Construction of An Audit Platform for Vehicles with Unusual Driving Behavior

Jinsong Ye[1, a], Tiannan Li[2, b*], Jiahao Feng[2, c], Lei Zhou[1, d]

[1]China Academy of Transportation Sciences, Beijing, China
[2]Beijing Wuzi University, Beijing, China

[a]email: yejs@motcats.ac.cn
[c]email: 1125735788@qq.com
[d]email: zhoulei@motcats.ac.cn
* Corresponding author's email: 20312125604049@bwu.edu.cn

Abstract. In order to improve the efficiency of the audit of vehicles with abnormal driving behavior, this paper constructs a vehicle detection information platform and designs the main functional modules of the audit platform of vehicles with abnormal driving behavior. This paper integrates the data of all parties related to the identification of the characteristics of vehicles with abnormal driving behavior, builds a subject warehouse and an exploratory data warehouse based on abnormal driving behavior, and lays the foundation for the update of the subject warehouse of abnormal driving behavior and online real-time audit. In addition, this paper designs the online audit system architecture, by comparing the behavioral characteristics of real-time vehicles and the characteristics of abnormal driving behavior in the historical data warehouse can assist the on-site audit, and can obtain feedback data to promote the improvement of the efficiency of the highway abnormal driving behavior audit.

Keywords: abnormal driving behavior; data warehouse; audit platform

1 Introduction

In recent years, the scale of China's motorway network has been expanding, the shape of the network has become increasingly complex, and the single and total volume of motorway tolls has grown rapidly, which has led to an increase in the probability of illegal profit-making behavior on the motorway, and has also increased the difficulty of toll evasion auditing, which urgently requires intelligent, digital auditing systems to assist manual auditing work. Since the networking of motorway tolls, the technology of motorway inspection has been continuously improved while the means of toll evasion by unlawful elements has also risen, coupled with the increase in the volume of motorway traffic data, which has brought great difficulties to the inspection work. "While this has facilitated the operation of the highway, it has also led to an increase in the distance travelled by vehicles within the network and an increase in the amount of tolls, as well as making it more difficult to check for toll evasion. Evasion audit systems

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are increasingly becoming the basis and key to the proper functioning of highway networked toll collection systems. At the stage of large-scale and networked operation and management, how to break the "information islands" between systems through the construction of big data platforms, break through the "chimney" application construction, enhance information interaction, improve data security and reliability, in order to enhance the operation and management efficiency and service level of the motorway toll collection system. System operation and management efficiency and service level, to effectively protect national property from infringement, and to be able to timely deal with abnormal driving behavior in the highway passage, become the current urgent core issues to solve.

Since the highway network toll, most researchers are more from the historical data to explore the abnormal driving behavior vehicle identification characteristics, and based on this to build highway audit system, but in building real-time audit system research is less, because of the lack of development of technology. At present, with the continuous development of technology [1], making it possible to build real-time audit system.

2 Overall design of the vehicle inspection platform for abnormal driving behavior

2.1 Design objectives

The abnormal driving behavior vehicle inspection platform is mainly used for the effective screening of vehicles that appear abnormal in the process of highway passage. Through the development and application of the digital platform, the highway passage data is monitored and managed, and data mining is carried out on the highway passage data. The use of mining technology from the massive amount of highway passage data, find the behavioral characteristics of abnormal driving behavior vehicles, combined with the relevant departments to provide verification data, timely discovery of abnormal behavior vehicles, to provide accurate information for on-site inspectors, to improve the efficiency of highway abnormal driving behavior inspection. Integrate the data of each relevant department from the macro level, break the limitation between information, bring the value of data into full play and improve the efficiency of law enforcement of the traffic department.[2]

2.2 Functional modules

The main functional module structure of the vehicle audit platform for abnormal driving behavior is shown in Figure 1.

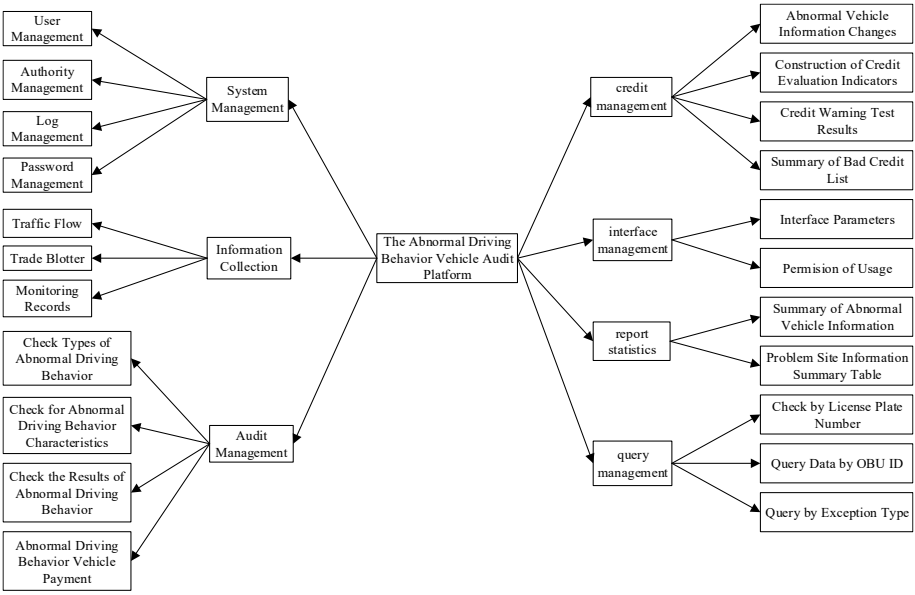

Fig. 1. Functional module of the vehicle inspection platform for abnormal driving behavior

As shown in Figure 1, the abnormal driving behavior vehicle audit platform is to analyze and process the data related to highway passage, improve the audit efficiency of the inspection department, and warn the general highway passers to know the law and abide by the law. The platform's functional modules include system management, information collection, audit management, credit management, interface management, report statistics, query management, etc.

System administration module: System administrators log in to the administrator account, handle changes to user access rights, obtain user browsing footprints and reset permissions for user passwords.

Information collection module: This section focuses on the sources of data and also the basic data for the audit of abnormal driving behavior, including structured data (passage flow and transaction flow) and unstructured data (monitoring video data of entrances and exits and gantries). In addition, it also includes some databases related to information verification, such as the license plate information database, ETC card issuer, etc.

Audit management module: through the data obtained by the information collection module and the type and characteristics of the known abnormal form of behavior, screening the information of vehicles with abnormal driving behavior, real-time notification to the relevant departments, so as to better help the relevant departments to carry out audit work; through the existing data mining new data mining the latest emergence of abnormal driving behavior, after repeated argumentation, update the classification and characteristics of abnormal driving behavior. The new data can be used to dig up the latest abnormal driving behavior and update the classification and characteristics of the abnormal driving behavior after repeated proof.

Credit management module: This module builds a credit evaluation system for motorway vehicles by means of the type of abnormal driving behavior of the vehicle, the frequency of occurrence and the impact caused. The results of the credit evaluation support, to a certain extent, the work of the inspection and management section.

Interface management module: The interface is mainly used by the inspection department and other credit departments. The data that the inspection department interfaces with is information about vehicles with abnormal driving behavior; other credit departments use the vehicle credit evaluation results as an influencing factor in their evaluation system.

Report statistics module: Report statistics results for abnormal driving behavior vehicle audit results reporting data. The departments concerned can download the statistical results of the reports directly through the system.

Query Management Module: The query management module serves the vehicle owner by querying the vehicle owner's vehicle history of abnormal driving behavior and the credit rating or score of the vehicle so that he or she can understand the vehicle's access to the motorway. The vehicle number or OBU number or exception type is required for vehicle enquiry.

3 Design of the data warehouse for the vehicle inspection platform for abnormal driving behavior

At present, the high-speed traffic data is increasing, the workload of the inspector is also increasing, how to dig out from the massive high-speed traffic data with abnormal driving behavior of the vehicle traffic data, is currently the focus of the relevant staff and research personnel research. Therefore, this paper based on the mastery of multiple database information on the basis of the establishment of data warehouses to better meet the needs of the abnormal driving behavior vehicle mining.

3.1 Data sources for the abnormal vehicle audit platform

The data warehouse of the abnormal driving behavior vehicle monitoring platform [3] is the data storage method for inspection decision analysis, and the main data sources it faces include highway passage information, special license plate archive information, and vehicle ETC issue information. These scattered information data will be integrated, unified placed in the data warehouse and carry out the corresponding data processing. This not only allows the inspection management personnel to query the various types of historical data related to abnormal driving behavior vehicles at any time, but also allows the various users of the abnormal driving behavior vehicle monitoring platform to carry out statistics and analysis at any time. Such as the longitudinal passage history data comparison, horizontal each province high speed abnormal driving behavior inspection management department between abnormal driving type, appearing times of comparison and so on. Thus, from many angles for highway law enforcement departments to provide the latest data analysis results, deep excavation highway passage data in the potential information.

Specific all kinds of information source carrier have the following aspects. 1) abnormal driving behavior vehicle audit platform's historical passage record, charge record, audit record as well as monitoring record and other data; 2) abnormal driving behavior vehicle audit platform's Web access record and other logs and other information that records the platform's operation; 3) abnormal driving behavior vehicle audit platform docking military and police license plate database and other special (4) abnormal driving behavior vehicle audit results query information: including the corresponding license plate number, OBU number and abnormal reasons and other information.

3.2 Design of the data warehouse for the abnormal vehicle inspection platform

On the basis of the functional module setting of the above abnormal vehicle inspection platform, this section divides the architecture design of the data warehouse into three layers, which are data source layer, data warehouse layer and data application layer. Among them, the data source layer includes pass data, transaction data, uniformed vehicle data, site monitoring data, etc.; data warehouse layer includes detailed data, aggregated data, data warehouse theme model or exploratory data warehouse, and then through two screening to present data with dimensions in the multi-dimensional data model; data application layer includes query business, report display, data analysis and data mining, on this basis, if you want to achieve abnormal The functional module in the vehicle audit platform for driving behavior also requires the transformation of target results. Through the above parts, the original data and vehicle inspection platform in the functional modules in series.

For the abnormal vehicle audit, the data warehouse theme mainly comes from different types of abnormal vehicles. The abnormal vehicle audit platform gradually forms different audit models by analyzing and summarizing the behavioral characteristics of different types of abnormal vehicles, i.e. the theme model in the data warehouse. Therefore, according to the abnormal behavior characteristics of the vehicle the theme model of the data warehouse of the abnormal vehicle audit platform is divided into break-in type toll evasion identification model, overtime and speed type toll evasion identification model, alternate use of OBU type toll evasion model, change of vehicle type toll evasion identification model. As the classification of abnormal driving behavior will change with the progress of relevant technology, in order to ensure that the platform keeps up with the times and better help the highway inspectors to carry out their inspection work, therefore, the abnormal vehicle inspection platform also needs to include an exploratory data warehouse to discover new abnormalities in the existing data at a faster speed. Accordingly, the theme model of the data warehouse is constantly updated. [4]

One of the reasons for the frequent occurrence of abnormal driving behavior of highway vehicles is that the information is not connected to each other, and it is necessary to integrate multiple information to verify whether the vehicle is the target vehicle of abnormal driving behavior audit. [5] Highway passage data, license plate information data, high-speed monitoring data and other information data related to abnormal driving behavior audit work stored in different databases, need through the data cleaning,

correlation and integration, the formation can be used for abnormal driving behavior vehicle audit data warehouse. [6]The data warehouse forms a star-shaped multi-dimensional data model based on abnormal driving behavior.

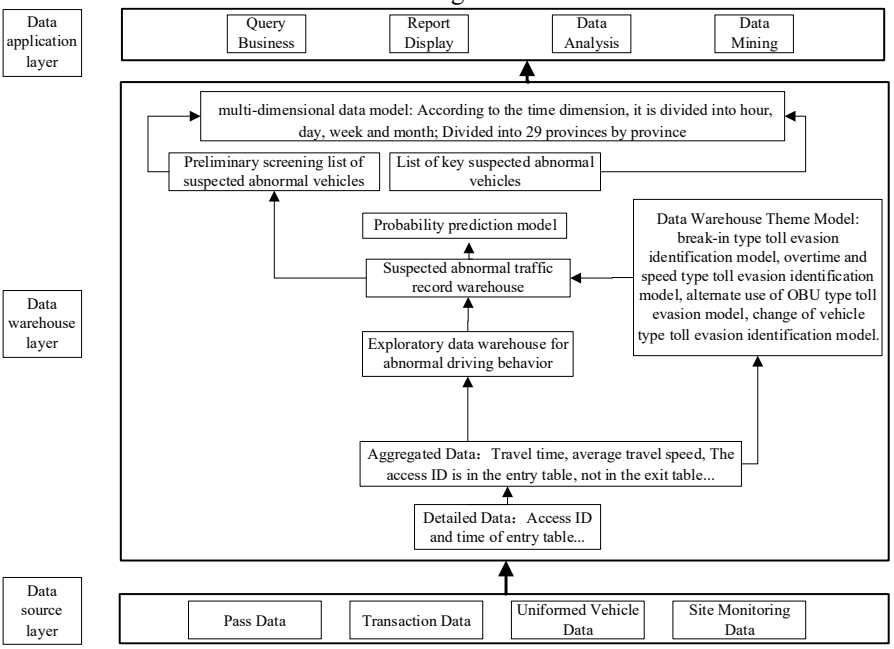

Fig. 2. Data architecture of the vehicle audit platform for abnormal driving behavior

4 Online auditing system architecture design

In the existing research, the highway abnormal driving behavior audit way is mostly afterwards audit, therefore, [7] this paper designs the highway abnormal driving behavior online audit system architecture, as shown in Figure 3.

This online system calculates the probability of a passing vehicle being a suspected vehicle by comparing the existing abnormal driving behavior characteristics with the vehicle's real-time high-speed passing information, and finally screens out suspected abnormal vehicles with a probability greater than a threshold value. [8]

(1) Abnormal driving behavior audit. The abnormal driving behavior audit module includes suspected vehicle search, vehicle abnormal behavior sorting and vehicle audit results. Abnormal driving behavior audit module by matching offline data and real-time online data to achieve through each functional module and complete real-time online abnormal driving behavior audit purpose.

(2) Suspected vehicle retrieval. Suspected vehicle retrieval is through real-time feature extraction to check the matching degree between the tags of vehicle basic features, road features, pass behavior features and identification feature database, and output the matching degree in the form of results to be transferred to the next step in the process.

(3) Vehicle abnormal behavior sorting. The vehicle abnormal behavior sorting module determines the appropriate threshold value by sorting the results output in the suspected vehicle search module to filter out vehicles that are prioritized for audit, and the inspector will carry out the audit in the field.

(4) Vehicle audit results. The vehicle audit results module is mainly used to collect the field audit results from the inspectors and update them to the offline data warehouse, which is used to support the updating of the subject library in the data warehouse.

In addition, the data highway functions to transfer data from external databases. The offline data consists of a data warehouse of pass records and a streaming computing platform. [9] In the pass record data warehouse, the raw pass data is processed to further develop the exploration of anomalous moving vehicle characteristics. The streaming computing platform focuses on the query resources required to support the search for suspected vehicles.

Real-time data on vehicle movements once they have entered the motorway is obtained from the signal detection devices in the roadside units and from the monitoring in the passing road. The system obtains the basic characteristics of the vehicles and the characteristics of the passing road and passing behavior from the monitoring records of the roadside units and the surveillance records and compares them with the results of data mining in the offline data warehouse. [10]

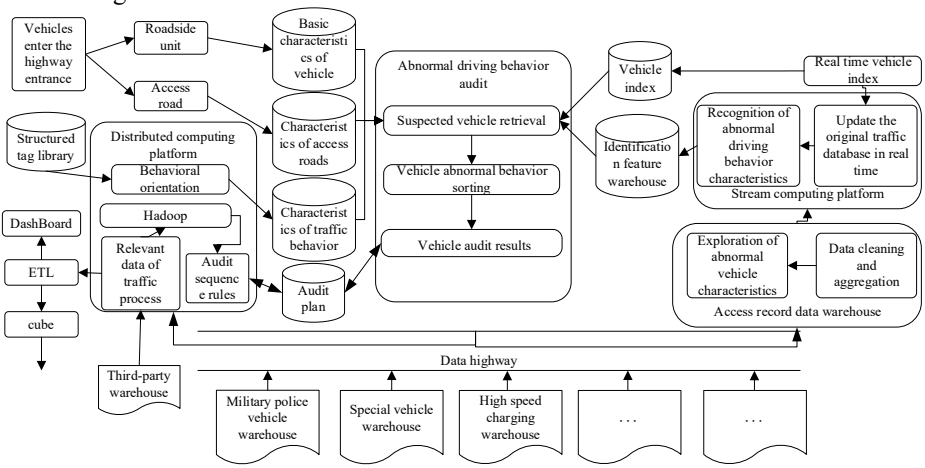

Fig. 3. Online audit system architecture

5 Conclusion

The abnormal driving behavior audit platform can improve the efficiency and accuracy of the audit and form a virtuous circle by implementing a joint online audit through the integration of multiple data. Through the data warehouse and data mining and information matching technology, the abnormal driving behavior audit platform is designed to integrate the relevant data about the abnormal driving behavior audit of the highway and establish a data warehouse with the theme of abnormal driving behavior

classification. And designed the online audit matching system, using real-time information matching, to assist the field inspectors to improve the efficiency of the audit work.

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