLNLM), power spectrum method(PSM),Gray level co-occurrence matrix(GLCM),Intensity histogram features and GLCM features are extracted in our proposed method.

A useful approach to texture analysis is based on the intensity histogram of all or part of an image. Common histogram features include: moments, entropy dispersion, mean (an estimate of the average intensity level), variance (the second moment is a measure of the dispersion of the region intensity), mean square value or average energy, skewness (the third moment which gives an indication of the histograms symmetry) and kurtosis (cluster prominence).

One of the simplest ways to extract statistical features in an image is to use the first-order probability distribution of the amplitude of the quantized image may be defined as: Where M represents the total number of pixels in a neighborhood window of specified size centered about (j, k), b is a gray level in an image, and N (b) is the number of pixel of amplitude rb in the same window.P (b) =P R {F (j,

V.

6 Content-based Image Retrival (cbir)

Several techniques have been proposed to extract content characteristics from visual data automatically for retrieval proposed. CBIR applications became a part of a practical life and used in several commercial, governmental archives, and academic institutes such as libraries. CBIR is alternative to the text-based image retrieval and becomes the current research area of image retrieval [8,9]. In CBIR systems, the image content is represented by a vector of image features instead of a set of keyword. The image is retrieved according to the degree of similarity between features of images.

7 Figure 1: Content-based Image Retrieval System

The main components of CBIR system are as follows [10]: 1. Graphical User Interface which enable the user to select the query which can be in one of the following forms: 2. An image example: content based image retrieval systems allow the user to specify an image as an example and search for the images that are most similar to it, presented in decreasing order of similarity score. 3. Query/search engine: it is a collection of algorithms responsible for searching the database for images that is similar to the user's query. 4. Image Database: it is repository of images. 5. Feature extraction: it is the process of extracting the visual features (color, shape and texture) from the images. 6. Feature Database: it is repository for image features.

VI.

8 Feature Detection Algorithsm

Feature detection algorithms consist of two basic categories [11] The drawback of a global histogram representation is that information about object location, shape, and texture is discarded. Color Histogram variants with rotation, scale, illumination variation and image noise with no sense of human perception. So, new algorithms are presented to overcome this limitation [4].

9 b) Features from Accelerated Segment Test (FAST) Algorithm

The beginnings of feature detection can be tracked with the work of Harris and Stephen and the later called Harris Corner Detector which aims to introduce a novel method for the detection and extraction of feature-points or corners.

The Harris corner detector is a popular interest point detector due to its strong invariance to: rotation, scale and image noise by the auto-correlation function. Harris was successful in detecting robust features in any given image meeting basic requirements that satisfied the first two criterions above [13]. But since it was only detecting corners, his work suffered from a lack of connectivity of feature-points which represented a major limitation for obtaining major level descriptors (such as surfaces and objects) and limitation in speed.

The main contribution of FAST was summarized as: ”A new algorithm which overcame some limitations of currently used corner detectors” [14].

With FAST, the detection of corners was prioritized over edges as they claimed that corners are one of the most intuitive types of features that show a strong two dimensional intensity change, and are therefore well distinguished from the neighboring points Also, FAST modified the Harris detector so as to decrease the computational time [8].

10 c) Scale Invariant Feature Transform (SIFT) Algorithm

SIFT was developed by David Lowe in 2004 Aim to presents a method for detecting distinctive invariant features from images that can be later used to perform reliable matching between different views of an object or scene. Two key concepts are used in this definition: distinctive invariant features and reliable matching [9]. SIFT is broken down into four major computational stages [11]:

The main contribution of SIFT was summarized as: ”A new texture algorithm which invariant feature transforms and overcome some limitations of currently used corner detectors”. In SIFT algorithm, ”there is no need to analysis the whole image” but you can use only interested key points to describe image. Unfortunately, the drawback of algorithm is that SIFT consider as the slowest texture-based algorithm, complex in computations and consume resources [15].

PCA is a standard technique for dimensionality reduction and has been applied to a broad class of computer vision problems, including feature selection, object recognition. While PCA suffers from a number of shortcomings, such as its implicit assumption of Gaussian distributions and its restriction to orthogonal linear combinations, it remains popular due to its simplicity. The idea of applying PCA to image patches is not novel. Our contribution lies in rigorously demonstrating that PCA is well-suited to representing keypoint patches (once they have been transformed into a canonical scale, position and orientation), and that this representation significantly improves SIFT’s matching performance. Research showed that PCA-SIFT was both significantly more accurate and much faster than the standard SIFT local descriptor. However, these results are somewhat surprising since the latter was carefully designed while PCA-SIFT is a somewhat obvious idea. We now take a closer look at the algorithm.

11 d) Principal Component Analysis -Scale Invariant

Feature Transform (PCA-SIFT Algorithm) Our algorithm for local descriptors (termed PCA-SIFT) accepts the same input as the standard SIFT descriptor: the sub-pixel location, scale, and dominant orientations of the key-point. We extract a 41×41 patch at the given scale, centered over the key-point, and rotated to align its dominant orientation. PCA-SIFT can be summarized in the following steps: pre-compute an eigenspace to express the gradient images of local patches; given a patch, compute its local image gradient; project the gradient image vector using the eigenspace to derive a compact feature vector. The feature vector is significantly smaller than the standard SIFT feature vector, and it can be used with the same matching algorithms. The Euclidean distance between two feature vectors is used to determine whether the two vectors correspond to the same key-point in different images [16]. According to PCA-SIFT testing, fewer components requires less storage and will be resulting to a faster matching than SIFT, they choose the dimensionality of the feature space , n=20, which results to significant space benefits. But, PCA suffers from a number of shortcomings, Such as its implicit assumption of Gaussian distributions, less accuracy, less reliable and its restriction to orthogonal linear combinations, it was proved to be less distinctive than SIFT.

The parameters which are used for the experimental evaluation of the results by the above stated algorithms are accuracy, precision and recall [17] where:

12 A Comparison of Image Retrieval Algorithms

The following table provides the comparison of various Image Retrieval algorithms:

13 Some Open Source of Contentbased Image Retrival Search Engines a) AltaVista Photo Finder Search Engine

Features Similarity is based on visual characteristics such as dominant colors only. No details are given about the exact features. First, the user type keywords to search for images tagged with these words. If a retrieved image is shown with a link "similar", the link gives images that are visually similar to the selected image. Similarity is based on visual characteristics such as dominant colors. The user cannot set the relative weights of these features, but judging from the results, color is the predominant feature.

14 b) Anaktisi Photo Finder Search Engine

In this website a new set of feature descriptors is presented in a retrieval system. These descriptors have not been designed with particular attention to their size and storage requirements. These descriptors incorporate color information into one histogram while keeping their sizes between 23000 and 740000 bytes per image.

High retrieval scores in content-based image retrieval systems can be attained by adopting relevance feedback mechanisms. These mechanisms require the user to grade the quality of the query results by marking the retrieved images as being either relevant or not. Then, the search engine uses this grading information in subsequent queries to better satisfy users' needs. It is noted that while relevance feedback mechanisms were first introduced in the information retrieval field, they currently receive considerable attention in the CBIR field.

The vast majority of relevance feedback techniques proposed in the literature is based on modifying the values of the search parameters so that they better represent the concept the user has in mind. But, the semantic gap between the user query and the result isn't maintained yet.

There is no ranking algorithm for more usability and reliability Figure 2.7 shows the result of bus query image of Anaktisi Photo Finder search engine.

15 c) Akiwi Photo Finder Search Engine

In this web-site a new set of feature descriptors is presented in a retrieval System. These descriptors have been designed with particular attention to their size and storage requirements, keeping them as small as possible without compromising their discriminating ability. These descriptors incorporate color and texture information into one histogram while keeping their sizes between 22 and 70 kilobytes per image. There are no High retrieval techniques and the semantic gap between human perception and the machine perception is very high. We considered that returned images by color feature. For semantic technique, Google used ontology tagging for retrieval process. Consequently, ranking method is page rank method as alternative of relevance feedback to optimize usability.

16 Conclusion and Future Scope

In this paper, compared to content-based image retrieval algorithms used in the most famous image search engines, the set of algorithms used and their results are discussed in detail. From the results of Year 2017 ( ) F the different methods discussed, it can be concluded that to improve algorithm retrieval performance must integrate these algorithms to increase the values of standard evaluation criteria such as accuracy, proportion of convergence or accuracy to obtain the higher values of the standard evaluation parameters used to evaluate a large algorithm to demand better results for retrieval performance.

The horizon is still wide for future studies to work on increasing the accuracy and speed of searching the web. Following points show open issues that need to be addressed: ? Increase the accuracy of search results by combining of Image Retrieval Algorithms ? Increase the accuracy of the search results in the retrieval of images ? Increase the speed (Response time) in image retrieval ? The development of search engines with high accuracy in retrieving information based on the integration of several algorithms of image retrieval. [1]

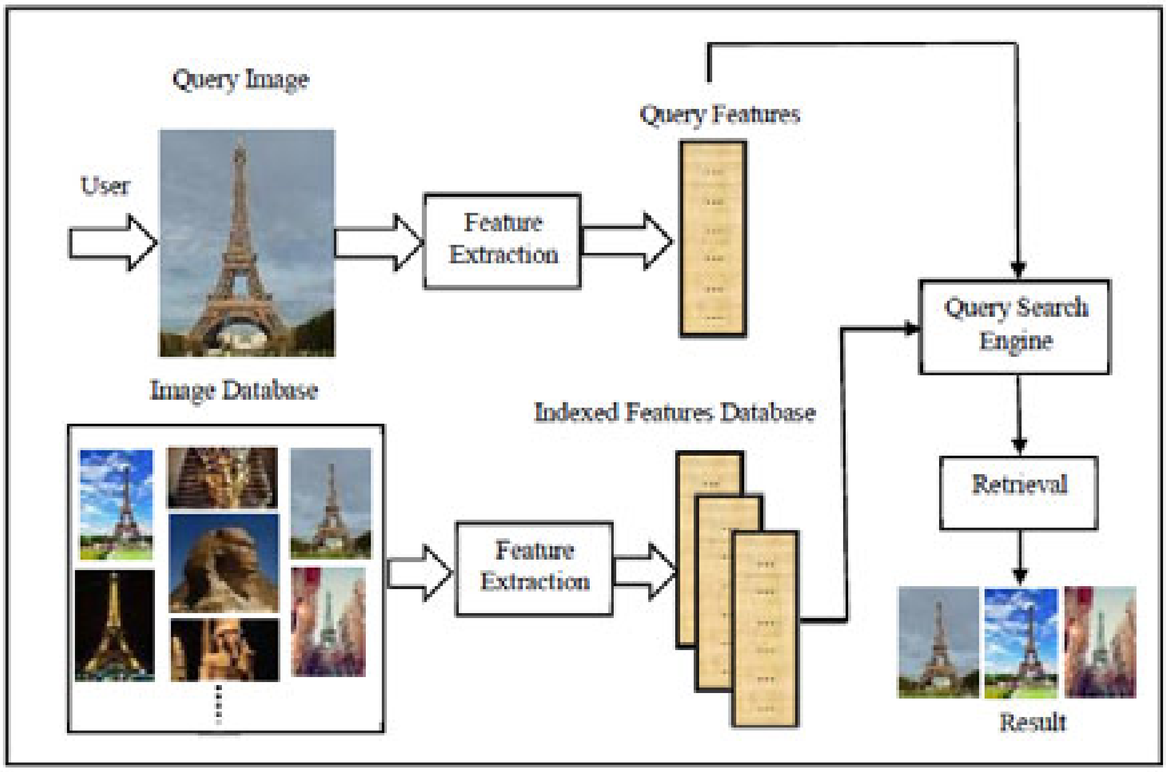


Figure 1:

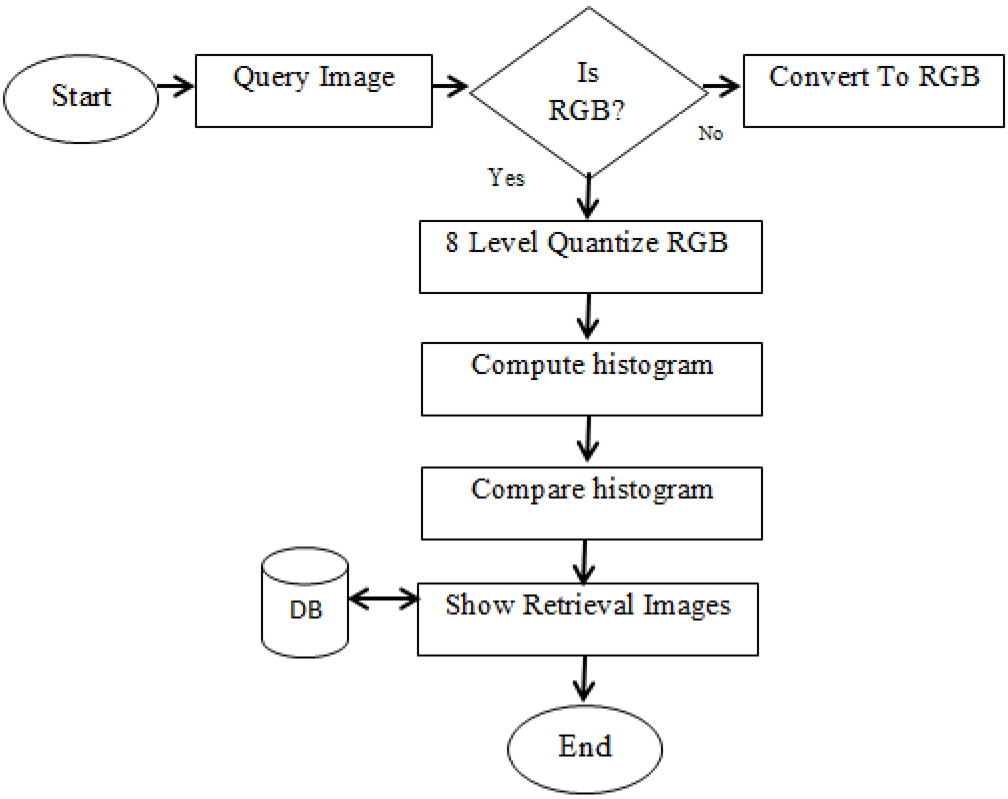


Figure 2:

2 

Figure 3: Figure 2 :

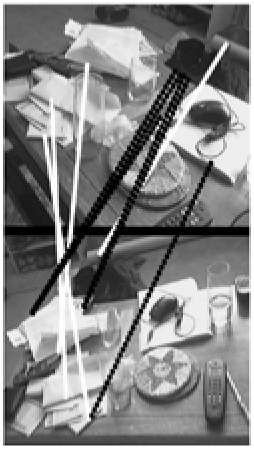
23 

Figure 4: Figure 2 :AFigure 3 :

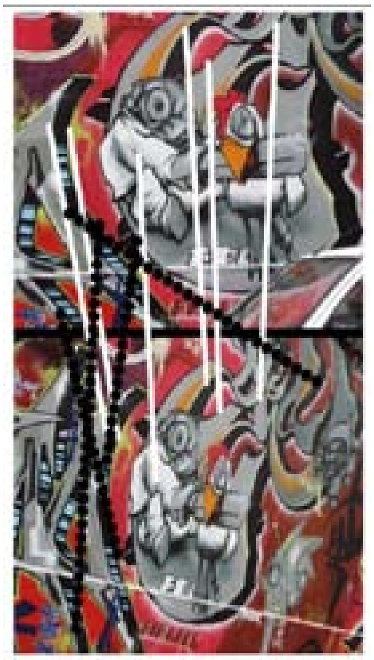


Figure 5:

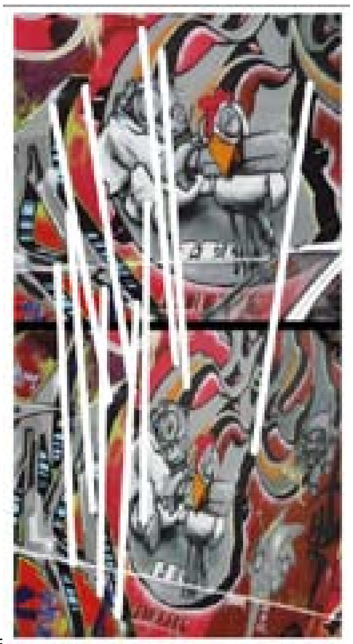
4 

Figure 6: Figure 4 :

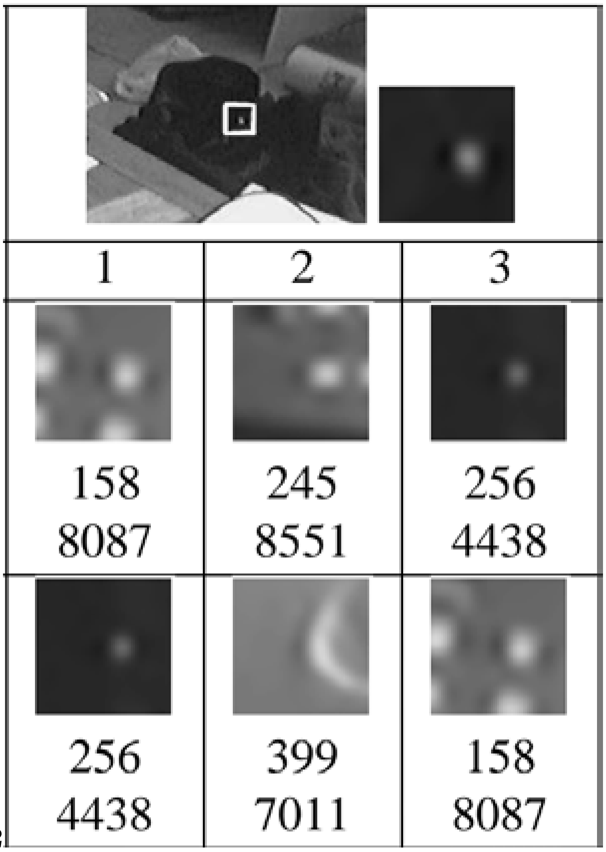
2 

Figure 7: Figure 2 .

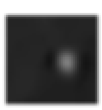
5 

Figure 8: Figure 5 :

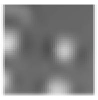
6 

Figure 9: Figure 6 :

Figure 10:

1

Figure 11: Table 1 :

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