International Journal of Soft Computing and Engineering (IJSCE)
ISSN: 2231-2307, Volume-4, Issue-2, May 2014

Efficient Item Image Retrieval System

S. Adebayo Daramola, Ademola Abdulkareem, K. Joshua Adinfona

Abstract— ***Content based image retrieval system is a very effective means of searching and retrieving similar images from large database. This method is faster and easy to implement compare to text based image retrieval method. Ability to extract discriminative low level feature from these images and use them with appropriate classifier is factor in determining retrieval result. In this work efficient item image retrieval system is proposed. The system utilizes Haar wavelet transform, Phase Congruency and Support Vector Machine. Haar wavelet transform acted on image to form four sub-images. Texture feature is extracted from smaller image blocks from detailed bands and it was combined with shape feature from approximation band to form feature vector. Feature distance margin is achieved between query image and images in the database using Support Vector Machine (SVM). The effectiveness of the system is confirmed from output retrieval results.***

Index Term — Content, Texture, shape, Support Vector Machine, Phase Congruency.

I. INTRODUCTION

Image retrieval systems involve accessing and retrieving of different types of images from collection of digital images in a database. Majorly there are two methods of retrieving digital images from database. They are called text based image retrieval and content based image retrieval method. The first method retrieves images from database based on assigned identification marks in form of keywords, phrase and numbers whereas content based image retrieval method performs image retrieving by using discriminative features. The features contain similarity attribute among images in different classes. Image retrieval systems have wide area of applications. They are very useful tools in marketing: to display variety of goods and services, in textile design: to show different styles and patterns, in medical imaging: to diagnosis diseases and many others.

Manuscript received on May, 2014.

Dr. S. Adebayo Daramola, Department of Electrical and Information Engineering, Covenant university, College of Science and Technology, Ota, Nigeria

Engr. Ademola Abdulkareem, Department of Electrical and Information Engineering, Covenant university, College of Science and Technology, Ota, Nigeria

F.Joshua Adinfona, Department of Electrical and Information Engineering, Covenant university, College of Science and Technology, Ota, Nigeria

This work is focus on content based image retrieval method; this method relies on image pixel characteristics in form of color, shape and texture. Feature vector extracted from image content is used to classify item images into different classes. Retrieving operation is performed by sending users defined image called query image into the system. Feature is extracted from the query image and compare with all the feature vectors of images in the database. The function of system classifier per each operation is to classify the images in the database into two classes that is relevant and non relevant. The relevant images are those that have maximum similarity score with the query image. Retrieval efficiency is calculated based on the rate and number of positive relevant images retrieved per operation.

Feature extractor and image classifier are two major components of content image based retrieval system. It is well-known that only one attribute from image content may not be enough to describe it completely. Many researchers have generated feature vector at local level by fusing image attribute from color, shape and texture [1][2] whereas some authors used combination of two image content attributes. Color and texture feature were used in [3], shape and texture attributes were extracted in [4] also in [5] color and shape feature were used. Decomposition of images using different techniques before feature extraction was done in previous works. Images were decomposed by contourlet transform before texture feature was extracted in [6][7][8] whereas in [2]images were partition into non-overlapping image blocks. Several classifiers have been applied to work with different version of feature vectors for content image based retrieval system they include Support Vector Machine [9], K-Nearest Neighbour [10] and Euclidean distance [8][11][12].

Extraction of content feature vector and selection of approximate classifier is very paramount for successful image retrieval operation putting into consideration content level of images in the database. In this work, Support Vector Machine is used to classify images in the system database. The images in our database are items of different content levels such as bag, ball, clock etc. as result of this; feature vector is formed from grayscale image using texture and shape content. The rest of the paper is organized as follows: Section 2 describes generation of feature vector, and section 3 explains implementation of Support Vector Machine (SVM) as image classifier. Retrieval result is shown in section 4. Finally conclusion is stated in section5.

Published By:
Blue Eyes Intelligence Engineering & Sciences Publication Pvt. Ltd.

II. GENERATION OF CONTENT FEATURE VECTOR

Color images are collected using digital camera. Features are obtained from these images by passing them through many processing stages as shown in Fig.1. Samples of images used to generate the feature vector in the database are as shown in Fig.2. In the preprocessing stage image is converted to grayscale and resized to 256 by 256 pixels ready for decomposition process.

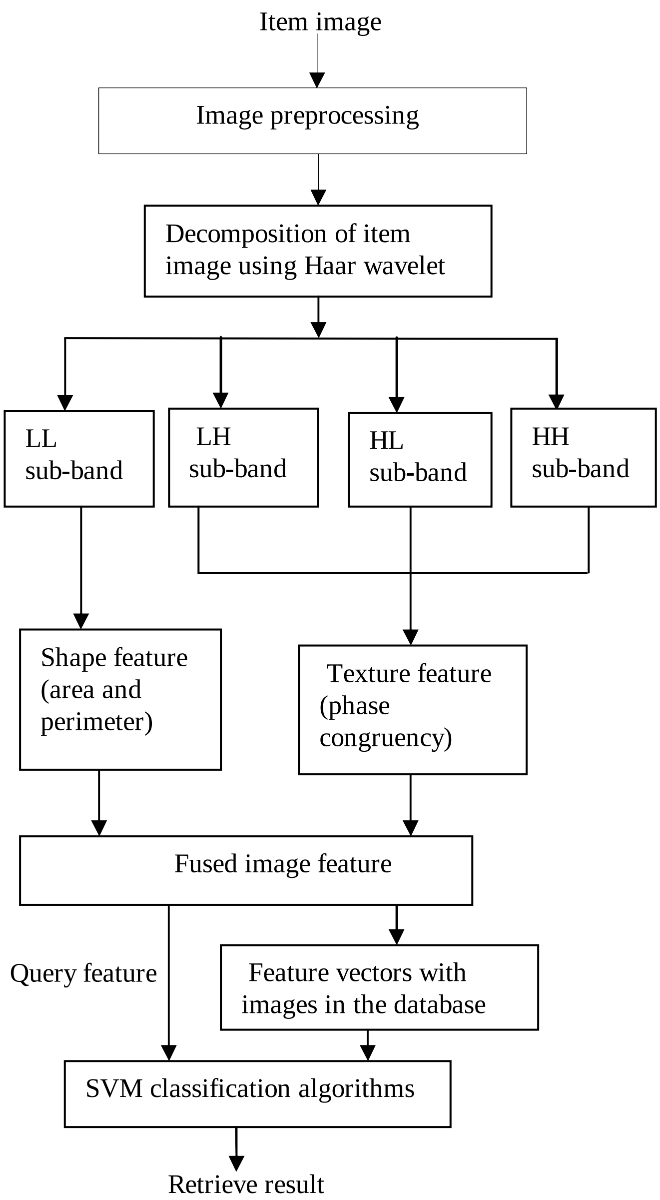

Fig.1: Block diagram of image retrieval system.

Fig.2: Examples of images in database.

A. *Image Content Decomposition*

Haar wavelet transform decompose image into four bands at any level which make image to be separated into different frequency components at different resolution scales thereby revealing image spatial and frequency attributes simultaneously. In this work, one-level Haar wavelet transform was used to produce four sub-band images. The input grayscale image is decomposed into four sub-bands called approximation and detailed bands. Fig.3 shows example of output image decomposition.

The detailed bands namely: HL, LH and HH sub-bands are divided further into 16 non-overlapping blocks per sub-band. A total of 48 blocks are obtained from the detailed bands. Fig.4, Fig.5 and Fig.6 show the smaller image blocks from LH, HL and HH band respectively.

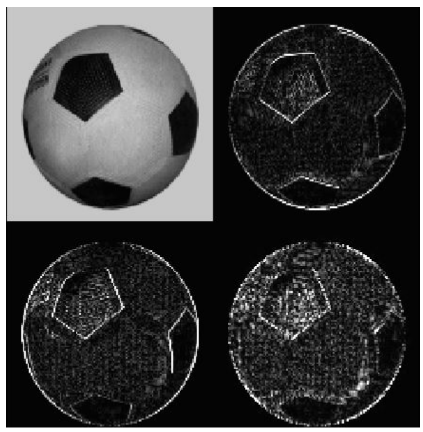

Fig.3: Output of image decomposition.

Published By:
Blue Eyes Intelligence Engineering & Sciences Publication Pvt. Ltd.

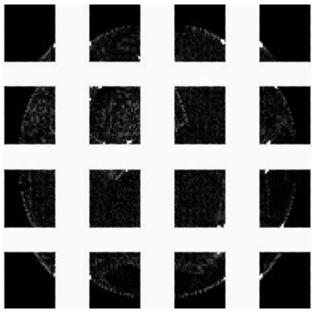

Fig.4: Output HL sub-band partition

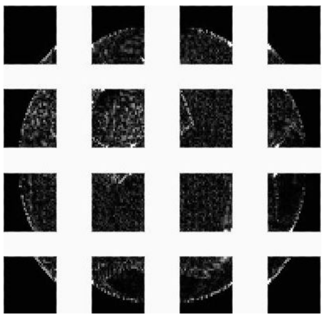

Fig.5: Output LH sub-band partition

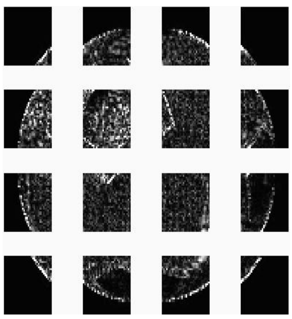

Fig.6: Output HH sub-band partition

B. Texture Feature

Texture feature called phase congruency is extracted from smaller blocks from detailed bands. Phase congruency has capacity to detect lines, edges and texture patterns. It is usually calculated from image information in frequency domain. It has value ranges between 0 and 1. In this work phase congruency values at all orientations are obtained by computing local energy function. The orientation values that give maximum phase congruency are obtained at all points in each smaller image blocks.

C. Shape Feature

The LL sub-band image is converted to binary image. Two geometric features (area and perimeter) are extracted from it. Area of the image specifies the number of pixels within the image region whereas perimeter is the distance around the boundary region of the image.

The shapes measures are then summed up and multiplied with texture feature vector generate to obtain a robust feature vector for each image.

III. IMAGE CLASSIFICATION

Support Vector Machine (SVM) is usually use for data classification. SVM creates a largest margin called optimal hyper plane between pattern classes. A small subset of the pattern vectors that lie exactly on the margin are the support vectors. In this work SVM is used for image classification, SVM takes as input image dataset that consist of positive and negative samples. The algorithm searches for an optimal hyper plane such that the distance to the support vectors is maximized. . The SVM's linearly learn decision function associate with the hyper-plane. This function is described by the input data, weight vector and a threshold.

Retrieval of relevant images from the database for a given query item image is accomplished by classify each of the feature vector as belong to two classes that is relevant and non-relevant. The decision is based on distance of the data from the hyper-plane.

IV. RETRIEVAL RESULT

The efficiency of this system is calculated based on retrieve operation per item using the evaluation measures called precision and recall. Precision and recall are defined as written in equation 1 and 2 respectively.

Three examples of output result of retrieval operations are show in Fig.7 and Fig.8 and Fig.9. In Fig.7 and Fig.8 all the retrieved images are relevant to the query image whereas two of the retrieved images shows in Fig.9 are not relevant to the query image. Table 1 shows the retrieval result for images in the database.

$$Precision = \frac{Number\ of\ relevant\ items\ retrieved}{Number\ of\ items\ retrieved} \qquad 1$$

$$Recall = \frac{Number\ of\ relevant\ items\ retrieved}{Total\ number\ of\ relevant\ items\ in\ the\ database} \qquad 2$$

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

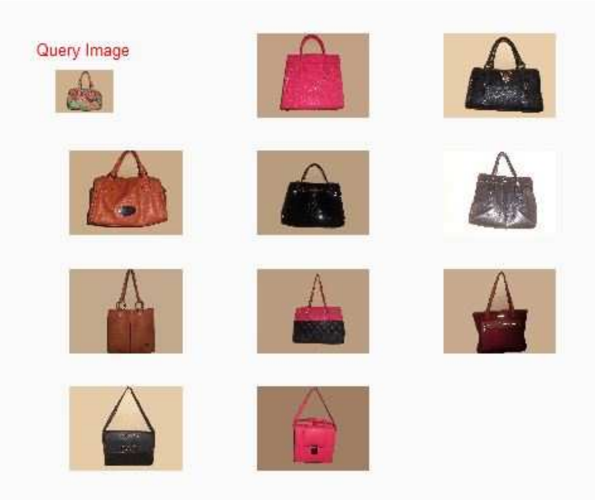

Fig 7: Retrieval result for bag image.

Fig.8: Retrieval result for T – Shirt image.

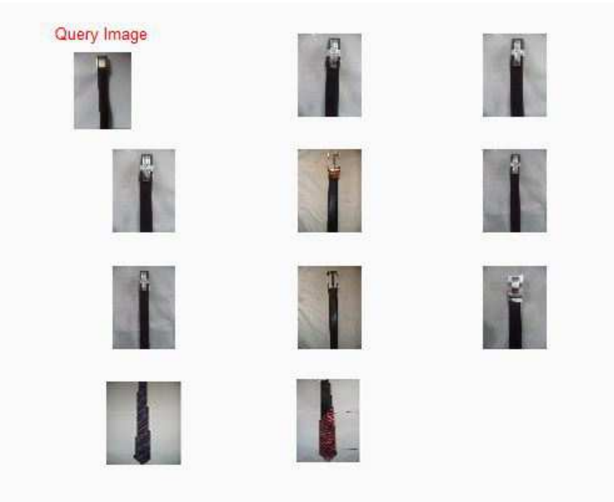

Fig.9: Retrieval result for belt image

Table 1: Retrieval result per class.

Image Class	Precision	Recall
Ball	1.0	0.00
T-shirt	1.0	0.00
Bag	1.0	0.07
Clock	1.0	0.05
Hat	1.0	0.07
Shorts	1.0	0.00
Glasses	0.9	0.10
Belt	0.8	0.20
Wrist Watch	0.8	0.25
Shoes	0.8	0.45

V. CONCLUSION

Item content retrieval system has been successfully developed in this work. Two image content attributes in form of texture and shape are extracted. Extraction of low level features was achieved by decomposition of images using Haar wavelet transform. Images at detailed bands are partition into non-overlapping blocks before phase congruency feature was extracted. Retrieval of images based on query images was done using Support Vector Machine (SVM) and fused feature from image shape and texture. The retrieval result shows clearly the effectiveness of the system. This system can be deployed for many applications particularly for advertisement of items.

References

[1] Neha Jain, Sumit Sharma, Ravi Mohan Sairam, "Content Base Image Retrieval using Combination of Color, Shape and Texture Features", *International Journal of Advanced Computer Research* Volume-3 Number-1 Issue-8, 2013, pp. 70 -77.

[2] P.S Hiremath and Jagadeesh Pujari, "Content Based Image Retrieval based on Color, Texture and Shape features using Image and its complement", *International Journal of Computer Science and Security*, Volume (1): Issue (4), pp.25 – 35.

[3] Monika Jain, S.K.Singh, " A Survey On: Content Based Image Retrieval Systems Using Clustering Techniques For Large Data sets", *International Journal of Managing Information Technology (IJMIT)* Vol.3, No.4, 2011, pp.23-39.

[4] Manimala Singha and K.Hemachandran, " Content Based Image Retrieval using Color and Texture", *Signal & Image Processing : An International Journal (SIPIJ)* Vol.3, No.1, 2012, pp.39-56.

[5] A.Komali , R.Veera Babu, "An Efficient Content Based Image Retrieval System for Color and Shape Using Optimized K-Means Algorithm",

Published By:
Blue Eyes Intelligence Engineering & Sciences Publication Pvt. Ltd.

International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 8, 2013, pp. 203-207.

[6] Arun K.S, Hema P Menon, "Content Based Medical Image Retrieval by Combining Rotation Invariant Contourlet Features and Fourier Descriptors", *International Journal of Recent Trends in Engineering*, Vol 2, No. 2, 2009, pp.35-39.

[7] Ch.Srinivasa Rao , S. Srinivas Kumar , B.N.Chatterji , "Content Based Image Retrieval using Contourlet Transform", *ICGST-GVIP Journal*, Volume 7, Issue 3, 2007, pp.9 – 15.

[8] Swapna Borde, Udhav Bhosle, "Image Retrieval using Contourlet Transform", *International Journal of Computer Applications* , Volume 34, No.5, November 2011 pp.37-43.

[9]Sujata T Bhairnallykar, V.B.Gaikwad, "Content based Medical Image Retrieval with SVM Classification and Relevance Feedback", *International Conference & workshop on Advanced Computing* 2013 (ICWAC 2013) pp.25 – 29.

[10] T. Dharani, I. Laurence Aroquiaraj, "Content Based Image Retrieval System Using Feature Classification with Modified KNN Algorithm, International Journal of Computer Treds and Technology, Vol.4, Issue 7, 2013, pp.2008 – 2013.

[11] Anju Maria, Dhanya S, "Amalgamation of Contour, Texture, Color, Edge, and Spatial features for Efficacious Image Retrieval", *International Journal of Research in Engineering and Technology*, Volume: 03 Issue: 02, 2014, pp. 674- 680.

[12]] M. S. Shirdhonkar and Manesh B. Kokare, "Handwritten Document Image Retrieval", *International Journal of Modeling and Optimization*, Vol. 2, No. 6, 2012, pp.693-696 .

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.