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Classification Analysis of Regional Characteristics Using Convolutional Neural Network on Satellite Image

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ABSTRACT

One of the developments of Machine Learning technology is Deep Learning which uses an algorithm based on mathematical concepts that work like the human brain. An example of the use of deep learning is for digital image processing. Image Processing is used to identify, classify objects quickly, precisely, and can process multiple data simultaneously. In this study, an analysis of the classification of regional characteristics will be carried out. Regional characteristics are divided into two aspects, namely water areas and land areas. The land area is divided into mountains, highlands, lowlands, and valleys. While the territorial waters include straits, bays, rivers, and lakes. Classification will be done using one of the algorithms from Deep learning used in image processing, namely Convolutional Neural Network (CNN). The CNN algorithm consists of 3 main layers, namely Convolutional Layer, Pooling Layer, and Fully Connected Layer. In this study using CNN architecture with a combination of 3 Convolutional Neural Networks and 2 Fully Connected Layers. At the stage of making a regional characteristic classification system using deep learning, there are several main process stages, namely data collection, system design, training, and testing. The processed dataset is a regional image dataset originating from the satellite.

INTRODUCTION

Color is an important element in a map. The presence of color can make it easier to read and understand maps. The colors in the map must be made as close as possible to the actual conditions so that they can represent the character of the region on the earth's surface. It is a very active factor in the map vision variable which has a visible function in the map design. Color itself is a type of map signal, and it also acts as a map decoration. That is, the color of the map has both informational and aesthetic value at the same time. In the design of thematic maps, color attributes need to be understood in order to properly utilize color. Therefore, this is the first in the map design to determine the basic color tone to express the map subject.

Artificial Intelligence or Artificial Intelligence is one part of computer science that studies how to make computer machines can do jobs like and as well as humans do, even better than humans can

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do. Artificial intelligence can also learn like humans, so the more data that is learned, the better the ability of artificial intelligence. Unlike humans, artificial intelligence can learn and find patterns and record them much more efficiently and quickly. The process of learning in artificial intelligence is also called learning. In the artificial intelligence branch, there is a specific or detailed learning process known as deep learning. Deep learning is a learning process that uses algorithms that refer to mathematical laws that work like the human brain. Deep learning is used for various kinds of work such as predicting opportunities or events and recognizing objects. One of the uses of deep learning is in the field of digital image processing. The existence of a digital image processing system is intended to assist humans in recognizing or classifying objects efficiently, namely quickly, precisely, and can process large amounts of data at once.

This study intends to develop an application using the Convolutional Neural Network that uses satellite image objects as test data. The CNN algorithm consists of 3 main layers, namely Convolutional Layer, Pooling Layer, and Fully Connected Layer. In this study using CNN architecture with a combination of 3 Convolutional Neural Networks and 2 Fully Connected Layers. At the stage of making a regional characteristic classification system using deep learning, there are several main process stages, namely data collection, system design, training, and testing. The processed dataset is a regional image dataset derived from satellite imagery. The architecture using the Convolutional Neural Network developed in this study is able to classify the characteristics of the region in satellite imagery and produce the best accuracy. There are three areas for classification, namely agricultural areas, residential areas, and water areas.

MATERIALS AND METHODS

In this study, there are several stages of completion in classifying regional characteristics as shown in Figure 1.

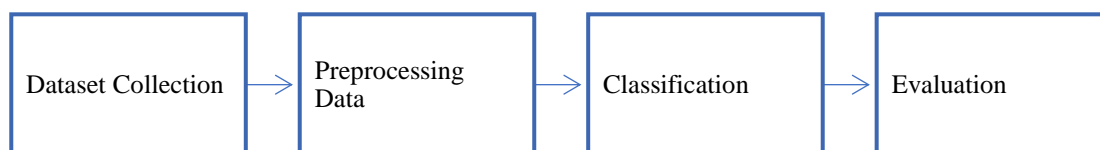


Figure 1. Research Framework

Figure 1 is a framework for research carried out in identifying regional characteristics using the Convolutional Neural Network on satellite imagery. Within the framework of this research, there are four stages starting from the dataset collection (data collection), preprocessing data (preparing the data before processing), then the classification stage on the map image used and the last is the evaluation stage which functions to evaluate the classification method that has been used. done. The following is an explanation of each stage in the research framework in Figure 1:

Datasets Collection

Dataset Collection is the stage of data collection that will be used in this study in determining regional classification. Because this research is supervised learning where the classification process uses existing data that has a label from each class, there are three areas for classification, namely agricultural areas, residential areas, and water areas.

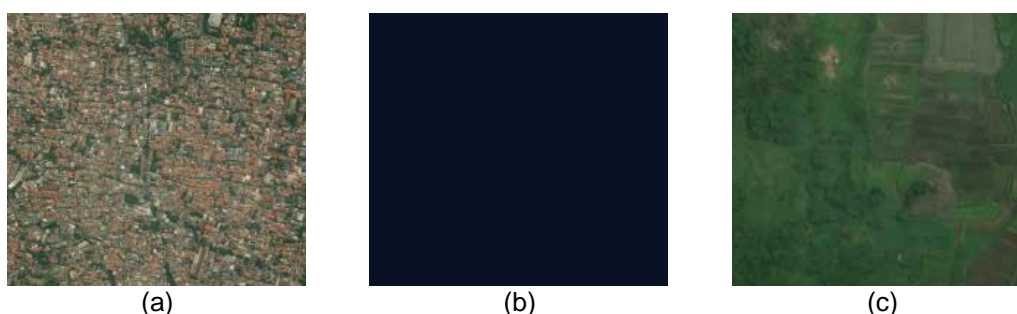


Figure 2. (a) Residential Areas, (b) Water Areas, (c) Agricultural Area

In Figure 2 (a) is a picture of a residential area with a dominant RGB color (164,100,90). Figure 2 (b) is an image of a water area with a dominant RGB color (8,20,36). Figure 2 (c) is a picture of an agricultural area with (60,89,61).

Preprocessing Data

Data preprocessing is the preparation stage before the data is processed and used for classification. At this stage, the data preparation carried out is to determine the amount of data used, namely 45 images from all aspects of the region.

Table 1. Dataset

Dataset	Data Training	Data Testing
Agriculture	50	20
Settlement	50	20
waters	50	20
Total	150	60

Classification

The next step is to classify images using the Convolutional Neural Network (CNN) method. The CNN algorithm is included in the supervised learning method where the identification of an image by training existing image data and targeting image variables.

The CNN convolutional layer helps the neural network on the CNN to recognize the regional classification based on the attributes it has. The neural network can recognize the characteristic image of the region based on the pixels in the image.

RESULTS AND DISCUSSION

Dataset Collection

Image data collection is carried out using the application of regional characteristic classification analysis using the Convolutional Neural Network (CNN) on satellite images. This application can select the area to be trained or tested. The number of regional images as training data is 150 and the test data is 60 images. Consists of 70 images of residential areas, 70 images of water areas, 70 images of water areas.

Data Preprocessing

After the dataset collection process, the next step is data preprocessing by entering data into the application for the introduction of regional characteristics. The introduction of regional characteristics is done using a deep learning method, namely the Convolutional Neural Network (CNN) method. The data used in the form of satellite image data.

The introduction uses the Convolutional Neural Network (CNN) method, which is to classify images starting with training. The training process is carried out so that the model created can recognize the desired object.

The distribution of training data and test data used in this study can be seen in the following graph:

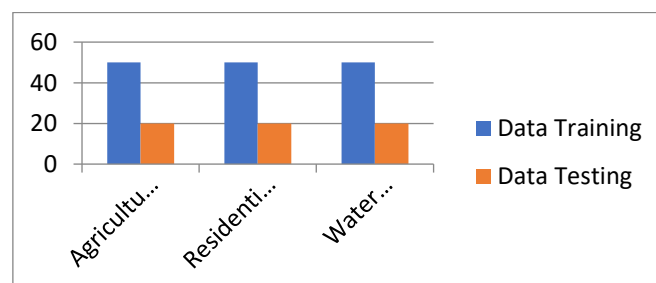


Figure 3. Dataset

The test data consisted of 50 images of residential areas, 50 images of water areas and 50 images of agricultural areas. Next, label the training images and test data. Labeling is done using

numbers 0, 1, and 2. Number 0 (zero) for the image label of residential areas, number 1 for labeling the image of water areas and number 2 for labeling images of agricultural areas.

Classification

Figure 4 describes the input image (input image) where the convolution process will be carried out to obtain feature maps in the sense of detecting the attributes or features possessed by the image. Then the result of this convolution is done by max pooling to change the image size to be smaller so that the data classification process will be faster, finally the result of max pooling is entered in the fully connected layer process.

The classification results obtained from the training data and test data are shown in Figure 4. Figure 4 shows the prediction results for the training data. The images of residential areas that have been successfully classified are all images of residential areas, which are 30, images of water areas that have been successfully classified are 50 of the 50 images used and images of agricultural areas that have been successfully classified are 50 images.

		Actual Class		
		0	1	2
Predicted Class	0	50	0	0
	1	0	50	0
	2	0	0	50

Figure 4. Classification of Training Data

The results of the classification of the test data can be seen in Figure 5. In Figure 5, the prediction results for the test data consist of 20 images for each region. The images of residential areas that have been successfully classified are 20, the images of water areas that have been successfully classified are 20 images of 20 images and the classified agricultural areas are 19 images of the 20 images used.

		Actual Class		
		0	1	2
Predicted Class	0	20	0	1
	1	0	20	0
	2	0	0	19

Figure 5. Test Data Classification

CONCLUSIONS AND RECOMMENDATIONS

In this study, the area classification using the Convolutional Neural Network (CNN) method has been successfully carried out with an accuracy rate of 98.33%. The Convolutional Neural Network (CNN) model used consists of four convolution layers with a filter size of 3x3, the activation function used is reLu, and 2 pooling layers with a size of 2x2. The images used for this research are 210 images.

In further research, it is better to add more specific regional characteristics including 2 aspects of regional characteristics, namely water areas and land areas. The land area is divided into mountains, highlands, lowlands, and valleys. While the territorial waters include straits, bays, rivers, and lakes.

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