Journal of Computer Science & Computational Mathematics, Volume 6, Issue 1, March 2016
DOI: 10.20967/jcscm.2016.01.004

Sketch Based Image Retrieval by Using Feature Extraction Technique

Mohammad Hossein Torabi Motlagh Fard*, Nazean Jomhari, Sri Devi Ravana

Faculty of Computer Science and Information Technology, University of Malaya
*Corresponding author email: mohammad.motlagh@siswa.um.edu.my

***Abstract*:** Nowadays, touch screen technology makes drawing a sketch easier. It also makes searching and surfing easier for disabled children. Retrieving images with a sketch is a highly desired feature for disabled children with autism. The image retrieval system was defined as a computer system for searching, browsing and accessing the image. It is not easy for autistic children to recognize suitable keyword because of their lack of processing ability and memorizing the information in their mind; otherwise they are good in drawing sketch. In this paper, attention is placed on developing an image retrieval search engine based on sketch to aid children with Autism Spectrum Disorders in retrieving relevant images without needing to insert text based input.

***Keywords*:** Image retrieval, feature extraction technique, Autism Spectrum Disorders.

1. Introduction

Most children are users of internet and they search and surf the web. These kinds of activities can present many challenges to them. Search engines are traditionally designed to support a single user working alone. However, various problems faced by children in the use of search engines. Search engines are as crucial tools for finding resources. For any internet user, the effective use of search engines for retrieval information is an important challenge.

The image retrieval system has been defined as a computer system for searching, browsing and accessing the image from database [1]. The image retrieval system is used to analyse visual features and contents of images in the database [2].
We show a sketch based image retrieval system that applies texture extraction technique. Texture extraction is one of the common techniques that is used for image retrieval.

In image retrieval system, the process method has been handled by similarity measurement between the selected image and all images in the database. The three low level features considered for this purpose are shape, colour and texture. The proposed method has been explained in section 4.

2. Related Literature

Children with Autism Spectrum Disorders (ASD) have difficulty in communication activities that consist of a lot of instructions, except when the instructions are given once at a time. The relationship between web search engines with appropriate accessibility and disabled people is a crucial factor in the information retrieval area since these tools are as self-determined lives [3].

Saavedra *et al*. proposed a novel local approach for SBIR based on detecting simple shapes which are named key shapes. Their method works as a local strategy, but instead of detecting keypoints, it detects keyshapes over which local descriptors are computed. Their proposal based on keyshapes allow them to represent the structure of the objects in an image which could be used to increase effectiveness in the retrieval task [4]. Mourato *et al*. described a solution that allows users to search clip arts using mobile devices based on their own sketches combined with image queries [5]. They applied two different descriptors in order to extract the image feature. The first one is Colour Moment Descriptor and the other is Topogeo Descriptor. This approach does not show how to deal with colours, although the authors present an interesting colour descriptor method.

Image retrieval is as an active field for a large and various research groups around the globe. But there is no similar sample method of information retrieval and children with autism in any scopes in previous knowledge within the database. Seldom, we can see any study in image retrieval technique and disabled people. In 1999, Selby and Oppenheim started to study on search engines interface and accessibility for disabled people. They observed how three popular search engines display information in a blind user group as the sample group.

Andronico and his colleagues have worked to improve the usability of search engines for blind people who use assistive technology to browse the web [6]. Currently, search engines which work based on text, are Google and Yahoo.

Bing Retriever works based on Content-Based Image Retrieval as a search engine. The Majority of search engines focus on the evaluation of the structure of the search engine output. It is difficult to find a research which works on accessibility and interface.

3. Research Method

The research methodology of the paper has been divided into two parts. Firstly in literature review we focus on related works in image retrieval techniques and systems. The second is observation, in which the participants' observation is an appropriate method for research.

Children Observations are a crucial step of research methodology. Observing the children with autism gave the opportunity of understanding their interactions with teachers, colleagues and their behaviours and general needs. The participants were randomly selected for sampling. The children were selected from a special school with house children with Autism Spectrum Disorder (ASD). Table 1 shows the details of participants.

Table 1. Details of participant

Name	Gender	Age
Child1	Male	12
Child2	Male	13
Child3	Female	8
Child4	Male	12
Child5	Male	15
Child6	Female	10
Child7	Female	13
Child8	Male	17

The sketches in Figure 1 and Figure 2 were drawn by children with autism. The following figure shows the sketch of children and relevant retrieved images.

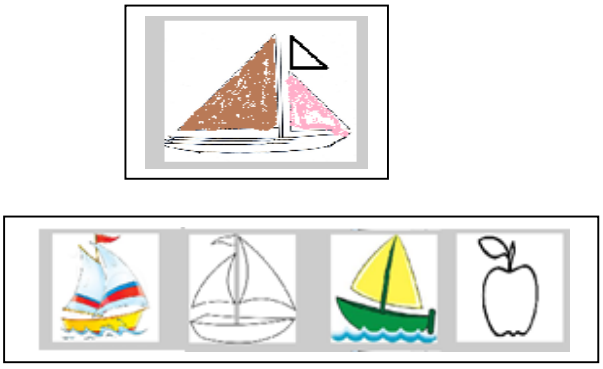

Figure 1. Sketch of boat by children with autism

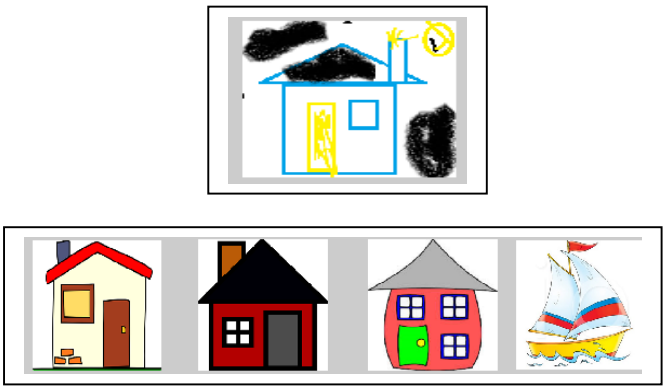

Figure 2. Sketch of house by children with autism

We have evaluated the proposed methods with various examples. The images are downloaded from the search engines of Google, Flickr. And Yahoo... Among all these images, twenty eight images are selected as samples. We have compared the effectiveness of the proposed method. An image database was applied in this experiment. Format of Image database has been changed to grey in order to apply with texture images. Contourlet transform has been applied to all images in the database. Four scales and four orientations for 1-4 scales were applied. For each sub-band image in the database, the Gaussian density function is calculated as a feature vector texture.

4. Proposed framework

The proposed framework (See Figure 3) was based on the literature review specifically in the area of the Instructional System Design Model, a model of sketch based information retrieval.

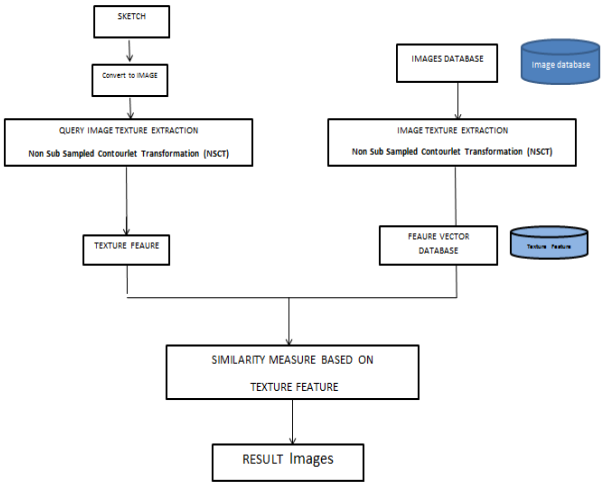

Figure 3. Framework

4.1 Convert Sketch into Image

The children have a drawing area where they are able to draw their favourite sketches. The sketches will be converted to simple image as query image.

4.2 Texture Extraction of Query Image

It is proposed to use Non Sub Sampled Contourlets Transform (NSCT) for Texture extraction. This technique was developed for analysis and representation the texture of the image. In this pattern, feature extraction was applied. The images as an input data are transformed into features in the process of extraction. The geometric information of all pixel images from None Sub Sampled Contourlets coefficients will be collected. None Sub Sampled Contourlets (NSCT) is a multi-scale and multi-direction expansion in which each pixel sub-bands corresponds to the transformation of the original image at the same location [7].

The NSCT decomposition process is demonstrated by details as follows in Figure 4.

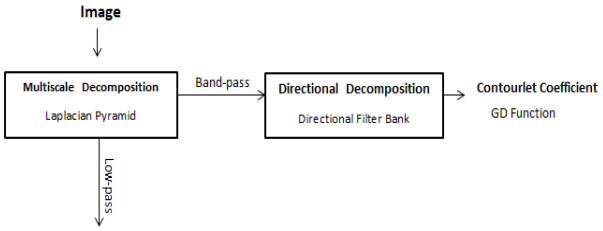

Figure 4: NSCT feature extraction overview

This processing method uses double filter banking with the purpose of obtaining a sparse expansion of images with smooth contours. First, point discontinuities of the image are detected by Laplacian Pyramid (LP). It means that LP is used to do multi-scale decomposition, then Bank (DFB) directional filter is used to connect the linear discontinuous structure .An

image expansion in which fundamental elements are used the same as contour segments, is the scheme result. It is named Contourlet Transform.

4.2.1 Decomposition using Laplacian Pyramids (LP)

Laplace pyramid provides a method for image decomposition which is a multi-scale. The Laplace Pyramid decomposition creates a down sampled and a band - pass of the main image at each step. This process may be continuously repeated in the low-pass image. It is Limited by the size of the original image due to the down sampling [8]. The scheme will be continued on the low bass part of the image to create new low scales. Sub bands generated by LP decomposition are pursued by DFB to display details of direction of sub band.

4.2.2 Decomposition Directional Filter bank (DFB)

The DFB is produced by Tree decomposition. Laplacian Pyramid and Directional Filter Banking decompositions are unrelated and independent of each other due to cascading structure of them [9]. Hence, multi-scale decomposition is able to decompose scales with and arbitrary power of two as shown in Figure 5 as follows.

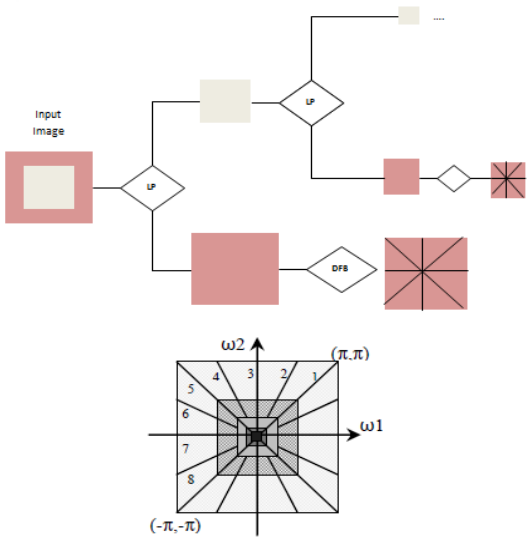

Figure 5. Decomposition DFB and PL

4.2.3 Calculate Contourlet Coefficient by GD function

At each step, the Gaussian Density function estimated sub band coefficient. The Gaussian Density function will be calculated by low complexity. The normal distribution function was used as an appropriate representative of sub band [10].

$$n(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi\sigma}}\ e^{-\frac{1}{2}\left(\frac{x-\mu}{\delta}\right)^2} \qquad -\infty < x < +\infty \qquad (1)$$

μ is the mean value or the coefficient of sub-band and σ is the standard deviation in the proposed method, the coefficient of symmetric unimodal distribution and is used to display images effectively function texture. The Gaussian density function can be applied to all sub-bands to generate a texture feature vector. Hence, for each sub-band coefficient can be calculated. The coefficients of all sub-bands images are suitable for obtaining texture vector directional information of all bands of the original image.

4.3 Similarity Measurement based on Texture Extraction

The similarity measurement technique is applied for doing a comparison between the query image and all images that are stored in the database. A Gaussian Density function is used for all sub-band images; the sub-bands have the Gaussian density function of its feature vector. In the first level of similarity comparison process, the similarity of two sub-bands in the same direction and scale is considered. It means both are corresponded sub-bands in which they were computed based on the distance between two features of Gaussian Density function to retrieve images with similarity. For any query image we have:

$$n(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi\sigma}}\ e^{-\frac{1}{2}\left(\frac{x-\mu}{\delta}\right)^2} \qquad -\infty < x < +\infty \qquad (2).$$

To estimate the similarity of query image and database, total sum of distance sub- bands are estimated as:

$$n(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi\sigma}}\ e^{-\frac{1}{2}\left(\frac{x-\mu}{\delta}\right)^2} \quad -\infty < x < +\infty \qquad (3)$$

$$D_{sb}(I,J) = \sum_{i=b1}^{bn} |\, n_{sbI}(x_i;\mu_I,\sigma_I) - n_{sbI}(x_i;\mu_I,\sigma_I)| \qquad (4)$$

$$D(I,J) = \sum_{sb=1}^{Nsb} |\, D_{sb}(I,J)| \qquad (5)$$

where μ is mean, σ is standard deviation, Nsb is the number of sub-bands, and the Distance between two Images of I and J is presented as Dsb (I, J). Comparing the two images is used as Distance between Gaussian Density functions as a measurement. The minimum value of Distance (I, J) represents the value of the highest similarity between the two images.

5. Conclusion

The Proposed algorithm is based on texture Feature Extraction for image retrieval for children with autism. Each expressed feature was separately computed for all images of database and images and similarities based on them were defined and then were used for combining these results and making the final decision about the images and similarities. Based on the proposed method, the information retrieval tools can be designed to make the search easier for children with autism. The system has gained good results in practical application for children with autism.

Acknowledgements

We would like to acknowledge the Computer Science and Information Technology Faculty at University Malaya for supporting us in this study. We also thank Dr. Sri Devi Ravana and Dr. Nazean Bint Jomhari who kindly help us to produce proposed sketched approach.

References

[1] N. Jain, S. Sharma, R.M. Sairam, "Content Base Image Retrieval using Combination of Colour, Shape and Texture Features", *International Journal of Advanced Computer Research*, vol. 3, no. 1, pp. 69-77, March 2013.

[2] J.-H. Su, W.J. Huang, P.S. Yu, "Efficient Relevance Feedback for Content-Based Image Retrieval by Mining User Navigation Patterns", *Proc. IEEE Int', Conf. Image Processing*, vol. 23, no. 3, pp. 360-372, 2011.

[3] P. Spikins, "Autism, the Integration's of 'Difference' and the Origins of Modern Human Behavior", *Cambridge Archaeological Journal*, pp. 179-201 , 2009.

[4] J. M. Saavedra, B. Bustos, "Sketch-based image retrieval using keyshapes", *Multimedia Tools and Applications*,vol. 73, no. 3, pp. 2033-2062, 2014.

[5] A. S. Mouratoa, R. Jesusa, "Clip art retrieval using a sketch Tablet application", *Procedia Technology* , vol. 17 , pp. 368–375 , 2014.

[6] M. Buzzi, P. Andronico, B. Leporini, "Accessibility and Usability of search engines: A preliminary study", *In: 8th User Interface for All (UI4ALL)*, pp. 22-27 , 2004.

[7] S.G. Chang, B. Yu, M. Vetterli, "Spatially adaptive wavelet thresholding with context modeling for image denoising", *IEEE Transactions on Image Processing* , vol. 9, no. 9, pp. 1522 - 1531 , 2002.

[8] P. J. Burt, E. H.Adelson, "The Laplacian pyramid as a compact image code", *IEEE Transactions on Communication* , vol 31, no. 4, pp. 532-540, 1983.

[9] M. N. Do, M. Vetterli, "Pyramidal directional filter banks and curvelets" *IEEE International Conference on Image Processing (ICIP)*, pp. 158–161, 2001.

[10] M. N. Do, M. Vetterli, "Wavelet-Based Texture Retrieval Using Generalized Gaussian Density and Kullback–Leibler Distance", *IEEE Transactions on Image Prcessing*, vol. 11, no. 2, pp. 146-158, 2002.