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Identification of Biodiesel from Used Cooking Oil Based on Image Color Characteristics

Bobo Sahta [a,1], Anton Yudhana [a,2,*]

[a] Department of Electrical Engineering, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[1] bobo1400022029@webmail.uad.ac.id; [2] eyudhana@ee.uad.ac.id
* corresponding author

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ABSTRACT

Biodiesel is a biofuel that will be used against the machine or motor type diesel, in the form of ester methyl fatty acids made from vegetable oils or animal. Biodiesel can overcome the problem of the depletion of petroleum and energy crisis. One of the raw materials to make the biodiesel is used cooking oil. Hardware design consists of the design of the black box measuring 27cm x 17cm x 13cm (Length x Width x Height) with 2 pieces of LED as lighting and those ones powered by a 9 Volt battery so that all samples taken in the same conditions. Then the software design consists of designing a GUI in MATLAB. Data retrieval biodiesel utilizing the camera of android SONY Docomo Xperia Z3 which has been equipped with a rear camera 20MP front camera and 5MP. Process to process the image itself with the transformation of the RGB color to HSV to the image by simply selecting the image Hue and the image of the saturation of the course, for the extraction of features (calculate the value of the mean on the image hue and saturation according to the columns or rows of a matrix). The determination of the class using the method of the closest distance that is Euclidean. The first stage to determine the traits that have standard data for reference. and the second stage testing process. Data to determine the characteristic wear 10 of each sample on each of biodiesel, which consists of 3 types. With a total of 30 samples were used as standard data for reference. A system test is performed with the test data, a total of 18 samples only. The results obtained for 15 samples of the test data successfully detected recognizable and 3 sample test data other not successfully detected. The level of accuracy of the system is the introduction of biodiesel shows the results of 83.3% by using the method of Euclidean distance, which means the level of accuracy is high.

1. Introduction

Biodiesel is a biofuel that will be used for diesel-type engines or motors, in the form of fatty acid methyl esters made from vegetable or animal oils. Its manufacture has been carried out a lot because of the current depletion of petroleum reserves [1][2]. Biodiesel can overcome the problem of depletion of petroleum, including being a solution to anticipate an energy crisis. On the one hand, it can also encourage exploration of other fuel oils which are of course environmentally friendly [3]. Therefore, there are several raw materials for making biodiesel, one of which is used cooking oil. The use of image processing methods to identify biodiesel from used cooking oil based on color characteristics has not been widely applied [4][5].

Biodiesel from oil derived from coconut, with oil derived from palm oil which has been used many times to become used cooking oil which is then processed into biodiesel, of course has different color characteristics [6][7]. One method for identifying biodiesel based on color is by using the Euclidean distance method. Research using image processing systems in MATLAB applications [8][9]. With several GUI facilities, several pieces of the program will be arranged to identify biodiesel based on the color characteristics of the image. Biodiesel data collection utilizes a camera from the Android Sony Docomo Z3 which has been equipped with a 20MP rear camera and a 5MP front camera. The process of processing the image itself with the RGB to HSV color transformation of the image by selecting only the hue and saturation images, for feature extraction (calculating the mean value of the hue and saturation images according to the column or row of a matrix). Class determination uses the shortest distance method, namely Euclidean [10].

Class determination uses the shortest distance method, namely Euclidean. The first stage is to determine the characteristics in order to have standard data as a reference. and the second stage of the trial process. Data to determine the characteristics used by each of the 10 samples for each biodiesel consisting of 3 types. With a total of 30 samples used as standard data for reference. The trial system was carried out with only 18 sample test data [11][12][13].

2. Research Method

Designing an image processing application with the MATLAB application to recognize biodiesel from used cooking oil based on the color characteristics of the image and create a black box to take research samples so that each sample is taken under the same environmental conditions.

2.1. System Design

The initial step to obtain information about the image of the biodiesel type is to calculate the average value of hue and saturation according to the column or row of a matrix. Then the average value will be entered into the database as training data.

2.1.1. Biodiesel Type Identification System Diagram

A diagram of the biodiesel type identification system can be seen in Fig. 1.

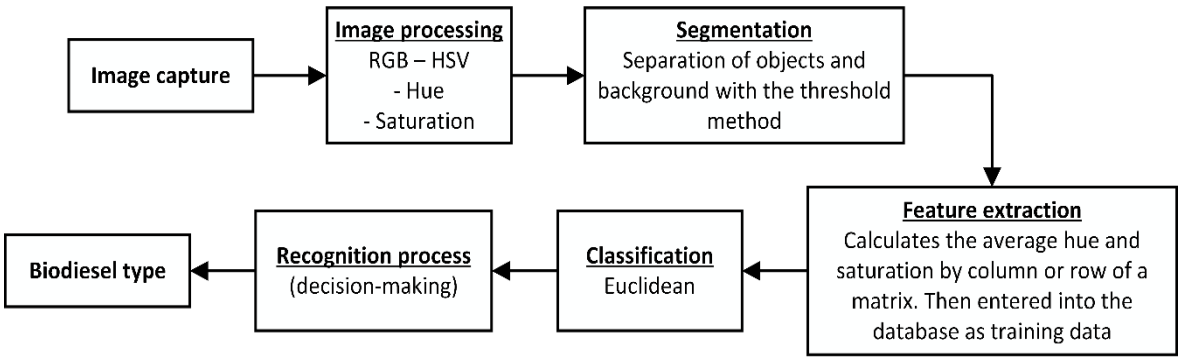

Fig. 1. Biodiesel type identification system diagram

In the HSV model, only the hue and saturation images are considered. Where hue will show the color of the object while for saturation it will show the purity of the color of the object. Then the hue and saturation images are segmented using the threshold method in order to distinguish objects from the background. If segmentation has been carried out, then the next process is to extract features by calculating the mean hue and saturation values of the objects. Then from this value the database is created. Then the classification of objects where the process uses the Euclidean distance classification. The match between the minimum distance between the training data and the test data is read by the application where the process will display the biodiesel class.

2.1.2. Block Diagram Of The Biodiesel Recognition System

The block diagram of the biodiesel introduction system can be seen in Fig. 2.

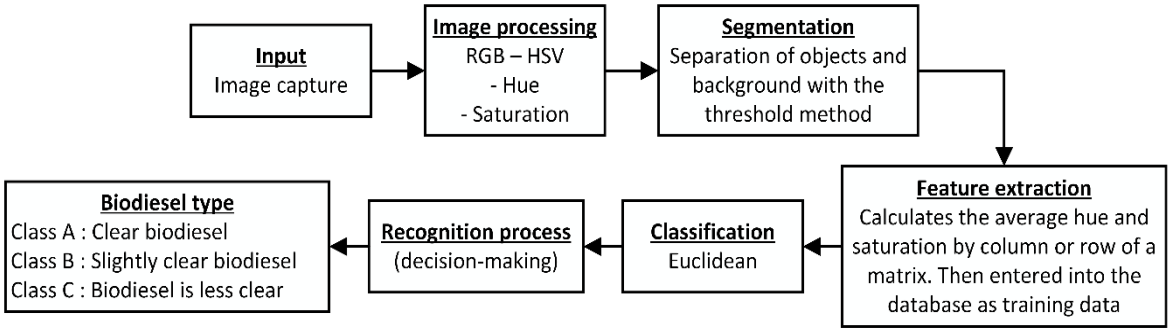

Fig. 2. Block diagram of the biodiesel recognition system

Image capture in this study using a digital camera. then the next step is to process the image with the MATLAB application. Image processing will apply the RGB color model to HSV. In the HSV model, the hue and saturation images are considered. Then the hue and saturation images are segmented using the threshold method in order to distinguish biodiesel from the background. The next process is feature extraction by calculating the mean hue and saturation values of the objects. Then from this value the database is created. Then the classification of objects where the process uses the Euclidean distance classification. The match between the minimum distance between the training data and the test data is read by the application where the process will display the biodiesel class.

2.2. Algorithm

The software is made using the MATLAB application. Making the program is made by compiling a flow chart (flowchart) first. The flowchart system can be seen in Fig. 3.

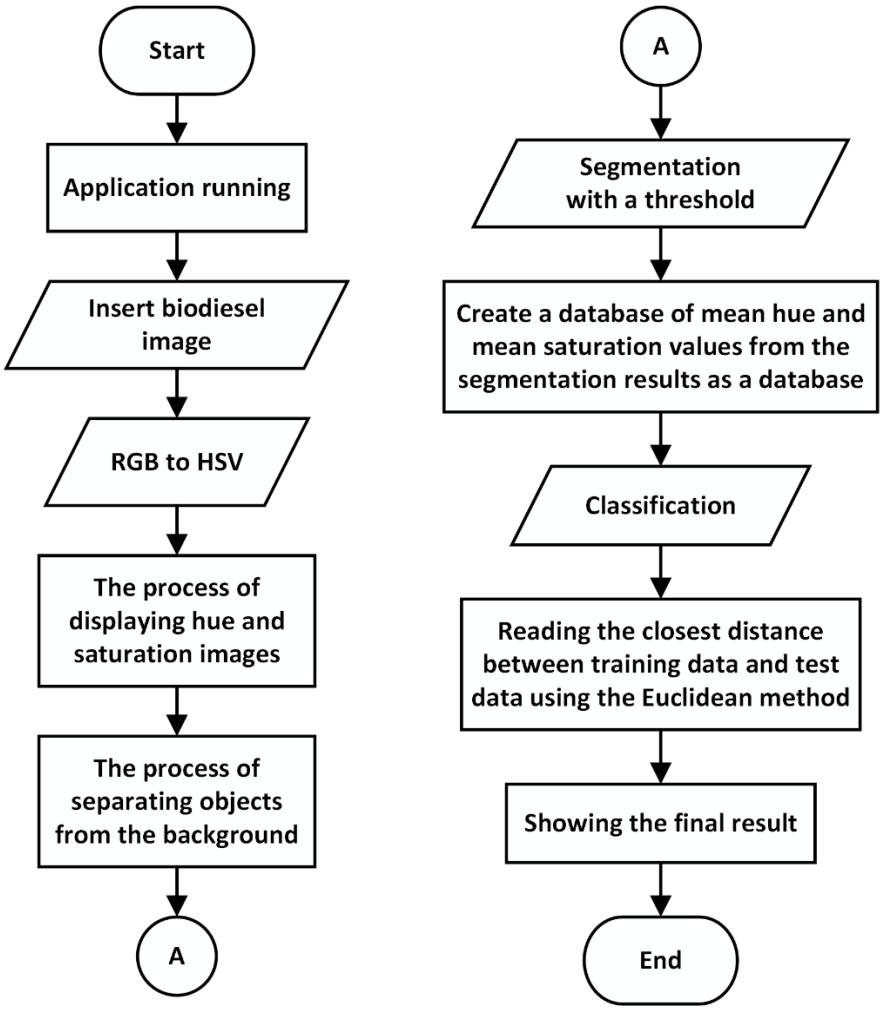

Fig. 3. Flowchart of biodiesel introduction system

The first step is when the application is opened it will display the User Interface of the MATLAB application. Then the image will be entered in .JPG format and then the RGB to HSV color transformation will be carried out. After the color transformation, the objects displayed are only hue and saturation images. If the hue and saturation images have been obtained, the two images will be segmented using the threshold method. If the threshold has been done, the next process is to create a database by taking the mean hue and saturation values from the segmentation as training data. Then the classification process where the process uses the Euclidean distance classification. If the system reads and captures the image of the type of biodiesel that has been trained before, the system will identify it.

2.3. Equality

The success rate of the biodiesel introduction system is calculated by equation 1.

$$Accuracy = \frac{Number\ of\ correct\ semples}{Total\ number\ of\ samples} \times 100\% \quad (1)$$

3. Results and Discussion

The process of identifying the type of biodiesel can be carried out after testing the training data. The way to test the system is to enter a new image in the sense that it has never been recognized and another image that has never been used for training data. In the biodiesel introduction system, the database used is divided into 2 parts, namely:

1. Training image data is used for learning systems or getting to know about the given image so that the system compiled has knowledge.
2. Test image data is used to determine whether the system can work in identifying images of biodiesel types.

3.1. Results of class A biodiesel introduction trials

Fig. 4, Shows the process of testing the introduction of biodiesel and where the detected results are class A biodiesel, namely clear biodiesel with a hue image distance of 0.0025166 and a saturation image distance of 0.006639.

Fig. 4. Results of class A biodiesel introduction trials

3.2. Results of class B biodiesel introduction trials

Fig. 5, Shows the process of testing the introduction of biodiesel and where the detected results are class B biodiesel, namely biodiesel that is less clear with a hue image distance of 0.0045357 and a saturation image distance of 0.0039806.

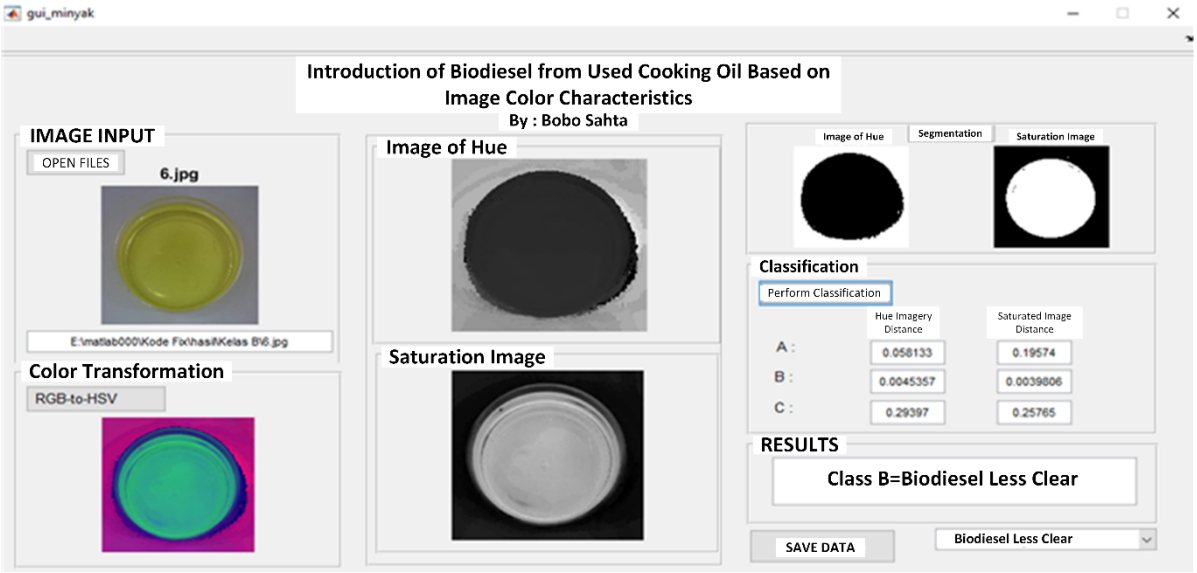

Fig. 5. Results of class B biodiesel introduction trials

3.3. Results of class C biodiesel introduction trials

Fig. 6, Shows the process of testing the introduction of biodiesel and where the detected results are class C biodiesel, namely slightly clear biodiesel with a hue image distance of 0.0047671 and a saturation image distance of 0.0043063.

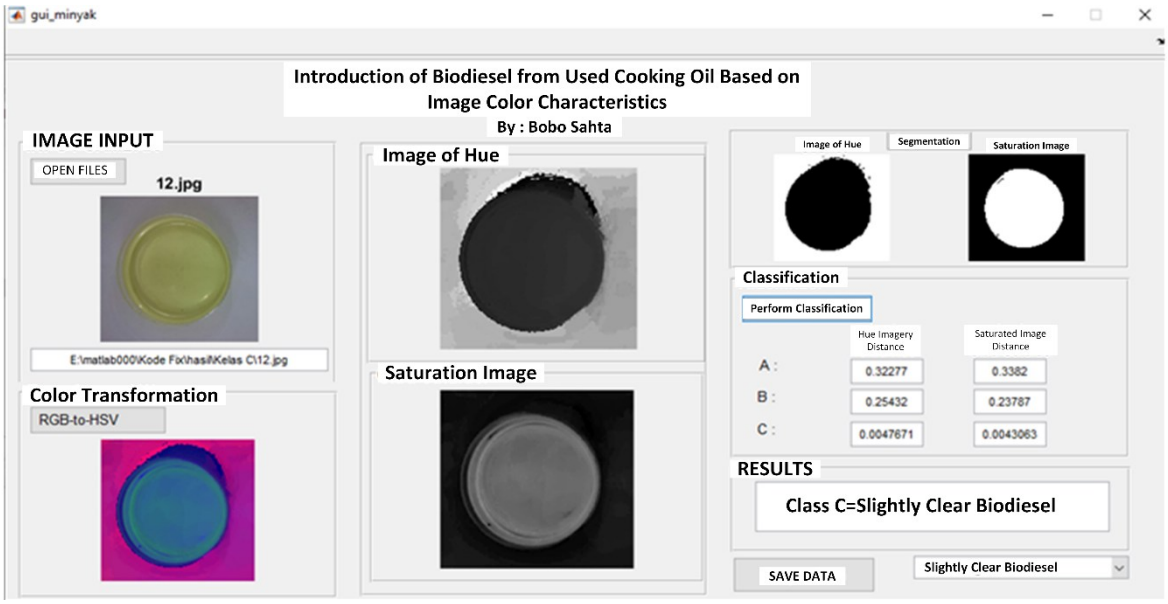

Fig. 6. Results of class C biodiesel introduction trials

3.4. Table of Test Results

Table 1 is the result of testing the introduction of biodiesel.

Table 1. Test results

No	Biodiesel Samples	Classification Results	Distance value		Information
			Image of Hue	Saturation Image	
1	Test data to 1	Class A	0.0025166	0.006639	Successfully identified as clear biodiesel
2	Test data to 2	Class A	0.0070032	0.0061135	Successfully identified as clear biodiesel
3	Test data to 3	Class A	0.005138	0.0065784	Successfully identified as clear biodiesel
4	Test data to 4	Class A	0.0050812	0.0029937	Successfully identified as clear biodiesel
5	Test data to 5	Class A	0.005632	0.0054197	Successfully identified as clear biodiesel
6	Test data to 6	-	0.0070032	0.0061135	-
7	Test data to 7	Class A	0.0023688	0.0031081	Successfully identified as clear biodiesel
8	Test data to 8	Class A	0.0059246	0.0041369	Successfully identified as clear biodiesel
9	Test data to 9	Class A	0.0070428	0.0061123	Successfully identified as clear biodiesel
10	Test data to 10	Class A	0.0043427	0.0064774	Successfully identified as clear biodiesel
11	Test data to 11	Class A	0.0045357	0.0039806	Successfully identified as clear biodiesel
12	Test data to 12	-	0.000049	0.0000077	-
13	Test data to 13	Class A	0.0047671	0.0043063	Successfully identified as clear biodiesel
14	Test data to 14	Class A	0.0015199	0.004829	Successfully identified as clear biodiesel
15	Test data to 15	Class A	0.0069351	0.0060248	Successfully identified as clear biodiesel
16	Test data to 16	Class A	0.003815	0.0068614	Successfully identified as clear biodiesel
17	Test data to 17	Class A	0.0038947	0.0014916	Successfully identified as clear biodiesel
18	Test data to 18	-	0.000072	0.0000093	-

Based on the results in Table 1, the percentage of accuracy can be found using equation 2.

$$Accuracy = \frac{Number\ of\ correct\ semples}{Total\ number\ of\ samples} \times 100\%$$
$$Accuracy = \frac{15}{18} \times 100\% = 83.3\% \quad (2)$$

4. Conclusion

The introduction of biodiesel using the Euclidean distance method is very accurate. The test results show an accuracy of 83.3%. The process of taking a good picture is greatly influenced by the surrounding light, so the presence of a black box with a little light in it determines the quality of the image itself. Determining whether or not the quality of biodiesel is clear in this study is based solely on personal matters. Due to the absence of other comparisons to determine the quality of biodiesel.

References

[1] S. L. Douvartzides, N. D. Charisiou, K. N. Papageridis and M. A. Goula, "Green diesel: Biomass feedstocks, production technologies, catalytic research, fuel properties and performance in compression ignition internal combustion engines," *Energies*, vol. 12, no. 5, p. 809, 2019.

[2] H. Brännström, H. Kumar and R. Alén, "Current and potential biofuel production from plant oils," *BioEnergy Research*, vol. 11, pp. 592-613, 2018.

[3] A. G. Santos, V. P. Caldeira, L. D. Souza, D. S. Oliveira, A. S. Araujo and G. E. Luz, "Study of the thermal stability by thermogravimetry for oil, biodiesel and blend (B10) of different oilseeds," *Journal of Thermal Analysis and Calorimetry*, vol. 123, pp. 2021-2028, 2016.

[4] M. Rashvand, A. Zenouzi amd R. Abbaszadeh, "Potential of image processing, dielectric spectroscopy and intelligence methods in order to authentication of microalgae biodiesel," *Measurement*, vol. 148, p. 106962, 2019.

[5] C. Ming, *et al.,* "Combustion characterization of waste cooking oil and canola oil based biodiesels under simulated engine conditions," *Fuel*, vol. 224, pp. 167-177, 2018.

[6] I. Thushari and S. Babel, "Sustainable utilization of waste palm oil and sulfonated carbon catalyst derived from coconut meal residue for biodiesel production," *Bioresource Technology*, vol. 248, pp. 199-203, 2018.

[7] A. Endut, *et al.,* "Optimization of biodiesel production by solid acid catalyst derived from coconut shell via response surface methodology," *International Biodeterioration & Biodegradation*, vol. 124, pp. 250-257, 2017.

[8] F. Laila, C. U. Zanetta, B. Waluyo, S. Amien and A. Karuniawan, "Early identification of genetic diversity and distance from Indonesia cassava potential as food, industrial and biofuel based on morphological characters," *Energy Procedia*, vol. 65, pp. 100-106, 2015.

[9] A. M. Hupp, J. Perron, N. Roques, J. Crandall, S. Ramos and B. Rohrback, "Analysis of biodiesel-diesel blends using ultrafast gas chromatography (UFGC) and chemometric methods: Extending ASTM D7798 to biodiesel," *Fuel*, vol. 231, pp. 264-270, 2018.

[10] U. Erkut, F. Bostancıoğlu, M. Erten, A. M. Özbayoğlu and E. Solak, "HSV Color Histogram Based Image Retrieval with Background Elimination," *2019 1st International Informatics and Software Engineering Conference (UBMYK)*, Ankara, Turkey, 2019, pp. 1-5, doi: 10.1109/UBMYK48245.2019.8965513.

[11] R. Nainggolan, R. Perangin-angin, E. Simarmata and A. F. Tarigan, "Improved the performance of the K-means cluster using the sum of squared error (SSE) optimized by using the Elbow method," In *Journal of Physics: Conference Series,* vol. 1361, no. 1, p. 012015, 2019.

[12] R. Samet and M. Tanriverdi, "Face Recognition-Based Mobile Automatic Classroom Attendance Management System," *2017 International Conference on Cyberworlds (CW)*, Chester, UK, 2017, pp. 253-256, doi: 10.1109/CW.2017.34.

[13] Y. Lei, F. Jia, J. Lin, S. Xing and S. X. Ding, "An Intelligent Fault Diagnosis Method Using Unsupervised Feature Learning Towards Mechanical Big Data," in *IEEE Transactions on Industrial Electronics*, vol. 63, no. 5, pp. 3137-3147, May 2016, doi: 10.1109/TIE.2016.2519325.