Effective Analysis of Image Retrieval Using Wavelet Transform and Local Binary Pattern

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Abstract: An image retrieval is a technique for searching and retrieving images from a large database of digital images. Most traditional and common methods of image retrieval utilize some method of adding metadata such as captioning, keywords, or descriptions to the images. Manual image annotation is time-consuming, arduous and pricey. In this paper we proposed a content based image retrieval method to process natural digital images. In advanced world volume of digital images increased vividly in all application which is available to user. In this paper we are proposing texture features extraction methods. In this paper we are combining two feature extraction methods, wavelet based texture feature extraction and LBP (Local Binary Pattern). For retrieving the image, we are making use of Support Vector Machine algorithm. Now a days Content based image retrieval is popular Technique for feature matching and retrieving. Here proposed system includes machine learning algorithm called Support vector machine (RBF-SVM). So image retrieval efficiency and accuracy is more than 90% in proposed method.

Keywords: Local Binary Pattern, LBP Derivation, Support Vector Machine, Wavelet Transform.

I. INTRODUCTION

Multimedia plays an important role in current information era. Multimedia Includes audio, video, images. One of the most popular medium is Image. An image is a two dimensional signal stored as an array of pixels. Images represent perceptual data. There are conventional methods for retrieval of data. But that cannot be applied directly to multimedia streams. So a new retrieval method is required.

Content-based image retrieval (CBIR) is the mechanism of retrieving images. Content-based retrieval measures the similarity between a given database query and image candidates. Retrieval of the relevant images from a query of large collection of images known as image database. Retrieval procedure contains a calls for an adaptive capability to process queries, based on user’s analyses of that image content or stated domain semantics. To access and manage image data, Content based image retrieval method is compulsory. To access large discrete data sets, tables are formed from data fields that will be present in queries. For Data streams like images, one of the possible solutions is to create indices. It is created from derived image attributes, called signatures. For a specified system, signatures of image candidates are created from quantized wavelet coefficients. It is used as the index for comparison with a signature obtained from a given query. The choice of attributes is essential to application requirements. And the change of the requirements has a profound impact on signatures. For new requirements, new signatures may be required to suite that necessities. This retrieval pattern does not access the images themselves. Indices representing images should be inherent to constituent semantic entities.

This paper proposes a rotation normalization method. Circular shift of the feature is used to achieve rotation normalization. The feature of rotation invariance by a circular shift, all images have the same dominant direction. Here we demonstrate our retrieval results both for texture and for natural images.

The remaining part of the paper is organized as follows. Section I gives an introduction of the system. Section II briefs about related work. Section III gives an overview of the system architecture. Section IV describes about Local Binary Pattern. Section V describes fundamentals of 2-D Gabor filters (wavelets). Section VI describes about Support Vector Machine. Section VII gives the results of image retrieval based on Gabor texture features. Section VIII states the conclusion.

II. RELATED WORK

Most of the previous work on Image retrieval is used Local Binary Pattern. Image can be retrieved by applying LBP algorithm shown in below Fig. 1.
Here images divided into Non-overlapped blocks. And performing equalization, and concatenated into a single vector. But here accuracy and precision is less. So we are combining LBP and DWT in proposed method. So accuracy can be increased.

III. SYSTEM ARCHITECTURE

The fig. 2 shows the block diagram of proposed system, this system is divided into two phases training and testing respectively. In training phase input sample images are pre-processed, i.e. image resized to standard dimension $256 \times 256$ and converted to gray scale from RGB color format image. And Gaussian filter is applied to converted image to remove noise and normalize the image.

IV. LOCAL BINARY PATTERN

The local binary pattern (LBP) operator was first presented as a complementary measure for local image differences. The first step of the operation worked with the eight-neighbors of a pixel, using the value of the center pixel as a threshold. An LBP code for a neighborhood was produced by multiplying the thresholder values with weights given to the corresponding pixels, and obtained result was summed.

But LBP was, invariant to monotonic changes in gray scale, it was supplemented by an orthogonal measure of local contrast. Fig. 3 shows how the contrast measure ($C$) was derived. The average of the gray levels below the center pixel is subtracted from that of the gray levels above or equal to the center pixel. Two-dimensional distributions of the LBP and that calculated local contrast measures, were used as features. So this operator was named as LBP/C.

A. Derivation

The derivation of the LBP explained here .Let us take texture $T$ as the joint distribution of the gray levels of $P + 1 (P > 0)$ image pixels, $T = t(g_0, g_1, ..., g_{P-1})$ where $g_c$ corresponds to the gray value of the center pixel of a local neighborhood $g_p (p = 0, ..., P - 1)$ correspond to the gray values of $P$ equally spaced pixels on a circle of radius $R (R > 0)$ that form a circularly symmetric set of neighbors. Fig 4 illustrates three circularly symmetric neighbor sets for different values of $P$ and $R$.

Without losing information, $g_c$ can be subtracted from $g_p$.

$$T = t(g_0, g_1, ..., g_{P-1}, g_c)$$

(1)

Assuming that the differences are independent of $g_c$, the distribution can be factorized,
T ≈ t(g_c);(g_{b_0} - g_c;⋯,g_{b_{p-1}} - g_c) \tag{2}

And \( t(g_c) \) describes the overall luminance of an image, which is unrelated to local image texture, so it can be ignored.

\[
T \approx t(g_b - g_c;⋯,g_{b_{p-1}} - g_c) \tag{3}
\]

Although invariant against gray scale shifts, the differences are affected by the scaling. The signs of the differences are also considered, to achieve invariance with respect to any monotonic transformation of the gray scale.

\[
T \approx t(s(g_b - g_c);⋯,s(g_{b_{p-1}} - g_c)) \tag{4}
\]

where

\[
s(x) = \begin{cases} 
1, & x \geq 0 \\
0, & x < 0 
\end{cases}
\]

Now, a binomial weight \( 2^p \) is assigned to each sign \( s(g_b - g_c) \) and transforming the differences in a neighborhood into a unique LBP code.

\[
LBP_{p,r} = \sum_{p=-1}^{p=1} s(g_b - g_c) \times 2^p \tag{5}
\]

V. WAVELET TRANSFORM

The Discrete Wavelet Transform (DWT) is one of the most common transforms that is recently applied to many image processing applications. The Daubechies wavelet can be used for extracting features in retrieving images based on the description of a particular object within the scene. This wavelet is extensively used for image compression. Wavelet Packet Decomposition (WPD) is a wavelet transform. In WPD, the discrete-time (sampled) signal is passed through more filters than the discrete wavelet transform (DWT). In the DWT, each level is calculated by passing the previous wavelet approximation coefficients (cAj) through discrete-time low and high pass quadrature mirror filters. In the WPD, coefficients cDj (in the 1-D case), cHj, cVj, cDj (in the 2-D case) and approximation coefficients are decomposed to create the full binary tree.

A. Wavelet Decomposition

The basic idea behind the wavelet decomposition is to separate the higher half and the lower half of the spectrum of a signal by using a second order band pass filter and a low pass filter, to subsample the image corresponding to the lower half of the spectrum and to iterate the process. The first band-pass filtering result will give us the difference of information between resolution 2j−1 and resolution 2j−1. The result of the corresponding next band-pass filtering will give us the difference of information between resolution 2j−1 and resolution 2j−2 and so on. From the theory of wavelets, we can understand that we can obtain filters which are very well localized both in the Fourier and spatial domain thus preserving the locality of information and that we can achieve a complete representation.

VI. SUPPORT VECTOR MACHINE

The concept of SVM has been attaining popularity because of its features which makes it attractive while doing real world performance. It provides the significant better outcomes in classifying the images in comparison to other variety of algorithms or presented techniques for the same purpose. It is primarily deals with the practical application problems normally arises during voice recognition, recognition of tones, categorization of text, classification of image as well as data. Basically there are two types present in the concept of machine learning. They are supervised and unsupervised learning.

Supervised learning works on the basis of learning by result

Obtained whereas learn by example is the main feature of unsupervised learning. In supervised learning the input is a collection of training data. Support vector machine works on the principle of supervised learning technique by studying the data as well as recognizing the pattern for classification purpose. It takes the whole set of input then reading it and then for each of the input, the relevant output is extracted. Now the result is in two forms either as discrete or continuous. In the case of discrete outcome, the process of classification is performed and in the other one reversion is done. SVM works by the principle of mapping the input space to the feature space. Feature space is the space which is kept for the purpose of calculating similarity by usage of the kernel function.

In the feature space, the two important concepts named as feature value and the feature vector should also be considered. The main attribute of any image is called its feature value and feature vector is vector in which these feature values offers the machine. Kernel function in the kernel method is implements the classification and the clustering of variety of the data like text document, image, graphs, vectors etc.

The images of same kind are grouped into one unit which is called the cluster of that image. So the classification can be done such that it should retrieve the correct result. And also it is possible to retrieve the nearby feature of the image so it will be helpful to attain the accuracy in the results.

In the previous works for image retrieval there were some difficulties when using in real world applications. A lots
of negative results may lead to more time consumption while searching etc. So we are using this CBIR system for retrieving images present in the database. It is very much similar to the query image here SVM is seen as giving the best result.

**VII. SOFTWARE REQUIREMENTS**

MATLAB is a programming language with powerful commands and syntax. Here we are using MATLAB for an image retrieval. To use the application, the user must have understanding of image processing concepts. And also user should have basic understanding of functions that is available in MATLAB to be used for image processing.

**VIII. EVALUATION**

In this section we give a detailed evaluation of the proposed image retrieval method. We first evaluate the image retrieval by using Wavelet transform and Local Binary Pattern (LBP).

Some of the results that is obtained are given in the following sections. Here first image is a query image used for retrieval and remaining images are the retrieval images from database with respect to query image.

**IX. CONCLUSION**

In this paper, an effective image retrieval method is presented by implementing the algorithms. Here we are using the principle of Wavelet transform and Local Binary Pattern (LBP) in order to increase the accuracy. Since this proposed method make use of these algorithms, the results obtained are more reliable.

**REFERENCES**


