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To cite this article: T A Zuraiyah *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **846** 012022

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Tajweed Segmentation Using Pattern Recognition, Extraction and SURF descriptor Algorithms

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Abstract. This paper proposes a method of detection and recognition algorithms and recitation of the Qur'an. The methods and algorithms are packaged into a software system application to allow a person to learn recitation and how pronunciation is good and right and real-time. Any recitation of the Qur'an written in a different color of the letters and punctuation instead of recitation and tajweed each have different shapes. Variable color is used as a reference for the segmentation process forms of recitation and SURF algorithm used for feature extraction process forms. Feature any form of recitation is stored in the data base (knowledge base) accompanied by explanatory text recitation of data and audio pronunciation files. In the process of recognition when the user enters a query tajweed image, Euclidian distance is used to measure the similarity between the query and the shape feature tajweed recitation shape features that exist in the database.

1. Introduction

Al-Qur'an holy book that must be practiced by every Muslim. One is the regular practice reading it with good pronunciation and correct. Tajweed is the main part of the Qur'an which regulate short length strains and humming sound when read. Currently available Qur'an Read Pen Digital utilizing barcode technology. The Qur'an is in the form of printed books that are equipped with a Read Pen Digital and barcode reading system. Each recitation in the Qur'an was given a barcode indexed in the database Read Pen Digital. Tajweed barcode unreadable when touching readings digital pen tajweed in the Qur'an and automatically sound the tajweed recitation accordance with role.

In fact, the Quran tajweed digital has been available on the online media and can be accessed easily by anyone who wants to learn the rules of recitation and how to read it [1][2][3][4], But until now has not provided the information and communication technology tools that can facilitate a person to learn the visual form of recitation and listening to audio how well and properly pronouncing[4].

This paper proposes a method of recitation in an image recognition Quran recitation based on the features digital form. When viewed from the side of its characteristics, any recitation of the Qur'an recitation can be identified by the color and the number of objects (the number of letters and punctuation) and the shape of each object. The recitation form. Figure 1 shows an example of the image from the Qur'an where tajweed written in a different color (red box marked dashed) of letters and punctuation marks that are not recitation (black) and white background. In the image shown that



recitation is always consisting of two or more objects, so it takes a feature extraction algorithm that is able to define the shape of the object into one unified collection.

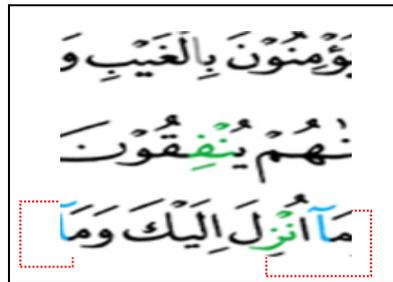


Figure 1. Example of Image Alqur'an Tajweed

In [5] using convolution techniques and Curtis Bray Distance to detect recitation in a sheet image of the Qur'an, but the introduction of forms and recitation has not been done. Tajweed detection techniques (especially in the recitation ikhfa) has been developed in [6] by using HSV segmentation algorithm and canny edge detection and SVM classifier. Tajweed recognition technique has not been used so that the shape feature's accuracy is still low. In addition, the handwriting recognition method based on similarity of features Arabic letter forms have been developed in [7]. Features shape extracted using methods freeman or chain code. The method developed is only able to extract a single character and can not be applied to the recitation because it has some letters and punctuation is a unity to recognize it. other than that[5]Arabic handwriting recognition using SVM classifier confined to recognize characters. One algorithm that can mengekstraksi feature some form of object and represent in a unified way tajweed is speeded-Up Robust Feature (SURF). SURF algorithm produces features such main points or more dominant keypoint represent object shape[6][7],

2. Research Method

Methods of recognition and learning Qur'an recitation proposed by the scheme shown in Figure 2. This method is divided into two parts: the first is the stage of making a knowledge base of recitation of the Qur'an and the second is the stage of introduction of recitation. The knowledge base contains data tajweed shape feature, a text explanation of the recitation, Tajweed and recitation audio recitation image itself. Features tajweed form obtainable by the process of segmentation, cropping, counting the number of objects and object feature extraction form (recitation). Tajweed introduction stage query based on common features tajweed form, together with the four first process at the stage of formation of a knowledge base. The number of objects forming tajweed query matched to the number of objects on-Tajweed recitation that exist in the knowledge base. Furthermore, tajweed have the same number of objects will be calculated degree of similarity to the query recitation based on shape features (extracted using SURF algorithm). Tajweed which has the highest degree of similarity is expressed as a recitation identified. Then tajweed recognizable image is displayed along with explanatory text and audio examples tajweed law correct pronunciation.

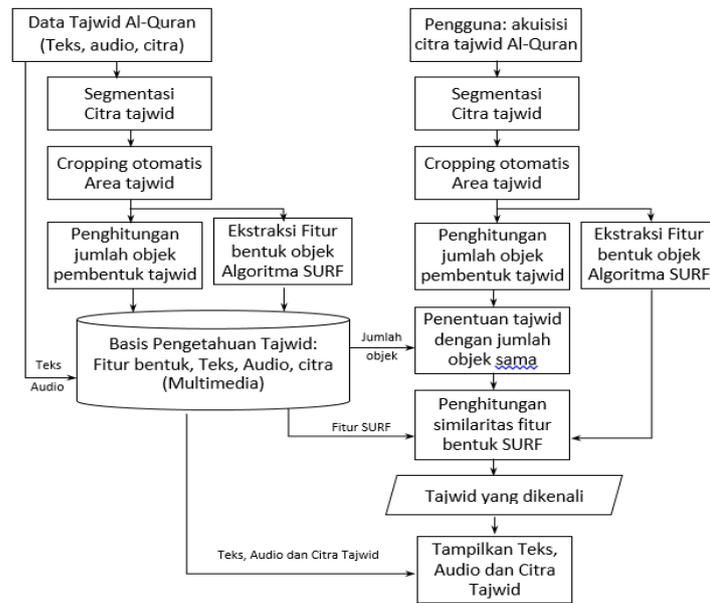


Figure 2. Flowchart Research

(a) Stages of Development Knowledge Base (b) Stages Introduction

2.1. Image Acquisition

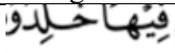
Tajweed acquired image of each page of Surat Al Baqorah Qur'anic Tajweed Digital publisher of Al-Kalam. There are 150 images recitation of three recitation (Idgham Bighunnah, Idgham Bilaghunnah and Ikhfa haqiqi) used in the creation of a knowledge base. Each image is included with the text data Tajweed recitation[15] and audio pronunciation examples[15], Acquisition, recitation destination is the focus point of the camera, so that the recitation is always located at the midpoint of the image. It is intended to facilitate the processing. Each image acquisition is automatically normalized on the size of 500x 500 pixels through rescale process. This size was chosen for reasons of speed and size of the object recitation process visually quite representative to be recognizable.

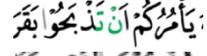
In the image acquisition process of recitation to prepare test data is done in the same manner as in the image acquisition is used to input image data to the knowledge base. Test data set is divided into two categories namely:

1. Image data derived from the Al-Quran Al-Kalam Surat Al-Baqoroh to perform the acquisition process is different for the same recitation
2. Image data obtained from the Al-Quran Qordoba with the acquisition of the same process and the same recitation anyway.

Data acquisition This test is used to test the introduction of forms of recitation of interest whether it remains recognizable in case of translation (shift) because it is done with a different image acquisition and whether identified when using the Qur'an with different prints (color is also different). Table 1 shows the results of the test data acquisition process.

Table 1. Image Acquisition Process Test

No.	law Tajweed	Test the image of Al-Kalam	Test image Qur'an Qordoba
1	Idghom Bighunnah Mim4.PNG	  	  

No.	law Tajweed	Test the image of Al-Kalam	Test image Qur'an Qordoba
2.	Idghom Bilaghunnah Lam4.PNG		
3.	IkhfaHaqiqi Fa1.PNG		

2.2. Segmentation Tajweed

Image in Figure 1 and Figure 3 shows that the recitation of letters and punctuation marks are printed with different colors of letters and punctuation marks instead of Tajweed (colors Hitan) and also different from the background color (white). This means to separate objects from non-Tajweed recitation and from the backside to do with the background segmentation algorithm based on the color feature. The author of the study results on the colors used for coloring recitation of the Qur'an is concluded that there is no standardization of color in perwanaan recitation. This means that the same recitation can be printed with different colors in two of the Qur'an from different publishers. This conclusion indicates that the variable color Hue can not be used as a reference in the segmentation process. Meanwhile, it can be seen that all in all a recitation of the Qur'an, both from the same publisher wants a different sort of publisher, printed using bright colors and a high saturation level. The brightness and saturation levels of the colors of recitation located at coordinates value $(V) > 0.5$ and saturation $(S) > 0.5$ for all kinds of color hue (H) in the HSV color space 3D. Two threshold value S (THS) and V (THV) is used in this study as a reference in the process of segmentation and extraction tajweed form. Figure 3 shows an example of image segmentation process results. On the left is the image of recitation as an input and that right is tajweed segmentation results. The brightness and saturation levels of the colors of recitation located at coordinates value $(V) > 0.5$ and saturation $(S) > 0.5$ for all kinds of color hue (H) in the HSV color space 3D. Two threshold value S (THS) and V (THV) is used in this study as a reference in the process of segmentation and extraction tajweed form. Figure 3 shows an example of image segmentation process results. On the left is the image of recitation as an input and that right is tajweed segmentation results. The brightness and saturation levels of the colors of recitation located at coordinates value $(V) > 0.5$ and saturation $(S) > 0.5$ for all kinds of color hue (H) in the HSV color space 3D. Two threshold value S (THS) and V (THV) is used in this study as a reference in the process of segmentation and extraction tajweed form. Figure 3 shows an example of image segmentation process results. On the left is the image of recitation as an input and that right is tajweed segmentation results.

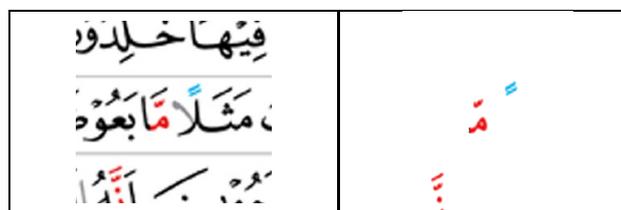


Figure 3. Example of segmentation results tajweed

2.3. Automatic cropping

Image segmentation results in Figure 4 show two segmented recitation. Tajweed as an object of interest you want to identify is always located at the center of the image. This means that if there are other areas of recitation at participating segmented, the recitation has to be removed. To eliminate cropping algorithm is used. Based on the results of manual analysis of the imagery used tajweed 500x500 pixels, the maximum size is 180x180 pixels recitation. This means automatic cropping

process can be set in the middle of the image area in the four-point coordinates (row, column): (160,160), (160, 340), (340, 160) and (340,340). Figure 4 shows the results of cropping image (middle) and a binary image of the results of cropping (right).



Figure 4. Example of cropping area recitation of interest

2.4. Feature Extraction Tajweed

As has been stated above that a recitation composed of two or more objects (letters and punctuation) that shape it. Therefore in this paper we use two types of recitation feature that the number of objects and features of the object shape. Object shape features extracted using SURF algorithm. This algorithm is known for reliable against geometric transformations (translation, scaling, rotation) and lighting, where it is often the case at the time of image acquisition using mobile devices. SURF algorithm determines the main points or keypoints dominant object and extracting represent its shape. Figure 5. Shows the result of the determination of SURF keypoints



Figure 5. Example of cropping area recitation of interest

2.5. Making the Knowledge Base

Each recitation is processed into a shape feature of recitation is accompanied by text files, audio files and image files, so that the unity of the information into a knowledge that will be used in the learning process of recitation of the Quran. There are 150 tajweed used in this paper as an example of the establishment of a knowledge base.

2.6. Determination Tajweed with Same Object

Determination Tajweed with the same object made through proses selection is the number of objects based on analysis of the characteristics of each recitation of the various sources of different Qur'an has the same number of objects. Besides the selection order is based on the similarity number matrix extraction process results SURF. In the SURF algorithm after Haar wavelet filtering process and obtained a description of the vector generating matrix of different orders on each image extracted. This Strategy is done automatically, especially to support the introduction process.

2.7. Recognition and Learning Tajweed Qur'an

Introduction stage is the stage where a user enters into the system tajweed image with the aim to identify recitation, an explanation recitation and listening to examples of correct pronunciation. After going through the selection process the data to be recognized are fewer in number. In the process of recognition is tested with a test images and test images results were compared with the results database SURF feature selection by calculating the shortest distance using the Euclidean distance. Euclidean distance formula using the following equation:

$$d_{ij} = \sqrt{\sum_{k=1}^n (X_{ik} - X_{jk})^2} \quad (1)$$

3. Results And Analysis

In the process of introduction of recitation is done testing include: segmentation and automatic cropping, SURF feature extraction, selection tajweed determination based on the number of objects and the order matrix SURF extraction and recognition result.

3.1. Segmentation Process Testing and Automated Cropping

Tajweed image segmentation process is done by using color segmentation in HSV space. Cropping the image segmentation results aim to take part image that contains only a recitation you wish to identify. Referring to the image acquisition technique in which the focal point is the image of the object intended Tajweed recitation then surely it is at the midpoint of the image. In addition, from the results of manual analysis of the imagery used size 500x500 pixels, the maximum size is 180x180 pixels recitation. This means automatic cropping process can be set on a four-point coordinates (row, column): (160.160), (160, 340), (340, 160) and (340.340). Tajweed image cropping process results are then converted to a binary image. Table 2 below shows the results of image segmentation, cropping and binary image.

Table 2. Image Segmentation process results, cropping and image Binary

No.	law Tajweed	First image	Cropping image segmentation	Binner image
1	Idgham Bighunnah (Mim1)	بَلِّغْهُنَّ وَأَخْبِرْ		
2	Idgham Bilaghunnah (Lam 1)	هُدًى مِّن رَّبِّهِ لَوْ أَنَّمَا خُنَّ مَ وَلَكِنَّ لَا يَشْعُرُ		
3	Ikhfa haqiqi (Fa 1)	بُرِّقَ الْإِنُّومُ وَجُتْمُونَ وَالْغُتَيْبُ نَهْمٌ يُنْفِقُونَ مَا أُنزِلَ إِلَيْكَ وَمَا		

3.2. Feature Extraction Process Testing Using SURF

SURF algorithm steps[8][9][10][11][12][13][14] through several stages as in Figure 6 is a reading a reference image and the image of the target, the detection of the feature points, the process of feature extraction, find points of matching between a reference image and the image of the target, the process of determining the location of an object by using matching point and display objects detected

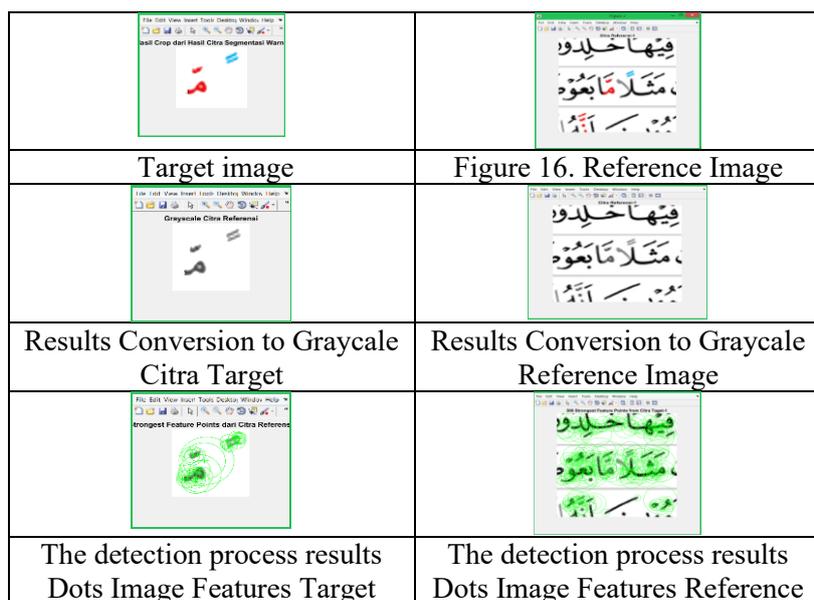


Figure 6. Results Feature Extraction process steps SURF

3.3. Results Introduction Process Image

The results of image recognition performed on the test images 150 images comprising 39 idghom bighunnah images, 20 images and 91 idghom bilaghunnah haqiqi ikhfa image. Rated accuracy of this recitation detection process by 98% from 3 150 test data found no data was spotted in appendix 3. The amount of data that is recognizable senanyak means $147 (147/150 * 100\%) = 98\%$. Figure 7 shows an example of the recognition of three recitation in breadfruit and tanwin nun.

Hukum Tajwid & Huruf	م	ل	ف	Hasil
Bighunnah				Dikenali
Bilaghunnah				kenali
Ikhfa Haqiqi				Dikenali

Figure 7. Sample Results Introduction Process Three Laws of Tajweed Nun Breadfruit And Tanwin which is Recognized

As for the test image data derived from the Al-Quran Qordoba not been identified dikarena number of objects and the order matrix resulting from the SURF feature extraction process is different. Figure showing Qordoba image recognition process analysis.

Table 3. Recognition Process Unrecognized

Alphabet	Test image	Objects and Matrix Order Number Trains	Number of Objects and the Order Matrix Test	Citra Detection Results	Results Detection	Information
Dal 4		4 26 x 64	4 26 x 64		Unrecognized Sound does not come	Not found the ideal spots
Kaf 1		4 38 x 64	4 38 x 64		Unrecognized Sound does not come	Not found the ideal spots
Zai 1		6 32 x 64	6 32 x 64		Unrecognized Sound does not come	Not found the ideal spots

4. Conclusion

In general, the application of methods and implementation of an algorithm developed was made into a prototype software that can automatically extract the image of the recitation of the Qur'an so as to facilitate the learning process in the Qur'an recitation. In particular the conclusions of this study were adapted to the formulation of the problem and research objectives are:

1. From the analysis of the most significant feature is used for the introduction of recitation in an image of the Quran recitation is a feature of forms. Features the form in question is the number of objects forming letters and punctuation marks recitation and features the shape of any object. Features color is only used for the segmentation process of recitation and is not used in the

recognition process. This is because some of the printing of the Qur'an uses different colors to mark the recitation of the same.

2. Making the knowledge base as a dictionary for information storage recitation recitation of the Qur'an which is equipped with multimedia data such as feature recitation, descriptive text, sound and image pronunciation Tajweed recitation. The knowledge base is used as information to facilitate the process of image recognition recitation.
3. From the test results as many as 150 images in 39 image tajweed idghom bighunnah recitation, Tajweed 20 idghom bilaghunnah law and legal recitation ikhfa haqiqi 91 values obtained 98% accuracy as there are three images that are not recognizable. From the analysis of the three images that are not recognizable due to the process of matching the feature points between the test images with trainer image was not found.
4. Learning system recitation of the Qur'an has been able to provide convenience in the process of image recognition recitation, so the detection results in the form of recitation, pronunciation and pronunciation examples in the form of audio files can be displayed properly.

Acknowledgments

Thanks are given to Kemenristek Higher Education which has provided support in the form of grants Doctoral Research Grant.

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