Research and Application of Technology for Highway Overload Control System

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Abstract: With the development of digitalization and informatization, vehicle super control has also been gradually transformed from traditional fixed super control stations to off-site law enforcement, but it is not uniformly applied to source super control and highway entrance/exit super control. Therefore, we adopt multi-source data fusion technology to develop the highway regional super control system, through the control and matching of multi-source data collection, the interactive verification of the collected data, the establishment of vehicle data correction system, the resolution of data pollution when multiple sources are collected, the improvement of the accuracy of the collected data, and the integrated use of decision models to make comprehensive determination of the illegal transportation behavior of freight vehicles, based on the MVC (Model a View - Controller) model framework to build the management platform of highway regional super control system. The system is able to obtain vehicle data at each inspection point in real time, and make timely pushing of illegal information of over-limit vehicles, effectively curb the damage of over-limit vehicles to the road surface and provide reference for similar projects.

1. Introduction

In recent years, with the abolition of tolls on secondary roads, the rapid growth of motor vehicle ownership and other factors, ordinary state and provincial roads continue to increase the volume of vehicle traffic, and most of the heavy-duty vehicles, the state and provincial highway bridges, road damage, highway maintenance costs remain high and road traffic safety hazards more prominent. According to the state on strengthening road traffic safety and the Ministry of Transport and Inspection of State and Provincial Trunk Roads work deployment and requirements, in order to further improve and enhance the ordinary state and provincial roads to pass the conditions and safety and security capabilities, prevent and reduce road traffic safety accidents, more effective protection of the masses of traffic safety, is bound to increase the over-limit overload control efforts, and fully promote the construction of technical monitoring systems.

After years of development and efforts, Nanping City has initially established a road monitoring system for super control based on joint traffic and public security control, combining fixed

detection and traffic police mobile inspection. But due to the more developed road network, there is a heavy vehicle detour phenomenon. In order to continue to consolidate and expand the effectiveness of super control, the adoption of highway technology for super control, through technical means to achieve full time monitoring of illegal overloading behavior on the entire road network. And it will effectively extend the scope of management, ease the contradiction of insufficient law enforcement force, promote the transformation and upgrading of further super enforcement mode, adjust the modernization level of super control system and governance ability, realize online instant supervision and monitoring by using information network technology, and achieve the law enforcement mode of 24-hour all-weather supervision, which is the solution to the current law enforcement process, such as untimely law enforcement, difficult evidence collection, weak safety guarantee. It is an effective means to solve the current problems of untimely enforcement, difficult evidence collection, weak security and ineffective super control. Steadily promote the dynamic enforcement of non-stop detection, realize the automatic online screening of violations and real-time evidence collection; promote the digitization of law enforcement cases (instruments), promote the sharing of data across the network, and serve the enforcement of road super control.

2. The Need and Connotation of Super Control

2.1. Definition Connotation

Highway super control refers to the comprehensive traffic administrative law enforcement agencies, public security traffic management agencies in accordance with the "Highway Law", "Road Traffic Safety Law", "Highway Safety Protection Regulations" and other laws and regulations and relevant provisions, in accordance with the law to fulfill the need to protect the safety of highway facilities and safeguard road traffic and people's life and property, through the setting of ordinary highway vehicle road dynamic detection technology monitoring, highway entrance, unloading points and freight source Weighing detection, and the corresponding supporting facilities, forming a perfect monitoring network for super control, real-time detection of freight vehicles, and data transmission, storage, integration, law enforcement, and re-application of the comprehensive project.

2.2. Demand Analysis

2.2.1. Road Monitoring Network Still Needs to be Improved

As the road dynamic detection technology monitoring and supporting unloading point has not yet carried out construction, relying on a few traffic and public security joint superstation has been unable to meet the basic functional requirements of unloading and eliminating violations. At the same time, the built traffic and public security joint superstation, highway entrance non-stop weighing detection, key freight source weighing detection, traffic flow survey points, public security chokepoint video surveillance, traffic law enforcement duty and other front-end dynamic and static sensing equipment satellite city law enforcement supervision system, the over-limit overload vehicles found difficult, difficult to investigate and deal with.

2.2.2. Information Platform Construction Still Needs to be Strengthened

At present, relying on law enforcement, front-end dynamic and static sensing facilities such as joint super control stations, highway entrance non-stop weighing detection, traffic flow survey points, public security chokepoint video monitoring, traffic law enforcement duty vehicles, key

freight source weighing detection and other front-end dynamic and static sensing facilities built by traffic, public security and other departments and relevant enterprises are the group network, and operating vehicle dynamic monitoring systems built by relevant super control member units, highway super-limit overload blacklist management system. The back-end data resources such as public security traffic control vehicle management system, road transport management system, and large transport permit system are not shared, and the law enforcement information system in the middle of the front and back ends does not have the function of interoperability of the front-end field equipment and back-end application system data, and has not yet realized application synergy.

3. The Basic Principle of the Super Control System

Off-site super control [1] is based on multi-source data collection and multi-source vehicle data interactive decision making, in the process of mutual correction and verification between the collected data, the interactive decision making strategy is applied to the determination of vehicle overloading illegal transportation. On the basis of highway off-site enforcement system according to standardization, it can access the data information of highway entrance overload and export weight counting, highway source overload control, highway traffic volume survey, highway overload detection station and other systems, improve the accuracy of data through data collection, comparison and analysis, perfect the complete evidence chain, and improve the objectivity and fairness of ensuring illegal determination.

The off-site law enforcement super control system contains sub-systems including front-end detection equipment technical monitoring, application software system, monitoring and monitoring center premises, operation support infrastructure, and related operation guarantee system construction.

Front-end detection equipment technology monitoring mainly includes ordinary highway vehicle road dynamic detection technology monitoring, highway entrance without stopping weighing detection, unloading point weighing detection, key freight source weighing detection, etc.

The application software system mainly includes the super control data center and super control network management information system.

The super control data center mainly realizes the storage of internal and external data resources required for off-site law enforcement and other related electronic documents, including the construction of the front intermediate library, basic database, business database, theme database and shared database, and provides support for the interconnection, interoperability, mutual sharing and interaction among all related business systems through the data exchange center, and provides synergy between heterogeneous data and heterogeneous software and hardware platforms. mechanism.

The super control network management information system includes super control basic information management, audio and video monitoring management, super limit overload operation supervision, super control command and dispatch management, super control comprehensive analysis and evaluation, mobile application, etc., realizing various types of super control business deep comprehensive re-application.

The operation support infrastructure mainly includes "three types of equipment" (network transmission equipment, computer room supporting equipment, security equipment) and "six systems" (operating system, mainframe system, storage system, database management system, backup system, security system) to support the operation of the pilot project. (operating system, host system, storage system, database management system, backup management system, security system) and other software and hardware facilities.

The operation guarantee system mainly includes the standard specification system, information

security guarantee system, construction and operation and maintenance guarantee system. The standard specification system includes the national, Ministry of Transport and local industry technical standards and specifications that should be observed in the construction of the pilot project; the information security guarantee system provides security support for the pilot project and realizes security protection for all levels of the system based on strict security management system and security technical specifications; the construction and operation and maintenance guarantee system is to ensure the smooth implementation of the whole process of the pilot project and guarantee the long-term stability of the project construction results The construction and operation and maintenance guarantee system is the basis to ensure the smooth implementation of the pilot project and guarantee the long-term stable operation and sustainable development of the project.

4. The Workflow of the Technology Super Control System

When the vehicle into the detection area, the system gets the vehicle weight, speed, wheelbase, license plate, profile (length × width × height) data and other information, the detection is completed to get the vehicle data and in accordance with the relevant standards for the vehicle overload judgment, if the vehicle is overloaded, the front variable intelligence panel will display the license plate number of the overloaded vehicle, prompting the owner of the vehicle may exceed the limit.

The communication system will transmit the data collected at the site to the regional management platform for super control, and make a comprehensive judgment on whether the vehicle exceeds the limit by comparing data from multiple sites in the system platform in combination with adjacent time periods.

Combined with the video license plate recognition system on the road to determine the vehicle's travel trajectory, the data pushed to the nearby law enforcement points and the over-limit vehicles for accurate interception, to improve the efficiency and accuracy of law enforcement.

5. Multi-source Vehicle Data Interaction Decision in Heterogeneous Environment

5.1. Multi-source Data Collection and Matching

The acquisition and matching of multi-source data is related to the accuracy of platform enforcement. In this paper, the front-end weighing area multi-source data acquisition control and matching technology is used [2]. When the system carries out vehicle data collection, a unified trigger signal is sent from the core weighing instrument to external devices such as cameras and height and width meters to ensure that each subsystem characteristic quantity such as weight, license plate, length, width, height, and video information collected when the vehicle passes through the detection area is correctly matched one by one. In order to enhance the matching rate of each subsystem data, when the system carries out vehicle data transmission, a standard communication protocol, interface is developed and transmitted to the management platform according to a standardized format so that each subsystem can accurately process the same vehicle, multi-source data collection and matching process.

5.2. Interaction Verification of Multi-Source Data

The data collected by each subsystem of the multi-source data collection system is not all single vehicle information, but multiple vehicle information, and there are multiple measurements of multiple vehicle data in the vehicle data obtained by the whole multi-source collection system. The weight acquisition system can get the wheel weight, axle weight, axle group weight, total weight,

axle number, speed, axle distance and other information of the vehicle, and the type of freight vehicle can be analyzed by the axle number and axle distance information. License plate, video collection system can get the vehicle license plate, color, type and other information, through the analysis of the video stream data of the passing vehicle can even get the speed information of the passing vehicle and the data of the length and width of the vehicle. Vehicle size acquisition system can get the length, width and height information of the vehicle through laser ranging principle, and also analyze the speed information of the vehicle. Vehicle speed acquisition system can accurately obtain the passing speed information of the vehicle.

Except for the information of weight, number of axles and wheelbase which can only be obtained through the weighing subsystem and the license plate information through the license plate recognition subsystem, all other information exists in the clear condition of multiple sources of measurement. By cross-validating the information collected from multiple sources, the working condition of each subsystem can be analyzed, and the corresponding data of the abnormal subsystem can be appropriately corrected to improve the accuracy of data collection.

6. Off-site Law Enforcement and Super Control System Integrated Platform and Applications

The comprehensive platform of off-site law enforcement and super control system [3]. It is developed based on the MVC (Model-View-Controller) pattern framework. After logging into the system, the same user can have the permission to access multiple law enforcement sites. Any computer interconnected with the Web server can access the Web server and perform various operations on the management system according to the privileges they have, as long as they have a browser installed. When the system needs to be upgraded, only a software upgrade of the server is required, and users can automatically use the new version of the management system, getting rid of the dependence on the client software.

In terms of data resource construction, it shall meet the data interfacing requirements of the Notice of the General Office of the Ministry of Transport on the Issuance of the Construction Guide of the National Networked Management Information System for Super Control at the Provincial Level and the provincial traffic comprehensive administrative law enforcement system, realize automatic data collection of joint traffic and public security super control stations, front-end detection equipment technical monitoring and traffic flow survey points, metadata and data. The interface standards are in line with the Notice of the Ministry of Transport on the Issuance of the Implementation Plan of the National Pilot Project for the Standardization of the Inspection Sites of Super Control [4], and the research on the interface standards for data collection and service release of front-end sensing equipment and back-end application systems is carried out [5].

In the business function of the system, the collected data is reapplied and seamlessly connected with the back-end super control business management to build a comprehensive super control "one network". It carries out big data application, super control command and dispatch and intelligent research and judgment, completes super control effectiveness evaluation and super-limit overload big data analysis, supports off-site enforcement of highway super control, realizes comprehensive monitoring and precise crackdown on illegal super-limit overload behavior, and promotes upstream and downstream coordination of super control management and whole chain linkage management.

Through a series of analysis such as data collection, correction and verification, the final multi-source data collection and matching, and interactive verification are carried out on the construction of the application software system. The construction of the application software system of the comprehensive platform of the off-site law enforcement super system in Nanping City includes the municipal super data center and the municipal super networking management information system, which are coordinated and constructed by the municipal traffic comprehensive

administrative law enforcement agencies. The system needs to realize the data authority and user access authority for sub-regional and sub-level control for use by the management departments at city, county (district, city) and station levels, and the county management departments do not develop business in separate Management system. The municipal-level traffic administrative law enforcement agencies carry out system construction according to the actual needs of off-site law enforcement business in comparison with the functions of the systems already built by the higher management departments, this-level agencies and the member units of super control, and for those that have been built and put into operation, it is recommended to meet the business needs at this level by way of system upgrade and renovation to avoid repeated construction [6-10].

7. Conclusion

The highway regional overload control system is based on multi-source data architecture and proposes a multi-dimensional vehicle data collection technology integrating dynamic weighing, video identification, radar speed measurement and Internet technology, which solves the blind spot of freight vehicle overload, overload and other illegal behaviors detection, standardizes the order of freight vehicle transportation, improves road safety governance, realizes all-weather monitoring of overload and overload transport vehicles, effectively extends the time and space of management, and alleviates the contradiction of insufficient law enforcement force. At the same time, the establishment of the vehicle multi-source data determination system, to solve the multi-source collection of data pollution, improve the accuracy of the collection of data to ensure the objectivity of the illegal determination, impartiality, but also to potential over-limit transport vehicles to form a certain deterrent. As highway data and informationization are getting higher and higher, the highway regional super control system is a trend where the system has been gradually applied in various provinces, but since the system requires multi-source data fusion and the collaboration of multiple departments, units and different devices, which requires the development of unified data transmission protocols and network security, the system has certain limitations and needs to be further improved.

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