An algorithm for Iraqi Vehicle License Plate Recognition

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Abstract:

In this paper, an algorithm of vehicle license plate recognition has been proposed. This algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. For extracting the plate region, edge detection algorithms and smearing algorithms are used. In segmentation part, smearing algorithms, filtering and some morphological operation are used. And finally statistical based template matching is used for recognition of plate characters. We used a large number of Iraqi plates for cars and consideration the new number, which contains a lot of complications. Where all the world use only one type of numbers, for example Arabic numerals (0, ... 9) with English letters A, B, ... Z)) or some countries using the Indian numbers (currently used in the Arab world), with Arabic letter (أ،ب،ت)or word (بغداد ، القاهرة .....) but the new Iraqi plate use all of these possibilities such as Arabic, Indian numbers , English and Arabic letters and in addition to Arabic and English words.

Keywords: Vehicle number plate recognition, mathematical morphology, edge detectors
Character Recognition, Image Processing.

1. Introduction

Vehicle number plate recognition has been intensively studied in many countries in the world and now we starting to study and implement this system. Due to the different types of number plates being used, the requirements of an automatic number plate recognition system is different for each country, a number plate localization and recognition system for vehicles depending on number type (Arabic or Indian) and the letters type (Arabic or English). This system is developed based on

digital images and can be easily applied to commercial car park or traffic light systems for the use of documenting access of parking services, secure usage of parking houses and also to prevent car theft issues (P.ANISHIYA et al, 2011).

The license plates recognition system has a wide range of applicationsin (Songke Li et al, 2001):

1) Highway automated tolling, monitoring management.2) Community automated parking management. 3) The urban road monitoring and illegal-events management.4) Checking vehicles.

5) Traffic statistics and safety management.

License plate recognition (LPR) is a form of automatic vehicle identification. It is an image processing technology used to identify vehicles by only their license plates. In real time, LPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads. Since every vehicle carries a unique license plate, no external cards, tags or transmitters need to be recognizable, only license plate (SerkanOzbayet al., 2005)

There are five different types of Iraqi vehicles plates as described in following:

1. The newest type of Iraqi vehicles plates which contains Indian numbers and Arabic numbers with city word and two letters one is Arabic number and the second one is Indian number in addition the kind of vehicles(special car, government car, Taxi,…) as shown in Figure 1 (a).
2. The second type is old version of Iraqi vehicles plates contains Indian numbers with Arabic word this kind of plate is temporary plate for government cars, as shown in Figure 1(b).
3. The third type is old version contains Indian numbers with Arabic word this kind of plate is temporary plate for general cars, as shown in Figure 1(c).
4. The fourth type is old version contains Indian numbers with Arabic word this kind of plate is original kind plate, as shown in Figure 1(d).
5. The fifth type contains Indian numbers, Arabic word and city word this kind of plate is use only in north of Iraq in Kurdistan province, as shown in Figure 1(e).

A

B

C

D

E

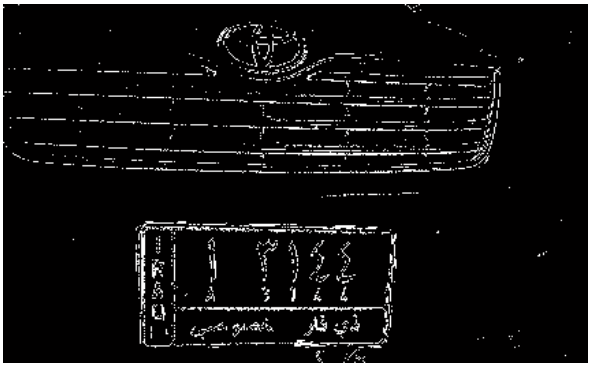
Figure (1) the types of license plate in Iraq

2. Plate Region Extraction

As far as extraction of the plate region is concerned, techniques based upon combinations of edge statistics and mathematical morphological operation featured very good results(F. Martín, M. García, et al.,2005) (BaiHonglianget al., 2004)(DanianZheng, et al.,2005).In these methods gradient magnitude and their local variance in an image are computed. They are based on the property that the brightness change in the license-plate region is more remarkable and more frequent than elsewhere, where the need is only the plate part and remove the background for the picture that captured from analogue camera. Block-based processing is also supported (SherrZheng Wang et al., 2003). Then, regions with a high edge magnitude and high edge variance are identified as possible license plate regions. Since this method does not depend on the edge of license-plate boundary, it can be applied to an image with unclear license-plate boundary and can be implemented simply and fast. A disadvantage is that edge-based methods alone can hardly be applied to complex images, since they are too sensitive to unwanted edges which may also show high edge magnitude or variance (e.g., the radiator region in the front view of the vehicle). In spite of this, when combined with morphological steps that eliminate unwanted edges in the processed images (C.N. Anagnostopoulos, et al., 2006).

The algorithm has been tested on real images that captured from analogue or digital camera. Based on the experimental results, we noted that our algorithm was the first algorithm Iraqi license plate recognition; plate region extraction is the first stage in this algorithm. Image captured from the camera is first converted to digital then enhanced and then converted to binary image. Captured image (original image) and binarized image are shown in Figure 2(a) and 2(b) respectively.

(a)



(b)

Figure 2 a-Original Image, b-Binarized Image

After smearing, a morphological operation, dilation, is applied to the image for specifying the plate location. However, there may be more than one candidate region for plate location. To find the exact region and eliminate the other regions, some criteria tests are applied to the image by smearing and filtering operation. The processed image after this stage is shown in Figure 3.

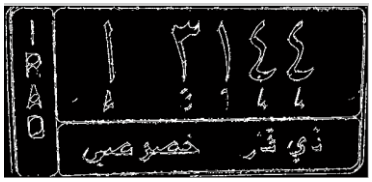


Figure 3 Image involving only plate

The binarized image is then processed using some methods. To find the plate region, firstly smearing algorithm is used. Smearing is a method for the extraction of text areas on a mixed image. With the smearing algorithm, the image is processed along vertical and horizontal runs (scan-lines). If the number of white pixels is less than a desired threshold or greater than any other desired threshold, white pixels are converted to black. In this system, threshold values are selected as 20 and 110 for both horizontal and vertical smearing. If number of white pixels < 10 pixels become black After obtaining plate location, region involving only plate is cut giving the plate as shown in Figure4.

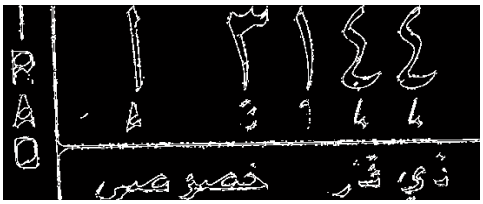


Figure 4 Plate Image

In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining the characters individually. Firstly, image is filtered for enhancing the image and removing the noises and unwanted spots. Then dilation operation is applied to the image for separating the characters from each other if the characters are close to each other. After this operation, horizontal and vertical smearing are applied for finding the character regions where Iraqi plate has two parts one for Arabic part and the second for English part. The result of this segmentation is in figure 5

Figure 5Locations of plate characters

The next step is to cut the plate characters. It is done by finding starting and end points of characters in horizontal direction. The individual characters cut from the plate are follows in figure 6.

Therefore we need several optical character recognition (OCR) for identify numbers, letters and words in both Arabic and English languages.

3. Algorithm and Result

The algorithm is based on combination of morphological operation with area criteria tests for number plate localization. Segmentation of the plate was achieved by the application of edge detectors, labelling and fill whole approach. The character recognition was accomplished with the aid of optical characters by the process of template matching. The system was experimented with three different edge detectors namely Sobel, Canny and Prewitt. Comparative analysis on the success rate of the proposed system showed overall better success rate of 96.8%by using canny edge detector this operation explain in Figure 7.

Figure 6 Individual character

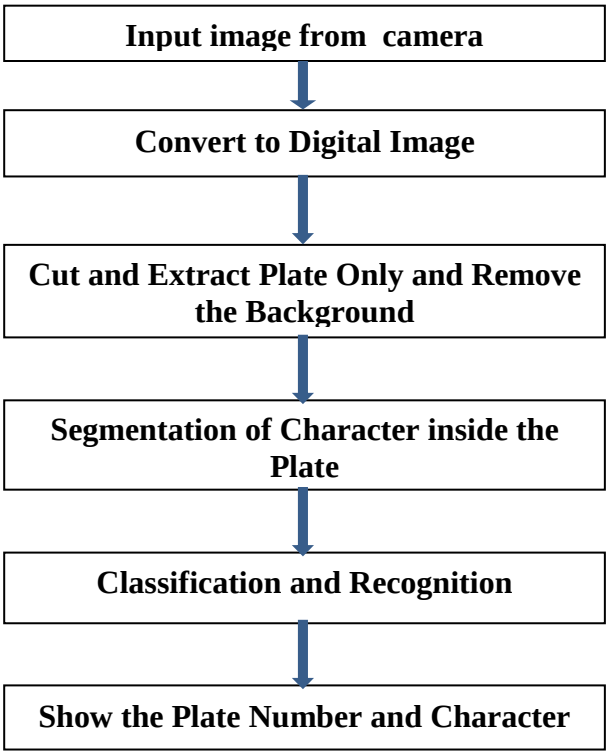


Figure 7 algorithm

4. Suggested algorithm

First step: - (Source of image)

The first step we can capture the input image from camera as show in the Figure 8.

Second step:-

(Convert to digital image)In this step we need to convert the pictures that captured from camera to digital picture and also need to enhancement from some problems such as noise, blurring, shading and etc, by using enhancement method such noise removable an histogram equalization as show in Figure 9.

Figure 8 source pictures

Figure 9 enhancement image

Third step:-

(Extraction the Plate) morphological dilation operation with rectangular structuring element (SE) of size 3X3 is the performed on the binary image. Dilation is a morphological transformation that combines two sets by using vector addition of set SEs, and Erosion can be obtained by dilating the complement of the black pixels and the taking the complement of the resulting point set as show in Figure 10.

Figure 10 plate region extraction

Fourth step:-

(Segmentation of Individual Characters in the Number Plate) The character segmentation acts as a bridge between the number plate extraction and optical character recognition modules. Its main function is to segment the characters on the chosen candidate region (number plate) such that each character can be sent to the optical character recognition module individually for recognition. This was achieved by the application of the edge operators and by the relaxation labelling approach. Four edge detection methods were used for comparison.

Fifth step:-

(Classification and Recognition(C&R)) It is employed for the purpose of conversion of images of text into characters. OCR Software and ICR Software technology are analytical artificial intelligence systems that consider sequences of characters rather than whole words or phrases. Based on the analysis of sequential lines and curves, OCR and ICR make 'best guesses' at characters using database look-up tables to closely associate or match the strings of characters that form words. The number plates may be bent and/or tilted with respect to the camera; characters extracted from such number plates may be deformed. Furthermore, input characters may be noisy, broken or incomplete. Character recognition techniques should be able to tolerate these defects. We developed our own character

templates to suit our particular application the topological features of the input character are computed and are compared with those of pre-sorted character templates. The character template which has best matches of the input characters will display at last. In Iraqi car plate there are six parts.

1-letters: - There are two types of letters in Iraqi car plate, English and Arabic letter as show in Figure11.

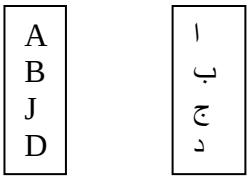


Figure 11letters in Iraqi car plate

2- Provinces:-

There are 18 Iraqi provinces each car has one word from one of these Iraqi provinces as show in figure 12.

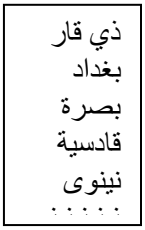
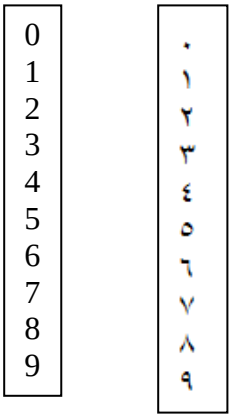


Figure 12 Provinces in Iraq

3-Number:- There are two types of numbers in Iraq car plate one is Arabic numbers and the second is Indian numbers as show in Figure 13.



a b

Figure 13 two type number

4-Types: - This part explain the type of car but not model as show in Figure 14.

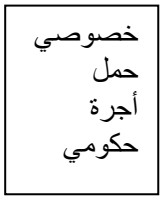


Figure 14 type of car

5. Results

Results have shown that canny detector offers greater accuracy of 96.8%. The system's accuracy in locating the number plate is more than 98%. The problem encountered in the earlier systems in locating the number plate when vehicle bodies and their number plates have similar colors were overcome with this method as morphological operation was employed, thereby achieving high accuracy in number plate extraction step. Our algorithm can find easy the numbers in both Arabic and Indian, easy to know the letters in both Arabic

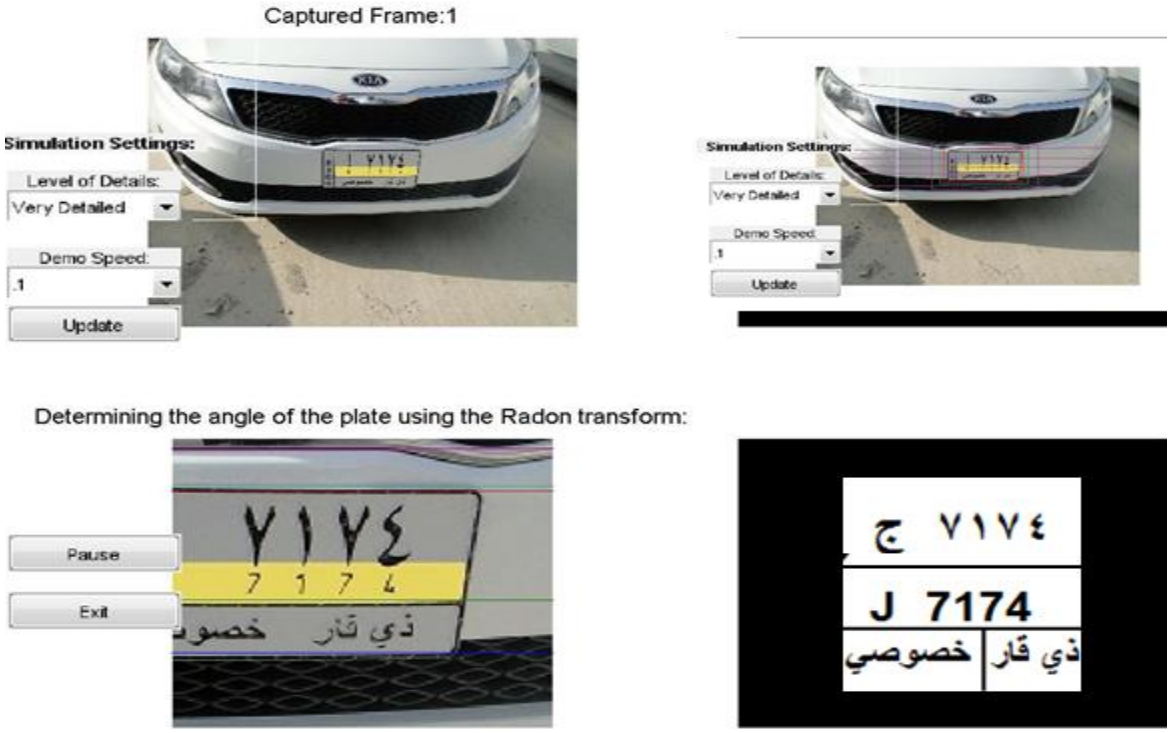
and English language, also can know the Arabic words as shown in figure 15.

6. Conclusion

We used a large number of Iraqi plates for cars and consideration the new number, which contains a lot of complications. Where all the world use only one type of numbers, for example Arabic numerals (0, ... 9) and the English letters A, B, ... Z)) or some countries using the Indian numbers (currently used in the Arab world), in addition to the Arabic letter (أ،ب،ت)or word (بغداد ، القاهره .....) but the number of the new Iraqi plate use all of these possibilities such as Arabic, Indian numbers , English and Arabic letters and in addition to Arabic and English words.

So we found the following:

1. The Iraq plate is most difficult to extract and recognition because the Iraq plate have 5 parts, the first one has Indian number, the second number has Arabic numbers, the third one has Arabic words, the fourth has Arabic letters, the fifth has English letters.
2. The execration of the plate is not easy and separate between the five part is also not easy.
3. Building the data base for the plane need more accuracy and many codes.
4. All the world use one or two kinds of plates for example English letters with Arabic numbers or Arabic word with Indian.



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خلاصة

معرفة ارقام السيارات غاية في الاهمية من نواحي كثيرة منها امنية ومنها شخصية وذلك بخزن جميع المعلومات عن السيارة في قاعدة بيانات لكي يتم الرجوع اليها في حالة تطلب الامر ذلك فمثلا عند خروج السيارة من بلد الى اخر او من اقليم الى اخر او حتى من مدينه الى اخرى يكون من السهل معرفة الزمان والمكان الذي خرجت منه السيارة وكذلك حينما تسرق السيارة يمكن تحديد مكانها بسهوله او حينما يقوم السائق بمخالفات مرورية يكون من السهل ان ترسل المخالفة الى قاعدة البيانات وبذلك تسجل مخالفة للسيارة ويمكن لصاحب السيارة ان يعرف المخالفة من خلال الانترنت وذلك بمراجعة الصفحة الخاصة بكل سيارة .

البحث يقوم بعملية تحديد الارقام وتحويل الصور التي تؤخذ من الكاميرات التي توجد في تقاطعات الشوارع او في مداخل المدن او في المرأب الي ارقام عن طريق تحديد الرقم ومن ثم قطع الرقم وحذف باقي الصوره حيث يرسل الرقم الي الشبكات العصبيه بعد تقطيع كل رقم وحرف على حده وبذلك تقوم الشبكات العصبيه بإعطاء الرقم النهائي للسيارة الذي بدوره يرسل الى قاعدة البيانات لمعرفه اسم المالك وتحديد نوع العمليه (غرامة ، ضريبة او أي شي اخر).

البحث استخدم عدد كبير من الارقام لسيارات عراقية فقط أي ارقام عراقيه واخذ بنظر الاعتبار الرقم الجديد الذي يحتوي على الكثير من التعقيدات. حيث ان جميع العالم يستخدم نوع واحد من الارقام مثلا ارقام عربيه (0،....9) والحروف الانكليزية (A,B,…Z) او يستخدمون الارقام الهندية (المستخدمة حاليا في وطننا العربي) بالإضافة الى حرف او كلمة عربيه مثلا(ا،ب...) او كلمه مثلا (القاهرة ،دبي ، بغداد.....) لكن الرقم العراقي الجديد استخدم جميع هذه الاحتمالات أي الارقام العربية والهندية والحروف العربية والانكليزية بالإضافة الى الكلمات العربية والانكليزية. على الرغم من جميع هذا التعقيدات والتي لا نعرف لماذا انفرد فيها العراق تقدمنا بتفصيل الارقام وإعطاء النتيجة المرضية.