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Automatic Vehicle Identification and Number Plate Recognition

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***Abstract*—Automatic Vehicle Identification (AVI) has many applications in traffic systems such as highway electronic toll collection, red light violation enforcement, border and customs checkpoints, etc. License Plate Recognition is an effective form of AVI systems. In this research work, a smart and simple algorithm is presented for vehicle identification and number plate recognition system. The proposed algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. For extracting the plate region, Edge Detection and Enforcement algorithms are applied. In segmentation part, filtering and morphological algorithms are used and each character is identified by bounding box method. And finally statistical based template matching is used for recognition of plate characters. The performance of the proposed algorithm has been tested on real images. Based on the experimental results, it has been noted that the proposed Automatic Vehicle Identification and Number plate Recognition System shows superior performance in identifying and recognizing the vehicle number plates.**

***Keywords*— AVINPR, License Plate Recognition, LVPR, Template Matching, Bounding Box.**

I. INTRODUCTION

Usage of vehicles is increasing day to day. Accident and offence are also increased in daily life. Human vehicle monitoring is very difficult to handle.

Automatic Vehicle Number Detection and Recognition is a technique which can easily identify the vehicle and its related information. AVLPR is a novel automatic technique proposed in this paper to monitor the vehicle navigation. Vehicle monitoring is helpful during parking of the vehicle, Traffic Monitoring and Army applications.

Image processing technique is essential for AVND which recognizes a vehicle's license plate number fetch from various color plates such as black, white and infrared camera.

A. Challenges in Vehicle number detection

Vehicle license plate detection is not a simple process. There is some difficulty in getting a clear picture of the vehicle. They are explained bellow.

1) Resolution

Low resolution camera gives blurred and low quality image. Quality of the surveillance camera is very important.

2) Illumination

Illumination is plays vital role in capturing vehicle images. Over brightness or darkness will not suitable for quality image.

3) Color

Color of the license plate should be clean color such as white, yellow. Color of the number should be dark color like black, dark blue.

4) Font

Font size for the license number should same manner which follows government rules.

After extracting the license plate region, identification of individual digits and characters in the plate must be carried out. Template Matching techniques are used to recognize the numbers and letters. Before applying the Template Matching techniques, the following steps are applied in pre-processing the located plate regions.

License plate quantization and equalization

License Plate normalizing

Character segmentation

Finally, the content of the number plates recognized.

The remainder of the paper is organized as follows: existing techniques are discussed in Section 2 of this paper. Section 3 describes proposed system and recognition methodology. Section 4 describes experimental analysis and result. Conclusion and future work is discussed in Section 5.

II. LITERATURE SURVEY

Generally, as a prior, license plate is characterized by a rectangular shape with a specific aspect ratio, and can be extracted by checking all possible rectangles in the image.

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Kinds of traditional locating methods, some other approaches based on local features have been proposed recently. A brief description of some of previous works is demonstrated below.

Muhammad Sarfraz, et al., proposed "Saudi arebian licence plate recognition system", in which license plate recognition is done with :(1)Image Acquisition: By digital camera (2) License Plate Extraction: a) vertical edge detection by sobel algorithm b) filtering by seed filling algorithm c) vertical edge matching (3) Segmentation: (4) Character Recognition: * Normalization * Template matching using hamming distance approach and getting the results like: License Plate Extraction: 587/610, 96.22% License Plate Segmentation: 574/610, 94.04% License Plate Recognition :581/610, 95.24%, and overall system efficiency: 95%. This approach has some problem in extracting the plate of diplomatic cars and military vehicles, are not addressed since they are rarely seen. The algorithm detects only for white, black, red, and green color plate or numbers [1].

Serkan Ozbay, and Ergun Ercelebi proposed" Automatic Vehicle Identification by Plate Recognition". The algorithm is carried out in three phases. (1)Extraction of plate region: edge detection algorithms and smearing algorithms (2) segmentation of Characters: smearing algorithms, filtering and some morphological algorithms (3) Recognition of plate characters: template matching. For final output it is proved to be 97.6% for the extraction of plate region, 96% for the segmentation of the characters and 98.8% for the recognition unit accurate, giving the overall system performance 92.57% recognition rate. The algorithm has one limitation that it is designed to recognize only Turkish car license plates [2].

The recognition steps (1)Image Enhancement: by histogram equalization method (2)Structuring Elements : by thickening, (3) Hat transformations: which is use for contrast, enhancement(top has & bottom has)setting (4) Morphological Operations like dilation and erosion (5) Plate region confirmation (6) Character Segmentation and Recognition by neuron implementation model were followed by Humayun Karim Sulehria,et al., " Vehicle Number Plate Recognition Using Mathematical Morphology and Neural Networks". 250 color images were used for testing this technique. These results report a high accuracy rate of above 95%. Although the technique is quite efficient enough to work very well in the real time environment but currently the technique proposed lays more emphasis on the accuracy of the overall system, while the some more work is to be done to make the technique more efficient [3].

III. Proposed System

Number plates are used for identification of vehicles all over the nations. Vehicles may be identified either manually or automatically. Automatic vehicle identification systems are used for the purpose of effective traffic control and security applications such as access control to restricted areas and tracking of wanted vehicles. A novel Automatic Vehicle Identification and Number Plate Recognition System (AVINPR) is proposed in this research work.

A. Working process of AVINPR System

The AVINPR system contains various processes like preprocessing for image enhancement, number plate extraction, character segmentation and character recognition. The block diagram for the proposed system is shown below in Figure 1.

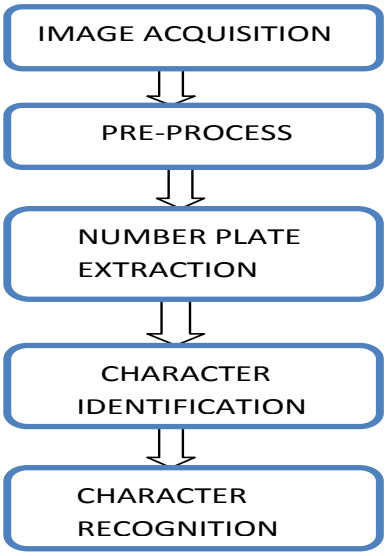

Figure 1.AVINPR system

B. Image Acquisition

A high resolution digital camera is used to acquire an image. Images are taken in different background, illumination conditions, and at various distances from the camera to vehicle. Vehicles are monitored at various stages.

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Figure 2.CCTV Surveillance Cameras

Figure 2 is shows CCTV which is used to capturing the sequences of images called video for monitoring. The video sequence broken as individual images and these are taken as input. The captured input image will contain the number plate area which is shown in Figure 3. The acquired input images will be in RGB color space. If the resolution of the image is more than 400 X 500, there is a problem of low quality or low contrast in images. The major issue in the proposed work is that how long it will take to compute and recognize the particular license plates. This is embarrassment and most needed when it is applied to real time applications. However, there is always a trade-off between computational time and success rate. In order to achieve an exact result and increase the performance of the system with less computational time, the input images will be resized.

Figure 3.Acquired Vehicle Image

C. Image Preprocessing

The aim of image preprocessing phase is to improve the quality of the input image to suppress the unwanted distortion or to preprocessing phase of AVINPR enhance the required image features for further processing. The schematic representation of preprocessing phase is shown in Figure 4.

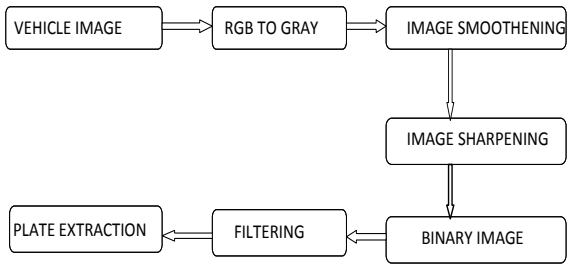

Figure 4.Preprocessing Phase

1) RGB to Gray Image

In the Initial phase of preprocessing, the resized RGB vehicle images are converted into Gray scale images. Most image file formats support a minimum of 8-bit grayscale, which provides 2^8 or 256 levels of luminance per pixel. Some formats support 16-bit grayscale, which provides 2^16 or 65,536 levels of luminance.

The proposed system removes all color information, by leaving only the luminance of each pixel. Since digital images are displayed using a combination of red, green, and blue (RGB) colors, each pixel has three separate luminance values. Therefore, these three values must be combined into a single value when removing color from an image. There are several ways to do this work. In this work for S_{RGB} color space, gamma expansion is defined in equation 1.

$$C_{linear} = \begin{cases} \frac{C_{srgb}}{12.92}, & C_{srgb} \leq 0.04045 \\ \left(\frac{C_{srgb}+0.055}{1.055}\right)^{2.4}, & C_{srgb} > 0.04045 \end{cases} \quad (1)$$

The S_{RGB} color space is defined in terms of the CIE 1931 linear luminance Y_{linear}, which is given in equation 2.

$$Y_{linear}=0.2126R_{linear}+0.7152G_{linear}+0.0727B_{linear} \quad (2)$$

The Gamma-Compressed Y_{srgb} given by the inverse of the gamma expression is expressed in equation 3.

The converted gray scale image is shown in figure 5.

$$Y_{srgb}=\begin{cases} 12.92\ Y_{linear}, & Y_{linear} \leq 0.0031308 \\ 1.055\ Y_{linear}^{1/2.4}, & Y_{linear} > 0.0031308 \end{cases} \quad (3)$$

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Figure 5.Gray Image

2) Image Smoothening

The converted gray image may contain lot of noises which in turn may affect the process. Smoothening is often used to reduce noise within an image or to produce a less pixels image. Most smoothening methods are based on low pass filters. Smoothening is also usually based on a single value representing the image, such as the average value of the image or the middle (median) value. The proposed system concentrates over Median filter which is suitable for Character recognition.

3) Grayscale to Binary

Gray scale image is converted into a binary image based on histogram Equalization and Threshold value. Binary image is required to reduce processing time and increase efficiency. The converted binary image is shown in Figure 6.

Histogram equalization is a technique used for adjusting image intensities to enhance contrast. Let f be a given image represented as a m_r x m_c matrix of integer pixel intensities ranging from 0 to L−1. L is the number of possible intensity values, often 256. Let p denotes the normalized histogram obtained by using the equation 4.

$$P_n = \frac{\text{number of pixels with intensity n}}{\text{Total number of pixels}} \quad \text{n = 0, 1..... L – 1} \quad (4)$$

The histogram equalized image g will be defined in equation 5.

$$g_{i,j} = floor(L-1)\sum_{n=0}^{f_{i,j}} p_n \quad (5)$$

Where floor () rounds down to the nearest integer. This is equivalent to transform the pixel intensities, k of f by the function which is described in equation 6.

$$T(k) = floor(L-1)\sum_{n=0}^{k} p_n \quad (6)$$

The motivation for this transformation comes from thinking of the intensities of f and g as continuous random variables X, Y on [0, L − 1] with Y defined in equation 7.

$$Y = T(X) = floor(L-1)\int_0^x P_x(x)dx \quad (7)$$

Figure 6.Binary Image

The performance of different edge improvement operators is normally measured using two methods. The subjective method is based on human visual analysis on the edge image while an objective method is based on signal to noise ratio as used in canny method. Threshold concept is used to change the image into binary format. Complement is applied to inverse the image. The binary image contains lot of objects including characters.

Characters are within the range of 30 X 40 pixels. More than 30 X 40 sizes of connected pixels are took outside to remove all except characters. Character Extraction is done by subtracting the noisy image from the binary image. Now the image has characters with some small components is shown in Figure 7.

Figure 7.Character Extraction

D. Character Segmentation

Characters are highlighted by bounding box method. This method covers the objects which are connected in 4x4 or 8x8 format of square or rectangle. Characters are segmented by image cropping as shown in Figure 8.

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Figure 8.Characters Covered by Bounding Box

E. Character Recognition

Character recognition is done by template matching. Template matching is a technique to compare two binary images. The segmented characters in figure 9 are matched with the already designed templates which are shown in Figure 10 using correlation function. The correlation coefficient is expressed as follows:

$$\rho_{X,Y} = \frac{NE[XY]-E[X]E[Y]}{\sqrt{E[X]^2-[E[X]]^2}\sqrt{E[Y]^2-[E[Y]]^2}} \qquad (8)$$

The character with the maximum value of the correlation with the template image is considered. In the final step, the matched or the recognized characters are written in a text file which is editable. Thus the target of recognizing the characters from the license plate are achieved is shown in Figure 11.

Figure 9.Segmented Image

Figure 10.Template Images

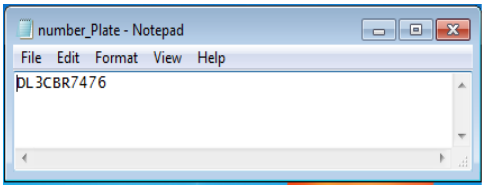

Figure 11.Character Identification

IV. Experimental Result And Analysis

From the literature survey it has been identified that the existing systems authendicate the characters when the correlated values are greater than 0.5 and yields 95.3% of accuracy. If the correlated value is below 0.5, then the system will not recognize the characters. The proposed AVINPR system also concentrates on the correlation values which impact the accuracy. The system authenticates the character while the correlated value is greater than 0.48 and the accuracy of the system is also increased. The result is 96% accuracy.

Once the characters are recognized, the vehicle number is compared with the RTO data base and then the vehicle owners' details like Vehicle name, model, color and Address are displayed. The detail for the detected number is displayed in Figure 12.

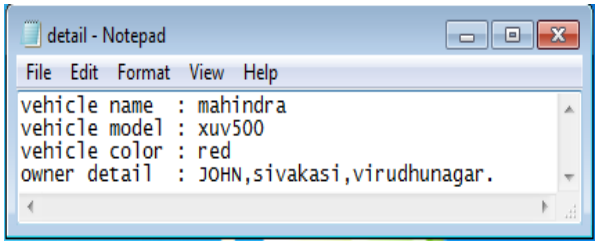

Figure 12.Resultant Image

The proposed system provides various result based on plate localization, character segmentation and character recognition.

Accuracy of proposed system is 0.7% more than existing system. Table 1 shows Plate Localization Success Rate.

Table 1
Plate Localization Success Rate

Total Images	Plate Located	Failed to Locate	Success Rate
50	49	1	98%

Successfully carried license plates are taken into character segmentation. Success rate of character segmentation is shown in Table 2.

Table 2
Character Segmentation Success Rate

Total Images	Character Segmented	Failed	Success Rate Cumulative	Success rate
49	48	1	97. 95%	96%

Segmented characters are carried into Optimal Character Recognition.

Table 3
OCR Success Rate

Recognition Rate on Training Data	Recognition on Actual images Extracted from AVINPR
90%	80%

V. Conclusion And Future Work

An Automatic vehicle Identification and Number Plate Recognition System (AVINPR) is designed for the recognition of car license plate. Initially, the plate location is extracted and then the plate characters are separated individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters. The system is designed for the identification of Indian License Plates and the system is tested over a large number of images. This system can be redesigned for multinational car license plates as well as other vehicles in future research.

REFERENCES

[1] Muhammad Sarfraz, Mohammed Jameel Ahmed, and Syed A. Ghazi ,"Saudi arebian licence plate recognition system", International Conference on Geometric Modeling and Graphics (GMAG'03), 2003.

[2] Serkan Ozbay, and Ergun Ercelebi," Automatic Vehicle Identification by Plate Recognition", Processing of world academy of science engineering and technology vol9, ISSN 1307-6884, november 2005.

[3] Humayun Karim Sulehria, Ye Zhang, Danish Irfan, Atif Karim Sulehria," Vehicle Number Plate Recognition Using Mathematical Morphology and Neural Networks", WSEAS TRANSACTIONS on COMPUTERS, Volume 7,ISSN: 1109- 2750, Issue 6, June 2008.

[4] Zhen-Xue Chen, Cheng-Yun Liu, Fa-Liang Chang, and Guo-You Wang," Automatic License-Plate Location and Recognition Based on Feature Salience", IEEE Transaction on vehicle technology, VOL. 58, NO. 7, september 2009.

[5] Dr. P.K.Suri, Dr. Ekta Walia, Er. Amit Verma," Vehicle Number Plate Detection using Sobel Edge Detection Technique", International Journal of Computer Science and Technology, ISSN : 2229 – 4333, IJCST Vol. 1, Issue 2, December 2010.

[6] Kumar Parasuraman, Member, IEEE and P.Vasantha Kumar, "An Efficient Method for Indian Vehicle License Plate Extraction and Character Segmentation", IEEE International Conference on Computational Intelligence and Computing Research, 2010.

[7] Muhammad H Dashtban, Zahra Dashtban, Hassan Bevrani, "A Novel Approach for Vehicle License Plate Localization and Recognition", International Journal of Computer Applications (0975 – 8887), Volume 26– No.11, July 2011.

[8] Stuti Asthana, Niresh Sharma, Rajdeep Singh, "Vehicle number plate recognition using multiple layer back propagation neural networks", International Journal of Computer Technology and Electronics Engineering (IJCTEE), Volume 1, Issue 1, July 10, 2011.

[9] Chetan Sharma1 and Amandeep Kaur2, "Indian Vehicle License Plate Extraction And Segmentation", International Journal Of Computer Science And Communication, Vol. 2, No. 2, Pp. 593-599, Julydecember 2011.

[10] R. T. Lee, K. C. Hung, and H. S. Wang, "Real Time Vehicle License Plate Recognition Based on 2D Haar Discrete Wavelet Transform", International Journal of Scientific & Engineering Research, Volume 3, Issue 4, ISSN 2229-5518, April-2012.

[11] Lekhana G.C, M.Tech; R.Srikantaswamy, Professor,"Real time license plate recognition system", International Journal of Advanced Technology & Engineering Research (IJATER) National Conference on Emerging Trends in Technology (NCET-Tech) ISSN, Volume 2, Issue 4, ISSN No: 2250-3536, July 2012.

[12] Wengang Zhou, Houqiang Li, Yijuan Lu, Member, IEEE, and Qi Tian, Senior Member, IEEE, "Principal Visual Word Discovery for Automatic License Plate Detection", IEEE transaction on image processing ,vol21, NO. 9, September 2012.