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Implementation of Vehicle Traffic Statistics Algorithm Based on ViBe Image Processing

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Abstract: This project uses all kinds of main roads and intersections of UAV aerial photography cities to obtain information on traffic flow and real-time traffic conditions of various main roads, and feeds back information to unmanned airborne image processing devices through big data and clouds. The extracted image is processed and analyzed, and then a traffic flow safety prediction and evaluation model database based on road vehicle conflict is established.Through the analysis of the data, relevant departments can better plan the layout of traffic facilities on the road, so that the traffic facilities can be fully utilized, relieve traffic pressure, and reduce the incidence of traffic accidents.

1. Project Overview

1.1. Research Background
With the rapid development of today's cities, people's lives are increasingly inseparable from transportation, and the transportation industry is developing rapidly. It brings great convenience to people.Traffic congestion can be seen everywhere, and the number of traffic accidents continues to increase, leading to a series of social problems such as personal safety, economic losses and environmental pollution. In order to solve various problems in transportation, the early practice was to build a large number of roads, but this method can only alleviate various problems in transportation. Road capacity has improved, traffic congestion is still very serious, and traffic accidents are still increasing.

1.2. Research Purposes
In order to alleviate various problems in traffic, we use drones for aerial photography, image traffic to monitor traffic flow, understand traffic conditions, and use big data and cloud computing based on dynamic changes in traffic flow. Urban traffic flow prediction model. Timely hand over the results to the traffic management department, thereby reducing the probability of traffic accidents to a certain extent and reducing traffic congestion. Ensure safe driving and make full use of transportation facilities to make transportation economical.

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2. Feasibility Analysis

2.1. Design Ideas

The realization of traffic safety analysis of UAV monitoring vehicles based on urban roads is mainly to use the images collected by aerial photography, use vibe background modeling to obtain the number of target vehicles, establish a traffic flow safety evaluation prediction model, and use it in a certain area. Cloud computing, big data and other technologies establish a database of traffic flow safety prediction and evaluation models for intersections in Chinese cities. The analysis results will be handed over to the competent transportation department to facilitate relevant departments to carry out relevant management measures.

2.2. Background Modeling Algorithm Analysis

A method of moving object detection in a video image, the basic idea of which is to model the background of the image.Once the background model is established, the current image is compared to the background model, and the foreground target (the moving target to be detected) is determined based on the comparison result.

ViBe is a detection method proposed in this paper.The specific idea is to store a sample set for each pixel.Each new pixel value is then compared to the sample set to determine if it belongs to a background point.The model mainly includes three aspects: the working principle of the model; the initialization method of the model; and the update strategy of the model.

When selecting the sample values in the sample set to be replaced, we randomly select the sample values to be updated to ensure that the smooth lifecycle of the sample values is randomly updated.Assuming that the time is continuous, the probability that the sample value is not updated at time t is (N-1) / N, and then after the time of dt, the probability that the sample value remains is

$$P(t, t+dt) = \left(\frac{N-1}{N}\right)^{(t+dt)-t}$$

Can also write,

$$P(t, t+dt) = e^{-\ln\left(\frac{N}{N-1}\right)dt}$$

This means that the sample values are replaced in the model regardless of the time t, and a random strategy is appropriate.Figure 1 shows the image of our drone after shooting at a certain intersection of Jinzhai Road:

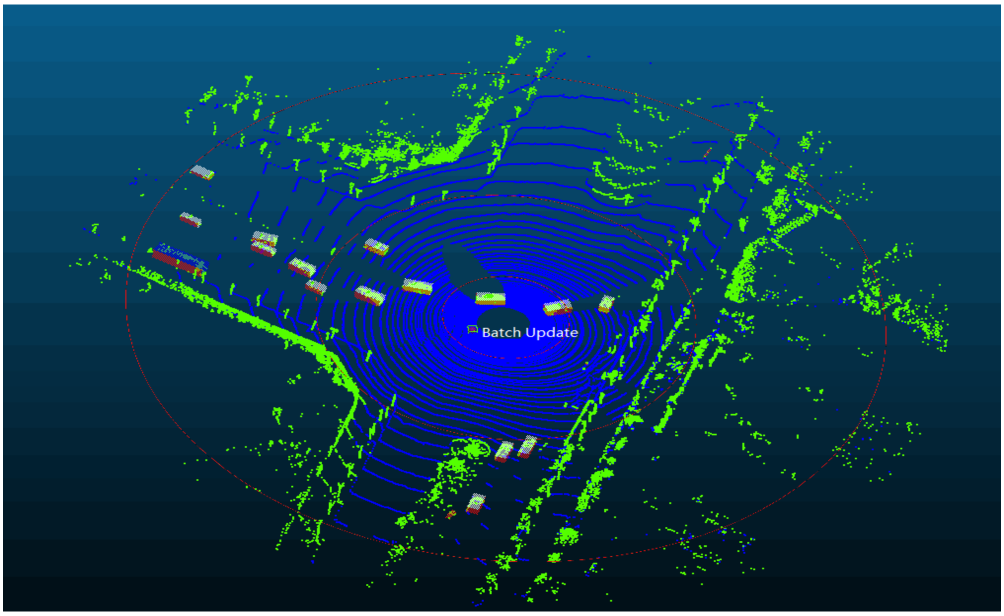

Figure 1. Image of the drone photographed at a certain intersection of Jinzhai Road

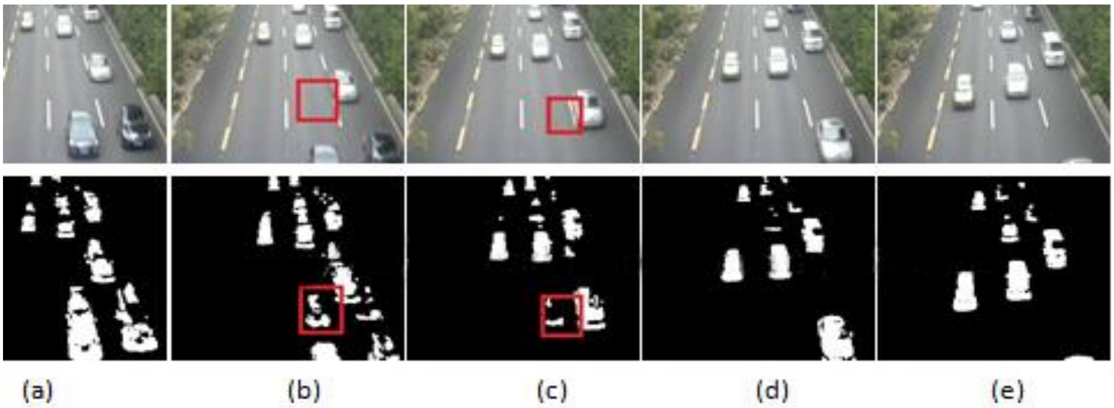

Figure 2. Traffic video foreground effects under Vibe algorithm: (a) frame 10 (b) frame 20 (c) frame 30 (d) frame 40 (e) frame 50

2.3. Traffic flow safety evaluation prediction model

After the image is collected to the number of vehicles, we can establish a traffic flow prediction model at this time.We simulate a regional road network, as shown in Figure 5. Each road grade (number of roads) is exactly the same for a certain period of time, with n cars starting at node 1 and destinations being node 0 (assuming there are no other vehicles in the road network during this time). During this time, the more vehicles passing through the road, the slower the vehicle will travel on the road.

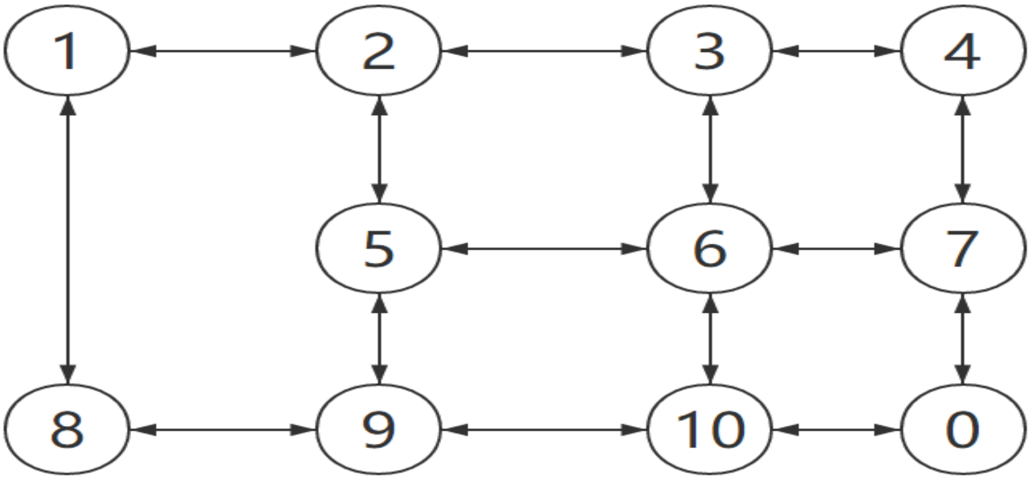

Figure 3. Traffic flow prediction model

The problem that needs to be solved is to correctly select the effective driving path and its algorithm, and to reasonably distribute traffic flow on each road. This method minimizes the total time which was taken for n vehicles traveling from nod 1 to nod 0.

2.3.1. Model Overview

(1) One-way traffic is unidirectional.

(2) The number of vehicles passing through the road segment is inversely proportional to the speed at which the vehicle travels on the road.

(3) The traffic density is uniform.

(4) Assume that n cars are turned on in a short period of time (the car is used as a quality point).

(5) The two branches of each cycle balance the time load.

2.3.2. Description of variables

The number of traffic from the Iim node to the n-node branch.

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The ti vehicle uses time from node m to n, Q traffic flow, v travel speed, L is path longitudinal length, 2L path lateral length, K inverse proportional coefficient.

ρ*t traffic density as a function of time.

2.3.3. Problem Analysis

There are many obstacles to directly optimizing the configuration of the transportation network, and we have some ideal treatments for this model.

First, we assume that the number of vehicles passing through the road segment is strictly inversely proportional to the speed at which the vehicle travels on the road segment, thereby eliminating the possibility of two-way traffic.For example, it is impossible to have 5 to 6 cars and 6 to 5 cars on 56 roads, because the more cars they drive, the slower they are. Therefore, in order to maximize speed, we can't give the car back space.

Then, because the graph has more "twigs", we use the traffic flow as the flow model(ie, it is impractical to integrate the traffic flow of each branch with time and find the best configuration). Therefore, we assume that traffic density does not change over time, which means that we consider the car as a qualitative point of analysis.

Finally, let us explain the focus of our model, which is hypothesis 5). In general, we can choose a loop (with loops for import and export).

We assume that, regardless of the probability, we must be able to increase the travel speed v of the path and increase the exercise time t by the path load I, which takes a short time to increase the time.And the path load I with long downtime causes the travel speed v of the path to rise, and the exercise time t decreases.Then there is always "time" in this dynamic change to achieve load balancing over time. And because, so the configuration of this static point is better than the original configuration. In other words, when the time load of two branches in one loop is unbalanced, we can always find the static point by adjusting the traffic load of the branch to balance the point load time.The original state time value is greater than the point time value. Regardless of the complex circuit network, we can always break down into links one by one.Therefore, we believe that all loops in the traffic network are optimally configured for time load balancing.

In the next model build, we will use our analysis hypothesis as the basis for mathematical modeling, and finally use matlab programming to solve the traffic optimization configuration.

2.3.4. Model establishment

For the optimal configuration of the network, first we define the following points:

Now we classify the linear equations of the traffic network on the basis of the optimal solution, and then solve the linear equation to get the optimal traffic load for the next segment. The linear equation consists of two parts (note: since the two branches in the open loop are hypothesized for the hypothesis 5), the time-line integral along the loop is necessarily zero. Then, for loops, you can use the loop theorem to list the equations.

From the knowledge of network graph theory, the effective node equation 9-1 = 8, the effective loop equation is 5, then the optimal load of 13 branches can be determined by the following 13 equations.

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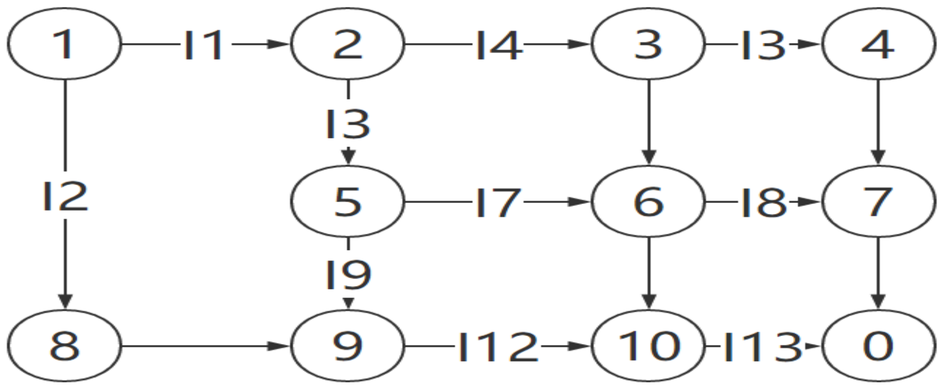

Figure 4. Road network effective path map

2.3.5. Model Solving
In order to better obtain the true flow between the various parts, the matrix operation is used to solve the linear equation. The results are as follows.

Among them, the 8 and 9 flow rates are all negative, indicating that the traffic flow direction is opposite to the predetermined direction, so 8 effective drives a.1-2-3-4-7-0 b.1-2-3-6-7-0 c.1-2-5-6-7-0 d.1-2-5-6-10-0 e.1-2-3-6-10-0 f.1-8-9-10-0 g.1-8-9-5-6-7-0 h.1-8-9-5-6-10-0

If the above traffic is allocated, the best traffic can be obtained.However, in the process of solving the actual solution, the result is found to be a decimal. However, the vehicle must be an integer, so there is still an integer programming problem in the solution process of the model.We provide a simple solution here: multiply each end of the branch (1, 2, 3, 6, 9) with several features and the scale factor corresponding to the front tree. This ensures that the input to the tree is an integer.In this way, when we simply surround the output, we can ensure that the number of vehicles is reasonable.Moreover, the comparison between the solution of the integer programming model and the theoretical value is close to one ten thousandth, so the model is accurate.

2.4. Cloud Computing Service
This project utilizes the Alibaba Cloud service to carry out cloud computing services, which facilitates the construction of a traffic flow safety prediction evaluation model database. Feitian was born in February 2009. It is a general-purpose computing operating system with Alibaba Cloud's proprietary rights and services to the world. At present, it provides corresponding network service services to enterprises and governments in hundreds of countries and regions around the world. Flying is designed to address the scale, efficiency and security of human computing. Feitian manages the Internet-scale infrastructure. The bottom layer is dozens of data centers and hundreds of PoP nodes around the world. The flying core runs in each data center.Support deployment and execution of distributed applications and automate failover and data redundancy.

3. Application prospects

3.1. Existing technology level
In the traffic field known to the public today, UAVs can achieve aerial surveys, control patrols, aerial exploration, search and rescue, rescue, rescue, special accident site surveys, traffic safety and so on. In short, a new perspective is added, along with analysis and application based on this. In the current market, the use of UAVs for observation of road traffic flow is only a reference for traffic flow research and control, and the level of application is relatively low.

3.2. Innovation points
The transformation of traditional artificial subjective conflicts into computerized automatic

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quantitative judgments saves manpower and material resources and reduces costs. The subjective error of manual judgment is avoided, and the accuracy of the judgment is improved by the computer instead of the artificial, so that the accuracy is greatly improved.

It can study the characteristics of traffic conflicts at various intersections and has a wide range of applications and practicalities.It is not only limited to one or several intersection traffic conflict features, it is convenient and quick to work, and greatly improves work efficiency.

Ability to analyze intersection traffic conflict characteristics from multiple dimensions.The functions are relatively complete, basically satisfying various incentives for traffic conflicts at intersections, conducting road detection in multiple directions and multiple angles, identifying hidden dangers of traffic conflicts in a timely manner, quickly processing and reflecting facts, avoiding traffic accidents, and improving road safety.

The evaluation model is accurate, and the solution of the planning model is compared with the theoretical value. The error is close to one ten thousandth, and it can be widely promoted, and it also has certain universality.

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