Logo Detection in Arabic Documents Using Multi Smearing Method and Decision Tree

Matheel E.Abdulmunim ,Ph.D.(Asst.Prof.)*

Haithem K. Abass, (Asst.Lecturer)**

Abstract

The detection of logo techniques play significant role for document image analysis and retrieval. In this paper, an effective logo detection method in Arabic document images has been proposed. In the proposed technique different logos can be detected based on extracting features that will distinguish logo from other non-logo parts of document like text, graph, table, and also stamp. This model is divided into three main stages. The first stage is smearing stage, where the document image has been smeared in multi directions to segment image to different blocks represent foreground objects of document. The second stage is to extract appropriate and significant features from these blocks by bounding blocks into rectangles. The third stage is performing decision tree that consist of a number of rules that will be applied to block features to correctly classify logo from non-logo objects. The proposed technique overcome many problem of logo detection like logos that contains separated parts, logos with text, and logo with noise. This technique has been tested and evaluated on dataset containing variety of Arabic document images of different colors, shapes and resolutions. Experimental results exhibit its performance in detecting logos with 96% for accuracy and 98% for precision.

Keywords: Logo detection, run length smearing, feature extraction, decision tree, classifying logo.

*University of Technology

**Al-Mansour University College

1. Introduction

Paper documents may contains logos and stamps that play a significant role in the confirming the source and the nature of the documents. Logo afford the identity of an organization in a document. It can be considered as a graphical symbol that represent an institution, community, or company that symbolize the basic functionality of their work [1][2]. Logos are often be used for identifying many documents, so that large numbers of printed documents are usually scanned and archived as images. Nowadays the need for automatic document classification that will leads to save time and cost is very important. The detection of logo can be defined as a technique for document image analysis and recognition. Many document retrieval systems depends on logo detection as a main step for matching and retrieval operations. There are different forms of Arabic logos as shown in figure 1. This paper proposes an effective logo detection technique that will detect different shapes of logos by using multi smearing strategy to segment the elements of document as foregrounds blocks. Then extracting appropriate block features and applying them on decision tree that will correctly classified logo objects from other parts of document.

(a) (b) (c)

Figure 1. Different form of logos. (a) Graphic logo; (b) Text logo;

(c) Mixed logo.

The rest of this paper is organized as follows. In section 2, the related work have been reviewed. In section 3, an overview of run length smearing algorithm is presented. In section 4, the proposed technique for automatic logo detection is illustrated in detail. In section 5, experimental results are listed and discussed and finally section 6 presents the conclusions.

2. Related Work

Previous researches related to logos extraction divided into logo detection domain and logo recognition domain. In logo detection domain, Seiden et al. [3] used X-Y cut segmentation methods to segment a binary document. Then features are extracted and a rule-based classifier is applied. But this segmentation is limited and not reliable. Pham [4] developed an unconstrained detection approach that based on spatial density of foreground regions. Zhu and Doermann [5] proposed method which combine between logo detection and logo recognition based on multi-scaled strategy. Wang and Chen [6] suggest a method based on that a logo will be detected by having background surrounding it and white spaces separate it from other elements in a document, but this technique is limited due to the variance of logo structure. Wang [7] proposed an approach to detect and then recognize logo by using the results of recognition as a feedback based on Bayesian model. Shirdhonkar and Kokare [8] implement discrete wavelet transform, then finds spatial density of wavelet coefficients to extract the logo. Hassanzadeh and Pourghassem [9] proposed method for detection and recognition by considering some characteristics of logo like centroid coordinates and crossing points of each logo's separated part in detection stage. Jha et al. [10] present a logo extraction from demerged watermarked images by using wavelet transform. Jo and Jung [11] present approach that use smart learning of logo detection in mobile applications. Oliveira et al. [12] developed a method to detect graphical logo by using region-based networks method.

3. Run Length Smearing (RLS)

Sometimes called run length smoothing algorithm. This method is top-down document segmentation strategy that convert the color of specific area of background pixels into the color of foreground region [13] [14]. The

process use smoothing effect that smears all the adjacent foreground pixels together. In this way, RLS will effectively increase the area of foreground regions [15]. The RLS method convert a binary sequence of pixel values in an image that accepting the following rules:

(1) 1's between two consecutive 0's in **A** are changed to 0's in **B** if the number of 1's is less than or equal to a predefined limit threshold ***L***
(2) 0's in **A** are unchanged in **B**.
(3) 1's at the boundaries of **A** are unchanged in **B**.

The RLS can be applied to an image in horizontal scan (row by row) and also in vertical scan (column by column).

For example, in horizontal RLS with ***L*** = 6, the sequence of pixel values in sub image **A** is mapped into sub image **B** as follows:

A: 1100011110111111001101111111011101
B: 1100011110000000011000000000011101

4. The Proposed Detection Technique

A workflow diagram of proposed logo detection technique has been described in figure 2. This model consist of a number of steps, each step is perform specific operation in detection process.

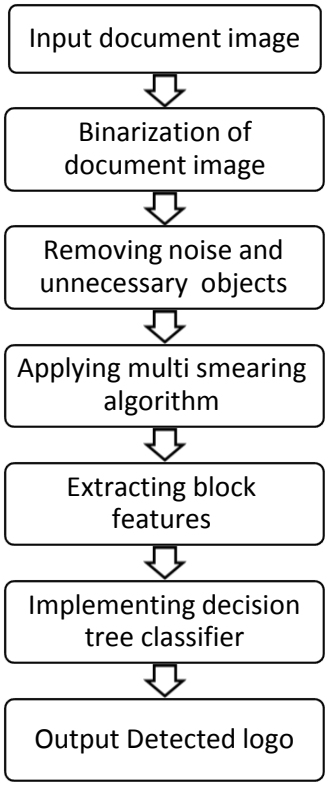

Figure 2. Workflow of proposed logo detection technique.

A. Image binarization

In this step color or gray level document image ***f(x,y)*** will be converted to black and white binary image ***g(x,y)*** according to specific computed local threshold value ***T*** as follow:

If $f(x,y) >= T$ then $g(x,y)=1$
Otherwise $g(x,y)=0$

B. Removing noise

Using accurate and appropriate value of ***T*** will greatly reduce some type of noises from document like gaps and can also sharp edges. Other type of noises like salt and paper noise will be reduced by using median filter. Also In this step unnecessary objects like dark margins of document image can also be detected and eliminated without effected or degraded logo.

C. Appling multi smearing algorithm

In the proposed technique, an adaptive multi smearing run length method has been modified and applied to a document image. The modifications comes from that RLS method is applied multi times in horizontal and vertical directions to a document with a different variable computed threshold values of ***L***. These values are used to control the number of sequence of pixels that will be smeared in a document. In the proposed technique image histogram is implemented to compute and estimate the value of threshold ***L***. To achieve better result, the value of ***L*** is multiply by a constant factor ***Ch*** for horizontal smearing, ***Cv*** for vertical smearing, and ***Cm*** for last and additional horizontal smearing to reduce or remove the small gaps between block regions. The following algorithm present the proposed technique.

Algorithm 1: Multi run length smearing

Input: Binary document image *g(x,y)*.
Output: smeared segmented image *s(x,y)*.
Begin

Step 1: Compute connected component of *g(x,y)*.
Step 2: Find bounding box for connected component resulting *b(x,y)*.
Step 3: Calculate image histogram for bounding box to estimate the value of smearing threshold value *L.*
Step 4: Apply horizontal RLS to *b(x,y)* with
limit_smear_value= *L * Ch* resulting image $s_h(x,y)$.
Step 5: Apply vertical RLS to *b(x,y)* with
limit_smear_value= *L * Cv* resulting image $s_v(x,y)$.
Step 6: Perform AND operation between image $s_h(x,y)$ and image $s_v(x,y)$ resulting image $s_m(x,y)$.

Step 7: Apply horizontal RLS to $s_m(x,y)$ with limit_smear_value=$L * Cm$ resulting final smeared image $s(x,y)$.

End

Figure 3 shows the effects of each step of multi smearing method applied to a part of Arabic document including logo.

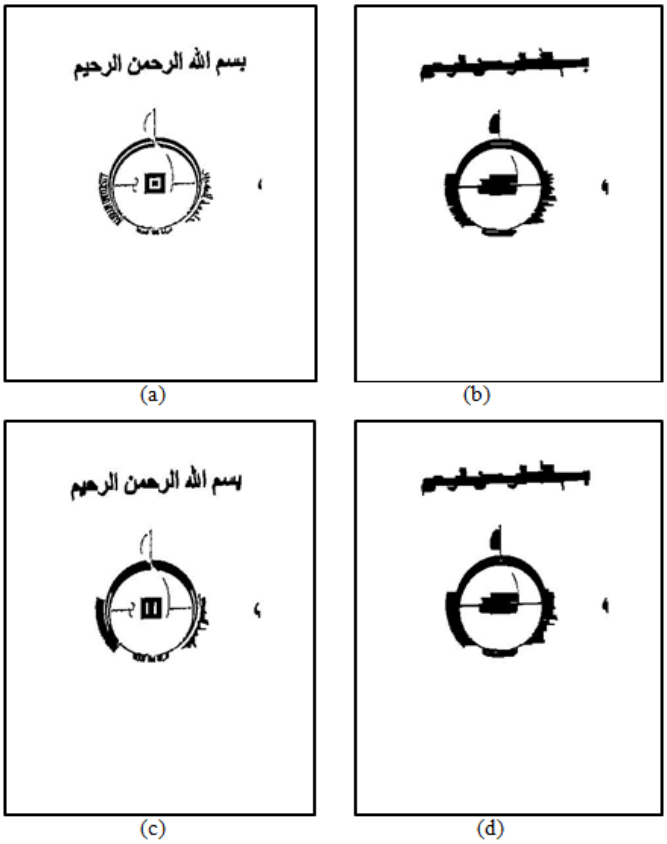

Figure 3. Steps of multi smearing technique. (a) Original binary image; (b) Image after horizontal smearing; (c) Image after vertical smearing; (d) Image after additional horizontal smearing.

D. Extracting block features

After segmentation by using multi smearing method, each region in a document is represented as a bounding rectangle with specified ***X*** and ***Y*** coordinates and dimensions ***W*** for width and ***H*** for height. Important and appropriate features that are relate to the bounding rectangles are extracted and saved to be applied in rules with decision tree to correctly detect the logo. In the proposed method the following features are extracted from each bounding block and there corresponding equations:

1) ***Y_pos***: y position of block (***Y***) relative to the height of image (***height***).
$$Y\_pos = Y/height \quad (1)$$
2) ***Width_ratio***: width of block (***W***) relative to the width of image (***width***).
$$Width\_ratio = W/width \quad (2)$$
3) ***Height_ratio***: height of block (***H***) relative to the height of image (***height***).
$$Height\_ratio = H/height \quad (3)$$
4) ***Aspect ratio***: the ratio of width to height of block.
$$Aspect\ ratio = W/H \quad (4)$$

E. Implementing Decision tree

The final step is to correctly classify an object as a logo from other non-logo objects in a document image. This can be performed by constructing a decision tree consisting of 4 nodes as shown in figure 4. These nodes represent suitable and sufficient rules that will be applied to block features obtained previously. The sequence of these nodes in a tree are implemented according to their significance and weight in making decision for logo or not logo. The feature rules for tree nodes and their suitable ranges are shown in table 1.

Table 1. Appropriate range value for each node with its rule

Node number	Feature Rule	Suitable range for logo
Node 1	Equation (1)	[0 , 0.20]
Node 2	Equation (2)	[0.05 , 0.30]
Node 3	Equation (3)	[0.05 , 0.20]
Node 4	Equation (4)	[0.40 , 3.80]

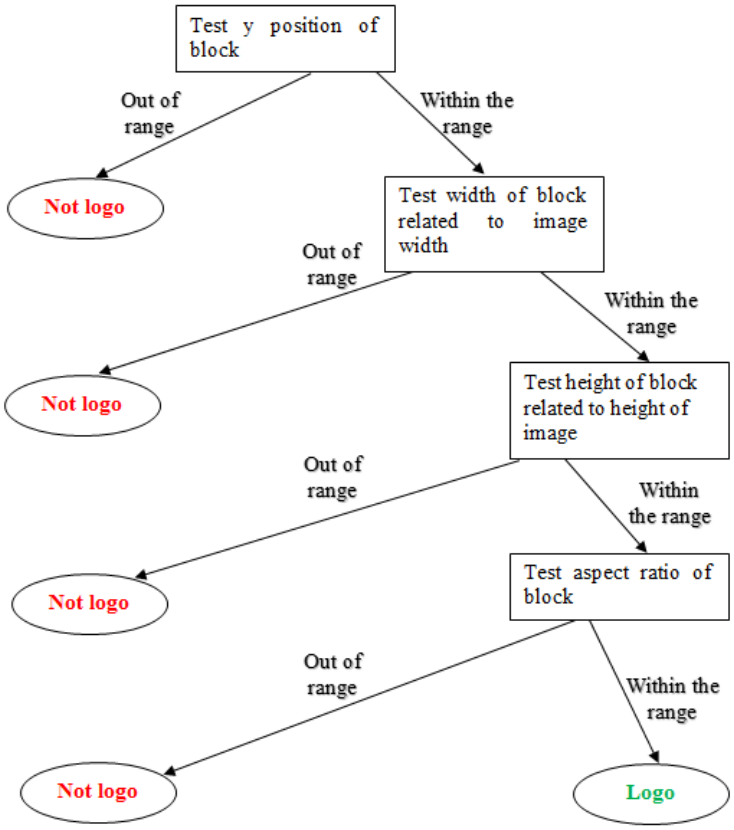

Figure 4. Decision tree to classify logo from non-logo objects.

5. Experimental Results

The proposed detection technique has been tested with 100 various type of real Arabic document images with different colors, dimensions, and resolutions. The tested images contain different type of logos that identify the documents and may contains diverse objects like text, tables, graphics, stamps, and signatures. 20 images from 100 are used for training and the other 80 images are used for testing. The proposed technique is able to detect the three different forms of logo (graphic logo, text logo, and mixed logo), and can also detect logos that contain separated parts. The detection technique has the ability to extract logo correctly which located in different positions, where the most Arabic document contain logo in the top middle position, but little logos may

appear in top left or top right position. In some documents, during detection process some objects like stamps, user photo, and block of text may pass through first and second node but they will be rejected in third or at least in the fourth node because of precise and significant rules and there range values that will help to get right decision in classification process. In some cases even if not the entire logo can detected, the propose technique can detect the most important part contained in the logo. Table 2 shows some images samples of different colors and resolutions where the proposed technique correctly detect logo. The performance of this technique is evaluated by considering two criteria **accuracy** and **precision** for evaluation [16], as follow:

$$Accuracy = \frac{number\ of\ logos\ correctly\ detected}{number\ of\ actual\ logos} \qquad (5)$$

$$Precision = \frac{number\ of\ logos\ correctly\ detected}{number\ of\ detected\ logos} \qquad (6)$$

According to this evaluation, the proposed technique obtained 96% for accuracy and 98% for precision.

Table 2. Samples of different Arabic documents and their smeared and detected logos

Document Image with Resolution	Smeared Logo	Detected Logo
 3312 x 2424 pixels		
 2964 x 2104 pixels		

 960 x 699 pixels		
 594 x 1267 pixels		
x  631 486 pixels		

6. Conclusions

In this paper, an adaptive logo detection technique for different Arabic document images has been proposed. The detection strategy in this technique is based on segmentation the document images by using multi smearing technique to represent the document as a number of smeared regions. These regions will be bounded as blocks to extract features from them. The features will be applied with significant rule based decision tree to correctly classify logo objects from other non-logo regions. Using a real-world Arabic document dataset has been used in experiments, and shown that the representing smeared objects as bounding rectangles then generate block features is very efficient and effective in logo detection. The proposed technique is simple and dose not required complex computations compared with other detection methods that use image transformation operations. This technique can be considered as important and significant step for logo recognition and matching technique that can be adapted in real document retrieval system.

7. References

[1] N. V. Kumar, V. V. Kantha, K. N. Govindaraju, and D. S. Guru, "Features Fusion for Classification of Logos," *Procedia - Procedia Comput. Sci.*, vol. 85, no. Cms, pp. 370–379, 2016.

[2] S. Soma and B. V Dhandra, "Automatic Logo Recognition System from The Complex Document Using Shape and Moment Invariant Features," vol. 4, no. 2, pp. 6–13, 2015.

[3] S. Seiden, M. Dillencourt, and S. Irani, "Logo detection in document images," *Proc. Int. conf. Imaging science, Sys, and Tech, pp. 446-449*, 1997.

[4] T. D. Pham, "Unconstrained logo detection in document images," *Pattern Recognit.*, vol. 36, no. 12, pp. 3023–3025, 2003.

[5] G. Zhu and D. Doermann, "Automatic Document Logo Detection," *Conf. on Document Analysis and Recognition*, pp. 864-868, 2007.

[6] H. Wang, "Logo Detection in Document Images Based on Boundary Extension of Feature Rectangles," no. c, pp. 0–4, 2009.

[7] H. Wang, "Document Logo Detection and Recognition Using Bayesian Model," *2010 20th Int. Conf. Pattern Recognit.*, no. c, pp. 1961–1964, 2010.

[8] M. S. Shirdhonkar and M. Kokare, "Automatic logo detection in document images," *2010 IEEE Int. Conf. Comput. Intell. Comput. Res. ICCIC 2010*, pp. 905–907, 2010.

[9] S. Hassanzadeh and H. Pourghassem, "A Novel Logo Detection and Recognition Framework for Separated Part Logos in Document Images," vol. 5, no. 9, pp. 936–946, 2011.

[10] R. K. JHA, P. K. BISWAS, and B. N. CHATTERJI, "Logo Extraction Using Combined Discrete Wavelet Transform and Dynamic

Stochastic Resonance," *Int. J. Image Graph.*, vol. 13, no. 01, p. 1350004, 2013.

[11] I. Jo and I. Y. Jung, "Smart learning of logo detection for mobile phone applications," *Multimed. Tools Appl.*, 2016.

[12] B. Ribeiro, "Automatic Graphic Logo Detection via Fast Region-based Convolutional Networks," *Accepted as a Conference Paper for IJCNN*, 2016.

[13] S. Hassanzadeh and H. Pourghassem, "Fast Logo Detection Based on Morphological Features in Document Images," pp. 283–286, 2011.

[14] J. H. Kim and B.-K. Sin, *Handbook of Document Image Processing and Recognition*, no. JANUARY 2014.

[15] P. P. Rege and C. A. Chandrakar, "Text-Image Separation in Document Images Using Boundary / Perimeter Detection," vol. 03, no. 01, 2012.

[16] S. C. Sheetala and U. D. Dixit, "Logo Recognition , Detection and Logo Based Document Image Retrieval : A Review," pp. 2822–2827, 2015.

الكشف عن الشعار في الوثائق العربية باستخدام طريقة التلطيخ المتعدد وشجرة اتخاذ القرار

أ.م.د. مثيل عماد الدين عبدالمنعم* م.م. هيثم كريم عباس**

المستخلص

تلعب تقنيات الكشف عن الشعار دورا مؤثرا في عملية تحليل واسترجاع الوثائق المصورة. في هذا البحث تم اقتراح تقنية فعالة في الكشف عن الشعار في الوثائق العربية. حيث يمكن في هّذا الطريقة المقترحة الكشف عن انواع مختلفة من الشعارات بالاعتماد على استخراج الصفات والتي من خلالها يمكن تمييز الشعار من الاجزاء الاخرى للوثيقة مثل النص والرسم والجدول والختم. هذه التقنية تتكون من ثلاثة مراحل اساسية. **المرحلة الاولى** هي مرحلة التلطيخ باتجاهات متعددة للوثيقة لاجل تجزئة الصورة الى كتل تمثل الاشياء الامامية من الوثيقة. **المرحلة الثانية** هي لاجل استخراج الملامح المناسبة والمؤثرة من هذه الكتل بواسطة ربط الكتل على شكل مستطيلات. **المرحلة الثالثة** هي تنفيذ شجرة اتخاذ القرار التي تتكون من عدد من القواعد التي يتم تطبيق صفات الكتل عليها ليتم تصنيف الشعارعن الاجزاء الاخرى التي لاتمثل الشعار. في تقنية الكشف هذه تم التغلب على عدة مشاكل في الكشف عن الشعار منها الشعارات التي تحتوي على اجزاء منفصلة والشعارات التي تحتوي على نص وكذالك الشعارات المشوشة. تم اختبار وتقييم الطريقة المقترحة على مجموعة من البيانات التي تحتوي انواع مختلفة من الوثائق العربية المصورة بمختلف الالوان والاشكال والدقة. من خلال النتائج المستخلصة من التجارب لقياس كفائة التقنية فأن نسبة الصحة في الكشف عن الشعار كانت 96% بينما نسبة الدقة كانت 98%.

*الجامعة التكنولوجة
**كلية المنصور الجامعة