LICENSE PLATE RECOGNITION USING IMAGE PROCESSING AND SHAPE COLLATION

Navid Samimi Behbahan*

Hedayat Bahadori*

Abstract

Effort has been made in this article to use new methods for recognizing Iranian vehicles' license plates. It would be possible for us to extract the area encompassing the license plate using the science of image processing on the blue regions within the plate, later to make the image areas separately distinct from other areas according to the geometrical plate shape. And, tease out – through modern methodology – in a much more secure manner, the license plate numbers, so that finally the extracted digits could be distinguished by means of shape collation.

Key words: License plate recognitions, image processing, shape collation, digits' recognition (OCR).

* Sama Technical and Vocational Training School, Islamic Azad University, Omidiyeh Branch, Omidiyeh, Iran.

1. Introduction

We are all in the know that nowadays – with the present advance in the field of science and technology and with the huge expansion in the number of vehicles – and, yet again in view of urgent needs to recognize license plates on vehicles, there is to be found ample application for intelligent systems of vehicles' license plate numbers. For example, such systems are to be of wide application in building blocks parking places, in controlling city traffic, and in recording driving transgressions. License plate number identification intelligent systems are deemed to be a branch of machine vision applying the image processing science [1] to extracting and distinguishing license plate. We are sure that a vehicle's license plate is one of the most prominent distinguishers for it; and, because of its uniqueness shape, and specific size it has, it is easily recognizable for us as human beings while recognizing it is a rather difficult job for machines. And images ought to be transferred onto the machine by means of a camera: i.e., the camera has to do the job of human eyes which makes our work something like human brain simulation in myriad times much simpler. Although, many works have been accomplished by different people for such systems, they have not been good substitute as of their inefficiency suitability, so that they could be brought into proper application despite the fact that each one has taken a step in evolving these systems. We shall later on review works done in this field in the present article.

Hajipour and Alian, having done the necessary preprocessing on images and finding out the differentials and coming to a threshold, dropped the extra edges to expand the image and discover the regions using license plate fuzzy possession functions finally to extract plates' characteristics after imposing the Gaussian filtration through the images to come to the thresholds. Then, they dropped the areas of the color of blue to extract the characters' areas which would make necessary the use of fuzzy possession functions in case the number of extraction areas were below eight, all of which led to the distinguishing of the numbers through the use of neural networks [2].

Ashrafi Khoozani and Monajemi – having used the image of processing method of changing necessary half-pre-processing over the images – came to apply the operations of image edge-finding and to convert the license plate's letters half image discovered as a result of the said

process, later to separate digits by means of multilayer percpetron neural network, finally to start to recognize the numbers [3].

We shall get into more exact discussion of the algorithm to be used in solving this problem in sections posterior to the present one which, of course, makes our intended algorithm a combinatorial one: i.e., a modern method to get hold of known the place of the license plate and presenting some way for teasing out digits one from the other. In this algorithm before the preprocessing necessary to be imposed on images using the blue color characteristic on the corner of the license plate [4] the region encompassing the plate is distinguished. Then, using the license plate geometrical characteristics [5] and operations of finding the edges [6], the license plate can be separated from the image. Upon separating the image from the license plate, we come to teasing out the digits themselves. In order to accomplish this things on the license plate are to be numeralized, then to be recognized under certain circumstances as the license plate's numbers. In the end, by means of collating shapes, we shall be able to recognize the separated digits from the license plate itself. Figure (1) shows various stages of license plate recognition.

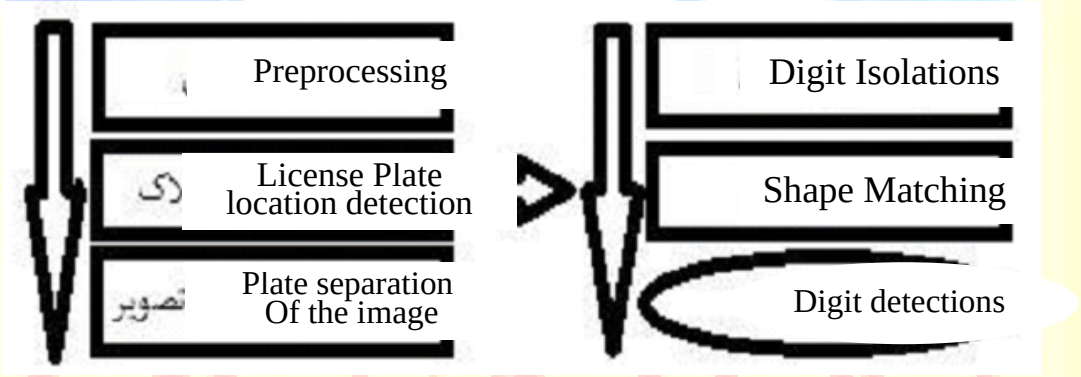

Figure 1: License Plate detection phases

2. The Problem

As with other algorithms, the input image of ours would be a color picture with indefinite dimensions in which the license plate might be located as any part of the image. The problem to be solved is finding the license plate within the picture of the car, so much so that the plate's number could be recognized in the final stage.

3. Preprocessing

Prior to calling on the image within the Matlab software, we turn it into the size of 500*300 in order to reduce down the volume of calculations to some degree and economize in time. Because of lack of wide ability on maneuvering over the RGB image color mode, we convert it from the RGB state into the HSV color modality whereby the separation of different colors might be much easier in addition to easier recognition of the plate's blue-color region. In figure (2), we have both pictures in two color modalities of RGB and HSV: as you can observe, the blue plate part in the HSV color mode has been turned into the right which means that colors with blue nature are recognized as white in the HSV color sphere.

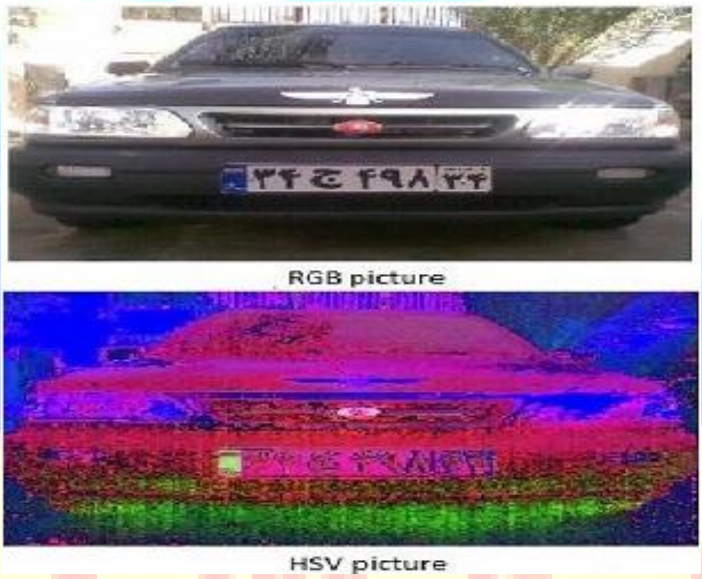

Figure 2: Vehicle image in two color mode (RGB and HSV)

The color sphere of HSV has three distinct characteristics indicating the color type, color intensity, and color brightness in which each color in any one of these three distinct characteristics has a value: i.e., as for any one certain color there are different three characteristics out of which comes a stupendous property by means of which the three characteristics could be most easily be extracted under whatever color which is desirable to us to, finally, arrive at the intended color region. We can observe in figure (3) how the blue license plate in each one of the HSV color modality spheres might come out.

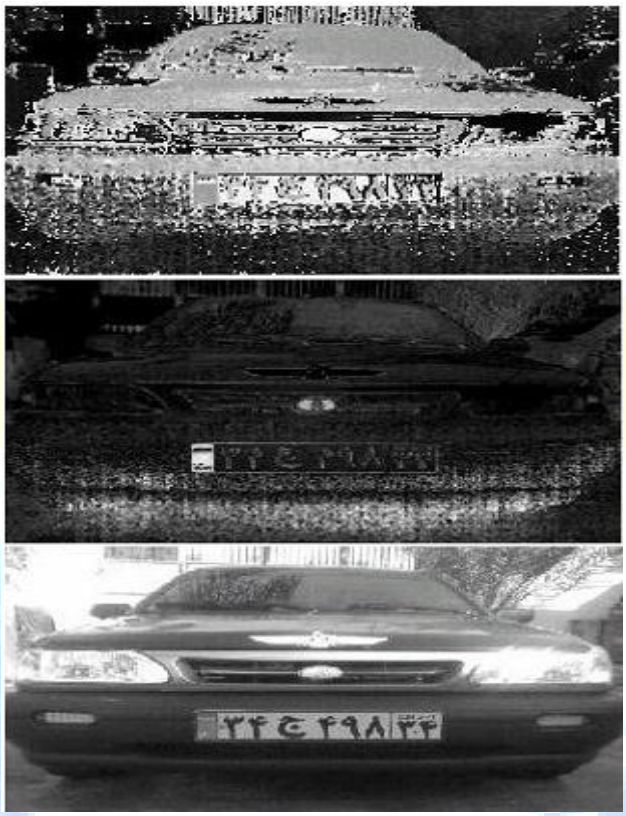

Figure 3: license plate Blue color in color space characteristic of HSV (from up H, S and V)

As we came to see, the combination of these three characteristics creates a certain unique property for the color of blue which makes the job of distinguishing more facile. You can see that the color of red in the three variables of H, S, and V are in white, while the blue in the same variables has come out to be, respectively, grey, white, and grey.

4. Recognizing the License Plate's Placement

After migrating into the HSV color sphere and in view of the blue color map within the HSV domain, we have to put down as a condition the fact that the pixels within the variable of H – if possessing a value number above 50 and below 70 – come to have the nature of the blue. Also, pixels with intensity above 50 and below 70%, and brightness more than 40 and less than 75% are to be a blue pixel of the same color as the license plate would be. Now, if in the image, 10 pixels within a certain line all juxtaposed one to the other have this very feature, then the place of the selected pixels – in as much as 95% of cases – would be the place of the license

plate on the vehicle in the picture. The quasi-code you can observe hereunder in the picture shows how to find the placement the license plate.

```
for i = 1 to picture.width
        for j = 1 to picture.height/2
                if ((h(i,j)>50 && h(i,j)<70) &&
                ( s(i,j)>50 && s(i,j)<70) ) &&
                (v(i,j)>40 && v(i,j)<75))
                //for detect blue color
                        count = count+1;
                end
                        if (count>10 && row==0)
                                row = i  ;
                                col = j  ;
                                break ;
                                // find location
                        end
        end
        count = 0;
end
```

Figure 4: code for finding license plate location

As you can observe in the quasi-code, upon finding 10 pixels with the mentioned characteristics on the same line all juxtaposed one to the other, then the license plate's placing would come out distinct. We can also see in figure (5) that the selected algorithm region does include the license plate within the image which includes the selective blue-color section.

Figure 5: Selected area from image that included of the license plate image

5- License Plate Teasing Out

After selecting for the intended region, our image is now turned into one of "black-and-white", and this is because in the RGB color modality we would not be able to do what we want to accomplish as our operations over the image. Upon converting the picture into a state of "grey"

we can find the edges using the "triple derivative" method. The reason why we use the triple derivative is that it can show the edges much more strongly, and the edges contain the plate itself except strong edges. We, then, strengthen the obtained edges and fill out the probably-created pits. This causes an object to be created within the realm of the image of greater area and higher height as compared with the other objects in the image. Now, the turn has come for extracting the license plate of which the stages are as follows:

1- Tagging the picture
2- Choosing for the largest object present in the picture
3- Collating the object of the greatest area with the object of the largest height
4- In case of any contrast on the part of the object with the greatest present area in the picture as against the object with the tallest height, the picture is cut out with the points of start of the greatest area and the points of end of the greatest height.

The teasing out operations – stage by stage – is brought out in figure (6).

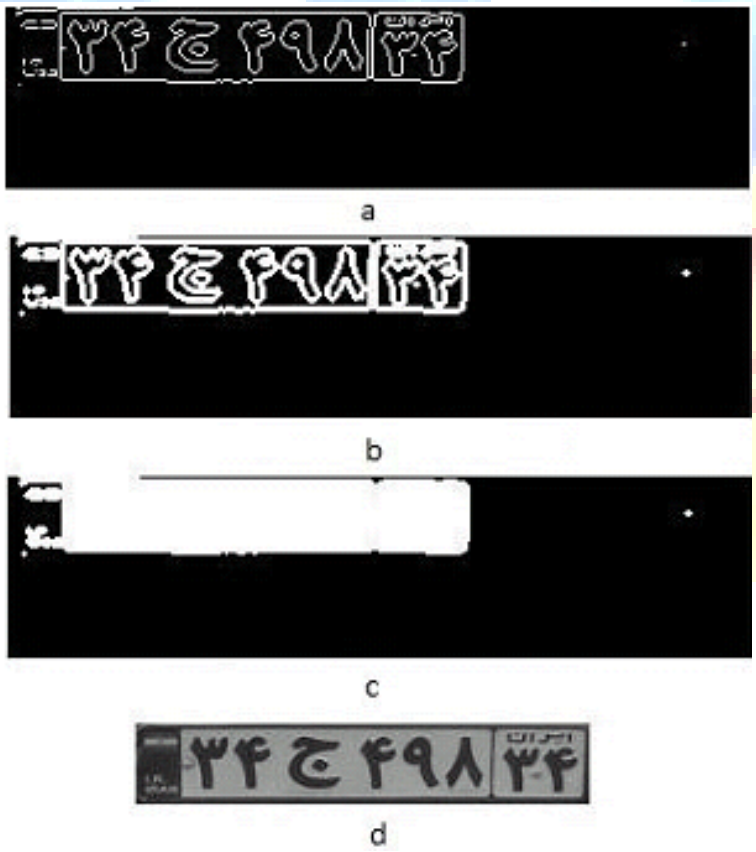

Figure 6: license plate separate stages from image (a: The edge detection of an image, b: edge strengthens, c: filling holes caused, d: license plate extraction from image)

The mentioned algorithms for recognizing the placement and extracting the algorithm license plate are relatively good, able to do the placement and extraction rather well in various distances and different angles. The algorithm comes to difficulties whenever there would have been, within the picture, an object of the color of blue behind the plate with the same blue intensity as the license plate itself. Of course, in case of non-recognition of colors and the algorithm's disability to recognize properly the placing of the plate, the program would go on to yet another algorithm of which the elucidation of workings may be as follow:

If blue colors are ever observed on the same line and in different distances, the prior algorithm's working program would be ceased to go on to the second algorithm. In this methodology, posterior to the preprocessing operations of the totality of the picture whose edges have been found, and posterior to the operations of boosting the edges and filling out probable pits in addition to giving numbers to pictures, the object possessing the following conditions could be recognized as the license plate:

1) Having a length of more than 200 pixels and a height of more than 60 pixels
2) Having all the three colors of black, white, and blue. This condition makes the probability of

the object itself being actually the license plate much higher

3) Possessing more white squares as compared with the black ones

This algorithm's capacity is greater than the previous one; however, because of lower speed in comparison with the previous algorithm, it has been chosen to act as a substitute for it: in case of the prior algorithm's disability, this one is brought into application.

6. Teasing out the Digits

Having extracted the license plate from the image, the turn comes to befall upon teasing out digits. The applied algorithm in this section of the work is absolutely fresh and unique. The said algorithm acts this way:

First, we convert the plate size into one of 200x60 to have a distinct size and increase the instructions' carrying out speed onto an acceptable level. We know that the digits' height on the plate contains some height smaller than that of the plate itself: of course, their height is bigger than half the size of the license plate. Additionally, their width is also smaller than the biggest

object in the picture. In point of fact, the greatest width goes to the framework around the license plate. As a result of this condition, the framing edges are not be taken into consideration. To carry this out, we need to find the edges; however, since the digits' edges are – this time – deemed as "weak edges" (we do need these "weak edges"), we have no way but to use "canny algorithm" to bring out the edges. Notwithstanding this, we do not boost up the edges this time in order not to cause their clinging together. In case of the sticking of the numbers to the surrounding framework or to any other object within the picture, they might be easily recognized as an object: dropping the totality the algorithm into a state of difficulty. Still, instead of blowing out in the width directionality, we can boost the edges up linearly, so that in case of the obliqueness of the numbers as a result of the way the picture has been taken from various angles or for deficiency on the part of the edge, all the non-complete edges would come into a state of completeness. In the next stage, all the objects present in the picture are being given numbers to, but the one object within the picture is extracted which needs the above-mentioned conditions, so that smaller regions like the flag and types of noise are not to be recognized as digits and numbers. Putting together Matlab figure plates after the operation of separating algorithm, figure (7) shows that the algorithm has functioned successfully.

Figure 7: phases of Letters separation algorithm

7. Shape Collation

Having separated out the numbers and digits from the picture ambience, we come to recognize those very digits as the most fundamental segment of our work. Our understanding is that a license plate's digits are made distinct with one certain font, all having their same specific pattern. Now, we are in a position to compare and collate each one of the digits with its own pattern. Wherever and whenever one of these patterns should have the greatest degree of congruence with the image itself, in as much as 86% of the cases, there is a full identity between

the pattern and numbers: thus, the numbers are able to be recognized. The procedure of the program's workings is as follows:

The patterns images are to be converted into the size of 50x60: we find their edges to boost them up and we do the same with the numbers arrived at. Now, we can collate all the picture's pixels square by square one to the other: conditioned the value of two pixels come out to be equal to each other, one unit is to be added to the collation variable value. For each and every one of these patterns where the collation variable has the largest degree of congruence, that pattern could be chosen as the digit intended. The general flow chart and the applied algorithms could be observed in Figure (8).

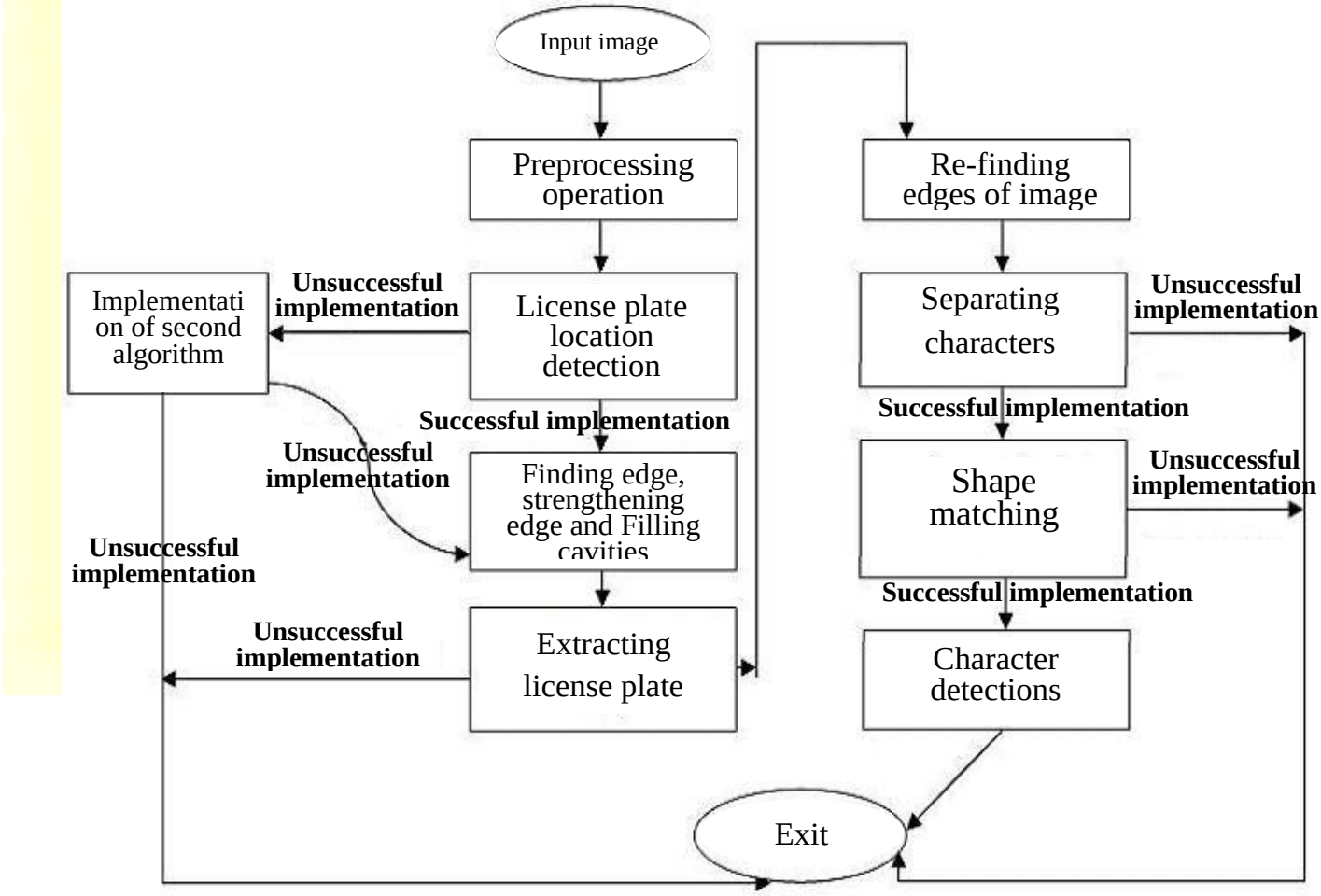

Figure 8: Diagram of the proposed method

8. Conclusion

An intelligent system for recognizing vehicles' license plate must needs have parameters like speed and precision. In our whole plot, we have done our utmost to arrive at these two important goals. Having done the necessitated preprocessing using the blue region on the license plate, we succeeded to locate it within the picture. In case of not coming to success, we have gone over to another algorithm where the probability degree of arriving at the right conclusion would be high: there, after extracting the license plate from the image by means of a modern unique algorithm, we embarked upon bringing out the digits, then, to use the numbers' shapes collation for the recognition.

The intended program has been tested on 100 images in various distances (the farthest distance has been 3 meters) whereby the placement recognition and distinguishing digits and numbers from the license plate has been successful up to 95%, while that of the recognition of numbers from the separated digits has met success in as much as 86% of the cases. The suggested solutions for improving upon this system in the future would be the usage of artificial neural networks in recognizing the numbers which possesses a higher degree of precision as compared with shapes' collation method.

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