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Classification of Motorcyclists not Wear Helmet on Digital Image with Backpropagation Neural Network

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Abstract

One of the world's leading causes of death is traffic accidents. Data from World Health Organization (WHO) that there are 1.25 million people in the world die each year. Meanwhile, based on data obtained from Statistics Indonesia, traffic accidents from 2006 to 2013 continue to increase. Of all these accidents, the largest accident occurred at motorcyclists, especially motorcyclists who not wearing standard helmet. In controlling the motorcyclists, police view directly at the highway, so that there are weaknesses which there are still a possibility of motorcyclist offenders who are undetectable especially for motorcyclists who are not wear helmet. This paper explains research on image classification of human head wearing a helmet and not wearing a helmet with backpropagation neural network algorithm. The test results of this analysis is the application can performs classification with 86.67% accuracy rate. This research can be developed into a larger system and integrated that can be used to detect motorcyclists who are not wearing helmet.

Keywords: *traffic accidents, classification, not wearing a helmet, backpropagation neural network*

1. Introduction

Traffic accidents are one cause of death in the world. Data obtained from World Health Organization (WHO), the number of people who died in the world caused by traffic accidents totaled 1.25 million people annually [1]. While in Indonesia, based on data from Statistics Indonesia, number of accidents recorded from 2006 to 2013 continues to increase. Of all these accidents, the biggest accident occurred on motorcyclists [2]. One of the reasons that the motorcyclist were not wearing a helmet according to standards set by the government.

The government has issued regulation No. 22 of 2009 on traffic and road transportation which one of the purpose is to decrease the death rate that caused by traffic accident. One of the contents in the regulation that is in article 106 paragraph 7 states that every person driving a motorcycle and the motorcycle passenger must wear a helmet that meets national standards of Indonesia [3].

Meanwhile, all this time, supervision of motorcyclists on the road by the police is still done manually by looking directly at the highway. There are weaknesses which there is still a possibility of motorcyclist off enders who are undetectable, especially for motorcyclists who were not wearing helmets, still if the police is standing guard at the police station, they can not know motorcyclists who were not wearing helmets. One solution to overcome that problem is to utilize the camera in conducting surveillance on highways and combined with the detection process for detecting the presence of motorcyclists who were not wearing helmets.

There are several researches that have been done relating to the monitoring of the traffic that is using a camera with good results [4-6]. On those researches, the camera was only used for monitoring and image from the result of recording was not used well. The result of the recording can be used for example to detect or to classify motorcyclist wearing a helmet or not automatically. Research from this classification issues has been done by using Support Vector Machines (SVM) to generate an accuracy rate of 85% [7].

This paper explains the classification process of motorcyclists wearing a helmet and not on the highway on digital image with backpropagation neural network. This method has been widely used in the process of identification and detection with good results, for example

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identification of varieties of food, stone texture identification, shape identification, moldy peanut kernels identification, identification of external quality of wheat grain, dermatological diseases detection, and renal tumor detection [8-18]. The results of this research may contribute to the development of violation detection systems, of motorcyclists not wearing a helmet, automatically based on digital image that captured by the camera.

2. Research Method

2.1. System Description

Description of application that undertaken in this research can be seen in Figure 1.

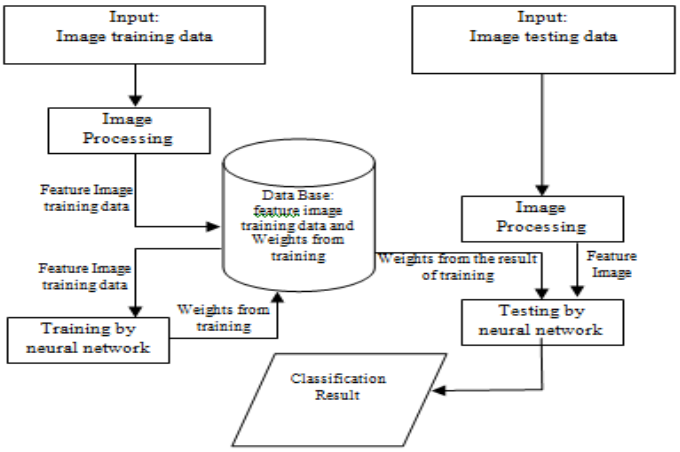

Figure 1. Description of Application

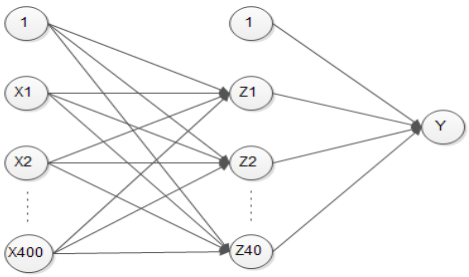

Figure 2. Architecture of Backpropagation Neural Network

In the outline, the system that was built is divided into two parts, namely training process and testing process.

a. The training process

The training process begins by entering some data in the form of motorcyclist image that wear helmet and not wear helmet. After that, the data is carried out a process of image processing so the result is image feature. Further, feature image is stored in the data base. Feature image that has been stored was trained using backpropagation neural network. The results of this training are in the form of weighted values of backpropagation neural network architecture.

b. The testing process

The testing process is used to determine accuracy level of the system that has been made. This process is started in the form of input image. Then do the image processing which will generate image feature. In testing process, data input is in the form of weighting value resulting from the training process and the feature image in the testing process. The results of

this process are used to test whether the image is an image of the head of a motorcyclist wearing a helmet or not.

Table 1. Example of Data That Will be Trained and Tested

(a). The image of head not wear a helmet		(b). The image of head wear helmet	
File Name	Image	File Name	Image
File001		File016	
File002		File017	
File003		File018	
File004		File019	
File005		File020	
File006		File021	
File007		File022	
File008		File023	
File009		File024	
File010		File025	
File011		File026	
File012		File027	
File013		File028	
File014		File029	
File015		File030	

2.1. Architecture of Backpropagation Neural Network

Backpropagation neural network architecture of this system consists of 400 inputs, one hidden layer consists of 40 neurons, and one output as in Figure 2.

3. Results and Discussion

This research conducted two tests, namely backpropagation neural network training and performance of backpropagation neural network algorithm.

3.1. The Testing of Backpropagation Neural Networks Training

The data that used as training amounted to 150 images which consists of 75 images of the head wearing a helmet and 75 images of the head not wearing a helmet. The image size that used as training is 20x20 pixel, the example is in the Table 1. The purpose of this training is to find the best suitable network patterns of the architecture that has been created which produces values of network weights.

Testing of network training is using training interface as in Figure 3 with same input limit of epoch and error which maximum limit of epoch is 30.000 and boundary error is 0.000001. This test will find the influence of variations in rate of learning (α) between 0.1 up to 0.9, then searched the lowest epoch. These test results are shown in Table 2.

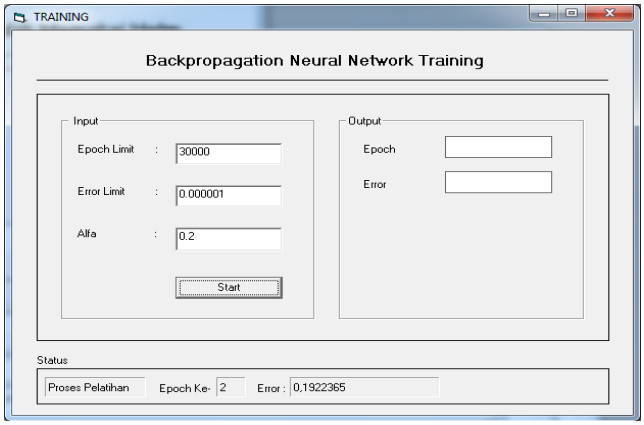

Figure 3. Training Interface of Backpropagation Neural Network

Table 2. Testing Training Result of Backpropagation Network with A Learning Rate (α) Variation

No.	Learning rate (α)	Epoch	Error
1	0.1	5988	0.000001
2	0.2	3055	0.000001
3	0.3	2103	0.000001
4	0.4	1451	0.000001
5	0.5	1129	0.000001
6	0.6	933	0.000001
7	0.7	914	0.000001
8	0.8	1016	0.000001
9	0.9	1049	0.000001

From Table 2 it appears that the maximum limit of the same epoch and the same error make all the testing has reached a predetermined error before reaching the maximum epoch limit. Additionally, the smallest epoch is achieved during the test by giving learning rate by 0.7 with 914 epoch. Moreover, it can be seen that the larger the learning rate value, the faster provision gives tendency in achieving an error or epoch value become smaller.

3.2. Testing Performance Backpropagation Neural Network Algorithm

This test is used to measure performance of back propagation neural network algorithm in classifying the image of a human head wearing helmets and not wearing a helmet. The interface used in these tests as in Figure 4. This test is using data from the network weights training result variation of learning rate. Input from these tests are 30 images with a size of 20 x 20 pixels composed of 2 types of 15 images of human heads were not wearing helmets and 15 images of man wearing a helmet as shown in Table 1. The testing results performance of the backpropagation neural network algorithm which using the data of network weights with each administration of learning rate values are as shown in Table 3.

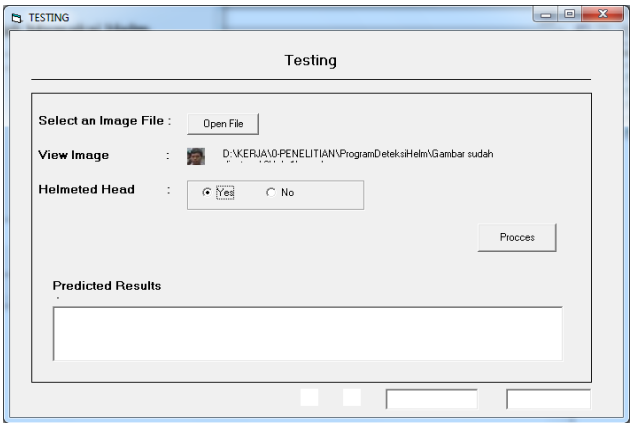

Figure 4. Testing Interface from Performance of Backpropagation Neural Network Algorithm

Table 3. Testing Performance Results of Neural Network Algorithm with a Variation of Learning Rate (α) Value on Training

No	Learning Rate (α)	Accuracy Rate
1	0.1	83.33 %
2	0.2	86.67 %
3	0.3	86.67 %
4	0.4	83.33 %
5	0.5	83.33 %
6	0.6	86.67 %
7	0.7	83.33 %
8	0.8	80.00 %
9	0.9	83.33 %

From Table 2 shows that the best accuracy is obtained on the results of training with a learning rate value of 0.2, 0.3, and 0.6 in the amount of 86.67%. Whereas the method of Support Vector Machines (SVM) was used for the same case with the average accuracy rate is 85% [7]. This accuracy level can be improved by increasing the number of training data because the performance of backpropagation neural network algorithm is affected by the amount of data variation that has been trained.

4. Conclusion

From the research that has been done, it can be concluded that the use of image processing and backpropagation neural network technique to classify human head who are not wearing a helmet and wearing a helmet provides the greatest accuracy rate of 86.67%. This accuracy level is achieved with a learning rate value of 0.2, 0.3 and 0.6 during network training. In granting the variations of learning rate value during training not affect the performance of this neural network algorithm.

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