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Video Based License Plate Recognition of Moving Vehicles Using Convolutional Neural Network

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Abstract: A built-in system was implemented with a GPU in order to recognize the license plate number without detection line. The deep-learning network to recognize the license plate number of the vehicle uses relatively simple AlexNet. Tests confirm that the vehicle license plate can be effectively recognized using CNN.

Keywords: License plate recognition, Convolutional Neural Network

1. INTRODUCTION

A number of studies have been conducted in various fields using deep learning. In particular, it is particularly noteworthy in the field of visual imaging, which is applied to objects detection, recognition, and tracking. The deep-learning algorithms, such as CNN (Convolutional Neural Network) have excellent performance compared to traditional algorithms in various fields. By leveraging the GPU, complex networks can also be deployed in real time [1]-[3]. When a real-time image processing application is implemented with a general-purpose computer (CPU) is usually heavily loaded and in many cases that CPU alone cannot meet the real-time requirement at all. Most modern computers are equipped with powerful Graphics Processing Units (GPUs) to accelerate graphics operations.

In this paper, the vehicle license recognition function, which is widely applied to the vehicle's illegal operation and outdoor parking lots, using CNN with a GPU, and is shown that the vehicle number plate is effectively recognizable without detection line.

2. LICENSE PLATE RECOGNITION BASED ON CNN

The license plate recognition based on CNN is carried out with AlexNet using license plate DB, as shown in Fig. 1. Next, the plates images are recorded in input video clip are recognized with a trained AlexNet [4-6].

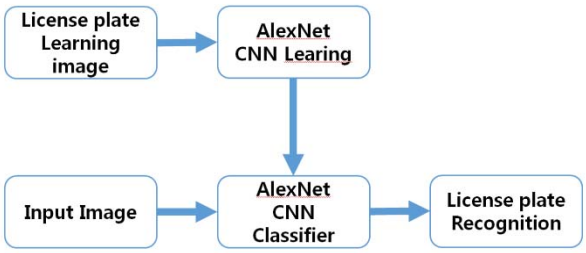

Fig. 1. Schematic diagram of learning and recognition for license plate.

2.1 Learning Model

AlexNet consists of five convolution layers and three fully connected layers, as shown in Fig. 2.

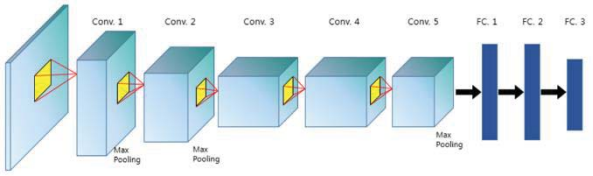

Fig. 2. Architecture for convolutional neural network of AlexNet.

2.2 CNN deep learning and recognition for license plate

500 vehicle license plates images were used for vehicle license plate learning. The images used in the study were only used to extract and use the license plate portion as shown in Figure 3. Using the extracted vehicle license plate, the vehicle number is learned and recognized by AlexNet. Two or more consecutive numbers are recognized by the vehicle number. The size of the input image is 1392 x 1040, and the image is removed by 20% of the horizontal and vertical planes and the remainder is treated as an area of interest.

We use DIGTIS to recognize numbers and letters first, then increase each recognized area by 40% to find objects around them. These discovered objects are identified by four consecutive numbers and two consecutive numbers, which are identified as the number plates. The training process for training using DIGTIS was shown in Fig. 4.

After identifying all the numbers that exist in the region of interest, a number of consecutive numbers are used to identify the number of plates. Figure 5 shows accuracy and error according to the progress of the epoch in Convolution Neural Network.

Fig. 3. Examples of extracted license plate images for learning.

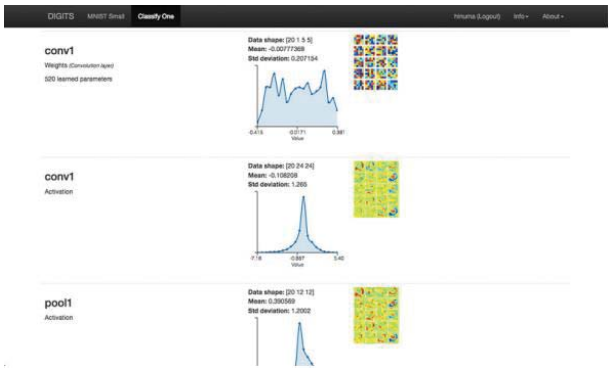

Fig. 4. Examples of extracted license plate images for learning.

3. EXPERIMENTAL RESULTS

For learning, we use openALRP, and the data were used 500 plates. The recognition rate was calculated with respect to the AlexNet of 100 input images. A result for license plate recognition is shown in Fig. 5. And total experimental results are shown in Table 1.

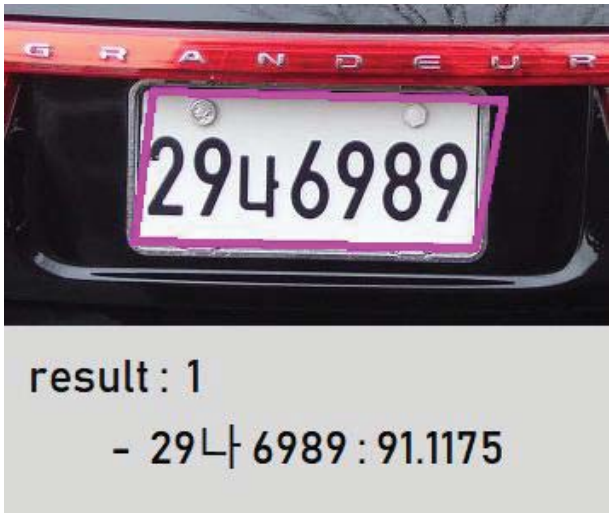

Fig. 5. A result for license plate recognition.

Table 1 The caption should be placed before the table.

Input Image (Number)	Recognition Rate (%)	Error Rate (%)
100	97	3

Most of the images that occur error are mostly images whose number plates are broken or heavily reflective. Also, we plan to improve through future studies in areas where we do not recognize the letters yet.

4. CONCLUSION

In this paper, a built-in system was implemented with a GPU in order to recognize the license plate number without detection line. The deep-learning network to recognize the license plate number of the vehicle uses relatively simple AlexNet. Tests confirm that the vehicle license plate can be effectively recognized using CNN. The problem is that the green license plate does not become a recognition rate, which will be secured through future research.

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