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Analysis of Traffic Accidents Based on Computer Image Recognition Technology

Tao Wang[1, a]

[1]Network Information Center, Xi'an Aeronautical University, Xi'an, 710077, China.

[a]Corresponding author e-mail: wangtao2633@163.com

Abstract

According to the principle of perspective imaging, various variability factors in the imaging process are analyzed, and a nonlinear model of imaging is established. Based on the application of digital image processing technology, an image processing system for the accident scene was compiled. In the vehicle logo recognition algorithm, a vehicle logo recognition algorithm based on the improved SIFT operator is proposed. This method uses the relationship between the relative position of the license plate and the vehicle logo to locate the location of the vehicle logo, and uses the method of non-fixed ring number and increasing the weight coefficient to solve the traditional SIFT feature descriptor due to the high number of dimensions and the complicated calculation time and time Overcome the problem, and finally identify the extracted SIFT feature descriptors of the car logo. The use of a customized three-dimensional coordinate bracket can eliminate all on-site measurements, and provides a simple and practical method and effective tool for reproducing the accident scene and investigation.

Keywords

3D reconstruction; image processing technology; accident scene investigation; vehicle recognition.

1. INTRODUCTION

When dealing with road traffic accidents, manually measuring various geometric data on the site, such as the length of trail marks, the location of scattered objects, vehicle damage, etc., is not only time-consuming, but also easily misses certain data. When dealing with most accidents, on-site photography is taken as an intuitive basis for analyzing the scene. A lot of visible information is recorded in these images (or videos). If this information is quantified, the scene image can be used to reproduce the accident scene and obtain the required geometric data. This not only saves on-site measurement time, but also facilitates the rapid restoration of normal road traffic. And, when analyzing the scene after the fact, the required geometric data can be extracted from the original image of the scene.

Image recognition technology is mainly applied in the three fields of intelligent vehicle electronic information system based on image recognition, traffic monitoring based on image recognition, and traffic management based on image recognition [1-3]. The electronic information system of smart car based on image recognition mainly realizes the functions of vehicle external environment and internal information interaction, including vehicle adaptive navigation, obstacle detection, road recognition, and fault analysis [4-6]. Image recognition-based traffic monitoring mainly uses computer intelligent technology to intelligently recognize the license plates of illegal vehicles through cameras or electronic eyes. The traffic supervision department performs functions such as information collection, analysis, tracking, and traffic

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flow parameter detection of vehicles on the road . Image recognition-based traffic management mainly implements intelligent toll collection functions, including automobile license plate recognition and automobile shape recognition. In the traffic monitoring based on image recognition, the traffic monitoring technology based on image recognition mainly uses digital cameras installed above the traffic pavement to collect and store the traffic information on the road in an image in a computer, and applies image processing and image recognition Cars in the image are inspected [7-9] and tracked to obtain relevant traffic flow information and vehicle information that violates traffic regulations as a basis for traffic management control flow regulation and legal rulings, thereby reducing traffic congestion, improving the traffic environment, Eliminate bad driving habits of drivers, improve road use efficiency, and realize intelligent traffic safety [10, 11]. In order to achieve the above objectives, the acquisition of vehicle identity information is key. Image recognition-based object detection technology can extract some of the iconic key information in the visual image with more information from complex backgrounds in real time, quickly, and accurately. It can be analyzed and processed by intelligent computer systems and applied to realize road traffic conditions, monitoring of vehicle driving conditions, and detection and prediction of traffic accident sections [12-14]. Obviously, the vehicle license plate is one of the landmark information for traffic monitoring, and the license plate recognition technology has become one of the key technologies of the traffic monitoring system. It can complete the identification and search of target vehicles and analyze the traffic flow to achieve reasonable optimization of traffic elements.

The method studied in this article is to use on-site photos (which need to be taken according to certain requirements) as the original image and apply image processing technology to accurately and quickly obtain the required geometric data (such as size, position coordinates, etc.) without the need for on-site measurement. In the model recognition process, 128-dimensional high-dimensional, so its computational complexity increases and the real-time performance weakens. In view of the above shortcomings, the SIFT algorithm is improved, and its dimensions are reduced while maintaining its excellent characteristics. An improved vehicle signature feature extraction algorithm based on the improved SIFT algorithm is proposed to extract the vehicle signature feature values as data for classifier classification. The extracted vehicle logo SIFT feature descriptors are used for identification.

2. COMPUTER IMAGE RECOGNITION

To obtain the geometric data of the three-dimensional scene from the original image, it is necessary to establish an expression of the mathematical relationship between the object point and its image point. The theoretical basis is derived from the linear perspective, that is, the central projective principle.

The coordinate relationship between the object point P_w and its image point P_i is expressed as a matrix using homogeneous coordinates:

$$\begin{bmatrix} x_i \\ y_i \\ z_i \\ w \end{bmatrix} = \begin{bmatrix} f,0,0,0 \\ 0,f,0,0 \\ 0,0,f,-f \\ 0,0,1,-f \end{bmatrix} \begin{bmatrix} x_w \\ y_w \\ z_w \\ 1 \end{bmatrix} \tag{1}$$

In actual application, the object coordinate system (world coordinate system) must be established on the site, that is, the coordinate system must be transformed by translation and rotation.

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According to the imaging model, a practical image processing system is designed in this paper, that is, the accident scene photos are first converted into digital images, and after processing with image processing technology, various site geometric data can be obtained, and the site and image measurement are eliminated Simple and easy. The basic hardware equipment running by this system is composed of host computer (486DX or more, memory 8M or more), mouse, scanner, etc.

In order to simplify on-site operation and improve the accuracy of the base point measurement, a three-dimensional coordinate support ((1.9mx1. 9mx1. 9m) can be used as the object coordinate system, and all selected base points are marked on it, and the photos taken at the scene of the accident are taken. The photo is used as the original image. After scanning by the scanner to obtain a digital image in bup format, the following processing can be performed:

(1) Read the image and show that if the amount of image data is greater than 16MB-64KB, read the reader in multiples; otherwise read the reader once to improve the processing speed;

(2) Use histogram equalization to improve the visual quality of the image. If the image is clear, skip this step;

(3) Use Haralick discrete orthogonal polynomial to best fit the edge, extract the model for edge detection, highlight the base point and the point to be measured, and make the point selection more accurate;

(4) Use the cubic interpolation method to enlarge the image, generally 4 times is appropriate to reduce the systematic error and accidental error;

(5) Selecting and reading the base point Use the mouse to select and enter the base point, calculate the coordinate value of the image point in the image coordinate system (using the upper left corner of the screen as the origin), and use the non-linear imaging model to calculate the pending coefficient;

So far, the calibration of one image has been completed, and it can be repeated 1-5 times. Then the second image is calibrated, and the three-dimensional coordinates of the point to be measured can be calculated in order to obtain the required geometric information;

(6) Use the mouse to select the coordinate values of the image points of a certain spatial point in the two images. According to Equation 5, use the linear least square method to solve the coordinate values, and save the data file after displaying.

In the calibration process, in order to improve the accuracy, numerical methods such as the least square method for solving linear equations and the least square method for solving nonlinear equations should be used. After the calibration is completed, the focus coordinates (x, y) and the focal length f are calculated as the basis for selecting the image.

Due to the huge amount of data in the image, a photo was scanned by a black-and-white scanner with a resolution of 300dpi, and the resulting image was about 1.6M bytes. If global image processing is to be performed, it will take a long time, so this system performs image processing When the image is small (for example, the image is less than 1024 X 1024 pixels), the global processing is used; otherwise, the sliding window method is used for image preprocessing to improve the speed. At the same time, WINDOWS is used as the operating system, programming under it, and using WINDOWS's large memory management and virtual memory technology to meet the requirements of processing huge data volumes. This system also adopts friendly interface design and menu-driven to enhance the practicability of the system.

3. KEY TECHNOLOGIES FOR TRAFFIC ACCIDENT ANALYSIS

The collection of vehicle logo images provides data preparation for traffic monitoring and management. Vehicles are generally placed outdoors, and the effect of their collection will be

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greatly limited by the external environment, such as: different angles of shooting, different climate, and distinctive Parameter recording devices and so on will have a greater impact on the acquisition results, resulting in different matching results. Therefore, many feature descriptors are difficult to accurately identify the vehicle logo due to their sensitivity to noise. Based on the prior knowledge, this paper uses the SIFT operator to have strong anti-noise ability to complete the feature extraction of the car logo image. In this paper, the SIFT operator algorithm of scale-invariant feature transformation is studied in depth. Since SIFT has a 128-dimensional high dimension, its computational complexity increases and its real-time performance decreases. In view of the above shortcomings, this paper improves the SIFT algorithm, reduces its dimensions while maintaining its excellent characteristics, and applies it to the feature extraction of vehicle logos. An algorithm for vehicle logo feature extraction based on the improved SIFT algorithm is proposed. Apply effects. The car logo feature extraction process is shown in Figure 1.

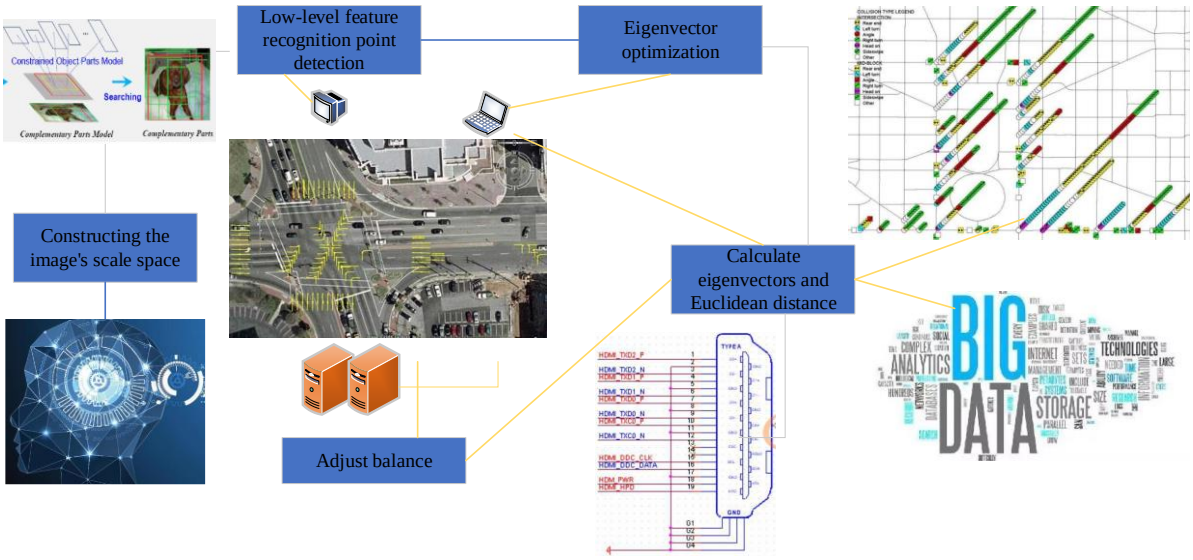

Figure 1. Vehicle logo feature extraction process based on improved SIFT algorithm

Table 1. Types of images

Kind	Form	Note
Binary image	$f(x,y)=0,1$	Text, curve, fingerprint, etc.
Grayscale image	$0 \le f(x,y) \le 2n-1$	Normal photos, n = 6-8 is standard
Color image	$\{f_i(x,y)\}, i=R,G,B$	According to the three primary colors
Multispectral image	$\{f_i(x,y)\}, i=1,\ldots m$	For remote sensing images, m is mostly 4-8
Stereo image	f_t, f_R	A pair of images from left and right viewpoints for stereo viewing
Moving image (time series image)	$\{f_i(x,y)\}, i=t1\ldots tn$	Dynamic analysis, animation.

He image samples of automobile tire tracks obtained at the scene of road traffic accidents are mostly taken by video cameras, digital cameras and other equipment, so the images before preprocessing are all color images. A true color image, also called an RGB image, uses three colors of red, green, and blue to represent three components to represent the color of a pixel.

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Arbitrary colors can be synthesized from the three primary colors. Because each pixel of the image has three different color components, there is a lot of information not related to recognition. Not only is it a large amount of storage, but it also slows down the system's execution speed in processing, which is not convenient for further recognition work. In the process of image recognition and other processes, color images are often converted into grayscale images to speed up the processing speed [15] the types of images are listed in Table 1.

The image of the license plate after the first positioning contains the border of the license plate, which is not conducive to the next character cutting. Therefore, we need to perform further precise positioning to remove the border of the license plate.

(1) Determination of the upper and lower boundaries: Since the image of the binarized image of the license plate has the texture feature of black and white two pixel transitions, when performing a horizontal scan, it can be determined whether it is the upper and lower boundaries of the license plate according to the number of consecutive transitions In addition, since there are 7 consecutive characters in the license plate area, and the distance between the characters is within a certain range, a jump from the target to the background or from the background to the target is defined for this purpose. The license plate area has more jumps than other non-license plate areas, and the number of jumps must be greater than a certain number of times within a certain range (usually 18, including 7 characters and two borders, each character and border have More than two jumps), in order to prevent the characters from being broken, blurred, and the license plate tilting, etc., this article chooses the number of jumps 15 here.

Because the algorithm determines the location of the license plate area by scanning the texture features in the edges of the binarized image, this paper uses the method of scanning from left to right and top to bottom. The specific algorithm is as follows: scanning from top to bottom, scanning each line of the vehicle image from left to right. When encountering a transition, record the current position. If a row has more than one consecutive transition, and for each transition, the distance between it and the next transition is within a certain range. Record the start and end positions of the transition in this line. This article refers to the line between the start and end points as the line scan line. If there are more than 10 consecutive line scan lines, the adjacent scan lines are adjacent to each other. Think of it as a license plate candidate area. This is done until the last line scan line is scanned.

In order to meet a wider range of actual matching labels, this paper divides the images to be matched into two types: simple images and complex images for experimental testing. The test results are shown in Figure 2.

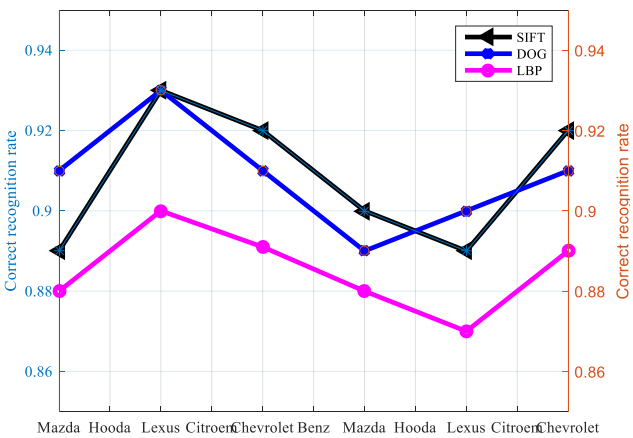

Figure 2. Extraction of different feature vectors of a simple car logo

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Through the above experimental results, it can be found that when feature extraction is performed on several simple car logo images, the correct recognition rate of the car logo by various feature extraction methods can basically reach more than 85%. In Mazda, Honda, Lexus, Citroen, Chevrolet, The advantages of SIFT for the relatively simple structure of Mercedes-Benz for feature extraction are not very obvious, but the overall performance is still better than several other feature vector extraction methods. In order to judge the overall performance, relatively complex The performance of the car standard structure is compared, and the experimental results are shown in Figure 3.

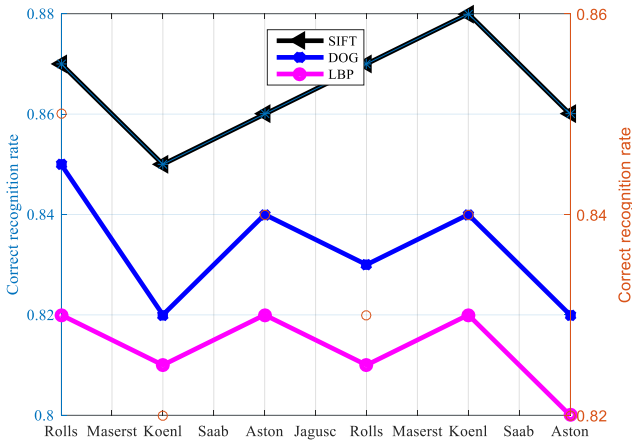

Figure 3. Extraction of different feature vectors for complex vehicle logos

Through the above experimental results, it can be clearly seen that the efficiency of the vehicle identification of complex structures is significantly better than several other feature extraction methods. During the experiment, several relatively complex vehicle logos, such as Rolls, Maserati, Koen Saab, Aston Martin, and Jaguar, were selected to compare the experimental results. It can be seen that although the final recognition rate varies all types of feature extraction methods have reached more than 80%. The recognition accuracy rate of complex vehicle logos must be reduced to a certain extent compared to simple vehicle logos. However, the decrease rate of SIFT feature extraction methods is the smallest, so SIFT's The recognition effect is also the best.

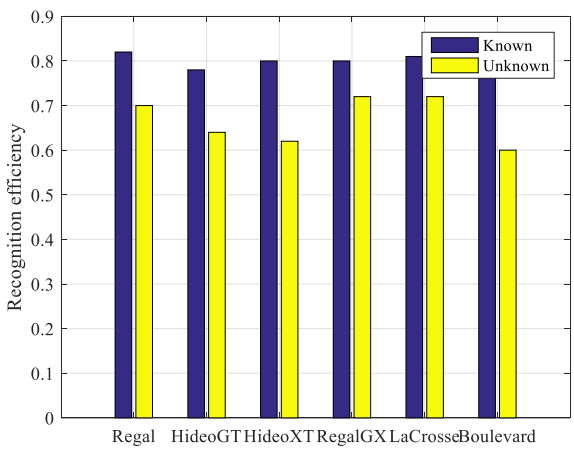

Figure 4. Recognition results of known and unknown Buick models from manufacturers

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From the perspective of recognition efficiency, as shown in Figure 4, the recognition efficiency of Buick models is inferior to that of Ford models. There is a certain relationship with the popularity of the design, but the recognition process is carried out in stages, so the overall recognition effect is better.

4. CONCLUSION

In this paper, linear and non-linear imaging models are established, and a computer image processing system is designed. According to the model and image processing software, corresponding experiments are performed on the scene according to various conditions on the scene, and the accuracy of the experiment and the factors that cause errors are analyzed. , Laid a foundation for further improving the practicability of system software. This paper proposes to use a non-fixed number of loops h and increase the weight coefficient w to solve the problem of excessive calculation and time complexity of the traditional SIFT feature descriptor due to too high dimensions, and integrate BP neural network algorithm to extract the SIFT of the car mark Feature descriptors are identified. The experimental results show that the model and image processing system are correct and feasible, and the use is simple and the measurement accuracy is high.

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