Application research on big data in energy conservation and emission reduction of transportation industry

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Abstract: In the context of big data age, the energy conservation and emission reduction of transportation is a natural big data industry. The planning, management, decision-making of energy conservation and emission reduction of transportation and other aspects should be supported by the analysis and forecasting of large amounts of data. Now, with the development of information technology, such as intelligent city, sensor road and so on, information collection technology in the direction of the Internet of things gradually become popular. The 3G/4G network transmission technology develop rapidly; and a large number of energy conservation and emission reduction of transportation data is growing into a series with different ways. The government not only should be able to make good use of big data to solve the problem of energy conservation and emission reduction of transportation, but also to explore and use a large amount of data behind the hidden value. Based on the analysis of the basic characteristics and application technology of energy conservation and emission reduction of transportation data, this paper carries out its application research in energy conservation and emission reduction of transportation industry, so as to provide theoretical basis and reference value for low carbon management.

1. Introduction

The introduction of the concept of big data first began in 1980s, and it was acclaimed as "the third wave of the CLS" by the famous futurist, Alvin Tovler\(^{[1]}\). In 2008, the famous Journals on Nature and Science respectively launched the special issue with "Big Data" and "Dealing with Data" for big data, and expounded the problems of big data from Internet technology, Internet economics, environmental science, biomedical science, transportation engineering and so on.

In the context of big data age, the energy conservation and emission reduction of transportation is a natural big data industry. The planning, management, decision-making of energy conservation and emission reduction of transportation and other aspects should be supported by the analysis and forecasting of large amounts of data. Now, with the development of information technology, such as intelligent city, sensor road and so on, information collection technology in the direction of the Internet of things gradually become popular. The 3G/4G network transmission technology develop rapidly; and a large number of energy conservation and emission reduction of transportation data is growing into a series with different ways. The government not only should be able to make good use of big data to solve the problem of energy conservation and emission reduction of transportation, but also to explore and use a large amount of data behind the hidden value. Based on the analysis of the basic characteristics and application technology of energy conservation and emission reduction of transportation data, this paper...
2. The basic characteristics of Energy Conservation and Emission Reduction of Transportation big data

The big data of energy conservation and emission reduction of transportation has many types, including traffic data, business operations statistics, vehicle basic data, vehicle space-time positioning data and vehicle micro energy data. According to the data type, it can be divided into five kinds: traffic flow data (Fixed Detector), traffic flow data (Motion Detector), location data (Motion Detection), unstructured video data and Multi-source Internet, government network data (Table 1).

Table 1. Classification of big data of energy conservation and emission reduction of transportation

| Type                        | Detection method                          | Case application                                      |
|-----------------------------|-------------------------------------------|------------------------------------------------------|
| Traffic flow data (Fixed Detector) | Ultrasound, radar and video surveillance | The Road Traffic Flow Forecasting System of Beijing⁶³ |
| Traffic flow data (Motion Detector) | buses, taxis and others with GPS          | Comprehensive Analysis and Data Quality Evaluation System of Beijing Road Traffic Flow⁴⁴ |
| Location data (Motion Detection) | Mobile communication technology, smart cards, vehicle terminals and so on | Traffic Flow Parameter Detection for Vehicle Network⁵⁵ |
| Unstructured video data     | Video surveillance systems                | High - definition Video Surveillance System of Liuzhou in Guangxi⁶⁶ |
| Multi-source Internet       | Internet, government network and so on    | Development of GIS Short Message Service System for Beijing 800MHz Wireless Government Network⁷⁷ |
| Government network data     |                                           |                                                       |

The big data of energy conservation and emission reduction of transportation is different from the traditional traffic data, mainly appearing in its different characteristics. The characteristics of current big data are 3V, 4V, 5V and 6V, as shown in Table 2, the energy conservation and emission reduction of transportation big data has 7V features.

Table 2. The basic characteristics of energy conservation and Emission reduction of transportation big data

| Characteristic  | Specific characterization                                                                                                                                 |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Volume: Huge capacity | Energy Conservation and Emission Reduction of Transportation information is large, the data is numerous and long-term storage |
|                 | Traffic flow has time-varying, energy-saving emission reduction management and service is timeliness, data processing speed require fast and accurate |
| Velocity: Processing fast | Wide range of data sources, rich in type, Energy Conservation and Emission Reduction of Transportation system has multi-state characteristics |
| Variety: Modal diversity | there are missing, error, redundancy and other anomalies in Energy Conservation and Emission Reduction of Transportation data |
| Veracity: True and false coexistence | With the time, space, history and other multi-dimensional features, and it is the basis of multi-service |
| Value: Rich in value | The data of Energy Conservation and Emission Reduction of Transportation has threshold, its data can not exceed the national planning ceiling |
The form of Energy Conservation and Emission Reduction of Transportation needs to be visualized

### Table 3. The analysis technology of energy conservation and emission reduction of transportation big data

| Technology platform                                      | Characteristic                                                                 | Application examples                                                                                                                                 |
|----------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Intelligent Energy Conservation and Emission Reduction   | Multi-dimensional Perception and Quality Control Technology of Vehicle Energy   | In view of the current traffic energy consumption data is complicated, scattered and so on, take the basic characteristics of the vehicle as the origin, time-based sensing technology |
| Transportation monitoring technology                     | Consumption                                                                     |                                                                                                                                                      |
| Intensive Energy Conservation and Emission Reduction     | High-resolution Simulation Technology and Multi-scale Evaluation Technology   | Based on Energy Conservation and Emission Reduction of Transportation big data, using a high-resolution traffic energy emission simulation technology and multi-scale, Constructing a Comprehensive Evaluation Model System for Five-level Traffic Energy Consumption Emission |
|   and Transportation monitoring technology               | for Traffic Energy Consumption Emission                                       |                                                                                                                                                      |
| Car network big data technology                          | High efficiency, high scalability massive data analysis and mining technology | For these problems of big data is difficult to calculate in real-time and the system is difficult to expand, using big data private cloud, Combing with flow calculation, Constructing massive data analysis and mining technology, meeting the rapid calculation of massive data, system expansion and other integrated application needs, achieving high timeliness, high scalability |
| Key Technology of Vehicle-mounted Interactive Safety     | Key Technology of Vehicle-mounted Interactive Safety System                   | Facing the road traffic scene, to achieve vehicle information exchange, protect the vehicle safe driving |
| System                                                   | Key Technology of Vehicle Interactive Cooperative Control System             | Facing the vehicle to vehicle information interaction, to realize the efficient communication between the vehicle and the car, to guarantee the cooperation efficiency and the safety of the vehicle |
| Vehicle road coordination system simulation, testing     | Vehicle road coordination system simulation, testing and verification of key  | For the system simulation test and display, to achieve large-scale vehicle road coordination system simulation verification |
| and verification of key technologies                     | technologies                                                                 |                                                                                                                                                      |
| Key Technology of Traffic Co             | Key Technology of Traffic Coordination Control in Vehicle Routing System     | Facing the intersection to achieve reliable interaction between vehicle and signal and other roadbed equipment, to ensure the efficient passage of the intersection and the safe driving of the vehicle |
Ecological driving technology

| Ecological driving technology                                                                 | Beidou positioning system, precise positioning information, vehicle running status and road conditions exact match |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Multidimensional Perception Technology of Motor Vehicle                                      | Through large data analysis, it can identify road conditions, traffic conditions, driving conditions and poor driving behavior |
| Ecological Driving Data                                                                      | Through the software simulation, to form the eco-driving experience training model system                          |
| Fault Diagnosis Technology of Micro - ecological Driving Behavior of Motor Vehicles           | Ecological Driving Behavior Monitoring System Based on Cloud Computing And feedback device complete sets of equipment |
| Comprehensive Evaluation Technology of Ecological Driving Behavior of Motor Vehicles          |                                                                                                                 |
| Training Technology of Ecological Driving for Motor Vehicles                                 |                                                                                                                 |

3. The application technology of Energy Conservation and Emission Reduction of Transportation

For these problems of energy conservation and emission reduction of transportation big data that is difficult to serve the macro decision-making and other issues\(^2,12\), domestic and foreign scholars have actively carried out the relevant aspects of research, mainly including three categories, respectively, Intelligent energy conservation and emission reduction of transportation monitoring technology, large-scale data technology and eco-driving technology (Table 3).

For the above analysis technology, it needs to create a management platform for managing, storing and analyzing large amounts of data, and now the relevant platforms in table 4 that have been developed include Hadoop, Storm and S4.

**Table 4.** Energy conservation and emission reduction of transportation data processing technology platform\(^13\)

| Technology platform | characteristic | Application examples                                                                 |
|---------------------|----------------|--------------------------------------------------------------------------------------|
| Hadoop              | slicing process a lot of off-line data , The data to be processed is stored on hdfs before processing, the advantage is that the computing work will be placed on the data node to improve efficiency | Research on Urban Traffic Carbon Emission Data Mining Based on Hadoop\(^14\) |
| Storm               | The data to be processed is placed in the real-time message queue, the user simply writes the topology logic and then receives the data to process It Is a common, distributed, scalable, with partitioned fault tolerance, support for plug-in distributed streaming computing platform | Design and Realization of Traffic Information Real - time Processing System Based on Storm\(^15\) |
| S4                  |                                                                          | Design and Implementation of Real - time Traffic Flow Data Processing System Based on Apache S4\(^16\) |
4. Analysis on the Application of Big Data for Energy Conservation and Emission Reduction of Transportation

In order to clarify the application of big data in the field of energy conservation and emission reduction of transportation industry and it take new opportunities, new challenges for energy conservation and emission reduction of transportation, especially the new changes of energy conservation and emission reduction of transportation is facing, it should explore and establish energy conservation and emission reduction of transportation management model relying on big data analysis, to provide suggestions for the realization of China's energy conservation and emission reduction of transportation management system and the modernization of governance capacity, application analysis mainly includes the following four parts:

A. Analysis on the problem of energy conservation and emission reduction of transportation in big data era. It is in the "golden opportunity for development" and "energy crisis highlights" coexistence of the development stage, and the development of big data era requires data decision-making, data management, data innovation, this has brought great challenges to China's traditional traffic management model. Therefore, this part mainly analyze big data content, big data industry type, characteristics, and focus on the development status and the outstanding problems of energy conservation and emission reduction of transportation under the background of big data.

B. The concept and characteristics analysis of energy conservation and emission reduction of transportation problem. With the global warming, the environment poses a serious challenge to human survival and development, the community is more concerned about energy conservation and emission reduction of transportation. Therefore, this part mainly hackles the development history, concept and characteristics of energy conservation and emission reduction of transportation concept.

C. The energy conservation and emission reduction of transportation model based on big data analysis. Based on the mismatch between the traditional traffic management model and the social and economic development, the problems in the field of transportation environment and the development of information technology such as "Internet +", networking, and cloud computing have provided the possibility for the extensive application of big data. Basing on the main characteristics of the governance in the field of energy conservation and emission reduction of Transportation, this part analyze its application conditions and the innovation of its management mode under the background of big data, including energy conservation and emission reduction of transportation management mode changes under the big data: it requires the whole community data samples of energy conservation and emission reduction of transportation, shares data between traffic and environmental sector, breaks the gap between traffic and environmental departments in the virtual integration of data, makes the traffic and environmental sector's decision-making scientific, objectively evaluates the effect of energy conservation and emission reduction of transportation and uses data to solve environmental problems based on big data; the innovative path of energy conservation and emission reduction of transportation management mode under big data age includes: data collecting, processing and digging, data sharing and integration, making participating subject to be initiative and diversified.

D. Study on the management framework of energy conservation and emission reduction of transportation in China. The framework of innovative mode of energy conservation and emission reduction of transportation in big data background is based on government traffic and environmental sector data disclosure. Big data applications forms public data by collection, mining, sharing; the transportation and environmental sector use public data to form a cooperative governance platform and form energy conservation and emission reduction of transportation management system which take the government as the leading, the technical enterprise as the main body, the non-governmental organization and the populace participation as the bridge. So this part use PSR model to analyze pressure indicators that is the problem in governance mode of energy conservation and emission reduction of national transportation under the background of big data industry, state indicators is the process status of energy conservation and emission reduction of national transportation management model under big data, response indicators that is how to use big data innovate energy conservation and emission reduction of national transportation management mode, and to build energy conservation and emission
reduction of national transportation management framework, so that making energy conservation and emission reduction of national transportation management sustainable.

**Figure 1.** Application analysis framework diagram

The above application analysis uses six research methods, namely, literature investigation and analysis method, questionnaire survey method, field interview method, case and general comprehensive analysis method, qualitative and quantitative comprehensive analysis method, system analysis method. The concrete frame form is shown in figure 1.

5. Conclusion

Now, China is in the depth of social transition, social interest adjustment period, the phenomenon of transportation energy consumption and environmental pollution serious highlight, and a variety of social pressure strengthen sharply in such environment, so traffic-related departments introduced a variety of energy conservation and emission reduction of national transportation measures. So, in the context of the current big data, researching how to fully tap and effectively use these massive data, changing the traditional management of traffic methods and models, exploring a new way of transport governance, methods and path, it will have a very high practical significance for that to enhance the government's traffic management capacity and to promote the transport sector to strengthen and innovate the traffic management objectives.

This paper based big data to research how to solve the problem of energy conversation and emission reduction of national transportation, its purpose mainly includes three aspects: firstly, in order to have a straightforward and clear understanding for traffic data, it makes a relatively accurate, scientific and reasonable explanation for energy conversation and emission reduction of national transportation data. Secondly, it requires investigating the current status of low-carbon traffic management and accurately analyzing the causes of the formation of problems. Thirdly, for the existing problems and causes, this paper use energy conversation and emission reduction of national transportation data thinking and means to put forward the corresponding measures and innovate the ways, methods of low-carbon traffic...
control in order to provide theoretical basis and reference value for low-carbon transportation management.

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