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License Plate Detection and Recognition using Vertical based Edge Detection Algorithm and Radial Basis Function Neural Network

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Abstract

Objectives: The projected aspects in this paper constitute the powerful means of a well-organized and an automated exposure and perception of license plates. **Methods:** This procedure exhibits an esteemed Vertical Based Edge Detection Algorithm and a Radial Basis Function Neural Network Algorithm for the revelation and disclosure of license plates. After the image procurement, the entity starts with certain primitive pre-processing steps. Consequently, the vertical edges are disclosed by adopting Vertical Edge Detection Algorithm and the number plates are identified and separated using the Structured Component Analysis. Lastly, the characters inside the License Plates are disjointed and discovered by applying Connected Component Labeling and Radial Basis Function Neural Network Algorithm. **Results:** The intended technique pinpoints the vehicle number plates and distinguishes the characters in 90.76% photographs fruitfully. **Application:** Focuses on the Intelligent Transportation System, which strengthens shipping capacity, security and flexibility.

Keywords: Connected Component Labeling (CCL), Intelligent Transportation System (ITS), Radial Basis Function Neural Network (RBFNN), Structured Component Analysis (SCA), Vertical Based Edge Detection Algorithm (VBEDA)

1. Introduction

Automatic License Plate Recognition (ALPR) organization is an outstanding image processing scheme which adequately regulates the wagons by diagnosing and tracking their number plates naturally, beyond any personal intervention explicitly. This organization performs a significant part in Intelligent Transportation System (ITS), which has an immense influence on our day today life and its outlook principally targets to heighten the shipping security, flexibility and productivity.

Nowadays number plate detection and recognition structure grows into a crucial investigation field because of its broad dimension of monetary applications, which encompasses trailing wagons during the time of traffic signal contraventions and associated applications, the remittance of parking wages, automatic toll-collection, traffic supervising and control, border regulations, robbed truck detection, automatic ticketing of wagons etc, with a enormous discounting of personal worth and strength. The paradigm of Automatic License Plate Recognition organization essentially is made up of four vital phases:

- Picture Procurement.
- Picture Pre-processing.
- Number Plate Detection.
- Number Plate Character Segmentation and Recognition.

The functioning of Automatic License Plate Recognition structure is displayed in Figure 1. To start with, the automobile vehicles' input photograph is attained and a few pre-processing activities are executed to boost the processing quickness and the quality of the captured input picture. Consequently, from the whole vehicular photograph, the specific section of the number plate is encountered and concentrated. Conclusively, the character separation and realization of each character

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from the extracted plate area is done and the plate number is achieved as result. Amidst these phases of Automatic License Plate Recognition scheme, number plate detection is the most difficult and toughest part because it shakes the full veracity of the procedure and the certainty of all further phases relies on the rigorous detection of the number plate.

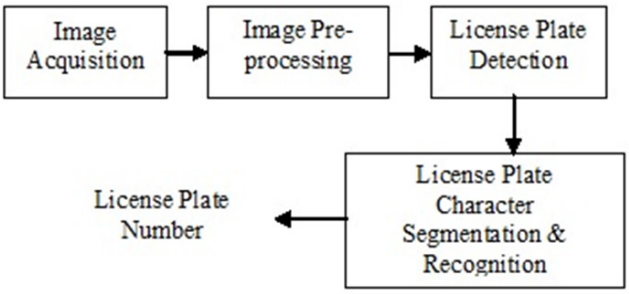

Figure 1. Primitive model of a number plate detection and recognition system.

Majority of the number plate detection and extraction schemes previously recommended are implied to be applicable for a very restrained environment. Numerous hazards, like the display intricacy, distinct spots of number plates in peculiar vehicles, diverse climate circumstances and noise obstacles in between camera capture, brightness effects and contrast troubles, mistaken camera and plate points, jagged illumination, obscured and low resolution photographs, reflection and shadow effects etc should be ironed out, meanwhile an outstanding and rapid number plate detection mechanisms.

This paper is coordinated in the following fashion. Unit 2 proposes a concise narration of related works or literature review. Unit 3 analyzes the proposed approach, which describes in two parts. The first part deliberates proposed design for number plate detection and the second part discusses the proposed design for character recognition, in detail. Experimental outcomes are presented in Unit 4 and Unit 5 draws the conclusions.

2. Related Works

Since 1990s, the dilemma of automatic number plate detection and recognition has been surveyed and distinct practices have been established for the successful detection and recognition of number plates from the online and offline trucks' pictures.

In[1], a quick procedure for automatic car number plate detection by adopting vertical based edge method and a comparison of the this technique to the Sobel edge operator[9] is also functioned, which proves that former approach is better in terms of the algorithm intricacy, certainty, efficiency and quickness of functioning. A number plate localization technique based on edge based multi stage technique is developed in[2]. This projected scheme only works right for the automobile pictures having legibly readable characters on the number plates and is limited noisy and the achievement rate is 89.2%.

A car number plate disclosure by means of vertically edge based detection approach and Structured Component technique is applied in[3] and the outcomes display heavy disclosure rate and calculation time. An Improved vertically edge based detection technique[4] and unnecessary edge elimination procedures crops reliable outcomes and employs in feature extraction based applications. An energetic implementation[5] for separation of number plate extraction employs some activities based on morphology, thresholding, sobel edge operator and Connected Component procedure.

In [6] a comparative study of Canny, Sobel and vertically based edge detection methods are applied and the outcomes display that last described approach presents enormous systematic conclusion. Vertically based edge detection method and Structured Component techniques are applied for the number plate region recognition and the findings show successful outcomes in terms of calculation time and huge disclosure rate. Sobel edge operator is experienced for[8,10] and the outputs seem to be absolutely satisfactory. A survey on this particular research area is projected in[12].

In the light of above facts, the proposed technique presents a fast and efficient technique for the revelation and identification of number plate regions from the vehicular images.

3. Proposed method for License Plate Detection and Recognition

An agile and adequate implementation for the number plate disclosure and extraction, which makes use of an eminent Vertical based Edge Detection Algorithm and

a Radial Basis Function Neural Network Algorithm, is presented in the succeeding section and comprises the successive steps:

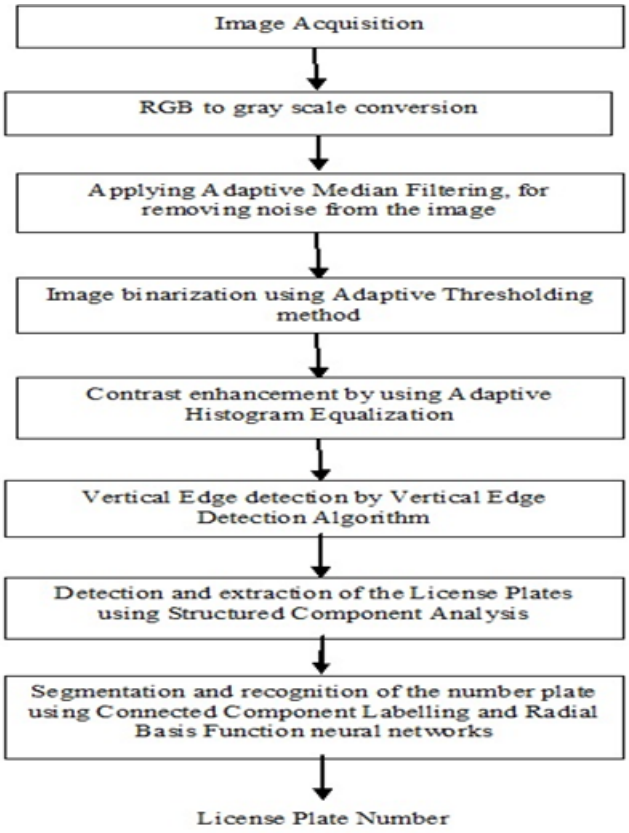

Figure 2. Flow diagram for the proposed procedure.

- Picture procurement.
- RGB to gray scale transformation.
- Applying Adaptive Median Filtering procedure, for expelling noises from the photographs.
- Image binarization by making use of Adaptive Thresholding technique.
- Contrast intensification by using Adaptive Histogram Equalization to enrich the binarized pictures.
- Edge detection by vertically based procedure.
- Localization and extraction of the number plates by means of Structured Component method.
- Separation and identification of the number plates using labelling approach and using the neural networks.

The flow diagram for the proposed procedure is displayed in Figure 2.

3.1 License Plate Detection

3.1.1 Image Procurement

The wagon input photographs are attained here in this step, with the help of a digitized camera. These vehicular photographs are taken at peculiar distances from the camera, in distinct brightness and climate circumstances.

Figure 3. The Vehicle Input Image.

3.1.2 RGB to Gray Scale Transformation

Since the wagon's input photograph consists of bountiful different colors, the RGB picture is transformed into gray scale picture to scale down the count of colors within the picture, using the ensuing formula:

$$Gray=0.299^{*}Red+0.587^{*}Green+0.114^{*}Blue$$

3.1.3 Applying Adaptive Median Filtering Procedure, for Expelling Noises from the Photographs

In this projected work, we adapts Adaptive median filtering approach so as to expel the noises within the photographs, which is a leading and progressive method while correlating it with the standard median filtering and continues to be applied universally nowadays. The main objective of executing this procedure is for expelling impulse noise, polishing of other kinds of noises, cutting down the distortions etc.

This approach performs spatial processing by correlating each pixel within the picture with its neighboring enveloping pixels. A pixel is designated as noise, which is not structurally corresponding to its neighboring enveloping pixels. Finally, these noise pixels are alternated with the median pixel value of its neighboring enveloping pixels.

3.1.4 Image Binarization using Adaptive Thresholding Technique

Adaptive Thresholding is exercised on the intensified gray scale picture to receive the binarized picture, which accommodates only black and white pixels, so as to select the number plates correctly from the vehicular images since they encompass irregularly disseminated gray level intensities.

3.1.5 Contrast Enhancement by using Adaptive Histogram Equalization to Enlighten the Binarized Picture

Adaptive Histogram Equalization is adopted to upgrade the diversity within the binarized picture, which is the variation between highest and lowest intensity values within the picture. It conflicts with the traditional Histogram Equalization in such a fact that it calculates numerous histograms, each correlating to a distinct part of the picture and reorganize the brightness values of the pictures and it gives better contrast than traditional Histogram Equalization.

3.1.6 Edge Detection by Vertically based Procedure

The vertical edges are excerpted by using the Vertically Based Edge Detection Algorithm (VBEDA), which discriminates the beginning and the end of each character within the number plate sector, which will count down the processing time of the number plate identification scheme. Since after the binarization process, the picture will only involve black and white pixels, the execution of VBEDA focuses on the intersections of black–white and white–black sectors of the pictures. By passing a 2×4 mask, which is proposed for this process, from left to right on the picture and when it met with the black–white sectors, the last two black pixels will only be preserved. Likewise, the first black pixel will be preserved, when it met with the white–black sectors.

3.1.7 Detection and Extraction of the Number Plates using Structured Component Method

After implementing the vertically based edge detection procedure, the next movement is to detect and extract the number plate area with the help of Structured Component approach. While performing this procedure, with the help of the VBEDA outcome, the number plate details are highlighted. Subsequently, a few of the logical and statistical activities are executed to disclose number plate candidate sectors and to determine the true number plate candidate sector out of them. Finally, the true plate sector is identified and separated from the vehicle input image.

Figure 4. The Number Plate Detection and Extraction.

3.2 Number plate Character Segmentation and Recognition

3.2.1 Segmentation and Recognition of the Number Plate using Connected Component Labeling Algorithm and Radial Basis Function Neural Networks

Character segmentation is the mechanism for isolating the characters within the number plate detected picture based on some of the aspects and features of the characters and digits. Here in this current approach or work, a Connected Component Labelling (CCL) algorithm, or Connected Component Analysis (CCA) algorithm is used to pin point the foreground components of characters and digits from the background components specifically. The separated characters and digits are passed to the character identification phase to diagnose each characters and digits within the number plates.

In this proposed work, a Radial Basis Function Neural Network (RBFNN) is designed for the character identification, which is a feed-forward network, trained using a supervised training procedure. Artificial Neural Networks (ANN) primitively upgrades the quality of character identification, displays acceptable performance

and will be able to identify more characters and digits than the primarily defined phases due to its training phases.

Figure 5. The Recognized Number Plates.

4. Experimental Results

This projected approach for the revelation and disclosure of number plates successfully obtained 90.76% accuracy and is quicker than traditional and existing systems, which is implemented in MATLAB. This method evaluated 130 vehicle pictures, taken in various brightness, illumination and climate conditions and it perceived 117 License Plates successfully. The proposed approach works nice for limited resolution, contrast and noisy truck input pictures and the experimental result of the proposed system is shown in Table 1.

Table 1. Experimental Result of the Proposed Number Plate Detection and Recognition System

Total vehicle images	Successfully recognized License Plates	Success rate (%)
130	117	90.76%

5. Discussion and Conclusion

The proposed technique focuses on the Intelligent Transportation System, which strengthens shipping capacity, security and flexibility and presents an agile and robust technique for the exposure and identification of number plate sectors from the vehicular photographs and performs well in various complex situations also. The proposed system will be an important milestone for the advancement of an entire Automatic License Plate Recognition organization system in terms of certainty, veracity, calculation time, and success rate.

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