Visual-CBIR: Platform for Storage and Effective Manipulation of a Database Images

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Abstract: Today, image retrieval system has become a vital necessity for computing users. Different search systems are increasingly invading the computing software markets, such as QBIC, Photobook and BlobWord. The only negative point these systems have in common is their lack of semantics in query processing, low interactivity and the irrelevance of search results. To overcome these limitations, we propose a more efficient alternative system: a system for image retrieval. This new system provides an intelligent search by content, by keyword, by index, etc. To confirm our approach, we have defined a combination with Oracle DBMS that would lead to 1) an advanced modeling of image type using a signature that describes the physical and semantic content of images, 2) the modeling of different types of search by creating stored procedures in PL/SQL language and 3) simple storage and handling of images in database through an intuitive interface. We prove that this system can be used in a distributed environment.

1 INTRODUCTION

Facing the speedy development of massive computing information through the web, together with technology progress, the issue related to data management became more acute and important in the context of information analysis and data visualization. In this work, we focus on image data that have experienced an evolution in terms of storage, manipulation and content processing.

Any form of imagery that does not reflect a specific field as content (science, geography, physics, literature…) would hardly be classified thus it would seem without any interest and would end up in as a random result on a search list. This kind of search results' inexactitude proved the necessity to develop Content-Based Image Retrieval (CBIR) systems.

Since 1995, several search systems have been commercialized, such as the systems presented by Pecenovic (Pecenovic et al., 1998): IBM QBIC, Photobook MIT Media Lab (Massachusetts Institute of Technology), BlobWord of the University of Berkeley in California, Virage and Cortina. Despite their efficiency, these search systems suffer from several limitations such as the limited storage for database used relatively to fit with the size of the current image database which involves a different problematic with a very strong constraints in time computing and the results relevance. In 2005, Landré (Landré, 2005) proposed a new architecture of CBIR based on the hierarchical construction about increasing size multiresolution signatures, the automatic grouping of images in visually similar families of images (database pre-classification), and the design of images retrieval interface. This system suffers from several problems such as non- trivial choice parameters like the blur setting parameter during the classification phase, which can lead to irrelevant classification.

This paper aims to explain the system's procedure for image retrieval and to propose an intelligent system for image retrieval (by content, by keyword, by index, etc.) using Oracle DBMS. To confirm our approach, we have defined a combination with Oracle DBMS that would lead to 1) an advanced modeling image type using a signature that describes the physical and semantic content of images, 2) the modeling of different types of search by creating stored procedures in PL/SQL language and 3) a simple storage and handling of images in database through an intuitive interface.

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The selection of Oracle DBMS is justified by Oracle Multimedia (formerly Oracle interMedia) feature that represents an extension to retrieve multimedia data by their content. This extension enables Oracle Database to manage, store, and retrieve images using a new data type that stores the inherent features of the image and using indexes to make queries faster.

The second section of this work explains the architecture of the image retrieval system and the main query types that were used. In Section 3, we discuss the reasons of our motivation. Our new approach will be fully illustrated in Section 4. Section 5 represents the validation and the implementation of our system. Section 6 concludes.

2 IMAGE RETRIEVAL SYSTEM

2.1 Classical Architecture of Content-based Image Retrieval System

In a content-based retrieval approach, the descriptive model associated with each image is represented as a signature (or an image descriptor). This signature is used to describe the visual content of the image. The search is based on a comparison between a query image and images database for classifying images according to a distance measured between signature of the query image and the images signature of the database. Figure1 represents the classical architecture of CBIR systems.

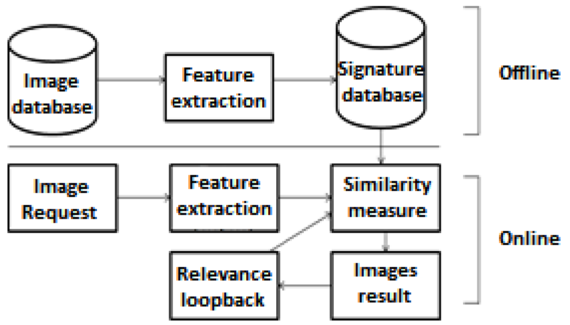

Figure 1: Classical architecture of a CBIR system.

The architecture of this system is divided into two phases of treatment:

- **The Offline Phase:** has a characterization step in which attributes are automatically extracted from the images of the database and stored in vectors. Then, these vectors are stored in a database of descriptors.
- **The Online Phase:** aims to extract the descriptor of the query image given by the user and compare it with descriptors in database to select similar images to the query image.

The system returns the search result in a list of images ordered according to "the similarity measure" between their signatures and the signature of the query image.

2.2 Example of Existing CBIR Systems

The development of several search systems allows us to facilitate the CBIR task. Among these systems we can provide: QBIC (Query By Image Content) (Flickner et al., 1995) of IBM, one of the first search systems which deals with the image search based on color, texture, shape and sketch. The BlobWorld (Carson et al., 1999) of the University of California; Berkeley; works on homogeneous areas from the image. It allows recovering from a motion picture, similar regions in color and texture. Photobook (Piccard et al., 1996), developed by MIT Media Lab, offers a powerful search to collect homogeneous images. The search is possible on three different criteria: appearance, shape and texture. For recent systems, we can find img(Rummager) and the website img(Anaktisi) (Zagoris et al., 2009.) which can execute an image search based on query image with a new set of descriptors which include the characteristic information of the color and texture in histogram. Despite their efficiency, these approaches suffer from several limitations, such as: small image databases used the lack of semantics in the query processing, imprecision of results and the lack of integration of image processing techniques.

The MedFMI-SiR system (Daniel et al., 2011) represents an open source module that executes similarity queries over DICOM images integrating metadata- and content-based image retrieval. This solution is attached onto the Oracle DBMS, benefiting from all the capabilities it natively provides. The main drawback of MedFMI-SiR is that it uses a specialized method to perform only a feature extraction of the DICOM type image.

In his approach, Landré proposed a CBIR system using MySQL DBMS. He represents search techniques for images using visual navigation in the database. His system organizes descriptors according to an increasing size to classify images into families based on multiresolution signatures. However, this system suffers from the irrelevant classification in case of non-trivial choice of parameters like the blur setting parameter.

Moreover, this approach does not support an integrated search query which joins textual information and visual content in the retrieval process.

2.3 Image Retrieval System and DBMS

Faced with a great quantitative evolution of images, the current DBMS developed their storage and data management capabilities in order to support the image databases. As an example of DBMS, we quote: MySQL and Oracle (Gabillaud, 2009).

In (Landré, 2005), Landré proposed a system of image retrieval based on the MySQL DBMS. The architecture of this system consists of a web server (Apache) that manages dynamic web pages (PHP) able to access data from the relational database (MySQL).

In this search system, the construction of the signature involves the following steps: the wavelet transformation of images, the extraction of multiresolution attributes form descriptor vectors, the organization of attributes in signature vectors stored in MySQL database and the classification of signature vectors in families according to distance. The CBIR task and the building of the image signature are detached from the MySQL DBMS and executed in a separate retrieval engine. Only storage and metadata-based queries are realized using the MySQL database.

Oracle database is a relational database management system (RDBMS) that has introduced multimedia applications and object-oriented development since version 8. Moving to Oracle Database 11g, Oracle Multimedia (previously interMedia) becomes a feature that extends Oracle Database reliability, availability, and data management to multimedia content in traditional, Internet, electronic commerce, and media-rich applications (Rod et al., 2001).

The Oracle Multimedia architecture defines the framework through which media content as well as traditional data are supported in the database (Rod et al., 2001). This architecture includes three principal levels: Oracle database server, Oracle database, and client application. Oracle database server is the software that manages Oracle databases, and client applications that interact with the server to add, update, retrieve or delete data.

Using Oracle multimedia feature, Oracle Database can store, manage, retrieve, and manipulate multimedia data, especially the image data. Oracle supports CBIR task that allows image retrieval using the Oracle Multimedia OrdImage object type. This can give the possibility to relieve image database management and to build new end-user image retrieval applications. In Oracle Multimedia, the CBIR has been adopted as a complementary technique to Text-Based Image Retrieval (TBIR) (Li et al., 2011).

The type ORDImage provides the ability to manage all image information as attributes (also called image metadata). These attributes include: source for the storage information, contentLength, height and width of the image, fileFormat, compressionFormat, contentFormat, and mimeType. This image metadata is collected and organized in schema-based XML documents. The metadata are useful to help search in image datasets by indexing the metadata for powerful text and thematic media retrievals using Oracle Text (Rod et al., 2001). Oracle Text provides a linguistic analysis on documents, as well as retrieval text using a variety of strategies performing keyword searching, context queries, pattern matching, HTML/XML section searching, Boolean operations, mixed thematic queries, and so on.

Oracle Multimedia is a single integrated feature that enables to integrate the qualities of the CBIR systems and the TBIR systems into a unique application (Dimitrovski et al., 2009.). Combining content-based and text-based image retrieval in an integrated retrieval engine can lead to a better accuracy, because one complements the other.

3 MOTIVATION

The approaches proposed in different search systems such as QBIC, Photobook, Virage and Cortina represent fairly important work in the Content Based image Retrieval area. However, these search systems suffer from several limitations such as the limited storage for database, the difficulty of handling the stored images and the image retrieval task with very strong constraints in time computing, and the irrelevance of search results.

The approach proposed by Landré represents an image retrieval system based on multiresolution signatures stored in MySQL database. For the signature construction, as we have seen in the previous section, Landré was forced to go through several steps to build image signatures in MySQL DBMS, which does not support the content based image retrieval task. In this approach, a limitation comes from the non-trivial choice of parameters such as blur setting parameter during the classification phase, which can lead to irrelevant data classification. Moreover, this system doesn't support the integrated search query which combines textual-based and content-based image retrieval.

Oracle Multimedia CBIR shows very good results of image search compared to other active retrieval systems tested by the proposed benchmarking system for CBIR in (Harald and Paul, 2010). Moreover, it provides the means necessary to build an integrated retrieval engine that can execute optimized search query by combining textual- and content-based image retrieval.

In section 4, we will propose our new CBIR approach based on Oracle DBMS.

4 NEW APPROACH

4.1 Principle of Our Approach

In this section, we represent a new approach of CBIR system based on Oracle database. Our approach is inspired from a system proposed by Landré, MedFMI-SiR system, and Oracle functions to manage the content of the images. To overcome the difficulties of retrieval and manipulation of image data in the retrieval systems, such as we have described in the previous section, we proposed a new content-based image retrieval system that allows 1) an advanced modeling of image type using a signature that describes the physical and semantic content of images, 2) the modeling of different types of search by creating stored procedures in PL/SQL language, 3) a simple storage and handling of images in database through an intuitive interface, and 4) an integrated search query combining text-based and content-based image retrieval.

In the construction phase of feature signatures, we can distinguish between two types of features: physical and semantic features (Atnafu Besufekad, 2003).

- **Physical Features:** or low-level features that describe the visual content of image. For example: "how closely its color and shape match a picture of a specific object".
- **Semantic Features:** or high-level features that describe the semantic content of the image: they describe the nature of the relationships that link objects within an image. We can use traditional text to describe the semantic significance of the image. Example of a query type for semantic content: "images of tumor in the right lobe of the brain".

In our system, the user disposes of a sample image to make his query. The search queries relate to color, texture, shape, location of these criteria in the image, and a combination of these different search modes. The system allows you to assign a weight to give more or less importance to certain search criteria, such as shape, texture, color and location. Thus each criterion is assigned a coefficient representing the importance attached to it during the comparison.

For text-based image retrieval task, the system allows the user to assign a textual description to one or a set of visually similar images when they are added to the database. After storing the images, the system extracts all image content and a rich set of metadata attributes. Once the image metadata has been extracted and stored, the system indexes the metadata and keywords assigned for each image for powerful thematic image retrieval based on Oracle Text. Thus, the database can locate easily the image data with indexes that can speed up queries based on metadata and keywords stored with the image. Moreover, our system can allow users to provide both textual- and content-based image retrieval to define the desired result.

The interface of our system provides the ability to visualize the images in the database in order to have a clear idea of what we want and to manage the contents of the database by adding or removing images.

As has already been explained, we will treat the architectures proposed by Landré and MedFMI-SiR system by using Oracle DBMS to develop our CBIR system. In addition, we will try to extract physical features (visual content) and semantic features (textual information) from images in order to improve and speed up our search by indexing the signature and the textual information of image.

4.2 Architecture of Our Approach

The architecture of our system is shown in Figure 2. The system provides an interface for easy management of image by storing, removing images and visual allowing navigation in database. Our approach replaces the construction sequence of image signatures (feature extraction, descriptor vectors, and signature vectors) by a single step of generating signatures using Oracle functionalities. At the end of each step of retrieval phase, an option to generate a SQL script for each data manipulation will be given to visualize the execution validity of tasks in complete transparency.

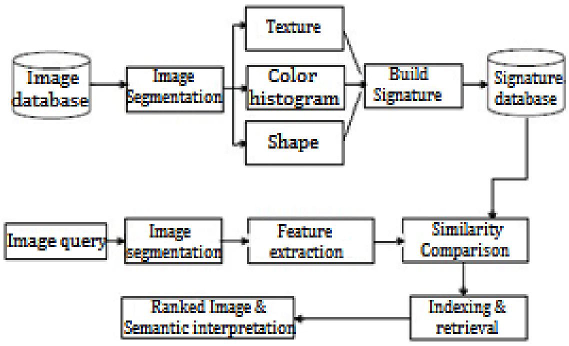

Figure 2: Architecture of our CBIR system.

The content image retrieval process in our system is based on extracting color, texture, shape, and where in the image these features are locating and comparing them. The features are extracted by 1) segmenting the image into regions according to color, 2) determining the features for each region. Color and texture information are determined globally, by unifying the region-based information, to generate global color and texture histograms. The region, texture, global color, and shape information are stored in the signature to represent these attributes for the entire image. This generated signature is stored in the signature-database.

For the online phase, when the user selects a query image, the system is responsible for registering the image in a temporary table in the Oracle database to be able to generate its signature. Then, a comparison will be made automatically with the database signatures to return a list of selected images whose content is very close to the query image. To measure the distance between signatures in comparison phase, the system uses the Manhattan distance.

To execute integrated image retrieval, the system allows posing integrated queries for text-based and content-based search. After selecting an example image, the user enters a few keywords that describe the content of the image he seeks. The textual description and the generated signature of the example image will be used to locate and select from the indexed database the images that share the same visual features and textual information with the proposed query.

Finally, we can deal with the phase of interpretation of the result obtained by the textual description of the semantic content of the selected images. This last step is based on the keywords extracted from database for all selected images in the search phase in order to semantically describe the content of images.

5 VALIDATION OF CONTENT-BASED IMAGE RETRIEVAL BASED ON ORACLE DBMS

5.1 Implementation of CBIR System and Database under Oracle

The implementation of a CBIR system in Oracle is always a difficult task especially with the huge mass and different types of images stored in database. In fact, this implementation, hand-signed by the designer, can make the CBIR like a delicate task that requires a thorough knowledge of Oracle database with a remarkable lack of transparency in handling image data.

Usually, the designer should stick to the following measures:

- Creating the images database.
- Textual description of the database content.
- Manual selection of search criteria corresponding to the type of images database.
- Defining PL / SQL scripts for each operation performed in the database to make image management and search task automatic and transparent.

The designer must define a threshold of similarity measurement between images in database in order to select the list of closest images to the image query.

To illustrate the tasks required to implement our CBIR example, we represent in the following a set of scripts to implement two tables images and image_signature, add an image (Figure 3) to the database and implement the CBIR task. For example, the following script can be issued to create images, image_metadata, and image_signature tables to store the image with its metadata and signature:

```
-- images table
CREATE TABLE images (
   id INTEGER PRIMARY KEY,
   image      ORDSYS.ORDImage,
   description varchar2(255));

-- image_metadata table
CREATE TABLE image_metadata(id
   INTEGER PRIMARY KEY REFERENCES
   images(id),
   metaORDImage XMLTYPE,
   XMLType COLUMN metaORDImage
   XMLSCHEMA  http://xmlns.oracle.com
   /ord/meta/ordimage
   ELEMENT "ordImageAttributes"
```

```
-- image_signature table
CREATE TABLE image_signature (
   id   INTEGER PRIMARY KEY
   REFERENCES images(id,
   signature_img
   ORDSYS.ORDImageSignature);
```

where OrdImage is the Oracle's abstract data type to store images. If the image content is stored in the database, it can be handled as another relational data using SQL. The ORDImageSignature object type supports content-based image retrieval, or image matching, where signature_img is an attribute that stores image signature. metaORDImage is the column where the ordimage metadata will be stored. It is bound to the XML schema stored at http://xmlns.oracle.com/ord/meta/ordimage, and defined as the XML element ordImageAttributes.

To add an image to Oracle database, we propose an example of a non-expert user of images database who wants to insert a "cerebrale.jpg" (Figure 3) file. This image is situated in a logical folder "IMG_DOSSIER" created under oracle by the user.

Figure 3: A medical image selected to be added to the database.

By adding an ORDImage to the database we intend to the addition of an image and the generation of its signature in an ORDImageSignature type attribute. The set of visual attributes is stored in a BLOB. Before the generation of an image signature, it must, like the type ORDImage call a builder, called init(), which is used to initialize the BLOB attribute to an empty BLOB. Once this realized, we can call the method generateSignature by giving the parameter ORDImage attribute to obtain its visual characteristics.

```
--initialization and image insertion
INSERT INTO images (id, image)
   VALUES(id_val, ORDImage.init());
INSERT INTO image_signature (id,
   signature_img) VALUES (id_val,
   ORDImageSignature.init());
SELECT i.image, s.signature_img into
   obj, obj_sign from images i,
   image_signature s where i.id= s.id
   and s.id=id for update;
obj.setSource('FILE','IMG_DOSSIER',
'cerebrale.jpg');obj.import(ctx);
UPDATE images set image = obj where
id=1;

--generation of image signature
obj_sign.generateSignature(obj);
UPDATE image_signature p SET
   p.signature_img = obj_sign WHERE
   id=id_val;
COMMIT;
END;/
```

To perform the CBIR task, the user needs to implement the following PL/SQL script:

```
DECLARE
   img_sig ORDSYS.ORDImageSignature;
   img_sig_req
   ORDSYS.ORDImageSignature;
   -- Specify a weight for criteria
   commande varchar(200) := 'color=0
   texture=1 shape=0 location=0';
   eval_score float;
   threshold float;
   similaire int;
BEGIN
   SELECT p.signature_req INTO
   img_sig_req FROM image_requete p
   WHERE p.id_req = 1 FOR UPDATE;
   FOR record_img IN (SELECT id,
   signature_img FROM
   image_signature
   FOR UPDATE) LOOP
    -- Comparison between signatures
      threshold := 20;
      similaire :=
      OrdImageSignature.isSimilar
      (record_img. signature_img,
      img_sig_req, commande,
      threshold);
      DBMS_OUTPUT.PUT_LINE('
      isSimilar'|| similaire);
   END LOOP;
COMMIT;
END;/
```

In the retrieval phase, it is necessary to make the comparison between the signature of an image query and all image signatures stored in the database. The image signature is obtained through an Oracle analysis of the image with generateSignature() method of ORDImage type. This signature contains color information, textures and shapes according to each area of the image. It also contains information on the image background. The result of this analysis is then contained in a type called ORDImageSignature.

Seen that the database is a medical images database, the user must give more importance to the texture criterion to execute a texture-based retrieval query. Therefore, the user must assign a weight in the range 0 to 1 for color, shape, texture, and location. To specify a high importance to the texture criterion, the user should select a high weight for texture. In our application, a high weight represents a value of 1, a medium weight is a value of 0.5, and a low weight represents a value of 0.

The operator used for ORDImage object type is: isSimilar(). This operator compares the signature of a query image with the signatures of images stored in a database, and determines whether or not the images match, based on the weights assigned to the search criteria and threshold value. The comparison of two signatures returns a score between 0.0 and 100.0, where a lower value indicates a closer match. The choice of threshold is empirical and it is vital to try to model and control the choice of appropriate threshold for a specific image type. Currently, we use an approximate value threshold that does not exceed 20. The value of the threshold must be comprised between 0 and 100, which is the range of the distance. Then only images whose signatures are a distance (score) of 20 or less from the query signature will be selected.

To improve the search performance and easily execute the task of CBIR, we have implemented an index-based retrieval on the image signature. This index is of type ORDImageIndex. By defining this index item we can filter and locate specific information and then retrieve it as efficiently as possible. Therefore, we can have an advantage of the increased performance based on image matching with image signature indexes on the signatures database. The following command creates an index on image_signature table, based on the data in the signature_img column:

```
CREATE INDEX indexSign ON
   image_signature (signature_img)
   INDEXTYPE IS  ORDSYS.ORDIMAGEINDEX
   PARAMETERS
   ('ORDImage_Filter_Tablespace =
   <name>,ORDImage_Index_Tablespace =
   <name>');
```

To easily locate the image data based on textual information, we implemented a full text index based on Oracle Text. Oracle Text is an extensive full text indexing technology that uses standard SQL to index, analyze, and search text and documents stored in the Oracle database. It can be used to index XML data. All image metadata is extracted in the form of XML database objects and returned as a database XMLSequence type. This XML format is easier to be used with database features and to be searched with Oracle text. The following command represents a query that selects the OrdImage attribute of image compressionFormat:

```
SELECT  i.image
FROM images i, image_metadata e
WHERE i.id = e.id
   AND extractValue(metaordimage,
   '/ordImageAttributes/
   compressionFormat/text()',
   'xmlns="http://xmlns.oracle.com
   /ord/meta/ordimage"')= 'JPEG' ;
```

where extractValue is the function that scans the XML data and identifies the elements that satisfy the given query. Image retrieval based on Metadata queries can be efficiently performed using a b-tree index which can be created on the extractValue function result. This index is employed to dramatically increase the speed of the previous query:

```
CREATE INDEX indexmeta
   ON images e
   (extractValue(metaordimage,
   '/ordImageAttributes/
   compressionFormat/text()','xmlns="
   http://xmlns.oracle.com/ord/meta/
   ordimage"'));
```

For the text retrieval, we used the context index type of Oracle text indexes. In the following command, we represent an example of context index created on the description column that contents semantic descriptions assigned for each image stored in database.

```
CREATE INDEX textindex
   on images (description)indextype
   is ctxsys.context;
```

The integrated search allows posing queries mixing the textual and visual information to achieve a better accuracy and flexibility regarding query resulting. By using a combination of different search queries which we have already executed, we were able to implement an integrated query which allows the selection of images whose signatures are the most similar to the given example image, and have a semantic description about brain with tumor. This query selects only the image which characterized by JPEG compression format:

```
SELECT i.image FROM images i,
image_signature s, image_metadata m
WHERE i.id = s.id AND i.id=m.id
   AND ORDSYS.IMGSimilar
   (s.signature_img, signature_query,
   Commande, threshold)=1
```

```
AND contains( description,
'brain,tumor') > 0
AND extractValue (metaordimage,
'/ordImageAttributes/
comprssionFormat/text()','xmlns=
"http://xmlns.oracle.com/ord/meta/
ordimage"')= 'JPEG';
```

Therefore, our system makes possible to integrate content-based and text-based retrieval for efficient image search by executing queries through indexed searching over triple image similarities, textual descriptions, and metadata attributes.

5.2 Intelligent-CBIR System

To remedy the lack of transparency and the implementation sensitivity of Oracle CBIRS, we propose a new layer that allows efficient manipulation of images data type and search by content in full transparency through a simple and intuitive interface. To implement our tool, we used Microsoft Windows Seven software environment. We use the Oracle 11g release2 database. For the development environment we use NetBeans IDE 7.4.

Intelligent-CBIR system provides designers with multiple screens. We illustrate some examples as follows:

Once the user chooses to connect to the database by clicking on the corresponding visual navigation button, the system loads the images in the database to allow the user to have an idea about the database content (Figure 4).

Using visual navigation, the user can get a general idea about the database content that will help him easily manipulate images by adding or deleting options. Figure 5 shows an example of adding an image to the database. To add an image to the database, you simply select an image through the system interface and validate your choices. SQL script will be displayed for each handling contents of the database for further data manipulation transparency in our system.

For the task of CBIR, the system allows selecting an image query and selecting search criteria with their degree of importance according to the information provided by the system or the user's choice as shown in Figure 6:

- **The Color Criterion:** shows the distribution of colors in the entire image.
- **The Texture Criterion:** represents the low-level models and textures in the image.
- **The Shape Criterion:** represents the forms that appear in the image. They can be determined by techniques based on color segmentation.
- **The Location Criterion:** shows the positions of shape, color and texture.

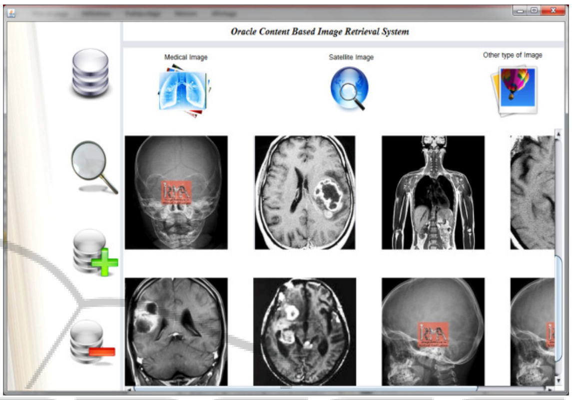

Figure 4: Interactive visual browsing of images databases.

Once the user validates the choice of search criteria and starts the images retrieval, the system browse through all images in database and compares the signature of the image query by those of images database.

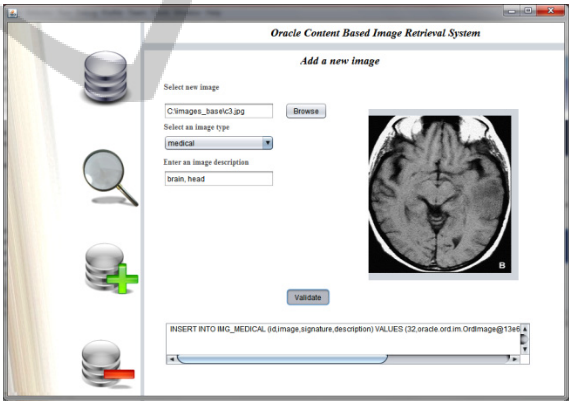

Figure 5: Adding an image to the database.

For each comparison, a value of similarity measurement is associated with each image: all images, whose value of similarity measurement is lower than a threshold (specified by the administrator), will be selected and displayed as search results (Figure 6).

5.3 Type of Search Query in Our System

This solution offers the user the flexibility for handling the choice of search criteria, using a single criterion or a combination of criteria, which allows multiple types of queries such as: query by color, query by texture, and query by shape and texture etc.

- **Query by Color:** search request relates to the color feature that is used to measure the similarity between the images based on the color criterion. This query gives more importance to color in the comparison phase between images.
- **Query by Texture:** search request relates to the texture feature that represents the visual patterns having homogeneity properties which do not result from the presence of a single intensity or color only. Texture determination is ideally suited for medical image retrievals (Lehmann, 2005).
- **Query by Shape:** search request relates to the shape feature to measure the similarity between different shapes contained in the images.
- **Query by Combination of Different Search Criteria:** search query involves a combination of criteria. Example of this type of query "homogeneous texture images and even distribution form."
- **Query by Keywords/Metadata:** search query based on a set of keywords which can describe the semantic content of the image. The metadata-based query performs an image retrieval based on the attributes attached to each image file which can be extracted and stored in the database.
- **Integrated Query:** this type of query is used in order to optimize the search task. We have achieved a combination of textual search (for the semantic content of the image) and content search (for the physical content of the image) in order to enhance the results and provide a semantic interpretation of the image content.

Figure 6 illustrates an example of image retrieval based on the texture and shape criteria. Since we are working on a database test containing medical images, we chose to give more importance to the texture criterion (Thomas, 2004) and less importance to the color, shape and location criteria. After each comparison, the system displays a measure of similarity (score) for each image, which is the rate of correspondence between the query image and the images of our database. Only images which have a score below a certain threshold will be selected.

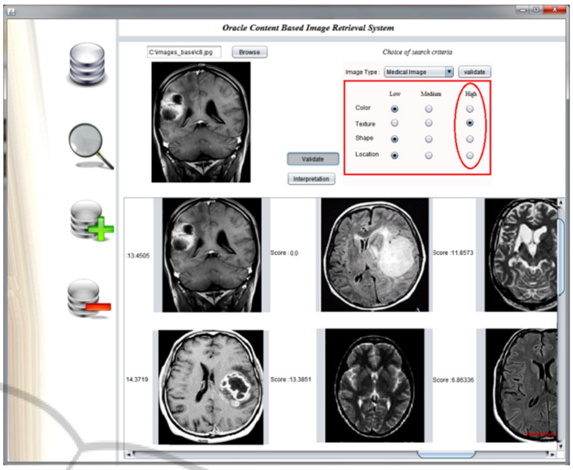

Figure 6: Content-based image retrieval interface.

5.4 Comparison with -- Other Approaches

Table 1 shows a comparison between the functionality provided by our system, the Landré approach and MedFMI-SiR system.

Table 1: Comparative table between our CBIR system and existing systems.

Functionalities	Landré approach	MedFMI-SiR	Our system
Multi-types of content search	✓	✗	✓
Search by physical content	✓	✓	✓
Search by semantic content	✓	✓	✓
Semantic interpretation	✗	✗	✓
Manipulation of images database	✓	✗	✓
Integrated search queries	✗	✓	✓

In our system, we were able to model the image data by the feature extraction and semantic interpretation of the visual content of the image. We make possible to integrate text- and content-based retrieval in order to execute an efficient image search. We could also provide a simple and transparent handling (compared to other systems) of data stored in the Oracle database by adding or deleting images through a simple interface of our system.

6 CONCLUSIONS

With the great mass of data stored in image databases, content-based image retrieval has become a necessity in order to classify images and extract useful information from this large amount of data. In this approach we have developed a simple and intuitive interface which ensures an advanced manipulation of images using Oracle database. One of the advantages of using a DBMS to manipulate images is to be able to search for images in many ways, as well as using a centralized manageable repository.

Through the study of the implementation manner of the content based image retrieval in Oracle and taking into consideration the absence of a simple and intuitive interface that allows user to do an intelligent and automatic search for images in database, we decided to create a layer of assistance to design and implement CBIR system. The result of this work is a search system that allows visual navigation, manipulation of the image database and CBIR. In addition, Oracle is a distributed DBMS (Özsu and Valduriez, 2011); so we can model our system directly into a distributed environment.

The CBIR in our approach is based only on the Oracle provided features. The future proceedings also involve integration of our own feature extraction and signature construction methods.

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