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Vehicle License Plate Recognition System

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Abstract: A number plate identification system is a security measure that uses optical character recognition (OCR) and image processing to recognize license plates on automobiles. There are several uses for this technology, including letting parking authorities approve a car for parking and toll road authorities identify and bill a vehicle automatically. The procedure entails taking a picture of the license plate, processing it, and correctly reading and decoding the characters using optical character recognition (OCR). Because it transforms the text in the image into legible characters, the OCR process is essential. This study uses OpenCV and Python to investigate two approaches for detecting license plates: morphological gradient detection and Sobel edge detection. A thorough analysis of these techniques shows their effectiveness and precision, serving as a model for upcoming systems that recognize license plates. For Indian number plates, the accuracy rate ranges from 75 to 85 percent.

I. INTRODUCTION AND BACKGROUND

I.1 Research Topic and Objectives

Detecting and recognizing a vehicle's license plate is the goal of the problem known as license plate recognition (LPR). Numerous real-world applications have made extensive use of it, including automated toll collection, unattended parking lots, and criminal pursuit traffic surveillance systems [5]. The goal of this thesis is to use license plate detection and recognition to develop a vehicle retrieval system for a surveillance camera. Vehicle tracking and vehicle activity analysis may become possible as a result of its utility for vehicle identification and registration. The suggested approach consists of two primary steps:

1) License Plate Detection: Scan potential zones identified by edge information, obtain license plate candidates, and use an SVM classifier with HOG features based on a sliding window technique. Next, use Non-Maximum Suppression (NMS) to ensure that the plate placements are finalized.

2) License Plate Recognition: After the detected license plate has been aligned, k-means can successfully cluster its pixels into two classes: background pixels and foreground pixels, such as character pixels. After that, the plate is divided into character patches, each of which will be identified by an SVM classifier on its own.

I.2 Challenges

Plate variation is the first difficulty. The plate may have screws or frames, and it may vary in quantity, size, color, font, occlusion, inclination, and placement [1]. Variation in the surroundings, such as shifting background and lighting, presents the second difficulty. The complexity of this task may be increased by certain lighting, weather, or even camera settings. With the exception of vanity plates created by individuals—which are extremely uncommon—some license plates have fixed fonts. While the typeface problem is resolved, other challenges such as plate amount, location variation, size, color, occlusion, and inclination persist. There are also a variety of weather conditions in the dataset's photo capture locations.

I.3 Background and Related Work

Applications including automatic toll collection, parking identification, traffic law enforcement, traffic surveillance, and vehicle access management in limited areas are made possible by license plate recognition (LPR) systems. License plate detection (LPD), license plate character segmentation (LPS), and license plate character recognition (LPR) are the three main components of an LPR system. In an LPR system, license plate detection is typically the first step. Its goal is to locate the license plate, which gives precise region information for the next LPR procedure. Before license plate identification, there must be license plate detection, which saves time by avoiding the need to process each and every pixel in the system's input image. Depending on the color level, the following categories can be used to group LPD methods:1) Classifiers; 2) Gray-Level Processing; 3) Color Processing; and 4) Binary Image Processing. The LPD methods can be divided into six divisions according to the data utilized to identify the license plate: using texture features, color features, edge information, global image information, character characteristics, texture features, color features, texture features, and combing two or more features

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II. LICENSE PLATE DETECTION

a. Filters

Utilizing a color transition between the license plate and the vehicle body, the Sobel filter is used to identify edges, which represent the borders of license plates. When detecting edges on the horizontal or vertical axes, two horizontal and two vertical lines are found, respectively. When two sets of lines appear at the same moment, the rectangle is fixed. A good performance was obtained when photos are of a fixed angle by F. Kahraman [2] et al. in 2003 when they utilized Gabor filters to detect license plate regions. The sensitivity of gabor filters to textures with varying sizes and directions makes them useful for texture analysis.

b. Edge Detection

Methods are frequently used to extract license plates from all conceivable rectangles based on the intuitive knowledge that the plate is of some shape, most likely rectangular, with a known aspect ratio. One way to locate the rectangles is by edge detection techniques. Only vertical or horizontal edges can be detected, and license plate candidate regions can be identified using statistical analysis [2]. For license plate detection, a rapid vertical edge detection algorithm (VEDA) was published in [3] and is said to be seven to nine times quicker than the Sobel operator.

c. Using Character Features

There have also been suggestions for license plate detecting techniques that locate characters or identify characteristics of characters. These techniques seek to identify the characters, from which the license plate region is then retrieved. On the basis of the common sense assumption that all text should have the same stroke width, the stroke width transform is presented in [5] to locate text in natural settings. This CVPR work presents a more general strategy that extracts text regardless of whether it is present in a license plate.

III. OVERVIEW OF THE EXTRACTION PROCESS

Preparation:

1) Take HOG elements out of the license plate training photos.
2) Train the model using SVM.
3) 3378 license plates were trained.

Start by applying edge detection to the supplied image. Use a scanning window to scan the entire image. The areas with edges greater than a predetermined ratio will be subjected to SVM classification within the window to determine whether the score of this window is greater than the threshold and, thus, positive, indicating the presence of a plate. As a result, the scanning process does not cover the entire image, saving detection time. Time is also saved because the HOG features for the entire image are computed in advance rather than having to be determined for each scan. The image will be enlarged to 909 by 523 pixels, and by setting the resized image various scales, the scanning window will be multiple scales. Thus, the HOG characteristics will be recalculated for every scale. Using k-means, the neighboring positive windows will combine to determine the final location.

IV. OVERVIEW OF THE LICENSE PLATE RECOGNITION

From the license plate, we may use k-means to extract two clusters based on precise alignment. The plate's background is one, while the characters are the other. Set the minor cluster to black and the large cluster to white with more points to make the characters black. The binary license plate is the foundation for segmentation.

Fig. 3. 1. Aligned binary license plate

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Fig. 3. 2. Segmented license plate

With a model, the segmentation is carried out. The model can be viewed in Figure 3.3. We know from past experience that Chinese license plates have seven characters total, with a dot appearing between the second and third characters.

model= (position, width1, width2, scale)

Fig. 3. 3. Segmentation model.

V. CONCLUSION

In this work, an SVM classifier with dense HOG features is used to construct a sliding window based plate identification approach. On a proportional image, searching is done at several different scales. Edge data is utilized to calculate the potential proportion and expedite the laborious scanning procedure. Using a non- maximum suppression procedure, mean shift is used to finalize the candidates. A successful technique for aligning the result of license plate detection is suggested. Additionally, a novel layout-based methodology can be used to split the aligned license plate into character patches following the use of k-means clustering.

The character patches are identified using an SVM classifier that uses a few basic features. It outperformed the bag-of-words model in terms of results, regardless of the automatic weighting mechanism and second level voting system. After that, the LPR system was transformed into an embedded system that used an auxiliary board and numerous TS-7250 boards to mimic the vehicle retrieval system.

Future research must be conducted to identify and instantly identify license plate images from video footage. To limit the scanning window area, motion compensation-based tracking can be used.

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