A Refinement: Better Classification of Images using LDA in Contrast with SURF and SVM for CBIR System

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ABSTRACT

Content Based Image Retrieval or CBIR is the image retrieval process which is based on visual features including color, texture and shape. Image databases that are large in size and traditional indexing of images have proven to be less sufficient, more laborious and extremely time consuming which led to its development. Image retrieval and face recognition systems have grown significantly in the area of security systems. Retrieval of images has become an challenging issue in real world applications due to high dimensions of image collection. Therefore it has become a major issue and downfall for Content-Based image Retrieval (CBIR). Furthermore, it results in the inefficiency and degraded classification accuracy. A classifier in combination with the better dimensionality reduction and higher class discrimination can provide higher classification accuracy. This combination must result in a better classification rate. In the field of medical image annotation, research shows that SURF is a very strong tool to be used. Herein, an effort has been formulated to present an efficient algorithm based on SURF which is fast and robust interest point detector, SVM and LDA for further classification.

General Terms

Feature Extraction, Description, Detection, Classification, Image Retrieval, Dimensionality Reduction.

Keywords

CBIR, SURF, SVM, LDA.

1. INTRODUCTION

The evolvement of digital image processing, feature extraction techniques, image dimensionality reduction, image compression techniques lead to a significant growth and development of CBIR in the field of research. Content based image retrieval systems are based on image retrieval through features including texture, shape and color that is totally different from textual indexing and image indexing based on descriptions.

The blooming of retrieval systems initiated with text based retrieval systems but later content based retrieval systems were pioneered. It came into existence as Content Based Image Retrieval.

The sudden rise in the image database size has stimulated the potent and efficacious development of retrieval systems. One of the chief problems of Content Based Image Retrieval (CBIR) system is the large semantic gap between the low-level visual features and the high level semantic concepts. Usually, the images inclusive of medical images, scientific images, digital photographs, etc. are high dimensional and low-level visual features have restricted ability for exhibiting these high-level concepts and it turns out to be arduous for human beings to elucidate these concepts. This contributes to

the problem of higher dimensionality in CBIR which results in degraded performance as well as affects the efficiency of the system. Therefore, to overcome the problem of high dimensionality, linear dimensionality reduction technique LDA could prove out to be the best option in addition to SURF and SVM.

1.1 Speeded Up Robust Feature (SURF)

In 2006, a robust local feature detector which came to be known as SURF (Speeded up Robust Features) was pioneered by Herbert Bay et al. SIFT descriptor prompted the origin of SURF. The SURF descriptor is a rapid and swift version as compared to SIFT. SURF is basically a fast interest point detector. SURF makes efficient use of integral images which results in less time consumption. SURF is used to extract relevant features and descriptors from images. This approach is preferred over its predecessor due to its succinct descriptor length i.e. 64 floating point values. SURF performs much better as compared to previous recommended strategies in the areas of distinctiveness, robustness and repeatability. This leads to a fusion of detection, description, and matching steps whose computation time is much faster.

1.2 Support Vector Machine (SVM)

Support vector machines (SVMs) are the models which make use of efficient algorithms to analyze data and pattern for the purpose of efficient classification and analysis. The training algorithm in SVM categorizes the new samples into the respective matching category out of two, which makes it a non-probabilistic binary linear classification model. It is a representation of points in space mapped in such a way that the samples belonging to different categories are divided wider by a distinguishing gap. New samples are also mapped in the given space in such a way that they are predicted to fall into their belonging category.

1.3 Linear Discriminant Analysis (LDA)

Linear Discriminant Analysis (LDA) is a technique used for data classification and dimensionality reduction. Principle of LDA is to preserve most of the class discriminatory information without losing any data. It has been used majorly in many real time applications such as image retrieval, face recognition, microarray data classification etc. In PCA, the shape and the location of the original data sets changes when transformed to different spaces whereas LDA doesn't change the location but only tries to provide more class separation and draw decision between the given classes. In this analysis, two of the scatter matrices namely within-class (S_w) and between-class (S_b) matrices quantify the quality.

GOOD CLASS SEPARATION

Fig 1: LDA Classification

According to LDA computation between-class scatter is maximized while within-class scatter is minimized. Such a transformation should reduce the variation caused due to sources namely illumination and maintain large amount of class separation. In the following equation, LDA computation is explained.

$$\text{Maximize } \det(S_b) \quad (\text{where } S_b = \text{within class scatter})$$

$$\det(S_w) \quad (\text{where } S_w = \text{between class scatter})$$

2. RELATED WORK

King-Shy Goh, Edward Y. Chang 2005 [13] proposed the usage of multiclass, one-class and two-class SVMs for annotation of images for keyword retrieval of images. Providing automatic annotation requires an accurate mapping of images with low-level visual features and to some high-level semantic concepts. Work has been done to a large extent in this field. However, there is a lack of potential to get a good quality of image annotation. Therefore the method of confidence-based dynamic ensemble (CDE), which uses a three-level classification scheme is proposed. CDE uses the confidence to improve accuracy of class-prediction and for the accommodation of new semantics, and evolution of new and useful low-level features to get very effective results.

K.Velmurugan, Lt.Dr.S. Santhosh Baboo May 2011 [12] proposed that the Content-Based Image Retrieval (CBIR) system retrieves the similar images from the large database and many of the CBIR system uses the visual features namely color, texture and shape to extract the visual features from the input images. Recently it is shown that the Interest points extracts the most like images with different scales and transformations. Herein, SURF is used in combination with the color feature to improve the overall accuracy.

Anna Wojnar, Antonio M. G. pinheiro 2012 [1] This paper depicts the annotation of medical images using SURF descriptor and SVM classifier. Fast-Hessian detector was used for the purpose of feature extraction. SVM is used for the feature matching process in combination with the quadratic kernel. The developed system was then tested on IRMA radiographic images. Obtained results with SURF and SVM were then compared to the results obtained from SIFT Descriptor and SVM Classifier. The usage of SURF descriptor gave out the results with a better categorization of medical lung images. The accuracy obtained in the results was over 96%. It is witnessed that in the field of medical image annotation SURF is a very strong tool to be used. In fusion with SVM, it may develop an efficiently better and robust system as a whole.

Dong Hui, Han Dian Yuan 2012 [4] introduced the image matching method of the SURF algorithm. In our method, the feature points are extracted by SURF algorithm even when the image's scale rotation. Particularly, the application of KD-tree algorithm is the particular, which improve the efficiency of

searching for the similar point-pairs. In this work, a pairs of images with different rotated angles were generated.

Juan C. Caicedo, Fabio A. González, Eduardo 2012 [11] proposed that huge amounts of histology images are stored and archived in pathology departments due to increasing use of digital microscopy. The potential of managing high collection of digital images is defined as a principle component of new medical imaging systems. The problem of accessing histopathology images from a large database of images using an image as query is addressed over here.. The proposed strategy annotates the images and query images automatically. This delivers an improved performance with best retrieval results.

Hatice Cinar Akakin and Metin N. Gurcan 2012 [6] proposed the development of a multi layered CBIR system for the microscopic images which utilizes a reference database which consists of lots of images for one disease described . The proposed system uses an approach so as to retrieve and classify microscopic images including their certain subtypes, which are hard to distinguish and classify otherwise. It protects and maintains the semantic consistency among the retrieved images.

Bob Zhang, B. V. K. Vijaya Kumar 2014 [2] proposed that Diabetes mellitus (DM) soon is going to become one of the chief health problems in 21st century. This could be a huge financial burden for health department and officials. To overcome this arriving epidemic, a non invasive technique was proposed to detect DM. The first stage of DR is based on three groups of features extracted from tongue images. They include texture, color and geometry.

3. PROPOSED WORK

Image Matching is proposed which is based on Improved SURF Algorithm using SVM Classifier and Linear Discriminant Analysis. In the proposed system.

- a) Firstly medical images will be captured and stored as database.
- b) Pre-processing of images are the operations implied on images at the lower level of abstraction so as to remove the unnecessary distortions and enhances the features of images for a better analysis and processing.
- c) Color histogram will be used for feature extraction of image. In image processing, a color histogram is a representation of the distribution of colors in an image. As it is invariant to rotation, better accuracy results must be obtained.
- d) SURF Descriptor will be used for detection , description and matching of image features.

Detection-Interest points will be identified and a vector will be constructed to extract the features.

Description-Each interest point will have a unique description and all the descriptors will be matched with all the descriptors in the database image respectively. The nearest distanced descriptor will be compared and stored.

Matching-All the generated outputs will be sorted and the one with the lowest distance will be the best match for the query image

- e) The results will be then fed into SVM for further classification and after preprocessing of images SVM will discriminate the various categories.

f) LDA computes a transformation that will maximize the between-class scatter and minimize the within-class scatter so as to get better retrieval accuracy rate.

Fig 2: Flowchart of Proposed System

4. CONCLUSION

In this paper, Image Matching is proposed which is based on Improved SURF Algorithm using SVM Classifier and LDA. The SURF detector is based on the determinant of the Hessian matrix. SVMs (Support Vector Machines) are a useful technique for data classification. The derived classification parameters are used to classify the images. The image content can be discriminated into the various categories in terms of the designed support vector classifier. Studies show that, the feature dimensionality has an adverse impact on the classification accuracy of a classifier. SVM is a widely used classifier. Therefore, it is beneficial to perform a dimensionality reduction method prior to the SVM. LDA gives higher class discrimination among the different classes. During dimensionality reduction, LDA selects the significant features for class separation and SVM classifier that classify input face images into one of available classes.

Furthermore, the development of substantial processing power, rapid and cost-effective memories is the major factors for the swift CBIR development. CBIR is still a growing field. Therefore, it assures a colossal scope of future applications using CBIR.

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