



Heterogeneity analysis of traffic information acquisition technology

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Abstract With the rapid development of science and technology, intelligent transportation system is an important part of traffic modernization construction, among which the most basic requirement is the real-time, accurate and efficient collection of basic traffic data. The collection of these data cannot be separated from the sensor and its related information collection technology. Therefore, the knowledge learned is combined, there are two kinds of traffic information acquisition methods, one is fixed type: ground sensor, image sensor, microwave radar sensor and geomagnetic sensor. The other is mobile: UAV, floating vehicle technology and GPS technology. The difference in the collection of traffic basic information is analyzed, and the future development trend is explored, which is conducive to the integration of traffic information acquisition technology and the rapid realization of intelligent road in the future, so as to solve the problems such as backward traffic service level in China.

Keywords Intelligent transportation; Information collection; Sensors; Technical application

1. Introduction

In the era of rapid development of information technology, intelligent transportation has become the focus of the world. With the rapid development of 5g technology, the technology of vehicle networking is becoming more and more mature. Once again, smart road has been successfully implemented. Since 0:00 on March 19, Shaoxing City's first smart expressway, which is officially opened to traffic on Yueyue expressway, is the first cooperative automatic driving Expressway in China, in addition, the whole section will be patrolled by automatic UAV at regular intervals. It can be seen that intelligent traffic cannot be realized without the combination of traffic information acquisition technology. Under the influence of new crown pneumonia, intelligent transportation plays a great role in reducing the contact of people. The advantages of sensors are that they can meet the requirements of long-distance data transmission, flexible structure and low cost [1].

Combined with the types of sensors, the current road sensors can be divided into three categories: traffic data collection, road condition collection and surrounding environment collection. Traffic data acquisition is the earliest and the most basic. This kind of sensor mainly collects the real-time information on the road section, and then supplies it to the driver and traffic management department so that they can better grasp the traffic information of the road section and make reasonable planning, so as to ensure the smooth and safe operation of the vehicle on the road section. With the development of traffic information acquisition technology, the corresponding sensors are increasing. There are security problems in laser sensors, and infrared sensors will cause harm to human eyes [2]. Therefore, they are not widely used. This study aims at the difference analysis of



the two kinds of typical traffic information acquisition sensors, the principle, application status and characteristics of the technology, And the future traffic information collection technology trend is explored.

2 Fixed Type

2.1 Ground coil sensor

For the sensor of ground sense coil, the vehicle is detected by using the principle of electromagnetic induction. The car itself can be understood as a magnet, which embeds the ground sensing coil into the ground to form a magnetic field. When the car passes through the magnetic field, it will cut the flux line, and the change of coil electric quantity will be generated, so that the frequency and phase in the oscillating circuit will change. The parameters such as vehicle spacing and speed are calculated according to the variation and the time interval between signal generation and end [3]. Generally, two groups of ring coils are used as sensors to collect and analyze the vehicle information in the detection area, which can accurately calculate the parameters of vehicle flow, average speed and average vehicle spacing, and also can take some characteristics of the vehicle, but the difference is difficult. In the field of traffic information acquisition, the ring ground coil has the advantages of high detection accuracy and low cost.



Figure 2.1: Ground sense coil

Of course, advantages and disadvantages are necessary. Its disadvantage is that this embedded equipment often embeds into the ground, which will inevitably cause damage to the road surface. When the equipment fails, it will be removed again, and it will cause secondary damage to the pavement, not only affect the appearance of the road surface, but also affect the service life of the road section. In view of this problem, some companies have designed the patented products of surface mounted coil sensor, which does not damage the laying mode of pavement, especially suitable for the detection of comprehensive parameters of highway traffic flow. The problem of pavement damage and product repair is solved effectively.

2.2 Image sensor

Video image sensor is mainly used to collect traffic information by installing cameras at road sections or intersections, and then using image processor to transform traffic information. At present, the development of these sensors has a certain degree of maturity, and it is widely used in the field of traffic information collection. Specifically, this technology has the advantages of convenient and flexible installation, high operation efficiency, wide monitoring area and no damage to the road surface. It can extract parameters such as traffic flow, lane occupancy and congestion. It can also automatically detect and identify license plates, take illegal photos, and collect and alarm all kinds of traffic abnormalities in real time, in addition, the video sensor can replace the ground induction coil buried in the road, reducing the damage to the road.



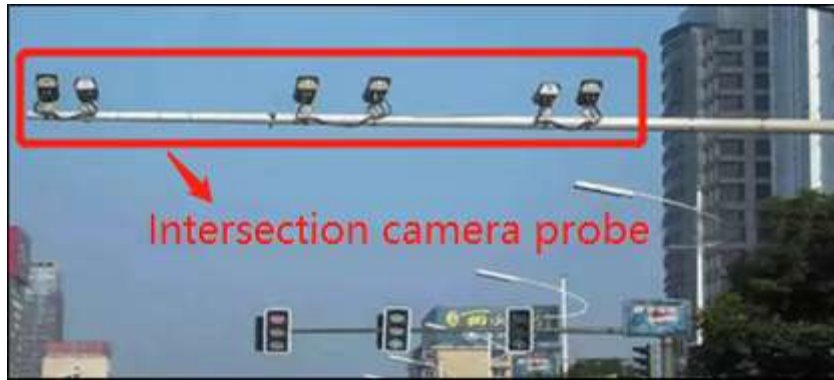


Figure 2.2: Intersection camera probe

Of course, there are also disadvantages, that is, the cost is high and it is easy to be affected by the weather, such as heavy fog, snow, storm and so on. It is easy to cause lens blur and equipment damage, making it difficult to accurately identify and extract traffic information data such as traffic flow and speed. With the development of traffic technology, image sensors are often used in combination with radar, to make up for this defect.

2.3 Microwave radar sensor

Based on the principle of Doppler effect, the electromagnetic wave of a certain frequency is transmitted through the radar, the wave reflected by the target is received, and the information of the vehicle is detected according to the echo. The main advantages of microwave radar sensor are reflected in three aspects: first, it has excellent performance under bad conditions, second, it can directly detect the speed, and third, it will not cause damage to the road. At present, the United States has MTD (Microwave Traffic Detector) microwave traffic detector, which is mainly used to collect traffic parameters of expressways, urban expressways, ordinary highway traffic flow survey stations and bridges, and provide real-time information such as traffic flow, speed, lane occupancy and vehicle types.



Figure 2.3: Millimeter wave radar

In the process of traffic information collection, radar combined with high-speed camera is the mainstream configuration, such as the mine vision fusion machine. The mine vision fusion machine is a new generation of intelligent sensor specially designed for vehicle road cooperation. It is a traffic sensor integrating camera, millimeter wave radar and high-performance processor, which can effectively meet the requirements of speeding photography. At the same time, it can also effectively meet the requirements of dynamic information acquisition such as bayonet capture and road speed measurement. Therefore, if only microwave radar is used for detection, there will be some technical limitations, such as the occlusion of multiple workshops and low-speed movement, which will have a great impact on the actual measurement.

2.4 Geomagnetic sensor

The geomagnetic sensor can detect the vehicle information by changing the magnetic field intensity by moving vehicles entering the magnetic field, and then converting the change into the more easily observed electrical signal. As the most common road vehicle detection method, geomagnetic sensor has the characteristics of small



volume, high precision, easy to install, and small environmental impact, simple maintenance, low power consumption and long service life. Compared with the ground sensor coil, it has a high advantage, especially in line with the data collection of fixed section [4].



Figure 2.4: Geomagnetic sensor

Considering the rapid development of Internet of things technology in China, the application scope of geomagnetic sensor is showing the advantages of gradual expansion, which can effectively meet the corresponding dynamic and static traffic supervision system. For example, in Wuhan Donghu tunnel project, by combining with ZigBee technology, the traffic information such as speed, traffic flow and road occupation time can be effectively monitored and measured, so as to meet the requirements of vehicle operation. From the data of 2013, the utilization rate of geomagnetic sensor at traffic signal intersection has reached about 10% - 15%, and it shows a growing trend year by year.

3 Mobile

3.1 UAV acquisition technology

UAV was first used in military field. With the opening of technology, UAV has also been used in civil field, especially in traffic information collection and traffic monitoring. UAV is usually equipped with cameras and sensors, which can collect information on the ground traffic in the air. Compared with the common video acquisition technology, UAV has its own remarkable characteristics.

In case of traffic accident, UAV can quickly arrive at the scene for photo collection. The traditional accident handling needs traffic police to receive police before it can arrive at the scene. Among them, it may take more time to deal with the accident due to traffic congestion, partial location and other uncontrollable factors. At this time, UAV without ground interference plays an important role. It can reach the accident site first, then guide the accident vehicles on site, evacuate the congested vehicles as soon as possible, not only saves police force but also saves time.

In case of traffic jam, UAV can acquire dynamic traffic in real time and transmit information to traffic control center, and then control center can timely handle and guide it. General information collection is limited by geography, setting and other conditions, so it is unable to collect traffic information in time. Therefore, UAV plays a key role in monitoring the blind area of vision. With the aerial perspective of UAV, the traffic distribution on the road can be obtained more comprehensively and widely to facilitate the regulation of congested sections. In addition, the traffic flow of sections can be monitored to study its law and provide data support for traffic guidance.

The advantages of using UAV as traffic information acquisition are: (1) wide detection perspective. Compared with ordinary image sensors, UAV has higher height, wide aerial view range and more traffic information data. (2) Flexible shooting perspective. UAV can change the shooting location and angle at any time to capture important traffic information in time, which is more flexible than traditional information acquisition technology. (3) High work efficiency. The UAV can reach the area to be detected at the first time and capture the information the operators want in time, which not only saves the cost, but also saves the time.

Of course, it also has some disadvantages, such as (1) the UAV itself is small and lightweight, which is very vulnerable to the weather and cannot be used normally in windy, snowy and foggy weather. (2) In multi



building areas or some places, UAVs are vulnerable to signal interference, such as WiFi and other signals, which is easy to cause "aircraft explosion".(3) There are higher technical requirements for operators, because the price of UAV itself is relatively high. Once human operation error, it will cause economic losses.

3.2 Floating vehicle technology

At first, buses and taxis were often regarded as the main objects of floating vehicle technology practice [5], because at that time, buses and taxis were the most commonly used public transport tools. They shuttle through the main roads, secondary trunk roads, branches, expressways and urban and rural roads in the city. Positioning devices are installed on the vehicles to obtain the traffic information of the city and between urban and rural areas at any time.

The main process of floating vehicle information acquisition is: the vehicles traveling on the specified road network are equipped with GPS positioning device, and the position, speed and direction information of the vehicle are recorded regularly according to the positioning device. The data acquisition system converts the format of the collected data, and finally transmits the converted information to the control center, and receives the instructions of the control center. Finally, the speed and traffic congestion of the road passed by the floating vehicle are obtained [5].

Although floating car technology can reflect certain traffic information, with the improvement of people's living standards, people's travel choices have increased accordingly, such as the surge in the number of private cars and electric vehicles, which have brought great pressure to the road traffic system. However, the installation of positioning system is not mandatory, Therefore, it can not accurately provide traffic information on the road. However, it can be used as an experimental method. For example, the green wave traffic on a main road can be designed, and the parameters such as vehicle speed and signal timing can be calculated by using the floating vehicle method.

3.3 GPS Technology

GPS is an omni-directional, real-time and dynamic positioning navigation satellite system, which is deeply favored by the transportation field. It is mainly to install GPS receiving devices on vehicles to record the three-dimensional position coordinates and time information of vehicles at a certain sampling interval [6]. At present, mobile positioning is more widely used, and its main advantages are low cost and wide coverage. The basic principle is to use the information interaction between the mobile phone and the base station to determine the location coordinate information of the mobile phone, and estimate the travel speed of the outlet section through path matching [7], through the software on the mobile phone. For example, application software such as Gaode navigation and Baidu map can not only determine their location and the destination they want to reach, but also monitor the road traffic information in real time, because at the same time of information interaction, they can also send their location information to the base station, which sends the information to the software, which can reflect whether the road is crowded, It is convenient for the driver to choose the optimal path.

In addition, it can also use open software to match the signal lights at the intersection in real time. For example, the software just developed by Zibo: Zibo travel, its function is to enable the car to drive according to the induced speed of the software when passing through the continuous intersection, and reasonably control the speed when passing through the intersection, which is not only conducive to reducing traffic accidents, it is also conducive to energy conservation and emission reduction, and improve the fuel economy of the automobile.

4 Future development trend

Through the analysis of the above principles and application of traffic information collection methods, combined with the application of current traffic information acquisition technology, although there are many kinds of traffic information collection methods at present, under the influence of specific working conditions and other subjective and objective factors, each collection technology will have its own shortcomings and advantages, Especially in the process of intelligent development of traffic system, there are some problems, but from the current application value, it has a certain development space, mainly reflected in the following aspects.



First, it is of high sensitivity, more durable and micro type. In the development of intelligent transportation system, the detection of traffic information needs higher sensitivity, stronger durability and smaller size structure [8]. High sensitivity reflects the processing capacity of sensors. The higher the sensitivity, the more accurate the traffic information is collected. The durability response is the long service life of the sensor, the maintenance cost and the stability of the equipment after the external environment interference. The smaller size structure is convenient for the sensor installation. Therefore, in the future intelligent transportation development process, the sensor should pay attention to its small size, more durable use, and higher sensitivity [9].

Second, we should break through the bottleneck of foreign technology monopoly and increase investment in domestic technology. At present, there is a huge development space for domestic intelligent transportation. The domestic sensors should meet the requirements of the times at home and abroad. At present, most of the domestic markets are mainly foreign European and American developed countries. This will limit the application of sensors. In order to further realize the breakthrough of technical barriers and better meet the requirements of the current rapid development of our country's highway, We must keep pace with the times, better integrate foreign technology into domestic production technology, on this basis, further improve the quality of products, create products belonging to the Chinese people, and better and faster to realize the construction of intelligent road.

Third, we should pay attention to the integration of various sensors and information acquisition technologies. With the advent of intelligent and information age, 5g, cloud computing, big data, vehicle networking and other technologies are integrated. The connection between people, vehicles and roads is closer and information exchange is more convenient. Intelligent roads will be popularized in the world. To provide more road traffic information for people and vehicles, this is how sensors and technologies are integrated [10]. Various traffic information collection technologies will have their own advantages and disadvantages, and the installation location and environment are also different. Therefore, different technologies focus on different collection information, which requires the integration of multi-source information to complement each other, so as to achieve the purpose of better traffic information collection, such as the collection of accident scene. By combining multiple sensors and collecting traffic information more accurately, we can reach the standard of intelligent development road and lay a solid foundation for future traffic information collection technology [11].

5 Conclusion

Through the above analysis and application of various sensors and information acquisition technology, the acquisition of traffic information data is the basis of realizing intelligent road, so it is a very important content. Traffic information acquisition technology is developing continuously. From a single sensor to the current UAV technology, the technology is constantly innovating and developing. Although the current traffic information acquisition technology has its own advantages and disadvantages, it can learn from each other, realize multiple combination and give greater play to its role, realize the accuracy and real-time dynamics of traffic information collection. Intelligent roads serve people's life. Only by paying attention to the development of intelligent roads and improving the standard of traffic information collection, can we better meet the needs of the development of intelligent cities.

In recent years, emerging information technologies such as the Internet of things, the Internet of vehicles and cloud computing have promoted the rapid development of intelligent transportation. For example, the "vehicle road coordination technology" is constantly maturing and practicing, and intelligent transportation is moving towards the four major goals of "digitization", "intellectualization", "Networking" and "coordination", Only by paying attention to the research and development of information acquisition sensors and the integration of acquisition technology can we better promote the development of urban intelligence.

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