Determination of RGB in Fingernail Image As Early Detection of Diabetes Mellitus

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***Abstract*---The aim of this research was to determine of component color RGB on fingernails as early detection of diabetes mellitus. Methods of the study consisted of material preparation and implementation procedures that carried out in three step i.e (1) data retrieval, (2) data processing and (3) data analysis. Firstly, random blood glucose levels were take with Autocheck GCU rapid test then fingernail images data were taken by digital camera and classified into into three categories namely diabetes, prediabetes and normal. Images data were segmented and transformed manually into R (red), G (green), and B (blue) histogram. RGB histogram was analyzed and grouped by frequency distribution to obtain RGB range number of each category. The results showed that range number of Red in diabetes, prediabetes and normal were 160-181, 170-185, and 165-183. Range number of Green were 100-119, 103-123, 107-129 for diabetes, prediabetes and normal . Also range number of Blue were 93-113, 90-110 and 97-117 for diabetes, prediabetes and normal. As conclusion, there was overlapping range number of RGB in all categories. Therefore, fingernail image as early detection of Diabetes Mellitus need to improve by added some feature such as texture image.**

Keywords—diabetes mellitus, histogram image, fingernail image, color feature, RGB

I. INTRODUCTION

Diabetes mellitus is a chronic metabolic disease caused by pancreas could not produce sufficient insulin or insulin resistance[1]. Based on Basic Health Research (Riskesdas) in 2013, the prevalence of diabetes mellitus in Indonesia reached 12 million people. This number had increased double than in 2007. However about 69,6% patients of diabetes mellitus had delayed medical treatment due to patients did not routinly take medical cheked up especially blood glucose levels. They has just did treatment when body affected complication disease. Therefore, the risk factors of diabetes mellitus could be anticipated by blood glucose test on early and routinly.

Diabetes mellitus has potential risk of various complication disease such as heart disease, stroke, neuropathy, diabetic retinopathy (blindness) and kidney failure. Based on Data and Information Center of the Ministry of Health Republic Indonesia in 2014 showed that many complication disease were caused by diabetes mellitus. Therefore, diabetes mellitus become one of deadly disease in the world[1].

In order to reduce the number of prevalence of diabetes mellitus required some prevention, one of them by doing routine blood glucose levels test. Blood glucose testing device was used by taking blood of patient invasively then diagnosted and blood glucose levels was showed on display of rapid test without any description of Diabetes Mellitus risk factors. An alternative blood glucose test need to developed with advanced biomedical device that cheap, easy to use and painless. Therefore, everyone could take blood glucose test without any fear and worry. An alternative method for early detection of diabetes mellitus that safe and comfortable could utilize fingernails color.

Research about early detection of diabetes mellitus using fingernails color need to be developed, due to fingernail abnormalities could be associated with systemic diseases, specific organs and systems also genetic disorders. Physical test of fingernails color use to be an integration part of a complete dermatologic test that occasionally could support health dignostic. Fingernails color has information about body systemic symptom[2]. Fingernails color is divided into four basic color such as pink, white, yellow and blue. Healthy body could be indicated when fingernails has pink as dominant color. But, unhealthy body is indicated when fingernails had white, yellow and blue as dominant color. Pancreas and kidney symptoms could be diagnosed by quantity of white color in fingernails. Pancreas damage symptom indicated diabetes mellitus, therefore diabetes mellitus could be diagnosed by fingernails color.

This research observed about detection of diabetes mellitus using fingernails image. Fingernails basic color contained red, green dan blue which has intensity range of each categories about 0-255. Primary's color image RGB was used in such application like computer graphic, image processing, analysis and storage[3]. Intensity of three basic color has differencess color each other although seen the same. Intensity color could be known by color histogram. Color histogram is a representation of the distribution of colors in an image. Color histogram counts similar pixels and store it. Basically color histogram is a color descriptor and each descriptor contains a feature extraction algorithm[4].

Blood glucose levels data was divided into three categories i.e normal data, pre-diabetes data and diabetes data based on Perkeni. Normal data was shown by blood glucose levels below 90 mmol/L, prediabetes data was shown by blood glucose levels between 90 mmol/L until 199 mmol/L and diabetes data was shown by blood glucose

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levels above 200 mmol/L[5]. Range number of RGB in those categories would been achieved by grouping frequency distribution.

Early detection of diabetes mellitus research used part of body detection that had been done by other researcher and finally they found iridology method. Iridology is studying about how to analyze the iris structure for predicting human health. Based on chart of iris (Dr. Bernard Jensen's Chart of Iris), Pancreas activity was shown on right Iris at 07.15-07.45 hour. Therefore, pancreas inactivity could be identified by iris structure[6][7]. Diabetes mellitus could be diagnosed by using iris image due to able to describe pancreas condition. Priya used fingernails image for counting energy rates. The third step on right fingernails and 6th region on left fingernails could be predicted pancreas condition[8]. When those regions have depletion of energy rate, patient might be a suspect of diabetes mellitus.

II. Material And Methods

A. Material

This study used autocheck GCU rapid test and blood glucose autocheck glucose strip for getting blood glucose data. Besides, alcolhol swab, autoclick set, and blood lancet as additional equipment for getting blood sample. Then each fingernails images at right and left hand were obtained by Canon Ixus 285 HS 20,2 MP digital camera under lighting. As inclusion data, fingernails should be free from nails polish because fingernails polish also contained color of red, green and blue that could interfere result of research. Sample of fingernail images was shown in Fig. 1.

Fig. 1. Fingernail image sample

B. Methods

Method of the study carried into two step i.e preparation of materials and analysis data. For performing analysis data consisted of three step namely data retrieval, data processing and data analysis. Research methodhology flowchart was shown in Fig. 2.

1) Data Retrieval Stage

Respondent that had been testing blood glucose levels, afterwards had been asked to take fingernails image. Result of random blood glucose levels used for categorizing data into normal, prediabetes and diabetes data. Based on Perkeni, normal data was shown by blood glucose levels below 90 mmol/L, prediabetes data was shown with blood glucose levels between 90 mmol/L until 199 mmol/L and diabetes data was shown by blood glucose levels above 200 mmol/L[5].

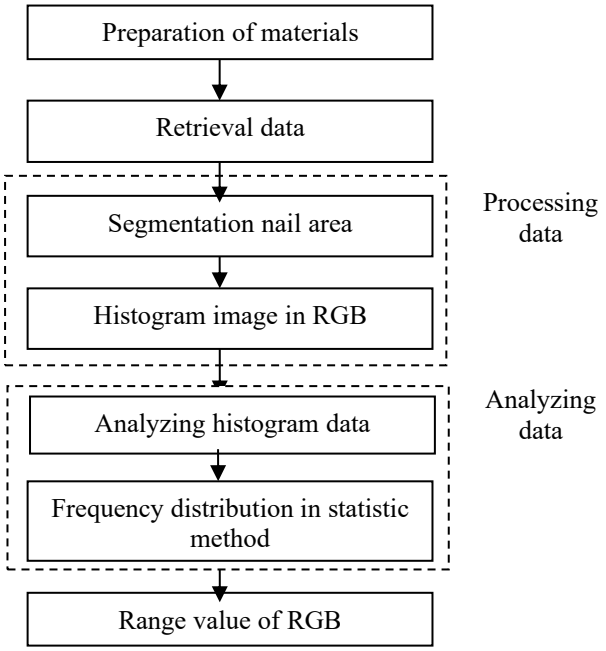


Fig. 2. Flow chart of research methodology

2) Data Processing Stage

Image data had been segmented manually, therefore image contained white background area on fingernail. Data processed used histogram image in red (R), green (G) and blue (B) color. As the results of data processing were graphically histogram in image and in table that contained range number of RGB histogram. Histogram data were used for analyzing data. On histogram graph, horizontal axis represented the intensity with range 0-255 and vertical axis represented the number of intensity pixel. At left side of the horizontal axis represented the black and dark areas, at middle represented medium grey and at right side represented lighting and pure white areas[9]. Flowchart of getting RGB histogram in an image is shown in Fig. 3.

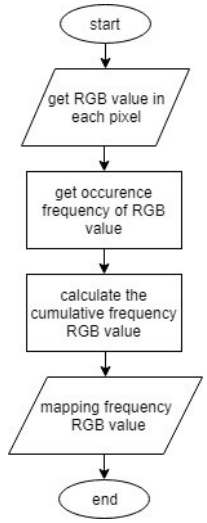


Fig. 3. Flowchart of getting RGB histogram in image

3) Data Analysis Stage

The aim of performing analysis data was to obtain the range number of component fingernails color such as red (R), green (G) and blue (B) to determine blood glucose levels data into categories of normal, prediabetes or diabetes. This method stage consisted of determining intensity by using image with highest frequency into histogram data and determining range number by using statistical methods based on frequency distribution. Grouping categories used when range of data was too large and more than one unit in width[10]. Three steps to obtain frequency distribution results such as classification determining (number class and interval class), tabulating raw data into appropriated class and putting data into table contained result of tabulating raw data. Classification was determined by number class and interval class. Sturges's formula was used to determine the number class as followed:

$$k = 1 + 3{,}3 \log n \qquad (1)$$

where n was number of the raw data. Besides, size of the gap between classes or interval class was determined using formula as followed:

$$i = (t - r) / k \qquad (2)$$

when t was number of the highest data, r was number of the lowest data and i was the size of interval class[10].

III. Experiments And Results

Data retrieval stage utilized 855 fingernail images. Two of sample images were shown in Fig. 4 and Fig. 5 that represented segmentation image results of fingernails. In this stage, data was divided into three categories were normal, prediabetes and diabetes based on blood glucose levels[8]. As the results, total normal data was about 362. Total prediabetes data were about 385 and diabetes data were about 108. Segmentation was excecuted manually. Histogram was generated using MATLAB that provided various toolbox in image processing[11]. Histogram R (red), G (green) and B (blue) of image were shown in Fig. 6.

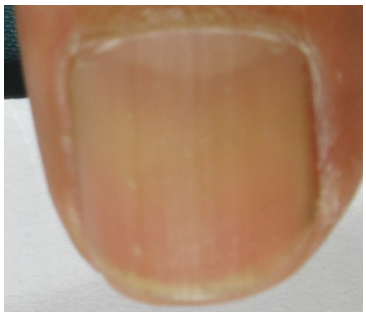
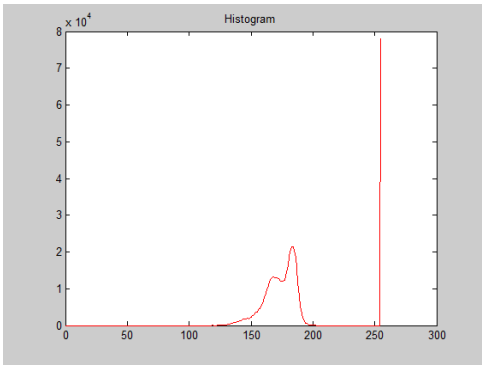
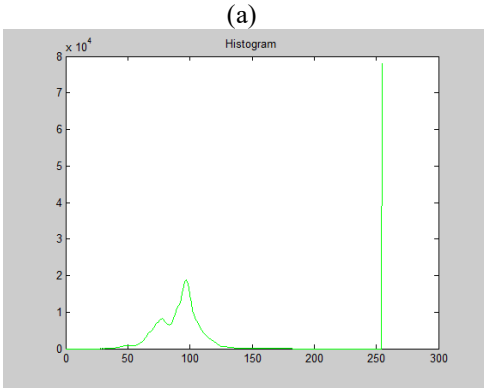


Fig. 4. Fingernails image sample

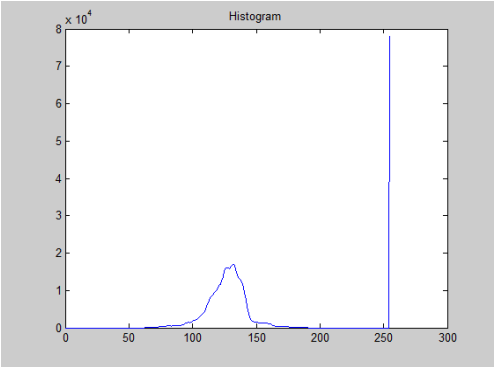
Fig. 5. Image result of segmentation



(a)



(b)



(c)

Fig. 6. Histogram of image (a) histogram of R (b) histogram of G (c) histogram of B

In Fig. 6 showed that each histogram data had peak number that pointed intensity with highest frequency on analysis data stage. Those peak number refered to exception of 255 intensity that represented white color as background image. On histogram graph, horizontal axis represented the intensity with range 0-255 and vertical axis represented the number of intensity pixel. At left side of the horizontal axis represented black and dark area, at the middle represented medium grey and at the right side represented lighting and pure white areas[9].

Analysis data stage used histogram data, each image intensity was determined based on highest frequency then grouped by frequency distribution to obtain range number of RGB at each categories. Afterwards, number class and interval class were determinated. Table 1 showed the result of grouping frequency distribution. Number class of RGB histogram within same categories were always identic due to calculated by using equation 1. But, interval of each histogram in same category could be different each other due to decided by using highest number data and lowest number data that were calculated by following on equation 2. Hereafter, limit class could be provided and intensity with the highest frequency would put in suitable limits class. Limits class with the highest frequency would be determined as range number.

TABLE I. FREQUENCY OF GROUP DISTRIBUTION

Detail	Diabetes data	Pre-diabetes data	Normal data
The number of data	108	385	362
Histogram of red			
Number class	8	10	10
Interval class	16	16	19
Range of value	160 - 181	170 - 185	165 – 183
Histogram of green			
Number class	8	10	10
Interval class	20	21	23
Range of value	100 – 119	103 - 123	107 - 129
Histogram of blue			
Number class	8	10	10
Interval class	21	21	21
Range of value	93 – 113	90 – 110	97 - 117

Table 1 showed that range number of RGB histogram. Range number of red histogram on diabetes mellitus was 160 - 181, pre-diabetes was 170 - 185 and normal was 165 - 183. As the result showed that any overlapped around 170 - 181 on red histogram. Range number of green histogram on diabetes mellitus was 100-119, pre-diabetes was 103 - 123 and normal data was 107 - 129. There were overlapped data around 107 - 119 on green histogran. Meanwhile, according to range number of blue histogram showed that diabetes mellitus was 93 - 113, prediabetes was 90 - 110, and normal was 97 - 117. As like range number of red and green histogram, range number of blue histogram also had any overlapped around 97-110. The visual of range number of RGB histogram is showed in Fig. 5,6 and 7.

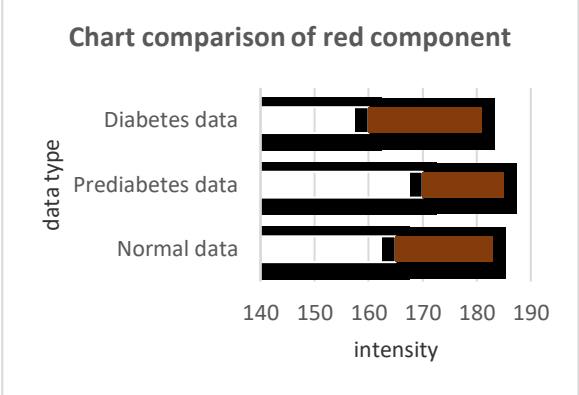


Fig. 7. Comparison range number of red component

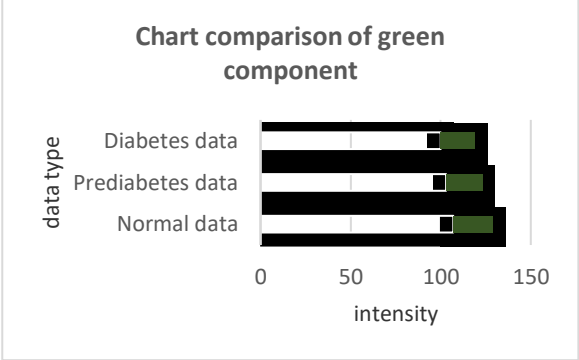


Fig. 8. Comparison range number of green component

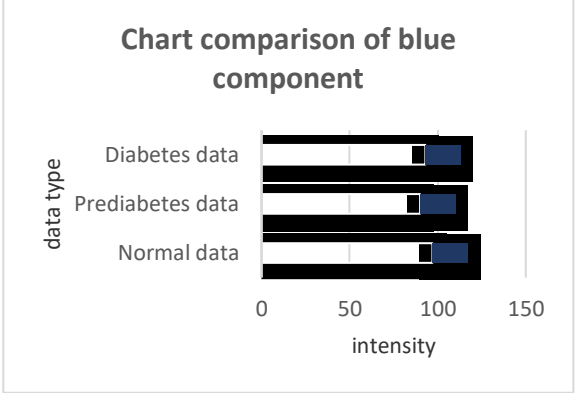


Fig. 9. Comparison range number of blue component

Based on the study showed that had overlapping data in all three types of histogram and in all categories with different range number of red, green and blue. Overlapping in RGB occured might be happened because of lighting intensity that could affect quality of fingernails color due to reflection of lighting when taken fingernails image[12]. In RGB space, three primary colors (R, G, B) represent not only the color but also the brightness. The brightness changes when the ambient light changes[13]. The effect of lighting has been anticipated beforehand. The effect of lighting is minimized by the imaging setup used when retrieving data.

The imaging setup is a box which inside of it there is a lamp. With the lights from lamp, all finger nails are taken with the same lighting conditions.

In future research, finger nail images could be extracted other feature such as texture feature. Color and texture feature are among low-level features which are extensively used in CBIR. Content-based image retrieval (CBIR) is a task of retrieving relevant image from a presented query image based on visual characteristics[14] [15]. Texture feature consist of mean, variance, skewness, kurtosis, correlation and entropy[9].

IV. Conclusion

The range number of Red in diabetes, prediabetes and normal were 160-181, 170-185, and 165-183. Range number of Green were 100-119, 103-123, 107-129. Also range number of Blue were 93-113, 90-110 and 97-117. As conclusion of the research obtained that range number of RGB histogram were overlapped.

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