Construction of university campus road planning decision system based on support vector machine algorithm

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ABSTRACT

The theory and design method of campus traffic planning is an important part of the overall campus planning. At present, the planning and design of university campus roads refer to the planning and design of urban roads to a great extent, but there are some differences between the urban traffic organization and that of university campus. The intelligent transportation system needs the traffic state prediction of the road network, but most of the current traffic state prediction methods are single-section prediction methods, which seldom consider the relationship between adjacent sections. Only the simple sum of traffic conditions of each section can not reflect the spatial distribution of road network sections. In this paper, through the analysis and research of road planning and design and road traffic organization of university campus, an intelligent planning model of university campus road based on support vector machine (SVM) algorithm is proposed. The experimental results show that the errors of this algorithm are small, and the accuracy rate is high, reaching 92.84%, which is about 18% higher than the traditional algorithm. Therefore, this method can build a good campus humanistic environment and natural environment, and effectively reduce the interference of motor vehicles on students.

Keywords: University campus road; Traffic status; Intelligent Transportation

1. INTRODUCTION

In the overall planning of university campus, campus road planning is one of its important components. The road is the carrier for people to travel on campus and an important part of campus planning, and the quality of its planning and construction directly affects the quality of campus planning and construction [1]. Nowadays, the university space is expanding day by day, and the number of students, teachers and other related personnel to be accommodated is also increasing. The traffic modes accommodated on the road include motor vehicles, non-motor vehicles and pedestrian traffic, and different traffic behaviors are mixed with each other. With the implementation of the strategy of rejuvenating the country through science and education, the links between universities and society are getting closer and closer, the organization and functions of university campuses are constantly changing, and the planning and construction of campus roads show new features [2]. The theory and design method of campus traffic planning is an important part of the overall campus planning. With the continuous expansion of the space scale of university campus, the scale has been equal to that of some towns, but the theory and design method of transportation planning of university campus are missing [3]. In order to create a better learning and living environment for teachers and students, and solve the traffic problems caused by the internal travel of the university campus, it is necessary to formulate the traffic planning theory and design method suitable for the university campus according to the traffic characteristics and traffic demand [4].

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From the reality of the current campus traffic problems, the road construction and traffic management of the campus lag behind the development of the school, resulting in problems such as crowded roads, chaotic order and frequent accidents [5]. Chai et al. studied the layout planning of campus road traffic system from two aspects: campus road traffic and campus traffic organization [6]. Zhao et al. used the systematic design method of integrating campus space layout, environment construction and traffic organization, and put forward the relevant strategies for optimizing the layout of campus road traffic system [7]. Wang et al. discussed the features of functional planning and perceptual planning of campus roads in China by analyzing the traffic flow characteristics of campus roads. With the development of transportation technology, the cost performance of transportation facilities has been continuously improved [8]. It has become a reality to install a large number of traffic flow state parameter acquisition devices on roads. Obtaining the traffic state of road sections and analyzing and forecasting the traffic state in a short time are helpful to improve people's travel quality and give full play to the utilization efficiency of existing traffic facilities [9]. Through reasonable campus road planning, determining the direction of vehicles and people flow in the campus can reduce the hidden dangers of traffic safety in the campus, benefit the humanistic and natural environment of the campus, reduce the interference of motor vehicles on students and rationally divide the parking spaces [10]. In this paper, through the analysis and research of road planning and design and road traffic organization of university campus, an intelligent planning model of university campus road based on SVM algorithm is proposed.

2. INTELLIGENT PLANNING MODEL OF UNIVERSITY CAMPUS ROAD BASED ON SVM

2.1 Principles of road planning and design on campus

As a place for teaching and educating people, the campus needs to form its own unique environmental atmosphere. The campus road system should not only meet the traffic function, but also achieve the function of dividing each functional area. The reasonable layout of the road network structure is conducive to the clear division and clear structure of each functional area on campus. On campus, road planning will have an important impact on the traffic organization behavior of motor vehicles, non-motor vehicles and pedestrian traffic, the connection of different functional zones and campus culture [11]. A scientific campus road network can divide the campus into different functional areas with clear structure and clear division of labor, and ensure that different functional areas remain relatively independent and complete. At the same time, campus roads can effectively connect various functional areas, form a campus road network system, and improve the traffic rate of roads.

When planning the campus road system, reasonable traffic organization means and traffic management measures should be taken to ensure the traffic safety of slow traffic participants, especially pedestrians. At present, in the public space of college campus, the longest time for teachers and students to stay is the road, which is conducive to improving people's interpersonal communication and psychological adjustment ability. Therefore, the road has the function of public space. When designing, we can combine architecture with roads, change the wrong idea that roads only serve traffic, take the extension of roads as the shape of buildings, and introduce the landscape of roads into indoor semi-open spaces [12]. Under the condition of conforming to the overall campus planning and design, the campus road planning and design should fully consider the characteristics of campus road traffic, so as to meet the needs of teaching, scientific research and life in colleges and universities. At the same time, pay attention to the combination of the original topography and geomorphology, try to protect the original ecological environment, and realize the harmony between the artificial environment and the natural environment.

2.2 Intelligent planning model of campus road

Campus road planning is an important part of campus traffic planning, and it is the deepening of the overall planning of campus. The overall planning of the university campus is a coordinated and comprehensive deployment measure for the development goals, functional zoning, spatial layout, greening and landscape, road traffic and various constructions of the university campus in a certain period. The planning of campus road traffic system refers to the function of transportation of motor vehicles, non-motor vehicles and pedestrians among all kinds of land, groups and functional divisions in the campus, as well as various municipal pipelines in the campus [13]. The road is the carrier for people to pass through the campus and an important part of campus planning. Road in the campus is not only a channel to ease traffic, which constitutes the skeleton of campus planning, but also provides a channel for teachers and students traveling in the

campus to enjoy the scenery. Campus roads are different from urban roads, so the width and speed should not be pursued, and the safety of teachers and students should be ensured. When planning roads, we should follow the principle of "no obstruction, no crossing". When designing roads, we should fully consider the main functional attributes and service objects of the roads. The flow chart of campus road traffic forecast based on SVM is shown in Figure 1.

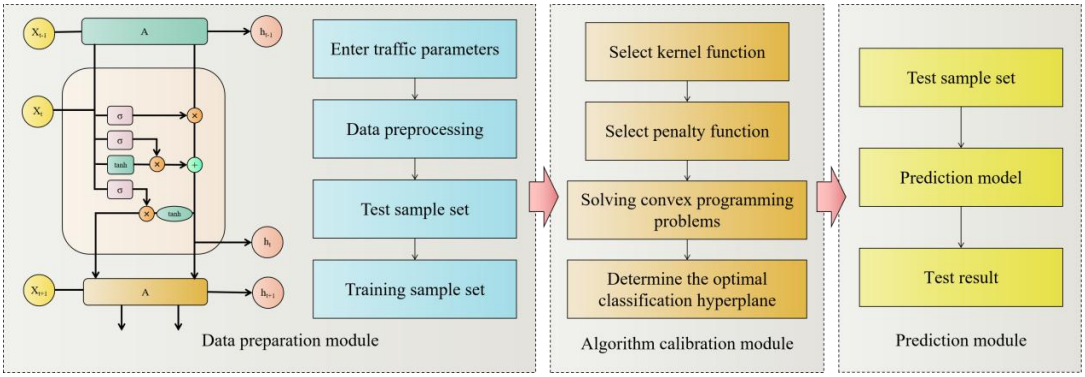

Figure 1. Campus road traffic forecast process based on SVM

The traffic flows of different sections in the same road network are interrelated in time and space, while the previous time series forecasting models only focus on the time series autocorrelation analysis of the data of each section, and seldom consider the information of other sections in the same road network. Only the single section forecasting method is used to independently forecast the traffic flow of all sections of the road network, which can't reflect the spatial distribution correlation of traffic flow of all sections. The framework of campus planning system is shown in Figure 2.

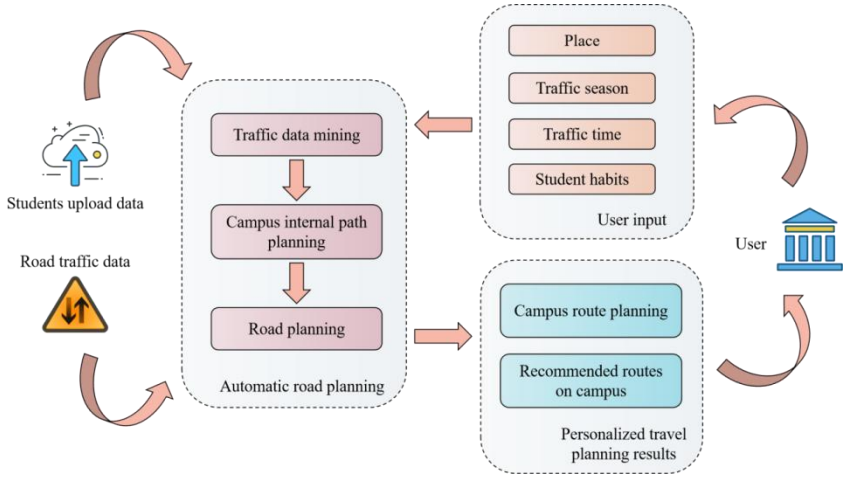

Figure 2. Framework of campus road planning system

The internal staff of universities is relatively single, with students as the basic group, followed by teachers and administrators. All kinds of people's transportation modes are also different. Students' transportation modes are relatively single, basically walking, and walking has the characteristics of flexibility, economy and aspects. The terrain in the campus fluctuates greatly, which is not conducive to the use of bicycles. In addition, for the sake of traffic safety inside the campus, students are prohibited from driving non-motor vehicles on the campus. The transportation modes of teachers and administrators are mainly motor vehicles and non-motor vehicles. Different types of personnel have different activity areas. Students' activity areas are concentrated in living areas, sports areas and teaching areas, and the communication among functional areas is mainly realized through internal roads. Teachers enter the campus functional areas from outside the school mainly through the outer ring road.

The optimal path planning of campus roads in reality requires many aspects of characteristic information such as node location, geometric length of road sections, travel time of road sections, and corresponding quantitative description data.

Abstract the real road network and establish the corresponding road network model. A road network model can be constructed as follows:

$$\begin{cases} G=(V,E,W) \\ V=\{v_i | i=1,2,\ldots,n-1\} \\ E=\{\langle v_i,v_j\rangle | v_i,v_j \in V\} \\ W=\{w_{ij} | \langle v_i,v_j\rangle \in E\} \end{cases} \tag{1}$$

Where V represents the vertex set; E represents the set of edges (road sections), and road sections $\langle v_i,v_j\rangle$ and $\langle v_j,v_i\rangle$ are two different road sections. W represents the weight set of road section E, and its attribute values can be selected according to different optimization objectives. The traffic form in campus is single-center gathering and divergent tidal traffic, and the traffic flow of people and vehicles on the road is easily excessively concentrated during peak hours, which is very easy to cause congestion. In the overall layout of the campus, it is considered that different teaching departments are arranged geographically separately, thus forming a number of teaching center areas, which makes the traffic appear scattered tidal. Time share refers to the ratio of the time spent by vehicles passing through a fixed road section to the total time:

$$\theta_{ij}(t)=\frac{1}{T}\sum_{k-1}^{N} t_k \tag{2}$$

In which $\theta_{ij}(t)$ is the time required for the node i and the node j to travel on the road in the time period t. t is the driving time interval, n is the total vehicle passing through the road section in the time period t, and t_k is the time when the vehicle passes the test point.

With the change of the scale of the university campus, it will have a certain impact on the travel mode chosen by the travelers on the university campus, and the change of travel mode choice will affect the travelers' demand for a reasonable road form in the transportation planning of the university campus. In the planning process of campus traffic system, the particularity of campus traffic should be fully considered. The peak flow of people and traffic during class hours is regular pulse type and single flow direction. It is best to set up multiple passages between the student living area and the teaching area to disperse the flow of people and ensure safety. The shortest path planning process of the campus road is shown in Figure 3.

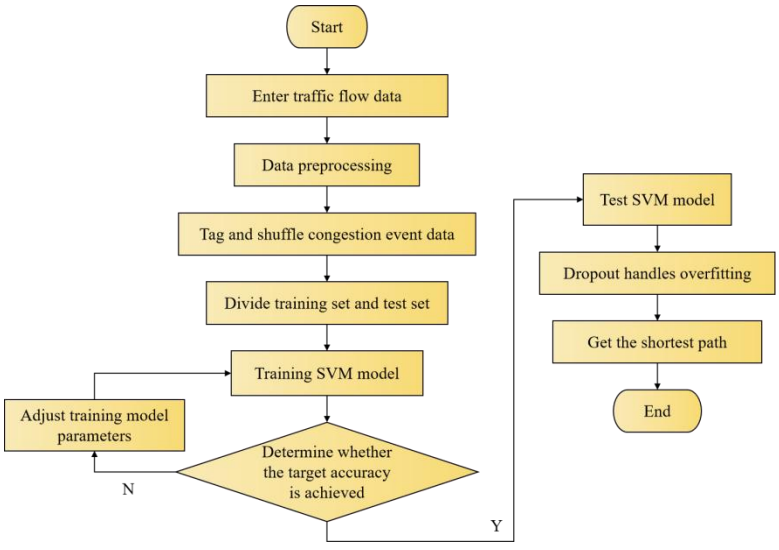

Figure 3. The shortest path planning process of campus roads

In campus road planning, there are many ways to calculate the travel time of road sections. Generally, the relationship between traffic flow Q, speed V and density K is mainly used to calculate the average speed:

$$V = Q / K \tag{3}$$

The driving time can be calculated by the average speed:

$$T = L / V \tag{4}$$

In the model, we can measure the relationship between time t, traffic occupancy rate $\theta_{ij}(t)$ on the research road section and average traffic density $K_{ij}(t)$ of vehicles running as follows:

$$K_{ij}(t) = \frac{\theta_{ij}(t)}{L_e} \tag{5}$$

In the formula, L_e is the length of the test vehicle, so it can be calculated that the number of vehicles $S_{ij}(t)$ passing in this time is:

$$S_{ij}(t) = L_{ij} \cdot K_{ij}(t) \tag{6}$$

L_{ij} is the length of the road section connected by node i and node j. The traffic planning of the university campus should be regarded as the core part of the overall planning of the university campus, and the development of the university campus should be reasonably guided by the traffic planning. That is, in the already tense area of the university campus headquarters, the road layout of the university campus and the corresponding traffic facilities should be reasonably arranged, and the functional zoning, spatial layout, greening and landscape of the university campus should be reasonably planned.

3. RESULT ANALYSIS AND DISCUSSION

As a road system, its constituent elements, roads and squares, are not independent of each other, but a five-phase interaction and mutual coordination. From the perspective of spatial form, roads and squares are connected in series, and there is not necessarily a clear boundary between them. From the functional point of view, at the same time, the local enlargement of campus road width can also have the function of square, while some squares only have the function of evacuating people and traffic. In practical application, the number of principal components is usually selected according to the accumulated variance. On the premise of ensuring the accuracy, the less the number of principal components, the better the training and testing of SVM model. The grading system of the campus should be a whole and coordinated system, rather than a simple positioning of grades. Especially in the special traffic environment on campus, the road classification system should weaken the concept of road grade and pay attention to the overall synergy of all kinds of roads.

The algorithm experiment is carried out under different transaction sets, and the error of the algorithm is shown in Figure 4. The accuracy of the algorithm is shown in Figure 5.

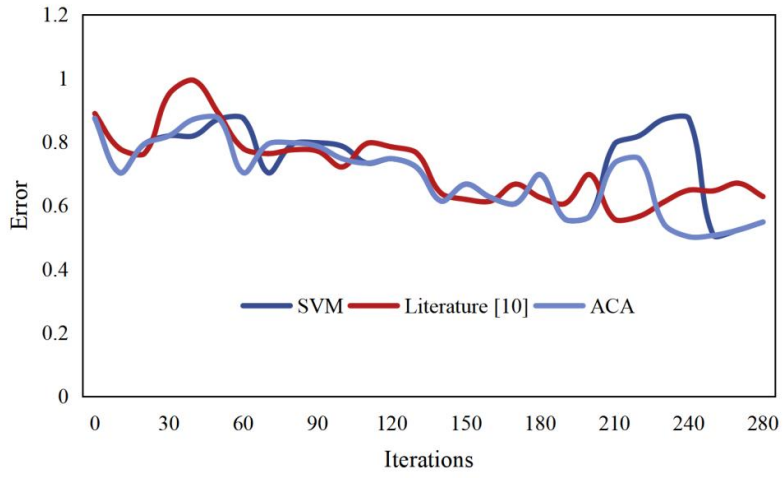

Figure 4. Errors of different algorithms

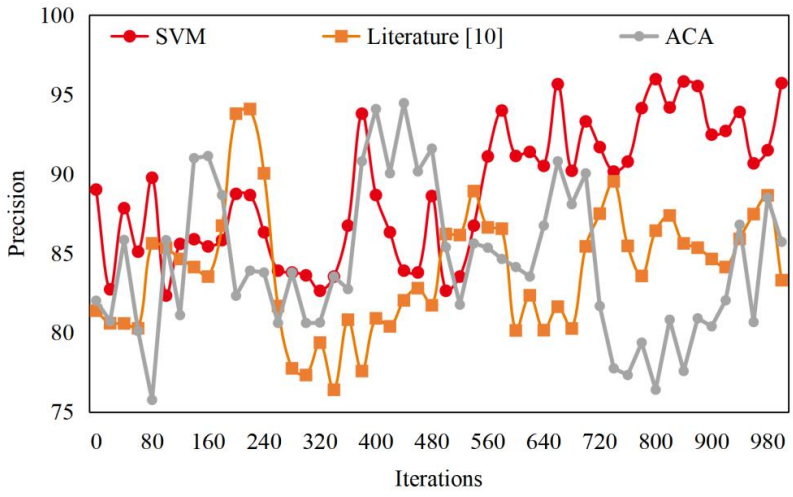

Figure 5. Accuracy of different algorithms

In the intelligent planning model of university campus roads, the traffic flow on each road section changes dynamically according to the change of time and space. Therefore, it is necessary to divide the road traffic network or inspection time into smaller intervals, and make the time interval as short as possible. The simulation results show that the error of this algorithm is small, and the accuracy rate is high, reaching 92.84%, which is about 18% higher than the traditional algorithm. When the problem becomes complicated, the possibility of finding the optimal solution by the algorithm will be reduced, so it is necessary to adjust the parameters in the algorithm. The traffic flow prediction method of SVM regression can be applied to the field of campus road prediction, and the results are reasonable and feasible, which will provide technical support for real-time short-term prediction of traffic guidance information service in campus intelligent transportation.

4. CONCLUSIONS

With the rapid expansion of the scale of university, it is very urgent for the construction of campus roads. With the development of large-scale campus road construction, the planning and design of campus roads, traffic organization and management, and ecological road construction have become an important content that must be solved in the process of campus road construction. The road is the carrier for people to travel on campus and an important part of campus

planning. The quality of its planning and construction directly affects the quality of campus planning and construction. The theory and design method of campus traffic planning is an important part of the overall campus planning. Based on this, this paper puts forward an intelligent planning model of university campus road based on SVM algorithm by analyzing and studying the planning and design of university campus road and road traffic organization. The simulation results show that the error of this algorithm is small, and the accuracy rate is high, reaching 92.84%, which is about 18% higher than the traditional algorithm. When the problem becomes complicated, the possibility of finding the optimal solution by the algorithm will be reduced, so it is necessary to adjust the parameters in the algorithm. Whether the campus planning is scientific or not is directly related to the travel safety and mood of teachers and students. Therefore, in the planning process, we must comprehensively consider various factors and pay attention to details, so as to get twice the result with half the effort.

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