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Multiform Frame Shape Extraction Using Neighbouring Pixel Be-Haviors for Mushaf Al-Quran

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ABSTRACT

Page decoration removal in the Al-Quran is an important step in document processing. One of the challenging parts of Al-Quran text recognition area is text extraction from its decorated page. Al-Quran decorations contain different patterns and textures depending on the Mushaf. In this paper, we propose a novel approach based on neighbouring properties by analysing the binary image page of current neighbouring pixels of point. This paper will focus on how to extract Al-Quran text from its decorative illumination frame. The accuracy of the result of the proposed algorithm depends on the noise of the images. The proposed method may contribute to the development of applications related to Optical Character Recognition (OCR).

Key words : Clustering of Al-Quran Decoration, Detection of Al-Quran Decoration, Extraction Of Al-Quran Text, Pattern Recognition of Mushaf Al-Quran Decoration, Text Segmentation.

1. INTRODUCTION

The process of compiling or binding the Holy Quran had evolved since it was first recorded in the reign of Abu Bakar (ra). Today, in the modern era, the Holy Quran is widely published in a book form with each of the pages decorated with various patterns and colours. All the decorated frames are not intended to change the meaning of the ayah, it is only meant to embellish the presentation of the Holy Quran. Extracting a complete text or the Arabic words of Al-Quran in a page require a proper algorithm. The proposed extraction method of the Arabic word from the Al-Quran page can contribute to further analysis. Thus, to extract the Arabic words from a page we used segmentation method to perform a change of representation of the Al-Quran.

Generally, the term 'image segmentation' refers to the partition of an image into a set of regions that cover it [1]. Here, we are focusing to categorize regions between Arabic words and its decorative illumination on Al-Quran pages by using image segmentation method. This is for removing the decorative illumination frame by using proposed techniques which analyse each pixel and its neighbouring pixels of point. Al-Quran decoration segmentation is much more difficult to develop because it has non-uniform pattern, texture or illumination on different Mushaf. The colours of the image on the Al-Quran page are not the main challenges because threshold methods are being implemented on this research.

2. RELATED WORKS

2.1 Image segmentation

Region-based methods mainly rely on the assumption that the neighbouring pixels within one region have similar values [2]. The method is to compare one pixel of binary point with its neighbours. The pixels are being set to the cluster if the similarity criterion was satisfied.

Relaxation is an iterative approach to segmentation in which the classification decision about each pixel can be taken in parallel [3]. It will examine at neighbouring points in the current iteration. Then, they are combined to make decisions on the next iteration. The types of relaxation are probabilistic and fuzzy.

Regions merging used regional neighbour search method to merge regions of similar properties [4]. This method is used to divide the image into regions. There are three categories in regions extraction: region merging, region dividing, and combination of region merging and dividing.

2.2 Text segmentation

Al-Quran was written in Arabic, thus this research can be referred from the research domain on Arabic handwritten. Besides that, research on Latin can also be used as reference to remove decorative illumination of Al-Quran pages.

Presently, research on Arabic handwritten using Jawi and Farsi were introduced by Anton Heryanto [5] for Arabic words. In addition, there were research by Khairuddin Omar [6][7], Mazani Manaf [8] and Remon Redika [9][10] for Jawi words. Research on Latin words were initiated by Moalla et al. [11] and Aiolli et al. [12][13].

Segmentation techniques at this time only focused on separation of word into sub-word and sub-word into characters. On Arabic domain, research of separation word into sub-word were introduced by Mazani Manaf [8] and Remon Redika [9][10]. However, for Jawi was introduced by Khairuddin Omar [6][7].

Segmentation technique of word onto sub-word was introduced by Mohammad Faidzul [14] using features of trace transform and feature comparison. Remon Redika [9][10] used the same technique with Mazani Manaf8 where it separated sub-word based on distribution of black pixels. For Jawi domain, Khairuddin Omar[6][7] used statistic features of non-moment change and the distribution of black pixels.

This research is continuity from past paleography research topic. This research can be relate with digital Jawi paleography field. This field of research can helps to identify authors, origin and date of manuscripts [15]. By analyzing manuscript illumination can discover the information of specific manuscript [16].

Other than that, this is a progression study from the past where the framework of page segmentation of Mushaf Al-Quran has been proposed [17][18]. In that study, text line segmentation has been done and proposed [19]. Hence, in this study we are propose a method for page segmentation.

M.S. Azmi introduced features from triangle geometry for digit recognition of this field [20][21]. Moreover, this researcher applied this technique for Arabic or Jawi [22] and this can be relate for this research topic because Al-Quran ware written in Arabic. Besides that, this researcher applied his techniques on Arabic calligraphy classification [23][24]. This calligraphy classification of the ancient manuscripts gives useful information to paleographers.

Based on the study, many researchers are focusing on segmentation of image and text. In this paper, segmentation research is focused to remove decoration that may exist on some versions of Mushaf Al-Quran. The purpose to remove the decoration is to make the texts available for further processes.

3. DATASET

We experimented on 6 different types of Al-Quran decorative pages. The result produced will be more accurate if the images had a high resolution quality.

Table 1: Dataset of Al-Quran Pages

Number	Source	Page
1	Image of Al-Quran Al-Karim from Mawarsoft Digital Furqan 1.0	2
2	Image of Al-Quran Al-Karim from Mushaf Al-Madinah Quran Majeed	1
3	Image of Al-Quran Al-Karim from KSU -Electronic Mosshaf	1
4	Image of Al-Quran Al-Karim from Mushaf Al-Madinah Quran Majeed	3
5	Image of Al-Quran Al-Karim from Mawarsoft Digital Furqan 1.0	4
6	Image of Al-Quran Al-Karim from Uthmani Script Mushaf	2

This proposed method is only applicable if there are existing decorative illuminations and has Arabic text in the middle of a page of Mushaf Al-Quran. Pages of Mushaf Al-Quran must have the outer space around its decorative illumination which is referred to as black space.

4. PRE-PROCESSING IMAGE

The main aim of pre-processing is to enhance the inputted signal and to represent it in a way which can be measured consistently for robust recognition [25]. Image is formed uniformly to be used throughout the process. The Al-Quran must have its decorative illumination frame acquired either from hardcopy or softcopy.

Text was first acquired from Al-Quran hardcopy decoration (see Figure 1) using a 200dpi and transformed into a digitized image. The image was transformed into binary (see Figure 2). Table 1 contained different pattern, texture and decoration. This image has different colour scale. Thus, a uniform process to convert the image pixel to binary was conducted using Otsu's method. This method was proposed by Scholar Otsu in 1979 [26].
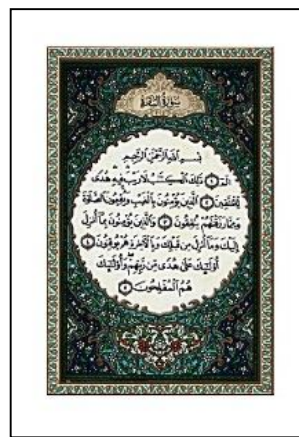

Figure 1: Example image of Al-Quran Al-Karim from Mawarsoft Digital Furqan 1.0 (Page 2).
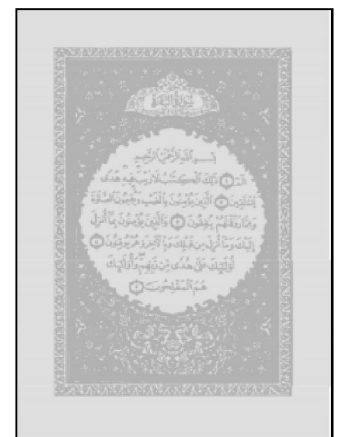
Figure 2: Image of Al-Quran Al-Karim from Mawarsoft Digital Furqan 1.0 (Page 2) converted into binary using Otsu's thresholding method.

The grey-scale image conversion into binary must use the thresholding method. Thresholding method is an important technique for image segmentation that converts colour image into grey-scale. The basic idea of thresholding is to select an optimal grey-level threshold value for separating objects of interest in an image from the background based on their grey-level distribution. If g(x, y) is a threshold version of f(x, y) at some global threshold T, it can be defined as6,

$$g(x, y) = 1 \text{ if } f(x, y) \geq T \qquad (1)$$
$$= 0 \text{ otherwise}$$

Otsu's thresholding method was used in this research. The Otsu method is a type of global thresholding in which it

depends on only the grey value of the image. This method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels on each side of the threshold [27].

Otsu's method define the within-class variance as the weighted sum of the variances of each cluster [28]. After the image was converted to binary colour based scale, the pixels were labelled as "1" for white pixels and black pixels as "0" (see Figure 1-2).

Figure 1 showed an example of input image and Figure 2 showed the result of output image after pre-processing step was done.

5. PROPOSED METHOD

In order to recognize the decorative frame, the space boundary regions between the frame and text or Arabic word of Al-Quran must be identified by the system (see Figure 3). Arabic words of Al-Quran are surrounded with the boundary regions that form a perimeter of space from the decoration. The regions are classified as line of perimeter regions for boundaries.
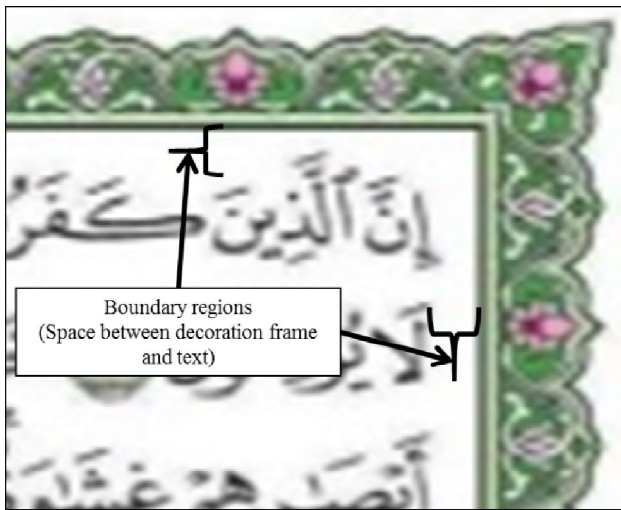

Figure 3: Example of Boundary Regions on the Al-Quran Page.

Practically, algorithms must be computed to identify the boundary regions (see Figure 3). There is always a gap or blank space regions between Arabic text (middle) and decoration (side) which is known as boundary regions. Hence, we proposed a method to detect the decorative illumination frame (see Figure 4).

The red arrows represent the path for the algorithm to identify and analyse each pixel along the path to detect the decoration point. The yellow dots represent the points with recognized borders (see Figure 4). To recognize each yellow point, the algorithm must compute a wide range of every pixel area to be analysed which is 4% from the length of a page for vertical point and horizontal point that continually has the same

properties of the pixel. Basically, the decoration region and text regions are black areas, while the area between a decoration region and text region is a white area, which is the same as the outer space of a decoration region. Thus, the differences between the areas were marked as yellow dots.

Step 1: The process initialized with the first yellow point. This point will be recognized as the outer space of decoration if it is a white area. If it is a black area it will be recognized as decoration area. Basically it will be a white area.

Step2: The second yellow point is recognized as start regions of decoration area. This point is recognized after every pixel wider range is computed for having the same properties of pixel continually.

Step 3: After the second point, the next pixel will be marked as decoration regions until it detected the third yellow point. This second point will be marked as the end point of decorative point of frame.

Step 4: The third yellow point was also recognized after being computed for every pixel wider range for having the same properties of pixel continually. This third point is marked as the end point of decorative point of frame.

Step 5: The fourth yellow point will be marked as the start point of text region of frame which is the end point of boundary regions (see Figure 3). This point was also recognized after being computed for every pixel wider range for having the same properties of pixel continually.

Basically, the method to compute for detecting decorative illumination frame for the oval shape remains the same as above. Four different paths will be determined at every point of each side of the decorative illumination frame (see Figure 5).
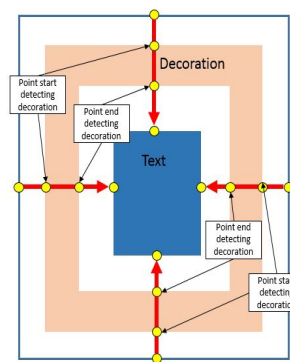

Figure 4: Example on detecting start point and end point of a rectangle decoration frame.
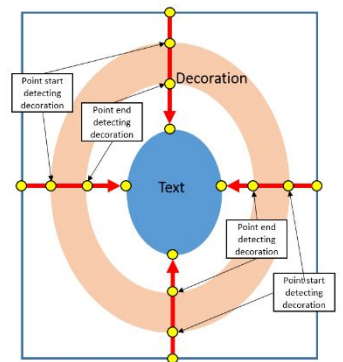
Figure 5: Example detecting start point and end point of oval decoration frame.

Having computed and justified the boundaries, the horizontal and vertical lines were projected to split into the active area and middle area. The active area is mostly decorative regions whereas the middle area has Arabic text and is slightly

decorated (see Figure 6). We had prepared to remove the decoration in the middle area.

Basically, the active area contained all the pixels point classified as cluster point. All the pixels of this point will be set purposely as decoration point. The properties of this point will be clustered to find neighbour regions on the middle area (see Figure 7). It will examine and make decisions based on the same pixel properties of its neighbours.
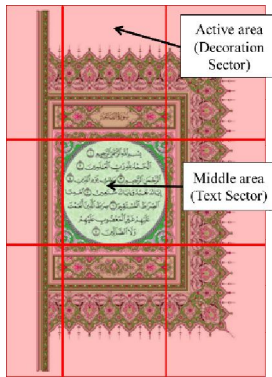

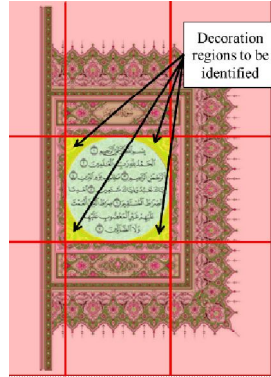**Figure 6:** Example of active area regions on the page of Al-Quran.

Figure 7: Decoration regions to be identified.

Practically, to identify decoration regions in the middle area we applied the recognition pixels of point based on neighbouring pixels properties. It will examine and make decisions based on the same properties of its neighbours. It will continually cluster the point if the similarity criterion is satisfied. The neighbouring pixel that does not have similar properties will be refused to be clustered. This will continually iterate until there is no properties that is the same with the specific pixels that were classified.

In applying neighbouring pixel technique, there is some basic rule to performing the proposed method. Based on region segmentation, the segmentation must be complete so that every pixel must be in a region.

The point must be connected with its neighbour point that has similar properties. It must not be connected with its neighbour point that has no similar content properties. It also must not connect with other point except its neighbour point even though it has similar properties. The neighbour point is relied on by setting the wide range of pixels areas. Each small box in Figure 8 is an example of an image pixel. Figure 8 described the current point surrounded by neighbour point and which only the neighbour pixel with similar properties with the current point can be clustered and classified as cluster point. After that, the cluster point will be used to check and cluster its own neighbour. The cluster point will continually grow to rely on the same properties as its cluster point of pixels.
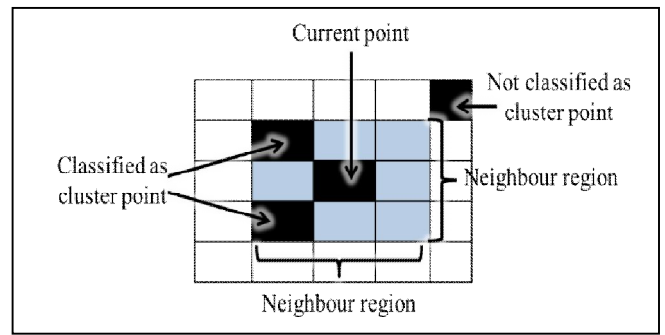

Figure 8: Example of identified pixels point to be clustered.

Step 1: The process initialized at the current point.
Step 2: Identified the neighbour regions surrounding the current point by setting the wide range of pixel of neighbour respectively by the accuracy of result produced.
Step 3: Examine the neighbour point by comparing the properties (black or white).
Step 4: Making decisions, if the neighbour point has similar properties with current point thereafter it will be clustered.
Step 5: Repeat steps 1-4 until all pixels in its neighbour have been allocated by exchanged initial new current point from its cluster.

By applying the proposed method, all point of pixels for decoration can be recognized and identified. Thus, we removed the decoration from a page to extract the Al-Quran word.

6. EXPERIMENT RESULTS

The method was implemented in Java and tested on selected Al-Quran pages. The results are shown in Table 2. Source are refer to the number from Table 1.

Table 2: Results Extraction of Decoration and Text from Al-Quran Page

Source (Refer Table 1)	Input Image	Decoration Frame Identification (Binary)	Text Extraction
1			
2			
3			

7. CONCLUSION

In this paper, we proposed an approach for removing decorative illumination frame which are of a variety of pattern and texture. To process the image uniformly, the image must be required to undergo a conversion image into binary by using Otsu's thresholding method. This is the pre-processing step which needed to be taken. To identify the decoration, we proposed to identify the boundary regions between decorative frame and the Arabic text of Al-Quran. In this paper, we applied the recognition pixels of point based on neighbouring pixels properties. It examined and made decisions based on the same properties of its neighbours. By applying this proposed method, all points of pixels for decoration were recognized and identified for removal in order to extract only the Al-Quran text.

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