Design of Intelligent Transportation System Based on the Technology of Information and Communication Engineering

Zhou Yuan, Miao Yao Feng*
Xi’an International University Modern Education Technology Center, Xi’an, Shanxi, China
*Corresponding author, e-mail: shifu396719@yeah.net

Abstract

With the development of social economy and city urbanization, city road traffic network has developed rapidly, great convenience for people’s travel, but also led to a sharp increase in traffic demand. The direct consequence is the rapid expansion of traffic flow, traffic-jam, the city has becoming increasingly serious, frequent traffic accidents. The worsening traffic environment has become a global problem. As a very important means to solve the problem of global transportation, intelligent transportation system (ITS) with real-time, efficient, accurate analysis, processing and control ability has won great recognition, has make a spurt of progress of development. Traffic information detection technology is an important part of the intelligent transportation system, has the abilities of real-time data acquisition, analysis, processing and distribution of a wide range of road network traffic data information, has gradually become the traffic administrative department of the daily traffic management activities and the important fields in traffic research work. The traffic information collection technique not only can effectively help the traffic management and law enforcement, and to provide basis data for future traffic planning. The introduction of laser technology, it will play an important role in the development of traffic detection techniques play. The integrated use of communication engineering, information engineering theory of traffic detection technology and data processing technology of two parts together in the intelligent transportation system, and put forward comprehensive traffic information acquisition platform based on laser scanning data to design a can detect multiple objects and provide a lot of traffic information data. This platform has the advantages of simultaneous running speed detection, traffic detection and vehicle recognition module, and processing the detected data, the establishment of the database at the same time, to realize the data acquisition and processing function diversification.

Keywords: intelligent transportation system, traffic detection technology, speed detection, traffic flow statistics, vehicle recognition

1. Introduction

With the process of urbanization gradually accelerate the development and improve the level of social economy, the auto penetration rate has been greatly enhanced, and the traffic demand, urban traffic congestion is increasing, the incidence of traffic accidents, air and environmental pollution worsening. This has become a global traffic problem, not only in developing countries, developed countries is also under this kind of problem. According to the forecast, American relevant departments to 2020, America due to traffic accidents caused economic losses each year will be more than $150000000000, while Tokyo at present because of traffic jams caused by the annual economic loss of about $123000000000. It is well known that the traditional solution to this problem is the construction or expansion of existing roads, improve road network capacity, but with the urban population growth, declining per capita living area, all cities are faced with limited space for the construction of roads, difficulties in raising funds for construction. Moreover, the traffic system is a comprehensive system and complex, if the two aspects of the vehicle and road are considered independent from it is difficult to effectively solve the traffic problem fundamentally. In addition, the increasingly serious energy and environmental issues are also gradually paid attention to. In this context, from the view of system, the vehicle and road links into consideration, the integrated use of current technology to solve the traffic problems of the system thought emerge as the times require, this is the intelligent traffic system (Intelligent Transportation System, ITS or ITS).

ITS is a comprehensive transportation management system in a real-time, efficient and comprehensive. Speed, vehicle and traffic is the main dynamic parameters of intelligent traffic
information acquisition system detection, accurate knowledge of these parameters can make the signal control of traffic scheduling effectively, so as to ensure the efficient circulation of the whole traffic system. At the same time, timely, accurately grasp the speed, traffic volume and vehicle traffic information for the road traffic prediction to improve the long-term planning of basic data, and has great guiding significance.

As part of ITS, the current traffic detection technology commonly used at home and abroad are for different test objects were independently designed and used, if the design of a system can be integrated to detect each object, the integrated use of communication engineering, information engineering theory in RRs traffic detection technology and data processing technology two most combined, which not only reduces the complexity of traffic data detection, but also saving due to different object detection system for construction and increase the construction cost, more conducive to improving the application effect of the intelligent transportation system. The guide of this idea and proposes a comprehensive traffic data detection system based on laser scanning data, it can also run the speed detection, traffic detection and vehicle recognition module, and processing the detected data, and establish the database, realize the data acquisition and processing function diversification.

2. The Development of Modern Information Technology and its Main Inspection

The current development situation in the world and the trend of intelligent transportation system, traffic information detection, data analysis and processing has become the traffic administrative department of the daily traffic management activities and an important part in traffic research work. The world has many large and medium-sized city traffic management departments have the ability of real-time acquisition, analysis, processing and distribution of a wide range of road network traffic data information. For the government of the traffic management department, accurate, timely and reliable ability to obtain traffic information data and based on these data, a reasonable analysis and correct treatment can make accurate decision support information has become increasingly important. From the traveler's perspective, to reflect the needs of more and more traffic in real time is able to obtain accurate traffic information on the road network [1].

In recent years, with the rapid development of intelligent transportation system, the current number of large and medium-sized city in China has been completed or are establishing traffic information detection, dynamic data analysis and processing system, the construction of dynamic network traffic information detection system has already begun to take shape, some of the traffic research institutions and enterprises, and institutions have launched the core technology of traffic information detection and related equipment, facilities, research and development. However, the current development status of traffic detection technology in the field of intelligent transportation, the current application is the dynamic traffic information detection equipment widely used mostly products imported from abroad, in the dynamic traffic information data processing field and lack of mature and practical technology. Therefore, the key equipment at present in our country as soon as possible to develop the dynamic traffic information data with independent intellectual property rights of the detection, analysis and processing system and related technology is necessary, so as to meet the growing traffic information services and traffic monitoring and management and other aspects of the practical needs.

2.1. Information Detection Equipment

Along with the construction and development of the road network, using the traffic detection equipment has been developed rapidly in recent years. Traffic detection equipment is an important part of the road network traffic control and management activities, is the main tool of acquisition, detection of traffic flow data. It is based on the measured road detection technology and traffic information data by means of monitoring equipment real-time access to a variety of road traffic flow, vehicle speed, traffic density and vehicle occupancy control system design and calculation of traffic information data. The traffic information data collection traffic detection system to obtain the local control system of the traffic management department or remote monitoring center computer system through appropriate communication techniques and related equipment and rational analysis, the processing, mainly on the basis of judgment, then as a control information and put forward the control scheme of [2-5]. Thus, the overall operation
of the road traffic control system's work efficiency and management level of the device depends on the detection system of traffic on the road traffic information detection ability and level of its detection technology.

Due to the relatively mature and the application of the relative stability of the fixed type, section of the traffic information data acquisition testing equipment is currently the world's most dynamic traffic information detection data acquisition equipment widely, and will be in for a long period of time is as the main equipment of [6] dynamic traffic information data the detection of acquisition.

The traffic detection equipment is the traditional loop detector contact, this device uses the loop device embedded in the measured along the road and the installation of traffic arteries in a certain distance in the vicinity of the camera to obtain traffic information data, and control information center data to detect and capture the picture sent to the traffic management department of analysis, processing and judgment, so as to carry out proper traffic management and provide accurate information for decision support. At present, the coil loop detector in electronic amplifiers has been standardized, mature technology, and easy operation, high detection precision, at the same time, the construction cost is relatively low, so far the most widely used. However, loop detector construction form is too single, at the same time as the main component of the induction coil is embedded in the roadway pavement need, so that its flexibility has been greatly affected, for the construction and commissioning of construction personnel work to bring a lot of inconvenience, the road opened, will not only affect the normal use of the road maintenance the work, but also bring risks to the safety of maintenance personnel. And when the measured subgrade instability or adaptability will transform the frequent induction coil decreased obviously. In addition, the induction coil is susceptible to freezing, roadbed subsidence, salinization and other natural environment, therefore, the induction coil life is generally not more than two years, some special road area roads and even less than a year, this causes a lot of damage on the road, the number of failures of loop detector in half, it is difficult to meet the real-time traffic and road network analysis traffic information on dynamic traffic data needs. Therefore, it is necessary in the field of road network traffic information detection data traffic non-contact detection technology is the. Traffic detection equipment non-contact without direct contact with the pavement in the construction, convenient installation, flexibility and adaptability is improved obviously, and the original advantages of contact detection technology combination, complementary functions, two kinds of technology optimization, dynamic traffic data will make the road traffic network detection more accurate in accordance with comprehensive.

2.2. Comparison of Detection Equipment Information

Currently applied in the intelligent traffic system of traffic detection technology for a wide range of equipment, the basic working principle of testing equipment of different equipment, various properties and characteristics are very different, each have advantages and disadvantages, object oriented detection are very different, so when used to comprehensive consideration, careful selection of traffic detection suitable equipment. At present, the traffic between the equipment evaluation standard main equipment performance, type of data acquisition, test results accuracy, influencing factors and installation, maintenance conditions and other aspects of [7].

The basic working principle of various traffic detection equipment based on the different, while the introduction of the development of the traditional technology and the new technology of sound detection equipment has great driving force; therefore, the performance of various traffic detection equipment is different, very different, as shown in table 1.
Table 1. All traffic information detection equipments performance

<table>
<thead>
<tr>
<th>Detection equipments</th>
<th>Advantage</th>
<th>Shortcomings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave radar detector</td>
<td>To play a good performance in bad weather conditions; direct detection of vehicle speed, and can be used in detecting multi lateral lanes.</td>
<td>Unable to detect static or low speed vehicles; only in the way forward through the directional antenna tracking vehicle</td>
</tr>
<tr>
<td>Infrared detector</td>
<td>In the night work can use the same algorithm, which solves the problem of the circadian transformation; can provide a variety of traffic information data</td>
<td>High requirements for infrared focal plane detector, also is used to improve the power, reduce the reliability to achieve high flexibility</td>
</tr>
<tr>
<td>Ultrasonic detector</td>
<td>Small volume, easy to install</td>
<td>Effect of performance will be affected by the environment, climate, temperature decreases</td>
</tr>
<tr>
<td>Loop detector</td>
<td>The coil has standardized electronic amplifiers; mature technology; easy to grasp; precise counting</td>
<td>Great influence on reliability and performance of the installation process; maintenance and installation will destroy the roads, traffic interruption, affect the pavement life; easy to be heavy vehicles, road maintenance and other damage</td>
</tr>
<tr>
<td>Magnetometer detector</td>
<td>Detection of small vehicles, including bicycles; suitable for installation inplaces with inconvenient loop; Can provide a visual image for accident management; provides a variety of traffic information data; single camera and image processor can detect multiple lanes</td>
<td>It is difficult to accurately distinguish the longitudinal too compact vehicle; Large vehicle occlusion, shadow, reflection and transformation of waterday and night may affect the detection accuracy</td>
</tr>
<tr>
<td>Video detector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3. The Direction of Development of Information Detection Technology

Traffic detection technology to the rapid development of computer, communication technology, sensor technology and artificial intelligence technology, driven in recent years obtained rapid increase, has been widely used in road traffic network construction and city traffic monitoring field.

The sensor is an important component of traffic detection equipment, the development of traffic detection equipment is based on the development of the sensor technology as the basis, to greatly improve the performance of traffic detection equipment will start from the development of sensor technology. For the traffic detection equipment detection by electromagnetic induction, the sensor is composed of detector probe and signal processing device, in order to improve the performance of this type of testing equipment to improve the reliability and the signal processing device life detector probe. For the traffic detection equipment to detect the wave frequency, the equipment performance testing equipment is mainly reflected in the accuracy and anti disturbance ability, this kind of traffic detection equipment easy to install and easy maintenance, so it has good prospects for development [8-10].

On the basis of the development of intelligent transportation systems, and artificial intelligence and more advanced calculation methods combined, finally realizes the intelligent traffic detection equipment, system and photoelectric integration. At present our country on the basis to promote the intelligent traffic management has already realized the induction coil traffic flow detection system based on intelligent traffic detection technology, the microwave remote sensing and fixed with far infrared technology camera detection system, intelligent system and photoelectric integration traffic detection equipment based on [11,12].

With the development of computer vision technology and image processing (ComPuterVision) technology has become more mature and progress, have now been introduced automatic vehicle detection and identification of road traffic accidents forecasting field, and become a hot research direction in the technical field of traffic detection. In vehicle automatic identification system, 3D data of the detected data by analyzing and processing of computer vision and image processing technology to obtain the measured traffic detection equipment which can not be detected before the traditional vehicle axle number, wheelbase,
track and appearance and composition of traffic parameters such as vehicle. The core problem of video traffic detection equipment is real-time and accuracy of image recognition technology, which is currently the research hot issues. Is now at the stage of research and development of the road traffic accident forecast technology based on image processing by computer vision technology, neural network, fuzzy logic technology and the integration of more advanced calculation methods for traffic accident detection, vehicle recognition and road traffic monitoring, traffic information parameters using this technology can not only obtain the road traffic flow, vehicle speed, road space occupancy and vehicle moving degree of importance, but also according to the real-time analysis, processing of these parameters to predict and find the traffic accident. The introduction of traffic video detection technology based on image processing, computer application and optical fiber communication technology, information processing technology and artificial intelligence technology, will become an important driving force of development to large-scale, comprehensive, intelligent and real-time traffic detection technology.

3. Research Method

3.1. The Overall Design of Information Collection Platform

Through the information acquisition platform is mainly composed of a laser scanning system, data communication system, data processing system and data storage system. The overall architecture is shown in figure 1.

![Figure 1. Diagram of traffic information acquisition platform](image)

The laser scanning system using laser scanner LMS200 produced by Germany SICK company. In the data communication system in order to solve the problem of data packet loss phenomenon in a large amount of data transmission in serial communication, the system uses the RS 422 standard, and at the same time, the use of high-speed serial interface matched with the LMS200 card is connected with the local computer. A data processing system by using the detected data, and get the traffic flow, vehicle speed and vehicle type data of traffic information parameters through the innovative algorithm, when the detected traffic violations will trigger the camera capture. The data storage system will not only the data obtained from the detection parameters are stored in the database, and can also be traffic violations to capture images stored in the database, as the traffic law enforcement evidence.

3.2. The Functional Architecture of Information Collection Platform

The design of traffic information collection platform mainly includes the data traffic information collection, traffic violations and data capture information storage function. The traffic information collection function mainly includes the traffic flow statistics, vehicle speed detection, vehicle type recognition function. The traffic information collection platform architecture is shown in figure 2.
3.3. The Realization of Information Collection Platform of Each Functional Module

The traffic information collection platform data collection is mainly composed of traffic flow, the three basic elements of vehicle speed and types. Usually, complete the vehicle type recognition can be directly obtained the basic data of traffic flow, therefore, detection equipment working actually needs to identify the calculation and type of vehicle driving speed of two to complete the inspection work. The basic principle of the traffic flow statistics is the height curve of motion object detection of road surface. The basic principle of vehicle type recognition is the identification of vehicle longitudinal peripheral contour. The basic principle of vehicle speed detection is the use of the vehicle through the probe before and after the time difference and distance calculation speed forward.

3.4. Implementation of Integrated Information Acquisition Platform Algorithm

The basic principle and algorithm of the modules can be seen, the detection of traffic information acquisition platform in the traffic flow, vehicle speed and vehicle type, in the statistical work can be completed in the process of vehicle recognition of traffic flow, so it can be based on algorithm integration and optimization, to achieve the overall function of traffic information collection on the platform of the highest operating efficiency, the flow chart of algorithm is shown in figure 3.
4. The Experiment and Data Processing

Computer and laser scanner LMS200 is realized by serial communication data exchange. This paper is based on the LMSZOO protocol in the VisualC++ development environment to write a computer program to achieve SICKLMS.exe control work. At the same time in the dynamic link library lmslib.dll and lmslib.lib package API function LMS200, to achieve the laser scanning range, angle resolution, baud rate configuration mode.

4.1. The Data Structure of the Experimental Data of Laser Scanning

Laser scanning data LMSZOO detected is sixteen hexadecimal and computer to realize data exchange, its content is mainly composed of a synchronous data head, distance data and check data of three parts. The synchronous data head is 7 bytes, divided into the start bit, the address bits, the overall message length (not including Cheeksun), command bits and distance data length, in which the overall message length and distance data length each accounted for 2 bytes, 1 bytes for the rest. The distance data is the basic data of traffic information acquisition platform are detected, through analysis and processing to obtain traffic information parameters, the length is determined by scanning mode setting (see section 3.3.5). Check data including index value, status bit and CRC data, the index value and CRC data each accounted for 2 bytes, 1 bytes status bit.
The process of this experiment using scanning range is 1000, the angular resolution is 0.25 °mm measurement mode, scanning accuracy of laser scanning data for 401 points. Moreover, LMS200 data transmission distance to sixteen hexadecimal detected, each distance data consists of 2 bytes, so that the experimental data of each frame length is 814 bytes, the synchronous data header is 7 bytes, the distance data is 802 bytes, 5 bytes of data check.

In summary, the traffic information collection platform is the first in the laser scanning data extracted from data, according to the data structure of LMS200 scanning distance data analysis after using the basic principle and formula of the third chapter of the traffic information parameters.

4.2. Analysis of the Experimental Data of Laser Scanning

During the experiment, according to the LMS200 communication protocol in VisualC development environment to write a laser scanning data analysis program named dataConvertor.exe Sic to achieve scanning data analysis work. The program can automatically check the analytical data, statistical index CRC errors and wrong, find out CRC position error data.

Detailed description of laser scanning data parsing algorithm
(1) read a data frame. From the buffer to read 814 bytes of data, according to the second step.
(2) Checksum and CRC checksum calculation. First extract the last two bytes of data from the data, 814th bytes of data left 8 bits, and 813rd bytes of data performs a bitwise OR operation, the Checksum value is obtained. According to the CRC checksum function to calculate the CRC checksum value, enter the third step.
(3) to check a data read. Checksum and CRC check values are equal, if not equal, the frame data is wrong, give up the data, return to the first step, read the next frame data. If they are equal, that check, enter the fourth step.
(4) analytic distance data. From the extraction of data from the data, every 2 bytes for a group. Select a set of pointers to the data, the data of 1 bytes left 8 bits, then the first 1 bytes of data and performs a bitwise OR operation, get a little distance value path. In the fifth step.
(5) to determine whether path is effective distance distance value. If the distance value path is greater than 8183, is that the distance value path is invalid, "1" will be assigned to path, the distance value is written to the file Path. Otherwise, the distance value path, directly written to the file, enter the sixth step.
(6) to a pointer to the next set of data, and determine whether the arrival of data at the end, if not, then go to the fourth step, continue to distance data analysis under a point. Otherwise, this frame data analysis is completed, the end of the program.

The above algorithm is data analysis thread data SickDataConvertor.exe analysis program in the overall circulation of the subroutine, its function is a frame of data analysis.

5. Conclusion

With the rapid development of social economy, a comprehensive network of modern traffic has become one of the important indexes to evaluate the level of social development. At present, China's road traffic has experienced explosive development has begun to take shape, which is of great convenience for people's daily life and travel, but also with the growing traffic demand, but also brings many problems and inconvenience. Intelligent transportation system and the rapid development in recent years has become one of the effective means is the current understanding of the traffic problem. Advanced information technology, computer technology has injected new vitality, data communications transmission technology and electronic automatic control technology introduction and application for the further development of the intelligent transportation system, traffic information collection and detection technology in the intelligent transportation system has become a very important topic of comprehensive application of computer science, automation technology, electronic engineering, communication engineering, information engineering and other fields, to achieve the technology of automatic detection, recognition and tracking of moving vehicles is the most important part of the. The moving vehicle in intelligent transportation system of the automatic detection and recognition technology makes some exploration and research, the advantages and disadvantages of other vehicle detection technology and testing equipment by the analysis and comparison, combined
with the actual situation of current technology development provides a new way of traffic detection, detection by analysis and processing of laser scan data to traffic information data. In view of the current domestic and foreign common traffic detection technology and detection equipment is the basic for different test objects independently design and use of the status quo, the integrated use of communication engineering, information engineering theory and data traffic detection technology in the intelligent transportation system and technology two parts together, designed to achieve a multiple object detection integrated acquisition system, namely traffic information acquisition platform based on laser scanning data, which can run at the same time the function module of vehicle speed detection, traffic flow statistics and vehicle type automatic recognition, processing and the detected data, the establishment of the database at the same time, realize the data acquisition and processing multi functional. This not only reduces the complexity of traffic data detection, but also saves construction due to respectively according to different objects in this paper, considering the present common laser detection equipment, laser detection technology of the traditional detection system and increase the construction cost, more conducive to improving the application effect of the intelligent transportation system.

References