

Plate Detection and Recognition of Iraqi License Plate Using KNN Algorithm

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Abstract

This paper presents an automated car license plate recognition system applied for Iraqi vehicle plate number that developed and applied to be used in control and law enforcement related applications. In this work, the proposed license plate recognition consists of three basic stages (preprocessing, license plate localization, license plate recognition). The license plate images are pre-processed through convert image to grayscale and apply morphological transformation filter not convert the result to binary image. Then, blurs the binary image using Gaussian filter and find all contour in image using OpenCV library. In the license plate localization KNN (k-Nearest Neighbors) algorithm are used to find all possible characters in the image. The last step is done by Crop the part of image with highest candidate license plate and apply the preprocessing and license plate localization again to find and recognize all part of license plate in the cropped image.

Keyword: Iraqi License Plate, k-Nearest Neighbors, License Plate Detection, License Plate Recognition

1. Introduction

Each vehicle has a unique identification number which is called license plate (LP). The license plate has a rectangular shape and contain a group of numbers and letters. Because the growth number of vehicles, which leads to many vehicles related issues, automatic license plate recognition (ALPR) became a very important application to be used in traffic control, parking lot administration, tracking the stolen vehicles, improving the transportation safety. Each country has different types of license plates, and different automatic license plate recognition system required for each plate type and country. The license plate is issued by the government with standard in term of size, colors, fonts and spacing between characters as stated in[1].

The license plate recognition system is the important factors to build the intelligent transportation system because each car has unique number that can distinguish between car as stated in [2] there are several type of Iraq license plate one of this issued before 2003 as show in figure (1). The second one is issued for import car after 2003 with temporary traffic registration as shown in figure (2). The third type is issue in 2012 as a new license plate that issue by using information system for owner car personal information as shown in figure (3). In Iraq, the standard colors and fonts according to the vehicle type, the plate colors used are white, red, blue, green, yellow, and black. Table 1 showing the description of the different license plates. The license plate recognition system used in other countries are nor suitable for Iraqi plate because the big different in the Iraqi license plate which adding more recognition difficulties.

Table 1: License plate color specification

Color	Refers to
White	private car
Red	Taxis
yellow	Trucks
Blue	government
Green	Military
Diplomatic	Red and White

In addition, each one of this plate consist of sex part. The parts are Hindi Number, Arabic number, English latter, Arabic latter, English text and Arabic text as shown in figure (4)



Figure (1) Iraq LP before 2003

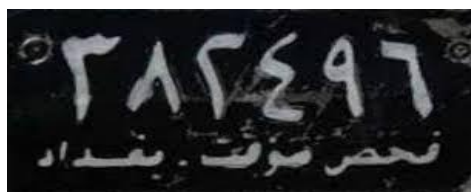


Figure (2) Iraq LP temporary registration



Figure (3) Iraq LP after 2003 new registration

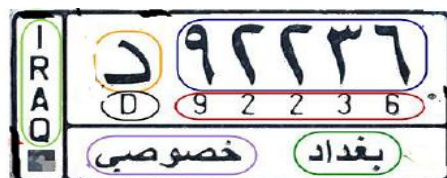


Figure (4) parts of New Iraq LP

The license plate recognition (LPR) is an image processing technology used to identify vehicles by their license plates only as mention in [3, 4]. The LPR issues can be divided in two level as mention in [1, 5]. First level is processes plate image by detecting the plate from entire image and segmentation the number and characters that found on the plate, then recognition the segments character and Number from plate as level two. The second level is very difficult step in the system because this step will determine the system performance and how accurate it is as mention in [6]. The license plate recognition has a lot off applications and many problems can be solved by using LPR as mention in [7].

The proposed work is organized as following. Section 2 preceding the related work. Section3 explain the proposed technique using KNN algorithm. Section 4 give the experimental results of the proposed method. Then, the conclusion. The performance of the automatic plate recognition systems depending on both hardware and software components. Where the hardware components responsible for vehicle detection, vehicle image acquisition and data transmission. While the function of the software components is preprocessing the taken image, license plate localization and characters recognition.

2. Related works

In recent years, some developed countries created license plate recognition systems for many applications of their traffic requirements. In regard to plate localization, many techniques have been used. Including connected domain analysis, mathematical morphology color model, fuzzy set theory, and statistical classifications. For license plate recognition, mainly the recognition techniques can be divided in to two main categories. The template based method and the supervised learning method as mention in [8].

The template based method usually used in character recognition by comparing each character with stored characters to find the exact matching or the closest character. The matching technique used is normalized correlation method to indicate how well the chosen character matches with the stored character. This method is sensitive to the noise disturbance, and image orientation[1]. While the supervised-based method has common classifiers that have been used for character recognition, Mark net and Bayes net have been used as mention in [9, 10] , which are Neural Network (NN) as mention in [11, 12] ,and support vector machine (SVM) as mention in [13-15]. Because of the rapid development in digital signal processing and digital image processing, many systems implemented on an embedded digital system to process video stream, such as in [16].The system consist of modules to detect and recognize characters.

AdaBoost technique used to detect license plate, and cascade framework used for license plate recognition, Amid the most recent two decades many research endeavors have been spent to build up the license plate acknowledgment system., some of the distributed work is exhibited, the emphasis will be on the technique utilized for executing those LPR frameworks. Additionally, Also, their related weakness, virtues, number of test samples and the attained success rates will be mentioned:

Sarfraz and et al [4] proposed system convert the acquisition to gray scaled image and using vertical edges detection for LP extraction. and remove the noise by using seed-filling algorithm. using the width to high ratio of LP to finding the region of LP. vertical projections and the number of pixels in each column are used for segmentation purpose the character recognition using the normalization for character recognition and template matching for recognize for the alphabets Deb and et al.,[17] presented a system that can defeat the disappointment of recognizing LPs when the vehicle and their LP have a similar color (e.g. a white auto has a white tag). Likewise, this paper talked about the tilt remedy of vehicle LP. In the

proposed system, the information vehicle picture is changed over into HSI shading space.

The plate shading data is utilized to identify the applicant locales. At that point, the geometrical properties of the LP, for example, region, bouncing box, and view point proportion are separated then utilized for order. An adjusted recursive marking calculation is utilized for unraveling the disappointment of distinguishing the limits of tags when vehicle and LPs have comparable hues. As indicated by the Minimum Square Fitting with Perpendicular Offsets (LSFPO) the LP area is fitted to a straight line. After the line slant is acquired, the required pivot point of the LP is assessed. At that point, the entire picture is pivoted for tilt redress in flat bearing by this edge. Tilt remedy in vertical heading is proficient by reverse relative change. The limits of competitor LP and vertexes are recognized by the crossing point of Hough lines.

At long last, the characters of LP areas are perceived. Be that as it may, the proposed technique fizzled when movement obscure show up in the info picture. A set of 200 tests of Korean LP pictures where utilized Cika, and et al.,[18], proposed a framework for identifying and perceiving the characters and quantities of Czech Republic LPs. Their framework comprises of number of modules that rely on upon each other. The utilized modules are: picture upgrade (differentiate extending), luminance change (RGB to YUV) to get the dim picture, thresholding to get the twofold picture, picture division into locales, and assessment of areas (to select rectangular articles or elliptical shape). At that point the picture is turned, gone through optical character acknowledgment (OCR), lastly looking at perceived tags with a database. Creators demonstrated that the proposed framework is appropriate for the auto parks. 50 tests were utilized. The accomplished hit rate of acknowledgment achievement is 88%. Ghofrani and Rasooli [19], The proposed framework first concentrates vertical edges, then, it swings to stamp hopeful locales. These areas are resolved by means of two stages: moving windows and checking the perspective proportion include. The districts were candidate just like the tag are gone through components analyses with a specific end goal to recognize the tag precisely. At that point, the required pivot edge is assessed and revolution conformity is finished. For character acknowledgment 25 elements are gotten from the characters zones (i.e., character district is isolated into four a balance of), these are considered as contribution to the two fake neural system classifiers (one for characters and the other for numbers).

3. K-Nearest Neighbor

One of the useful supervised based learning and anon-parametric techniques is K-Nearest Neighbor or KNN algorithm. KNN is a wide applied method used as a classifier and regression in different field such as image processing, data mining, pattern recognition and other applications. The output result of the algorithm depends on K- nearest neighbor category which implemented by finding K-number of training points closest to the required character and consider the votes among the K object. The algorithm is very simple. However, is capable of learning highly-complex non-linear decision boundaries and regression functions. The intuition of KNN that similar instances should have similar class labels (in classification) or similar target values (regression). On the downside, the algorithm is computationally expensive, and is prone to overfitting.

4. Proposed System

The proposed technique was designed for LPR system. Before start the method the KNN need to train using an image with Arabic character and Hindi Number. Fig. 5 show a sample of train data that used to train KNN by using different font type and

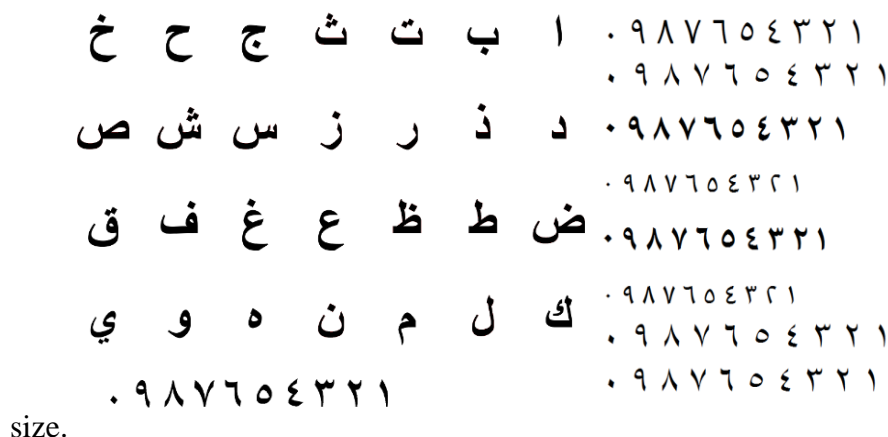


Figure 5 KNN learning Data

4.1. Extraction License Plate

4.1.1. Pre-image

Using the image processing technique to detect LP. Use camera to image acquisition for LPR with maximum distance 3m as first step

4.1.2. LP Recognition and Extraction

Given an image as in figure 7 and by using the procedure of finding and detecting the license plate is based on the following steps:

Step 1 Convert the original image that taken by camera to grayscale image figure 8.

Step 2 Convert grayscale image as result of step 1 to binary image and apply morphological transformation using OpenCV library to easy detect LP location Figure 9.

Step 3 Apply Gaussian blur filter to smooth the image Figure 10.

Step 4 List all contour in image to remove boundary of image that has same color of intensity Figure 11.

Step 5 Using KNN algorithm to list all matching character in image Figure 12.

Step 6 List all possible plate that can be found in image Figure 13.

Step 7 Select the highest probability LP that matching standard LP measurement and extracting the LP Figure 14.



Figure (7) original Image



Figure 8 Convert original image to Grayscale



Figure 9 Transforms grayscale image to binary image and apply Morphological Transformations



Figure 10 apply Gaussian blur filter



Figure 11 List all contour in image

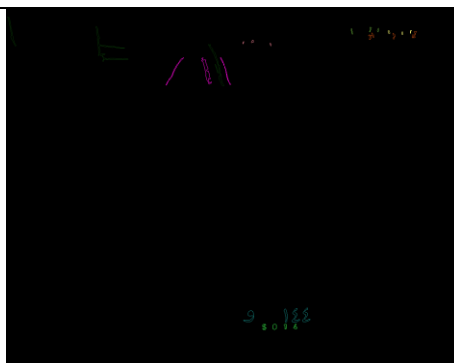


Figure 12 list all matching character



Figure 13 list all possible plate



Figure 14 extracted plate

4.1.3. Finding the character in plate

After detect the LP, reapplying the seven steps as in LP Recognition and Extraction to find and recognize the characters and numbers in the LP. Each character and number in LP should be segment using KNN to recognize each character and number using training data, each character of the plate will be matching with trainings data of KNN to recognized the character if Number or Letter and will give the result as output.



Figure 15: recognized LP character

Algorithm 1: Finding License Plate Using K-NN

- 1: **Begin**
 - 2: **Input:** Original Image
 - 3: **Output:** Characters
 - 4: **Method:** K-Nearest Neighbors
 - 5: **LP:** License Plate
 - 6: *Convert RGB image to Grayscale*
 - 7: *Filter Morphological Transformation*
 - 8: *Transforms Grayscale image to binary image*
 - 9: *Filter Gaussian for Blurs image*
 - 10: *Finding all contours in image*
 - 11: *Search & recognize all possible character in image*
 - 12: *Crop part of image with highest candidate LP*
 - 13: *Crop the LP from original image*
 - 14: *Apply steps from 6 to 11 again on crop image*
 - 15: *Print the characters in LP*
 - 16: **End**
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5 Experimental results

The experiment is based on a 2.80 GHz Intel Core i7 processor with 8 GB RAM and implemented using C# with OpenCV library. From 70 images that taken in different condition used to test the proposed method 64 images around 91.5% of them re detected accurately. There are some reasons lead to unrecognized License plate. First reason is if license plate dirty and not clear. Another reason if there is not enough lighting on license plate at night. Moreover, it's difficult to detected crooked license palate.

6 Conclusion

This paper presents a proposed technique to detect and recognize the Iraqi license plate based on KKN algorithm. The image for the license plate first pre-processed through several steps; to specify the plate location in the image then cutting he plat part from the image. Then, according to the Iraqi license plate features, the proposed algorithm separates the characters and the numbers in the plate, and recognize each character. The proposed system was tested and the experimental result showed that the designed technique is robust and it perform 91.5%.

Next implementation is to handle more various complex conditions such as blurring, low resolution, character noise by enhancing the robustness and selection more character features to increase the character recognition in such conditions.

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