Flower Classification Using Multi SVM and KNN Algorithms

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ABSTRACT

Flower type classification is one of the examples of the application of classification-based algorithms. This study used training data and test data consisting of images of 3 flowers, namely Daisy, Rose, and Sunflowers, with training data as many as 1069 RGB images in *.jpg format consisting of 315 Daisy Flower images, 268 Rose Flower images, and 486 Sunflower images. While the test data is 417 images in *.jpg format consisting of 165 images of Daisy Flowers, 109 images of Roses, and 113 images of Sunflowers. Flower recognition requires an algorithm. In previous research, there have been several methods or algorithms that can be used for classification, for example, SVM (Support Vector Machine), Naïve Bayes, KNN (K-Nearest Neighbors), and K-Means. In this research, 2 methods have been compared, namely K-Nearest Neighbor (KNN) and Support Vector Machine (SVM) with kernels in the process of classifying flower types. In classification testing using Support Vector Machine (SVM) with Linear kernel with ecoc method got the result 68.1055% and Classification with the K-Nearest Neighbor (KNN) algorithm obtained the best results when using K = 7 with a testing accuracy of 76.7386%.

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1. INTRODUCTION

Flowers are plants that are very numerous and easy to find around us. The research researched by Arinda Yola Kuswari, Muhammad Ade Rahman, and Derry Alamsyah explained that flowers are one part of plants with various types. Each flower has its own color, uniqueness, characteristics, and shape. Flowers have a function as a means of plant reproduction. There are several types of flowers in this world such as daisies, roses, and sunflowers.

The Daisy flower is one of the beautiful flowers with charming colors despite its small shape. Daisy flowers originated in China and are often used as decoration and the petals of daisy flowers can also be consumed. The characteristic of the daisy flower is its relatively white and yellow color and the petals are arranged neatly and stacked on top of each other. Daisy flowers have a height of about 30-70 cm. There are several types of Daisy Flowers such as the Marguerite Daisy, African Daisy, and Shasta daisy. According to a paper prepared by Ni Made Gangga Dwipayani Arjana, explained that the daisy flower is one of the most recognizable flowers in the world. The structure of the daisy flower itself has white petals and the petals surround/circle the center which is usually bright yellow, more or less similar to a sunflower.

Roses whose Latin name Rose is one of the most beautiful flowers with its striking red color and unique shape of the petals. According to research conducted by Wellia Shinta Sari and Christy Atika Sari, it is explained that roses have various shapes, sizes, and colors, therefore there are many types of roses scattered on this earth. Roses are often called the Queen of flowers because of their beauty and beauty. There are several types of roses that are distinguished according to their colors such as Red Roses, White Roses, and Pink Roses but the dominant one that is spread is Red Roses. The characteristics of roses include sharp thorns on the stalk, a unique petal shape that only has one color based on its type, and rose petals stacked or stacked.

Sunflowers are native to Eastern North America. Sunflowers are synonymous with bright colors and round brown centers. The characteristics of sunflowers include bright yellow sunflowers with the shape of petals that circle around the center of the sunflower with a fairly rough texture and a towering and sturdy stem. The center of the Sunflower is a seed that can be consumed by humans and the seeds can be made into oil based on research researched by Aditya Rajbongshi, Al Amin Biswas, Jahanur Biswas, Rashiduzzaman Shakil, Bonna Akter and Mala Rani Barman in 2021.This research aims to classify 3 types of flowers using a computer this technique is called Digital Image Processing.

Flowers can be utilized in the industrial field, one of which is the cut flower industry. Based on a book written by Ir. Nin Rismini Harry about cut flowers, cut flowers are very much managed by flower farmers in Indonesia. Flowers that are usually a lot to be processed are roses, orchids, gerberas, chrysanthemums, and gladiolus. The cut flower industry is very much developed in Indonesia because of the many requests made by customers, especially when there are celebrations carried out. For example, in the celebrations of Eid al-Fitr, Christmas, New Year, and Chinese New Year, even because of the large demand for cut flowers, so cut flower entrepreneurs can import from other countries to meet customer needs.

Research by Asahar Johar T, Delfi Yanosma, and Kurnia Anggriani explained that KNN (K-Nearest Neighbors) is a simple but effective method for image classification.The way the KNN algorithm works is by distance, which means that if there is an image whose characteristics are similar, the distance is close or one class. Important things that must be considered in the KNN algorithm include determining the value of K and determining the distance matrix. methods that can be used in running the KNN algorithm are Minkowski Distance, Manhattan Distance, Euclidean Distance, Cosine Distance, Cityblock Distance, Chebychev Distance, Correlation Distance, Hamming Distance, Jaccard Distance, Mahalanobis Distance, Seuclidean Distance, and Spearman Distance. Usually, the most widely used method in running the KNN algorithm is Euclidean Distance. There are several steps in the KNN algorithm. The first step is to determine the value of K for class determination consideration, the value of K is usually odd because if K is an even value, it is included in Multi KNN. The second step calculates the distance of new data to each data point in the dataset. the third step is to take a number of K data with the closest distance and then determine the class of the new data. The KNN algorithm has a weakness, namely its inefficiency, which results in requiring a long time in the image classification process. Research researched by Nur Ridha Apriyanti, Radityo Adi Nugroho, and Oni Soesanto states that the KNN algorithm also has the advantage of being easy to apply, quite effective in classifying objects and not affected by the order of objects.

In previous research researched by Maiwan Abdulrazzaq and Hivi Dino, it was explained that SVM (Support Vector Machine) is an algorithm that is usually used for image classification and regression. SVM aims to find the best Hyperplane by maximizing the distance between classes. The way the SVM algorithm works is by forming a hyperplane as a boundary between 2 classes. How to determine which class the image belongs to by looking at the characteristics that have been extracted from the figure and then seeing which class is more prominent. The image can be in a class that is positive or negative or in between negative and positive classes, which means it is in the middle. The condition in the middle is called the Support Vector.Support Vector is very difficult to classify because it almost overlaps with other classes. There are 2 methods that can be used in the SVM Algorithm, namely the Linear Method and the Kernel Method. Accuracy in the SVM algorithm depends on the parameters and kernel functions used. Generally, SVM can only classify 2 classes but if there are many class conditions then Multi SVM can be used. Research conducted by Karthik Thirumala, Sushmita Pal, Trapti Jain, and Amod C. Umarika explained that Multi SVM means comparing multiple classes using the SVM Algorithm. There are several methods in Multi

SVM, namely one vs one and one vs all. One vs one is a classification method by comparing one by one class with the final result of having to learn to distinguish the 2 classes being compared. Whereas One vs All is a method by assuming the main sample class is positive and the others are negative. The disadvantage of the SVM Algorithm is that the SVM Algorithm is not suitable if the dataset is large because it takes a long time.

Digital Image Processing is a branch of Informatics that aims to transform/identify by processing each pixel in an image. Digital image processing is done by computer with the help of software. In image processing, there are several operations that can be done such as image quality improvement, image repair, image compression, image segmentation, and image analysis. The techniques in image processing include low-level processing, medium-level processing, and high-level processing. Low-level processing is basic operations such as reducing image noise, improving image quality, and image restoration. Digital Image Processing requires an algorithm to process the image. Available algorithms include the KNN (K-Nearest Neighbors) algorithm and the SVM (Support Vector Machine) algorithm. One of the software that can be used to process images is Matlab. Matlab is a programming language specifically used for numerical computing, programming, and visualization. In Matlab, there are many features that can be used to process/classify images such as providing functions for various image processing algorithms, creating a GUI (Graphical User Interface), displaying images, and features for extraction.

Based on the literature that has been presented in this introduction, the classification of flower types will be carried out with the aim of classifying flowers so that they know what type of flower they are and the GUI (Graphical User Interface) that is made to classify the types of flowers that have been inputted by the user.

2. METHOD

2.1 State Of Art

Research researched by Yusuf Eka Yana and Nur Nafi'iyah (2021) discusses how to identify or classify banana types based on image features (color, texture, and shape) with the SVM and KNN algorithms. The purpose of this research is so that the computer can classify images according to predetermined samples. The conclusion of this research is that the process of classification or identification of images has a very influential thing, namely the background of the image. The accuracy results of this study are with KNN accuracy with k = 2 58.33% while SVM 41.67%.

Research researched by Mohammad Farid Naufal, Selvia Ferdiana Kusuma, Zefanya Ardya Prayuska, Ang Alexander Yoshua, Yohanes Albert Lauwoto, Nicky Setyawan Dinata, and David Sugiarto in 2021. discusses the ongoing pandemic in the world, therefore this research aims to create technology to classify people who wear masks and do not wear masks with pixel intensity. This study uses the SVM, KNN, and CNN algorithms. The number of datasets taken was 3,886 images. the conclusion of this research is KNN, SVM, and CNN are good algorithms for mask detection using 3886 images. the performance of KNN and SVM is good with 81% SVM accuracy and 87% KNN. The execution time is also fast. CNN has better accuracy with 96% but has a longer execution time.

Research researched by Shidqi Aqil Naufal, Adiwijaya, and Widi Astuti in 2020 in Bandung, Indonesia discusses how computers can detect cancer early by using Microarray data. Microarray is a technology used to determine the structure and function of the human body. The conclusion of this study is that the dimensional reduction process greatly affects the accuracy results with the highest accuracy of 98.54% with k = 5 while SVM kernel RBF has an accuracy of 85.60 with parameters C = 1 and gamma = 1 using dimensional reduction. The accuracy obtained without dimensional reduction is 100% with the KNN method with k = 5.

Research researched by Rusydi Umar, Imam Riadi, and Dewi Astria Faroek in 2020 discusses image matching which is a digital image processor that has a level of similarity. Image matching uses the classification method. The images used are the original logo image and the manipulated logo image. This research uses the KNN and SVM algorithms with SMO to calculate the match based on the accuracy value. KNN is based on the calculation of k while SVM by measuring the distance between the hyperplane and the closest data.

Research researched by Hivi Ismat Dino and Maiwan Bahjat Abdulrazzaq in 2019 discusses how computers can read human facial expressions. In this study, there are 8 facial expressions that must be classified, namely ordinary, happy, angry, contempt, shock, sadness, fear, and disgust. The dataset used this time is CK + type and the algorithms used are SVM, KNN, and MLP. The conclusion of this research is that SVM has a higher accuracy of 93.53%.

2.2 Flowers

Flowers are one part of the plant that is useful for reproduction in plants. Flowers also have different characteristics such as color, shape, texture, and much more. In the introduction of Flowers this time using flowers namely Daisy Flowers, Roses, and Sunflowers. The three flowers were chosen because they have different colors, shapes, and textures.

Fig. 1.0 Daisy Flower

Fig. 1.1 Sunflower

Fig. 1.2 Roses

This research uses a flower dataset which is divided into 2, namely training data/train and test data/test. Training data and test data consist of images of 3 flowers, namely Daisy, Rose, and Sun. The training data is 1069 images in *.jpg format consisting of 315 images of Daisy Flowers, 268 images of Roses, and 486 images of Sunflowers. While the Test Data has data as many as 417 images in *.jpg format consisting of 165 images of Daisy Flowers, 109 images of Roses, and 113 images of Sunflowers.

Training Data is used to train the program to recognize the flower being identified while Test Data is used to testing the program that has been trained with training data whether it matches what it should or not. Try to store the training data and test data in different folders.

2.3 Feature Extraction

Image Processing is a method in computers to process/analyze an image based on the characteristics of the image that has a specific purpose. When processing/analyzing an image this research requires a feature to extract the image so that this research can distinguish the image based on the characteristics of each image. Feature extraction is a process where the program takes characteristics from the image to identify the characteristics of the image. Feature extraction has many types such as color extraction, texture extraction, shape extraction, and size extraction. This program uses several extraction features, namely color, shape, texture, and size extraction.

A. Color Extraction Feature

RGB

RGB is a method for recognizing red, green, and blue colors through the matrix of the image. To find the RGB value in the image, you can use the formula:

$$r = \frac{R}{R+G+B} \tag{1}$$

$$g = \frac{G}{R+G+B} \tag{2}$$

$$b = \frac{B}{R+G+B} \tag{3}$$

Formula to calculate each RGB image kernel

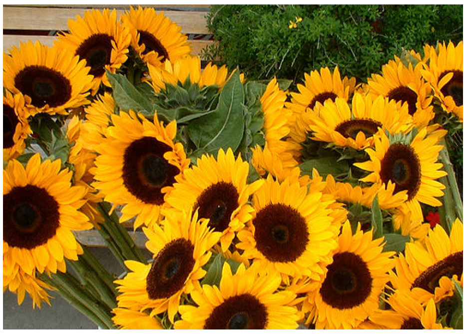


Fig. 1.3 RGB Image

Can be seen in figure 1.3 is an RGB / original figure. The RGB Feature method does not change the color and shape of the original figure only recognizes the 3 basic colors, namely Red, Green, and Blue.

HSV

HSV (Hue, Saturation, Value) is a component that represents colors that can be seen by humans from the wavelength of visible light. Hue is a measure of wavelength obtained from the intensity of the most dominant color that can be accepted by the eye. and Saturation is the amount of white light that appears in the Hue component. To find the HSV value, mathematically in an image can use the formula below:

$$R = \frac{R}{255} \tag{4}$$

$$G = \frac{G}{255} \tag{5}$$

$$B = \frac{B}{255} \tag{6}$$

$$V(value) = nilai\ max \tag{7}$$

$$S = 0, if\ max = min \tag{8}$$

$$S = \frac{max - min}{V}\ , if\ max > 0 \tag{9}$$

$$H = 0,\ if\ max = min \tag{10}$$

$$H = 60°(\frac{G-B}{max-min}\ mod\ 6), if\ max = R \tag{11}$$

$$H = 60°(\frac{B-R}{max-min} + 2), if\ max = G \tag{12}$$

$$H = 60°(\frac{R-G}{max-min} + 4), if\ max = B \tag{13}$$

The formula for calculating each HSV image kernel

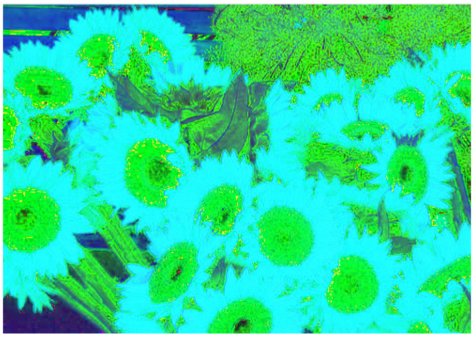


Fig. 1.4 HSV Image

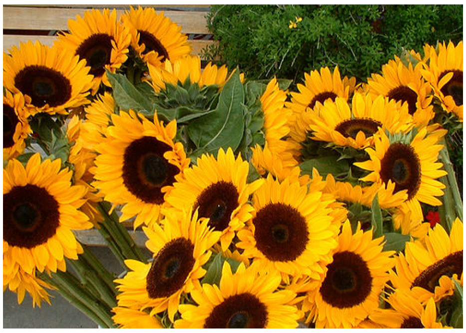


Fig. 1.5 Original Image

It can be seen that there is a huge difference between Fig. 1.4 and Fig. 1.5. In Fig. 1.5 the image is still the original image while Fig. 1.4 is an image that has been extracted with HSV features that have an impact on the original color, color purity, and brightness of the color.

B. Shape Extraction Features

Dilation

Dilation is a method to add pixels on the outer side/limit of the image according to the inputted shape. The shapes that can be inputted include diamond, line, square, and disk. To find the value of dilation in the image, you can use the formula:

$$A \oplus B = \{z \mid z = a + b, \ dengan \ a \in A \ dan \ b \in B\} \tag{14}$$

Formula for calculating Dilation

A is the original image and B is the structural element. The result of dilation is the sum of the coordinates of A(x,y) and B(x,y).

Fig. 1.6 Delineated Image

C. Texture Extraction Features

LBP

LBP is an efficient operator that names image pixels by delimiting the area of each pixel and treating the result as a binary number.

$$LBP(x_i, y_i) = \sum_{n=0}^{7} 2g^{n}\left(I_{n} - I(x_i, y_i)\right) \quad (15)$$

Formula for calculating LBP

LBP(x_i,y_i) is the LBP value at the center pixel(x_i,yi). I(x_i,y_i) is the value of the neighboring pixel and the center pixel respectively. n is the index of the neighboring pixel. The function g(x) will be 0 if x < 0 and g(x) = 1 if x ≥ 0.

GLCM

GLCM is a method of calculating the distance between 2 adjacent pixels at a certain distance that has grayish intensity. In GLCM there are 8 angles that can be used including 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°. Parameters that can be used in GLCM include Correlation, Energy, Contrast, and Homogeneity. Contrast is a measure of the variation between the gray levels of an image region. Correlation is a measure of the gray level between one pixel and another. Energy, also called ASM, shows the highest value in the pixel. Homogeneity shows the distribution value between elements.

$$contrast = \sum_{i,j=0}^{levels-1} P_{i,j}(i - j)^2 \quad (16)$$

$$homogeneity = \sum_{i,j=0}^{levels-1} \frac{P_{i,j}}{1+(i-j)^2} \quad (17)$$

$$ASM = \sum_{i,j=0}^{levels-1} P^2_{i,j} \quad (18)$$

$$energy = \sqrt{ASM} \quad (19)$$

$$correlation = \sum_{i,j=0}^{levels-1} P_{i,j}\left[\frac{(i-\eta_i)(j-\eta_j)}{\sqrt{(\sigma^2_i)(\sigma^2_j)}}\right] \quad (20)$$

Feature calculation formula - features in GLCM

P(i,j), i mean a matrix row value in the image while j is a matrix column value in the image.

Fig. 1.7 Grayscale Image

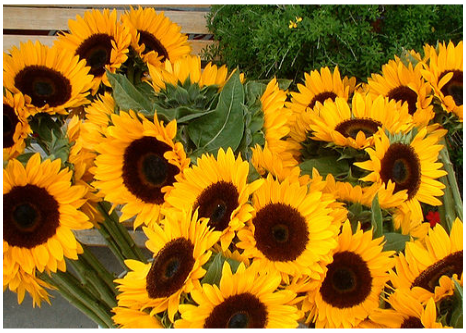


Fig. 1.8 Original Image

The difference between Fig. 1.7 and Fig. 1.8 is in the base color, Fig. 1.7 changes Fig. 1.8 into a gray color. After the image is converted to grayscale the image will be extracted with Contrast, Homogeneity, Energy, and Correlation values.

Skewness

Skewness is a measure of the asymmetry of a pixel's distribution.

$$S = \frac{1}{MN} \sum_{i=1}^{M} \sum_{i=1}^{N} \left[\frac{(P(i,j) - \mu)}{\sigma}\right]^{n} \qquad (21)$$

Formula for calculating Skewness

Standard Deviation

Standard Deviation is the root mean of the gray pixel value.

$$\sigma = \sqrt{\frac{1}{MN} \sum_{i=1}^{M} \sum_{i=1}^{N} (P(i,j) - \mu)} \qquad (22)$$

The formula for calculating standard deviation

2.4 SVM Algorithm

SVM (Support Vector Machine) algorithm is one of the algorithms in image processing that is usually used for classification and regression.SVM is used to find the best hyperplane by maximizing the distance between classes. The hyperplane is used to separate one class from another so that it can be classified as desired by looking at the results of image extraction whether it tends towards which class or is in the middle between 2 classes. The level of accuracy produced by SVM depends on the parameters and kernel functions used. In SVM the outermost data object is called the support vector. The outermost data object / Support Vector is the most difficult data to classify because of its proximity to other classes which results in almost overlapping. The disadvantage of the SVM Algorithm is that the SVM Algorithm is not suitable if the dataset is large because it takes a long time. The advantage of the SVM algorithm is that it is able to produce good classification even with little data and can generalize new samples well.

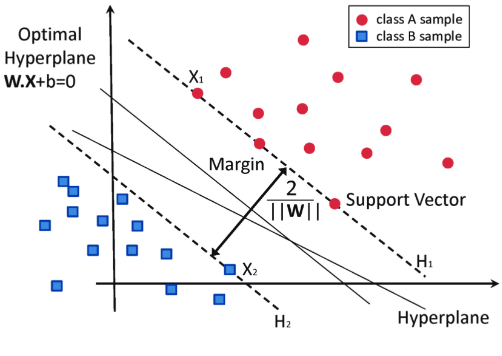


Fig .1.9 Illustration of how the SVM algorithm works

The SVM algorithm can only accommodate 2 classes therefore there is an addition to the SVM algorithm called Multi SVM. Multi SVM is an algorithm that compares many classes with the SVM method. Multi SVM can have 2 ways, namely one vs all or one vs one. one vs all is a method of classifying one class sample by likening the class sample to a positive sample and the other class sample to is negative. While One vs One is a classification method by comparing one by one class with the final result having to learn to distinguish the 2 classes being compared.

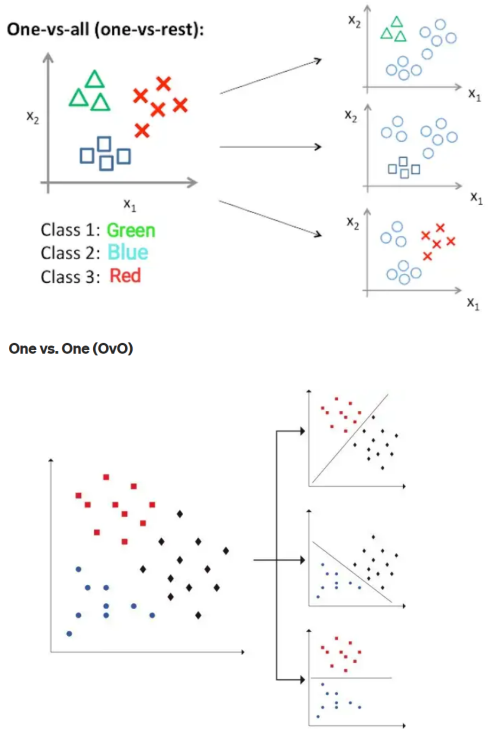


Fig 2.0 Illustration of how the multi-SVM algorithm works

2.5 KNN (K-Nearest Neighbors) Algorithm

The KNN (K-Nearest Neighbors) algorithm is an algorithm that uses distance as a solution in solving a problem. The KNN algorithm runs by looking for K groups or groups of nearest neighbor data that have similar or almost the same characteristics as the new data, then seeing which data group the new data tends to so that when many similarities are found with certain data groups, the data will be included in the data group that has more similarities and the new data will be classified as members of the data group. The paths or methods that can be used in running the KNN algorithm are Minkowski Distance, Manhattan Distance, Euclidean Distance, Cosine Distance, Cityblock Distance, Chebychev Distance, Correlation Distance, Hamming Distance, Jaccard Distance, Mahalanobis Distance, Seuclidean Distance, and Spearman Distance. Usually, the most widely used method in running the KNN algorithm is the Euclidean Distance.

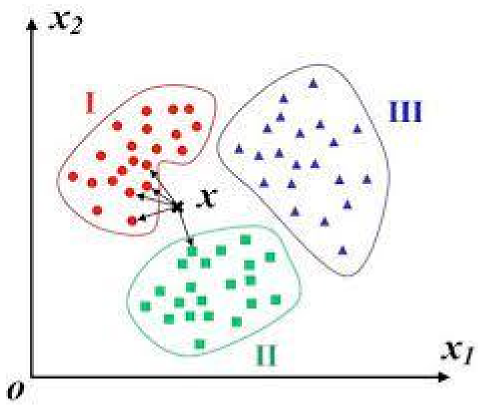


Fig. 2.1 Illustration of how the KNN algorithm works

When determining the value of K or the number of neighbors in the KNN algorithm, it is best to use an odd value of K, because the value of K is even, usually used for MultiKNN. And also the use of an odd K value is used to avoid the similarity of the nearest neighbor distance that appears in the KNN process run in solving a problem. Choosing the K value also depends on the amount of data used. There is no special way or setting that determines the best K value as a parameter in the KNN algorithm. If you use K that is too small, it may cause overfit. If you use a K value that is too large, the computer will learn more, but data that has a small number/cluster will lose during the classification process, so the classification will be a lot of misses, besides that, if the larger the K value, it will increase the computation time for program execution.

The KNN algorithm has weaknesses, for example, the lack of efficiency of the KNN algorithm itself. Due to the lack of efficiency of the KNN algorithm, so that it results in requiring a long time in the image classification process because, in the process of classifying each image, the distance calculation is carried out on each feature in the tested image against the previously trained features. The KNN algorithm will also run less optimally if there are non-informative variables or features that are not good. Suppose there are features that are not good, it will usually affect or reduce the accuracy produced later. So the selection process of features or characteristics used in the KNN algorithm is very important to do.

2.6 Proposed Method

In image processing to classify 3 types of flowers, here using Matlab software with version R2021a and R2022a, for the Matlab version used does not affect the accuracy of the results of the algorithm process, the only difference in features and application layout. The classification process is divided into 2 stages, namely the training stage and the testing stage. The training stage is used to train both KNN and SVM algorithms so that they can perform classification based on data obtained from the results of feature extraction from each image. For the workflow of each algorithm, both the KNN and SVM algorithms can be seen in the flowchart below. In KNN classification, the most important thing is to provide the K and distance values that will be used as parameters for the KNN algorithm to run. While in SVM classification, because it uses more than 2 classes, the kernel used is linear and the method used is fitcecoc, instead of the multi SVM function, because in Matlab both in version R2021a and R2022a, the multi SVM function is no longer found

At the classification stage, the data given as input is in the form of data that has been sorted in such a way, which is obtained from the kaggle.com website after the data is obtained, then the data is moved in their respective folders, namely the training image folder and the test image, then the two folders containing the sorted data can be processed using the KNN and SVM algorithms using the Matlab software. The following are the stages of the classification process with the KNN and SVM algorithms.

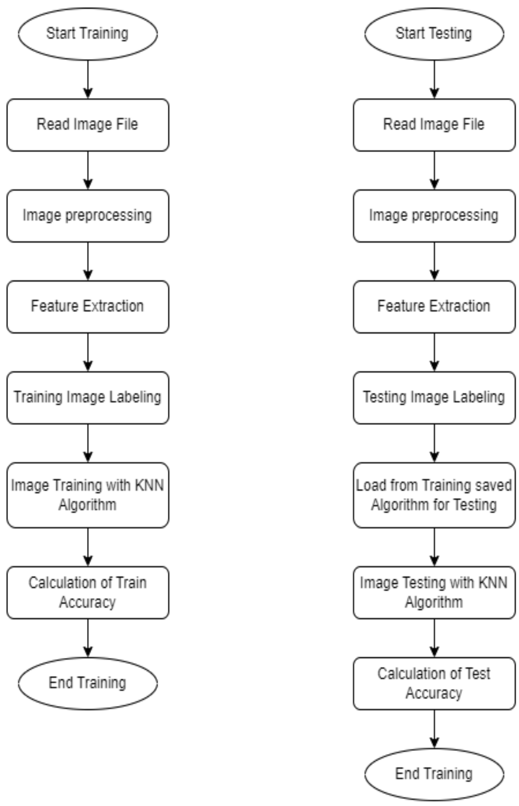
a. Read the folders and images that have been previously sorted. The test data and training data folders used should be in the same folder as the classification project so that they are easy to read.
b. After obtaining the image file to be processed, the data preprocessing process is carried out. The first data preprocessing process is to convert the image into a grayscale image. The conversion of the original image into a grayscale image is intended so that the image can be dilated. After converting the image to grayscale, the process of determining the shape and r value that will be used for the dilation process is carried out. When you have determined the shape and r value to be used, then the dilation process can be carried out which aims to add pixels to the outer side/boundary of the image according to the inputted shape, so that the image object can look bigger. Furthermore, when the dilation process has been carried out, the dilated image is converted again into a binary image so that the image background and object can be separated, which when converted into a binary image, the object will turn white and the background will become black. After dilation, the process of converting the RGB image into an HSV image is carried out again, so that later feature extraction can be carried out.
c. At this stage, after data preprocessing, the feature extraction process is carried out. The feature extraction carried out is the extraction of RGB, HSV, LBP, and GLCM characteristics. In the RGB feature extraction process, it is calculated by taking each of the R, G, and B kernels, and then the value of each kernel is divided by the object forming the image, namely the preprocessed binary image. In the HSV feature extraction process, it is done by taking each kernel from the preprocessed HSV image, then the value of each H, S, and V kernel is divided by the object forming the image, namely the binary image that was obtained earlier. After that, LBP extraction is done again from the transformed grayscale image. After getting the LBP extraction feature, then another extraction feature is performed, namely the GLCM extraction feature from the preprocessed grayscale image. From this GLCM feature extraction, it will get the correlation, contrast, energy, and homogeneity

features. In addition, there is another skewness feature extraction obtained from each of the R, G, and B kernels of the original image. After skewness, the standard deviation feature extraction is also done for each of the R, G, and B kernels in the original image.

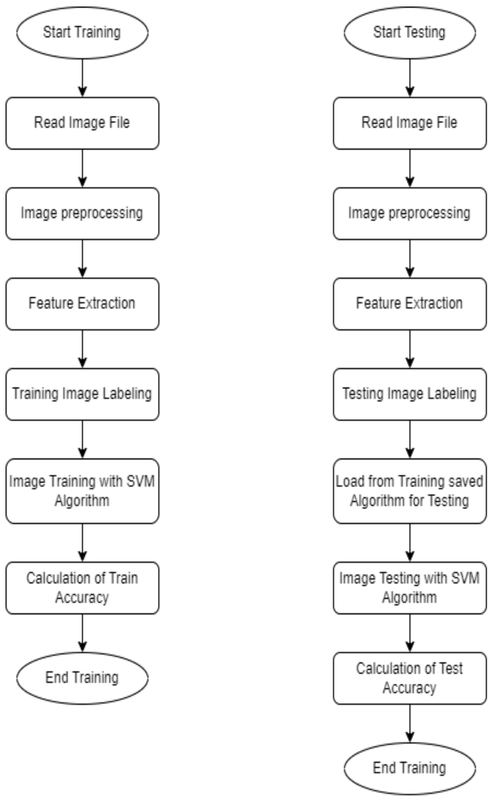
d. After feature extraction, data labeling will be carried out, and later this labeling result data will be used for the accuracy calculation process, which is carried out by comparing the predicted results of the machine with the results that this research is labeled manually. This data labeling is done according to the order of the images in the dataset.

e. After image labeling, the classification process of flower images into Daisy, Roses, and Sunflowers classes will be carried out using the KNN and SVM algorithms with linear kernels and ecoc methods that can be used for multiclass classification (classification of more than 2 classes). The parameters used in the KNN algorithm are with k values of 3, 5, 7, 9, and 11 with distance Minkowski and categorical predictors all.

f. After the image classification process is carried out, an accuracy calculation will be carried out by comparing the predicted machine data with the target that has been labeled manually. At this stage, analysis is also carried out to get the most effective k value and analysis of effective features included in the KNN and SVM algorithms.



Classification diagram with KNN



Classification Diagram with SVM

2.7 Training and Testing

To find the accuracy used to calculate the accuracy of the guessing results of the machine using the KNN and SVM algorithms in the training and testing process, the Matlab application can be done in the following way:

$$Correct = 0 \quad (23)$$

$$if \sum_{i=1}^{number\ of\ test\ data} result(i) = target(i), then\ correct = correct + 1 \quad (24)$$

$$Accuracy = \frac{correct}{data} x\ 100 \qquad (25)$$

Formula to calculate accuracy

In calculating the accuracy used, it works by comparing the machine learning prediction target with the target that we have labeled before. If the target of the machine prediction result is the same as the target of the labeling result that we have made, then the correct variable will increase. then the correct variable will be divided by the number of datasets available and multiplied by 100 so that the percentage of the machine prediction results that we have trained is obtained. The percentage that has been obtained will be used as the accuracy value of the machine that has been made with the KNN and SVM algorithms.

3. RESULTS AND DISCUSSION

In the classification test carried out, the software used for execution is Matlab with versions R2021a and R2022a. This is where these two versions of Matlab are the same, only different in some layouts and some bug fixes. However, the difference in Matlab versions will not affect the accuracy of the results of the training and test processes in the KNN and SVM algorithms on each input image.

The algorithms used are the KNN and SVM algorithms. Each of these algorithms is first carried out training on the training image and testing of the algorithm obtained from the training results on the test image. The data preprocessing process carried out is the process of converting the original image into grayscale, the dilation process of the converted grayscale image, the process converting the dilated image into a binary image, and converting the RGB image into an HSV image. After data preprocessing, extraction is carried out from each image, both RGB images, HSV, LBP features, and GLCM features. in the extraction of GLCM features, the parameter used is the angle direction. In the KNN algorithm, we will look for the best parameters in the k value used, and in the SVM algorithm, we will look for the best parameters in the type of multiSVM kernel used.

In the classification process, first, the data is inputted and data reading is carried out. After reading the data, the next process is that the input image is transformed into a grayscale color space so that the results of the transformation can be morphologically processed in the form of dilation. Then, the image that has been carried out in the dilation process is transformed again into a binary image, so that the background of the image will become black and the object of the image will become white so that the object can be recognized and the extraction process can be carried out. In the RGB feature extraction process, it is calculated by taking each of the R, G, and B kernels, and then the value of each kernel is divided by the object forming the image, which is the binary image that was obtained earlier. In the HSV feature extraction process, first, the RGB image is transformed into an image that has an HSV color space and after being transformed into an HSV image, then for HSV feature extraction, namely by taking each kernel from the HSV image, then the value of each H, S, and V kernel is divided by the image-forming object, namely the binary image that was previously obtained. After that, LBP extraction is done again from the transformed grayscale image. After getting the LBP extraction feature, then another extraction feature is performed, namely the GLCM extraction feature from the grayscale image. From this GLCM feature extraction, it will get the correlation, contrast, energy, and homogeneity features. Then there is the skewness extraction feature obtained from each of the R, G, and B kernels of the original image. After skewness, the standard deviation feature extraction is also done for each of the R, G, and B kernels in the original image.

For the KNN algorithm, the extraction features used are the results of the RGB, HSV, LBP, and GLCM extraction features. As for the SVM algorithm, the extraction features used are the results of the RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation extraction features. For the KNN algorithm, it does not use skewness and standard deviation extraction features because if you add these features, the accuracy obtained is worse than not using these two features. After getting the features used, labeling will be done again to mark the image into what type of flower classification, based on the order of the images in the folder, and the results of this labeling will be stored in the target variable which will later be used to find the accuracy of the results of the KNN or SVM algorithm process.

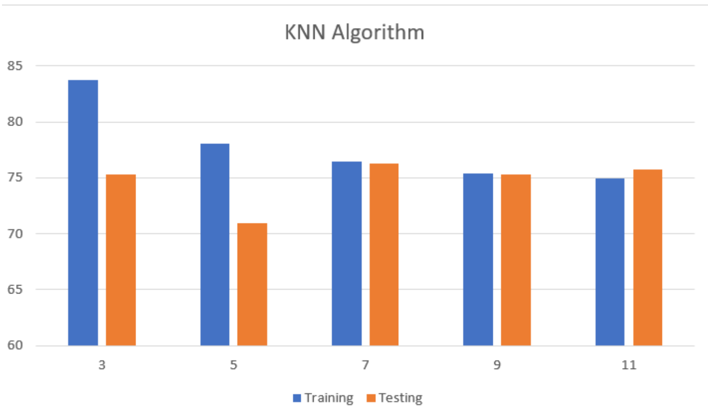
After extracting the characteristics and selecting the features used, the features obtained will be collected into 1 data table, so that from the data table, both KNN and SVM algorithms can be used to classify flower types. When the machine has predicted and classified each image based on the data provided, then a comparison will be made between the classification results based on the machine classification and the predetermined classification target. After testing and testing each image with the KNN algorithm and SVM with linear kernel and ecoc method, the accuracy is calculated. In the SVM algorithm with a linear kernel with the ecoc method, the training accuracy is 78.2975% and the testing accuracy is 64.9880%. While the KNN algorithm gets different training and testing accuracy results depending on the input K results.

3.1 Testing K Values

Testing the value of k, is done by choosing which value of k is the most optimal for executing or classifying images. The following table gives the results of training and testing images using the KNN algorithm with k values of 3, 5, 7, 9, and 11.

Numeric K	Training	Testing
3	83.7231%	75.2998%
5	78.0168%	70.9832%
7	76.4266%	76.2590%
9	75.3936%	75.2998%
11	74.9298%	75.7794%

Table 1.0 comparison of K values in training and testing



Graph 1.0 comparison of K values in training and testing

In testing the value of k in the KNN algorithm, both during training and testing, it can be seen that the most optimal results are obtained when using k = 3 with distance Minkowski, obtained training results of 83.7231% and testing of 75.2998% so as to get an average of 79.51145%. And less optimal results are obtained when using a value of k = 11, obtained training results of 74.9298% and testing of 75.7794% so as to get an average of 75.3546%.

3.2 Kernel Testing

Kernel testing is done by choosing which kernel is the most optimal for executing or classifying images in the SVM algorithm. The following table gives the results of training and testing images using the SVM algorithm using polynomial, gaussian, linear, and RBF kernels.

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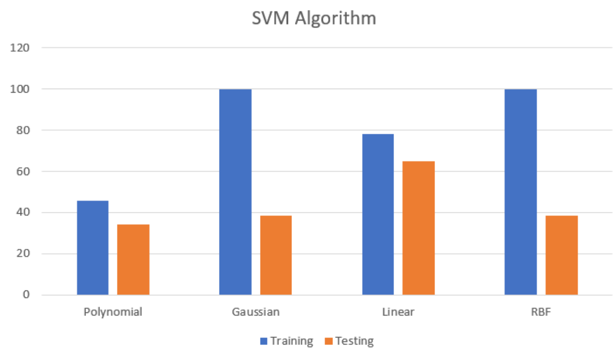
Kernel	Training	Testing
Polynomial	45.7437	34.2926
Gaussian	100	38.3693
Linear	78.2975	64.9880

RBF	100	38.3693

Table 1.1 SVM kernel comparison on training and testing



Graph 1.1 SVM kernel comparison on training and testing

In kernel testing that has been carried out on the SVM algorithm with the fitcecoc method, both in training and testing, it is found that the most optimal results when using a linear kernel, where the accuracy of the test gets 64.9880%. And less optimal results are obtained when using a polynomial kernel, which gets a test accuracy of 34.2926%.

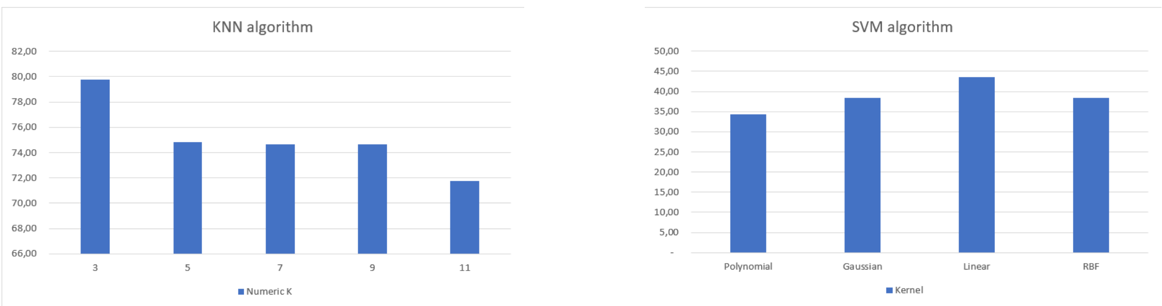
In feature testing, the most optimal features used in the KNN and SVM algorithms have been selected along with parameters that can be used. The features that will be included in the KNN and SVM algorithms are RGB features, HSV features, LBP features, GLCM features, skewness features, and standard deviation features. The following is a comparison table and graph of the results table of the KNN and SVM algorithms with the ecoc method when given test data based on the features that have been selected.

Feature Extraction: RGB

Numeric K	Testing
3	79.7942%
5	74.8363%
7	74.6492%
9	74.6492%
11	71.7493%

Kernel	Testing
Polynomial	34.2926%
Gaussian	38.3693%
Linear	43.6451%
RBF	38.3693%

Table 1.2 test results with KNN and SVM algorithms with RGB extraction features



Graph 1.2 test results with KNN and SVM algorithms with RGB extraction features

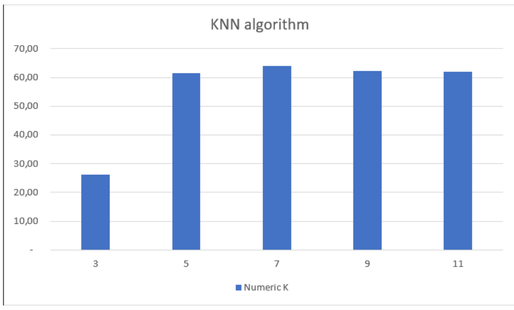
Based on the table and graph of test results with RGB extraction features and KNN and SVM algorithms with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 3 with distance Minkowski, which is 79.7942%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using the Linear kernel is 43.6451%.

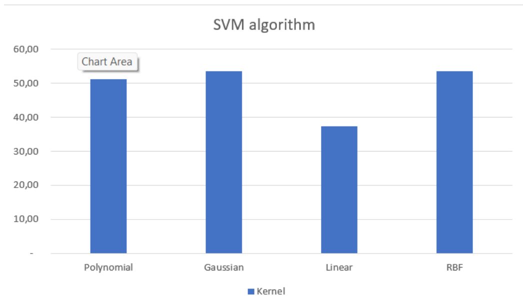
Feature Extraction: HSV

Numeric K	Testing
3	26.1391%
5	61.3909%
7	64.0288%
9	62.3501%
11	61.8705%

Kernel	Testing
Polynomial	51.3189%
Gaussian	534772%
Linear	37.4101%
RBF	53.4772%

Table 1.3 test results with KNN and SVM algorithms with HSV extraction features





Graph 1.3 test results with KNN and SVM algorithms with HSV extraction features

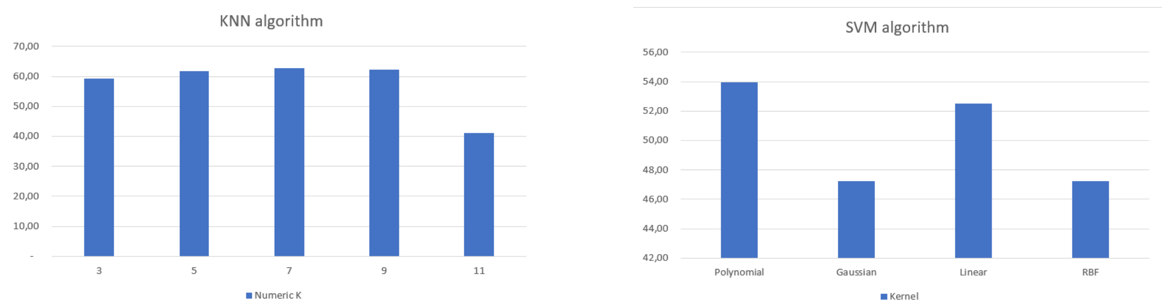
Based on the table and graph of test results with HSV extraction features and KNN and SVM algorithms with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 7 with a distance of Minkowski, which is 64.0288%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using the gaussian and RBF kernels is 53.4772%.

Feature Extraction: GLCM

Numeric K	Testing
3	59.2326%
5	61.6307%
7	62.8297%
9	62.3501%
11	41.0072%

Kernel	Testing
Polynomial	53.9568%
Gaussian	47.2422%
Linear	52.5180%
RBF	47.2422%

Table 1.4 test results with KNN and SVM algorithms with GLCM extraction features



Graph 1.4 test results with KNN and SVM algorithms with GLCM extraction features

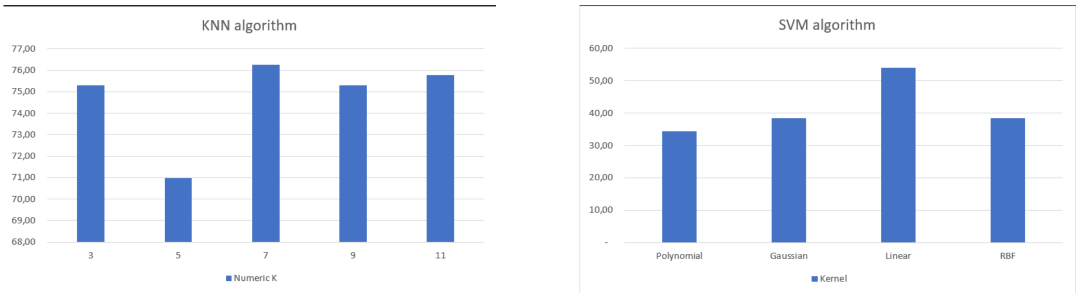
Based on the table and graph of test results with GLCM extraction features and KNN and SVM algorithms with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 7 with distance Minkowski, which is 62.8997%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using a polynomial kernel is 53.9568%.

Feature Extraction: RGB and HSV

Numeric K	Testing
3	75.2998%
5	70.9832%
7	76.2590%
9	75.2998%
11	75.7794%

Kernel	Testing
Polynomial	34.2926%
Gaussian	38.3693%
Linear	53.9568%
RBF	38.3693%

Table 1.5 test results with KNN and SVM algorithms with RGB and HSV extraction features



Graph 1.5 test results with KNN and SVM algorithms with RGB and HSV extraction features

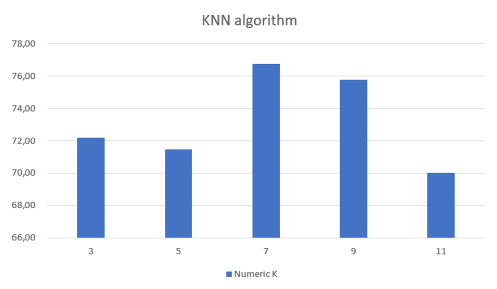
Based on the table and graph of test results with RGB and HSV extraction features using the KNN algorithm and SVM with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 7 with distance Minkowski, which is 76.2590%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using a linear kernel is 53.9568%.

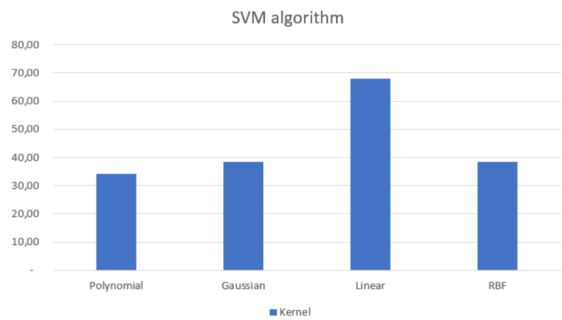
Feature Extraction: RGB, HSV, and GLCM

Numeric K	Testing
3	72.1823%
5	71.4628%
7	76.7386%
9	75.7794%
11	70.0240%

Kernel	Testing
Polynomial	34.2926%
Gaussian	38.3693%
Linear	68.1055%
RBF	38.3693%

Table 1.6 test results with KNN and SVM algorithms with RGB, HSV, and GLCM extraction feature





Graph 1.6 test results with KNN and SVM algorithms with RGB, HSV and GLCM extraction feature

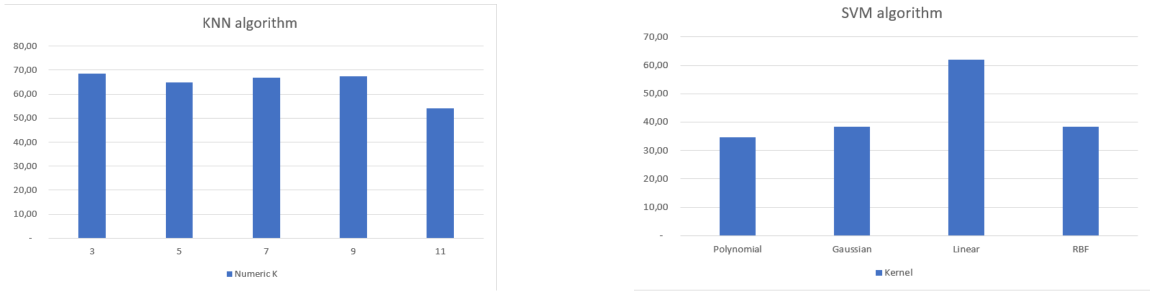
Based on the table and graph of test results with RGB and HSV extraction feature using the KNN algorithm and SVM with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 7 with distance Minkowski, which is 76.7386%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using a linear kernel is 68.1055%.

Feature Extraction: RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation

Numeric K	Testing
3	68.5851%
5	64.9880%
7	66.9065%
9	67.3861%
11	54.1966%

Kernel	Testing
Polynomial	34.5324%
Gaussian	38.3693%
Linear	62.1103%
RBF	38.3693%

Table 1.7 test results with KNN and SVM algorithms with RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation extraction features



Graph 1.7 test results with KNN and SVM algorithms with RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation extraction features

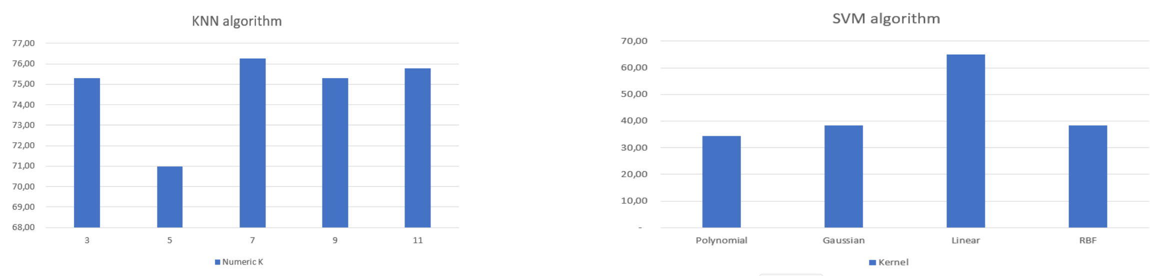
Based on the table and graph of test results with RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation extraction features using the KNN algorithm and SVM with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 3 with distance Minkowski which is 68.5851%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using the Linear kernel is 62.1103%.

Feature Extraction: RGB, HSV, LBP, and GLCM

Numeric K	Testing
3	75.2998%
5	70.9832%
7	76.2590%
9	75.2998%
11	75.7794%

Kernel	Testing
Polynomial	34.2926%
Gaussian	38.3693%
Linear	64.9880%
RBF	38.3693%

Table 1.8 test results with KNN and SVM algorithms with RGB, HSV, LBP, and GLCM extraction features



Graph 1.8 test results with KNN and SVM algorithms with RGB, HSV, LBP, and GLCM extraction features

Based on the table and graph of test results with RGB, HSV, LBP, and GLCM extraction features using the KNN algorithm and SVM with the ecoc method, the results show that the KNN algorithm gets the most efficient accuracy when using k = 7 with a distance of Minkowski, which is 76.2590%. As for the SVM algorithm with the ecoc method, getting the most optimal test accuracy when using the Linear kernel is 64.9880%.

In training and testing flower classification using RGB, HSV, LBP, GLCM, Skewness, and Standard Deviation extraction features using the KNN and SVM algorithms with linear kernels and ecoc methods, the

KNN algorithm gets the best accuracy results with parameter k = 7 with distance Minkowski and with extraction features in the form of RGB, HSV, and GLCM, namely with testing: 76.7386%. While SVM gets the best accuracy results with a linear kernel with RGB, HSV, and GLCM extraction features as well, namely with a test of 68.1055%.

4. CONCLUSION

Based on the results of the training and testing carried out for images in order to classify the types of Daisy, Roses, and Sunflowers using the KNN algorithm and SVM with the ecoc method, the results show that the best parameters and features that can be provided for the KNN algorithm are with the num neighbors (k) value of 7, using the Minkowski distance where these parameters get the most optimal test accuracy at 76.2590%. As for the SVM algorithm with the ecoc method, the best parameters and features that can be applied are using a linear kernel, where these parameters when tested get the most optimal results at 64.9880%.

Based on the results of feature testing that has been carried out, the results show that more features used do not always guarantee that the accuracy of both training and testing can increase. And if you only use a few extraction features, it can also make the resulting accuracy poor, because the data provided for training algorithms both KNN and SVM is less and when testing the results will be poor. This can be proven from the feature testing that has been done, based on the table and graph and table, it can be seen that if only using RGB extraction features, the KNN algorithm gets the most optimal test results when k = 3 with distance Minkowski which is 79.7942%, while in the SVM algorithm with the ecoc method, getting the most optimal test results on the linear kernel which is 43.6451%. If only using HSV extraction features, the KNN algorithm gets the most optimal test results when using k = 64.0288% with distance Minkowski and the SVM algorithm with the ecoc method gets the most optimal results when using Gaussian and RBF kernels, which is 53.4772%. If only using the GLCM extraction feature, the KNN algorithm gets the most optimal accuracy results when using k = 7 with distance Minkowski which is 62.8997%. Meanwhile, the SVM algorithm with the ecoc method gets the most optimal accuracy when using a polynomial kernel, which is 53.9568%. Because the accuracy obtained is still not optimal, the features are combined for training and testing. If using RGB and SVM extraction features, the KNN algorithm gets the most optimal accuracy when using k = 7 with distance Minkowski which is 76.2590% and the SVM algorithm gets the most optimal accuracy when using a linear kernel which is 53.9568%. If using RGB, HSV, and GLCM extraction features, the KNN algorithm gets the most optimal accuracy when using k = 7 with distance Minkowski which is 76.7386%. As well as for the SVM algorithm with the ecoc method gets the most optimal accuracy when using a linear kernel which is 68.1055%. If using RGB, HSV, GLCM, Skewness, and Standard Deviation extraction features, the KNN algorithm gets the most optimal accuracy at 68.5851% by using k = 3 with distance Minkowski and for the SVM algorithm with the ecoc method gets the most optimal accuracy at 62.1103% when using a linear kernel. If using RGB, HSV, LBP, and GLCM extraction features, the KNN algorithm gets the most optimal accuracy when using K = 7 with distance Minkowski which is 76.2590%, and for the SVM algorithm with the ecoc method gets the most optimal accuracy when using a linear kernel with an accuracy of 64.9880%. From the explanation that has been done, it can be concluded that when using the KNN algorithm the best extraction features are RGB, HSV and GLCM combined and get an accuracy of 76.7386%, while when using the SVM algorithm with the ecoc method the best features obtained are RGB, HSV and GLCM combined which get a testing accuracy of 68.1055%.

So it can be concluded that the best parameters and extraction features that can be applied in the KNN algorithm are using the value of num neighbors (k) = 7 with distance Minkowski and extraction features namely RGB, HSV, and GLCM get the most optimal test results of 76.7386%. As for the SVM algorithm with the ecoc method, it can be concluded that the best parameters and features that can be given are using a linear kernel and extraction features RGB, HSV, and GLCM, which when tested, these parameters and features get the most optimal test results of 68.1055%. In this research, the most optimal value that can be obtained by the KNN algorithm is still less than 80% and the SVM algorithm is still less than 70%. This is due to the limited dataset that can be obtained and used as material for testing and training and also due to the lack of variation in the parameters and extraction features used for model training.

5. ADVICE

In this study, the SVM and KNN algorithms have not achieved maximum accuracy, therefore in further research, it is hoped that it can add more extraction features used or parameters used in each algorithm both the KNN and SVM algorithms with the ecoc method so that the accuracy of the program when testing can be further increased. Because in this research, the KNN algorithm only gets the most optimal accuracy in testing, namely 76.7386% by using k = 7 and with distance Minkowski, while the SVM algorithm gets the most optimal accuracy in testing, namely 68.1055%.

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BIOGRAFI

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