Automated road marking recognition system

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Abstract. Development of the automated road marking recognition systems in existing and future vehicles control systems is an urgent task. One way to implement such systems is the use of neural networks. To test the possibility of using neural network software has been developed with the use of a single-layer perceptron. The resulting system based on neural network has successfully coped with the task both when driving in the daytime and at night.

1. Introduction
Modern vehicles meet high requirements for driving control and safety comfort. For this purpose, vehicles are equipped with various systems that enhance driving safety on the road. One of such systems, which belongs to the make-up systems of active safety is the Lane Keeping Assist System. It is designed to help the driver to stick to the selected lane, preventing traffic accidents. The system shows high efficiency when driving on federal highways where drivers are characterized by inattention, craving to sleep because of the monotony of movement. One of the main functions of the Lane Keeping Assist System is the function of road marking recognition.

Today, the trend in the automotive industry has been the development of prototypes of self-driving vehicles, allowing to refuse from the driver in perspective. Such vehicles require recognition systems of ambient conditions including a road marking recognition systems.

2. Recognition of road markings
The task of road marking recognition in real time is reduced to forming a sequence of frames or video using camera and subsequent processing of the images. In images recognition neural networks are frequently used [1, 2]. A neural processing element can be considered as a simple device that performs a set of given simple functions. These devices combining neural processing elements by connections can be assembled into a single network. In this paper for finding markings we used a single-layer perceptron, which, despite its simple architecture, is able to solve quite complex problems [3]. Herewith the resulting model is quite simple and easy to implement using standard software tools [4-7].

For simple neural architectures, methods and objectives, you can use almost any programming language, but for complex projects most useful languages are object-oriented programming. When choosing a programming language such factors as the target platform, language flexibility, performance, prevalence and other factors were taken into consideration. As a result, the common programming language Python was selected, together with a library of algorithms of computer vision, image processing and numerical universal algorithms Open CV [8].
The algorithm of the road marking recognition system includes the following steps:

1. Pre-processing of images.
2. Detection of road marking lines.
3. Error filtering.
4. Approximation of the obtained values

Operations of images recognition in images of certain objects usually are preceded by image processing to create conditions that increase the efficiency and quality of the extraction and recognition of the unknown objects or the objects under study. Pre-treatment methods depend on the research objectives and are quite diverse. In this paper we used one of the most commonly used algorithms for image pre-processing - Canny algorithm. Canny algorithm is still one of the best detectors. In addition to special individual cases it is difficult to find an algorithm that would work much better than the Canny algorithm.

Before applying the algorithm the original image was converted to the grayscale. This can reduce computational costs. This action is typical for many image processing techniques. After a conversion, we obtain a binary image for further actions.

In the next step the neural network detects the road line. Each synapse in its domain is responsive to the road line.

After a neural network recognizes lines, false positives are possible or unnecessary lanes can be determined, for example, road markings of the neighboring lanes. Mistakenly found data will further affect the quality of the determined line, and therefore a control system in general. That is why it is necessary to remove them by filtration.

In the last step the data are approximated. In this paper, to simplify the task a linear approximation by the method of least squares was used. The results of road marking recognition on the captured video from the DVR in the daytime and night-time are shown in Figures 1 and 2 respectively.

Figure 1. Marking recognitions in the daytime
3. Conclusion
Creating systems that enhance driving safety on the road, undoubtedly, is one of the important tasks. Currently, this topic is particularly relevant in connection with interest all over the world to create unmanned vehicles, where a high reliability and performance regardless of external conditions is required from these systems.

The use of neural networks for image recognition allows to define a road marking in real time and thus to apply it for automated Lane Keeping Assist System in modern and future unmanned vehicles.

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