Innovative system for Auto-recognizing license plates based on matching shape and getting weight

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Abstract: *Car license plate auto-recognizing system is so useful for supervision on laws and security control in urban and out urban transportation.*
An effective license plate auto-recognizing system has engages with many problems like full-noise environments, damaged license plates, different light emitting conditions, weather conditions and processing problem because of movement cars.
So that in this paper we are trying to use some more reliable and stable features in numerous conditions. Thus in here we use pattern recognition algorithms, innovative matching shape and new getting weight method to points for this objective. In both detecting plaque and reading characters used this new procedure. Results shows suggested methods able to find the just process zone for more performance and faster than other algorithms. One of the best features of this procedure is its accuracy about 95% in even full-noise environments. license Plate reader algorithms in this method separately able to process and extract the numbers exist in image in any conditions which we are not able to separating the specified process zone in received image.

Keywords: Plaques distinguish , divide the area of image , letters distinguish , model adapt , morphologhy.

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1. Introduction

Nowadays , distinguish the plaque of automobile have important role in many of intelligent systems such as study thee automobiles traffic in roads and highways , pay the taxes in entrance of highways intelligently , entrance and exit path of parking , exert the laws of traffic department,… For this reason , speed researches are performing about distinguish the automobile plaque and we expect to find the methods that have acceptable results at undesirable condition of imaging. A plaque recognition system generally consist of two main parts : distinguish the place of plaque at automobile image and distinguish the characters for reading the plaque. The stage of distinguish the place of plaque is a difficult stage and have special sensitive. Because of different conditions in take picture such as distance,angle of plaque with optical axis of camera,environmental variations,dirty and injury of some plaques and variety of placing the plaque in automobile,the automatic distinguish of plaque place isn't easy.

Among these used methods is determining the place of plaque according to Gabor changea [3] ,genetic programme writingb [5] and genetic Algorithm [6] which the percent of recognition has reported about 80/6% .Haff changec [HT] is used for distinguishing the plaque too,[1] but executing the HT on binary images with many points need to hard and time-consuming accounts. The method of distinguish the outomobile plaque at images of grey surface and extraction the vertical edges and finding the area with great density of edge has been done too. The tittles of investigation consisted of automatic recognition of plaque hase on Histogram and morphology operations [9],displace the stroke small wave which is a method for extraction of regions that have upper contrast [2],Vector quantization [4] and phase logic [10][11]. Hidden markov model [1],pattern conformityd [12] and Havsdorf distancee [7] has been used for recognition the letters on plaque. Because of existence the documentary information of edge at region of plaque,the use of finding the edge [8] and it's extraction [12] has considered. In this paper a method show on this hasis which is base on characteristic of plaque that have more constancy such as : parallel lines around the plaque,rectangular around yhe plaque that for Special plaque (national plaque) the ratio of length to width is a constant number , the Persian numbers on the plaque and the frequency of plaque region that differ from other region because of existence yhe numbers. The parallel lines around the plaque and rectangular around the plaque have been used in this algorithm.

In the present investigation , our proposed method for distinguish the place of plaque will describe that is base on use of conformity frames and weight to pixels (section 2) , then consider the method for distinguishing

the characters on yhe plaque (section 3) , finally , the obtained results will discuss and conclude.

2.   Proposal Algorithm

Now, we study the algorithm stages of separation yhe place of plaque and distinguish it's numbers and characters.

2.1   Pre-Process

After take the picture A0 from entry of upper filter , we use h which it's function is reinforcing the difference between points and their neighbor regions. Then we use a threshold by T parameter , so the points of image will reveal that their abstract valus is greater than threshold or equal to it and the other will eliminate. Figure 1 show the example of results and using of this stages.[3]

$$A_1 = A_0 \times h \qquad (1)$$

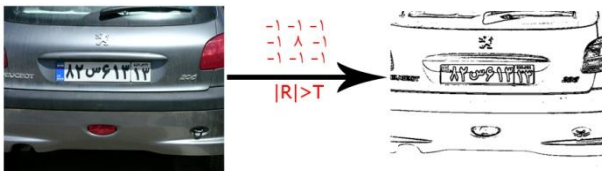$$h = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix} \qquad (2)$$

$$(3)$$

Figure 1 : The results of using the upper filter and using threshold pre-process operation :

We used the standard method of minimum point between two histogram maximum to determine the best threshold T. Finally,A2 is the threshold from in the above relations.

2.2   obtain the weight centre for pixels on the edge

Afler determining the edges of image in the previous stage , we divide the image to 5*5 (or similar dimensions) and calculate the weight centre f of all pixels on the edges as follow :

$$G_x^{u,v} = \frac{\sum_{i=1}^n x_i}{N} \qquad , x_i \in p^{i,j} \qquad (4)$$

$$G_y^{u,v} = \frac{\sum_{i=1}^n y_i}{N} \qquad , y_i \in p^{i,j} \qquad (5)$$

Where N is the number of all pixels of one region , (yi) xi is the horizontal (vertical) coordinate of pixels that connect to central pixel , and Gu,v is the region (u,v)th of neighbor 5*5 image. 5*5 windows will slip on the image while the weight centre for points on the edge calculate and save until the volume of calculation will decrease. The points that calculate in previous region , will be mark and don't use at new regions calculations again.
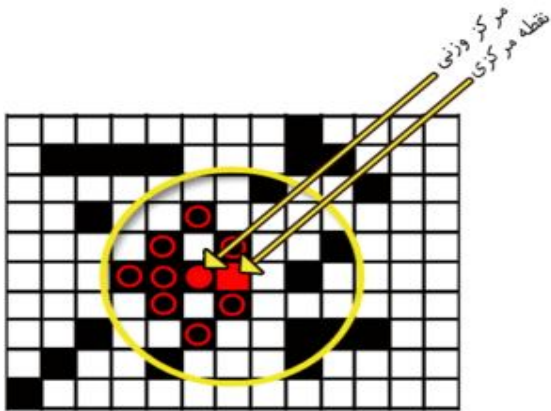
Figure 2 : is an example of the manner of calculation the weight centre

2.3 obtain the existing lines in one page by line pattern

It is used of adapling with pattern of a line for obtain the existing lines at the image. This pattern rotate around it's central point and is in common with all edes of image by adapting wih all weight centre. The angle that have the most in common pixel with line pattern , weight in amount of length of the same line. In every defined direction , if notch will be less than 3 pixell , this notch will be ignore. This amount obtain by error and trial and in according to environmental conditions of take picture. Weight will be done in the manner of geometrical progression with ratio 1.1 .

$$W_i = 1.1 \, W_{i-1} \qquad (6)$$

This matter cause the points that place on the line , reinforce the weight of line constantly and the points that consider as a line at a stage by mistake , their weight will be very lesser than the main lines of image because they don't place on the other line. We consider only vertical and horizontal lines for distinguishing the plaque. So , the line pattern rotate only between following angles :

$$\theta_V = [90° \pm 5]° \, , \quad \theta_H = [180^0 \pm 5]° \qquad (7)$$

Then the main vertical and horizontal lines obtain by combine the pixels which have weight more than threshold.
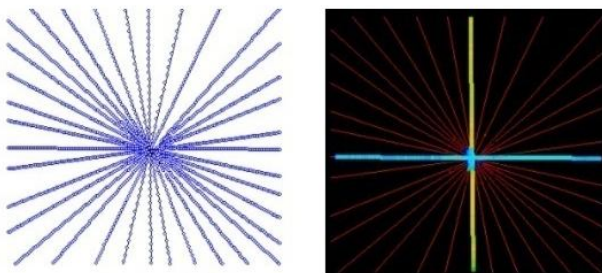

Figure 3 : the manner of vertical and horizontal lines pattern and the effect of give weight

We use of parallel line to have monotonous and continuous long lines. Of course , all operation of this stage accomplish on the weight centres because of increasing the speed. After use above pattern , we can conclude that all pixels which their weight is higher than certain amount , place on a vertical or horizontal line and we can distinguish the vertical or horizontal of line by saved information of angle of edes. From this stage to next , all of operations accomplish only on these pixels for finding the plaque.

2.4 Finding the necessary pattern for plaqueplace finder we have used four

frame for distinguishing the left,upper,right and down edges of plaque. Figure 4 show these the four frames. In according to extracting the information about vertical and horizontal edges in previous,such az the number of pixels or angle,we can distinguish the place of plaque on image by moving this frame on the lines and definging an adapting amount. We can compensate the difference in plaques size that,due to automobile distance to camera , by sliping the 15 frames with different size on the image and announce the adapting only one of them is enough to confirm the place of plaque. If there isn't adapting , the quality such as figure 5 will happen. Unadapting part have distinguished by grey point.

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Figure 4 : A pattern with different sizes for finding plaque frame

Figure 5 : An example of error code of unadapting in plaque

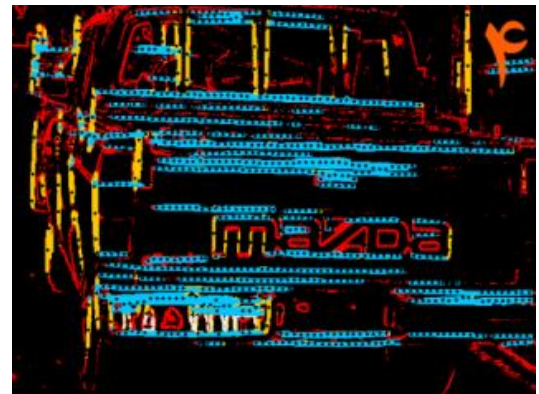In figure 6 you can see the stages of algorithm use on image of one automobile

1-The first image

2-The image after using the edge filter

3- The image after obtaining the weight centre

4- use the filter for distinguishing the vertical and horizontal lines

5-The plaque frame after use the pattern for distinguishing the plaque frame

Figure 6 : representation the results of different stages of plaque finder algorithm

3. The manner of plaque reading

After distinguishing the place of plaque on image , the algorithm of this part will operate for distinguishing the charactars which are on the plaque. The proposal way for this part is base on adapting the frames. In the plaque frame , the algorithm for determine the weight centres repeat for finding the weight centres of characters. We can adapt the frame with a number of limited frame for every character (numbers from 0 to 9 and permissible letters) because,the shape frame of charactors usually is constant .Then we relate a frame with maximum adapting to every weight centre .Figure 7 show the five frames which is used for number 3 and weight centres.
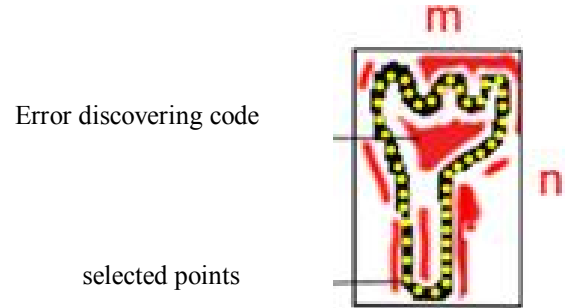

Figure 8 : The critical regions in pattern

We use the software technique of addressing between layer so , we use only the frames which have reliable edges.

It is possible to repeat the algorithm with increasing adapting threshold for refining the doubtful patterns and protect the final pattern of numbers. In practical tests , we can reach to better results by repeat twice this algorithm with increasing thresholds. You can see the operation stages of algorithm for distinguishing the characters in figure 10. In this place the operations of distinguishing the numbers on one image with noise have been done. The resulte of distinguishing the numbers and weight of every number at exit of algorithm determined at parts C and D of this figure
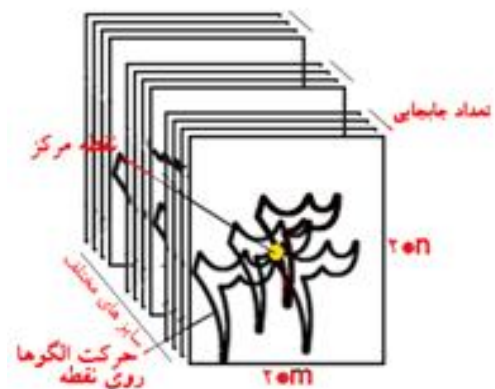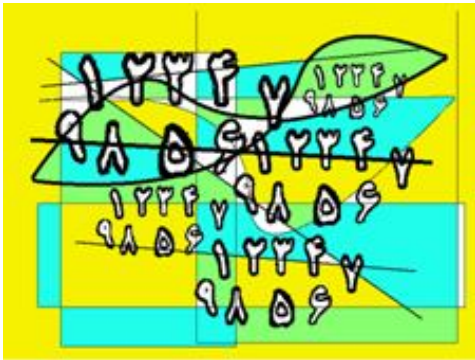

Figure 7 : region dividing pattern and finding the weight centre

Practically , for every character have been used 6 frames with 6 sizes The total speed of operation is acceptable with due attention to binary nature of adapting operations. Of course , the patterns establish a little thick because covering more sizes. The critical regions consider at pattern because increasing the accuracy these regions have negative weight and place in regions that there is numbers difference. This matter Improve the separation of similar numbers. Figure 8 show this critical regions or disconvering the error for frame 3.

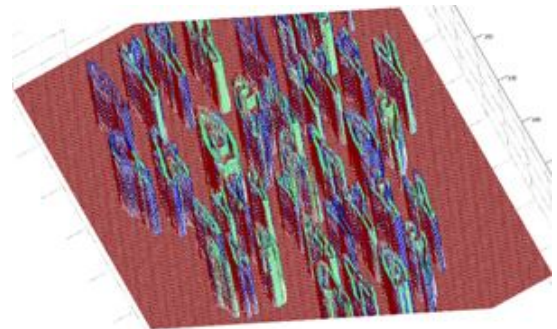Figure 9 : find the pattern which it's edge is reliable

A) The first image : numbers in compound and nois environment
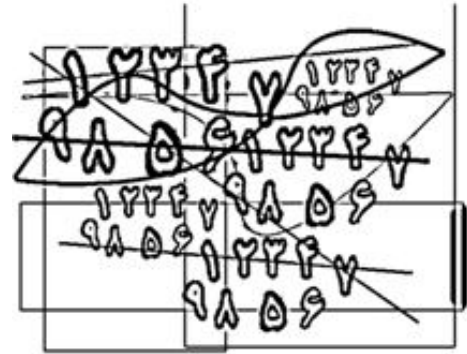
B) The finded edge image

C) The image after using the number frame and eliminate the pixels that have weight less than threshold


D) Three dimensional graph of weights after finishing the algorithm

Figure 10 : Algorithm stages of plaque reading

Conclusion and add up

The results of use two plaque-finder and plaque-reading algorithms is on figure 11. In these experiments , the proposal manner examine on the 130 images of different automobiles which taked Picture at different conditions. The environmental light conditions , camera angle and distance were different and for example , the approximate distance of automobile to camera was between 2 to 5m. The accuracy of system at plaque-finder was about %94 in the above experiment and the accuracy of plaque-reading part was %100 of the accurate distinguish of characters.

Above results indicate the accuracy and efficiency of proposal manner in plaque-finder and plaque-reading. More experiments is in prepavation because of reliable and generating of results.
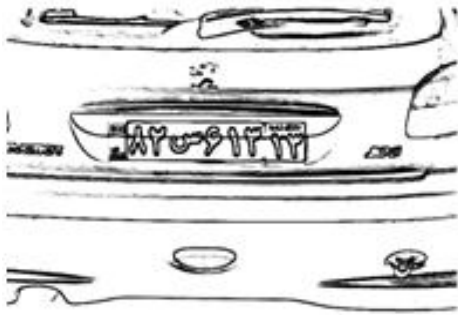
A : plaque-finder
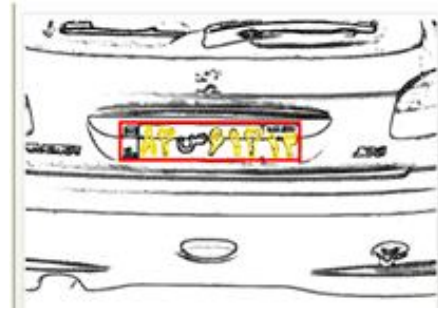
B : plaque-reading

Figure 11 : sample of plaque-finder and plaque-reading

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