International Journal of Decision Science
Volume 11 • Number 1 • June 2020

The Application of Web Crawler Technology in Capturing Urban Traffic Information

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ABSTRACT

At present, there are few researches on traffic based on crawler data, and the problems of not being public and not easy to obtain traffic data on the network. In this paper, Python was used as a tool to evaluate and analyze the traffic situation in the rectangular area of Shanghai by using the technology of web crawler. Then, ArcGIS was used to visualize the regional road condition and speed, and K-means clustering method was used to analyze the speed. The results of this paper show that it is feasible and reliable to use the technology of network crawler to capture traffic data. In addition, the traffic data from the Gaud map also provides a new data source for researchers.

Keywords: Web Crawler Technology, Traffic data, Road conditions, Speed, K-means clustering

INTRODUCTION

1.1 Research Status

With the rapid development of the network and the rapid increase of information resources, there are accumulated data such as statistical yearbook, real-time measured data such as traffic, logistics and so on published by the government, enterprises and other units on the Internet [1]. Although there are many data published on the network, they cannot be obtained casually. Most of the data are only for browsing and cannot be downloaded, with certain restrictions [2-3]. Traffic data is very important for traffic researchers and the primary basis of research and analysis. However, the traffic data of urban roads obtained by governments, enterprises and universities are rarely published on the network due to some factors. Urban traffic data has the characteristics of large quantity, high real-time and high speed. In addition, when the traditional relational database is faced with massive traffic data, it will have insufficient write performance. There are also problems of data mining and data recovery. How to obtain the massive traffic flow data, and how to collect and store them effectively, and how to carry on the effective statistical mining to the data has become a big problem.

In order to solve these problems, the role of web crawler is very important. Web crawler, also called web spider, can automatically grab Internet resources according to certain rules [4]. The application of web crawler is very extensive, it has the characteristics of powerful, fast and accurate, and can meet the actual needs of users. The following is a list of recent applications about web crawlers. Dang Aili uses the technology of web crawler to obtain the news information of radio and television, and uses the maximum matching method to process it. Through the similarity detection model of radio and television news, it determines the similarity and repeatability of the text, to realize the information classification. The test results show that the radio and television news editing method based on text mining can accurately classify news information in a short time and ensure the quality of news reports [5]. Yang Yin uses the technology of web crawler to analyze the source of students' homework efficiently and accurately in search engine, to effectively curb the phenomenon of homework plagiarism. It plays an important role in improving the teaching quality and promoting the construction of learning atmosphere [6]. Ye Lianlian thinks that the traditional cultivation information is blocked and the old method of cultivation based on experience has various disadvantages in the production practice. The aquatic products produced are difficult to meet the market demand. Therefore, the use of web crawler technology to obtain the price data of aquatic products from major e-commerce websites, in order to further analyze the price of aquatic products for data collection preparation

[7]. Lu Fengling designed a kind of web crawler program with recruitment information as the theme based on the scrappy framework. The program only searches the resource data related to the theme information, which is used to serve the college graduates as an auxiliary means to collect recruitment information before employment [8]. Medical and health information is very important for people to understand and obtain medical resources, especially its accuracy and real-time. In order to facilitate accurate and fast retrieval of medical and health information, Feng Sidu and others built a special search website related to medical and health information based on the subject web crawler and SQL server data storage [9]. Traditional Libpcap power grid big data mining strategy cannot allocate the network occupied resources on demand. To solve this problem, Feng Hao and others designed a new type of power grid big data intelligent mining technology model based on web crawler, which makes the network occupied resources realize the real on-demand allocation [10]. Ye Huixian uses Python to capture the information data of the college's enrollment source and provide it to the enrollment management staff, providing reference for the college's long-term enrollment planning [11].Wang Tao grabs the recruitment information of 51job recruitment website involving Java, python, big data and Android, and analyzes the current recruitment needs of software technology in China [12].

As mentioned above, web crawler technology has been applied in news industry, education industry, breeding industry, recruitment and employment, medical industry and power industry. The application of network crawler technology in the field of transportation also provides convenience for many researchers to obtain traffic data. Chen Qichen grabs the space information of the shared bicycle from the Moby bicycle mobile client, and analyzes the distribution and running state of the shared bicycle by using two indexes of "stacking degree" and "using heat degree". It is found that the shared bicycles in Xi'an have the following characteristics: first, the distribution of shared bicycles in the urban area of Xi'an is in the shape of "talent"; second, the more serious the accumulation of vehicles, the lower the marginal amount of space borrowing and returning; third, the areas with high vehicle utilization are usually located in the areas with single land use nature and the marginal areas with poor public transport accessibility; fourth, self-organized areas appear in some areas Bicycle "quasi station" with fixed position [13]. FSA is an evaluation system established based on industrial risk management combined with the current characteristics of maritime transport, which can help to evaluate the new regulations on maritime safety and marine environmental protection. FSA method needs the support of historical data in risk assessment, but the purpose of building ship related database is not to apply to risk assessment when China Maritime Department initially accumulates data, which leads to some obvious limitations in using existing ship database for risk assessment. Therefore, when Yu Chen designs FSA oriented ship safety database, he grabs ship safety data from different maritime departments and enterprises, providing data basis for building ship safety database [14]. Nowadays, more and more people are interested in tourism, but how to get to the scenic spot quickly and conveniently in the new city has become a concern. Therefore, Yu haochuan has designed an urban public transport route planning system, which captures the public transport route data and POI data through cooperative API and web crawler technology based on scrappy framework. Finally, the system can provide convenient city play services for users who like to travel [15]. Based on the tile pyramid technology and characteristics of current network map, Li Wei analyzed the attributes of traffic flow tile map. By referring to the data structure knowledge such as queue and breadth first traversal, this paper focuses on the working principle and basic operation method of web crawler technology. On this basis, it is found that web crawler can be constructed to obtain all kinds of information on the network in batches. So in order to download the traffic flow map in batch and extract the traffic flow data for the follow-up, a traffic flow tile downloader based on web crawler technology is designed [16]. Kaltenbrunner[17]0Vogel[18], Lathia [19], have also carried out research on shared bicycles based on the data of web crawlers, but there are few studies on other aspects of traffic, more on the optimization of crawler technology [20-22].

Scholars at home and abroad use the technology of web crawler to grab the data of shared bicycle, and there are many cases used for research and analysis. However, there is little research on the use of web crawler technology to capture real-time traffic data from maps (such as Baidu, Gaud, etc.) to analyze urban traffic characteristics. Therefore, based on the software python, this paper uses

the web crawler technology to grab the traffic situation information of the rectangular area of Shanghai from the Gaud map to analyze the traffic characteristics of the area. There are many researches on urban traffic, such as traffic flow characteristics, traffic prediction, traffic congestion, intersections, and so on. Peng Wuxiong and others show that the use of big data of transportation can more accurately depict and judge the spatial development pattern of Wuhan. The analysis of traffic distribution and spatial activity law of citizens can provide reference for traffic policy making, facility planning and layout, travel improvement and function quality improvement [23]. Zhang Zhenlong and others collected real-time road condition data for one week. Based on ArcGIS operation platform, this paper analyzes the temporal and spatial characteristics of frequent traffic jams in the old town of Suzhou, and analyzes the main causes of traffic jams. The research shows that there are two travel peaks in the working day and the rest day in the ancient city of Suzhou, but the peak time and peak value are different. The degree of road congestion changes greatly during working days and the tide phenomenon is more obvious. Spatially, the traffic congestion presents the characteristics of "point and line" coexistence, and has the trend of spreading to the surrounding areas to form "face" congestion [24]. Wang Zehua's research on vehicle lane changing behavior and seeking for effective measures to reduce traffic accidents is of positive significance to improve road safety. Based on the theory of cellular automata, the lane changing behavior of vehicles in multi-lane system is analyzed. And the MATLAB simulation software is used to analyze and obtain the relevant characteristic curve of lane changing traffic flow [25]. Based on the monitoring data of the annual traffic operation index of Chongqing main urban area in 2018, Wu Xiangguo summarized the time-varying law of the road traffic index of the main urban area in terms of quarter, cycle and working day. This paper analyzes the impact of holidays, weather, bridge traffic restriction, bus lane opening and other factors on the traffic operation index, and uses the single factor ANOVA method to study the significance of the differences of various factors, in order to provide reference for the application of traffic planning, management and other projects [26]. Hu Guirong proposed a real-time traffic signal control model of Urban Road intersection, which solved the problem of traffic congestion. This paper analyzes the current situation of traffic flow by using the release matrix, and puts forward a basic model to minimize the total delay time of vehicles at intersections. A real-time non-stationary periodic traffic signal model is established by using Webster timing method. Finally, the simulation results are compared with the traditional model to verify the effectiveness of the proposed model [27].

1.2 Research Significance

The research of this paper has the following significance. Web crawler technology can apply for relevant website interface and use API services to obtain the service resources provided by the website, which cannot be retrieved by search engines. This paper applies for a key in the open platform of Gaud, and selects the traffic situation in the development document to obtain the desired traffic data. This paper provides a feasible method for the traffic big data acquisition based on the application of network crawler technology in the Gaud map. In addition, based on the traffic big data obtained by network technology, using the relevant statistical mining methods, research and analysis, intelligent transportation has some applications. First, help the relevant traffic departments to find out the urban congestion points, accident occurrence points and road violation points; second, analyze the traffic capacity and congestion situation of the road network to help residents travel and provide effective suggestions; third, provide decision-making basis for road network planning, line planning and other planning activities. There are many applications of traffic big data based on web crawler technology, which provide powerful data support and foundation for the development of traffic.

2 DATA GRABBING

2.1 Web Crawler Technology

With the rapid development of network and information technology, the information is growing explosively, and a variety of information emerges at every moment. In the face of many resources on the Internet, users get the resources they want through search engines. Due to the complexity of users' backgrounds and different needs, traditional search engines (such as Baidu, 360, Google, etc.) are also unable to meet the actual needs of users due to the limitations of invalid information, fuzzy positioning, unable to identify multi format data, etc.

Web crawler, as a program (or script) for grabbing

web resources, is that some Internet search engines or other websites follow certain rules to automatically grab the information that can access the page. Web crawlers first collect data, then use related mining methods for processing, and finally summarize and store the data. In essence, this is also the function of web crawler. Web crawler technology can help users quickly and accurately get the desired resources. Search engine also provides resources for users by collecting data. Furthermore, web crawler technology also plays an important role in search engine.

Users get the desired resources through the search engine system, which comes from the function that the web crawler system can download the resources of the World Wide Web and provide to the search engine system. Therefore, many large-scale search engine systems, such as Google, Baidu and so on, provide network resources for users by collecting data. Furthermore, the web crawler system is very important for search engines. The workflow of web crawler mainly includes initiating request, obtaining response content, parsing content and finally saving data. See Figure 2-1 for details.

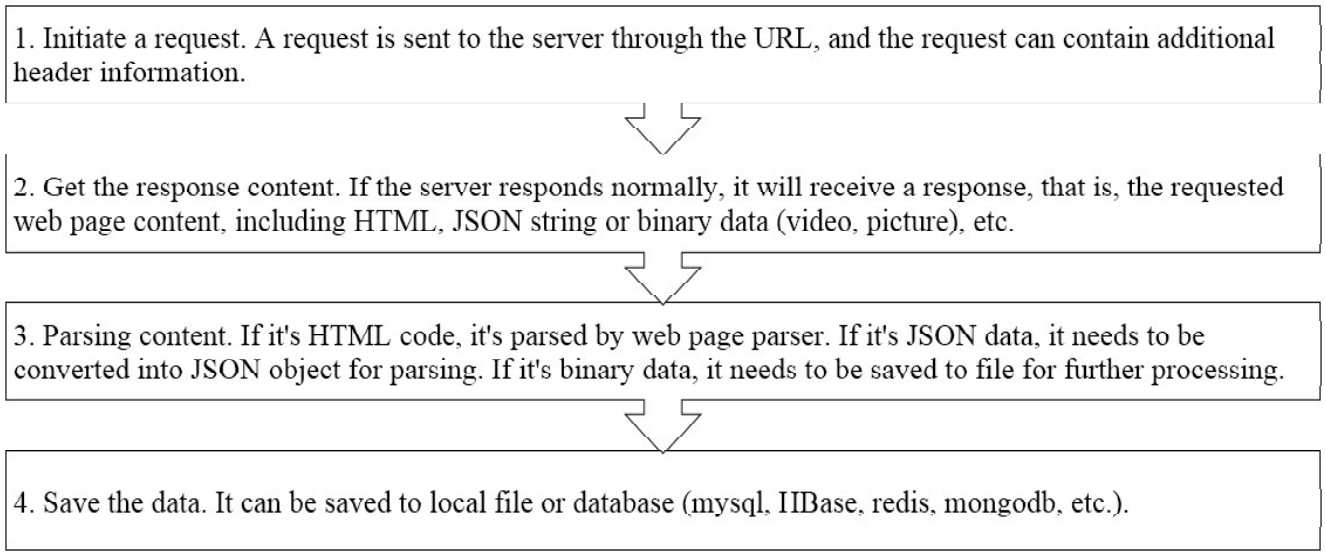


Fig.2-1 Workflow of web crawler

Table 2-1 Types of data that can be grabbed

Type	Explain
text	Such as HTML document, JSON format text.
picture	Get binary image and save.
video	Same as binary file, save as video format.
others	As long as it can be requested, it can be obtained

In essence, the working process of web crawler is to simulate the user to search the desired information using a browser (search engine system). However, users need to filter and judge the useful information and delete the useless and invalid information, while web crawler can help users to select the required information without other redundant garbage information. Web crawlers can capture many resources, such as text, pictures, and videos and so on in table 2-1.

2.2 Web service API

Developers who want to enjoy various types of geographic data services provided by Gaud map can apply for HTTP interface from Gaud Web Services API [28].All users can enjoy the web service API. In addition, Gaud map only supports the return results in JSON and XML formats. As shown in table 2-1, the functions supported by Web Service API are mainly used in this paper, such as coordinate transformation and traffic situation.

Table.2-1 Web Service API support functions

Geocoding / reverse geocoding	Path planning	Search POI	Input prompt
Bulk request interface	Administrative region query	Static map	IP location
Coordinate transformation	Weather query	Trajectory correction	Traffic situation

Traffic situation is a relatively simple HTTP interface in Gaud Web Services API documents. Users can query information of rectangle, circle or a road according to the input content.

In this paper, rectangular traffic situation information was queried. For the traffic situation of rectangular area, the main parameters of the returned results are traffic information, which includes description, evaluation and roads. Table 2-2 and table 2-3 are descriptions of specific return result parameters included in road condition evaluation and road confidence.

Table.2-2 Parameter description of return results of road condition evaluation

Name	Meaning	Rule description
expedite	Percentage of unimpeded traffic	
congested	Percentage of slow traffic	
blocked	Percentage of congestion	
unknown	Percentage of unknown	
status	road conditions	0: unknown;1: expedite;2: congested;3: blocked
description	Road description	

Table.2-3 Parameter description of road information return result

Name	Meaning	Rule description
name	Road name	
status	Road conditions	0: unknown;1: expedite;2: congested;3: blocked
angle	Driving angle, judge the positive and negative use of the road	0° in the east direction, positive in the counterclockwise direction, value range: [0-360]
speed		Unit: km / h
lcodes	That is, the set of location codes, which is the ID of a certain section of the road. A road includes multiple location codes	Angle takes a positive value between [0-180] and a negative value between [181-359]
polyline	Corridor coordinate set	Longitude and latitude are separated by ","; between separated coordinates

2.3 Data description

Take Python as the tool platform and Gaud map as the data acquisition source. Using the technology of network crawler to obtain the traffic situation information of rectangular area in Shanghai, the storage format is CSV. The acquired data includes field information such as road name, road condition, speed, longitude and latitude, as shown in table 2-4.

Table.2-4 Shanghai road data attribute column

Field name	Data type	Field description
Serial number	Number	
Road name	Text	
Status	Char	Road conditions
Speed	Number	
Field name	Data type	Field description
Numb	Varchar	Classification
Longitude	Number	
Latitude	Number	

On the Gaode map, the traffic situation information of the rectangular area is captured from left to right and from bottom to top, starting from Nansan community (longitude and latitude: 121.465135, 31.218262) in Shanghai. Due to the limited grabbing range of Gaud map, the area is divided into 9 blocks by grid, and then grabbing is carried out in turn by circular algorithm, as shown in Figure 2-2 is the description of rectangular area division, which is only for illustration. At 6 p.m. on September 29, 2019, 42672 sets of data were captured from the Gaud map.

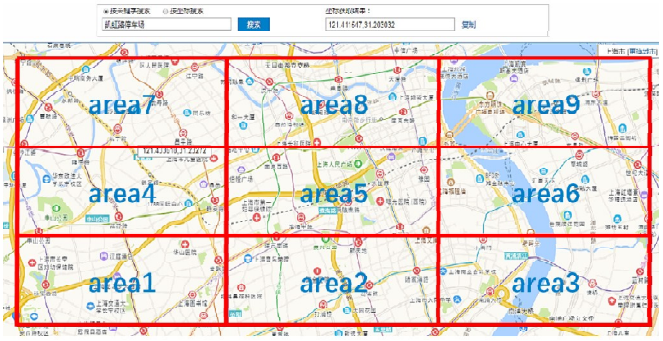


Fig.2-2 Rectangular area division of Shanghai

3 ANALYSIS OF TRAFFIC CHARACTERISTICS IN SHANGHAI

3.1 Overview of regional road conditions

Nine links are returned at the operation terminal of vs Code platform, corresponding to the traffic situation information of each area, including road condition evaluation and road information. As shown in table 3-1, the road condition evaluation of rectangular area in Shanghai includes the percentage of smooth, slow and congested traffic in each area, as well as the road condition level and road condition overview. It can be seen from the table that only area 1 has a road condition level of three, which is in a medium congestion state, and the other eight areas are in a light congestion state.

Table.3-1 Road condition evaluation of rectangular area in Shanghai

area	expedite	congested	blocked	unknown	status	description
area1	67.41%	21.48%	10.37%	0.74%	3	Moderate congestion
area2	76.88%	12.72%	6.94%	3.46%	2	Mild congestion
area3	81.65%	9.17%	4.59%	4.59%	2	Mild congestion
area4	82.55%	12.02%	5.43%	0.00%	2	Mild congestion
area5	80.43%	10.14%	7.97%	1.46%	2	Mild congestion
area6	86.17%	6.38%	2.13%	5.32%	2	Mild congestion
area7	84.44%	10.00%	4.44%	1.12%	2	Mild congestion
area8	80.20%	10.89%	5.94%	2.97%	2	Mild congestion
area9	87.10%	6.45%	4.84%	1.61%	2	Mild congestion

As shown in Figure 3-1, the running status of vehicles in Shanghai is shown. The lowest percentage of smooth traffic is 67.41% in area 1, the highest is 87.10% in area 9, and the highest percentage of slow traffic is 21.48% in area 1, which is far higher than other eight areas. The highest percentage of congestion is also in area 1.According to table 3-1; area 1 is more congested than other eight areas.

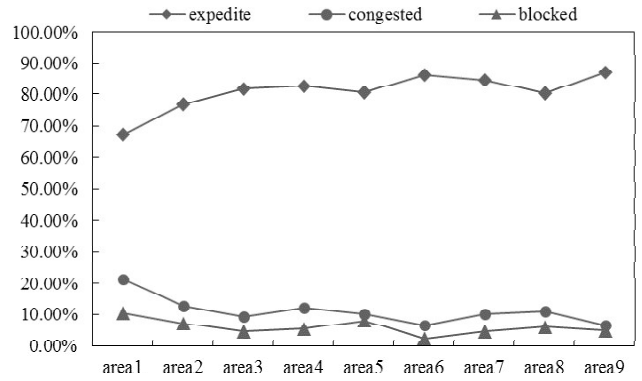


Fig.3-1 vehicle operation status in rectangular area of Shanghai

To explore the congestion in area 1, check the road condition in area 1.As shown in table 3-2, it reflects the road traffic operation. It can be clearly seen that the vehicles in area 1 are running slowly or congested, and there are even serious congestion in Huai Hai Zhong Road, East Zhongshan No.1 Road, Jiujiang Road.

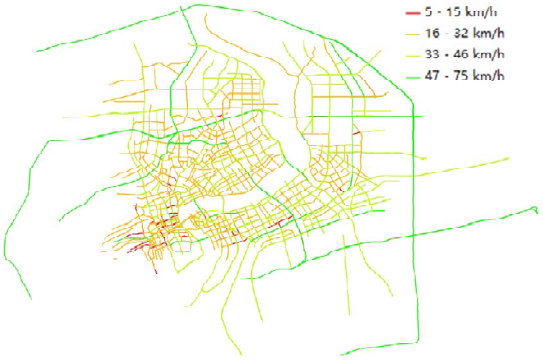
Table.3-2 Road condition of rectangular area 1 in Shanghai

Road name	Road condition information
Huai Hai Zhong Road	There is a serious congestion from west to east near the Times Square in Shanghai, and the reverse driving is slow. The West Building of new Hualian building is slow from east to west.
East Zhongshan No.1 Road	Two way slow, from Yan'an East Road to Fuzhou Road serious congestion.
Ji'nan Road	Congestion from south to north, slow reverse.
Jiujiang Road	There is a serious traffic jam from east to west near the Hongyi international square.
East Nanjing Road	There is a serious traffic jam from east to west near the Hongyi international square.
Huimin Road	Congestion from east to west.
South-North Elevated Roads	From the overpass of Yan'an East Road to Xujiahui Road, the traffic is slow.
Pudong avenue	Near the international shipping finance building, it runs slowly from west to East.

3.2 Visualization of regional road condition and speed

In order to observe the road condition and speed distribution in the rectangular area of Shanghai. Use arcgis10.4 to load area coordinate points and connect them into lines, that is, all roads in the area. In Figure 3-2, figure (a) shows the road conditions of all roads in the area. Throughout the whole area, the vehicle operation status is mainly smooth, while area 1 has many slow and congested sections. Figure (b) shows the vehicle speed distribution of all roads in the region. The speed is preliminarily divided into four categories. The speed classification is based on the maximum natural discontinuity point method (Jenks) of arcgis10.4. It can be seen from the color in the figure that the distribution of vehicle speed is mainly concentrated in 16-32 km / h and 33-46 km / h, and there are fewer sections with a speed of 47-75 km / h, and the most obvious section with a speed of 5-15 km / h is mainly concentrated in area 1.

(a) Road condition visualization



(b) Speed visualization

Fig.3-2 Road condition and speed visualization of area 1

3.3 Speed cluster analysis

K-means clustering algorithm is an iterative algorithm, which has the advantage of fast computing speed when dealing with a large number of data. Euclidean distance is used for similarity, and small distance indicates high similarity. The formula is as follows:

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \quad (1)$$

There are 42673 groups of data captured from Gaud map, and 739 groups of abnormal data (no vehicle running on the road) are removed. For the remaining data, K-means clustering is used to analyze all road speeds, find out the clustering center and divide the data with similar characteristics. As shown in table 3-3, the initial clustering centers are quite different and cannot represent the overall data characteristics.

Table.3-3 Initial cluster center

	1	2	3
Speed(km/h)	75	40	5

Therefore, the number of iterations is set to 10 and the convergence condition is set to 0.As shown in table 3-4, the iteration record is completed 6 times in total.

Table.3-4 Iteration record

Iteration	1	2	3
1	19.127	7.654	9.981
2	.253	.061	.002
3	2.815E-5	2.123E-6	5.072E-7
4	3.130E-9	7.473E-11	1.143E-10
5	3.268E-13	.000	2.665E-14
6	.000	.000	.000

Table 3-5 is the final cluster center after the iteration. There are 41934 valid cases without any missing. It can be seen from the table that the number of cases with 32 km/h as the cluster center is the largest, with 28643 cases, and the number of cases with 15 km/h as the cluster center is the smallest, with 4435 cases.

Table.3-5 Final cluster center and number of cases

	1	2	3
Speed(km/h)	56	32	15
Number	8865.000	28634.000	4435.000
Effective	41934.000		
Defect	.000		

4 CONCLUSION

Based on the traffic situation information of rectangular area in Shanghai captured by the web crawler technology in the Gaud map, this paper analyzes the road situation information and road speed in the rectangular area. ArcGIS is used to visualize the road condition and speed, and K-means clustering method is used to classify and analyze the speed. The following conclusions can be drawn:

(1) It is feasible and effective to use network crawler technology to capture traffic data from map, and it provides a new source for researchers to obtain traffic data.

(2) The traffic data captured has many applications in intelligent transportation. It can help the traffic department to find the urban congestion point and accident occurrence point, can be used to analyze the traffic capacity and congestion situation of the road network, help residents to provide effective suggestions for travel, and can also provide decision-making basis for road network planning, line planning and other planning activities.

(3) Throughout the rectangular area of Shanghai, the vehicle speed is divided into three centers with

15, 32 and 56 km/h, of which 32 km/h is the most. Among the nine areas divided by grid in rectangular area of Shanghai, only area 1 is moderately congested, with the most slow and congested sections.

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