paper_lutfi

by Moch Lutfi

Submission date: 25-Jun-2021 10:06PM (UTC+0900)
Submission ID: 1611543608
File name: Paper_lutfi.docx (263.34K)
Word count: 3812
Character count: 20965

Feature Extraction And Naïve Bayes Algorithm For Defect Classification Of Manalagi Apples

Moch. Lutfi1, Hasan Syaiful Rizal2, Mochammad Hasyim3
[1]Informatics Engineering, Yudharta University, Indonesia
[2]Islamic Religious Education, Yudharta University, Indonesia
[3]Islamic Religious Education, Yudharta University, Indonesia
Email: moch.lutfi@yudharta.ac.id1 , hsr@yudharta.ac.id2 , hasyim@yudharta.ac.id3

ABSTRACT

Apple is one of the trees that is widely cultivated and grows in subtropical areas. In Indonesia, there are many areas that cultivate apples, including Malang, Batu, Nongkojajar. One way to increase the economic value of apple farmers is by sorting them before sending them to the market. This is important to do in order to make it easier to determine the quality and selling price of manalagi apples. Most apple sellers will sort the apples manually which results in high costs, difficulty, and inconsistency in the sorting process. So far, the classification of defects in apples has been done using the naked eye. This also requires expertise or experts in distinguishing which apple defects are. However, experts have limitations, not all apple defects can be recognized or classified. In addition, each researcher only uses one image feature, namely the texture feature. In this study, using an image dataset of Manalagi apples totaling 337 images, where there are 184 images of good apples and 153 images of defective apples by extracting features on apples, it can be concluded that the nave Bayes method can be used to classify defects of manalagi apples based on texture.
Keywords: extraction, features, glcm, nave bayes.

1. INTRODUCTION

Apple is one of the trees that is widely cultivated and grows in subtropical areas. In Indonesia, there are many areas that cultivate apples, including Malang, Batu, Nongkojajar-Pasuruan, and apples that are widely grown in Indonesia are manalagi, anna, romebeauty and green apples.[1]. Manalagi apples are the main commodity in the Tutur area, especially the Nongkojajar area, Pasuruan district. One way to increase the economic value of farmers[2]Apples are processed by sorting before being sent to the market. This is important to do in order to make it easier to determine the quality[3] and the selling price of apples, what else?.

Fruit sorting is a selection process based on external characteristics (size, texture, color, foreign matter/dirt), and internal characteristics (sweet taste, acidity, and texture of apple fiber). Sorting in general is the process of separating or selecting good fruit and defective or damaged fruit. Most apple sellers will sort the apples manually which results in high costs, difficulty, and inconsistency in the sorting process.[4][5].

Ronald's research on the classification of sorting apples using nave Bayes[4]based on color, in this study manual selection of apple varieties resulted in high costs and inconsistencies. Therefore, a system is needed to distinguish the types of apples accurately and quickly. In the research of Halela et al[6]states that the K-NN algorithm using Histogram feature extraction can be applied well to the identification of apple species using 100 image data of apples, 50 pacific rose apples and 50 envy apples. 90 apples as training data and 10 apples as test data consisting of five images of Envy apples and five Pacific Rose apples which obtained an accuracy rate of 90%. While the research conducted by Arie Qur'ania[7]about extraction of texture features and color features for image-based apple classification. Texture and color feature extraction analysis can be used for image feature extraction. In the study, experiments were carried out three times, the first experiment was carried out on each feature in the grayscale image and color features, then the second experiment combined the features that exist in grayscale and color features that would be input to the K-NN method and the third combined all the features of texture and color. The results of the classification of apple species using K-NN show the level of texture feature extraction accuracy of 73.33%.

Gavhale proposes[8]technique of extracting the image processing of the defective leaf part. The proposed model framework is divided into four pre-processed image parts including RGB to different color space conversion, image enhancement, region segmentation using K-mean clusters, feature extraction and classification. texture feature extraction using GLCM statistics and color features through mean values.[2]identification and detection of disease in apples using computer vision and the proposed algorithm to analyze the surface of apple defects using color and texture features. K-mean cluster is performed for Region Of Interest (ROI) segmentation on image pixels based on intensity values. On research[9]propose a hybrid method to detect and classify diseases in plants using a method consisting of a primary phase; (a) detection of fruit and leaf spots; (b) classification of citrus diseases. Extraction of grape spots with optimal weighting segmentation method, which is done to improve image, texture, color, and geometric features. Next, apply a hybrid feature to select the best feature consisting of the PCA score method, and the skewness-based covariant vector, entropy. The selected features are distributed into the Multi-Class Support Vector Machine (M-SVM) for the disease classification process.

Naïve Bayes is a simple and efficient classification method[10] [11]and the time required in the learning process is faster than other machine learning[12]. Therefore, in this study, we propose a classification system for apple defects using the nave Bayes method[13] with texture feature extraction and color feature extraction[14][9]. One of the most reliable texture feature extraction and is often used by researchers is the Gray-level Co-occurence Matrix (GLCM) method.[15]and the color feature extraction used is a combination of RGB and HSV because RGB feature extraction is able to separate components of color image intensity. In this study, a combination method of color and texture feature extraction is proposed in the input image, which is then used as an input for the nave Bayes classification to identify the type of apple defects in the apple image. The dataset that will be used in this study is 200 apple images taken at random from apple collectors consisting of 100 normal apples and 100 defective apples, the dataset is taken from one of the largest apple producers in East Java, namely the Nongkojajar area, Pasuruan district.

2. RESEARCH METHOD

The method proposed in this research is the nave Bayes method using variables generated from feature extraction of apple images, the initial stage of preprocessing on apple digital images is carried out with texture and color feature extraction approaches. In general, the method proposed in this study consists of dataset collection, feature extraction and classification as shown in Figure 2.1 as follows:

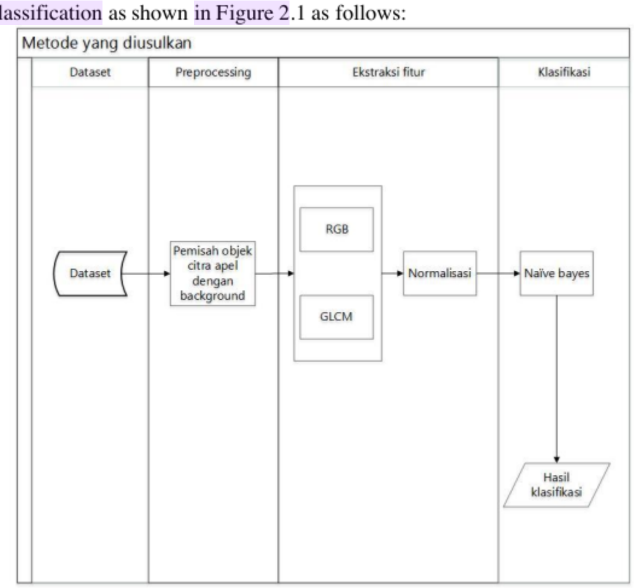

Figure 2.1 proposed method

The initial step that has been taken is collecting datasets that are used as test data and training data. Then the extraction of color and texture features is carried out on each training and test image data. After the extraction process is carried out, the data is normalized so that no parameter dominates at the data calculation stage. After that the data is classified and tested using the nave Bayes method, then the next step is testing the data to evaluate the accuracy of the data using a confusion matrix.

2.1 *Image Processing*

The definition of image processing is a process to analyze and observe an object, according to Jain[16][17]Image Processing is "two-dimensional image processing via a digital computer". According to Efford[18]Image processing is a term commonly used to modify and manipulate images. Photo is an image that has two dimensions that can be processed easily. In this study, apple images are used which will later be used to classify apple defects using GLCM texture features and HSV color features.

2.2 Segmentation

Image segmentation is a process used to get objects that are in an image or image process divisiondigital imageinto several parts with each part or object having similarities in its attributes[7]. In this study, object segmentation is carried out as a first step to classifying an object. The segmentation process is carried out to separate[19] the foreground region with the background region which aims to simplify the feature extraction process.

2.3 Feature Extraction

Feature extraction is the process of taking a feature contained in an object in the image. Then an object that is in the image may need to be detected for its edges, then the related object characteristics are calculated as features. During the feature extraction process it may be necessary to convert some input images as binary images, perform pattern thinning, and so on[20].

2.4 Color Features

The visible color is the spectrum of light reflected by objects which are then captured by the eye's sense of sight and then translated by the brain as a certain color. Gonzales et al[21]conveys several color models known in image processing, namely RGB, HSV, CMY, CMYK, HIS, YCbCr, YIQ and NTSC. The National Television Systems Committee (NTSC) color space is used on television. The advantage of this format is that the gray level information is separated from the actual color data, so the same signal can be used for both monochrome and color television. in NTSC image data consists of three components, namely luma (Y), in-phase (I) and quadrature (Q). Furthermore, the RGB color model is used on the monitor which consists of red (red), green (green) and blue (blue).[22]. These three colors are referred to as primary colors.

2.5 Texture Features

Texture characteristics are important features in an image which is information in the form of the arrangement of the surface structure of an image. This is because some objects have certain patterns, which for humans are easy to distinguish. And because of that with the existence of a computer machine, it is expected to be able to recognize such characteristics. In this feature extraction, the distinguishing feature is the texture which is the defining characteristic of the image. The statistical technique commonly used for feature extraction is the gray level co-occurrence (GLCM) matrix.[23]. The technique is carried out by scanning to find traces of the degree of gray for every two pixels separated by a fixed distance d and angle . Usually the angles used are 0^o, 45^o, 90^o, and 135^o[17].

2.5.1 Gray Level Co-occurrence Matrices (GLCM)

In 1973 research conducted by Haralick[24] proposed Gray Level Co-occurrence Matrices (GLCM) by describing 28 spatial pattern features[17]. The calculation phase (GLCM) uses texture extraction in the second order, which is the relationship between the two original image pixels. Example: f(x, y) is an image of size Nx and Ny which has pixels with a probability of up to L level and is a direction vector of spatial offsets. defined as the number of pixels with which there is an offset to the pixel with a value of , which can be expressed in the equation$\vec{r}$ $GLCM_{\vec{r}}(i,j) j \in 1,..,L \vec{r} i \in 1,..,L$[2.1] :

$$GLCM_{\vec{r}}(i,j) = \{(x_1,y_1),(x_2,y_2) \in (N_x,N_y)x(N_x,N_y) | f(x_1,y_1) = j^{\vec{r}} = \overrightarrow{(x_2-x_1, y_2-y_1)}\} \quad (2.1)$$

In this case, the offset can be an angle and/or a distance. For example, the following figure shows the four directions for GLCM.$\vec{r}$

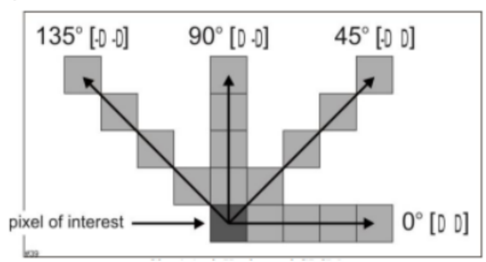

Figure 2.2 Example of Direction for GLCM with Angles 0o, 45o, 90o, and 135o

To get the GLCM feature proposes Haralick[24]using some of the quantities used. For example, Newsam and Kammath[25] using 5 quantities in the GLCM feature, namely ASM, entropy, contrast, IDM, and correlation.

- *Angular Second Moment* (ASM)

ASM is a measure of image homogeneity that can be calculated in the following way:

$$ASM = \sum_{i=1}^{L} \sum_{j=1}^{L} (GLCM(i,j))^2 \quad (2.2)$$

Where L = number of levels

- *Contrast*

  Measures the spatial frequency of the image and the GLCM moment difference. Contrast will be 0 if the neighboring pixels have the same value. To calculate the gray value of pixels is calculated by the following formula:

$$Kontras = \sum_{n=1}^{L} n^2 \left\{\sum_{|i-j|=n} GLCM(i,j)\right\} \quad (2.3)$$

- *Inverse Different Moment* (IDM)

  The IDM feature is used to measure homogeneity which can be calculated in the following way:

$$IDM = \sum_{i=1}^{L}\sum_{j=1}^{L} \frac{(GLCM(i,j))^2}{1+(i-j)^2} \quad (2.4)$$

- Entropy

  Entropy is used to measure the complexity (random) of an image. Entropy will be high value when the image is not uniform. Equation to calculate entropy:

$$Entropi = -\sum_{i=1}^{L}\sum_{j=1}^{L}(GLCM(i,j)\log(GLCM(i,j)) \quad (2.5)$$

- Correlation

  Correlation is used to measure the linearity of a number of pixel pairs, calculated using the equation:

$$Korelasi = \frac{\sum_{i=1}^{L}\sum_{j=1}^{L}(ij)(GLCM(i,j) - \mu_i'\mu_j'}{\sigma_i'\sigma_j'} \quad (2.6)$$

Where

$$\mu_i' = \sum_{i=1}^{L}\sum_{j=1}^{L} i * GLCM(i,j) \quad (2.7)$$

$$\mu_j' = \sum_{i=1}^{L}\sum_{j=1}^{L} j * GLCM(i,j) \quad (2.8)$$

$$\sigma_j{}^2 = \sum_{i=1}^{L}\sum_{j=1}^{L} GLCM(i,j)(i-\mu_i')^2 \quad (2.9)$$

$$\sigma_i{}^2 = \sum_{i=1}^{L}\sum_{j=1}^{L} GLCM(i,j)(i-\mu_i')^2 \quad (2.10)$$

2.6 Data normalization

*preprocessing*digital image of apples is done by using texture and color feature extraction approach. Color feature extraction includes mean, standard deviation, skewness, and kurtosis. Then the texture feature extraction includes inverse different moment (IDM), entropy, angular second moment (ASM), and correlation and contrast. In data processing, the normalization process is needed before the data mining process, so that no parameters dominate in calculating the distance between data[26]. All variables will be normalized in the range 0 -1. The following equation for the normalization process is carried out.

$$\text{Normalisasi} = \frac{(Data - Min)}{Max - Min} \quad (2.11)$$

2.7 Bayes' Theorem

Naive Bayes is a simple probability classification algorithm based on Bayes' theorem. The nave Bayes classifier argues that the value of each attribute in a particular class does not depend on other attributes, this opinion can be interpreted as class conditional independence (cci) so that the nave Bayes calculation can be implemented more simply and is called nave[26]. Another nave Bayes equation uses a gaussian distribution on the Manalagi apple image dataset. To calculate the mean and standard deviation of all attributes, the following equation is used:

$$g(x,\mu,\sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \quad (2.11)$$

The flow of the nave Bayes method is as follows:

1. Read *training data*
2. Calculatenumber and probability, but if the data is numeric, then:
   a. Find the mean andstandard deviation of each parameter which is numerical data.
   b. Find the probabilistic value withhow to calculate the number of appropriate data from the same category divided by the number of data in that category.
3. Get the mean, standard deviation and probability. Bayes' basic rule is that a hypothetical outcome or event (Y) can be estimated based on the observed evidence (S). There are several important things from the Bayes rule, namely:

1. initial/priority probabilityY or K(Y) is the probability of the hypothesis before the evidence is observed.
2. final probabilityY or K (Y|S) is the probability of the hypothesis after the evidence is observed

2.8 *Confusion Matrix*

Confusion Matrix is a classification table that contains information on the results of the overall system calculation[27]. Measurement data is evaluated through accuracy, precision and recall. The measurement results are represented in a classification table for easy reading. Accuracy is the number of percentages of the correct classification system. Precision is a measure of the accuracy of a class that has been classified by the system. While recall is the percentage of data with a positive value from the classification results whose value is also positive. The calculation formula is[28] [29]:

Accuracy = (TP+TN) / (TP+FP+TN+FN) (2.12)

Precision = TN / (FP+TN) (2.13)

Recall = TP / (TP+FN) (2.14)

Table 2.1 confusion matrix

		Predicted	
		negative	*Positive*
actual	*negative*	*TN*	*TP*
	Positive	*FN*	*FP*

3. RESULTS AND DISCUSSIONS

The experiment was carried out using a Dell E7270 laptop with a Core i7-6600U 2.60GHz processor, 16GB of memory (RAM), 256GB NVMe SSD with Windows 10 pro 64-bit OS. While the software used to extract the apple image uses Matlab, to analyze the performance measurement results, the Rapidminer Studio application is used.

The dataset used in this study is the image of Manalagi Apple taken directly using the Xiaomi Redmi Note 8 cellphone camera using a 16 mega pixel camera specification. In this study, the Manalagi apple image data used were 337 apple images, consisting of 184 good apples and 153 defective apples. In research that uses digital images, it is necessary to have steps to convert image data into numeric data, so it is necessary to process images into numbers or numerics so that they can be processed using the methods used in this study. The research process carried out is based on the proposed model as shown in Figure 2.1.

The initial stage of preprocessing aims to eliminate noise and cropping so that the apple image object can be distinguished between the background so that the following results are obtained:

Figure 3.1 Uncropped apples   Figure 3.2 Cropped apples

The apple image that has been preprocessed as shown in Figure 3.2 is then converted into a gray image as shown in Figure 3.3 then from the gray image to a digital binary like Figure 3.4 so that the image only has two values, namely the value 1 as white and the value 0 as black. . In this case the value of the number 1 signifies as the object and the value of the number 0 as the background of the image. The results of binary images if converted in Excel will be like in Figure 3.4.

Figure 3.3 Gray image apple

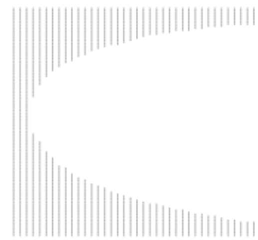

Figure 3.4 Binary to excel conversion

The dataset used in this study amounted to 337 images, where there were 184 images of good apples and 153 images of defective apples. The feature extraction from GLCM used in this study is the contrast, correlation, energy, homogeneity, skewnees, kurtosis, entropy and IDM features. Experiments were carried out using k-fold = 5 to k-fold = 10 in the nave Bayes method on the apple defect classification dataset using Rapidminer tools and the results can be seen in Figure 3.5 below:

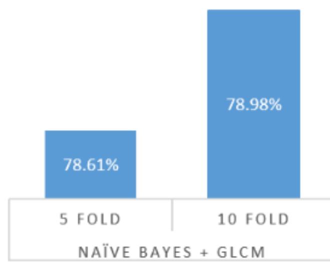

Figure 3.5 accuracy results with nave Bayes method

In the classification of apples can be done using feature extraction Gray Level Co-Occurrence Matrix (GLCM) and nave Bayes algorithm. After the experimental process with the feature extraction method as feature selection and the nave Bayes algorithm, then validation with cross validation is carried out, then the last step is to evaluate the results of the experiments that have been carried out. This process aims to find out how much accuracy is obtained.

Table 3.1 table confusion matrix

	true Good	*true* Ugly	*class precision*
pred. Good	146	33	81.56%
pred. Ugly	38	120	75.95%
classrecall	79.35%	78.43%	

The experimental results show that the highest accuracy is obtained with k-fold = 10 and the lowest result is k-fold = 5. The following is an example for calculating the accuracy of nave Bayes at a value of k-fold = 10:

a. *Recall*is a column that contains the results of research that are classified appropriately. Here is an example for the calculation:

$$recall = \frac{TP}{TP + FN} = \frac{146}{146 + 38} = \frac{146}{184} = 0.7934 = 79.35\%$$

b. *Precision*is a line that contains the results of research that are classified appropriately. Here is an example for the calculation:

$$presisi = \frac{TP}{TP + FN} = \frac{146}{146 + 33} = \frac{146}{179} = 0.8156 = 81.56\%$$

c. Accuracy is the percentage of classification results that have a correct value that can be obtained by the following calculations:

$$Acc = \frac{TP + TN}{TP + FN + FP + FN} = \frac{146 + 120}{146 + 33 + 38 + 120} = \frac{266}{337} = 0.7893 = 78.98\%$$

4. CONCLUSION

Based on the results of research tests carried out on the manalagi apple defect classification process totaling 337 images, of which there are 184 good apple images and 153 defective apple images by extracting features on apples, it can be concluded that the nave Bayes method can be used to classify manalagi apple defects based on texture. The best accuracy results with the proposed method use the cross fold validation 10 parameter with 78.98% results and other tests with the cross fold validation 5 parameter the results are less than optimal at 78.61%.

REFERENCES

[1] Subejo, Prasetyono, and M. Zainuri, "Agrieconomics, ISSN 2301 - 9948 April," *Agrieconomics*, vol. 1, no. April, 2012.

[2] P. Jolly and S. Raman, "Analyzing Surface Defects in Apples Using Gabor Features," *Proc. - 12th Int. conf. Signal Image Technol. Internet-Based System. 2016*, pp. 178–185, 2017, doi:10.109/SITIS.2016.36.

[3] SR Dubey and AS Jalal, "Detection and classification of apple fruit diseases using complete local binary patterns," *Proc. 2012 3rd Int. conf. Comput. comm. Technol. ICCCT 2012*, pp. 346–351, 2012, doi:10.1109/ICCCT.2012.76.

[4] R. Misigo, "Classification of Selected Apple Fruit Varieties Using Naive Bayes," *Univ. Nairobi*, vol. 3, no. 1, p. 56, 2016, doi: https://doi.org/10.3929/ethz-b-000238666.

[5] C. Iswahyudi, "Application Prototype for Measuring Apples Ripening," *J. Teknol.*, vol. 3, pp. 107–112, 2010.

[6] IA Halela, "Identification of Types of Apples Using the K-Nearest Neighbor (KNN) Algorithm with Histogram Feature Extraction." pp. 1–8, 2016.

[7] A. Qur'ania, L. Karlitasar, and S. Maryana, "Texture Analysis and Color Feature Extraction for Image-Based Apple Classification," *Computing Workshop in Science and Technology. Nuclear.*, pp. 296–304, 2012.

[8] KR Gavhale, U. Gawande, and KO Hajari, "Unhealthy region of citrus leaf detection using image processing techniques," *2014 Int. conf. Converg. Technol. I2CT 2014*, pp. 2–7, 2014, doi:10.109/I2CT.2014.7092035.

[9] M. Sharif, MA Khan, Z. Iqbal, MF Azam, MIU Lali, and MY Javed, "Detection and classification of citrus diseases in agriculture based on optimized weighted segmentation and feature selection," *Comput. electrons. agric.*, vol. 150, no. May 2017, pp. 220–234, 2018, doi:10.1016/j.compag.2018.04.023.

[10] LH Lee and D. Isa, "Automatically computed document dependent weighting factor facility for Naïve Bayes classification," *Expert System. app.*, vol. 37, no. 12, pp. 8471–8478, 2010, doi: 10.1016/j.eswa.2010.05.030.

[11] P. Domingos and M. Pazzani, "On the Optimality of the Simple Bayesian Classifier under Zero-One Loss. Machine Learning,"*Mach. Learn.*, vol. 29, pp. 103–130, 1997, [Online]. Available: https://link.springer.com/article/10.1023/A:1007413511361.

[12] H. Zhang and X. Zhang, "Data mining static code attributes to learn defect predictors," *IEEE Trans. Softw. eng.*, vol. 33, no. 9, pp. 635–636, 2007, doi:10.109/TSE.2007.70706.

[13] O. Kleynen, V. Leemans, and M. Destain, "Development of a multi-spectral vision system for the detection of defects on apples," vol. 69, pp. 41–49, 2005, doi:10.1016/j.jfoodeng.2004.07.008.

[14] A. Ciputra, A. Susanto, and et al, "With Naive Bayes Algorithm and Digital Image Feature Extraction," *Symmetrical J. Tek. Mechanical, Electrical and Computer Science.*, vol. 9, no. 1, pp. 465–472, 2018.

[15] M. Widyaningsih, J. Teknik, I. Computer, S. Palangkaraya, and JG Obos, "Identification of Ripe Apples Using Gray Level Co-Occurrence Matrix (Glcm)," no. 114.

[16] M. Tuceryan and AK Jain, "Handbook of Pattern Recognition &Amp; Computer Vision," no. October, pp. 235–276, 1993.

[17] AK Friday, "Abdul Kadir Friday," no. August, pp. 2011–2014, 2013.

[18] N. Efford, "Digital Image Processing," p. 372, 2000.

[19] P. Priya and AD Dony, "Study of Feature Extraction Techniques for the Detection of Diseases of Agricultural Products," no. c, pp. 4–8, 2015, doi:10.17148/IJIREEICE.

[20] R. Munir, "Pattern Recognition," pp. 229–236, 2014.

[21] RC Gonzalez and RE Woods, *Digital Image Processing*. Pearson/Prentice Hall, 2010.

[22] V. Leemans, H. Magein, and M. Destain, "Defects segmentation on 'Golden Delicious' apples by using color machine vision," vol. 20, pp. 117–130, 1998.

[23] S. Jatmika and D. Purnamasari, "Using Image Processing Method Based on Color Composition," vol. 8, no. 1, pp. 51–58, 2014.

[24] I. Haralick, RM, Shanmugam, K., & Dinstein, "Textural Features for Image Classification," *IEEE Trans. syst. Man, Cyberne.*, vol. 34, pp. 1811–1815, 2015, doi:10.1190/segam2015-5927230.1.

[25] S. Newsam and C. Kamath, "Comparing Shape and Texture Features for Pattern Recognition in Simulation Data," *IS&T/SPIE'S Annu. sym. electrons. Imaging*, 2005.

[26] J. Han and M. Kamber, *Data Mining: Concepts and Techniques (3rd ed)*. 2012.

[27] M. Sokolova and G. Lapalme, "A systematic analysis of performance measures for classification tasks," *inf.*

Process. Manag., vol. 45, no. 4, pp. 427–437, 2009, doi: 10.1016/j.ipm.2009.03.002.
[28] Moch. Lutfi and Mochamad Hasyim, "Handling Missing Value Data on Corn Production Quality Using the K-Nn Imputation Method on the C4.5 Algorithm,"*J. Resist. (Computer System Engineering)*, vol. 2, no. 2, pp. 89–104, 2019, doi:10.31598/jurnalresistor.v2i2.427.
[29] F. Gorunescu, *Data mining: concepts and techniques*. 2011.

paper_lutfi

ORIGINALITY REPORT

14%	6%	9%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Lambung Mangkurat University Student Paper	2%
2	Fathorazi Nur Fajri, Nur Hamid, Ricardus Anggi Pramunendar. "The recognition of mango varieties based on the leaves shape and texture using back propagation neural network method", 2017 International Conference on Sustainable Information Engineering and Technology (SIET), 2017 Publication	2%
3	Submitted to Universitas Siswa Bangsa Internasional Student Paper	1%
4	Submitted to International Islamic University Malaysia Student Paper	1%
5	Irfan Salimi, Bima Sena Bayu Dewantara, Iwan Kurnianto Wibowo. "Visual-based trash detection and classification system for smart trash bin robot", 2018 International Electronics Symposium on Knowledge	1%

Creation and Intelligent Computing (IES-KCIC), 2018
Publication

6	Muhammad Sharif, Muhammad Attique Khan, Zahid Iqbal, Muhammad Faisal Azam, M. Ikram Ullah Lali, Muhammad Younus Javed. "Detection and classification of citrus diseases in agriculture based on optimized weighted segmentation and feature selection", Computers and Electronics in Agriculture, 2018 Publication	1 %
7	ieeexplore.ieee.org Internet Source	1 %
8	Submitted to Universitas Dian Nuswantoro Student Paper	1 %
9	Lecture Notes in Computer Science, 2009. Publication	1 %
10	mafiadoc.com Internet Source	1 %
11	research.wsulibs.wsu.edu:8080 Internet Source	<1 %
12	file.allitebooks.com Internet Source	<1 %
13	"Improving Productivity through Automation and Computing", 2019 25th International	<1 %

Conference on Automation and Computing (ICAC), 2019
Publication

14	Gómez-Sanchis, J., J. Blasco, E. Soria-Olivas, D. Lorente, P. Escandell-Montero, J.M. Martínez-Martínez, M. Martínez-Sober, and N. Aleixos. "Hyperspectral LCTF-based system for classification of decay in mandarins caused by Penicillium digitatum and Penicillium italicum using the most relevant bands and non-linear classifiers", Postharvest Biology and Technology, 2013. Publication	<1 %
15	www.hendun.org Internet Source	<1 %
16	www.hotdealsdigest.com Internet Source	<1 %
17	Muhammad Attique Khan, Tallha Akram, Muhammad Sharif, Muhammad Awais, Kashif Javed, Hashim Ali, Tanzila Saba. "CCDF: Automatic system for segmentation and recognition of fruit crops diseases based on correlation coefficient and deep CNN features", Computers and Electronics in Agriculture, 2018 Publication	<1 %
18	Natalia Zakhvatkina, Anton Korosov, Stefan Muckenhuber, Stein Sandven, Mohamed	<1 %

Babiker. "Operational algorithm for ice/water classification on dual-polarized RADARSAT-2 images", Copernicus GmbH, 2016
Publication

---

19 bbrc.in
Internet Source
<1 %

---

20 tutorsonspot.com
Internet Source
<1 %

---

21 www.aprp.pt
Internet Source
<1 %

---

22 www.mdpi.com
Internet Source
<1 %

---

23 "Smart and Innovative Trends in Next Generation Computing Technologies", Springer Science and Business Media LLC, 2018
Publication
<1 %

---

24 Zahid Iqbal, Muhammad Attique Khan, Muhammad Sharif, Jamal Hussain Shah, Muhammad Habib ur Rehman, Kashif Javed. "An automated detection and classification of citrus plant diseases using image processing techniques: A review", Computers and Electronics in Agriculture, 2018
Publication
<1 %
