# A kind of ECC - KNN classifier's vehicle identification algorithm

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***Abstract*—this article presents an improved classifier vehicle identification algorithm to improve the efficiency of the existing vehicle recognition algorithm. First, using edge orientation histograms to extract image characteristics, then, Error correction coding is applied to the classification of classifier, the multi-class classification problems turned into multiple binary classification problems. A large number of experimental analysis shows that the improved vehicle identification algorithm has good recognition performance and robustness. Therefore, the algorithm which this article used has high theoretical and practical value.**

***Keywords- edge orientation histograms; Error correction coding; K-Nearest neighborhood classifier;***

## I. INTRODUCTION

Traffic is the lifeblood of the city, while the car is an important component of maintaining traffic lifeline cells. Vehicle Recognition has important applications in the field of traffic monitoring, scheduling and bridge toll management; Vehicle Recognition is the integration of computer vision, image processing technology and pattern recognition, it is also a very important technology in the field of intelligent transportation. Therefore, the vehicle identification is the focus of attention

Currently, widely used vehicle identification algorithms, are all through using Various devices to obtain the vehicle weight parameters or Lateral geometry parameters (Vehicle length, vehicle width, aspect ratio, axle number and so on), then, classify the extracted parameter characteristics by using Template matching or neural network method. These two kinds of method application earlier, performance is relatively stable, but the recognition rate is not very high. In this paper, an ECC-KNN classifier vehicle identification algorithm will be putted forward, based on the deficiencies of the existing algorithms, and the analysis models feature.

## II. ECC-KNN CLASSIFIER VEHICLE IDENTIFICATION

To improve the recognition rate of existing vehicle recognition algorithm, this paper presents a method based on ECC - KNN classifier's vehicle identification algorithm, This algorithm is of the edge histogram feature extraction and ECC - KNN realization two parts.

EOH (edge orientation histograms) is based on is based on the image edge of the statistical features, It is able to accurately reflect the image edge and texture information, and extract features fast etc. So, EOH is used to extract vehicle image feature in this paper, vehicle characteristics of the edge histogram extraction are described below:

This article selects sobel operator to perform the edge detection and extraction, considering a grayscale image I, uses two sobel operators S1 and S2 to extract the edge feature.

$$S1=\begin{vmatrix}1 & 2 & 1\\ 0 & 0 & 0\\ -1 & -2 & -1\end{vmatrix} \quad \text{and} \quad S2=\begin{vmatrix}1 & 2 & -1\\ 2 & 0 & -2\\ 1 & 0 & -1\end{vmatrix}$$

Sobel operator edge extraction characteristics of the vehicle in Figure 1, Effect is shown in Figure 2.


Figure 1 to extract edge character vehicle

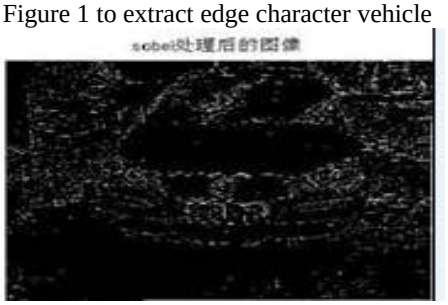


Figure 2 Sobel operator sub-processing image

In Figure 2, pixels $P_{i,j}$ of the original image I (The $i, j$ said in pixel column and row number $0< i, j < 9$), Assuming the gradient of the x and y directions are respectively $G_x(x, y)$

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and $G_y(x,y)$, so sample pixels gradient amplitude and gradient direction calculation process are described below:

Step1: calculate th gradient amplitude $G$

$$G = \sqrt{G_x^2 + G_y^2} \quad (1)$$

Step2: calculate the gradient direction $\theta$

$$\theta(x,y) = \tan^{-1}[\frac{G_x(x,y)}{G_y(x,y)}] \quad (2)$$

In the formula (2), $-\frac{\pi}{2} \le \theta \le \frac{\pi}{2}$,

The $\theta(p_{i,j})$ is divided into 8 equal portions,quantification $\theta(p_{i,j})$.

Step3: Calculate $\theta(p_{i,j})$ the histogram

$$H_t = \sum_{i,j} G(p_{i,j}) \bullet \delta[\theta(p_{i,j}) - t] \quad (3)$$

In the formula (3), $\delta[x-t] = \begin{cases} 1, x = t \\ 0, x \neq t \end{cases}$ $t = 1 \cdots 8$

### A. *ECC-KNN Classification*

Classify the extracted characteristics of the vehicle model, in section A. It is mainly composed ECC coding of treatment sample and KNN classifier training classification. The algorithm described below.

#### 1) *The principle of error correction coding*

ECC (Error Correcting Code), after Error occurred in the process of transmission ,it will find or correct the error code in the receiving end. ECC is first applied to solve the multi-classification problem by Dietterich; the idea converts the multi-class classification problems into the multiple binary classification problems. Effective ECC code must meet two conditions: ⅰ)the encoding matrix of the rows Irrelevant; ⅱ) the encoding matrix of the columns Irrelevant. Therefore, for K class classification problem, Coding length L must satisfy $\log_2 N < N < 2^{N-1} - 1$.

ECC encoder implementation methods are described below:

Step1; Encoding the unclassified sample (Label), All target classification were randomly divided into A, B, the label is changed into zero, whose instances are divided to A, the numeral of the other examples labeled 1.

Step 2: the training sets whose label were changed trained the binary classifier. This process is repeated 10 times and produced 10 different binary classifications.

Step 3: if classification result is one, it votes for the final target classification which is divided into corresponding to the classifier part B, classification with the most votes regarded as the final classification results. Encode for sample category, 6X10 coded matrixes as is shown in table

| class | codeword | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $W_1$ | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| $W_2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| $W_3$ | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| $W_4$ | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| $W_5$ | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

Table 1 sample classification code table

#### 2) *The ECC-KNN Categories*

KNN (K-Nearest neighborhood classifier) is based on statistical classification methods. The basic idea is: According to the similarity criterion, investigated to identify K most similar samples of X, the K most similar element which has the largest class of sample; X will be attributed to that class. ECC - KNN classification algorithm is described as follows:

Step1; In accordance with the Table 1,Encoding the known category label, The Multi-class problem is transformed into several binary classification problem.

Step 2: The KNN classifier is used to train the EOH characteristics, Produced 10 KNN classifier (KNN1, KNN2… KNN10)

Step 3: We extract the EOH characters for the unrecognized object, sequentially input the 10 KNN into classifier to get a set of code, and then reverse this code. The methods as follows: if output of KNN1 is one, as is shown in table 1, adding one ticket to corresponding class scale (class 4, class 5), or adding one votes to the other three kinds of class. if output of KNN2 is one, as is shown in table 1,adding one ticket to corresponding class scale (class 1, class 5),or adding one votes to the other three kinds of class; so, finally the class marked the highest number of votes in the five classes is the classification results of the sample class.

Classification results is shown in figure 2

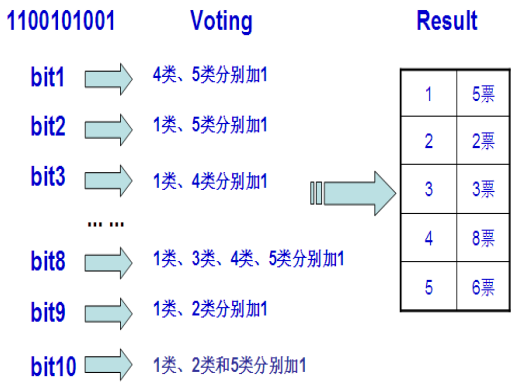


Figure 2 sample classification results diagram

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## III. RESULTS AND ANALYSIS

In order to verify the validity of the vehicle identification algorithm proposed in this paper, we select independent training samples and unidentified samples. The Training sample consisted of 372 samples, including 73 cars, 73 vans, 89 trucks, 89 buses, 48 off-road vehicles. The ECC - KNN algorithm and the traditional KNN algorithm identification results contrast effect such as table 2 and figure 3.

| methods | ECC-KNN | KNN |
|---|---|---|
| recognition rate | 0.973 | 0.943 |

Table 2 the error coding method and the original average recognition rate

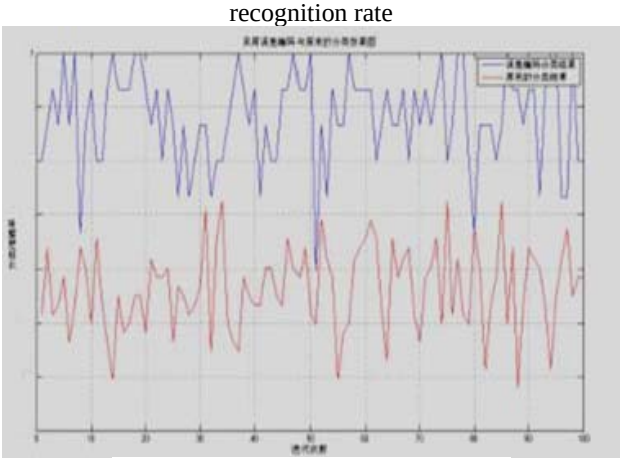

Figure 3 100 recognition rate statistics

## IV. CONCLUSION

In this paper, we use EOH to extract edge features, and then identify the type of the Vehicle by combining ECC with traditional KNN classifier, and Achieved good classification. Experiments showed that Compared with traditional recognition algorithms, this algorithm can improve the recognition efficiency of 2%, can improve the accuracy of classification, and have good robustness; better solve the models to identify the problem.

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