

Review on Different Techniques for Open Road Tolling System Using Pattern Recognition

Supreethkumar S Naik, Th Bidya Chandra Singha, A Rafega Beham
ISE Department, New Horizon College of Engineering, Bangalore, Karnataka, India

ABSTRACT

As the modern world values time and competition grows to provide fast services, transportation sector also has to keep up with the immense growth in technology and services. One of the types of services in transportation which can benefit from modern technology is Open road tolling system. Open road tolling (ORT) utilizes the combination of image processing, and pattern recognition techniques allowing the vehicles to freely pass through toll facility without requiring any action by the driver to pay the toll. This paper submits the review on Open road tolling method using Automatic Licence Plate Recognition (ALPR) and Automatic Vehicle Classification (AVC).

Keywords : Open road tolling, ALPR, AVC, Vehicle Identification

I. INTRODUCTION

In metropolitan cities of India like Bangalore, with population of 11.5 million, consists of vehicle population over 6 million which increases by 5 lakhs every year. The problems cause by this is manifold. This has not just rendered the Transportation department helpless but the traffic police too are bearing the brunt. One of the ways to mitigate it is to reduce the wait time caused to the vehicles at toll plazas. The idea of Open road toll in this paper is to 1. Identify the number plate of the vehicle, 2. Determine the type of vehicle light, heavy or transportation to further process it. The hardware consists of a high quality camera will collect the video evidence. The software consists of image processing. The data can be processed to obtain the driver information and vehicle category.

The [1] Open Road Tolling (ORT) can be can be classified into A) Automatic Licence plate recognition (ALPR) B) Automatic Vehicle Classification [2] (AVC)

A. Automatic Licence Plate Recognition

i. Pre processing

Pre-processing is done to the input image in order to be able to further perform operations on the image. This

process involves greyscale conversion of the image, binarization, morphological erosion and dilation. The resultant image is given to the localization function.

ii. Licence Plate Localization

Licence plate localization is the important indispensable part of ALPR as it localizes the number plate from the rest of the vehicle. Any techniques involving localization focuses on edges or the boundary of the region enclosing the number plate. Complexity of extraction depends on the background and noises in the image. Multiple processes are done to extract the desired region. The resultant output image is fed to the segmentation function.

iii. Character Segmentation

After extracting the image containing licence plate characters from the image, individual characters must be recognized. The segmentation or isolation of characters is performed on already binarized images. The region of interest is taken and split into individual characters.

iv. Character recognition

Here the individual characters consisting of alphabets and numbers are recognized and output in a file or displayed. If template matching is used, then the

segmented image must be resized to match the templates. This is the last step in ALPR and is crucial factor in determining the accuracy of the system. Template matching and neural networks can be used for character recognition.

B. Automatic Vehicle Classification

This technique is used to determine the type of vehicles, ie, two wheelers, light motor vehicles, heavy motor vehicles etc. This is required to assign the varying toll for different type of vehicles.

Vehicles can be classified using two techniques

- i) Hardware based vehicle classification
- ii) Software based vehicle classification

II. LITRATURE REVIEW

Literature review will be categorized into two sections. In section A we discuss about techniques involved in Automatic Licence Plate Recognition. And section B we discuss about techniques involved in Automatic Vehicle Classification.

A. Review for Automatic Licence Plate Recognition

1. Automatic Licence Plate Recognition

This paper describes automatic license plate recognition processes. The ALPR system consists of four steps, Licence Plate Localization, Preprocessing, Segmentation and Normalization and Optical Character Recognition (OCR). The RGB image is converted to the gray image and binary image. Otsu method applied to convert the gray image into Binary image. Then the morphological operator applied on the image to identify the plate location. Then the plate region is preprocessed by applying the histogram equalization technique. The smearing and morphological algorithms are used to segment the characters and segmented result is normalized and fed to the OCR part for recognition [3].

Advantages:- The recognition rate will be greater if the template exists.

Disadvantages:- There are some similar characters, which is confusing for the recognition, such as O and 0, B and 8, z and 2. This decreases the accuracy.

2. Automatic Vehicle Identification by Plate Recognition

The paper presents a new smart and simple algorithm is presented for the license plate recognition. The ALPR has three stages namely, plate region extraction, character segmentation and recognition. The plate is firstly converted into binarized image then the smearing algorithm is applied to find out the plate region. After this the morphological operator is applied to get the location. Then segmentation is done with the morphological function. The dilation operator is used for separate the characters. Before the recognition, the characters are normalized. Normalization is done for refine characters into a block containing no white spaces and then characters are fit into equal size for template matching. Cross correlation method is used for character recognition [4].

Advantages:- The recognition rate seems to be high with few set of training samples. Character recognition rate is 98.8%.

Disadvantages:- Similar characters such as O and 0 decrease the accuracy.

3. Vehicle Licence Plate Recognition Based on Neural Networks

This paper publishes an innovative approach for License plate recognition based on Neural Network. To recognize the number plate a hardware component, neural network chip, cognimem cm1k is used. The chip is composed of two modules video image processing module with neural network module using equalized image processing algorithm and network classification algorithm. The chip includes image sensor, CogniMem chip, interface circuit and PC monitoring module. The video from the image sensor is sent to video module of the CogniMem chip. The feature vector is automatically generated by the chip from the region of interest given by user. The recognition is shown on the PC [5].

Advantages:- The recognition speed is high. It has high stability than the software system.

Disadvantages:- Recognition rate is less.

4. An algorithm for Licence Plate Recognition Using Radial Basis Function Neural Network

This system uses Sobel edge detector, vertical and horizontal projection and mathematical morphological operation for Licence Plate region. The character segmentation is done with the help of different process like binarization based on core region, Unifying the background color, connected component analysis, and Extract character size judgment. And Radial Basis Function Neural Network is (RBFNN) used for the character recognition process. This uses single hidden layer which provides maximal output according to the input given [6].

Advantages:-The character segmentation is done by connected component analysis, where the components which do not match height on the characters on plate are eliminated.

Disadvantages:-The system fails if the surface of the plate is not clear.

5. Smart Hybrid Licence Plate Recognition Based on Image Processing Using Neural Network and Image Correlation

This technique uses the image processing for the character segmentation. Image correlation and Neural Network with Learning Vector Quantization (LVQ) used for recognition process. The hybrid method is better for recognition, as it uses image correlation and Neural Networks (NN) with LVQ with increases the probability of recognition of the right character. The character first passed to the image correlation if its value is greater or equal to the half ($\frac{1}{2}$) then characters is recognized correctly. If it less than $\frac{1}{2}$ then character is wrong. And finally it is passed to the NN for recognition and recognised as valid [7].

Advantages:- The character segmentation process accuracy is 100% where all unwanted areas are removed.

Disadvantages:- The Correlation recognizes and accepts the character not the neural network. Correlation coefficient comparison value might not always be correct, since wrong character may be accepted.

B. Review for Automatic Vehicle Classification

Hardware based classification techniques utilizes Lasers, Vertical cameras, magnetic scanners, treadles, etc. Here we discuss software based classification techniques.

1. Neural Network-Based Classification

Neural Network-Based vehicle classification approach extracts various features from a vehicle image, normalises and classifies them. This method uses a set of features retrieved/extracted from the vehicle. Many different angles are used to view the vehicle that includes all angles of rotation by capturing the video of vehicle. Then normalize the images based on normalized features and classifier help in classifying in one of the vehicle types. First, Direct Solution Method will be created. Then the system modifies the original DSM by adding more neurons to the original method. Three training methods can be used, namely Back Propagation, Direct Solution Method and Direct Solution Method with added neurons. The Procedure of Neural Network Classification is it accept input images frame from videos then it proceed for vehicle images pre-processing then it go for feature extraction and selection then it classify multi-layer perceptron (MLP) and finally classifies a vehicle. This classifier can differentiate car, bus, van etc [8].

Advantages:-The main reason for choosing this is it can produce 100% classification accuracy on training data and has good generalisation abilities.

Disadvantages:-It doesn't handle shadow problem and natural weather conditions.

2. Eigenface Classification

This is a real-time vehicle classification method based on eigenface classifier. It includes two main steps: training and classification. In the training step, outline of the moving vehicle is extracted which consist of left, right, bottom. The vertical height is fixed. After normalization is applied, the vehicle image library is built. Later on this library is used for comparison in classification step. In classification step, features of given vehicles are extracted using eigenvector method and then based on difference between stored features and current features vehicles are classified. Results are

affected by real world conditions such as rain and fog etc [9]. Advantages:-It can produce 100% accuracy for training set but not implemented in test set.

Disadvantages:-This classifier cannot handle real world conditions such as rain and fog etc.

3. Partial Gabor Filter-Based Classification

Here vision-based classification is used in order to overcome the problems of hardware based vehicle classification. This classification technique uses different digital camera detectors. This system has three phases: 1) Vehicle segmentation 2) Feature extraction and 3) Vehicle classification. To reduce the influence caused by the hues of vehicles, Gabor features are extracted from the edge image of vehicle, instead of from the grey image. Due to high memory requirement and computational burden Gabor filter becomes inefficient so partial Gabor filter is used, which can save memory and computation cost significantly [10].

Advantages:- The accuracy is 95.17 % for edge images of vehicles while, 89.57% for vehicle grey-images.

Disadvantages: - Occlusion, shadow, rain problems are not handled.

III. CONCLUSION

When this system is actively functioning on the toll plaza, both the ALPR and AVC need to have very high rate of recognition and accuracy. As for AVC, software based classification helps to resolve lots of problems than hardware classification systems. This paper has presented review on five ALPR techniques and three AVC techniques. The concepts of the techniques, its advantages and disadvantages are also summarized in this review paper.

IV. REFERENCES

- [1]. Dipti Jadhav, Manoj Sabnis “Open Road Tolling in India by Pattern Recognition” 2015 International Conference on Technologies for Sustainable Development (ICTSD-2015), Feb04 – 06, 2015, Mumbai, India.
- [2]. Pedro MFerreira, Gonçalo Marques, Pedro MJorge, Arnaldo JAbrantes and António Amador

“Automatic Vehicle Detection and Classification” Proceedings of the 11th International IEEE Conference on Intelligent Transportation Systems Beijing, China, October 12-15, 2008.

- [3]. DRenuka Devi & DKanagapushpava Ui “Automatic License Plate Recognition”, pp75-78 IEEE 2011
- [4]. Serkan Ozbay, and Ergun Ercelebi “Automatic Vehicle Identification by Plate Recognition”, World Academy of Science, Engineering and Technology, pp 778-781, Sep 2007
- [5]. Yi Qing Liu and Dong Wei, Ning Zhang and Min Zhe Zhao “Vehicle-License-Plate Recognition Based on Neural Networks”, Proceedings of IEEE International Conference on Information and Automation Shenzhen, pp363-366, China June 2011
- [6]. Nureddin AAbulgasem, Dzulili Mohamad, Siti Zaiton Mohamad Hashim “Automatic License Plate Detection and Recognition Using Radial Basis Function Neural Network” Indian Journal of Computer Vision and Applications Vol1.No1 pp15-23 2011
- [7]. KYilmaz “A Smart Hybrid License Plate Recognition System Based on Image Processing using Neural Network and Image Correlation”, pp148-153 IEEE 2011
- [8]. Anshul Goyal and Brijesh Verma ,“ A Neural Network based Approach for the Vehicle Classification”, Proceedings of the 2007 IEEE Symposium on Computational Intelligence in Image and Signal Processing (CIISP 2007)
- [9]. Tao Xu, Hong Liu, Yueliang Qian and Han Zhang, “A Novel Method for People and Vehicle Classification Based on Hough Line Feature”, International Conference on Information Science and Technology March 26-28, 2011 Nanjing, Jiangsu, China
- [10]. Peijin Ji, Lianwen Jin, Xutao Li,” Vision-based Vehicle Type Classification Using Partial Gabor Filter Bank”, Proceedings of the IEEE International Conference on Automation and Logistics August 18 - 21, 2007, Jinan, China