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Remote Monitoring System of Logistics Transport Vehicles Based on Internet of Things

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Abstract

With the development of highway transportation industry, the number of logistics transportation vehicles has greatly increased. While strengthening the carrying capacity and improving the transportation efficiency, problems such as vehicle route management, safe operation management and vehicle running state monitoring also arise. Because the dispatcher can't grasp the position of each vehicle in time and accurately, and can't mobilize the vehicles in time, the vehicles can't be used efficiently, and at the same time, the operating cost of the fleet is increased. In addition, with the increase of transport vehicles, the safety of vehicles has become the focus of fleet management, such as vehicle robbery, vehicle theft and other phenomena that affect social stability and endanger public security are increasing year by year, and vehicle accidents caused by fatigue driving, speeding and overweight driving are also increasing year by year. In view of the development of logistics and transportation industry and the development demand of intelligent transportation, this paper proposes a remote monitoring system of logistics and transportation vehicles based on the Internet of Things. The system integrates scheduling, monitoring and management, and has the characteristics of good real-time, high transmission rate, high collection frequency, large data storage capacity and convenient use, which provides a strong technical support for the development of intelligent transportation system.

Keywords

Internet of Things; Logistics Transport Vehicle Remote Monitoring System.

1. THE DOMESTIC STATUS QUO

With the rapid development of express delivery and other industries, the number of logistics vehicles in China has increased substantially. While strengthening the carrying capacity and improving the transportation efficiency, the demands of vehicle driving route management, safe operation management and vehicle running state monitoring also arise, and logistics vehicles lack unified and effective management. Therefore, there is an urgent need for a logistics vehicle monitoring and management system that can meet the needs of practical applications. However, the current Internet of Things remote vehicle monitoring systems in China are all independent devices, which are inconvenient to operate. Therefore, it is imperative to develop a set of Internet of Things remote vehicle monitoring system which is powerful, easy to use and suitable for logistics and transportation by using embedded system and Internet of Things data communication resources sharing.

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2. OVERALL SYSTEM ARCHITECTURE

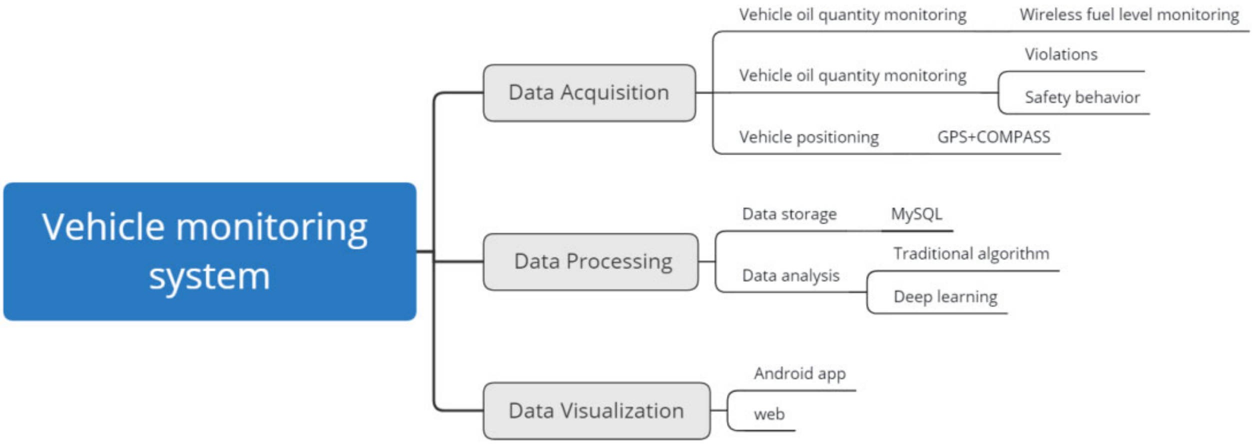

Figure 1. Overall System Architecture

The system architecture of the logistics vehicle remote monitoring system is shown in Figure 1.

When the system is running, firstly, the data collection terminal collects the vehicle running information, including the current fuel quantity of the vehicle, the driver's behavior information and the current position of the vehicle. Then, the collected data is transmitted to the cloud server, which will save the data in MySQL database and analyze the data by using the traditional algorithm+deep learning method. Then, the result data will be displayed visually on Android app and web, and the calculated data will be sent to each vehicle control sensor as the feedback result for corresponding response.

3. DETAILED SYSTEM ARCHITECTURE

The remote vehicle monitoring system is mainly composed of three modules: data acquisition, data processing and data visualization, which will be introduced in detail in the following section.

3.1. Data Acquisition Module

As the most important module among the three modules, the data acquisition module is mainly responsible for collecting the running data of the vehicle in real time by using sensors and transmitting it to the cloud in real time, in which the running data mainly includes the most important status data of the transport vehicle-vehicle positioning, driver status and vehicle fuel quantity.

3.1.1 Vehicle positioning

In the past, single GPS navigation was mainly used for vehicle positioning. The advantage of this positioning method is that it has a wide positioning range and can almost achieve global positioning, but the disadvantage is that in the scene with dense buildings, the signal is poor and the positioning accuracy is poor. To solve this problem, this system innovatively adopts GPS+ Beidou dual positioning navigation system.

Beidou navigation system is a navigation system independently developed by China, which has developed rapidly in recent years and has been widely used. Compared with GPS global positioning and navigation system, Beidou system has the greatest advantages of better signal availability, faster first positioning time and high cost performance in urban high shelter areas.

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After obtaining the approximate position of the vehicle by using GPS, the system selects the navigation system according to the real-time situation, which can simultaneously ensure a wide positioning range and high positioning accuracy.

3.1.2 Driver status monitoring

This module is mainly responsible for monitoring the driver's status. If the driver violates regulations such as fatigue driving, smoking, making phone calls, etc., it is easy to have safety accidents. Therefore, the system uses traditional vision and deep learning to monitor the driver's state.

The video stream data of the driver driving the vehicle is collected by the system camera. First, the well-trained yolov4_tiny target detection network is used to locate the driver's position, and at the same time, the well-recognized illegal behaviors such as smoking and phone calls are detected. Then, the positioned driver pictures are sent to the set fatigue detection algorithm to detect the driver's fatigue. Finally, the detected index results are returned to the cloud, and the driver's state detection is completed here.

Yolov4_tiny and MTCNN neural network architecture are mainly used in the system. [1]

Yolov4_tiny is a mature target detection network with both lightweight and high precision. [2] It is very suitable for locating drivers and conducting some simple behavior tests, such as smoking tests and phone calls tests. Yolov4_tiny is a simplified version of Yolov4, which retains the main structure of Yolov4, but the feature extraction and other parts have been partially simplified, and the speed has been greatly improved on the premise of ensuring the accuracy. Yolov4 has 60 million parameters, while Yolov4_tiny has only 6 million parameters, which only uses two feature layers for classification and regression prediction. In order to be faster and more accurate, Yolov4_tiny used CSPdarknet53 with LeakyRelu as the activation function as the main feature extraction network, and adopted the feature pyramid, FPN and other optimized structures. CIOU is used to calculate the error value, and the penalty factor in CIOU simultaneously considers the distance between anchor, overlap rate and other data. The regression box obtained by this calculation method is more stable than that obtained by IOU and GIOU. [3]

We have adjusted the CSP residual structure of yolov4_tiny for the data set detected by drivers, and tested it with the optimized neural network, and the test results show that MAP=94.52%. Can meet the system requirements. As follows, Figure 2 shows the network structure of yolov4_tiny.

For the driver's fatigue detection, the system mainly detects the face and locates the feature points through MTCNN, and extracts the region of interest (ROI) by using the feature points, and judges the driver's fatigue degree by detecting the degree and frequency of eye closure. MTCNN mainly adopts three cascaded networks, and adopts the idea of candidate frame plus classifier for fast and efficient face detection. These three cascaded networks are P-Net which can quickly generate candidate windows, R-Net which can filter and select candidate windows with high precision, and O-Net which can generate the final bounding box and face key points. And many convolutional neural network models for dealing with image problems, which also use image pyramid, border regression, non-maximum suppression and other technologies. After testing, MTCNN can accurately locate the key points of the face, and at the same time can accurately capture the eye information for analysis. Figure. 3 below shows the network structure of MTCNN, which can complete the tasks of face detection and key point detection simultaneously. [4]

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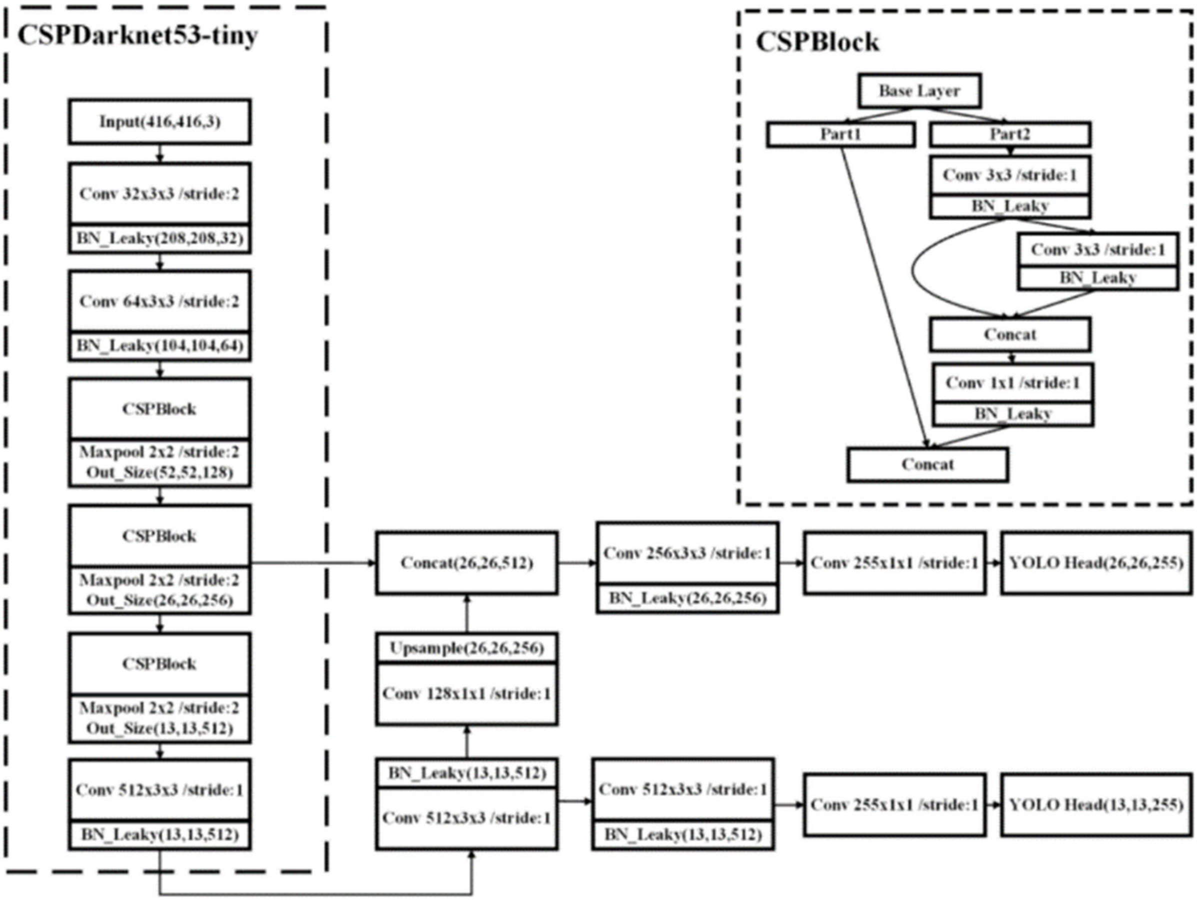

Figure 2. Yolov4_tiny network structure

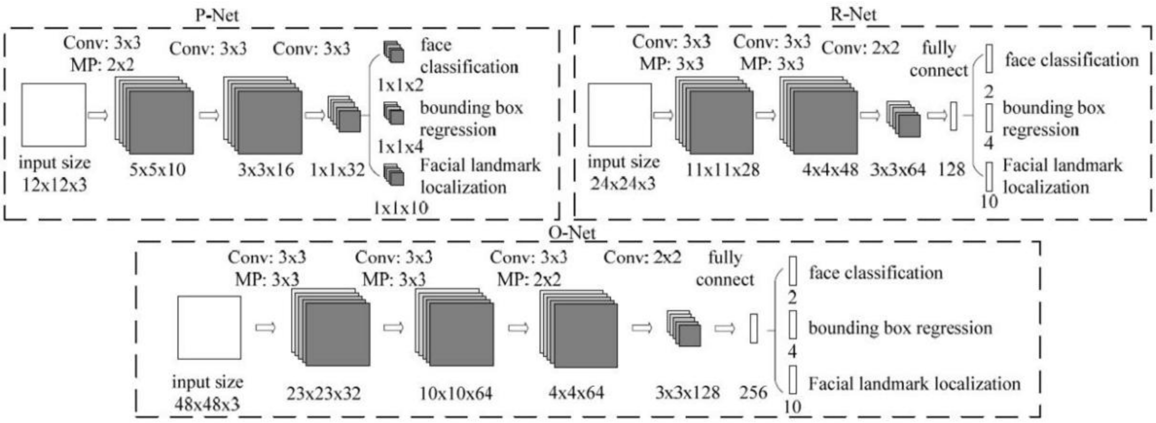

Figure 3. MTCNN network diagram

3.1.3 Oil Quantity Detection

Based on the special application environment and usage mode of the oil quantity detection device, we use the wireless liquid level meter to detect the current oil quantity, which has the advantages of convenient charging, long standby time and accurate detection, and wireless work ensures the tightness of the oil tank and easy installation of the device.

3.2. Data Processing

We use SQL Server to create a database for data management, and the data acquired by the data acquisition terminal will be transmitted to the server. Then the system will first store it in

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the database, then fuse the real-time data and historical data in the database, establish a mathematical model, and model the current vehicle running state. Then, the calculation results will be fed back to the control system on the vehicle, and the control system on the vehicle will make corresponding control and prompt actions according to the information fed back by the server.

3.3. Data Visualization

For the convenience of management, we set up data visualization for the system. We choose the most commonly used web and Android app as visualization platforms, so that data can be observed in real time, which is convenient for system management and operation.

4. INNOVATION AND SUMMARY

The system combines Beidou navigation with GPS navigation, and through the dual navigation system, the vehicle can be accurately located. Ensure the driver's driving safety through high-precision driver fatigue detection and other driver's illegal operation monitoring; The system is highly integrated, and can comprehensively monitor the running state of transport vehicles in real time, thus ensuring the safe operation of transport vehicles.

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