



Image processing of periapical radiograph on granuloma detection by analysis method based on Android

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ABSTRACT

Objectives: The study assesses periapical radiograph image with various android based analysis method to detect granuloma.

Materials and Methods: The study uses survey descriptive cross sectional by using questionnaire. The questionnaire is distributed to 70 random respondents. The methods of the android application used are BLOB (Binary Large Object), DCT and LDA (Discrete Cosine Transform and Linier Discriminant Analysis), DWT and PCA (Discrete Wavelet Transform & Principal Component Analysis), and multiwavelet transformation. The questionnaire assessment included accuracy, effectiveness, attractiveness, innovativeness of the android application.

Results: Android application with BLOB has effectivity and accuracy of 62,5%, attractiveness and

innovativeness of 75%. Android application with DCT and LDA has effectivity and accuracy of 50 %, attractiveness of 70% and innovativeness of 80%. Android application with DWT and PCA has effectivity of 50%, accuracy of 60%, attractiveness of 66,66% and innovativeness of 80%. Android application with multiwavelet transformation has effectivity and accuracy of 50%, attractiveness of 55% and innovativeness of 73%.

Conclusion: Based on assessment, the four methods used to detect granuloma are effective and applicative with android-based application. Android-based Application can detect granuloma with approximately more than 70% successful rate. These methods ease the practitioner to interpret the granuloma image.

Keywords: *Periapical radiograph, granuloma, android-based application*

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INTRODUCTION

Practitioners use of periapical radiographs to see the condition of dental and surrounding tissue were accurate.³ However, the interpretation of a radiographic image by dentists and radiologists is still limited. Thus, the supporting tools for periapical radiograph haven't been well distributed to all region in Indonesia, especially rural and remote areas because of the machine is big and expensive.⁴ Advancing technology gives more accuracy interpret in medical treatment.

Granuloma is growing granulomatous tissue which is correlated with periodontal ligament caused by necrotic pulp, bacterial fusion and bacterial toxin from surrounding tissue through apical foramen and lateral canal.^{1,2} Granuloma radiographic image has a radiolucent with clear borderline or diffuse on periapical, with vary size, round shape, lamina dura missing which may involve the bone condensation and root resorption won't occur.²

Android-based application is expressed to be able to diagnose granuloma. Android is Linux-based system which created for touchscreen cellular

device as smartphone and tablet computer. Android has a community applicate-development expanding device functional, generally is created by costumed version java-based program. Android may use to installed third application that obtainable in Google Play and Amazon. In Google Play Store, Users can explore, download and update application published in google and developed with third users in appropriate capability Google term.⁵

Android-based application varies method including BLOB method, DCT and PCA method, Multiwavelet method and DCT and LDA method. BLOB method is the one of methods image segmenting to analyze more specific and accurate by differentiating color. BLOB uses to isolate bright objects from the background and unites them into one region.¹⁵ The previous research Gemintang (2016) with BLOB shows an accuracy of approximately 80%.⁹

According to Wijayanti (2016), Android-based application with DWT & PCA method shows an accuracy of approximately 90%. DWT is form conversion from signal imaging which doesn't the



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information in a different time. Wavelet transform gives information of frequency, scale and duration.¹⁴ PCA is a linier-reduction technic using a similar theory from statistics. PCA is use to extract image features where the number of image dimension is more than that of samples used.⁸

Multiwavelet transformation is development form of the wavelet transformation. The basic theory of multiwavelet is multiresolution analyze (MRA). The wavelet transformation consists of one scaling and one wavelet function, whereas in multiwavelet consist of several scaling function and wavelet function.^{15,16} The study according to Damanik (2016) shows accuracy approximately 90%.¹¹

According to Buana (2016), DCT and LDA method shows a maximum accuracy 85%. DCT is one of the significant transformations on digital image processing. It interprets image from sinusoidal combination from magnitude and frequency change. LDA is one of the methods which uses statistic. It is a pattern recognitions method to find linier combination of features to be characterized to separate greater than or equal to two objects.¹² Based on these studies with a good accuracy, effectiveness of android-based application for granuloma detection needs to be assessed.

MATERIALS AND METHODS

This study uses periapical conventional radiographs of male and female patients on productive age between 20-70 years old that came into Radiology Department, Padjadjaran University Dental Hospital. The photos were inputted into application by using a Canon scanner (CanoScan 9000 F Mark II) under jpg. format. The photos used are normal and granuloma teeth photos that were manually cropped at the periapical area, converted into HSV format and resized. This study uses four Android-based methods: Binary Large Object (BLOB); Discrete Wavelet Transform (DWT) and Principal Component Analysis (PCA); Multiwavelet Transformation type Geronimo-Hardin-Massopust (GHM); and Discrete Cosine Transform (DCT) and Linier Discriminant Analysis (LDA).

Binary Large Object (BLOB) Method

An android-based mobile device to run the simulation program is Android 5.1.1 Lollipop-A53 Quad-core 1.2GHz Cortex with 13 Megapixel camera (Figure 1 and 2). Periapical radiology photo images used are 18 granuloma photo data and 18 normal photo data. These photo data are paired randomly, resized to 256x256 pixels, and converted to HSV. Granuloma detection analysis is executed on the offline android studio by using programming languages Matlab R2015a software (version 8.5.0).

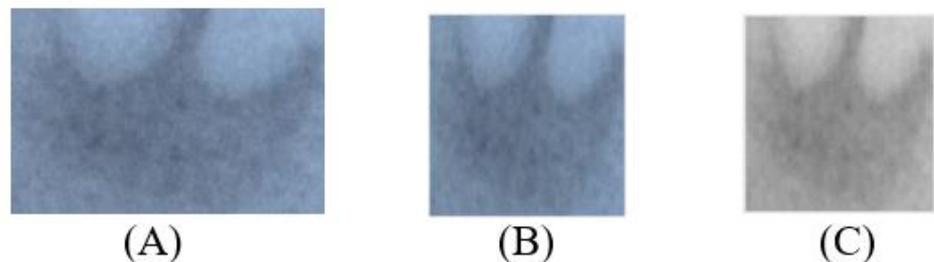


Figure 1. (A) Result of cropping, (B) Result of resize, and (C) Result of conversion HSV.

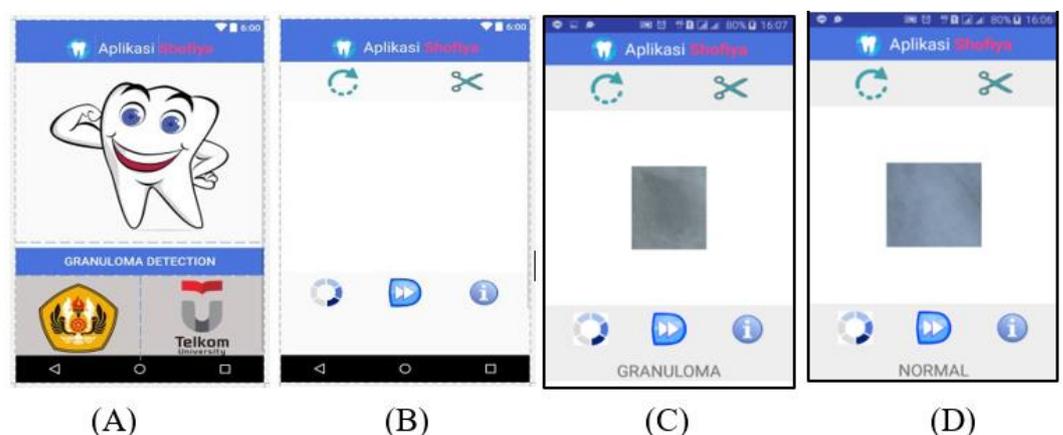


Figure 2. (A) System layout, (B) Home layout (C) Normal teeth image data, (D) Granuloma teeth image data.

Discrete Cosine Transform (DCT) and Linier Discriminant Analysis (LDA) Method

An Android-based mobile device to run the simulation program is 4.4.2 Kitkat Mediatek MT6592 Octa-core 1,7GHz with 13 Megapixels camera (Figure 3 and 4). Periapical photos used are 8 normal photos and 8 granuloma photos. These photos are entered to the pre-processing stage. In this stage, the photos are resized into 128x128 pixels and then cropped at the tooth root. Furthermore, the image is converted from RGB into Grayscale format.



Figure 3. Cropped Image Photo

Discrete Wavelet Transform (DWT) and Principal Component Analysis (PCA) Method

An Android-based mobile device to run the simulation program is Android™ 6.0.1

Marshmallow (Figure 5 and 6). Periapical radiology photo images used are 8 granuloma photo data and 8 normal photo data. These photo data are paired randomly. These photos are used as input photo data to be processed into the system. Each cropped photo leaving only the teeth were diagnosed with granuloma disease. To simplify the process of granuloma disease detection, a periapical radiograph photo should be rotated with the root is positioned at the bottom and the crown is positioned on top. Next, photos are resized.

Multiwavelet Transformation type Geronimo-Hardin-Massopust (GHM) Method.

An Android-based mobile device to run the simulation program is Android 4.4.2 Kitkat A74D Evercross model with 8 Megapixel camera (Figure 7 and 8). Periapical photos image used are 8 normal photos and 8 granuloma photos. These photo data are paired randomly. These photos are used as input photo data to be processed into the system. Digital photos are resized then changed from RGB into grayscale resulting in pre-processing image.

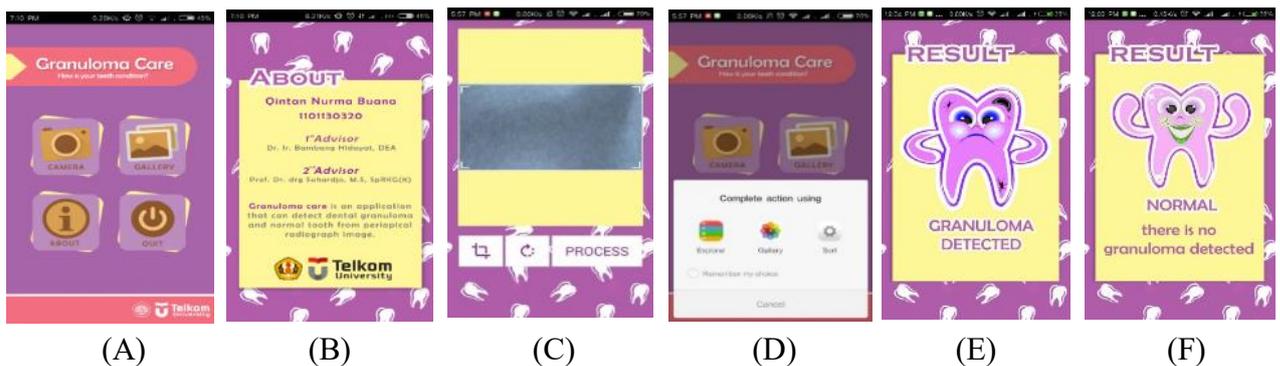


Figure 4. (A) Home Layout, (B) 'About' Layout, (C) 'Option' Layout, (D) Process Layout, (E) Normal Layout, (F) Granuloma layout.

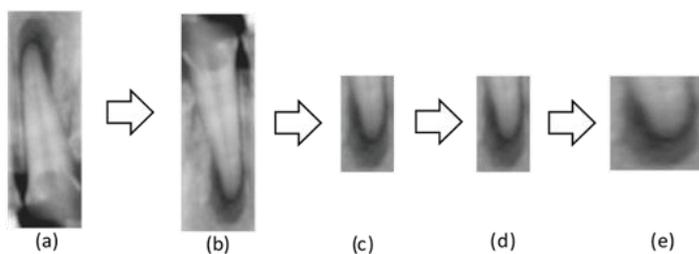


Figure 5. a) Diagnosed Granuloma image, (b) Result of rotated image, (c) Cropped Granuloma Periapical image, (d) Result of Grayscale image, (e) Resized image.

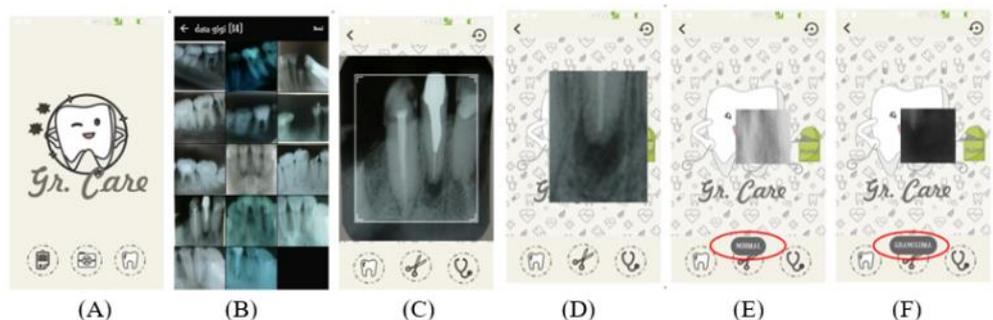


Figure 6. (A) System layout, (B) Home layout, (C) Teeth image data, (D) Resized image data, (E) Normal layout, (F) Granuloma layout.

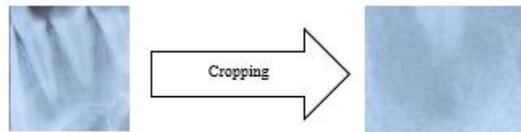


Figure 7. RGB image into Grayscale image

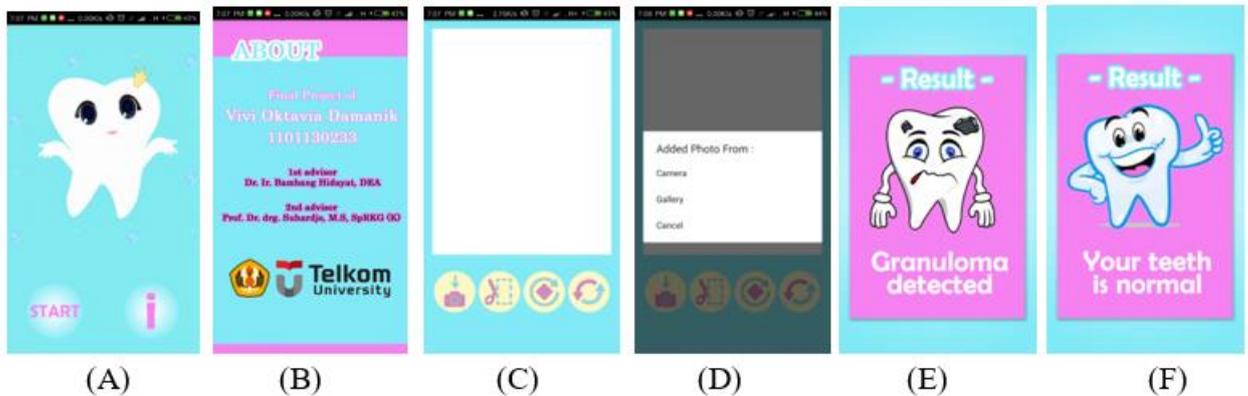


Figure 8. (A) Home Layout, (B) 'About' Layout, (C) 'Option' Layout, (D) Process Layout. Result layout showing (E) Normal Layout, (F) Granuloma layout.

After inserting the photos, questionnaire is distributed to 70 peoples of co-assistant and dentists, and images are assessed in Oral and Maxillofacial Hospital, Padjadjaran University.

RESULTS

The aim of this study is to measure the android application to users. The questionnaire is given to 70 respondent including co-assistant and dentist, in Dentistry Faculty, Padjajaran University. The questionnaire assessment included accuracy, effectiveness, attractiveness, innovativeness of the android application.

Figure 9 shows assessment-chart Android-based application method using BLOB, DCT and LDA, DWT and PCA, and Multiwavelet. In BLOB method, the percentage of application accuracy and

effectiveness shown by 62,5%. The BLOB-application has an attractiveness as shown by 75%. It hasn't used before (innovativeness) shown by 75%.

Testing DCT and LDA method application quietly helpful for assessing to diagnose granuloma (attractive and accuracy) as shown by 50%. It's quietly effective (effectivity) as shown by 50% . It has an attractive view and helpful (innovativeness) as shown by 70%. It hasn't used before and it shown by 80%.

Testing DWT and PCA method application quietly helpful for assessing to diagnose granuloma as shown by 50%. It's quietly effective and simple uses as shown by 60% . It has an attractive view and helpful as shown by 66,66%. It hasn't used before and it shown by 80%.

The last method is multiwavelet method application. This method application quietly helpful for assessing to diagnose granuloma as shown by

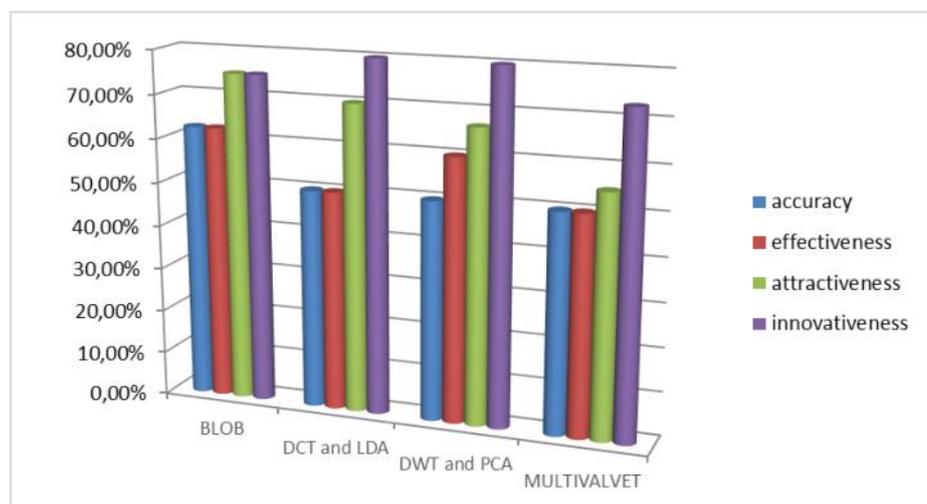


Figure 9. Assessment-chart Android-based application method

Table 1. Questionnaire of granuloma detection periapical radiograph in Android-based application method

QUESTIONNAIRE OF RADIOGRAPH PERIAPICAL DETECTION	
Name:	
Institution:	
Position:	
Thank you for using an Android-based application in radiograph periapical detection. To know how performance of this system, please answer this questions:	
Does this Android-based application can help in displaying the information in radiograph periapical detection?	
	a. Very helpful
	b. Helpful
	c. Quite helpful
	d. Not helpful
Does this Android-based application radiograph periapical detection easy and effective?	
	a. Very easy
	b. Easy
	c. Quite easy
	d. Not easy
How about the layout of this Android-based application radiograph periapical detection?	
	a. Very attractive
	b. Attractive
	c. Quite Attractive
	d. Not Attractive
Do you know or have used other similar application?	
	a. Yes
	b. No
Thank you for your participation on this questionnaire.	

50%. It's quietly effective and simple uses as shown by 50%. It has an attractive view and helpful as shown by 55%. It hasn't used before and it shown by 73%.

DISCUSSION

Decision to interpret a diagnostic imaging should be based on patient needs. Diagnostic image refers not only to conventional radiograph but also to any digital radiograph as an output X-ray. Patient's need of dental radiograph imaging is determined by dental medical record and clinical examination findings related to age and general health condition. Diagnostic imaging is needed when dental medical record and clinical examination cannot give enough information for comprehensive evaluation of patient condition and for appropriate management.

Image quality describes the subjective judgment by the clinician of the overall appearance of a radiograph. It combines the features of density, contrast, latitude, sharpness, resolution, and other parameters. Various mathematic approaches are used to further evaluate these parameters, thoroughly. Density is a degree of darkness of a radiographic film. The density of tissue irradiated with X-rays affect black area density on the radiographic film. These terms used to indicate density of black films, showing radiographs photographic film which has been developed and expressed by the logarithm opaque zone that depends on film. In this study, assessing android-based application on detect periapical photo normal teeth and granuloma. Each of method has

advantages and disadvantages.

The first method is BLOB. The advantages of BLOB are isolating and detecting an object from the dots pixel having a brightness of the background color and incorporating them into a part. BLOB classifying a pixel with another pixel is almost similar uses the concept of neighborhood and labeling then separate into a part. Approaching use to analyze the texture of an area, (statistical and structural). Statistical approach considering intensity is raised and based on the frequencies of space (spatial) and produces characteristic texture as smooth, rough, and others. While structural engineering related to the preparation of the smallest parts (primitive) of an image.

DCT and LDA methods have kontras level, structure and color better because of histogram equalization (technique to get a new image that is grayscale image with the range of kontras 0-225). DCT method describe spatial information to describing the shape of object roughly, therefore LDA method is needed to classify an object in a linear manner to one of the two or more groups.

DWT and PCA method have a high accuracy rate. This method combines decomposition image on a certain level of decomposition, which in this level of decomposition was process through high pass filter and low pass filter signal with a linear reduction technique using simple theories of statistics. With this PCA method, the changes occur in feature extraction based on "appearance", where the dimensions of the image are bigger than the amount of sample data that been used.

Multiwavelet transformation method also has a high accuracy rate. This method using two scaling function and two wavelet functions in the image. The accuracy of this method is affected by the

magnitude of the image pixel input and computation time. The larger image size, the accuracy of the system is declining, and more time to takes the system to perform processing on the image.

Through Android system, respondents judge about the usefulness of the information display, effective and accuracy, attractiveness and innovativeness system. The system that can helpful on view displays system of effective and accuracy is DCT and LDA system and multiwavelet system. The useless method is DWT and PCA. A View display simulation, all system is attractive except DWT and PCA system. Neither Multiwavelet is innovative because it hasn't use it before nor DCA and LDA system.

CONCLUSION

From the assessment, it can be concluded that Android-based analysis method is successful in detecting granuloma on periapical radiograph. Android-based Application can detect granuloma with approximately more than 70% successful rate. The granuloma detection with the fourth method is effective and applicative so practitioners can interpret easily.

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article. This article does not contain any studies with human or animal subjects performed by the any of the authors.

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