Section 2. Transport

https://doi.org/10.29013/AJT-22-7.8-22-25

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DEVELOPMENT OF AUTOMATED TRAFFIC CONTROL SYSTEMS USING ARTIFICIAL INTELLIGENCE

Abstract. Almost all major cities suffer from significant traffic congestion. To achieve improved detection performance and multi-vehicle recognition in a complex urban environment, a detection algorithm based on histogram oriented gradients (HOG) features is applied. This algorithm takes full advantage of HOG for vehicles, i.e. we can talk about the good descriptive ability of the HOG function. With ever-increasing demand for urban mobility and modern developments in logistics, the number of vehicles has been steadily increasing over the past few decades.

In our proposed method, the system is designed to control the time of a traffic light depending on the traffic density on the corresponding road. It acts as a multi-class classification that recognizes traffic. The system detects a traffic event in real time.

Keywords: capacity, multiclass classification, automated traffic control system, planning algorithm, traffic intensity.

With the ever-increasing demand for urban mobility and the expansion of the modern logistics sector, the vehicle fleet has grown steadily over the past few decades. One of the natural consequences of the growth of the vehicle fleet is the increase in traffic congestion. The normal operation of a traffic light requires supervision and coordination to ensure that vehicles and pedestrians move smoothly and as safely as possible. For this, a variety of control systems are used, ranging from simple clockwork to complex computerized control and coordination systems that self-adjust to minimize the delay of people using the intersection.

According to the international classification, four generations of systems should be distinguished that allow managing traffic [1, p. 24]:

1. First generation systems, in which all calculations necessary for traffic coordination were performed manually.
2. Second generation systems, within the framework of which partial automation of the traffic control process on the roads was carried out.
3. Third-generation systems, which made it possible to fully automate the control process based on predictive data on the degree of traffic congestion.
4. Fourth generation systems that allow traffic management based on real-time traffic data.

Currently, all existing traffic control systems can be divided into three main categories:

1. Systems of decentralized type.
2. Systems of a centralized type.

3. Intelligent type systems.

As part of the use of decentralized traffic control systems on the roads, there is no need for the system to be connected to a single control center.

When using centralized traffic control systems, on the contrary, all data falls into a single control center that coordinates the entire work process.

Intelligent systems are similar to centralized ones, as all traffic data goes to a single center. The difference lies in the fact that in simple centralized systems decisions are made by personnel, and in intelligent systems – by a computer using artificial intelligence technologies.

Accordingly, the most advanced, and therefore most often used in large cities, are intelligent systems, one of the variants of which will be proposed in this scientific article.

These innovative software projects provide an effective means of understanding traffic scenarios that allows you to control a 4-way traffic signal control system. The system consists of 4 signals corresponding to each road. In this paper, we propose planning traffic signals based on a density algorithm. The system is designed to control the timing of traffic lights depending on the traffic density on the corresponding road. The system presents road congestion traffic graphically using traffic signaling devices. Measuring traffic on a particular road gives you the ability to adjust signal timings to allow that particular path to clear and then move on to the next problem area. The whole system works according to an algorithm that allows you to smoothly and effectively regulate the traffic flow in all four directions. It also includes an emergency stop system that allows control operators to remotely turn off a particular signal in the event that an ambulance or an important vehicle is following the path.

Many researchers have studied various types and techniques of multi-traffic scene perception and also in the field of social networks, since it is useful in terms of basic multi-traffic scene perception for vehicle detection. Scientists from India, in particular, are focused on the analysis and implementation of the twitter feed with real-time traffic detection and the search for a framework that allows you to check the event and identify the location of activity through the study of the twitter feed.

Italian expert Alberto Rosi has studied social sensors and pervasive approaches to services and the perspectives they provide, as this social perception technique is integrated into the computing system.

Chinese experts studied the multi-vehicle detection algorithm by combining the functions of Harr and HOG, based on which they developed a system to achieve better performance for multi-vehicle detection in complex urban environments. environment with a two-stage detection algorithm. This system provides higher vehicle detection accuracy and is also more time efficient.

Indian scientists were implementing a project to develop an automatic traffic light system for the city of Chandigarh. This is a system monitoring that allows you to automatically identify the traffic flow in the signal traffic. This system also had sensors that sense road data in traffic. This system provided real-time traffic detection and eliminated the loss of green light time needed to optimize traffic on the relevant section of the road.

Chinese scientists have also explored automatic environmental recognition changes for drivers in the driver assistance system. They developed a computational model to study critical environmental changes for drivers in a driver assistance system. They demonstrated the practicality of a computational model for recognizing changes in the system under study.

Chinese scientists have also improved the vehicle detection method based on the Bio-Inspired approach to improve the image by the feature fusion method of the weighted evaluation level. Using this method of vehicle detection was possible even at night. Thanks to this system, it was possible to deal with a significant number of different types of scenes, including cars of different types and sizes. It also allowed identification of a vehicle in various locations and vehicle numbers.

Japanese experts studied the possibility of vehicle detection using active learning and derivative symmetry analysis. They developed a system that worked on the road to detect the vehicle, which was a very important operation. This system uses seven types of data sets to track road, weather, and traffic conditions.

French specialists have developed a multidimensional model for classifying high-resolution optical images based on wavelets of texture features. This model was based on the strategy of a supervised classification system that classified images according to a training database storing information to enable the classifier to make a decision.

Convolutional Neural Network (CNN) is one of the most popular deep learning algorithms. CNNs are used to recognize and classify images and videos. In our system, we use this algorithm to calculate traffic density. At each stage, feature extraction is performed, and it produces a large set of features for the original input. These feature sets help describe the characteristics of the data. Each frame is classified and the resulting value is displayed in the video frame window.

To detect vehicles, the Hoard backlight descriptor is used, which defines a picture on a 64x128 fix. Obviously, the image can be any size. Usually corrections at different scales are checked on many areas of the image. The main limitation is that kink patches have a fixed angular proportion. For our situation, the patches should have a 1:2 aspect ratio. For example, they may be 100 × 200, 128 × 256, or 1000 × × 2000, but not 101 × 205.

To calculate the HOG descriptor, we initialize the calculation of the horizontal and vertical gradients; then the histogram of the gradients should be calculated. This makes it possible to simply filter the image using subsequent procedures.

At this stage, the image is divided into 8 × 8 cells and the band of the gradient graph is calculated for each 8 × 8 cells.

The gradient of the picture is very sensitive to the level of general lighting. In case you make the image darker by dividing all the pixel values by 2, the value of the tilt angle will change significantly, and together these lines of the evaluation histogram will change very significantly. In an ideal world, we want our handle to be free of lighting options. Thus, there is a need to "standardize" the histogram so that it is not affected by lighting variations.

To compute the last element vector for the entire fix image, the 36 × 1 vectors are concatenated into one giant vector. What is the size of this vector? Let us calculate.

1. How many places do we have in 16 × 16 squares? There are 7 levels and 15 vertical positions in total. 7 × × 15 = 105 positions.

2. Each 16x16 square is checked against a 36×1 vector. Therefore, when we connect them all into one giant vector, we get a dimension of 36 × 105 = 3780 vectors.

The current location of the traffic light gives a fixed traffic control plan, the settings of which depend on the previous ones. However, traffic checks can be physically modified. This is the most widely recognized type of sign control for day-to-day management and can cause the system to misbehave at an hour that is different from what the layout was based on, such as utilizing redundant stages when there is little traffic.

We can integrate our system with official traffic signal analysis app to capture real-time status notification traffic. Thus, our system will be able to signal traffic-related events even in the worst case.

In addition, we are exploring the possibilities of integrating our system into a more sophisticated traffic detection infrastructure. This infrastructure can include both advanced physical sensors and social sensors such as social media streams. In particular, social sensors can provide low cost wide coverage of the road network, especially in areas (urban and suburban) where traditional traffic sensors are not available.

Thus, the control system considered in the paper has significant advantages in organizing traffic on the roads and optimizing it, which is achieved, first of all, by using elements of artificial intelligence in it.

The system allows:

1. Introduce an integrated approach to the organization of the traffic system in large cities.

2. Actively apply visual traffic control with vehicle type recognition.

3. Significantly save money in large cities by reducing losses that inevitably arise as a result of vehicles standing idle in traffic jams.

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