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Real-time Monitoring and Analysis of Computer Image Processing in Intelligent Transportation System

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Abstract: *As one of the foundations of building a "smart city", and as an effective means to improve the current transportation situation, which is particularly reflected in cities, intelligent transportation can provide great help for people's daily travel, but the development of intelligent transportation system (ITS) is accompanied by some problems and shortcomings. This article believed that computer image processing technology can be used to assist the real-time monitoring and analysis system in the system, helping it carry out daily traffic monitoring and management work. Computer image processing technology can improve image quality and even restore some damaged and incomplete images, making them easy to observe. It can also uses methods such as frame difference to analyze vehicle and road conditions in real-time, thereby locating and processing illegal vehicles, and improving road conditions.*

Keywords: *Computer Image Processing Technology, Intelligent Transportation System, Real-Time Monitoring and Analysis System, Frame Difference Method*

1. Introduction

The main working method of the ITS is to obtain the road surface image through various external devices, so as to grasp the traffic conditions. The computer image processing technology is good at improving the image quality, so this paper decides to use this technology to assist the improvement of the ITS.

Daily travel accompanies everyone's life, but the traffic situation is always unsatisfactory. Therefore, the concept of intelligent transportation based on artificial intelligence technology has emerged, and many researchers have proposed suggestions for the update iteration of intelligent transportation. Njoku J N believed that the primordial universe is conducive to the development of ITSs from a data-driven perspective [1]. Ramesh T R stated that the ITS can be assisted by the vehicle self-organizing network [2]. Khan M A said that drones can improve the safety and reliability of transportation systems [3]. This article proposed the need to establish a real-time monitoring and analysis system. Zhou L Q pointed out that real-time monitoring and analysis systems are of great significance for earthquake monitoring and analysis [4]. Ferlin M A proposed that the detection system for cerebral hemorrhage is very important in related treatment work [5]. It can be seen that real-time monitoring and analysis systems are necessary.

To improve the working mode of real-time monitoring and analysis systems, image processing is naturally essential. This article proposed the use of computer image processing technology for assistance. Chen Y believed that computer image processing may be used for robot path planning [6]. Lopez Marcano S proposed that computer image processing technology can be used for marine ecological protection [7]. Manoharan D J S stated that image processing technology can help establish a fingerprint feature user layer cloud security model [8]. Black S argued that multiple imaging techniques have greatly improved the ability to characterize healthy and diseased tissues at the cellular level [9]. Hou Y pointed out that image processing technology is very suitable for road surface monitoring work [10]. Road surface monitoring is also an important part of improving traffic.

This paper first made a series of reviews of ITS to analyze the operation logic of ITS, and then proposed the construction of vehicle road integration to analyze the development trend of ITS. After

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that, it pointed out the working principle of the real-time monitoring and analysis system, so as to reflect its importance in the ITS. Finally, computer image processing technology was introduced. ITS needs to process and analyze the road image, so the introduction of computer image processing technology has great potential for the improvement of ITS.

2. Overview of ITS Review

As a derivative of the rapid development of computer technology, it is based on the use of a series of emerging computing technologies to ensure road safety, improve traffic efficiency and save human resources. Li X proposed the idea of vehicle road integration based on ITS [11]. The first part is the information and data processing part of the ITS.

Table 1: Information Collection and Processing of Intelligent Traffic System

Data collection layer	Coil, geomagnetism	Geomagnetism, radar	Floating car
Data transport layer	Online transmission	Network	Wireless transmission
Data mining layer	Data preprocessing	Data analysis	Data mining
Data application layer	Traffic control	Signal control	Bus dispatch

Information collection and processing in the ITS are shown in Table 1. This section mainly includes four parts: data collection layer, data transmission layer, data mining layer, and data application layer. Firstly, there is the data acquisition layer, where the system utilizes external devices such as coils and geomagnetism to collect traffic data. Video and radar are also used for remote detection, and floating vehicles are also deployed for data collection. The data transmission layer first needs to be based on the network architecture, either wired or wireless transmission. The data mining layer would preprocess, analyze, and mine the data. The data application layer would use this data for various transportation tasks such as traffic control, signal control, and bus dispatch. Wang J W believed that the collection and analysis of road condition information is crucial for improving the traffic situation of this section [12].

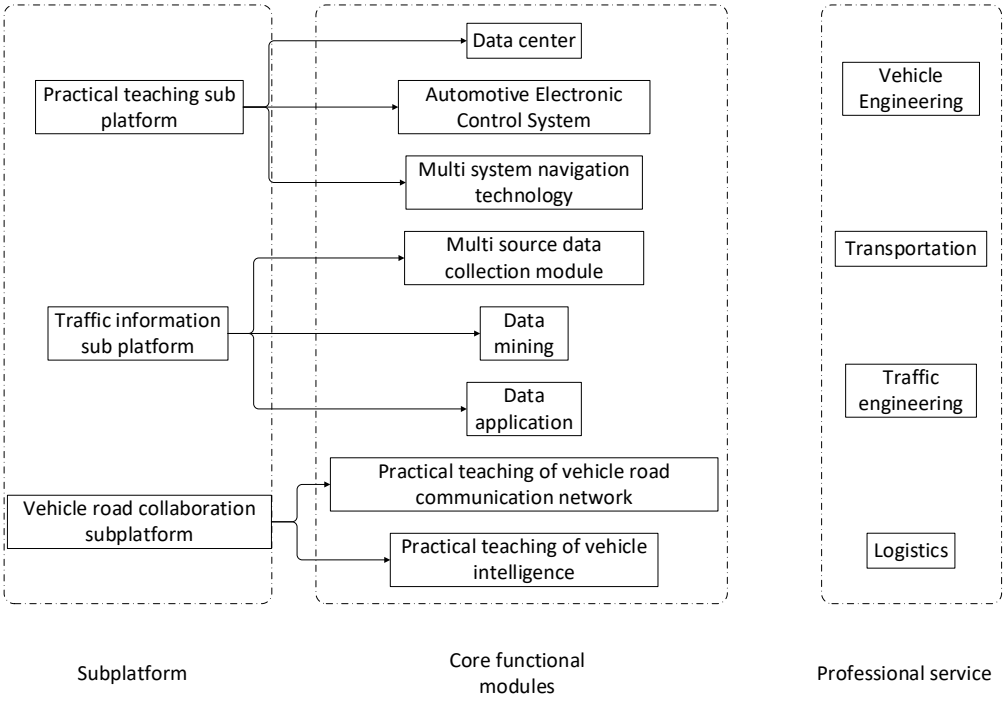

Figure 1: Vehicle Road Integration Construction of ITS

The vehicle road integration construction of the ITS is shown in Figure 1. In the entire component, it is mainly divided into sub platforms, core functional modules, and service specialties. The sub platform consists of a practical teaching sub platform, a traffic information sub platform, and a vehicle road collaboration sub platform. The core functional modules included in the practical teaching sub platform include data center, automotive electronic control system, and multi-system navigation technology. The core functional modules included in the transportation information sub platform include multi-source data collection module, data mining, and data application. The core functional

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modules included in the vehicle road collaboration sub platform include vehicle road communication network practical teaching and vehicle intelligence practical teaching. At the same time, the service disciplines closely related to these modules include vehicle engineering, transportation, transportation engineering and logistics engineering. Completing these tasks is also the purpose of vehicle road integration.

3. Working Principle of Real-time Monitoring and Analysis System

Real time monitoring and analysis systems are widely used in various fields, such as industrial production, construction, healthcare, and education. The ITS needs to understand the traffic condition in real time, so the real-time monitoring and analysis system needs to collect and process the traffic condition data in time. The traffic condition data is generally the traffic flow, vehicle speed, road condition and other factors. After these data are analyzed, the correct early warning and decision-making can be obtained, so as to make reasonable measures for the current situation. Therefore, the real-time monitoring and analysis system plays an important role in the ITS. Li C Y also held the same view on the road condition warning. She believed that the road condition warning can reduce the occurrence of traffic accidents [13]. Xie Q constructed its real-time monitoring and analysis system for urban rail ITS [14].

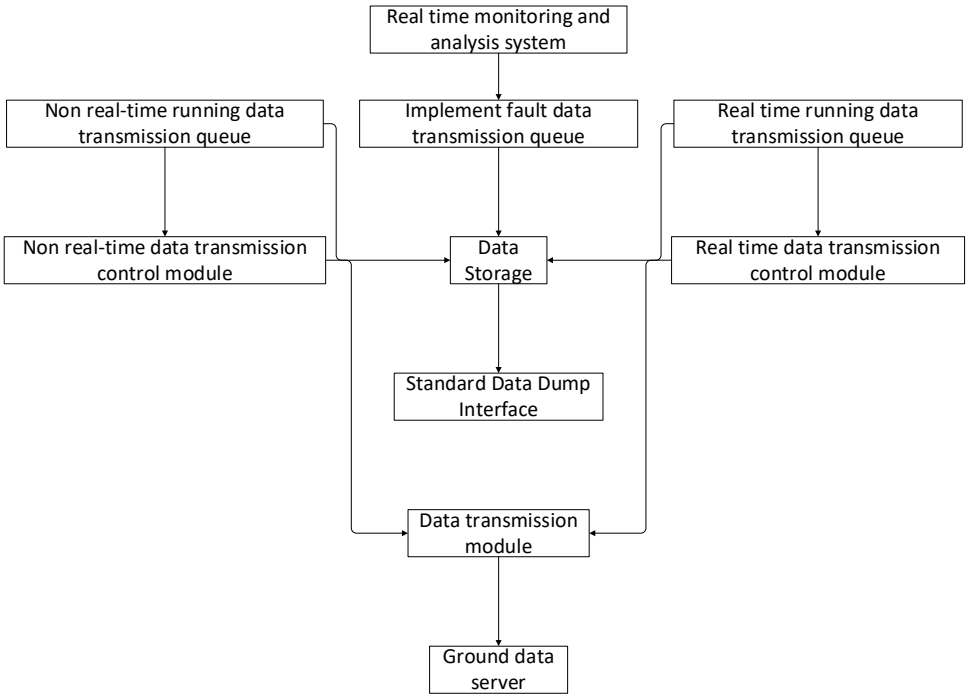

Figure 2: Connection between Online Real-time Monitoring and Analysis System and Ground Receiving Station

The connection between the online real-time monitoring and analysis system and the ground receiving station is shown in Figure 2. It can be seen that after the real-time monitoring and analysis system transmits the signal to the wireless transmission system, the real-time operation data transmission queue and non real-time operation data transmission queue in the system are responsible for transmitting the data to the ground data server through the real-time data transmission control module and non real-time data transmission control module, respectively. Moreover, both real-time and non real-time data transmission queues would work together with the implementation of fault data transmission queues to store data and ultimately transmit it to the standard data dump interface. Hua L J analyzed the internal architecture of the real-time monitoring and analysis system [15], and now it is restored as follows.

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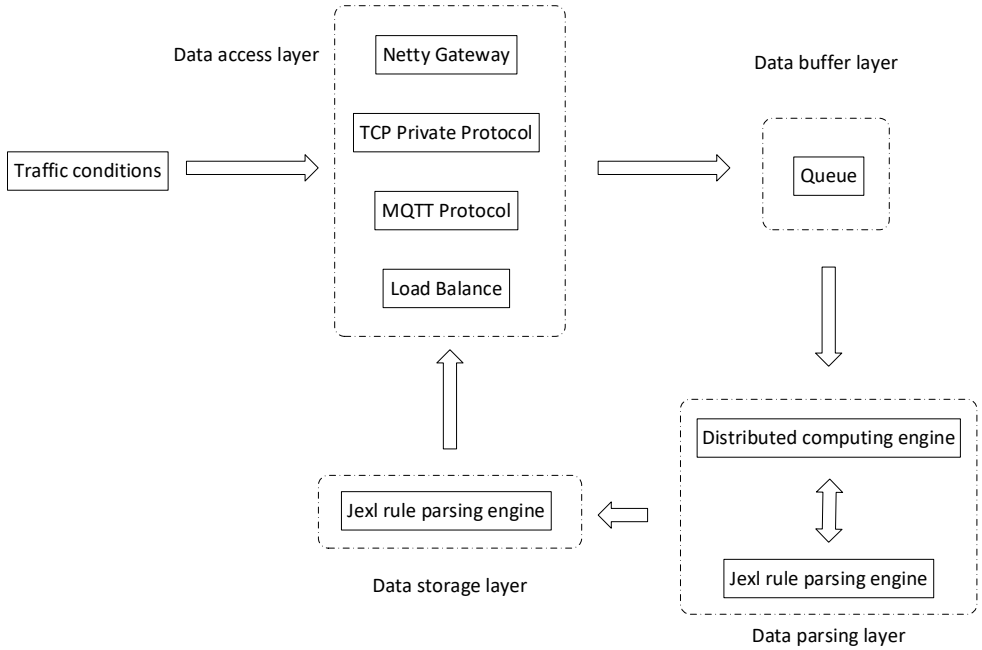

Figure 3: Internal Architecture of Real-time Monitoring and Analysis System

The internal architecture of the real-time monitoring and analysis system is shown in Figure 3. Firstly, the system would extract data from traffic conditions, which is the data access layer. This layer is based on the Netty (Java open source framework) gateway, TCP (Transmission Control Protocol) private protocol, MQTT (Message Queuing Telemetry) protocol, and load balancing. After that, the data enters the data buffer layer, which temporarily stores the data as a message queue. After buffering, the data begins to be parsed, which requires a distributed computing engine and a Jexl (Java Expression Language) rule parsing engine. Finally, the data would enter the data storage layer and be saved.

4. Application of Computer Image Processing in ITS

As an important tool for carrying the appearance of the real world, images are undoubtedly of great help for people to obtain information, express information, and transmit information. Today's highly developed computer technology has brought image processing to a higher level. By compressing, enhancing, restoring, matching, describing and identifying digital images, computers can better transmit image information, and even restore some damaged and incomplete images. Guo W pointed out that image restoration is a very important component of image processing technology [16]. Computer image processing technology has been applied in many fields. For example, Song R pointed out the working principle of computer image processing technology in research related to tea picking [17]. In this study, the researchers proposed that the fundamental problem with automated tea picking lies in the feature recognition of target tea leaves, so the goal of computer image processing technology is the characteristics of these target tea leaves.

The feature recognition process of computer image processing technology is shown in Figure 4. Firstly, the image feature vector is inputted, then the feature vector and the clustering center distance is calculated; whether the distance is greater than the distance threshold comparison is calculated to analyze whether it is the target or not. After that mark the output and record the recognition time, observe whether the image recognition is complete. If yes, the process is over; if no, then select the next image to re-execute the process once more, and through this process to continuously screen eligible targets. Zhang Y Z pointed out that extracting the image feature vectors of the studio image recognition of the core problem [18].

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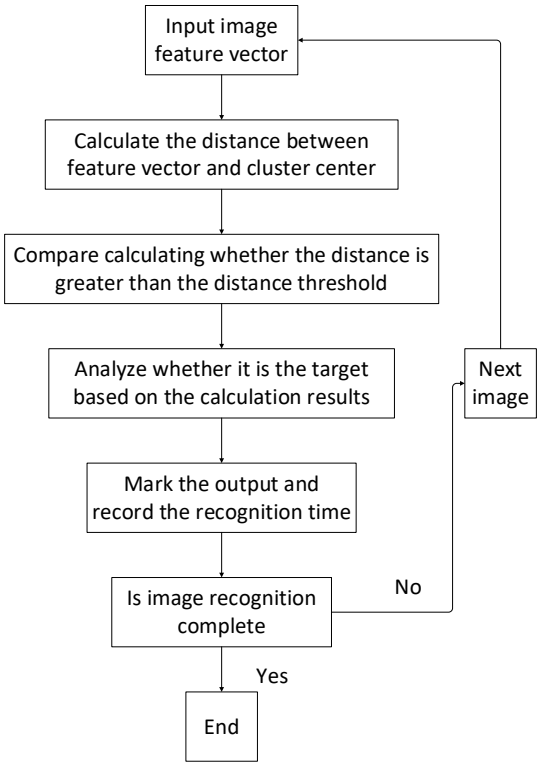

Figure 4: Feature Recognition Process of Computer Image Processing Technology

In the ITS, the road condition information needs to be mastered, so the computer image processing technology can play its role to help analyze the road condition photos, so as to extract effective traffic information. Song T S discussed some drawbacks of the transportation system and the solution of the drawbacks by image processing technology [19].

Table 2: Disadvantages of ITS

Disadvantages in ITS	Specific vehicles	Difficult to recognize license plates
		Difficult to recognize body shape
		Difficult to recognize vehicle color
	Overall road conditions	Difficulty in identifying road congestion in real-time
		Easy to be disturbed by weather factors

It can be seen from Table 2 that some drawbacks of the ITS can be divided into two categories, namely, specific vehicles and overall road conditions. In terms of specific vehicles, there are three main points: difficulty in identifying license plates, difficulty in identifying body shape, and difficulty in identifying vehicle colors. In other words, in some complex situations, the impact is not clear enough, resulting in the appearance of some illegal vehicles being difficult to recognize. In terms of overall road conditions, it is mainly difficult to conduct real-time analysis of road congestion and is easily affected by weather factors.

Table 3: Solutions to Drawbacks of Computer Image Processing Technology

Reference method	Problem classification	Concrete measure
Background subtraction method Frame difference method Optical flow	Specific vehicles	Determine if the target has committed any violations and lock in the identity information of the offending vehicle
	Overall road conditions	Establish an obstacle detection system to perform emergency rehearsals for road conditions that are constantly changing,

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Table 3 shows that the methods needed to solve these problems include background subtraction method and Optical flow method. Li C M proposed that the frame difference method can effectively track lane lines [20]. Based on these methods, whether the specific measures for specific vehicles utilize clear images and more accurate vehicle parameters brought by computer image processing technology to determine whether there are violations and lock the identity information of the violating vehicles. The specific measure for the overall road conditions is to establish an obstacle detection system, which can preview sudden changes in road conditions at any time, and use the image restoration function in image processing technology to overcome the difficulties caused by weather factors.

5. Conclusion

This paper improved the real-time monitoring and analysis in the ITS by using computer image processing technology, which is innovative. The main means of ITS is to take images through external devices and analyze the images. After obtaining accurate traffic information, external devices were used to record or control traffic. Therefore, image quality is crucial to the efficiency of ITS. The computer image processing technology that excels in this field naturally becomes the preferred research topic in this article. However, there are still some shortcomings in this article, which is that the improved system has not been applied to any examples to observe the specific situation of its work.

In general, as a product of artificial intelligence, the development speed of ITS is rapid, and the establishment of smart cities is advocated in the current era. As an important part of it, intelligent transportation has greatly promoted the development of the whole city. It can be foreseen that in the current era of rapid technological development, urban transportation and even the overall construction of the city would make progress in the future.

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