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Vehicle Plate Recognition for Ethiopian License Plate : based Sift Feature

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***Abstract*—This paper presents a car plate detection and recognition for Ethiopian car plate which is very vital for track rode traffic violation surveillance and stolen car recovery. The study has two modules namely *vehicle plate detection (VPD)* module and *optical character recognition (OCR)* module. This paper present robust method for Amharic character recognition in Ethiopian plates using sift features which shows 84.67 performance accuracy.**

Keywords— Connected component analysis, segmentation, recognition, detection

I. INTRODUCTION

Vehicle plate recognition systems implemented in many developed countries for varies objective to track rode traffic violation surveillance, stolen car recovery and driving speed law enforcement which currently in Ethiopia often influenced by the physical limitations faced by the traffic polices.

VPR usually include mainly two major section plate detection and character recognition which the former localizes plate location based on connected component analysis (CCA) and latter change car plate image to human readable text include Amharic characters in case of Ethiopia license plate.

Due to nature of OCR the extracted plate image section must spliced to single character. Since in Ethiopian vehicle plate there are 3 class of characters the 1st class called plate code it indicate the ownership type represented by single numeric value and surrounded by circle, 2nd class is region (state) indicator which use four characters to represent two Amharic and two English characters, and the 3rd class is vehicle identification number which contain four to six characters and each character has to be assigned to specific class.

The rest of this paper is organized as follows. The Section II constitutes a literature review of License Plate Recognition systems. The proposed system described in Section III, Experimental Result is discussed in Section IV along with dataset used for this work and finally, conclusions as well as future directions are summarized in Section IV.

II. PREVIOUS WORKS

A. *Preprocessing*

Often original images degraded from various types of quality such as blurring and illumination problem are very typical in VPD. Original images processed to improve their quality [2] named preprocessing which aims to make the resulting image more suitable for the job to follow. This step basis on concepts such as removing noise, spatial filtering, contrast enhancement techniques, and others.

First [5] convert the input image (color image) into grayscale image. Then a median filter (5x5) is applied to the grayscale image in order to remove the noise while preserving the sharpness of the image.

[2] grayscale image obtained from original image. Due to the impact of different light, the license plate is not prominent against the background. Due to this, gray balancing is used to improve image contrast. Finally, to filter out the small particle noises, Gaussian Filter is chosen.

B. *Plate Location Detection and Extraction*

The fact that the recognition system is influenced highly by the plate localization method increased the motivation of researchers to work on different algorithms A number of methods have been used for plate region detection. These include morphological [12] operations, edge statistics [6][7] (vertical and horizontal edge detection), [1][3][10] color-based operations, transforms (Wavelet transform, Hough transform) and others. Those localization methods followed by filtering accurate plate from candidate plates many researchers use different algorithms. According to [4] which apply skew correction the character pixels about the center of gravity are used as features for feature extraction process.

[1] use histogram analysis to extract the plate region form candidates. In [7] the authors use connected component analysis (CCA) to extract the plate region form a binary image.

characters on the image extracted and each character separately recognized. [1] developed an OCR to recognize the characters. Their OCR used row and column scanning to segment the individual characters and a correlation technique to match each character. In another paper [8], the researchers used SCW technique to segment the characters and Neural Network for the recognition process. Also in [11], the recognition of the contents of the License Plate is performed using cross correlation followed by Neural Network.

C. *Character Recognition system (OCR)*

Character recognition system is the system, which is used to extract the characters on the license plate. Individual

III. PROPOSED APPROCH

In this section the proposed system described in detail, which can be divided into two main parts; plate detection system and the OCR system where preprocessing is done prior to improve quality.

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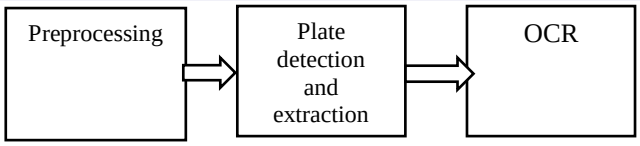

Figure 1. General flow chart of proposed system.

A. Preprocessing

In this section, we first convert RBG image to grayscale. Then low pass filter in order to remove noise and Morphological operations like opening and closing is applied in [8] order to further improve the quality of image for further processing.

Figure 2. (Top) original image, (Down) after preprocessing.

B. Plate detection and extraction

Plate location detections and extraction play a major role in the performance of the proposed system. To do so the image passed through various processing as shown in Figure 3. In image processing and computer vision,

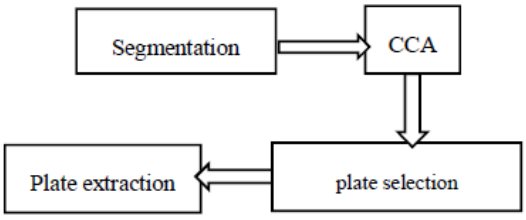

Figure 3. Plate detection and extraction flow chart

Figure 4. Input image Adaptive thresholding

segmentation is the process of partitioning an image into several segments. Segmentation is used for locating objects and boundaries in an image. We use Adaptive thresholding since it takes no account for spatial variations in illumination [9].

Connected component labeling is the process of detecting and labeling connected regions in a binary image. Once region boundaries have been detected, it is often useful to extract regions which belong to the same region.

set of pixels which is not separated by a boundary is called connected. Each region of connected pixels is connected

Component and the set of connected components partition an image into segments. After applying to connect component labeling connected component are labeled and

Figure 5. Extracted plate

selected based on their number of non-zero element for extraction.

C. Optical character recognition (OCR)

due to perspective projection extracted plate region may be distortion so to correct the distorted plate it passes through de-skew process; de-skew calculates angle θ the distorted image rotates and try to recover the correct alignment [4] which could be advantageous and significantly improve for recognition rate.

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

after skew is corrected the next step we apply segment the plate image and CCA is applied so that each character can be labeled, but since some non-character pixel chunks could also be extracted we set plate pixel threshold based on there pixel size so that we can remove non-character noise region.

In order to recognize plate number each character has been segmented and labeled using CCA, but some noise also segmented as a character, to overcame this problem normalize size of plate image would be ideal solution so it's possible to filter out those noise based on their size.

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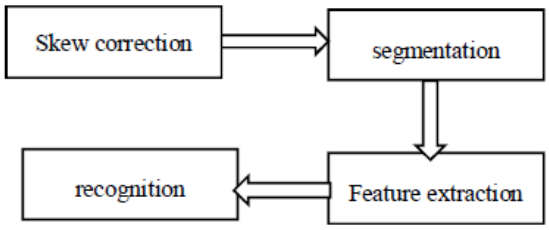

Figure 6. OCR flow diagram

The feature extracted sub module use Sift which very powerful local feature descriptor. After each character labeled this module extract sift features from each character and using flann matcher extracted character feature compared with candidate preset character class descriptor to deicide to which class the character belongs since in Ethiopia there are five plate code and ten region indicators it needs to check maximum of 15 passes.

License Plate	result
	Code : 2 Regional : AA-AA Plate Number : A33455

Figure 7. OCR module result

IV. EXPERMENAL RESULT

In this section, we present the dataset we use and results of plate detection and extraction module along with OCR module of license plate.

A. *Image dataset*

To measure performance of our system we employed: total of 423 images used for experiments from different plate class and regional class and additional 30 images used to for class template generation. As shown below in figure 7. All images gathered from different environments evenly classified as along each class.

	No images
Experiment	450
Template generation	30
Total	480

Figure 8 Dataset used for description.

B. *System performance*

The experimental results show that the proposed method can extract and recognize efficiently the number of licenses with accurate plate class descriptions (like ownership and region description). Figure 8 shows the result achieved in this work.

System performance

Total number of plates	*Number of plate regions correctly detected and extracted*	*Number of plate number correctly detected and extracted (out of correctly detected and extracted)*	*Number of plate number correctly detected and extracted (out of the total image)*
450	389	381	381
	86.44%	97.94%	84.67%

Figure 9. Overall system performance.

V. CONCLUSION

In this paper, we have presented a robust method for Ethiopian vehicle plate recognition using sift features. The proposed work contains 3 major submodules such as vehicle plate detection VPD and optical character recognition for Ethiopia license plate number. We used CCA for former submodule and sift features for features extractions in order to generate sift descriptor of extracted character for each character of plate number and the template class preset descriptors. We tested the method with a large number of plate images captured in different environments and even class distribution along with each class. The experimental results show that the proposed algorithm can detect the extract of vehicle plate (86.4%) and recognize it in different environments with 84.67% rate.

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