Real Time License Plate Detection Using Adaptive Correlation Comparison

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Abstract: License plate detection(LPD) can be considered as an intelligent system for transportation. Applications of LPD are in parking lots,in toll collection and traffic controlling. There are number of studies has been carried out over licence plate detection. The commonly license plate locating algorithms includes line detection method, neural networks method, fuzzy logic vehicle license plate locating method. In india when the concern is about low cost implementation of system ,different algorithm comes in practice . In this paper adaptive approach is taken for comparison of correlation coefficient with use of low cost cameras.Number of techniques are used prior which considers a maximum threshold for comparison of correlation, but it might happen that image quality will not cross that threshold. So adaptive approach is considered.A minimum thereshold can be set to overcome several issues In this paper correlation is compaired with different opearatos and the best one is considered..The main purpose of this paper is to develop real time algorithm which detects the number plate of a car with adjustable threshold. The proposed system is implemented using MATLAB 12 and the recognisition accuracy varies from 85-90%.

Keywords – Segmentation, Adaptive correlation comparison, Edge detection

I. INTRODUCTION

License plate detection (LPD) is a technology comes under image-processing technology used to identify vehicles by their license plates. This technology has gained popularity in security and traffic installations. License plate detection system is an application of computer vision. Computer vision is a process of using a computer to extract high level information from a digital image Implementation of a computer vision system also depends on if its functionality is pre-specified or if some part of it can be learned or modified during operation. There are, however, typical functions which are found in many computer vision systems

1.1 Image acquisition

A digital image is produced by one or several image sensor which, besides various types of light-sensitive cameras, includes range sensors, tomography devices, radar, ultra-sonic cameras, etc. Depending on the type of sensor, the resulting image data is an ordinary 2D image, a 3D volume, or an image sequence. The pixel values typically correspond to light intensity in one or several spectral bands but can also be related to various physical measures, such as depth, absorption or reflectance of sonic or electromagnetic waves.

1.2Pre-processing

Before a computer vision method can be applied to image data in order to extract some specific piece of information, it is usually necessary to process the data in order to assure that it satisfies certain assumptions implied by the method some examples like resampling in order to assure that co-ordinate system is correct. Noise reduction, contrast enhancement and scale space representation to enhance image structure are also considered.

. II. REVIEW OF PREVIOUSLY ADOPTED TECHNIQUES

In this study, [1] is used for Inductive Learning Based Method and SVM method. Inductive Learning Based Method is used to divide all classes into smaller groups. SVM method is used for classification of these groups. All these methods are applied on the plate characters. Then, a training process is used for each character.

This system [2] is a web based system. This system consists of three modules:

- Creating digital image form the video signals, using hardware for this;
- Using pattern recognition and artificial intelligence for plate recognition;

• Accessing to the database from web browser and run query for vehicles

In this system [3] morphological operators are used for preprocessing. After preprocessing, Template Matching is used for character recognition. This system is used for Macao-style license plates.

In this study, it is the first time that the plate image is normalized [4]. Scaling and cross- validation are applied for remove the outliers and find clear parameters for SVM method. Then use SVM method for character recognition. Correct recognition rate is higher than neural network systems.

This method [5] is applicable in camera-in-motion applications. Images are acquired via a webcam. The light conditions, background and position of the vehicle are not important for character recognition. This method can localize different sizes of the plate from the image. After localization of the plate, the characters are segmented. Multiple neural networks are used for character recognition. The correction rate is %95 in this method. This application was used in University of Malaga (Spain) in the entrance of the Computer Science building.

Sobel color edge detector is used for detecting vertical edges in this study [6]. Then, the invalid edge is eliminated. The license plate region was searched by using template matching. Mathematical morphology and connected component analysis was used for segmentation. Radial basis function neural network was used for character recognition. This system is also successful in night hours and daytime real conditions.

Plate location is found by using plate background and the character□s color in this study [7]. For segmentation, the column sum vector is obtained. The Artificial Neural Network is used for character recognition.

This system is designed for Islamabad Computerized Number Plates [8]. SCAN_NP algorithm is developed for plate extract. This algorithm can find candidate plates. The algorithm brings out these candidate objects which would turn out to be the plate characters. The objects have horizontal and vertical lines. This algorithm scans the image to remove the noises from the image. Neural Network and template matching is used for character recognition. The correction rate is %90 in this method.

This method [9] is used in off-line Thai license plate recognition. Hausdorff Distance technique is used for recognition. The correction rate in this method is %92.

This method [10] is used for Chine license plate recognition. The plate image is converted into a binary image. Then the noises are removed from the image. The skeleton is used for generating the feature of the character. Then the character is normalized to size 8*16 pixels. The plate image is processed in the Back-Propagation Neuronal Network for recognition after being normalized. Back-Propagation Neuronal Network is used for character recognition

This method [11] is not used to preprocess for recognition. Image transformation is applied for original license plate picture. After transformation process, in the database, the number of the input and the data increase. Convolution neural network is used for character recognition. The correction rate in this method is %98..

This method [12] has two modules: plate locating and plate segmentation modules. Fuzzy geometry is used for the first module. Fuzzy C mean is used as the second module. The correction rate for segmentation is %94.24

In this method [13] blob labeling and clustering are used for segmentation. The studies of Kirsch, Sobel, Laplacian, Wallis, Prewitt, Frei Chen on edge detectors are compared and corner of the component of the original image detail (high frequency). You can then continue to the low frequency components of the same upper left corner of the 2nd, 3rd inferior wavelet transform.

In this study [13] Robert edge detector and morphology operator is used for finding plate edge from the picture. Horizontal and vertical projections are used for rotating plate image when it is needed. Least squares support vector machines are used for character recognition.

This method [14] is used different method for finding plate location from the picture. White and black pixel have different weight according to this method. Hence, this method uses this feature for finding plate location. Hybrid neural network is used for character recognition. The correction rate in this method is %97

This method uses is [15] Ostu Threshold algorithm for converting into binary level for plate image.Character coordinates are used for character segmentation. Improved pattern matching algorithm is used for character recognition. The correction rate is %98 in this method.

Scanline checking is used for plate localization in this study [16]. Dynamic projection warping is used for character recognition.

This method [17] is about plate localization and character segmentation. AdaBoost algorithm is used for finding plate localization from the image. Vertical edge detection and horizontal projection histogram are used for upper and lower boundary disposal. Image binarization and vertical projection histogram are used for character segmentation. The correction rate is %96.4 in this method.

This method [18] uses composite colors for detecting the plate area of the image. Horizontal and vertical histograms are used for character segmentation. Artificial hippocampus algorithm is used for character recognition. The correction rate is %95 in this method.

III.IMAGE PRETREATMENT

All vehicle images acquired through camera and image card are colour image and image format is not same. The commonly used image forms are JPEG and BMP. If treatment with acquired image directly , not only the image format is complex, moreover the computation data quantity is extremely huge, such license plate location cannot satisfy the request for fast and real- time.

In this work, preprocessing of image is done before segmentation for better results, steps involved in pretreatment are"

A. *Croping of an image*

Cropping refers to the removal of the outer parts of an image to improve framing, accentuate subject matter or change ratio. By considering the x and y coordinates of the car and also height and width, we can crop the digital image to our required image.

B. *Gray Level conversion*

The coloured image contains red, green, blue colours. After converting it into gray level image it has only black, white and gray values. So now it becomes 8-bit value. An image consists of numeric values between 0 – 255.

C. *Binary Conversion*

The numerical value of the picture is reduced to two values with binary level. Thus, a 8 - bit image is converted into 2 - bit format.

D..*Spatial Filtering*

If the image has any noise, to remove that noise we do the filtering. The concept of filtering has its roots in the use of the fourier transform for signal processing in the so-called frequency domain. In this work average and median filters are used to filter image the best result obtained by median filter. Outputs after image pre-treatment are shown below

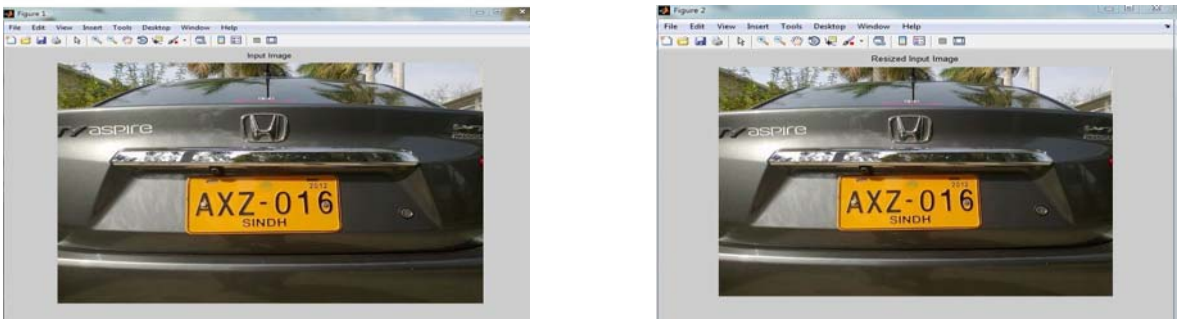


Figure 1 (a) Original image (b) Cropped image

Figure 2 (a) Gray Scale Converted (b) Weiner Filtering

IV.IMAGE SEGMENTATION

After the filtering process is over we should do the segmentation process. Segmentation of an image entails the division or separation of the image into regions of similar attribute. The basic attribute for segmentation is image amplitude- luminance for a monochrome image and colour components for a colour image. Image edges and textures are also useful attributes for segmentation. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image.

Edge detection is an important step in segmentation, here in this work edge detection is done by three methods that is morphological gradient,canny and prewitt edge detector. Number extracted by Morphological operator ,canny and prewitt is compared in further section. Morphological operators often take a binary image and a structuring element as input and combine them using a set operator (intersection, union, inclusion, complement). Morphological based gradient detection uses structuring element for neighborhood operations.

A. Structuring element

Morphology provides a number of important image processing operations, including erosion, dilation, opening and closing. All these morphological operators take two pieces of data as input. One is the input image, which may be either binary or grayscale for most of the operators. The other is the *structuring element.*

B Erosion

The basic effect of the operator on a binary image is to erode away the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels shrink in size, and holes within those areas become larger.

D. *Dilation*

Basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels grow in size while holes within those regions become smaller.

Edges detected by different detectors are shown in figure below:

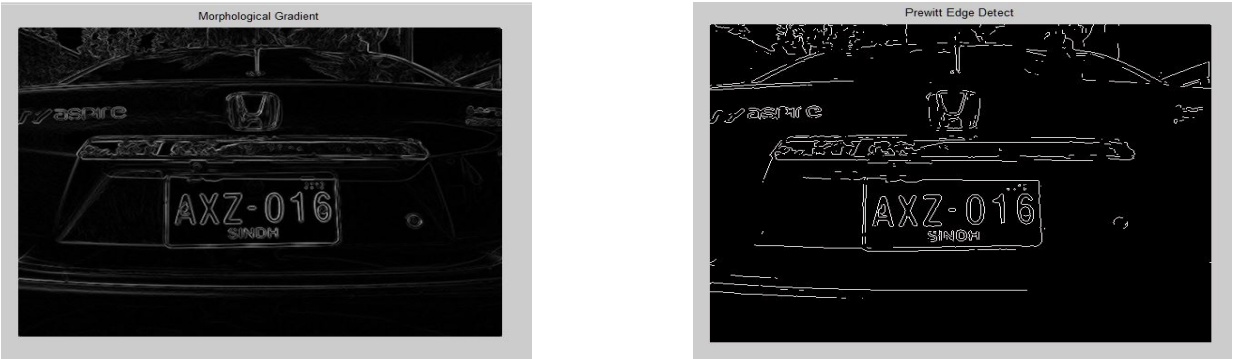


Figure 3 (a) Morphological Gradient (b) Prewitt Edge

V. ADAPTIVE CORELATION COMPARISON

Now this approach is called "ADAPTIVE CORRELATION COMPARISON", where minimum threshold can be set to enhance the performance of the system and rate of detection of character is high .it has an advantage over fixed threshold technique that if threshold is not exceeded in fixed threshold technique, no character would be recognized, but in our work ,character would be recognized in any manner.

A. *connected component analysis*

Before correlation comparison analysis of connected component takes place. Connectivity between the pixels is a fundamental concept that simplifies the definition of numerous digital image concepts, such as regions and boundaries. To establish if two pixels are connected ,it must be determined if they are neighbors and if their gray levels satisfy a specified criterion of similarity.

- Connected components in image after edge detection are stored in a matrix and labeled.

- Two properties are of great interest are bounding box and image
- The pixels labeled 0 are the background. The pixels labeled 1 make up one object; the pixels labeled 2 make up a second object; and so on
- Find the total no. Of connected objects in the Label matrix.
- Store the value in some variable using concatenate array.
- Now controlling function is called,it determines the array of indices of bounding box.
- If indices are of desired box is obtained, it extracts the binary image corresponding to indices And will read the letter corresponding the binary image.

Template matching is the next step to be taken. It can be set to minimized value ,as every matching occurrence at least cross this threshold so ,there are less chances of wrong detection.

B. Template matching with adaptive correlation

After extracting the numbers and alphabets to read them we use template matching technique.
Template matching is a technique in digital image processing for finding small parts of an image which match a template image. It can be used in manufacturing as a part of quality control, a way to navigate a mobile robot, or as a way to detect edges in images.
Template matching can be subdivided between two approaches: feature-based and template- based matching. The feature-based approach uses the features of the search and template image, such as edges or corners, as the primary match-measuring metrics to find the best matching location of the template in the source image. The template-based, or global, approach, uses the entire template, with generally a sum-comparing metric (using SAD, SSD, cross-correlation, etc.) that determines the best location by testing all or a sample of the viable test locations within the search image that the template image may match up to.

We find the matching between the two images by using the CORRELATION. Correlation finds the similarity between the two templates. The similarity between the two templates can be found by using the CORRELATION COEFFICIENT. The range of correlation coefficient is from „-1 to „+1. If the value of the correlation coefficient is near to „+1 then the two templates are nearly same otherwise they are different. We found the correlation between the template and with our dataset.

$$cor = \frac{\sum_{i=0}^{N-1}(x_i - \bar{x})\cdot(y_i - \bar{y})}{\sqrt{\sum_{i=0}^{N-1}(x_i - \bar{x})^2 \cdot \sum_{i=0}^{N-1}(y_i - \bar{y})^2}}$$

x is the template gray level image
x is the average grey level in the template image y is the source image section
y is the average grey level in the source image N is the number of pixels in the section image (N= template image size = columns * rows)

VI. EXPERIMENT AND RESULTS

A. In This Section Of Paper Images are shown ,extracted by different operators. Highest value of correlation Is obtained through morphological gradient.

Figure 4 (a) Input Image (b) Number Plate Extracted Using Morphological Operetor.

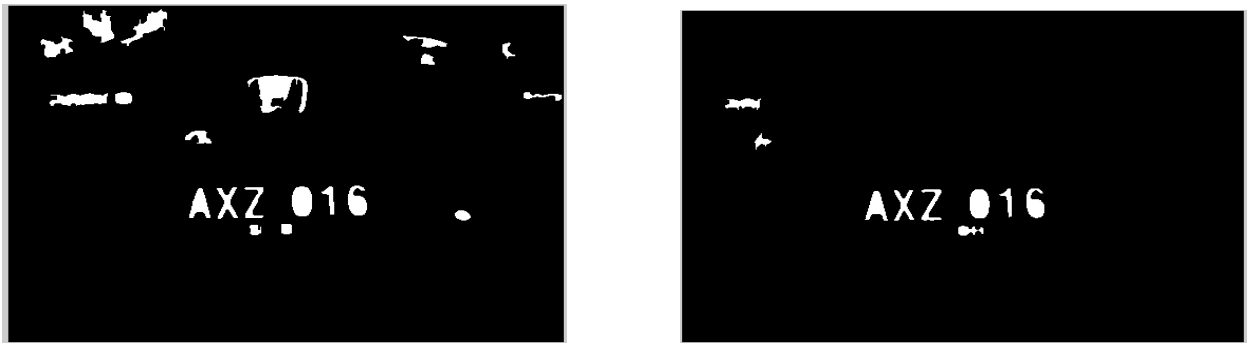
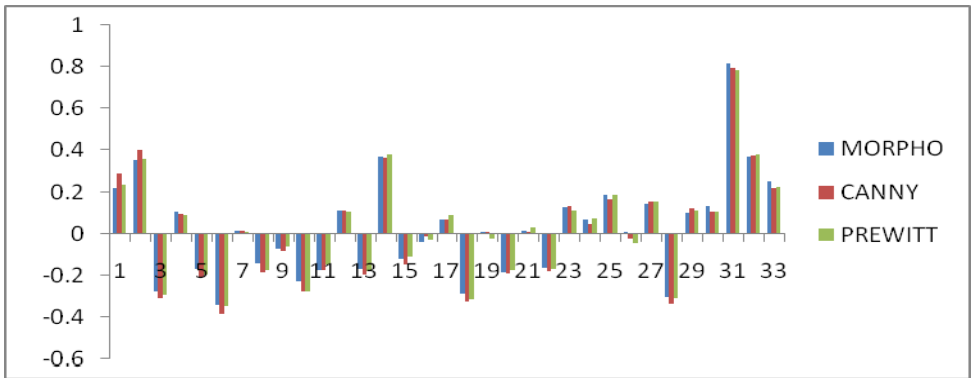
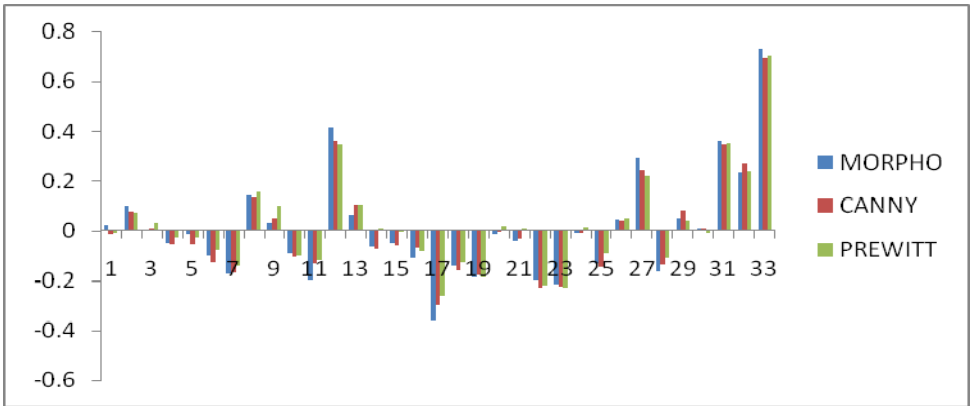


Figure 5 . (a) Image Extracted Using Cannyl Operetor (b) Number Plate Extracted Using Prewitt Operetor

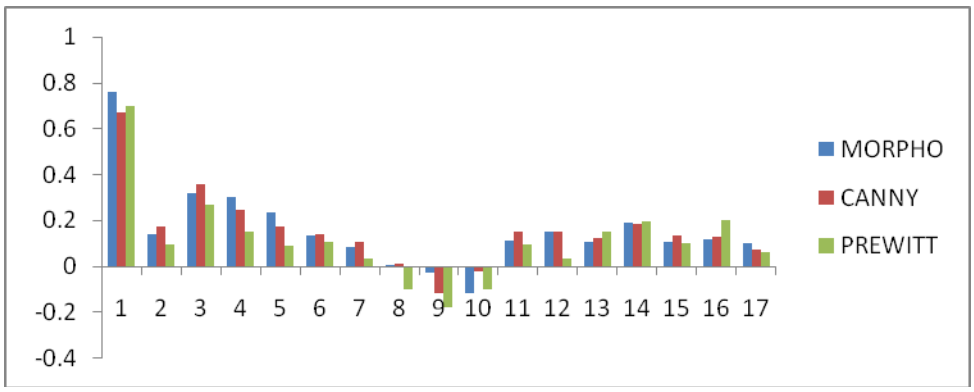
B. Comparison of correlation coefficient for all three operators can be understand by following Graphs.



Graph 1. Comparison of correlation coefficient for Letter "X".



Graph 2.



Graph 3. Comparison of correlation coefficient for "1".

C. After Comparison of correlation through graph it is clear that morphological operators secures highest correlation value . In adaptive approach morphological operator shows best results and probability of detection goes high.

VII. CONCLUSION

MOPHOLOGICAL, CANNYAND PREWITT operators. No threshold is used value used .To compare "A" the values of correlation coefficients are 0.8981, 0.8120 and 0.8071 respectively. To compare "X" the values of correlation coefficients are 0.81450.7922 and 0.7852 respectively. To compare "Z" the values of correlation coefficients are 0.7311, 0.6930 and 0.7021respectively.

Similarly the alphabets are also compared. To compare "0" the values of correlation coefficients are 0.8962, 0.8345 and 0.7845 respectively. To compare "1" the values of correlation coefficients are 0.7610, 0.6683 and 0.6976 respectively. To compare "6" the values of correlation coefficients are 0.9102, 0.8213 and 0.7653 respectively.

So for the MORPHOLOGICAL operator the value of correlation coefficient is MAXIMUM. So that among the three operators MORPHOLOGICAL operator is the best one.

The proposed ADAPTIVE CORREALTION COMPARISON technique is very easy to implement and we are getting 85% to 90% best results using this technique. A minimum threshold condition can be put so matching algorithm at least crosses the minimum one .But over all fast detection of characters is obtained through proposed algorithm.

VIII. LIMITATIONS

The above technique is not applicable when image is extracted when the car is in motion. We cannot find the good connectivity between the edges of that image after the edge detection.

If any other number is present at any part of the image we cannot detect the number plate exactly. This is the main disadvantage of this method.

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