Automatic Vehicle License Plate Recognition System Based On Image Processing and Template Matchingapproach

Vikas Chaudhary, Department of Computer Science & Engineering, RDEC, Ghaziabad. vikas.chaudhary@gmail.com

Abstract

Using a newly developed localization method that is adjusted to account for the local environment, this study proposes a vehicle licence plate recognition system. It also includes a A hybrid classifier capable of recognising text on licence plates. This approach to licence plate detection is based on a modified template matching method that uses target colour pixel analysis. Several European nations and Iran use a common color-geometric template, which may be located using a modified strip search.This method determines the colour of each pixel dynamically by use of periodic strip search. Also, when a cluster of target pixels is found, it is examined to make sure its proportions and form are identical to a regular licence plate. This approach not only remains unchanged when rotated or scaled, but it also skips over the tedious process of scaling and applying picture algorithms like Hough, Fourier, and wavelet transforms to each every pixel, which significantly reduces the time it takes to identify changes. Using a homogeneous fifth-degree polynomial kernel, a hybrid classifier combining decision trees and support vector machines can identify licence plate characters.

Keywords:—Color template matching, image recognition, license plate detection, license plate localization, license plate number identification, license plate recognition (LPR).

Introduction

Recent years have seen a surge in funding and focus on developing ALPR systems, or automatic licence plate readers. The licence plate serves as a vehicle's unique identifier, hence it'sidentify has several applications. For instance, smart toll booths and parking lots may utilise licence plate recognition (LPR) systems to let in authorised cars, or to determine the average speed of a vehicle between two stations by reading its licence plate at both locations. Another way to keep tabs on banned cars is to place licence plate readers on roadways, especially in high-traffic areas and at intersections where police presence is required. These days, highway speed traps capture colour photographs of speeders captured on film.

Because they are not linked to a central database, these control stations often employ local memory on Iranian roadways [1]. Sooner or later, the majority of the stations have a low-disk-space issue due to the high-resolution images captured by the speed control cameras. The automatic licence plate reader (ALPR) technology can decompress massive amounts of picture data into a string of bits, thereby solving this issue. At speed control stations, an ALPR system can detect licence plates using high-resolution photos. Following detection, the photographs are reduced in size and quality before being sent over low-band connectivity devices like a GSM board or regular messaging apps. It would be more beneficial to penalise offenders at the scene of the crime rather than after the fact in order to avoid accidents and discourage future offences, rather than just identifying and issuing traffic tickets to them. Because of this, an ALPR system that uses colour photos captured by regular, high-resolution security cameras is fantastic. For this reason, a number of studies have used colour attributes to pinpoint number plate locations. The majority of their algorithms are country-specific and use colour characteristics for licence plate localization [2]. To discover the background or foreground colour using tiling and hue histogram, they often transform all of the picture pixels to another colour space, such hue, saturation, and value (HSV) or hue, saturation, and intensity (HSI)[3]. This is done for localization purposes. To pinpoint licence plates, several systems use colour characteristics and fuzzy sets [4], [5]. Licence plate detection using colour edge detection is common practice; it has also been employed as an assisted feature in Persian licence plate detection [2, 4, 6]. Since most Iranian licence plate LPR systems rely on infrared photographs, specialised photographic equipment is needed for this kind of photography [1]. Building on recent advances in image processing and optimised template-matching approaches, the suggested system demonstrates the feasibility and practicality of a rapid LPR system that relies on colour information. The reaction time is reduced since it can identify licence plates in colour photos without scaling or converting them. Automated toll booths, tunnels, roads, intelligent parking, and LPR zones equipped with security cameras may all benefit from this. The system's capacity and dependability are shown by the findings based on photos from highway speed control cameras. Two phases are involved in the operation of the ALPR system. First, the system crops the original picture to reveal the licence plate position; this process is called licence plate localization. Step two involves the system extracting and categorising all the accessible

The licence plate is very near to the camera, To improve upon and speed up licence plate identification, for instance, some earlier research used hybrid approaches.

Most algorithms used for licence plate localization rely on gray-level or binary processing rather than colour characteristics, as discussed above. Licence plate localization using colour features is more in line with human eyesight and decision-making [7]. As a result, we provide a novel color-feature-based technique that finds minimal candidates via low-level processing.

New Approach for License Plate Detection

An optimised template-matching algorithm is suggested as a way to localise licence plates. In its most basic form, it is an algorithm that searches the whole picture for theobject by use of a template or the description of it [25], [31]. Imported photos of any size are often not supported by template-matching systems due to their lack of flexibility and scalability [25].

So that it can identify licence plates of any size or orientation, the suggested technique provides optimised template matching that is both scale and orientation invariant. A template or description of a template is required to use a template-matching algorithm. Consequently, it is essential to have a *prominent and standardised format for Persian licence plates. The blue rectangle on the* side of licence plates from Iran and a few European countries is a good feature. By analysing the blue rectangle using its standard aspect ratio, the licence plate may be identified. Because of its color-geometric description as a mask, it is easier to recognise. As shown in Figure 2, licence plates from Iran and a few European nations have a blue rectangle. It is not required to transform the whole picture to grayscale, monochrome, or binary level as colour information is used to locate a licence plate. The challenge of object detection in images has persisted throughout the history of image processing [25]. In order to compare a template with a portion of the picture using convolution, template-matching algorithms often sweep the image pixel by pixel or window by window. The matching candidate is determined by the component with the lowest error rate. Finding a method that can quickly sweep the whole picture surface while being scale and rotation invariant is crucial since this entire procedure puts a substantial burden on the system [31]. The suggested technique for licence plate localization makes advantage of colour features. As a built-in feature, the RGB channel format connects all of the channels with each other to reflect actual colours. Hue, saturation, and vibrancy (HSV) are aspects of colour space that include the primary hue's brightness and saturation. Saturation shows how pure a colour is, whereas hue shows which wavelengths are more prominent.

Colours with a high saturation level have a narrower range of visible light waves than those with a lower saturation level [31]. Using colour, the first stage of localization seeks for colonies of blue pixels.

When searching, colour spaces with discrete hues, like HSI and HSV, are very helpful. In order to locate blue rectangles with a licence plate aspect ratio, the suggested approach searches for blue pixel colonies. In order to do a vertical or slope search utilising (1) and the γ condition, it is not need to convert all picture pixels from RGB to HSV. However, peri are converted on demand.

If the γ criteria are not met, the pixel is presumed to not be blue and the result is found using Equation (1) as "do not care." The three RGB matrices, R, G, and B, are shown at the bottom of the page in Equation (1). In a $m \times n$ picture resolution, n is the number of rows (length) and is the number of columns (width). ϕ finds the white pixels with low saturation and the black pixels with low value that may be ignored.ϕ is the default value, which the user may change in certain instances; it starts at 0.21.images of odic strip lines

Confirming License Plates

Cropping the candidates from the source picture follows the discovery of all the candidates by vertical or slope search.But there's still the issue of which one to choose driver's licence? By matching the licence plate's aspect ratio, the suggested algorithm finds and crops all the blue rectangles The projection analysis verifies the main step's actual plates. Since a typical Iranian licence plate consists of seven numerals and one letter, the projection technique must include a minimum of eight distinct peaks, as shown in figure 1

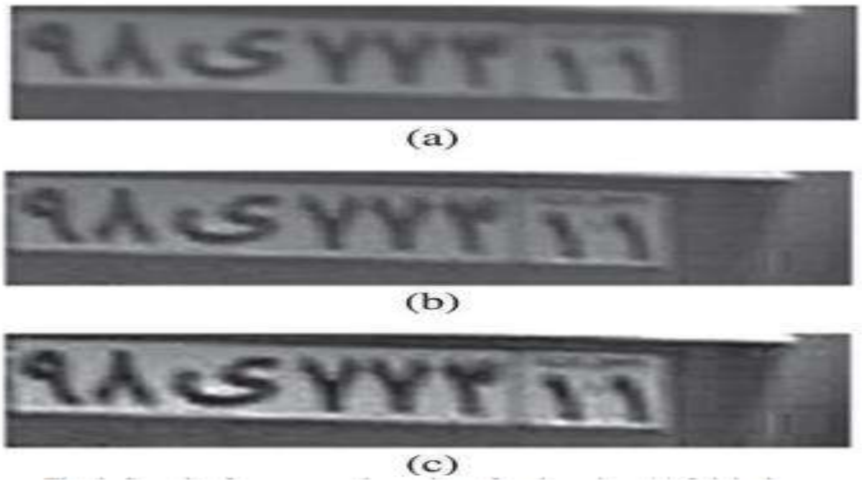

Fig. 1.Samples from cropped car plate after detection. (a) Original cropped license plate. (b) Applying histogram equalization and gamma adjustment. (c) Applying the Laplacian filter.

Two basic arrays plus the determination of the semilocal maximum and minimum are sufficient to accomplish projection peaks. Recognising the peaks would allow the machine to locate the actual licence plate; failing which, the applicant is rejected and removed from the pool of candidates. One practical method for detecting the actual licence plate is to use texture, shape, and colour analysis to locate the vehicle's lights or bumper region. Finding vehicle lights or bumpers is a waste of time and resources because some images have blue rectangles that don't actually belong there, mimicking the shape and aspect ratio of a licence plate. The suggested system only detects these rectangles 1.27% of the time.

Conclusion

A novel method for detecting licence plates has been introduced; it employs periodic vertical or slope sweep to analyse the colour characteristics seen on Iranian licence plates. Considering thethis system can identify licence plates by their colour and form and pinpoint their exact position. Scale and rotation are not factors affecting the localization. All potential licence plate candidates in a given scene are detected by the proposed localization method. The system then extracts the potential licence plate numbers and sends the picture to the recognition part, which is responsible for deciphering the eight characters found on every Iranian licence plate. In 98.73% of the photos, the suggested detection algorithm finds the actual candidate—the licence plate—without any intermediate steps. 4 GB of RAM and 1704 PU/S. Applying image processing filters such histogram equalisation and the Laplacian filter improves the licence plate picture quality after successful recognition, especially at the letters' edges. By using certain principles and morphological functions, all unnecessary components are eliminated. After the hybrid classifier extracts the licence plate characters using connected component or projection analysis, the data is handed on for recognition. A support vector machine (SVM) and a decision tree make up the hybrid classifier.

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