Construction of Urban Intelligent Transportation Platform Based on Large Data

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Abstract

The traditional urban public transport system has a long waiting time, low service level, poor management level and other problems, and the overall passenger satisfaction is low. In order to solve these problems, the company based on large data and cloud computing technology designed a set of intelligent bus travel cloud platform. The platform collects, stores and builds the algorithm model through the mass information of the public transportation vehicles and the large number of user application information. In addition, it can provide the large data modeling and analysis platform for the urban public transportation intelligence, which gathers the information collection, the intelligent dispatching, the information distribution and so on. The actual operation of the platform will greatly improve the efficiency of the bus system operation, and give passengers a better bus travel experience. This paper introduces the design ideas and functions of the platform. Urban intelligent transportation platform is a more intelligent means to plan the urban traffic situation, in order to alleviate the traffic congestion problems, traffic incident handling, traffic induction and so put forward an effective and reasonable means.

Keywords: Urban Intelligent Transportation Platform, Traffic flow data, Large Data, Traveler function module.

1. INTRODUCTION

With the process of urbanization getting faster and faster in our country, urban traffic plays an increasingly important role as an important pillar of industrial and agricultural development, urban construction and economic prosperity. However, the urban transport has also brought some negative effects, such as traffic congestion, traffic noise, air pollution, taxi driving difficulties, driving problems and other issues. It becomes the work of the public and the face of a major problem, economic development (Han et al., 2016). Because we put forward the "Smart city", people see a practical way to solve the urbanization process encountered in the various problems. "Urban intelligent transportation platform" is a more intelligent means to plan the urban traffic situation, in order to alleviate the traffic congestion problems, traffic incident handling, traffic induction and so put forward an effective and reasonable means (Sun et al., 2016). As shown in Figure 1, the classic smart city mode is given in details.

Figure 1. Classic Smart City Mode

Through comparative analysis, we can see that the development of California in the United States is very prominent, which has developed five large data based on the application of traffic systems, covering all aspects of daily life, greatly improving the efficiency of the relevant government departments management. Japan is also more mature in the field of intelligent transportation development, which is mainly to P-DRGS as the representative. However, in the area of environmental monitoring, the system is not involved (Lv et al., 2010). The UK currently uses four intelligent transportation systems, such as Transport-for-London, to distribute traffic information based on historical data and real-time data from the floating vehicle system, and to estimate the traffic conditions at other times or locations through historical data. Thus it can greatly reduce the cost of the system. In recent years, China has also invested a lot of money and manpower in the field of intelligent transportation, and achieved some success. Beijing, Hong Kong, Shanghai, Hangzhou, Guangzhou and Shenzhen, which are represented by several cities in the field of intelligent transportation, have been at the forefront of our country (Yuan C, et al., 2016). And Beijing is the most prominent development. In 2005, Beijing built the first floating vehicle information collection system, and the center independently developed a traffic information release experimental system, which can be daily for the public to provide road network speed monitoring data. At present, the system receives more than 30,000 real-time data uploaded by the taxi, which can quickly and accurately map the GPS sampling point and deal with the road speed information.

2. TRAFFIC DATA CHARACTERISTICS

The main data of the large data and the traditional traffic data are mainly embodied in the characteristics. The main description of the large data features are: 3V, 4V and 5V, etc. Combining the basic types of large traffic data, traffic data are with6V characteristics (Peixotoet al., 2012). The traditional application of the system provides a basic data support to Beijing, for example, based on microwave radar, ultrasonic, induction coil, video monitoring and other detectors. Traffic Administration has established a traffic information collection, processing, publishing system, Beijing road traffic flow forecasting system and so on.

2.1 Traffic flow data (motion detector)

We can use the fixed detector and mobile detector data fusion to obtain more accurate traffic flow data. For example, Beijing Public Security Bureau of Public Security Traffic Management conducted a "Beijing road traffic flow comprehensive analysis and data quality evaluation System research "project, which fixed detectors, mobile detectors and other multi-source data obtained to study and optimize the quality of traffic data. The expression of the data stream is as follows,

$$Flow(t) = \lambda \cdot Flow(t-1) + random(n) \tag{1}$$

2.2 Position data (motion detection)

Advanced mobile communication technology can expand the scope of application of traffic motion detection from the traditional traffic data acquisition to the location of the data acquisition, which can make location-based services possible based on the bus smart card data to achieve travel travel behavior analysis (Agamennoni et al., 2011). And it can provide support for bus infrastructure construction and operation service management. Based on the data of taxi terminal, we study the impact of travel distance, travel time and road preference on driver path selection, and then the path prediction is realized. In addition, the emergence of the car network has greatly improved the level of comprehensive access to urban traffic information, which can enrich the sources of traffic data and the development of the traffic data. The processing and analysis of massive location data provide support for traffic travel behavior analysis, bus system optimization, vehicle priority control. The relationship between the position data is as follows,

$$\begin{bmatrix} x_i \\ y_i \\ z_i \end{bmatrix} = \begin{bmatrix} x_{i-1} \\ y_{i-1} \\ z_{i-1} \end{bmatrix} + \begin{bmatrix} v_{x,i-1} \\ v_{y,i-1} \\ v_{z,i-1} \end{bmatrix} \cdot \Delta t \tag{2}$$

2.3 Unstructured video data

Unstructured video data on the one hand can be used for macroeconomic situation monitoring, Liuzhou, Guangxi. For example, the construction of high-altitude high-definition video surveillance system can be used to control the multi-intersection or larger regional traffic macro situation (Gregor et al., 2016). On the one hand, through the video processing module, characteristic parameters and other parameters to bayonet system, electronic police system can also be used in vehicle type identification. The mean and variance of large traffic data are expressed as follows,

$$\overline{X} = \frac{\sum X_i}{N} \tag{3}$$

$$\sigma^2 = \frac{\sum \left(X_i - \overline{X} \right)^2}{N} \tag{4}$$

2.4 Multi-source Internet and government network data

Internet, government network for intelligent transportation system provides a wide range of data sources and distribution channels to the social network, and the representative of the Internet for intelligent traffic system to provide traffic events such as video data. In addition, Internet can also become a traffic police on-site law enforcement, system optimization, etc. The government network provides a safe and stable information exchange platform for urban decision-makers and managers, and it can access the urban road network structure, meteorological changes, special events and emergencies for intelligent transportation system through the government network events, emergency rescue and other data. Multiple data source fusion meets the following formula,

$$R = \max\left(X_1, X_2, ..., X_N \right) \tag{5}$$

3. URBAN INTELLIGENT TRANSPORTATION PLATFORM FUNCTION MODULE

Based on the traffic data of the city, this paper analyzes the traffic speed, geographical location and vehicle trajectory of the vehicle by digging the massive traffic information data, and then analyzes the congestion index of different sections and identifies the causes of traffic events. At the same time, with the use of vehicle traffic statistics and speed, you can also calculate the air quality of the designated areas for the government to develop policies and provide a reference for residents travel. The framework of the intelligent platform is specifically divided into traffic management module, travel auxiliary module, the government decision-making module three parts, as shown in Figure 2.

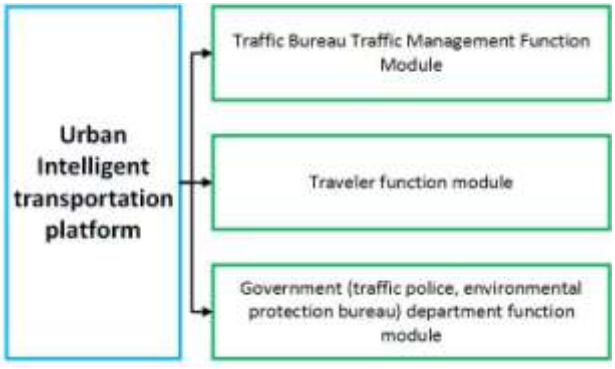

Figure 2. Modules of Urban Intelligent transportation platform

3.1 Traffic Bureau Traffic Management Function Module

• Abnormal event detection based on large traffic data: It is possible to determine whether there is a traffic incident on the road by collecting traffic flow data in real time, analyzing the characteristics of traffic flow parameter change or vehicle driving characteristics, which is mainly based on support vector machine and other detection algorithms, the data for sample training and testing, detection of traffic events category.

• Intelligent dispatching based on GPS-based taxi and GPS-bus data: for the current taxi free rate, the taxi for intelligent scheduling is analyzed by the taxi pull passengers on and off the record and the corresponding geographical and social functionality. To provide recommended services to the driver, it is recommended that some "live" location in the shortest possible time to pull the passengers and to maximize the income.

• E-government management: E-government is the use of modern information and communication technology by government agencies to integrate management and services through network technology to achieve the optimal reorganization of government organizational structures and workflows across the Internet, which can beyond time and space.

3.2 Traveler function module

• Public transport transfer based on time and space dimensions: Using real-time GPS data from buses, you can get bus arrival time and real-time location of the bus. Bus line inquiries are based on passenger travel and final site name. Combined with other travel methods such as light rail and car rental,we plan a number of reasonable transfer routes for selection.

• Multi-factor game-based traffic induction: We consider the optimal path set of the induction problem by using an incremental dynamic re-planning method based on multiple factors. First, we use the reverse multi-target heuristic search for global planning. And then we find the way to the global plan to retain some of the information effectively reused. Finally, you can quickly adjust the location of the change between the location and the new path.

• Information release based on the cloud platform: Information dissemination module, with cloud computing, data migration calculations and information push and other advantages of information dissemination, can reduce the user's energy consumption and computing time, and better meet the real-time performance.

3.3 Government (traffic police, environmental protection bureau) department function module

• Intelligent traffic management strategy based on large traffic data: This module optimizes the traffic light control strategy, analyzes the rationality of the existing and additional stations, the rationality of the bus lane, the departure frequency and the turn-off position distance setting rationality, vehicle priority control strategy, snowmelt snowmelt effect evaluation based on traffic data.

• Urban (traffic) environmental inquiries based on traffic data and air quality monitoring data: Urban traffic environment inquiries are based on urban air quality monitoring data and floating vehicle data, which includes the following air quality, weather information (temperature, wind, etc.), PM2 .5 haze weather monitoring, minimum visibility range, rainfall and snowfall impact assessment of traffic.

4. EXPERIMENTAL RESULTS

Traffic is a typical open and complex giant system. In the traffic modeling research, the systematic application of mechanism, knowledge and data have the special significance. The large data laid the foundation for the establishment and calibration of the traffic model, and the self-improvement of the traffic model. Especially, the study of the characteristics of mixed traffic flow, the discovery of traffic travel behavior, the extraction of time and space characteristics of dynamic traffic flow are very important. The performance of the proposed intelligent transportation platform is obtained through the experimental policy.

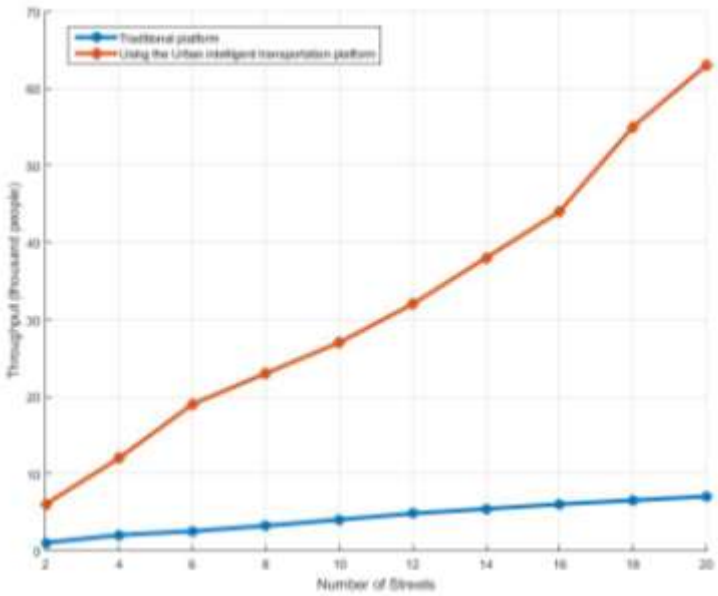

Figure 3. Throughput vs Number of streets of the proposed urban intelligent transportation platform

From the above Figure 3, we see that the use of this proposed urban intelligent transportation platform for urban traffic management can make the improvement of the throughput of each street. Because, the intelligent traffic platform can be effectively managed for each traffic participant, and through the management of traffic lights to achieve enhanced street throughput. And with the increase in the number of streets, this paper presents the performance advantages of the algorithm will be more prominent.

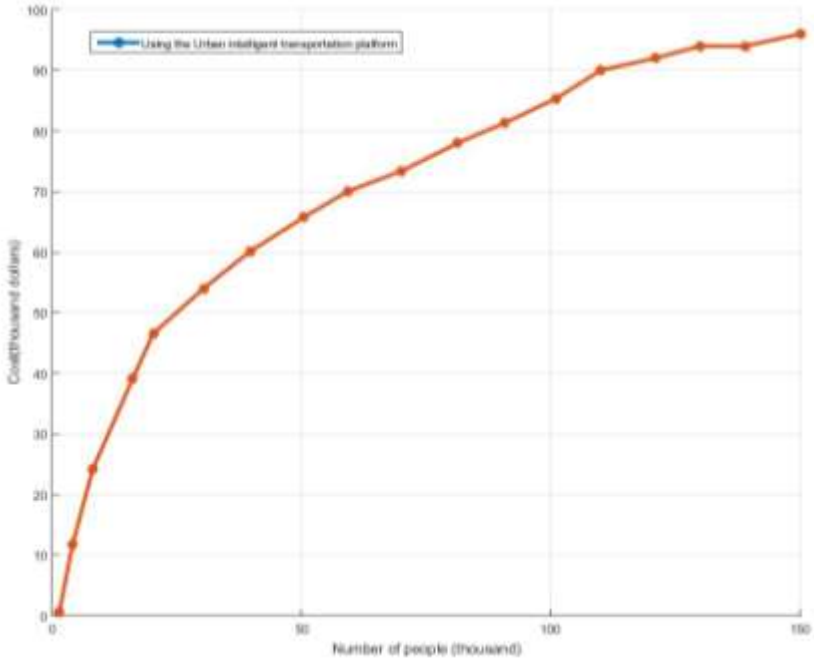

Figure 4. Cost vs Number of people of the proposed urban intelligent transportation platform

From the above Figure 4, we analyze the relationship between the cost of using the intelligent transportation platform proposed in this paper and the urban population. As can be seen from the Figure 4, the cost of intelligent transportation platform will increase rapidly with the increase in urban population, then the growth rate is gradually slowing down. This is because that the original cost of the platform is high, and as the number increases, the additional cost of the platform will increase at a slower rate. In summary, this paper presents

alarge data based on the city intelligent transportation platform can effectively manage the urban traffic, and the cost of the platform is also in the city construction can bear. And the greater the size of the city, the more benefits the smart traffic system will use.

5. CONCLUSIONS

The platform collects, stores and builds the algorithm model through the mass information of the public transportation vehicles and the large number of user application information. The actual operation of the platform will greatly improve the efficiency of the bus system operation, and give passengers a better bus travel experience. This paper introduces the design ideas and functions of the platform. Urban intelligent transportation platform is a more intelligent means to plan the urban traffic situation, in order to alleviate the traffic congestion problems, traffic incident handling, traffic induction and so put forward an effective and reasonable means.

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