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Image Classification of Meat Using Support Vector Machine Method

Yuli Christyono[1*], Sukiswo[2]
Department of Electrical Engineering, Diponegoro University, Semarang, Indonesia
yuli@live.undip.ac.id

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Abstract
Meat is one of the essential food ingredients in meeting the nutritional needs. The current problem lies in the consumers' lack of knowledge on how to differentiate between pork, beef, goat, and lamb meat. This is because when the meat is already cut, their appearances may seem similar at first glance. Many consumers are unaware of the practice of mixing different types of meat for consumption. One way to classify animal meat is by using image processing. In this research, an image processing system is created to classify meat, specifically pork, beef, goat, and lamb. Support Vector Machine (SVM) is a development of Machine Learning that can be used in classifying images into specific classes. SVM method as a classifier is performed using a confusion matrix. The test results show the highest accuracy value obtained in the class of Goat Meat 91.4%, the highest precision in the class of goat meat 80%, the highest recall in the class of beef 81.3%, and the highest F1-score in the class of beef 0.76.

Keywords:
Classification
SVM
Confusion matrix

Abstrak
Daging merupakan salah satu bahan pangan yang penting dalam memenuhi kebutuhan gizi. Permasalahan yang ada saat ini terletak pada kurangnya pengetahuan konsumen dalam membedakan daging babi, sapi, kambing, dan domba. Hal ini karena, jika daging sudah dipotong, tampilannya mungkin terlihat mirip jika dilihat sekilas. Banyak konsumen yang tidak menyadari praktik pencampuran berbagai jenis daging untuk dikonsumsi. Salah satu cara untuk mengklasifikasikan daging hewan adalah dengan menggunakan pengolahan citra. Pada penelitian ini dibuat sistem pengolahan citra untuk mengklasifikasikan daging khususnya daging babi, sapi, kambing, dan domba. Support Vector Machine (SVM) merupakan pengembangan dari Machine Learning yang dapat digunakan dalam mengklasifikasikan gambar ke dalam kelas tertentu. Metode SVM sebagai pengklasifikasi dilakukan dengan menggunakan matriks konfusi. Hasil pengujian menunjukkan nilai akurasi tertinggi diperoleh pada kelas daging kambing 91.4%, presisi tertinggi pada kelas daging kambing 80%, recall tertinggi pada kelas daging sapi 81.3%, dan nilai skor-F1 tertinggi pada kelas daging sapi 0,76.

Kata Kunci : Klasifikasi, SVM, Matriks Confusi

INTRODUCTION

Machine Learning is the development of artificial intelligence technology. This machine learning is based on the disciplines of statistics, mathematics, and data mining so that machines can learn and analyze data using prepared datasets. In its development, Machine Learning has evolved into a tool that can classify images. Support Vector Machine (SVM) is used in image classification, which has high generalization capabilities without additional knowledge.

There are two methods in classification, supervised learning and unsupervised learning. Supervised Learning is an algorithm that generates a function that maps input to the desired output. There are many methods in supervised learning classification, including K-nearest Neighbor, Support Vector Machine, Naive Bayes, and Decision Tree.

Confusion Matrix is a table consisting of the number of test data rows predicted correctly and incorrectly by a classification model. This table is necessary to determine the performance of a classification model. This method is often used in cases of multiple classifiers or classes that are more than two. Therefore, this method is very suitable for use in classifying types of meat to measure the accuracy of classification results using the SVM method.

METHOD

Designing a program using the Python programming with the sklearn library as the place for classifying types of meat. The input is the type of meat : beef, goat, and lamb. The program will then process it using the SVM algorithm. The output will be the information of the input type of meat. Figure 1 shows the block diagram of classification using the SVM method.

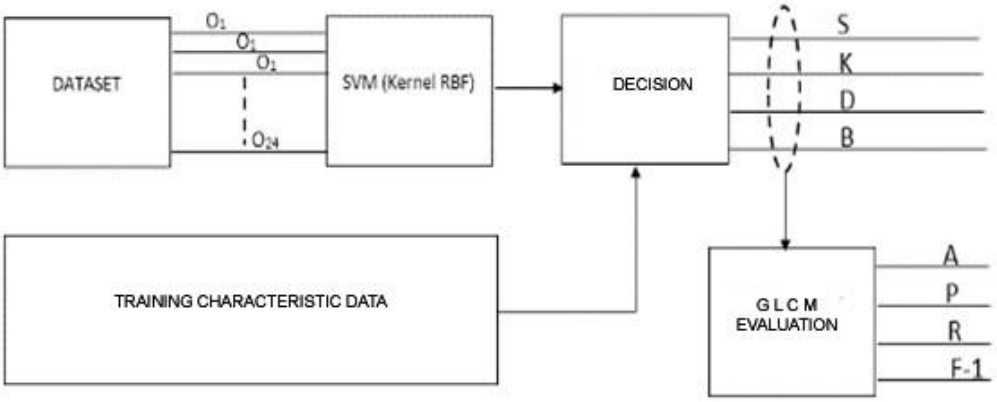

Figure 1 Meat Classification Block Diagram

The flow diagram of the meat classification system can be seen in Figure 2 below.

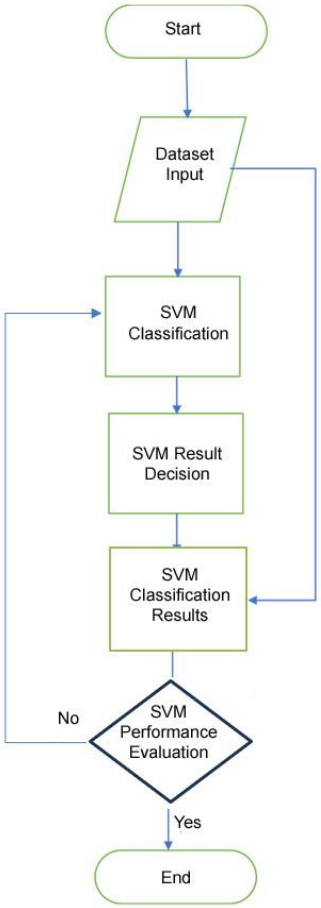

Figure 2 Flow Chart Diagram

The data input in this research is meat images. The data used is data from the characterization of beef, goat, lamb, and pork using the GLCM method. The data is used as input parameters for classifying types of meat with the dependent variable (X) consisting of 4 classes, X = 0 for pork, X = 1 for lamb, X = 2 for goat, X = 3 for beef. The independent variable consists of 6 basic components, Dissimilarity (Y1), Correlation (Y2), Homogeneity (Y3), Contrast (Y4), ASM (Y5), and Energy (Y6). Image Characterization Results Using GLCM can be seen in Table 1.

Tabel 1 Image Characterization Using GLCM

Items	Angle			
	0	**45**	**90**	**135**
Y_1	9.5054	9.7548	9.9525	9.8108
Y_2	0.7351	0.7322	0.7247	0.7297
Y_3	0.468	0.2396	0.2361	0.2383
Y_4	394.519	399.829	410.067	403.498
Y_5	0.0017	0.0017	0.0017	0.0016
Y_6	0.0410	0.0406	0.0406	0.0405

RESULTS AND DISCUSSION

Classification using the SVM method is built by dividing training and test data for each type of meat. The aim is to determine the performance of the classification method used, namely accuracy, precision and recall in the classification of meat types. Table 2 is the result of testing use RBF kernel of 5 parameter σ as analysis in the SVM method in percentage form at σ =1, σ =2, σ =3, σ =4 and σ =5.

Table 2 Result of Test Data

C	RBF				
	σ = 1	**σ = 2**	**σ = 3**	**σ = 4**	**σ = 5**
1	91.46	92.68	93.10	92.68	93.10
5	91.46	92.68	93.10	92.68	93.10
10	91.46	92.68	93.10	92.68	93.10
50	91.46	92.68	93.10	92.68	93.10
100	91.46	92.68	93.10	92.68	93.10

In Table 2, it can be seen that the highest accuracy is obtained when σ =3 with the smallest value of C (C=1) which has an accuracy of 93.101%. Table 3 below is the Confusion Matrix data on the Gaussian RBF kernel for σ = 3, C = 1 in the testing data.

Table 3 Confussion Matrix Data Testing

F_{gh}		Prediction Label			
		Pork	**Lamb**	**Goat**	**Beef**
Actual label (g)	**Pork**	20	4	0	2
	Lamb	3	7	0	3
	Goat	0	1	4	5
	Beef	4	1	1	26

The results of calculating the multiclass confusion matrix elements can be seen in Table 4.

Table 4 Image Confusion Matrix

Meat	True Positive	True Negative	False Positive	False Negative
Pork	20	48	7	6
Lamb	7	62	6	6
Goat	4	70	1	6
Beef	26	39	10	6

The next step is to calculate the confusion matrix for each class to find the accuracy, precision, recall, and F1-score. The results of the confusion matrix calculation based on the class can be seen in Table 5.

Table 5 Confusion Matrix Evaluation

No	Class	Accuracy	Precision	Recall	F1-Score
1	Pork	84%	74.1%	76.9%	0.75
2	Lamb	85.2%	53.8%	53.8%	0.54
3	Goat	91.4%	80%	40%	0.53
4	Beef	80.2%	72.2%	81.3%	0.76

The evaluation of the confusion matrix shows the highest accuracy in the class of goat (91.4%), the highest precision in the class of goat (80%), and the highest recall in the class of beef (81.3%). In the calculation of the F1-score, the highest value is for beef (0.76) and the lowest is for goat (0.53). The F1-score is the harmonic mean of precision and recall. The best F1-score value is 1 and the worst is 0. If the F1-score value is good, it indicates that the classification model being run has good precision and recall.

CONCLUSION

Meat type classification testing using the SVM method with a confusion matrix, the best accuracy values were obtained in the goat meat class (91.4%), the best precision in the goat meat class (80%), the best recall in the beef class (81.3%), F1 -best score for beef (0.76) and lowest for goat meat (0.53).

The best type of meat classification is the goat meat class because it gets the highest accuracy and precision values, while the worst classification of meat is the lamb meat class.

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