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Analyzing Patterns in Image

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Abstract. Nowadays progressing in generating images and saving them in the database are developed. Our target for extracting knowledge from images is obtaining new features of the images. This process is the best way for getting knowledge of images in the database. These images can be useful if we analyze them in the best way. In this paper we try to identify patterns. By knowing these patterns we can analyze images for predicting data. Also we can use these patterns for extracting and processing images. These patterns can be used in vision of computers.

Keywords: Pattern, time series, regression, image mining, association rule, sequence discovery, summarization.

Introduction

Today with the rapid growth of the number of digital images, the need for intelligent tools to index, sort and organize the digital images is very urgent. Content-based image retrieval system attracted widespread researchers' interest during the last few years. It supports image searches based on low-level perceptual features, such as color, texture, and shape etc. In traditional databases the stored data is searched through alphanumeric matching. Each entry in the database has several key fields by which a query is matched. However images and videos cannot be characterized by the alphanumeric strings. [1]

It is said that "image contents more than one thousand words." These words are used for measuring and analyzing images. Every word has one or some values. Some patterns are used for organizing images. Patterns can fascinate structures of images. For instance we can have these features and gathering them for presenting new images.

A. Target

We present a framework for patterns in images. This framework searches for images behavior and generate acceptable applications. In this paper we are going to present important definitions in image patterns.

By studying patterns and analyzing them on the images we have a new vision for these patterns.

B. Paper outline

The paper is organized as follows: In 2 sections summarize the definitions of models and patterns. Section 3 classifies patterns and vocabulary definitions on patterns. Section 4 analyzes patterns in images and presents types of patterns. Section 5 presents a framework of image mining and patterns. Finally, summary and conclusions are provided in section 6.

2. Definition

The pattern is the relationship and correlation between at least two features among concepts or classes or events that has these specifications: frequency of values in data and non-frequency of previous patterns. [2]

Patterns can be interpreted as a kind of metadata. Metadata represents data over data and, since patterns represent knowledge over data, there is a strong relationship between metadata management and pattern management. [3]

Knowledge definition: "Data mining is the process of pattern extraction from database, features and previous knowledge in accordance with a definite section to discover required knowledge". [2]

Among many definitions to data, Information and knowledge we can find Spek and Spijkervet's definition relevant to our subject: "Data is not yet interpreted symbols; Information is Data with meaning, and Knowledge is the ability to assign meaning". [4]

Modeling: Select and apply a variety of modeling techniques, and calibrate tool parameters to optimal values. [5]

Pattern evaluation: In this step, interesting patterns representing knowledge are identified based on given measures [6-7]. Thoroughly evaluate the model, and review the steps executed to construct the model, to be certain it properly achieves the business objectives. Determine if there is some important business issue that has not been sufficiently considered. At the end of this phase, a decision on the use of the data mining results is reached. [5]

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Interpreting mined patterns: This is crucial if the discovered patterns have to support effective improvement of expert's knowledge about the analyzed phenomenon or further decision-making. [8, 9, 10]

Consolidating discovered knowledge: Documenting and reporting results, or using them inside the target system. [8]
Knowledge representation: It is the final phase in which the discovered knowledge is visually presented to the user. This essential step uses visualization techniques to help users understand and interpret the data mining results. [6-7]

3. kind of pattern

Patterns or models have two kinds of definitions and predictions that those definitions are described below.

Predictive model: in these kinds of models permits the value of one variable to be predicted from the known values of other variables.
This task is most commonly used for text and image data sets. [6]

Descriptive model: In description model, pattern or relationship between the data is described. From this model is used for features discovers on data.
It describes all the data. It includes models for overall probability distribution of the data, partitioning of the p-dimensional space into groups and models describing the relationships between the variables.[6]
All kinds of patterns are described here: Classification, Clustering, Regression, Time Series, Sequence Discovery, Association Rules [11, 12], and Summarization.

- Identifying new patterns.
- Discovering and documenting collections of unknown facts.
- Regression is recursive. But in mathematics and statics means return of average value.
- Collections of facts that sorting in time.
- Patterns of analyzing sequence events. Sequence shows which events should be the first.
- Patterns which show the relations between events.
- Describing issues in summary ways so that subjects keep their main idea.

4. Patterns in images

4.1. Classification in image

Classification consists of large expand of spectrum for identifying images. All classified algorithms assume that image shows one or many features which these features belong to one of the unique classes. Classes might be recognized by analyzer (with observer) or automatically (without observer).
Classification evaluates all features of data and allocated them to pre-defined groups. Classification is common model and understandable in data mining. Data mining could be used by old data for generating model of group with data features. So we can use this model for classifying collections of new data.

According to this difference that J. Sirot and J. Stauder have used 1900 images as a database and example of these images are indoor & outdoor images, city and landscape and also they have used video images such as audience, close-ups, graphics, sunset, flowers, clouds, mountains, cars that in figure 1 and 2 is shown an example of indoor & outdoor images. The feature extraction process has been divided in two parts: grid based representative color selection and DCT (modified quantization). The authors have suggested many approaches for automatically classifying images into packets. The first one is visual features such as color, shape, texture, land and sub band energies. [13]

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Figure1. Outdoors images

Figure2. Outdoors images classified as “indoor”

PERNER in knowledge exploring has used medical images database that these pictures contains investigation of breast MRI and LYMHODE diagnosis in MRI. Used features in image extraction involve shape and texture and edges. [14] MARCELINO PEREIRAS has used regular shaped polygons and remote sensing images and multi temporal images. [15] E. B. Filip Florea with his coworkers also has used ground truth database and X-ray and medical images. Example images are shown in figure 3. They placed his algorithm based on color features and texture. [16]

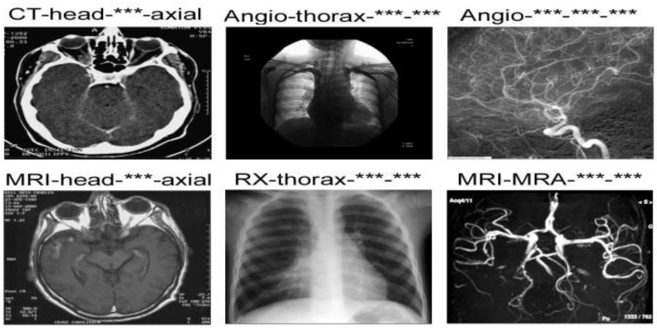

Figure3. Inter-class similarities

4.2. Clustering in the image

Clustering discovers same data in set of data group without classes of data. Clustering divides homogenous Group in sub groups. This process is different from classifying, because in the model we don’t have any learning pattern. Clustering automatically defines features in subset data and organizes groups. Also there is indirect data mining in clustering.

Another usage of clustering, sample of images is shown in figure 4. These images are segmented in terms of places that they are equal from color and texture. Each region recognized by a color descriptor feature, texture and shape feature. In a result, an image is shown by a set of features. For segmenting images, first systems classify the images into 4×4 size blocks that they have relations. Then index feature extracts for each block. Each index of features has six features that 3 features are about the average color in blocks in Figure 4. [17]

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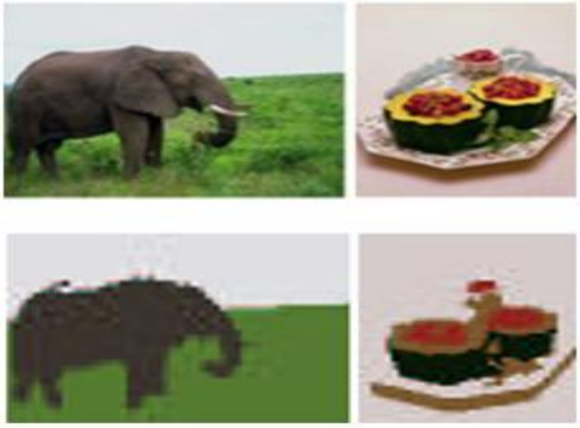

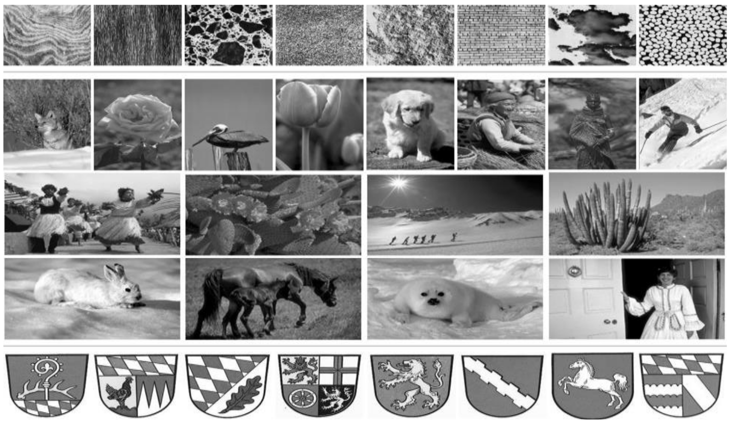

Figure4. Segmentation results by the *K-Means* clustering algorithm.

Figure5. Test datasets. First row: Brodatz dataset, second to fourth row:Corel dataset, last row: coats-of-arms dataset.

EIDENBERGER has used topological clustering algorithm for image clustering with the difference that this author has chosen images set from COREL and BRODATZ database. From these databases have been used COATS_OF_ARMS images and texture images that they are shown in figure 5. [18]

4.3. Regression in image

Image regression is a technique for recognizing changes and analyzes them. For instance by observing sick's images we can realize that whether this sick can be live or not. Also we can have function for commercials and customer demands, etc. [19]

One technique that has received little attention, however, is image regression. In a comparison of alternative change detection techniques within an urban environment, Ridd and Liu (1998) concluded that image regression is at least as effective as the other techniques examined. Furthermore, image regression possesses a number of benefits, notably its analytic capability, that are largely absent in other procedures. This paper focuses on the usefulness of the image regression change detection technique to study urban sprawl. Geographers have long recognized the importance of examining the spatial structure of data and analyzing its impact on the relationship between variables. Data derived from satellite imagery are inherently spatial, but change detection techniques are typically not designed to account for this spatiality. This is true of image regression, which is specified as a-spatial global model, as well as for other change detection techniques. A key statistical assumption of regression is that relationships are stationary. Many years of geographic research have demonstrated that this is often not the case with spatial data (Cliff and Ord, 1975; Haggett et al, 1977). Geographic data are typically non-stationary, and the spatial structure of data will affect the estimation of regression model parameters and, hence, residuals from the regression. [20]

Another usage of regression is estimated skew angle based on linear regression analysis. The method considers all the black pixels present in the document without segmenting the individual text lines. The linear regression analysis is used to find slope of a skewed document using all the pixel coordinate values. This method gives better accuracy up to ±10° but fails when non-textual region is encountered in the document due to more scatter of pixels in the non-textual regions. The novelty of the proposed method is that, it is robust for machine printed document of any size/font, multi-column layouts and documents containing graphics, pictures, charts, tables etc. [21]

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Figure 6. Input image

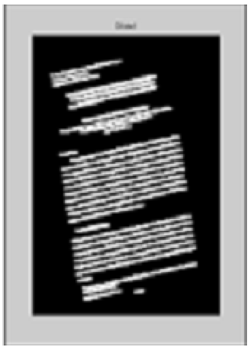

Figure 7. Image after dialtion

Like face detection and facial point's localization, head pose estimation also plays a very important role in vision-based automatic face perception processes. Most of pose-invariant face recognition systems need to normalize face patterns according to their poses prior to extracting features. Other man-machine interaction applications, such as gaze tracking system and driver mental status monitoring system, also need to estimate head orientations before making decisions. [22]

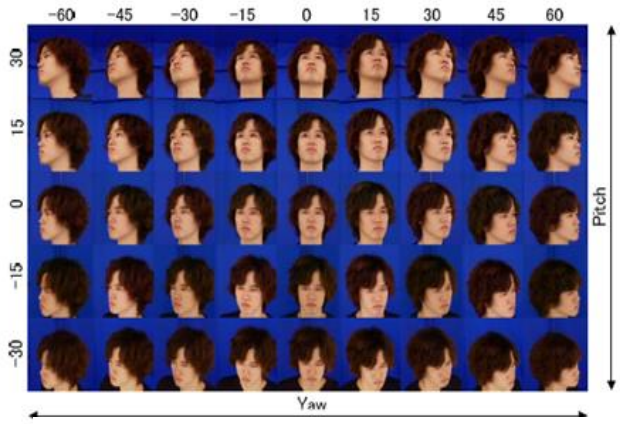

Figure 8. Head pose estimation range

Figure 9. Flowchart of the pose estimation system

The coordinate descent method is employed to minimize a mean squared error between image pairs. Based on a simple regression model, a non-parametric estimator, the empirical conditional mean and its polynomial fittings are used as histogram transformation functions for the exposure compensation. [23]

(a) (b)

Figure10. Images for registration(Pair A). (a)Whole image V (1/640sec, f5) and Template T. (b) Image U (1/640sec, f4).

We propose a framework to track facial features and recognize the universal expressions by tracking changes in the feature shapes. Our approach is based on discriminative, conditional, probabilistic model trained on pro-typical expressions, namely anger, disgust, fear, joy, sadness and surprise.[24]

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Figure11. Recognition for Anger and Disgust expression

4.4. Time series in image

User can identify factors in jungles and nature by using time series. Therefore comparing images let us have new idea for these changes.[25]

Let us consider, for instance, the scene illustrated in Figure 12. Each image contains four main regions (R1 to R4) and the series show their evolution on four different dates. In July 2007, regions R1 and R2 were mainly covered with trees, region R3 with a river and region R4 with roofs. A global evolution to this example is the urbanization process, where the trees disappear, replaced by bare soil and finally by urban items (roads and roofs). [26]

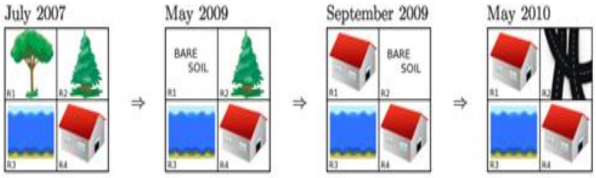

Figure12. Example of change in a scene involving trees and urban growth where a pattern of evolution is "trees → bare soil → urban", varied by 50 % of regions (i.e. R1 and R2).

We want to analyze images from SITS databases, such as Kalideos. In our experiments, for instance, we have extracted a series of 35 images Spot-1, Spot-2 and Spot-4 (the scenes are located in the south-west of France) as illustrated by Figure 4. These images are described by three attributes, corresponding to three spectral bands: Near Infrared (NIR), Red (R) and Green (G). To these bands, we add a fourth one, corresponding to the Normalized Deference Vegetation Index (NDVI).It is the most used index in remote sensing since it makes it possible to distinguish between several spectral signatures. The NDVI is calculated as follows for a pixel p: NDVI (p) = NIR (p) −R (p) NIR (p) +R (p). Since the images from these databases are acquired by different sensors, the comparison of radiometric levels of a pixel (x, y) from one image to another calls for corrections. The value of each pixel has to be adjusted. First, we need to make sure that pixel (x, y) in a series covers the very same geographic area in every image. Then, some corrections are performed in order to reduce the impact of the difference of the solar lighting and of the difference of composition of the atmosphere. These corrections make it possible to guarantee that a geographic area (x, y) can be studied throughout the image series with comparable values.[26]

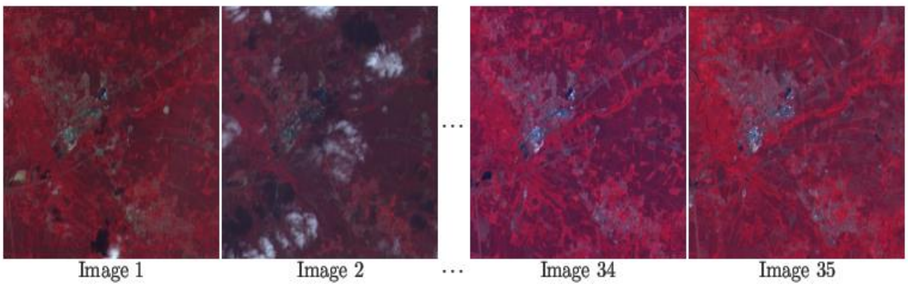

Figure13. Extract of the Satellite Image Time Series from the Kalideos database. CNES 2010 – Distribution Spot Image

Human motion analysis is a significant research topic in the computer vision community. General reviews provide a detailed documentation of research in this field. By using the relationship between humans and the involved environment, we may broadly divide human motion into three types: (a) single person motion, such as walking, bending and sitting, as described in , where the action is performed by a single person and involves no interaction with the environment; (b) interactions between people, such as hugging and punching, as presented in; (c) activities involving inanimate objects, such as climbing and opening a file cabinet in. [27]

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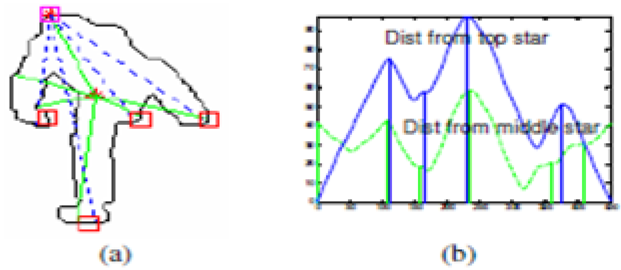

Figure 13. Extended star-skeleton

4.5. Association rule in image

In the case of market and basket analysis, the items are all the merchandizes and the transactions are the set of all the items that are bought together (basket). For image association rule, the goal is ending semantic associated images. In order to use association rules to capture this information, it is necessary to model the images in term of items and transactions. In the association rules for image feedback, the terms for describing association rules are defined as follows:
• Items: All the images in the database.
• Transactions (Basket): One complete session of the user retrieval /browsing. It consists of the images that are retrieved from the beginning till the end of the retrieval/browsing.
• Association rule: Semantically associated images. During one complete session of retrieval, the user tends to browse semantically similar images. For example, if the user is interested in wolf images, the images he or she browsed all belong to wolf. Thus, the transaction (basket) is actually a group of semantically similar images. The frequent items (images) found by association rules have strong semantic association.[1]

We have conducted experiments on a data set consists of 800 images. The images belong to 8 categories, each consists of 100 images. These are: lion, wolf, horse, canyon, flower, race car, wave and penguin. All the images come from the Corel image database. The user interface is implemented with MATLAB as shown in figure 14. The user selects the query image from the list-box on the left. Then the system will present the top 16 retrieval images. User can then use the pop menu under each retrieved image to mark it as either 'good' or 'bad'. [1]

Association can see special active in the image which have a close relationship with feature and processing inside it. These processing is independent from each other. When we watch an image from far distance, for instance watch at the shopping center, we understand beside the shopping center there is a big parking and outside the city. So we can estimate the price of land, social values, etc.

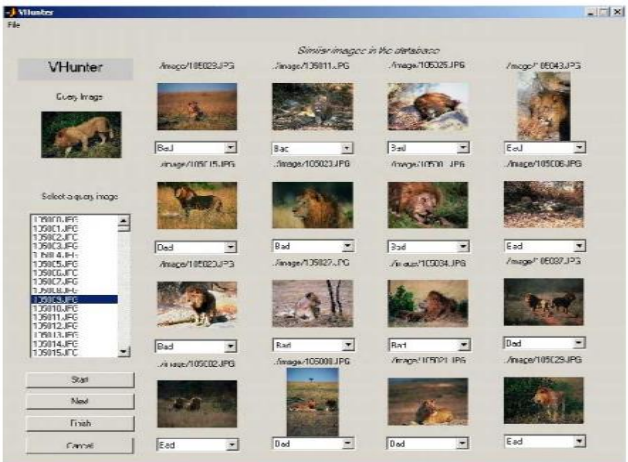

Figure14. ARIRS Retrieval

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It describes the association relationship among different attributes. The origin of association rules is in market basket analysis. A market basket is a collection of items purchased by a customer in an individual customer transaction. One common analysis task in a transaction database is to find sets of items, or item sets, that frequently appear together. Each pattern extracted through the analysis consists of an item set and its support, i.e., the number of transactions that contain it. Businesses can use knowledge of these patterns to improve the placement of items in a store or for mail-order marketing. The huge size of transaction databases and the exponential increase in the number of potential frequent item sets with an increase in the number of attributes (items) make the above problem a challenging one. [28]

4.6. Sequence discovery in image

Analysis sequence is the models from sequential patterns like time-series data. The goal is to model the process of generating the sequence or to extract and report deviation and trends over time. The framework is increasingly gaining importance because of its application in Bioinformatics and streaming data analysis. [28]
Sequence discovery is very similar to association's rules that are related over time in associations.
The analysis of image sequences is a challenging problem and has been an important research topic in the areas of photogrammetric and computer vision for some time. Horn (1986) for example uses optical flow to determine the motion of a camera from an image sequence. An algorithm obtaining a 3D model from image sequences is presented by Pollefeys et al. (2000). The system is able to extract automatically a textured 3D surface from an image sequence without prior knowledge about the scene or the camera. [29]

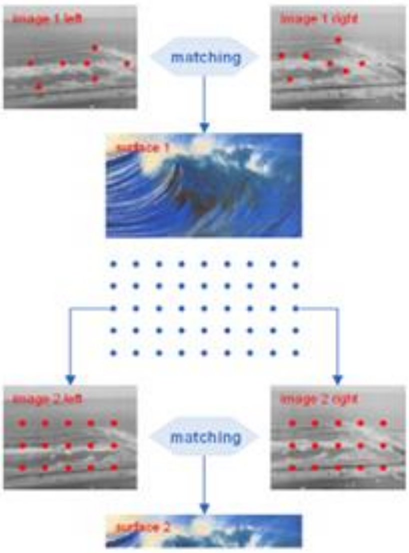

Figure15. Determination of wave surfaces from image sequences

4.7. Summarization in image

Summarization provides a compact description for a subset of data. A simple example would be mean and standard deviation for all fields. For this model have used in summary rules, multivariate visualization techniques and functional relationship between variables. Summarization functions are often used in interactive data analysis, automated report generation and text mining. [28]
We can use summarization for gathering images and eliminate unwanted partials of the image. [30]
Given a large image/video, we often want to display it in a different (usually smaller) size – e.g., for generating image thumbnails, for obtaining short summaries of long videos, or for displaying images/videos on different screen sizes. This smaller representation (the visual summary) should faithfully represent the original visual appearance and dynamics as best as possible, and should be visually pleasing. The simplest and most commonly used methods for generating smaller-sized visual displays are scaling and cropping. Image scaling maintains the entire global layout of the image, but compromises its visual resolution, and distorts appearance of objects when the aspect ratio changes. Cropping, on the other hand, preserves visual resolution and appearance within the cropped region, but loses all visual information outside that region. [30]
Image Summarization: Figure 16 presents results of image summarization obtained with our algorithm for several input images and for several different output sizes. It shows how the algorithm performs under different space limitations, down to very small sizes. These results are compared side-by-side with the output of the "Seam Carving" algorithm. Our algorithm exploits

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redundancy of image patterns (e.g., the windows in the building) by mapping repetitive patches in the source image to a few representative patches in the target image (as in "Epitome"), thus preserving their appearance at the original scale. "Seam Carving" removes vertical and horizontal paths of pixels with small gradients, nicely shrinking large images as long as there are enough low-gradient pixels to remove. It first removes uniform regions (such as the sky in the building image of Figure 16), while maintaining the faithful appearance of all objects in the image. However, when the image gets too small and all low-gradient pixels have been removed, "Seam Carving" starts distorting the image content. Moreover, since its decisions are based on pixel-wide seams, it does not try to preserve larger image patterns, nor does it exploit redundancy of such patterns. As such, it is less adequate for highly structured images (like images of buildings). Note that our algorithm is inherently slower when compared to "Seam Carving", as its running time is dominated by the nearest-neighbor search over all patches in an image. [30]

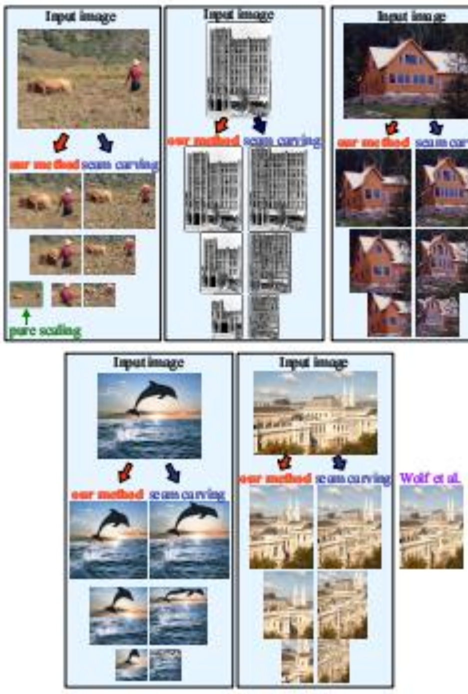

Figure16. Image summarization results

Our method exploits redundancies in the images (bushes, waves, windows of the buildings, etc.), often creating coherently-looking images even for extremely small target sizes. "Seam Carving" prefers to remove low-gradient pixels, thus distorts the image considerably at small sizes, when there are no more low-gradient pixels left. The Dolphin image is from Avidan and Shamir, the rightmost building image from Wolf et al.

Video summarization: We further applied our optimization algorithm to generate a visual summary of video data (where S and T are video clips, and the patches are space-time patches of multiple space-time scales).We summarized a complex ballet video clip S by a shorter target clip T of half the temporal length – see Figure 17. The resulting output clip, although shorter, is visually coherent – it conveys a visually pleasing summary of the ballet movements at their original speed! On the other hand, it is also complete in the sense that it preserves information from all parts of the longer source video. [30]

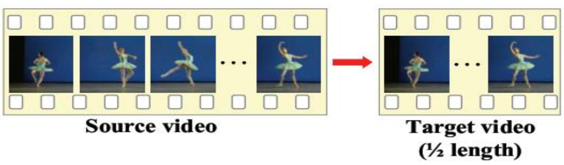

Figure17. Video summarization result

A complex ballet video sequence was summarized to half its temporal length by our algorithm.

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In many sciences, arts and technical's sites, images impress contented of sites. Texts and images can describe websites better. Summarizations describe the contents from images. The main ideas of analyzing images are featured in all kinds of images. For getting images with high quality we need lots of images. We present logos and trademarks in figure 18 for assigning new method for selecting images. [31]

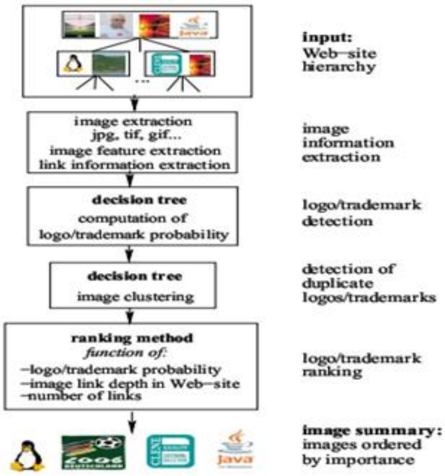

Figure18. Web site image summarization system

Framework

Progressing in image technology leads to create a big database with a large amount of medical images, digital images and so on.

These databases can be useful if they gather data in a good way. Unfortunately gathering knowledge and patterns are difficult for human. Image mining with knowledge and pattern never keep in the database. Images before processing can be kept for best quality.

Database tests all images for generating important features of images by using these features we can generate new applications for patterns.

Conclusion

In this paper we analyze differences of image patterns and present framework for these patterns in images.

Future work

By studding on details of patterns in images we suggest combining one or many patterns so we can have better performance in image mining. Also combination of patterns can solve many problems of identifying in images.

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