Scientists develop a traffic monitoring system based on artificial intelligence

August 28 2019

Credit: South Ural State University

Scientists of South Ural State University have developed a unique intelligent system for monitoring traffic flow using artificial intelligence, which does not require specific recording equipment and can work on almost any type of camera. The system instantly processes data received in real time, unlike existing programs in which processing incurs a delay of up to 10 to 15 minutes. An article on the results of the study was published in the *Journal of Big Data*.

Traffic Jam Solution

"We have proposed and implemented a modernized system for assessing traffic flows, based on the most recent advances in the detection and tracking of vehicles. Unlike existing analogs, our system recognizes and analyzes in real-time the direction of movement of vehicles with a maximum relative error of less than 10 percent. The closest analogs are able to determine the speed and classify vehicles in only one direction and with the condition of placing the cameras above the traffic flow with an accuracy of 80-90 percent. Operating a neural network allows you to generate up to 400 traffic parameters in real-time at each intersection," says project manager Vladimir Shepelev, associate professor at the Automotive Transport Department of the Polytechnic Institute SUSU.

The unique AIMS monitoring system collects, interprets and transmits data on the intensity of road traffic, classifies 10 categories of vehicles, measures speed, the current load level of each direction of the intersection, determines the further direction of vehicles. At the same time, real-time object recognition at the sheer intersection AIMS produces through the use of only one Full HD CCTV camera.

Credit: South Ural State University

"The results of this study can be applied by city authorities to improve the overall traffic capacity of the intersection. We have already proved our system at several intersections in Chelyabinsk to verify that the proposed solution is sufficiently accurate and can be used as a basis for other high-level models," says Shepelev.

The innovative technology delivers data on the structure of the traffic flow, vehicle directions and speeds in real-time. Using data mining technology will support implementation of efficient traffic patterns, reduce traffic congestion and improve resource management.

Neural networks for the urban traffic analysis

The current practice of monitoring traffic frequently relies on the use of expensive sensors for continuous data collection or on a visual study of traffic, usually measured over several days over certain periods of time. However, transport services do not receive proper and accurate information on the structure of the traffic flow, its intensity, speed, and in the following direction of movement.

"We managed neural networks to process massive amounts of video data, not only for detecting and tracking vehicles but also for analyzing the sequence of events," continues Shepelev. "In the process of developing the technology, we used the open-source Mask R-CNN and YOLOv3 neural network architectures to detect objects in real-time, as well as the SORT tracker, the code of which was modified by the team to improve the quality of object tracking."

Credit: South Ural State University

The embedded analytic block based on artificial intelligence determines the level of traffic organization at the intersection and assigns KPI to each direction of movement.

Increased efficiency and lowering monitoring costs

As a result of optimization of the YOLOv3 neural network algorithms, SUSU scientists were able to achieve accuracy at the level of 95 percent, taking into account the loss of objects during tracking, and significantly reducing the cost of real-time monitoring equipment.

"Artificial intelligence with machine vision takes data collection and analysis of road traffic to a new level, making it possible to recognize vehicles with much greater reliability than ever before," says Vladimir Shepelev. "Our deep learning networks are easy to configure, do not require specific recording equipment and can work on almost any type of camera."

The technology developed by scientists of the South Ural State University will increase the efficiency of using urban road infrastructure. In the near future, technology for monitoring road traffic using artificial intelligence will become part of the Sustainable Public Transport project for the city of Chelyabinsk.

Provided by South Ural State University