

## Courier Receipts Retrieval System Design Combining the Inverse Zernike Moments and the SIFT Features

<sup>1, 2</sup>Wenyan Ni, <sup>1</sup>Jianxin Wang and <sup>2</sup>Xiaohui Yan

<sup>1</sup>School of Information Science and Engineering, Central South University, Changsha 410083, China

<sup>2</sup>Department of Computer Science and Technology, Changsha University, Changsha 410003, China

**Abstract:** In response to the demand of the logistics industry's application, a retrieval algorithm for logistics bill is proposed which combines the local feature with the global feature of images, which solved the problem of rotation positioning and applied to a set of practical courier receipts retrieval system. By using the scale invariance principle of the local features combined with Zernike invariant moments of the global features, we can quickly calculate the image rotating angle and make the exact match. Experimental results show that this method not only keeps the well precision and recall ratio ability of SIFT features, but also reduces the counting times which are required by fine matching.

**Keywords:** Content based image retrieval, Scale Invariant Feature Transform (SIFT), zernike invariant moments

### INTRODUCTION

The concept of modern logistics has gone through the course of 20 years in China since 1978. According to the Statistical data of the China Logistics Information Center (CLIC) and the China Federation of Logistics & Purchasing (CFLP), the total growth rate of China's logistics has been grown more than 20% for many years. The barcode management has become the mainstream method for the logistics industry to achieve a network information management now, the applications of bar code in the logistics industry is mainly food 59.6%, household 13.6%, clothing and shoes 7.9%, health care 6.6% and other 12.3%. The electronic development of Chinese Logistics (freight forwarding, warehouse management and distribution systems) has become one of the prerequisites for the development of this industry, the same is true of the Electronic exchange system (EDI).

The main drawback of the barcode management is small capacity and low density of information, no error correction capability except by the Checksum character only, poor confidential security and weak anti-interference ability. At the same time, the destination data can't lead to be included in the barcode management because that they represent of Chinese characters is very difficult by barcode. So the destination's identification and sorting present in all logistics center have to be done manually and severely limit the sorting efficiency and the development of the logistics industry.

The academia has put forward a variety of programs about the shape recognition of image retrieval, such as use the histogram of adjacent edge and the circumcircle's radius and the feature point distance (Qi *et al.*, 2010), use wavelet modulus maxima and invariant moments for edge location (Cao *et al.*, 2006), by sub-image shape and spatial structure (Guo *et al.*, 2005) and combination of global features and internal structure (Wei *et al.*, 2009), etc.

Among the programs above, some programs can only recognize the image with similar outline and easily lead to false detection, others also easily lead to false detection because of the segmentation and the change of sub-image position.

In recent years, the SIFT feature has been widely used in image matching because of its strong anti-blocking and noise immunity, especially to do with the scale transformation, mirroring and rotation. The downside of the SIFT descriptor to be retrieved (Lin and Zhao, 2008) is as follows, the first one is its requires of a lot of computing time and storage space during the iterative matching processing caused by the SIFT feature points' high dimensional. Secondly, the frequent rotation of the target image in actual usage often cannot meet the practical requirements in the characteristic expression and the noise sensitivity.

Against these shortcomings and the actual application requirements of logistics industry, the idea in this study is to extract the global features of Zernike moments' rotation invariants to analyze, use of the Euclidean distance to zero between the SIFT feature

value to determine the rotation angle of the inverse Zernike transform, then on this basis determine the location of destination field image and extract the destination field by character recognition. The experiment shows that this program can solve the image's rotation problem quickly and accurately and overcome the shortcomings of local descriptors.

## METHODOLOGY

**The invariant zernike moments and the inverse transform of the zernike moment:** The core of Zernike moments is defined as orthogonal Zernike polynomials in the polar coordinate unit circle, the expression of order p with Zernike moments is:

$$Z_{p,q} = \frac{p+1}{\pi} \int_0^{2\pi} \int_0^1 V_{p,q}^*(r, \theta) r dr d\theta, \quad r \leq 1 \quad (1)$$

P is a non-negative integer, q is a integer and satisfy that  $q-|q|$  is a even and  $|q| \leq p$ .

Denoted  $k = n-2s$ , then:

$$B_{n,m,k} = \frac{(-1)^{(n-k)/2} ((n+k)/2)!}{((n-k)/2)! ((k+m)/2)! ((k-m)/2)!}$$

and the Zernike moments can be introduced in the Cartesian form as follows:

$$Z_{n,m} = \frac{n+1}{\pi} \sum_{k=m}^n B_{n,m,k} \iint_{x,y} (x-iy)^m (x^2+y^2)^{(k-m)/2} f(x,y) dx dy \quad (2)$$

When the image rotated  $\alpha$  angle and denoted its Zernike moments as  $Z_{p,q}^t$ , we can reconstruct the image gray level function  $f(r, \theta)$  from the limited number (n) of the Zernike moments depended on the Fourier expansion principle:

$$f(r, \theta) = \sum_{p=0}^n \sum_{q=-p}^p Z_{p,q} V_{p,q}(r, \theta) \quad (3)$$

We can also introduce Eq. (4) because that Zernike moment's function is an invariant:

$$\alpha = \frac{i}{q} \ln \left( \frac{Z'_{p,q}}{Z_{p,q}} \right) \quad (4)$$

**Note:** We consider only the real part of the Zernike moments in image processing as the image intensity function is a real value. There are many methods about the calculation of Image Scale Invariant Feature

Transform (SIFT) with eigenvalue (Wang, 2008; Zhong-hai et al., 2011), so we will not repeat them here.

**System design and retrieval algorithms:** Depended on the invariant Zernike moments and the Scale Invariant Feature Transform (SIFT), this study presents a retrieval system program for the logistics which integrated the invariant Zernike moments and SIFT features shown in Fig. 1. The design goal is adapt to the logistics sorted requirements under different operating environments and automatic distinguish, extract and output the destination field picture to fill in electronic bills of lading automatically after character recognition to reduce the burden of manual sorting effectively and develop the Electronic exchange system (EDI) further to accommodate the demand of modern logistics development.

The system, shown in the Fig. 1, is different to the general image retrieval system which based on the content for the reasons as follows, the first one is because that we can locate the positioning and calculation of image's rotary quickly and accurately depend on the calculation rotation angle of the image by extracting image's global features of the invariant Zernike moments. Secondly, we can use the different order of invariant Zernike moments to control the matching accuracy that the lower order moments to focus on the rough of shape and higher order moments contain more detailed and precise image information.

Due to the limited space, here only to introduce the core algorithm of the system:

- Normalize the match figure S and the original figure by the size of 1000\*500
- Extract the SIFT features value of the original target figure, i.e., the three groups eigenvalue of "STO"、" Company Name" field and "Barcode" and calculate  $Z_{p,q}$  by formula (3)
- Default rotation angle is 0, extraction the four vertex coordinates of the destination location
- Extract the three groups corresponding eigenvalue from the match figure by formula (3)
- Calculate the rotation angle by the formula (4) and (5)
- Reverse rotate angle  $\alpha$  of the match figure
- Intercept the destination field image in accordance with the original vertex coordinates
- Call the character recognition module
- Output

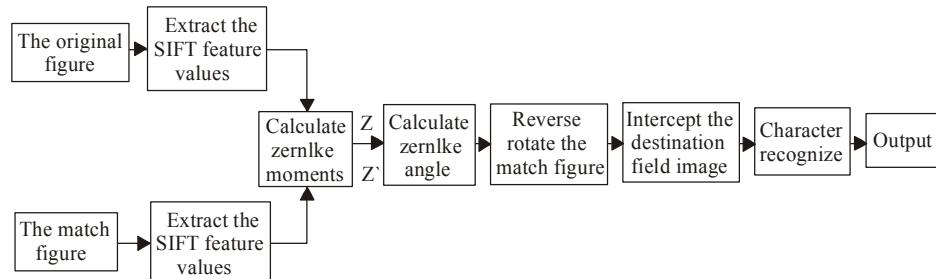


Fig. 1: The block diagram of retrieval system for Logistics bill

## EXPERIMENTAL RESULTS AND ANALYSIS

Experimental environment: Intel dual-core CPU 1.6 GHz, 3 GB DDR3 1066, algorithm using c #, the image test database includes more than a thousand pieces of courier receipts.

**Experiment 1:** In order to analyze the performance of this program, randomly selected six courier receipts 1000\*500, using 520\*250 matching figure as destination content search, the output results verify the feasibility.

**Experiment 2:** To further analyze the performance of the proposed program, we choose out of focus, water stains, excessive dust on the surface, overexposure, tear, poor replication, etc., of the actual courier receipts to process, the output results verify the feasibility.

The experiments showed that this program can be an effective solution to the application requirements and be able to overcome the interferences occurring in the actual situation.

## CONCLUSION

This study face to the current actual demands of the logistics industry depended on the integrated application of image's Global features and local features and propose a rapid retrieval system of courier receipts combining the inverse Zernike moments and the SIFT features. This system can quickly identify the destination address from the courier receipts and effectively improve the recognition accuracy and recall rate Compared to manual sorting. Currently, the system has been put into use in the ShenTong Express agency point of Changsha Institute.

## ACKNOWLEDGMENT

This study was supported in part by the science and technology project of Hunan Province, China (No. 2010ZK3008、2011GK3023) and the key project of the Education Department of Hunan province, china (ID: 09A010).

## REFERENCES

- Cao, F., S. Chen and D. Wei, 2006. An improved algorithm for content based trademark image retrieval. Comp. Eng., 16: 174-176.
- Guo, L., Y. Huang and J. Yang, 2005. Using shape and spatial information in trademark retrieval. Comp. Appl. Software, 01: 93-95.
- Lin, C. and Y. Zhao, 2008. Trademark retrieval algorithm based on sift feature. Comp. Eng., 23: 275-277.
- Qi, H., K. Li and Y. Shen 2010. An effective solution for trademark image retrieval by combining shape description and feature matching. Pattern Recogn., 43: 2017-2027.
- Wang, Y., 2008. The zernike moments and its application. J. Shanghai Dianji University, 01: 44-46.
- Wei, C., Y. Li and W. Chau, 2009. Trademark image retrieval using synthetic features for describing global shape and interior structure. Pattern Recogn., 42: 386-394.
- Zhong-hai, L., L. Shen and C.U.I. Jian-guo, 2011. Template matching algorithm based on fast sift feature extraction. Comp. Eng., 37: 222.