

Vietnam License Plate Recognition System based on Edge Detection and Neural Networks

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Abstract. This paper proposed an improved Automatic License Plate Recognition (ALPR) system for all types of Vietnam license plates (LP), which consists of three modules: license plate location (LPL), characters segmentation and characters recognition. In the LPL module, we have combined edge detection, image subtraction, mathematical morphology, radon transform, interpolation and specific characteristics of Vietnam LP to locate exact LP region. In the characters segmentation module, we have used peak-to-valley method and statistical parameters of Vietnam LP to segment characters & numbers in one-row & two-row types of Vietnam LP. In the characters recognition module, we have used a Multilayer Perceptron (MLP) neural network and back-propagation (BP) algorithm to recognize characters & numbers of Vietnam LP, two MLP networks used independent for characters & numbers and MLP has trained with noises in the training task. Character & number images processed by the pre-processing task, which obtained high quality of character & number images for the using network task to improve accuracy of the system. We have implemented our ALPR system on 700 Vietnam vehicle images taken from actual system with different conditions such as lightening conditions (night & day), license angles, illumination, size and type, colors and reflected light. Our method is more effective than some existing methods and efficiency of computing time & accuracy is improved and very satisfied for all types of Vietnam LP and Vietnam environment.

Keywords: License plate location, Characters segmentation, Characters recognition, Automatic license plate recognition, Artificial neural network.

1. Introduction

The Automatic License Plate Recognition (ALPR) system is very important part of the Intelligent Transportation System (ITS) which is very important for the development in the transport infrastructure on the world. Specially, in the developing countries such as Vietnam, where the ITS have been beginning to apply for some years ago. Usually, an ALPR system consists of three parts: 1) license plate location (LPL), 2) characters segmentation, 3) characters recognition.

In the LPL work, there are many techniques have been proposed such as: mathematical morphology and hat transform [1], edge detection, auto-correlation and morphology operation [2], local intensity variance & local vertical edge density and a model of edge densities [3]. Vertical sobel color edge detection & edge density analysis [4], color and shape information [7], hough transform and contour algorithm [8], vertical & horizontal edge detection [12,19], sharp spikes in the horizontal projection [13]. Hough transform and feature-saliency theory [14], morphological operations, edge detection, normalized correlation coefficient [15], adaboost algorithm [21], morphological operations and edge detection [22]. Beside on that, there are some other technologies such as wavelets transform, template matching, SVM based method, neural network and genetic algorithm proposed for this work.

In the characters segmentation module, there are also some techniques to address this work such as: edge detection, color model transform, connected components analysis [4], an intelligent framework that outlines character of car LP by various illumination [5]. Horizontal projection [8,19], multi-clustering algorithm [10],

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threshold and connected components [12], horizontal and vertical projections [13,15,18]. Color reverse, vertical edge detection, horizontal projection histogram, vertical projection [9], morphology operation and connected components [22].

In the characters recognition module, there are also many techniques to address this work such as: decision trees [6], color image processing [7], hidden markov model [8], support vector machine [9], multi-cluster and multilayer neural networks [10]. Least squares support vector machines [11], multi layer perceptron network [12,13], template matching [14,22], fuzzy multilayer neural network [15], bayesian framework [16], radial basis function neural networks [17]. And fuzzy method & template matching [18], extension theory [20], and OCR software [21].

Although, there are many method proposed for ALPR system. But, there are not single method can provide satisfactory performance in all the applications in various complicated background such as: uncertainty of edges, various types of plate, the plate is small, dim lighting, the images are fuzzy, low or high illuminated images, types of plate, colors, character fonts, syntax, size, spacing, angle of the LP, weather and environment, multi-rows. On the other hand, every researcher used various image sources, environment, quality of the images, parameters of the images are not same, and the vehicle images not collected in Vietnam. Therefore, most of the previous methods could not apply for all the countries, all the environments, all types of the LP and Vietnam LP.

To cope with these limitations, we have considered for the specific characteristics of Vietnam LP and Vietnam environment to propose a new method for the Vietnam ALPR system, which satisfied for all types of Vietnam LP and Vietnam environment, our ALPR system has main contributions as following:

- In the LPL module: We have combined morphology operation & subtract operation on the grayscale image, which very efficiency for complex background images, night & day images and different illumination, different light conditions, from that we have obtained the better image with new intensity values, which more satisfied for the image binarization to reduce candidate regions. And then we used opening operation on binary image to remove small objects (noise areas), using radon transform and interpolation method to find LP angle & rotating LP, and measuring properties of license plate regions to cut exactly for different Vietnam LP dimensions (one-row and two-row LP). Therefore, our method is more effective than some existing methods and very satisfied for Vietnam LP.
- In the characters segmentation module: We have considered statistical parameters of Vietnam LP and types of Vietnam LP (one-row LP and two-row LP) to propose an improved method to segment characters & numbers in one-row & two-row types of Vietnam LP based on the peak-to-valley method & statistical parameters of characters and digits. We also combined pre-processing (image quantization, normalized image, adjust horizontal contours, morphology opening to remove noises) to improved image quality and remove noise, our approach is very satisfied for all types of Vietnam LP.
- In the characters recognition module: We proposed an improved method to recognize characters & numbers of Vietnam LP by using a Multi-layer perceptron (MLP) neural network and back-propagation algorithm to recognize characters & numbers of the Vietnam LP. In the training task, we used two networks in training task for characters & numbers with noises, which the computing time and accuracy be improved, in the using network task, we used image processing technology for pre-processing to obtain high quality of characters & numbers before put them in the trained network to improve accuracy of the system

This paper is organized as follows: section 2 introduces license plate location, section 3 shows the characters segmentation, section 4 shows characters & numbers recognition, section 5 shows experimental results and section 6 is conclusions and the last is references.

2. License plate location (LPL)

2.1. Flowchart of LPL