Research on Visualization Technology of Urban Traffic Based on Big Data

Yi Ren [1,a], Cuirong Chi [1,b] Jie Huang [1,c] and Jintao Zhang [1,d]

[1] Shenyang Jianzhu University Liaoning, China

[a] 1181134429@qq.com; [b] 726733255@qq.com; [c] 1269028746 @qq.com; [d] 370530803 @qq.com

Keywords: Urban traffic; Data visualization; Web front-end technology

Abstract. As the research object, it is based on the urban traffic data visualization. Firstly, this paper analyzes the basic frame of data visualization, including the process and core elements of data visualization, and discusses the traffic data visualization method for the low dimensional data and multidimensional data visualization methods. The data visualization system was realized using the Web front-end technology and the practical case to test validation, and showing the effect on the big city traffic data visualization.

Introduction

In recent years, with the rapid development of urban infrastructure construction, it has become more and more important to use big data technology, cloud computing technology and artificial intelligence technology to provide support for intelligent transportation system. By improving the data analysis ability of the urban traffic system, optimizing the operation efficiency of the traffic management link and mastering the traffic operation status in real time, more intelligent services can be brought to the traffic travelers. At present, the total amount of traffic big data has jumped from TB level to PB level and is still rising. These big data with the characteristics of different formats and structures are generated continuously every day. It is very difficult to directly extract the hidden rules and patterns behind them, so the ideal processing method is "information visualization" [1].
Information visualization technology is a means of presenting complex or abstract information in an intuitive and visual way and quickly being understood by people. How to use big data technology to visually analyze big data of urban transportation, study the distribution rule and mode of urban transportation, and provide decision support for traffic supervision and planning is an important task of intelligent transportation development at this stage[2][3].

Visualization of Urban Traffic

The generation of traffic big data is the inevitable result of the development of intelligent traffic system. Generally speaking, urban traffic visualization is to encode the data generated in the traffic system, present the traffic data to users through static and dynamic graphs, and support the analysis of traffic data for user interaction, mainly including the visualization of object trajectory, monitoring data and road network condition [4]. It can be understood as the sum of all visualization techniques which has been used in traffic intelligent analysis systems. An intelligent analysis system can generally be roughly divided into four parts: data collection, data preprocessing, data query and data analysis [5].

Data mining is a technology that classifies and processes a large amount of data and seeks for rules. It is divided into three steps: data collection, data processing and data display. Traffic data mining is in view of the data mining with the geographical spatial attribute object, because the traffic data object itself has spatial properties, such as geographical location, the topological relation, the correlation of spatial location, so traffic data mining processing relative to other data types processing method is more complex, the algorithm used in the process of mining is more special, it is the cross subject research on GIS, spatial analysis and data mining [6].

  DOI: 10.25236/icess.2019.299

In the process of traffic data mining with traditional process which includes the exploratory analysis of the rules with spatial correlation. While data preprocessing, all kinds of problems may occur in the original traffic data collected, including repetition and lack, visual data cleaning of raw traffic data can help users to get rid of repetitive and congruent operation, improve the availability of data; while data query, through the visual query interface, it can help users to optimize query conditions, analyze query results and so on; while data analysis, visualization technology can be combined with other methods of data analysis and support user intervention.

The visual representation is the expression of statistical results eventually. Now there are dozens of mature visualization tools and plug-ins number as many as their various types, such as iCharts provides online flash chart generated services, Raw is very convenient to transform the spreadsheet data into vector graphics file, Google Charts provides a simple easy-to-use API for developers to use [7,8].

Traffic Visualization Technology

Parallel Coordinate System Technology.

Parallel coordinate system is the most commonly used in visualization technique based on geometry. Parallel coordinate visualization technology is the representation of multidimensional space in two-dimensional plane. Its drawing process is as follows: N equally spaced vertical parallel axes are drawn in the two-dimensional plane according to the dimensions of the multidimensional data (assuming the n-dimensional data), each axis representing respectively one dimensional properties of multidimensional data, then every dimension attribute values of multidimensional data being mapped to the corresponding coordinate of the corresponding calibration point and all coordinate points in turn connected to a line [9].

Icon-Based Technology.

The basic idea of icon-based technology is to use geometric icons with visual features to express multidimensional data, including size, length, shape, color and so on. In icon-based visual graphics, each visual feature represents each dimension attribute of the cube, and each icon represents a cube point. Some representative ions-based visualization techniques include Star drawing method and Chernoff-face method.

Hierarchical-Based Technology.

Hierarchical-based visualization technology is mainly aimed at multi-dimensional data with hierarchical or hierarchical relations, such as genealogical data, biological genetic relationship data and social network complex data and so on. The basic idea of hierarchical technology is to divide the multidimensional space into several subspaces according to the hierarchical relation structure of the multidimensional data and display each subspace with the hierarchical structure. At present, the common techniques based on hierarchy mainly include node linking method and space filling method.

Depressed Dimension Mapping Technology.

The original high-dimensional data often contain some redundant information and noisy information, which brings errors and interference to visualization research and analysis and reduces the accuracy of visualization results. By using depressed dimensionality mapping method, high-dimensional data are mapped into low-dimensional visualization space for analysis to reduce errors caused by useless information and improving the accuracy of identification [10]

Design of Traffic Visualization System

In this paper, the responsive layout of the front-end page is implemented. According to the prototype diagram of the Web interface, the system is divided into two Web pages, which are respectively used to display the low-dimensional data visualization results and the multi-dimensional data visualization results. Both pages have the same navigation bar, but the corresponding visual area is different. According to this feature, Angular JS is adopted as the front-end framework in this paper to realize dynamic refresh of a single page local modules according to different routes. In this way, both

redundant front-end code and the requesting number of the server can be reduced, and system performance can be improved.

Angular JS is used as the front-end framework, and two visualization plug-ins, Echarts.js and D3.js, are integrated. Firstly, initializing an Angular JS application with the ng-app directive in the DOM element of the corresponding HTML page. In HTML, a layout template are needed to create that tells Angular JS where to render the template, often by combining the ng-view directive with the route to specify exactly where the template for the current route will be rendered in the DOM. Angular JS provides two methods named ‘when’ and ‘other’ to define the application route, using the ‘config’ function to define the route in a particular template or application. The parallel coordinate diagram page of this system is shown in Fig 1.

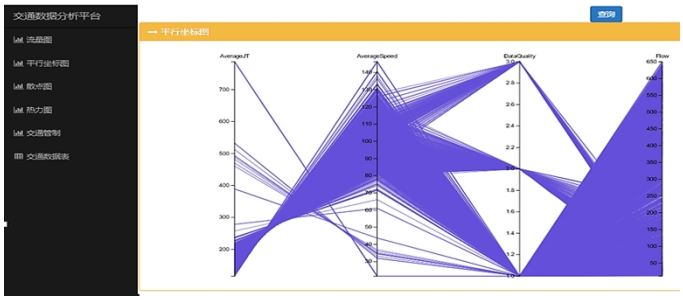

Fig. 1 The parallel coordinate diagram

Conclusion

Visual analysis technology provides us with an intuitive and effective method. It visually presents complex traffic data and its analysis results in a visual way and supports interactive filtering and browsing of the results. In addition, when people find some unexpected or unexpected features from the visualized images, they can also start the analysis algorithm to dig into the traffic information automatically and pertinently.

References

[1]. Andriendo G, Andrienko N, Demsar U, et al. Space, Time and Visual Analytics [J]. International Journal of Geographical Information Science, 2010, 24(10):1577-1600.

[2]. Ragan E D, Endert A, Sanyal J, et al. Characterizing Provenance in Visualization and Data Analysis: An Organizational Framework of Provenance Types and Purposes[J]. IEEE Transactions on Visualization & Computer Graphics, 2016, 22(1): 31-40.

[3]. Ward M O, Grinstein G G, Keim D. Interactive Data Visualization[J]. Crc Press, 2015, 51(4): 188-195.

[4]. Brigham T J. Feast for the Eyes: An Introduction to Data Visualization.[J]. Medical Reference Services Quarterly, 2016, 35(2): 215.

[5]. Bertuca D J. Mapping time: Illustrated by Minard's map of Napoleon's Russian campaign of 1812[J]. Book Review, 2015(76): 98-112.

[6]. Campello R J G B, Moulavi D, Zimek A, et al. Hierarchical Density Estimates for Data Clustering, Visualization, and Outlier Detection[J]. Acm Transactions on Knowledge Discovery from Data, 2015, 10(1): 5.

[7]. Chenard C A, Richard S. Information Visualization[J]. Encyclopedia of Database Systems, 2008, 1(4):1-4.

[8]. Kerren A, Schreiber F. Why Integrate Info Vis and Sci Vis: An Example from Systems Biology [J]. IEEE Computer Graphics & Applications, 2014, 34(6): 69-73.

[9]. Fisher B, Green T M, Ariashernández R. Visual analytics as a translational cognitive science [J]. Topics in Cognitive Science, 2011, 3(3): 609.

[10]. Schroeder W, Martin K, Lorensen B. The Visualization Toolkit, Third Edition [M]. New York; Kitware Inc, 2014, August:131-169.