

Segmentation of Symbols on the Car License Plate Images

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Abstract: The offered method of car license plate symbols segmentation is based on use of models of a symbols arrangement on plate image. Matching of various models to the real image defines the model having the best conformity which parameters are used for determine of coordinates of symbols. Such approach has allowed to obtain also type of plate and a symbol accessory to letters or numbers that facilitates their further recognition. The offered method of symbols segmentation allows to use it successfully in systems of recognition of car plates.

Keywords: image processing, car plate segmentation, car plate recognition, symbol segmentation.

1 Introduction

It is possible to present the decision of a problem of car plate recognition in the form of a complex of algorithms of processing and the analysis of images including plate area detection on the image, normalization of the plate image, segmentation of symbols and recognition of symbols. The decision of a problem of detection of license plate can be executed according to the approach offered in work [1]. In work [2] the decision of a problem of normalization of the car plate image is offered. This article is devoted to decision of a problem of symbols segmentation on the images of car plate.

As the initial data arriving on an input of algorithm of segmentation, we will use images of preliminary detected one-line license plates by one of known methods. Such images can have following deviations from the standard plate image having a zero angle of rotation in an image plane (see Fig.1): plate angle in an image plane can be in the range from -10 to +10 degrees; the ratio of the horizontal size to the vertical size belonging to interval $[0.6K_t; 1.2 K_t]$ that can be caused changes of a perspective of car plate observation. Here K_t – the reference ratio of the horizontal size of the plate image to the vertical size, equal, according to the accepted standard, 520/112 [3].



Figure 1. a) Standard car plate image,

б) Examples of car plate images on an input of algorithms of normalization and segmentation.

After normalization carrying out input images of car plates are transformed so that the line of symbols settled down horizontally. Then the received images put on an input of symbols segmentation algorithm.

2 Symbol segmentation algorithm

For segmentation of symbols on a car plate images it is offered to use the approach based on adjustment under the real image of various models of an arrangement of symbols on plate. Each of models corresponds to the certain standard of an arrangement of symbols. In given article two models of an arrangement of symbols in one-line license plates which it is possible to present following types are considered: {LL NNNN LL} and {NNN-NN LL}, where L – letter, N – number.

It is possible to present each model in the form of the image of the dark rectangles corresponding to symbols, on a light background (see Fig.2).

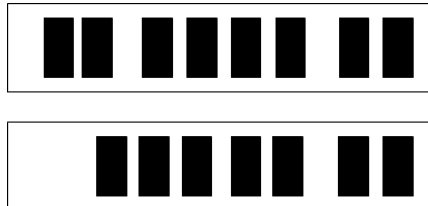


Figure 2. Examples of used models of an arrangement of symbols.

If plates have other type, for example white symbols on a red background, or on black before comparison of model to the image the last can be inverted on brightness.

As criterion of conformity of model to plate image is used:

$$K(x, y, W, H) = \frac{S_w - S_b}{\sigma_w}.$$

Here S_w - average brightness of the image under light area, S_b - average brightness of the image under black area, σ_w - standard deviation of brightness of the image under light area, x and y - coordinates of model in plate image, W and H – the horizontal and vertical sizes of model. The larger value of criterion corresponds to the more model accordance to plate image.

Model adjustment under the image consists in a choice according to the accepted criterion of the best position and the sizes of model. After that according to the same criterion the decision on the best type of model for the current plate image is made. If to consider possible errors at number normalization, on the basis of the offered criterion it is possible to define independently more exact position for each symbol separately near to its found position with use of total model.

Calculation of criterion value in each possible position of model in the license plate image can be effectively executed on the basis of use of integral images for the initial image of plate and the image of squares of its pixels brightness [4].

Examples of working results of the offered algorithm of symbols segmentation are resulted on Fig.3. In the top line (see Fig.3) are presented the initial images of car plate, in the bottom line – result of segmentation of symbols (each symbol represents the separate image) are shown.

The images of symbols received after segmentation stage allow to use them for the decision of a recognition problem. The offered algorithm of segmentation allows to estimate also license plate type and, hence, to find out is each of symbols a letter or number that will allow to simplify the analysis of images at the subsequent stage of recognition. Offered simple enough models allow to carry out operation of segmentation with high efficiency on quality and computational speed, and also allow to expand

in case of need without considerable additional efforts number of used license plate models by inclusion in consideration of other possible arrangements of symbols.



Figure 3. Examples of symbols segmentation results.

3 Conclusion

The algorithm of symbols segmentation considered in article on quality and computational speed allow to use it in car plates recognition system as a preliminary stage of preparation of images to recognition. The offered models of plate images can be easily added or replaced by other models corresponding to other standards of an arrangement of plate symbols. Received at a stage of segmentation the information allows to estimate as well number type that simplifies the further recognition at the expense of knowledge of an accessory of a symbol to letters or numbers.

References

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