



Introduction to types of motorized vehicles based on shape and model using convolutional neural network based on digital images

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ABSTRACT

The process of classifying images of different vehicles is an interesting challenge for research. The process of classifying different vehicles is widely used in various things such as electronic ticketing, e-parking and other fields. One method often used in the classification process is the Convolutional Neural Network (CNN) method. The CNN method is widely used to perform the classification process because it has been tested and proven to be effective in image processing and pattern recognition. By classifying different vehicles, CNN can automatically extract features from image data and detect complex patterns. The CNN method provides high efficiency and accuracy in classifying various vehicles for various practical applications such as traffic management and license plate recognition systems. The study performed motor vehicle image recognition by determining the types of two-wheeled vehicles (motorcycles) and 4-wheeled vehicles (cars) using a combination of Otsu threshold and CNN method. From the results of the research, two types of vehicles can be well identified, showing the confidence level of the classification process. of.)

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1. Introduction

On the road, cars serve as means of transportation. They can be either motorized or non-motorized. Observe how cars have developed and how dependent Indonesians are on them (Yedidiya et al., 2023). Given the country's roadways, it's not implausible that existing car usage will eventually overtake people's lifestyle choices. contemporary environment where daily activities are dependent on automobiles (Radikto et al., 2022). One method of attempting to lessen traffic congestion is to designate particular routes for vehicles with two, four, or more wheels. Artificial intelligence and other technologies can be used to identify passing vehicles on the road, allowing computer-based apps to be employed for traffic monitoring tasks (Fadlia & Kosasih, 2019) (Prasetyo et al., 2023).

Research on the classification process of different vehicle photos is an intriguing subject (Rahman et al., 2022). The vehicle variety classification technique is extensively utilized in e-ticketing, e-parking, and other domains. Convolutional neural networks are one of the frequently used techniques for classification (CNN) (Rahmadhani & Marpaung, 2023) (Prasetyo et al., 2023) (Manajemen et al., 2024). One information system technology for classifying and capturing items in an area image is digital

image processing (Taufiq, 2021). There are various techniques for capturing an object with Each offers benefits and drawbacks to the approach (Cahyono & Budiyanto, 2020).

The most often used method for graphing trees is Convolutional Neural Network (CNN), one of several types of graphing methods available (Fasounaki et al., 2021) (Nugroho & Puspaningrum, 2021). CNN is the development of the Multi-Layer Perceptron (MLP) and is one of the Deep Learning algorithms. The method CNN has the most significant results in image processing; this is because CNN continuously refines its image processing system on the human visual cortex, giving it the ability to process images more effectively (Peryanto et al., 2020) (Dwi Nugraha et al., 2019) (Amwin & Rani, 2020). Vehicle detection and recognition has been used in recent years to identify different types of cars, detect traffic lanes, and detect automobiles. A vehicle is any form of transportation propelled by a machine or by living organisms. The following vehicle types are categorized according to multiple literatures: vehicle, truck, or bus (Amwin & Rani, 2020). This research was carried out to see the outcomes of the level of classification accuracy type of motor vehicle using the Convolutional Neural Network method (CNN), based on the challenges that have been mentioned and previous research.

2. Research Methods

In order to conduct this study, a survey of the literature on image processing approaches for detection and vehicle recognition was done. Videos or photos might be used as input data. By entering relevant terms, Google Scholar and ResearchGate were used to conduct the literature search. A) "vehicle detection," B) "vehicle classification," C) "image based," and D) "video based" were the four main keywords that were searched for. The following are the selection criteria for literature: (a) scientific publication is called literature, (b) Vehicle detection and recognition techniques are covered in the literature, (c) English and Indonesian scientific publications provide the literature, (d) Vehicle classification is covered in the literature (e) The literature takes a picture- or video-based method. Research is an effort to develop knowledge, as well as develop and test theories. The gathering of data is the most crucial aspect of research. While creating instruments is a crucial part of the research process, gathering data is even more crucial, particularly if the researcher employs techniques that could lead to the inclusion of the researcher's subjective viewpoint. For this reason, gathering data collection tools—that is, gathering the relevant variables—must be approached carefully in order to produce results that are suitable for their application. The literature's title, abstract, and conclusion are taken into consideration during the selection process. The chosen literature will next be examined in terms of methodology, dataset quantity and quality, input type, vehicle type, and accuracy/performance.

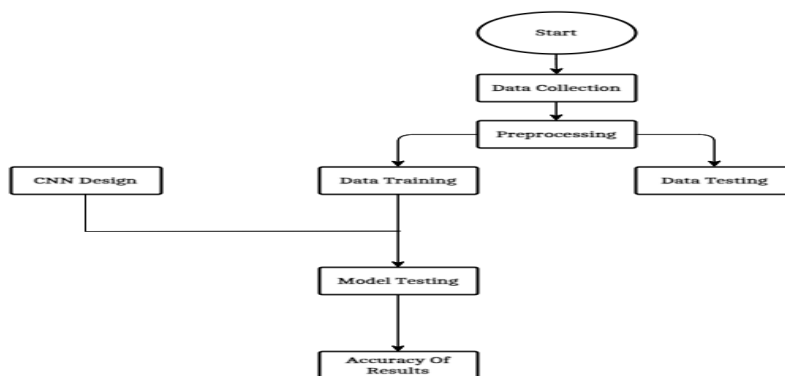


Figure 1. CNN method flow

Data Collection

Data gathering on images was done with the use of extra Google apps, specifically Fatkun

Batch Downloader. This program has the ability to download a lot of pictures.

Preprocessing

preprocessing an image so that vehicles, motorcycles, and bicycles are all the same size. The next action is to separate the gathered data into two categories: training data and test data (testing). The next phase is to label every vehicle, including cars, motorcycles, and bicycles, so that they can be identified using test and training data.

CNN Design

The process of building a model that trains data to recognize desired objects is known as CNN design. The number of layers employed, the determination filter, the kernel size, the activation function, and the pooling size make up the compiled model.

Data Training

Following the completion of the CNN model construction, the following step involves training the model using previously gathered data. The number of epochs, or iterations, was then employed in the model testing procedure to calculate the number of times the network would do training. At this point, the CNN model's performance is measured using a loss function.

Data Testing

Model testing with test data is the next step. This phase was used to evaluate the Convolutional Neural Network (CNN) model's accuracy. This degree of precision shows how accurately vehicle types have been classified. The high degree of accuracy demonstrates the model's ability to classify all three categories of cars effectively.

3. Results and Discussions

There are a few forms carried out, to be specific the primary process of taking information that's as of now accessible, for classifying picture information. At that point the another prepare is resizing the picture so that each picture has its claim uniform or the same measure. Information collection is carried out to get pictures that will be utilized in handle of preparing and testing the Existing CNN engineering show. Another the information will be prepared by changing The picture estimate gets to be the same estimate, at that point the information is partitioned into two, to be specific preparing information (preparing) and test information (testing), after preparing it enters the plan organize of the Existing CNN inner design This arrange is utilized to prepare information in recognizing objects. The following organize is show preparing utilizing already collected preparing information. At that point it is carried out to test the level precision of the Existing CNN design.

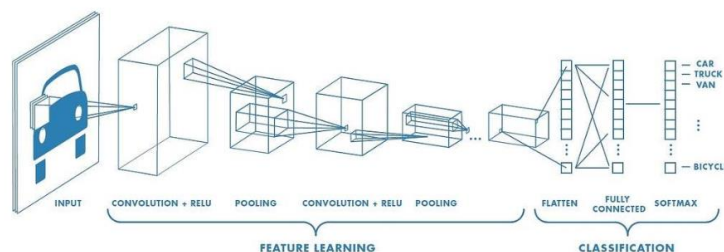


Figure 2. CNN architecture

Artificial neural networks and CNN share certain structural similarities. CNN processes and classifies incoming images into distinct categories in order to classify them. An additional architecture to CNN that is tailored for the features in the input image is what separates CNN from ANN. CNN is made up of multiple primary parts, which include: (a) Layers of Convolution, (b) Layer of Pooling, (c) Completely Networked Layer, (d) Discontinuities.

A dataset is an assemblage of items derived from data and transformed into information. The photos in the data, or images extracted from already-existing data, are used. Table 1. shows the number

of photos utilized for training and testing purposes, respectively, at 400 and 1600. 4000 photos of data from every kind of car and motorcycle.

Table 1. Overall Dataset

No	Dataset	Amount Of Data
1	Motorcycle Data	2000
2	Test Data	2000

There are two categories of vehicles in the 4000 total data: motorcycles and cars. Each dataset in the class is now separated into training and test data for use in Table 2 presents the findings of this study.

Table 2. Dataset Division per Class

No	Dataset	Amount Of Data
1	Motorcycle	400
2	Car	400

Training data that has been divided and preprocessed into a model with model fit is used to carry out model training. Batch_size = 32 and epoch = 10 are used in the fit model. The number of times the network will train or run through the complete dataset is determined by the epoch. The amount of data samples utilized in a single training iteration—which updates the model weights through feedforward and backpropagation—is indicated by the batch_size variable.

```

Epoch 37/40
31/31 [=====] - 23s 745ms/step - loss: 0.0998
- accuracy: 0.9574
Epoch 38/40
31/31 [=====] - 23s 755ms/step - loss: 0.0666
- accuracy: 0.9815
Epoch 39/40
31/31 [=====] - 24s 779ms/step - loss: 0.0600
- accuracy: 0.9825
Epoch 40/40
31/31 [=====] - 24s 763ms/step - loss: 0.0790
- accuracy: 0.9722
Execution Time: 13.783737583955128 minutes
    
```

Figure 3. Training Process 32x32 – 20 epochs

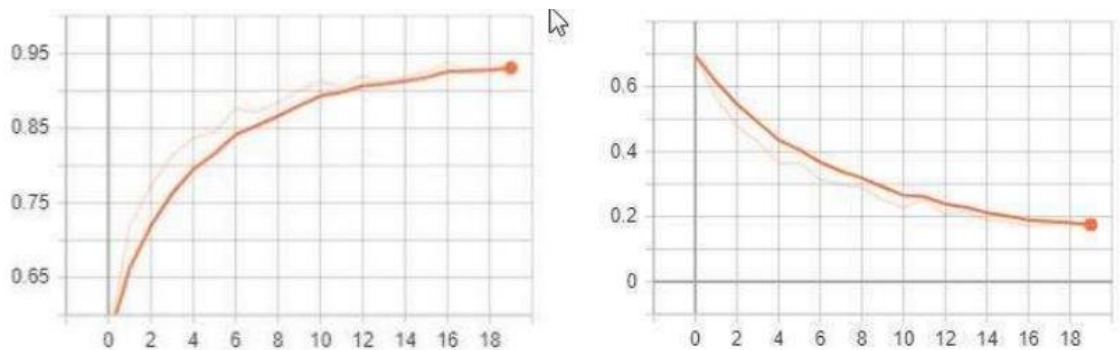


Figure 4. Accuracy and Loss Training Graph 32x32 – 20 epochs

The findings of the second experiment, which was conducted by attempting the following parameters—increasing the number of epochs from the previous 20 to 40 while maintaining the same image size of 32 × 32—are shown in figures 3 and 4. The accuracy has improved, going from 94% to 97%

previously. It seems that the accuracy does not increase much with increased epoch numbers. The training process takes a lengthy period with the addition of epoch.

4. Conclusion

With an accuracy rate of 87.12%, research on the categorization of vehicle types using the Convolutional Neural Network (CNN) method has been successfully conducted. The CNN model in use is composed of two 2x2 pooling layers, one reLu activation function, and three 3x3 convolution layers with filter size. For the research, 4000 photos were used. Model fit is employed during the training phase, with batch_size = 32 and epoch = 10. During testing, the resultant loss value is 0.5573 with an accuracy of 0.8712, which is less than or equal to zero. The research findings indicate that the developed model is capable of classifying various vehicle kinds, including cars and motorcycles. It is clear from this research that a model with more sophisticated learning capabilities is needed in order to perform classifications well and obtain high accuracy values.

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