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Rhizome Image Classification Using Support Vector Machine

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***Abstract*— Rhizomes, also called rootstalks, are stems that help plants to reproduce asexually, survive in winter, store food, and make stem tubers. They possess many functions and merits. Some of the commonly found rhizomes are ginger, turmeric, and galangal, yet still a lot of people still find it difficult to distinguish those three rhizomes. That's because those mentioned rhizomes do share several similarities in their shape and texture. This research submits a rhizome identification system with SVM (Support Vector Machine) classification method. Based on the experiments done, this particular method is chosen because it showed great results, quite high-valued accuracy level for data classification, and has minimum error rate. The types of rhizomes used in this research's dataset are those three varieties mentiones above, while the amount of images in this experiment consists of 150 training images and 30 testing images. The experiment is done by calculating the accuracy value from data testing classification of three classes, which are ginger class, turmeric class, and galangal class utilizing the mentioned method. This rhizome identification system that uses the SVM classificafion method gets 78% accuracy value.**

Keywords— svm, rimpang, clasification

I. INTRODUCTION

Rhizomes are parts of a plant that spread under the soil surface. Rhizomes contain essential oil and alkaloid, which are beneficial for our health [1]. In the last year, rhizomes have become a major and valuable asset for Indonesian peopla and the world's, in terms of health.

Several studies stated that rhizomes can help boost one's body immunity for the prevention and treatment of Covid-19 [2, 3]. Furthermore, rhizomes, especially ginger, can multiply the natural killer cells that destroy the wall of virus' cells which have infected the human host [4].

Rhizomes have many different varieties, each of them has plenty similarities in shapes. That is the reason why most people are having a hard time distinguishing one from the other. Therefore, there needs to be a rhizome classification system based on characteristic features, shapes, and textures to solve that problem.

Several classification studies using SVM, KNN, Fuzzy Logic have been done for images recognition [5]. For instance, the study done by [6], has used SVM and KNN algorithm to do the classification of tubers varieties based on texture feature, shape feature, and the combination of both. The types of the tubers in tha study are cassava, yam, and taro.

Another study, conducted by [7], used the SVM technique to classify multi-spectral satellite image datasets and compared the overall accuracy with conventional image classification methods. In this study, several open source tools are used to determine whether SVM can be a potential classification for the classification of high performance satellite imagery.

Hereinafter, the study done by [8], has used the Multiclass-SVM algorithm and ANN to classify human diseases based on Kirlian image features. Several Kirlian images in each of the 6 different categories of body organs were taken and classified according to the region of the body that was deformed.

From the prior studies, we know that the SVM method is quite reliable when used for solving problems of image classifications. This study submits a rhizome image classification system using SVM method to identify three varieties of rhizomes, which are ginger, turmeric, and galangal. These three types

are chosen because the three of them are most often used than the other rhizomes.

II. OVERVIEW OF RHIZOME

Rhizomes or rhizomes are plant stems that spread below the soil surface. This stem can produce tuna and new roots from the segments. This type of plant is included in the Zingiberaceae family group or findings. Some rhizomes can be used as a treatment because they contain essential oils and alkaloids. There are about 283 types of rhizome plants that can be used for treatment [9, 10]. Three of them that we often encounter and often use are ginger, galangal and turmeric.

Some of the benefits contained in each of these rhizomes are as follows:

1. Ginger

Ginger is one of the healthiest spices in the world. Ginger contains many nutrients and bioactive components that can produce many benefits for the human body and brain.

The benefits of ginger for health and beauty include:

- Relieves body aches and pains.
- Treat rheumatism and osteoarthritis.
- Overcoming nausea.
- Lowering blood sugar levels.
- Make a face do not have.
- Soften the face.

2. Galangal

Galangal or laos is a plant that is often used as a spice in cooking. This plant has a myriad of benefits that are good for health, including:

- Can reduce fever.
- Relieves cough and sore throat.
- Can overcome asthma.
- Treating diabetes.
- Nourish and rejuvenate the skin.
- Overcoming the problem of male vitality and fertility.
- Reducing the risk of cancer and tumors.

3. Turmeric

Consuming turmeric regularly can increase antioxidants in the body. Antioxidants contained in turmeric can overcome free radical attacks the emergence of cancer cells in the body. Besides being known as an anticancer and antitumor plant, turmeric also contains various positive things for health. Turmeric can be a drug for inflammation and cytotoxic properties that can prevent the proliferation of cancer cells.

III. OVERVIEW OF CLASIFICATION

Classification is a way of grouping data according to the characteristics or characteristics of the data. In the process, classification can be done in many ways, either manually or with the help of technology. Classification that is done manually is a classification that is done by humans without the help of computer intelligent algorithms. While the classification carried out with the help of technology has several classification methods including Artificial Neural Networks, Naïve Bayes, Support Vector Machines, Decission Tree, Fuzzy, and nearest neighbor. In this study, two classification methods were used, namely Support Vector Machine and Nearest Neighbor, which will be explained in the next sub-chapter [11, 12].

IV. OVERVIEW OF SUPPORT VECTOR MACHINE

SVM is a machine learning method that works on the principle of Structural Risk Minimization (SRM) with the aim of finding the best hyperplane that separates two classes in the input space. The Support Vector Machine (SVM) was first introduced by Vapnik in 1992 as a harmonious series of superior concepts in the field of pattern recognition [13, 14, 15]. As a method of pattern recognition, SVM is still relatively young. However, evaluation of its capabilities in various applications places it as state of the art in pattern recognition (C & V, 1995).

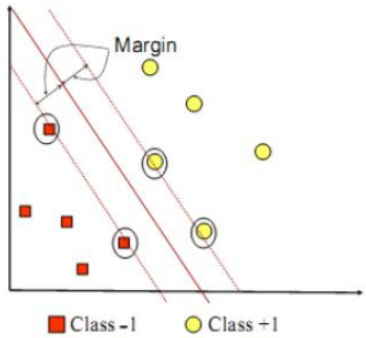

Fig 1. SVM tries to find the best hyperplane that separates the two classes

Figure 1. shows some patterns that are members of two classes: +1 and –1. Patterns belonging to class -1 are symbolized by red (box), while patterns in class +1 are symbolized by yellow (circle). The classification problem can be translated by trying to find a line (hyperplane) that separates the two. The best dividing hyperplane between the two classes can be found by measuring the hyperplane's margins. And find the maximum point. Margin is the distance between hyperplane with the closest pattern from each class. This closest pattern is called a support vector. The solid line in the figure shows the best hyperplane, which is located right in the middle of the two classes, while the red and yellow dots in the black circle are support vectors. Efforts to find the location of this hyperplane is the core of the learning process in SVM

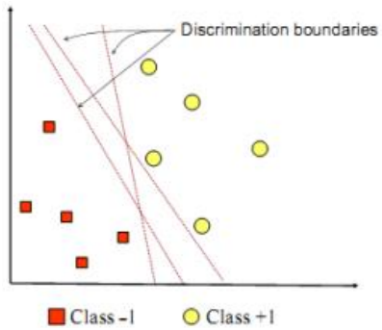

Fig 2. Hyperplane is formed between the two classes

The kernel used in this SVM classification is the RBF kernel with a Gamma value of 0.08 and the concept of multiclass labeling is used because the class of rhizome recognition is not a binary class. In this case, 3 classes will be built, namely Ginger, Galangal and Turmeric classes.

V. SYSTEM DESIGN

Research on rhizome recognition with SVM and KNN classification is divided into 4 stages, namely the stage of collecting rhizome image data, feature extraction stage, classification stage, and introduction stage. The mechanism of work that will be in this research can be seen in Figure 3.

Fig. 3. Block diagram of the work order in the proposed research

5.1 Data Collection

At this stage, rhizome image data was collected by taking photos of 3 types of rhizomes with a camera. The three types of rhizomes are ginger, turmeric, and galangal. For each type of rhizome, 50 images were taken with different backgrounds, lighting, and slopes so that 150 rhizome image data were obtained from 3 types of rhizomes. The data will be used as training data, and 10 from each type of rhizome are taken to be used as testing data.

5.2 Pre Processing

At this stage, the rhizome image data will be processed by grayscalling, which changes the rhizome image to gray. The rhizome image that has turned gray, then the thresholding process will be carried out to obtain a binary image with the aim of separating the rhizome object and its background.

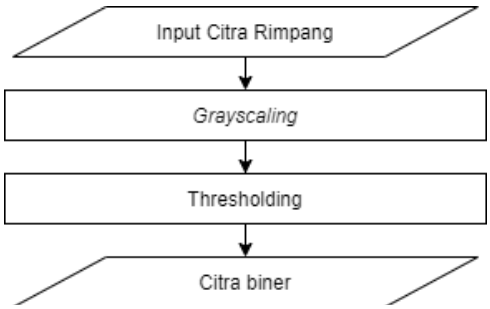

Fig. 4. Prepocessing diagram

5.3 Fitur Extraction

The rhizome image that has been pre-processed will then be carried out with the feature extraction process. The feature extraction used is shape and texture feature extraction. Extraction of shape features taken in the form of Area, perimeter, metric, major axis, minor axis, and Eccentricity. Meanwhile, for texture feature extraction in the form of contrast, correlation, energy, and homogeneity

5.4 Clasification

At this stage, the classification process is carried out from the results of feature extraction using SVM. In this study, there are 3 classes that will be built, adjusted to the type of rhizome dataset used, namely classes of ginger, turmeric, and galangal. Because there are more than 2 classes, the kernel used in this SVM classification is the RBF kernel and the concept of multiclass labeling is used. The flow chart for svm classification can be seen in Figure 5

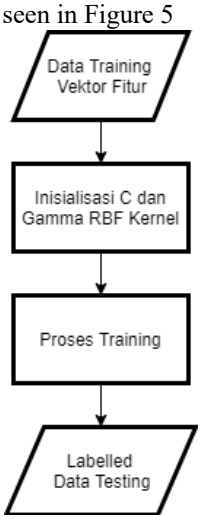

Fig 5. SVM Diagram

VI. RESULT AND EVALUATION

The feature extraction used in this study is the texture feature in the form of the average value of RGB light intensity, the value of the standard deviation of the grayscale image, contrast, energy, correlation, homogeneity and entropy. The results of

the shape feature extraction process can be seen in table 1.

Table 1. feature extraction result

rata-rata	standar_deviasi	kontras	energi	korelasi	homogenity	entropi
33.77	9.28	0.38	0.26	0.76	0.87	5.68
33.51	9.58	0.28	0.28	0.83	0.89	5.49
44.05	16.94	0.57	0.22	0.83	0.82	6.02
57.64	20.42	0.77	0.17	0.85	0.80	6.25
44.04	13.25	0.69	0.17	0.74	0.79	6.16
39.55	12.43	0.92	0.22	0.67	0.78	5.97
54.67	15.63	0.65	0.19	0.85	0.81	6.12
59.00	17.60	0.70	0.15	0.85	0.80	6.45
47.01	18.10	0.61	0.22	0.85	0.82	6.01

These features are classified using SVM with 3 labels, namely turmeric, ginger, and laos. As for the results of accuracy using the SVM method can be seen in table 2.

Table 2. Accuration

shape feature extraction	texture feature extraction	Combination
72%	78%	78%

It can be seen in the table that the accuracy of rhizome classification using SVM with shape features is 72%, texture features 78% and a combination of the two is 78%. that is, for rhizome classification, the SVM method with texture feature extraction produces better accuracy

VII. CONCLUSION

The problem of the difficulty of distinguishing the types of rhizomes can be helped by automatic classification of rhizome images using the support vector machine method. with the SVM method obtained good accuracy reaching 78%, meaning that the SVM method is quite reliable for classification with 3 classes, in this case the ginger, galangal and turmeric classes. As for further work, it can be improved in terms of rhizome image quality to get higher accuracy.

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