Implementation of Vehicle License Plate Recognition Using Canny Edge Detection

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Abstract— Vehicle number plate identification based on digital image processing is a vital area of research ongoing in present scenario. It offers various applications expanding through many fields. This technique may be used for parking, access control, tolling, border control, traffic control, enforcement etc. This article presents implementation of simple yet robust existing method to enable vehicle number plate identification based on canny edge detection. The system is designed for localizing the number plate, detecting and extracting it. The system has been specifically designed keeping in mind, standard license plates.

Keywords- Image Processing, vehicle recognition, edge detection, License plate extraction, Morphological Operations

I. INTRODUCTION

The unbridled increase in motor vehicle population of Goa against only a nominal increase in road length has been causing serious concern regarding road safety in this tiny picturesque state of India. According to reports of a research wing attached to the Ministry of Road Transport, the total surfaced road length in the state till 2011 is 10,627 km and the motor vehicle population has increased by 87 per cent in the last seven years. According to the latest estimates, every month about 5,000-6,000 new vehicles are added to the vehicle population of the state, whereas till March 2015 the figure has touched 10, 83,678 of which 70 per cent vehicles comprise of two wheelers. As the number of two wheelers increased from 7.12 lakh to 7.66 lakh, the number of accidents involving such vehicles increased four times from 4,520 in 2012 to 17,870 in 2013[1].

To address the above situation, we in the past carried out research on mitigating the effects of road accidents by implementing projects such as vehicle collision avoidance based on arduino system [2]. This was later upgraded to accommodate feature such as drowsy driver detection. The subsequent part of our ongoing research led us to formulate the method for automated vehicle license plate detection and after doing intensive research we proposed license plate detection and segmentation for Goan vehicles. The upright application of this system throughout the state can bring about control and order in vehicular traffic system thereby curbing the number of casualties.

This paper is organized as follows: Section I, deals with need and motivation for the project. In Section II, Literature is reviewed. Section III, explains the core of the idea, Canny edge based detection. Section IV enlists the steps for formulation of the problem statement and definition together with implementation and results. Section V, deals with usefulness, limitations and concluding remarks.

II. LITERATURE REVIEW

A. System framework

LPI (License Plate Identification) is an image-processing technology used to recognize vehicles by their license plates. The external effects (sun and headlights, bad plates, non-uniformity of plate types) and the limited level of the recognition software and vision hardware yielded low quality systems.

Typical Elements of such system include, camera, illumination source, computing machine, designed software, related hardware and database for efficient use. At present this system is primarily directed to extract standard license plates. But, the number plates today are seen in different font styles and fancy formats. The system totally fails when the vehicles has a complex alpha numerical characters in the number plates. This, addresses the need for strict law enforcement throughout the nation and heavy penalty to defaulters. As a case study, author has used Goa State registered vehicle.

The capture and communication process typically follow these steps:

- Detect the vehicle and license plate
- Locate the license plate in the image
- Extract license plate characters from the license plate
- Determine the license plate
- Communicate results to the back-end system

B. Existing algorithms

Various license plate (VLP) detection algorithms have been developed in past few years. Each of these algorithms has their own advantages and disadvantages. And most of them use gradient edge detection.

In general, the most common approaches for VLP detection include texture [3], color feature [4], edge extraction [5], combining edge and color [6], morphological operation [7] and learning-based method [8]. Shidore et. al. described the method in which license plate extraction had been done using Sobel filter, morphological operations and connected component analysis [9]. Anishiya et. al. proposed algorithm based on a combination of morphological operation with area criteria tests for number plate localization [10]. Paunwala et. al. described the technique for extracting license plate using Wavelet analysis [11]. Mirashi et. al. originally proposed the scheme for License Plate Detection and Segmentation for Goan Vehicles, based on morphological operations like opening, dilation, erosion followed with filling. To extract the actual license plate from image, centroid of the area is marked and depending on this license plate is finally extracted [12]. Shirwoiker et. al. extended the work further by taking into consideration the two row format of license plate numbering. A well-organized GUI was designed for end users for speedy processing and reduced execution time [13].

In general, License plate location algorithm consist of steps like as Edge Detection, Morphological operation like dilation and erosion, smoothing, segmentation of characters and recognition of plate characters are described in [14][15]. In this article, we have implemented VLP based on canny edge detection. This approach is robust and simplest of the existing techniques as far as execution time is concerned.

III. CANNY EDGE DETECTION

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images [16][17].

The general criteria for edge detection includes:

Detection of edge with low error rate, which means that the detection should accurately catch as many edges in the image as possible 1)The edge point detected from the operator should accurately localized. 2) the center of the edge.3) a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

The Process of Canny edge detection algorithm can be broken down to 5 different steps:

1. Apply Gaussian filter $G_\sigma(m,n)$ to smooth the image $f(m,n)$ in order to remove the noise

$$g(m,n) = G_\sigma(m,n) * f(m,n) \tag{1}$$

Where $G_\sigma(m,n)$ is given by

$$G_\sigma(m,n) = \frac{1}{\sqrt{2}\pi\sigma^2}\exp\left[-\frac{m^2+n^2}{2\sigma^2}\right] \tag{2}$$

2. Find the intensity gradients of the image

$$M(m,n) = \sqrt{(g^2{}_m(m,n) + g^2{}_n(m,n))} \tag{3}$$

and $\theta(m,n) = \tan^{-1}[g_n(m,n)/g_m(m,n)]$ (4)

3. Apply non-maximum suppression to get rid of spurious response to edge detection

4. Apply double threshold to determine potential edges

$$M_T(m,n) = M(m,n) \;\; if \;\; M(m,n) \rangle T; 0 \;\; otherwise \tag{5}$$

Where T is chosen, such that all edge elements are kept, most of the noise is suppressed.

5. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

IV. IMPLEMENTATION

Simulation is performed for purposes of investigation . The priority steps of the LPR system is as follows:

A. Read and resize the image

B. Convert the image toward gray scale

C. Receive the complement of the image and find the edges

D. Filter the image of small objects

E. Separate the image into objects

F. Recognition of the license plate

The Figure 1. shows the overall processing of algorithm, whereas Figure 2. shows extracted number plate. Table 1. shows the time taken for execution for images of various sizes. It can be observed that higher the image size, naturally more time for processing it takes. Image below required 0.120687s for processing.

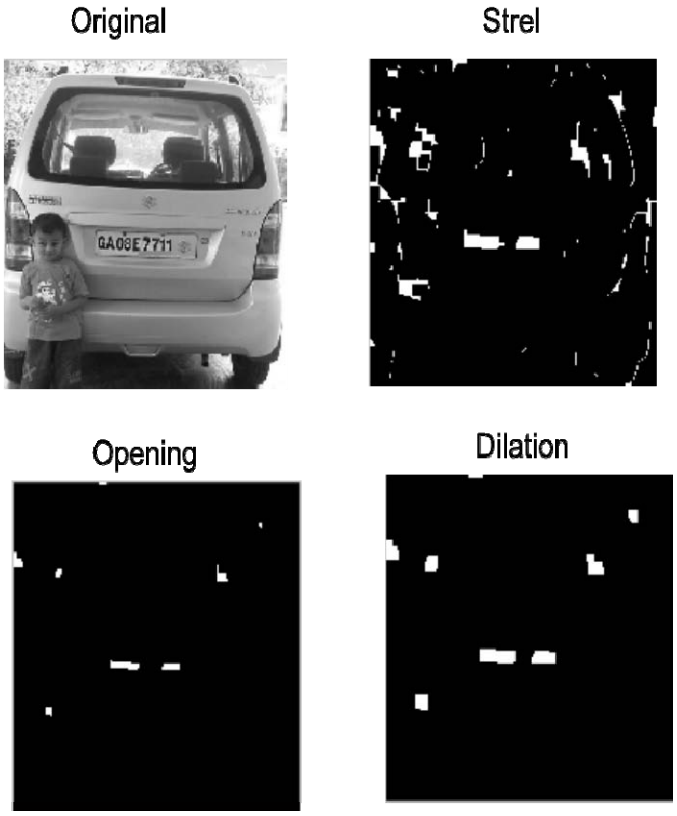

Figure 1. Preprocessing steps for VLP.

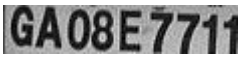

Figure 2. Extraction of Vehicle license number plate.

TABLE I. EXECUTION TIME V/S IMAGE SIZE

Sr. No.	Table Column Head		
	Execution Time(s)	***Column***	***Row***
1.	0.259657	1024	768
2.	0.119758	800	600
3.	0.101261	550	413
4.	0.156410	768	288
5.	0.076346	461	346

IV. CONCLUSION

The important factor in the license plate recognition is the design and development of software. The sophistication of the recognition software, the intelligence and quality of the applied license plate recognition algorithms together with the mathematical knowledge determines the effectiveness of the recognition software.

Major limitations observed in above implementation are identification of only specific characters, lower image resolution puts limitation on the applicability, interference with alphanumeric background in the image and deblurring is required as preprocessing step for out of focus image [18].

The future work in this field can be aimed at one or following problems.

· the higher recognition accuracy,
· the faster processing speed,
. the position and angle of view,
. the ambient lighting conditions with dynamic contrast range.

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