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An Automatic Detection of License Plate Number Using Genetic Algorithms

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Abstract: *License plates being the unique identity for any registered vehicle, License plate recognition systems have been used to resolve the issue of identification of vehicles. In this paper, a new novel approach is proposed to detect the locations of license plate symbols. Dynamic threshold method is applied to overcome dynamic changes, when converting RGB image to binary. Connected component analysis is used to group the pixels based on pixel connectivity from the scanned image. A scale-invariant geometric relationship matrix is introduced to model the layout of symbols in any license plate. In addition to these techniques, two new crossover operators are introduced, which improves the convergence speed of the system. This system can be useful in video surveillance applications such as intelligent parking, automated toll payment, intelligent surveillance and security enforcement.*

Keywords: *Genetic Algorithms (GAs); Connected Component Analysis (CCA); License Plate (LP); Crossover operations.*

I. Introduction

The detection stage of license plate is the most critical stage in an automatic vehicle identification system. All the developed techniques can be categorized according to the selected features upon which the detection algorithm was based and the type of the detection algorithm itself. Color-based systems have been built to detect specific plates having fixed colors. External-shape based techniques were developed to detect the plate based on its rectangular shape. A license plate recognition system generally consists of three processing steps: 1.license plate detection 2. Character segmentation 3. Character recognition. There are many factors to be taken into account when developing license plate detection method. Images can be captured in different illumination conditions and may contain other objects such as buildings, people, trees, fences etc. Also the number of vehicles and the distance between the vehicle and the position of camera can vary. This makes license plate detection to be the most important and challenging step. GA was used to search for the best fixed rectangular area having the same texture features as that of the prototype template. The used technique lacks invariable to scaling because fixed parameters have been used for the size of the plate's area. In GA was used to locate the plate vertically after detecting the left and right limits based on horizontal symmetry of the vertical texture histogram around the plate's area. Detecting license text and at the same time distinguishing it from similar patterns based on the geometrical relationship between the symbols constituting the license numbers is the selected approach. Consequently, a new technique is introduced in this paper that detects LP symbols without using any information associated with the plate's outer shape, internal colors and capturing conditions such as poor lighting, shadows, and camera position and orientation. The proposed system is composed of two phases: image processing phase and GA phase. GA selects the optimum LP symbol locations depending on the input geometric relationship matrix (GRM) that defines the geometrical relationships between the symbols in the concerned LP.This system can be applied in several applications such as car theft, intelligence traffic emergency, monitoring of vehicle traffic and flow control, intelligent parking, automated toll payment, intelligent surveillance and security enforcement. A very important achievement is overcoming most of the problems arising in techniques based on CCAT by allowing the GA to skip gradually and randomly one or more symbols to reach to an acceptable value of the objective distance.

II. Block Diagram

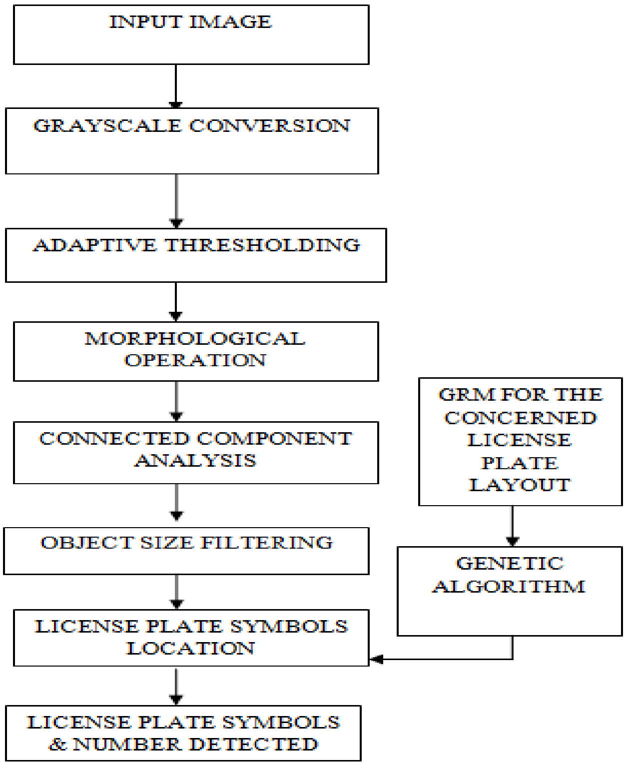


Fig 1; Detection of License Plate Number

2.1. Gray Scale Conversion

Input image is captured as a color image. This conversion is performed using standard NTSE method by eliminating hue and saturation.

$gs = 0.299 \times R + 0.587 \times G + 0.114 \times B.$

2.2 Adaptive Binarization

A local adaptive method is implemented to determine the threshold at each pixel dynamically depending on the average gray level in the neighborhood of the pixel. If the pixel intensity is higher than 90% of the local mean, it is assigned to the background; otherwise, it is assigned to the foreground.

2.3 Morphological Operation

Morphological operations, such as dilation and erosion are performed to eliminate noises and retain only the targeted patterns. In LP detection, closed operation is applied (dilation followed by erosion) to fill spaces inside the object and connect broken symbols.

2.4 Connected Component Analysis

In this technique, it scans an image and groups pixels in labeled components based on pixel connectivity. An eight-point CCA stage is performed to locate all the objects inside the binary image.

2.5 Size Filtering

The objects extracted from the CCA stage are filtered based on the basis of their widths W_{obj} and heights H_{obj} such that the symbols lie between their respective thresholds.

$Wmin \leq Wobj \leq Wmax$ *and* $Hmin \leq Hobj \leq Hmax$

2.6 Genetic Algorithm

The proposed fitness is selected as the inverse of the calculated objective distance between the prototype chromosome and the current chromosome. Before clarifying how the objective distance is measured, we will show first how the geometric relationships between the objects inside a compound object are represented, followed by a discussion of parameter adaption in case of various LP detection layouts.

III. Algorithm

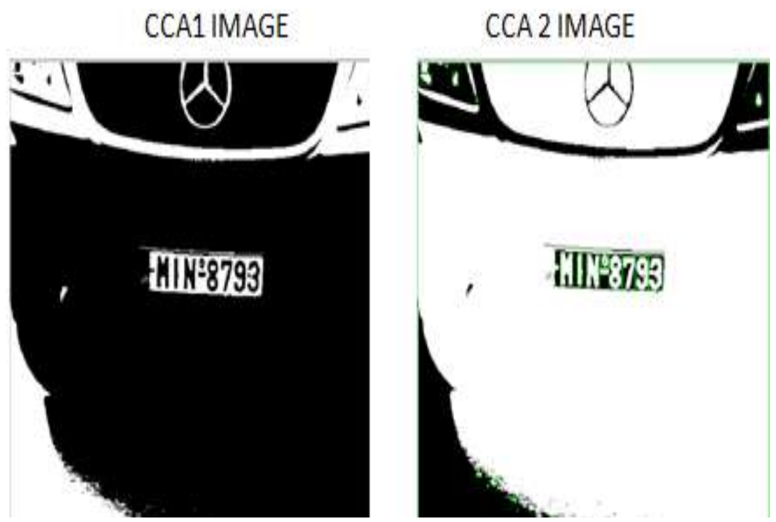
The algorithm includes the following steps:
Step1:
Converting the input (RGB) image into grayscale image.
Step2:
The obtained grayscale image is converted into binary.
Step3:
Morphological operations such as dilation, erosion are applied to the binary image to eliminate noisy objects and retain the targeted patterns.
Step4:
Connected Component Analysis technique is used to group the pixels in labeled component based on pixel connectivity.
Step5:
Size filtering concept is applied to the obtained image, which is followed by plot bounding box.
Step6:
Genetic Algorithm is applied for pattern recognition and sorting.

IV. Results and Discussion

The proposed system is implemented using MAT-LAB. The experiments were carried out on an image acquired at various cameras to object relative conditions in suitable lighting conditions. The images corresponding to the algorithm are displayed below:

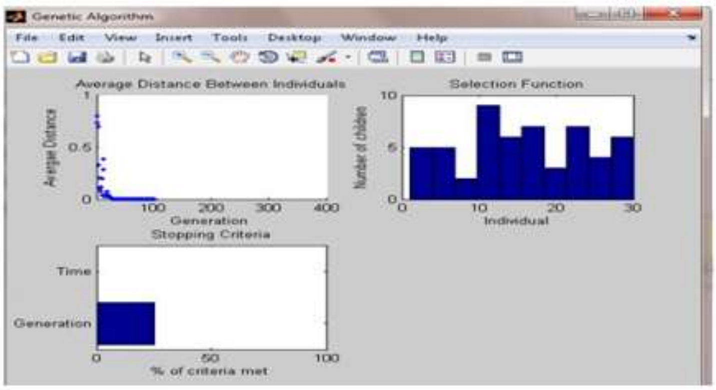
Output of Grayscale conversion

Output of Morphological operation



Output of CCA technique and GAs

Fitness Function: Genetic Algorithm



V. Conclusion

This method gives better performance compared to the existing system and it can be used in video surveillance. In this system, dynamic adaptive thresholding and Connected Component Analysis techniques are implemented to determine threshold at each pixel and eliminate noisy objects. Pattern recognition and sorting are performed by using genetic algorithms.

VI. Future Work

A new research dimension for GAs was opened to allow for the detection of multiple plates and even multiple styles in the same image and to increase the performance in terms of speed and memory and to apply the same technique in other problem domains analogous to the LP problem.

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