License Plate Detection and Segmentation Using Cluster Run Length Smoothing Algorithm

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ABSTRACT

For the different types of license plates being used, the requirement of an automatic license plate recognition system is different for each country. In this paper, an automatic license plate detection system is proposed for Malaysian vehicles with standard license plates based on image processing and clustering. Detecting the location of license plate is a vital issue when dealing with uncontrolled environments and illumination difficulty. Therefore, a proposed algorithm called Cluster Run Length Smoothing Algorithm (CRLSA) was applied to locate the license plates at the right position. CRLSA consisted of two separate proposed algorithms which applied run length edge detector algorithm using $3 \times 3$ kernel masks and 128 grayscale offset plus a threedimensional way to calculate run length smoothing algorithm, which can improve clustering techniques in segmentation phase. Six separate experiments were performed; Morphology, CRLSA, Clustering, Square/Contour Detection, Hough, and Radon Transform. From those experiments, analysis based on segmentation errors was constructed. The prototyped system has accuracy more than 96%.

Keywords: Clustering, Image Detection, License Plate Recognition, Run Length Smoothing Algorithm

INTRODUCTION

Image detection is one of the crucial issues in image processing besides feature extraction and recognition (Bataineh, Abdullah, & Omar, 2011, 2012). Computer surveillance such as license plate recognition (Romero, Prabuwono, & Taufik, 2011) is an example of object detection application. To ensure that the selected and determined objects were correctly obtained, a very strategic way for object detection is highly required (Abdullah, PirahanSiah, Abidin, & Sahran, 2010; Prabuwono & Idris, 2008). Several prominent ways License Plate Detec-
tion (LPD) were for contour detection (Han, Han, Wang, & Zhai, 2003), Hough transform (Soh, Chun, & Yoon, 1994), Radon transform (Shapiro, Gluhchev, & Dimov, 2006), Morphology (Xu & Zhu, 2007), clustering (Siah, 2000; Abdullah, Khalid, Yusof, & Omar, 2007; Abdullah et al., 2010; PirahanSiah, Abdullah, & Sahran, 2011; Abidin, Abdullah, Sahran, & PirahanSiah, 2011) and Speed Up Robust Features (SURF) (Bay, Tuytelaars, & Van Gool, 2006). However, this paper will elaborate on the theories and applications of only some of the mentioned techniques for object detection. Later, these techniques are experimented and compared.

The rest of the paper is organized as follows. Related works and proposed method are discussed in subsequent sections. Then, we justify our proposed work in the Results and Analysis section. This paper concludes our findings in the Conclusion section.

RELATED WORKS

Object Detections

SURF is a technique proposed for object detection (Bay et al., 2006). SURF applies Fast Hessian, Harris-Laplace and DoG Detectors to calculate its descriptors that identify the interest point and area based on image intensity pattern. The experiments achieved up to 85.7% recognition rate. However, this technique seems to be dangerous to apply in LPD because illumination can cause an object of interest’s area broaden or lengthen due to lengthening or inconsistency of intensity pattern. Combining with thresholding process can reduce unwanted intensity but, unfortunately, it may destroy important features. Examples of image result using LPD is shown in Figure 2 and Figure 3.

Square detection, line detection (Han et al., 2003) and object detection have been widely applied to detect the location of license plates. Square detection is highly dependent on threshold value. Normally, Canny edge detector with a fixed upper and lower threshold is a powerful technique to produce gradient shading out of an image. Meanwhile, dilation operation is used to remove potential holes between edge segments. After applying these two techniques, contour search is executed. Typically, the searching is also highly threshold dependent which may deviate the actual square object.

Morphology technique is a common way to extract a region or object of interest. In practice, morphology techniques consists of several important classes that applies different operators which sometimes the region or object of interest may be lost or missing due to standardized of filtering operators for all image cases.

Hough transform is a second order operator which also depends on edge detector performance. If the resultant image of the edge detector shows clear lines of the license plate’s border, therefore the line detection may be useful else otherwise. Applying Canny edge detector, the resultant lines in the image proved

Figure 1. (a) Samples of common and (b) Samples of special Malaysia license plates

![Figure 1](image-url)
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