Model Naïve Bayes Classifiers For Detection Apple Diseases

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Abstract— Apples are one of the most productive varieties of fruit in the world, with a high nutritional and medicinal value. However, numerous diseases affect apple production on a wide scale, resulting in significant economic losses. These diseases often go overlooked until just before, after, or after fruit has been processed. Many pathogens can be avoided with cultural traditions and (optional) fungicides, even if there are no cures for tainted fruit. However, accurate diagnosis is essential for determining the right management practices and preventing further losses. Apple scab, apple rot, and apple blotch are some of the most prevalent diseases that affect apples. The proposed approach will greatly aid in the automated identification and classification of apple diseases, according to our test results. We discovered that normal apples were easy to discern from diseased apples in our trial, and that the texture-based GLCM function produced more reliable results for apple disease classification, with a classification accuracy of more than 96.43 percent. This demonstrates that combining the GLCM extraction function with naive bayes classification will greatly improve accuracy.

Keywords—Naive bayes, Apple Diseases, Classifier

I. Introduction (*Heading 1*)

Apple is a fruit that is eaten and cultivated all over the world, Because of its delicacy and high nutritional value [1][2], Apples are one of the most productive varieties of fruit in the world, with a high nutritional and medicinal value. However, numerous diseases affect apple production on a wide scale, resulting in significant economic losses [3]. Traditionally, plant disease severity has been determined by qualified experts visually inspecting plant tissues[4], This results in high costs and inefficiency. Cultivation and management specialist systems have been widely used as a result of the widespread use of digital cameras and the advancement of information technology in agriculture, significantly increasing plant production capacity[5]. Apple fruit diseases can result in major yield and quality losses. These diseases often go overlooked until just before, after, or after fruit has been processed. Many pathogens can be avoided with cultural traditions and (optional) fungicides, even if there are no cures for tainted fruit. However, accurate diagnosis is essential for determining the right management practices and preventing further losses[6]. Healthy recognition of fruits and apples is an important issue for the economic and agricultural fields.

The traditional method for detecting and identifying fruit diseases relies on professional examination through the naked eye. Owing to the remote areas of their supply, consulting experts can be costly and time consuming in some developed countries. Automatic fruit disease detection is important for detecting disease signs on developing fruits as soon as they appear. When fruit infections strike during harvest, they can cause severe production and quality losses [7]. Apple scab, apple rot, and apple blotch are some of the most prevalent diseases that affect apples[8]. Apple scabs appear as gray or brown corky patches on the apple. Apple rot causes somewhat sunken, oval brown or black patches that are often surrounded by a red halo. Apple blotch is a fungus that causes black, uneven, or lobed edges on the fruit's surface[8].

(a) (b) (c)

Figure 1. The following are three common apple fruit diseases: (a) apple scab, (b) apple rot, and (c) apple blotch [8]

Apple samples with identical feature values may be grouped into one group in a multidimensional space [9][10]. The identification of apple diseases using the Plant Pathology Apple Dataset is discussed in this article. Pre-processing is the next stage, which includes image enhancement and grayscaling. The pre-processed image is then used to apply feature extraction methods. The Gray Level Co-occurrence Matrix (GLCM) is used in this case, with six parameters (Angular Second Moment, Contrast, Entropy, Variance, Correlation, and Inverse Different Moment). After that, the image generated by GLCM's feature extraction will be processed using two different learning algorithms: Naive Bayes.

II. LITERATURE REVIEW

In previous research has been conducted a lot of research in the field of apple disease, but still not get significant results, here are some studies related to the problems of this study. Jamdar and Patil (2017) Presented Image processing based solutions are proposed and evaluated for the detection and classification of apple fruit diseases. The proposed approach consists of mainly three steps. In the first step, image segmentation is performed using the K-Means grouping technique. In the second step the features are extracted. In the third step, the training and classification was carried out at LVQNN and resulted in an accuracy of up to 90% [13]. Misigo and Miriti (2016) The use and performance of the Naive Bayes algorithm in the categorization of apple varieties were explored in this paper. With 91 percent, 90 percent, 89 percent, and 83 percent, respectively, the accuracy of analysis of major components, fuzzy logic, and MLP-Neural, the accuracy of Naive Bayes is higher than the accuracy of analysis of major components, fuzzy logic, and MLP-Neural. This study demonstrates that Naive Bayes is a viable option [14]. Mishra and Barskar (2021) Presented In the future, Decision trees and Nave Bayes classifiers are examples of machine learning classification approaches that may be used for disease detection in plants, with the goal of assisting farmers in the automatic identification of all types of illnesses in plants. [15]. Yuan (2018) Presented Analysis of the Nave Bayes algorithm for image classification using the co-occurrence matrix texture attribute extraction approach yielded a 96 percent accuracy score[11]. Yuan (2020) Presented This is the driving force behind the author's decision to use the algorithm to diagnose apple disease. Apple Disease Detection Using a Deep Learning Algorithm had an accuracy of 88.5 percent [12] and For the automated identification and classification of fruit diseases, the CLBP function and Multi-class Support Vector Machine as a classifier were used. 93 percent of the time[8] in previous studies. For the classification of apple disease, we used the GLCM function extraction and the nave Bayes algorithm in our research. It is anticipated that using GLCM and Naive Bayes would result in greater precision.

III. METHOD

Figure 2 depicts the steps of the suggested solution. For the fruit disease classification challenge, precision picture segmentation is expected; otherwise, the characteristics of the non-affected region would prevail over the features of the diseased region. To determine the region of interest, which is only the infected section, this technique favors K-Means dependent picture segmentation. Features are derived from the segmented image of the fruit after it has been segmented using GLCM. Finally, a naive bayes classifier is used for training and classification.

The suggested solution's structure is depicted in Fig. 2. The rest of this section goes over each phase of the proposed method.

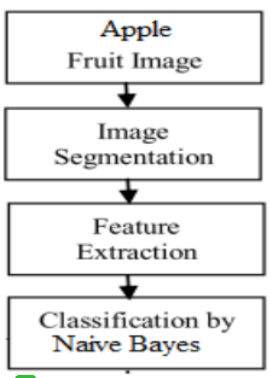


Figure 2. Framework of the proposed approach.

A. *Data acquisition*

Data acquisition was done to obtain the sampling data needed in this study. The object used is using 4 types of apple disease,namely apple blotch, apple rot, apple scab and healthy.

B. *Image Segmentation*

At this stage to get an image with the same provisions with the intention of making it easier for the system to process the image is done cropping and then the image data used is converted into grayscale imagery with the aim to be able to display 1 color on each image after that is done noise removal to smooth the image so that in the process later can produce maximum results that are then done detection of canny edge lines that are useful as segmentation c itra. on each preprocess done with the intention to give good results at the time of extracting texture characteristics.

C. *Feature Extraction*

The number of pairs of pixels with the same brightness degree, split by d pixels, and with an inclination angle of are the components of the GLCM Method. To put it another way, the matrix represents the probability of two pixels separated by d and angle j having the same gray level I and j. As seen in the figure, neighboring pixels with a distance and between them can be found in eight different directions. Haralick et al. suggest different types of statistical texture properties that can be derived using the co-occurrence matrix approach. Any of these include, but are not limited to[16]: The four characteristics of GLCM are extracted and summarized as follows: comparison, entropy, homogeneity, and energy. The following is the equation for these characteristics:

1. In the GLCM matrix, the gray level variation is visible as contrast. It calculates the pixel's and its neighbor's intensity.
2. The energy function is used to calculate local homogeneity, which is referred to as the Entropy. It has a spectrum of 0 to 1 as a value.
3. Homogeneity feature: in the GLCM, compute the not-zero, which is the opposite of the contrast weight. It has a spectrum of 0 to 1 as a value.
4. The amount of energy, or entropy.

D. *Naïve Bayes*

Classification is a function f that translates each set of attributes (features) x to one of the possible class labels y. Job teaching would result in the creation of a blueprint, which will then be stored as a memory[17]. To construct a model, classification algorithms use training data. The model is then used to estimate the class mark of new data that has not yet been classified. Democracy (independence) is a solid (naive) assumption. The "model with individual functions" is the model that was used.

The application of Bayes' theorem is used to create a basic probabilistic-based prediction strategy known as Nave Bayes.

- Democracy (independence) is a solid (naive) assumption.
- The “model of individual features” is the model that was used.

The easiest approach for using current opportunities is the Nave Bayes classification, which assumes that any vector X is open (independence).

IV. Result and Discussions

A. Datasets

A dataset of damaged apple fruit was also investigated, with 391 images split into four categories: apple blotch (104), apple rot (107), apple scab (100), and normal apples (80)[18] as the picture below:

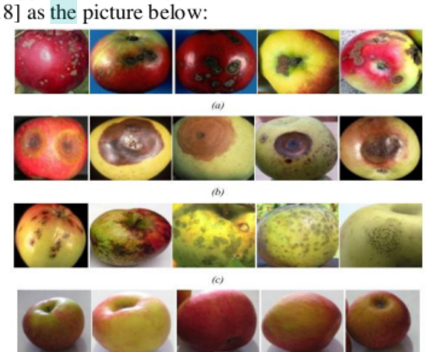
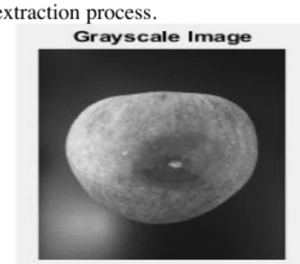


Figure 3: Images of form (a) apple scab, (b) apple rot, (c) apple blotch, and (d) standard apple from the data collection.

B. Feature Extraction

We get GLCM values at each angle for apple picture from GLCM in Algorithm. To simplify the interpretation of the proposed procedure, we took one of the closest samples to display the findings clearly, the three disease pictures. When we add the apple image to the Gray level co-occurrence matrix in our proposed process, we get eight values for each angle (0o, 45o, 90o, and 135o), which we use in the texture feature extraction stage to get four features. Figure 5 shows the GLCM result for an apple image, which will be used in the feature extraction process.



	0	45	90	135	average
Contrast	0.039378	0.055427	0.036399	0.057972	0.047294
Correlation	0.99268	0.98969	0.99322	0.98922	0.9912
Energy	0.19458	0.19027	0.19547	0.18987	0.19255
Homogeneity	0.9807	0.97307	0.98226	0.97236	0.9771

Figure 4. the results of processing sample data with GLCM

C. Classifier

In this study using matlab as supporting software for the implementation of naive bayes the following is a display of naive bayes algorithm modeling using matlab:

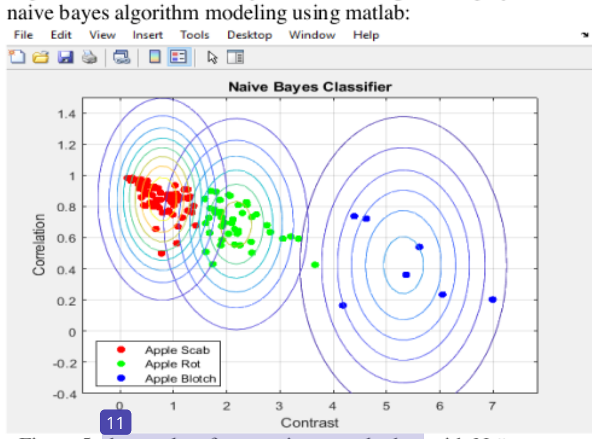


Figure 5. the results of processing sample data with Naïve bayes

The picture above is a modeling of the Naive Bayes algorithm for disease classification using Matlab, first the dataset to be processed is entered into the Citra_Latih folder, then the dataset is processed using the GLCM feature feature and then for classification using the Naive Bayes algorithm to get clusters of 3 diseases from apples, Processing results Then the data accuracy is measured and the accuracy of the modeling is done by using the performance object to the results of data accuracy are obtained as follows:

```
Command Window
Replicate 1, 4 iterations, total sum of distances = 24.2934.
Replicate 2, 3 iterations, total sum of distances = 24.2934.
Replicate 3, 2 iterations, total sum of distances = 24.2934.
Replicate 4, 1 iterations, total sum of distances = 24.2094.
Replicate 5, 3 iterations, total sum of distances = 24.2934.
Best total sum of distances = 24.2094

accuracy =

   96.4286
```

V. Conclusion

In this article, image processing-based solutions for detecting and classifying apple fruit disease are suggested and evaluated. The suggested method consists primarily of four stages. Data preprocessing is performed in the first step, followed by image segmentation in the second. GLCM is used to remove the functionality in stage three. The fourth stage included using Naive Bayes for preparation and classification. As case studies and to test our software, we used three forms of apple disease: Apple Blotch, Apple Rot, and Apple Scab. The proposed approach will greatly aid in the automated identification and classification of apple diseases, according to our test results. We discovered that normal apples were easy to discern from diseased apples in our trial, and that the texture-based GLCM function produced more reliable results for apple disease classification, with a classification accuracy of more than 96.43 percent. This demonstrates that combining the GLCM extraction function with naive bayes classification will greatly improve accuracy.

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