

# Retraction

# **Retracted: Expressway Information Collection Processing and Control Technology Based on RFID Internet of Things**

# Journal of Control Science and Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation. The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

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# Research Article

# Expressway Information Collection Processing and Control Technology Based on RFID Internet of Things

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In order to solve the problems of highway traffic congestion and frequent traffic accidents, a technology method for highway information collection, processing, and control based on RFID Internet of Things is proposed. The highway information collection and processing control technology designed in this paper is based on radio frequency identification technology to realize the collection of highway vehicle information, analyze, and process the collected information, and finally get the road condition information. Through the extraction and analysis of the traffic flow information in the video surveillance, the background difference method is used to extract the relevant vehicle factors in the video, including the extraction of traffic flow information, vehicle model extraction, and vehicle speed extraction. Traffic detection provides convenience. The experimental data shows that from Monday to Friday on weekdays, the road congestion rates are 2.72%, 1.94%, 2.77%, 2.27%, and 3.47% respectively; the average vehicle speed on weekdays is 89.96 km/h, and the test results are fast and accurate. The proposed method integrates road information collection and road information service, realizes traffic detection when there are vehicles, and realizes detection and perception of large-scale road traffic systems. Travelers provide real-time traffic information and navigation services.

## 1. Introduction

In recent years, the vigorous construction of expressways has improved the structure of my country's highway network, promoted interregional and regional economic connections, effectively stimulated domestic demand, and stimulated the economic prosperity and development of areas near expressways; it plays a very important role in regional economic development and spatial pattern evolution [1]. However, while the "hardware" configuration of the expressway has been improved, due to the increase in traffic flow, frequent accidents, and free passage on holidays, etc. The frequency of traffic congestion is getting higher and higher, the duration of congestion is getting longer and longer, and the scope of influence of congestion is also expanding, which puts forward higher and higher requirements for the modernization, and information operation and management of expressways [2].

Therefore, the relevant operation and management departments urgently need to dynamically understand the actual traffic conditions of the road, such as the spatial distribution, congestion level, and duration of the congested road sections in real time, so as to take targeted management measures in a timely manner, remind the public to detour routes, travel time and precautions, so as to provide a good highway traffic environment for the public to travel [3].

At present, various fixed detectors such as geomagnetic detection, microwave detection, and video detection are set up in some important areas (such as toll stations) on expressways, which have a certain ability to collect fixed-point traffic parameters, but their installation and maintenance costs are high, and the coverage is rather limited [4]. However, the GPS floating car data of two passengers and one danger has problems such as a small number of valid samples, and it is not completely consistent with the normal driving state of vehicles on the road section, and the reliability and reliability of the collected traffic state information are also relatively limited.

The technology of collecting road traffic state feature information based on mobile communication base station

signal data (also called mobile phone signaling data or mobile phone data) is an emerging mobile acquisition method [5]. It uses the current mobile base station signal network that covers very few blind spots in the whole range, and collects the location and activity information of each mobile phone terminal in the geographic space. With the popularization of mobile terminals, the proportion of people traveling on highways holding mobile phones is getting higher and higher, reaching the level of one or more mobile phones per person. At the same time, due to the needs of network optimization, the signaling monitoring platform of mobile communication network operators is becoming more and more mature, which can monitor the signaling data of mobile phone terminals in real time, such as sending and receiving text messages, Internet access, and telephone calls; these data contain the spatial activity of the signals of each mobile terminal base station over time, after filtering out personal privacy information, big data technology can be used to analyze and calculate mining related traffic engineering parameter data [6].

The mobile operator opens the original signaling data source of the mobile phone, and according to the base station signal data requirements of the traffic information collection system, the operator customizes the output of the real-time base station signal original signaling every minute. On this basis, the operator build a traffic analysis model of traffic, macro, and micro traffic, and builds a highway traffic state collection system based on the big data of mobile communication base stations through the real-time analysis and processing of massive base station signal big data, the real-time dynamic collection of the highway traffic status information based on mobile communication base station machine data can be realized [7].

## 2. Literature Review

Traffic flow has become an important indicator to measure the information of urban road conditions, and it is an indispensable and important data for the management and regulation of urban road conditions [8]. Therefore, the monitoring of traffic flow needs to be controlled in a lowcost and high-efficiency visual monitoring system. The traditional monitoring system has a poor sense of spatial position, the road condition information cannot be accurately reflected in real-time. Regarding the abovementioned issue, the author extracts vehicle and road information through video satellite data, monitors the traffic flow and extracts vehicle information, and finally realizes functions such as density map drawing, noise monitoring, and congestion degree query, and publishes the data to the network through WebGIS, so as to realize the interactive sharing of road condition information [9].

The urban intelligent traffic guidance release system is to establish a fast and convenient query mechanism through the collection, integration, and management of urban traffic information resources, and provides a series of scientific data analysis and processing methods which are fast, accurate, and illustrate road traffic flow data for travelers and relevant departments [10]. The geographic information platform provided by the system enables travelers to easily realize the functions of map query, thematic map display, layer display, and road positioning, etc.. Services such as traffic flow prediction, optimal route search, and travel time estimation can also be provided to assist travelers in decision-making. At the same time, the driver can also timely understand the traffic congestion situation of the upcoming road section through the LED information board set up outdoors, so as to choose a reasonable driving route in real time.

The World Wide Web Geographic Information System (WebGIS) refers to a GIS that runs on the Web based on the Internet platform and client application software, using the WWW protocol. It is a new technology that uses Internet technology to cross-site and improve GIS, its core is to embed HTTP and TCP/IP standard application system in GIS and realize the GIS function under the Internet environment. WebGIS is composed of multiple hosts, multiple data, and multiple terminals connected through Internet/Intranet. Because WebGIS has a C/S or B/S structure, the client has the function of obtaining various geographic information and applying it, and the server-side system provides geographic information or GIS system services to the clients. WebGIS generally consists of WebGIS browser, WebGIS information agent, WebGIS server, and WebGIS editor. The whole process of the intelligent traffic information release system is shown in Figure 1.

## 3. Methods

#### 3.1. System Development Tool Selection

- (1) ArcEngine is a software development engine [11]. This system is built on VisualStudio2010 and ArcEngine10.2 platforms, and uses C<sup>#</sup> language for system programming. By using the geoprocessing tool it calls the system definition and self-defined model in the built environment, so as to realize the corresponding function of the function module.
- (2) ModelBuilder is a data modeling tool, it provides a graphical modeling environment for designing and implementing various data processing in ArcGIS [12]. Models are represented in the form of flow-charts, which consist of data processing tools and data. The entire data processing process is executed sequentially according to the flow chart, similar to the tool flow in e-government, which is sequential, supports parallelism, and has data input and data output. All processing can be performed directly in ModelBuilder.
- (3) As a server, Mapserver supports a variety of vector and raster format data, and supports the loading and use of block vector data and raster data. The map publishing is managed by a configuration file written with zero code, and the configuration file is called Mapfile [13].

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FIGURE 1: System implementation flow chart.

#### 3.2. System Framework

3.2.1. Data Extraction. The detection and extraction of satellite video data include vehicle type extraction, density map drawing, noise analysis, vehicle speed detection, and traffic congestion analysis [14].

*3.2.2. Platform Construction.* Build an open source WebGIS platform using Mapserver, Tomcat as the web server, QGIS as the desktop software, PostgreSQL (PostGIS) as the spatial database, and Openlayers as the browser client [15].

3.2.3. Design Route. Design the system from three aspects: interface, database, and function.

3.2.4. Function Realization. Through the acquired data, the detection, tracking, traffic flow analysis, and display of the target vehicle and the display of road congestion are realized.

(1) Traffic Flow Detection Method. Video-based traffic flow information extraction is usually divided into three main stages: video data preprocessing, moving vehicle monitoring, and moving vehicle target tracking counting [16].

The author adopts the background estimation method, and the purpose of background estimation is to obtain all stationary objects except moving objects (including noise) [17]. In the vehicle detection part, the background difference method is used for detection, and the morphological filter is used to remove noise in the detection process, and then, the monitoring result of the moving vehicle is obtained. First, in the background difference process, different thresholds are used to distinguish the noise from the vehicle, and the obtained noise weight is updated to the background. For preliminarily detected vehicles, it is assumed that the pixel values at moving objects change faster than they change in the actual background image, so the foreground and background can be accurately distinguished by a simple frame-to-frame difference method (as shown in the following equation).

$$F_{ij}(k) = \begin{cases} 0, & \left| I_{ij}(k) - I_{ij}(k - \gamma) \right| \le Tf, \\ 1, & \text{otherwise.} \end{cases}$$
(1)

In formula (1),  $F_{ij}$  (k) represents the image obtained by the frame difference method,  $I_{ij}$  (k) represents the input data at time k, (i, j) represents the position of the pixel, and  $\gamma$  represents the distance between the current frame and the subtracted frame., and the *Tf* threshold indicates whether the pixel changes at time k. However, when the inner color of the target is the same, the method cannot detect the change of the pixel value, and this method will fail. At this time, the dynamic matrix D (k) (as shown in formula 2) needs to be used to analyze the detection results obtained by the interframe difference method.

$$D_{ij}(k) = \begin{cases} D_{ij}(k-1), F_{ij}(t) = 0, \\ D_{ij}(k-1) \neq 0, \\ \lambda, F_{ii}(t) \neq 0. \end{cases}$$
(2)

In formula (2),  $D_{ij}$  (k) represents the dynamic matrix data at time k, (i, j) represents the position of the pixel,  $D_{ij}$ (k-1) represents the dynamic matrix data at time k-1, and  $\lambda$  represents the continuous frame. There is no change in the pixel value in [18]. The motion state of each pixel is stored in this dynamic matrix, and only when those pixel values that do not change are updated to the background, that is, when the dynamic matrix D(k) is 0, the pixel is updated to the background. Although the background update method based on the pixel layer can solve the shortcomings of a large amount of calculation and slow background update, however, this method considers independent pixels and does not consider the motion information within the frame. Once the motion speed v (as shown in Equation 3) is less than the threshold, the stationary object in the current image can be determined and the stationary object is updated to the background.

$$v = \frac{\sum_{i=1}^{n} \sum_{j=1}^{m} F_{i,j}(k)}{m \times n}.$$
 (3)

In formula (3), m and n represent the width and height of the image, and v represents the motion speed.

(2) Vehicle Type Extraction. This system classifies vehicles by simple vehicle types and divides the vehicle types into three types: large vehicles, medium vehicles, and small vehicles. The classification principle is as follows: use the iterator to read the same type of the raster image in the folder, obtain the corresponding vehicle area information of each vehicle after reclassifying the extracted vehicle information, and then, add the vehicle type field, and it is classified according to the size of the vehicle area of each vehicle.

(3) Vehicle Speed Detection. The detection of the vehicle speed is mainly to settle the speed information of the vehicle according to the moving distance and time of the corresponding vehicle in the two frames of pictures. The time interval between every two frames of pictures is 1/24 s, so the speed formula is as follows: ((distance)  $\times 24$ )/1000  $\times 3600$ , in km/h. We can judge the speed of the current road section according to the speed interpolation, so as to judge the driving situation of the current road. For areas with slow speed, we can further judge whether there is a traffic accident, whether it is located at a traffic post, etc.

(4) Traffic Congestion Analysis. The degree of traffic congestion can be judged by the speed information of vehicles on the road [19]. Add the congestion degree field in the attribute table, and then judge the congestion degree of the road section according to the classification of the speed field, and add it to the corresponding field of the attribute table.

The vehicle speed extracted by this system ranges from 29 to 90 km/h, and the congestion degree is classified according to the speed of the vehicle; this system divides the congestion degree into four grades: the vehicle speed is greater than 50 km/h as unimpeded, the vehicle speed is greater than 40 km/h and less than 50 km/h as mild congestion, the vehicle speed is greater than 30 km/h and less than 40 km/h as congestion, and the vehicle speed is less than 30 km/h as severe congestion.

### 3.3. Design Ideas

3.3.1. Platform Design. The entire query system is built on the platform of WebGIS, using Mapserver, Tomcat as the web server, QGIS as the desktop software, PostgreSQL (PostGIS) as the spatial database, and Openlayers as the browser client. As one of the mainstream combinations of open source WebGIS, the platform built by Mapserver supports WMS (WebMapservice) more efficiently, and can better meet the system's requirements for map switching and display. The following is the working principle of the Mapserver server, as shown in Figure 2.

- (1) Apache WebServer transmits the user's access parameters to MapServer
- (2) When the Mapserver (mapserv) receives the parameters sent by WebServer, it first obtains the name of the spatial data and other related information from the document (mapfile) defined by the parameters
- (3) After obtaining the spatial data information, send a data service request to the spatial data
- (4) After obtaining the corresponding spatial data including attribute information, pass the information back to Mapserver
- (5) Mapserver converts the spatial data into PNG or JPG graphics by GDGraphicslibrary through a series of processing such as spatial changes
- (6) After the GIS graphic file is generated, Mapserver grabs the specified template file (templatefile) according to the definition, and embeds the corresponding graphic dynamic shape into the HTML document
- (7) After completion, the generated HTML document conforming to the browser standard will be transmitted to the client for display by the WebServer.

3.3.2. Feature Design. The WebGIS-based video star vehicle flow analysis and road condition query system uses ArcGIS Modelbuilder to design and implement a vehicle density detection model, a noise model, and a traffic congestion level model, and uses AE and  $C^{\#}$  as the development platform to realize the call of the abovementioned models and analyze the results, the data of GIS is released to the network through WebGIS to support online preview; combined with the characteristics of GIS and video surveillance, it solves the problem of poor spatial sense of position in traditional video surveillance systems [20]. The system is divided into three modules: traffic flow detection module, traffic flow analysis module, and system function module (as shown in Figure 3) [21].

3.4. Traffic Flow Evaluation Model. In order to improve the computing efficiency of the computer and at the same time to ensure the accuracy of the traffic flow information, the basic mathematical model of the algorithm for evaluating the traffic flow state is given, such as the following formula:

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$$F = aF_q + bF_k + cF_n. \tag{4}$$

Among:

$$F_{q} = \frac{Q_{\text{suin}}}{Q_{\text{sat}}} F_{k} = 1 - \frac{\sum_{i=1}^{n} v_{i}}{n V_{d}} F_{n} = \frac{p}{NN} = \frac{Q_{c}}{96400} \Delta t.$$
(5)

In formula (5), *a*, *b*, and *c* are the weights of traffic, speed, and queuing status, respectively, usually, a = 0.4, b = 0.4, and c = 0.2 (according to the actual road conditions, a, *b*, and *c* can be there are different value combinations);  $F_q$ ,  $F_k$ , and  $F_n$ 

are the saturation coefficients of the three parameters: flow, average vehicle speed, and queue length;  $Q_{5\min}$  is the measured traffic volume in 5 minutes [6];  $Q_{sat}$  is the saturated traffic volume (related to the length of the road section, road grade, and number of lanes);  $\sum_{i=1}^{n} v_i$  is the sum of the instantaneous speeds of all vehicles in the measured road section; *n* is the number of vehicles detected;  $V_d$  is the design speed of the road section; *p* is the number of vehicles queuing at the intersection, which is automatically collected by the video head set at the intersection; N is the maximum number of queues allowed at the intersection;  $Q_c$  is the traffic volume during peak hours;  $\Delta t$  is the parking delay at the

TABLE 1: Evaluation of crowding degree.

F Value range	Degree of crowding
0~0.3)	Smooth
0.3~0.6)	Balance
0.6~0.7)	Crowded
[>0.7,+∞)	Congestion



FIGURE 4: The proportion of total congestion mileage in working days.

intersection under the F-level service level, which is found according to the manual, and takes 50 s, the value range of F in the model and its congestion degree classification are as follows, as shown in Table 1 [22].

## 4. Results and Discussion

The following is an example of the collection results of the system in a certain time period of the expressway; introduce the overall operation characteristics of the system on the expressway, the characteristics of each high-speed operation, the time and space characteristics of each expressway congestion, and the operation characteristics of different types of holidays, etc., applications in analytics.

The result data of this system is itself a component of big data. In the future, it will accumulate for a longer period of time and cover a wider range, combined with data such as traffic flow, passenger flow, and license plate OD. It can further carry out more comprehensive and in-depth mining and extraction work. In a certain period of time, the overall situation of expressway working days is shown in Figures 4 and 5.

The order of congestion degree on weekdays is as follows: friday > wednesday, monday > thursday > tuesday; the average speed of vehicles throughout the working day is not much different, slightly faster on tuesday and slightly slower on friday.



FIGURE 5: The overall average speed of the working day.

This system has been integrated into the integrated traffic operation analysis system platform. Aiming at the collection of expressways with serious congestion problems and with base station signal data conditions, the congested road sections and congested nodes are detected in time, which accurately reflects the traffic operation characteristics of the expressway road network. And, it has played an important role in the real-time detection of expressway traffic operation conditions, holidays, traffic congestion warning of major accidents, traffic congestion evaluation and control measures, traffic macro decision support, and traffic information guidance release. In addition, it can also count the expressway traffic index, the average vehicle speed, congestion mileage and ratio, congestion duration and ratio, and other indicators, as well as the relative historical changes (relatively more congested, stable, or better), so as to more comprehensively grasp the overall operating characteristics.

## 5. Conclusion

The author proposes the real-time road condition information monitoring of expressways based on the Internet of Things technology. It is the integration and innovation of the Internet and traffic management, which is the main development trend of traffic management at this stage. Through in-depth integration with Internet technology, information can be shared on Internet electronic maps and traffic management big data, further enriching data sources; at the same time, through the rational application of visualization, big data, and cloud computing, it can provide better management decision-making and public daily travel, and data support to ensure the accuracy of research and analysis results; finally, different traffic management information can be released through multiple channels, which can provide a reference for the daily travel of the public for different purposes. In the future work, we should focus on the traffic management innovation based on the "Internet +," continuously promote technological innovation, and create a more refined and efficient new traffic management model.

## **Data Availability**

The data used to support the findings of this study are available from the corresponding author upon request.

# **Conflicts of Interest**

The authors declare that they have no conflicts of interest.

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