Common car plate detection systems

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***Abstract*—Nowadays, due to rapid growth and development of vehicles and transportation system, traffic problems increases and leads to difficulties in managing traffic system. License Plate Detection (LPD) system application is to optimize efficiency in controlling traffic system. There are many methods for license plate detection system, but they usually consist of three main steps: plate detection, character segmentation and character recognition. In detection step, we find the regions that may be car plates by applying . Character segmentation is done later by using different algorithms connected component and thresholding method.¿??. Optical character recognition is applied to remaining step. The purpose of our study is to represent some common license plate recognition methods.**

***Index Terms*—plate localization, plate detection,character segmentation, license plate detection**

I. Introduction

Five states of an Introduction. (*from slides of professor Raymond Close, POSTECH, Korea*)

- Establish the field
- Review what has already been studied
- Show where investigation is needed
- Describe your purpose
- Explain why this is valuable

Because of the number of vehicles on the road today, the role of license plate detection systems is becoming more and more important. The use of LPD system is applied in various work includes border crossing control, traffic management, identification of stolen vehicles, transgressor driver penalization, speed control, red light control and automated parking systems, i.e. [1]

There are many different algorithms and methods proposed for building a LPD system. Some of them have good performance with more complexity[n].A few methods focus on optimizing memory usage. The others are computationally intensive.[n] Therefore, selecting one of them based on some aspect mentioned above in different situations and purpose is a challenging problem. Due to that, the aim of this paper is to study and to evaluate some license plate detection (LPD) systems methods and compare them. [1]

Most of the LPD systems are based on image-processing methods and character recognition systems. License plate recognition applies image processing and character recognition technology to identify vehicles by reading their license plate numbers. They usually consist of three steps: license plate detection, character segmentation and character recognition. In the first step, possible license plates are determined based on the features of license plates. Features commonly employed have been derived from the license plate format and the alphanumeric characters containing license numbers [2]. The features regarding license plate format include shape, symmetry, height-to-width ratio, color, texture of grayness, spatial frequency, and variance of intensity values [1]. Character features include lines, blobs, the sign transition of gradient magnitudes, the aspect ratio of characters, the distribution of intervals between characters, and the alignment of characters [2]. Most of the images processing methods for the license plate detection are based on neural network, Gabor transform, Hough transform, and AdaBoost models [2]. But there are some common features affecting on performance of these algorithms including:

- Lighting conditions such as light overexposing, nighttime, reflecting sunlight, e.i.
- Complex background which may causes problems in detecting the real region of plate.
- Dirty or covered license plates that causes fault identification numbers.
- Various view angles.
- Motion-blurred errors.

The rest of this paper organized as below.The next section is Background and Related work. In section III, different methods of license plate detection are discussed. Experiment results and paper conclusion are mentioned in section IV and section V, respectively. [1]

II. Related work

Nowadays, some developed countries created license plate recognition systems for many applications of their traffic

requirements. In order 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 types. The template based method and the supervised learning method. [1],[2]The template based on the 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. While the supervised-based method has common classifiers that have been used for character recognition, Mark net and Bayes net have been used, which are Neural Network (NN),and support vector machine (SVM). 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. The system consist of modules to detect and recognize characters.[1],[2] [3] AdaBoost technique using 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 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 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.[3] 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, 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 two fold 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%. 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).

III. Method

A. System 1

1) Detection:
   - Use LBP algorithm to find possible license plate areas with coordinates, width and height. This happens one time creating many license plates and forward them to the next phase. This phase is the most processing-intensive phase of the pipeline.
   - LBP algorithm labels each pixel of an image and thresholding theirs neighborhood. Resulting a binary number. This algorithm is a powerful method for texture classification.
2) Binarization:
   Binarization will occur for each possible license plate area from the Detection phase. Resulting in multiple binary images for each plate region, reducing the complexity of each binary image. Multiple images will provide the best possible chance to find all of the characters. Binarization uses the Wolf-Jolien method and the Sauovola method.
3) Character Analysis:
   Character Analysis will find all connected blobs in license plate areas. It will mainly look for blobs with the size of a license plate character and have theirs tops and bottoms in line with other characters and have similar width and height. This will determine whether an image will be saved for further processing or not.

4) Plate Edges:
   In this phase, OpenALPR will search all of Hough lines for the license plate area, resulting a list of horizontal and vertical lines. This list combined with character height competed in Character Analysis will be use to find the most possible plate line edges.
5) Deskew:
   Re-map the plate area to stand size and orientation, produce a plate image without rotation or skew ready for later phases
6) Character Segmentation:
   This plase divide the plate image into different segments without plate edges, removing disconnected speckles, isolating all the characters that make up the plate. This phase is very useful for analyzing each character independently.
7) Optical Character Recognition:
   Compute all possible characters for each character image from Character Segmentation phase.
8) Post-processing:
   From the result of OCR phase, make a list of best possible character combinations for a license plate.

B. System 2

1) Detection:
   - Use LBP algorithm to find possible license plate areas with coordinates, width and height. This happens one time creating many license plates and forward them to the next phase. This phase is the most processing-intensive phase of the pipeline.
   - LBP algorithm labels each pixel of an image and thresholding theirs neighborhood. Resulting a binary number. This algorithm is a powerful method for texture classification.
2) Binarization:
   Binarization will occur for each possible license plate area from the Detection phase. Resulting in multiple binary images for each plate region, reducing the complexity of each binary image. Multiple images will provide the best possible chance to find all of the characters. Binarization uses the Wolf-Jolien method and the Sauovola method.
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   Character Analysis will find all connected blobs in license plate areas. It will mainly look for blobs with the size of a license plate character and have theirs tops and bottoms in line with other characters and have similar width and height. This will determine whether an image will be saved for further processing or not.
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7) Optical Character Recognition:
   Compute all possible characters for each character image from Character Segmentation phase.
8) Post-processing:
   From the result of OCR phase, make a list of best possible character combinations for a license plate.

IV. Result

A. System 1

Figure 1: RESULT

B. System 2

V. Conclusion

References

[1] Andrej Karpathy and Li Fei-Fei. Deep visual-semantic alignments for generating image descriptions. In *The IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2015.