Identification of Medicinal Plant Leaves Using Convolutional Neural Network

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Abstract. Medicinal plants (herbs) are plants that are known to have certain compounds which are nutritious for health. In Indonesia there are 30,000 types of plants and 7000 of them are classified as medicinal plants (herbs). The human body is complex and organic, while chemical medicines contain chemicals that are inorganic and pure. Therefore, chemical medicine are considered not very suitable for consumption by the human body, which if consumed continuously can even be bad for human health. However, some chemical drugs are actually symptomatic (temporary) so they must be taken for life by patients with certain diseases. Therefore a system is needed to be able to help the community to recognize medicinal plants better, in this case the medicinal plants are focused on the introduction of medicinal leaves. In this study identification of medicinal plant leaves was carried out using the Convolutional Neural Network method. This research will build a system of identification of medicinal plant leaves by using Convolutional Neural Networks. Using training data that is carried out in a computer set and then implemented in mobile-based software to recognize the types and benefits of medicinal plant leaves identified.

Keywords: Image of medicinal plant leaves; Deep Learning; Convolutional Neural Network; Medicine.

1. Introduction

Medicinal plants (herbs) are plants that are known to have certain compounds that are nutritious for health. Each part of the medicinal plant is believed to have various properties to prevent, diverse or even cure a certain disease. In Indonesia there are 30,000 types of plants and 7000 of them are classified as medicinal plants (herbs)[1]. In addition to the many presence of these medicinal plants, the use of medicinal plants is also considered to be safer because it has natural ingredients compared to chemical medicine. To find out the content of medicinal plants can be done by phytochemical screening methods, so it can be known active compounds that are in certain plants that can be useful as a madicine[2].

The human body is complex and organic, while chemical medicines contain chemicals that are inorganic and pure. Therefore, chemical medicine are considered not suitable for consumption by the human body, which if consumed continuously can even be bad for human health. However, some chemical drugs are actually symptomatic (temporary) so they must be taken for life by patients with certain diseases[3]. The number of medicinal plants is still not balanced with the public's knowledge about the medicinal plants themselves, so many people prefer chemical medicines because they are considered more practical and easy to obtain. Therefore a system is needed to be able to help the community to recognize medicinal plants better, in this case the medicinal plants are focused on the

introduction of medicinal leaves. Leaves can be identified from image images[4] by color, size, texture[5],[6] and shape[7] using various methods including Neural Network[8],[9], [10].

Previous studies identified herbal medicinal plants based on leaf imagery using Artificial Neural Networks (ANN)[11],[12], Gray Level Co-occurrence Matrix and K-Nearest Neighbor Algorithms[3], Local Binary Patterns[13], Support Vector Machines[14], Multilayer Perceptron (MPL)[15]. The leaves to be identified are medicinal plant leaves which are often used for hypertension medicine, including bay leaves, avocado leaves, cat's whiskers leaves, celery leaves, soursop leaves, african leaves, starfruit leaves, grass jelly leaves, and betel leaves. These leaves were chosen because hypertension is a health problem that is considered serious and suffered by most people[12].

In this study identification of medicinal plant leaves was carried out using the Convolutional Neural Network method. CNN is one of the algorithms from the branch of Machine Learning that is based on Artificial Neural Networks (ANN) or its development, namely Deep Learning which is a development of the Multilayer Perceptron (MPL) to process two-dimensional data, one of them is image[16]. CNN is used in image data to detect and recognize objects in an image, with Backpropagation type training[17]. The way CNN works is similar to MLP, but in CNN each neuron propagated on the network has a two-dimensional shape, so that the weight and linear operating parameters on CNN are different[18].

This research will build a system of identifying nine types of leaves of hypertensive medicinal plants using Convolutional Neural Networks. In order to facilitate the user in using the system, the system built will be implemented on a mobile-based software (Android) to recognize the types and benefits of medicinal plant leaves that are identified.

2. Methods

2.1. Data Acquition

In this study, the leaves identified in this study consisted of nine medicinal leaves including bay leaves, avocado leaves, cat's whiskers leaves, celery leaves, soursop leaves, african leaves, starfruit leaves, grass jelly leaves and betel leaves which can be seen in Figure 1. There are 180 of training data used by grouped by type of leaf, with the number of each leaf 20 data.

Fig. 1. The Leaves of a Medicinal Plant Identified

2.2. Convolutional Neural Network

Convolutional Neural Network (CNN) is one of Deep Learning and neural networks method that are most commonly used to analyze visual image data. The results of studies using CNN features with different classifiers show consistency and excellence[19]. The architecture of Convolutional Neural Networks can be seen in Figure 2. Convolutional Neural Networks has two layers namely the Feature Learning layer and the Classification layer using Backpropagation.

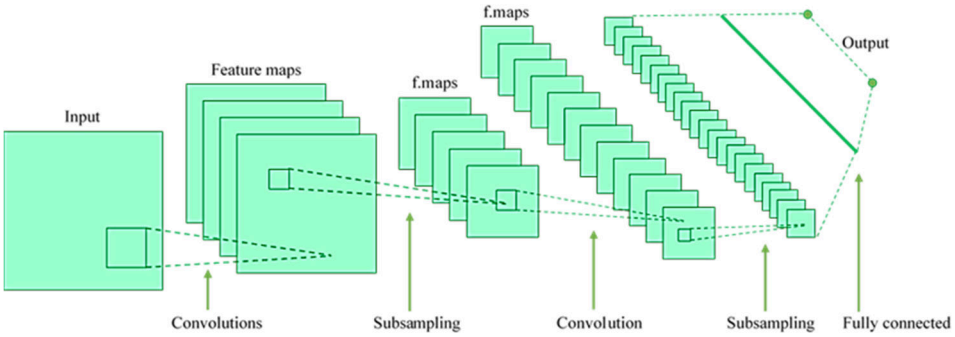

Fig. 2. The architecture of Convolutional Neural Networks

Convolutional is the main building block of the Convolutional Neural Network. Convolutional Layer consists of neurons arranged in such a way as to form a filter with length and height (pixels). The filter block is shifted above the image and for each product position the point between the filter block and the part of the image covered by the block taken[20]. Equation of Convolusion can be seen in Equation 1.

$$h_j = \tanh(\sum x_i * x_{ji} + bias) \quad (1)$$

This layer changes the image to a different depth by calculating the Kernel of the input image and then shifts the Kernel according to the Stride value so as to produce an output or commonly referred to as a Feature Map.

2.3. Backpropagation

Backpropagation is a supervised learning algorithm that uses the MLP architecture and is used for classification on CNN. Another advantage possessed by this ANN is its ability to learn (is adaptive) and immune to errors (fault tolerance) with these advantages ANN can realize a system that is resistant to damage (robust) and consistently works well[21]. Backpropagation corrects the weight of the information output obtained by feed forward to the output should be. This process is repeated until the error between the output produced should be smaller than the specified value. There are three stages in the training process of this algorithm, namely: the feed-forward phase of the training input pattern, the back-ward phase of errors that occur, and the weight value modification phase.

The initial step is to initialize the weighing factor by randomly assigning a small value, then repeat the feed-forward phase, the back-ward phase, the modification phase of the weight value and test the stopping condition until the stopping condition is met. For each pair of training do the feed-forward phase, the back-ward phase, and the weight value modification phase (calculate all weight changes).

3. Result and Discussion

First the software asks the user to input the leaf data to be identified. The program will read the image pixels into the matrix, and then extract the color parameters. Then extract the shape parameters. The calculated parameters will be compared with all the training data leaves that were previously identified in the database, using a minimum difference size to display the most suitable leaves. This software uses 180 training data with 20 data types and is tested with 50 leaf data consisting of 45 leaves that correspond to training data (5 leaves of each type) and 5 leaves that are not recognized. The software will identify the name of the leaf identified with information related to the leaf, and will display a notification that the leaf is not recognized if the data identified does not match the training data.

4. Conclusion

This research has successfully implemented the Convolutional Neural Network method to extract features on medicinal plant leaves and identify them into 9 classes of hypertensive medicinal plant leaves based on the closest value between the training data and test data.

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